

Quarterly Report Q4/2023 according to article 9(4) of the common methodology for the pricing of balancing energy and cross-border capacity

March 2024

From: ENTSO-E

ENTSO-E Mission Statement

Who we are

ENTSO-E, the European Network of Transmission System Operators for Electricity, is the association for the cooperation of the European transmission system operators (TSOs). The 39 member TSOs, representing 35 countries, are responsible for the secure and coordinated operation of Europe's electricity system, the largest interconnected electrical grid in the world. In addition to its core, historical role in technical cooperation, ENTSO-E is also the common voice of TSOs.

ENTSO-E brings together the unique expertise of TSOs for the benefit of European citizens by keeping the lights on, enabling the energy transition, and promoting the completion and optimal functioning of the internal electricity market, including via the fulfilment of the mandates given to ENTSO-E based on EU legislation.

Our mission

ENTSO-E and its members, as the European TSO community, fulfil a common mission: Ensuring the security of the inter-connected power system in all time frames at pan-European level and the optimal functioning and development of the European interconnected electricity markets, while enabling the integration of electricity generated from renewable energy sources and of emerging technologies.

Our vision

ENTSO-E plays a central role in enabling Europe to become the first climate-neutral continent by 2050 by creating a system that is secure, sustainable and affordable, and that integrates the expected amount of renewable energy, thereby offering an essential contribution to the European Green Deal. This endeavour requires sector integration and close cooperation among all actors.

Europe is moving towards a sustainable, digitalised, integrated and electrified energy system with a combination of centralised and distributed resources. ENTSO-E acts to ensure that this energy system keeps consumers at its centre and is operated and developed with climate objectives and social welfare in mind.

ENTSO-E is committed to use its unique expertise and system-wide view – supported by a responsibility to maintain the system's security – to deliver a comprehensive roadmap of how a climate-neutral Europe looks.

Our values

ENTSO-E acts in solidarity as a community of TSOs united by a shared responsibility.

As the professional association of independent and neutral regulated entities acting under a clear legal mandate, ENTSO-E serves the interests of society by optimising social welfare in its dimensions of safety, economy, environment, and performance.

ENTSO-E is committed to working with the highest technical rigour as well as developing sustainable and innovative responses to prepare for the future and overcoming the challenges of keeping the power system secure in a climate-neutral Europe. In all its activities, ENTSO-E acts with transparency and in a trustworthy dialogue with legislative and regulatory decision makers and stakeholders.

Our contributions

ENTSO-E supports the cooperation among its members at European and regional levels. Over the past decades, TSOs have undertaken initiatives to increase their cooperation in network planning, operation and market integration, thereby successfully contributing to meeting EU climate and energy targets.

To carry out its legally mandated tasks, ENTSO-E's key responsibilities include the following:

- › Development and implementation of standards, network codes, platforms and tools to ensure secure system and market operation as well as integration of renewable energy;
- › Assessment of the adequacy of the system in different timeframes;
- › Coordination of the planning and development of infrastructures at the European level (Ten-Year Network Development Plans, TYNDPs);
- › Coordination of research, development and innovation activities of TSOs;
- › Development of platforms to enable the transparent sharing of data with market participants.

ENTSO-E supports its members in the implementation and monitoring of the agreed common rules.

ENTSO-E is the common voice of European TSOs and provides expert contributions and a constructive view to energy debates to support policymakers in making informed decisions.

Table of Content

| | | |
|-----------|--|-----------|
| 1. | Background of the report | 4 |
| 2. | Scope of the report | 5 |
| 3. | Indicators of the balancing energy price formation | 5 |
| 3.1 | Monthly average values of used and available cross-zonal capacity for the exchange of balancing energy | 5 |
| 3.2 | Average percentage of submitted and activated standard balancing energy bids compared the upper (and lower) transitional price limit | 10 |
| 3.3 | Volume weighted average price of the most expensive balancing energy bids | 14 |
| 4. | Analysis of the price incidents | 18 |
| 4.1 | Analysis of the aFRR pricing spikes | 18 |
| 4.2 | Analysis of the mFRR pricing incidents | 23 |
| 4.3 | Analysis of the RR pricing incidents | 23 |
| | List of figures | 24 |
| | List of tables | 25 |
| | Annex – Calculation formulas for the PIs | 26 |

1. Background of the report

According to its decision 03/2022¹ published in February 2022², ACER has amended the methodology for pricing balancing energy and cross-zonal capacity used for the exchange of balancing energy or operating the imbalance netting process in accordance with Article 30(1) of Commission Regulation (EU) 2017/2195 establishing a guideline on electricity balancing ('Balancing Pricing Methodology' hereafter)³.

As a main element, article 9(3) of the amended Balancing Pricing Methodology introduces a transitory upper price limit of 15 000 EUR/MWh and a transitory lower price limit of – 15 000 EUR/MWh for the first 4 years of the European balancing platforms' operations, until July 2026.⁴ These price limits apply for the TSOs participating in the RR-Platform from 1 July 2022.

Furthermore, article 9(4) of the amended Balancing Pricing Methodology requires all TSOs to report to ACER and regulatory authorities on quarterly basis on the balancing energy price formation during the transitional period (see above). In particular, all TSOs have to submit the following indicators:

- a) monthly average values of used and available cross-zonal capacity for the exchange of balancing energy per each bidding zone border and direction;
- b) 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;
- c) 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;

In addition, it was agreed with ACER and regulatory authorities to include the analysis of the pricing incidents according to article 9(5) of the amended Balancing Pricing Methodology in the quarterly reports. By the present report, all TSOs fulfil the obligations according to article 9(4) of the amended Balancing Pricing Methodology.

¹ ACER decision 03/2022:

https://www.acer.europa.eu/sites/default/files/documents/Individual%20Decisions/ACER%20Decision%2003-2022%20on%20the%20Amendment%20to%20the%20Methodology%20for%20Pricing%20Balancing%20Energy_0.pdf

² Press release by ACER:

<https://www.acer.europa.eu/events-and-engagement/news/acer-has-decided-amendment-common-pricing-methodology-european>

³ Amendment of Balancing Pricing Methodology:

https://www.acer.europa.eu/sites/default/files/documents/Individual%20Decisions_annex/ACER%20Decision%2003-2022%20on%20the%20amendment%20of%20the%20pricing%20methodology%20-%20Annex%20I_0.pdf

⁴ If the harmonised 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 in accordance with subparagraph (a) shall automatically increase by the same amount. In this case, the transitional lower price limit shall be decreased to the same absolute value.

2. Scope of the report

This report covers the operational period from 1 October to 31 December 2023 for the European balancing platforms PICASSO, MARI, and TERRE in line with the requirements stipulated in the amended Pricing Methodology.

3. Indicators of the balancing energy price formation

3.1 Monthly average values of used and available cross-zonal capacity for the exchange of balancing energy

The monthly average values of used and available cross-zonal capacity (CZC) for the exchange of balancing energy are calculated for each balancing energy platform per bidding zone border in both directions. Please note that the calculation of monthly average values does not allow to draw specific conclusions about the availability of CZC in single MTUs. Please note also that the use of CZC from A to B does not distinguish between fulfilment of an upward balancing energy demand in B or fulfilment of a downward balancing energy demand in A.

| | |
|-----------------|---|
| Legal reference | Article 9(4) of the common methodology for the pricing of balancing energy and cross-border capacity |
| Data source | aFRR, mFRR and RR platforms |
| Calculation | <ol style="list-style-type: none"> 1. CZC available per BZ border and direction for the aFRR/mFRR/RR exchange 2. CZC used per BZ border and direction for the aFRR/mFRR/RR exchange |

1) PICASSO - Monthly average values of used and available CZC

| | October 2023 | | November 2023 | | December 2023 | |
|--------|---------------|----------|---------------|----------|---------------|----------|
| | Available CZC | Used CZC | Available CZC | Used CZC | Available CZC | Used CZC |
| DE->CZ | 393 | 19 | 569 | 19 | 345 | 7 |
| CZ->DE | 692 | 47 | 639 | 38 | 551 | 31 |
| DE->AT | 248 | 38 | 482 | 35 | 468 | 53 |
| AT->DE | 1494 | 64 | 1018 | 83 | 1673 | 65 |
| CZ->AT | 27 | 3 | 144 | 13 | 137 | 18 |
| AT->CZ | 73 | 6 | 100 | 16 | 171 | 26 |
| AT->IT | 10 | 3 | 43 | 16 | 92 | 29 |
| IT->AT | 46 | 15 | 218 | 69 | 286 | 60 |

Table 1: PICASSO – Monthly average values of used and available cross-zonal capacity for the exchange of aFRR [MW]

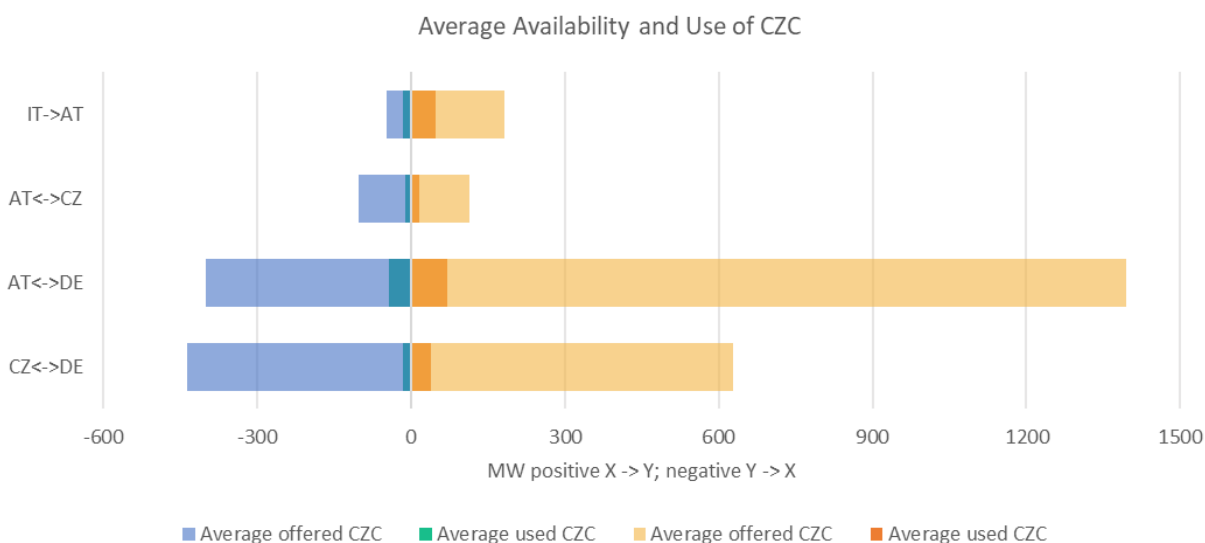


Figure 1: PICASSO – Average used and available cross-zonal capacity for the exchange of aFRR [MW]

2) MARI – Monthly average values of used and available CZC

| | October 2023 | | November 2023 | | December 2023 | |
|--------|---------------|----------|---------------|----------|---------------|----------|
| | Available CZC | Used CZC | Available CZC | Used CZC | Available CZC | Used CZC |
| CZ->DE | 701 | 0.1 | 616 | 0.2 | 554 | 0.1 |
| DE->CZ | 397 | 0.2 | 763 | 0 | 343 | 0 |
| CZ->AT | 15 | 0 | 91 | 0 | 130 | 0.1 |
| AT->CZ | 25 | 0 | 76 | 0 | 149 | 0.1 |
| AT->DE | 806 | 0.4 | 621 | 0.3 | 215 | 0.5 |
| DE->AT | 142 | 0 | 236 | 0 | 132 | 0.1 |

Table 2: MARI – Monthly average values of used and available cross-zonal capacity for the exchange of mFRR [MW]

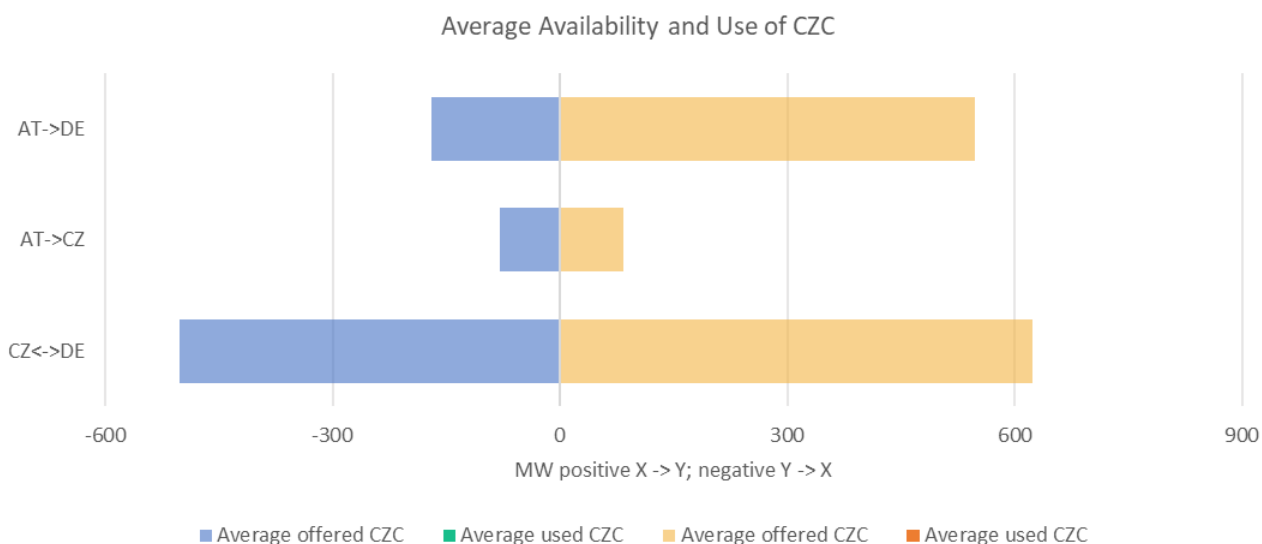


Figure 2: MARI – Average used and available cross-zonal capacity for the exchange of mFRR [MW]

3) TERRE - Monthly average values of used and available CZC

| | October 2023 | | November 2023 | | December 2023 | |
|--------|---------------|----------|---------------|----------|---------------|----------|
| | Available CZC | Used CZC | Available CZC | Used CZC | Available CZC | Used CZC |
| CH->IT | 85 | 5 | 159 | 7 | 243 | 6 |
| IT->CH | 3603 | 3 | 4879 | 8 | 3971 | 5 |
| ES->PT | 2555 | 108 | 3110 | 155 | 2469 | 136 |
| PT->ES | 3394 | 80 | 2482 | 47 | 3693 | 60 |
| CH->FR | 2464 | 25 | 3124 | 62 | 3682 | 75 |
| FR->CH | 232 | 9 | 371 | 15 | 437 | 13 |
| ES->FR | 311 | 29 | 142 | 27 | 276 | 35 |
| FR->ES | 259 | 14 | 422 | 20 | 280 | 15 |
| FR->IT | 38 | 2 | 230 | 8 | 425 | 54 |
| IT->FR | 2425 | 7 | 3197 | 12 | 3840 | 7 |

Table 3: TERRE – Monthly average values of used and available cross-zonal capacity for the exchange of RR [MW]

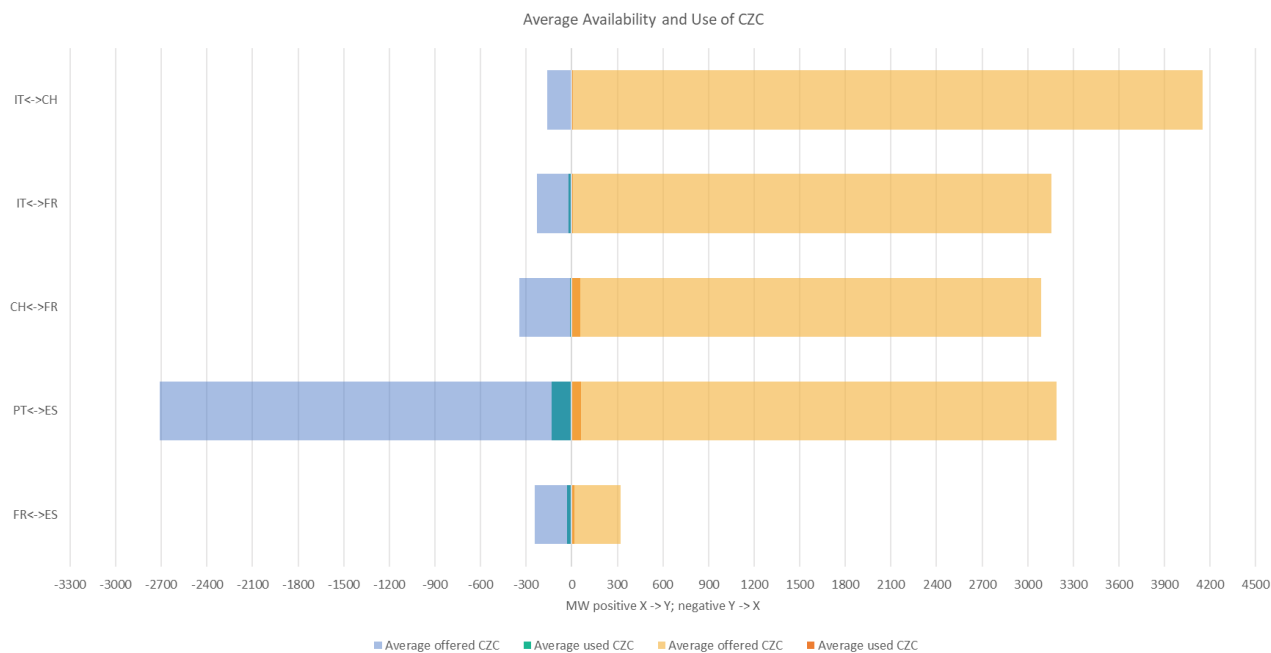


Figure 3: TERRE– Average used and available cross-zonal capacity for the exchange of RR [MW]

3.2 Average percentage of submitted and activated standard balancing energy bids compared the upper (and lower) transitional price limit

This PI calculates the average percentage of all submitted (CMOL) and selected standard balancing energy bids on a monthly basis. In total, 20 values are to be reported per platform: five values (50%, 75%, 90%, 95% and 99%) in upward and respectively in downward direction for a) submitted and b) selected balancing energy bids.

| | |
|-----------------|--|
| Legal reference | Article 9(4) of the common methodology for the pricing of balancing energy and cross-border capacity |
| Data source | aFRR, mFRR and RR platforms |
| Calculation | <ol style="list-style-type: none"> 1. Submitted upward balancing energy bids with prices higher than [50%, 75%, 90%, 95%, 99%] of the transitional price limit 2. Submitted downward balancing energy bids with prices lower than [50%, 75%, 90%, 95%, 99%] of the transitional price limit 3. Upward balancing energy with prices higher than [50%, 75%, 90%, 95%, 99%] of the transitional price limit 4. Downward balancing energy with prices lower than [50%, 75%, 90%, 95%, 99%] of the transitional price limit |

1) PICASSO – Average percentage of submitted aFRR bids with prices more expensive than 50%, 75%, 90%, 95% and 99% of the transitional price limit

| Threshold | Positive aFRR | | | | | Negative aFRR | | | | |
|---------------|---------------|------|------|------|------|---------------|------|------|------|------|
| | 50% | 75% | 90% | 95% | 99% | 50% | 75% | 90% | 95% | 99% |
| October 2023 | 6.3% | 4.4% | 4.2% | 4.1% | 4.0% | 6.8% | 5.6% | 5.3% | 5.3% | 5.0% |
| November 2023 | 5.9% | 3.7% | 3.4% | 3.3% | 3.3% | 5.9% | 4.7% | 4.4% | 4.2% | 4.1% |
| December 2023 | 5.6% | 3.9% | 3.7% | 3.7% | 3.7% | 5.9% | 4.4% | 4.0% | 3.9% | 3.8% |

Table 4: PICASSO – Average percentage of submitted bids over certain price limits

2) PICASSO – Average percentage of selected aFRR bids with prices more expensive than 50%, 75%, 90%, 95% and 99% of the transitional price limit

| Threshold | Positive aFRR | | | | | Negative aFRR | | | | |
|---------------|---------------|--------|--------|--------|--------|---------------|-------|-------|-------|-------|
| | 50% | 75% | 90% | 95% | 99% | 50% | 75% | 90% | 95% | 99% |
| October 2023 | 0.032% | 0.018% | 0.012% | 0.008% | 0.006% | 0.01% | 0.01% | 0.01% | 0.01% | 0.01% |
| November 2023 | 0.025% | 0.009% | 0.007% | 0.007% | 0.007% | 0.03% | 0.02% | 0.02% | 0.02% | 0.02% |
| December 2023 | 0.043% | 0.033% | 0.033% | 0.033% | 0.033% | 0.01% | - | - | - | - |

Table 5: PICASSO – Average percentage of selected bids over certain price limits

3) MARI – Average percentage of submitted mFRR bids with prices more expensive than 50%, 75%, 90%, 95% and 99% of the transitional price limit

| Threshold | Positive mFRR | | | | | Negative mFRR | | | | |
|---------------|---------------|-------|------|------|------|---------------|-------|------|------|------|
| | 50% | 75% | 90% | 95% | 99% | 50% | 75% | 90% | 95% | 99% |
| October 2023 | 13.8% | 7.8% | 4.9% | 4.1% | 3.7% | 10.2% | 6.4% | 4.3% | 3.4% | 2.3% |
| November 2023 | 16.6% | 8.6% | 5.8% | 5.0% | 0.5% | 17.0% | 9.4% | 5.5% | 4.3% | 2.9% |
| December 2023 | 21.1% | 11.5% | 8.3% | 7.7% | 7.3% | 19.4% | 11.5% | 7.1% | 5.7% | 4.1% |

Table 6: MARI – Average percentage of submitted bids over certain price limits

4) MARI – Average percentage of selected mFRR bids with prices more expensive than 50%, 75%, 90%, 95% and 99% of the transitional price limit

| Threshold | Positive mFRR | | | | | Negative mFRR | | | | |
|---------------|---------------|-----|-----|-----|-----|---------------|-----|-----|-----|-----|
| | 50% | 75% | 90% | 95% | 99% | 50% | 75% | 90% | 95% | 99% |
| October 2023 | - | - | - | - | - | - | - | - | - | - |
| November 2023 | - | - | - | - | - | - | - | - | - | - |
| December 2023 | - | - | - | - | - | - | - | - | - | - |

Table 7: MARI – Average percentage of selected bids over certain price limits

5) TERRE – Average percentage of submitted RR bids with prices more expensive than 50%, 75%, 90%, 95% and 99% of the transitional price limit

| Threshold | Positive RR | | | | | Negative RR | | | | |
|---------------|-------------|------|------|------|------|-------------|------|------|------|------|
| | 50% | 75% | 90% | 95% | 99% | 50% | 75% | 90% | 95% | 99% |
| October 2023 | 1.5% | 0.9% | 0.5% | 0.3% | 0.1% | 0.8% | 0.6% | 0.6% | 0.2% | 0.2% |
| November 2023 | 1.3% | 1.1% | 1.0% | 0.9% | 0.9% | 2.0% | 1.8% | 1.8% | 1.7% | 1.6% |
| December 2023 | 1.1% | 1.0% | 1.0% | 1.0% | 0.8% | 0.8% | 0.7% | 0.7% | 0.7% | 0.7% |

Table 8: TERRE – Average percentage of submitted bids over certain price limits

6) TERRE – Average percentage of selected RR bids with prices more expensive than 50%, 75%, 90%, 95% and 99% of the transitional price limit

| Threshold | Positive RR | | | | | Negative RR | | | | |
|---------------|-------------|-----|-----|-----|-----|-------------|-----|-----|-----|-----|
| | 50% | 75% | 90% | 95% | 99% | 50% | 75% | 90% | 95% | 99% |
| October 2023 | - | - | - | - | - | - | - | - | - | - |
| November 2023 | - | - | - | - | - | - | - | - | - | - |
| December 2023 | - | - | - | - | - | - | - | - | - | - |

Table 9: TERRE – Average percentage of selected bids over certain price limits

3.3 Volume weighted average price of the most expensive balancing energy bids

The VWAP of the last 5% of the submitted bids per platform, per direction and per participating TSO is calculated on a monthly basis. Each balancing platform provides two values per connected TSO, one for upward and one for downward direction.

| | |
|-----------------|--|
| Legal reference | Article 9(4) of the common methodology for the pricing of balancing energy and cross-border capacity |
| Data source | aFRR, mFRR and RR platforms |
| Calculation | <ol style="list-style-type: none"> VWAP of the last 5% of the upward balancing energy bids submitted per TSO connected to the platform VWAP of the last 5% of the downward balancing energy bids submitted per TSO connected to the platform |

1) PICASSO – VWAP of the 5% most expensive aFRR bids submitted

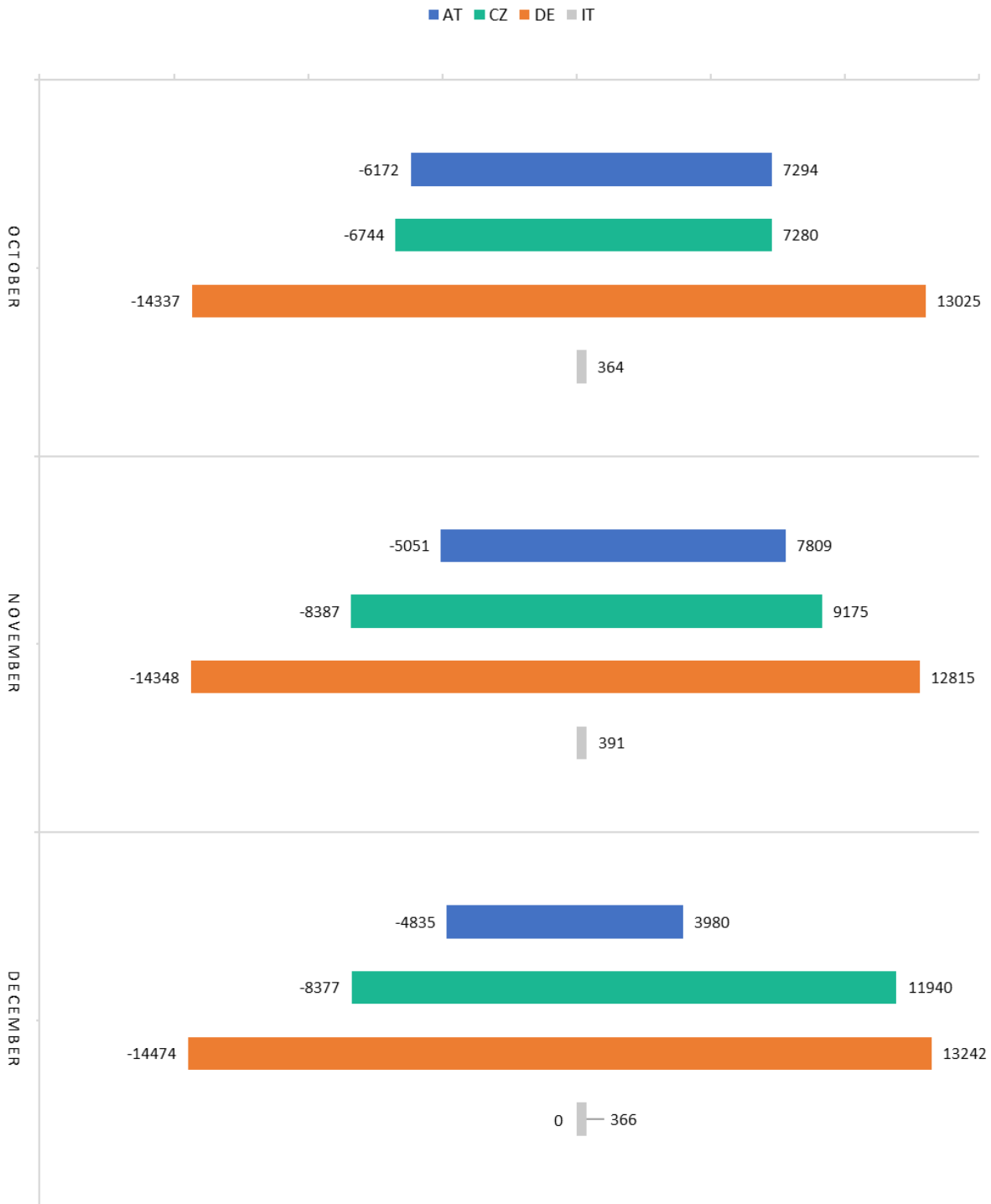


Figure 4: PICASSO - VWAP of the 5% most expensive aFRR bids submitted [EUR/MWh] per country

2) MARI – VWAP of the 5% most expensive mFRR bids submitted

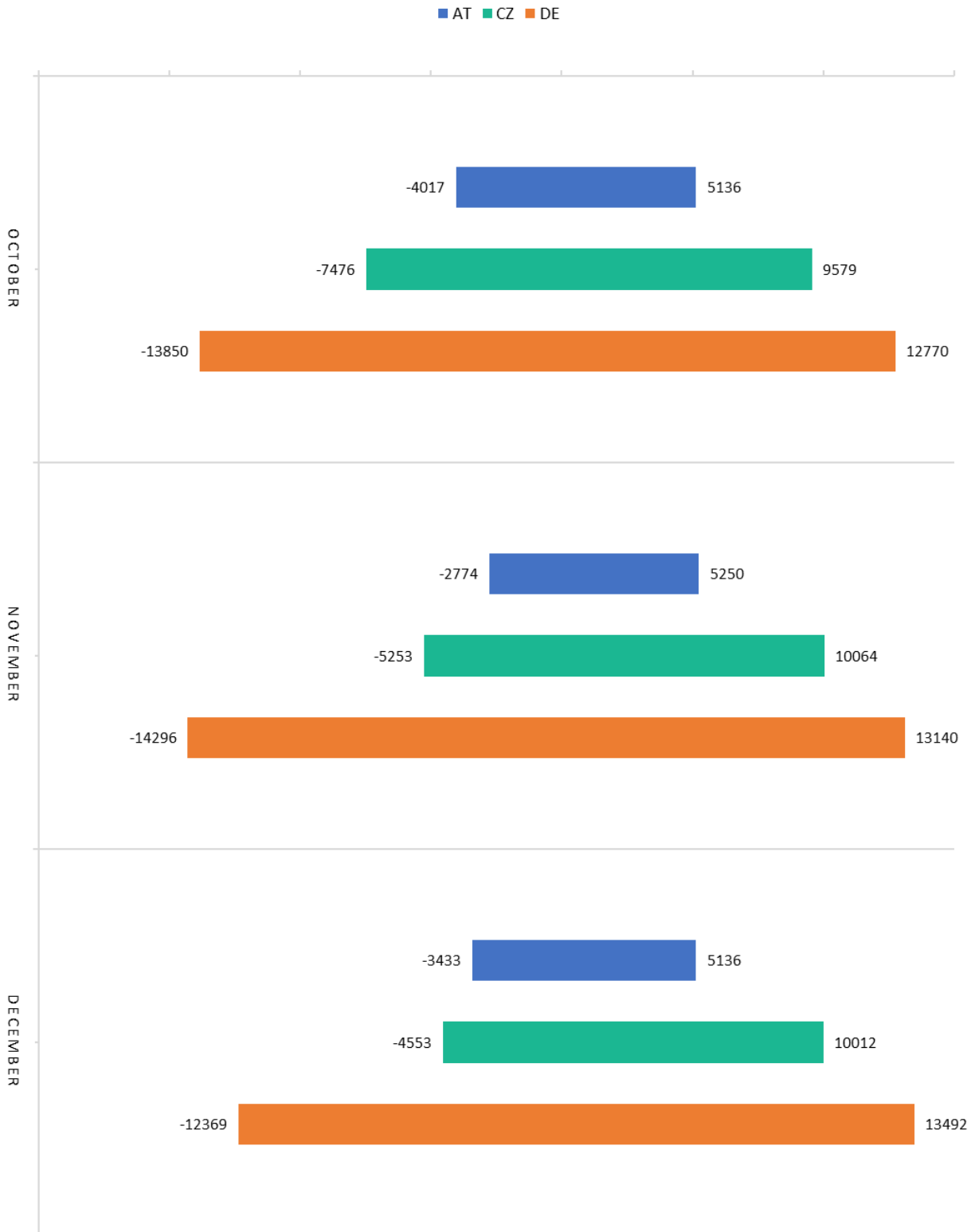


Figure 5: MARI - VWAP of the 5% most expensive mFRR bids submitted [EUR/MWh] per country

3) TERRE – VWAP of the 5% most expensive RR bids submitted

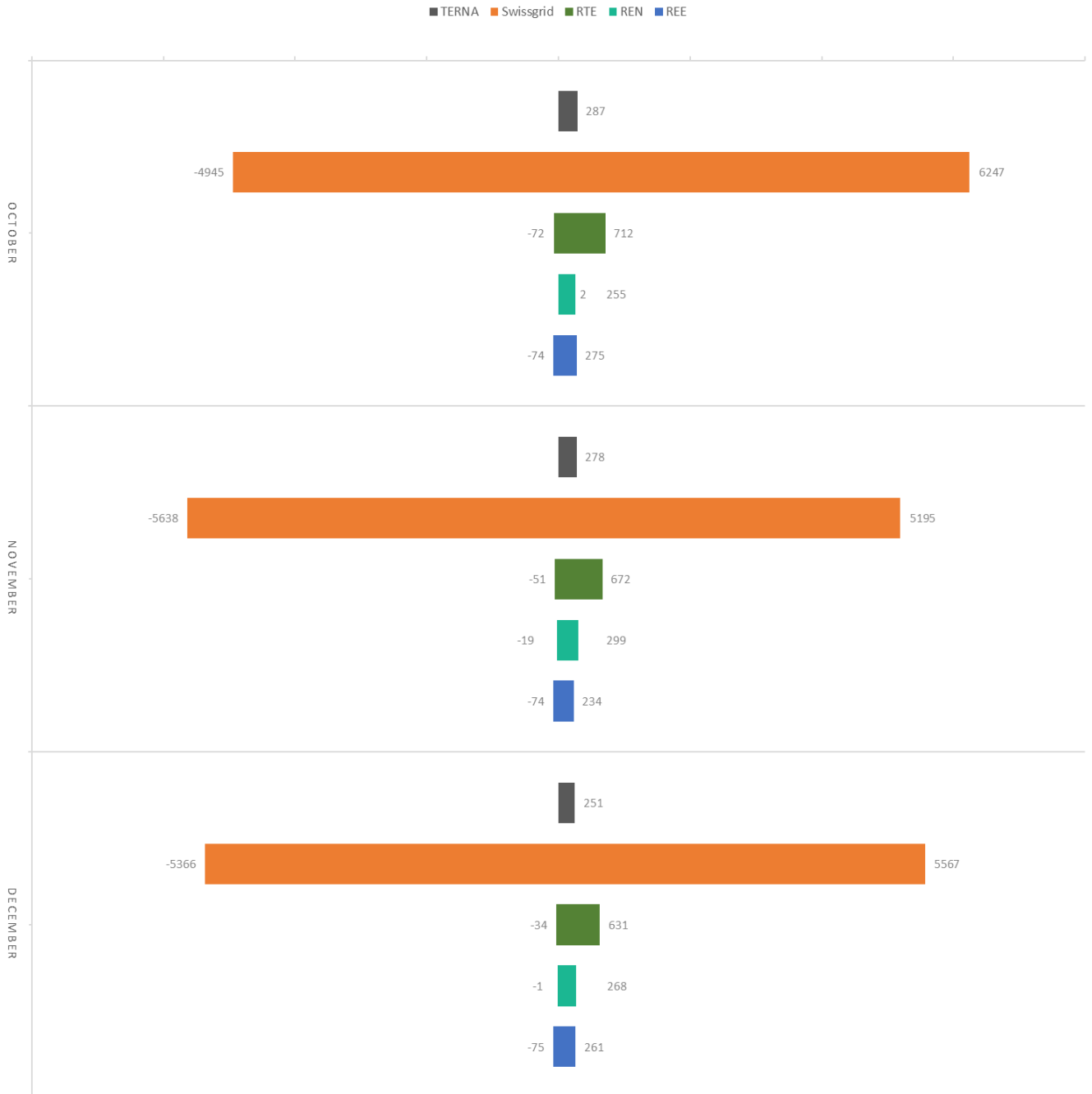


Figure 6: TERRE - VWAP of the 5% most expensive RR bids submitted [EUR/MWh] per country

4. Analysis of the price incidents

In accordance with Article 9(3) of the amended Balancing Pricing Methodology, all TSOs have to prepare a joint report whenever the CBMP reaches at least 50% of the minimum or maximum transitional price limit. Such a price incident is triggered whenever the threshold has been reached in at least one MTU (referred to as “event”). All events within one 15-min period are grouped into one incident if they cover the same uncongested area. For TERRE and MARI this equals one market-time unit (MTU). For PICASSO several events can take place within one 15-min incident period as the MTU equals 4 sec (i.e., an incident in PICASSO can be of duration from 4 sec to 15 min). All TSOs chose this approach for PICASSO as the bid structure and therefore the CMOL remain the same for the 15-min period.

4.1 Analysis of the aFRR pricing spikes

In total 415 price incidents occurred between 1 September and 31 December 2023 in the aFRR market, 178 in positive direction and 237 in negative direction. This represents an increase by 51 % of price incidents compared to the the previous quarter.

1. Majority of incidents occur in negative direction

Similar to the distribution of price incidents during past quarters, majority of the aFRR incidents in Q4 2023, i.e., 57 %, occurred in negative direction. However, the share of incidents in positive direction increased to 43 % while it reached only 28%, 21% and 25% in Q1-3 of 2023.

2. Involvement of Czech Republic in price incidents reaches almost 80% in Q4 2023

At the beginning of platform operation, majority of incidents have occurred with Austria forming part of the affected uncongested area. This number decreased to 25% in Q4 2023. Figure 8 shows that total numbers for Austria remain at the same level given the total increase of price incidents over the operational period. Czech Republic is currently undergoing the opposite development. While at the beginning of platform operation, Czechia was not often affected by an incident, in Q4 2023, the country was part in 79% of all price incidents and formed the uncongested area alone in 74% of all cases. Germany was involved in 3% of all incidents in Q4 which also is a significant decrease compared to the previous quarters. Italy was affected by 13% but never formed a single country uncongested area.

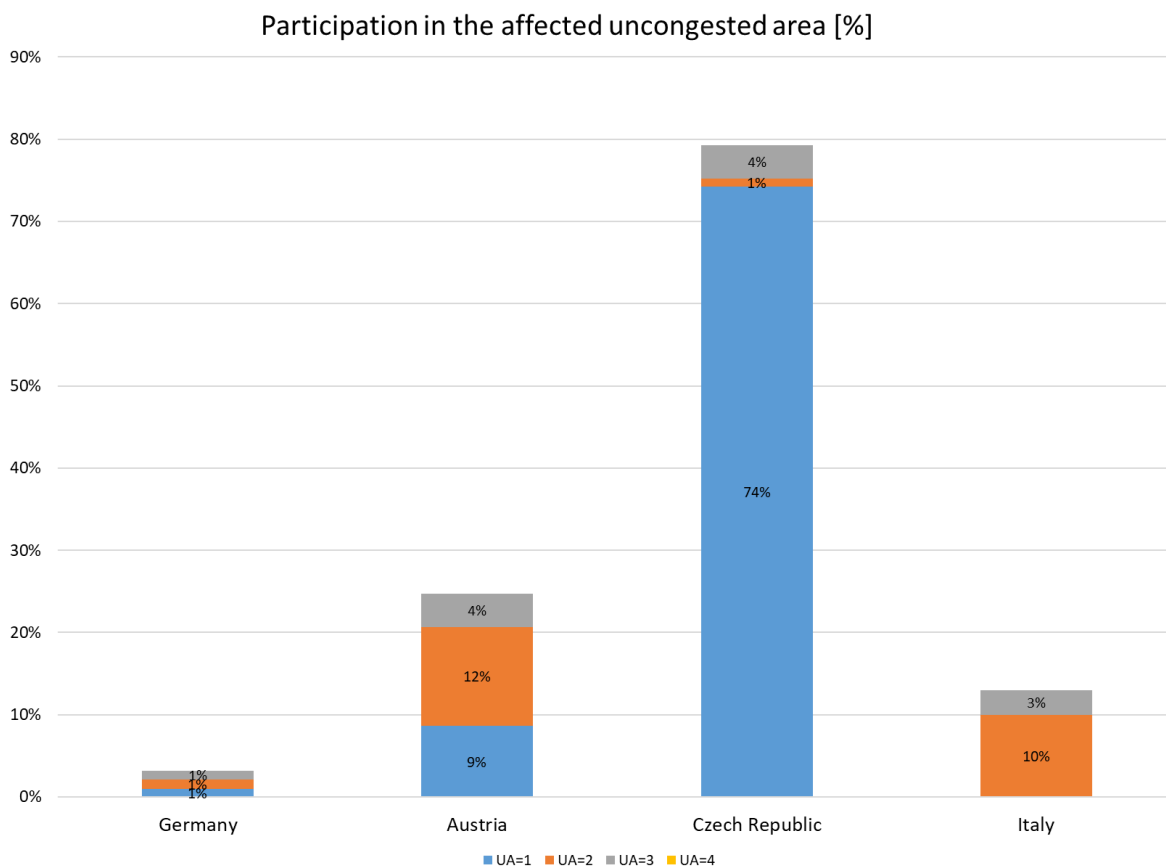


Figure 7: Country participation in the uncongested area affected by an aFRR price incident⁵

⁵ UA =1: one country forms the uncongested area; UA =2: two countries form the uncongested area; etc.

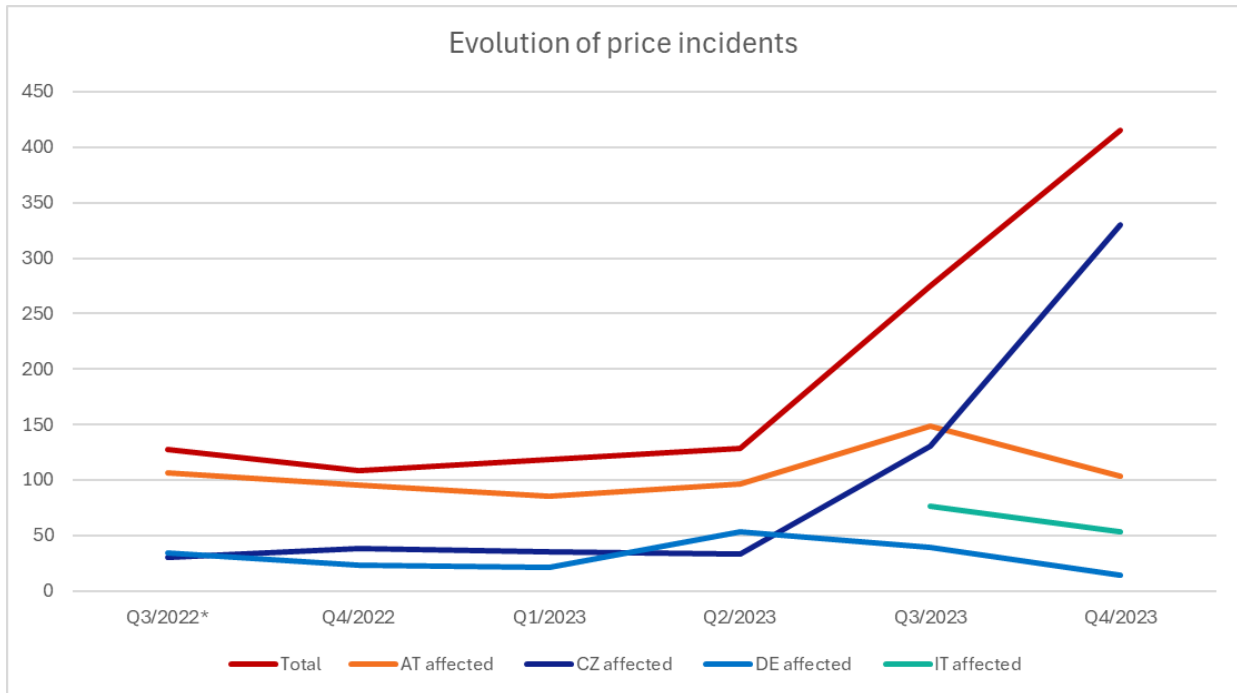


Figure 8: Evolution of price incidents since PICASSO go-live (*Q3 here covers the period from 22/06 to 30/09)

3. Incidents are largely triggered at a CBMP below the 15 000 EUR/MWh price cap

Majority of the price incidents occur at a CBMP below/above the temporary price cap of +/- 15 000 EUR/MWh. This has been the case since go live of the PICASSO platform. Only 9 out of the 415 price incidents in Q4 reached the maximum/minimum possible clearing price. Majority of the remaining incidents are triggered up to 10 000 EUR/MWh in both directions. By looking at the graphs below it stands out that in December almost all price incidents in positive direction occur at the same CBMPs of 12 194, 12 195 and 12 196 EUR/MWh originating in the Czech market area.

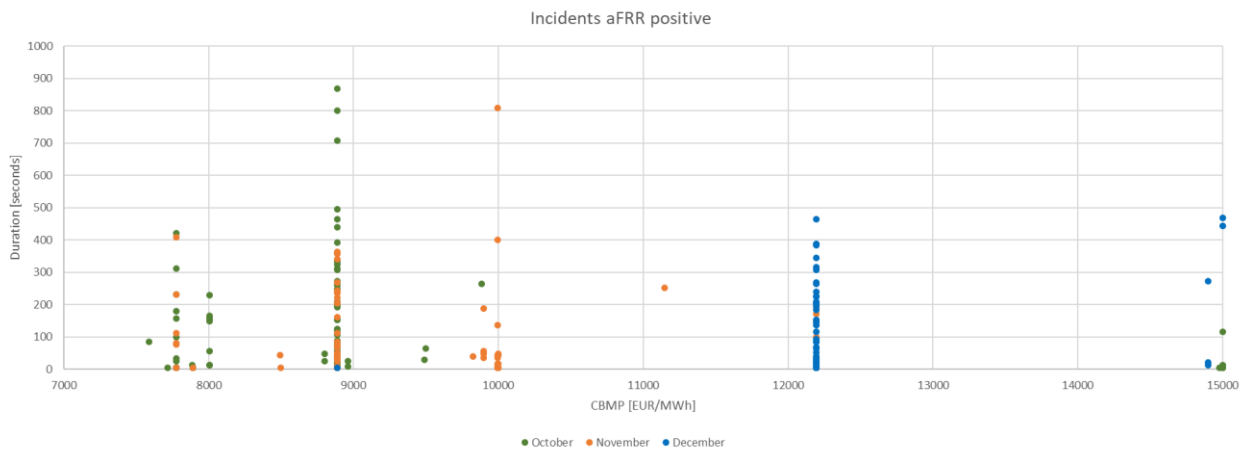


Figure 9: Duration and CBMP of aFRR positive price incidents

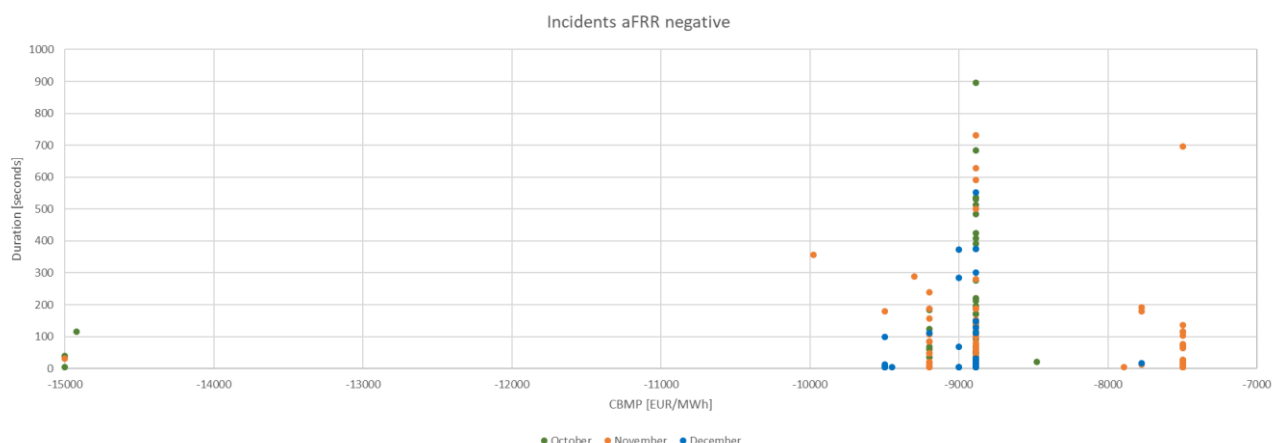


Figure 10: Duration and CBMP of aFRR negative price incidents

4. BSPs remain with pivotal position

The overall market concentration level for the aFRR price incidents remains stable with most incidents occurring with a low to medium market concentration. A slightly higher concentrated market can be observed for positive clearing prices (Figure 11). The pivotality of BSPs remains very high with only one price incidents out of the 415 in which no pivotal BSP was involved (Figure 12). This is an issue that has been observed since the beginning of platform operation and as highlighted before, will probably not change with more TSOs joining the platforms as local BSP structure will not change and there will always be moments when local markets are isolated due to non-available ATCs or moments when low or no amounts of non-contracted balancing energy bids are submitted. The accession of Italy to the PICASSO platform had no significant impact on the RSI distribution so far.

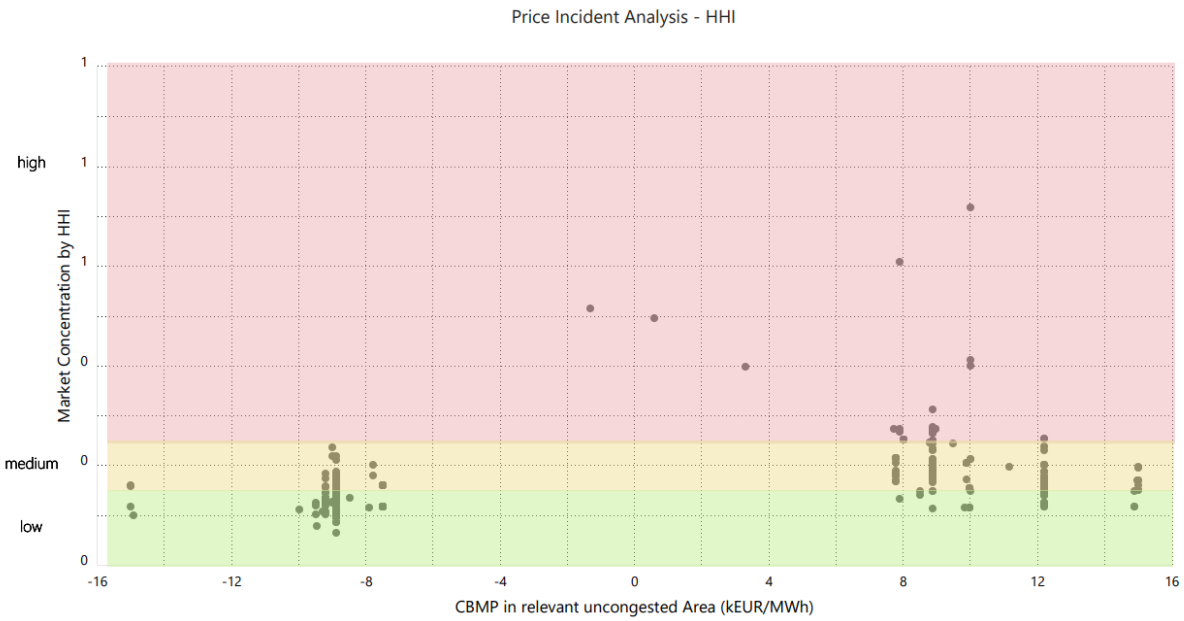


Figure 11: aFRR price incident analysis – HHI

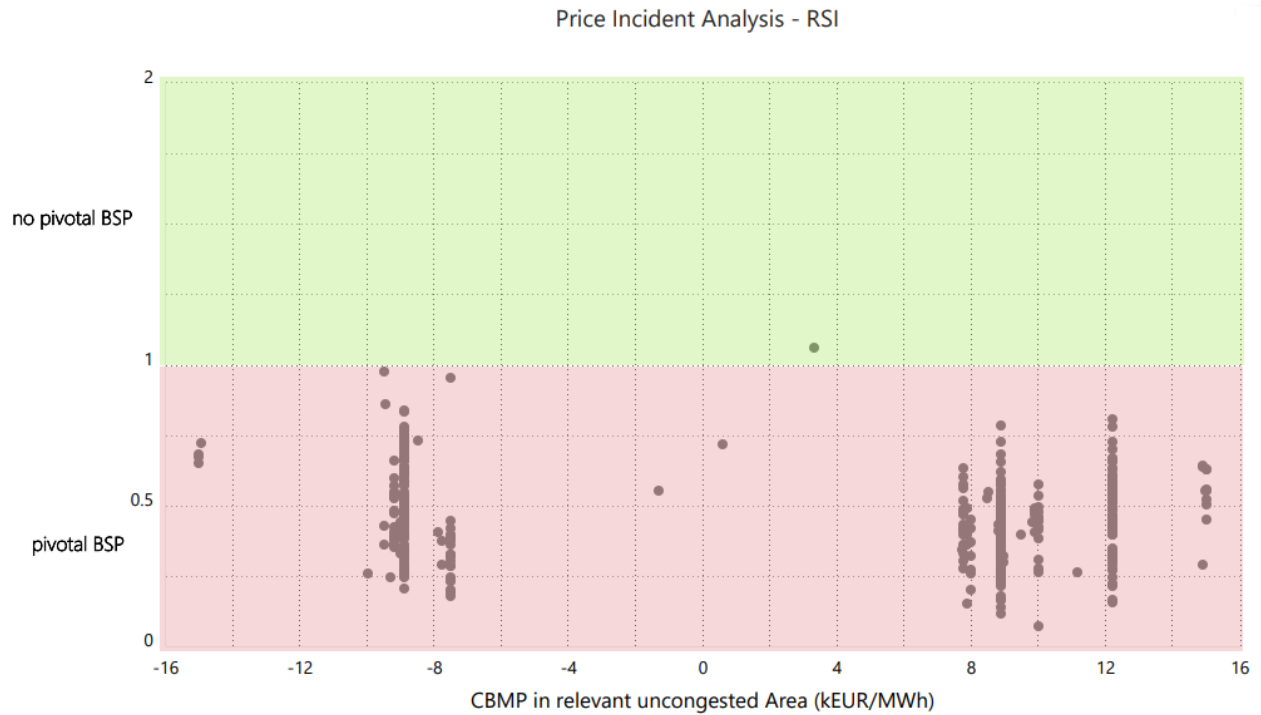


Figure 12: aFRR price incident analysis - RSI

4.2 Analysis of the mFRR pricing incidents

No mFRR incidents according to article 9(5) of the amended Balancing Pricing Methodology occurred in Q4 2023.

4.3 Analysis of the RR pricing incidents

No RR incidents according to article 9(5) of the amended Balancing Pricing Methodology occurred in Q4 2023.

List of figures

| | |
|---|----|
| Figure 1: PICASSO – Average used and available cross-zonal capacity for the exchange of aFRR [MW] | 6 |
| Figure 2: MARI – Average used and available cross-zonal capacity for the exchange of mFRR [MW] | 7 |
| Figure 3: TERRE– Average used and available cross-zonal capacity for the exchange of RR [MW]..... | 9 |
| Figure 4: PICASSO - VWAP of the 5% most expensive aFRR bids submitted [EUR/MWh] per country | 15 |
| Figure 5: MARI - VWAP of the 5% most expensive mFRR bids submitted [EUR/MWh] per country | 16 |
| Figure 6: TERRE - VWAP of the 5% most expensive RR bids submitted [EUR/MWh] per country | 17 |
| Figure 7: Country participation in the uncongested area affected by an aFRR price incident | 19 |
| Figure 8: Evolution of price incidents since PICASSO go-live..... | 20 |
| Figure 9: Duration and CBMP of aFRR positive price incidents | 20 |
| Figure 10: Duration and CBMP of aFRR negative price incidents | 21 |
| Figure 11: aFRR price incident analysis – HHI..... | 22 |
| Figure 12: aFRR price incident analysis - RSI..... | 22 |

List of tables

| | |
|---|----|
| Table 1: PICASSO – Monthly average values of used and available CZC for the exchange of aFRR [MW] | 6 |
| Table 2: MARI – Monthly average values of used and available CZC for the exchange of mFRR [MW] | 7 |
| Table 3: TERRE – Monthly average values of used and available CZC for the exchange of RR [MW] | 8 |
| Table 4: PICASSO – Average percentage of submitted bids over certain price limits | 11 |
| Table 5: PICASSO – Average percentage of selected bids over certain price limits | 11 |
| Table 6: MARI – Average percentage of submitted bids over certain price limits | 12 |
| Table 7: MARI – Average percentage of selected bids over certain price limits | 12 |
| Table 8: TERRE – Average percentage of submitted bids over certain price limits | 13 |
| Table 9: TERRE – Average percentage of selected bids over certain price limits | 13 |

Annex – Calculation formulas for the PIs

1. Monthly average values of used and available cross-zonal capacity for the exchange of balancing energy

| | |
|-------------------|---|
| Definition | Monthly average values per MTU to be calculated for each balancing energy platform per each BZ border in both directions. Each balancing energy platform needs to report four values per BZ border: the CZC initially available per border and per direction and the CZC used per border and per direction. |
|-------------------|---|

Legal reference Article 9(4) of the amended pricing methodology

| | |
|-----------------------|--------------------------------|
| Time reference | Monthly average values per MTU |
|-----------------------|--------------------------------|

Data source TERRE, MARI, PICASSO

The data will be collected directly from the platforms in a ready-for-reporting format.

| | |
|--------------------|---|
| Calculation | <p>Available CZC for BZ border_{ij} [MW] (one indicator per direction)</p> $= \frac{\sum_{MTU} \text{Volume of initial (import/export) CZC available on BZ border}_{ij} \text{ for RR/mFRR/aFRR}}{\text{Market Time Units per month}}$ <p>where BZ border_{ij} represents the border of BZ_i and BZ_j of all bidding zones connected to the RR/mFRR/aFRR platform</p> <p>Used CZC for BZ border_{ij} [MW] (one indicator per direction)</p> $= \frac{\sum_{MTU} \text{Volume of initial (import/export) CZC available on BZ border}_{ij} \text{ for RR/mFRR/aFRR}}{\text{Market Time Units per month}}$ $- \frac{\sum_{MTU} \text{Volume of residual (import/export) CZC available on BZ border}_{ij} \text{ for RR/mFRR/aFRR}}{\text{Market Time Units per month}}$ <p>where BZ border_{ij} represents the border of BZ_i and BZ_j of all bidding zones connected to the RR/mFRR/aFRR platform</p> |
|--------------------|---|

2. Average percentage of submitted and activated standard balancing energy bids compared the upper (and lower) transitional price limit

| | |
|------------------------|--|
| Definition | The average percentage of the submitted and selected standard balancing energy bids are calculated on a monthly basis. For each balancing energy platform 20 values are collected, 5 values (50%, 75%, 90%, 95% and 99%) in upward and respectively in downward direction for a) submitted and b) selected balancing energy bids. |
| Legal reference | Article 9(4) of the amended pricing methodology |
| Time reference | Monthly average values per MTU |
| Data source | <p>TERRE, MARI, PICASSO</p> <p>The data will be collected directly from the platforms in a ready-for-reporting format.</p> |
| Calculation | <p>Submitted upward balancing energy bids with prices higher than x% of the upper price limit [%]</p> $= \frac{\sum_{MTU} \text{volume of submitted upward RR/mFRR/aFRR bids}_j \text{ higher than } x\%}{\sum_{MTU} \text{volume of all submitted upward RR/mFRR/aFRR bids}}$ <p>where bids_j represent all submitted upward RR/mFRR/aFRR bids with offered prices higher than p_j = 50%, 75%, 90%, 95% and 99% of the upper transitional price limit</p> <p>Submitted downward balancing energy bids with prices lower than x% of the lower price limit [%]</p> $= \frac{\sum_{MTU} \text{volume of submitted downward RR/mFRR/aFRR bids}_j \text{ lower than } x\%}{\sum_{MTU} \text{volume of all submitted downward RR/mFRR/aFRR bids}}$ <p>where bids_j represents all submitted downward RR/mFRR/aFRR bids with offered prices lower than p_j = 50%, 75%, 90%, 95% and 99% of the lower transitional price limit</p> <p>Upward balancing energy with prices higher than x% of the upper price limit [%]</p> $= \frac{\sum_{MTU} \text{volume of (activated) upward balancing energy RR/mFRR/aFRR with prices higher than } x\%}{\sum_{MTU} \text{volume of upward balancing energy RR/mFRR/aFRR}}$ <p>where x% refers to 50%, 75%, 90%, 95% and 99% of the upper transitional price limit</p> <p>Downward balancing energy with prices lower than x% of the lower price limit [%]</p> |

$$= \frac{\sum_{MTU} \text{volume of (activated) downward balancing energy RR/mFRR/aFRR with prices lower than } x\% \text{ of the lower transitional price limit}}{\sum_{MTU} \text{volume of downward balancing energy RR/mFRR/aFRR}}$$

where x% refers to 50%, 75%, 90%, 95% and 99% of the lower transitional price limit

3. Volume weighted average price of the last and most expensive balancing energy bids

Definition The VWAP of the last 5% of the submitted bids per platform, per direction and per participating TSO is calculated on a monthly basis. Each balancing platform needs to report two values per connected TSO, one for upward and one for downward direction.

Legal reference Article 9(4) of the amended pricing methodology

Time reference Monthly

Data source TERRE, MARI, PICASSO

The data will be collected directly from the platforms in a ready-for-reporting format.

Calculation **VWAP of the last most expensive 5% of the upward balancing energy bids submitted by TSO_i [EUR/MWh]**

$$= \frac{\sum_j \text{volume of most expensive 5\% submitted RR/mFRR/aFRR bid}_j \times \text{price of submitted RR/mFRR/aFRR bid}_j}{\sum_j \text{volume of most expensive 5\% submitted RR/mFRR/aFRR bid}_j}$$

where i=1,2,... represents the TSOs connected to the RR/mFRR/aFRR platform and where j represents the last 5% of submitted upward balancing energy bids by TSO_i

VWAP of the last 5% of the downward balancing energy bids submitted by TSO_i [EUR/MWh]

$$= \frac{\sum_j \text{volume of most expensive 5\% submitted RR/mFRR/aFRR bid}_j \times \text{price of submitted RR/mFRR/aFRR bid}_j}{\sum_j \text{volume of most expensive 5\% submitted RR/mFRR/aFRR bid}_j}$$

where i=1,2,... represents the TSOs connected to the RR/mFRR/aFRR platform and where j represents the last 5% of submitted downward balancing energy bids by TSO_i