Second amendment of the Day-Ahead Capacity Calculation Methodology of the Core Capacity Calculation Region

in accordance with Articles 20ff. of the Commission Regulation (EU) 2015/1222 of 24th July 2015 establishing a guideline on capacity allocation and congestion management

31st March 2023

Whereas

TSOs of the Core CCR ("Core TSOs"), taking into account the following:

(1) Hybrid coupling refers to the combined use of Flow-Based (FB) and Available Transmission Capacity (ATC) constraints in one single capacity allocation mechanism. There are two forms of hybrid coupling: Standard Hybrid Coupling (SHC) and Advanced Hybrid Coupling (AHC). The difference between SHC and AHC is how power flows on interconnectors between the Core CCR and adjacent CCRs are mapped onto Core CNECs. The SHC grants access to the scarce CNEC capacity by reserving capacity on the Core CNECs based on the forecasted power flows on the interconnectors. On the other hand, in the AHC, the power flows on the interconnectors between the Core CCR and adjacent CCRs are subject to non-discriminatory competition for CNEC capacity with all other power flows within the Core CCR. Besides ensuring a non-discriminatory competition for the scarce CNEC capacity, the expectation is that Core FB DA MC will benefit from the implementation of AHC in terms of socio-economic welfare as well;
(2) Six months after Core FB DA MC Go-Live, Core TSO need to submit to Core NRAs a proposal for amendment of this methodology detailing the implementation of AHC. In order to elaborate and discuss this proposal for amendment in detail, it was agreed with the Core NRAs to extend this deadline to the end of March 2023;
(3) With this amendment, Core TSOs aim to both detail the AHC methodology and set a timeline for the technical readiness of the tools used in the Core FB DA CC and MC processes for the introduction of AHC;
(4) The following changes fulfil the objectives set out in Article 3 CACM. In particular, an improvement will be made in relation to Article 3 (b), (d) and (j) improving the allocation of capacity at borders to other CCRs. The aim of the measures is to create a level playing field in Single Day Ahead Coupling ('SDAC') with regard to flows resulting from intra-CCR trade and flows resulting from trade with bidding zones outside the core CCR.

For the purposes of this second amendment to the Core CCR TSOs' Day-Ahead Capacity Calculation Methodology, terms used in this document shall have the meaning of the definitions included in Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity, Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (recast), Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management (CACM Regulation), Commission Regulation (EU) 2016/1719 of 26 September 2016 establishing a guideline on forward capacity allocation (FCA Regulation), Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing (EB Regulation) and Commission Regulation (EU) No 543/2013 of 14 June 2013 on submission and publication of data in electricity markets and amending Annex I to Regulation (EC) No 714/2009 of the European Parliament and of the Council and the definitions set out in Article 2 Annex I of the Decision No 02/2019 of the Agency for the Cooperation of the Energy Regulators of 21 February 2019 on the Core CCR TSOs' proposal for the regional design of the day-ahead and intraday common capacity calculation methodologies.

Article 1
Implementation of Advanced Hybrid Coupling

1. Article 2. Definitions and interpretation shall be amended by introducing a new number 1a and 1b accordingly:

> "1a. 'AHC border' means a border between a bidding zone within and outside of Core CCR where both bidding zones are part of Single-Day-Ahead Coupling and the AHC is applied;"
>
> "1b 'external virtual hub' means a virtual bidding zone without any buy and sell orders, used to represent the imports and exports on an AHC border as specified in article 13 of this Methodology;"

2. Article 13. Consideration of non-Core bidding zone borders shall be amended accordingly:

1. Paragraph 3 letter (b) shall be replaced and be read accordingly:

> "(b) In the AHC, the CNECs of the Core Day-ahead capacity calculation region shall not only limit the net positions of Core bidding zones due to exchanges on bidding zone borders of the Core CCR but also the exchanges on bidding zone borders between the Core CCR and adjacent BZs. Core TSOs applying AHC shall apply the following rules:
>
> i. For each AHC border, the Core TSOs shall introduce at least one single external virtual hub.
>
> ii. The CCC shall define GSKs for the external virtual hubs according to Article 9 (1) as follows:
>
> > b.ii.1. In case an AHC border contains only HVDC interconnectors, the GSK shall be defined by all converter stations of the HVDC interconnectors, weighted based on the respective transmission capacity.
> >
> > b.ii.2. In case an AHC border contains only AC interconnectors, the CCC shall use the GSK of the adjacent bidding zone provided by the TSOs of that bidding zone. When this GSK is not available, the CCC shall define a GSK based on all positive injections in the IGM of the adjacent bidding zone.
> >
> > b.ii.3. In case an AHC border contains both HVDC interconnectors and AC interconnectors, the respective Core TSO shall define a single combined GSK based on the GSK for the HVDC interconnectors and the GSK for the AC interconnectors.
>
> iii. The CCC shall compute zone-to-slack PTDFs and zone-to-zone PTDFs for the external virtual hubs in accordance with Article 11.
>
> iv. The Core TSOs shall send to the CCC adjustment values for each

AHC border according to Article 4 (4) (b).

v. The FRMs shall not cover forecast uncertainties according to Article 8 (1) (a) induced by AHC borders.

vi. The maximum zone-to-zone PTDF of a CNEC ($PTDF_{z2zmax,l}$) according to Article 11 (5) shall additionally consider the PTDFs of the external virtual hubs.

vii. Cross-zonal network elements pursuant to Article 5 (1) shall additionally include those on AHC borders. In case the capacity constraints resulting from cross-zonal network elements on an AHC border are already considered in another CCR, a Core TSO may decide not to define such network elements as CNE or CNEC in Core. Such a CNE or CNEC on an AHC border shall be regularly monitored only in a single CCR. Any deviation from this rule shall be subject to a sound justification.

viii. Core TSOs may impose a limit to the net position of the external virtual hubs for AHC borders consisting of at least one cross-border HVDC interconnector to account for the physical limitations of the HVDC cables on that border and the converter stations on the Core side.

ix. The zone-to-zone PTDFs used to compute RAM_{rel} for the non-costly remedial actions optimisation pursuant to Article 16 (3) shall additionally consider the PTDFs of the external virtual hubs.

x. The situation for the computation of $\vec{F}_{0,Core}$ according to Article 17 shall exclude the commercial exchange on the AHC borders. The computation of PTDF_f shall include the external virtual hubs. The $\overrightarrow{NP}_{ref,Core}$ shall include the net positions of the external virtual hubs. $\vec{F}_{uaf}$ shall not include flows resulting from commercial exchanges on the AHC borders.

xi. The RAM as referred to in Article 17 (5) shall be the capacity offered within the Core CCR and to the AHC borders. $\vec{F}_{uaf}$ shall be the flow per CNEC assumed to result from commercial exchanges outside the Core CCR except the AHC borders.

xii. When applying the rules for LTA inclusion according to Article 18, Core TSOs shall additionally take into account the previously-allocated cross-zonal capacity of AHC borders. $\overrightarrow{NP}_{LTAi}$ and $\overrightarrow{NP}_{ref}$ shall include the net position of the external virtual hubs.

xiii. The PTDFs of the external virtual hubs shall be included in the flow-based parameters according to Article 21. The CCC shall include the exchanges on the AHC borders resulting from LTN as net position of the external virtual hubs when computing the $\overrightarrow{NP}_{LTN}$.

xiv. The computations performed according to Article 22 shall also be performed for the external virtual hubs. In case of application of default

flow-based parameters, the bilateral capacities on the AHC borders shall be defined based on the LTA capacity increased by the adjustment provided pursuant to Article 13 (3) (b) (iv).

xv. The ATCs for the SDAC fallback procedure according to Article 23 shall be based on the LTA capacity increased by the adjustment provided pursuant to Article 13 (3) (b) (iv).”

2. Paragraph 3 letter (c) shall be replaced and be read accordingly:

“(c) Core TSOs shall introduce the AHC until 2025 for borders to bidding zones adjacent to the Core CCR insofar as these bidding zones are part of the Single Day Ahead Coupling (‘SDAC’), subject to the prioritisation of its implementation in SDAC. Until the AHC is implemented, the Core TSOs shall monitor the accuracy of non-Core exchanges in the CGM. The Core TSOs shall report in the annual report to all Core regulatory authorities the accuracy of such forecasts.”

Article 2
Amendments to ensure correct handling of HVDC interconnectors

1. Article 11. Calculation of power transfer distribution factors and reference flows shall be amended accordingly

Paragraph 5 shall be replaced and be read accordingly:

“The maximum zone-to-zone $PTDF$ of a CNEC ($PTDF_{z2zmax,l}$) is the maximum influence that any Core exchange has on the respective CNEC, including exchanges over HVDC interconnectors which are integrated pursuant to Article 12:

$$PTDF_{z2zmax,l} = max\Big(\max_{A\in BZ}\big(PTDF_{A,l}\big) - \min_{A\in BZ}\big(PTDF_{A,l}\big), \max_{H\in HVDC,}\big(|(PTDF_{A,l} - PTDF_{VH_1,l}) - (PTDF_{B,l} - PTDF_{VH_2,l})|, |PTDF_{VH_1,l,H} - PTDF_{VH\_2,l}|\big)\Big)$$

Equation 1

with

$PTDF_{A,l}$	zone-to-slack $PTDF$ of bidding zone A on a CNEC l
HVDC	set of HVDC interconnectors integrated pursuant to Article 12
BZ	set of all Core bidding zones
$\max_{A\in BZ}(PTDF_{A,l})$	maximum zone-to-slack PTDF of Core bidding zones on a CNEC l
$\min_{A\in BZ}(PTDF_{A,l})$	minimum zone-to-slack PTDF of Core bidding zones on a CNEC l

$PTDF_{VH\_1,l}$	zone-to-slack $PTDF$ of Virtual hub 1 on a CNEC l, with virtual hub 1 representing the converter station at the sending end of the HVDC interconnector located in bidding zone A
$PTDF_{VH\_2,l}$	zone-to-slack $PTDF$ of Virtual hub 2 on a CNEC l, with virtual hub 2 representing the converter station at the sending end of the HVDC interconnector located in bidding zone B"

2. Article 12. Integration of HVDC interconnectors on bidding zone borders of the Core CCR:

Paragraph 1 shall be replaced and be read accordingly:

> "The Core TSOs shall apply the evolved flow-based (EFB) methodology when including HVDC interconnectors on the bidding zone borders of the Core CCR . According to this methodology, a cross-zonal exchange over an HVDC interconnector on the bidding zone borders of the Core CCR is modelled and optimised explicitly as a bilateral exchange in capacity allocation, and is constrained by the physical impact that this exchange has on all CNECs considered in the final flow-based domain used in capacity allocation and constraints modelling the maximum possible exchange of the HVDC interconnector."

Explanatory document to the second amendment of the Day-Ahead Capacity Calculation Methodology of the Core Capacity Calculation Region

in accordance with article 20ff. of the Commission Regulation (EU) 2015/1222 of 24th July 2015 establishing a guideline on capacity allocation and congestion management

31st March 2023

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1. Introduction

The Commission Regulation (EU) 2015/1222 establishing a guideline on Capacity Calculation and Congestion Management ('CACM') requires the development and implementation of a common Day-Ahead Capacity Calculation Methodology ('DA CCM') per Capacity Calculation Region ('CCR').

Based on Article 13 (3) of the currently effective DA CCM for the CCR Core ('Core DA CCM'), the Core TSOs must no later than six months after the implementation of this methodology and in accordance with Article 28 (3) develop a proposal for the implementation of Advanced Hybrid Coupling ('AHC') and submit it by the same deadline to all Core regulatory authorities as a proposal for amendment of said methodology in accordance with Article 9 (13) of the CACM Regulation. To elaborate and discuss this proposal for amendment in detail, it was agreed with the Core NRAs to extend the resulting deadline until the end of March 2023.

With the Capacity Calculation Methodology (CCM) of the Nordic Capacity Calculation Region (CCR) as a reference, Core TSOs originally did not foresee a detailed methodological description of the AHC and respective far-reaching changes to the Core DA CCM. However, a discussion with Core NRAs led to the conclusion that the implementation of the AHC should be prioritized, the Core DA CCM should be amended in a single step and include all changes to the methodology triggered by the implementation of the AHC. Within the course of the discussion, Core TSOs also see the benefit and have agreed upon drafting such detailed proposal for amendment.

Furthermore, the second amendment of the Core DA CCM brings about an update to ensure correct handling of core internal HVDC interconnectors.

In this explanatory document Core TSOs explain the background to the changes included in the proposal for amendment of the Core DA CCM. A track-change version of the Core DA CCM reflecting the proposed changes is shared for informative purpose.

In section 2.3, a specific question to stakeholders regarding the prioritisation of the implementation of can be found. Feedback on these two aspects was explicitly requested in the course of the public consultation. The respective question on page 7 is marked accordingly.

2. Advanced Hybrid Coupling

2.1. General Aspects of Advanced Hybrid Coupling

The term hybrid coupling refers to the combined use of Flow-Based ('FB') and Available Transmission Capacity constraints in one single capacity allocation mechanism. There are two forms of the hybrid coupling: Standard Hybrid Coupling ('SHC') and Advanced Hybrid Coupling ('AHC').

The difference between SHC and AHC is how power exchanges over interconnectors between bidding zones ('BZ') within the Core CCR and BZs outside of the Core CCR, where both BZ are part of the Single Day Ahead Coupling ('SDAC'), are mapped onto Core CNECs. SHC grants access to the scarce CNEC capacity by reserving a capacity on the Core CNECs before capacity calculation, based on the forecasted power exchanges over the respective interconnectors and including a security margin for deviations from this forecast. By contrast, in AHC, the power exchanges over the respective interconnectors are subject to competition for CNEC capacity with all other cross-zonal power exchanges within the Core CCR during market coupling, e.g., in SDAC. The expectation is that by ensuring a non-discriminatory competition for the scarce CNEC capacity, AHC will lead to an increase in socio-economic welfare and improved operational gird security at the same time.

Only SHC is in use in the Core CCR today; however, there is an obligation to introduce AHC although an implementation timeline has not yet been set. Furthermore, a detailed specification of the AHC method was still to be defined as well as an assessment of the influence of AHC on existing processes and tools.

Core TSOs do not intend to conduct a Cost Benefit Analysis ('CBA') regarding the introduction of AHC, as the obligation resulting from the CCM to introduce AHC is independent of economic viability. Therefore, no market analysis is planned for the introduction of the AHC, but only an implementation assessment and impact analysis.

The method explained in the following paragraphs is intended to be as general and flexible as possible and shall not be bound to specific configurations, borders, or today's grid topology. For example, the merging of two separate CCRs or cross-CCR-border grid expansion could make new or less borders applicable for AHC.

Core TSO prefer to keep all changes regarding the AHC in one single article as this makes it easier to combine the AHC with any other amendments and makes the formal proposal, which is the legally binding document, much leaner. It creates less work and is less prone to errors. Besides, it is futureproof, as a change of AHC can be amended by working on a single article as well.

2.2. Explanation of Changes to Article 2, Article 13 (3) (b) and Article 13 (3) (c) of the DA CCM

AHC can be applied to any border to a bidding zone ('BZ') outside the Core CCR which is part of the SDAC.[1] To avoid confusion with the methodology to include virtual hubs of core internal HVDC lines (often referred to as evolved flow-based or EFB), the virtual hubs for AHC are referred to as 'external virtual hubs.' Whilst the concept of AHC is identical to a large extent to this concept used to integrate HVDC interconnectors on bidding zone borders inside the Core CCR, a distinction shall be

[1] This means that the AHC can be implemented for the borders with Norway but not for borders with Switzerland, for example.

possible in the Core CCM.

> *1a. 'AHC border' means a border between a bidding zone within and outside of Core CCR where both bidding zones are part of Single-Day-Ahead Coupling and the AHC is applied;*
>
> *1b 'external virtual hub' means a virtual bidding zone without any buy and sell orders, used to represent the imports and exports on an AHC border as specified in article 13 of this Methodology;*

The underlying idea of the AHC concept is to treat such AHC borders analogously to Core internal borders whenever possible. The methodology for the AHC itself is subsequently described in Article 13 (b):

> *In the AHC, the CNECs of the Core Day-ahead capacity calculation region shall not only limit the net positions of Core bidding zones due to exchanges on bidding zone borders of the Core CCR but also the exchanges on bidding zone borders between the Core CCR and adjacent BZs. Core TSOs applying AHC shall apply the following rules:*

For each border where the AHC shall be applied, at least one virtual hub must be defined. TSO propose no legal requirement to introduce only one single external virtual hub per border. However, due to computation complexity and as a simplification to limit the expected challenges with respect to performance that are already foreseeable, Core TSOs foresee only one single external virtual hub per border.[2] However, for future extensions of the AHC concept and if computational performance improves after the AHC is successfully deployed, the Core TSOs intend to expand the concept for parallel HVDC connections in a way that such connections can be included in the single day-ahead market coupling by separate external virtual hubs. Hence, they can be used to further increase capacity, e.g., by optimizing them in the market coupling with different load factors.

The Net Position ('NP') of such external virtual hub thus represents the imports and exports from a bidding zone ('BZ') outside of the Core CCR.

> *For each AHC border, the Core TSOs shall introduce at least one external virtual hub.*

For each external virtual hub the challenge of having to define exactly one GSK border that maps all paths (different DC lines, parallel AC lines, etc.) with a fixed ratio arises. While the PTDFs of the converter station can simply be used for HVDC interconnectors, a detailed GSK must be defined for AC or mixed AC/DC borders. For AC areas outside of Core CCR, a detailed GSK might be unavailable and hence core TSOs must make a best estimate assumption:

[2] In this context, border is interpreted as a connection between two bidding zones where one is outside and one is inside the Core CCR.

The CCC shall define GSKs for the external virtual hubs according to Article 9 (1) as follows:

In case an AHC border contains only HVDC interconnectors, the GSK shall be defined by all converter stations of the HVDC interconnectors, weighted based on the respective transmission capacity.

In case an AHC border contains only AC interconnectors, the CCC shall use the GSK of the adjacent bidding zone provided by the TSOs of that bidding zone. When this GSK is not available, the CCC shall define a GSK based on all positive injections in the IGM of the adjacent bidding zone.

In case an AHC border contains both HVDC interconnectors and AC interconnectors, the respective Core TSO shall define a single combined GSK based on the GSK for the HVDC interconnectors and the GSK for the AC interconnectors.

Subsequently, PTDFs are required for the external virtual hubs. The existing rules for the computation of PTDFs should be applied:

The CCC shall compute zone-to-slack PTDFs and zone-to-zone PTDFs for the external virtual hubs in accordance with Article 11.

The Core TSOs shall send to the CCC adjustment values for each AHC border according to Article 4 (4) (b).

Since the effects of flow-changes on the CNEs resulting from deviations in imports and exports on the AHC borders are now implicitly considered during the market coupling, there is no longer a need to maintain additional safety margins for these borders in the FRM:

The FRMs shall not cover forecast uncertainties according to Article 8 (1) (a) induced by AHC borders.

The introduction of new PTDFs automatically leads to an adjusted selection of CNECs. Cross-zonal lines become CNEs per legal requirement, internal lines may be defined by the TSO. It seems reasonable that possible congestions in the grid shall not be considered twice and that the capacity is not limited unnecessarily. Therefore, in the case of AHC, TSOs may exceptionally decide not to define a cross-border grid element as a CNE (for example, because the respective CNEs have already been considered in the calculation of the NTC of the neighbouring CCR). However, it should also be possible to introduce new CNEs if the ATC of the neighbouring CCR can potentially be increased as a result. Thus, the respective TSO at the border takes over a coordinating role between the two CCRs. For HVDC interconnectors, analogous to the consideration of internal HVDC interconnectors, there shall be the possibility to limit the NP of the virtual hubs to the physical installed transmission capacity (e.g., the thermal limits of the cables and the converter) since those assets itself cannot be a CNEC. Since this methodology is only concerning the Core side Core of an interconnection, this limitation shall only cover the limitations on the Core side of the connection.

The maximum zone-to-zone PTDF of a CNEC ($PTDF_{z2zmax,l}$) according to Article 11 (5) shall additionally consider the PTDFs of the external virtual hubs.

Cross-zonal network elements pursuant to Article 5 (1) shall additionally include those on AHC borders. In case the capacity constraints of resulting from cross-zonal network elements on an AHC border are already considered in another CCR, a Core TSO may decide not to define such network elements as CNE or CNEC in Core. Such a CNE or CNEC on an AHC border shall be regularly monitored only in a single CCR. Any deviation from this rule shall be subject to a sound justification.

Core TSOs may impose a limit to the net position of the external virtual hubs for AHC borders consisting of at least one cross-border HVDC interconnector to account for the physical limitations of the HVDC cables on that border and the converter stations on the Core side.

To keep the computation in the Remedial Actions Optimisation ('RAO') consistent with the updated computations, the following adjustment is necessary:

The zone-to-zone PTDFs used to compute RAM_{rel} *for the non-costly remedial actions optimisation pursuant to Article 16 (3) (d) shall additionally consider the PTDFs of the external virtual hubs.*

The objective of equal treatment of flows resulting from exchanges within Core and from exchanges on AHC borders implicitly results in a change in the computation of $\vec{F}_{0,Core}$.[3] Both share the same capacity on the CNECs.

The situation for the computation of $\vec{F}_{0,Core}$ according to Article 17 shall exclude the commercial exchange on the AHC borders. The computation of $PTDF_f$ shall include the external virtual hubs. The $\overrightarrow{NP}_{ref,Core}$ shall include the net positions of the external virtual hubs. $\vec{F}_{uaf}$ shall not include flows resulting from commercial exchanges on the AHC borders.

The RAM as referred to in Article 17 (5) shall be the capacity offered within the Core CCR and to the AHC borders. $\vec{F}_{uaf}$ shall be the flow per CNEC assumed to result from commercial exchanges outside the Core CCR except the AHC borders.

Regarding the inclusion for Long Term Allocations ('LTA'), the same rules shall apply as for borders within the Core FB Region:

When applying the rules for LTA inclusion according to Article 18, Core TSOs shall additionally take into account the previously allocated cross-zonal capacity of AHC borders. $\overrightarrow{NP}_{LTAi}$ and $\overrightarrow{NP}_{ref}$ shall include the net position of the external virtual hubs.

Regarding fallbacks, the same rules shall apply as for borders within the Core FB Region:

[3] The name of the figure is maintained for the sake of simplicity.

The PTDFs of the external virtual hubs shall be included in the flow-based parameters according to Article 21. The CCC shall include the exchanges on the AHC borders resulting from LTN as net position of the external virtual hubs when computing the $\overrightarrow{NP}_{LTN}$.

The computations performed according to Article 22 shall also be performed for the external virtual hubs. In case of application of default flow-based parameters, the bilateral capacities on the AHC borders shall be defined based on the LTA capacity increased by the adjustment provided pursuant to Article 13 (3) (b) (iv).

The ATCs for the SDAC fallback procedure according to Article 23 shall be based on the LTA capacity increased by the adjustment provided pursuant to Article 13 (3) (b) (iv).

In Article 13 (3) (c) Core TSOs aim to propose a reasonable timeline for their methodological and technical readiness to introduce the AHC. Since the implementation in SDAC is still subject to feedback from tool vendors and NEMOs on the time required to make the necessary adaptations to the respective tools (e.g., Core Capacity Calculation tool, Backup tool and Euphemia) and based on the estimated time to configure the local validation tools to handle the changes introduced by AHC to the Core DA CC process, this timeline is based on considerable uncertainty that must be pointed out as effects on the performance of the tools cannot be estimated at present. It is also worth noting that the implementation of AHC for Core is a complex undertaking due to the size of the CCR and the number of borders to other areas:

Core TSOs shall introduce the AHC until 2025 for borders to bidding zones adjacent to the Core CCR insofar as these bidding zones are part of the Single Day Ahead Coupling ('SDAC'), subject to the prioritisation of its implementation in SDAC. Until the AHC is implemented, the Core TSOs shall monitor the accuracy of non-Core exchanges in the CGM. The Core TSOs shall report in the annual report to all Core regulatory authorities the accuracy of such forecasts.

A detailed explanation regarding the next steps and a reasoning for the implementation timeline can be found in the following chapter.

2.3. Next steps towards the implementation of the AHC

Since one external virtual hub needs to be introduced for each border where AHC is applied and Core TSOs aim for simultaneous introduction of the AHC for all relevant borders, significant challenges for the capacity calculation and the market coupling could be faced and hence performance issues may arise. Since, the introduction of AHC can influence the performance of internal (e.g., the tools used for the Capacity Calculation and the TSOs tools for individual validation), and external processes (e.g., market coupling algorithm EUPHEMIA), an appropriate assessment of all tools and process steps is necessary. Subsequently, modifications of tools and processes might become necessary before finally committing to an implementation timeline. The corresponding studies and surveys are currently being planned for the calendar year 2023. Tools and process steps that need to be assessed compromise inter alia the Core

CC Tool ('CCCt'), the Core Backup Tool, the Non-costly Remedial Action Optimization ('NRAO'), the tools used for the validation (this covers both the Individual Validation and Coordinated Validation which is currently under development) and the reporting tools and processes. Furthermore, an analysis is pending for the interference with the Core Intraday Capacity Calculation ('Core IDCC'), the extraction of Intraday ATC, the Publication Tool ('PuTo') and the IGM creation.

While the aforementioned aspects are within the sole sphere of influence of the Core TSOs, this is not the case with EUPHEMIA, the SDAC market coupling algorithm. Significantly increased computational efforts are to be expected and hence performance challenges arise due to the "stronger" coupling and the newly introduced external virtual hubs. Core TSOs will submit the corresponding change request ('RfC') to SDAC OPSCOM immediately after the AHC method has been finally described in Core. Investigations into the performance of EUPHEMIA – especially in the context of 15 min Market time unit ('MTU') – are currently being planned.

It may turn out that a simultaneous introduction of AHC on all borders to bidding zones that are adjacent to the Core CCR and in the SDAC at the same time is not reasonably feasible during the concretisation of the implementation planning. Explanations for this could be performance problems of the tools or (expected) changes to the CCR layout. ITN borders would be excluded of the scope of AHC implementation, and moreover implementation of AHC on ITN borders would also not be explored as a temporary solution if a merger is planned. AHC implementation is to be continued and should not hinder any future merging of Core and Italy North CCR. Only in case a merger of Core CCR and Italy North CCR Day-Ahead CC process does not materialise (now or in the future), AHC could be a fallback solution to enable some efficiency gain on Core side. However, this is currently not actively explored as priority should be on exploring the merger as target solution. To unlock the full potential of a merger and implement the most efficient solution, the integration of CH borders in market coupling is needed.

Stakeholder question

The Core TSOs intend to complete all the necessary steps on Core CCR's side by the end of 2025. However, implementation is also subject to prioritisation in SDAC since a conflict with 15 min MTU introduction, which has a higher priority at the moment, must already be anticipated. Hence, stakeholders are kindly requested to provide feedback if this prioritisation should be changed.

With the approval of this second amendment for the Core day-ahead CCM, the necessity to transfer the changes into the methodology for Core intraday ('ID') arises implicitly. The corresponding regulations for this task can already be found in the Core ID CCM. Respective processes will start after the approval of this proposal to maintain maximum efficiency.

With a view to required tests prior to the AHC go-live, Core TSO do not foresee to conduct a 6-month external parallel run before the implementation of the AHC. Core TSOs' legal assessment in Summer 2022 led to conclusion that from legal perspective no such test is needed. However, AHC will not be implemented without proper testing.

A 6-month external parallel test seems too demanding for the Core TSOs' operators as they would have to monitor two capacity calculation processes in parallel. A detailed test concept is currently being developed. The go-live tests are planned for 2024 and the results will be made publicly available. The results will also show what implications the AHC will induce on the other parameters of the flow-based domain.

3. Updates to ensure a correct handling of core internal HVDC interconnectors

The updates to Article 11 have already been publicly consulted for to the Core ID CCM and are required for standardization. It is a change that is necessary for the mathematically correct description of the calculation in the context of Core internal HVDC interconnectors (e.g., ALEGrO) and must not be confused with the AHC despite the concept is similar and the term virtual hub is used. More details regarding the modelling of Core internal HVDC interconnectors in capacity calculation has been added. Therefore, equation 5 of article 11 has been extended with additional terms to reflect the impact of an HVDC link to CNECs.

New equation:

$$PTDF_{z2zmax,l} = max\Big(\max_{A\in BZ}\big(PTDF_{A,l}\big) - \min_{A\in BZ}\big(PTDF_{A,l}\big), \max_{H\in HVDC}\Big(\big|(PTDF_{A,l} - PTDF_{VH\_1\ \ ,l}) - (PTDF_{B,l} - PTDF_{VH\_2\ \ ,l})\big|, \big|PTDF_{VH\_1\ \ ,l} - PTDF_{VH\_2\ \ ,l}\big|\Big)\Big)$$

The new formula is based on the concept of Evolved Flow Based, meaning that the market is given the freedom to freely select the virtual hub net positions for system optimality (not only for BE-DE exchanges) and that the sensitivity regarding this optimization variable should also be part of the CNEC selection.

To complete the description of the HVDC interconnector integration of Core bidding zones, additional constraints that model the maximum possible exchange of the HVDC interconnector itself have been added to Article 12. These constraints ensure that HVDC links are operated within its technical limits, this is in addition to modelling their impact on CNECs in capacity calculation and allocation.

Public Consultation Report to the second amendment of the Day-Ahead Capacity Calculation Methodology of the Core Capacity Calculation Region

in accordance with article 20ff. of the Commission Regulation (EU) 2015/1222 of 24th July 2015 establishing a guideline on capacity allocation and congestion management

31st March 2023

Purpose:	☐ methodology draft ☒ for NRA approval	☐ for public consultation ☐ for final publication
Status:	☐ draft	☒ final
TSO approval:	☐ for approval	☒ approved
NRA approval:	☒ outstanding	☐ approved

CONTENT

GLOSSARY

All definitions and abbreviations of the second amendment of Core DA CCM apply accordingly.

1. INTRODUCTION

This document is the consultation report for the Core TSOs' proposal for the second amendment of the Core Day-Ahead Capacity Calculation Methodology (Core DA CCM) in accordance with article 20ff. of the Commission Regulation (EU) 2015/1222 of 24th July 2015 establishing a guideline on Capacity Allocation and Congestion Management (CACM).

Core TSOs would like to thank all parties involved in the public consultation for their interest in the second amendment of the Core DA CCM. Core TSOs welcome the feedback received as it is valuable for the further development and detailing of the second amendment of the Core DA CCM.

1.1. Public consultation on second amendment of Core DA CCM

Via the ENTSO-E Consultation Platform, the public consultation document for the second amendment of the Core DA CCM was available to Core stakeholders from 25 November 2022 until 25 December 2022. In total, two stakeholders submitted their response.

Since the outcome of the public consultation should be processed in an anonymised manner, the identity of the respondent is not disclosed in this consultation report. Please note that the response was, however, shared with the Core National Regulatory Authorities (NRAs) in a non-anonymised manner.

The Core TSOs wish to clarify that the content of this document is intended to summarise the outcome of the public consultation. The Core TSOs did their best to reply to all comments and concerns.

2. CORE TSOS SECOND AMENDMENT OF THE CORE DA CCM – CONSULTATION FEEDBACK

2.1. Introduction

In this chapter, a summary is provided of the stakeholder responses received via the ENTSO-E Consultation Platform. The response is structured in a table showing the stakeholder response, the action taken by Core TSOs and in addition a Core TSOs' answer to the stakeholder response.

2.2. Proposal for amendment – Stakeholder feedback

Stakeholder response		Action taken	TSOs answer
S1.1	The stakeholder welcomes the opportunity to provide comments regarding the Core TSOs' proposal for the 2nd amendment of the Day-Ahead Flow-based Capacity Calculation Methodology - Related to Advanced Hybrid Coupling implementation. AHC (as opposed to Standard Hybrid Coupling – SHC), refers to a new explicit approach to represent the exchanges between Core and non-Core neighboring regions. The AHC approach proposes to extend the Core Flow-Based domain (PTDF matrix) in order to internalize the exchange capacities with non-Core neighboring BZs. The Stakeholder proposes modifications to the DA Core CCM in order to accommodate the legal requirements for AHC, as required by Article 13(3) of the current document. The roll-out is a legal requirement from the Core CCM and an implementation roadmap is to be released in 2023 for a go-live by 2025. AHC should theoretically deliver improvements in volume of capacity allocated (thus welfare), but the associated computational cost is high. The TSOs have not performed any quantification, nor are they certain a full roll-out will be technically feasible in Euphemia due to performance limitations. The stakeholder agrees that, in theory, AHC is a superior representation than the status quo. However, in their view it is clear that Euphemia has limitations and that the finite amount of computational power	See Core TSOs' answer..	Core TSOs welcome the given feedback. Core TSOs agree that limited computing resources should be used where they provide the most benefit. Specific feedback on the topics "quantification" (S1.2) and "prioritization in the context of 15 min MTU" (S1.3) can be found below to avoid redundancy. Core TSOs agree that introducing AHC asynchronously for all relevant borders to other CCRs might result in unequal treatment of these borders. In spite of that, this will still reduce the number of borders to other CCRs whose exchanges are prioritised on Core CNECs and thus be an improvement. Hence, the advantage of AHC will still be present with a partial implementation. In the long term, Core TSOs aim to have a solution for all borders to other CCRs, which may not always be AHC but could also, e.g., involve merging the CCRs.

	available should be used for the most efficient and welfare-maximising measures. As long as AHC and other measures such as 15' MTU are not properly quantified on real market conditions, the TSOs' questions cannot be answered properly. Besides, a partial AHC implementation also raises issues of discriminatory access to capacity and of defining go/no-go criteria for each border.		
S1.2	Which borders should be prioritized for the implementation of AHC? A partial, border-based implementation of AHC would raise concerns of level-playing field and equal access to capacity, which is initially mentioned as a core motivation for the implementation of AHC. It is also unclear who would get to decide on the go-live for each border and which KPI would be used to prioritize (performance to welfare ratio? Border size or line type?). Eventually, if AHC is to be deployed, the TSOs must ensure beforehand that it can be done in full and that roll-out is not at risk of being permanently stopped part-way due to unforeseen technical limitations. From a welfare perspective, it would probably make the most sense to deploy borders impacting CNECs with the highest shadow prices and/or with the highest uncertainty in flow forecast. But this should be quantified first. The TSOs state that they « *do not intend to conduct a Cost Benefit Analysis (...), as the obligation resulting from the CCM to introduce AHC is independent of economic viability* ». However, given the very high computational cost of AHC, we would still urge the TSOs to assess achievable welfare gains per border under realistic market conditions to determine whether AHC is realistic (cf. question 2). It must also be ensured that the validation process performed by TSOs does not operationally erase the capacity gains achieved with AHC (which would lead to a worse-off trade-off than the status quo).	See Core TSOs' answer.	Currently, we assume that an introduction is particularly advantageous at borders where the respective forecasts have low accuracy, and which have a large influence on core-internal exchanges. A quantification of these factors can also be used as a KPI. Core TSOs will provide such an evaluation together with the specific implementation plan. Core TSOs will only perform any AHC go-live when this can be done safely. This covers both grid security and the security of the capacity calculation processes and hence also includes coordinated and individual validation. Looking back to the spirit of the first CCM amendment, in both the public consultation and the consultation with NRAs and ACER, it was agreed not to quantify the impact of AHC to speed up its implementation. Undertaking such a study would mean, that the timeline which has been set up would have to be significantly extended. Currently, doing this is also not possible due to the lack of available simulation resources. However, prior to a go-live, we will provide further data for stakeholder assessment.
S1.3	Currently, 15' MTU has a higher implementation priority, should this be changed?	See Core TSOs' answer.	Regarding prioritization of 15 min MTU over AHC, the feedback from the stakeholders appear contradictory. However, we will take both feedbacks into account to the most possible extent. At the moment,

	As a general comment the stakeholder thinks that the 15' MTU in SDAC should have a lower priority given the high computational challenge, for which solutions are not stable yet and that have a direct impact on market participants IT systems and processes, contrary to the AHC implementation. Several ongoing design topics will affect Euphemia's performances (AHC, 15' MTUs, possible BZ reconfigurations, ...). Given the finite amount of computational power and time available to solve, trade-offs will have to be made, and it is paramount to allocate resources where they are the most efficient and welfare-generating for society. The stakeholder thus finds the TSOs' question ill-defined. The implications of such measures are complex and far-reaching, yet to their knowledge a view of their impact on Euphemia's performance (in terms of computation time, welfare and duality gap achieved) has not been provided. Without that information, the stakeholder cannot realistically provide an answer.		Core TSOs expect guidance from the first performance tests with AHC in EUPHEMIA in the second half of 2023.
S1.4	Comments on specific TSO amendments In Article 11, §5: update of the PTDF_z2z formula for internal HVDC links should be explicit and/or aligned for transparency In Article 13, §3.b: GSK generation for non-Core borders is not clear in which situations GSKs would not ''be available' from non-Core TSOs. Is it only zone and/or process-related or should we expect this also to vary in time. Having time-dependent GSK methodologies could also have significant impacts on the standardization of the PTDF and could go against the goal of creating a better level-playing field.	See Core TSOs' answer.	• The formula changed in Article 11 was consulted based on the second Core IDCCM proposal for amendment. There were no such comments on this formula, but this modification was explicitly welcomed. To ensure consistency between the two methods, the TSOs would like to use identical formulas. While the formula in Article 12 used by the stakeholder for comparison only generally describes the calculation of PTDFs for a single HVDC interconnector in EFB, the formula on the PTDF_z2z_max also the "2-element z2z-PTDF" is applicable, because in EFB the market has been given the freedom to freely select the VH net positions for system optimality (not only for the exchange on the specific EFB interconnector). This is in line with what EUPHEMIA can choose from to be optimal: it can find the optimal allocation via AC and/or DC, so both exchanges could materialize and the respective sensitivities should be considered in CNEC selection. The unavailability of a detailed GSK can be both zone and process related. Not all

			adjacent CCRs data is necessarily available at full resolution at the time of capacity calculation in Core. Short-term fluctuations, e.g., a time-dependent GSK, are not to be expected. However, the method per border may change if better data becomes available for a BZ in the future. A corresponding comment was included in the Explanatory Note.
S2.1	The stakeholder welcomes this consultation on the second amendment of the Day-Ahead Capacity Calculation Methodology of the Core Capacity Calculation Region (CCR) on a proposal for the implementation of Advanced Hybrid Coupling (AHC), in accordance with Article 9(13) of the CACM Regulation. While acknowledging the theoretical benefits of the AHC from a global welfare perspective, the stakeholder takes note of the significant challenges for the capacity calculation and the market coupling which could be faced due to the introduction of one AHC Virtual Hub for each border where the AHC is applied. The main concern for the stakeholder as a market participant is to maintain sufficient operational performance of the coupling algorithm, so as not to restrain the existing set of products offered to the market. Consequently, the results of investigations into the performance of EUPHEMIA – especially in the context of 15 min Market time unit ('MTU') – which are currently being planned are essential to fully appreciate the proposed methodology. The stakeholder would favor prioritizing developments that are already ongoing and are already challenging, before launching other new developments. More generally considering the evolutions to come, the stakeholder does not support too speedy implementations without the insurance that the SDAC algorithm is able to handle products already admissible today, in particular linked, exclusive and loop block products. Considering the implementation plan of the AHC methodology, the stakeholder has no specific request on borders to be prioritized and agrees with the higher priority given to 15 min MTU introduction than the priority given to AHC implementation.	See Core TSOs' answer.	Core TSOs welcome the given feedback. Core TSOs will only perform any AHC go-live when this can be done safely. This concerns both grid security and the security of the capacity calculation processes. Considering performance, guidance can be expected from the first performance tests with AHC in EUPHEMIA in the second half of 2023. Related to prioritization of 15 min MTU compared to AHC, the feedback is contradicting the feedback of another stakeholder who would give lower priority to 15 min MTU. However, we will take this feedback into account to the most possible extent.