European Network of Transmission System Operators for Electricity

Quarterly Report Q3/2022 according to article 9(4) of the common methodology for the pricing of balancing energy and cross-border capacity

5 December 2022

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.

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1. Background of the report

According to its decision 03/2022[1] published in February 2022[2], 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 obliges 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;

By the present report, all TSOs fulfill the obligations according to article 9(4) of the amended Balancing Pricing Methodology. 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.

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[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 22 June to 30 September 2022 for PICASSO and from 1 July to 30 September 2022 for 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 and RR platforms
Calculation	1. CZC available per BZ border and direction for the aFRR/RR exchange 2. CZC used per BZ border and direction for the aFRR/RR exchange

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

	June		July		August		September	
	Available CZC	Used CZC	Available CZC	Used CZC	Available CZC	Used CZC	Available CZC	Used CZC
DE -> CZ	208	5	407	9	501	10	445	14
CZ -> DE	165	15	298	28	330	29	624	32
DE -> AT	231	24	287	30	359	36	348	47
AT -> DE	1 115	71	1 361	53	1 144	48	1 371	37
CZ -> AT	112	3	32	6	60	10	74	9
AT -> CZ	966	13	1 100	20	990	18	764	23

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

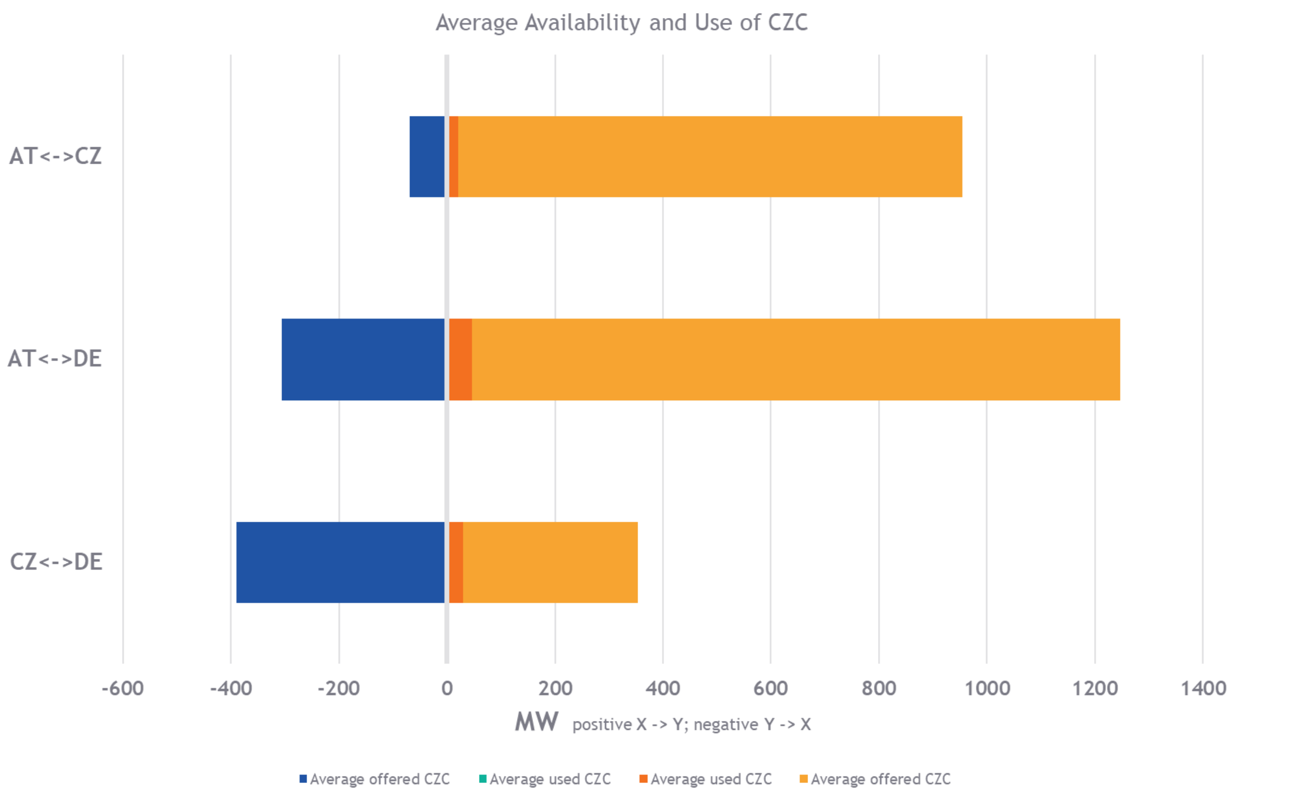

Figure 1: PICASSO – Average used and available cross-zonal capacity for the exchange of aFRR between 22 June and 30 September 2022 [MW]

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

	July		August		September	
	Available CZC	Used CZC	Available CZC	Used CZC	Available CZC	Used CZC
ES -> FR	145	44	273	116	2	0
ES -> PT	1 412	232	2 137	213	2 829	55
FR -> ES	496	81	499	82	494	2
FR -> CH	2 765	157	2 502	129	2 025	49
FR -> IT	795	76	1 091	121	504	23
CH -> FR	1 984	160	1 881	101	1 982	22
CH -> IT	222	58	437	70	162	18
IT -> FR	3 604	131	2 234	78	2 353	18
IT -> CH	4 259	93	3 593	158	2 639	17
PT -> ES	3 488	166	3 676	252	3 623	119

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

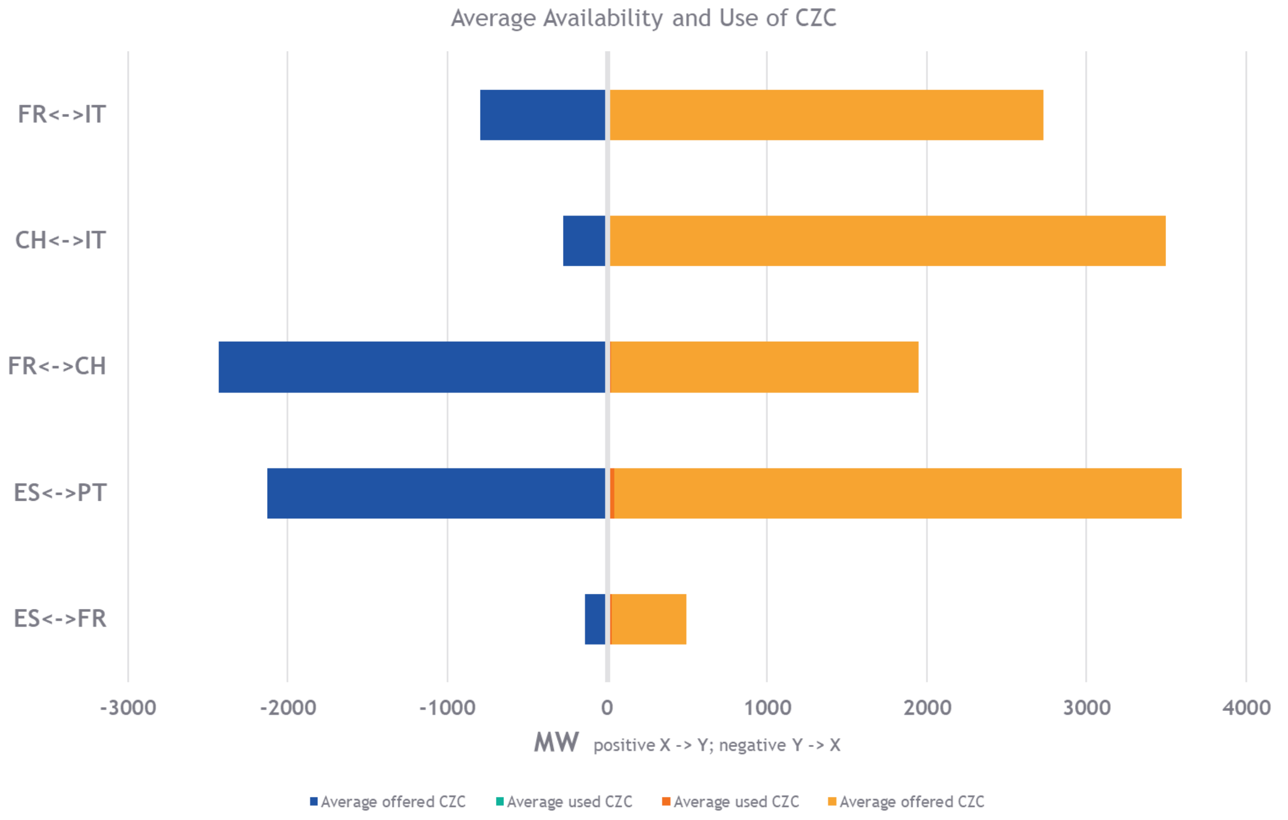

Figure 2: TERRE - Average used and available cross-zonal capacity for the exchange of RR between 1 July and 30 September 2022 [MW]

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 and RR platforms
Calculation	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

	Positive aFRR					Negative aFRR				
Threshold	**50%**	**75%**	**90%**	**95%**	**99%**	**50%**	**75%**	**90%**	**95%**	**99%**
June	12.8	9.7	8.5	7.5	7.2	13.2	10.9	9.9	9.0	8.7
July	11.4	9.8	9.1	8.3	8.1	9.8	8.0	7.3	6.9	6.8
August	10.7	8.4	7.4	6.9	6.7	4.0	2.6	2.3	2.2	2.1
September	5.3	3.6	3.1	3.0	2.9	3.3	1.8	1.5	1.4	1.3

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

	Positive aFRR					Negative aFRR				
Threshold	**50%**	**75%**	**90%**	**95%**	**99%**	**50%**	**75%**	**90%**	**95%**	**99%**
June	0.011	0.005	0.005	0.004	0.004	0.114	0.067	0.007	0.005	0.005
July	0.169	0.033	0.032	0.029	0.029	0.020	0.011	0.009	0.008	0.008
August	0.087	0.070	0.062	0.058	0.054	0.072	0.057	0.052	0.048	0.039
September	0.024	0.005	0.005	0.005	0.005	0.024	0.003	0.002	0.002	0.002

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

	Positive RR					Negative RR				
Threshold	**50%**	**75%**	**90%**	**95%**	**99%**	**50%**	**75%**	**90%**	**95%**	**99%**
July	0.2	-	-	-	-	-	-	-	-	-
August	0.9	-	-	-	-	-	-	-	-	-
September	3.4	2.2	1.8	1.6	1.0	-	-	-	-	-

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

	Positive RR					Negative RR				
Threshold	**50%**	**75%**	**90%**	**95%**	**99%**	**50%**	**75%**	**90%**	**95%**	**99%**
July	-	-	-	-	-	-	-	-	-	-
August	-	-	-	-	-	-	-	-	-	-
September	-	-	-	-	-	-	-	-	-	-

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 and RR platforms
Calculation	1. VWAP of the last 5% of the upward balancing energy bids submitted per TSO connected to the platform 2. 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

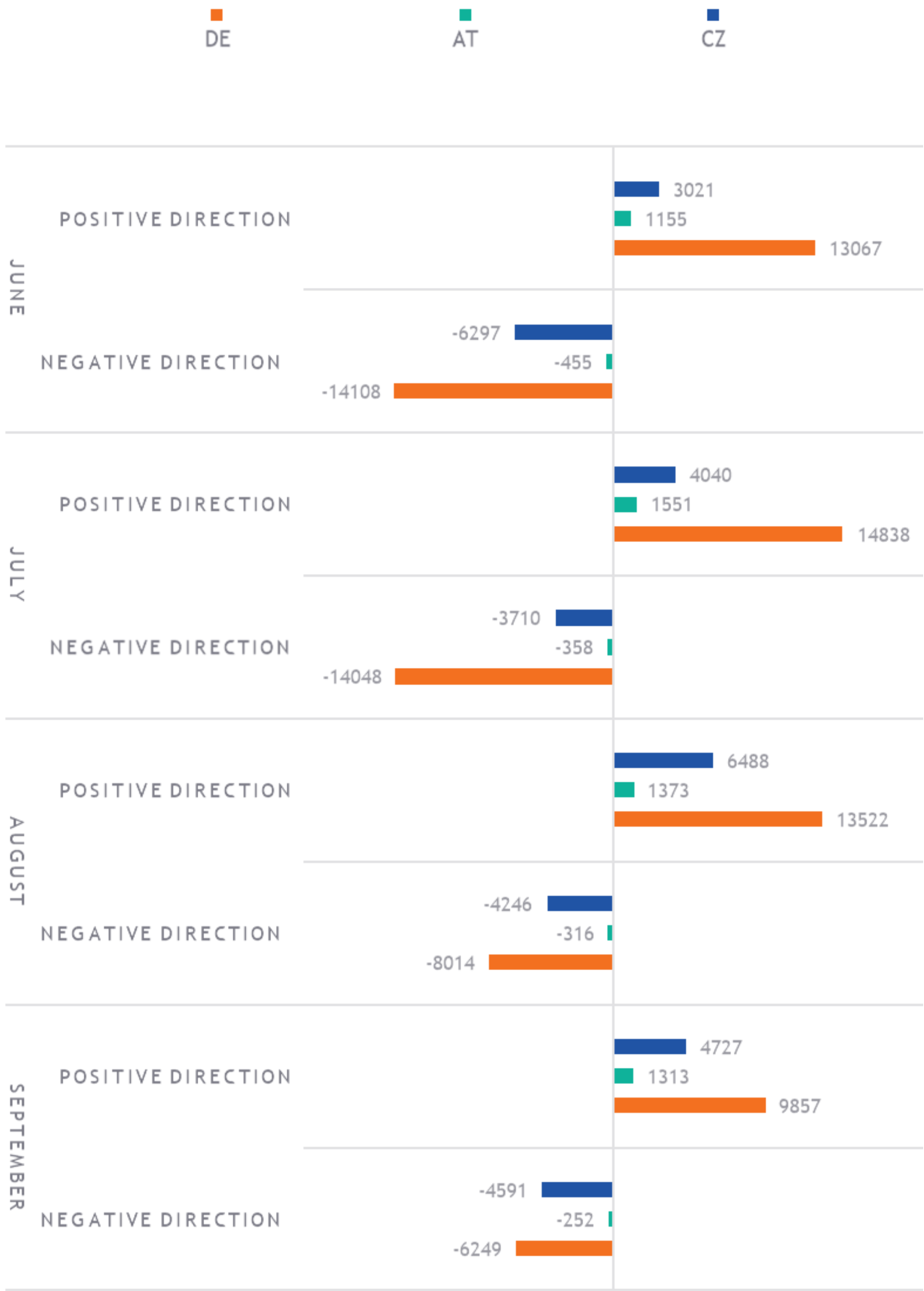

Figure 3: PICASSO - VWAP of the 5% most expensive aRR bids submitted [EUR/MWh] per country

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

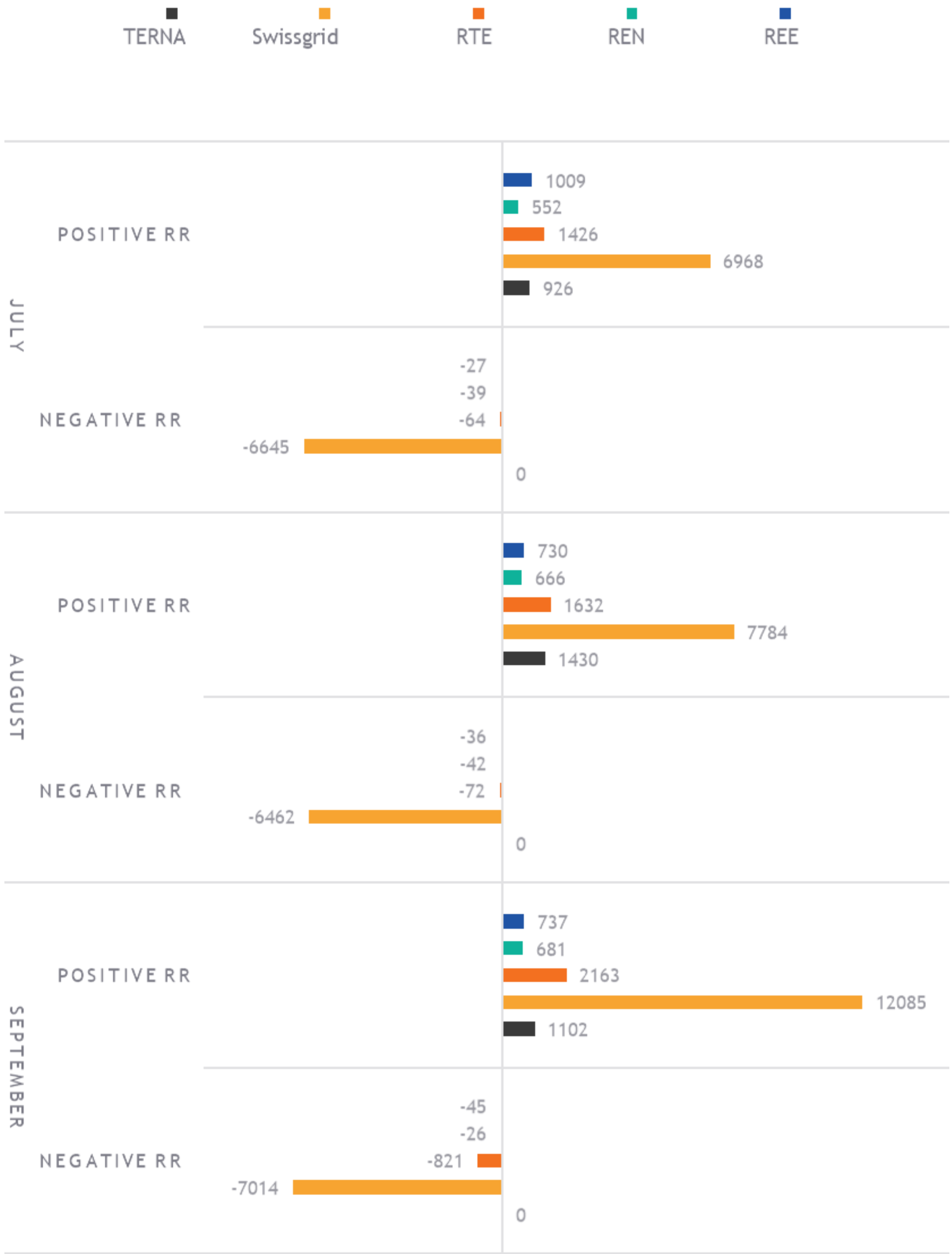

Figure 4: TERRE - VWAP of the 5% most expensive RR bids submitted [EUR/MWh] per country

4. Analysis of the price incidents

4.1 Analysis of the aFRR price incidents

European TSOs strongly support the European target model for integrated balancing energy markets, demonstrated by the successful go-live of all platforms for the exchange of balancing energy, and see significant advantages resulting from it. However, given the developments and observations made during the first months of operation of PICASSO with a total number of 127 grouped aFRR incidents[5] in the period from 22 June to 30 September 2022 (60 in negative and 67 in positive direction), all TSOs see the importance of the transitional price limit being applied, as approved by ACER in its decision 03/2022, to ensure the efficient functioning of the balancing energy markets.

For the price incidents in the aFRR market analysed for this report Czech Republic was never affected solely by a CBMP beyond the price reporting threshold (i.e. CBMP higher or lower than 50% of the transitional price limit). Either Austria, Germany, both countries together or all three participating countries including Czech Republic formed the affected uncongested area[6] (see Figure 5). The main cause for the expensive aFRR CBMP are the “hockey-stick” shaped MOL in Germany and Austria. The “hockey-stick” shape results from BSPs bidding significantly more expensive bids from a certain position in the MOL compared to the front part of the MOL. This results in an expensive CBMP, if sufficiently many bidders submit expensive balancing energy bids at the end of the MOL and a high demand for balancing energy realizes the activation of these bids. The 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).

[5] An incident is triggered each time the CBMP reaches at least 50% of the upper or lower transitional price limit of 15 000 EUR/MWh in one MTU (=event). All events within one 15-min period are grouped into one incident if they cover the same uncongested area. Therefore, an incident in PICASSO can be of duration between 4 sec and 15 min.

[6] During the aFRR optimization a CBMP is calculated per uncongested area and is the same for all countries within this area. The affected uncongested area is defined as the uncongested area where the CBMP reaches the pricing reporting threshold. There can be more than one affected uncongested area at the same time if in two or more areas the CBMP reaches this threshold.

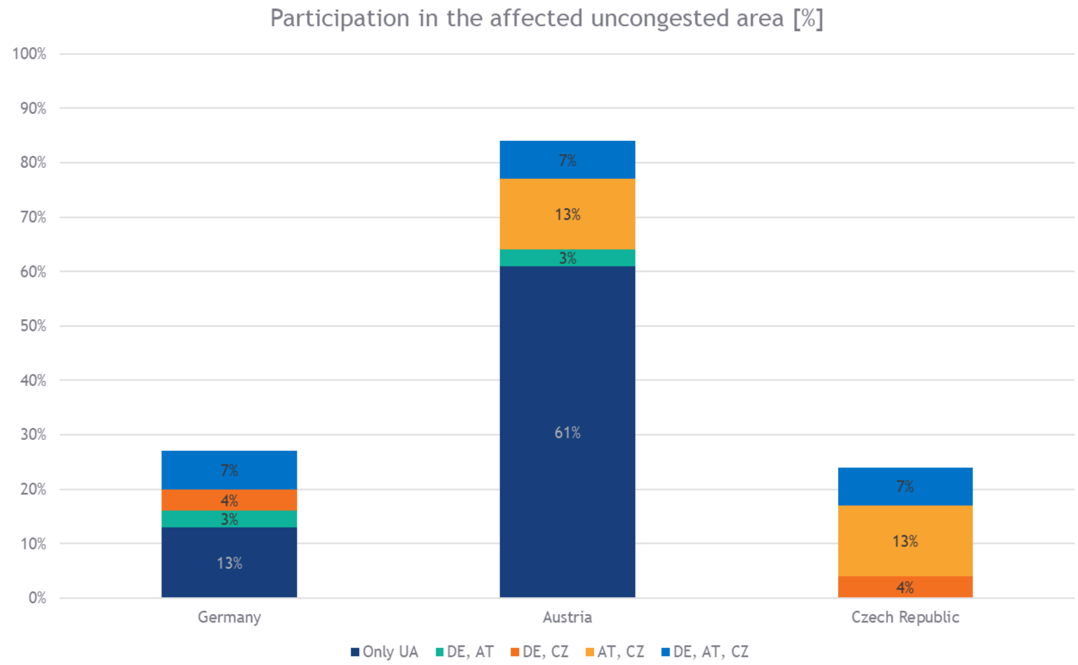

Figure 5: Country participation in the uncongested area affected by an aFRR price incident

One of the main arguments of TSOs during the discussions to introduce a price limit was the substantial risks resulting from applying marginal pricing in the balancing energy markets, especially during the transitional phase with only a few TSOs being connected to the platforms. The limited liquidity and the heterogeneous structures of the (local) energy markets add the fact that BSPs with market power are present which may lead to exaggeratedly high balancing energy bids to be submitted and activated. Looking at the market shares of the largest BSP in the affected uncongested areas during the price incidents shows that in over 60 percent of all aFRR incidents the largest supplier had a market share of at least one third and in 40 percent of all incidents the largest supplier even had a market share of 50 percent or more (see also Figure 6 for market concentration levels). This observation is supported by the RSI calculated for the affected uncongested area which measures the reliance of a market on its largest BSP. Figure 7 clearly shows that in all cases except one incident the largest suppliers were pivotal to the market (i.e., RSI being less than 1). This issue will very likely not change with more TSOs joining the platforms as local BSP structure will not change. Additionally, CZC will not be available constantly. In situations where no CZC is available for the exchange of balancing energy via the platforms we already observe today extremely high CBMP as the demand has to be satisfied locally by activating expensive balancing energy bids at the end of the MOL.

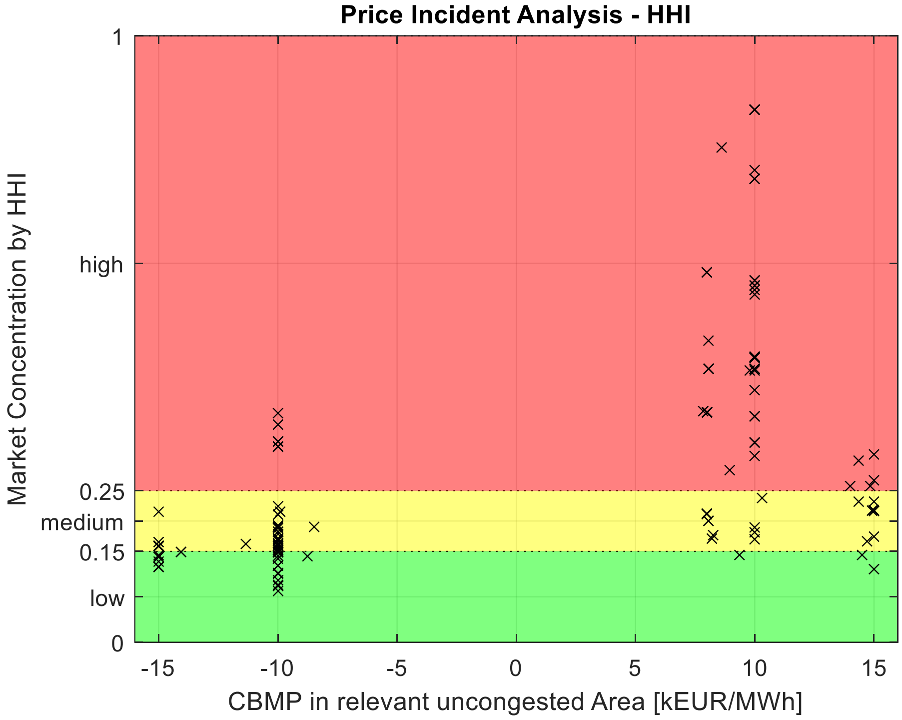

Figure 6: Price incident analysis - HHI

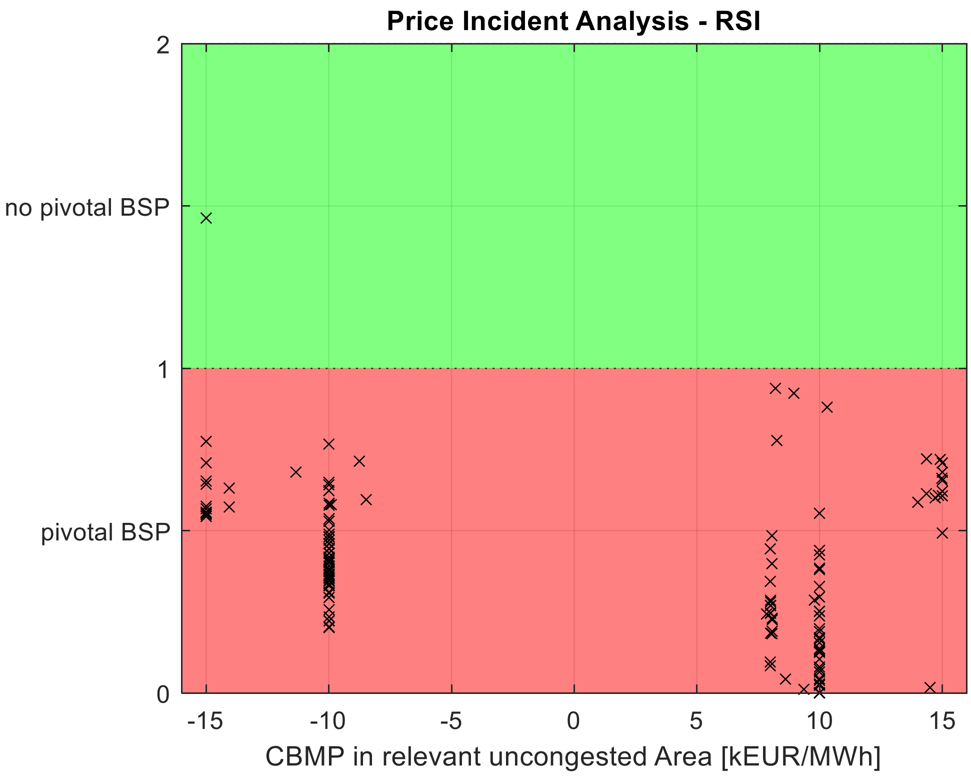

Figure 7: Price incident analysis - RSI

In market theory[7], BSPs that participate with several power generating modules in the market, additionally allowing for the submission of small incremental bids, have an incentive to exaggerate in their bids the costs of their expensive power generating modules to increase the marginal price being paid for all their activated bids. This particularly applies to powerful BSPs with a large market share. In addition, regular repetition of the balancing energy auctions under similar conditions and short validity periods of bids (15 minutes for PICASSO) are factors that may incentivize tacit collusion: submission of high bids in order to coordinate the regularly participating BSPs on high bids[8]. Figures 8 and 9 show that majority of the prices triggering an incident were close to either 8 000 EUR/MWh or 10 000 EUR/MWh with a handful of bids submitted at the full transitional price limit of 15 000 EUR/MWh. Having this price setting behavior and having almost no bid prices in between may be an indication that there are other bidding strategies than bidding the costs of energy generation.

In addition, the two figures demonstrate that majority of the incidents were of short duration with 64 percent of all incidents lasting less than 60 seconds (81 incidents in total) and only 19 longer incidents with a duration of more than five minutes. High balancing energy prices may constitute a risk for balancing responsible parties to be charged with unusual and not reasonable high imbalance settlement prices which are not correlating with the locally observed system situation and thus with the real time value of energy anymore. As the imbalance prices are calculated over a period stretching over multiple aFRR MTUs, the impact of a price incident is difficult to estimate. The length and level of the CBMP during an incident play a role but also do several other factors wherefore further conclusions on the imbalance price cannot be drawn.

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[7] *Please see the External Study attached to the submission of the pricing methodology amendment for further information: https://consultations.entsoe.eu/markets/proposal-for-amendment-of-pricing-methodology/supporting_documents/210602_Report%20on%20Justification%20of%20Max%20Min%20BE%20Prices.pdf*

[8] *Berninghaus, S.K., and Ehrhart, K.-M. (1998): Time Horizon and Equilibrium Selection in Tacit Coordination Games: Experimental Results. Journal of Economic Behavior and Organization 37(2), 231–248.; Fudenberg, D., and Maskin, E. (1986): The Folk Theorem in Repeated Games with Discounting or Incomplete Information, Econometrica 54(3), 533–554.; van Damme, E. (1991): Stability and Perfection of Nash Equilibria, 2nd edition, Springer.*

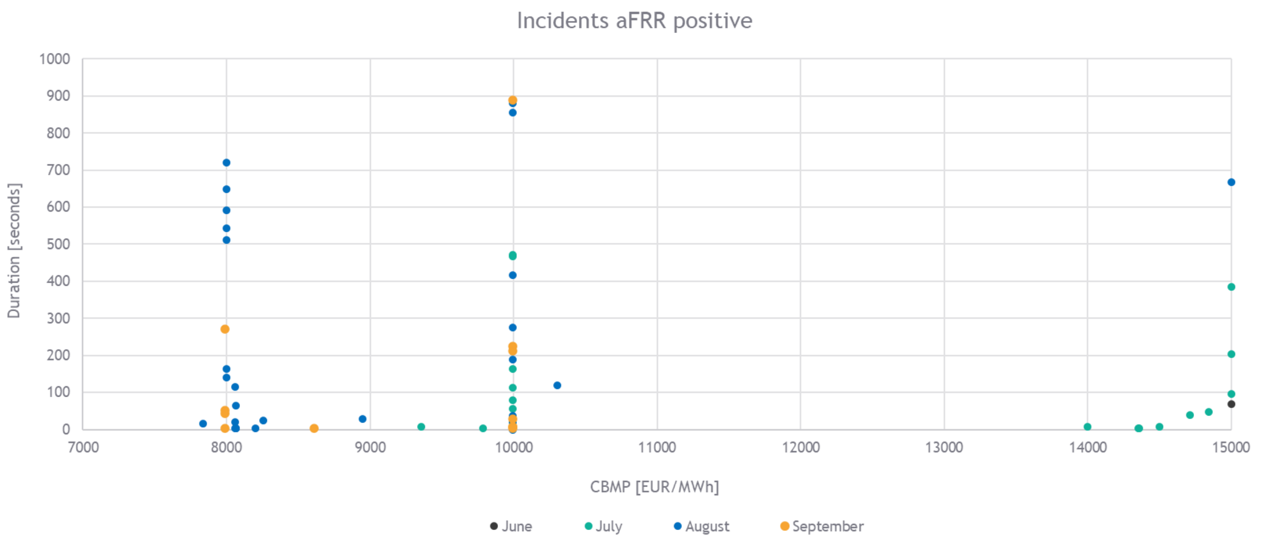

Figure 8: Duration and CBMP of aFRR positive price incidents

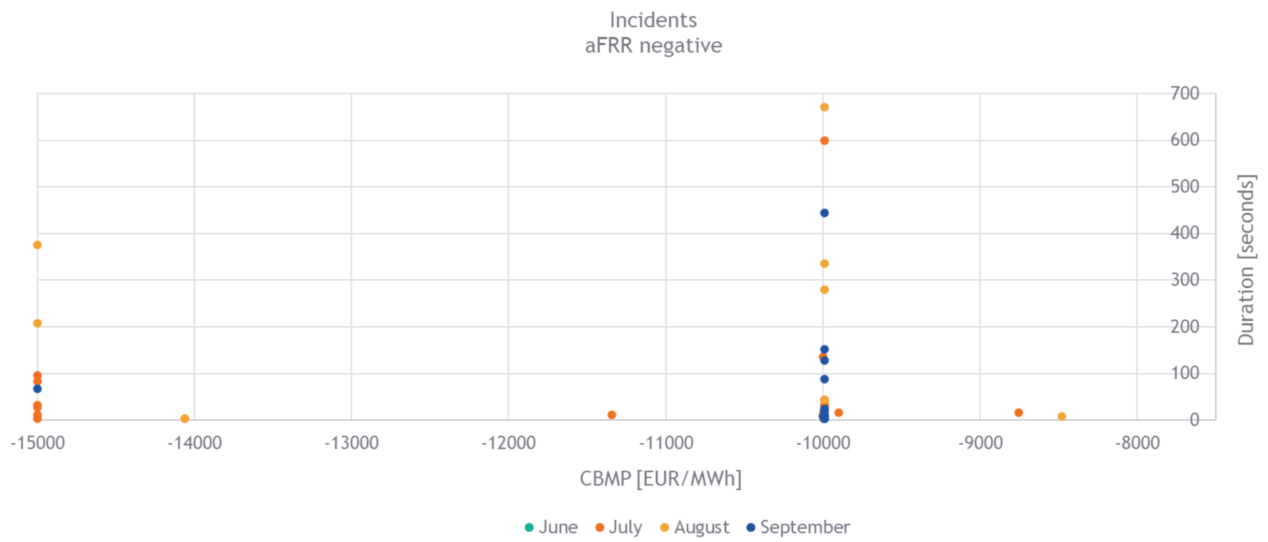

Figure 9: Duration and CBMP of aFRR negative price incidents

4.2 Analysis of the RR price incidents

No RR incidents according to article 9(5) of the amended Balancing Pricing Methodology occurred between 1 July and 30 September 2022.

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

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	TERRE, MARI, PICASSO The data will be collected directly from the platforms in a ready-for-reporting format.
Calculation	**Submitted upward balancing energy bids with prices higher than x% of the upper price limit [%]** $= \frac{\sum_{MTU} volume\ of\ submitted\ upward\ RR/mFRR/aFRR\ bids_j \text{ higher than x\%}}{\sum_{MTU} volume\ of\ all\ submitted\ upward\ RR/mFRR/aFRR\ bids}$ 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 **Submitted downward balancing energy bids with prices lower than x% of the lower price limit [%]** $= \frac{\sum_{MTU} volume\ of\ submitted\ downward\ RR/mFRR/aFRR\ bids_j \text{ lower than x\%}}{\sum_{MTU} volume\ of\ all\ submitted\ downward\ RR/mFRR/aFRR\ bids}$ 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 **Upward balancing energy with prices higher than x% of the upper price limit [%]** $= \frac{\sum_{MTU} volume\ of\ (activated)\ upward\ balancing\ energy\ RR/mFRR/aFRR\ with\ prices\ higher\ than\ x\%}{\sum_{MTU} volume\ of\ upward\ balancing\ energy\ RR/mFRR/aFRR}$ where x% refers to 50%, 75%, 90%, 95% and 99% of the upper transitional price limit **Downward balancing energy with prices lower than x% of the lower price limit [%]** $= \frac{\sum_{MTU} volume\ of\ (activated)\ downward\ balancing\ energy\ RR/mFRR/aFRR\ with\ prices\ lower\ than\ x\%}{\sum_{MTU} volume\ of\ downward\ balancing\ energy\ RR/mFRR/aFRR}$ 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]** $= \frac{\sum_j volume\ of\ most\ expensive\ 5\%\ submitted\ RR/mFRR/aFRR\ bid_j\ x\ price\ of\ submitted\ RR/mFRR/aFRR\ bid_j}{\sum_j volume\ of\ most\ expensive\ 5\%\ submitted\ RR/mFRR/aFRR\ bid_j}$ 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]** $= \frac{\sum_j volume\ of\ most\ expensive\ 5\%\ submitted\ RR/mFRR/aFRR\ bid_j\ x\ price\ of\ submitted\ RR/mFRR/aFRR\ bid_j}{\sum_j volume\ of\ most\ expensive\ 5\%\ submitted\ RR/mFRR/aFRR\ bid_j}$ 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