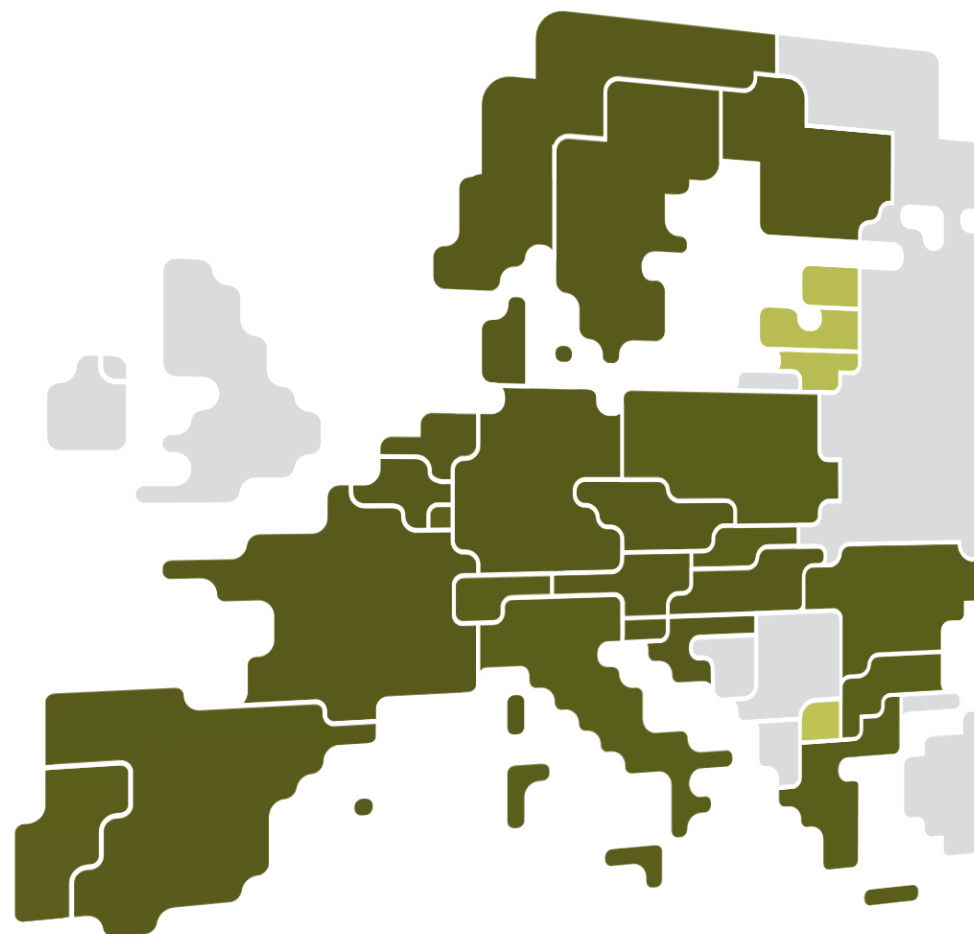




PICASSO & IGCC Stakeholder Workshop Meeting

30 November 2023, telco





1. Project planning and progress

9:05 - 9:25 CET

2. Business Processes

9:25 - 9:45 CET

3. KPI Reporting

9:45 - 10:10 CET

4. Questions and Answers

10:15 - 10:30 CET

Project Planning and progress

PICASSO

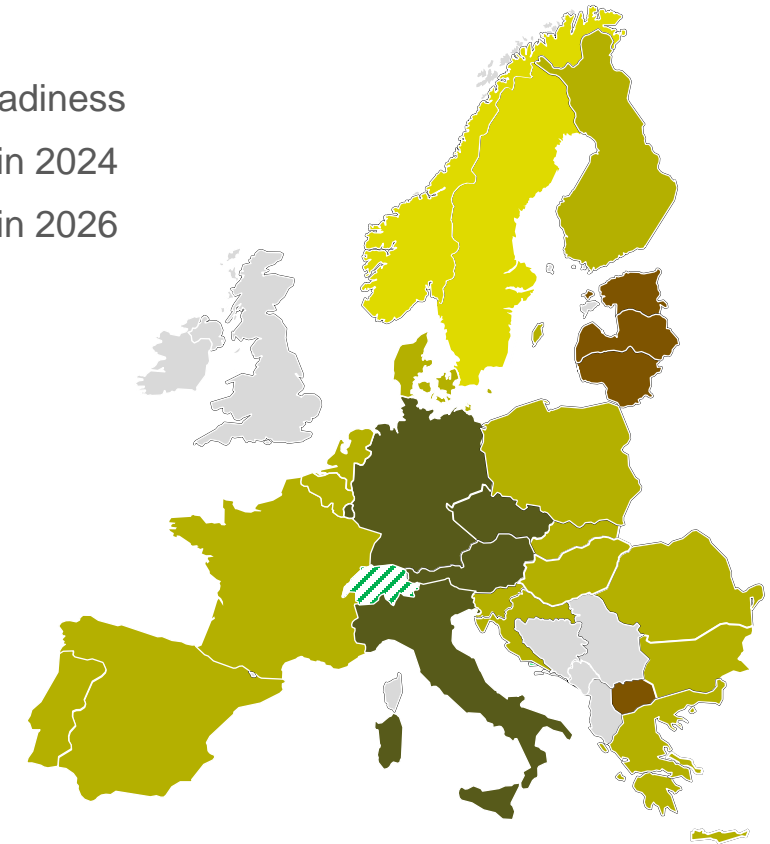


- The “Platform for the International Coordination of Automated Frequency Restoration and Stable System Operation” (PICASSO) has been endorsed by all TSOs in 2017 as implementation project for the European aFRR platform pursuant to GL EB.
- Currently. 26 TSOs from 23 countries have joined the project. 4 TSOs and ENTSO-E are observers.
- Successful go-live on June 1st, 2022 with CEPS as first operational member, earlier than required by the regulation
- First exchange of energy on June 22nd, 2022, after APG and the 4 German TSOs joined the platform, on 19th July Terna joined
- The remaining Member TSOs will gradually join the platform

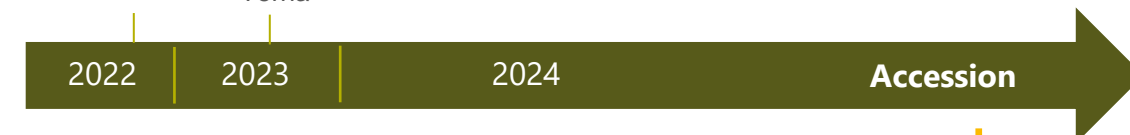
Relevant Features

- The PICASSO Platform establishes a European domestic energy market for aFRR energy, based on a common standard product.
- PICASSO fosters operational stability by coordinating the activation of aFRR.
- Using a market time unit of 4 seconds. The PICASSO optimizer has performed more than 11 Mio. market clearings since go-live with 100 % availability.
- The PICASSO IT solution is also used for the International Grid Control Cooperation (IGCC), which is closely interacting with the PICASSO Optimization to maximize the economic surplus while ensuring that the netting potential of all IGCC TSOs is used.

- In operation
- Technical readiness
- Plan to join in 2024
- Plan to join in 2026
- Observers

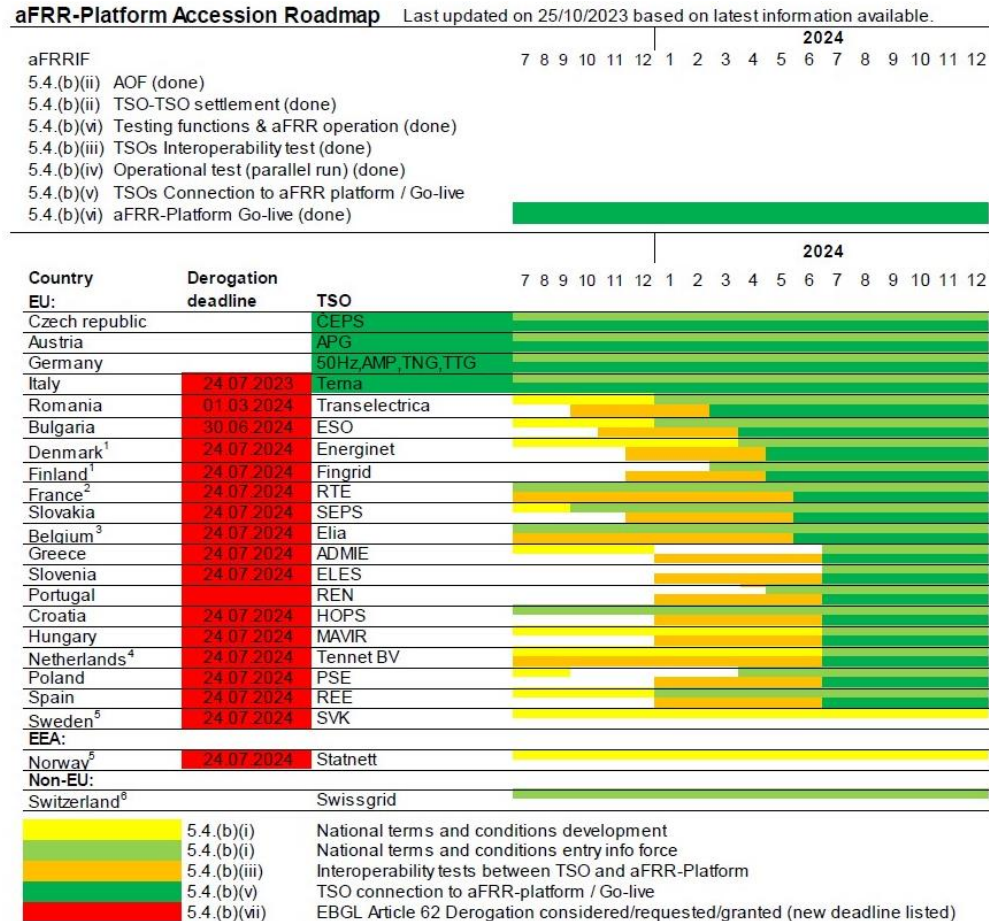


50Hertz,
Amprion,
APG
ČEPS,
TenneT DE,
TransnetBW Terna





- The accession of member TSOs to aFRR-Platform (PICASSO) is planned in accordance with the following accession roadmap.
- PICASSO member TSOs and ENTSO-E Share this accession roadmap for informative purposes only and it does not, in any case, represent a firm, binding or definitive position of PICASSO on the content.
- The content is subject to change as the implementation progresses and new information becomes available.
- In particular, the feasibility of the present accession roadmap may depend on final detailed accession planning and possible operational and/or technical constraints that would result in the number of parallel accessions.



1) The plan presented in this roadmap shall be regarded as a preliminary, non-binding estimate. The planned connection time is expected in Q2 2024. 2) RTE aims for implementation and go live by June 2024 provided risks related to balancing energy high prices observed on the PICASSO platforms are mitigated. 3) A first version of the T&C has entered into force early May 2022 when local bidding has been adapted and a second one will enter into force when ELIA will connect to PICASSO. 4) TenneT NL aims for implementation and go-live by July 2024 and has been granted a derogation until then. However, there is a real risk that the final derogation will take place even later than the requested derogation period. If TenneT takes these risks into account, TenneT expects to participate in the summer of 2025 to participate in the aFRR platform and TenneT will enter into discussions with relevant stakeholders if it becomes clear that the risks already in the planning manifest themselves. 5) The plan presented in this roadmap shall be regarded as a preliminary, non-binding estimate. The planned connection time is expected in 2026. 6) The technical readiness of Swissgrid has been acknowledged. The participation of Switzerland in the aFRR-Platform is regulated based on article 1.6 and 1.7 of the EB Regulation and currently the subject of litigation by Swissgrid at the Court of Justice of the European Union.



Activity	Q4/2023			Q1/2024		
	October	November	December	January	February	March
Transparency Platform at ENTSO-E						
Accessions						
<ul style="list-style-type: none"> Planned accession date 	<div>AR update</div> <div>AR update</div> <div>Transelectrica</div>					
Monitoring						
<ul style="list-style-type: none"> aFRR IF amendments Full activation time Control demand model Tentative implementation roadmap for IGCC 	<div> <div>aFRR IF pricing & methodology webinar</div> <div>Public consultation</div> <div>Submission to ACER</div> <div>ACER consultation</div> </div>					
Reporting (IF art. 13)						
External stakeholder meetings	<div>EBSG</div> <div>BP public stakeholder workshop</div>					

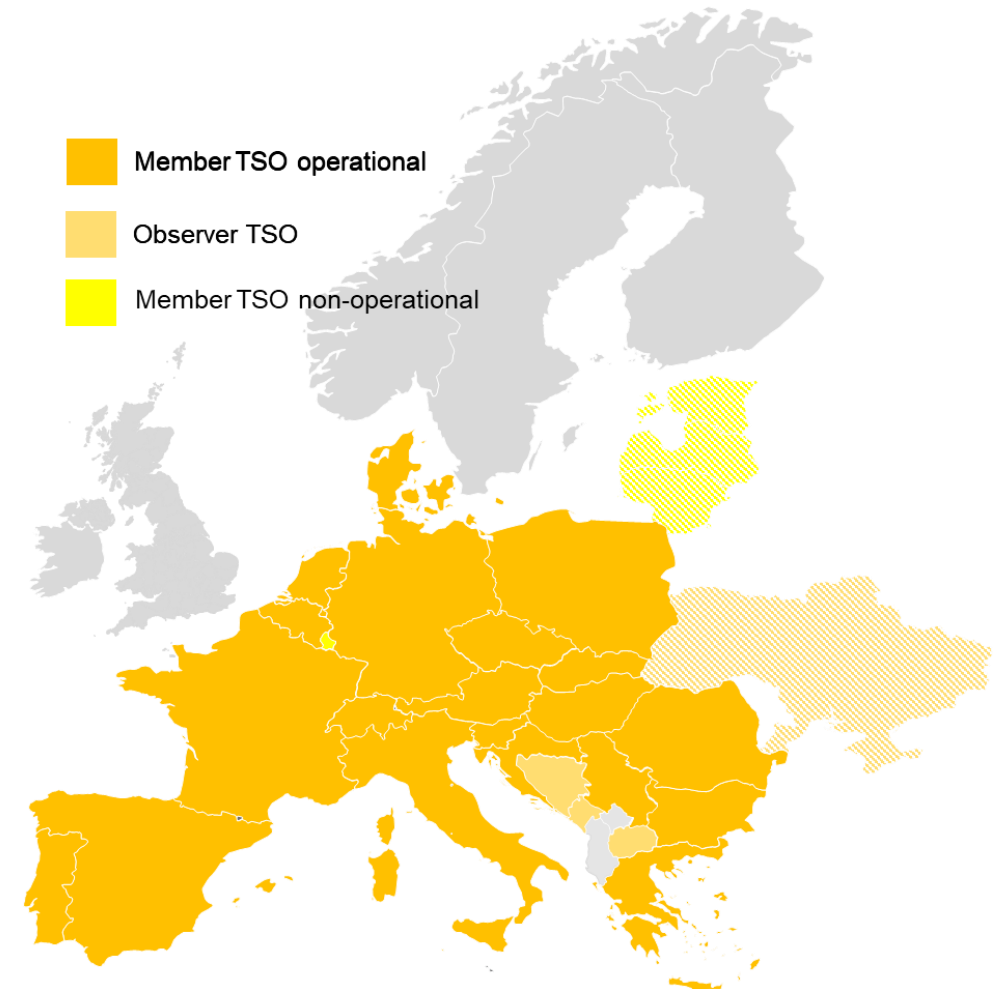


Activity	Q2/2024			Q3/2024			Q4/2024		
	April	May	June	July	August	September	October	November	December
Transparency Platform at ENTSO-E									
Accessions	AR update								
Planned accession date	30 ESO	28 ENDK Fingrid SEPS	04 RTE ELIA	12 ELIA	01 ADMIE, ELES	10 REN	24 HOPS, MAVIR, TenneT BV, PSE, RE, Svk, Statnett		
Monitoring	ACER consultation								
aFRR IF amendments	ACER decision								
Full activation time									Due date
Control demand model									Due date
Tentative implementation roadmap for IGCC						Due date			
Reporting (IF art. 13)			2nd annual IF report						
External stakeholder meetings	EBSG							EBSG	



- All TSOs with the obligation to connect as a result of the EB Regulation are connected to IGCC*.
- IGCC is the first Balancing Platform to achieve this objective.

- IGCC has 30 members in total, out of which
 - 24 are operational members and
 - 6 are observers.
- With the go-live of ESO in March, all EU-TSOs with legal obligation are connected and can net their imbalances.
- As of January 2024 Litgrid, AST and Elering will become IGCC Member TSOs
- Historical evolution (starting in 2010):

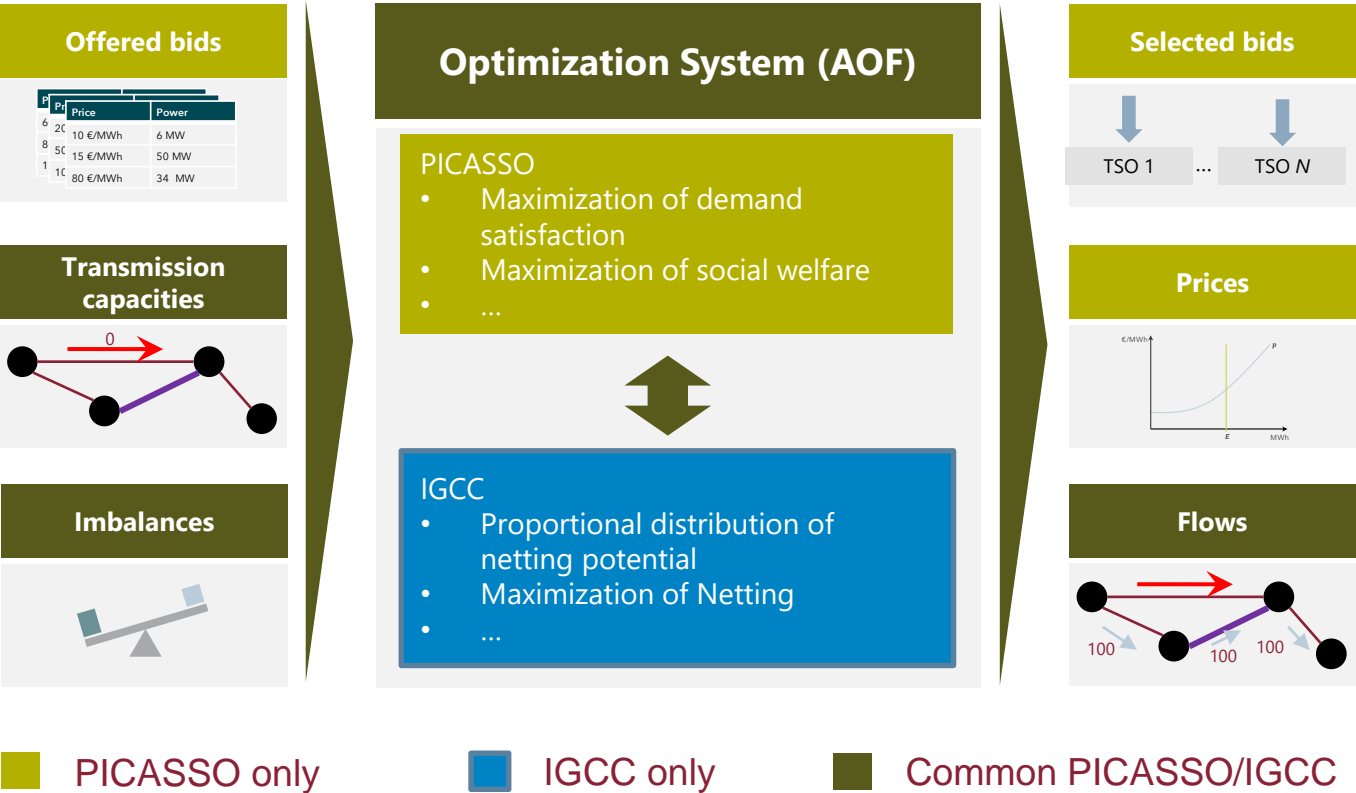


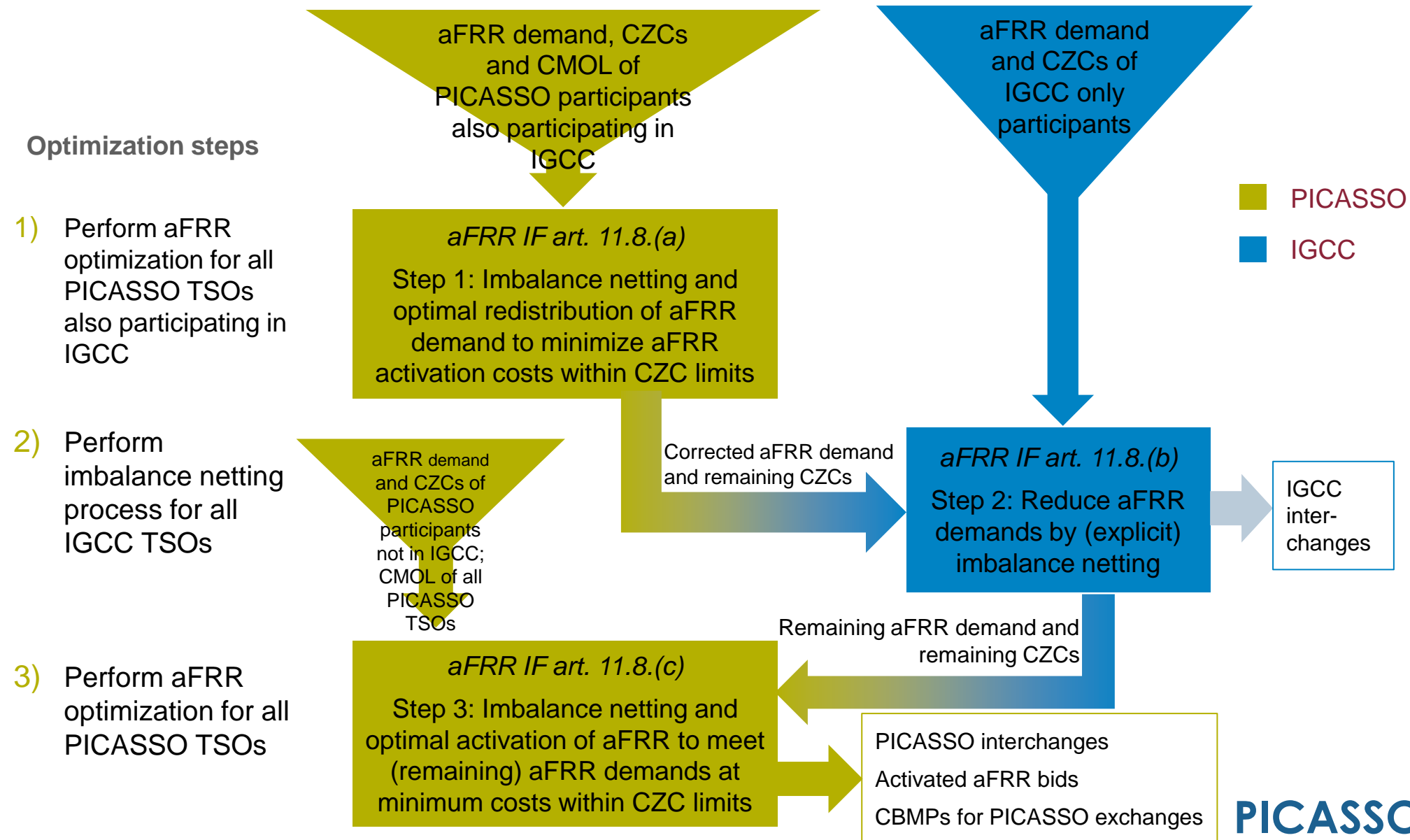


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High level design of Optimization

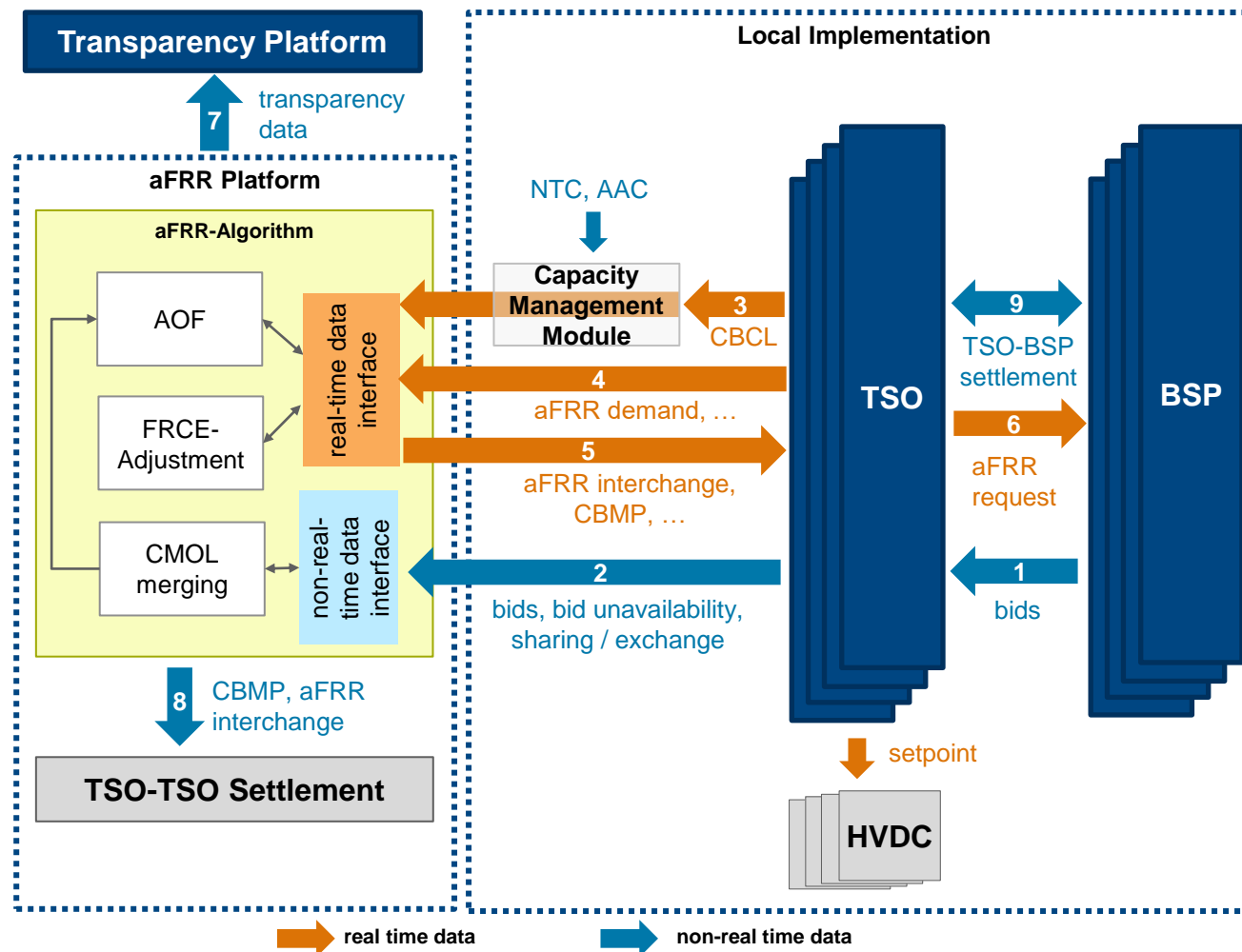






Common and Individual Characteristics

Requirements	IGCC <ul style="list-style-type: none">• Imbalance netting process pursuant to SOGL 146• No Cross-border exchange of activated FRR• No maximization of social welfare• Implementation deadline: July 2021• Well-established process (since 2011)• Will cease to exist when all IGCC members are participating in PICASSO	PICASSO <ul style="list-style-type: none">• Cross-border aFRR activation process pursuant to SOGL 147• Maximization of social welfare by Cross-border activation according to Common Merit Order• Implementation Deadline: July 2022• New process (but predecessors exist on a regional level, e.g. DE/AT)
Individual Characteristics	<ul style="list-style-type: none">• Individual participation of each TSO in one or both platforms possible• Individual optimization steps• Individual use of cross-border capacities• Individual Settlement• Individual Governance / Steering Committees	
Common Characteristics	<ul style="list-style-type: none">• Common software solution• Common management of Transmission capacity• Similar interaction with LFC loops• Common Host TSO• Common operational governance / OPSCOM envisioned	



1. TSO receives bids from BSPs in their LFC area
2. TSO forwards standard aFRR balancing bids to platform
3. TSOs communicate Cross-Border Capacity Limits to Platform
4. TSOs communicate aFRR demands to platform
5. Communication of clearing results to TSO
6. Communication of aFRR request from each LFC to BSP
7. Data Publication
8. TSO-TSO settlement process and invoicing
9. TSO-BSP settlement process and invoicing

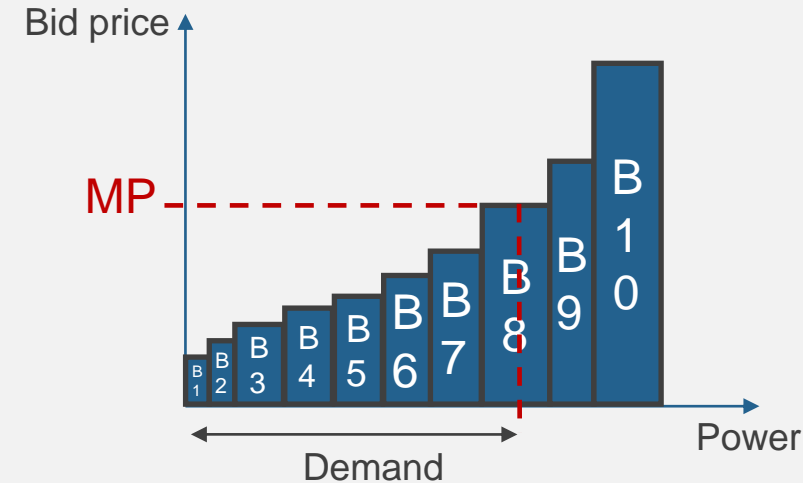
AOF Activation Optimisation Function
 FRCE Frequency Restoration Control Error
 CMOL Common Merit Order List
 CBMP Cross-Border Marginal Price

NTC Net Transfer Capacity
 AAC Already Allocated Capacities
 CBCL Cross-Border Capacity Limits
 HVDC High Voltage Direct Current



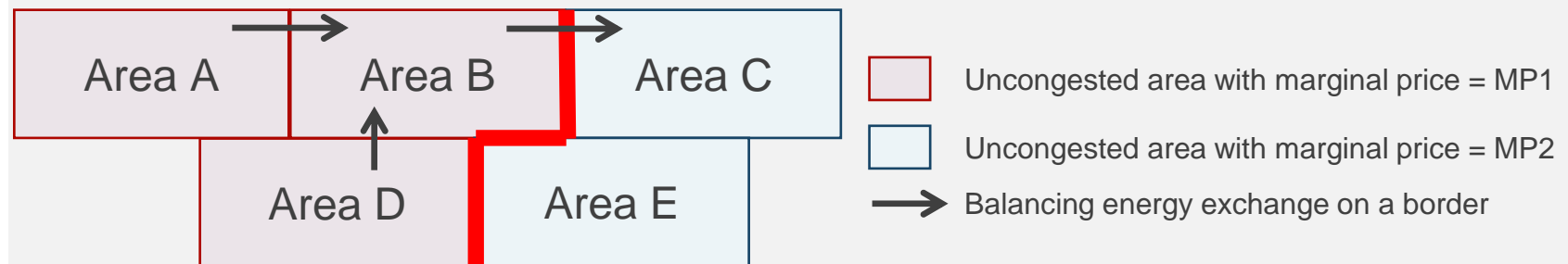
Marginal pricing principles

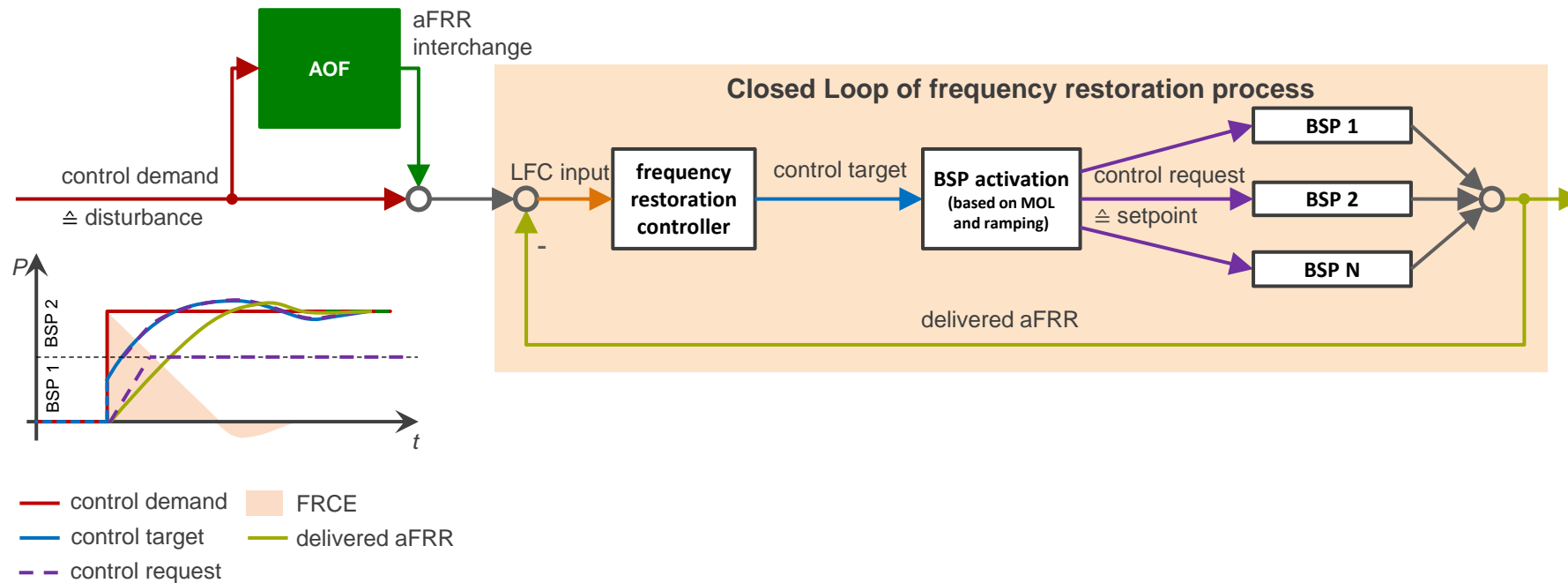
- According to EBGL, pricing for balancing energy shall be based on marginal pricing
- The Marginal Price (MP) represents the price of the highest price bid of a standard product which has been selected to cover the energy need for balancing purposes within a specified area.
- The PICASSO AOF will compute the balancing energy price per LFC area and optimization cycle



Cross-Border Marginal Pricing

- In case there is no congestion between adjacent LFC areas, the Cross-Border Marginal Price (CBMP) will be the same in these areas
- In case there is a congestion, there will be a price split and congestion rent will be allocated to the respective TSOs (c.f. day-ahead or intraday markets)



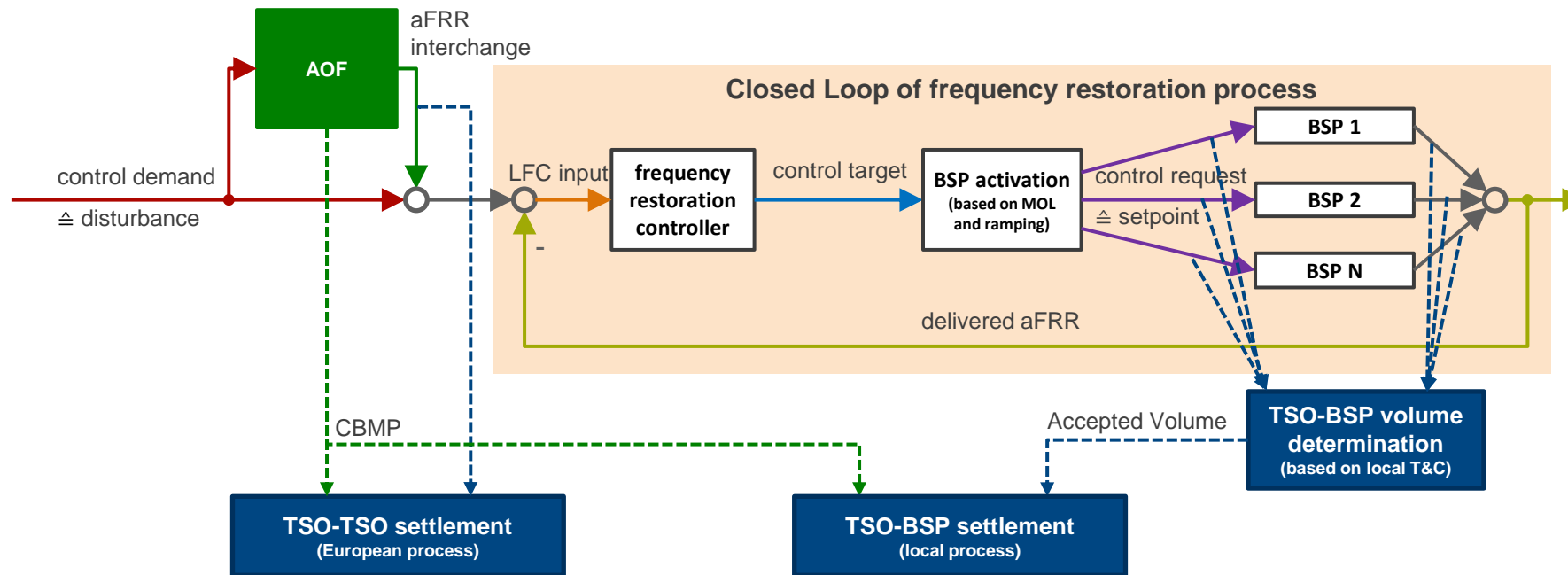


Frequency Restoration control

- Objective: Regulate LFC input (difference between disturbance and activated aFRR) to zero and by this restore frequency deviations
- The control target (LFC output) follows the control demand with a certain delay, depending on the controller settings that are adjusted to the expected dynamic BSP behavior

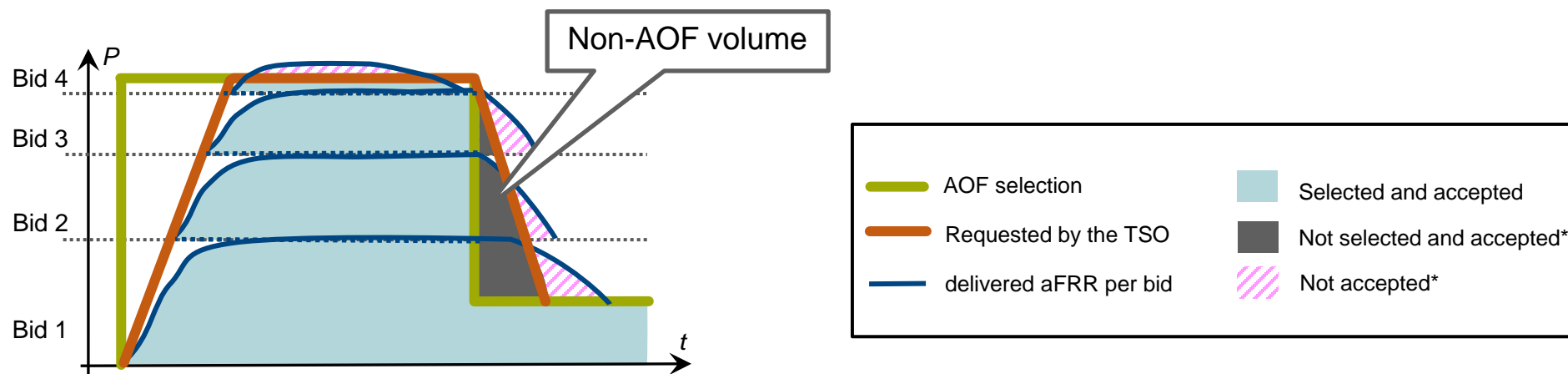
Control Demand model

- Each TSO calculates in each control cycle the demand, which resembles the imbalance before any aFRR activation and provides it to the AOF
- The AOF determines the aFRR interchange based on the CMOL, without considering any ramping constraints



PICASSO settlement

- TSO-TSO settlement is based on a aFRR interchange calculated by the AOF, multiplied with CBMP, not taking into account activation delays
- TSO-BSP settlement is based on “accepted volumes” determined by each TSO based on local terms and conditions (e.g. on basis of control request and/or measures/metered physical aFRR delivery)
- Accepted volumes are multiplied with CBMP, centrally determined on basis of the bid selection by the PICASSO AOF



*Bid acceptance depends on local terms & conditions. In this figure, a volume determination scheme based on measured volume capped by requested volume is assumed

TSO-BSP settlement

- Due to the dynamic behaviour of the LFC and the BSPs, discrepancies between AOF bid selection, aFRR request and aFRR delivery cannot be prevented
- Remuneration of accepted bid activation is based on the maximum of the CBMP determined by the PICASSO platform and bid price
→ Non –AOF volumes are remunerated with the bid price



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Background

- According to Article 13.1 of the aFRR Implementation Frameworks, TSOs will annually report on the implementation and operation of the PICASSO platform.
- The first report will be published on the ENTSO-E website in January 2023 and inform on the first operational Year of the platform operation (July 2022 to June 2023). A summary will be shown in today's workshop.
- The Imbalance Netting Implementation Framework requires no corresponding reporting on the IGCC. However, TSOs publish quarterly reports on the performance and results of the imbalance netting process on the ENTSO-E website, a summary will also be shown today.

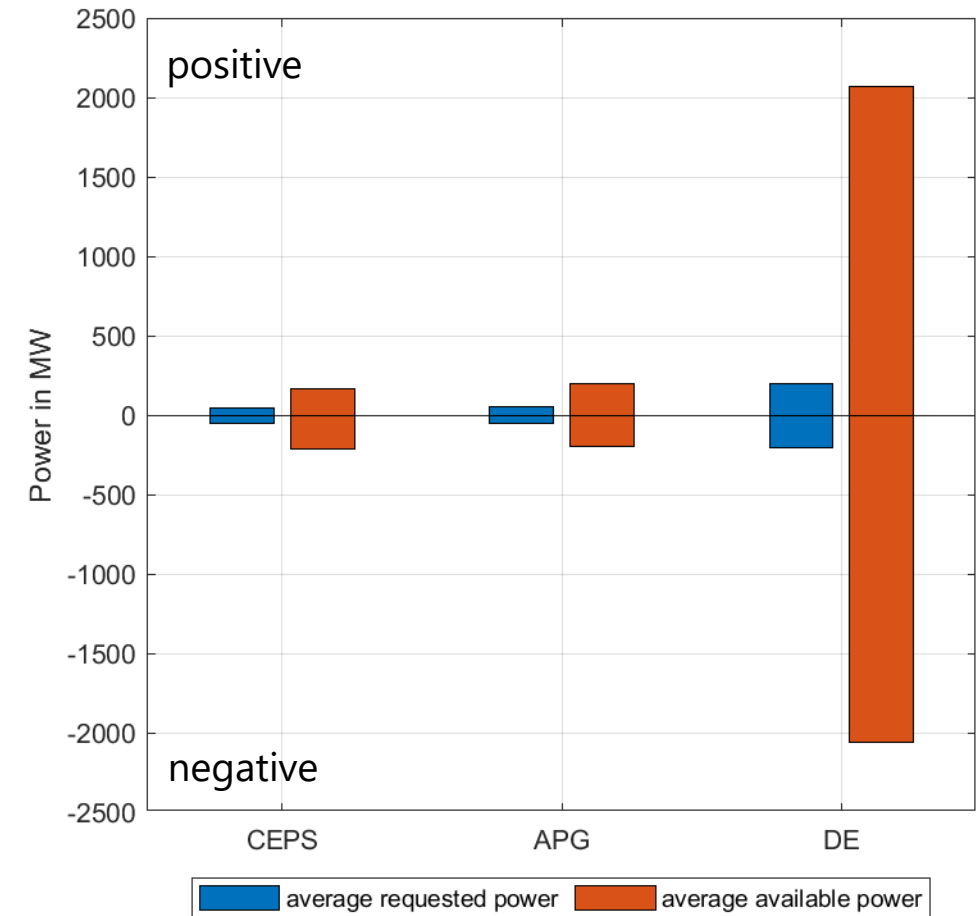
General remark

- Aggregated information and statistics on bids that were declared unavailable are not included in the 2023 report, since none of the TSOs that participated in the first operational Year has implemented a local process to declare bids as unavailable after submission.
- The results of the annual stakeholder survey are not a subject of today's workshop as they have been presented in the recent EBCG meeting and are available on the ENTSO-E website.

Requested and available volume of balancing Energy



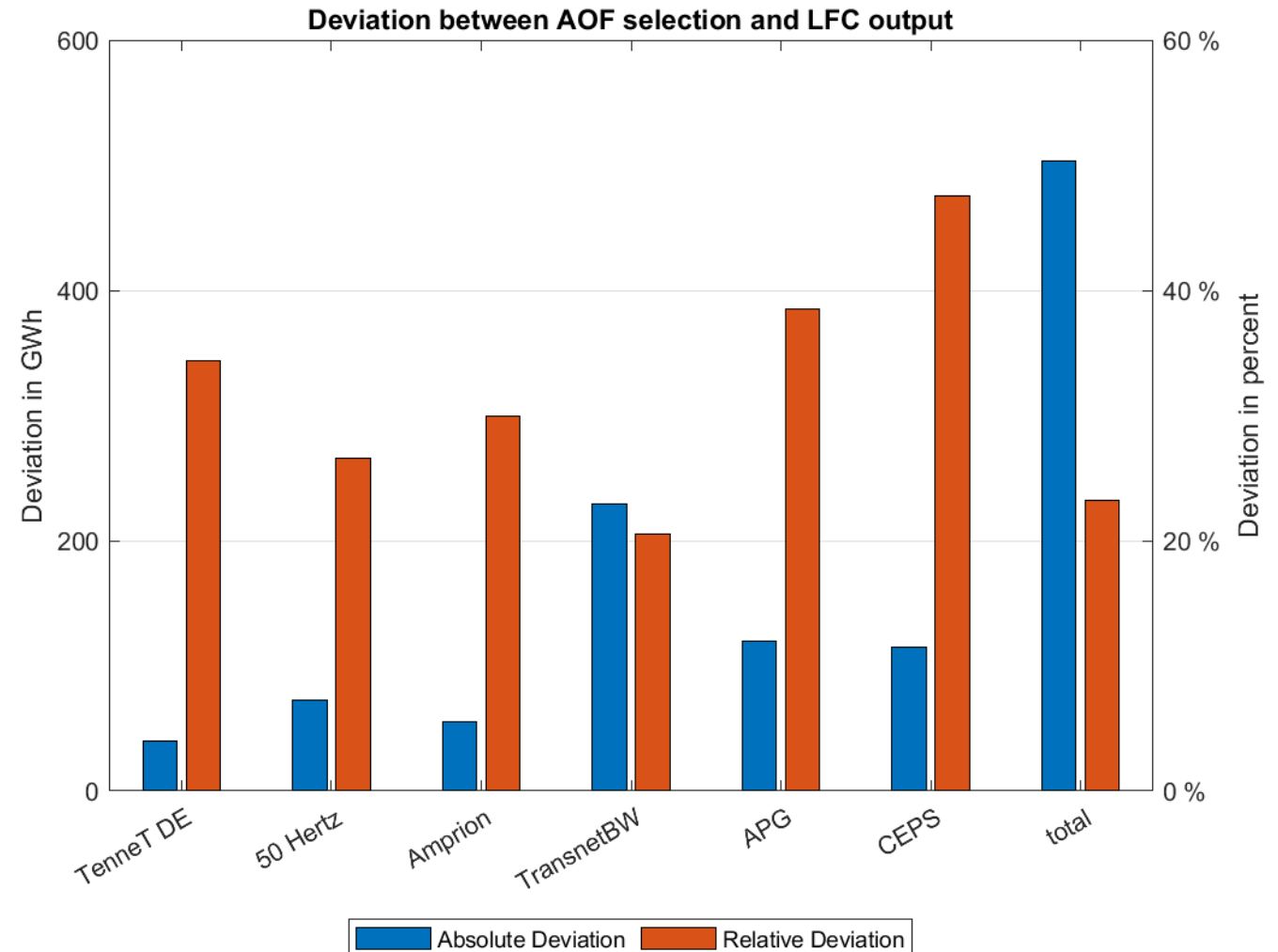
- To make requested and available volumes comparable, all values are shown as average, represented as power in MW.
- From July 2022 to June 2023, an average of 2431 MW positive aFRR and 2464 MW negative aFRR were available to the PICASSO platform.
- An average power of 97 MW of positive and 101 MW of negative aFRR has been requested.
- In available volume, the sharing of reserves within Germany and the exchange between Austria and Germany is considered.



Deviation between AOF selection and LFC output



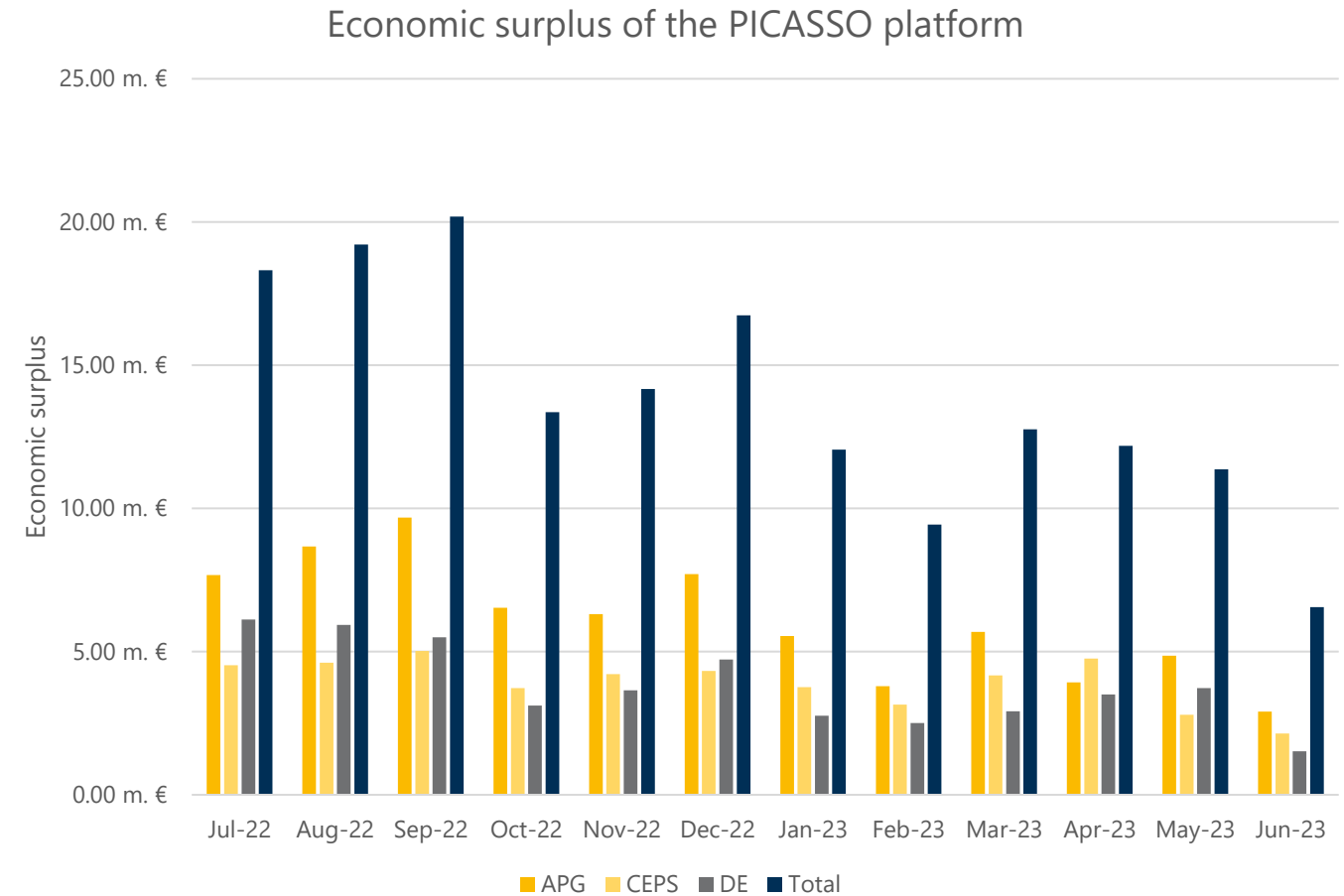
- Due to the usage of the control demand model, deviations between AOF selection and LFC output are inherent and ubiquitous
- The absolute deviations are strongly impacted by the magnitude of the selected volume in each LFC area and thus by the structure of the CMOL. To compensate this effect, the deviations are additionally shown in relation to the total volume selected by the AOF.
- The deviations are further impacted by the volatility of the activation and the dynamic behavior of the aFRR controllers
- To be considered: Deviations between AOF selection and LFC output are not identical to “non-AOF-volumes”, which only occur if bids are accepted despite having a higher price than the CBMP
- Minor differences in calculations for different TSOs are possible since “LFC output” is not yet commonly defined



Economic surplus of PICASSO



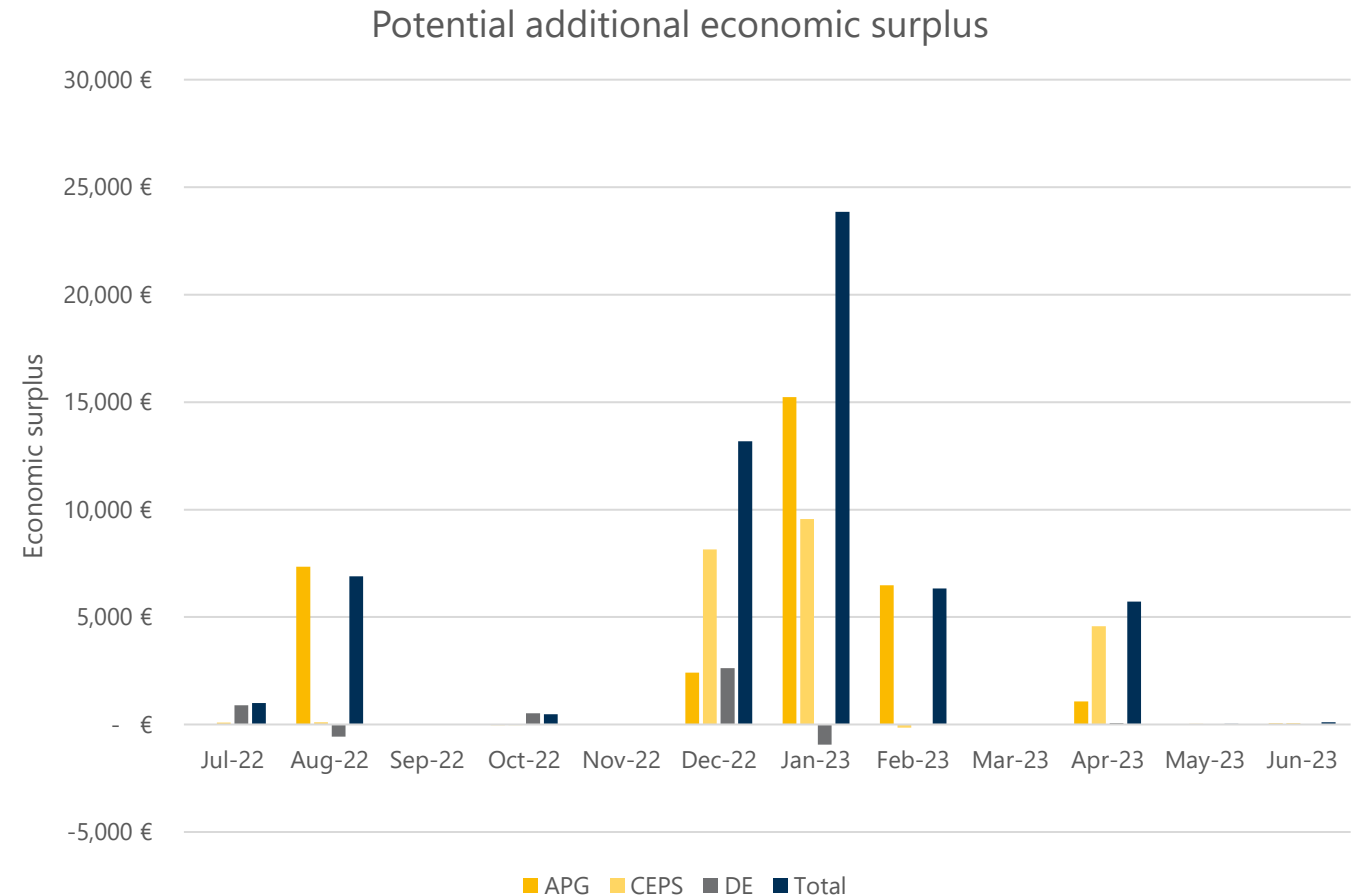
- Economic surplus is calculated by comparing the actual activation of aFRR to a reference scenario with the same bids, demands and market design, but without international interchange.
- Economic surplus from in the first operational Year was around 166.3 Mio. €, without surplus from additional satisfaction of demand. Additional surplus of 6 – 462 Mio. € for additional demand satisfaction, depending on the assumed price.
- Economic surplus higher for small LFC areas, that get access to a much larger market via PICASSO.
- Surplus from aFRR interchange within Germany is not included.



Economic impact of minimizing bid selection



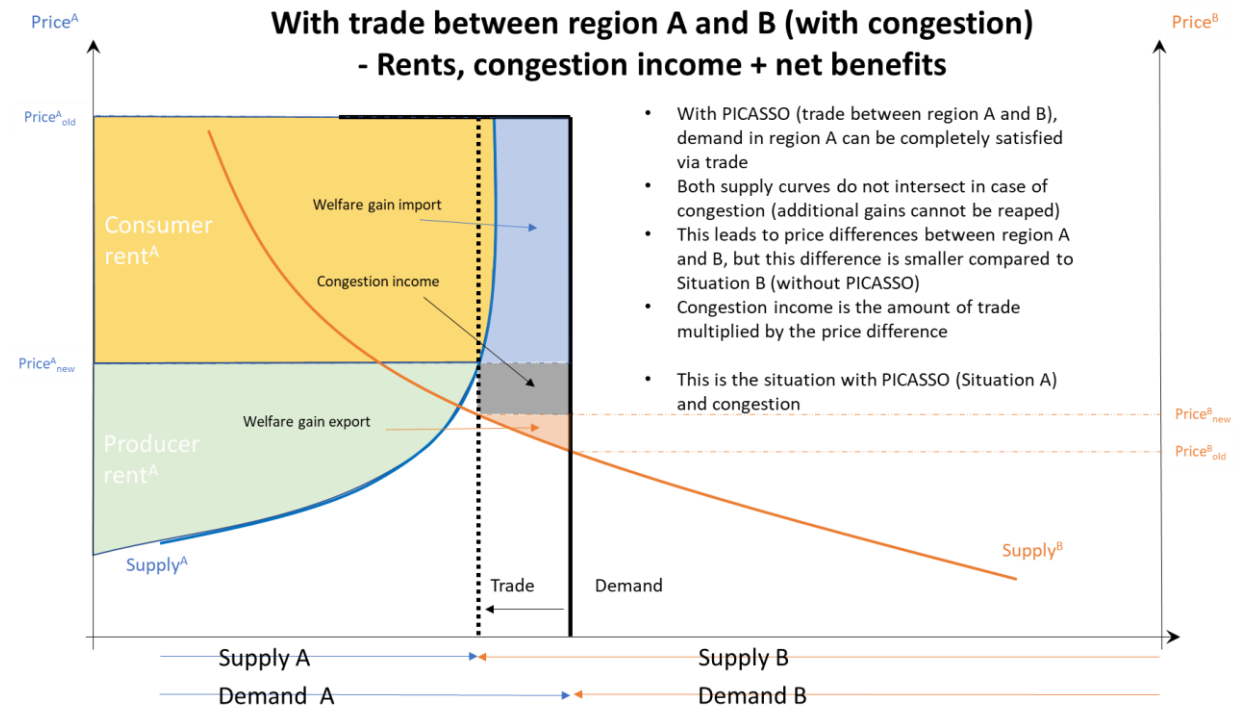
- The PICASSO AOF minimizes the amounts of selected bids and thus prevents the counter activation of bids for economic purposes. The main reason for this behavior are dynamic effects of the frequency restoration process that could cause additional imbalances if counter activation is performed.
- The potential additional economic surplus by not minimizing the bid selection sum up to 57 600 € for the first Year of operation, which is 0.03 % of the total economic surplus of the PICASSO platform.
- This small potential for additional surplus does currently not justify a change of the design principle to block counter activation.



Backup: Economic surplus calculation



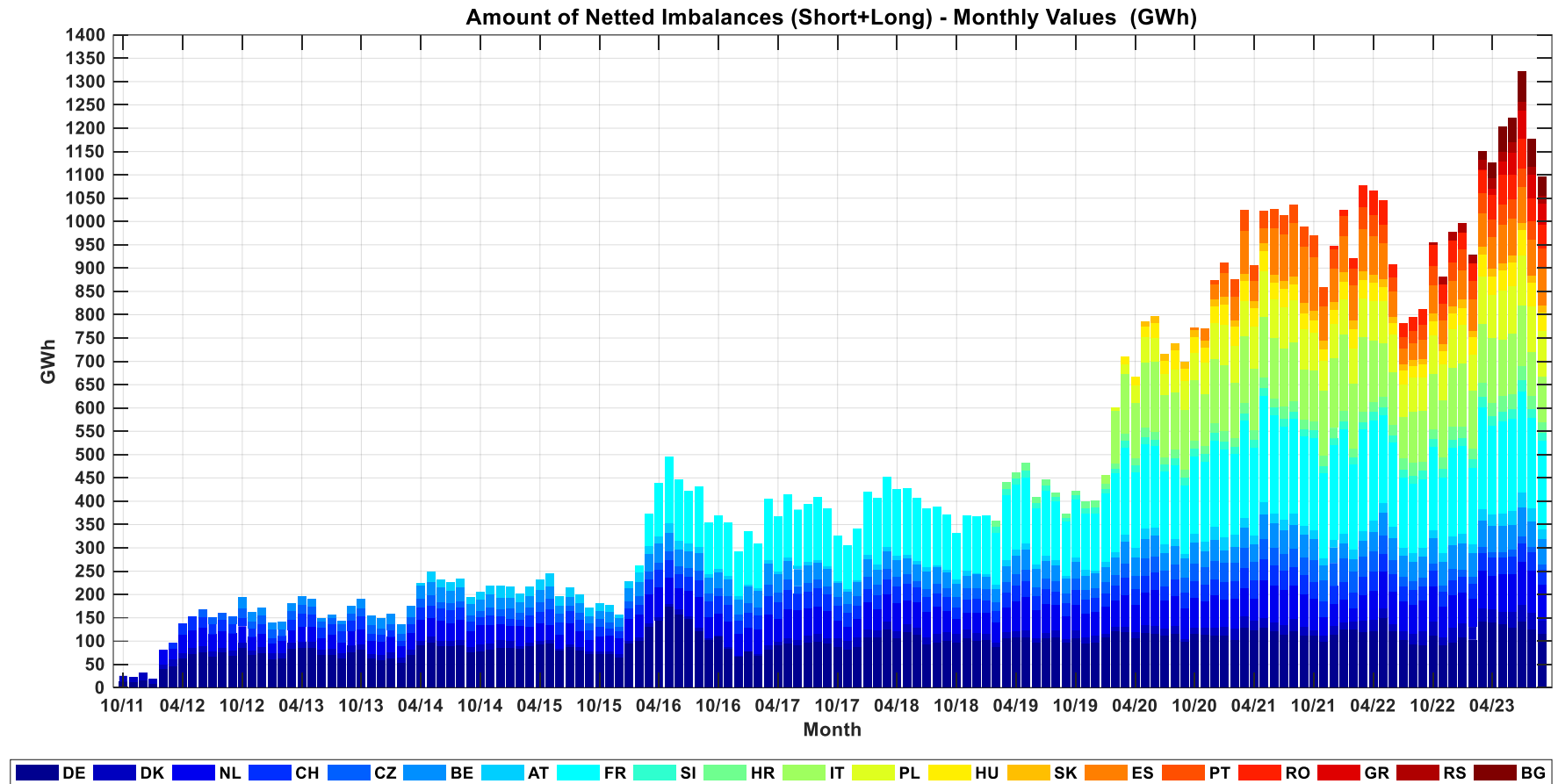
- Based on the decoupled scenario simulation, the “old” price of region A and B is calculated.
- Graph on the right shows the different components of the total social welfare. For this example, the demand of area A is higher than the available volume provided in area A.
- The consumer rent for area A is equal to the reduction of the producer rent of area A compared to the decoupled scenario.
- If there is a congestion, there is a congestion income and an additional welfare gain based on the export.
- The value of the welfare gain based on the import (blue area), is based on the price that is used to calculate this amount.
 - Method 1: no price
 - Method 2: price cap
 - Method 3:



Amounts of netted imbalances in the IGCC

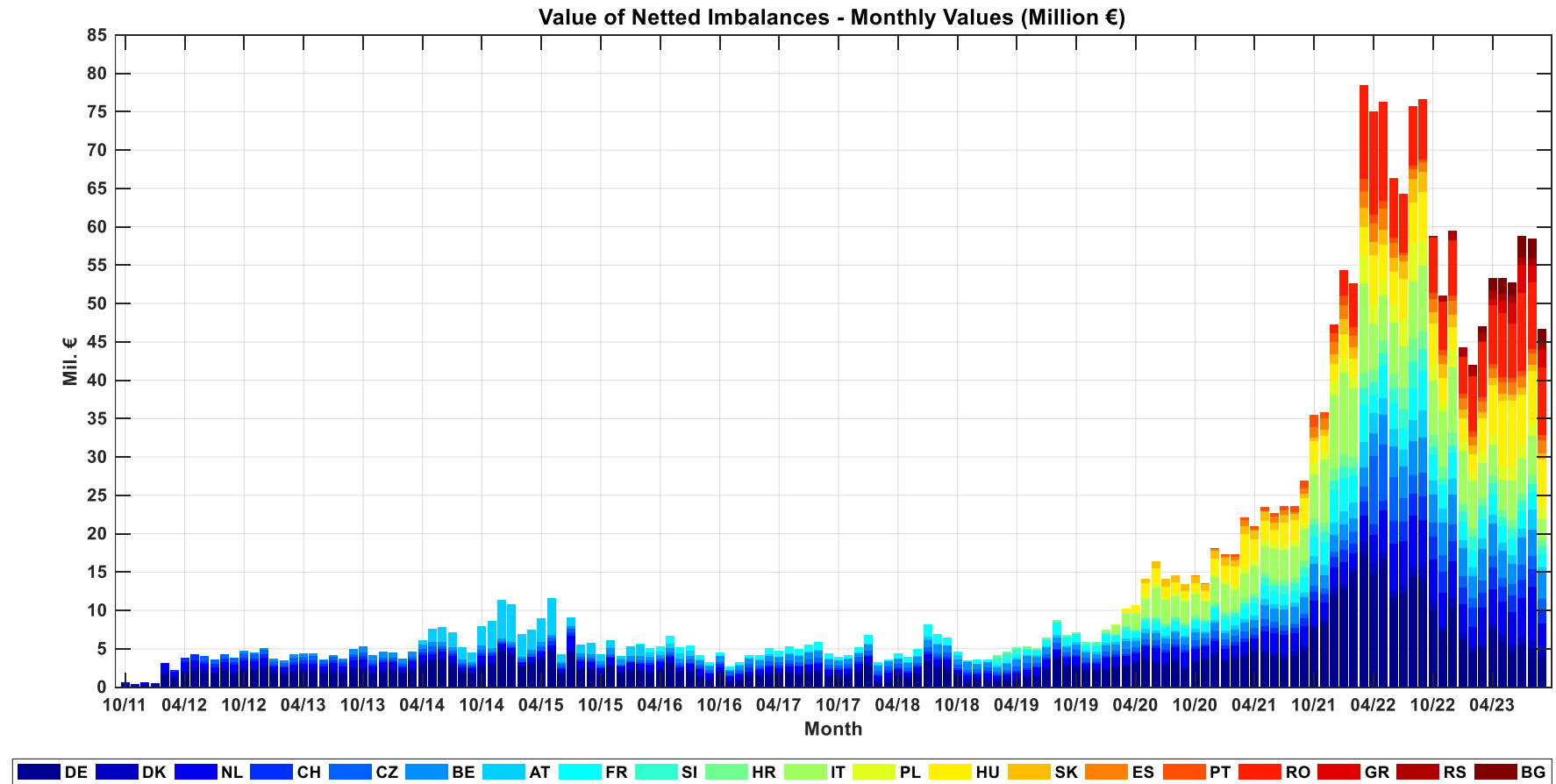


- Temporary drop of the IGCC netting in 2022 due to the initial PICASSO accessions
- After that, the IGCC netting reached a new all-time high of up to 1.3 TWh/month due to accession of remaining countries and increase of transmission capacity after the end of the trial phase of new members
- Decrease of IGCC netting expected in 2024 as more implicit netting will be performed in PICASSO





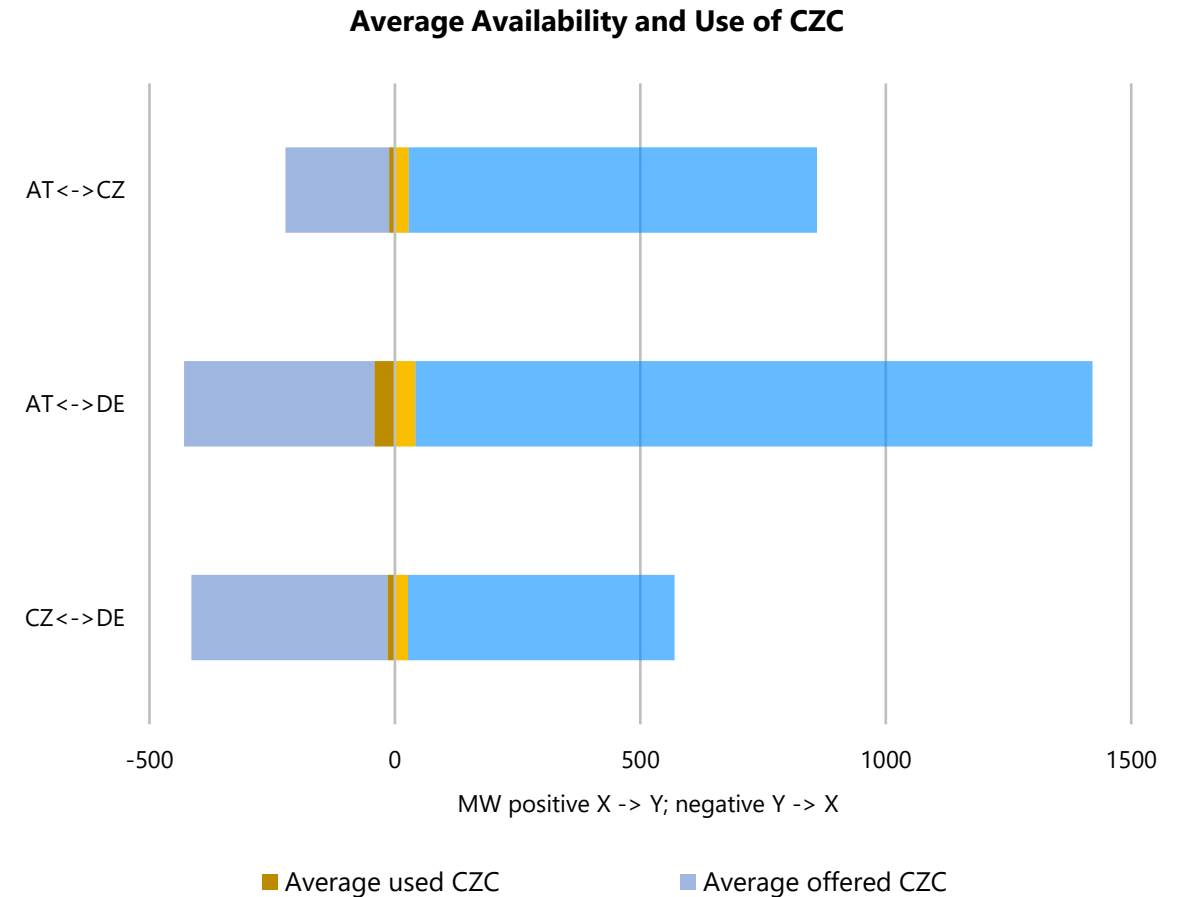
- Decrease of value netted imbalances in 2023 due to overall decrease of energy prices
- Aggregated savings of the IGCC since its initiation:
2250 Mio €



Average and used CZC in PICASSO



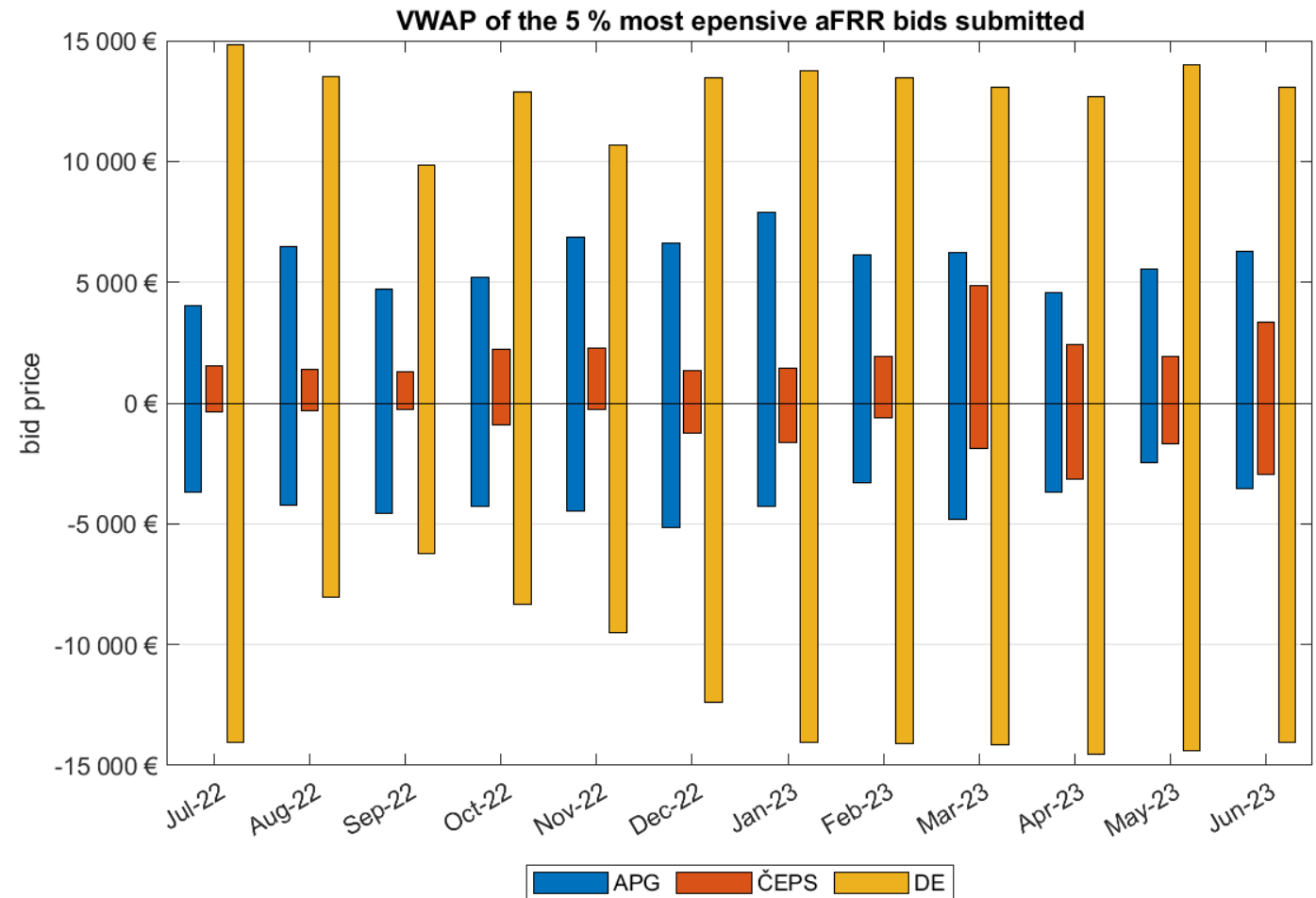
- Only few balancing borders have been available for the exchange of aFRR in the first operational Year due to limited participation of TSOs. More balancing borders will be integrated in 2024.
- As the CZC depends on the leftover capacity from previous markets, usually large transmission capacities are available in one direction. If the imbalances do not require the exchange of aFRR in this direction, they remain unused. Thus, only a small percentage of the available CZC is used for balancing, which not an indication for an inefficient aFRR market.



VWAP of the most expensive submitted bids



- Volume weighted average price of the 5 % of the most expensive aFRR bids can be seen as an indicator of the end of the Merit Order Lists. This metric is only relevant for the CBMP formation in case of high demands, reaching the end of the MOL of the respective uncongested area
- Changes in the VWAP of the most expensive bids in 2022 caused by market changes (introduction of marginal pricing, suspension of bid release process in Germany) and overall development of energy prices





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ANY QUESTIONS?