Commissie voor de Regulering
van de Elektriciteit en het Gas

CREG

Study

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Study on the functioning of the Core day-ahead flow-based market coupling mechanism and the impact of low margins available for cross-zonal exchanges

Non-confidential

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TABLE OF CONTENT

EXECUTIVE SUMMARY

The Core Day-Ahead Flow-Based Market Coupling Project celebrated its go-live on 8 June 2022 (delivery on 9 June), following months and years of preparations of its project parties: the Core TSOs and Core NEMOs. This ambitious project aims to implement the main deliverable of the CACM Regulation: a coordinated capacity calculation and market coupling process, covering cross-zonal exchanges between 12 bidding zones in 13 European Member States. In many ways, this is one of the most important projects and a crucial milestone towards a truly coupled, integrated Internal Electricity Market in Europe.

Since its go-live, cross-zonal capacities were successfully calculated and allocated on a daily basis, allowing market participants to exchange electricity between the different bidding zones. In principle, this maximizes welfare by allow electricity to flow from lower-priced to higher-priced zones, subject to the constraints imposed by the available cross-zonal capacities. No major operational issues with significant impact on capacity calculation and market coupling have materialized. In light of the complexity of the procedures, this can be called an impressive success.

Despite the proper functioning from an operational point of view, the CREG has important concerns related to the capacities that are made available for cross-zonal, intra-Core exchanges. As the main constraint which the welfare optimization algorithm must respect, these cross-zonal capacities are a crucial element to assess the performance of the Core DA FBMC. Higher interconnection capacity is commonly understood as one of the main success factors for enhancing market coupling and integration. This is reflected in European legislation and the methodologies that lie at the basis of the Core DA FBMC Project.

Several elements in the methodology allow for reducing cross-zonal capacities. In this study, the CREG focuses on individual validation reductions and allocation constraints. Both of these have the effect that they limit the cross-zonal capacity made available for the market, outside of the usual flow-based capacity calculation and allocation processes.

Individual validation adjustments (IVAs) allow TSOs to reduce margins, under very specific circumstances, as long as this happens in an exceptional manner which is transparently justified. This study demonstrates that such validation reductions are commonly and structurally applied by many TSOs. The extent to which this has an impact on the market varies, according to the situation. It is particularly problematic when this happens on network elements which are actively constraining the market (hence restricting exchanges and creating price spreads), especially when the available margins are below the minimum threshold of 20% of the maximum capacity of a line. The latter threshold has been in place since 2018 and was confirmed, by ACER, to be an absolute minimum, only to be breached in extraordinary circumstances.

As this study will show, the occurrence of such violations is neither exceptional nor strictly limited to what is necessary for operational security. In light of these observed problems, it is particularly relevant to highlight the behaviour of the TSOs participating in the DAVinCy validation project. This project allows to reduce capacities on network elements of one of the participating TSOs, in order to solve overloads on network elements of others, thereby allowing the inclusion of network elements which do not meet the requirements of the relevant ACER Decision to restrict cross-zonal exchanges. This is highly problematic and discriminatory, given that the lack of transparency does not allow regulatory monitoring and enforcement of these reductions.

It can be shown, through a single case study based on actually observed numbers, that these reductions are overestimating the required validation reductions, and subsequently have the tendency to increase prices in other bidding zones. This negatively impacts import capabilities of countries and zones with generation deficits, for example France or Hungary (typical net importers). The reduced electricity imports, in turn, increase the occurrence of price peaks and generate very significant price spreads with exporting bidding zones.

Related to allocation constraints, ACER's methodology allows the Belgian, Dutch and Polish TSOs to restrict the net position of its bidding zone in the allocation phase, thereby ignoring the outcome of the flow-based capacity calculation process. From the available data, it can be calculated that the Polish allocation constraint actively reduces the ability of the Polish zone to export electricity in nearly 80% of the hours. This artificially reduces the export from Poland to its neighbours, keeping the Polish prices at a much lower level and reducing the convergence with its neighbours. This constraint, and this constraint alone, explains why the Polish bidding zone has an average clearing price which is nearly 200 €/MWh below its neighbours.

The impact of these actions to circumvent the normal flow-based capacity calculation process cannot be underestimated. Especially in light of the current market circumstances, whereby the turmoil on the international gas markets have spilled over to the European electricity markets, increasing the available capacities for cross-zonal exchanges is crucial. In its Final Assessment of the EU Wholesale Electricity Market Design,[1] ACER identifies several measures to increase the European electricity sector's resiliency against external price shocks. The first of these measures relates to speeding up electricity market integration, in particular ensuring the compliance with minimum capacity thresholds and implementing an efficient flow-based market coupling mechanism.

It is clear, from the theoretical and practical assessment of the occurrence of individual validation adjustments and allocation constraints, as well as from the case studies presented in this study, that there is much room for improvement on this issue. The CREG therefore calls for the immediate commitment of Core TSOs to strictly limit the application of IVAs to the minimum extent possible, and in any case not reducing the margins below 20% of a network element's maximum capacity. When individual or coordinated validation reductions are absolutely indispensable to maintain operational security, the CREG is of the opinion that this should be applied in a proportionate and transparent manner. In particular, the CREG invites the relevant TSOs to present, in detail, the functioning of the DAVinCy validation mechanism.

Furthermore, the CREG is of the view that allocation constraints shall, under no circumstances, be used anymore to limit the cross-zonal exchanges, irrespective of the underlying reason for which these constraints were conceived.

[1] https://www.acer.europa.eu/events-and-engagement/news/press-release-acer-publishes-its-final-assessment-eu-wholesale

INTRODUCTION

Through this study, the COMMISSION FOR ELECTRICITY AND GAS REGULATION (hereafter: “the CREG”) presents the findings from its analyses regarding the functioning of the Core Day-Ahead Flow-Based Market Coupling Project (hereafter: “the Core DA FBMC Project”). These analyses follow from the operational data which has been made available by the Core transmission system operators (hereafter: “Core TSOs”), focusing on the first 100 days of operations. The period under consideration, therefore, spans from 9 June 2022 (the go-live date of the project) until 16 September 2022.

The CREG presents, in the first chapter, shortly the context prior to the Core DA FBMC Project’s go-live, in particular focusing on the results of the external parallel runs and earlier investigations of the CREG regarding this topic. Secondly, the global operational market coupling results such as exchanges, net positions, prices and price convergence are provided. The third chapter presents the main issues observed related to reductions of cross-zonal capacities and exchanges: individual validation adjustments and allocation constraints. This chapter includes a conceptual description with the link to the relevant provisions in the applicable methodologies, a quantification of the occurrence and impact of these problems and two case studies. In its conclusion, the CREG presents the main issues and some considerations for improving the detrimental impact on the functioning of the Core DA FBMC Project.

This study has been approved by the Board of Directors of the CREG on 6 October 2022.

1. CONTEXT

1. In February 2019, ACER adopted its decision to establish the day-ahead and intraday capacity calculation methodologies for the Core region.[2] In May 2021, Core NRAs approved amendments to these methodologies.[3] These two approvals together form the methodology to be implemented to calculate and allocate cross-zonal capacities in the day-ahead (and intraday) timeframes.

2. Despite an earlier deadline for implementation in the original decision and the NRAs' amendments to this methodology, a go-live date in April 2022 was announced by the Core DA FBMC Project Parties (i.e. the Core TSOs and NEMOs). Following the assessment of the results of the external parallel runs, however, severe issues related to operational stability, intraday capacity calculation and low margins for the network elements in the day-ahead timeframe were observed. This led to calls from several stakeholders as well as TSOs and NRAs to postpone temporarily, again, the go-live.

3. These concerns were, among others, identified by the CREG and published in a report summarizing the results of the external parallel runs.[4] Building on these observations, all Project Parties committed to improvements on the short and medium term, prior to and after the new go-live date on 8 June 2022 (delivery on 9 June).

4. The CREG investigated these commitments and the decision taken by the Project Parties to postpone the go-live. The results of this investigation were published as well.[5] The CREG observed, based on preliminary data, that for the operational stability and the intraday capacity concerns, significant improvements had been implemented leading to a reduction of the impact of these issues after the go-live. On the issue of the low margins for exchanges, though, the CREG reiterated its concern, highlighting this discriminatory practice to be against the spirit of the methodology as well as in contradiction with the objectives of the applicable European legislation.

5. There is significant divergence in views between all involved parties, including NRAs, ACER, and the Core TSOs, regarding the severity of this issue. For this purpose, and in order to be able to discuss this based on actual data and detailed insights into the Core DA FBMC's functioning, the CREG publishes this study, where it investigates the impact of capacity reductions on the market coupling mechanism in the Core region.

[2] ACER Decision 02-2019 on the Core CCR TSOs' proposals for the regional design of the day-ahead and intraday common capacity calculation methodologies, hereafter the "ACER DA CCM Decision".

[3] Décision (B) 2241 relative à la demande d'approbation, formulée par la SA ELIA TRANSMISSION BELGIUM et tous les gestionnaires de réseau de transport de la région de calcul de la capacité Core, de modifications apportées à la méthodologie commune pour le calcul de la capacité (available in French or Dutch)

[4] Note (Z) 2359 on the functioning and the result of the Core Day-Ahead Flow-Based Market Coupling Project's external parallel runs (available in English only)

[5] Note (Z) 2390 on the investigation of the CREG related to the postponement of the go-live of the Core Day-Ahead Flow-Based Market Coupling Project (available in English only)

2. CORE DA FBMC OPERATIONAL RESULTS

2.1. CROSS-ZONAL EXCHANGES

6. The Core DA FBMC typically allows for exchanges reaching between 7.000 to 10.000 MWh/h between its bidding zones, with large fluctuations on a day-to-day and even more so on an hour-to-hour basis. Typical net exporters include Belgium, Germany / Luxembourg, the Netherlands, Czech Republic, Poland and Romania. Austria, France, Hungary, Slovakia and Slovenia are structural net importers of electricity in the Core DA FBMC (see also section 2.2).[6]

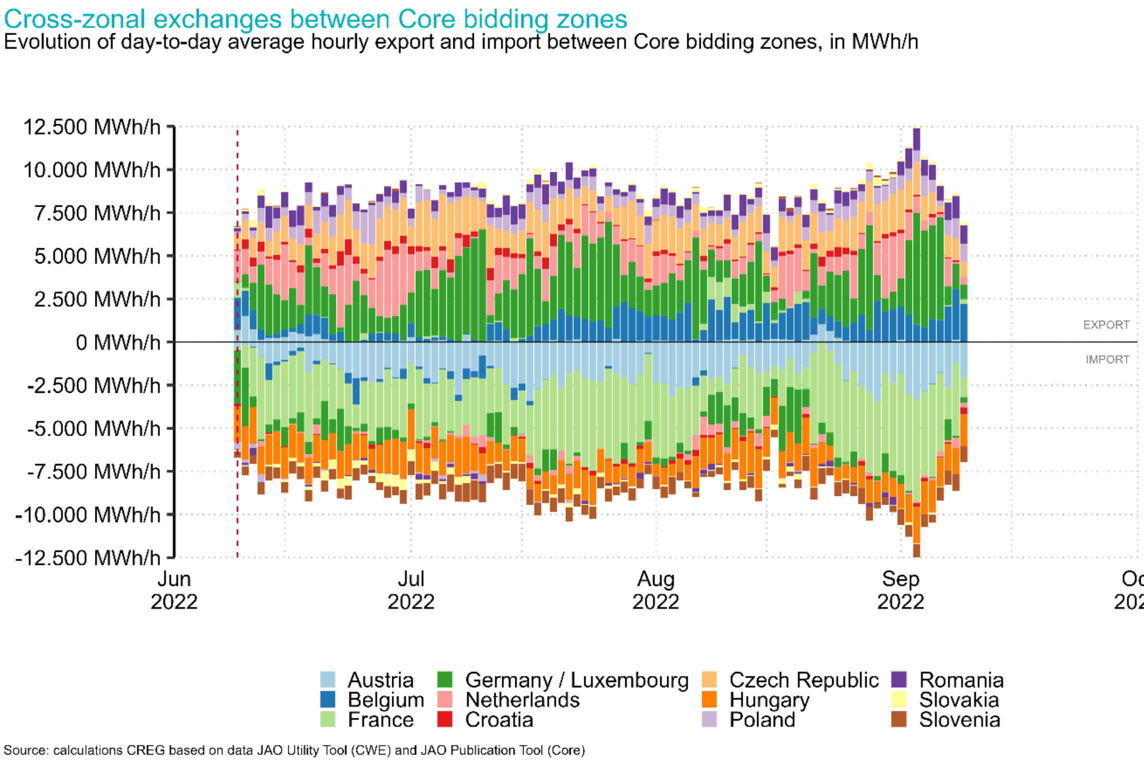


Figure 1 Cross-zonal exchanges between Core bidding zones

7. The sum of the average exchanged volumes between Core bidding zones following the go-live of the Core DA FBMC is, in terms of order of magnitude, similar to the exchanged volumes in the former CWE DA FBMC. This is remarkable, given that the CWE DA FBMC consisted of only 5 bidding zones, while the Core DA FBMC allows for exchanges between 12 bidding zones. This might be, in part, due to the seasonal nature of these exchanges: Figure 2 clearly shows that average exchanged volumes between the CWE bidding zones are generally about twice as high in the winter months compared to the summer. Rough extrapolation of this pattern would suggest average exchanges in the Core DA FBMC reaching about 20 GWh/h during the upcoming winter months.[7]

[6] These net positions refer to the Core net positions, not to be confused with the SDAC net positions (which can be consulted on the Entso-E Transparency Platform). Exchanges with non-Core bidding zones are not taken into account. This may impact the absolute net position of a Core bidding zone in the day-ahead timeframe.

[7] In order to understand the magnitude of this number: this is roughly comparable to the electricity consumption of Poland.

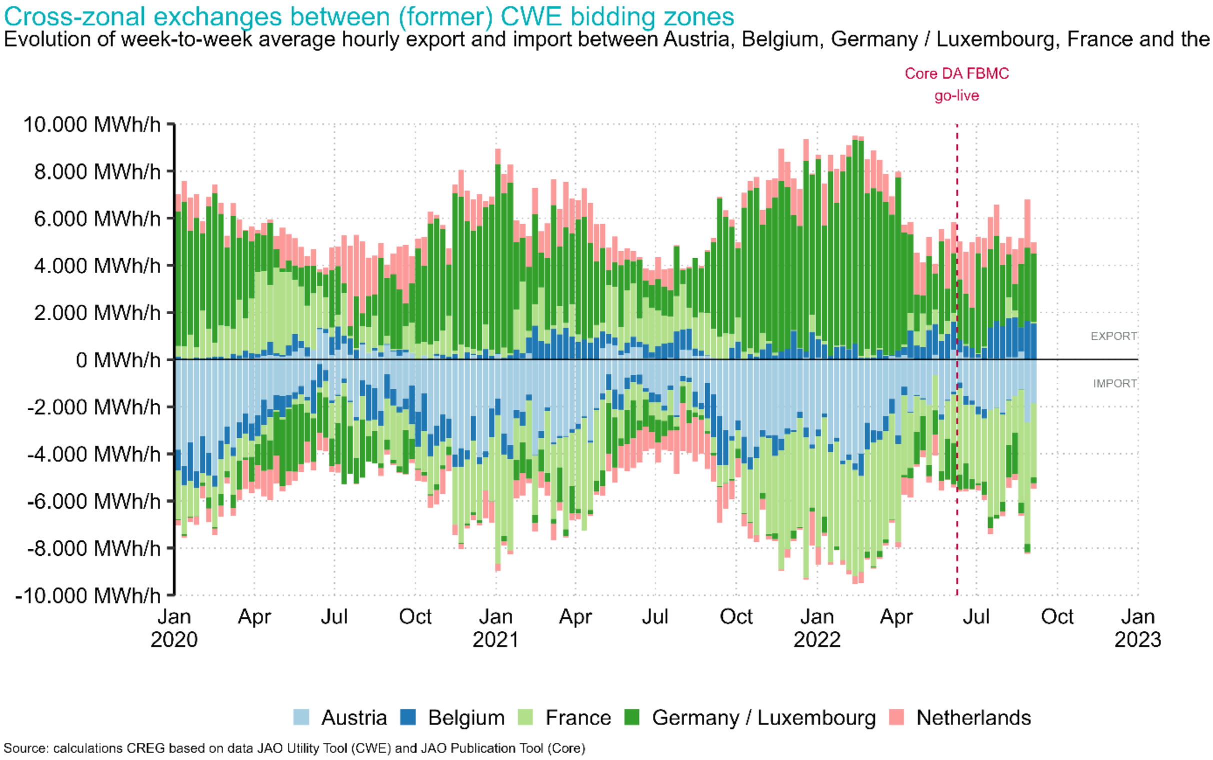


Figure 2 Cross-zonal exchanges between (former) CWE bidding zones

2.2. CLEARING PRICES AND NET POSITIONS

8. Figure 3 shows the average net position of each Core bidding zone during the observed period. Typical net exporters are Germany, the Czech Republic, the Netherlands and Belgium, among others. These bidding zones generate excess electricity that flows to the main structural importers, most notably France, Austria and Hungary.

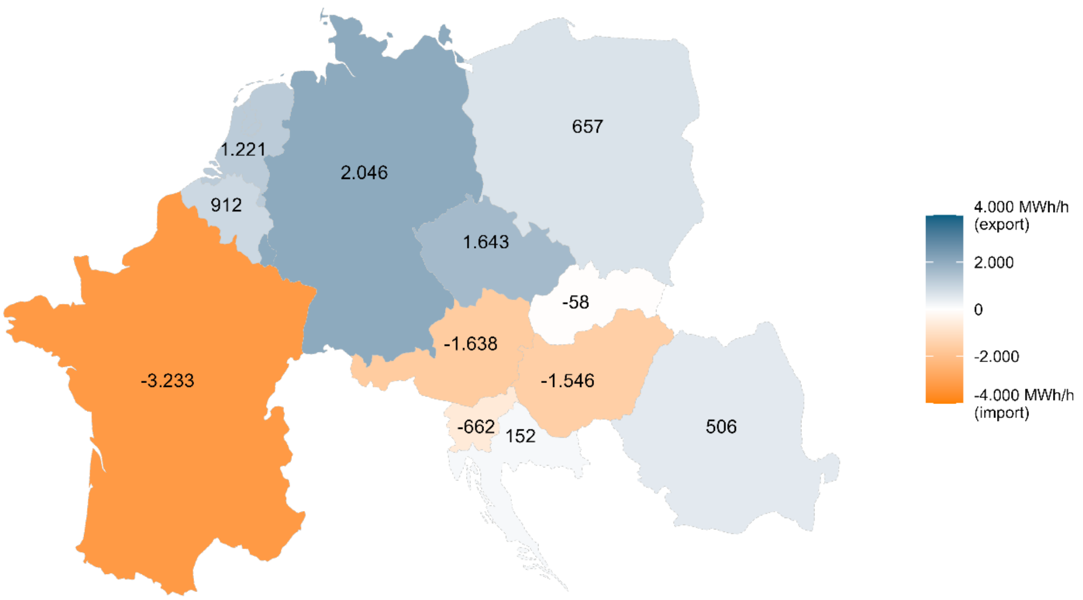
9. These global net positions are typically rather volatile and may change significant from day to day and even from hour to hour. They however reflect a dynamic equilibrium between the Core bidding zones, whereby electricity generally flows from lower-priced to higher-priced bidding zones, taking into account the available transmission capacity. Not surprisingly, countries where power generation is often unable to meet demand at reasonable prices[8] need to import more electricity, while countries with excess generation can export large volumes to their neighbours.

10. Positive net export positions are observed in countries with lower prices, as can be deduced from the analyses of Figure 3 and Figure 4. The main exception in this quasi linear relationship between prices and net export positions is Poland: this bidding zone has a competitive advantage in the current market circumstances, linked to the generation from brown coal and lignite in Poland which is less expensive than the gas required for most other bidding zones' marginal units.[9] One would however expect that, in light of the very big price differences between Poland and the other Core bidding zones, much larger volumes are being exported from Poland than those we observe today. This issue will be addressed later on, when this note presents the Polish allocation constraint.

[8] "Reasonable" being at a level comparable to the prices in neighbouring bidding zones.

[9] A more detailed description of the price formation and market coupling mechanism is out of scope of this note.

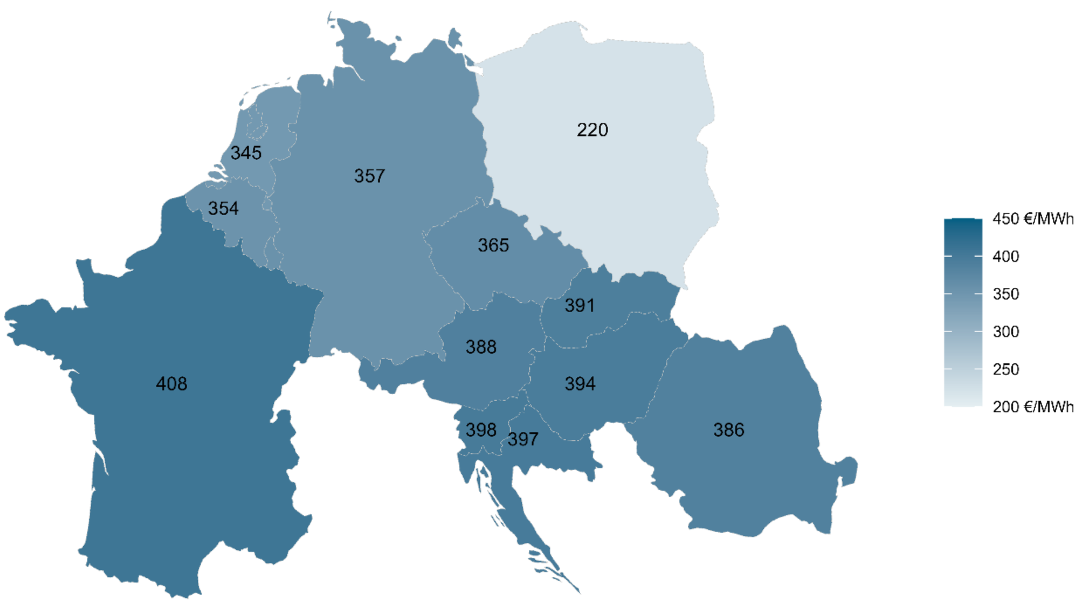
Net position of Core bidding zones
Average hourly net position, in MWh/h, of individual Core bidding zones between 9 June and 16 September 2022



Source: calculations CREG based on data JAO Publication Tool

Figure 3 Net position of Core bidding zones

Clearing prices in Core bidding zones
Average hourly clearing price, in €/MWh, of individual Core bidding zones between 9 June and 16 September 2022



Source: calculations CREG based on data Entso-E Transparency Platform

Figure 4 Clearing prices in Core bidding zones

2.3. PRICE CONVERGENCE

11. In historical perspective, price convergence is at an all-time low and price spreads very often exceed 50€ / MWh between the Core bidding zones. Even though this is a striking observation, it is the CREG's estimation that this is not necessarily the result of the implementation of the Core DA FBMC but rather more a side-effect of the current tense situation on electricity markets. The start of the decrease in price convergence seems to coincide with the increase in the general price level, back in the summer of 2021.

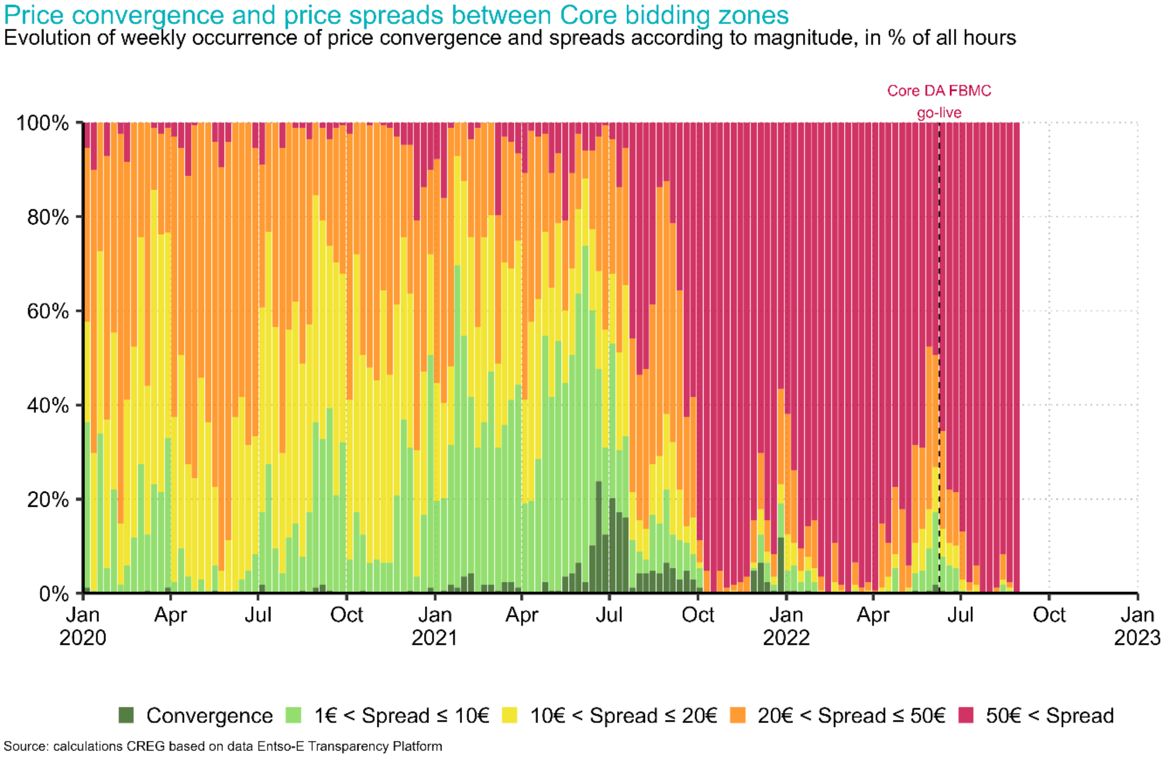


Figure 5 Price convergence and price spreads between Core bidding zones

12. Looking back at Figure 4, the average price levels seem to converge somewhat, with the exception of Poland. The large average price spread between Poland (229 €/MWh) and the second-least expensive bidding zone (the Netherlands, at 335 €/MWh) is undoubtedly at least partly responsible for the large share of "red" observations in Figure 5 (indicating the spreads bigger than 50 €/MWh).

3. CAPACITY REDUCTIONS

3.1. ACER DA CCM DECISION

13. The ACER DA CCM Decision lays out the rules by which Core TSOs need to calculate, in a joint and harmonized manner, the available capacities on network elements which constitute the flow-based domain, available for exchanges between the 12 bidding zones. While a thorough description of the capacity calculation process is out of scope of this note, several elements in the methodology are of relevance for the actual size of the flow-based domains, which – when insufficient – restrict the possible cross-zonal exchanges.

14. Two elements are highlighted in this note: the individual reductions of margins for cross-zonal exchanges (in general, but in particular when the 20% minRAM criterium is violated) and the allocation constraints.

3.1.1. Individual validation adjustments

15. Article 20 of the ACER DA CCM Decision describes the individual and coordinated validation adjustments, which allow Core TSOs to reduce the margins for cross-zonal exchanges under specific circumstances, for reasons of operational security. These validations allow Core TSOs to lower the margins below 20% of a CNEC's F_{max} – under normal circumstances this constitutes an absolute minimum according to Article 17(7).

16. While coordinated validations (Article 20(3)) is not applied today in the absence of coordination processes with the coordinated capacity calculator, individual validation adjustments exist – and are applied often, as will be demonstrated in the next section.

17. One particular initiative, from the Austrian, Dutch and German TSOs, the so-called *"DAVinCy project"* needs to be mentioned.[10] Through a joint validation process, this project allows the participating TSOs to remedy (local) overloads with individual validation adjustments on network elements in other bidding zones. Through this joint validation, DAVinCy TSOs aim to apply less IVAs (and hence less capacity reductions) than in the counterfactual situation where each TSO individually assesses and solves overloads on their network elements.

18. While a high-level process description of the DAVinCy project has been shared with the regulatory authorities, a detailed description including the rules and methodologies that are applied in this process has not been made available. This impedes a rigorous assessment of the efficiency of this approach and makes it difficult to check whether any subsequent violations of minimum margin requirements are legitimate according to the criteria of the ACER DA CCM Decision.

19. It is furthermore problematic, as probably not in line with the spirit of the ACER DA CCM Decision, that the DAVinCy process allows for solving overloads on internal network elements which are not necessarily part of the set of (cross-border relevant) critical network elements. The capacity calculation and market coupling processes typically start from the premise that only cross-border relevant network elements (as defined in Article 16) can be considered.

[10] DAVinCy stands for *Day-Ahead Validation of Capacity* and is applied by TenneT NL, TenneT DE, Amprion, 50Hertz, TransnetBW and APG.

3.1.2. External and allocation constraints

20. ACER’s methodology also provides for the option to implement allocation constraints as a temporary measure for 2 years following the Core DA FBMC go-live (see also Article 7). This allows for taking into account operational security limits that cannot be transformed efficiently into F_{MAX} values on specific CNECs. Two options are foreseen: constraints on a bidding zones Core net position, or on the global SDAC net position.

21. These solutions exist specifically for Elia, TenneT NL and PSE (i.e. the Belgian, Dutch and Polish TSOs). The justifications and applicable methodologies for these constraints are listed in Annex 1 to the methodology.

22. For Belgium, Elia maintains an allocation constraint to ensure a minimum of power to be generated in the Belgian control area, to avoid voltage collapse risks by ensuring a minimal dynamic stability. This is translated into an import constraint, which is estimated with regularly performed offline studies. Similar constraints, but for the import and export direction, may apply in theory for the Netherlands.

23. For Poland, the use of allocation constraints is justified by PSE through the need to ensure that reserve capacity for balancing purposes is at all times ensured within the Polish control area. In application of Poland’s central dispatching model, reserve capacity is not blocked by the TSO in advance of the day-ahead wholesale market (SDAC), meaning that they can participate to the day-ahead clearing and subsequently not be available to provide (upward) reserve capacity.

In order to avoid that these units are not present, an export constraint may be activated to avoid that these units, which typically have lower marginal costs than similar units in neighbouring zones, sell too much of their energy in the day-ahead market.

24. The allocation constraint for Poland applies on the SDAC level, meaning that they do not restrict Poland from exporting to other Core bidding zones – at least as long as these are compensated by imports from Nordic or Baltic zones, when the allocation constraint is limiting Poland’s net position.

3.2. QUANTIFICATION OF OCCURRENCE AND IMPACT

3.2.1. Individual validation adjustments

25. Individual validation adjustments are applied frequently, though with varying impact, on the network elements in the Core DA FBMC. Looking at the final presolved domains, the occurrence of IVAs can be estimated per TSO – indicating big differences in applied practices. **Figure 6** shows, for each TSO, the share of hours where on at least one CNEC an IVA was applied as well as the average IVA (in % of the total capacity of the line on which it was applied). The size of the circles indicate how many CNECs were observed in the presolved final domains, irrespective of whether there were any validation reductions.

26. Some TSOs (for example RTE and Transelectrica) apply IVAs fairly often, up to almost a quarter of all considered hours. These are however, relatively small reductions, compared to other TSOs. The four German TSOs as well as TenneT BV (Netherlands) and APG (Austria) apply reductions less frequently (in terms of time, less than 10%), yet the impact is much higher: when applied, these IVAs reduce the available margins with more than 50% (even up to 84% in case of TenneT GmbH – on average).

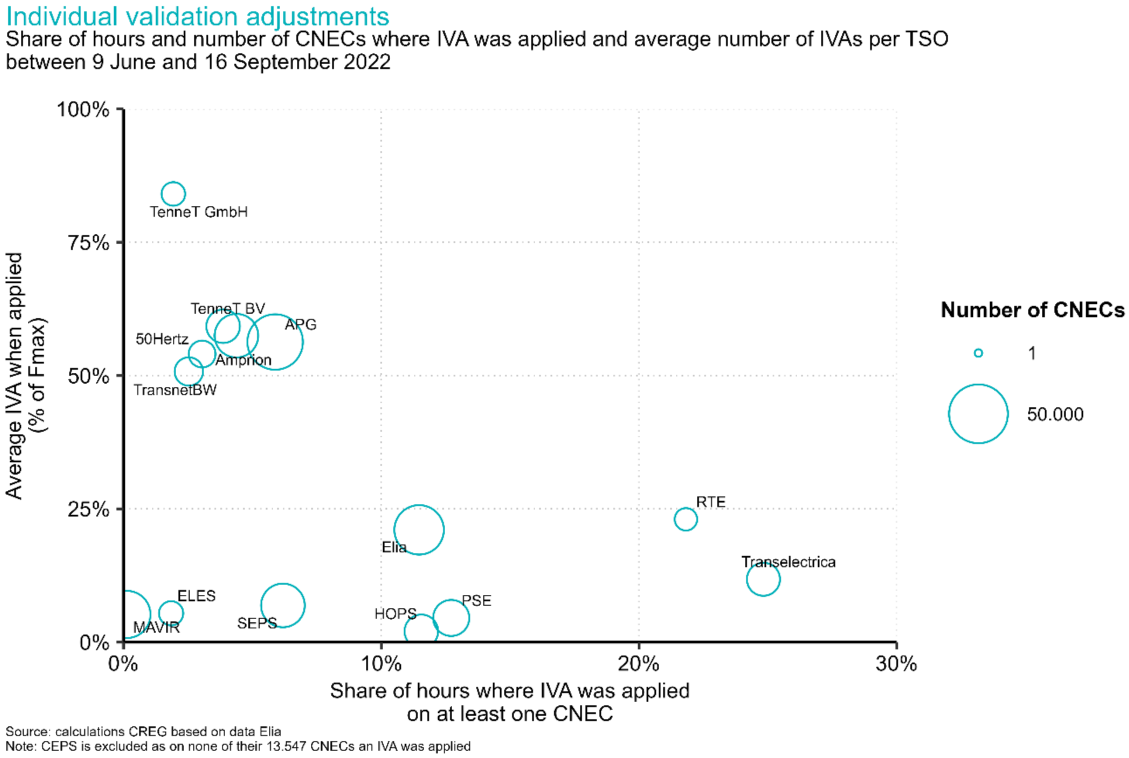


Figure 6 Individual validation adjustments

27. Given the large size of these reductions, especially for some TSOs, it is no surprise that these validation reductions frequently lead to violations of the 20% minRAM principle. The table below shows, per TSO, how often (expressed as number of network elements and expressed as number of hours) minRAM violations occurred, and how high on average the IVA was that led to this violation.[11]

	CNECs where RAM < 20%	Distinct MTUs where at least one CNEC has RAM < 20%	Average IVA when RAM < 20%
50Hertz	104	41	48,6%
Amprion	348	52	67,0%
APG	679	89	65,2%
CEPS	0	0	
ELES	0	0	
Elia	0	0	
HOPS	55	46	7,6%
MAVIR	0	0	
PSE	80	71	14,4%
RTE	0	0	
SEPS	0	0	
TenneT BV	256	32	71,6%
TenneT GmbH	230	38	86,6%
Transelectrica	422	238	18,9%
TransnetBW	154	34	59,9%

Table 1 Violations of 20% minRAM requirement and IVAs per TSO

[11] In line with established practice between Core TSOs and NRAs, a minRAM violation is evaluated as follows, based on the data from the JAO Publication Tool (presolved final domains): $(RAM + F_{LTN} + 3) / F_{MAX} < 20\%$. The 3 MW added to the margin is to avoid rounding errors, adding the F_{LTN} ensures that flows from nominated long-term transmission rights, which still exist currently, are counted towards compliance with the 20% minRAM.

28. Again, large differences between the TSOs may be observed. Transelectrica, for example, very frequently reports margins below 20%. This is not due to high IVAs, however (only 19,1% on average), so part of the low margins available are linked to high reference flows. Other TSOs, though, also record frequent violations (both in absolute CNECs as in number of hours), resulting from the massive application of validation adjustments: as high as 86,6% for TenneT GmbH. These violations are not caused by high reference flows in the electricity network. In case of the Dutch, German and Austrian TSOs, they are used as a means to guarantee operational security on network elements in other bidding zones. It is not clear to which extent operational security on those network elements is actually at risk due to the absence of transparency in the DAVinCy mechanism.

29. Between the Core DA FBMC go-live on 9 June and 16 September 2022, i.e. during the first 100 days of operations, 6.363 active constraints were identified. Out of these, 837 (or 13,2%) had positive IVAs. This ratio is much different looking at the entire presolved final domain (instead of only the active constraints): positive IVAs were identified on 6.246 CNECs (i.e. 2,4 % out of the 260.637 CNECs in the presolved final domains). While it is difficult to state anything about causality, it is clear that there's at least a positive correlation between applying IVAs on a CNEC and that CNEC being an active constraint. These numbers are repeated below for each individual TSO, in Table 2.

	Complete presolved final domain			Only active constraints (with positive shadow price)		
	CNECs	CNECs with IVA	Average IVA when applied	CNECs	CNECs with IVA	Average IVA when applied
50Hertz	7.365	2,8%	54,0%	267	7,9%	65,9%
Amprion	25.180	2,1%	57,3%	829	11,0%	51,7%
APG	44.890	3,1%	56,1%	1.025	12,8%	54,9%
CEPS	13.987	0,0%		17	0,0%	
ELES	5.367	0,9%	5,4%	47	14,9%	3,7%
Elia	34.197	1,6%	23,1%	1.288	5,2%	22,5%
HOPS	13.234	2,4%	2,0%	159	13,2%	5,5%
MAVIR	30.876	0,0%	5,2%	53	1,9%	0,4%
PSE	15.981	3,1%	4,5%	753	15,5%	7,7%
RTE	4.312	14,0%	22,9%	453	35,5%	34,7%
SEPS	25.900	0,8%	6,9%	49	14,3%	15,9%
TenneT BV	13.109	4,0%	59,1%	419	7,6%	55,5%
TenneT GmbH	5.014	4,8%	84,1%	150	24,0%	85,4%
Transelectrica	12.728	7,4%	11,7%	360	34,2%	17,5%
TransnetBW	8.497	2,3%	50,5%	494	4,5%	37,9%

Table 2 Application of IVA per TSO on presolved and active CNECs

30. When IVAs are applied following from the DAVinCy validation tool, the justification on the line where the margins are reduced includes an indication of which network element has an overload that needs to be solved. As mentioned before, this latter element is most often in another bidding zone and is not necessarily included as a critical network element in the Core DA FBMC. Analyzing these justification shows that, in the considered period, IVAs were applied on 1.030 network elements during 128 different hours. This was done to solve overloads on 3.239 other network elements, even though there are only 30 unique observations, summarized in Table 3.

EIC	Network element	TSO	Frequency of causing DAVinCy validation	Included in presolved domain?
49T000000000004G	**Eemshaven-Meeden 380 W**	**TenneT BV**	**647**	**No**
49T000000000105A	Eemshaven - Eemshaven het Hogeland 380 Zwart	TenneT BV	589	Yes
49T0000000001068	**Eemshaven het Hogeland - Meeden 380 Zwart**	**TenneT BV**	**589**	**No**
N/A	**NA**	**NA**	**564**	**No**
49T000000000057W	Borssele - Rilland 380 Grijs	TenneT BV	319	Yes
14T-220-0-0231AB	Salzburg - Tauern 231A	APG	140	Yes
10T-AT-DE-000061	Buers - Westtirol ws (422)	TransnetBW	80	Yes
49T0000000000428	**Wateringen-Bleiswijk 380 W**	**TenneT BV**	**56**	**No**
14T-220-0-0273AQ	Strass - Zell 273A	APG	52	Yes
11TD2L000000159R	**Lehrte - Mehrum 1**	**TenneT GmbH**	**40**	**No**
49T000000000000O	Zwolle - Hengelo 380 Wit	TenneT BV	38	Yes
11TD2L000000249Q	**Wilster/W - Audorf/S blau**	**TenneT GmbH**	**29**	**No**
49T0000000000096	Diemen - Lelystad 380 Wit	TenneT BV	22	Yes
10T-AT-DE-000231	Buers - Meiningen gn (406A)	APG	20	Yes
10T-AT-DE-000231	Buers - Meiningen gn (406A)	TransnetBW	20	Yes
14T-220-0-002213	Tauern - Weissenbach 221	APG	16	Yes
10T1001C--000332	Vill_Thaur - Silz 273C	APG	13	Yes
14T-220-0-00227S	Bisamberg - Wien Suedost 227	APG	10	Yes
14T-220-0-0228AV	Kledering - Wien Suedost 228A	APG	10	Yes
14T-220-0-0228BT	Bisamberg - Kledering 228B	APG	10	Yes
10T-AT-DE-000037	St. Peter 2 - Pleinting 258	APG	8	Yes
10T-AT-DE-000037	Pleinting - St. Peter 258	TenneT GmbH	8	Yes
10T-AT-CH-00003T	Meiningen - Ruetli 407	APG	4	Yes
14T-220-0-0225A3	Hessenberg - Ternitz 225A	APG	4	Yes
10T-AT-DE-00001B	St. Peter 2 - Altheim 233_230	APG	1	Yes
10T-AT-DE-000045	St. Peter 2 - Simbach 234_230	APG	1	Yes
10T1001C--00062W	Y-St.Peter (-Altheim - Simbach) 234/230	TenneT GmbH	1	Yes
11T0-0000-0962-R	**Y-Tiengen (-Buers - Hoheneck - Werben) BLUDNZ W**	**Amprion**	**1**	**No**
11TD400000538-L7	**NABuers - Obermooweiler bl**	**TransnetBW**	**1**	**No**

Table 3 List of network elements with overloads solved by the DAVinCy validation tool

31. Not less than 1.927 of these 3.239 network elements (59,5%) with overloads are not included in any of the presolved domains of the entire considered period, indicating that either they are not considered sensitive to cross-zonal exchanges (according to the CNEC selection mechanism in the ACER Decision) or that they are redundant (not constraining the flow-based domain. In 564 of the cases, "N/A" is reported: in these cases we cannot assess for which network elements the validation reductions are performed. As these elements are not in the presolved domain, it is therefore not clear why they should be reported as being at risk of operational security violations.

32. From a transparency perspective, this is a crucial flaw in the design of the Core DA FBMC. It allows TSOs to circumvent the rules for selecting network elements that are sensitive to cross-zonal exchanges, and externalizing the costs for solving overloads on these network elements to the market coupling mechanism. It is a clear violation of the principle that congestions shall not be *"pushed to the borders"* and constitutes a discriminatory practice.

3.2.2. Polish allocation constraint

33. Allocation constraints are, in theory, possible for 3 different bidding zones: the Netherlands, Belgium and Poland. However, in practice, only two bidding zones apply these, for different reasons: Belgium and Poland. The extent to which it is triggered in the day-to-day operation between the Belgian and the Polish case, differs strongly, as can be seen in Figure 7.

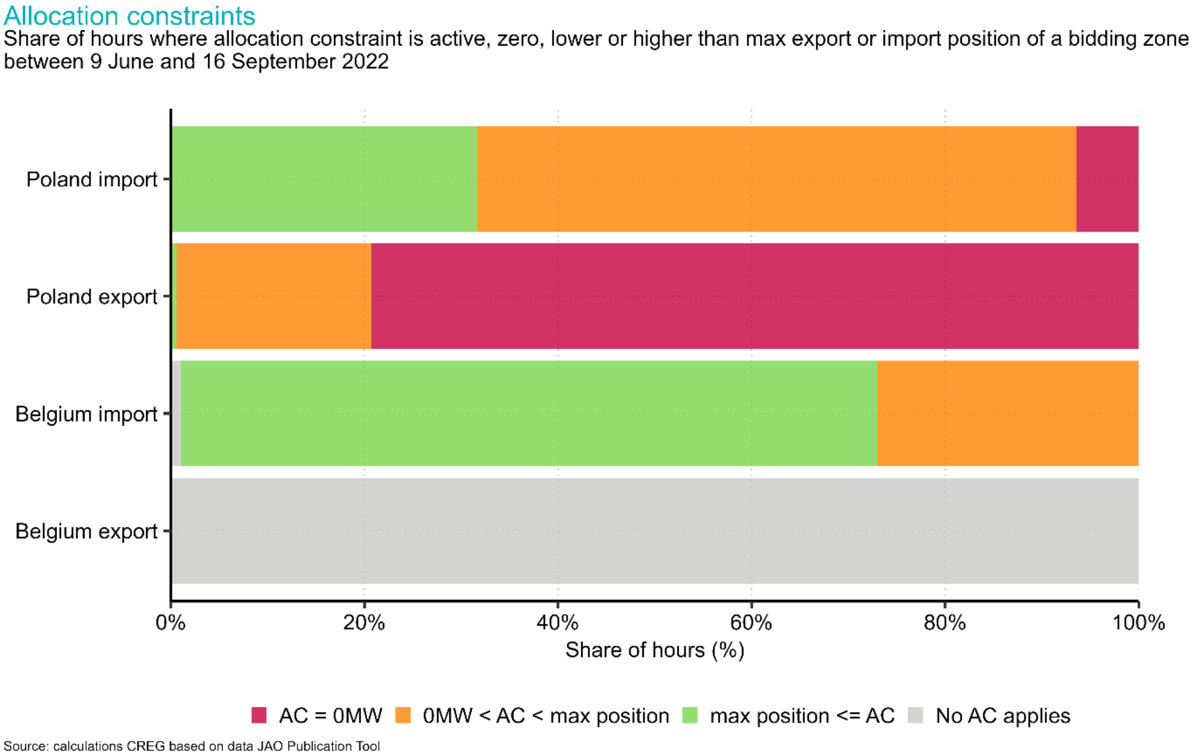


Figure 7 Allocation constraints

34. The distinction is made between four categories: either the allocation constraint is set at zero (meaning that no import or export is possible[12]), the allocation constraint is lower than zero but lower than the max import or export position (in absolute value), the allocation constraint is higher than the max import or export or there is no allocation constraint set. From the observed data, no export constraints from Belgium are observed, while the large part of the import constraint (72,0% of hours, see green bar) it is above the maximum import position under the flow-based domain, meaning that it cannot possibly restrict trade opportunities.

35. For Poland, the situation is very different: in only 0,5% of observed hours, the allocation constraint exceeds the max export position. In 79,3% of hours, the allocation constraint sets the maximum export position of the bidding zone at 0 MW, meaning that any possible exports in the Core region need to be compensated by imports from the Nordic and Baltic regions. This is highly inefficient and destructive of socio-economic welfare: cheap Polish coal-fired generation capacity is not allowed to export electricity to neighbouring Core bidding zones as a result of this mechanism.

[12] It is worth reminding that these constraints are set at the SDAC level, meaning that with an AC = 0MW export or import would still be possible from or to that bidding zone, as long as this is compensated by import from or export to other, non-Core bidding zones.

36. Assessing the actual impact of these constraints would require a re-run of the Euphemia algorithm, to understand how much additional export from Poland to other zones would increase, by how much prices in neighbouring bidding zones would decrease and how Polish prices (and convergence with more expensive zones) would increase. This is not within the scope of this note.

3.3. ADDITIONAL CONSIDERATIONS

37. Low capacities available for cross-zonal exchanges may be a valid and efficient outcome of any flow-based market coupling mechanism. Indeed, such a mechanism intends to restrict trade where this is operationally necessary, while preserving the goal of maximizing social welfare. In order to avoid undue restrictions and protectionary measures of individual bidding zones, several elements are identified in European legislation as being crucial to the proper functioning of the (Core) FBMC.

38. These elements relate to maximizing cross-zonal capacity, increasing transparency, avoiding undue discrimination and not pushing congestions to the border. The two practices identified (validation reductions and allocation constraints) fail to meet these objectives. They are particularly problematic in the current context, as restricting cross-zonal exchanges impedes the ability of the market coupling mechanism to integrate markets and lead to higher welfare, among others by decreasing the occurrence of price peaks in importing bidding zones.

39. The issues identified are particularly controversial, as the CREG has identified that:

- They are applied in a non-transparent manner. The functioning of individual validation reductions is, from stakeholders' perspective, a black box as long as no detailed description of the mechanism and its rationale is made available. This applies in the same way to the application of allocation constraints.
- While being allowed in the relevant methodologies, their application is understood to be acceptable only in specific circumstances. From the data shown, it is clear to all that both validation reductions as well as allocation constraints are applied structurally, as default individual adjustments to the coordinated processes.
- They allow to circumvent the existing rules, by making it possible that network elements with low sensitivity to cross-zonal exchanges are constraining the flow-based domains through reductions of the margins on other network elements. This way, costs for internal congestion management are externalized to the market coupling mechanism.
- These individual validation adjustments lead, for some specific TSOs, to reductions of the available margins below the minimum threshold of 20% of the maximum capacity. Again, this is allowed, yet under specific circumstances, while the observations show that this occurrences of these violations are not at all exceptional.

40. Through these mechanisms, the efficiency and the fairness of the Core DA FBMC Project is severely compromised.

3.4. CASE STUDIES

3.4.1. 30 August 2022

41. On 30 August 2022, the day-ahead clearing price in Hungary exceeded 1.000 €/MWh for two consecutive hours: from 19:00 to 20:00 (1.047,10 €/MWh) and from 20:00 to 21:00 (1040,76 €/MWh). In France, a clearing price of 1.021,73 €/MWh was recorded between 21:00 and 22:00. The case study below focuses on the French price peak, but the argumentation can be easily extended to the Hungarian case as the active constraint, validation adjustments and margins for cross-zonal exchanges are very similar.

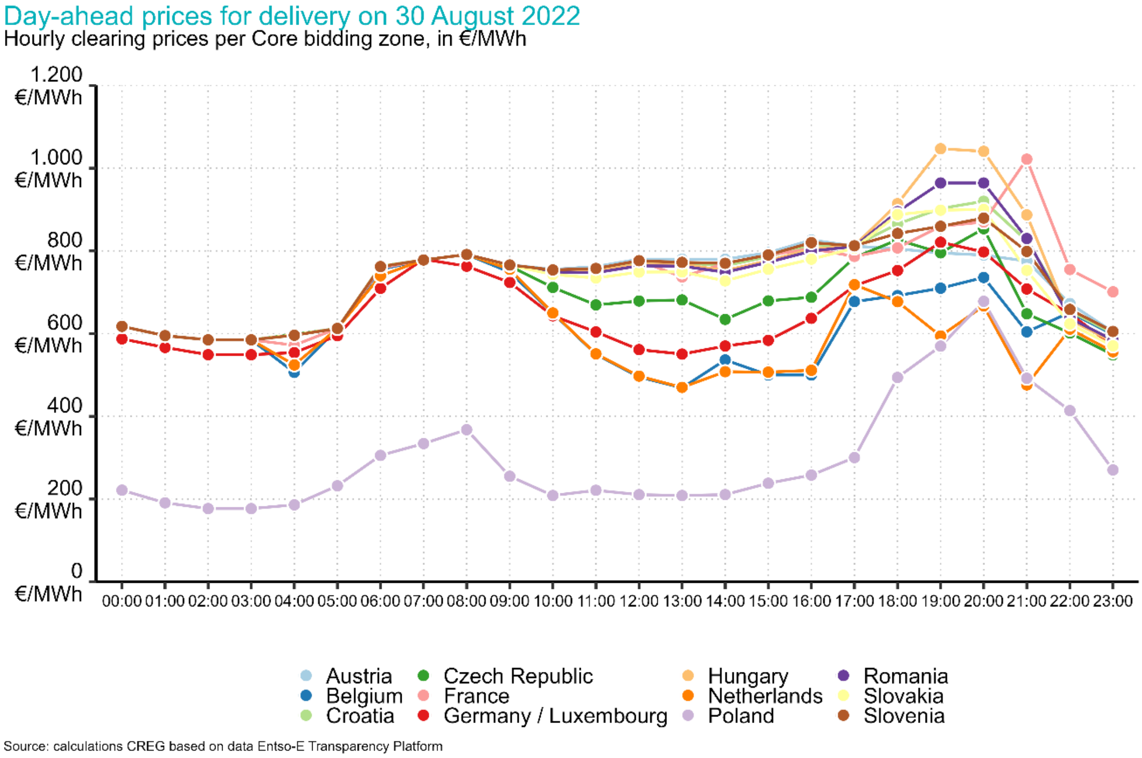


Figure 8 Day-ahead prices for delivery on 30 August 2022

42. These high prices and the associated price spreads to neighboring bidding zones are caused by six network elements, limiting the market clearing during that hour. These are so-called *"active constraints"*, and their shadow price indicates the increase in social welfare that would result from making 1 MW more available to the market for cross-zonal exchanges. Very high shadow prices (nearly 3.500 €/MW) are rather uncommon: they indicate congestion with a severe impact on socio-economic welfare (by restricting cross-border flows from low-priced to high-priced zones).[13]

[13] It is worth noting that, on the same CNEs (belonging to APG, i.e. Wien Suedost - Gyoer) during the hours before (19:00 and 20:00) when prices peaked in Hungary, shadow prices reaching nearly 6.000 €/MW were observed.

#	CNE	TSO	RAM (MW)	F_{MAX} (MW)	RAM (% of F_{MAX})	Shadow price (€ / MW)	IVA (MW)
1	Ernsthofen – Hausruck	APG	23	420	5,5 %	103,7	382
2	Wien Suedost – Gyoer	APG	20	234	8,5 %	3.463,3	184
3	Grosskrotzenburg – Urberach	Amprion	194	1.884	10,3 %	3.065,8	354
4	Maasbracht – Siersdorf	Amprion	661	1.732	38,2 %	338,4	745
5	Paffendorf – Oberzier	Amprion	358	2.114	16,9 %	404,0	1.918
6	Dresden/Sued - Schmoelln	50Hertz	36	1.732	2,1 %	547,2	747

Table 4 Active constraints on 30 August 2022 21 :00 – 22 :00
Source : calculations CREG based on data JAO Publication Tool (ShadowPrices)

43. What these active constraints have in common, is that they consistently report low margins available for trade (in five out of the six cases lower than the 20% minRAM requirement), caused by individual validation adjustments. In absolute terms, these IVAs differ greatly in order of magnitude (from several hundreds to nearly 2.000 MW) while in absolute terms, on two elements at least 90% of F_{MAX} is reduced as such.

44. The reasons for these validation adjustments are reported by the Core TSOs. Depending on the TSO, more or less details regarding the operational security issue are included in the justification. In this particular case, focusing on the line Paffendorf - Oberzier (with an IVA of 1.918 MW or 90,7% of F_{MAX}), the justification is as follows:

> *IVA applied due to results of joint security analysis by 50Hertz, Amprion, APG, TNG, TTG, TTN: **1546MW of the IVA are needed** to shift the nonpresolved CNEC to the considered vertex of the intermediate domain *** Violated OSL: **Eemshaven - Eemshaven het Hogeland** 380 Zwart, EIC: 49T000000000105A, TSO: NL;**Eemshaven het Hogeland - Meeden** 380 Zwart, EIC: 49T0000000001068, TSO: NL;**Eemshaven-Meeden** 380 W, EIC: 49T000000000004G, TSO: NL *** Core net positions of considered vertex: AT: -274 MW;BE: 549 MW;BE_AL: -528 MW;CZ: -681 MW;DE: 781 MW;DE_AL: 528 MW;FR: -2456 MW;HR: 1134 MW;HU: -3068 MW;NL: 2915 MW;PL: 581 MW;RO: -42 MW;SI: 344 MW;SK: 218 MW*
>
> *(source: JAO Publication Tool – Validation Reductions, **bold** text highlighted by the CREG)*

45. This indicates a joint security analysis by the DAVinCy TSOs, in order to solve overloads on internal Dutch network elements. These network elements are cross-border relevant: they appear in other (presolved or non-presolved) domains as well, hence they have passed the selection step in ACER's methodology.[14] From the justification it is not clear, however, to which extent these Core net positions are relevant to the market clearing, why this is not a feasible dispatch, how much remedial actions were already applied to solve this overload (if any) and whether the IVAs on the elements in Table 4 were as small as required to maintain operational security.[15]

46. For this specific network element, respecting the 20% minRAM would require a RAM of 423 MW (instead of the current 358). Given that an IVA of 1.918 MW was applied and only 1.546 MW was needed, this would appear possible without overloading the three Dutch network elements. Looking at the zone-to-zone PTDFs, an additional 65 MW (423 – 358) would have allowed 2.382 MW import to France from the Czech Republic (PTDF_FR = 0,00721 and PTDF_NL = 0,03450; PTDF_NL>FR = 0,02729), which would likely have resulted in a significant decrease of the price.[16]

[14] Indicating they have at least one zone-to-zone PTDF exceeding 5%.

[15] As the justification indicates that only 1.546 MW is needed and 1.918 MW is applied, it is probably not the case that the IVA is limited to what is strictly necessary.

[16] This is a simplification: increasing the available margin could also result in additional imports to other zones than France (for example Austria). However, the high shadow price in combination with the high spread between France and the Netherlands, suggests that the welfare optimization gained from increasing the margin would have been highest by increasing

47. In conclusion, the application of a non-transparent joint security analysis between a consortium of TSOs allows for the externalization of congestions on Dutch network elements that are not necessarily very sensitive to exchanges between (geographically) distant bidding zones in the market coupling mechanism. By allowing validation reductions on German and Austrian network elements, the ability of the market coupling mechanism to increase imports to France in order to lower their clearing price, is seriously affected by the low margins for cross-zonal exchanges. In light of current general market circumstances, this is a serious problem that could, in the coming winter, significantly impact the ability of importing bidding zones to rely on cross-zonal exchanges to cover their demand at *"reasonable"* prices.[17]

48. This demonstrates that the 20% minRAM is not a trivial requirement. While in itself it is a low margin, and complying with it should not pose an unsurmountable barrier to each individual TSO, non-compliance has serious detrimental effects on capacity calculation and market coupling results. It is not unlikely that, in times of general generation scarcity, import-constrained bidding zones (such as France, or Hungary) face difficulties securing electricity imports necessary for reaching an equilibrium between supply and demand. This is not only problematic for importing bidding zones: given the very big differences in size between Core bidding zones, large zones like France have a structural advantage through the flow factor competition effect. This is especially relevant when prices reach the clearing limit, currently at 4.000 €/MWh. Under these circumstances, negative effects resulting from restricted import for the French bidding zone, which in extreme cases may lead to demand curtailment, will undoubtedly spill over to neighboring bidding zones (even those that are exporting) and to the Core region as a whole.

3.4.2. 29 August 2022

49. On 29 August 2022, zonal prices cleared at much lower prices in Poland than in the other Core bidding zones. The maximum spread between the highest and the lowest price was observed at 14:00, when Austria (913,47 €/MWh) was 781,,92€/MWh more expensive than Poland (131,55 €/MWh). In the evening, between 19:00 and 21:00, there was near perfect convergence between the 11 other Core bidding zones while the Polish price was 300 to 400 €/MWh cheaper.

France's net position. In order to verify this statement, a parallel execution of the Euphemia algorithm to recalculate clearing prices and net positions would be needed. In any case, if the imports would go elsewhere, that would imply that there the welfare gain in that other zone is even higher than the one reached by lowering the French prices.

[17] Similar analyses can be made for other bidding zones: during the same day but from 19:00 to 21:00, Hungary surpassed the 1.000 €/MWh mark as well, again caused by network elements with even higher shadow prices caused by IVAs which reduce the RAM to (well) below 20% of F_{MAX}.

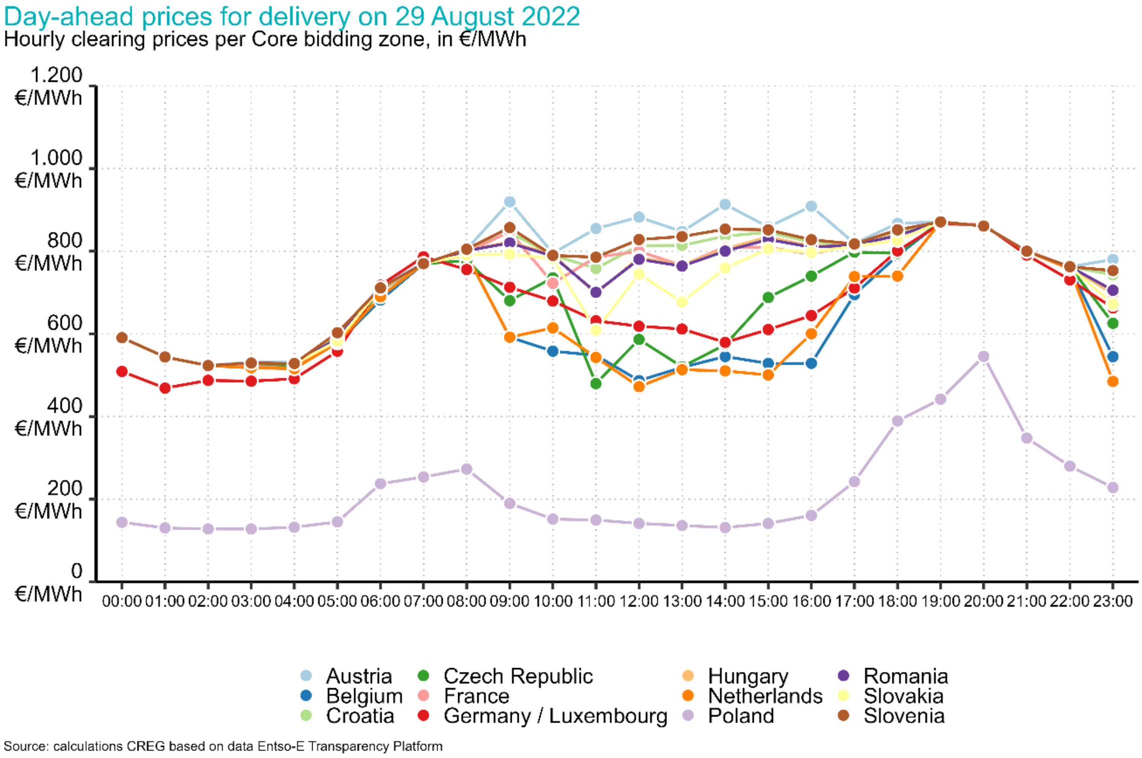


Figure 9 Day-ahead prices for delivery on 29 August 2022

50. Despite these very high price differences, the Polish net export position in the Core region did not exceed 1.100 MWh/h, dropping as low as 612 MWh/h at 14:00 (when the 781,92 €/MWh spread was observed). The maximum net export position was, however, consistently between 4.000 and 5.000 MWh/h throughout the day.

51. We may now focus on hour 20:00, when all other bidding zones converged nearly perfectly (aside from Poland, a 5 €/MWh spread was observed with Germany / Luxembourg, the 10 other zones cleared at 860,69 €/MWh). No active constraints were found during that hour, so no shadow prices can be evaluated to assess the impact of congestion. The allocation constraint for Poland, however, was 0 MWh/h in the export direction for most of the hours (including 20:00) of 29 August 2022. Even though Poland was a net exporter in the Core region, this must have been offset by imports from Baltic and Nordic countries, leading to a net position that was zero or strictly negative. Indeed, the SDAC net position, found on the Entso-E Transparency Platform, was exactly equal to the allocation constraint, in casu 0 MWh/h.

52. This is particularly problematic because the impact of this restriction in the net position cannot be quantified in the same manner as the impact of congestion on a network element. This is exactly the benefit of a flow-based approach over an cNTC-based approach: the shadow price on a network element indicates the welfare loss from the restriction of cross-zonal capacity. We cannot estimate how much welfare would have increased by allowing massive exports from Poland to their neighbouring bidding zones – but given the price spreads and the near perfect convergence in other zones, this is likely to be very significant.

53. Especially in the current context, where the coal-fired power generation in the Polish bidding zones is at a strong competitive advantage over gas-fired production (given the actual and forecasted clean dark and spark spreads), it can be expected that this restriction of export will continue to lead to significant welfare losses for other (Core) bidding zones.

4. CONCLUSION

In this study, the CREG presented its assessment of the operation of the Core DA FBMC Project, which went live on 8 June 2022 for delivery on 9 June. Despite its operational success, the CREG identified severe concerns regarding the application of two particular mechanisms: the individual validation reductions as well as the application of allocation constraints.

Regarding individual validations, it can be shown that, despite the intention to limit this to exceptional, well-defined circumstances, they are applied structurally by many Core TSOs. For some of these TSOs, this leads to reductions well below the minimum threshold, being 20% of an elements' maximum capacity. This is most often the case as a result of severe validation adjustments applied by the TSOs participating in the DAVinCy validation project. This allows to reduce margins on one of the participating TSOs' network elements to solve overloads on another TSOs' elements, even if these elements are not selected in the coordinated capacity calculation process.

Regarding allocation constraints, the available data demonstrate that these are applied in Belgium and Poland, yet to a different extent. While they are hardly ever limiting the net position of Belgium, the Polish export allocation constraint is set to zero in nearly 80% of the considered hours. This artificially reduces the net position of Poland, severely restricting the exports of the bidding zone and artificially reducing the Polish clearing price, at the expense of more expensive generation in neighboring bidding zones.

Both issues can be shown to have a significant impact on the market coupling results. In the identified case studies, the impact of validation reductions and allocation constraints, in particular on bidding zones that do not control these issues, is demonstrated.

The CREG calls upon Core NRAs, ACER and TSOs to immediately implement measures to avoid the most detrimental impacts of these artificial capacity reductions. In particular:

- The application of individual or coordinated validation adjustments should be limited to what is strictly necessary for operational security and should not be applied structurally as a default option;
- Individual and coordinated processes, in particular the DAVinCy process but also each individual TSOs' validations, should be published transparently, in order for regulatory authorities and stakeholders to be able to assess their impact and understand the functioning of the Core DA FBMC as a whole;
- The 20% minRAM principle, which establishes a minimum margin to be given to exchanges in the Core DA FBMC, should be an absolute minimum, not even to be violated in case of individual validation adjustments. This should be maintained as a principle by Core TSOs in the short term, and inscribed in the ACER methodology in the medium to longer term.
- Despite the transitory nature of the allocation constraints, the CREG calls upon Elia and PSE to commit to immediately stop its application, hence allowing electricity to flow, without artificial restrictions, into and out of bidding zones.

The CREG is of the opinion that these measures are indispensable to the efficient, fair and non-discriminatory functioning of the Core DA FBMC and may be considered as a crucial lever to address the current challenges in European electricity markets.

For the Commission for Electricity and Gas Regulation

Andreas TIREZ Director	Laurent JACQUET Director	Koen LOCQUET Acting Chairman of the Board of Directors