Background

- ACER decision 03/2024 amended the ID CCM and introduced requirements to:
  - Analyze possible measures to increase cross-zonal capacities in the intraday timeframe, and over time, to reach the minimum capacity threshold of 70% pursuant to Article 16(8) of the Regulation (EU) 2019/943
  - Submit the related amendment proposals by 1 October 2025
- On 06/06 Core TSOs submitted to NRAs and ACER
  - Final common report of the Intraday Flow-based Capacity Improvement Study
  - Individual reports
  - Report on alternative BZ configuration
- During Core CG 27/05, MPs requested Core TSOs to provide more detailed CIS results

Core TSOs prepared material to inform external stakeholders on the outcomes of the Core IDCC capacity improvement study

The material is structured as follows

- Introduction to pre-congestions and its impact on ID capacity calculation
- Scope of the study
- Investigated measures
- Implementation timeline of planned improvements

IDCC CIS

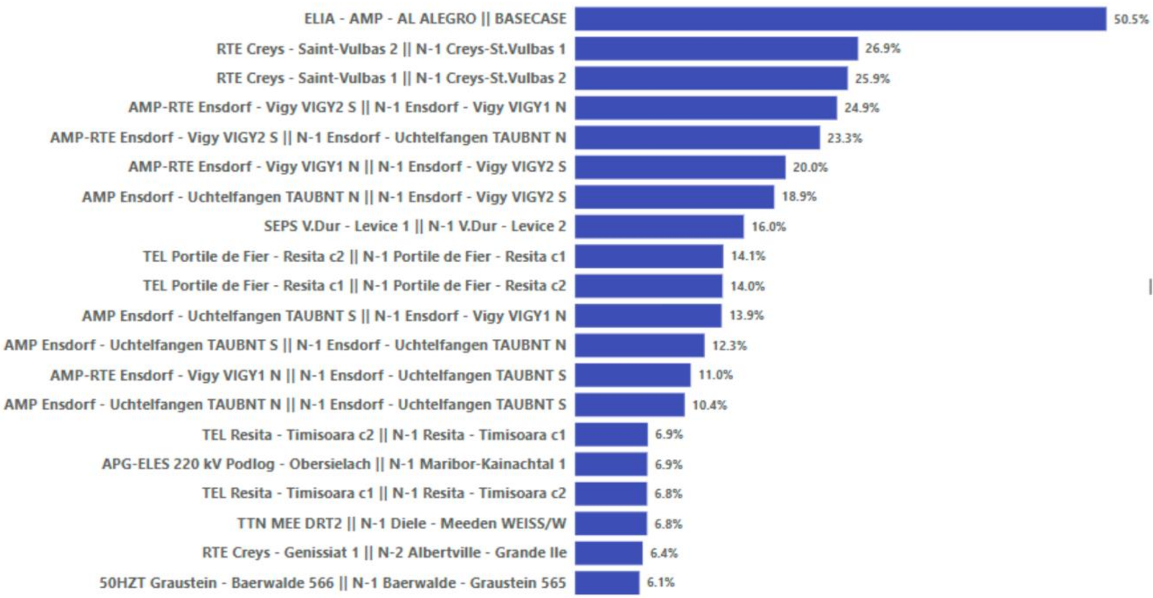
Introduction to pre-congestions and its impact on ID capacity calculation

General

- Pre-congestions in the DACF grid models of the IDCC(b) process have a impact on available ID capacities.
  - CNEs are considered as pre-congested and or negative and have at least one zone2zone PTDF > 3%
- A biddingzone is isolated when there is no transmission capacity available in both the import and export direction.
  - Multiple pre-congested CNECs can lead to bidding zone isolations in case these CNECs are sensitive (zone2zone PTDF) to the import and export direction
- Focus of the study was on the reduction of pre-congestions to avoid bidding zone isolations and increase ID capacities for all borders while checking how close ID capacities can get to 70% (ACER target)

A dedicated KPI for pre-congestions has been developed to assess the initial situation prior to the start of the study. However, since not all investigated measures directly affect the pre-congestions of the DACF, most KPIs focus on the impact on bidding zone isolations and the resulting ID capacities.

Top 20 pre-congested CNECs – based on the initial FB domain



- Percentage of pre-congestions = # congested hours / # total hours (excluding fallback)
- Period: Since IDCC(b) go-live (29/05) until 31/12/2024
- Granularity: 15 min

- ALEGrO is the CNE with highest values across all borders since go-live: it limits the BE>DE trades around a third of the time, the DE->BE trades less often. It indicates that the market has previously utilized the capacity fully
- Taubental' (Ensdorf<->Uchtelfangen) grid elements are pro-forma internal CNECs of Amprion but practically topological extensions of the Vigy interconnectors between France and Germany. Therefore, Taubental and Vigy grid elements should be considered as one cross-border congestion instead of internal congestions when interpreting the results.

Pre-congestions are responsible for limited ID capacities and predominantly located across the BE, DE, FR, NL, SK and RO borders. The Top 20 pre-congestions determine the initial level of capacities for the reference scenarios in this analysis. Nonetheless, additional pre-congested CNEs and regions not mentioned in the Top 20 and other CNEs with low positive RAM values impact the available ID capacities.

Core TSOs harmonised the approach for the Capacity Improvement Study of the common and individual assessments

- Potential impacts on the capacity calculation methodology can be differentiated into short-term and long-term effects:
  - Short-term: Does not require an amendment of the ID CCM
  - Long-term: Requires an amendment of the ID CCM
- The figure shows high-level how compliance with the study requirements has been reached

Art 25(2)
Common assessment

- Ignore marginal PTDF values in case of FB to ATC conversion.
- Remove interconnectors with non-Core BZs from the list of CNEs
- Activate remedial actions closer to real time

Art 25(3)
Individual assessment

- RAs activated closer to Realtime
- Further potential refinements of capacity calculation principles & data
- Targeted investments contributing to min. capacity requirements on specific CNECs
- Alternative bidding zone configurations

Short-term improvements
- ATC parameter optimisation
- Removal of interconnectors with non-Core bidding zones from CNEC list.

Short term improvements:
- RAs in CGMs/RA optimisation
- Process and IT optimisation

Long-term improvements
- Increase of FB domain

- Core TSOs have performed an analysis on the alternative BZ configurations by extracting quantitative data from the BZR study
- Targeted investment are part of the individual analyses.

The results and conclusions of the investigated measures will be presented in the following slides

Investigated measure: Relaxation of PTDF threshold for IDCC(a) from 0.5% to 1%

Art 25(2) Common assessment			Art 25(3) Individual assessment			
Ignore marginal PTDF values in case of FB to ATC conversion.	Remove interconnectors with non-Core BZs from the list of CNEs	Activate remedial actions closer to real time	RAs activated closer to Realtime	Further potential refinements of capacity calculation principles & data	Targeted investments contributing to min. capacity requirements on specific CNECs	Alternative bidding zone configurations

Approach

- Core TSOs recalculated the IDCC(a) process using different thresholds for PTDF filtering, setting smaller PTDF values to zero and using different RAM thresholds as the upper activation limit for the filtering.
- Analysis of the results with focus on:
  - Increase of ATCs (average ATC, frequency of zero/negative ATC per border)
  - Potential grid security issues due to neglected flows i.e. additional flows not monitored in capacity calculation due to PTDF filtering
  - Bidding zone Isolation analysis (Import, Export and both directions)

Conclusion

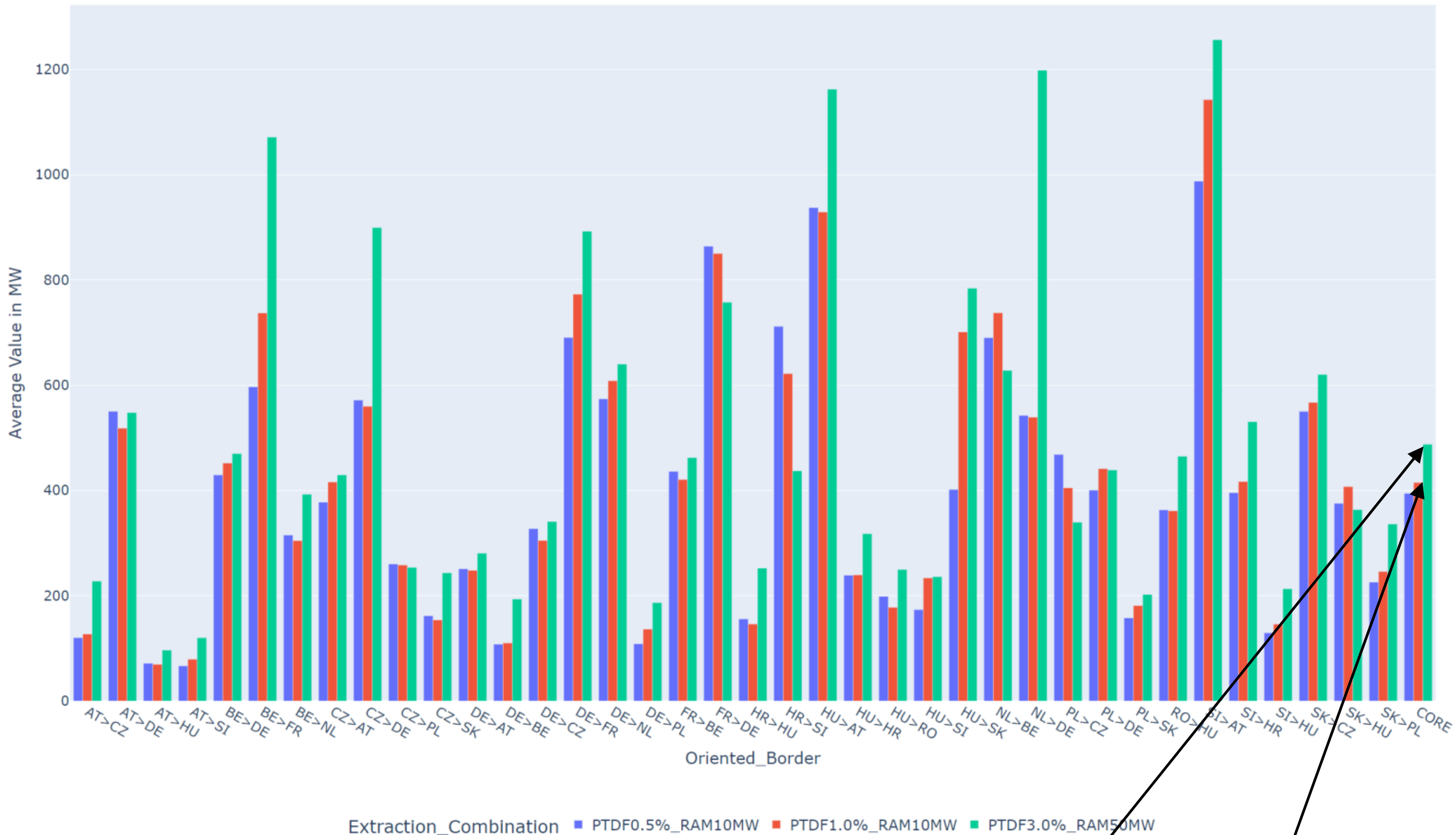
- Positive impact on ID capacities that can be offered after IDCC(a)
- The impact on the neglected flows is considered acceptable regarding operational security.

Core TSOs concluded to increase the PTDF threshold for IDCC(a) from 0.5 to 1% starting for BD 01/08. More details of this analysis including impact on ID capacities and bidding zone isolations can be found on the next slides

IDCC CIS

Investigated measure: Relaxation of PTDF threshold for IDCC(a) from 0.5% to 1%

IDCC(a) – Total average ATC per oriented border – RED bar is relevant for implementation



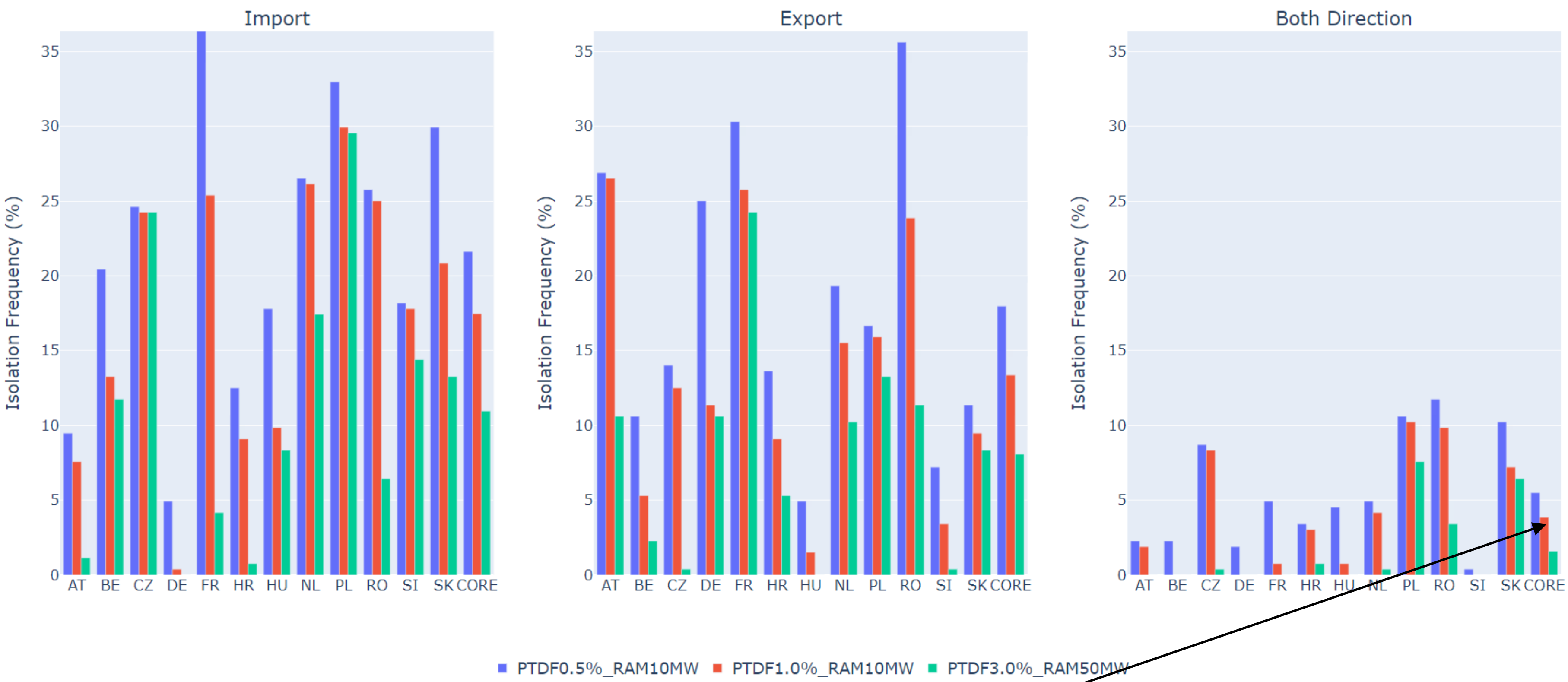
Observations

- The total average (positive and zeros) ATC increase in Core region increase from ≈ 394 MW to ≈ 415 MW when shifting from 0.5% PTDF to 1% PTDF (same RAM_ID 10MW).
- The total average (positive and zeros) in ATC increase from ≈ 394 MW to ≈ 488 MW when shifting from 0.5% PTDF to 3% PTDF and RAM_ID 50MW.

IDCC CIS

Investigated measure: Relaxation of PTDF threshold for IDCC(a) from 0.5% to 1%

IDCC(a) – BZ Isolation analysis (Import, Export and both Directions) – RED bars are relevant for implementation



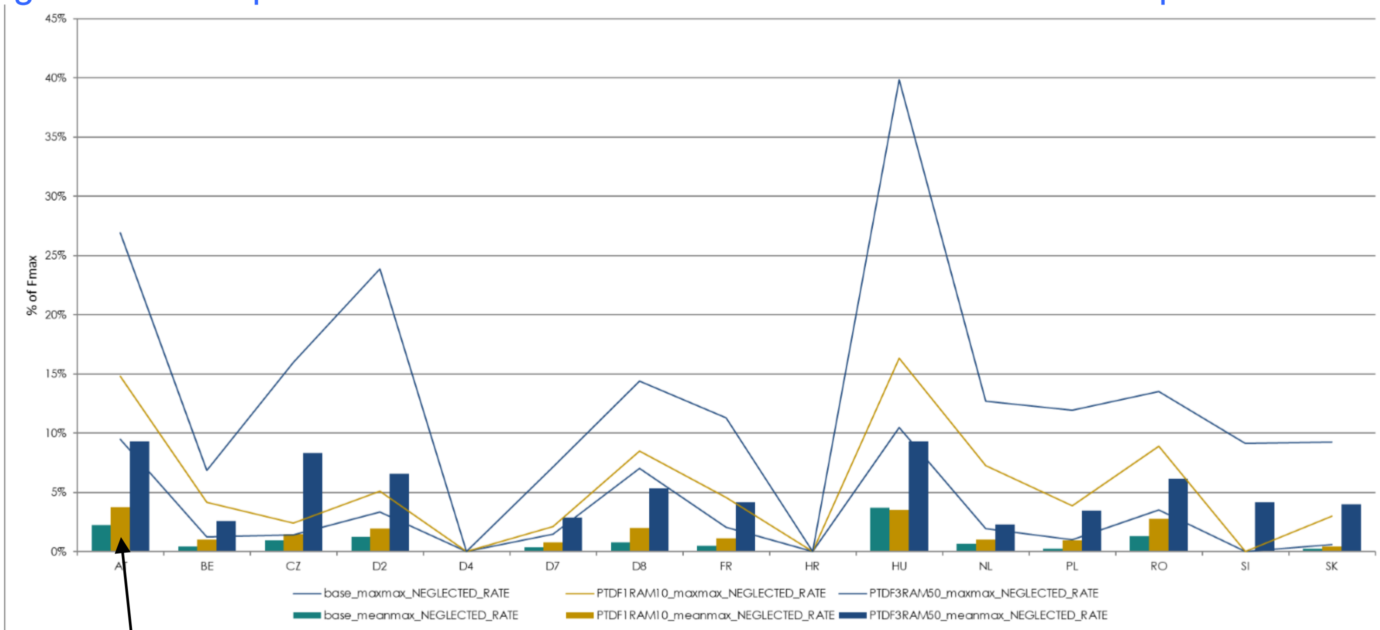
Observations

- Increasing the PTDF “unblocks” more borders at the “trade-off” of having less total positive average ATC.
- The isolations in both directions reduce from 5.5% to 3.85% when increasing the PTDF from 0.5% to 1%

IDCC CIS

Investigated measure: Relaxation of PTDF threshold for IDCC(a) from 0.5% to 1%

IDCC(a) – Neglected Flows per Control area – Yellow lines and bars relevant for implemenation



KPI explanation:
- *MeanMax: Mean of maximum neglected flows for all CNECs of a TSO*
- *MaxMax: Maximum of maximum neglected flows for all CNECs of a TSO*

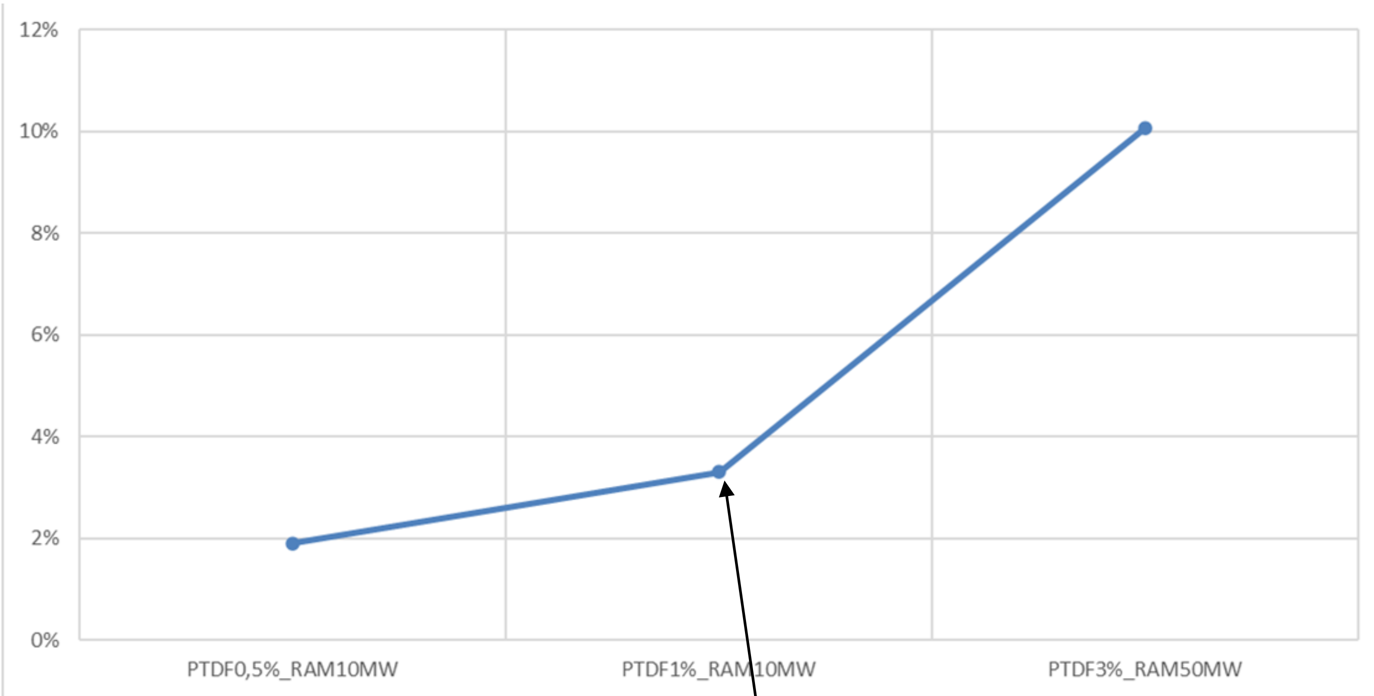
- Neglected flows are induced flows on a CNE that result from intentionally ignoring small PTDFs (from a BZ to a CNE) for the ATC extraction process. It is applied for CNEs that fall below a predefined (low) RAM.

Observations

- There is a relevant increase of neglected flows when shifting from current prod extraction parameters (0.5% PTDF and 10MW RAM_ID) to 1% PTDF and 10MW RAM_ID.
  - For example for AT the neglected flows increase from around 2% to 4% in average (average of maximums per hour)
  - The dotted lines represent the maximum value within the range of analysed BDs for each BZ showing significant difference in some cases such as HU for example where it goes from around 10% to around 16%

Investigated measure: Relaxation of PTDF threshold for IDCC(a) from 0.5% to 1%

IDCC(a) – Mean of maximum neglected flows for all CNECs of the Core Region



Observations

- There is an average increase for CORE Core from around 2 % to around 3.5% in the neglected flows when shifting from 0.5% PTDF and RAM_ID 10MW to 1% PTDF and RAM_ID 10MW.

Investigated measure: IT and Process optimization for IDCC(b)

Art 25(2) Common assessment			Art 25(3) Individual assessment			
Ignore marginal PTDF values in case of FB to ATC conversion.	Remove interconnectors with non-Core BZs from the list of CNEs	Activate remedial actions closer to real time	RAs activated closer to Realtime	Further potential refinements of capacity calculation principles & data	Targeted investments contributing to min. capacity requirements on specific CNECs	Alternative bidding zone configurations

Approach

- Core TSOs considered the effect of process and IT changes to improve the capacities offered in Core IDCC(b) by reducing process timings to use later and better quality DACF CGM (Day Ahead Congestion File Combined Grid Models)
- Analyze existing DACF version provision to the IDCC(b) process, identify time savings, and rerun computations using the potential later DACF provision.
- Effect on ID ATCs and bidding zone isolations has been analyzed

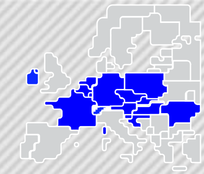
Conclusion

- Timing analysis indicates that time savings of 12-24 minutes can be achieved in the IDCC(b) process due to improvements since its go-live and anticipated future enhancements. For optimal process stability, a delay of up to 16 minutes is considered most appropriate.
- The timing improvements can be used for a later DACF provision to IDCC(b) in roughly 30% of the analyzed BDs
- Using later DACF version reduces the amount of zero and negative ATC and bidding zone isolations

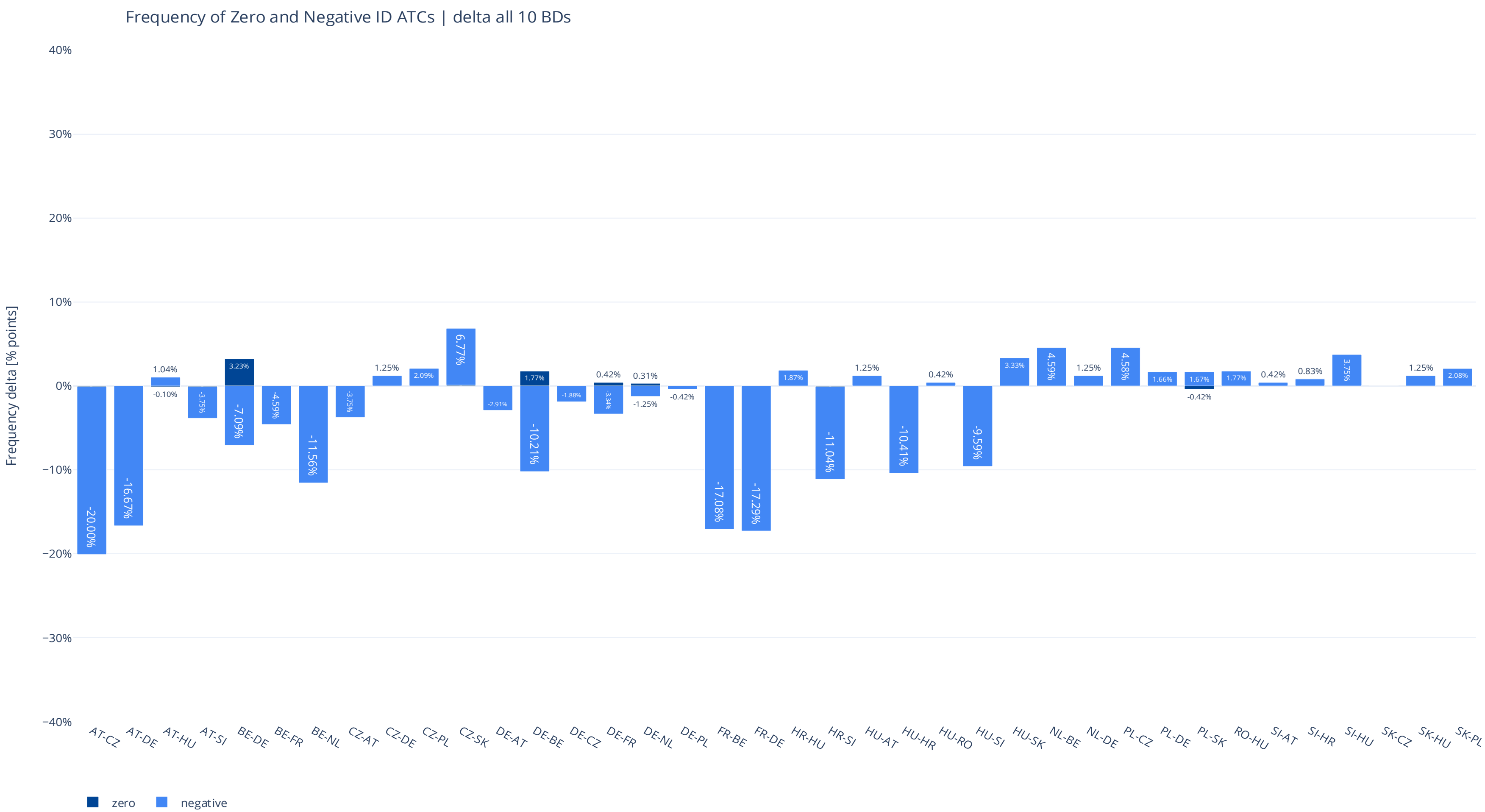
Core TSO concluded to implement the investigated IT improvements and usage of later DACF. More details of this analysis including impact on ID capacities and bidding zone isolations can be found on the next slides

IDCC CIS

Investigated measure: IT and Process optimization for IDCC(b)



KPI delta, negative value is improvement here!

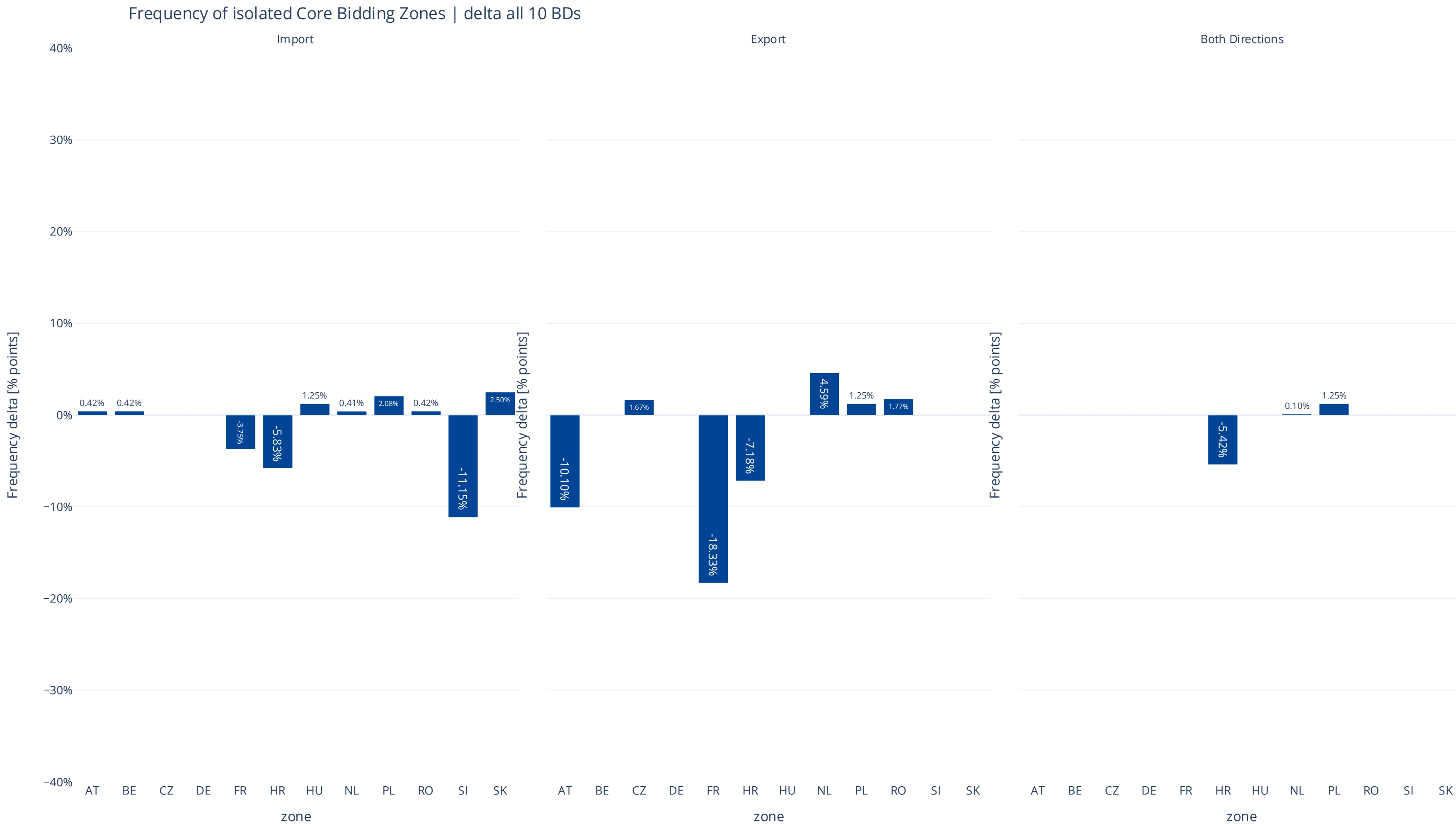


- The amount of zero or negative ID ATCs decreases for most of the borders when using later DACF

IDCC CIS

Investigated measure: IT and Process optimization for IDCC(b)

KPI delta, negative value is improvement here!

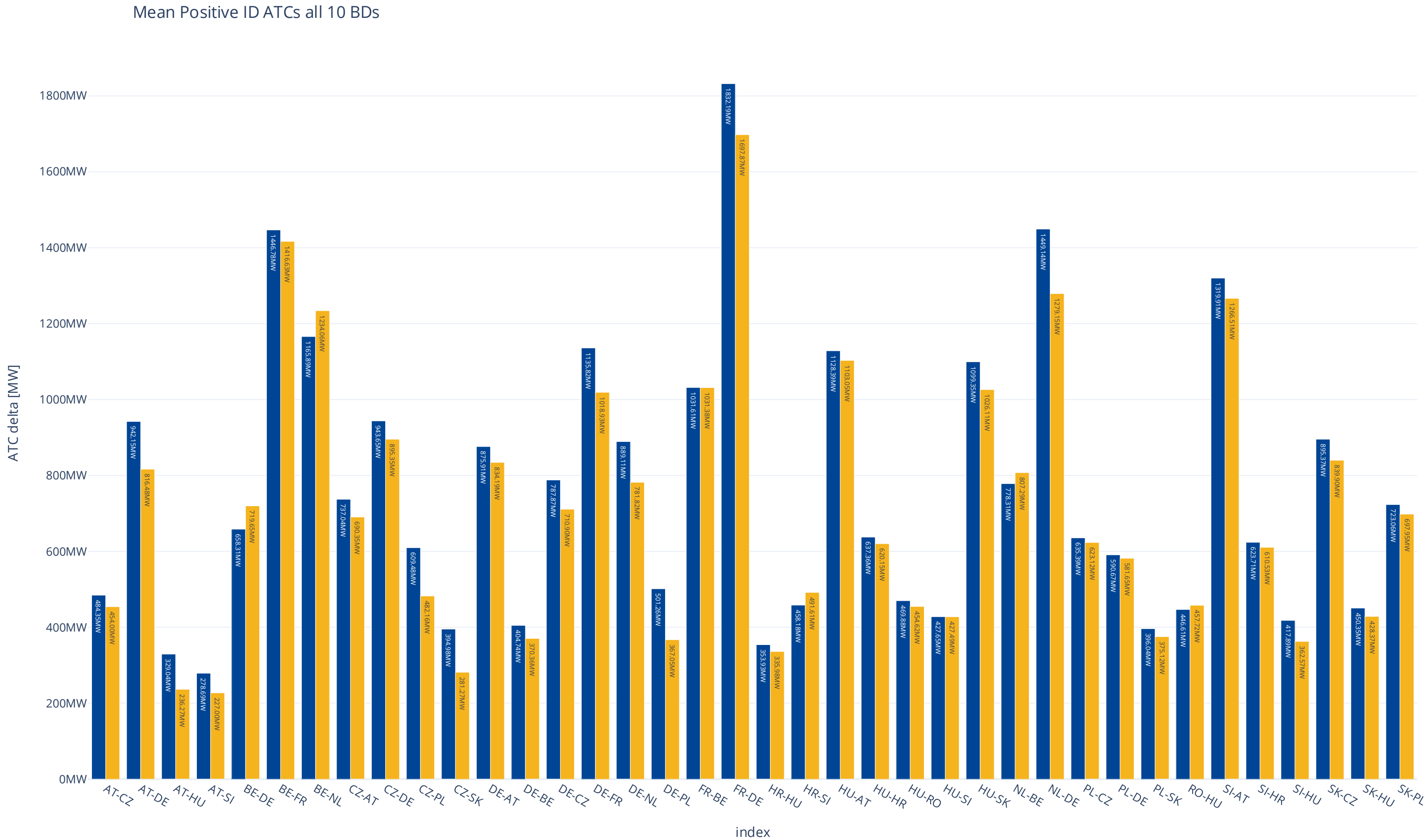


- The amount of bidding zone isolations decreases for most of the border directions when using later DACF, in particular the export direction for FR

IDCC CIS

Investigated measure: IT and Process optimization for IDCC(b)

KPI (mean positive ATCs)



- Mean positive ID ATCs are decreasing for several borders due to the general decrease of zero/negative ID ATCs, and of BZ isolation when using later DACF i.e. "after". Reopening border-directions that were closed during the BDs in production necessarily decreases the ID ATC levels on other borders. Instead of having only a few open border-directions with high ID ATCs, there are more open border-directions with in general slightly lower ID ATCs.

IDCC CIS

Investigated measures

Investigated measure: Increase of FB domain

Art 25(2) Common assessment			Art 25(3) Individual assessment			
Ignore marginal PTDF values in case of FB to ATC conversion.	Remove interconnectors with non-Core BZs from the list of CNEs	Activate remedial actions closer to real time	RAs activated closer to Realtime	Further potential refinements of capacity calculation principles & data	Targeted investments contributing to min. capacity requirements on specific CNECs	Alternative bidding zone configurations

Approach

- To investigate the activation of remedial actions closer to real-time, TSO analyzed the implementation of two different methods of virtual capacities in ID to increase the initial FB Domain and thus ID capacities.
- For both potential measures i.e. minATC & minRAM a PoC was conducted followed by a general assessment and additional individual TSO assessments focusing on grid security aspects. All potential virtual capacities need to be safeguarded by remedial actions that can be activated after the ID CZGT.

Conclusion

- While the MinATC and MinRAM approaches offer different pathways to increase intraday capacities, their successful implementation depends on addressing grid security challenges, ensuring operational feasibility, and performing thorough validations in limited time.
- Both approaches come at the cost of the potential need for significant remedial actions to manage potential overloads after ID CZGT and thus close to real-time. The increased complexity at the local level due to virtual capacities requires extensive validation and coordination efforts, make grid security management more challenging. There is a potential increased risk that insufficient or mismanaged RAs could compromise grid security, especially if forecast errors or unexpected conditions arise.

Conclusions continued

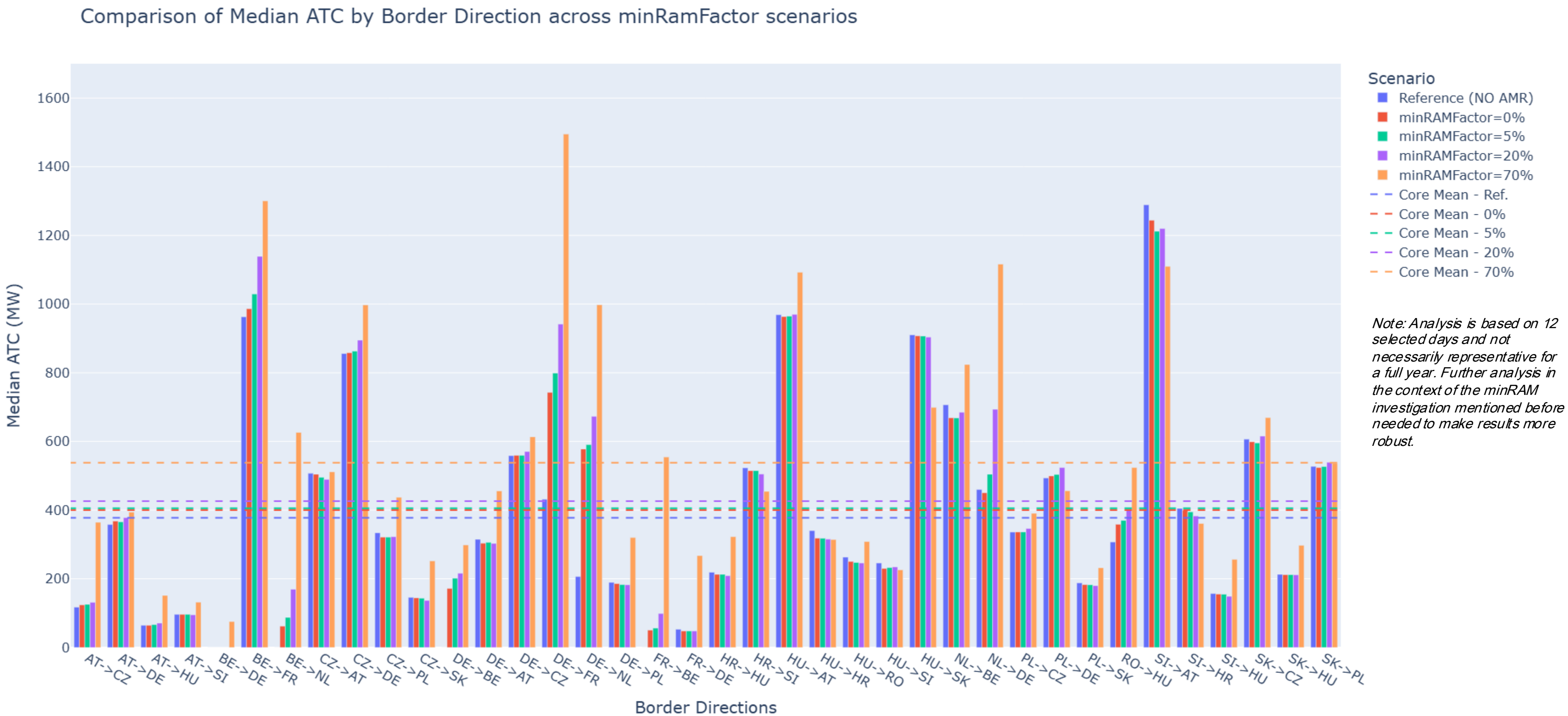
- In the 70% scenario, virtual capacity utilization is much more intense than in MinRAM scenarios up to 20%, raising concerns about the feasibility of implementing MinRAM 70% in intraday as suggested by ACER. The MinRAM approach would require a robust validation setup within a limited 40-minute timeframe and rely on the application of remedial actions after ID CZGCT for which no coordination process exists.
- The minATC PoC showed negative initial results, in alignment with Core NRAs and ACER it has been decided to not further detail the approach.

Core TSOs agreed not to implement the investigated minATC and minRAM approach. More details of this analysis and conclusions including the impact on ID capacities and bidding zone isolations from the minRAM PoC can be found on the next slides.

IDCC CIS

Results before TSO validation!

Investigated measure: Assessment of minRAM application (in line with ACER suggestion)

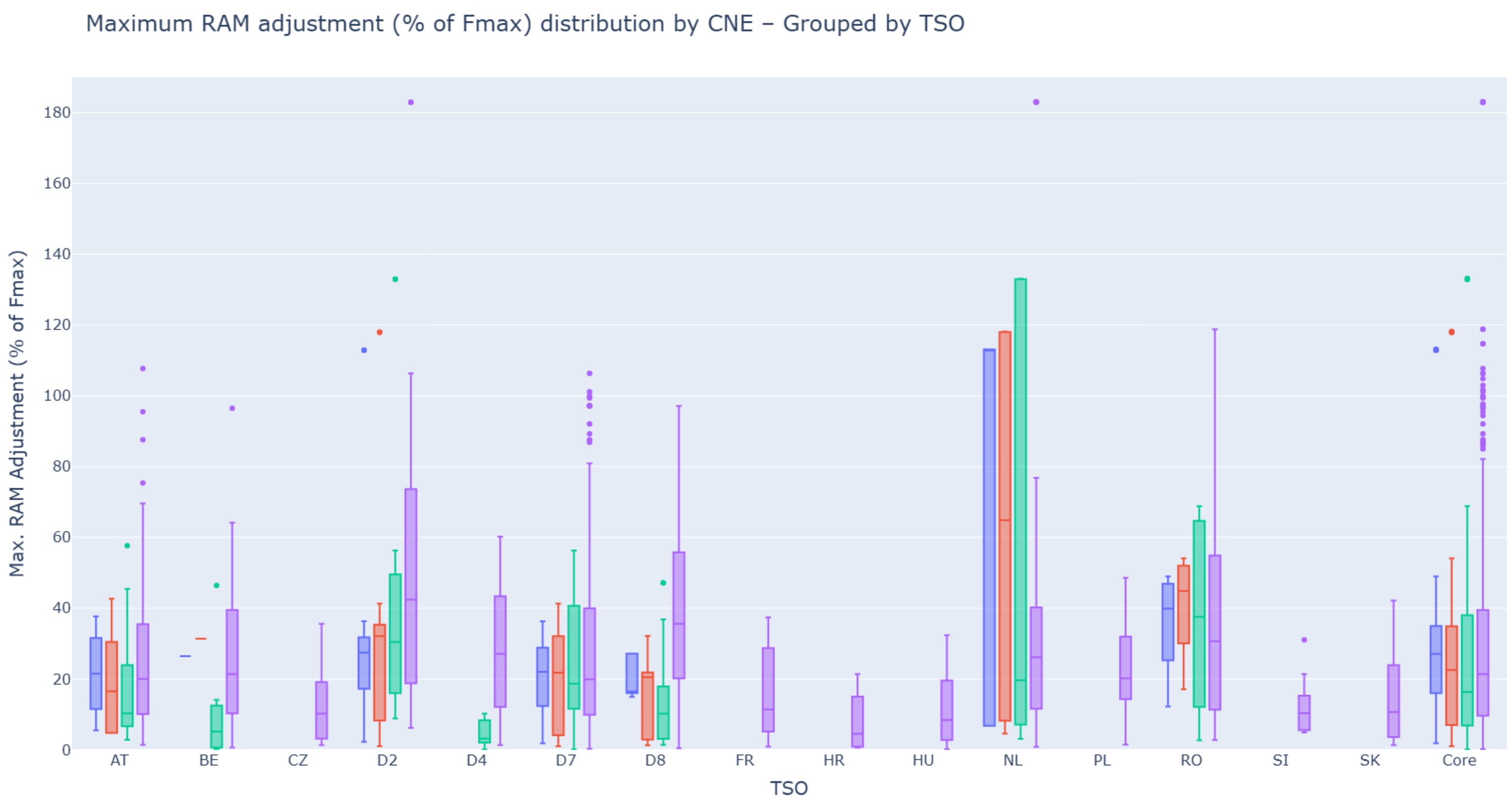


- Application of 70% MinRAM lead to a significant increase of ID ATCs for some borders, in case of high initial ID capacities the values can decrease
- A smaller MinRAM 20% or lower has a noticeable capacity increasing effect for BE-NL, DE-BE, DE-FR, DE-NL, FR-BE and RO-HU borders compared to other borders in Core

IDCC CIS

Investigated measure: Assessment of minRAM application (in line with ACER suggestion)

Results before TSO validation!

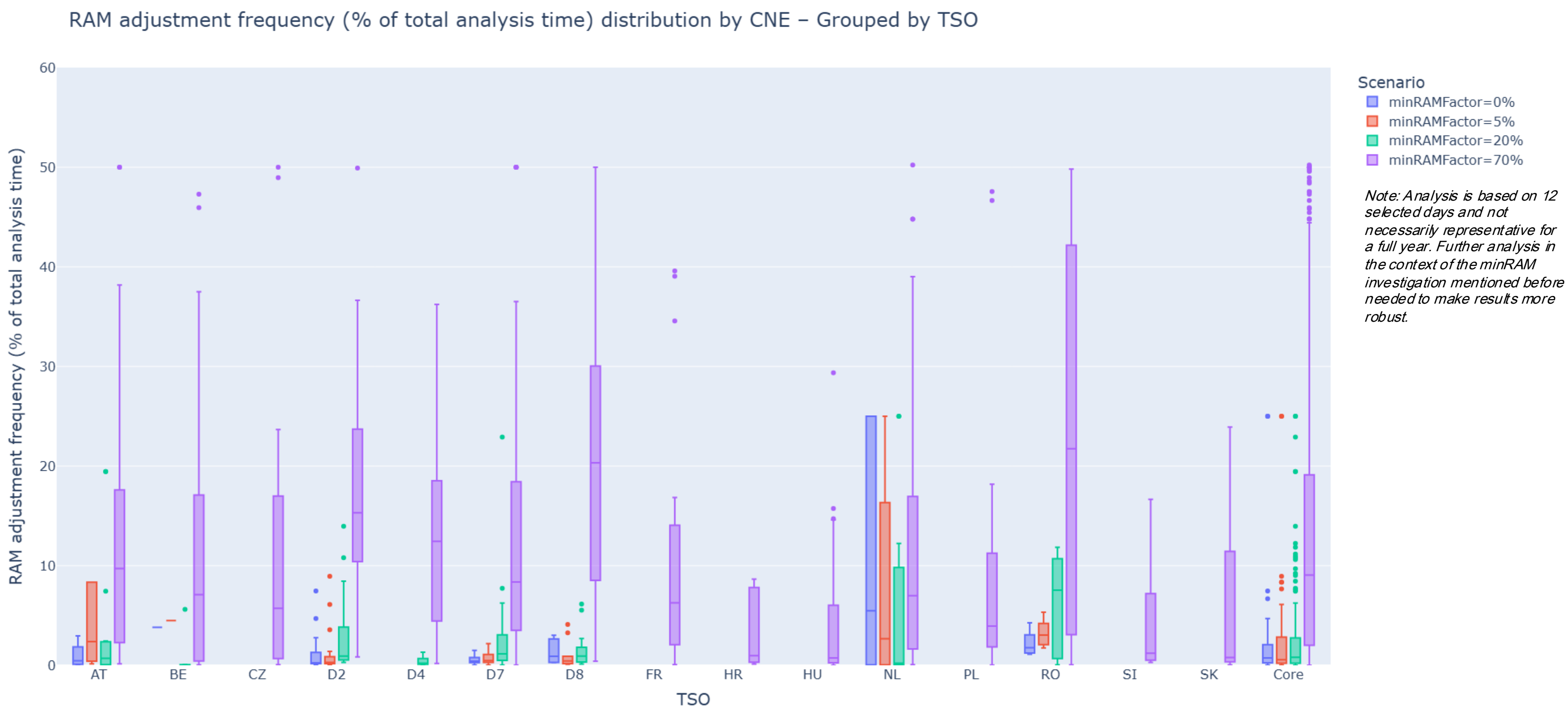


Note: Analysis is based on 12 selected days and not necessarily representative for a full year. Further analysis in the context of the minRAM investigation mentioned before needed to make results more robust.

- CNECs for TSOs require an adjustment of RAM for the 70% MinRAM scenario, for lower values CNECs of AT, BE, NL, RO and DE TSOs are impacted
- Increased maximum adjustments can be observed for higher MinRAM values
- Median RAM adjustments can decrease for higher MinRAM values in case more CNEs are adjusted by smaller values

Investigated measure: Assessment of minRAM application (in line with ACER suggestion)

Results before TSO validation!



- For the 70% MinRAM scenario RAM adjustments are needed up to 50% of the selected 12 days for some CNEs.

Investigated measure: Central (N)RAO study

Art 25(2) Common assessment			Art 25(3) Individual assessment			
Ignore marginal PTDF values in case of FB to ATC conversion.	Remove interconnectors with non-Core BZs from the list of CNEs	Activate remedial actions closer to real time	RAs activated closer to Realtime	Further potential refinements of capacity calculation principles & data	Targeted investments contributing to min. capacity requirements on specific CNECs	Alternative bidding zone configurations

Approach

- A Central approach for RA improvements for IDCC is outlined to enhance ID capacities by incorporating explicit RA in a Core-wide remedial action optimization (RAO) for the IDCC(b) DACF model

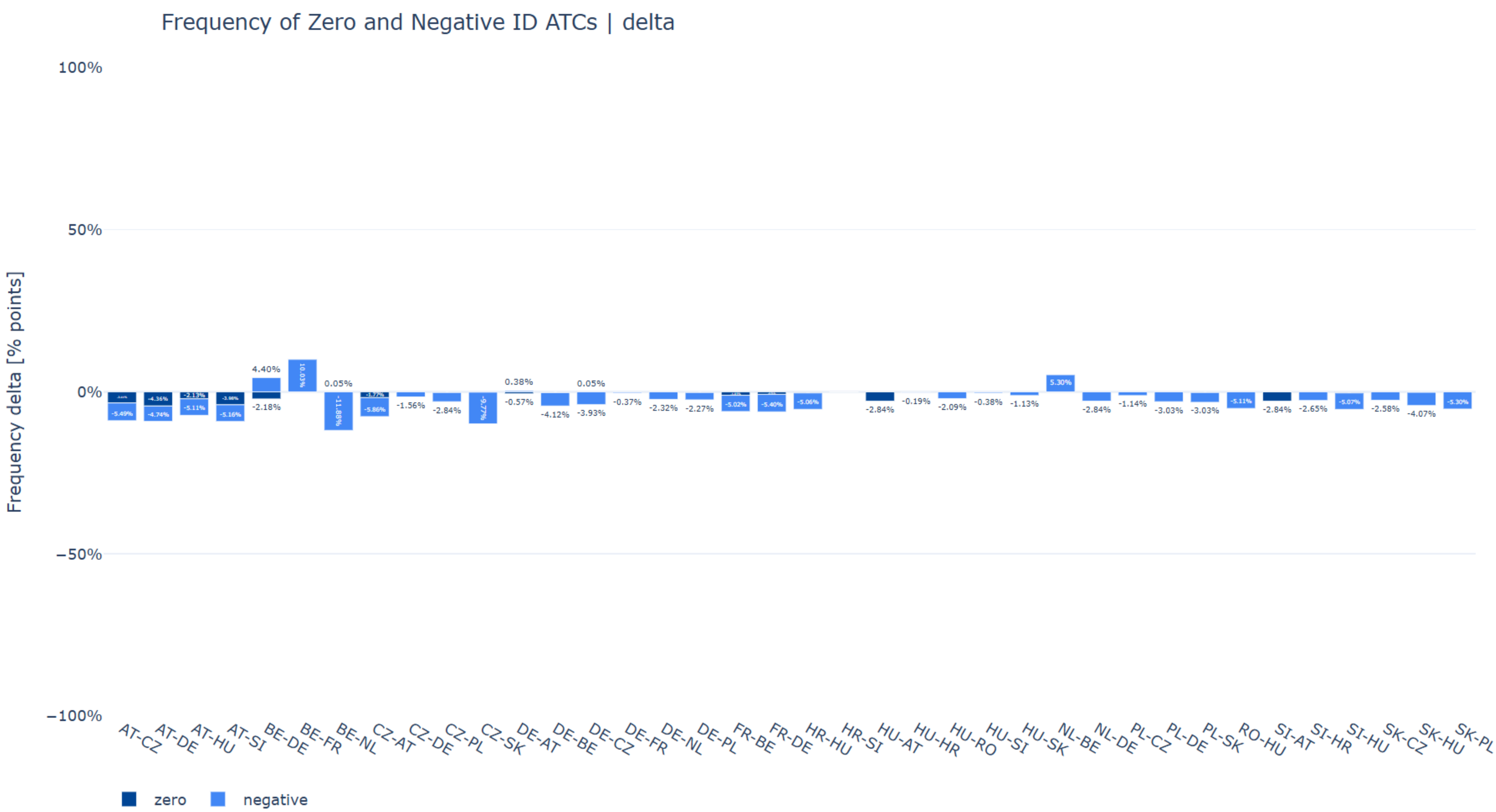
Conclusion

- Outcomes from the NRAO showed limited benefits for reducing pre-congestions and BZ isolations.
- RAO study indicated limited improvements in reducing bidding zone isolation and pre-congestions with RAO implementation although implementing RAO enables centralized application of remedial actions which can result in lower pre-congestions.
- Core TSOs do not view (N)RAO inclusion as effective or realistic for short-term congestion resolution due to:
  - The infeasibility of incorporating RAO within current IDCC(b) timings, potentially causing deviations in IDCC and DACF CSA processes.
  - The incompatibility of creating an operational process with the short-term goal of improving ID capacities.

Core TSO agreed not implement an (N)RAO step in IDCC. More details of this analysis for the NRAO including impact on ID capacities and bidding zone isolations can be found on the next slides

IDCC CIS

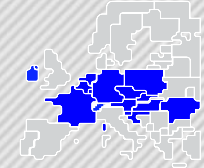
Investigated measure: NRAO results



- Limited impact on zero ID ATC KPI by implementing additional RA from the optimization

IDCC CIS

Investigated measure: NRAO results



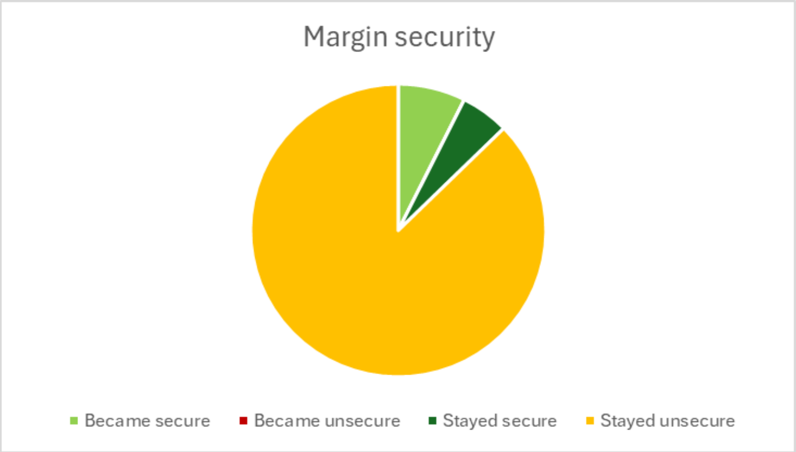
- Limited impact on bidding zone isolations by implementing additional RA from the optimization

IDCC CIS

Investigated measure: NRAO results

The NRAO demonstrates limited effectiveness in resolving pre-congestions, as in most cases, the overloads cannot be mitigated, remaining in negative RAM.

- In 8% of the studied TS, the network situation became secure (No more CNECs with negative RAM)
- In 5% of the studied TS, the network situation stayed secure and the NRAO improved the lowest RAM.
- In 87% of the studied TS, the network situation stayed unsecure (at least one RAM stayed negative) but the lowest RAM was improved.



On short term, the optimized IT and process for IDCC(b) with later DACF usage is seen as more beneficial and provides more time for additional RA applications to address pre-congestions, both non-costly and costly.

For Core TSOs, the target model is to implement a Core-wide RA coordination through ROSC with Cost Sharing to improve pre-congestions.

Investigated measure: Removal of CNECs ending in non-Core countries

Art 25(2) Common assessment			Art 25(3) Individual assessment			
Ignore marginal PTDF values in case of FB to ATC conversion.	Remove interconnectors with non-Core BZs from the list of CNEs	Activate remedial actions closer to real time	RAs activated closer to Realtime	Further potential refinements of capacity calculation principles & data	Targeted investments contributing to min. capacity requirements on specific CNECs	Alternative bidding zone configurations

Approach

- Perform sensitivity analysis to investigate how much Core trade is transported physically via CNECs ending in non-Core countries.
- Perform FB computations for a day with high amount of pre-solved interconnectors to non-Core bidding zones.
  - Analyze the impact of removing CNECs on capacities.
  - Analyze the impact of removing CNECs on grid security.

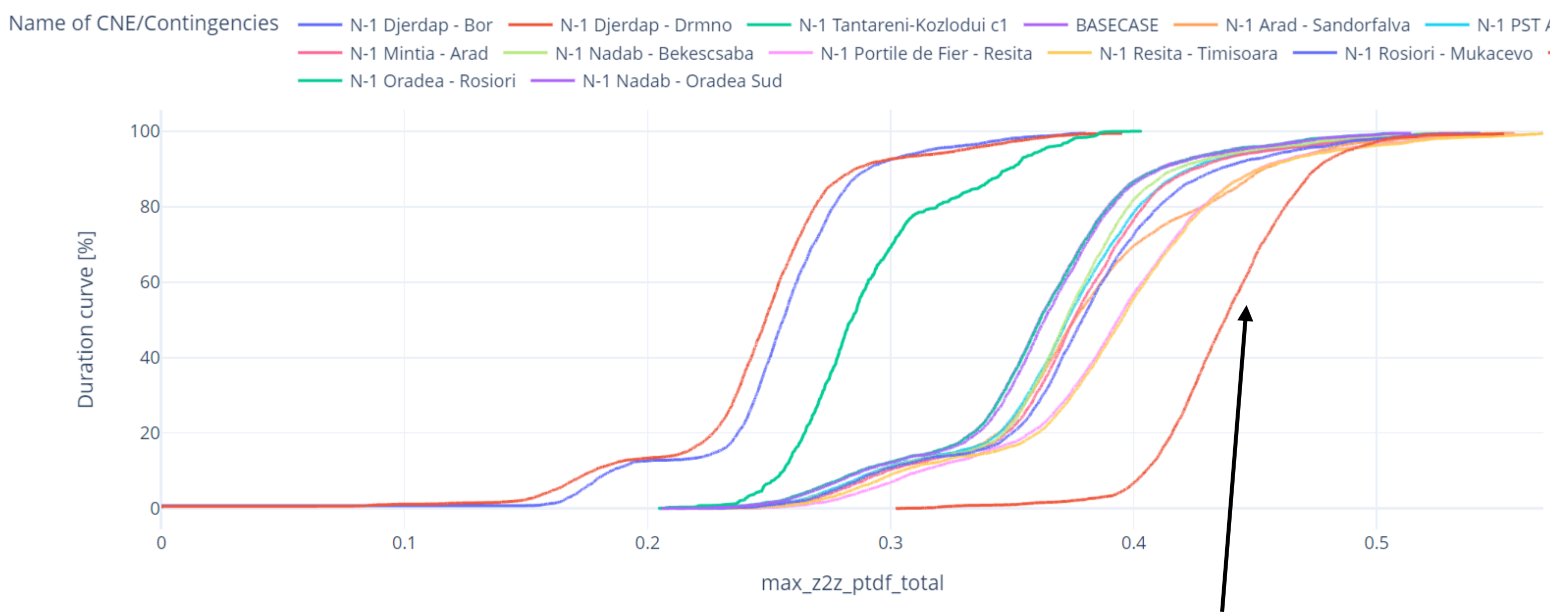
Conclusion

- Removing CNECs ending outside of Core CCR is deemed not feasible due to high impact on operational security.
  - CNECs, despite appearing redundant, are crucial for contingencies and ensure that planned outage situations are properly considered.
  - CNECs ending in non-Core countries are sensitive to Core trade and transport significant electricity between Core hubs.
- The loading is largely influenced by trade within the Core region.
- They comply with the 5% PTDF threshold and minRAM obligations, similar to other CNECs.
- From a physical and grid operations perspective, these CNECs are vital for secure grid operation.

For Core TSO it's necessary to keep interconnectors with no Core bidding-zone as CNEs due to grid security reasons. More details and examples to underline the importance of CNECs to non-Core countries can be found on the next slides

Investigated measure: Removal of CNECs ending in non-Core countries

- CNECs ending outside of Core are quite sensitive to Core trade.
  - Example 1: Up to 50% of the trade between two Core bidding zones will physically flow via the interconnector [RO-RS] Portile de Fier – Djerdap in the N-1 state (graph shows the max zone to zone PTDF of this CNE in different N-1 states in 2024). The graph shows the max z2z PTDF is much larger than the currently used threshold.



- Example: This line shows that the max z2z PTDF of CNEC (N-1 Tan) is above 0.4 most of the time

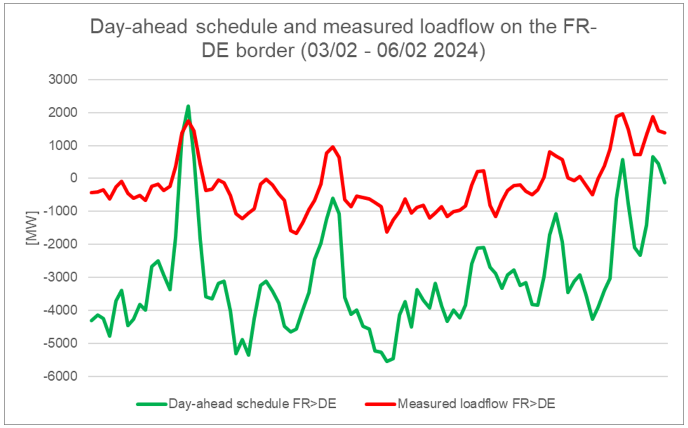
Investigated measure: Removal of CNECs ending in non-Core countries

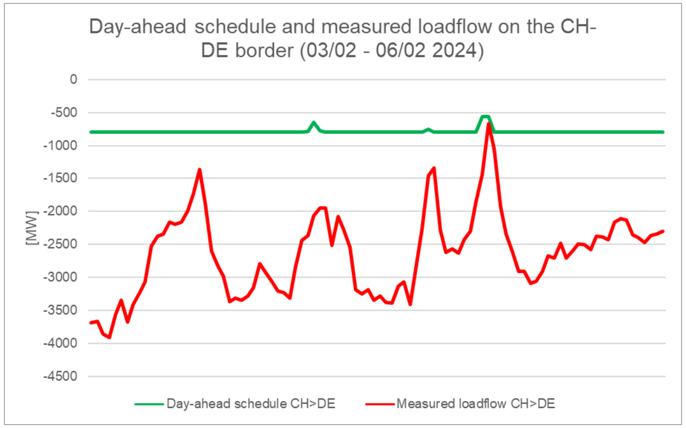
- CNECs ending outside of Core are quite sensitive to Core trade.
  - Example 2: More than one third of the trade between Germany and France flows via Switzerland (PTDFs of DE-CH interconnectors add up to more than 35 %)…

Table 1: Zone-to-zone PTDFs of the largest transmission lines between Germany and Switzerland

CNE	z2z-PTDF DE-FR
[CH-DE] Laufenburg - Trossingen rt	6 %
[DE-CH] Kuehmoos - Laufenburg ge (Seelbach)	14 %
[DE-CH] Kuehmoos - Laufenburg br (Heimbach)	8 %
[DE-CH] Kuehmoos - Laufenburg rt (Murg)	8 %
Sum	**> 35 %**

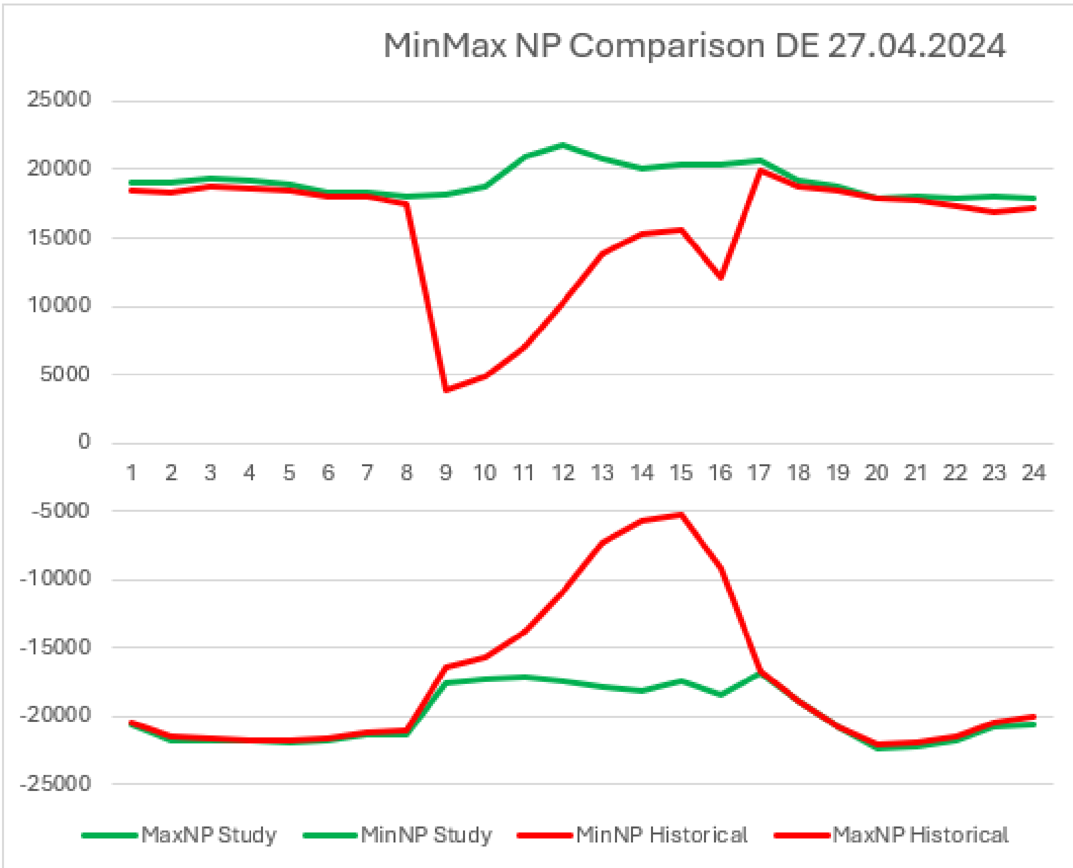
  - …and this materializes in daily grid operation. The graphs show that even low amount of scheduled flow between DE-CH could lead to very high physical flow on this border
    - Left graph: DE-FR border with more than 5 GW schedule (green) but only 0-2 GW of loadflow (red).
    - Right graph: DE-CH border with 800 MW schedule (green) but up to 4 GW of loadflow (red).





Investigated measure: Removal of CNECs ending in non-Core countries

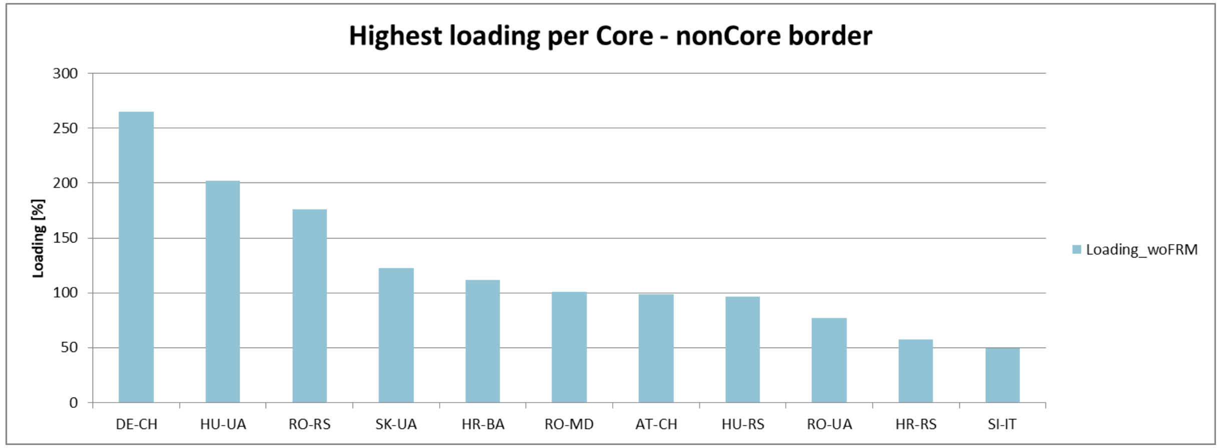
- CNECs ending outside of Core significantly affect the capacities and size of the FB Domain
  - Removing CNECs ending in non-Core countries can drastically change capacities e.g. minimum and maximum netpositions
  - MinMaxNPs increase by up to 14 GW due to the removal of those CNECs (difference between green and red lines).

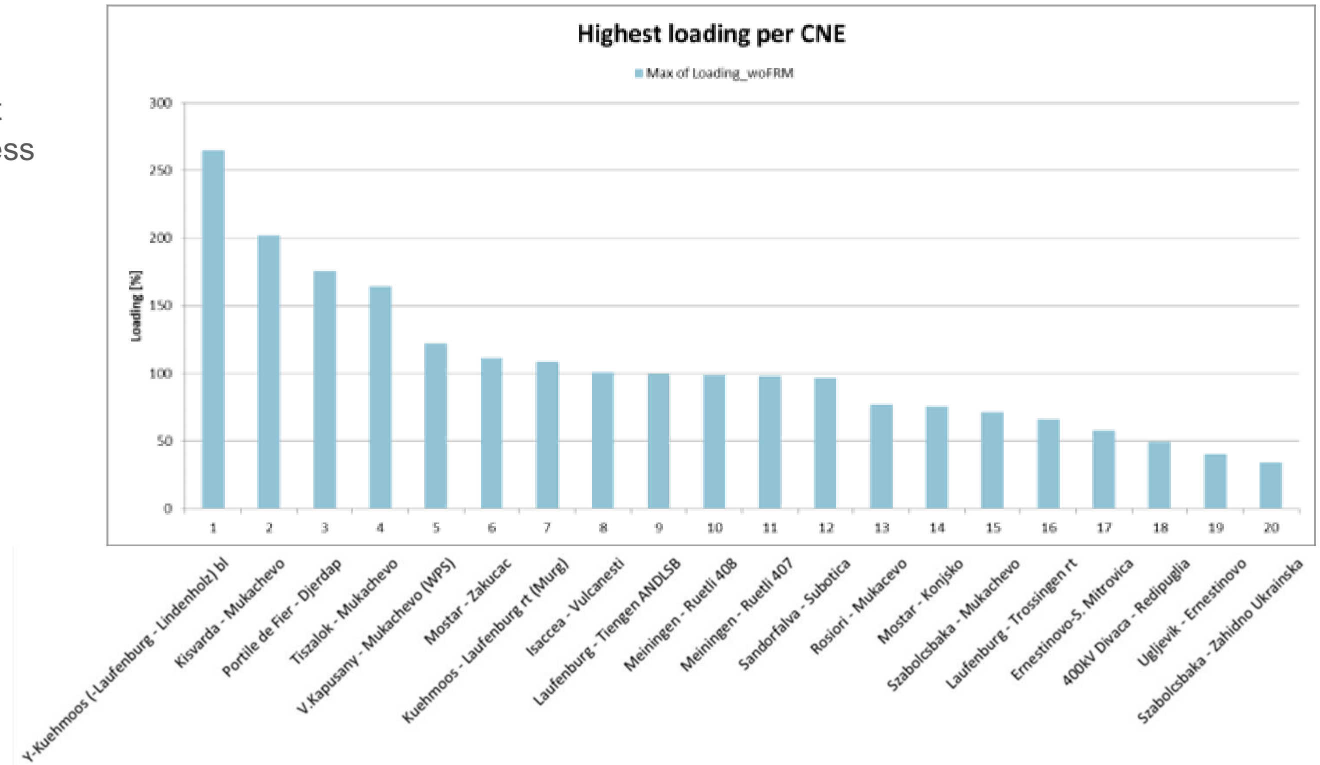


IDCC CIS

Investigated measure: Removal of CNECs ending in non-Core countries

- The capacity increase comes at a high costs for grid security.
  - Vertices of the enlarged domain lead to overloads of more than 250% on the removed CNEs.
  - Vertices of the enlarged domain lead to overloads of more than 250% (e.g Y- Kuehmoos – (Laufenburg-Lindenholz)) on the removed CNEs.
  - If available RAs are not sufficient to cover the overloads, a potential measure could be to apply IVAs but this is considered less robust and less efficient.





Investigated measure: Bidding zone configuration

Art 25(2) Common assessment			Art 25(3) Individual assessment			
Ignore marginal PTDF values in case of FB to ATC conversion.	Remove interconnectors with non-Core BZs from the list of CNEs	Activate remedial actions closer to real time	RAs activated closer to Realtime	Further potential refinements of capacity calculation principles & data	Targeted investments contributing to min. capacity requirements on specific CNECs	Alternative bidding zone configurations

Core TSOs performed an analysis on the alternative bidding zone configurations by extracting quantitative data from the bidding zone review study. Among others, splits of the Germany-Luxemburg bidding zone could lead to some increased margins for ID, while the effects will partly be offset in the near future by targeted investments mentioned above.

- 3-4% increase of RAM on average
- Increase differs depending on the region in which CNE is located. Highest RAM increase is seen on eastern borders of Germany (15-20%), as well as on internal CNECs in Germany and Poland (~5%)
- Note: this increase is assuming a full regional coordination of remedial actions e.g. ROSC in place

At the same time, the investigated bidding zone split does not enable 70% in intraday.

Limitations and disclaimers apply, and for the holistic view on the impact of bidding zone reconfiguration Core TSOs refer to the bidding zone review study.

TSOs concluded on 2 improvement measures for implementation not requiring an update of the ID CCM

- IDCC(a): ATC parameter optimization by increasing the PTDF threshold from 0.5% to 1%
  - Implementation date: Implemented as of BD 01/08

- IDCC(b): Process and IT optimization. Core TSOs concluded to use 16 min of the available time savings for a taking a later DACF in the IDCC(b) process. This is to balance the risk of having a robust process and avoid experiencing process failures in case of delay
  - **Before October 2025**: Implementation of 10 min time savings in the business processes
  - **Q2 2026**: Additional time savings of 6 min to reach to goal of 16 min in total.
  - Core TSOs decided to have this two-folded implementation as a new version of the Core Capacity Calculation Tool which will be deployed in Q1 2026 includes a set of functionalities that require additional process time and TSOs want to reserve sufficient time for these developments.

Complementary measures to improve capacities

- Go-Live of IDCC(c) in June 2025 followed by IDCC(d) go-live in the beginning of 2026 and IDCC(e) go-live later in 2026
- Moving towards a full flow-based allocation for the IDA’s
- In parallel each TSOs is implementing targeted investments

Core TSOs see a need to further reduce pre-congestions and bidding zone isolation for IDCC(b) and plan to further investigate

- Potential minRAM concepts in intraday ID

IDCC CIS

Key Messages individual studies - DE TSOs

The German TSOs focused on three areas which are identified to potentially enable higher intraday capacities

- Remedial Actions
- Grid expansion projects and targeted investments
- GLSK improvement of German TSOs

Remedial Actions

- The ability of German transmission system operators to ensure the secure operation of the transmission grid through remedial actions will increase significantly in the upcoming years.
- In the study, the German TSOs presented 7 HVDCs projects with a total capacity of 18 GW, 9 PST projects and 3 Grid Booster projects with a total capacity of 750 MW.
- This increased flexibility in the operating of the German transmission grid will enhance transmission capacities for the day-ahead and intraday markets.

Grid expansion projects and targeted investments

- The central instrument for grid planning in the German bidding zone is the Network Development Plan Electricity (NDP), which is created every two years by the transmission system operators. The NDP is an outlook to the target year 2045 and defines the expansion of the extra-high voltage grid in Germany for this period.
- The study focuses on analysing how targeted grid expansion measures as they are thoroughly planned in Germany can possibly increase capacities available for cross-zonal electricity trading. In total, more than 250 measures with about 4,800 km of new lines and about 2,500 kilometers of reinforcements are expected until 2037.
- German TSOs would like to highlight that any grid expansion measure will influence day-ahead capacities, which in turn will impact the ID capacities.

GLSK improvement of German TSOs

- The German TSOs are currently implementing further refinements in their GLSK methodology.
- Based on the Core-wide post go-live study, the German TSOs will switch to the country GLSK during the course of 2025.

MinRAM requirements and virtual capacities are not feasible in the intraday timeframe:

- Unlike in the day-ahead timeframe, the intraday timeframe lacks sufficient time and coordination frameworks to activate remedial actions that would safely allow the provision of virtual capacities.

The planned introduction of further IDCC calculations, CROSAs, and flow-based allocation in the IDAs will significantly improve capacity calculation accuracy and enable more reliable ID capacities:

- The introduction of IDCC(c) allows for the use of updated grid models, where more remedial actions have been included, and thus pre-congestions are avoided.
- The introduction of DA and ID CROSAs as part of ROSC will provide a coordinated and decongested grid model as a basis for the IDCC calculations, which in turn will help prevent bidding zone isolation.

Merging Core and Italy North CCRs will reduce complexity and inconsistencies:

- The upcoming integration into the Central Europe CCR will harmonize methodologies, respectively processes and their input data. This will lower the complexity of current validation processes and potentially reduce the number of adjustments, as a comprehensive consideration of all borders becomes simultaneously feasible.

Grid development projects are crucial for long-term ID capacity growth:

- While internal and cross-border reinforcements and new projects benefit all timeframes, they also help relieve critical network elements and thus tend to result in an enlargement of the intraday flow-based domain.
- APG presents 16 projects from the TYNDP 2024 that will help expand cross-border transmission capacities.

Influence of potential bidding zone reconfiguration:

- we found benefits regarding capacity improvements mostly in DE BZ reconfigurations, with DE3 as the best option.
- Analysis of DE3 configuration showed average impact on MACZT levels of 17,3 %

Topology reconfiguration in Podlog substation - in addition to the two common studies (Pre-congested CNECs assessment – approach per TSO and RAs in CGMs/RA optimisation

- we found benefits in decreased BZ isolations and increased average ID ATCs.
- Although we see benefits in terms of capacity improvements, this measure has a negative impact on other parallel lines and weakens the internal grid, thus we see it as not feasible for short-term implementation (not before merging of Core and IN CCRs into CE CCR)

Implementation of DTR on SI-HR border for Fmax determination:

- we found benefits in increased average ATC values on SI-HR border.
- ID ATCs increase on average for 62,4 MW on HR-SI and 71,4 MW on SI-HR border direction.

Target investments – we see the following 4 target investments with high potential to improve overall capacities:

- DV 2 x 400 kV Hrenca – Kozjak,
- PST Divača third unit (600 MVA),
- upgrade of the 220 kV lines Divača-Kleče-Beričevo-Podlog-Cirkovce to 400 kV,
- implementation of STATIC SYNCHRONOUS SERIES COMPENSATOR in Substation Podlog 220 kV (150 MVA).
- Analysis of implementation of the SSSC in substation Podlog showed promising results in all aspects (descreased occurence of negative ATCs, decreased frequency of BZ isolations and increased ID ATCs)

Process and IT optimisation:

- We see clear benefits with later DACF CGM provision and therefore support to further explore options for implementation

ATC Extraction parameter optimisation:

- For IDCC(a) we support using: 1% PTDF & 10MW RAM_ID
- For IDCC(b) we support using: 4,0% PTDF & 50MW RAM_ID

Key Messages individual studies - ELIA

Assessing possible measures (if applicable) to address the pre-congestions:

- The pre-congestions observed in IDCC(b) since go-live, leading to negative/zero ID ATCs and bidding zone isolation, are not frequently observed on Belgian CNECs. Elia integrates already the necessary RAs in its individual grid model.

Assessing the impact of the relaxation of IDCC(b) ATC extraction parameters on Belgium borders:

- The increase of the PTDF threshold for IDCC(b) would significantly reduce the frequency of negative BE ATCs and BE bidding zone isolation (mostly in the import direction) while not jeopardizing grid security as far as BE CNECs are concerned.

Identifying what are the drivers of the virtual capacity usage in a 70% MACZT scenario:

- A 70% MACZT scenario comes along with a widespread use of virtual capacity on BE CNECs, both on cross-border and internal CNECs, mostly driven by loop flows and less by internal flows.
- The alternative German bidding zone configurations assessed help reducing the loop flows on the BE CNECs yet it is not a silver bullet to reach the 70% MACZT without the use of virtual capacity. Grid reinforcements on the Doel-Mercator-Bruegel axis, the internal corridor most prone to the use of virtual capacity, are in execution with planned completion by 2026.

Identifying what are the RA potential to secure the usage of virtual capacities to achieve the goal of 70% MACZT:

- There is a clear distinction between the application of low levels of minRAM (up to 20%) and the application of 70% minRAM. The introduction of minRAM 70% leads to high (up to 1GW) and widespread overloads across the Belgian grid (dozens of CNEs). Combined with the high number of hours requiring IVAs (half of the time), this measure is putting most timestamps at risk.
- The 20% minRAM scenario is beneficial and leads to less extreme situations, with lower and less IVA applications.

The individual study from MAVIR focuses on the ATC limiting elements for the HU borders as well as the 70%minRAM fulfilment

- The results demonstrate the fact that the TOP 20 ATC limiting elements are located outside of the Hungarian bidding zone (HU BZ) during the IDCC(a) and IDCC(b) process, except one cross-border element, that appears.
- MAVIR recommends an increase of the PTDF filtering threshold to at least 1% in IDCC (a) and further assessing a potential increase in IDCC (b).

The study also covers the statistical analysis on the 70%minRAM fulfilment

- The analysis shows that the 70%minRAM non-fulfilment rate is considerably lower when the analysed CNECs are taken from the group of flow-based domain limiting constraints (pre-solved)
- The correlation between the frequency of ATC capacity limitation and 70%minRAM non-fulfilment also demonstrates the fact that even if there are elements that do not provide 70%minRAM, they do not primarily limit the ATC capacity.

Any virtual capacity introduction in the intraday timeframe undoubtedly carries an increased risk of compromised grid security

- For several network elements the RAM may be limited to maintain operational security.
- For an increase of the RAM the key is the improvement of security coordination in the Core CCR with the implementation of ROSC, as well as the realisation of the listed network investments at least.

PSE study focuses on grid expansion projects and targeted investments.

- The central instrument for grid planning in Poland is the National Gric Development Plan. The plan is updated every 2 years and outlines key investment directions and infrastructure needs over the medium- and long-term horizon. The analysis is based on the plan.
- Many of the investments are located in the western and southern parts of Poland and will increase both DA and ID capacities. The study highlights both the investments targeted to improve cross-zonal capacities and investments which will positively impact capacities as secondary objective.

Key Messages individual studies - SEPS

SEPS's individual capacity improvement study focuses on targeted investments, with particular emphasis on topological changes at the Veľký Ďur and Levice substations.

- These efforts aim to enhance both the reliability and transmission capacity of critical network elements, including the deployment of Dynamic Line Rating (DLR) systems.
- A detailed analysis of these investments indicates that Available Transfer Capacity (ATC) could increase during most periods of the year.
- However, introducing virtual capacity in the intraday timeframe inherently increases the risk of compromised grid security. To mitigate this, SEPS identifies additional potential for capacity enhancement through the targeted adjustment of the rLTAincl and rAMRid parameters, enabling more effective ATC extraction.
- The provision of virtual capacities in the intraday timeframe presents particular challenges in terms of maintaining grid security. As such, applying MinRAM requirements or enabling virtual capacities in this context may not be feasible without risking operational security. Enhancing RAM levels will rely on further strengthening security coordination within the Core CCR — particularly through the implementation of ROSC — and on the timely completion of key network investments.

Planned Grid Investments:

- Major upgrades, especially on CZ-DE corridors, aim to boost cross-border capacity and reduce congestion.

Validation Adjustments Frequent:

- Significant capacity reductions occur during ATC and IVA validations, often limiting market-accessible capacity.

Need for Better Validation Practices:

- Streamlining and coordinating validation steps may retain more of the initially calculated capacity.

Regional Coordination is Crucial:

- Any changes, especially in bidding zones, must be regionally aligned to avoid shifting problems elsewhere.

Focus on the Ten-year national development plan and commissioning of grid investment projects:

- 1.a. OHL 400 kV Porțile de Fier – Reșița
- 1.b. TIE 400 kV Reșița – Pancevo d.c
- 1.c. Switch to 400 kV voltage level of the 220 kV OHLs Reșița – Timișoara/ Săcălaz
- 1.d. Switch to 400 kV voltage level of the 220 kV OHLs Timișoara/ Săcălaz – Arad
- 2.a. New TIE 400 kV Nădab – Beckescsaba circ. 2
- 2.b. New TIE 400 kV Oradea Sud – Jozsa
- 3. New Autotransformer 400 MVA, 400/220 kV Roșiori
- 4. Increasing the transmission capacity on the OHLs 220 kV Urechești – Târgu Jiu Nord – Paroșeni – Baru Mare –Hășdat
- 5. Increasing the transmission capacity on the OHL 220 kV Porțile de Fier – Reșița
- 6. New TIE 400 kV Porțile de Fier – Djerdap circ. 2

Usage of remedial actions in case of congestions:

- Only addressed in real-time as there is no congestion market available before.

Removal of redundant CNECs:

- Eventhough the impact is not high, the removal of the redundant CNECs has been analysed in the individual study.

Planned Grid Investments upcoming years:

- Borssele-Rilland: Improves transporting wind infeed
- Eindhoven-Maasbracht: Improves connecting the BE interconnector with van Eyk to the german interconnector of Siersdorf
- Maasbracht-Boxmeer-Dodewaard: Improves connecting the BE and DE interconnectors connected to Maasbracht

Other grid related improvements:

- Continuous roll out of Dynamic Line Rating, providing higher Fmax for many lines.

HOPS

- The expected finalization of the targeted investments (increasing realibility and transmission capacity of transmission network elements, starting the use of DTRs, etc.) is planned by 2026., while the capacity improvements are focused on the 220kV and 400kV projects (during and after 2025.)
- Based on a detailed analysis of targeted investments, the results show that ATC capacities can be improved on average about 38%, including all BZBs. Releiving effect on the ATC constraints is observed during the most critical period of the year (spring, May-June), and export/import capacities generally increase
- It can be observed that the bidding zone configuration can guarantee significant improvements. The reconfiguration of the DE BZ can guarantee an improvement of the MACZT on the most critical elements (on average up to 25%)
- HOPS RAs do not contribute much to RAO for all simulated BDs, but using all available Core non-costly RAs slightly decreases HR isolation for import/export directions (around 0,4%), while using Core costly and non-costly RAs resulted in larger improvements. The isolation of HR BZ decreases by about 3,25% for import and export direction (both directions 1,36%)
- HOPS area is surrounded by some limiting CNECs of CCR (especially with the CNECs of APG, SEPS, ELES) which potentially limit export/import directions and increase BZ isolations in the HOPS area
- HOPS suggests additional measures to consider in order to improve results:
  - Improvements to the coordination of ENTSO-E pan-EU outage planning to increase grid flexibility and maximize capacity,
  - Improvements of the IDCC(b) ATC extraction parameters, while HOPS supports the use of the following settings: PTDF ≥ 4% and RAM_ID = 50 MW,
  - Process improvements and IT changes, for example updating process times to use later and better quality DACF CGM,
  - Improvements in (cross-)regional coordination and inclusion of third countries,
  - supporting the WB3 CCR determination regarding the potential accession to the CE Capacity Calculation Region (CCR)

Specific 70 % MinRAM requirements for ID is not feasible in the intraday timeframe:

- Unlike in the day-ahead timeframe, there is not enough time to coordinate and activate safely remedial actions to face the virtual margins.

The main objective for IDCC improvements is to reduce pre-congestions and BZ isolations.

- Go-lives of next IDCC Flow-based re-calculations (IDCC(c), IDCC(d) and IDCC(e)), combined with DA and ID CROSAs, is the most effective way to deal with pre-congestions and BZ isolations without jeopardizing grid security.
- Flow-based allocation in the IDAs should also enable more reliable ID capacities.

Merging Core and Italy North CCRs will reduce complexity and inconsistencies:

- CE region should help RTE facing with important export flows and avoid reductions close to real time.