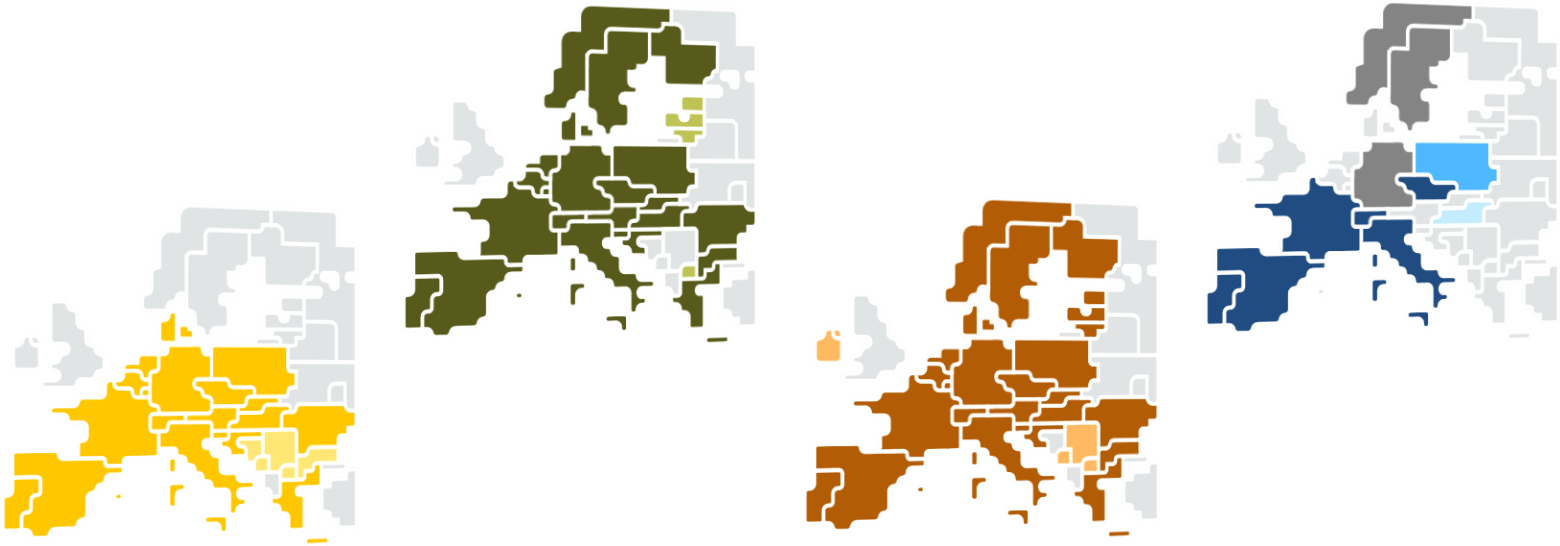
Update on Balancing Platforms

May 25th, 2023

Electricity balancing stakeholders meeting



Introduction

Background and Motivation

Regulatory background

- Entry into force of Guideline Electricity Balancing on 2017/12/18
- Entry into force of Clean Energy Package on 2019/06/25

Target model based on Guideline Electricity Balancing

- European domestic market for balancing energy
- Separate procurement of balancing capacity and energy
- Marginal pricing (at least) for balancing energy
- Minimum requirements for balancing capacity cooperations

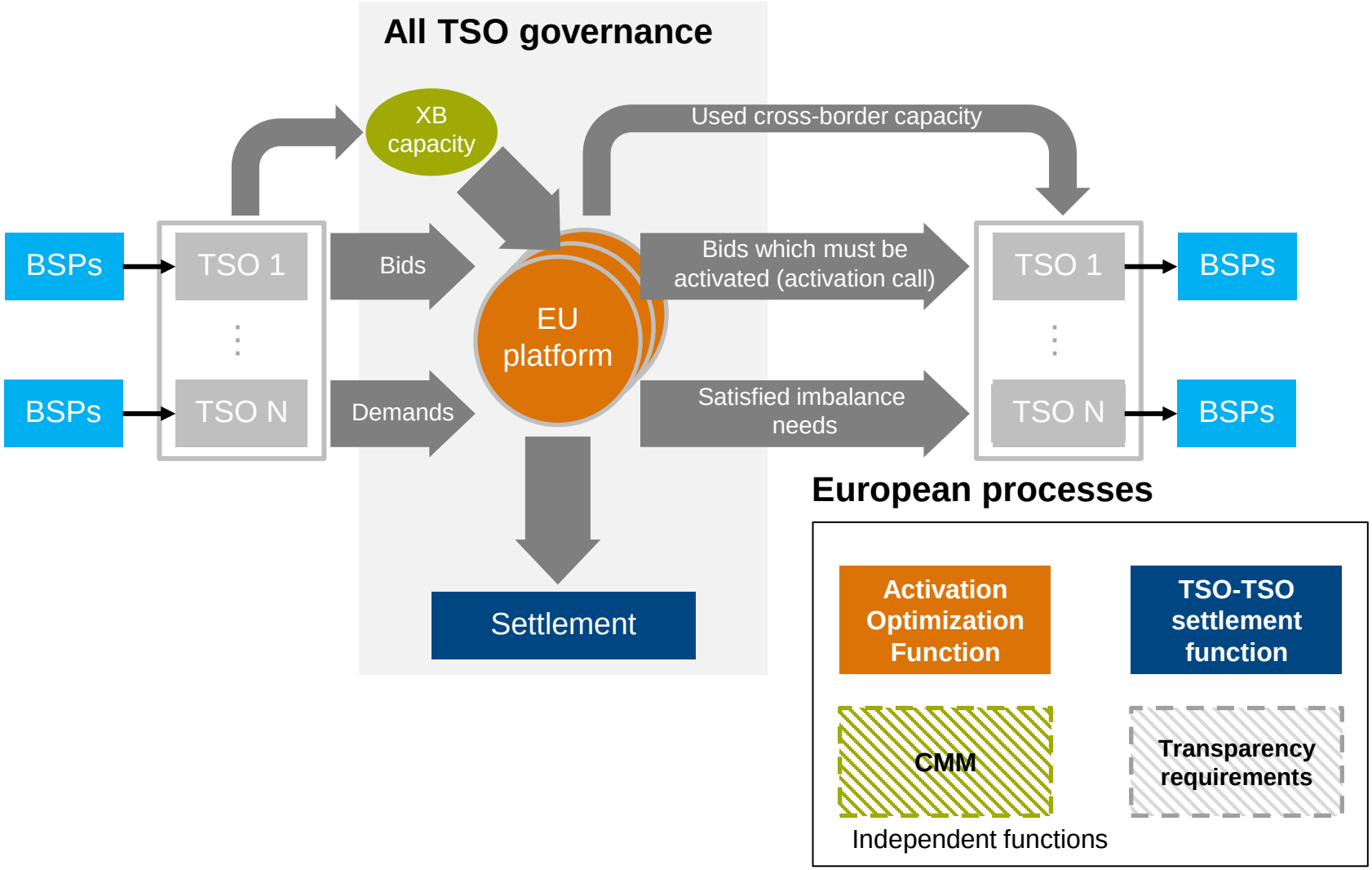
Additional requirements based on Clean Energy Package

- Regional sizing of reserves
- Facilitation of balancing capacity procurement

» (Voluntary) regional projects may have facilitated early implementations.

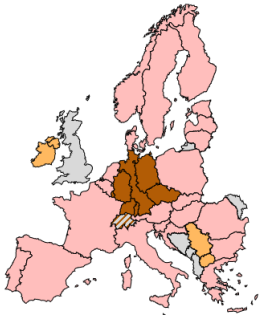
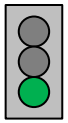
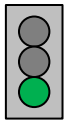
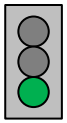
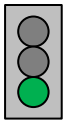
» But European projects (balancing platforms) facilitate target model according to GL EB.

Concept of Balancing Platforms (Exemplary Setup)



Introduction

Overview on current status of European Balancing Platforms

	IGCC	MARI	PICASSO	TERRE
Balancing service	IN	mFRR	aFRR	RR
Participants				
Target area	Continental Europe	Europe	≥ Continental Europe	≥ RR TSOs
Go-live	24/06/2021 & operational since 01/10/2011	05/10/2022*	22/06/2022*	29/09/2020*
Status				
Highlights	Economic surplus of around ~790 Mio. € in 2022	Cross-border exchange of >2.5 GWh between DE and CZ until April 2023	Economic surplus of 135 Mio. € until March 2023	Economic surplus of 766 million € in 2022.

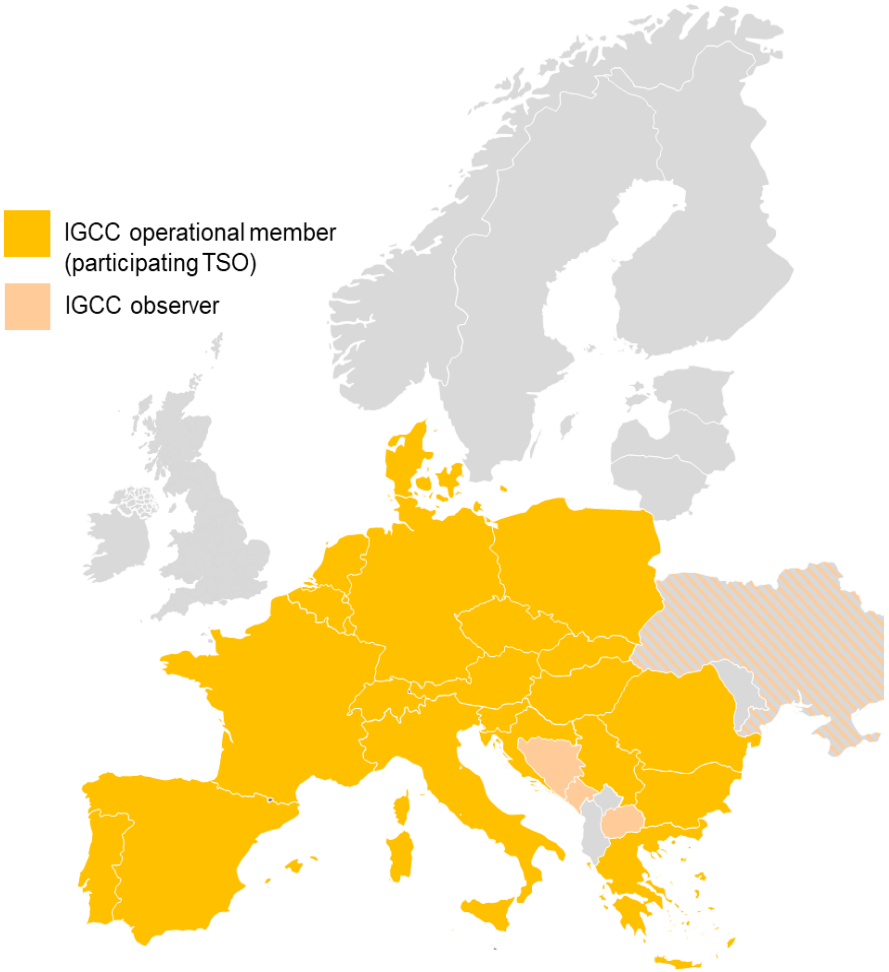
* Date as of when cross-border exchanges were possible due to neighboring TSO joining. Technical go-live of platform was earlier.

- » European domestic market (at least) for balancing energy has been established in 2022.
- » European market design has significantly changed the local procurement rules.

Market Results

Important achievements in IGCC

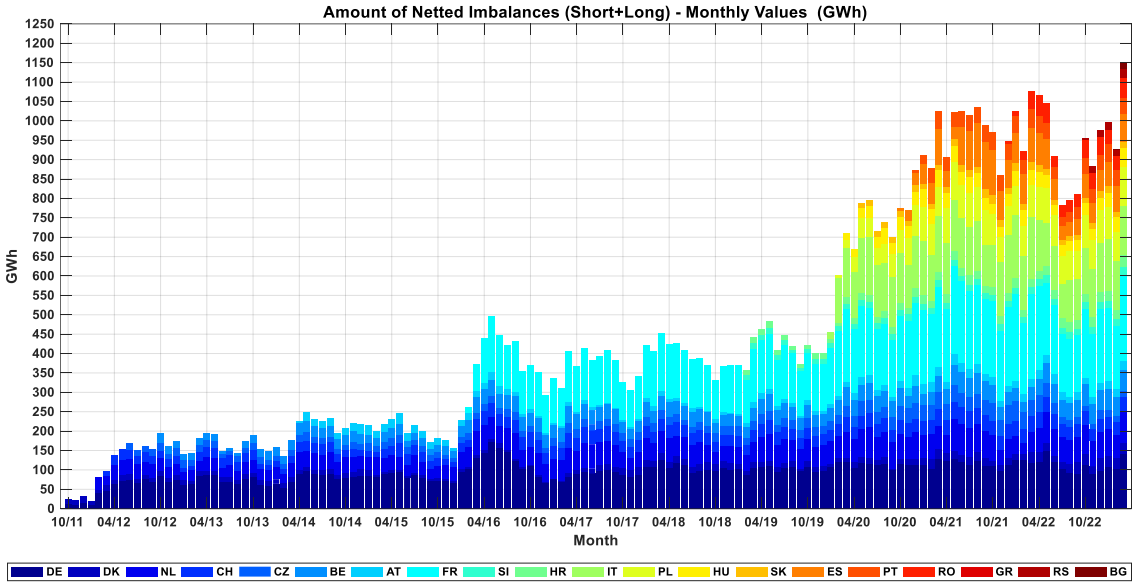
- All TSOs with the obligation to connect as a result of the EB Regulation are connected to IGCC*
- IGCC is the first Balancing Platform to achieve this objective.



- IGCC has 27 members in total. out of which
  - 24 are operational members and
  - 3 are observers
- With the go-live of ESO in March, all EU-TSOs are connected and can net their imbalances.
- Historical evolution (starting in 2010):

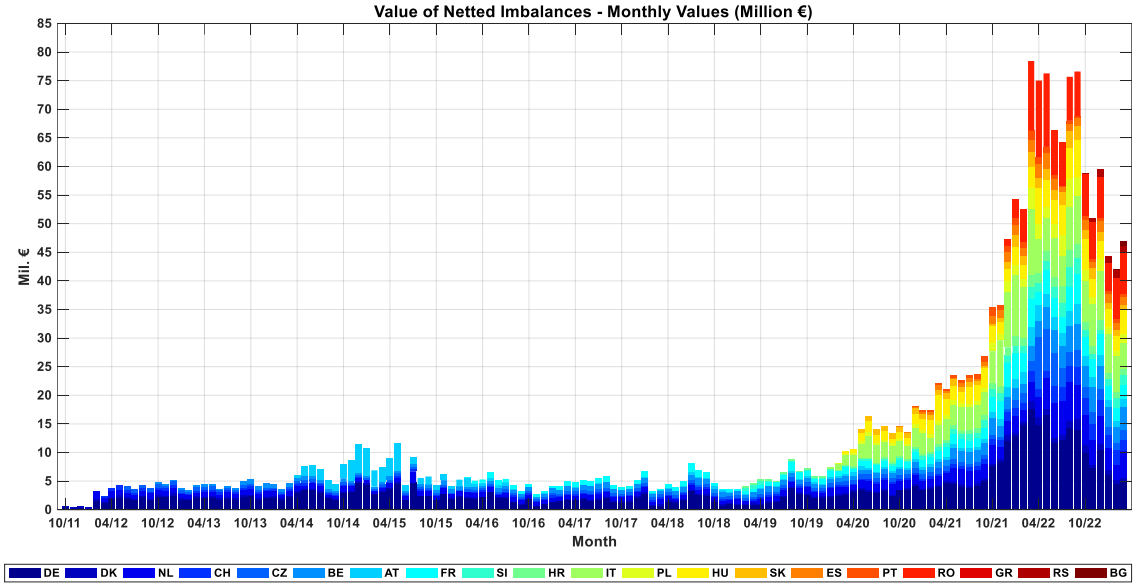
Market Results including Q1/2023

Imbalance Netting Energy Exchanges in IGCC



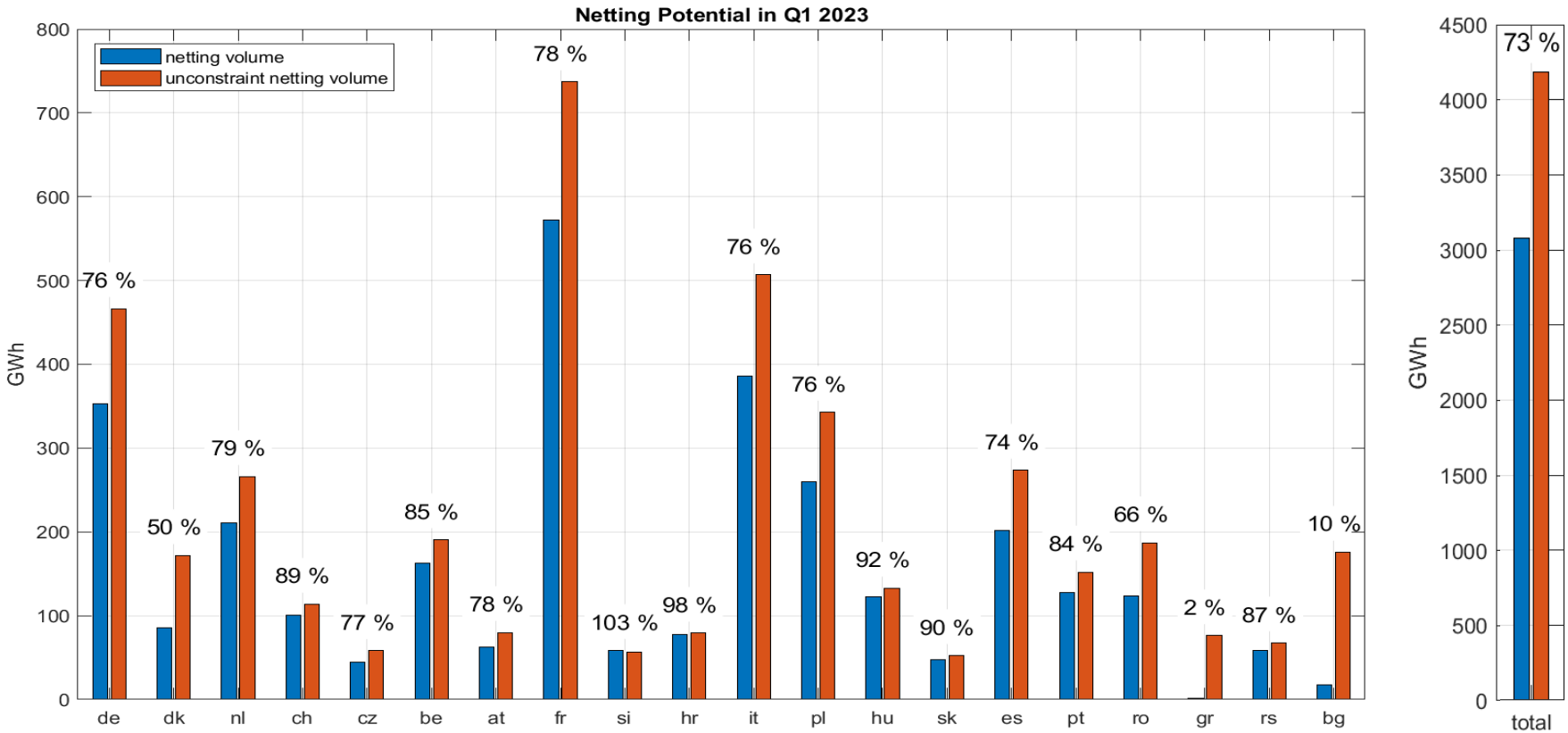
- The quarterly energy savings have reached around 2813 GWh in Q4 2022 and 11.24 TWh during all 2022 year.
- New record of monthly value amount of netted imbalances more than 1.15 TWh in March 2023
- The impact of PICASSO go-live is visible from June 2022 with a reduction of the amount of netted imbalances. Effect is “covered” since 10/2022 by the go-live of EMS and ESO

- The value of quarterly energy savings have reached around 170 million € in Q4 2022 and 789 million € during all 2022 year.
- The impact of the critical increase of energy price is visible, increasing the value of netted imbalances from end of 2021 until Q3/22, followed by a small decrease in Q4/22 and a significant decrease in 2023

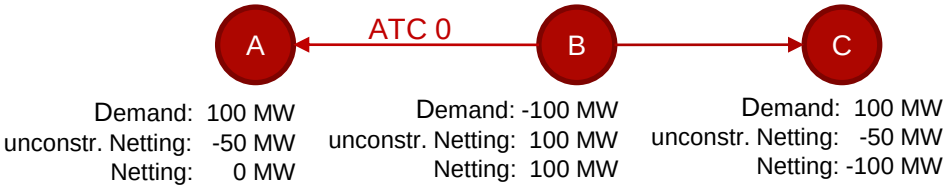


Market Results including Q1/2023

Imbalance Netting Energy Exchanges in IGCC



- The theoretical netting potential in Q1 2023 exceeded 4 TWh in total. 73% of this total potential was used by the IGCC, the rest was not used due to limited transmission capacity
- Due to the proportional distribution of netting potential and maximization of netting, network constraints can lead to a netting volume that is larger than the unconstraint netting (see LFC area C in the example)



Manually Activated Reserves Initiative (MARI)

Overview

- Project “Manually Activated Reserves Initiative” (MARI) has been set up already in 2017 to provide the basis for a European mFRR platform.
  - Currently, 29 TSOs from 26 countries have joined the project (Creos as non-operational member only).
- Start of dry-run (CEPS) on 18/07/2022
- Technical go-live on 15/09/2022
- First TSOs (CEPS and German TSOs) joined on 05/10/2022.

Relevant Features

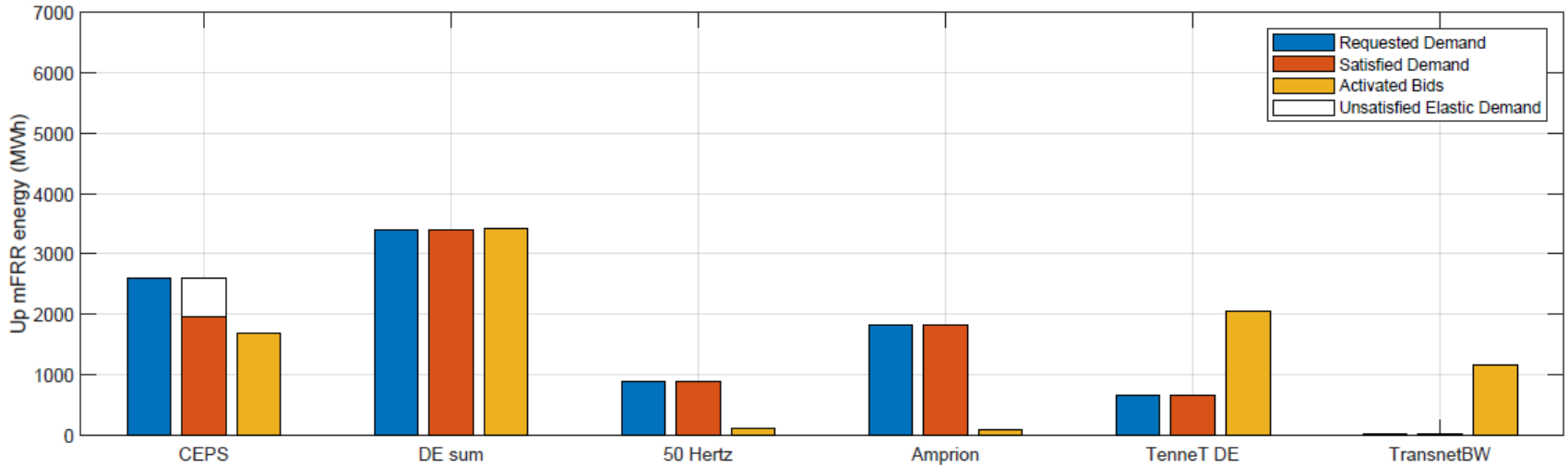
- Counter activation of mFRR balancing energy for economic optimization
- mFRR balancing energy bids can be activated either for balancing or system constraints purposes
- One common standard product in Europe with some national specialties (due to unit-based vs. portfolio-based bidding)
- 100 % availability since Go-Live

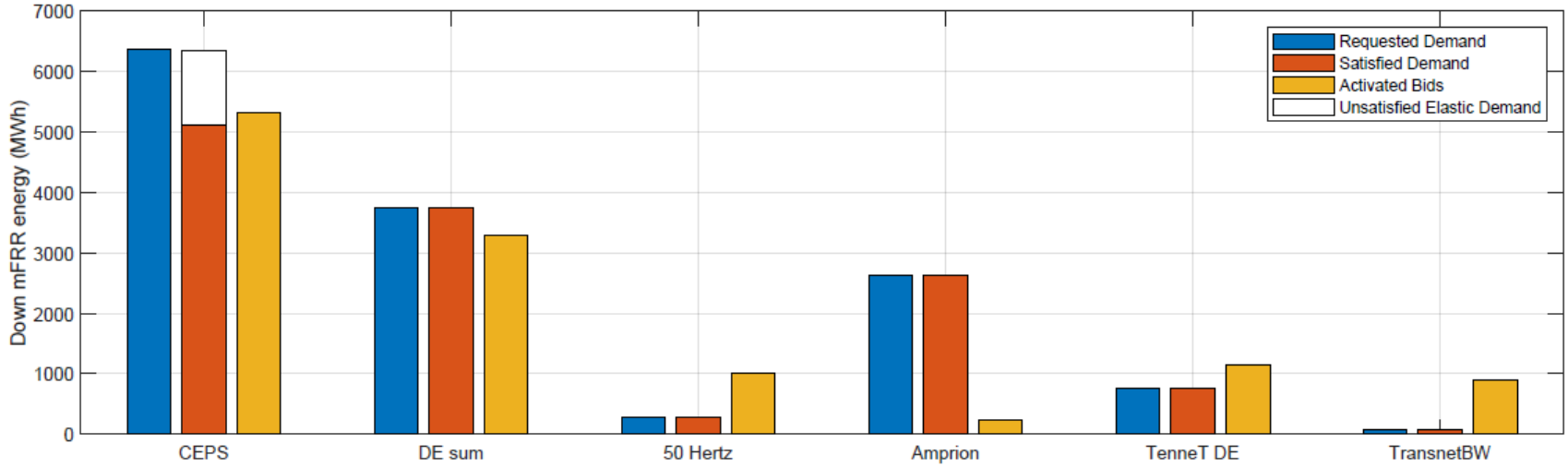
» Road to individual TSOs go-live will also continue in 2023

Operational Platform Reporting

mFRR requested and activated via MARI

Based on operational data from 05.10.2022 to 29.04.2023



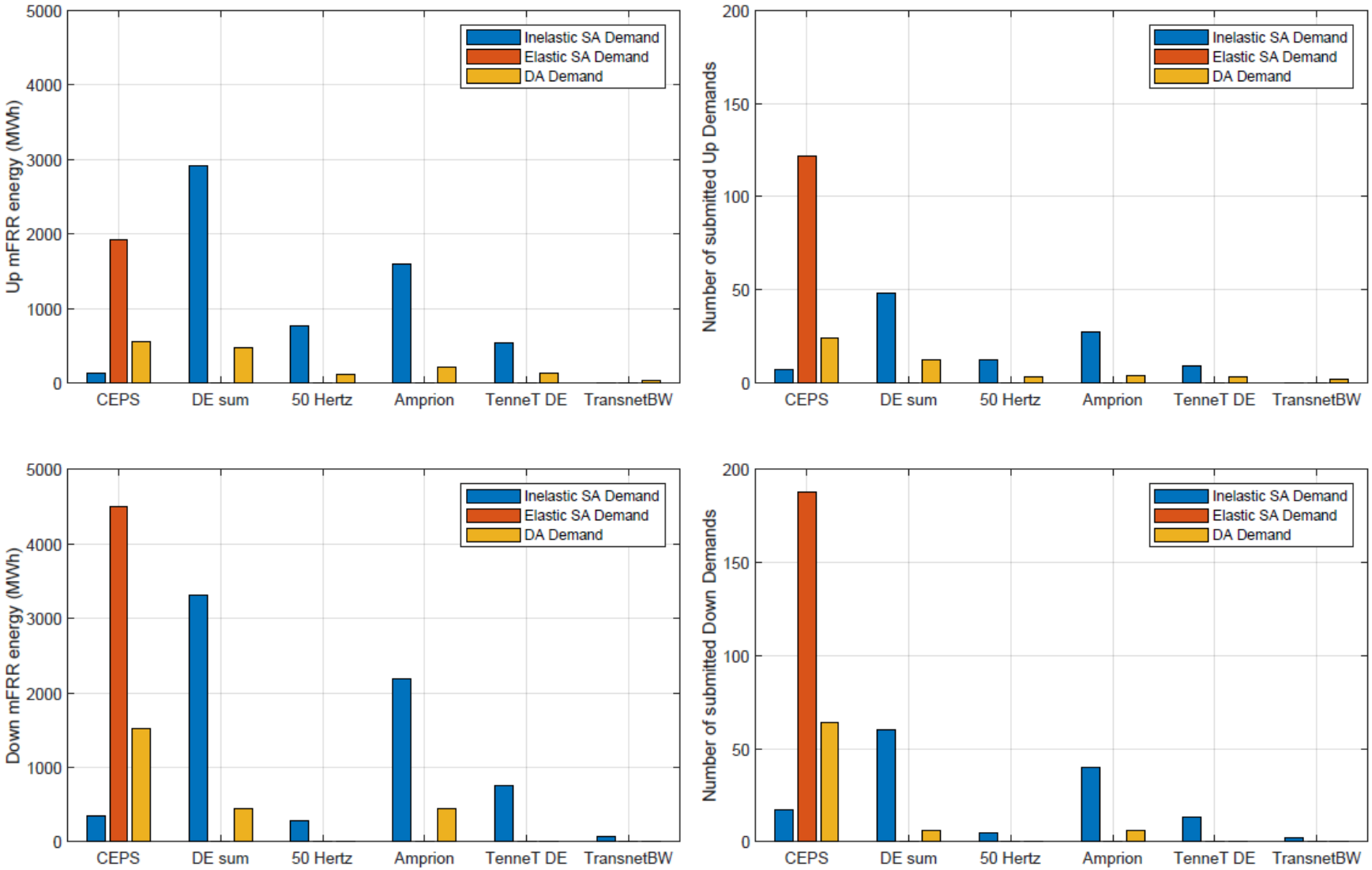


- » Price elastic demand is applied by CEPS.
- » Generally, more activation of negative than positive mFRR

Operational Platform Reporting

mFRR Demand

Based on operational data from 05.10.2022 to 29.04.2023



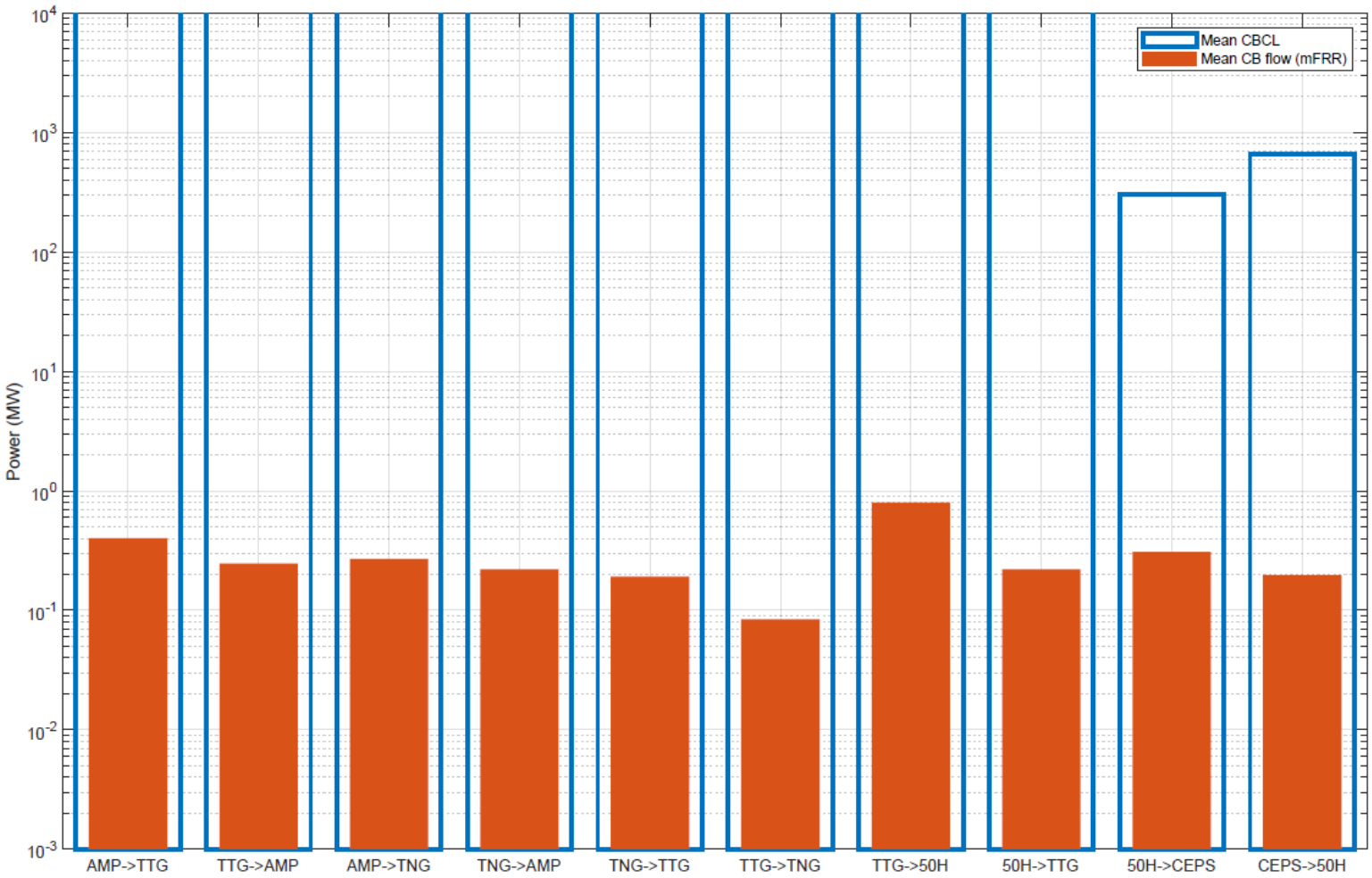
» Quite small amounts of activation in average compared to CMOL volume

» The probability of occurrence of high prices can be assumed as low

Operational platform reporting

Average available and utilized ATC for exchange of mFRR energy

Based on operational data from 05.10.2022 to 29.04.2023

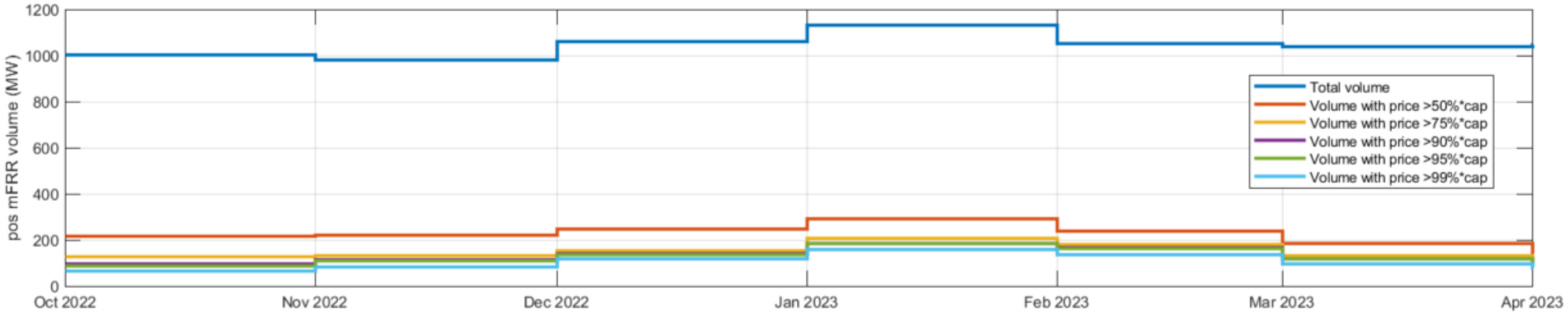


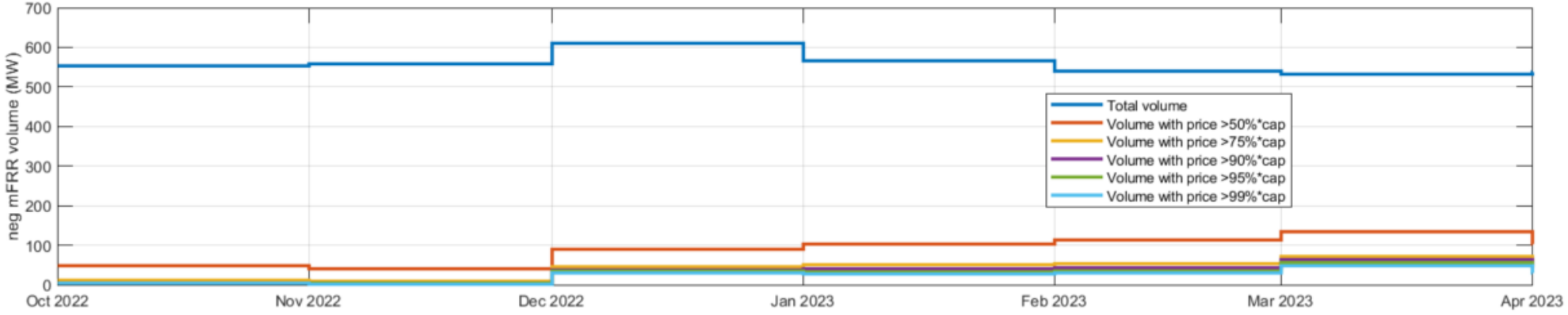
- Average values are used for all the graphs (Frame represents the available ATC, Colored bars the flow induced by mFRR exchange
  - Within Germany (based on the common dimensioning) the technical limit for the ATCs are used.
- DE + CZ = uncongested area in 97.8 % of all quarter hours during observation time period

Operational platform reporting

Price levels and volumes of MARI CMOL

Based on operational data from 05.10.2022 to 29.04.2023





- CMOL volume with prices above 7,500 EUR/MWh (50 % of price cap) are low
- CMOL volumes > 11,250 EUR/MWh (75% of price cap), > 13,500 EUR/MWh (90 % of price cap), 14,250 EUR/MWh (95 % of price cap) and 14,850 EUR/MWh (99 % of price cap) are quite similar
  - Rarely mFRR balancing energy bids between 11,250 EUR/MWh and price cap
  - Some bids are always submitted with a price equal to the price cap

MARI

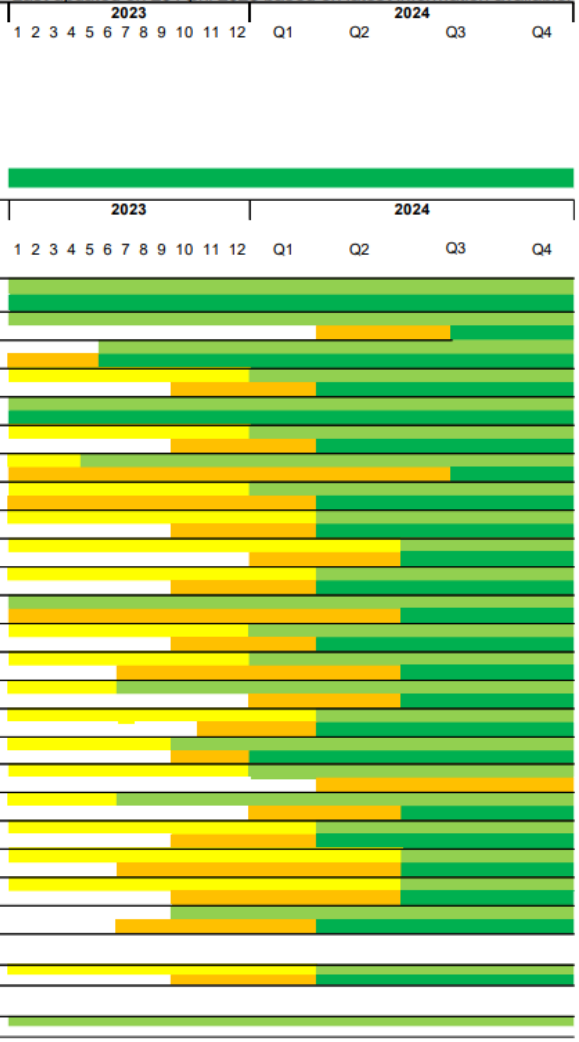
Updated Accession Roadmap

- The accession of member TSOs to mFRR-Platform (MARI) is planned in accordance with the following accession roadmap.
- MARI member TSOs and ENTSO-E share this accession roadmap for informative purposes only and does not, in any case, represent a firm, binding or definitive position of MARI on the content.
- The content is subject to change as the implementation progresses and new information becomes available.
- In particular, 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 maximum number of parallel accessions.

mFRR-Platform Accession Roadmap — Last updated on 20 April 2023 based on latest information available.

	mFRRIF	
mFRR-Platform	5.4.(b)(ii)	AOF
	5.4.(b)(ii)	TSO-TSO Settlement
	5.4.(b)(vi)	Testing functions & mFRR operation
	5.4.(b)(iii)	TSOs Interoperability tests
	5.4.(b)(iv)	Operational tests (parallel run)
	5.4.(b)(v)	TSOs Connection / Go-live
	5.4.(b)(vi)	mFRR-Platform Go-live

Country	Derogation deadline[1]	TSO
Germany		50Hz/Amprion/ TenneT Gmbh/ TransnetBW
Greece	24.7.2024	IPTO[2]
Austria		APG
Latvia	24.7.2024	AST[3]
Czech republic		CEPS
Estonia	24.7.2024	ELERING[3]
Slovenia		ELES
Belgium	24.7.2024	Elia[4]
Denmark	24.7.2024	Energinet[5]
Bulgaria	30.6.2024	ESO[6]
Finland	24.7.2024	Fingrid[3]
Croatia	24.7.2024	HOPS[7]
Lithuania	24.7.2024	LITGRID[3]
Hungary	24.7.2024	MAVIR[8]
Poland	24.07.2024	PSE[9]
Spain	24.07.2024	RE[10]
Portugal	24.07.2024	REN
France	24.07.2024	RTE[11]
Slovakia	24.07.2024	SEPS[12]
Sweden	24.07.2024	SVK[3]
Netherlands		TenneT BV[13]
Italy	24.7.2024	Terna[14]
Romania	01.03.2024	Transelectrica[15]
EEA		
Norway	24.07.2024	Statnett[3]
Non-EU Member State		
Switzerland		Swissgrid[16]



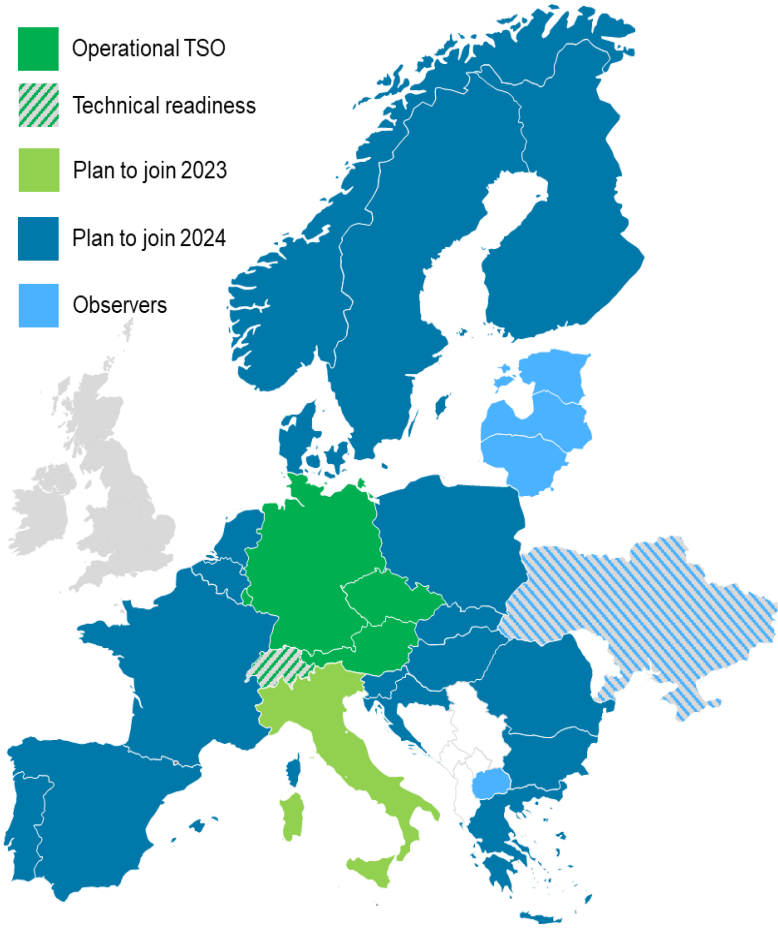
MARI_Accession_roadmap_April_2023.pdf (windows.net)

Platform for the International Coordination of automated Frequency Restoration and Stable System Operation (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
- 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 ~ 4,125,000 market clearings in 2022 with **100 %** availability.
- The PICASSO IT system 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.



* based on the current accession roadmap which includes additional information and risks on the planning

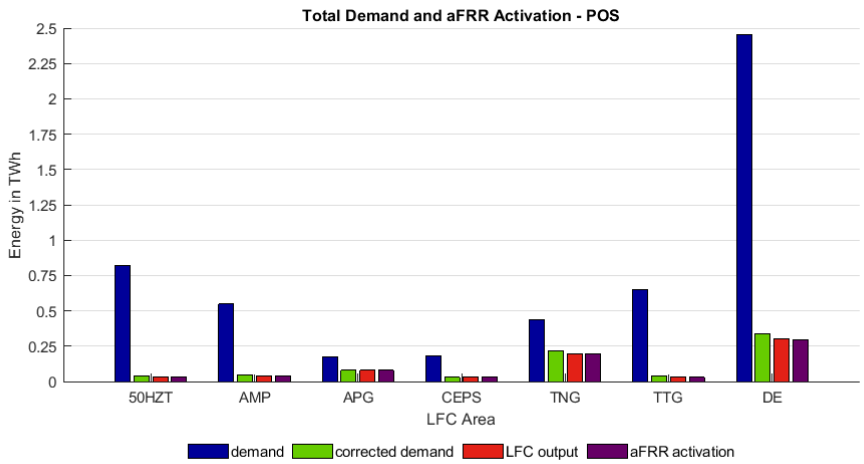
Operational Platform Reporting

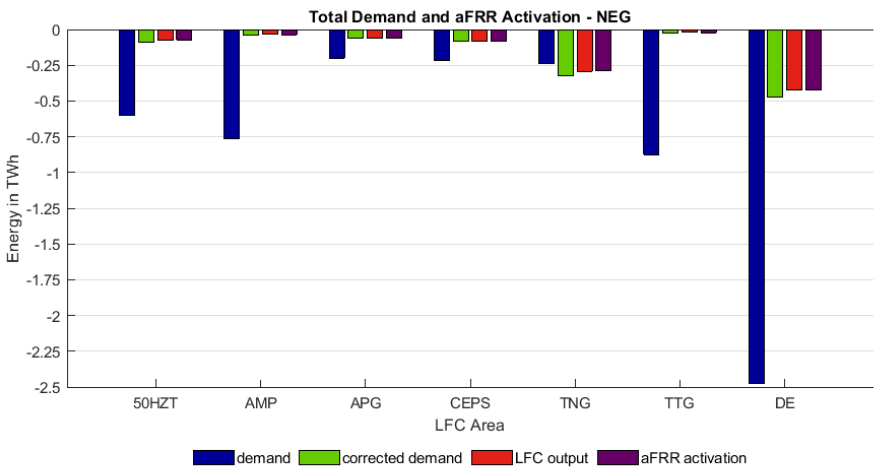
Demand and activation

Based on operational data from 01.11.2022 to 30.04.2023

- Graph shows the aggregated energy amounts for the 6 PICASSO LFC areas and the German LFC-block covering the period from 1.11.2022 until 30.4.2023.

- The effect of the optimization steps is clearly visible:
  - The aFRR-demand (blue) submitted to the platform is for most of the LFC areas much higher than the corrected demand (green) calculated by the platform (-> Netting within the PICASSO region and the IGCC)
  - There is a decrease visible between the corrected demand (output of PICASSO), the local LFC output and the activated aFRR by the BSP due to the dynamic behavior of the involved components.
  - The negative aFRR for TNG demonstrates most obviously the “CMOL”-effect: bids in the area of TNG are cheaper, the corrected demand is higher than the original demand.

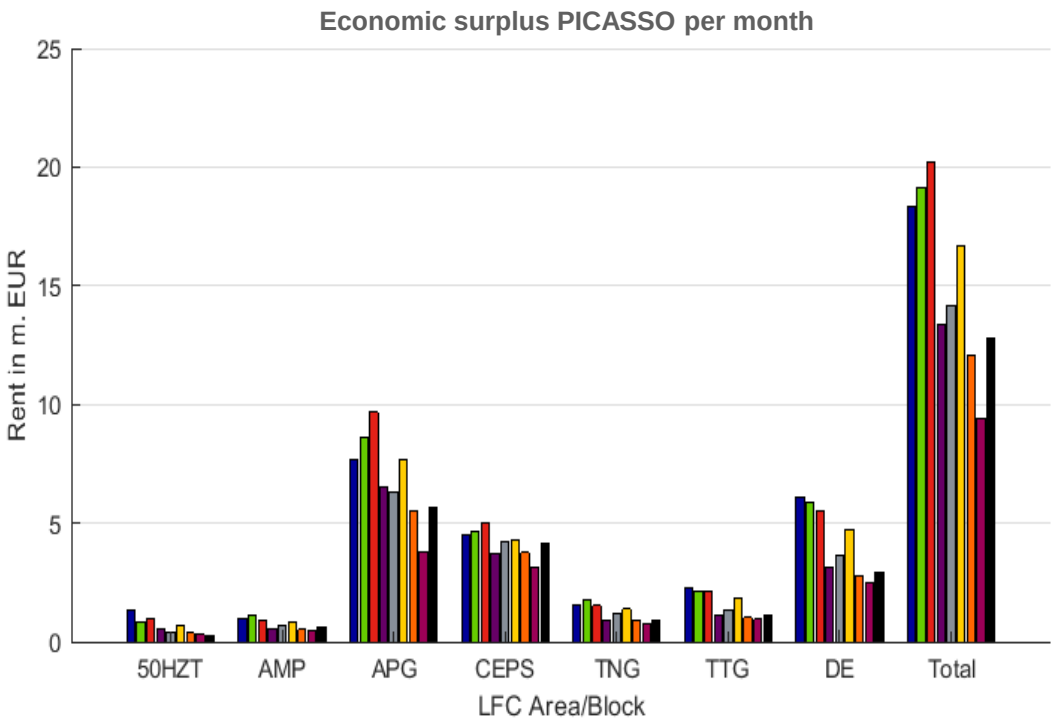




Market Results until End of March 2023

Economic surplus PICASSO

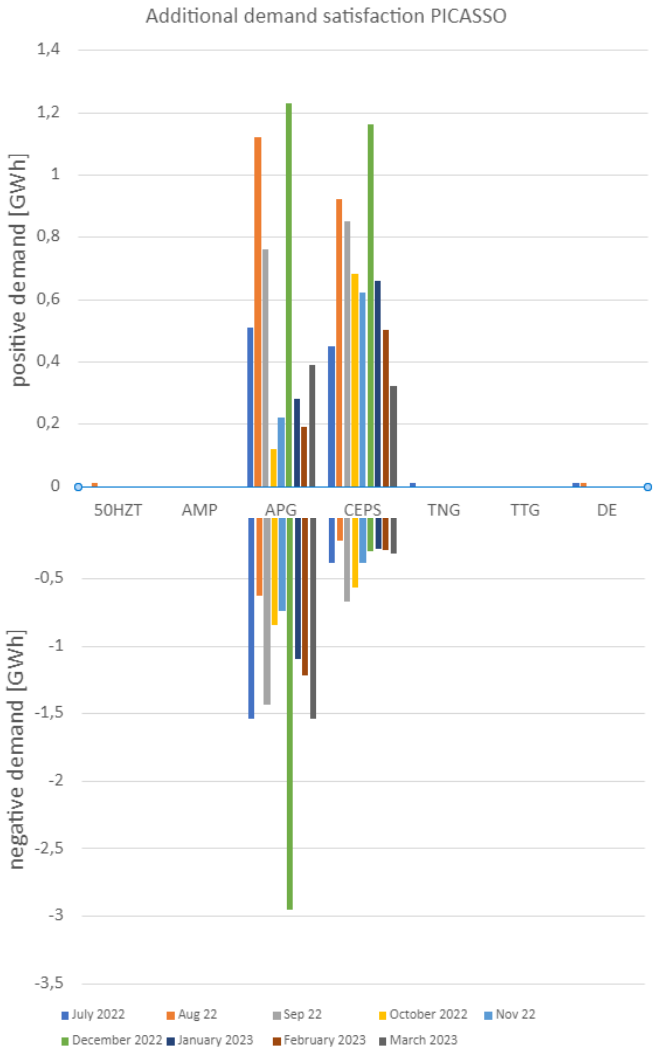
- Economic surplus is calculated by comparing the actual activation of aFRR to a reference scenario with the same bids, demands and market design, but without international interchange.
- Economic surplus from July 2022 until March 2023 131 Mio. € (without additional satisfaction of demand). See next slide for details regarding the additional demand satisfaction
- Influence of the general high market prices is also visible in the values (comparable to the IGCC), surplus in Q3/22 in in general higher than in Q1/23
- Large economic surplus mainly for small LFC areas, that get access to a much larger market via PICASSO



Market Results until End of March 2023

Additional demand satisfaction in PICASSO

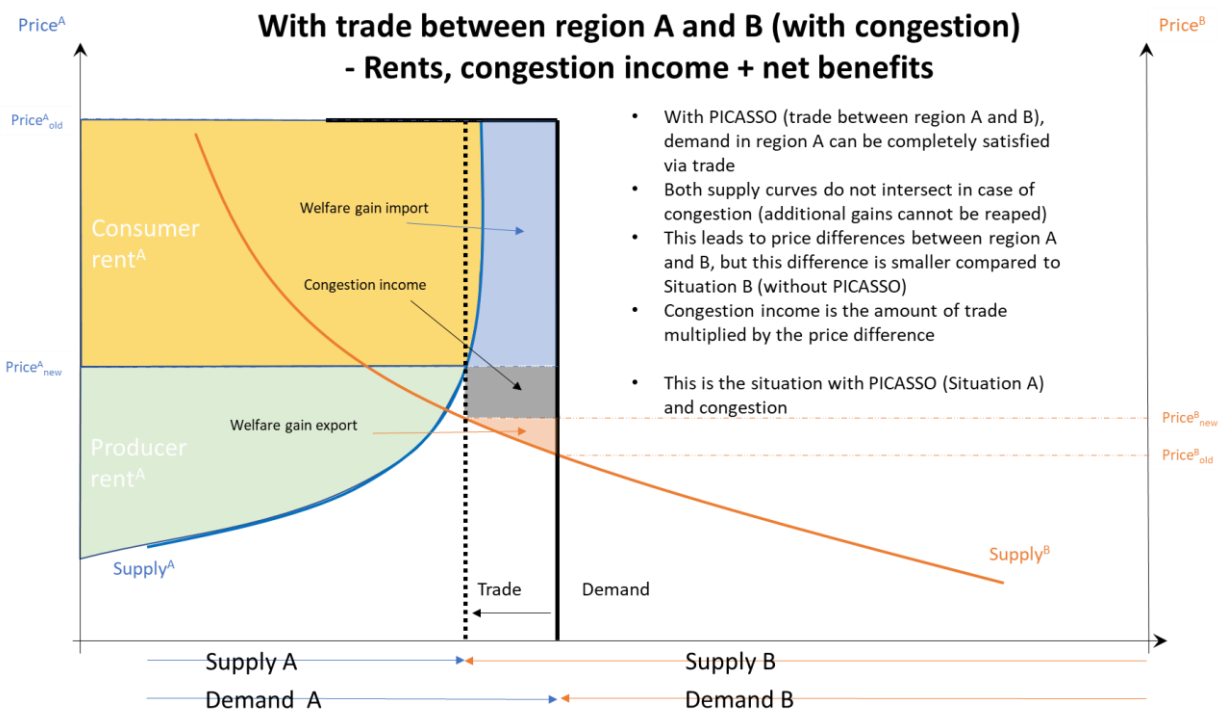
- Since the balancing platforms allow TSOs to access more balancing reserves than they've locally procured, the platforms reduce the amount of unsatisfied demand for balancing energy. Therefore, the balancing platforms improve the frequency quality, while decreasing system imbalances (FRCE) and contributing to the security of supply.
- The monetary value of the additionally satisfied demand has not been included in the welfare gains but is shown as explicit contribution to the security of supply in terms of energy
- Each TSO is responsible for maintaining balance in his LFC areas and has to take measures to resolve insufficient satisfaction of FRR demand in his LFC areas to secure stable operation. Therefore, exchanges via PICASSO and IGCC platform cannot be considered as guaranteed.



Market Results until End of March 2023

PICASSO: 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: ….

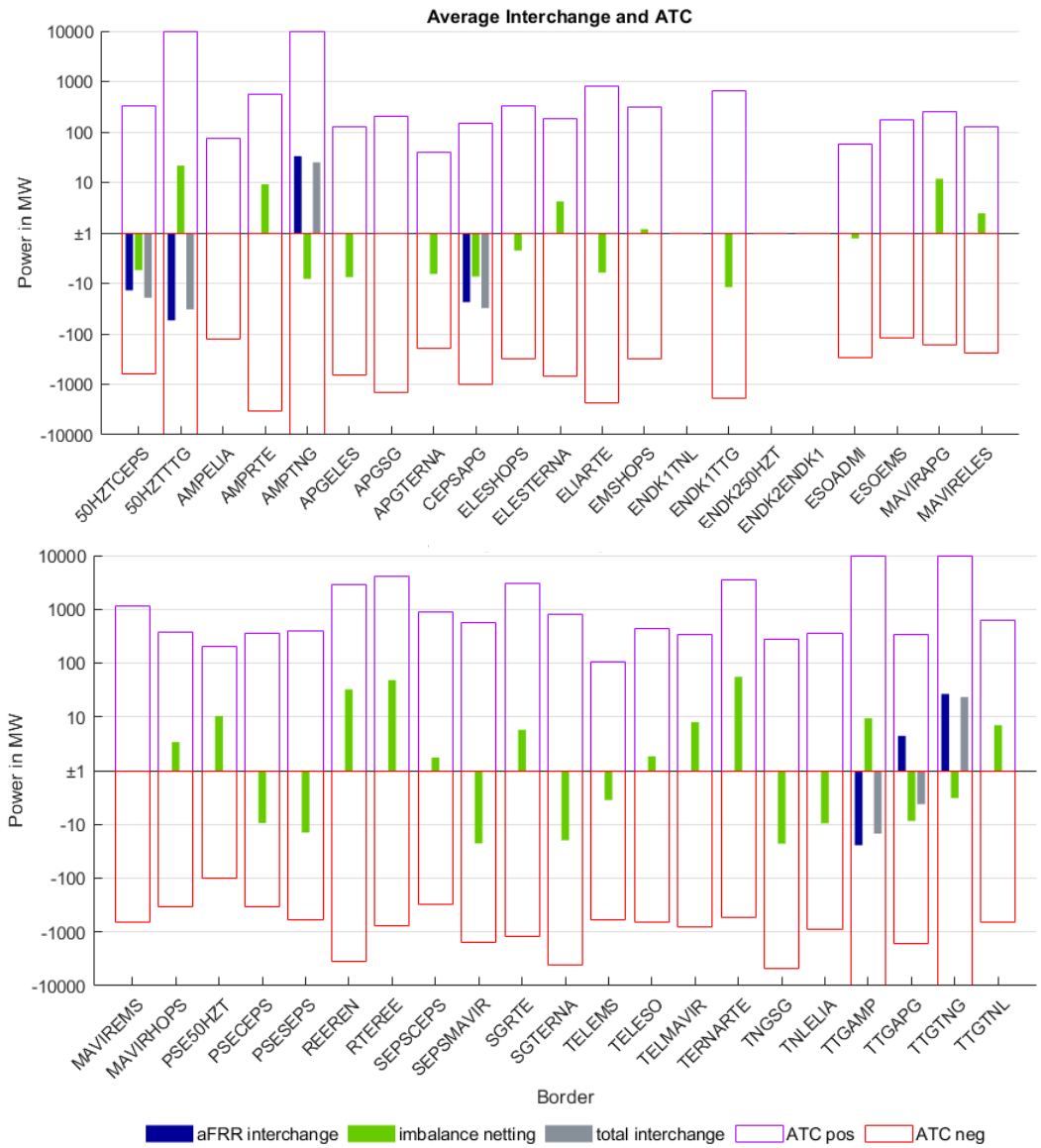


Operational platform reporting

Average ATC and exchange of aFRR energy

Based on operational data from 01.11.2022 to 30.04.2023

- Explanation of the graphical representation:
  - Average values are used for all the graphs
  - Frame represents the available ATC
  - Colored bars the flow induced by aFRR or IN exchange
- Within Germany (based on the common dimensioning) the technical limit for the ATCs are used.
- Exchange of aFRR and IN are in a comparable range



Operational platform reporting

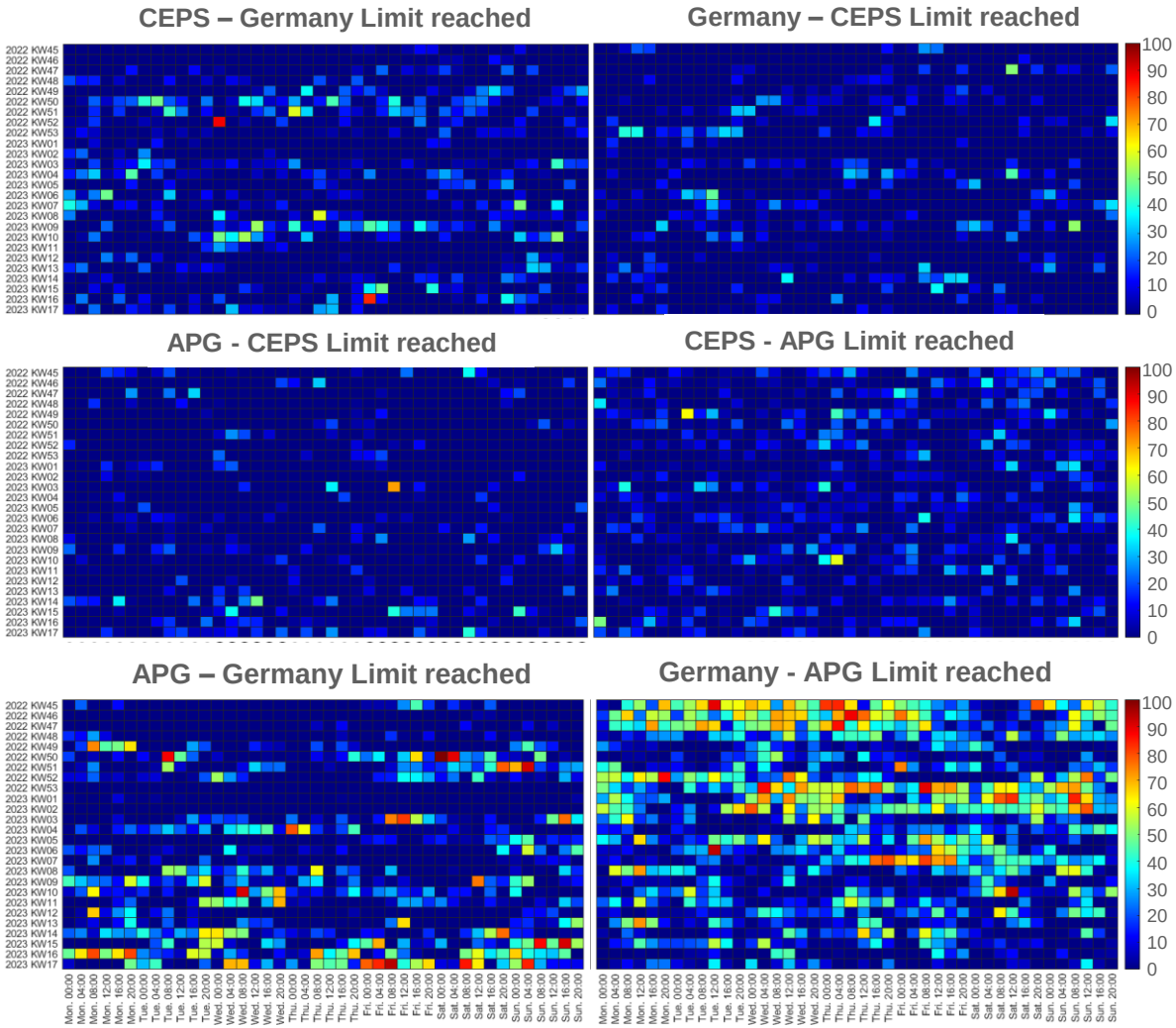
Average ATC and exchange of aFRR energy

Based on operational data from 01.11.2022 to 30.04.2023

- Explanation of the graphical representation:
  - Heatmap show the percent of time. in which the ATC limit was reached
  - Lines represent one week; columns represent the week divided in 4-hour blocks
  - Color represents the percent value: 100 % → ATC was reached for full 4 hours

- Especially the border Germany – Austria is often completely saturated (meaning: ATC is used to 100 %)

- Border Austria – Germany showed especially in November 2022 and end of December a high saturation in direction Germany → Austria
- During the March the border was more often saturated in the direction Austria → Germany



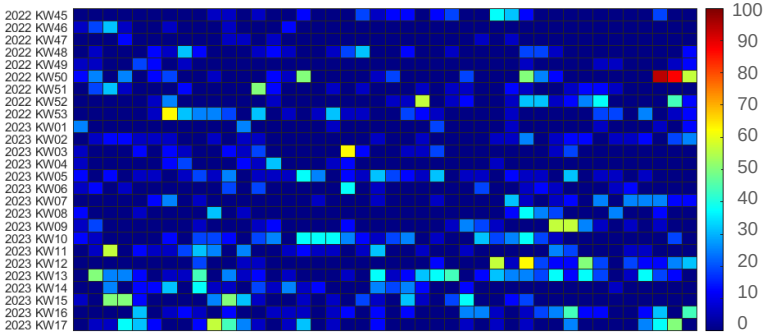
Operational Platform Reporting

aFRR demands for balancing energy exceeding submitted MOL volume

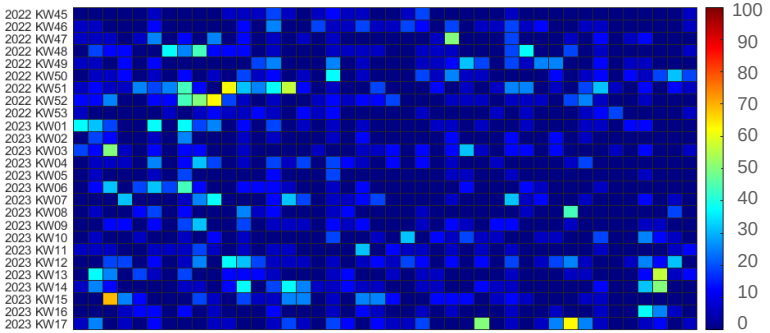
Based on operational data from 01.11.2022 to 30.04.2023

- Explanation of the graphical representation:
  - Heatmaps show the percent of time the average aFRR demand of the country is exceeding the offered MOL-volume (in positive and negative direction).
  - Lines represent one week; columns represent the week divided in 4-hour blocks
  - Color represents the percent value: 100% → aFRR demand exceeded offered volume for the whole 4 hours
- Small LFC areas (APG and CEPS) exceed their MOL volume on a regular basis. Most of the time the percentage is lower than 30 % with outliers up to 90 %
- Within Germany, the number of periods in time with exceeding demand is quite low.
- Not under investigation on MARI because of very rare events.

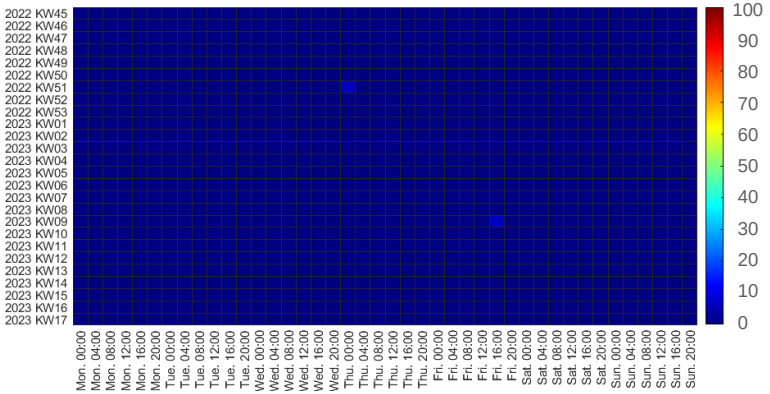
APG exceeding aFRR demand



CEPS exceeding aFRR demand



Germany exceeding aFRR demand



Operational Platform Reporting

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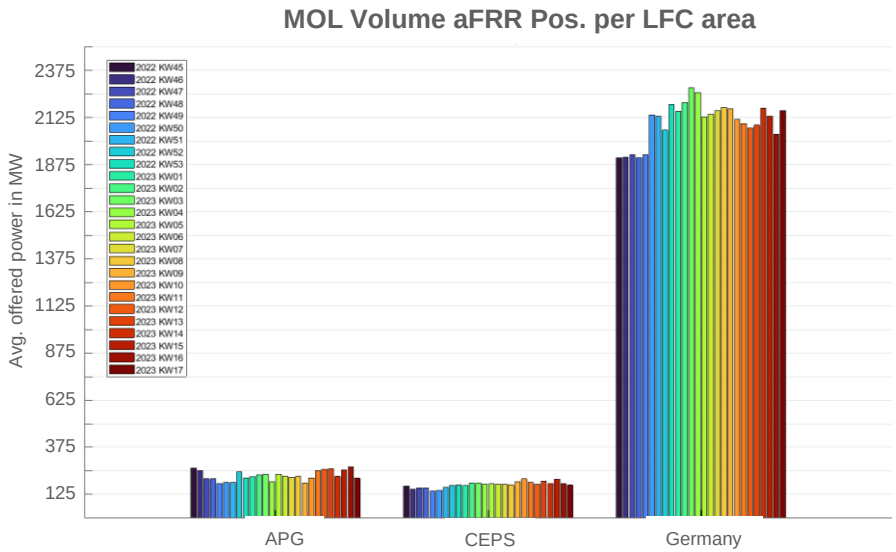
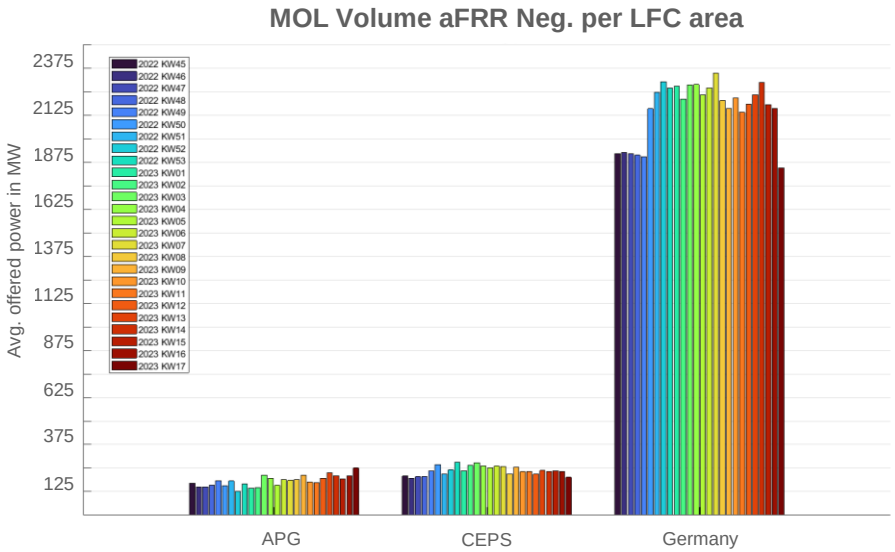
- Small LFC areas (APG and CEPS) exceed their MOL volume on a regular basis. Most of the time the percentage is lower than 30% with outliers up to 90 %
- Within Germany, the number of periods in time with exceeding demand is quite low.
- For information, the average available MOL-volumes per week and area are shown in the additional graph. In week 50, a market change in Germany is visible: Introducing of “free bids” (no cap in the energy market at the capacity level) leads to a higher available MOL-volume.





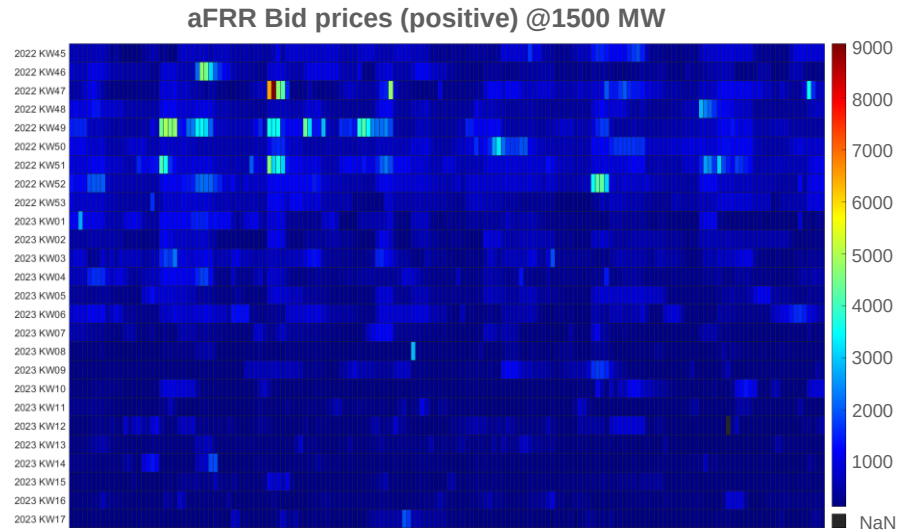
Operational Platform Reporting

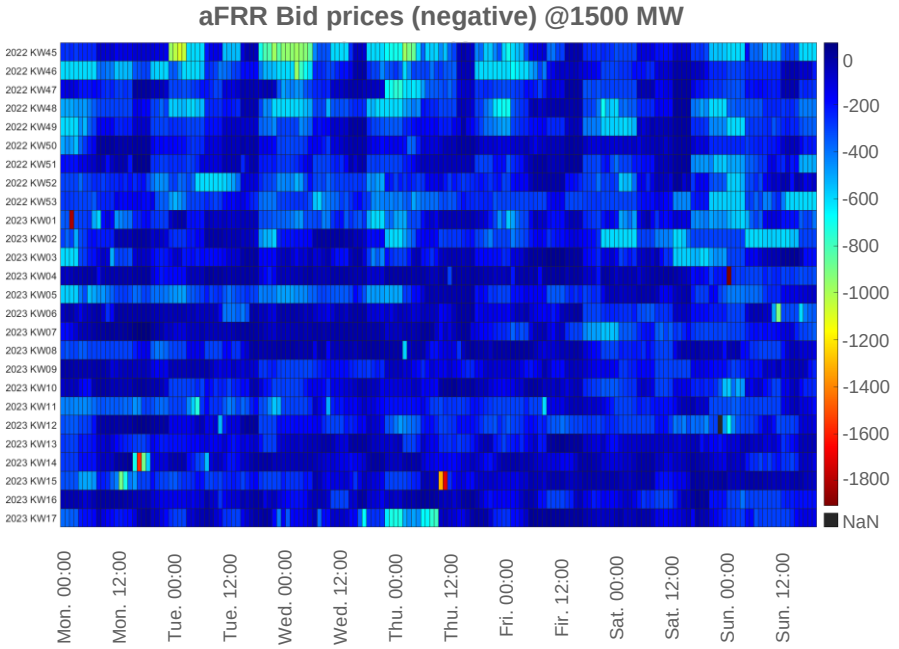
Insight in the structure of the PICASSO CMOL

Based on operational data from 01.11.2022 to 30.04.2023

- Explanation of the graphical representation:
  - Heatmaps show the CBMP in case of an UA for all PICASSO member that would have been reached if 1500 MW would have been activated per direction
  - Lines represent one week; columns represent the week divided in 1-hour blocks. During this hour, mean values are used.
  - Color represents the price of the bid at 1500 MW, Different scales for negative and positive direction necessary.

- Since week 53, the reduction of Day-Ahead prices is visible, prices in positive direction are reduced. Same effect is also seen in negative direction
- In general, few outliers -> MOL structure in the first 2/3 is stable.
- Weekdays and time of the day is visible in the MOL-structure, prices are slightly lower during the afternoon.



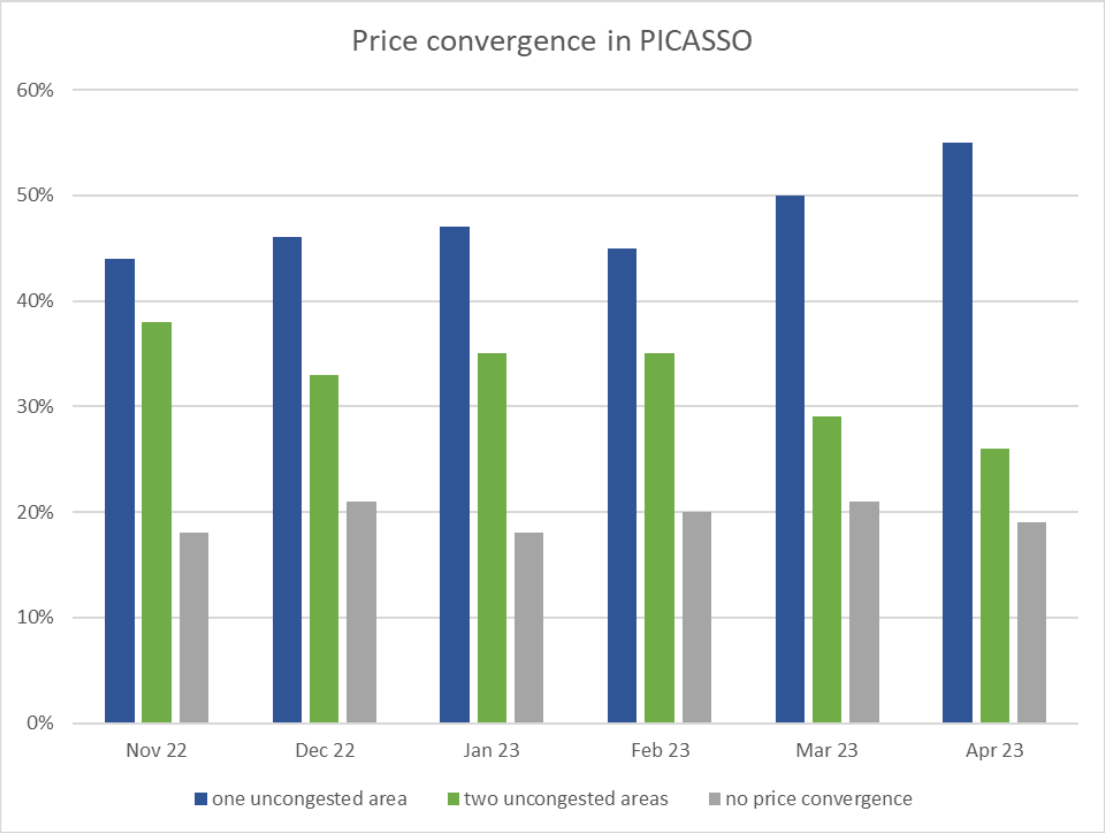


Operational Platform Reporting

PICASSO Price convergence

Based on operational data from 01.11.2022 to 30.04.2023

- The PICASSO region consists of three areas: Germany, Czech Rep. and Austria
- In more than 80% of the optimization cycles, there is a price convergence of at least two of those areas
- In mean, the whole PICASSO region forms one uncongested area during 48% of all optimization cycles, resulting in a full price convergence



PICASSO

Updated Accession Roadmap

- 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.

aFRR-Platform Accession Roadmap — Last updated on 28/04/2023 based on latest information available.

aFRRIF	2023 (1 2 3 4 5 6 7 8 9 10 11 12)	2024 (Q1 Q2 Q3 Q4)
5.4.(b)(ii) AOF (done)		
5.4.(b)(ii) TSO-TSO settlement (done)		
5.4.(b)(vi) Testing functions & aFRR operation (done)		
5.4.(b)(iii) TSOs Interoperability test (done)		
5.4.(b)(iv) Operational test (parallel run) (done)		
5.4.(b)(v) TSOs Connection to aFRR platform / Go-live		
5.4.(b)(vi) aFRR-Platform Go-live (done)		

Country	Derogation deadline	TSO	2023 (1 2 3 4 5 6 7 8 9 10 11 12)	2024 (Q1 Q2 Q3 Q4)
EU:				
Austria		APG		
Belgium[1]	24.07.2024	Elia		
Bulgaria	30.06.2024	ESO		
Croatia	24.07.2024	HOPS		
Czech republic		ČEPS		
Denmark[2]	24.07.2024	Energinet		
Finland[2]	24.07.2024	Fingrid		
France	24.07.2024	RTE		
Germany		50Hz,AMP,TNG,TTG		
Greece	24.07.2024	ADMIE		
Hungary	24.07.2024	MAVIR		
Italy	24.07.2023	Terna		
Netherlands[3]	24.07.2024	Tennet BV		
Poland	24.07.2024	PSE		
Portugal		REN		
Romania	01.03.2024	Transelectrica		
Slovakia	24.07.2024	SEPS		
Slovenia		ELES		
Spain	24.07.2024	REE		
Sweden[2]	24.07.2024	SVK		
EEA:				
Norway[2]	24.07.2024	Statnett		
Non-EU:				
Switzerland[4]		Swissgrid		

	5.4.(b)(i)	National terms and conditions development
	5.4.(b)(i)	National terms and conditions entry info force
	5.4.(b)(iii)	Interoperability tests between TSO and aFRR-Platform
	5.4.(b)(v)	TSO connection to aFRR-platform / Go-live
	5.4.(b)(vii)	EBGL Article 62 Derogation considered/requested/granted (new deadline listed)

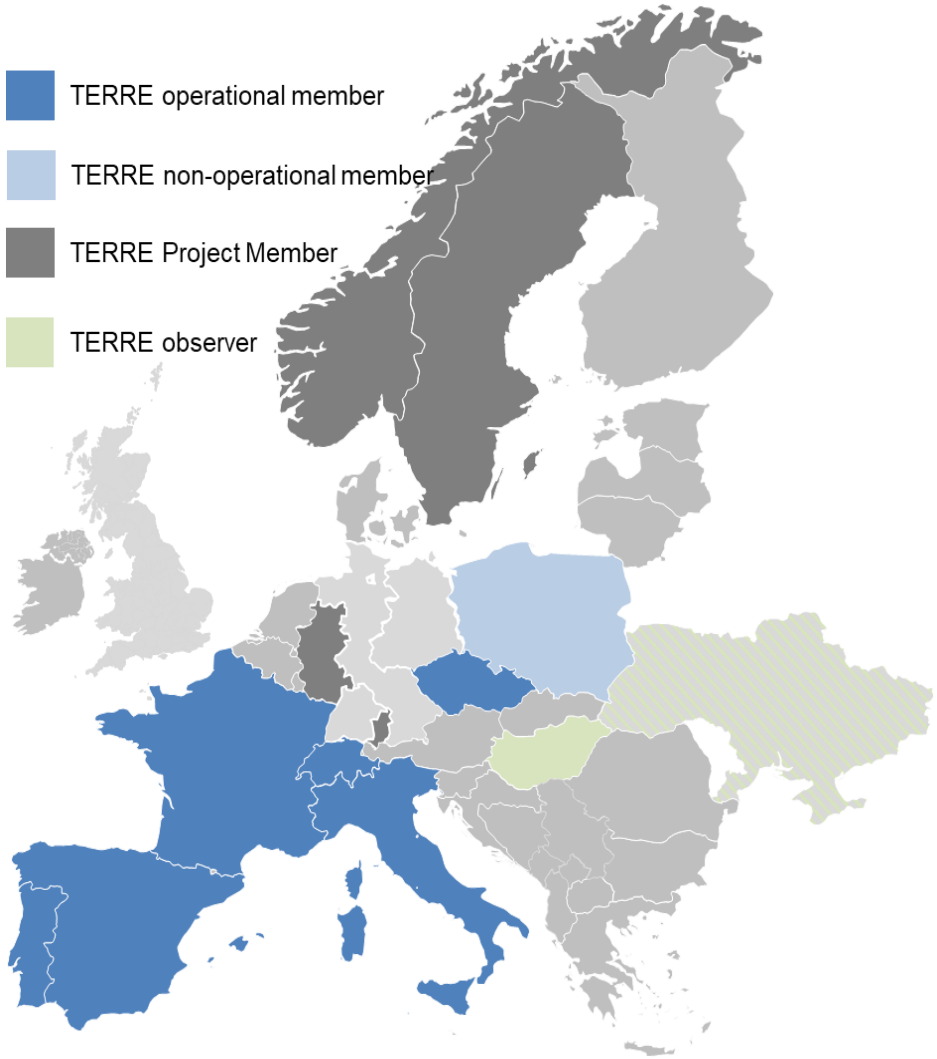
1) A first version of the T&C has entered into force early May w hen local bidding has been adapted and a second one w ill enter into force w hen ELIA w ill connect to PICASSO. 2) The plan presented in this roadmap shall be regarded as a preliminary, non-binding estimate. The planned connection time is expected in Q2 2024. 3) TenneT NL aims for implementation and go-live by July 2024 and has been granted a derogation until then. How ever, there is a real risk that the final derogation w ill 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 w ill enter into discussions w ith relevant stakeholders if it becomes clear that the risks already in the planning manifest themselves. 4) The technical readiness of Sw issgrid has been acknow ledged. The participation of Sw itzerland 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 Sw issgrid at the Court of Justice of the European Union.

PICASSO_7th_Accession_roadmap_ext.pdf (windows.net)

Trans European Replacement Reserves Exchanges (TERRE)

Last main milestones

- The “Trans European Replacement Reserves Exchanges” platform include:
  - 6 operational members: REN (Portugal), Red Electrica (Spain), RTE (France), Terna (Italy), Swissgrid (Switzerland), CEPS (Czech Republic)
  - One non-operational member: PSE (Poland) which is expected to connect at mid-2024.
  - Two observers: Mavir (Hungary) and ENTSO-E

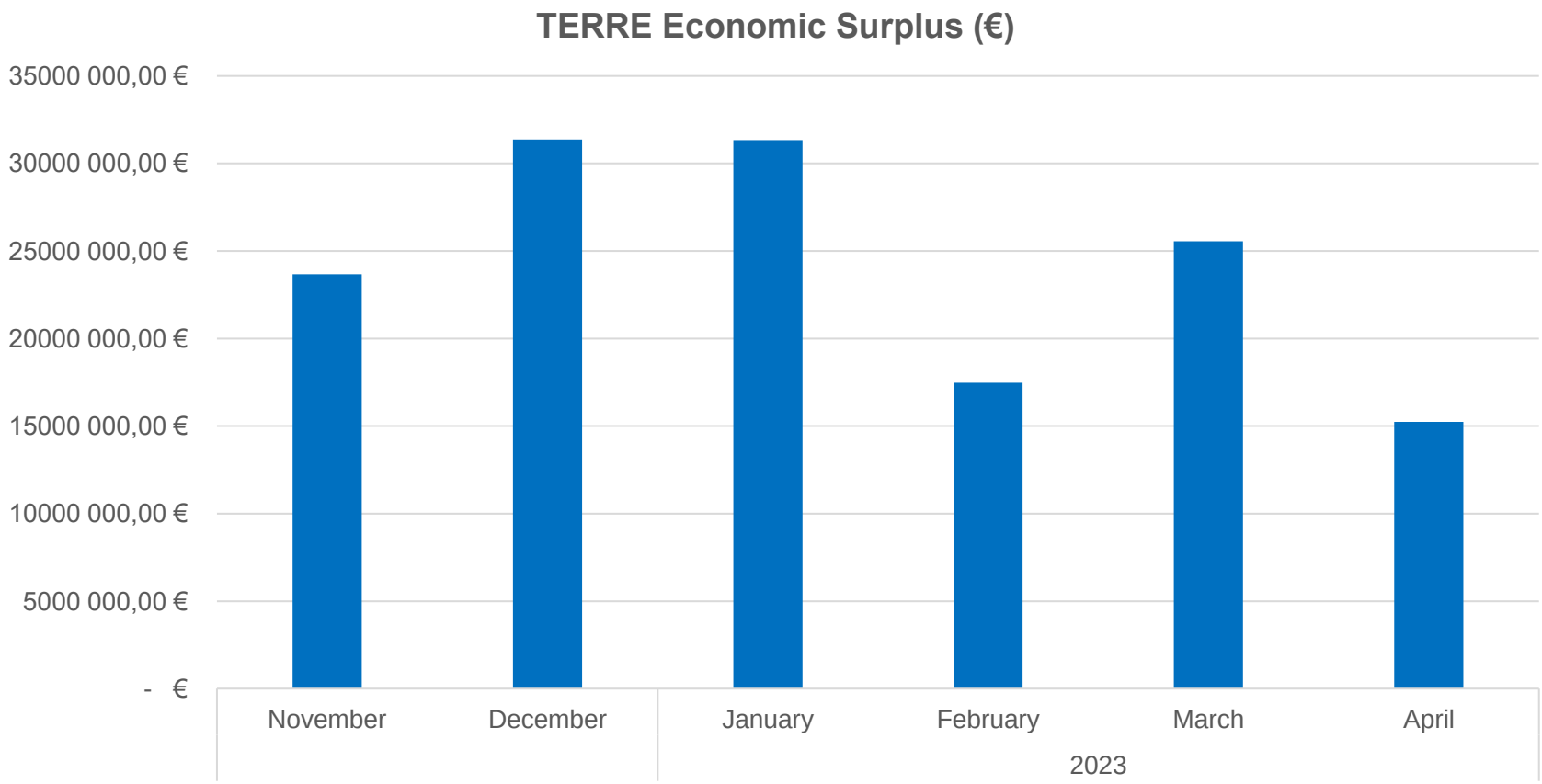


Relevant update

- TERRE TSOs investigated how could the number of clearings be increased in the RR process to follow legal requirements.
- At this time, several options are feasible and each of them has pros/cons compared to the others.
- Therefore, TSOs decided, in agreement with RR NRAs, to gather public survey feedback (constraints and preferences) to be part of the discussions to select the more profitable option through a public consultation which will be launched at end of Q2 2023.

Market Results until End of April 2023

TERRE Economic surplus from November 2022 to April 2023

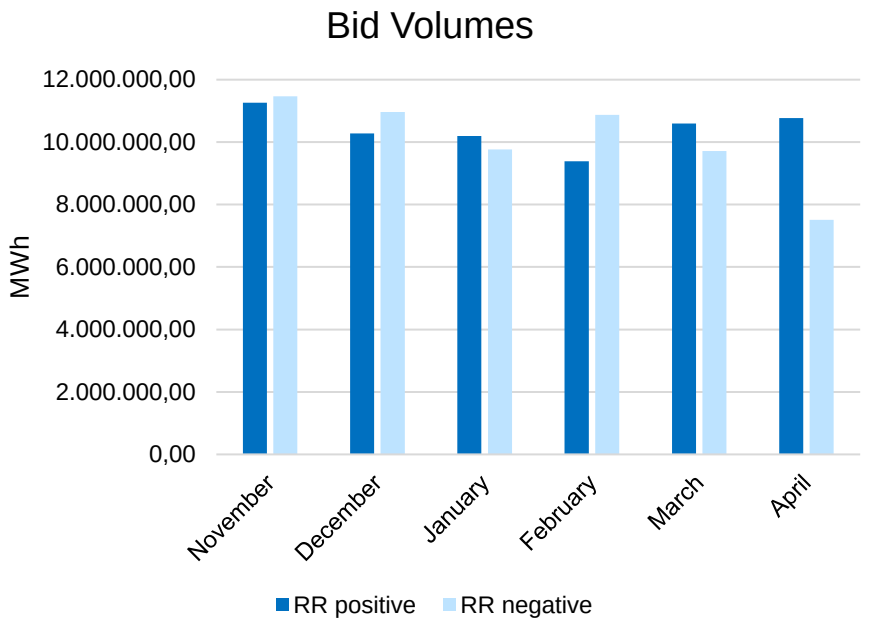


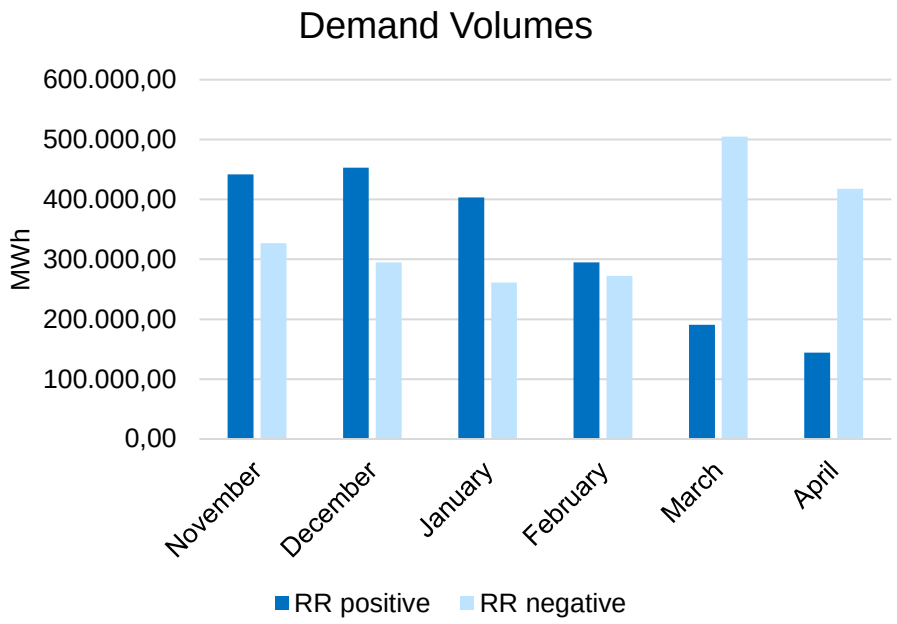
- TERRE platform is allowing important financial benefits for all countries involved in the project with more than 15 million euros per month since November.

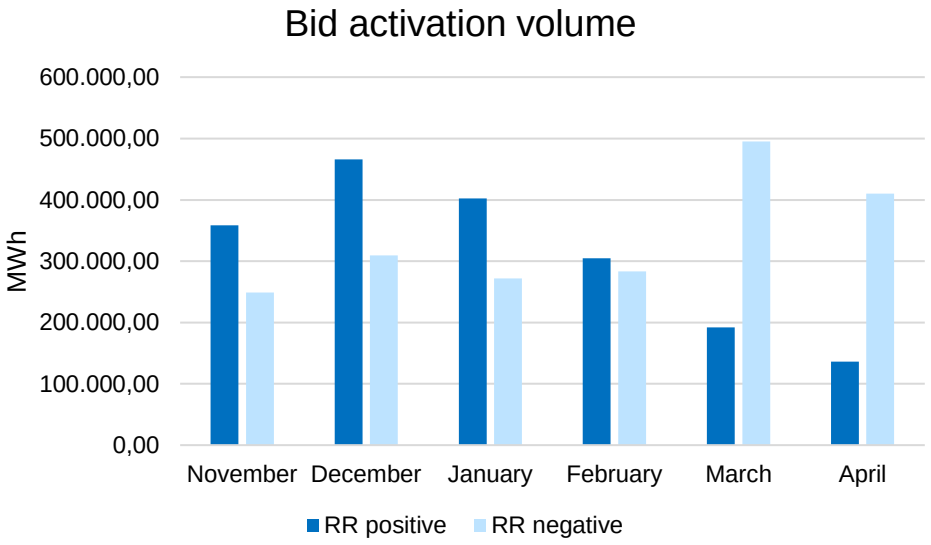
Operational Platform Reporting

TERRE Operational results

Based on operational data from 01.11.2022 to 30.04.2023







- Important volumes of bids, demands and activated bids are processed by the TERRE platform each month.
- Globally, volume of bids is much more important than the demands which conduct to a high rate of demand fulfilled by the TERRE platform.
- The TERRE platform was available **100%** of the time since November

Important change in RR process: Upcoming public survey (i)

- **Context (1/2)**
  - Today. the RR process consists of 24 daily gates with 24 clearings per day. This design was mainly chosen because at the time of the introduction of the RR platform. the cross-border scheduling step was 60 minutes on most borders.
  - According to the current IF, the cross-border scheduling step must be reduced to 15 minutes, on all borders. That would allow to increase the number of daily gates for the RR process.

> **RR IF Article 11.5:**
>
> *All RR TSOs shall harmonise number of daily clearings:*
>
> *(1) At the go-live of the RR-Platform, the number of daily gates will be 24. The RR TSOs will reduce the cross-border scheduling steps to less than 60 minutes for the borders included in the Region.* ***The deadline will be the date required by the EBGL for using the European Platform for exchange of mFRR*** *which is still subject for possible derogation and the date required by the CACM regulation for the intraday cross zonal gate closure frequency definition.*
>
> *(2) Starting from this deadline,* ***the cross-border scheduling step will be 15 minutes, therefore an increase of the number of daily gates, may be evaluated*** *taking into account the maturity of the European balancing market at that time.*

  - Together with the reduction of the cross-border scheduling step, relevant market regulation also prescribes a combined reduction of the market time unit (MTU) and of the Imbalance Settlement period on both balancing markets and energy markets.

> ***EBGL Article 53(1)***
>
> *By three years after the entry into force of this Regulation, all TSOs shall apply the* ***imbalance settlement period of 15 minutes*** *in all scheduling areas while ensuring that all boundaries of* ***market time unit shall coincide*** *with boundaries of the imbalance settlement period.*

Important change in RR process: Upcoming public survey (ii)

- **Context (2/2)**

> ***REG.(EU) 2019/943 Article 8***
>
> *(1) […]*
>
> *(2) NEMOs shall provide market participants with the opportunity to trade in energy in time intervals which are **at least as short as the imbalance settlement period** for both day-ahead and intraday markets.*
>
> (3) […]
>
> (4) *By 1 January 2021, **the imbalance settlement period shall be 15 minutes** in all scheduling areas, unless regulatory authorities have granted a derogation or an exemption. Derogations may be granted only until 31 December 2024.*

- The RR platform already allows the use of a 15-minute MTU, while only performing 24 daily clearings. On the other hand, the number of daily gates for the cross-zonal intraday, which is also 24 at the moment, will increase to 96 gates in the future (as per the above Article of Reg.(EU) 2019/943). Also, as set by the following art. 24.2(b) of EBGL, the balancing energy gate closure time shall not be before the intraday cross-zonal gate closure time:

> ***EBGL Article 24(2)***
>
> *Balancing energy gate closure times shall:*
>
> *a) be as close as possible to real time;*
>
> *b) **not be before the intraday cross-zonal gate closure time**;*
>
> c) *ensure sufficient time for the necessary balancing processes.*

- Therefore, **the new number of intraday gates necessarily leads to the increase of the number of daily gates for the RR process.**

Important change in RR process: Upcoming public survey (iii)

- **Last updates**
  - TERRE TSOs studied numerous options to increase the number of daily gates in the RR process in close cooperation with RR NRAs
  - IG meetings were organized with RR NRAs on the 28th November 2022. 3rd March and 20th April 2023 to present TSOs conclusions on the topic and gather their advice and feedback.
  - TERRE TSOs and RR NRAs decided to submit 3 possible options with 96 gates as TERRE TSOs assessed 48-gates options are not feasible.
    - *96-clearings with same timing with linking necessary*
    - *96-clearings with reduced timing with no linking*
    - *96-clearings with reduced timing but the possibility to have delivery period up to 30*
  - TERRE TSOs aim at launching a public survey by the end of Q2 2023 to gather all BSP feedback on the proposed options. A stakeholder workshop will be also organized during the second week of the consultation to present in detail all ins and out of the topic..

Conclusions

Outlook

- European TSOs have implemented MARI and PICASSO since 2017 (i.e. before entry into force of Guideline Electricity Balancing).
  - Several hundred experts from TSOs have contributed to MARI and PICASSO in the last years.
  - Also, cross-platform related topics are addressed under the framework of MARI.

- PICASSO started operation in June 2022, MARI in October 2022.
  - Road to individual TSOs go-live will also continue in 2023 and 2024 with TERNA planning to join as next TSO PICASSO and APG planning to join as next TSO MARI .
  - During 2022, high CBMP were observed (in relation to high day-ahead prices).
  - Occurrence of price peaks up to the price cap for mFRR and aFRR.
  - Using a market time unit of 4 seconds, the PICASSO optimizer has performed ~ 4.125.000 market clearings in 2022 with 100 % availability.

- TERRE is in operation since January 2020.
  - Since the go-live 6 TSO connected to the platform. 24 daily gates
  - Public consultation to be launched end of Q2/2023 to increase the number of daily gates

- First market results already show significant economic surplus generated by balancing platforms.
  - IGCC generated an economic surplus in 2022 of around 790 Mio. €.
  - TERRE generated an economic surplus in 2022 of around 766 Mio. €.
  - PICASSO generated an economic surplus of 135 Mio. € (without additional satisfaction of demand) until March 2023.
  - MARI has facilitated an exchange of >2.5 GWh between DE and CZ until April 2023. More exchanges are expected when additional TSOs connect.

What is Stakeholder's feedback on shown operational results?

Balancing Energy Prices

Balancing Energy Prices

Introduction

Observation of price spikes after Go-Live of FRR Balancing Energy Platforms leading to concerns

- There have been always price spikes in balancing markets. Thus, Price spikes maybe considered as usual, but an acceptable number of price spikes is hard to determine
  - Price spikes may incentivize a BSP to bid in the market
  - With marginal pricing price spikes may have much more impact than before
    - VWAP approach possible to be applied on imbalance pricing, which may limit risk of high prices for BRPs
  - EU BE Price cap is higher than some current local BE price caps

One of the basic assumptions for the integration of the balancing energy market is empirically questioned: benefits of marginal pricing may only be achieved with sufficient competition which does not (always) materialize.

- Sufficient competition is further hindered by not available cross-zonal-capacities resulting in a quite stable probability that high demands will have to be solved locally.
  - Small LFC block with hockey stick MOL + congestion on border (uncongested area = small LFC block) will most likely result in high prices for short periods
- Marginal pricing applied in a small market-area is likely to cause high prices.

Following slides give insights in already performed analysis by allTSOs
and ongoing discussions between ACER/NRAs and allTSOs

Balancing Energy Prices

Price incidents (CBMP > 7500 EUR/MWh)

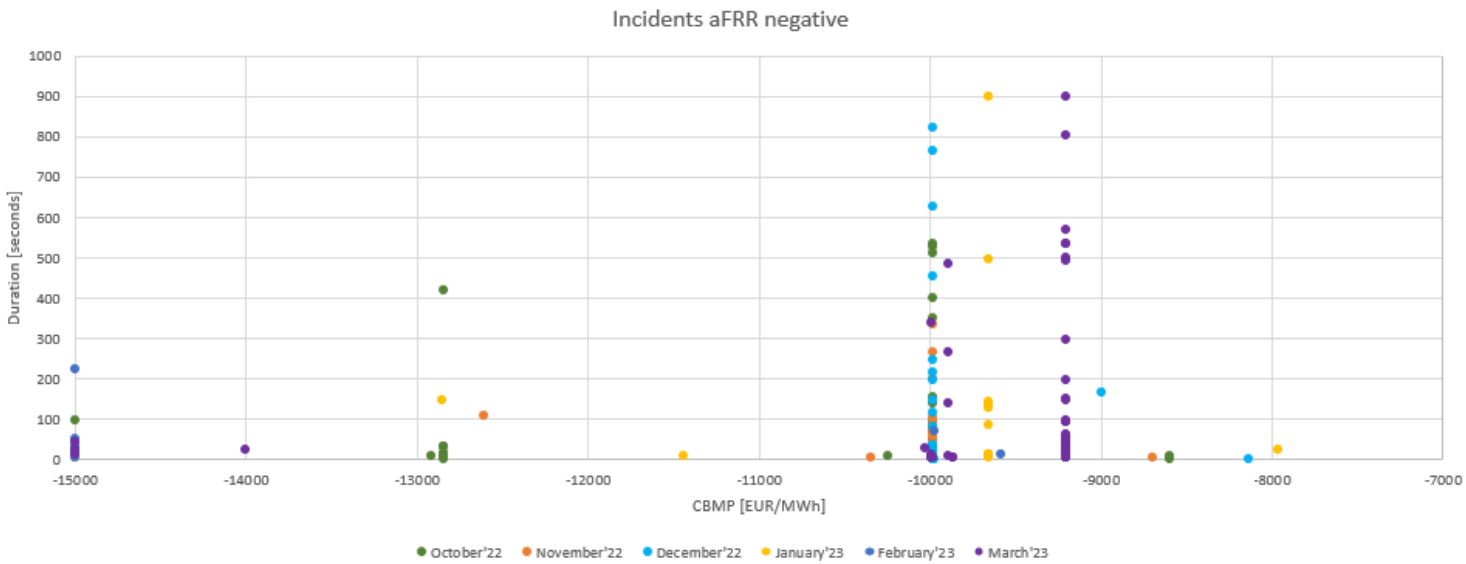
- ACER Decision 03-2022 on the amendment of the pricing methodology
- Provisions on Price limits
  - The transitional upper price limit shall be 15.000 €/MWh and the transitional lower price limit shall be –15,000 €/MWh;
  - If the harmonized maximum clearing price for the single intraday coupling in accordance with Article 54(1) of Commission Regulation (EU) 2015/1222 increases above 9,999 €/MWh. the transitional upper price limit shall automatically increase by the same amount. In this case. the transitional lower price limit shall be decreased to the same absolute value.
- Reporting Obligations
  - All TSOs shall report to ACER and to regulatory authorities on quarterly basis on the following aspects of the balancing energy price formation during the transitional period
    - monthly average values of used and available cross-zonal capacity for the exchange of balancing energy per each bidding zone border and direction;
    - average percentage of both submitted and activated standard balancing energy bids per product and per direction with prices higher (and lower) than 50 %, 75 %, 90 %, 95 % and 99 % of the upper (and lower) transitional price limit; and
    - volume weighted average price of the last (most expensive) 5 % of the volume of submitted standard balancing energy bids for each European balancing platform per direction and per participating TSO
  - If the cross-border marginal price during the transitional period pursuant to paragraph (3) reaches at least 50 % of the upper or lower transitional price limit, all TSOs shall prepare a joint report and submit it to ACER and all the regulatory authorities within a month following this event. This report shall include an analysis of the event and the indicators of the balancing energy market concentration level including at least Residual Supply Index (RSI). Herfindahl - Hirschman Index (HHI) and the market shares of 5 largest BSPs from the BSPs for which the participating TSOs have forwarded balancing energy bids.

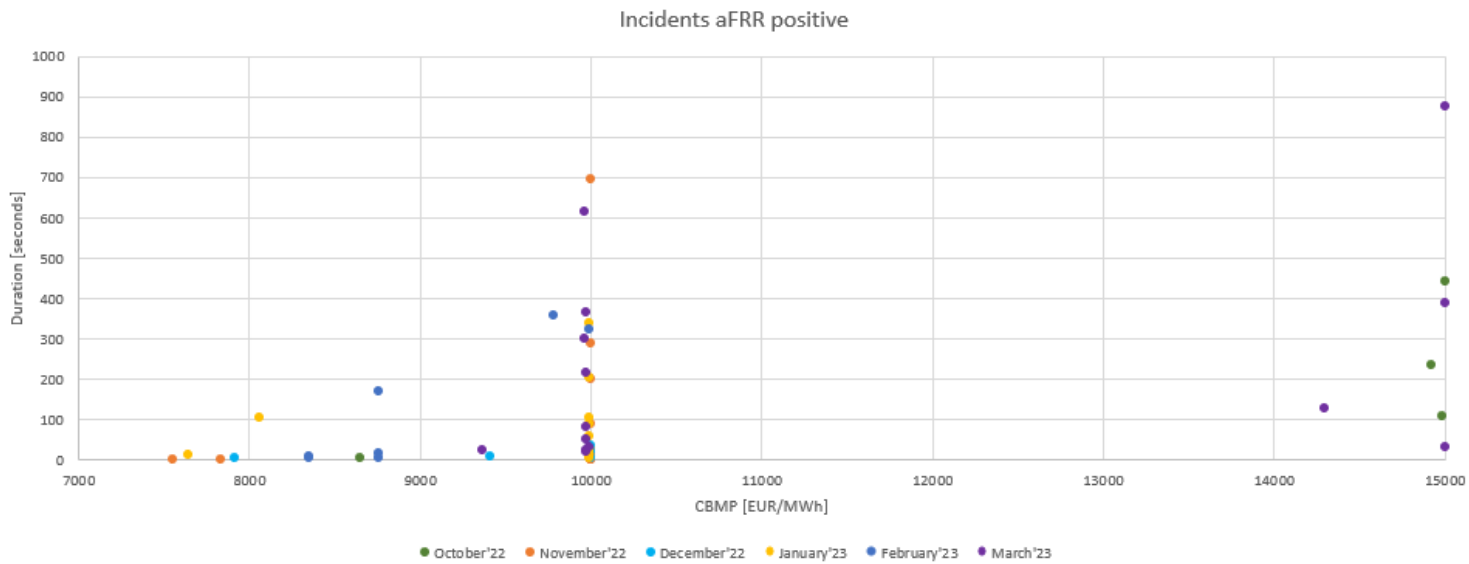
Balancing Energy Prices

aFRR Price Incident Level and Duration

Based on operational data from 01.10.2022 to 31.03.2023

- In total 227 aFRR price incidents occurred during Q4 2022 and Q1 2023 with only 3 participating Countries
- Average duration of aFRR price incidents (up to 15 min)
  - Negative aFRR: 118 sec
  - Positive aFRR: 151 sec
- Selection of bids at high aFRR prices for just a few OCs.





Balancing Energy Prices

aFRR Price incident Market Indicators

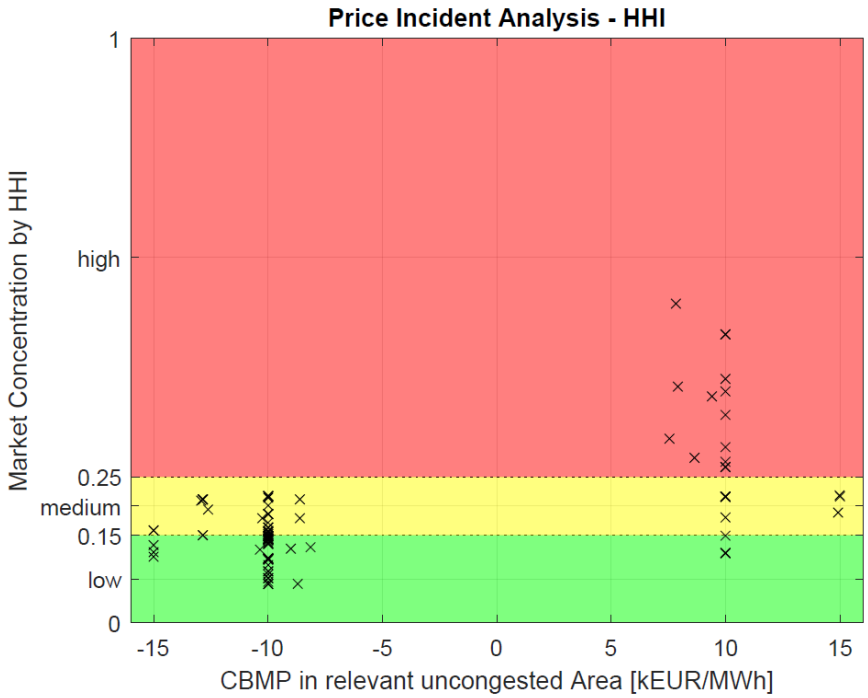
Based on operational data from 01.10.2022 to 31.03.2023

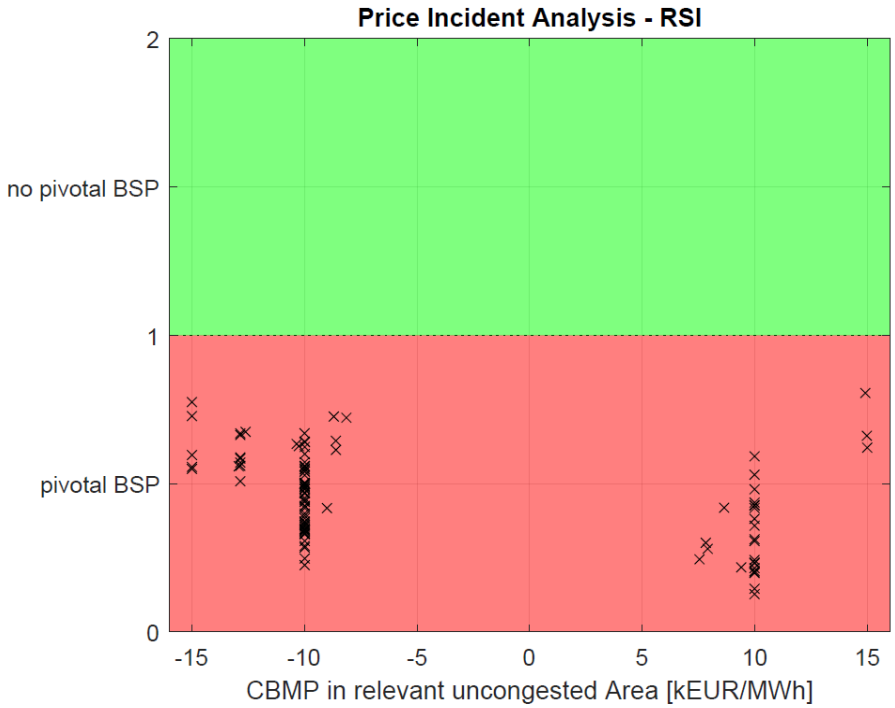
Herfindahl–Hirschman Index (HHI)

- measure of the size of BSPs in relation to the aFRR balancing energy market and an indicator of the amount of competition among them.
- Calculated by squaring the market share of each BSP and then summing the resulting numbers. The result is proportional to the average market share. weighted by market share.

Residual Supply Index (RSI)

- static concentration measure which monitors market power
- measures to which extent the BSPs can meet the current demand with their submitted balancing energy bids.
- The RSI is a measure of the “pivotalness” of BSPs.



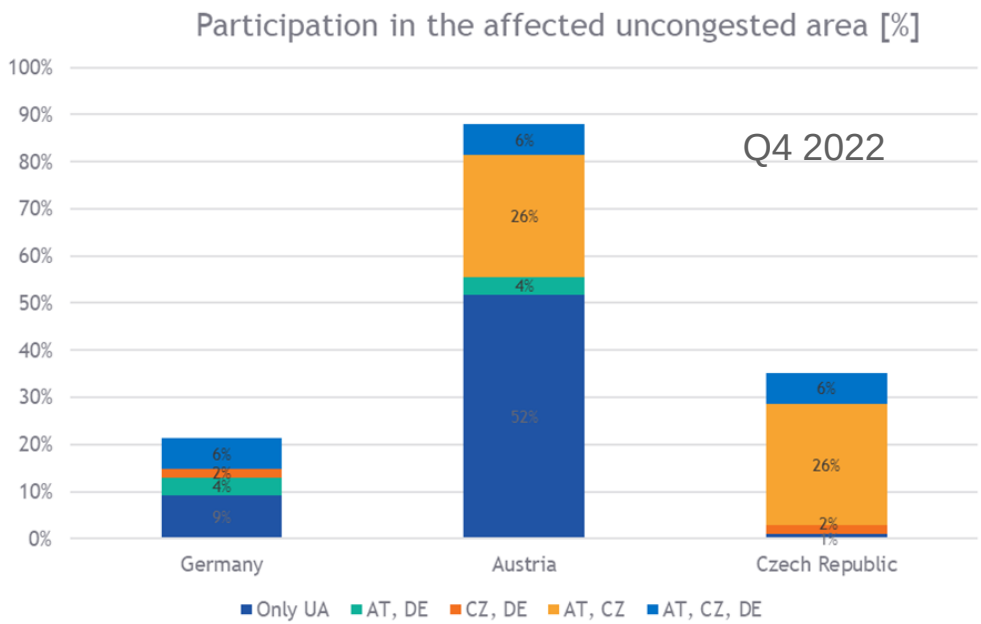


- High prices for positive aFRR CBMP are often related to high HHI, but for negative aFRR CBMP there seems to be less correlation with a high HHI.
- During most price incidents it was not possible to satisfy this demand without the BSP with the largest bid volume in the CMOL of the uncongested area

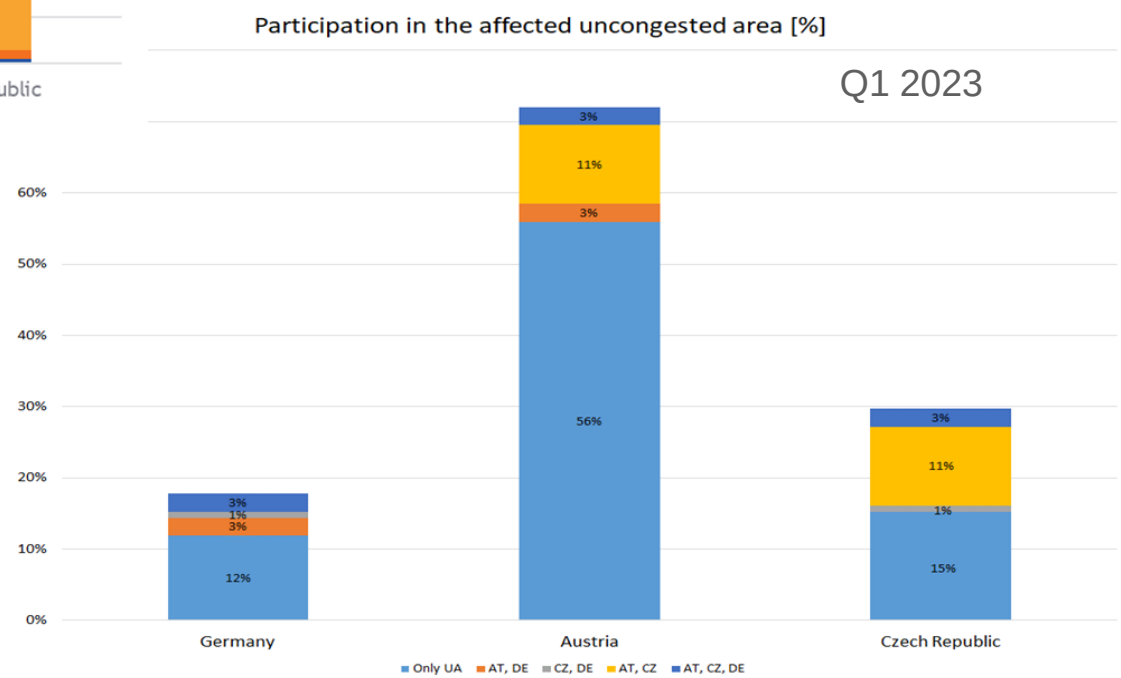
Balancing Energy Prices

aFRR uncongested areas

Based on operational data from 01.10.2022 to 31.03.2023



- For the price incidents observed in the aFRR markets until end of 2022, Czech Republic was rarely affected solely by a CBMP above the price reporting threshold.
- Either Austria, Germany, both countries together or all three participating Countries including Czech Republic formed the affected uncongested area.



Additionally performed analysis of the incidents shows that the CBMP often jumps exaggeratedly if demand is high and passes a certain threshold (tipping point of hockey stick MOL).

Balancing Energy Prices

mFRR Price incident Market Indicators

- 9 mFRR price incidents during Q1 2023
  - Average duration 15,67 min
  - Each price incident occurred only in a single participating LFC block and thus related to unavailable CZC
  - 8 of 9 mFRR price incidents occurred in negative direction (2x DA, 6xSA)
    - Average price of incidents: -9449 EUR/MWh
  - 1 of 9 mFRR price incidents occurred in positive direction (SA)
    - Price was 15 kEUR/MWh
- Market indicators
  - RSI for relevant uncongested area <1 during 4 of 9 mFRR price incidents
  - HHI for relevant uncongested area on medium competition level during 2 of 9 mFRR price incidents, else on competitive level

Balancing Energy Prices

Based on operational data from 01.10.2022 to 31.03.2023

KPIs on MOL Volume – average share of submitted and activated bids more expensive than X% to 15 kEUR/MWh

Submitted Activated	Positive aFRR					Negative aFRR				
Threshold	**50%**	**75%**	**90%**	**95%**	**99%**	**50%**	**75%**	**90%**	**95%**	**99%**
October 2022	10.193%	7.350%	6.248%	5.940%	5.748%	3.221%	2.024%	1.826%	1.766%	1.681%
	0.085%	0.070%	0.069%	0.068%	0.067%	0.056%	0.022%	0.016%	0.014%	0.013%
November 2022	6.782%	4.245%	3.578%	3.385%	3.243%	4.153%	3.030%	2.687%	2.582%	2.483%
	0.015%	0.008%	0.008%	0.008%	0.008%	0.005%	0.003%	0.003%	0.003%	0.002%
December 2022	13.385%	9.331%	7.853%	7.516%	7.240%	6.684%	5.514%	4.971%	4.774%	4.652%
	0.004%	0.001%	0.001%	0.001%	0.000%	0.008%	0.004%	0.004%	0.004%	0.004%
January 2023	13.6%	10.3%	8.6%	8.3%	8.0%	11.8%	9.6%	8.5%	8.2%	7.9%
	0.013%	0.003%	0.003%	0.003%	0.003%	0.021%	0.018%	0.015%	0.014%	0.013%
February 2023	11.3%	9.0%	7.4%	7.1%	6.9%	7.9%	6.2%	5.6%	5.4%	5.3%
	0.013%	0.005%	0.003%	0.003%	0.003%	0.019%	0.010%	0.008%	0.008%	0.008%
March 2023	7.0%	5.7%	5.0%	4.8%	4.7%	7.7%	5.6%	5.1%	4.9%	4.6%
	0.231%	0.157%	0.152%	0.149%	0.146%	0.028%	0.016%	0.012%	0.010%	0.009%

- The risk of high prices exists for nearly all MTUs but the probability of occurrence of high prices is quite low in the countries currently connected to PICASSO

Balancing Energy Prices

Based on operational data from 01.10.2022 to 31.03.2023

KPIs on MOL Volume – average share of submitted and activated bids more expensive than X% to 15 kEUR/MWh

Submitted Activated	Positive mFRR					Negative mFRR				
Threshold	**50%**	**75%**	**90%**	**95%**	**99%**	**50%**	**75%**	**90%**	**95%**	**99%**
October 2022	25.03%	14.46%	10.87%	10.23%	8.06%	9.04%	3.07%	1.24%	1.02%	0.82%
	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
November 2022	25.28%	14.32%	12.32%	11.90%	9.54%	7.20%	2.16%	0.88%	0.81%	0.57%
	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
December 2022	26.05%	15.99%	14.24%	14.14%	12.48%	17.05%	10.77%	8.56%	8.06%	7.18%
	0.00%	0.00%	0.00%	0.00%	0.00%	18.85%	11.48%	0.00%	0.00%	0.00%
January 2023	28.35%	20.17%	18.16%	17.93%	16.02%	17.05%	10.77%	8.56%	8.06%	7.18%
	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%
February 2023	23.63%	17.91%	16.66%	16.37%	14.34%	15.97%	10.37%	8.96%	7.45%	6.73%
	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
March 2023	20.42%	14.19%	13.14%	12.96%	11.22%	20.52%	13.75%	12.34%	11.36%	10.29%
	7.89%	7.89%	7.89%	7.89%	7.89%	22.70%	1.25%	1.25%	1.25%	0.00%

- The risk of high prices exists for nearly all MTUs but the probability of occurrence of high prices is quite low in the countries currently connected to MARI

Balancing Energy Prices

KPIs on MOL Volume – VWAP of last 5% of bids submitted

Based on operational data from 01.10.2022 to 31.03.2023

€/MWh	Positive aFRR			Negative aFRR		
	DE	CZ	AT	DE	CZ	AT
Oct'22	12875	2245	5194	-8339	-900	-4269
Nov'22	10656	2296	6851	-9495	-253	-4458
Dec'22	13470	1363	6607	-12363	-1255	-5136
Jan'22	13064	4881	6229	-14142	-1900	-4812
Feb'22	13437	1949	6148	-14086	-606	-3308
Mar'22	13770	1435	7911	-14065	-1645	-4288

	Positive mFRR		Negative mFRR	
€/MWh	DE	CZ	DE	CZ
Oct'22	15000	2872	-11008	-650
Nov'22	15000	2845	-11392	-643
Dec'22	15000	2812	-11607	-689
Jan'22	15000	3883	-15000	-1312
Feb'22	15000	4194	-15000	-1723
Mar'22	15000	4845	-15000	-8146

- VWAP of last 5% of bids submitted results in higher values for mFRR than for aFRR

  Analysis of MARI CMOL already showed that there are rarely mFRR balancing energy bids between 11250 EUR/MWh and the price cap. Some mFRR balancing energy bids are always submitted with a price equal to the price cap.

Balancing Energy Prices

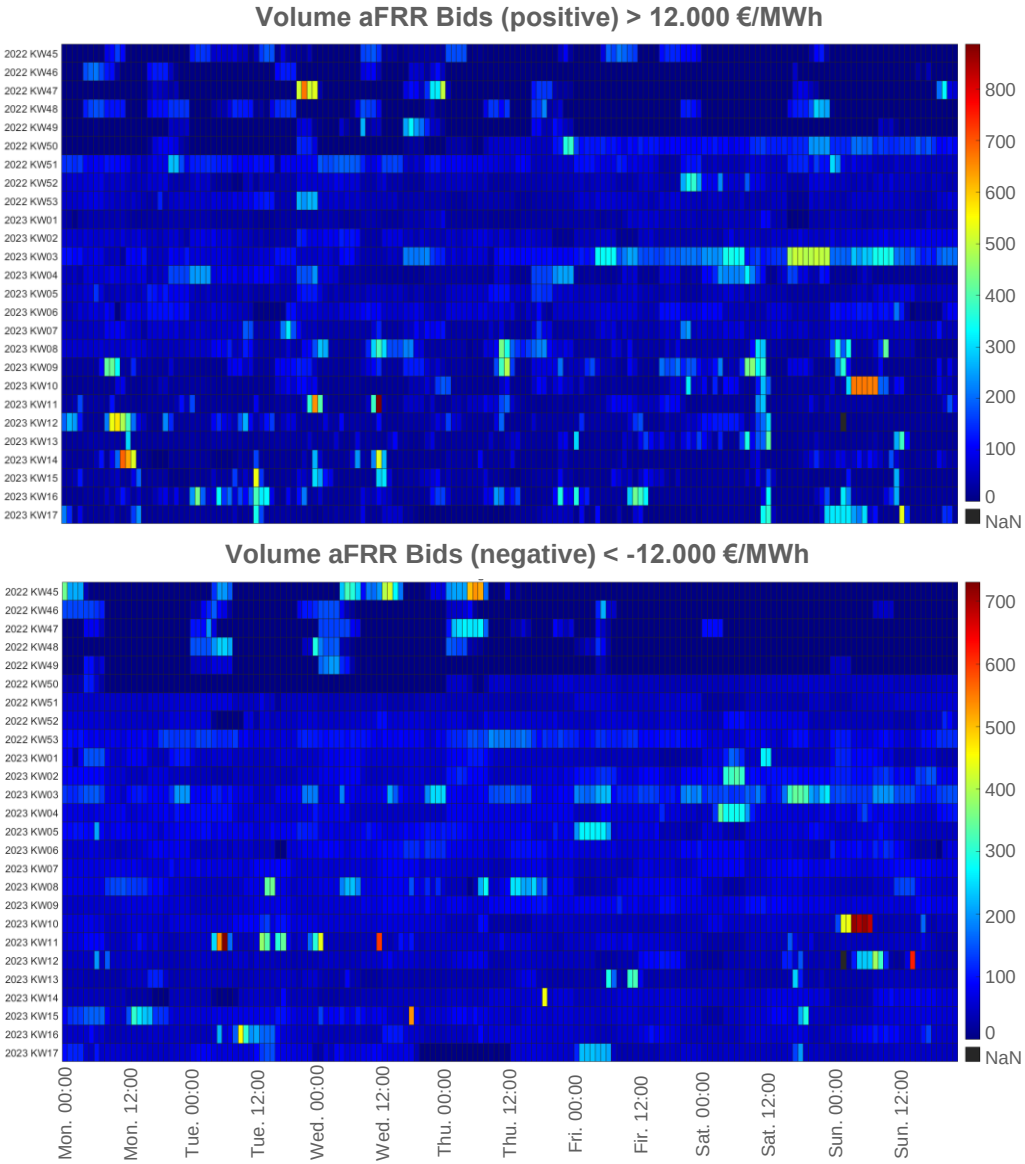
Insight in the structure of the PICASSO CMOL

Based on operational data from 01.11.2022 to 30.04.2023

- Explanation of the graphical representation:
  - Heatmaps show the volume of bids that have a higher price than 12,000 €/MWh (upper part) or lower than -12,000 €/MWh (lower part).
  - Lines represent one week; columns represent the week divided in 1-hour blocks. During this hour. average values are used.
  - Color represents the volume of the bids

- Market change in Germany in week 50 is visible: Suspension of release of “free bids” leads to a higher MOL-volume but also higher volumes above 12,000 €/MWh
- Since week 50, each CMOL contains bids with prices that are above 12,000 €/MWh.

- In positive direction the reduction of Day-Ahead prices is visible (starting in week 10), as the amount of bid prices above 12,000 €/MWh is decreasing
- Price level of negative direction is quite constant with some outliers in week 10/11



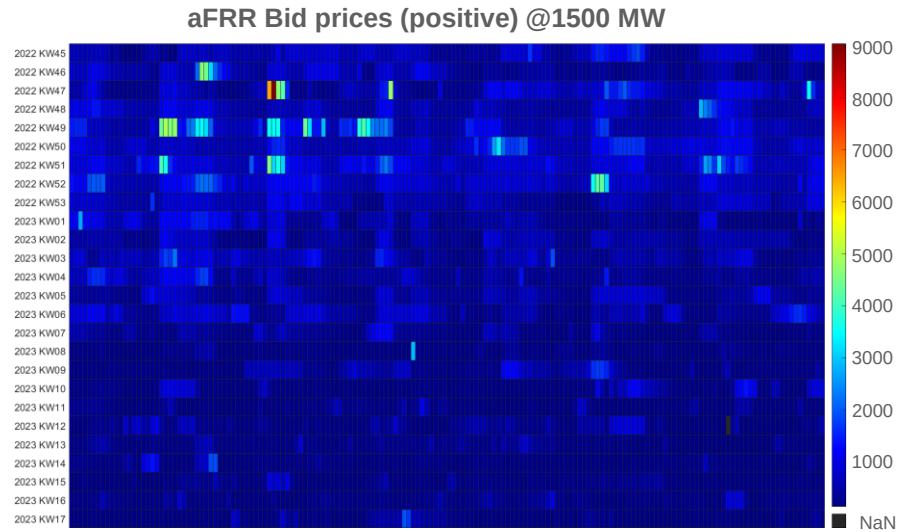
Balancing Energy Prices

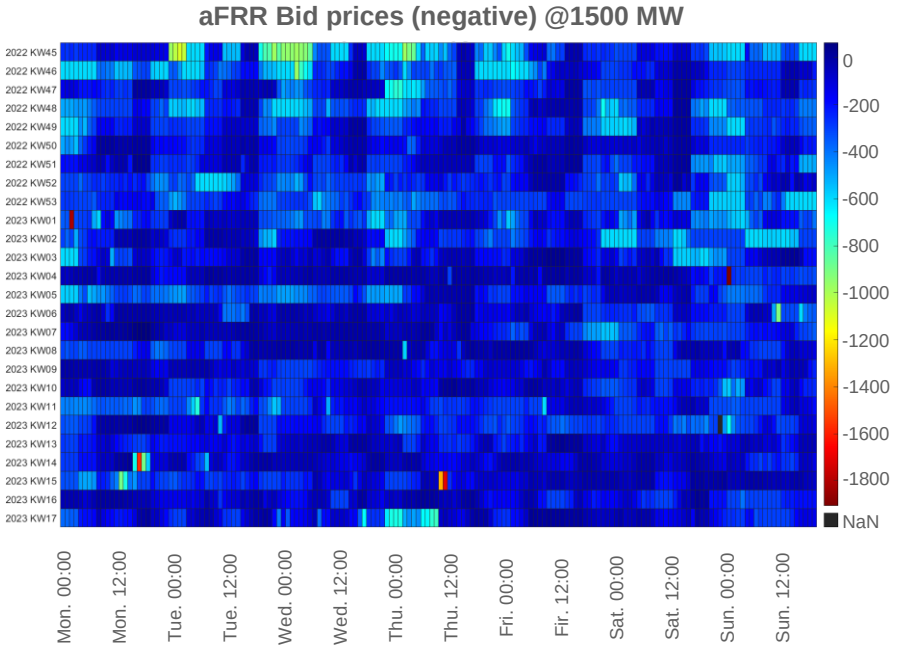
Insight in the structure of the PICASSO CMOL

Based on operational data from 01.11.2022 to 30.04.2023

- Explanation of the graphical representation:
  - Heatmaps show the CBMP in case of an UA for all PICASSO member that would have been reached if 1,500 MW would have been activated per direction
  - Lines represent one week; columns represent the week divided in 1-hour blocks. During this hour, mean values are used.
  - Color represents the price of the bid at 1500 MW, Different scales for negative and positive direction necessary.

- Market change in Germany in week 50 (see slide before) is not visible. no direct change in MOL-structure.
- Since week 53, the reduction of Day-Ahead prices is visible, prices in positive direction are reduced. Same effect is also seen in negative direction
- In general. less outliers compared to the analysis on the slide before -> MOL structure in the first 2/3 is much more stable.
- Weekdays and time of the day is visible in the MOL-structure, prices are slightly lower during the afternoon.

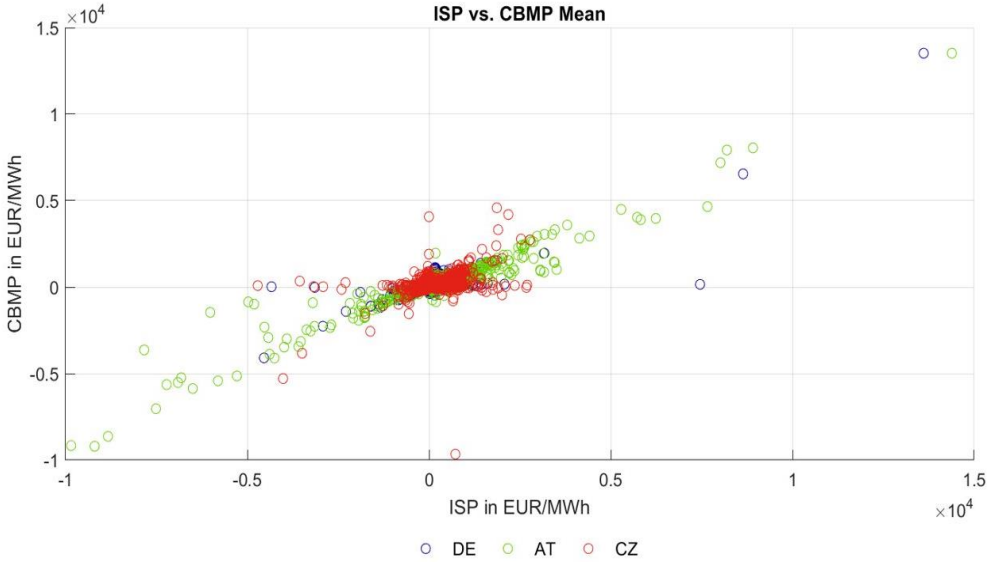


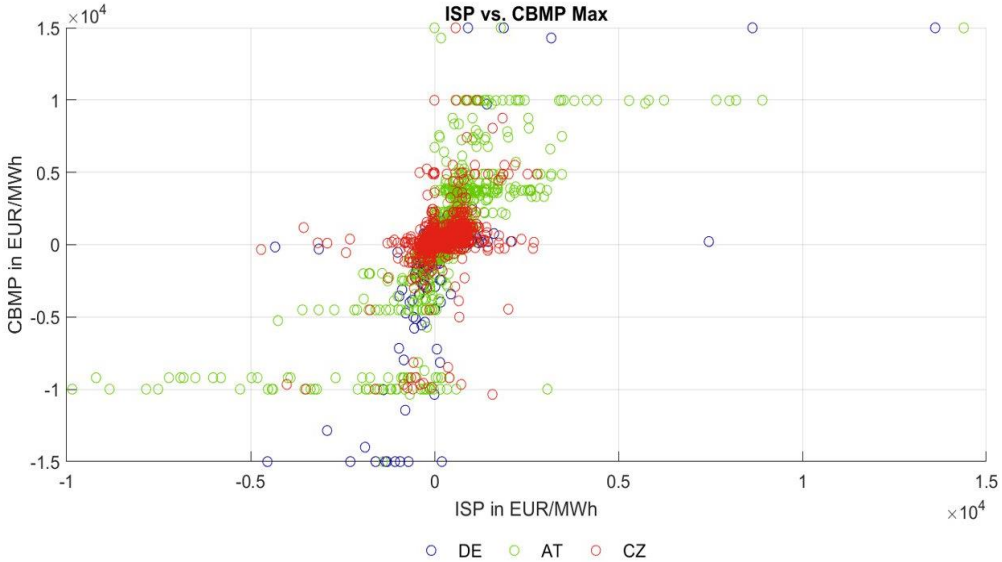


Balancing Energy Prices

Relation of Imbalance Settlement Prices and CBMP

Based on operational data from 01.07.2022 to 31.12.2022





- Analysis of relation of Imbalance Settlement Prices and aFRR CBMP shows more or less linear relation in case of VWAP based ISP, which his not the case with regard to maximum price approach
  - VWAP approach for ISP may be considered as a mitigation measure with regard to the assumed risk of high balancing energy prices
  - Linear relation shows that TSO recovers the activation costs from the BRP; the BRP may be exposed to extreme imbalance prices. If bid prices are based on true costs, there are correct incentives established.

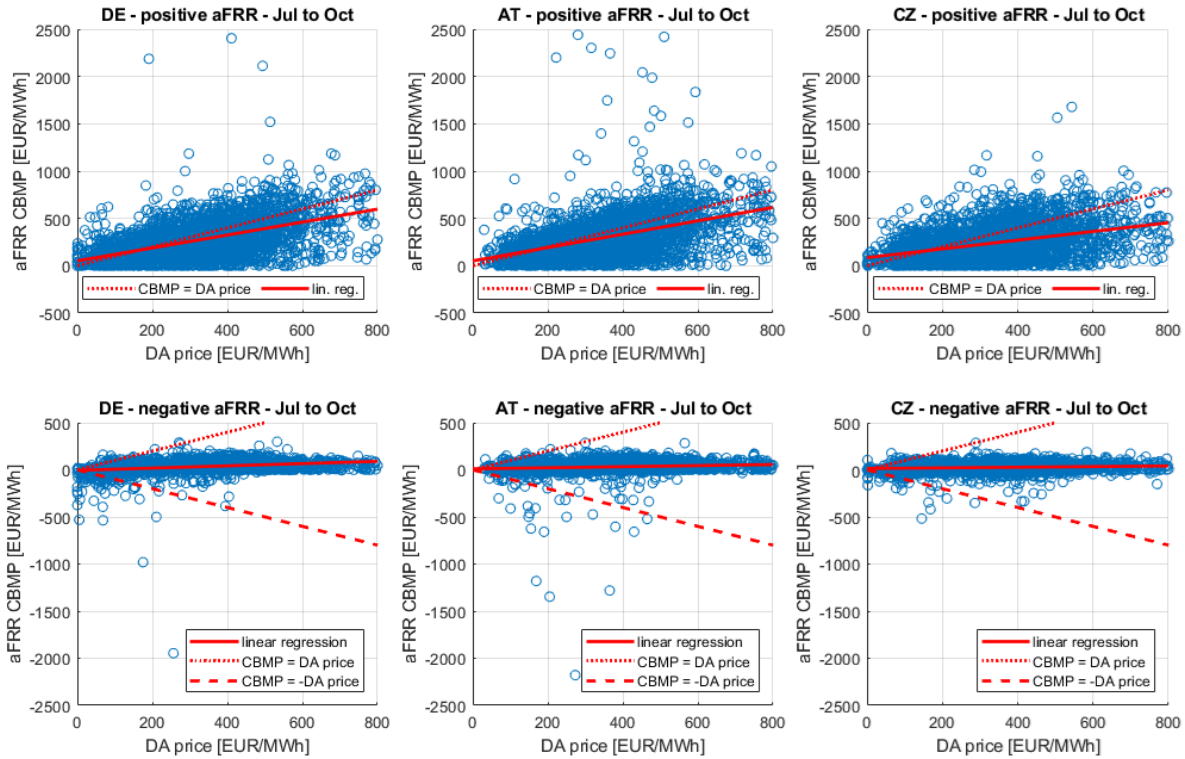
Balancing Energy Prices

Eurelectric Question in advance of EBSG Meeting

Based on operational data from 01.07.2022 to 31.12.2022

" PICASSO platform : is it possible to have a presentation of an "experience feedback / historical analysis" in terms of price formation with the link between the clearing prices and the fundamentals of the market ? (typically for BZ where this market is already developed) has this been done already by ENTSOE or some TSOs ? (We noted a lot of occurrence of very high prices in 2022) "

Any open questions from Eurelectric?



- Analysis of correlation of DA + aFRR_pos CBMP prices shows a positive correlation and more or less constant ratio with some outliers
  - From a first assessment, CBMP were not too high compared to DA prices.
  - Fundamental market developments in 2022 leading to higher price levels at BE market
  - Higher occurrence of prices spikes as expected by TSOs (and some NRAs) in first operational months of platforms

➢ Average observed CBMP are not considered to be too high (esp. compared to Wholesale Energy Market Prices) over the observed period. Price spikes occurring as assumed.

Balancing Energy Prices

Conclusions

- Sufficient competition is further hindered by not available cross-zonal-capacities, as with a quite stable probability also high demands will have to be solved locally.
- Marginal pricing applied in a small market-area is likely to cause high activation costs for BE.
  - In economic theory, BSPs have an incentive to offer bids with a price higher than their marginal costs even though there is competition in the market. Therefore, marginal cost bidding cannot be expected at all times. Different bidding strategy apart from marginal bidding may exist.
  - It has been proven that there is a spill-over of high prices from one market area to another.
  - NRAs and TSOs have sufficient market surveillance measures in place to detect unusual bidding behavior. Up to NRAs to evaluate it in terms of REMIT.
  - The risk of high prices exists for nearly all MTUs but the probability of occurrence of high prices is quite low in the observed countries, considering market structure.

- On availability of information for market participants: TSOs have properly implemented the requirements regarding the publication of information according to provisions of the regulations.
- Observed CBMP are not considered to be too high in general (esp. compared to DA market).
  - Price spikes occur as predicted by TSOs.
  - Mitigation measures to avoid reflection of high CBMP in ISP exist through VWAP approach.

- Selection of bids at high aFRR prices for just a few OCs. TSOs currently investigate which mitigation measures can be put in place to eliminate these short-lived selection of balancing energy bids, not leading to an activation.

TSOs are interested in feedback from market parties on possible measures to decrease identified risk of high prices.