PUBLIC

RECOMMENDATION No 01/2019
OF THE EUROPEAN UNION AGENCY FOR THE COOPERATION OF ENERGY REGULATORS

of 08 August 2019

on the implementation of the minimum margin available for cross-zonal trade pursuant to Article 16(8) of Regulation (EU) 2019/943

THE EUROPEAN UNION AGENCY FOR THE COOPERATION OF ENERGY REGULATORS,

Having regard to Regulation (EU) 2019/942 of the European Parliament and of the Council of 5 June 2019 establishing a European Union Agency for the Cooperation of Energy Regulators[1], and, in particular, Article 6(2) thereof,

Having regard to the favourable opinion of the Board of Regulators of 07 August 2019, delivered pursuant to Article 22(5)(a) of Regulation (EU) 2019/942,

Whereas:

(1) According to Article 6(2) of Regulation (EU) 2019/942, the European Union Agency for the Cooperation of Energy Regulators (hereafter referred to as the ‘Agency’) may on its own initiative make recommendations to assist regulatory authorities and market participants in sharing good practices.

(2) Without prejudice to the obligation to maximize capacities for cross-zonal trade, Regulation (EU) 2019/943 on the internal market for electricity prescribes that Transmission System Operators (‘TSOs’) shall, as from 1 January 2020, make available for cross-zonal trade a minimum binding level of capacity (70%). The purpose of offering a minimum level of available capacity for cross-zonal trade is to reduce the effects of loop flows and internal congestions on cross-zonal trade and to give a predictable cross-zonal capacity value for market participants.

(3) Regulation (EU) 2019/943 also allows for transitory measures, such as action plans pursuant to Article 15 or derogations pursuant to Article 16(9), gradually to reach this minimum capacity by the end of 2025 at the latest.

[1] OJ L158, 14.6.2019.

(4) In order to ensure consistency and assist regulatory authorities and all parties involved in capacity calculation in sharing good practices, the Agency deems it necessary to take the initiative and to provide guidance to TSOs on how to implement the minimum capacity target referred to above, and to regulatory authorities on how to monitor the achievement of this target in a harmonised and consistent way. Regulatory authorities should use the results of the monitoring that will also be performed by the Agency in accordance with this Recommendation.

HAS ADOPTED THIS RECOMMENDATION:

1. INTRODUCTION

The development of rules for the calculation and allocation of cross-zonal capacities is an integral step, within the European legal and regulatory framework, for the completion of the internal electricity market. The primary objective of the above-mentioned rules is an efficient management of network congestions, i.e. situations when the capacity of a network is insufficient to accommodate all requests for transport over this network. Efficient management of network congestions consists of several processes. From long run to short run, these consist of network development and investments, definition of bidding-zones, calculation and allocation of cross-zonal capacities in different timeframes, and, finally, identification of remaining congestions, which need to be addressed with remedial actions such as redispatching.

Over the last decade, significant progress has been achieved in the area of capacity allocation, in particular with the development and introduction of market coupling, which ensures that the available cross-zonal capacities, as calculated by TSOs, are allocated in the most efficient manner. In the area of capacity calculation, progress has been much slower. Regulation (EC) No 1228/2003 repealed by the Regulation (EC) No 714/2009 laid down general requirements on coordinated capacity calculation. Yet, these requirements have generally not been adequately implemented in practice[2]. Regulation (EU) 2015/1222 (hereafter referred to as the 'CACM Regulation') provided further detailed specifications on coordinated capacity calculation and more clarity on the process and timeline for its implementation. Following this Regulation, TSOs developed regional methodologies for coordinated capacity calculation, but these methodologies still need to be implemented. Therefore, despite many legal, regulatory and implementation efforts, capacity calculation has in general not yet reached the expected level of efficiency, transparency and non-discrimination in Europe.

One of the main problems related to capacity calculation is the discrimination between electricity exchanges within and between bidding-zones. This problem was first addressed in point 1.7 of Annex I to Regulation (EC) No 714/2009 and further clarified in Article 21 of the

[2] Despite significant delays, some progress was however achieved in the Central-West Europe ('CWE') region.

CACM Regulation, which requires that capacity calculation methodologies should avoid undue discrimination between internal and cross-zonal exchanges.

Article 16(8) of Regulation (EU) 2019/943 prescribes that TSOs shall not limit the volume of interconnection capacity as a means of solving congestion inside their own bidding-zone, or as a means of managing flows resulting from transactions internal to bidding-zones. The same Article also defines that this requirement shall be considered to be complied with if a minimum level of available cross-zonal capacity is reached. While this level is generally set to 70% of the capacity (respecting operational security limits) of critical network elements, transitory measures, such as action plans pursuant to Article 15 of Regulation (EU) 2019/943 or derogations pursuant to Article 16(9) of the same Regulation, allow graduality in reaching this minimum capacity.

As the requirements of Article 16(8) of Regulation (EU) 2019/943 are general, additional clarity is needed for TSOs and regulatory authorities on how to implement them. Such clarity could be provided by amending the CACM Regulation, which is considered as an implementing act for Regulation (EC) No 714/2009 and for Regulation (EU) 2019/943. However, until such amendments are adopted, TSOs and regulatory authorities may need detailed guidance on how to implement in a harmonised and consistent way the requirements of Article 16(8) of Regulation (EU) 2019/943.

The Agency, in coordination with regulatory authorities, represented in its Board of Regulators, agreed on providing a harmonised approach on how to monitor the achievement of the minimum level of available cross-zonal capacity set by Article 16(8) of Regulation (EU) 2019/943. In that regard, the provision of certain data by TSOs will be critical in enabling regulatory authorities to monitor, according to Article 59(1)(h) of Directive (EU) 2019/944, the TSOs' compliance with Article 16(8) of Regulation (EU) 2019/943, and it will be instrumental in facilitating the Agency's monitoring of the internal electricity market according to Article 15(1) of Regulation (EU) 2019/942. To that end, this Recommendation also specifies the data which the regulatory authorities and the Agency will request from TSOs for the purpose of monitoring the achievement of the minimum level of available cross-zonal capacity. This Recommendation may later be complemented by further guidance on how the results of the monitoring should be used to assess and, where necessary, address the overall compliance with Article 16(8) of Regulation (EU) 2019/943.

2. DEFINITIONS AND ABBREVIATIONS

The terms used in this Recommendation shall have the same meaning as in the definitions contained in Article 2 of the CACM Regulation, in Regulation (EU) 2019/943, in Directive 2019/944, in Commission Regulation (EU) 2016/1719 (hereafter referred to as the 'FCA Regulation'), in Commission Regulation (EU) 2017/2195 and in Commission Regulation (EU) 543/2013. In addition, the following definitions, abbreviations and notations shall apply:

'Already allocated capacities' or 'AAC' means the cross-zonal capacities, which have already been allocated (and nominated) in the previous timeframes. For the DA timeframe, the previous timeframes are the yearly and monthly timeframes. For the ID timeframe, the previous timeframes are the yearly, monthly, day-ahead and previous ID timeframes. Capacity may have been allocated for the exchange of energy or for the exchange of balancing capacity.

‘CC MTU’ is the capacity calculation market time unit, which means the time unit for the considered capacity calculation, and is equal to either DA CC MTU or ID CC MTU;

‘CCC’ means the coordinated capacity calculator of the considered coordination area (as defined in Article 2(11) of the CACM Regulation) or, in case this does not exist in a coordination area, the entity responsible for conducting capacity calculation in the considered coordination area;

‘CCM’ means a capacity calculation methodology;

‘CCR’ means the capacity calculation region as defined in Article 2(3) of the CACM Regulation;

‘CGM’ means the common grid model as defined in Article 2(2) of the CACM Regulation, and means a CGM established for the considered capacity calculation process for the CC MTU in accordance with the common grid model methodology pursuant to Article 17 of the CACM Regulation;

‘CNE’ means a critical network element;

‘CNEC’ means a CNE associated with a contingency used in capacity calculation. For the purpose of this Recommendation, the term CNEC also covers the case where a CNE is used in capacity calculation without a specified contingency;

‘Coordination area’ means a set of bidding-zone borders within which capacity calculation is fully coordinated for the considered timeframe. A coordination area may also be a single bidding-zone border, or one side of a bidding-zone border in case two different NTC values are calculated by each TSO and the lower one is used for capacity allocation;

‘Core DA CCM’ means the common day-ahead capacity calculation methodology for the Core CCR pursuant to the Agency’s Decision No 02/2019[3];

‘DA’ means the day before electricity delivery;

[3] See https://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Individual%20decisions/ACER%20Decision%2002-2019%20on%20CORE%20CCM.pdf

'DA CC MTU' is the day-ahead capacity calculation market time unit, which means the time unit for the day-ahead capacity calculation, as defined in the implemented CCM;

'External constraint' means a type of allocation constraint that limits the maximum import and/or export of a given bidding-zone;

'Fmax' means the maximum flow on critical network element, as referred to in Articles 23(3)(a) and 29(7)(a) of the CACM Regulation and applies equally to the flow-based and coordinated NTC approaches. It also means the capacity respecting operational security limits taking into account (or after deduction of) contingencies of critical network elements as referred to in Article 16(8) of Regulation (EU) 2019/943;

'HVDC' means a high voltage direct current network element;

'ID CC MTU' is the intraday capacity calculation market time unit, which means the time unit for the intraday capacity calculation, as defined in the implemented CCM;

'Long-term timeframes' means capacity calculation timeframes pursuant to the FCA Regulation;

'MACZT' means the margin available for cross-zonal trade, i.e. the portion of capacity of a CNEC available for cross-zonal trade;

'MCCC' means the margin from coordinated capacity calculation, i.e. the portion of capacity of a CNEC available for cross-zonal trade on bidding-zone borders within the considered coordination area;

'MNCC' means the margin from non-coordinated capacity calculation, i.e. the portion of capacity of a CNEC available for cross-zonal trade on bidding-zone borders outside the considered coordination area;

'NTC' means the (coordinated) net transmission capacity calculation approach, as defined in Article 2(8) of the CACM Regulation;

'Oriented bidding-zone border' means a given direction of a bidding-zone border (e.g. from Germany to France);

'PTDF' means a power transfer distribution factor which describes the impact of a bidding-zone net position or of a commercial exchange between two bidding-zones on a CNEC, as computed in the implemented CCM. In case the implemented CCM does not define how to compute PTDFs, these factors should be computed pursuant to Article 11 of the Core DA CCM.

'RAM' means a remaining available margin of a CNEC for the considered CC MTU, as provided to SDAC/SIDC pursuant to the implemented flow-based CCM;

'SDAC' means the single day-ahead coupling;

'Shadow price' means the dual price of a CNEC or allocation constraint representing the increase in the economic surplus if a constraint is increased by one MW;

'SIDC' means the single intraday coupling;

'Timeframe' means either DA or ID.

3. APPLICABLE LEGAL FRAMEWORK

Article 16(8) of Regulation (EU) 2019/943 states that "*[t]ransmission system operators shall not limit the volume of interconnection capacity to be made available to market participants as a means of solving congestion inside their own bidding zone or as a means of managing flows resulting from transactions internal to bidding zones.*" Without prejudice to derogations or national action plans pursuant to the same Regulation, *"[this requirement] shall be considered to be complied with where the following minimum levels of available capacity for cross-zonal trade are reached:*

(a) for borders using a coordinated net transmission capacity approach, the minimum capacity shall be 70 % of the transmission capacity respecting operational security limits after deduction of contingencies, as determined in accordance with the [CACM Regulation];

(b) *for borders using a flow-based approach, the minimum capacity shall be a margin set in the capacity calculation process as available for flows induced by cross-zonal exchange. The margin shall be 70 % of the capacity respecting operational security limits of internal and cross-zonal critical network elements, taking into account contingencies, as determined in accordance with the [CACM Regulation]*."

Furthermore, "*[t]he total amount of 30 % can be used for the reliability margins, loop flows and internal flows on each critical network element.*"

4. MAIN PRINCIPLES FOR IMPLEMENTATION AND MONITORING

4.1. Concepts of MACZT, MNCC and MCCC

As regards the reference to '*available capacity for cross-zonal trade'*, this Recommendation defines MACZT, which is the margin available for cross-zonal trade. Article 16(8) of Regulation (EU) 2019/943 specifies that this margin represents the capacity available for cross-zonal trade. It further specifies that, for the flow-based approach, it is a margin set in the capacity calculation process as available for flows induced by cross-zonal exchanges. MACZT should therefore represent the capacity available for cross-zonal trade on all bidding-zone borders and, for the flow-based approach, the margin available for flows induced by cross-zonal exchanges on all bidding-zone borders, which is computed in accordance with capacity calculation processes pursuant to Article 21 of the CACM Regulation[4].

The CACM Regulation defines the scope of capacity calculation to be performed within specific coordination areas (i.e. CCRs). This means that capacity calculation is coordinated among the bidding-zone borders of such areas and not among all bidding-zone borders within the EU. Thereby, the capacity calculation within a coordination area needs to take into account the impact that bidding-zone borders outside such a coordination area have on the physical flows on the critical network elements used within such a coordination area. To do that, CCMs currently first estimate the flow induced by cross-zonal exchanges over bidding-zone borders outside the coordination area (MNCC), and then derive the margin available for cross-zonal trade within the coordination area (MCCC). The MACZT calculation should be consistent with this approach.

According to the guidance provided by the services of Directorate-General for Energy of the European Commission in a letter of 16 July 2019, consideration of third (i.e. non EU member) country flows in capacity calculation and MACZT should be possible on the condition that an agreement has been concluded by all TSOs of a CCR with the TSO of the third country, approved by the respective regulatory authorities. The agreement should be fully in line with EU capacity calculation principles and rules, and should cover at least:

(i) consideration of internal third country constraints for intra-EU capacity calculation,

(ii) consideration of EU internal constraints for capacity calculation on the border with third country, and

(iii) cost-sharing of remedial actions.

Until such an agreement has been concluded, two different MACZT values should be computed to estimate the impact of third country flows: one including flows induced by exchanges with third countries, and the other excluding them.

Furthermore, the reference to the *‘capacity respecting operational security limits taking into account (after deduction of) contingencies of critical network elements’* should be understood as the maximum flow on a CNE in a situation with a contingency (i.e. Fmax)[5]. This understanding should take into account contingencies. CCMs adopted in accordance with Articles 20 and 21 of the CACM Regulation take into account contingencies by ensuring that operational security limits (i.e. Fmax) of critical network elements are not exceeded even in

[4] If CCMs change significantly in the future, the methodology used to estimate and monitor MACZT may also need to be updated accordingly.

[5] See e.g. Article 6 of the Core DA CCM.

case a contingency occurs. This translates the requirement for taking into account contingencies into the requirement that MACZT values are equally considered for all CNECs regardless of whether they are defined with (or without) contingency[6]. More details on contingencies may be found in Annex IV.

Article 16(8) of Regulation (EU) 2019/943 also mentions that the minimum capacity available for cross-zonal trade shall be determined in accordance with the CACM Regulation. Therefore, the calculation and monitoring of MACZT should only be conducted for timeframes which fall under Article 14 of the CACM Regulation, namely the day-ahead and intra-day timeframes.

4.2. Scope of MACZT, MCCC and MNCC

Based on the aforementioned considerations, the margin available for cross-zonal trade should individually be estimated for each CNEC, timeframe, CC MTU and coordination area. The MACZT should be computed based on two main flow components:

(a) **the MCCC,** which is the portion of capacity of a CNEC available for cross-zonal trade on bidding-zone borders within the considered coordination area; and

(b) **the MNCC**, which is the portion of capacity of a CNEC available for cross-zonal trade on bidding-zone borders outside the considered coordination area. MNCC may consist of different flows induced by several other coordination areas.

Within NTC coordination areas, it may be possible to compute 'benchmark' NTC values, which reflect the 70% target. In practice, such values can unambiguously be defined for non-interdependent bidding-zone borders. However, for interdependent borders, there are many ways to share the power flow capabilities of CNECs among borders; therefore, many sets of benchmark NTC values could be elaborated. As a result, it would be practically impossible to monitor the achievement of the 70% target and unambiguously to determine which Member State(s) do(es) or do(es) reach this target based on benchmark NTC values, as a given Member State could be considered as achieving the target based on one set of benchmark NTC values, but as not achieving it based on another set of benchmark NTC values. Nevertheless, as all sets of benchmark NTC values reflect the same underlying power flow capabilities of CNECs, monitoring MACZT at CNEC-level would lead to an unambiguous and therefore more robust approach. Finally, for non-interdependent NTC bidding-zone borders, monitoring benchmark NTC values is equivalent to monitoring MACZT on the underlying CNECs, but monitoring underlying CNECs better allows attributing the provided MACZT level to a TSO or Member State[7]. As a result, a uniform and consistent monitoring approach should be taken to monitor MACZT at CNEC-level for all flow-based and coordinated NTC coordination areas. However,

[6] See the definition of a CNEC

[7] Monitoring only an NTC value does not allow inferring the underlying limiting CNEC, and therefore does not allow inferring the underlying TSO and MS.

given that currently-implemented NTC CCMs do not define CNECs or do not explicitly compute MACZT on these CNECs, an interim solution in NTC coordination areas will focus the monitoring to limiting CNECs.

The calculation of MNCC and MCCC requires defining a coordination area, i.e. the set of bidding-zone borders within which capacity calculation is fully coordinated for the considered timeframe. For regional CCMs approved and implemented pursuant to Articles 20 and 21 of the CACM Regulation, the coordination areas are equal to the CCRs. Until the implementation of these CCMs, coordination areas should be defined on a yearly basis by regulatory authorities and the Agency, in coordination with TSOs, based on the declared level of coordination in capacity calculation among bidding-zone borders for the considered timeframe.

4.3. Monitored timeframes

MACZT should in general be monitored for the day-ahead capacity calculation timeframe. When coordinated capacity calculation is implemented for the intraday timeframe and in some cases (deemed justified by regulatory authorities) where TSOs are unable to reach the MACZT target in the day-ahead timeframe, the intraday timeframe may also be taken into account in the monitoring of the MACZT target. TSOs should as much as possible avoid delaying the offering of high MACZT after the day-ahead timeframe, in order to avoid adversely affecting the internal electricity market (see Annex III for details). In order to define justified cases and whether additional capacity was effectively [8] provided in the intraday timeframe, this Recommendation may need to be updated once intraday coordinated capacity calculation is implemented.

MACZT should not be monitored for long-term timeframes, since the requirement of Article 16(8) of Regulation (EU) 2019/943 only refers to capacity determined in accordance with the CACM Regulation. Flows induced by nominations resulting from capacity allocation in long-term timeframes should however be taken into account when estimating MACZT.

5. ESTIMATING MACZT

Monitoring MACZT levels for a given timeframe and CC MTU should rely on the following process. First, CNECs should be defined and attributed to a single TSO, Member State and to one or more coordination areas. The margin available within the coordination area (MCCC) and outside the coordination area (MNCC) should then be estimated for these CNECs.

[8] Where additional capacity on a CNEC has been provided in the intraday but could never be allocated because another CNEC is always more binding, the CNEC should not be considered to offer additional capacity. See Annex III for details.

5.1. Definition of CNECs

The CNECs used for the calculation of MACZT are those CNECs which have been used for the calculation of cross-zonal capacities for the considered timeframe and CC MTU[9]. Each CNEC should be based on an (oriented) CNE and should be associated with a contingency[10] where relevant. A given CNEC should be attributed to one TSO only (and as a result one Member State only), i.e. to the TSO which introduced the CNEC during capacity calculation. The CNE of a CNEC should be located within or on the border of the TSO's control area, whereas contingencies should be located in the observability area of that TSO.[11]

As a main principle, for transparency and consistency purposes, MACZT should be monitored on all CNECs used in capacity calculation regardless of whether the capacity calculation applies the flow-based or coordinated NTC approach[12]. For the flow-based approach, this principle implies monitoring all[13] CNECs introduced by TSOs within the capacity calculation, including for example CNECs identified as redundant by the CCC. The same principle should apply for the coordinated NTC approach[14,15]. However, given that most currently-applicable NTC CCMs do not define CNECs or do not calculate MCCC on these CNECs, until the implementation of a proper methodology to compute MCCC within CCMs is adopted pursuant to the CACM Regulation[16], regulatory authorities should and the Agency will estimate MCCC on CNECs based on NTCs for the considered timeframe and CC MTU. Due to methodological limitations related to this MCCC estimation, only those CNECs which were limiting NTC

[9] In the absence of capacity calculation for the considered timeframe, the TSOs on each side of the border should define CNECs for the monitoring, taking capacity calculation in other timeframes into account.

[10] Outages included in the CGM (such as e.g. planned outages) of the considered coordination area should be taken into account when computing PTDFs, not when defining CNECs.

[11] See Section 4.1. If a CNEC describes an interconnector between an EU Member State and a third (i.e. non-EU member) country, one half of the interconnector should be considered as being located within the EU, and could thus be included within MACZT estimates. This practice reflects the use of x-nodes to define interconnectors within the CWE region.

[12] The principle that MACZT should be monitored on all CNECs used in capacity calculation does not automatically imply that the authorities assessing the compliance with Article 16(8) of Regulation (EU) 2019/943 should consider all CNECs used in capacity calculation. The CNECs considered for compliance purposes might indeed differ from the CNECs considered for monitoring purposes.

[13] Within the Core (CWE) region, and until the implementation of the Core DA CCM, CNECs resulting from the application of the long-term allocated capacity ('LTA') inclusion patch should not be monitored, because the application of this patch leads to the introduction of virtual CNECs, and makes it difficult to link the MACZT of these CNECs to physical network characteristics. When the Core CCM will be implemented, all CNECs should be monitored, given that the LTA inclusion patch defined in the Core CCM retains most of the physical characteristics of CNECs.

[14] This may require the CCCs of CCRs applying the coordinated NTC approach to calculate MCCC and provide this data to regulatory authorities and the Agency. The Agency may verify the quality of this data.

[15] For bidding-zone borders with only HVDC interconnectors, one equivalent CNEC per oriented bidding-zone border should be declared by each TSO for the whole border as the sum of capacity of all available HVDC interconnectors (without any contingency). This CNEC should be monitored in addition to other (non-HVDC) CNECs introduced within the coordination area (if any).

[16] Regulatory authorities and the Agency are aware that the implementation of such a methodology may require some additional work and that the timeline for this implementation is not yet defined.

capacity calculation will be monitored during this transitory period. In this case, at least one limiting CNEC (or allocation constraint) should be defined per oriented bidding-zone border[17].

Pursuant to Articles 3(2) and 15 of Regulation (EU) 2019/942, the Agency will request TSOs to provide, on a biannual basis, the following information for each monitored CNEC, timeframe and CC MTU:

- Identifier of the CNE and of the contingency;
- Name of the CNE and of the contingency;
- TSO which introduced the CNEC;
- Member State to which the CNEC is attributed;
- Fmax;
- RAM for the flow-based approach, MCCC for the coordinated NTC approach (when available);
- For the coordinated NTC approach, the oriented bidding-zone borders for which the CNEC was limiting during the capacity calculation process, if any;
- PTDFs for all bidding-zones having a non-zero impact on such CNEC[18].

5.2. MCCC

MCCC describes the portion of capacity of a CNEC which is available for cross-zonal trade on bidding-zone borders within the considered coordination area. MCCC should encompass:

a) The margin made available for the capacity allocation in the day-ahead (or intraday) timeframe; and

b) The margin for already allocated capacities (AAC) in previous timeframes.

MCCC therefore represents the margin that would be available for the considered timeframe if already allocated capacities were set to zero. For example, if AAC consumed 20% of Fmax on a given CNEC, then this CNEC should offer an additional 50% in the day-ahead timeframe to reach an MCCC value of 70%. Until TSOs are able directly to provide regulatory authorities

[17] If a CNEC limits the calculation on a set of bidding-zone borders, then it should be considered to limit each bidding-zone border individually.

[18] As a first step in order to ease implementation, while waiting for TSOs to deliver such information, regulatory authorities should and the Agency will compute these PTDFs.

and the Agency with MCCC values, different methodologies should be used to estimate MCCC within the flow-based and coordinated NTC approaches.

5.2.1. MCCC in flow-based approach

For coordination areas which apply the flow-based approach in the considered timeframe for the considered CC MTU, the MCCC should be equal to the RAM[19] of the considered CNEC for the considered timeframe and CC MTU, which is adjusted for AAC as follows

$$MCCC_{FB}(CC\ MTU) = RAM_{timeframe}(CC\ MTU) + F_{AAC}(CC\ MTU)$$

where

$RAM_{timeframe}$	Margin offered within the CCM as an outcome of the capacity calculation process for the considered timeframe
F_{AAC}	Margin for already allocated and nominated capacities

For the day-ahead timeframe, the above formula becomes

$$\begin{aligned} MCCC_{FB}(CC\ MTU) &= RAM_{DA}(CC\ MTU) + F_{AAC,DA}(CC\ MTU) \\ &= RAM_{DA}(CC\ MTU) \\ &\quad + \sum_{b\,\in\,coordination\ area} PTDF_{z2z,b}(CC\ MTU) * AAC_{DA,b}(CC\ MTU) \end{aligned}$$

where

$F_{AAC,DA}$	Margin for already allocated and nominated capacities in the long-term timeframes
b	Oriented bidding-zone border which belongs to the considered coordination area
$PTDF_{z2z,b}$	Zone-to-zone PTDF associated with the oriented bidding-zone border
$AAC_{DA,b}$	Already allocated and nominated capacities from the perspective of day-ahead timeframe (i.e. the capacities allocated and nominated in the long-term timeframe) for the oriented bidding-zone border.

[19] As e.g. defined in Equation 23 of the Core DA CCM

Similarly, for the intraday timeframe, the above formula becomes

$$MCCC_{FB}(CC\ MTU) = RAM_{ID}(CC\ MTU) + F_{AAC,ID}(CC\ MTU)$$

$$= RAM_{ID}(MTU) + \sum_{b \in coordination\ area} PTDF_{z2z,b}(CC\ MTU) * AAC_{ID,b}(\mathrm{CC}\ MTU)$$

Where

$F_{AAC,ID}$	Margin for already allocated capacities resulting from capacity allocation in the previous timeframes (including long-term, DA, and previous ID timeframes)
b	Oriented bidding-zone border which belongs to the considered coordination area
$PTDF_{z2z,b}$	Zone-to-zone PTDF associated with the oriented bidding-zone border
$AAC_{ID,b}$	Already allocated and nominated capacities from the perspective of the intraday timeframe (i.e. the capacities allocated and nominated in the long-term, DA and previous ID timeframes) for the oriented bidding-zone border.

5.2.2. MCCC in coordinated NTC approach

For coordination areas which apply the coordinated NTC approach for the considered timeframe and CC MTU, and until MCCC is directly provided by TSOs to regulatory authorities and the Agency according to a proper methodology to be included within the CCM, the MCCC for each limiting CNEC is calculated based on the combination of NTCs that results in the highest loading of the CNEC. The margin combines positive zone-to-zone PTDFs and NTCs as follows[20]:

$$MCCC_{NTC}(CC\ MTU) = \sum_{b \in coordination\ area} pPTDF_{z2z,b}(CC\ MTU) * NTC_{b}(\mathrm{CC}\ MTU)$$

[20] This equation describes the reverse conversion of a flow-based domain into an ATC domain, as e.g. specified in Article 23 of the Core DA CCM

where

b	Oriented bidding-zone border which belongs to the considered coordination area
$pPTDF_{z2z,b} = \max(0, PTDF_{z2z,b})$	Positive zone-to-zone PTDF associated with the oriented bidding-zone border b (0 for a negative zone-to-zone PTDF)
NTC_b	Net transfer capacity of the considered oriented bidding-zone border[21] for the considered timeframe. The NTC should also include capacity reserved for the exchange of balancing capacity. If no NTC value is computed for the considered timeframe, the NTC value published as DA NTC for the considered CC MTU should be used (as such a publication is required pursuant to Article 11(1)(a) of Commission Regulation (EU) 543/2013).

This flow estimation only reliably estimates the margin for limiting CNECs, i.e. for CNECs which limit capacity calculation. For other CNECs, the margin would be underestimated[22]. As a result, only limiting CNECs should be monitored until TSOs are able directly to provide MCCC to regulatory authorities and the Agency.

5.3. MNCC

MNCC describes the portion of capacity of a CNEC which is available for cross-zonal trade on bidding-zone borders outside the considered coordination area. Non-coordinated bidding-zone borders include the bidding-zone borders[23], which are outside the coordination area of the CNEC for which MACZT is estimated. To define the impact of these borders, it is important to refer to Article 16(8)(b) of Regulation (EU) 2019/943, which specifies that, in the flow-based approach, "*the minimum capacity shall be a margin set in the capacity calculation process as **available for flows induced by cross-zonal exchange**.*"

The Regulation therefore defines the minimum capacity in the case of the flow-based approach as the margin available for flows induced by cross-zonal exchange. In all capacity calculation methodologies in all CCRs[24], the margin available for flows induced by cross-zonal exchanges on bidding-zone borders outside the considered CCR is calculated based on forecast net

[21] In case the declared coordination area consists of one side of a bidding-zone border, the NTC computed by the TSO on the considered side of the border should be used instead of the NTC resulting from consolidation with the neighbouring TSO.
[22] See Annex I
[23] See Section 4.1
[24] Except those where flows induced by cross-zonal exchange outside a coordination area are considered directly within the MCCC, e.g. with advanced hybrid coupling.

positions and cross-zonal exchanges represented in the CGM[25] (see Annex II for details). This assumption is the same in CCRs applying the flow-based and the coordinated NTC approaches.

MNCC can therefore be defined (for both flow-based and coordinated NTC approaches) as the flow induced by cross-zonal exchanges on bidding-zone borders outside the coordination area, as determined in implemented CCMs. This flow should be computed based on forecast[26] exchanges and net positions provided by TSOs to regulatory authorities and the Agency. For a given timeframe and CC MTU, the MNCC on the CNEC is then:

$$MNCC(CC\ MTU) = \sum_{bz \in Europe} PTDF_{z2h,bz}(CC\ MTU) * CGMNP_{bz,ext}(CC\ MTU) + \sum_{\substack{b \notin coordination\ area \\ i\ HVDC\ interconnector}} PTDF_{z2z,b,i}(CC\ MTU) * CGME_{\ b}(CC\ MTU)$$

where

bz	Bidding-zone, both inside and outside[27] the coordination area
$PTDF_{z2h,bz}$	(positive or negative) zone-to-hub PTDF associated with bidding-zone *bz*
$CGMNP_{bz,ext}$	CGM forecast net position of the bidding-zone reflecting trade outside the considered coordination area[28], for non-HVDC (i.e. AC) bidding-zone borders. For example, if a bidding-zone within the coordination area has a (global) forecast net position of 2GW over all AC bidding-zone borders, and a forecast net position over AC borders within the coordination area of 0.5GW, the forecast net positions reflecting trade outside the coordination area should be 1.5GW
b	Oriented HVDC bidding-zone border, which does not belong to the considered coordination area

[25] As a fallback in case no CGM is available for the considered timeframe and CC MTU, different grid models may be used by different CCRs or coordination areas. In this case, the cross-zonal exchanges used as boundary conditions for these grid models should be used to depict forecast cross-zonal exchanges of other CCRs (or coordination areas).
[26] The provided data should reflect the forecast available at the time of capacity calculation for the considered timeframe and CC MTU.
[27] See Section 4.1.
[28] See Section 4.1.

$PTDF_{z2z,b,i}$	(positive or negative) zone-to-zone PTDF associated with the oriented bidding-zone border b and HVDC interconnector i
$CGME_b$	CGM forecast of the exchange on the oriented HVDC bidding-zone border b (in case the exchange over the bidding-zone border is not already reflected by the forecast bidding-zone net positions). As a fallback (e.g. for historical analyses), scheduled exchanges resulting from SDAC/SIDC (depending on the considered timeframe)[29] should be used as a proxy

In case forecast cross-zonal exchanges are available for all bidding-zone borders, the above formula would be equivalent to

$$MNCC(CC\ MTU) = \sum_{b \notin coordination\ area} PTDF_{z2z,b}(CC\ MTU) * CGME_b(CC\ MTU)$$

Where

b	Oriented bidding-zone border, which does not belong to the considered coordination area
$PTDF_{z2z,b}$	(Positive or negative) zone-to-zone PTDF associated with the oriented bidding-zone border b
$CGME_b$	CGM forecast of the net exchange on the oriented bidding-zone border b. As a fallback (e.g. for historical analyses), scheduled exchanges resulting from SDAC/SIDC (depending on the considered time frame)[30] should be used as a proxy

Such a flow contribution may be negative, i.e. may free capacity on the CNEC. This additional capacity should then become available for trade on bidding-zone borders within the

[29] For bidding-zone borders, which are not part of SDAC/SIDC for the considered timeframe and CC MTU, the net schedule resulting from capacity allocation may be used.
[30] For bidding-zone borders which are not part of SDAC/SIDC for the considered timeframe and CC MTU, the net schedule resulting from capacity allocation may be used.

coordination area. This assumption is in line with Article 16(11) of Regulation (EU) 2019/943, which requires that "*[a]s far as technically possible, transmission system operators shall net the capacity requirements of any power flows in opposite directions over the congested interconnection line in order to use that line to its maximum capacity. Having full regard to network security, transactions that relieve the congestion shall not be refused.*" While the netting of flows opposite to congestion is legally required, it has to be noted that in the case referred to above such flows are computed based on forecasts, which have inherent uncertainties. For this reason it is important to consider the technical limitations necessary to support stable and secure grid operation, which may require some temporary relaxation of the MACZT target as described below.

MNCC values are expected to decrease in the future, e.g. following the implementation of the CGM methodology and of the CCMs pursuant to the CACM Regulation, which will enlarge existing coordination areas to CCRs. Further, after the CCMs pursuant to the CACM Regulation are implemented, TSOs should further work on increasing the size of CCRs (which is expected gradually to diminish the flows resulting from cross-zonal exchanges outside CCRs) and, where such increase would not be efficient, to implement advanced hybrid coupling (which is expected to consider the flows resulting from cross-zonal exchanges outside CCRs within MCCC). However, until TSOs are able to implement the above-mentioned solutions, regulatory authorities and the Agency should recognise that, in some cases, the high uncertainties related to forecast cross-zonal exchanges outside coordination areas may result in a higher reliability margin in relation to cross-zonal exchanges outside the coordination area and may impede the ability of TSOs to reach the MACZT target[31]. In such cases, the temporary relaxation of the MACZT target (e.g. through derogations)[32] might be an appropriate instrument.

5.4. HVDC CNEs

In case a bidding-zone border only encompasses HVDC interconnectors, the MACZT calculation for these interconnectors[33] may be simplified as follows. The flows on HVDC interconnectors are, in contrast to AC network elements, assumed to be fully controllable[34]. Therefore, the interconnectors may be controlled in order to ensure that flows through them only reflect the cross-zonal exchange on the considered bidding-zone border. As a result, the flow induced by exchanges on all other bidding-zone borders (both within and outside the coordination areas) is zero, i.e. MNCC is zero and MCCC only reflects trade on the considered

[31] This large uncertainty may stem from the fact that the current coordination areas may be much smaller than CCRs pursuant to the CACM Regulation (e.g. within the Core CCR).
[32] This paragraph does not portend any decision by regulatory authorities or the Agency on derogation processes.
[33] In case other AC CNECs are introduced within the coordination area of the considered bidding-zone border, MACZT of these CNECs should also be monitored, following the methodology defined in Sections 5.2 and 5.3.
[34] This Section does not apply for HVDC interconnectors operated in AC emulation mode.

bidding-zone border. Assuming that the zone-to-zone PTDF is equal to one on the considered border, MACZT then becomes for an oriented CNEC

$$MACZT = MCCC = NTC_b(MTU)$$

Where

b	Oriented bidding-zone border, for which the (oriented) DC interconnector MACZT is computed
NTC_b	Net transfer capacity of the considered border for the considered timeframe and CC MTU

6. MONITORING THE ACHIEVEMENT OF THE MACZT TARGET

Monitoring the achievement of the minimum MACZT target should rely on two tests (subject to derogations and action plans). First, MACZT should reach at least 70% for all monitored CNECs in all coordination areas during all CC MTUs. Second, the impact of allocation constraints on the CNECs’ MACZT target should be monitored.

6.1. Monitoring MACZT on CNECs

Within a coordination area, for a given CNEC, timeframe and CC MTU, the test is defined by the following equation:

$$MACZT(CC\ MTU) = MCCC(CC\ MTU) + MNCC(CC\ MTU) \geq 70\%\ F_{max}(CC\ MTU)$$

F_{max} should be computed in accordance with the implemented CCM. In particular, in case of time-varying operational security limits (e.g. dynamic line rating reflecting varying ambient conditions[35]), the time-varying F_{max} value should be used to define the MACZT target.

MCCC is expected always to be positive, whereas MNCC may be negative. In the latter case, reaching the MACZT target should entail offering more than 70% of F_{max} within the

[35] See e.g. Article 6(2)(a)(ii) of the Core DA CCM

coordination area, in order to ensure that the sum of both margins is greater than or equal to 70% of F_{max}, as prescribed by Article 16(11) of Regulation (EU) 2019/943.

In case derogations or action plans define minimum MACZT targets (or rules from which such targets can be derived) which differ from 70% of F_{max}, the test should be updated as follows

$$MACZT(CC\ MTU) = MCCC(CC\ MTU) + MNCC(CC\ MTU) \geq MACZT_{min}(CNEC, CC\ MTU)$$

where

$MACZT_{min}$	Minimum MACZT target level which is derived from the derogation or action plan proceedings for the considered CNEC, timeframe and CC MTU (e.g. 40% Fmax), if applicable

6.2. Monitoring allocation constraints and technical profiles

Pursuant to Article 23(3)(a)[36] of the CACM Regulation, when constraints are needed to maintain the transmission system within operational security limits, and when such constraints cannot be transformed efficiently into Fmax on CNEs, TSOs may introduce additional constraints ('allocation constraints') to be respected during capacity allocation. Other constraints, such as technical profiles, are also currently used in order to restrict simultaneously the capacity which may be allocated on a predefined set of two or more bidding-zone borders.

The second sentence of Article 16(8)(b) of Regulation (EU) 2019/943 specifies that the first sentence of this Article is complied with if a predefined minimum capacity is made available for cross-zonal trade. For the flow-based approach, this minimum level must be provided on CNEs (i.e. 70% of Fmax of CNEs), without any reference to allocation constraints. This implies that, in case allocation constraint effectively reduced capacity of any CNEC below 70% of its Fmax, such allocation constraint would effectively reduce the MACZT level of this CNEC below the target.[37]

The monitoring process should assess the impact of allocation constraints on MACZT. The process should be tuned to ensure relevant monitoring of all kinds of allocation constraints and technical profiles.

[36] The impact of allocation constraints introduced pursuant to Article 23(3)(b) of the CACM Regulation on MACZT should not be monitored.
[37] This is without prejudice to the assessment of the compliance of these allocation constraints.

6.2.1. External constraints

External constraints are a type of allocation constraints that limits the maximum import and/or export of a given bidding-zone. External constraints should be subject to a similar test as MACZT on CNECs, to monitor whether they effectively lead to decrease MACZT below the minimum threshold on any CNEC. This check is performed through the following tests (see Annex V for details).

Within flow-based and NTC coordination areas, each external constraint should be tested as follows. First, MCCC should be adjusted such that MACZT on each monitored CNEC is exactly equal to 70% of Fmax (or, if defined, should reflect the applicable derogation or action plan). The resulting capacity domain would be the smallest domain defined by monitored CNECs, which reaches the minimum MACZT target described in Section 6.1 for all CNECs for the considered CC MTU. It should then be assessed whether the external constraint would not be redundant in this domain, i.e. whether adding the external constraint would reduce the capacity domain defined by the minimum margin target on each monitored CNEC. If the external constraint is not redundant, it would mean that the allocation constraint effectively restricts the opportunities for cross-zonal exchanges below 70% (or, if defined, below the target reflecting the applicable derogation or action plan) on at least one CNEC.

6.2.2. Other allocation constraints

Other types of allocation constraints should also be monitored to assess their impact on the achievement of the minimum MACZT target (or the minimum MACZT defined in the applicable derogation or action plan) on some CNECs.

TSOs which introduce such allocation constraints within the implemented CCMs (or within the CCMs approved pursuant to the CACM Regulation) should jointly investigate how best to monitor the impact of these other allocation constraints with respect to the MACZT target, and should report to regulatory authorities and the Agency on potential methodologies to monitor these constraints within two years following the adoption of this Recommendation.

6.2.3. Technical profiles

A technical profile is a single capacity value, which constrains a combination of NTC capacities that can simultaneously be allocated on a predefined set of oriented bidding-zone borders. For example, the technical profile for Poland-export limits the sum of allocated capacities on the PL-CZ, PL-DE, and PL-SK borders. Thereby, the capacity value can either be allocated on exclusively one of the three borders or be spread on two or three borders, such that the sum of the allocated capacities over these three borders is not higher than the technical profile value.

Each technical profile should individually be monitored, separately from the CNEC test described in Section 6.1 and from the external constraint test described in Section 6.2.1. In order to identify whether the technical profile actually restricts MACZT below the minimum target on at least one CNEC, the technical profile is first converted into a simultaneously feasible combination of NTCs on all corresponding bidding-zone borders. To do so, a simplified assumption should be used, that the complete capacity of the technical profile is allocated on the border with the highest price spread (for the considered timeframe and CC MTU)[38], whereas the NTCs on all other concerned borders are set to zero[39]. The NTCs calculated in this way would then be defined per bidding-zone border and would be compliant with the technical profile.

Once the technical profile has been converted to NTCs on bidding-zone borders, MCCC and MACZT are computed for all the CNECs attributed to the TSO[40] which defined the technical profile, in order to perform the test mentioned in Section 6.1 on the updated MACZT.

6.3. Additional monitoring information

In case either of the tests described in Sections 6.1 and 6.2 indicates that MACZT is below the minimum target, in order to allow regulatory authorities, and help the Agency, to investigate such situations in line with their monitoring activities, TSOs should provide at least the following information to regulatory authorities and the Agency for the considered timeframe (per Member State):

(a) the network situation (including e.g. exceptional outages or circumstances) and its impact on CNECs at the CC MTUs when MACZT was below the minimum target;

(b) MACZT before the optimisation of remedial actions for the CNECs at the CC MTUs when MACZT was below the minimum target (if an optimisation of remedial actions is conducted within the implemented CCM);

(c) the flow decomposition[41] on the CNECs at the CC MTUs when MACZT was below the minimum target;

(d) whether the CNECs, which did not reach the minimum MACZT target, restricted cross-zonal trading opportunities at the CC MTUs when MACZT was below the minimum target:

---

[38] Even if the NTC on this oriented bidding-zone border (as defined by another TSO) has a lower value than the technical profile value, because such NTC is separately monitored.

[39] As a simplification, other combinations of NTCs consistent with the technical profile should not be monitored.

[40] In case a given technical profile stems from a combination of constraints provided by more than one TSO, each TSO should provide the Agency with the declared profile as submitted before profiles were combined.

[41] The flow decomposition should be based on a methodology approved within the CCR, e.g. for cost sharing. Until such a methodology is approved, TSOs should consult regulatory authorities and the Agency to define the relevant methodology to decompose flows.

- in coordination areas where the flow-based approach is implemented, whether these CNECs were presolved by the CCC, and their shadow prices;

- in coordination areas where the coordinated NTC approach is implemented, whether these CNECs limited the NTC calculation, and whether the NTC was fully utilised[42]. In this case, a shadow price may be estimated based on the price spreads in the coordination area.[43]

The monitoring information related to a specific TSO should be provided to the competent regulatory authority, and should be shared with regulatory authorities within the CCR.

[42] i.e. whether one of the NTCs within the coordination area was fully used

[43] E.g. as the maximum over the coordination area bidding-zone borders of the price spread divided by the zone-to-zone PTDF, or as the weighted average (over bidding-zone borders of the coordination area with a positive price spread) of the price spread divided by the zone-to-zone PTDF. The methodology to define shadow prices for NTC capacity allocation may gradually be refined throughout the monitoring work.

7. CONCLUSION

The Agency recommends that, when monitoring the TSOs' compliance with Article 16(8) of Regulation (EU) 2019/943, regulatory authorities rely on the methodology described in this Recommendation in order to monitor the fulfilment of the 70% target, by estimating the level of MACZT offered on the CNECs introduced in CCMs already in place in all coordination areas[44], for all considered timeframes and CC MTUs, and by assessing the impact of allocation constraints and technical profiles on the capacity which is effectively available for cross-zonal trade on CNECs. The Agency will support regulatory authorities in collecting the data and calculating these values; the Agency recommends that regulatory authorities use these values when monitoring the legal compliance of TSOs.

The Agency also recommends that TSOs and Regional Coordination Centres (RCCs) take this Recommendation into account when implementing CCMs adopted pursuant to the CACM Regulation at CCR level. In particular, TSOs should strive to ensure that they reach the relevant MACZT target as described by this Recommendation, and that they provide regulatory authorities and the Agency with the data required to monitor the achievement of this target.

This Recommendation is addressed to regulatory authorities, the European Network of Transmission System Operators for Electricity, TSOs, and the RCCs[45] involved in computing or monitoring cross-zonal capacities.

Done at Ljubljana, on 08 August 2019.

- SIGNED -

For the Agency
Director ad interim

Alberto POTOTSCHNIG

Annexes:

Annex I – Assumptions related to mccc estimates for NTC CNECS
Annex II - Detailed description of MNCC calculation
Annex III - Adverse effects on the internal market when the 70% target is not simultaneous
Annex IV – Detailed modelling of contingencies within MACZT calculations
Annex V - Monitoring of the impact of external constraints on MACZT

[44] Monitoring MACZT in all coordination areas relies on the assumption that the sum of MACZT components from the 'native' coordination area (MCCC) and the 'neighbouring' coordination areas (MNCC) does not vary much when one changes the 'native' coordination area.
[45] Once these are established.

ANNEX I – ASSUMPTIONS RELATED TO MCCC ESTIMATES FOR NTC CNECS

This Annex describes the underlying methodological assumptions behind the estimation of MCCC for NTC CNECs, which explain why only limiting NTC CNECs should be monitored during a transitory period until TSOs are able to compute and provide regulatory authorities and the Agency with MCCC data for all CNECs.

Monitoring the achievement of the 70% target for CNECs used in capacity calculation on bidding-zone borders applying the coordinated NTC approach requires estimating MACZT (and thus MCCC) on such CNECs. When performing capacity calculation on bidding-zone borders applying the coordinated NTC approach, CCCs estimate the maximum level of cross-border exchanges which ensures operational security on CNECs. Such maximum exchange results in congestion on a limited set of CNECs (i.e. the MCCC of these congested CNECs is fully utilised by such maximum exchange), whereas MCCC of other CNECs is not fully utilised as further increasing the maximum exchange is not possible. The resulting maximum exchanges (i.e. NTC value(s)) therefore account for the uneven distribution of flows on individual network elements; at this exchange level, (at least) one CNEC is congested, whereas others are not.

Nevertheless, current NTC CCMs applied by TSOs do not systematically define CNECs, calculate MCCC on those CNECs and then find the maximum exchange which fully utilises the MCCC on at least one CNEC. Rather, the CCMs implicitly perform the same process, which essentially means that CNECs are not explicitly defined and stored and the corresponding MCCC values are not explicitly calculated and stored.

For historical data, when no CNECs were explicitly defined or stored, a list of CNECs needs to be constructed again. Even if CNECs were defined, MCCC on these CNECs was not explicitly computed. Deriving the MCCC values for CNECs based on NTC values does not work for those CNECs where MCCC was not fully utilised; only for those CNECs where MCCC was fully utilised, such MCCC value could be derived from NTCs. Indeed, most CNECs are not congested when cross-zonal exchanges reach NTCs, i.e. the highest flow induced by these coordinated NTCs is below MCCC on these non-limiting CNECs. For limiting CNECs, the highest flow induced by NTCs is by definition equal to the available capacity (because no further margin was available on these CNECs); this flow can thus be used to infer MCCC for these limiting CNECs.

As a result, for NTC coordination areas, TSOs should provide information about limiting CNECs, for which MCCC can reliably be assessed. For other CNECs, the highest flow induced by coordinated NTCs would underestimate MCCC, thus preventing a reliable MACZT calculation. In the future, TSOs and CCCs of NTC coordination areas should consistently define CNECs and calculate MCCC values for each CC MTU and monitored timeframe. This data should then be reported to regulatory authorities and the Agency, to ensure a more comprehensive monitoring process, and a level-playing field with the monitoring of the flow-based approach.

ANNEX II – DETAILED DESCRIPTION OF MNCC CALCULATION

When conducting coordinated capacity calculation and when calculating how much capacity of the CNEC is available for cross-zonal trade within a coordination area, TSOs need to split the capacity of a CNEC between all electricity exchanges impacting this CNEC. These are:

(i) cross-zonal electricity exchanges on the bidding-zone borders within the coordination area;

(ii) cross-zonal electricity exchanges on the bidding-zone borders outside the coordination area; and

(iii) internal electricity exchanges within all bidding-zones (within and outside the coordination area).

This Annex describes the rationale underlying the estimation of MNCC, i.e. of the flow induced by (ii).

The first category of electricity exchanges is considered within MCCC and is subject to regional capacity calculation and allocation. These exchanges are not known at the time of capacity calculation, but since they are considered as optimisation variables within regional capacity calculation and allocation, they **do not need to be determined** at the time of capacity calculation (only the constraints limiting these cross-zonal exchanges need to be determined at that time).

The second and third category of electricity exchanges are not considered within MCCC. They are also not known at the time of capacity calculation, and since they are not considered as optimisation variables of the considered coordination area within capacity calculation and allocation, they **need to be determined as fixed inputs** for capacity calculation. To determine these fixed inputs, TSOs estimate the physical impact on a CNEC of the capacity offered for internal electricity exchanges in all bidding-zones and cross-zonal electricity exchanges outside the coordination area. This forecast is done when building a CGM, which includes assumptions on the most likely impact of the electricity exchanges within and between bidding-zones. Therefore, the capacity of a CNEC available for flows induced by internal exchanges in all bidding-zones and cross-zonal exchanges outside the coordination area is determined from the CGM. The CGM is a European-wide model, which will apply in the whole Europe and all CCRs, and therefore will use harmonised assumptions about electricity exchanges for the considered CC MTU. One of the main purposes to establish the European-wide CGM is to ensure that all TSOs use the same assumptions about electricity exchanges within and between bidding-zones. This will ensure that capacity calculation, which is applied at CCR level (and is thereby not fully coordinated across CCRs), does not lead to inconsistent assumptions related to electricity exchanges, and thus ensures operational security.

Finally, all three categories of exchanges entail some uncertainties. For the first category, the uncertainty arises mainly from simplified capacity calculation (e.g. linearization). For the second and third categories of electricity exchanges, the uncertainty arises mainly from the assumptions made in the CGM about the internal exchanges in all bidding-zones and cross-zonal exchanges outside the coordination area. These uncertainties should be considered in the reliability margin, i.e. they should not be included in MACZT.

Finally, MNCC values are expected to decrease in the long-term future as the common goal of the Agency, regulatory authorities and TSOs should be to include all flows resulting from cross-zonal exchanges in MCCC, which means that whenever a CNEC is impacted by flows resulting from cross-zonal exchanges outside the considered coordination area (i.e. MNCC), TSOs should either:

(a) Merge the interdependent coordination areas, such that bidding-zone borders outside coordination areas become bidding-zone borders within a coordination area and the respective impacts are considered within the MCCC;

(b) Widen the definition of MCCC to include MNCC, e.g. through the implementation of advanced hybrid coupling, where cross-zonal exchanges outside the considered coordination area are reflected within the MCCC;

However, until TSOs are able to implement one or both of the above solutions, regulatory authorities and the Agency should recognise that in some cases the uncertainties related to forecast cross-zonal exchanges outside coordination areas may impede the ability of TSOs to reach the MACZT target.[46] In such cases, TSOs may ask regulatory authorities to consider temporary relaxation of the MACZT target (e.g. through derogations)[47].

[46] This large uncertainty may stem from the fact that the current coordination areas may be much smaller than CCRs pursuant to the CACM Regulation (e.g. within the Core CCR).
[47] This paragraph does not portend any decision by regulatory authorities or the Agency on derogation processes.

ANNEX III – ADVERSE EFFECTS ON THE INTERNAL MARKET WHEN THE 70% TARGET IS NOT SIMULTANEOUS

As described in the main body of this Recommendation, the methodology for computing MACZT may apply indifferently to various timeframes. Regulatory authorities should and the Agency will monitor MACZT in the DA timeframe, which may be complemented with the monitoring of MACZT in the ID timeframe. However, in doing so the following adverse effects on the internal market should be avoided, in case Member States (and thus TSOs) were allowed to reach the target in different timeframes. Such adverse effects may relate to very low effectively available capacity, discrimination of cross-zonal exchanges through loop flows, reduction of the relevance of the DA market, or impossibility to ensure high MACZT levels due to forecast errors. This Annex highlights such potential adverse effects.

First of all, capacity allocation is mostly determined by the CNECs with the lowest margin levels. In case TSOs do not simultaneously provide high MACZT, the capacity perceived by the market may be low for all timeframes. The table below describes a simplified example where one TSO (A) offers 10%[48] in DA and 70% in ID, whereas another TSO (B) offers 70% in DA and 10% in ID.

TSO	MACZT – DA	MACZT – ID
A	10%	70%
B	70%	10%

The figure below depicts how the flow-based domain could look like in DA (top) and ID (bottom), in case the two TSOs had similar CNECs[49]. The CNEC from TSO A (resp. B) is depicted in red (resp. blue), whereas CNECs from other TSOs are depicted in black. In DA,

[48] Throughout this Annex, the MACZT is illustrated at zero net position within the coordination area (i.e. with zero nominations or schedules)

[49] This similarity could regularly happen in practice, e.g. when considering CNECs on each side of a bidding-zone border.

CNECs from TSO B would be redundant and CNECs from TSO A would strongly restrict capacity allocation. In ID, the opposite would occur.

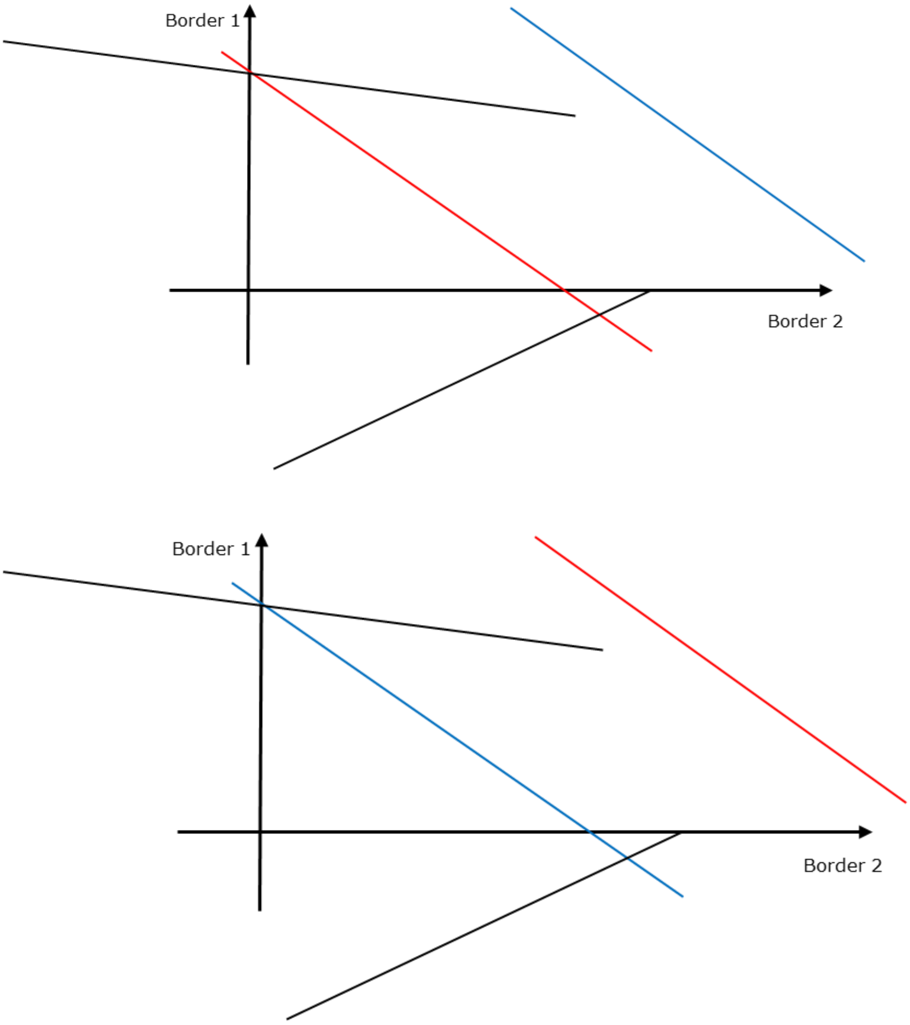


Figure 1 – example flow-based domain for DA (top) and ID (bottom). CNECs from TSO A (respectively B) are depicted in red (respectively blue).CNECs from other TSOs are depicted in black.

As a result, TSO A would strongly restrict capacity allocation in DA, whereas TSO B would strongly restrict capacity allocation in ID. Cross-zonal capacity would thus be very limited during both the DA and the ID timeframes, effectively leading to 10% MACZT and rendering void the 70% requirement. If reaching the MACZT target is allowed during either timeframe, and is not coordinated among TSOs or Member States, both TSOs could nevertheless be considered as reaching the 70% target.

Furthermore, allowing some TSOs to reach the 70% target in a timeframe after DA may allow those TSOs to keep high level of loop flows when computing the capacity available for the DA market, possibly leading to undue discrimination of cross-zonal exchanges. The low cross-zonal capacity in the DA market may also decrease the relevance of the price signals coming from this market, which are often used to settle other contracts (including financial transmission rights), thus undermining the relevance of these other contracts.

Finally, if TSOs are allowed to reach the 70% in ID, TSOs may forecast some flow patterns in DA and take some decisions, assuming that, based on these forecast, they would reach the target in ID. However, in case of forecast error (for which the TSOs may not be to blame), providing high MACZT on CNECs may then become impossible in ID (e.g. given the short time left to activate remedial actions in ID). As a result, the responsibility of individual TSOs in reaching (or not) the MACZT target may be more difficult to establish, hampering legal compliance assessment and enforcement.

ANNEX IV – DETAILED MODELLING OF CONTINGENCIES WITHIN MACZT CALCULATIONS

This Annex describes the underlying rationale for how contingencies should be taken into account within MACZT calculations. It first looks at how Regulation (EU) 2019/943 prescribes that contingencies should be handled for the flow-based and coordinated NTC approaches. It then describes the similarities with how the CACM Regulation requires to take contingencies into account, and studies how the implemented CCMs deal with contingencies, in order to reach a conclusion on how to model contingencies within MACZT calculations.

For the coordinated NTC approach, Recital (28) of Regulation (EU) 2019/943 describes that "*The transmission capacity to which the 70 % minimum capacity criterion shall apply (…) is the maximum transmission of active power which respects operational security limits and* ***takes into account contingencies***", Article 16(8) further adds that "*the minimum capacity shall be 70 % of the transmission capacity respecting operational security limits* ***after deduction of contingencies***". For the flow-based approach, Recital (27) prescribes that "*[the] minimum capacity should determine the minimum share of the capacity of a cross-zonal or an internal critical network element respecting operational security limits to be used as an input for coordinated capacity calculation under [the CACM Regulation],* ***taking into account contingencies***", Article 16(8) also mentions that "*The margin shall be 70 % of the capacity respecting operational security limits of internal and cross-zonal critical network elements,* ***taking into account contingencies***". Therefore, the management of contingencies should be similar when computing MACZT for flow-based and NTC coordination areas, and should "take into account contingencies".

Furthermore, Article 29(7)(e) of the CACM Regulation describes the following task within regional calculation of cross-zonal capacity: "*calculate the available margins on critical network elements,* ***taking into account contingencies***". As a result, and given that Article 16(8) mentions that "*the minimum capacity shall be a margin set* ***in the capacity calculation process***", the (harmonised) modelling of contingencies within MACZT calculations should be aligned with regional CCMs, which have been adopted pursuant to the CACM Regulation.

Adopted CCMs[50] define the following process to take contingencies into account. First, outages, which already occurred or are expected to occur (e.g. due to maintenance) for the considered CC MTU are modelled in the CGM and are therefore by default considered in capacity calculation. This means that, during capacity calculation, all calculated physical flows reflect the fact that some network elements are out of operation. In contrast, contingencies, which are possible unexpected outages of network elements, are then reflected when defining CNECs, by combining CNEs with these contingencies.

[50] See e.g. the CGM methodology and Article 5 of the Core DA CCM

Therefore, the reference to the "*capacity respecting operational security limits* ***taking into account (after deduction of)*** *contingencies"* is understood that under the assumption that contingency has occurred, the MACZT shall be at least 70% of the capacity respecting operational security limits. This implies that, without contingency, the MACZT may effectively be significantly lower than 70% of the capacity respecting operational security limits, so that when the contingency would occur the MACZT would be 70% of the capacity respecting operational security limits. As a result, the cross-border capacity resulting from MACZT taking into account contingencies (i.e. based on CNECs) would be lower than the cross-border capacity ignoring such contingencies (i.e. based on CNEs only); the difference between these two levels of cross-zonal capacity is an effective **deduction** of the capacity respecting operational security limits for the reason of contingency.

The management of contingencies applied in the monitoring is illustrated in the figure below: all CNECs (with and without contingency) should have (at least) 70% MACZT; similarly, all CNECs should have a maximum of 30% available for internal flows, loop flows and reliability margin.

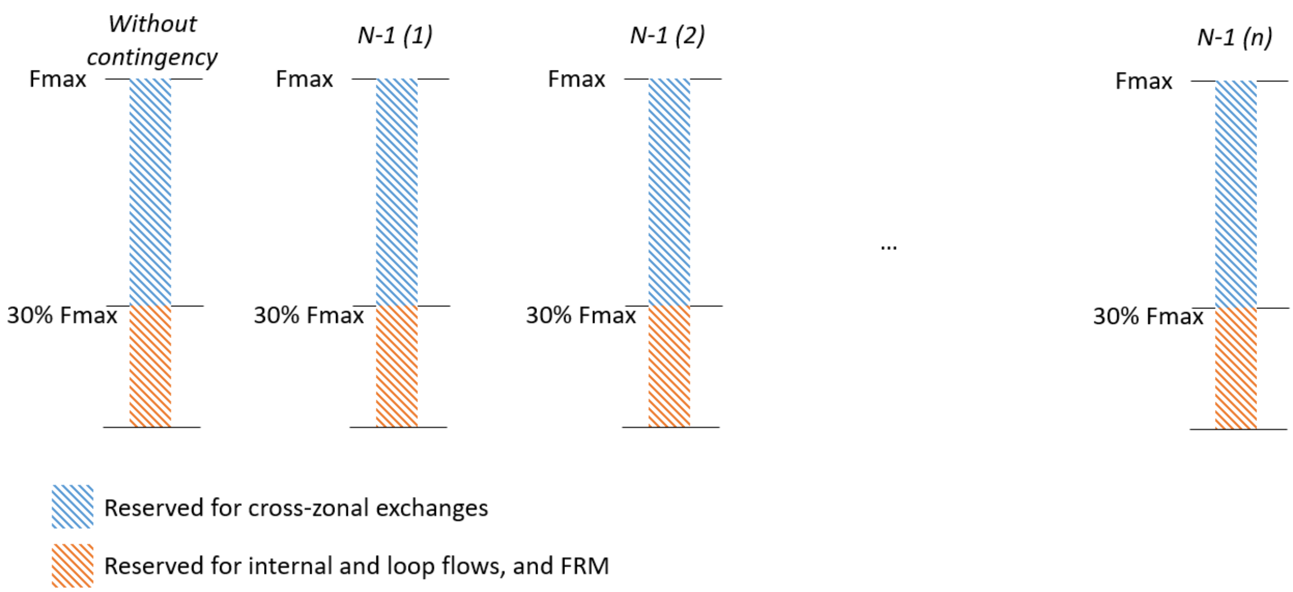


Figure 2- Management of contingencies through the definition of CNECs – suggested methodology

Note: situations with and without contingency are depicted for the same underlying CNE. The hatched blue part describes MACZT, whereas the hatched orange part depicts the share available for internal and loop flows, and reliability margin. Outages included in the CGM are reflected by PTDF calculations, both with and without contingency.

This management of contingencies should also apply when monitoring allocation constraints: allocation constraints should not effectively restrict MACZT below 70% on any CNEC.

An alternative way to take contingencies into account may be to consider an N-1[51] flow margin, which would reduce Fmax on a CNE (e.g. computed as the largest margin necessary to ensure that flows remain below Fmax in all contingency situations), and to consider the MACZT target as 70% of the remaining capacity of CNEs, once this N-1 margin has reduced Fmax (as depicted in the figure below). The capacity available for cross-zonal trade should at least be the minimum MACZT level for CNEs (without contingency), and the flow resulting from this CNE-level capacity for CNECs (with contingency).

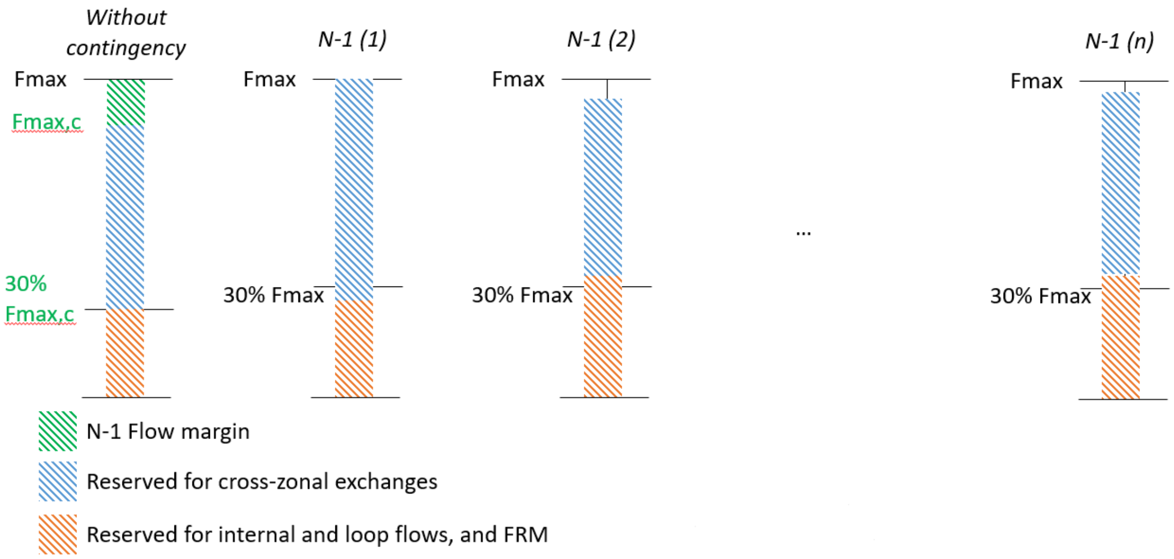


Figure 3 - Alternative management of contingencies – MACZT is first computed without contingency, but reflect an N-1 flow margin. MACZT in contingency situation is then equal to the N-1 flow resulting from MACZT without contingency.

Note: situations with and without contingency are depicted for the same underlying CNE. The hatched blue part describes the share of the CNEC reserved for cross-zonal trade (MACZT), whereas the hatched orange part depicts the share available for internal and loop flows, and reliability margin. The hatched green part depicts the N-1 flow margin, defined e.g. as the minimum margin to ensure that the flow remains smaller than or equal to Fmax in all considered contingency situations. Fmax,c is the maximum active power flow which ensures that, in all considered contingency situations, the flow induced by Fmax,c remains below Fmax. Outages included in the CGM are reflected by PTDF calculations with and without contingency.

However, this alternative methodology leads to the following weaknesses:

- The alternative methodology is not in line with the approved CCMs pursuant to the CACM Regulation (e.g. the Core DA CCM)
- The ratio between cross-zonal flows and other flows (internal flows, loop flows)[52] is likely to change between states with and without contingency (as illustrated for e.g. N-1 (1)). Therefore, cross-zonal exchanges may end up consuming more (or less) than 70% of Fmax in contingency situation, possibly restricting internal and loop flows and

[51] In this Annex, 'N-1' refers to a contingency situation, as described in the implemented CCM

[52] Depending on the implemented CCM, the reliability margin may or may not change depending on contingency.

reliability margin below 30% of Fmax in contingency situation. Conversely, internal, loop flows and reliability margin may sometimes use more than 30% of Fmax of a CNEC (as illustrated for N-1 (2)), which may be interpreted as contradicting Article 16(8) of Regulation (EU) 2019/943.

- Designing the N-1 margin used to compute Fmax,c is challenging. If only one N-1 margin is designed per CNE, it would likely be the smallest necessary margin to ensure that the CNEC flow remains below Fmax in all N-1 situations. Therefore, in all but one N-1 situations, part of the CNEC capacity would remain unused (as e.g. reflected by N-1 (2)). If many N-1 margins are computed, e.g. one per contingency, the methodology would be closer to the methodology suggested above because it would effectively reflect the N-1 margin of each CNEC, but the other mentioned weaknesses would still apply. Furthermore, in case a CNEC is influenced by multiple bidding-zone borders, the N-1 margin would depend on which border would use the CNEC capacity, therefore creating a loop between MCCC, which would be derived from Fmax,c and Fmax,c which would depend on how MCCC is allocated among bidding-zone borders[53]. Finally, Fmax,c may be overestimated in case of precongested network elements (i.e. elements which are overloaded without contingency), because the flow without contingency would by definition be too high.

Within MACZT-related calculations, contingencies should therefore be taken into account as is currently done in approved CCMs, i.e. by defining CNECs based on the considered (possible but uncertain) contingencies. Outages defined in the CGM (without contingency) should not be considered as contingencies, but should be reflected by the PTDF calculations.

[53] It may be possible to avoid this loop by considering Fmax,c as the flow margin needed to accommodate the considered contingency based on the CGM used in capacity calculation. However, there is no guarantee that the CGM is representative of the actual use of the CNEC, as the shares of the various flow categories may not be in line with the 70% target (e.g. the loop flows may be too high).

ANNEX V – MONITORING OF THE IMPACT OF EXTERNAL CONSTRAINTS ON MACZT

External constraints are a type of allocation constraints that limits the maximum import and/or export of a given bidding-zone. This Annex describes how the redundancy test should be performed for a given coordination area, CC MTU and external constraint, in order to estimate whether the considered external constraint effectively restricted MACZT below 70% (or the target defined by a derogation or action plan) on any monitored[54] CNEC. In order to assess the redundancy of the external constraint, the capacity domain is first adjusted in line with the target MACZT values. Then, a test checks whether the external constraint is redundant with respect to this adjusted capacity domain.

First, a capacity domain which exactly reflects the target value is defined as follows. For each monitored CNEC[55], MCCC is adjusted in order to ensure that MACZT on this CNEC is equal to the MACZT target. The MACZT target should either be equal to 70% of Fmax, or should reflect the applicable derogation or action plan. Therefore, for a given CNEC, the adjusted MCCC value for the test of the external constraint should be

$$MCCC_{adjusted}(CC\ MTU) = MACZT_{target}(CC\ MTU) - MNCC\ (CC\ MTU)$$

where

$MCCC_{adjusted}$	Adjusted MCCC value to use to assess the external constraint
$MACZT_{target}$	MACZT target, defined as either 70% of Fmax, or in line with the applicable derogation or action plan
$MNCC$	MNCC computed pursuant to Section 5.3

The calculation of this adjusted MCCC value is described for five example CNECs in the table below

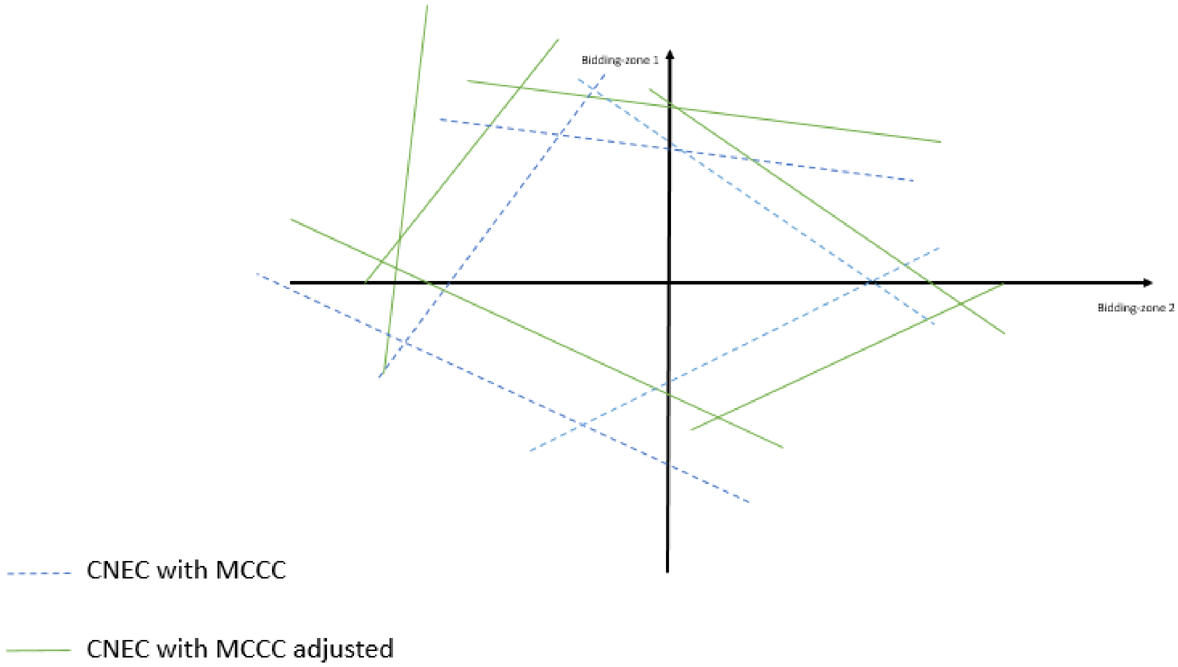
[54] A full (presolved) capacity domain is necessary in order fully to monitor the impact of external constraints on MACZT.

[55] All CNECs' MCCC values should be adjusted, not only the CNECs introduced by the TSO which declared the external constraint.

CNEC	Fmax	MNCC	MACZT target	MCCC adjusted
CNEC1	1000	250	700	450
CNEC2	1000	50	700	650
CNEC3	1000	0	500	500
CNEC4	1000	-100	700	800
CNEC5	1000	100	600	500

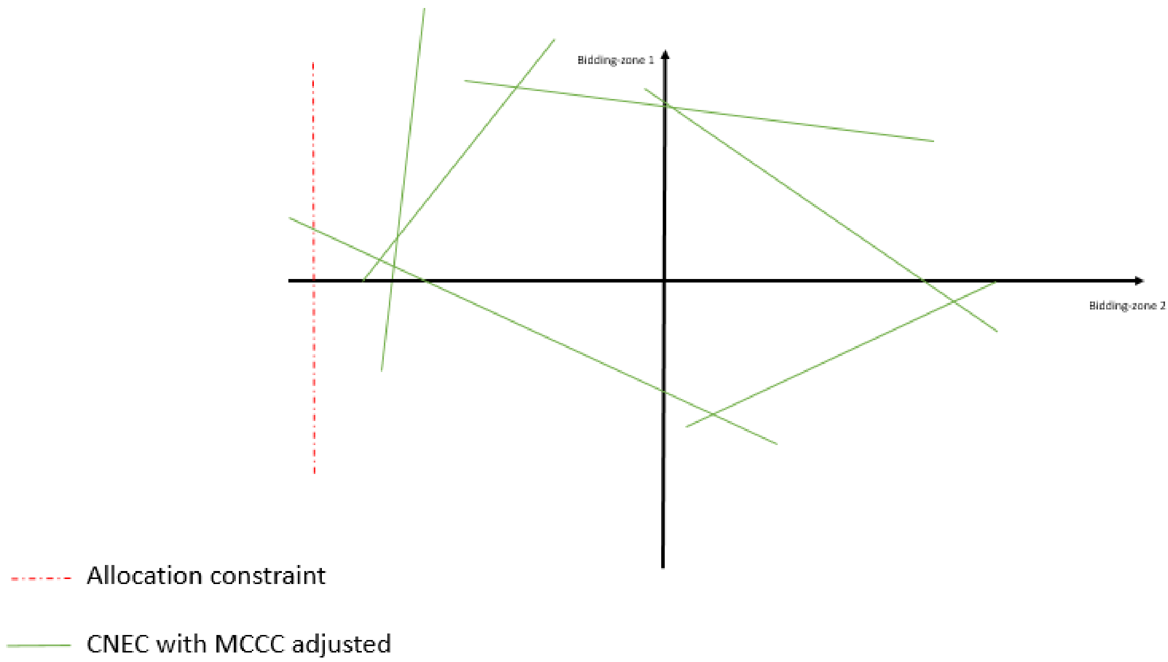
Note: The adapted MCCC value is computed based on the equation above.

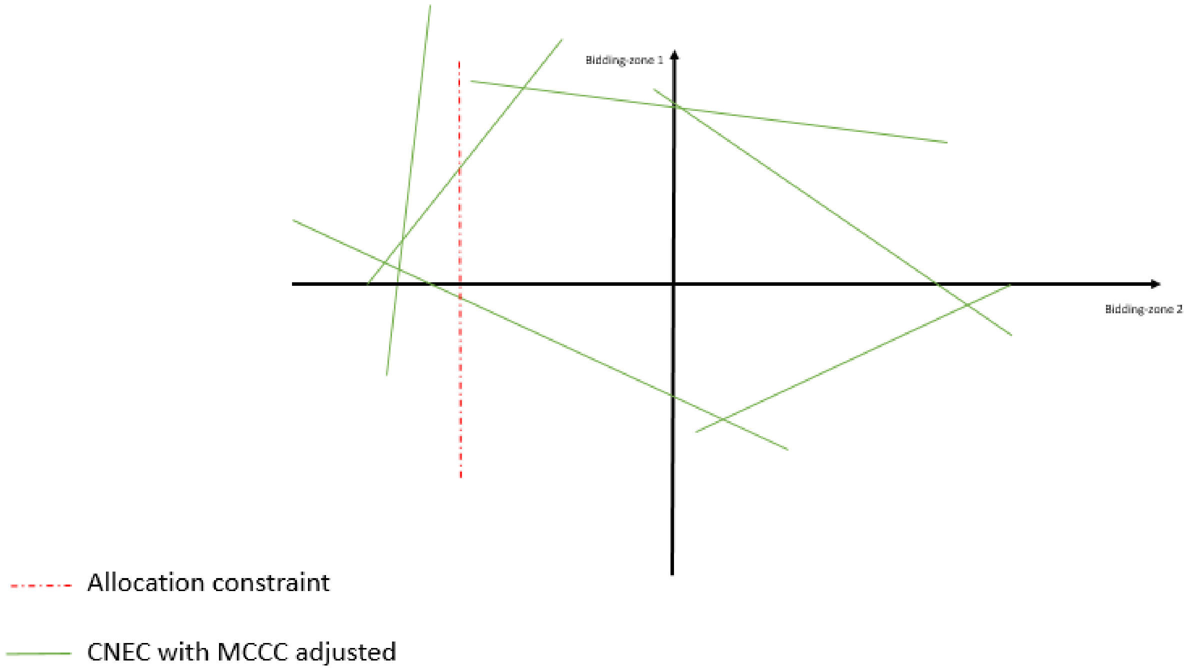
An adapted capacity domain is defined by all monitored CNECs, with their MCCC level set to $MCCC_{adjusted}$. The figure below provides a graphical representation of how the capacity domain resulting from capacity calculation and how the adjusted capacity domains could look like.



Note: the capacity domain resulting from capacity calculation is the area limited by CNECs depicted in dashed blue. The adjusted capacity domain is defined by adjusted MCCC on CNECs, and is the area limited by CNECs depicted in green.

A mathematical test then assesses whether the external constraint would not be redundant in this domain, i.e. whether introducing this external constraint effectively reduces the capacity domain below the adjusted domain. The figure below describes the two possible outcomes of this test.





Note: the top picture depicts a redundant allocation constraint, whereas the bottom picture describes an allocation constraint which is not redundant, i.e. which further restricts the area limited by CNECs.