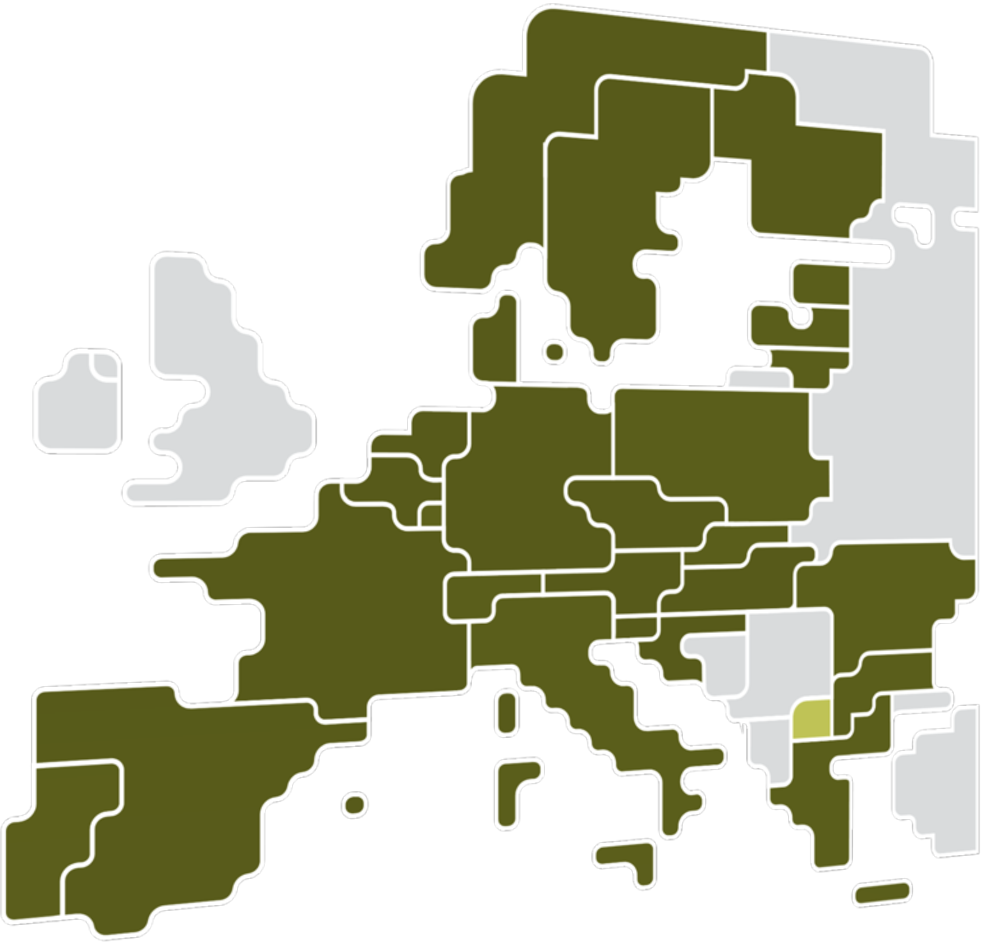
seps 50hertz
FINGRID PSE
APG
ipto
HOPS TenneT
SVENSKA KRAFTNÄT RED ELÉCTRICA DE ESPAÑA
REN MAVIR
ELES amprion
TRANSNETBW Rte
Statnett
ENERGINET čeps
swissgrid Terna
ESO elia
Litgrid elering
creos
AST

PICASSO & IGCC Stakeholder Workshop Meeting

11 December 2024, web conference



Agenda

1.	**Project overview and progress**	**13:05 - 13:15 CET**
2.	Business Processes	13:15 - 13:40 CET
3.	Operational Reporting	13:40 - 13:50 CET
4.	Questions and Answers	13:50 - 14:00 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.
- On 15th March, TERNA suspended its operation.
- In October 2024, TenneT NL and Energinet.dk joined
- In November 2024, SEPS and ELIA 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 more than 7.8 Mio. market clearings per.
- 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.

2022: 50Hertz, Amprion, APG ČEPS, TenneT DE, TransnetBW

2023: Terna

2024: EnDK West, EnDK East, Tennet NL

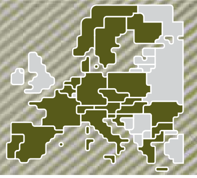
SEPS, ELIA

Accession

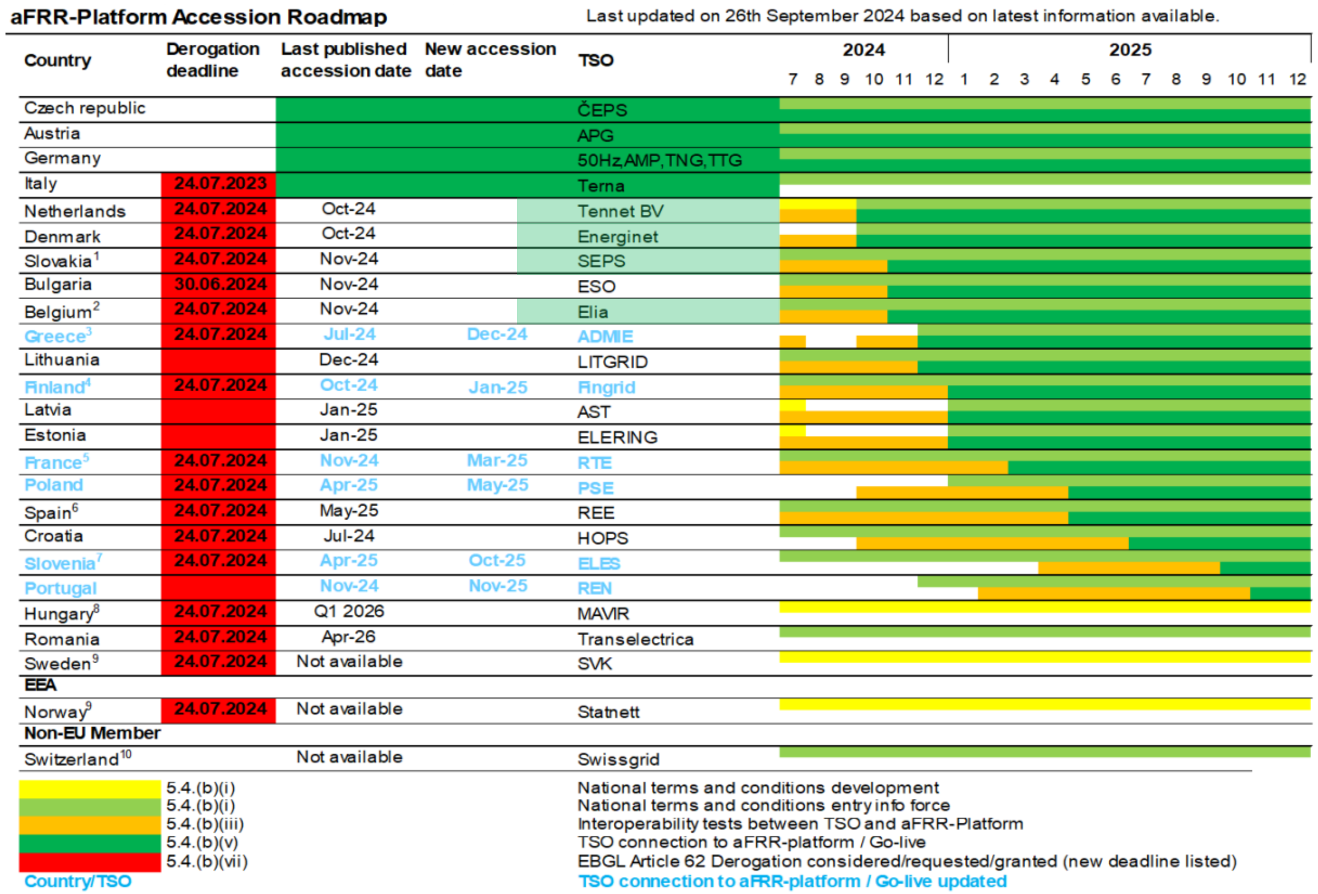
*The technical readiness of Swissgrid has been acknowledged. The participation of Switzerland in the aFRR-Platform is regulated based on article 1.6 and 1.7 of the EB Regulation and currently the subject of litigation by Swissgrid at the Court of Justice of the European Union.

PICASSO

Accession Roadmap (last publication on 26th September 2024)



- 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 26th September 2024 based on latest information available.

Country	Derogation deadline	Last published accession date	New accession date	TSO
Czech republic				ČEPS
Austria				APG
Germany				50Hz,AMP,TNG,TTG
Italy	24.07.2023			Terna
Netherlands	24.07.2024	Oct-24		Tennet BV
Denmark	24.07.2024	Oct-24		Energinet
Slovakia[1]	24.07.2024	Nov-24		SEPS
Bulgaria	30.06.2024	Nov-24		ESO
Belgium[2]	24.07.2024	Nov-24		Elia
Greece[3]	24.07.2024	Jul-24	Dec-24	ADMIE
Lithuania		Dec-24		LITGRID
Finland[4]	24.07.2024	Oct-24	Jan-25	Fingrid
Latvia		Jan-25		AST
Estonia		Jan-25		ELERING
France[5]	24.07.2024	Nov-24	Mar-25	RTE
Poland	24.07.2024	Apr-25	May-25	PSE
Spain[6]	24.07.2024	May-25		REE
Croatia	24.07.2024	Jul-24		HOPS
Slovenia[7]	24.07.2024	Apr-25	Oct-25	ELES
Portugal		Nov-24	Nov-25	REN
Hungary[8]	24.07.2024	Q1 2026		MAVIR
Romania	24.07.2024	Apr-26		Transelectrica
Sweden[9]	24.07.2024	Not available		SVK
EEA				
Norway[9]	24.07.2024	Not available		Statnett
Non-EU Member				
Switzerland[10]		Not available		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)
Country/TSO		TSO connection to aFRR-platform / Go-live updated

1) SEPS observed the risk related to the regulatory and technical developments which may influence SEPS´ accession date. **2) ELIA** - 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. 3) **ADMIE** - Connection date not finalized. Functional connection dependent on ability to exchange balancing energy with neighboring zones. **4) Fingrid** - Postponed due to delayed PCN connection. New accession date not yet agreed. aFRR energy market go-live 12. 06. 2024 **5) RTE** aims for implementation and go live in March 2025 once risks related to balancing energy high prices observed on the PICASSO platform are mitigated. **6) REE** - Delays on the national aFRR market implementation (go-live in November 2024) due to operational technical reasons identified in the last tests scheduled with aFRR BSPs, prior to the preliminary planned implementation date of the national aFRR market. Efforts during next months would be focused on increasing aFRR energy offers through an increase in the prequalified aFRR BSPs (mainly PV), and also by implementing a tool for reutilization of non-activated mFRR bids as aFRR bids. This national milestone also requires gaining experience through new scheduled tests with aFRR BSPs. Meanwhile, final IT adjustments are progressing towards PICASSO connection. **7) ELES** has postponed the accession to October 2025 due to technical reasons. **8) MAVIR** - A derogation has been granted by the NRA until 24. 07. 2024 for both MARI and PICASSO. MAVIR preliminary expects to connect to the platform by Q1 2026. **9) SVK/STATNETT** - The Norwegian and Swedish TSOs have focused on completing the Nordic balancing market before connecting to the European platforms, which, along with challenges of IT development, means that the planned accession to PICASSO is 2026 **10) Swissgrid** - 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.

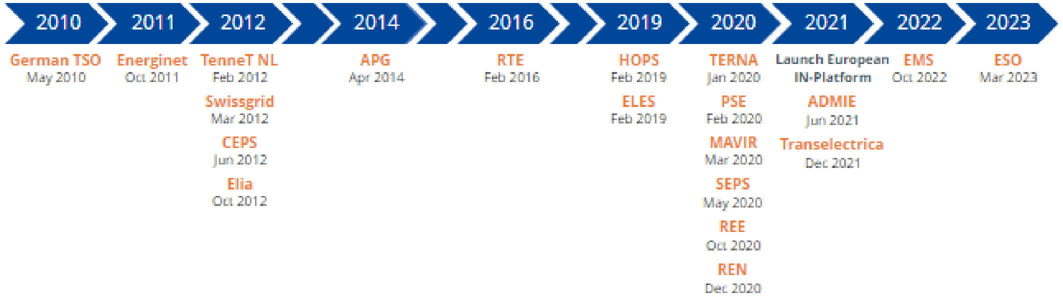
https://www.entsoe.eu/network_codes/eb/picasso/

Project Planning and progress

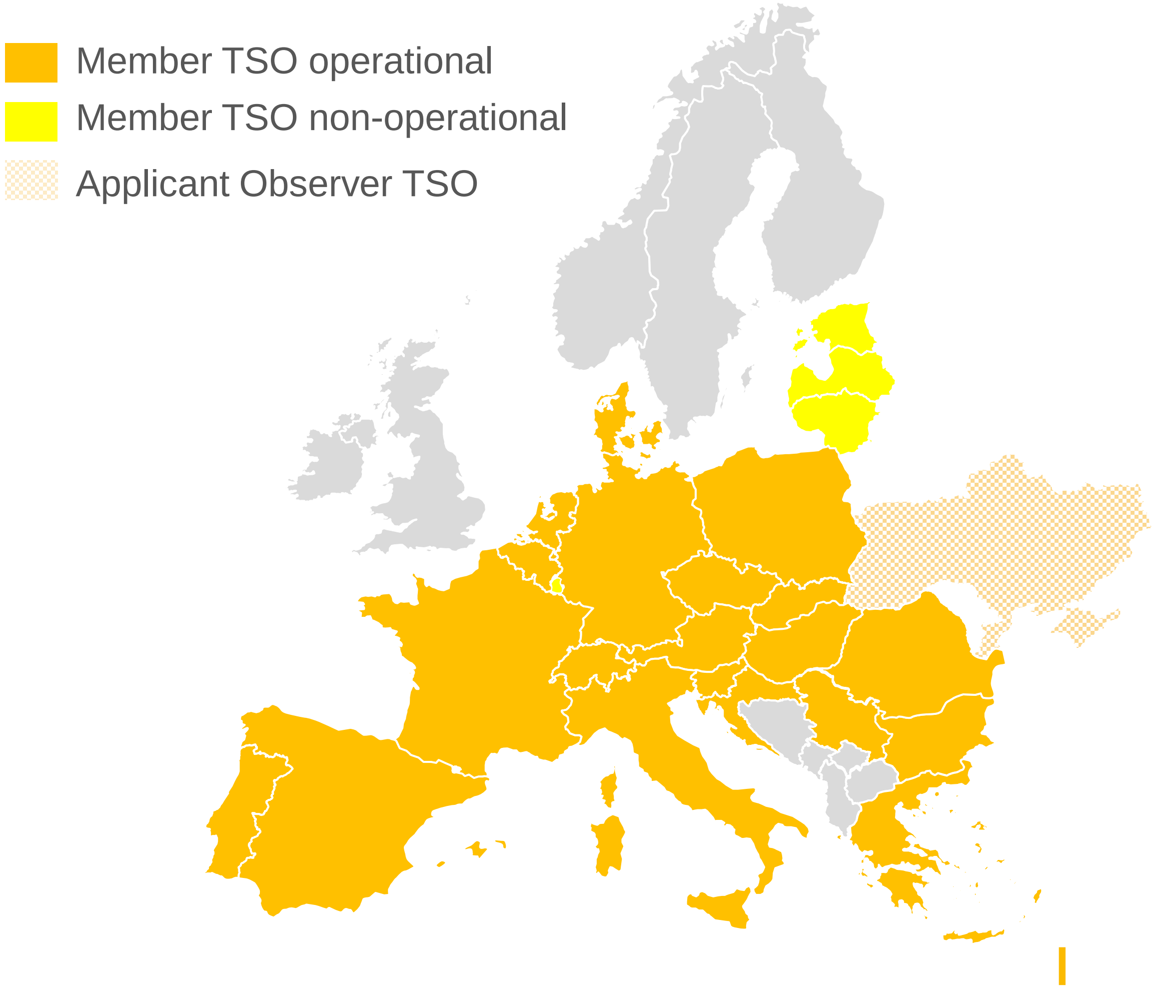
IGCC

- 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 24 are operational members
- With the go-live of ESO in March 2023, all EU-TSOs with are legal obligation are connected and can net their imbalances.
- As of January 2024 Litgrid, AST and Elering will become IGCC Member TSOs
- Connection of Baltic TSOs is planned in January 2025
- Historical evolution (starting in 2010):



2010	2011	2012	2014	2016	2019	2020	2021	2022	2023
German TSO May 2010	Energinet Oct 2011	TenneT NL Feb 2012 Swissgrid Mar 2012 CEPS Jun 2012 Elia Oct 2012	APG Apr 2014	RTE Feb 2016	HOPS Feb 2019 ELES Feb 2019	TERNA Jan 2020 PSE Feb 2020 MAVIR Mar 2020 SEPS May 2020 REE Oct 2020 REN Dec 2020	Launch European IN-Platform ADMIE Jun 2021 Transelectrica Dec 2021	EMS Oct 2022	ESO Mar 2023



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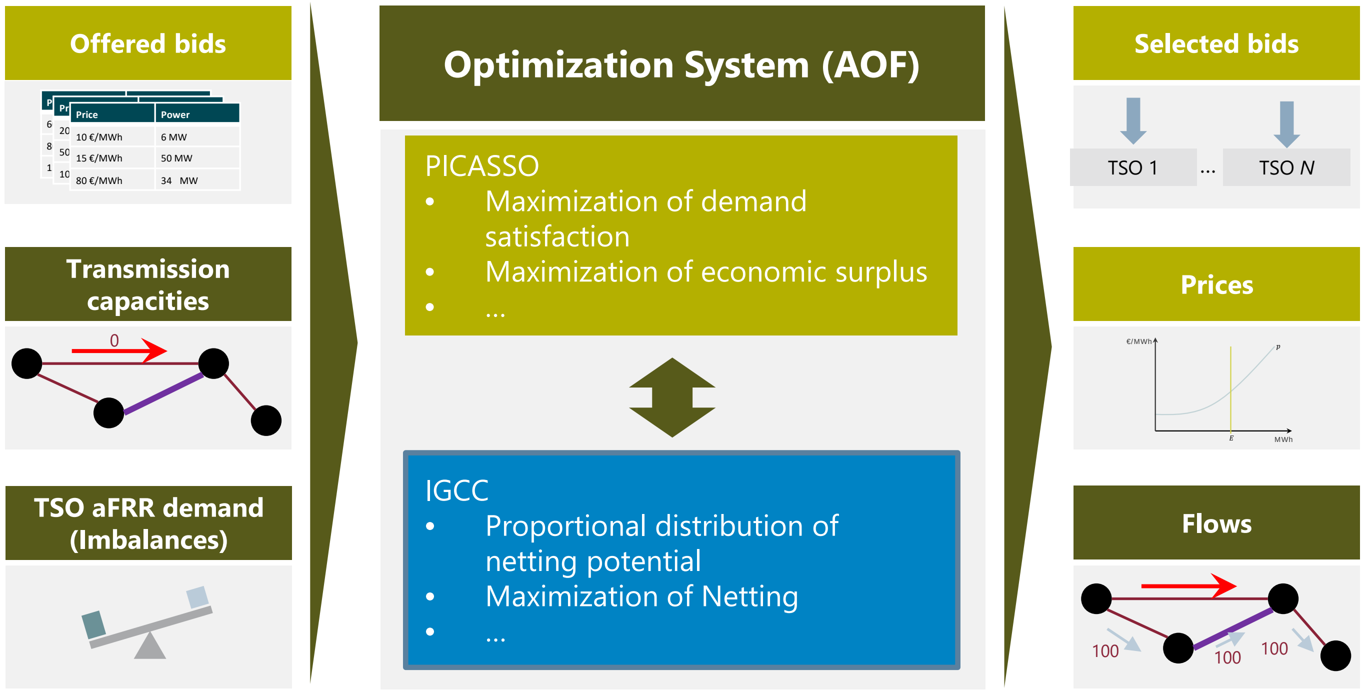
How PICASSO and IGCC work

High level design of Optimization



Offered bids

Transmission capacities

TSO aFRR demand (Imbalances)

Optimization System (AOF)

PICASSO
- Maximization of demand satisfaction
- Maximization of economic surplus
- …

IGCC
- Proportional distribution of netting potential
- Maximization of Netting
- …

Selected bids

TSO 1 … TSO *N*

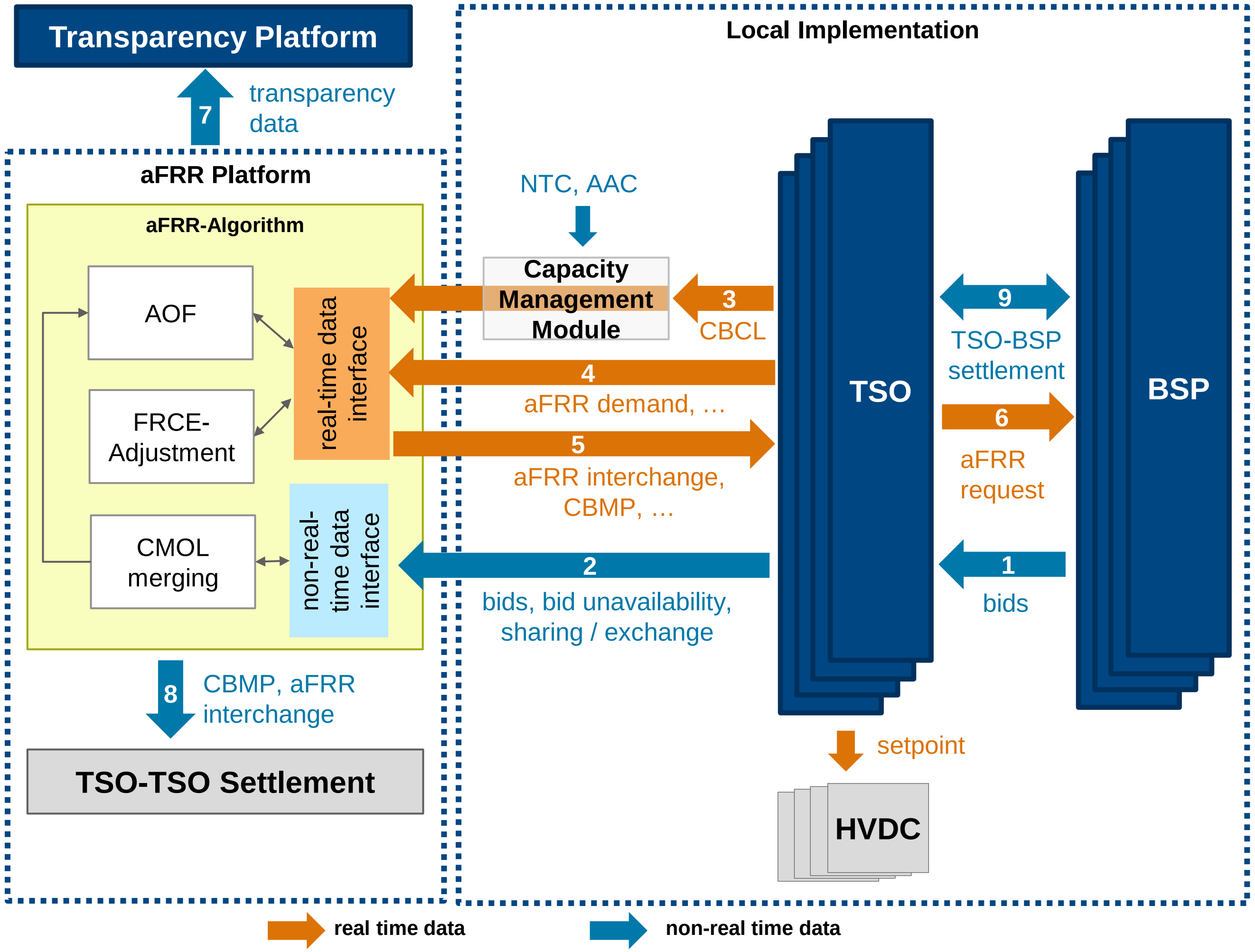
Prices

Flows

🟩 PICASSO only 🟦 IGCC only 🟩 Common PICASSO/IGCC

PICASSO Platform design

PICASSO High Level Design



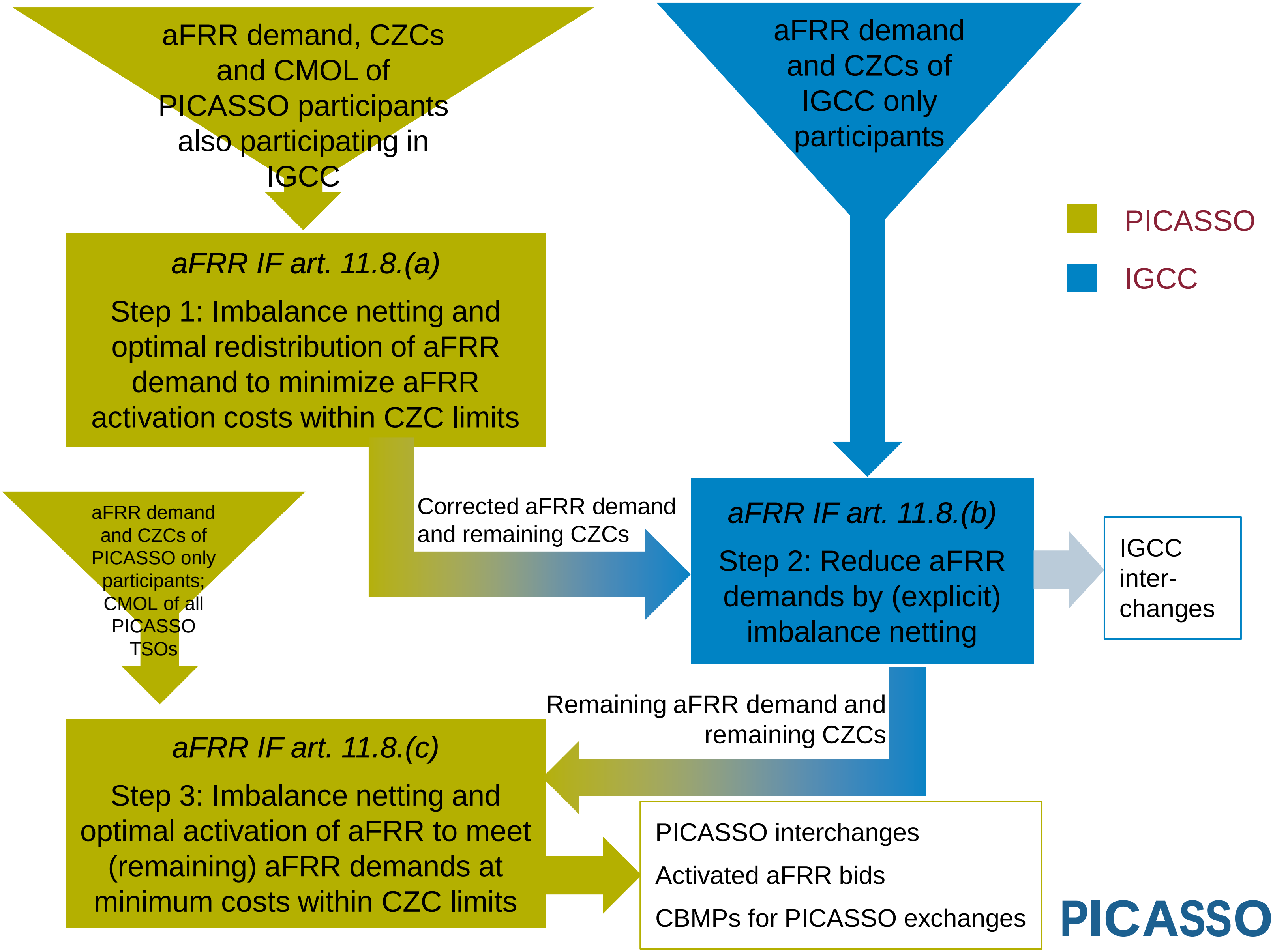
AOF	Activation Optimization Function	NTC	Net Transfer Capacity
FRCE	Frequency Restoration Control Error	AAC	Already Allocated Capacities
CMOL	Common Merit Order List	CBCL	Cross-Border Capacity Limits
CBMP	Cross-Border Marginal Price	HVDC	High Voltage Direct Current

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

How PICASSO and IGCC work

Optimization steps

1) Perform aFRR activation optimization for all PICASSO TSOs also participating in IGCC
2) Perform imbalance netting process for all IGCC TSOs
3) Perform aFRR activation optimization for all PICASSO TSOs



aFRR demand, CZCs and CMOL of PICASSO participants also participating in IGCC

aFRR demand and CZCs of IGCC only participants

🟩 PICASSO

🟦 IGCC

aFRR IF art. 11.8.(a)

Step 1: Imbalance netting and optimal redistribution of aFRR demand to minimize aFRR activation costs within CZC limits

Corrected aFRR demand and remaining CZCs

aFRR IF art. 11.8.(b)

Step 2: Reduce aFRR demands by (explicit) imbalance netting

IGCC inter-changes

aFRR demand and CZCs of PICASSO only participants; CMOL of all PICASSO TSOs

Remaining aFRR demand and remaining CZCs

aFRR IF art. 11.8.(c)

Step 3: Imbalance netting and optimal activation of aFRR to meet (remaining) aFRR demands at minimum costs within CZC limits

PICASSO interchanges

Activated aFRR bids

CBMPs for PICASSO exchanges

PICASSO & IGCC

Interaction of IGCC and PICASSO

IGCC

Aim: Avoid aFRR activation

- Imbalance netting only
- Calculates net imbalance and distributes netting proportionally to initial FRCE of each participating TSO within the uncongested area
- Explicit netting
- TSO changes LFC input with IGCC result

PICASSO

Aim: Cost minimal activation of aFRR

- Imbalance netting and cross-border aFRR activation
- Relocates FRCE to the area with the best priced bids and implicitly performs imbalance netting by looking at the summed FRCE within an uncongested area when doing the optimization
- Implicit netting
- TSO changes LFC input with PICASSO result

Example IGCC:

- Assuming sufficient XB ATC

Area	FRCE before IGCC	FRCE after IGCC correction
A	50	0
B	-60	-30
C	-40	-20

Example PICASSO:

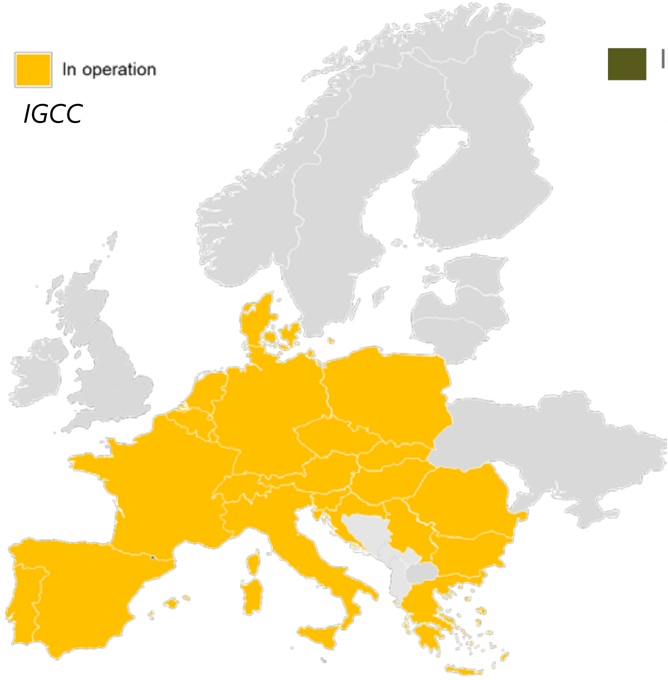
- Downward CMOL with first 20 MW bids in A and a further 100 MW Bids in B
- Assuming sufficient XB ATC

Area	FRCE before PICASSO	FRCE after PICASSO correction
A	50	-20
B	-60	-30
C	-40	0

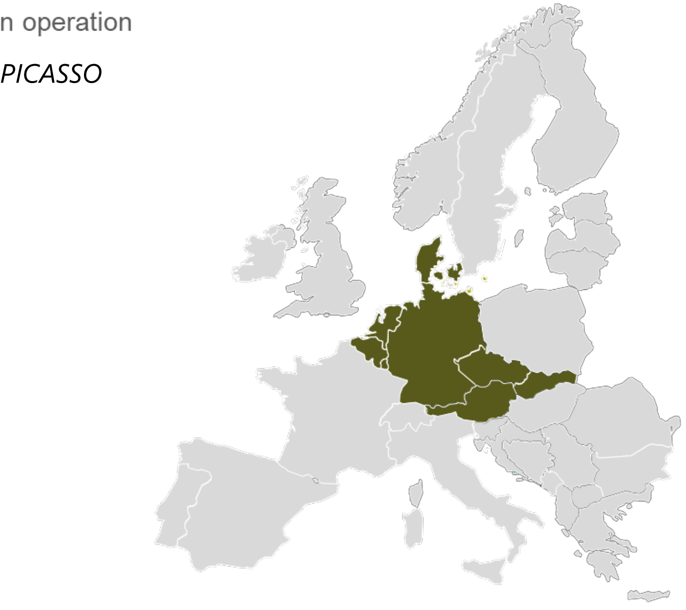
Interaction of IGCC and PICASSO

Effect of different geographical areas of IGCC and PICASSO

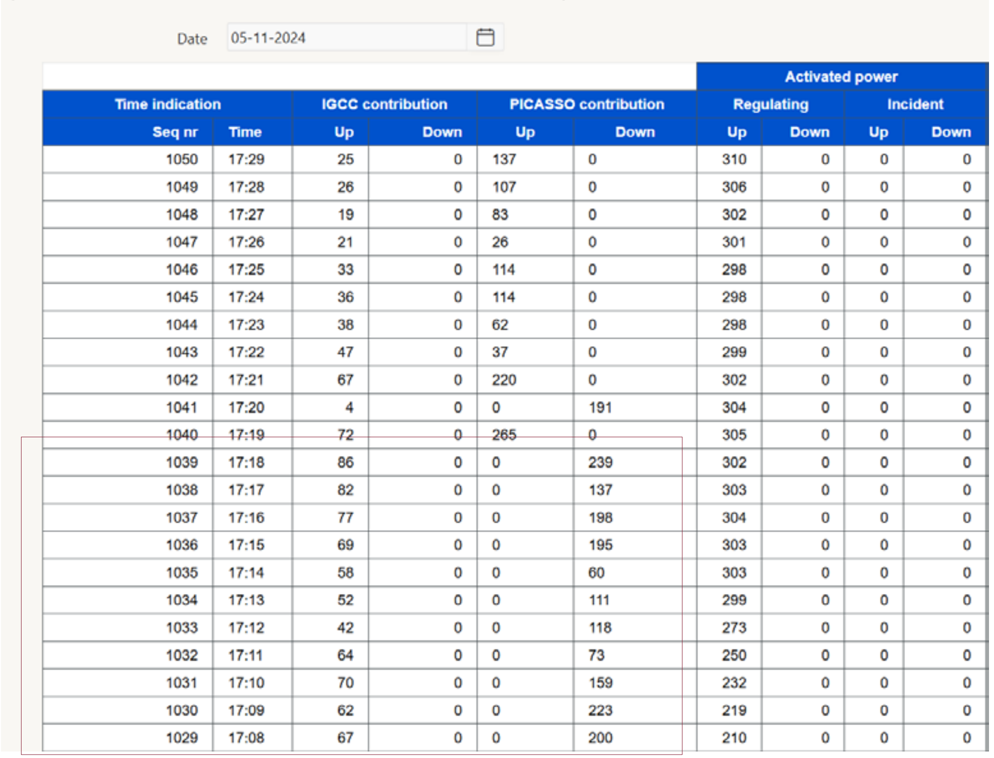
- Geographical areas of TSOS participating in IGCC and TSOs participating PICASSO are different
- TSOs can thus receive contrary correction signals for IGCC and PICASSO
- As long as more TSOs participate in IGCC but not (yet) in PICASSO, this can lead to large effects.
- For the local aFRR activation of a TSO only the sum of the IGCC and PICASSO contributions for that TSO is relevant
- When more and more TSOs take part in PICASSO the volume netted through IGCC will decrease, as netting will take place directly through PICASSO.



IGCC



PICASSO



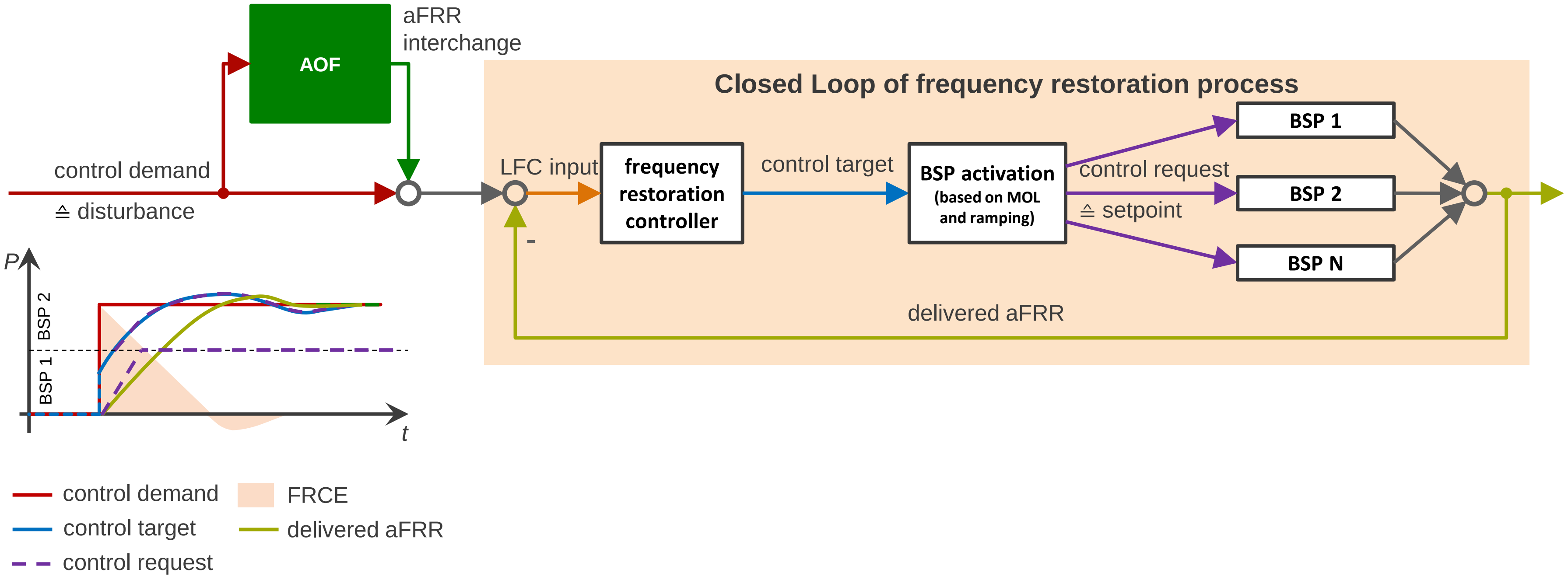
Date 05-11-2024

						Activated power			
Time indication		IGCC contribution		PICASSO contribution		Regulating		Incident	
Seq nr	Time	Up	Down	Up	Down	Up	Down	Up	Down
1050	17:29	25	0	137	0	310	0	0	0
1049	17:28	26	0	107	0	306	0	0	0
1048	17:27	19	0	83	0	302	0	0	0
1047	17:26	21	0	26	0	301	0	0	0
1046	17:25	33	0	114	0	298	0	0	0
1045	17:24	36	0	114	0	298	0	0	0
1044	17:23	38	0	62	0	298	0	0	0
1043	17:22	47	0	37	0	299	0	0	0
1042	17:21	67	0	220	0	302	0	0	0
1041	17:20	4	0	0	191	304	0	0	0
1040	17:19	72	0	265	0	305	0	0	0
1039	17:18	86	0	0	239	302	0	0	0
1038	17:17	82	0	0	137	303	0	0	0
1037	17:16	77	0	0	198	304	0	0	0
1036	17:15	69	0	0	195	303	0	0	0
1035	17:14	58	0	0	60	303	0	0	0
1034	17:13	52	0	0	111	299	0	0	0
1033	17:12	42	0	0	118	273	0	0	0
1032	17:11	64	0	0	73	250	0	0	0
1031	17:10	70	0	0	159	232	0	0	0
1030	17:09	62	0	0	223	219	0	0	0
1029	17:08	67	0	0	200	210	0	0	0

Example of contrary IGCC and PICASSO correction signals as published by TenneT NL on their website

PICASSO Pricing

aFRR controller and merit-order activation principle



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

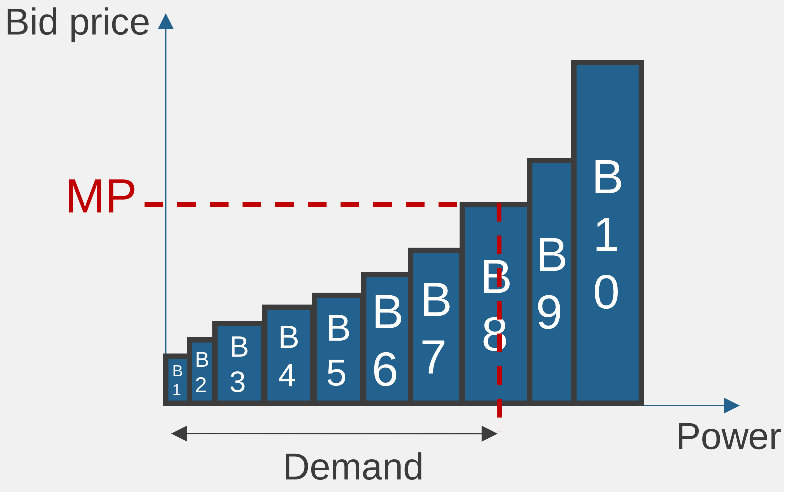
- Each TSO calculates in each control cycle the demand, which resembles the imbalance before any aFRR activation and provides it to the AOF
- The AOF determines the aFRR interchange based on the CMOL, without considering any ramping constraints

PICASSO Pricing

Basic Principles

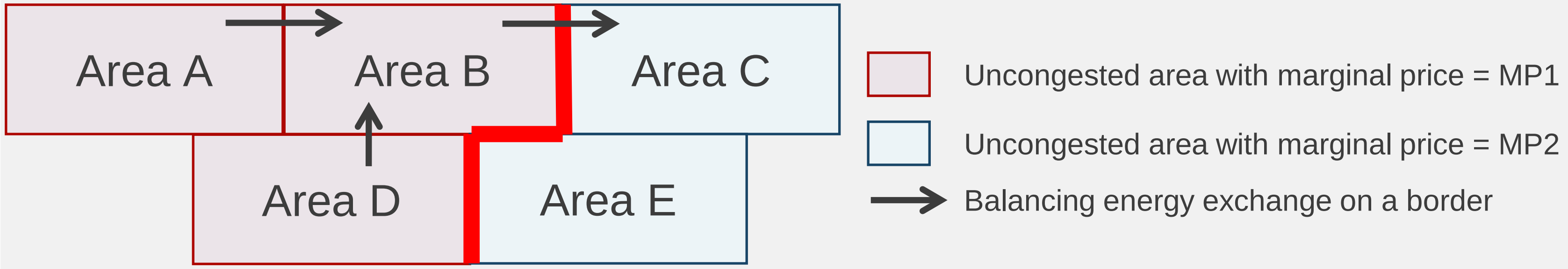
Marginal pricing principles

- 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 either selected or locally requested (see next slide) to cover the energy need for balancing purposes within a specified area.
- The PICASSO AOF will compute the cross-border marginal price (CBMP) per LFC area and optimization cycle



Cross-Border Marginal Pricing

- In case there is no congestion between adjacent LFC areas (-> uncongested area) 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)



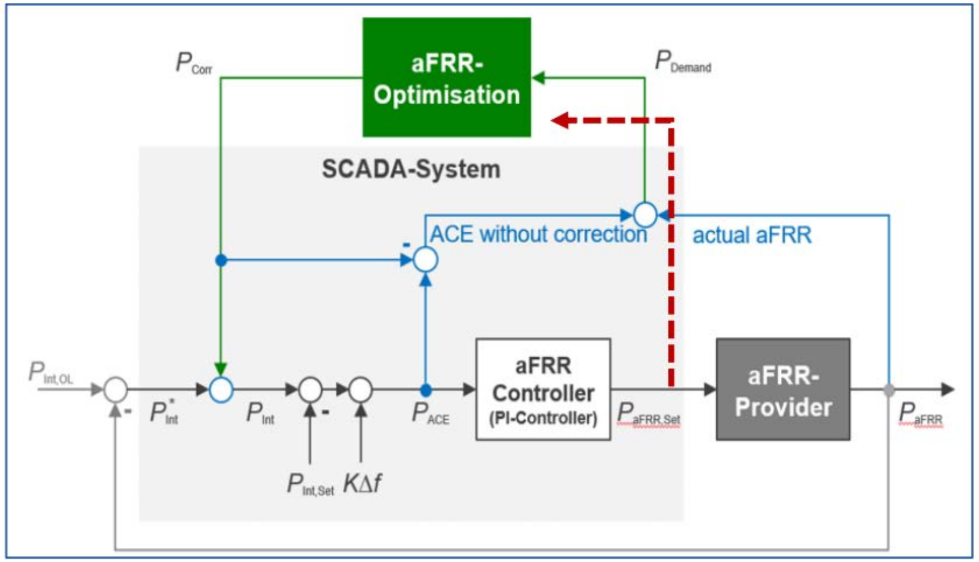
PICASSO Pricing

Changes with the ACER Decision 8/2024 and 9/2025

Connecting the actual local LFC output with the central selected

- Based on the ACER Decision 8/2024 and 9/2024, also setpoint for automatic FRR activation (LFC output) has to be taken into account in the MP determination
- Therefore, the sum of all LFC outputs of each local aFRR Controller is submitted to the AOF

The PICASSO AOF will compute the CBMP per LFC area and optimization cycle based on the two values (aFRR selected by the AOF and the LFC output)



Defining the CMBP

The CBMP in an uncongested area is the minimum of:

1) Maximum local marginal price
   Intersection of LMOL and LFC output determined by PICASSO platform
2) and the aFRR-CBMP determined according to the results of the
   Intersection of CMOL and sum of aFRR requirements (LFC input) determined by PICASSO platform.

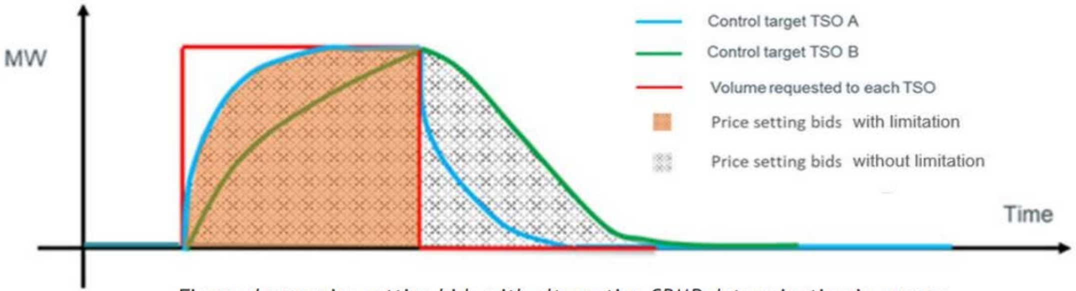


Figure shows price setting bids with alternative CBMP determination in orange

If in an uncongested area, no aFRR is requested (by the AOF or by the controllers), the price for perfect netting is applied.
This also applies for situation were the LFC output of all controllers of the uncongested area differs from the sign of the selection of the AOF.

PICASSO Pricing

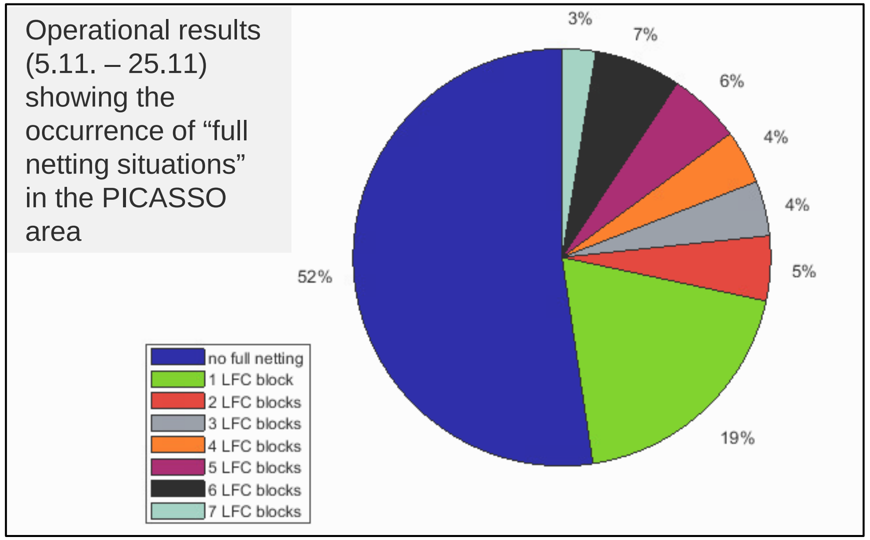
Full netting situation

Price determination in full netting situation

The PICASSO AOF calculates a CBMP in every optimization cycle. Because of implicit netting (and explicit netting via IGCC), a situation with no aFRR activation in an uncongested area is possible.

In such cases, the CBMP is calculated based on the Methodology for pricing balancing energy, Art. 7 and is the mid point between:

- The cheapest bid in upward direction
- The most expensive bid in downward direction



Operational results (5.11. – 25.11) showing the occurrence of “full netting situations” in the PICASSO area

Standard Example

Taking into account a “standard” common Merit order list (CMOL):

- Starting point of CMOL positive direction: 1st bid [120 €/MWh | 4 MW], 2nd bid [125 €/MWh | 10 MW]
- Starting point of CMOL negative direction: 1st bid [40 €/MWh | 10 MW], (…), 102nd bid [-0.4 €/MWh | 4 MW]

Full netting price: (120 €/MWh + 40 €/MWh) / 2 = 80 €/MWh

Publication: Full netting situation is indicated by publishing the full netting price in positive AND negative direction.

Extra-ordinary case

Taking into account an “extraordinary” common Merit order list (CMOL):

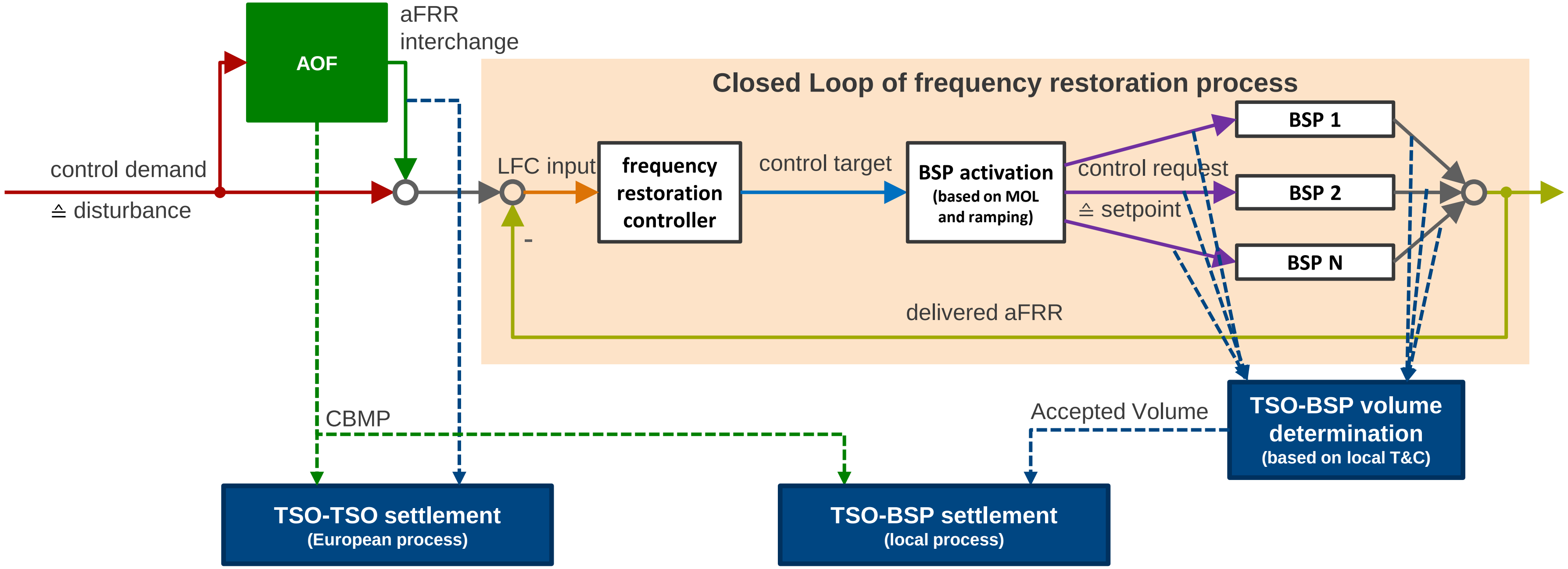
- Starting point of CMOL positive direction: 1st bid [120 €/MWh | 4 MW], 2nd bid [125 €/MWh | 10 MW]
- Starting point of CMOL negative direction: 1st bid [4000 €/MWh | 2 MW], (…), 2nd bid [40 €/MWh | 4 MW]

Full netting price: (120 €/MWh + 4000 €/MWh) / 2 = 2060 €/MWh

Publication: Full netting situation is indicated by publishing the full netting price in positive AND negative direction.

PICASSO Pricing

aFRR controller and merit-order activation principle



PICASSO settlement

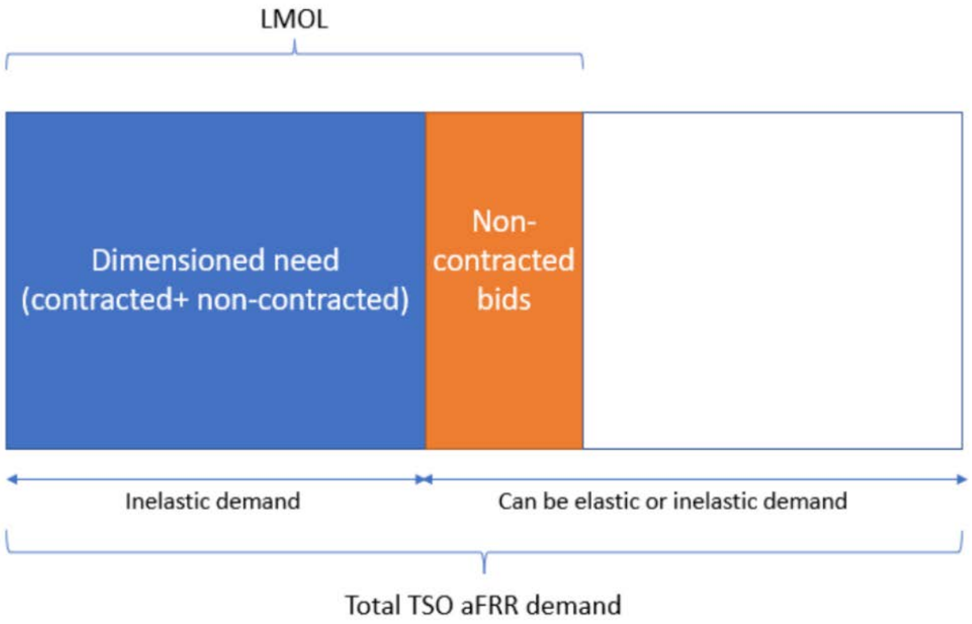
- TSO-TSO settlement is based on the aFRR interchange calculated by the AOF, multiplied by the CBMP, not taking into account activation delays
- TSO-BSP settlement is based on “accepted volumes” determined by each TSO based on local terms and conditions (e.g. on basis of control request and/or measures/metered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

Voluntary Elastic aFRR Demand

Introducing the elastic demand

- Based on the ACER Decision 8/2024 and 9/2024, TSOs have the possibility to declare some parts of their demand as “elastic”
- The part of the demand that can be elastic is limited to a demand above the **dimensioned need**

The aFRR demand in the range of dimensioned aFRR (“inelastic demand”) must be satisfied regardless of the price. For the elastic demand, the TSO submits a price threshold, the elastic demand is covered up to this threshold.
Each TSO that uses elastic demand has to publish the local terms how the elastic demand and the price threshold are calculated.



LMOL

Dimensioned need (contracted+ non-contracted)

Non-contracted bids

Inelastic demand

Can be elastic or inelastic demand

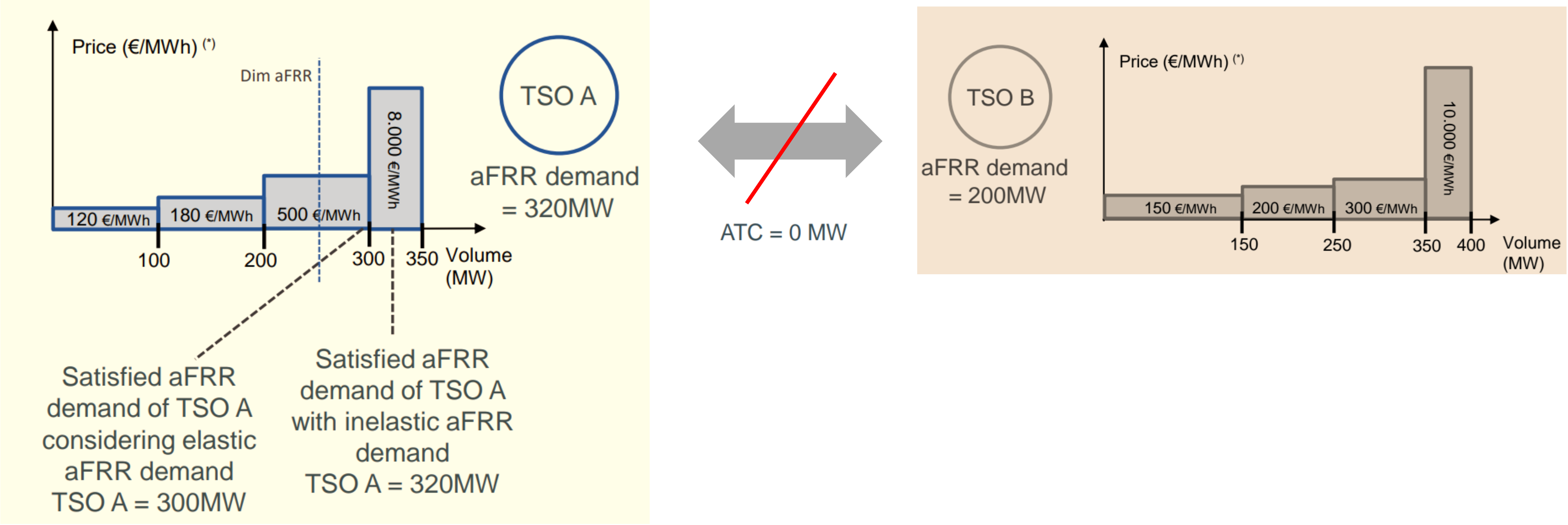
Total TSO aFRR demand

Overview

From the TSOs in operation, only ELIA applies the elastic demand

Further information on the central application can also be found in the public mathematical AOF description

Voluntary Elastic aFRR Demand Examples



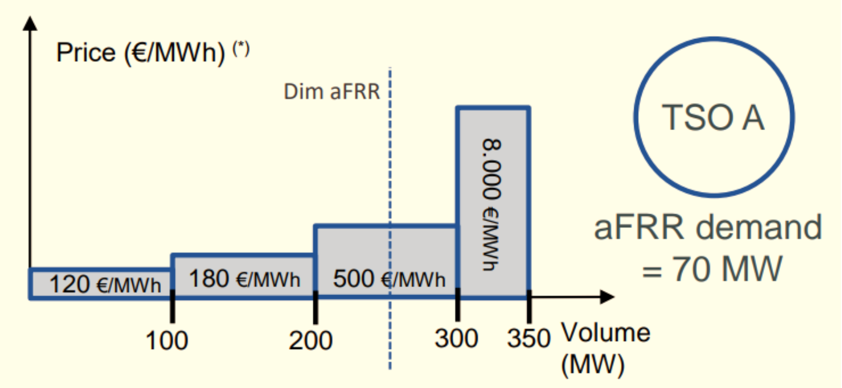
Example 1

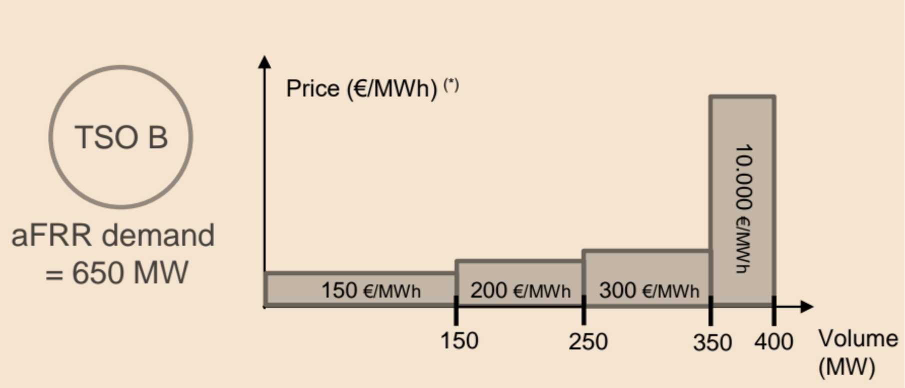
<u>Without elastic aFRR demand from TSO A</u>
CBMP for TSO A is 8000 €/MWh | Full demand satisfaction for TSO A

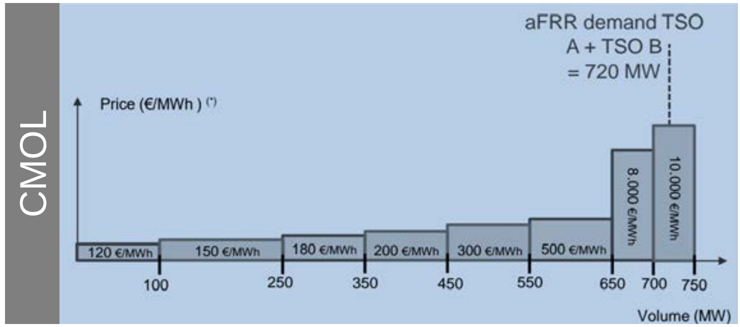
<u>With elastic aFRR demand from TSO A [threshold is 250 MW and 600 €/MWh]</u>
CBMP for TSO A is 500 €/MWh
TSO A needs to limit the output of the controller to aFRR bids ≤ CBMP to prevent automatic activation of the bid at 8.000 €/MWh
TSO A has an unsatisfied aFRR demand of 20 MW [320 MW – 300 MW]
TSO B is not impacted as there is no ATC available with TSO A

(*) Prices are not on scale

Voluntary Elastic aFRR Demand Examples







Example 1

<u>With elastic aFRR demand from TSO A [threshold is 250 MW and 600 €/MWh] and inelastic demand of TSO B</u>
The demand of TSO A is fully inelastic (70 MW is below the threshold of 250 MW)
The AOF selects all bids up to 720 MW to cover the inelastic demand of TSO B and of TSO A

AOF output: CBMP of 10.000 €/MWh and activation of the bids at the end of the LMOL of TSO A
[even though this TSO has defined an elastic demand]

In this case, elastic demand of TSO A has no impact on the CBMP of the uncongested area

(*) Prices are not on scale

1.	Project overview and progress	13:05 - 13:15 CET
2.	Business Processes	13:15 - 13:40 CET
3.	**Operational Reporting**	**13:40 - 13:50 CET**
4.	Questions and Answers	13:50 - 14:00 CET

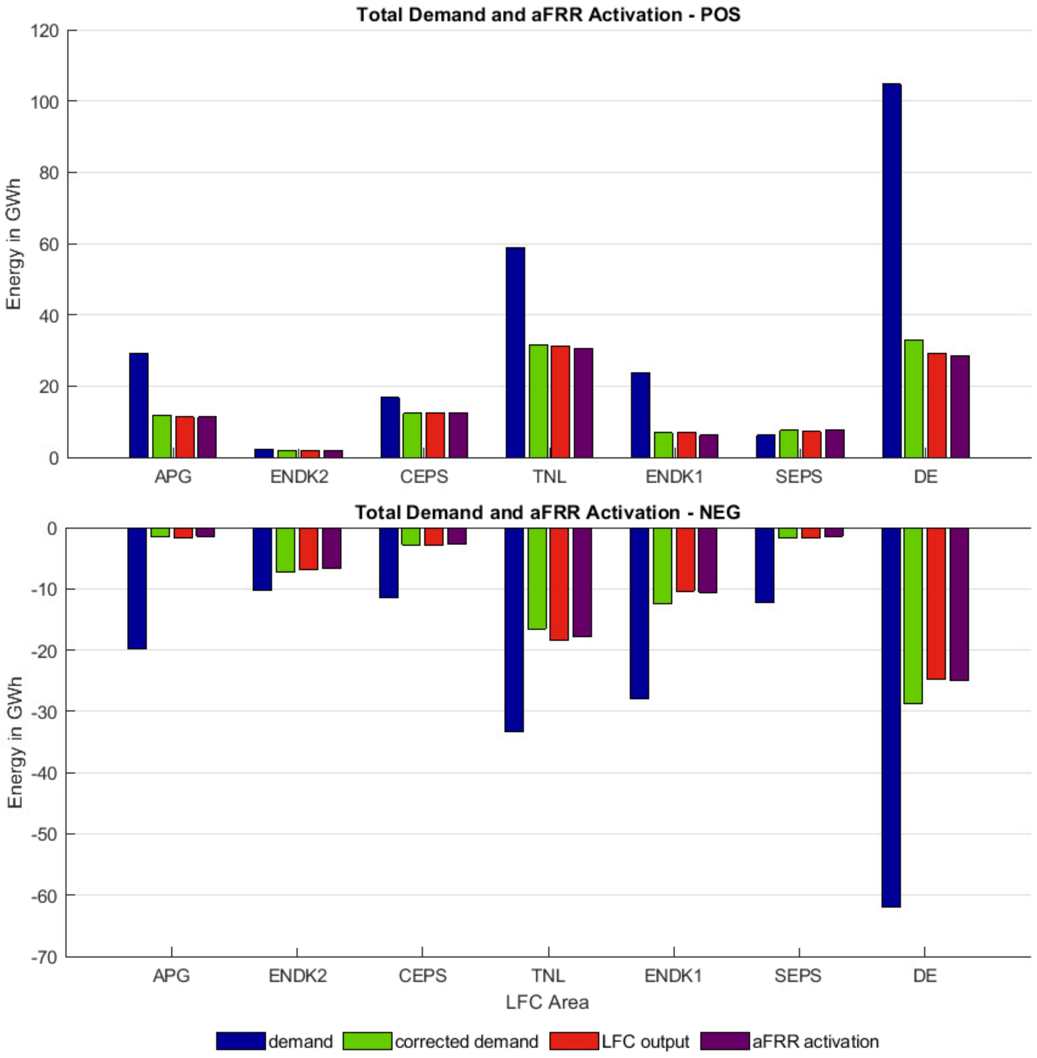
Platform operation – Demand and activation

- Graph shows the aggregated energy amounts for the 6 LFC areas and the German LFC-block covering a period in November (period from 2024/11/05 to 2024/11/25).

- 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 in some areas 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.



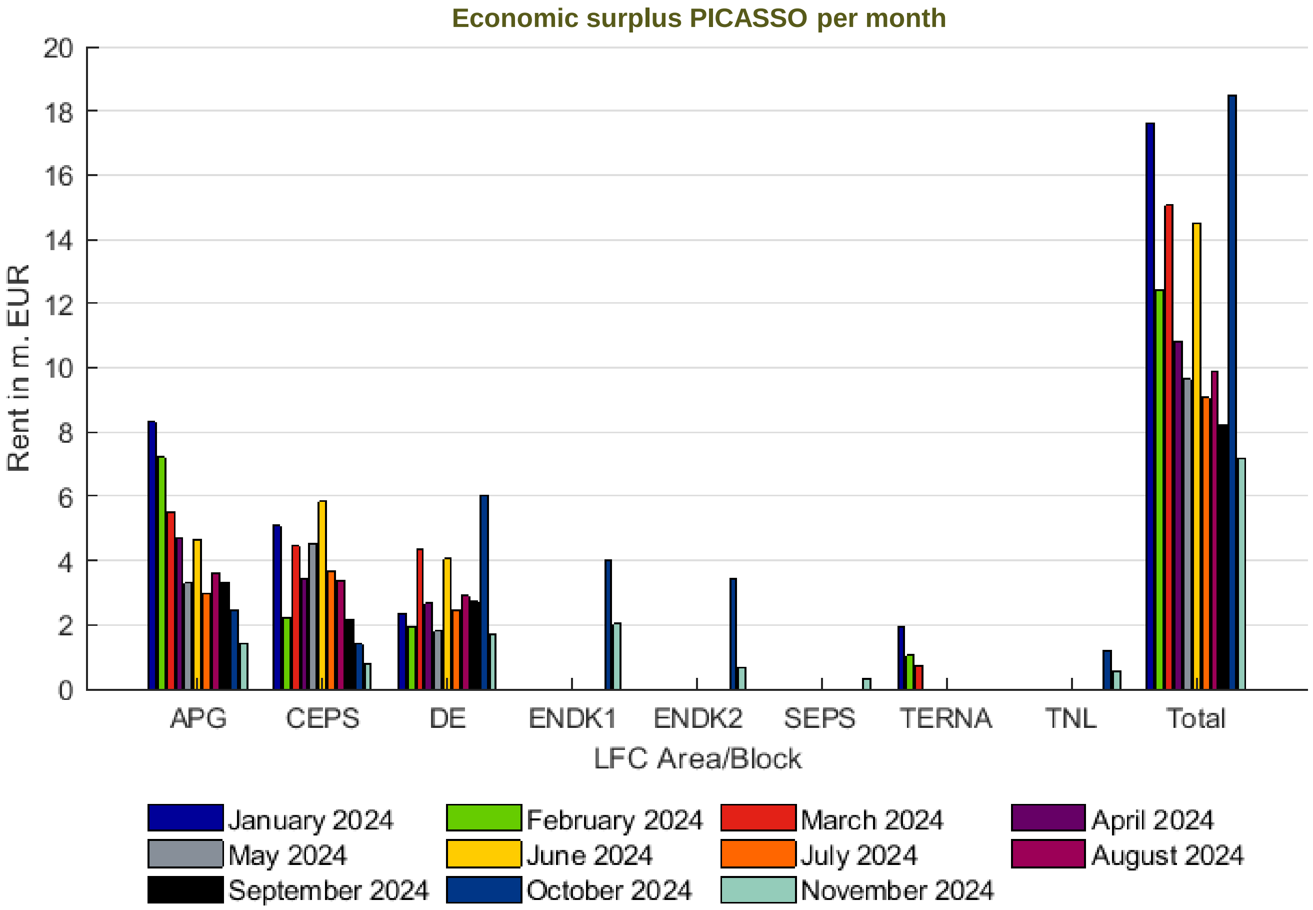
Economic surplus of PICASSO

- 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 year 2024 (January – 15. November) was around 132.8 Mio. €, without surplus from additional satisfaction of demand. Additional surplus of up to 588 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.

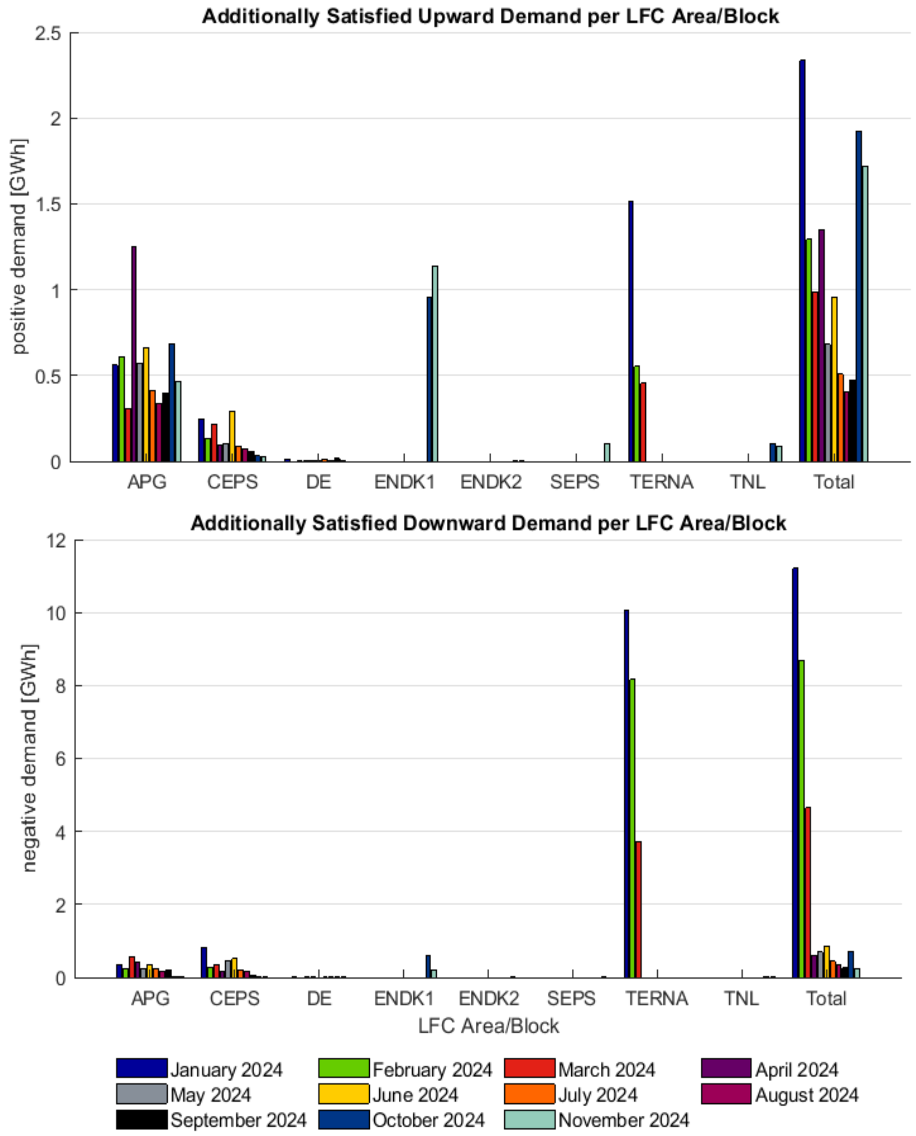


Additional demand satisfaction in PICASSO

- Since the PICASSO allow TSOs to access more aFRR balancing energy reserves than they've locally procured, it can lead to additional demand satisfaction through aFRR than would locally possible. Furthermore, it allows to activate more aFRR in relation to other products, which can benefit FRCE quality. Therefore, PICASSO improve the frequency quality, while decreasing system imbalances (FRCE) and contributing to the security of supply.

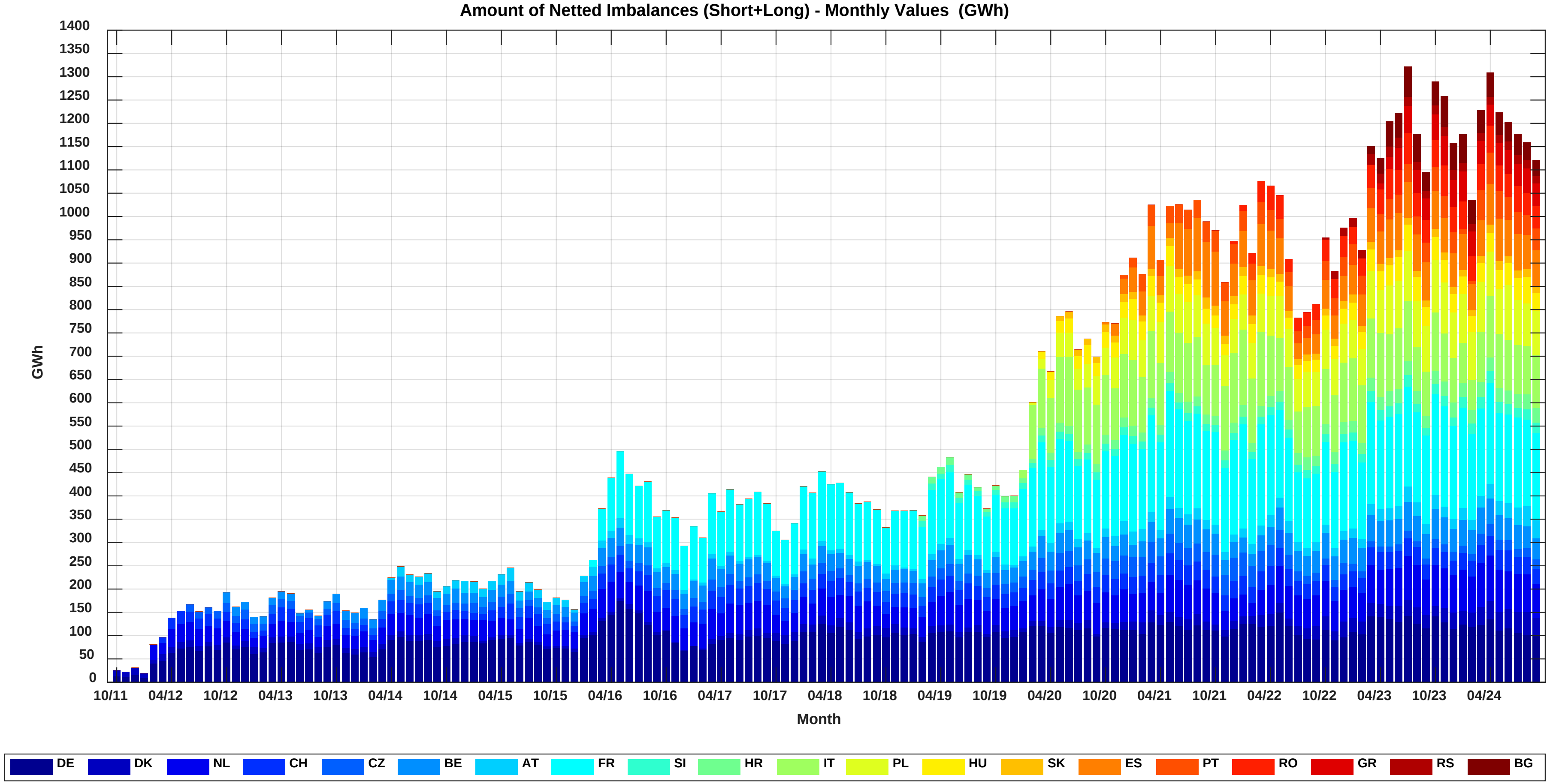
- The monetary value of the additionally satisfied demand has not been included in the economic surplus gains but is shown as explicit contribution to the security of supply in terms of energy.

- Each TSO is responsible for maintaining balance in his LFC area 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.



Amounts of netted imbalances in the IGCC

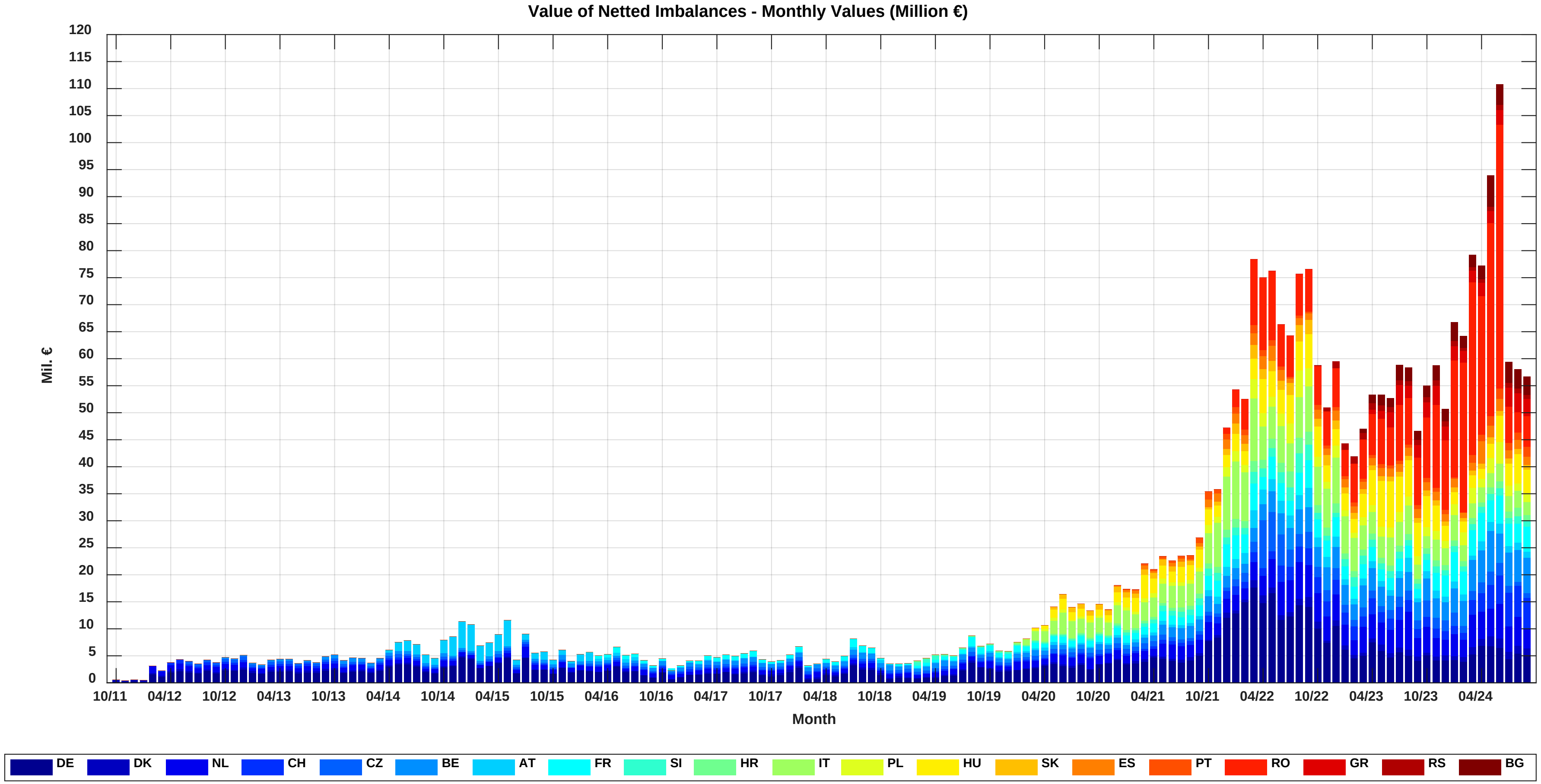
- Temporary drop of the IGCC netting in 2022 due to the initial PICASSO accessions
- After that, the IGCC netting reached a new all-time high of up to 1.3 TWh/month due to accession of remaining countries and increase of transmission capacitary after the end of the trial phase of new members
- Slight decrease of IGCC netting visible in 2024 as more implicit netting will be performed in PICASSO, this will most likely continue in 2025



Economic surplus of the IGCC

- Decrease of value netted imbalances in 2023 due to overall decrease of energy prices
- Increase in 2024 mainly driven by high imbalance settlement prices in Romania.

- Aggregated savings of the IGCC since its initiation:
  3142 Mio €

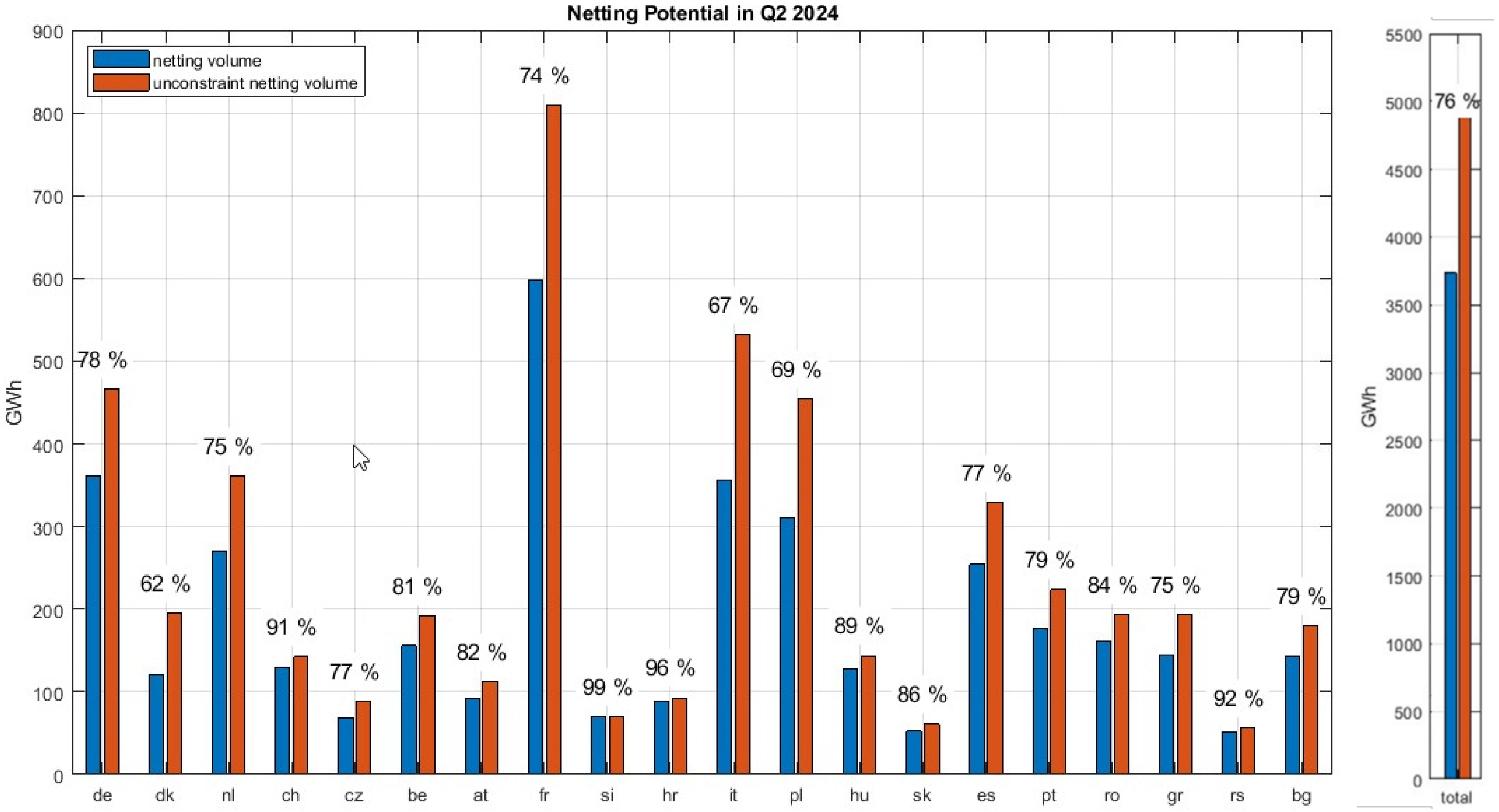


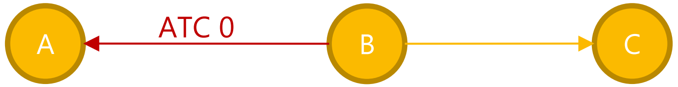
Imbalance Netting Energy Exchanges IGCC for Q2/2024

- The theoretical netting potential in Q1 2024 reached almost 4.9 TWh in total. 76 % 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)





Demand: 100 MW
unconstr. Netting: -50 MW
Netting: 0 MW

Demand: -100 MW
unconstr. Netting: 100 MW
Netting: 100 MW

Demand: 100 MW
unconstr. Netting: -50 MW
Netting: -100 MW

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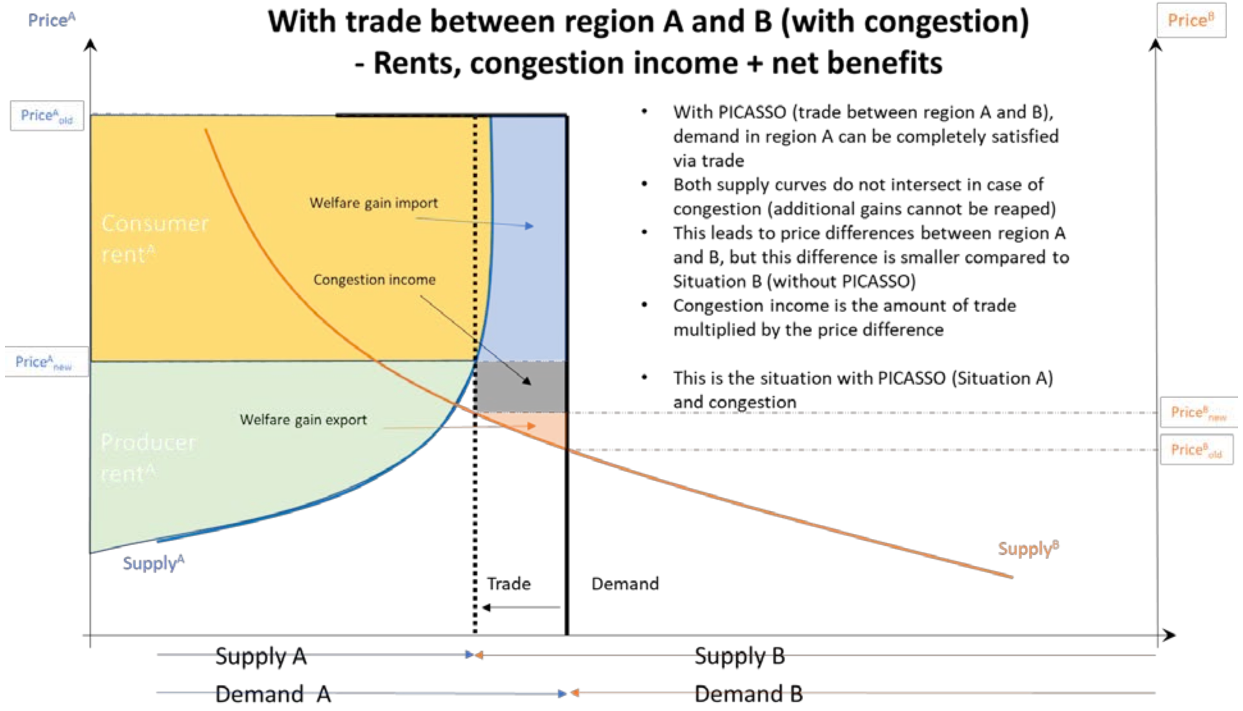
ANY QUESTIONS?

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 economic surplus. 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: ….

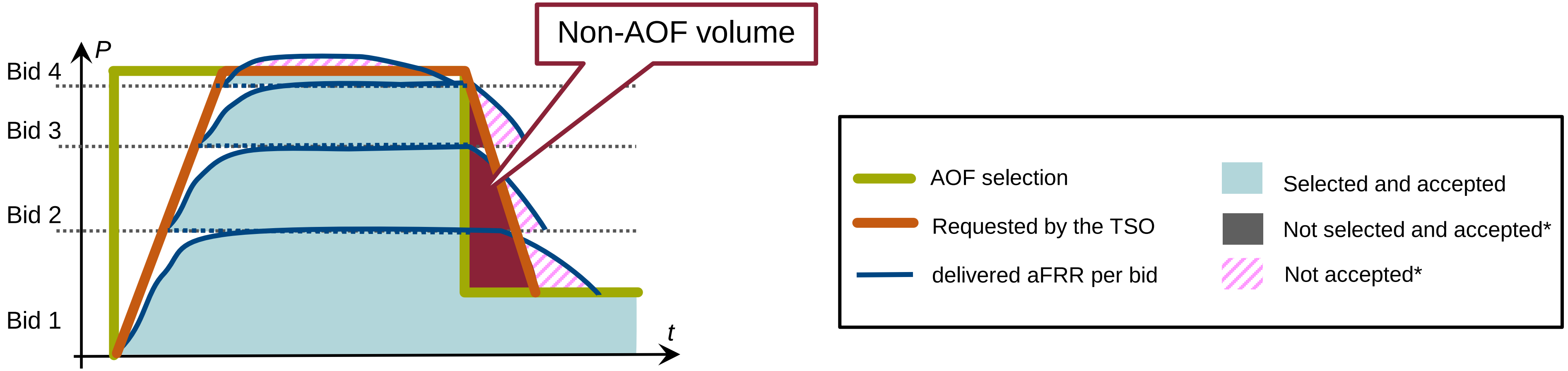


With trade between region A and B (with congestion)
- Rents, congestion income + net benefits

- With PICASSO (trade between region A and B), demand in region A can be completely satisfied via trade
- Both supply curves do not intersect in case of congestion (additional gains cannot be reaped)
- This leads to price differences between region A and B, but this difference is smaller compared to Situation B (without PICASSO)
- Congestion income is the amount of trade multiplied by the price difference
- This is the situation with PICASSO (Situation A) and congestion

Backup: PICASSO Pricing

- AOF bid selection vs BSP energy delivery



*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 behavior 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

Backup: List of the acronyms

Acronym	Meaning	Acronym	Meaning
AAC	Already Allocated Capacities	FRCE	Frequency Restoration Control Error
ACER	European Agency for the Cooperation of Energy Regulators	FRR	Frequency Restoration Reserve
aFRR	Automated Frequency Restoration Reserve	HVDC	High-Voltage, Direct Current
AOF	Activation Optimisation Function	IF	Implementation Framework
ATC	Available Transmission Capacity	IGCC	International Grid Control Cooperation
BSP	Balancing Service Provider	LFC	Load-Frequency Control
CBCL	Cross Border Capacity Limit	LMOL	Local Merit Order List
CBMP	Cross Border Marginal Price	MP	Marginal Price
CMOL	Common Merit Order List	NTC	Net Transfer Capacity
CZC	Cross Zonal Capacity	PICASSO	Platform for the Interntional Coordination of Automated Frequency Restoration and Stable System Operation
EBGL	Electricity Balancing Guideline	SCADA	Supervisory Control and Data Acquisition