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Future imbalance pricing in the Nordics when connected to MARI and PICASSO

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Common Nordic webinar

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Agenda

1. Introduction to the need for change

- 5 minute break -

2. Design options
3. Next steps

Additional material and examples found at the end

1. Introduction to the need for change

The road leading to the needed changes

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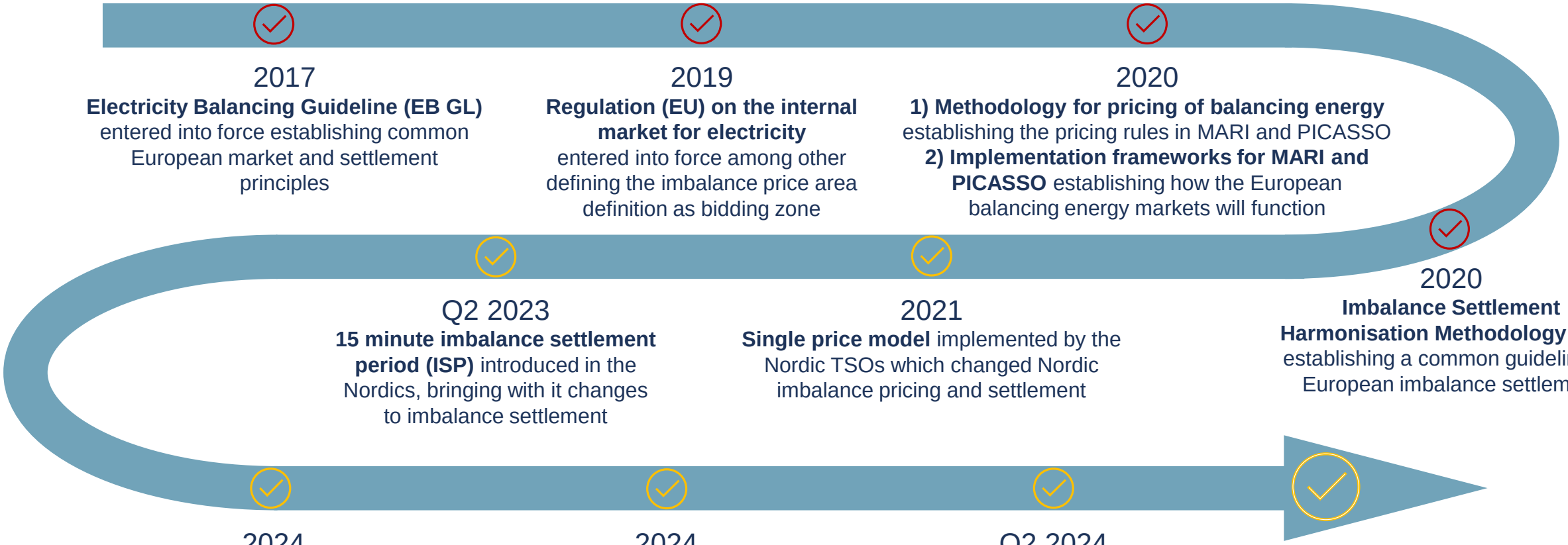

2017
Electricity Balancing Guideline (EB GL) entered into force establishing common European market and settlement principles

2019
Regulation (EU) on the internal market for electricity entered into force among other defining the imbalance price area definition as bidding zone

2020
1) Methodology for pricing of balancing energy establishing the pricing rules in MARI and PICASSO
2) Implementation frameworks for MARI and PICASSO establishing how the European balancing energy markets will function

2020
Imbalance Settlement Harmonisation Methodology (ISH) establishing a common guideline on European imbalance settlement

Q2 2023
15 minute imbalance settlement period (ISP) introduced in the Nordics, bringing with it changes to imbalance settlement

2021
Single price model implemented by the Nordic TSOs which changed Nordic imbalance pricing and settlement

2024
New Nordic **mFRR energy activation market** introduced, aiming at keeping current Nordic pricing principles – targeting operational transition

2024
15 minute market time unit (MTU) introduced in the Nordics, bringing with it 15 min product prices for FRR and 15 min Intraday trading

Q2 2024
The Nordic TSOs connect to the **MARI and PICASSO** balancing energy platforms

Future imbalance pricing design introduced in the Nordics

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: Legal methodology or framework implemented

: Market or settlement changes implemented

Starting point – Single Price Model and the implementation of ISH "part 1"

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- On 1 November 2021, the Nordic countries implemented the Single Price Model, implementing single imbalance pricing and single balance/position
- The implemented model is compliant with the **European methodology for imbalance settlement harmonisation (ISH)**, and can be seen as the first step of implementing the ISH
- The current Nordic imbalance settlement model is based on the mFRR balancing energy prices and the application of an exception rule to set the direction of imbalances (dominating direction) based on the uncongested area
  - The exception rule is only valid as long as the Nordic synchronous area is frequency based

Ending point – connection to MARI and PICASSO and the implementation of ISH "part 2"

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The Nordic TSOs are working on implementing…

- ACE-based balancing in the Nordic synchronous area
- Connection to the European energy balancing platforms, MARI and PICASSO, for respectively mFRR and aFRR
- Implementing a future imbalance price design, reflecting the new balancing energy pricing rules and ISH “part 2”

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From frequency-based to ACE-based

- Today: We activate for the net imbalance in the so-called mutually regulated or uncongested area. We do not know the imbalance of an individual bidding zone, and are only able to activate on the net imbalance. We mainly use mFRR to balance (together with the "frequency-band") and only have one price-setting product.
- Future: With ACE-based balancing, we can identify the imbalance of each bidding zone and forecast the mFRR demand of each bidding zone. It is possible to optimise how to meet this demand (by netting or activation) taking into account available transmission capacity (ATC) and bid prices. It is not always economical to net. We will use and have several price-setting products with MARI and Picasso. ACE-based balancing is a prerequisite to join MARI and Picasso.

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… this drives two large changes

- Netting will not happen by default as today → Netting will still occur, but sometimes it is more economical to activate bids than to net two opposite demands

- Sequential balancing process with mFRR and aFRR in MARI and Picasso → Netting of demand may occur only in parts of the balancing process in an imbalance settlement period (ISP)

Balancing approach for a bidding zone – proactive TSO

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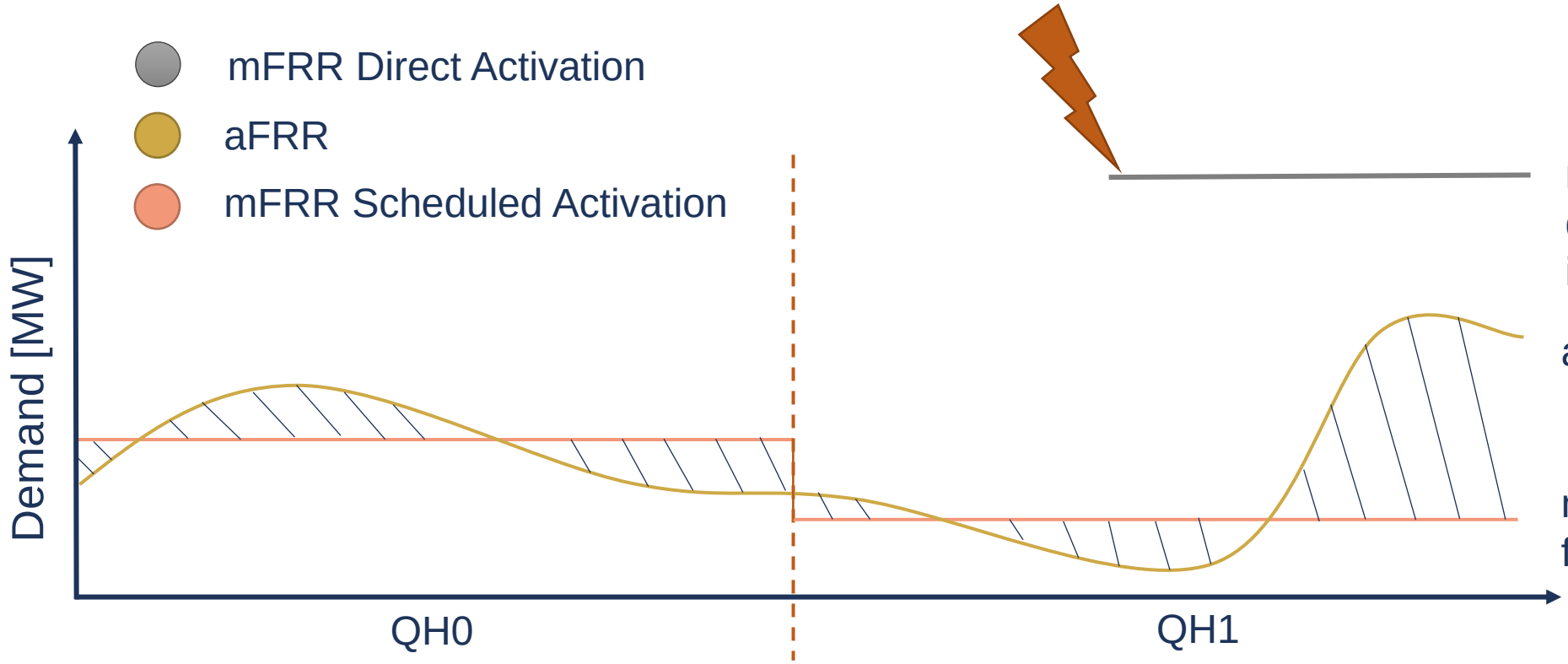

mFRR Direct Activation due to incident or large rest imbalance

aFRR which fills the "gap"

mFRR Scheduled Activation for the forecasted imbalance

The mFRR and aFRR processes in MARI and Picasso

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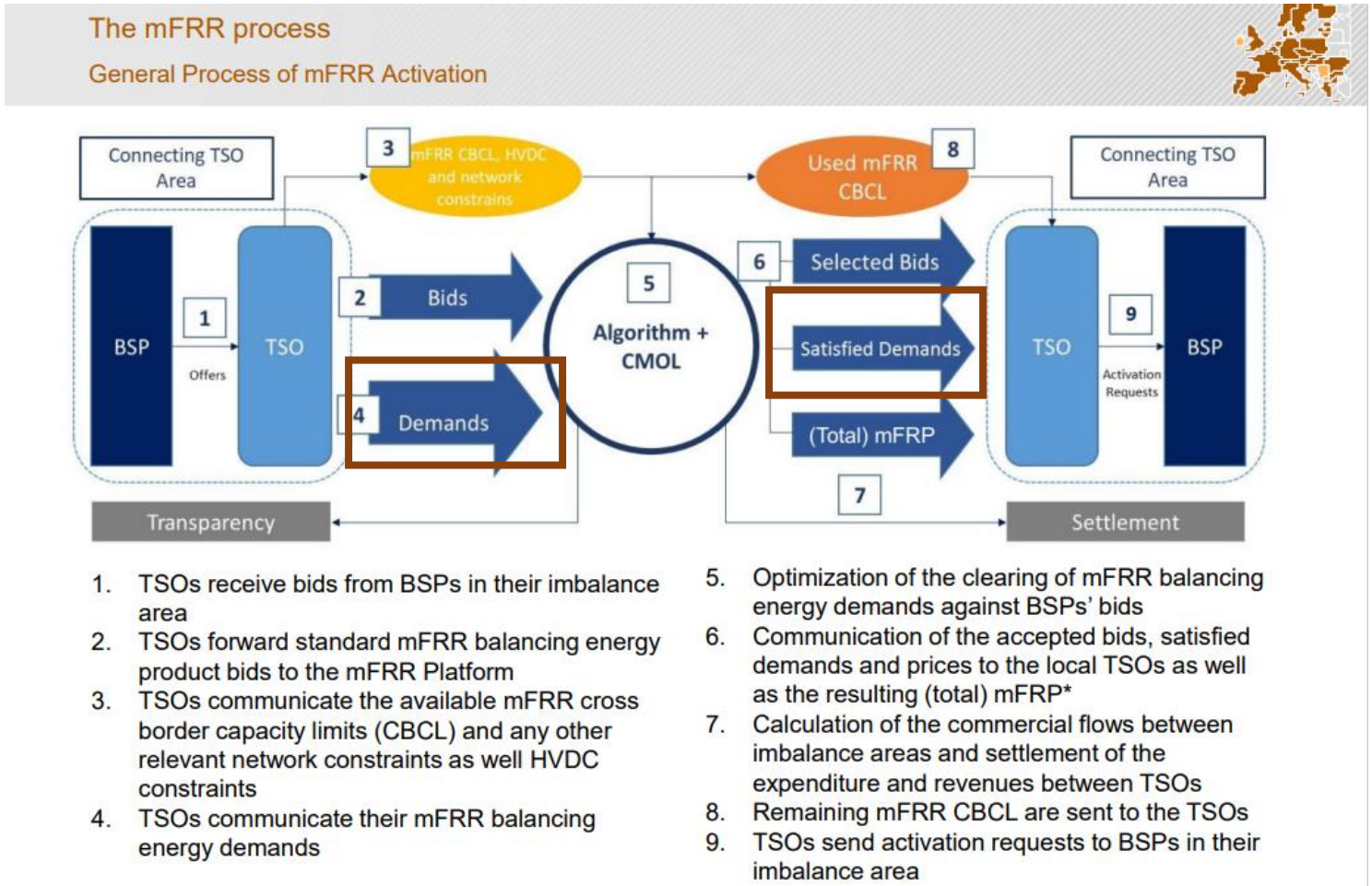

- With MARI and PICASSO, each Nordic TSO will set the **balancing energy demand** for mFRR and aFRR **per bidding zone (BZ)**
- The balancing energy **demand for each BZ** will be sent to MARI and PICASSO, which will optimize how to resolve the total demand
  - MARI only nets the demands if economically profitable
  - PICASSO always nets the demands
- The TSOs will receive back the **satisfied demand** per BZ, which can differ from the original BZ **demand** in case of insufficient available bids
- Activation volumes in a bidding zone may also differ from the satisfied demand of the bidding zone due to exchange

mFRP: Manual Frequency restoration process

Many balancing energy product prices gives a new frame

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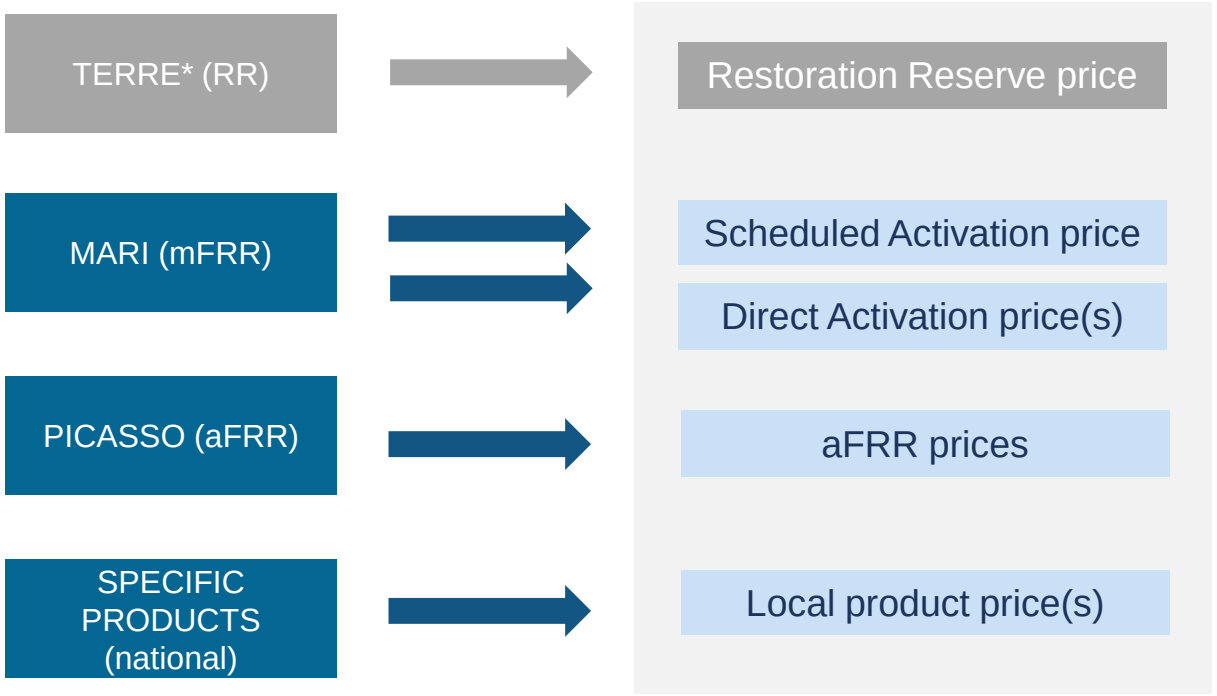

Activation type	Price setting and activation direction of standard products
Scheduled activation (SA)	• **One price per 15 min MTU = ISP** • Activation direction: Up, Down, Up and down (both) or None
Direct activation (DA)	• **Up to four prices per 15 min MTU = ISP** (two prices possible per direction as a DA activation will last for two quarter hours) • Activation direction: Up or Down
aFRR	• One price per MTU = control cycle ≈ 4 sec = **225 prices per 15 min ISP** • Activation direction: Up, Down or None

The balancing energy prices are used to settle the BSPs and as an input for the imbalance price for the BRPs

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**The Nordic TSOs will not utilize the TERRE platform*

How to set the dominating direction gives a new frame

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- Dominating direction set per bidding zone
  - Clean Energy package article 6(6):
    Each imbalance price area shall be equal to a bidding zone
  - Exception rule in the ISH article 8(3):
    Only areas that do frequency-based balancing are allowed to set the dominating direction across imbalance prices areas
- Dominating direction targeting to reflect the imbalance direction of the bidding zone
  - The calculation shall as a starting point be set based on the bidding zone's satisfied demand of FRR balancing energy

Dominating direction shall be set per bidding zone based on (satisfied) demand

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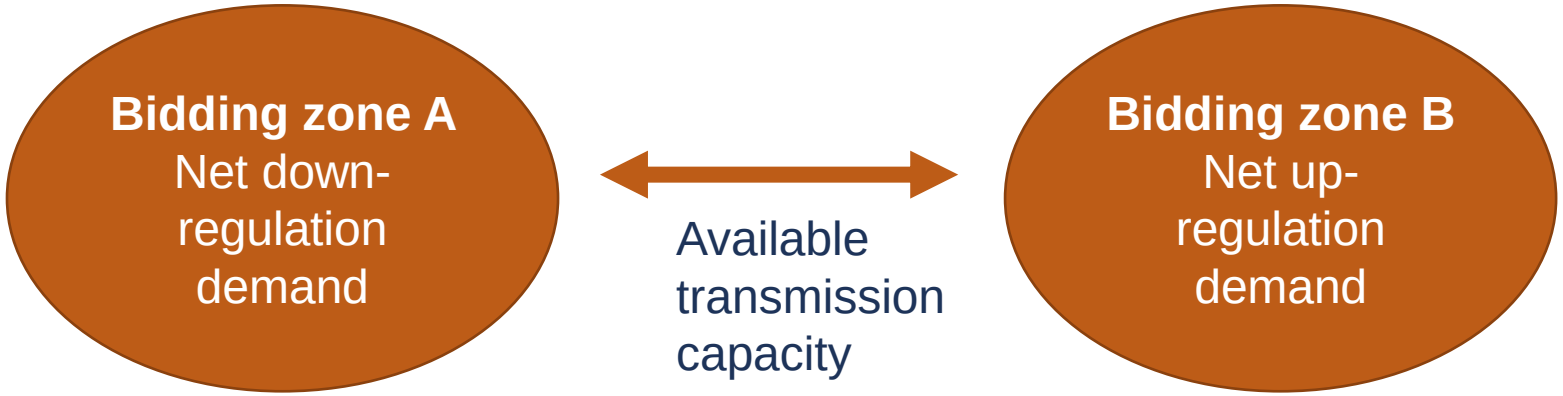

- Today, bidding zone A and B will get the same imbalance price
- In the future, the bidding zones will get different imbalance prices (if there is a balancing energy price for down regulation in bidding zone A and a balancing energy price for upregulation in bidding zone B).
- In the future, also bidding zones with the same dominating direction are likely to get different imbalance prices when we are connected to both MARI and Picasso, depending on the approach of how to set the imbalance price

Questions for part 1: Introduction to the need for change

Use the Q&A function to ask questions

5 minute break

2. Design options

Design choices to be made

- Select the method for imbalance price calculation
  - Max/Min approach
  - Combined approach
  - Volume weighted average approach
- Local or uncongested area pricing: Whether or not to take into account balancing energy prices for which you have a satisfied demand equal to zero
- How to set the Value of Avoided Activation (VoAA)

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Principle for the imbalance price

EB GL Article 55(4):

4. The imbalance price for negative imbalance shall not be less than, alternatively:

(a) the weighted average price for positive activated balancing energy from frequency restoration reserves and replacement reserves;

(b) in the event that no activation of balancing energy in either direction has occurred during the imbalance settlement period, the value of the avoided activation of balancing energy from frequency restoration reserves or replacement reserves.

5. The imbalance price for positive imbalance shall not be greater than, alternatively:

(a) the weighted average price for negative activated balancing energy from frequency restoration reserves and replacement reserves;

(b) in the event that no activation of balancing energy in either direction has occurred during the imbalance settlement period, the value of the avoided activation of balancing energy from frequency restoration reserves or replacement reserves.

- If there is a balancing energy price for the dominating direction (bidding zone), it shall be used to set the imbalance price
- If there is no balancing energy price for the dominating direction (bidding zone), then the value of avoided activation (VoAA) must be defined

Imbalance price
- Example of a short bidding zone

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Max/min approach

- Imbalance price would be max of all aFRR and mFRR prices in the ISP

Combined approach

- Imbalance price would be max of mFRR SA, mFRR DA and volume weighted aFRR in the ISP

Volume-weighted average approach

- Imbalance price will be calculated as volume weighted average of all FRR balancing products in the ISP

Additional components

+ Scarcity component
+ Incentivizing component
+ Financial neutrality

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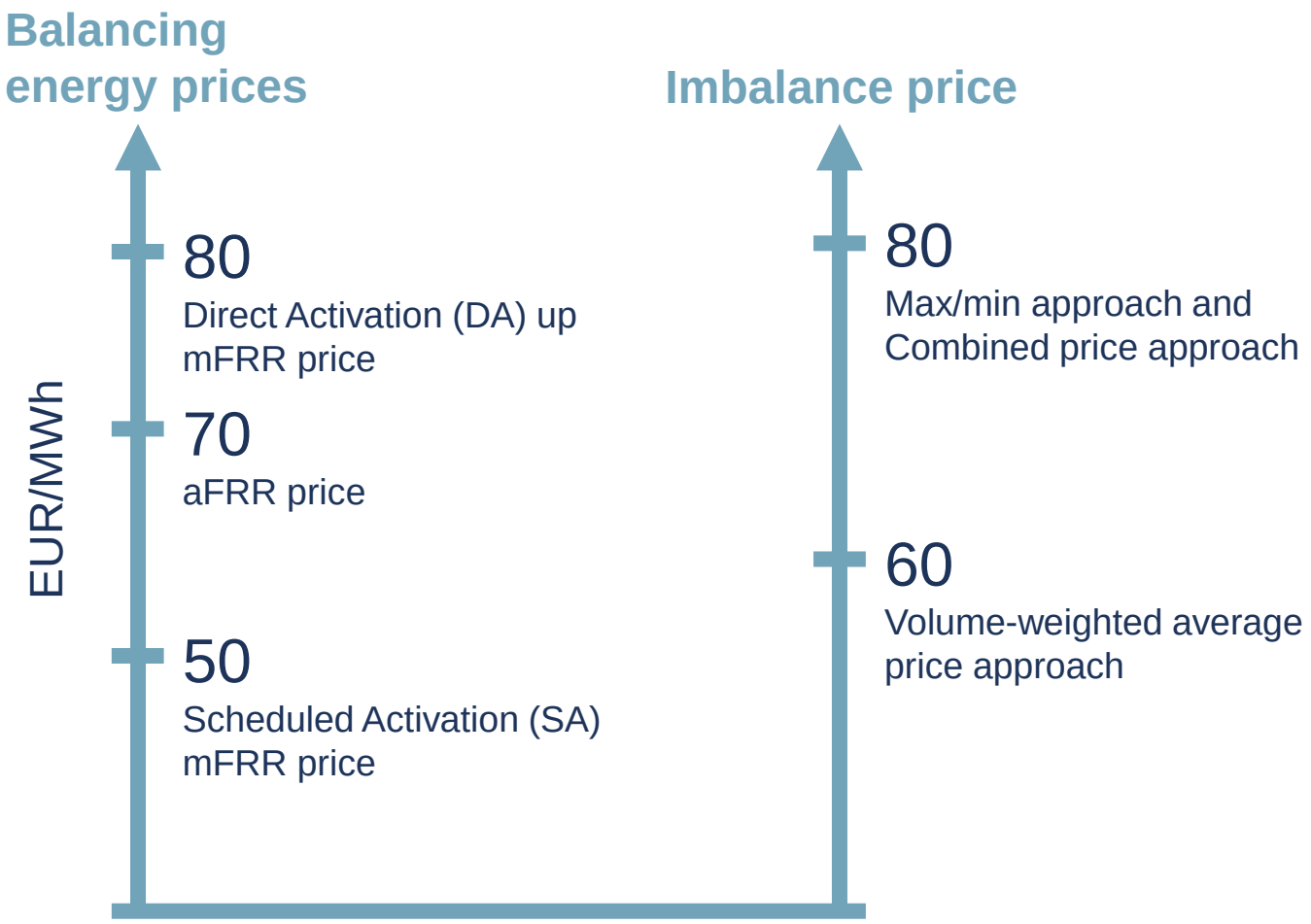
**A short bidding zone has a net demand for upward regulation*
***The volume weighted average is calculated using the bidding zone's satisfied demand of balancing energy products*

Example of misalignment of incentives

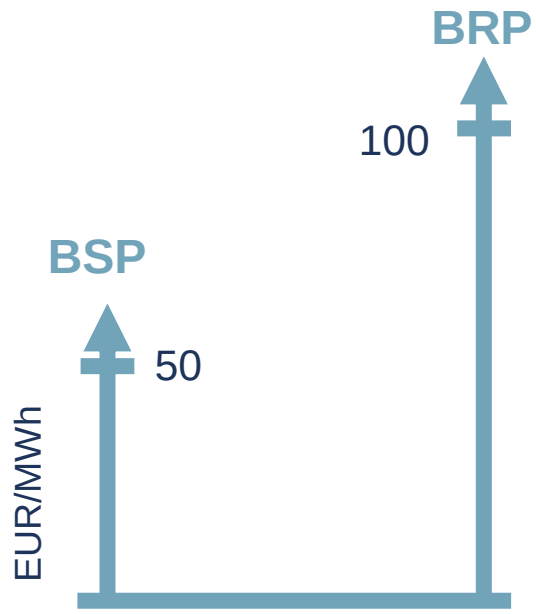


Due to different balancing energy prices, there will never be one-to-one between the ***activation price for BSPs*** *and* ***imbalance price for BRPs***

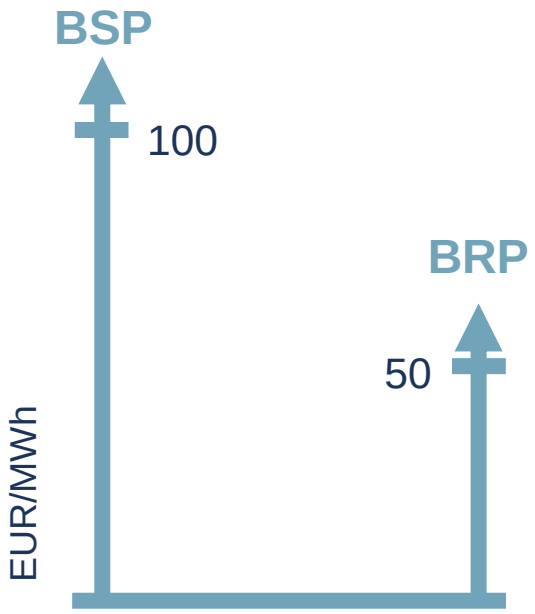
→ The relation between the different prices is unknown - and will continue to be unknown until we join the platforms

The situation may lead to design trade-offs

- Imbalance price > Product price
  Incentive to keep flexibility available as BRP and manage own imbalances instead



- Product price > Imbalance price
  Less incentive to actually deliver for the BSP, possibility for arbitrage profit



What is the issue with the max/min approach?

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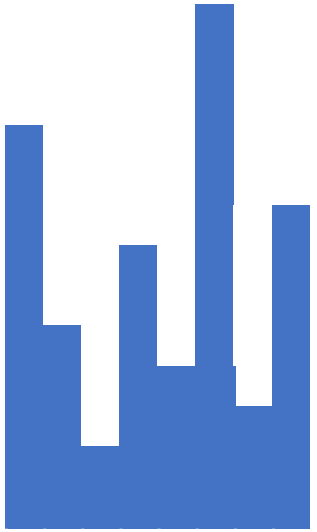

Imbalance price would be selected as max/min of all aFRR and mFRR prices in the 15 min ISP

- May give extreme imbalance prices and high volatility due to aFRR prices. Too strong price signals based on 4 second prices?
- Highest risk of misalignment between balancing energy prices and imbalance price
- The imbalance prices may be highly divided between bidding zones or high prices may spread depending on other design choices

- aFRR prices may be very volatile and a spike may occur per 15 min ISP
- Is it necessary to somehow dampen the effect of the dynamics in aFRR price setting on the imbalance price?

The two other imbalance pricing options

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Volume weighted average (VWA) approach

Imbalance price will be calculated as volume weighted average (based on satisfied demand) of FRR balancing product prices in the 15 min ISP

- Cheapest imbalance price of the different approaches, which will also give the most stable imbalance price
- Gives the weakest price signal of the different approaches
- Imbalance price can be lower than price of some balancing energy products

Combined approach

Imbalance price would be max/min of mFRR SA price, mFRR DA price and volume weighted (based on satisfied demand) aFRR prices in the 15 min ISP

- Intending to give a marginal price signal, but avoiding effects from overly high aFRR prices
- Possible to give a stronger price signal
- Imbalance price can also here be lower than price of some balancing energy products

"Local price" signal versus "Uncongested area" price signal:

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- Take into account only balancing energy prices for which the bidding zone has an explicit demand or should also other balancing energy prices from the uncongested area be applied?

Imbalance price:
Local pricing: 20 €/MWh
Uncongested area pricing: 100 €/MWh

Imbalance price:
Local pricing: 100 €/MWh
Uncongested area pricing: 100 €/MWh

Take into account prices with a satisfied demand in local area or in uncongested area?

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When is this a relevant choice?

- In case of volume-weighted average approach, it is mandatory to use the satisfied demand of the area as the weight – no choice
- With max/min or combined approach, we can choose if all available prices should be taken into account

Why would you choose one or the other?

- BSPs in a bidding zone may be activated due to demand elsewhere, even if the bidding zone itself has a demand of zero (incentive to deliver the balancing energy)
- Evaluation of what is the relevant reference for the real-time cost of energy (is the balancing energy price relevant to reflect in the imbalance price even if the bidding zone has not had explicit demand for this balancing energy product in the ISP?)

Design choice for Value of Avoided Activation (VoAA)

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(d) 'value of avoided activation' means a reference price that can be calculated by the TSO or TSOs of a given imbalance price area after the balancing energy gate closure time for a given ISP, at least when there is no balancing energy demand for that imbalance price area for that ISP or no balancing energy activation for that imbalance price area for that ISP.

ISH article 2(2)

- When we are connected to both MARI and Picasso, we expect it to be most likely that we will have both a) demand and b) balancing energy price in both activation directions during an ISP because of aFRR
- This means it is fair to expect situations which require VoAA to be limited in the future.
- There are several design options, but a pragmatic and simple approach may be desirable and also acceptable due to limited application
- VoAA shall be based on bid price or prices. It is for example possible to use the mFRR SA price as the new "reference price" instead of day-ahead or use the average of first up and down bid.

3 (4) design alternatives for imbalance price design to be investigated further

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Design alterative 1

- **Volume weighted average (VWA) approach**
- **Local prices** **(**only take into account prices for which you have an explicit demand)
- **VoAA design** could either be based mFRR SA or first available up and down bids

Design alterative 2 A

- **Combined approach**
  - Max/min price of VWA of aFRR prices and mFRR SA and mFRR DA prices
- **Local prices** **(**only take into account prices for which you have an explicit demand)
- **VoAA design** could either be based mFRR SA or first available up and down bids

Design alterative 2 B

- **Combined approach**
  - Max/min price of VWA of aFRR prices and mFRR SA and mFRR DA prices
- **Uncongested area prices** (take into account all prices available for the bidding zone)
- **VoAA design** could either be based mFRR SA or first available up and down bids

Design alterative 3

- **Max/min approach**

As of now, the Nordic TSOs do not recommend this approach.

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Key insights so far

- Balancing energy activation prices and the imbalance price will be decoupled compared to current situation, and give changed incentives, which may be difficult to fully foresee the impact of (depends on actual prices)
- The financial incentive to deliver balancing energy for the BSP through the cost of an imbalance may be weakened, and other measures necessary
- Expectation of much more variation in the imbalance price between all bidding zones, both in and between the Nordic countries – especially when we are connected to both MARI and PICASSO
- It may be hard to justify to use the Max price approach directly, due to how aFRR prices will be set
- Cases where we will need to apply the Value of Avoided Activation (VoAA) are likely limited – when we are connected to both MARI and PICASSO

Questions for part 2: Design options

Use the Q&A function to ask questions

3. Next steps

Next steps

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Next planned national TSO stakeholder meetings:

- Norway: Topic will be raised in relevant forums (Norwegian NBM reference group and "Kundeforum for balanseavregning"), no separate national meeting on imbalance pricing planned yet
- Denmark: 7 March, physical meeting, sign up here (meeting not yet published)
- Sweden: 15 February, digital meeting
- Finland: National meeting in March (date will be announced soon)

- We are working on a Word document to set the basis for giving informal stakeholder feedback and we aim to publish the document during Q1-2023

Timeline for TSO work and stakeholder interaction

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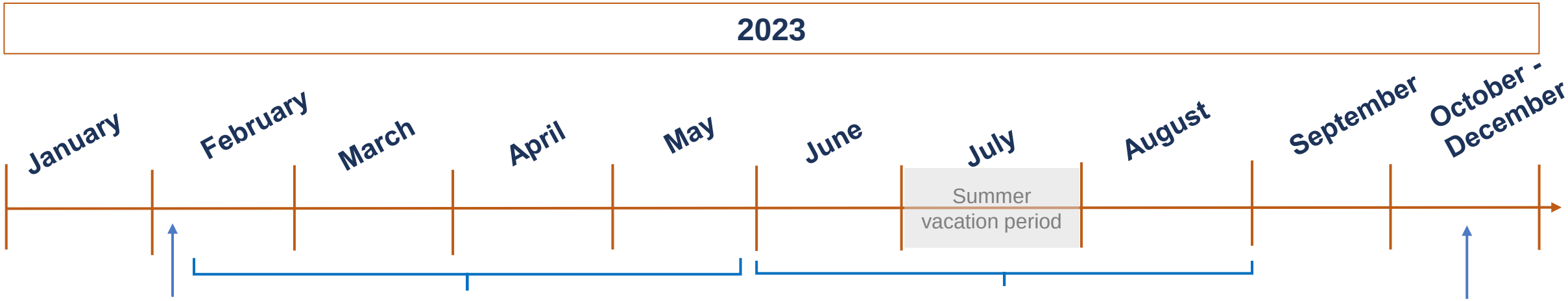

TSO work on design option space, define design proposal and internal TSO anchoring

Questions for part 3: Next steps

Use the Q&A function to ask questions

Additional material

Previous presentations and material on the topic

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- Stakeholder Reference Group Meeting 2 June
- Presentation for stakeholders July 2022
- NBM stakeholder reference group meeting 21 September
- NBM stakeholder reference group meeting 14 December

Relevant legislation (1 of 2)

- Art. 44 of the Electricity Balancing Guideline (EBGL); settlement principles
- Art. 7, 8 and 9 of the Imbalance Settlement Harmonization Proposal (ISH); establishing the direction of system imbalances and setting the imbalance price
- Art. 6(6) of the REGULATION (EU) 2019/943 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5 June 2019 on the internal market for electricity; each imbalance price area shall be equal to a bidding zone

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Relevant legislation (2 of 2)

- Methodology for pricing of balancing energy, ACER decision 01-2020, Annex 1
- Implementation framework for PICASSO, ACER decision 02-2020, Annex 1
- Implementation framework for MARI, ACER decision 03-2020, Annex 1

Examples

Calculating the imbalance prices for areas A and B using the three different design options

Example 1) Max/min of FRR prices
- For which you have a satisfied demand

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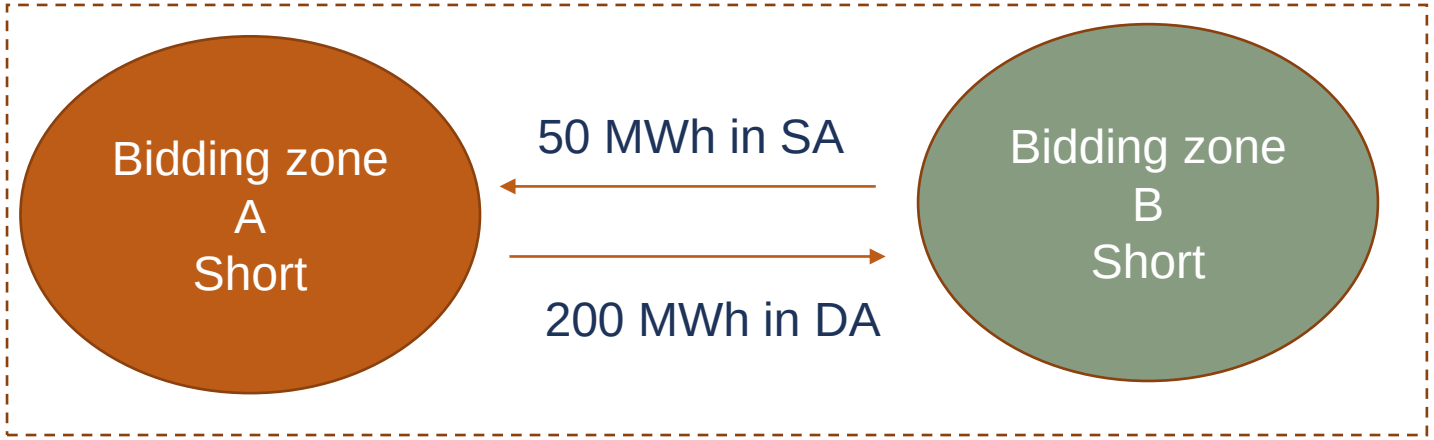
Area A	Satisfied demand (MWh)	Activated with BSPs (MWh)
SA	+200	+150
DA up	0	+200
aFRR run 1	0	0
aFRR run 2	0	0

Area B	Satisfied demand (MWh)	Activated with BSPs (MWh)
SA	+100	+150
DA up	+200	0
aFRR run 1	+10	+10
aFRR run 2	+10	+10



A and B uncongested both in SA and DA
- SA price 40 EUR/MWh
- DA price 60 EUR/MWh

- aFRR price run 1: 80 EUR/MWh
- aFRR price run 2: 100 EUR/MWh

Imbalance prices, Marginal price approach
- Area A = 100 EUR/MWh with zero demand or 40 EUR/MWh without zero demand
- Area B = 100 EUR/MWh

Example 2) Volume Weighted Average of FRR prices
- For which you have a satisfied demand

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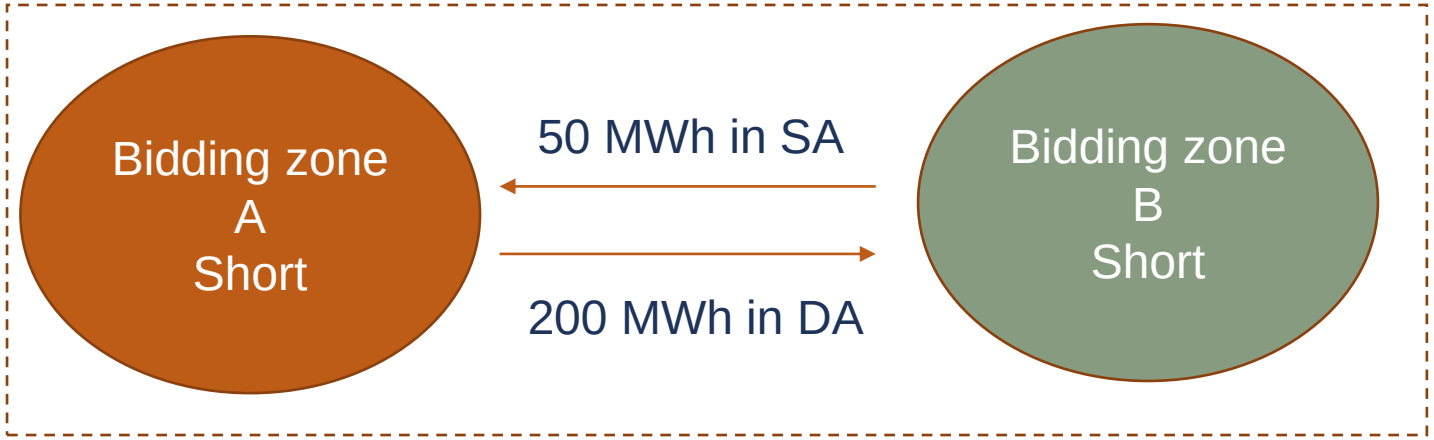
Area A	Satisfied demand (MWh)	Activated with BSPs (MWh)
SA	+200	+150
DA up	0	+200
aFRR run 1	0	0
aFRR run 2	0	0

Area B	Satisfied demand (MWh)	Activated with BSPs (MWh)
SA	+100	+150
DA up	+200	0
aFRR run 1	+10	+10
aFRR run 2	+10	+10



A and B uncongested both in SA and DA
- SA price 40 EUR/MWh
- DA price 60 EUR/MWh

- aFRR price run 1: 80 EUR/MWh
- aFRR price run 2: 100 EUR/MWh

Imbalance prices, Volume Weighted Average approach
- Area A = 40 EUR/MWh
- Area B = 55,63 EUR/MWh

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Area A: (200 MWh * 40 €/MWh) / 200 MWh) = 40 EUR/MWh
Area B: (100 MWh * 40 €/MWh + 200 MWh * 60 €/MWh + 10 MWh * 80 €/MWh + 10 MWh * 100 €/MWh) / 320 MWh) = 55,63 EUR/MWh

Example 3) Combined approach
- Highest of VWA of aFRR prices and marginal of mFRR prices

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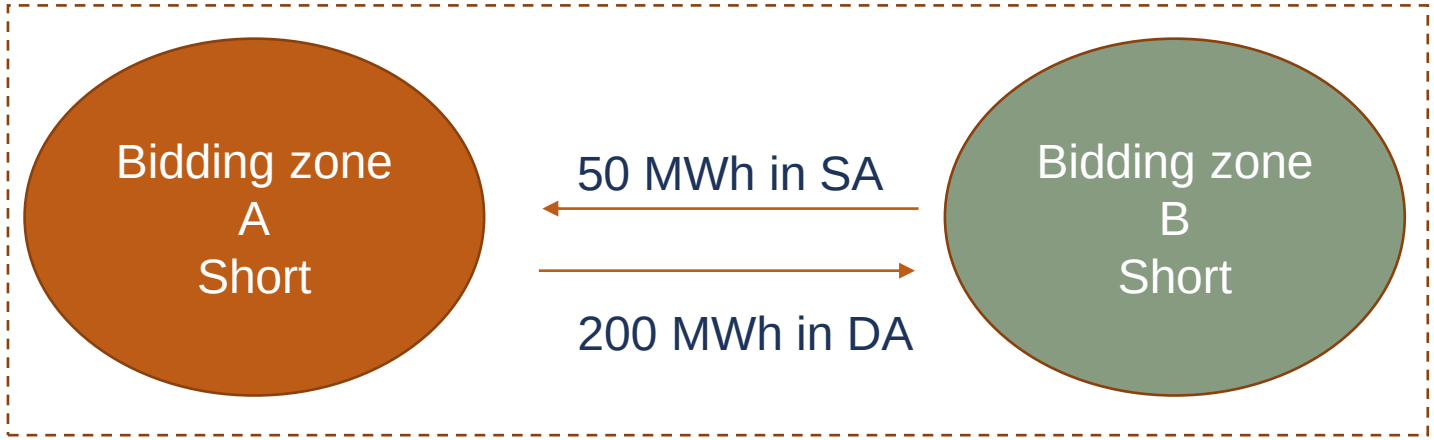
Area A	Satisfied demand (MWh)	Activated with BSPs (MWh)
SA	+200	+150
DA up	0	+200
aFRR run 1	0	0
aFRR run 2	0	0

Area B	Satisfied demand (MWh)	Activated with BSPs (MWh)
SA	+100	+150
DA up	+200	0
aFRR run 1	+10	+10
aFRR run 2	+10	+10



A and B uncongested both in SA and DA
- SA price 40 EUR/MWh
- DA price 60 EUR/MWh

- aFRR price run 1: 80 EUR/MWh
- aFRR price run 2: 100 EUR/MWh

Imbalance prices, Combined approach
- Area A = 60 EUR/MWh with zero demand for DA up or 40 EUR/MWh without zero demand
- Area B = 90 EUR/MWh* as the VWA from aFRR prices is the highest FRR price

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* Area B, VWA of aFRR:
(10 MWh * 80 €/MWh + 10 MWh * 100 €/MWh)) / 20 MWh = 90 EUR/MWh