

**Updated explanatory document to the second
amendment of the Day-Ahead Capacity
Calculation Methodology of the Core Capacity
Calculation Region regarding the
Advanced Hybrid Coupling**

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 of March 2025

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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').

The 2nd Amendment to the DA CCM for the CCR Core ('Core DA CCM') describing the introduction of Advanced Hybrid Coupling ('AHC') in Core states that the Core TSOs shall

- By 31st of March 2025, have developed AHC, have updated the explanatory note and published an analysis that allows market participants to understand the impact of AHC.
- By 30th of June 2025 implement AHC for borders to bidding zones outside of the Core CCR insofar these bidding zones are part of SDAC, excluding borders with Italy North CCR and with SWE CCR. The implementation is subject to the readiness of SDAC.

Against this background, this updated explanatory document describes the changes to the Core Capacity Calculation triggered by the introduction of AHC. With the publication of this updated Explanatory Note, Core TSOs have also made sample files – taken from the internal tests on AHC – and a report publicly available to allow market participants to understand the impact of AHC. The report also covers a section describing Core TSOs readiness for AHC, hence serving as proof that the deadline for AHC development is met.

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 grid 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.

2.2. Concept of AHC and Changes to 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 to a large extent identical to the concept of EFB used to integrate HVDC interconnectors on bidding zone borders inside the Core CCR, a distinction shall be possible in the Core CCM.

'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;

'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 AHC borders analogously to Core internal borders whenever possible. 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.

Core TSOs applying AHC shall introduce at least one external virtual hub for each AHC border, meaning that multiple HVDCs at a single AHC border can be assigned to separate EVHs.

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

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.

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.

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.³

The CCC shall define GSKs for the EVHs [...] as follows:

- (a) In case an EVH represents only HVDC interconnectors, the GSK shall be defined by all converter stations of the HVDC interconnectors, weighted based on the respective transmission capacity.*
- (b) In case an EVH represents only AC interconnectors, the CCC shall use the GSK of the adjacent bidding zone provided by the TSOs of that bidding zone. If this GSK is not available, the CCC shall define a GSK based on all positive injections in the IGM of the adjacent bidding zone.*
- (c) In case an EVH represents both HVDC interconnectors and AC interconnectors, the respective Core TSO shall define a single combined GSK based on the GSK for the HVDC and the GSK for the AC interconnectors.*

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.

³ Core TSOs aim to have a detailed D2CF grid model for both DK1 and BG for or shortly after AHC go-live, allowing for a high-quality GSK-

Subsequently, PTDFs are required for the external virtual hubs. The existing rules for the computation of PTDFs should be applied. Hence the virtual hubs are included in the PTDF computation, covering both external and internal virtual hubs

The introduction of new PTDFs implicitly leads to an adjusted selection of CNECs. Cross-zonal elements on the AHC borders become CNEs per legal requirement, internal lines may be defined by the TSO. Possible congestions in the grid shall not be considered twice as this could potentially limit capacity 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. 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.

CNEs [...] shall additionally include those elements 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 in Core. Such a CNE 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:

- (a) for HVDC interconnectors, the limit takes into account the physical limitations of the HVDC cables on the border, and the converter stations on the Core side;*
- (b) Core TSOs may consider a limit in the form of an NTC value as an outcome of the capacity calculation from the neighbouring CCR.*

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 action optimisation pursuant will 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 $\vec{F}_{0,Core}$.⁴ Both share the same capacity on the CNECs. Thus, the situation for the computation of $\vec{F}_{0,Core}$ according will also consider the commercial exchange on the AHC borders as $\vec{NP}_{ref,Core}$ will include the net positions of the external virtual hubs. Vice versa, $\vec{F}_{uaf}$ will not include flows resulting from commercial exchanges on the AHC borders.

Regarding the inclusion for Long Term Allocations ('LTA'), the same rules shall apply

⁴ The name of the figure is maintained for the sake of simplicity.

as for borders within the Core FB Region, meaning that extended LTA inclusion ('ELI') will be applied for AHC borders. However, the decision whether LTA inclusion shall be performed or not is subject to guidance on LTA inclusion of the neighboring CCR. In fallback scenarios (DFP), only the ATC provided by the neighbouring CCR will limit the exchanges on AHC borders.

2.3. Implementation of AHC

Core TSO will meet the 31st of March 2025 deadline to have developed AHC, updated the explanatory note and publish an analysis that allows market participants to understand the impact of AHC. However, a "go-live" of AHC by 30th of June 2025 in SDAC will not be feasible due to performance issues identified in EUPHEMIA and the delayed go-live of 15 min MTU.⁵ Core TSOs and CCR Core are working closely with SDAC experts to resolve any potential performance issues. Based on the current SDAC planning, the go-live of AHC can be expected between Q4 2025 and Q3 2026, depending on EUPHEMIA performance.

⁵ Both NRAs and market participants asked for a stabilization period for 15 min MTU before AHC go-live.