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2022 Assessment of available cross-zonal capacity for the Netherlands

In accordance with article 15(4) of Regulation (EU) 2019/943 of the European Parliament and the Council of 5 June 2019 on the internal market for electricity (recast)

Executive Summary

With the establishment of the Electricity Regulation - part of the Clean Energy package - several provisions entered into force which specify the minimum levels of capacity margins that TSOs need to make available for cross-zonal trade. More specifically, article 16(8) of the Electricity Regulation requires TSOs to ensure that at least 70% of the transmission capacity is offered for cross-zonal trade, while respecting operational security limits. However, the Electricity Regulation also allows Member States to adopt transitory measures, such as action plans or derogations, to reach gradually the minimum capacity margin available for cross-zonal trade (MACZT) by the end of 2025 at the latest.

For the Netherlands, an action plan has been adopted as transitory measure to reach gradually the minimum capacity margin of 70% on the critical network elements included in CWE flow-based day-ahead capacity calculation (until June 8, 2022) and CORE flow-based day-ahead capacity calculation (since June 9, 2022). Next to the action plan, for the year 2022 also a derogation applies.

As a consequence of the action plan, TenneT is obliged to assess on an annual basis whether the available cross-zonal capacity has reached the required minimum levels. **This report provides the results for the assessment on the transmission capacity made available for cross-zonal trade in the year 2022**. Furthermore the report contains an assessment of the transmission capacity made available on the bidding zone borders with Norway and Denmark, which are not part of the action plan, on which the target capacity margin of 70% already applies.

Because of the interplay between action plan, derogation and the CWE and CORE flow-based capacity calculation methodologies, it is not straightforward to assess whether the capacity made available was in accordance with all the applicable provisions. Within this report, TenneT clarifies what specific provisions related to minimum capacities apply for the Netherlands, how it implemented those specific provisions in operations and how it has monitored its compliance against those provisions.

For this assessment, TenneT has followed the approach and principles as set out by ACER and applied in ACER's EU MACZT monitoring report. In addition, this report provides more specific information for the Netherlands, as well as additional figures and results including the level of capacity made available on individual network elements. By doing so, TenneT aims to provide maximum transparency on its performance to its stakeholders.

For the **Central West Europe (CWE) region**:

- For **99%** of the time, **TenneT has provided capacity margins at or above the required minimum levels of the action plan** on all its network elements
- For 1**%** of the time, **TenneT has offered insufficient capacity margins**. The main underlying reason is erroneous human intervention on two business days and local tool configuration impacting some MTUs (see paragraph 5.1.1).

For the **CORE region**:

- For **100%** of the time, **TenneT has provided capacity margins at or above the required minimum levels** on all its network elements

For the **HVDC bidding zone borders (NL-DK1, NL-NO2)**:

- For **100%** of the time**, TenneT has provided capacity margins at or above the required minimum level** of 70% of the net transmission capacity for the NL-DK1 and NL-NO2 bidding zone border.

TenneT expects that – with the applicable derogation for loopflows – for 2023 a continuation of the 2022 capacity margins is realistic. Also, after the go-live of Core flow-based day-ahead capacity calculation the need for a separate local tooling for the calculation of the flow that is assumed to results from exchanges outside the CORE region became obsolete, as this is calculated as an integral part of the central CORE tooling. This increased the robustness of the capacity calculation process.

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1. Introduction

In December 2019, the Ministry of Economic Affairs and Climate Policy of the Netherlands has established an action plan pursuant to Article 15 of the Electricity Regulation[1].

Article 15, paragraph 4 of the Electricity Regulation prescribes that on an annual basis, during the implementation of the action plan and within six months of its expiry, the relevant transmission system operators shall assess for the previous 12 months whether the available cross-border capacity has reached the linear trajectory.

This report provides the assessment of TenneT TSO B.V. (hereinafter "TenneT") of the cross-border capacity made available in the year 2022, and whether this was in accordance with the various provisions on minimum capacities that were applicable to TenneT in the year 2022.

It is the third report in its kind, and follows in general the structure as was applied before in the assessment of the cross-border capacity made available in 2020 and 2021 (2020 MACZT assessment report and 2021 MACZT assessment report)[2,3]. The main difference between the years 2021 and 2022 is the transition from CWE area to the larger CORE region. On June 9, 2022 the go-live of CORE day-ahead market coupling took place successfully. Therefore the 2022 report contains both a CWE and CORE data representation throughout the entire report to ensure a similar structure as the previous reports. Specifically, up to June 8, 2022 concerns compliance reporting based on CWE capacities and as of June 9, 2022 CORE capacities.

The outline of the report is as follows:

- First in chapter 2, TenneT sets out the various obligations on minimum capacities that were applicable for TenneT in the year 2022
- Then in chapter 3, TenneT sets out how these various obligations have been implemented in its daily operations
- Chapter 4 describes the methodology applied behind the assessment as performed for this report
- Chapter 5 contains the results from the assessment
- Chapter 6 provides the main conclusions resulting from the assessment

Furthermore, five annexes with relevant background information are included to this report.

[1] Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity (recast), available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R0943&from=EN

[2] 2020 Assessment of available cross-zonal capacity for the Netherlands, approved by ACM on 26 August 2021 and available at: https://www.acm.nl/sites/default/files/documents/bijlage-bij-besluit-tennet.pdf

[3] 2021 Assessment of available cross-zonal capacity for the Netherlands, approved by ACM on 17 August 2022 and available at: https://www.acm.nl/system/files/documents/bijlage-1-beoordelingsverslag-tennet-2021.pdf

2. Obligations on TenneT TSO B.V. with respect to minimum capacities to be made available for cross-zonal trade

In the year 2022, several provisions related to the minimum levels of capacity margins that TenneT needs to make available for cross-zonal trade were applicable. This chapter sets out the relevant provisions from:

- The EU Electricity Regulation and the Action Plan established for the Netherlands
- The Derogation from the minimum level of capacity
- The Flow-Based Day-ahead Capacity calculation Documents

2.1 The EU Electricity Regulation and the Dutch Action Plan

The Electricity Regulation article 16(8) requires TSOs to ensure that at least 70% of the transmission capacity is offered for cross-zonal trade, while respecting operational security limits. According to this Regulation, Member States may also adopt transitory measures, such as action plans or derogations, to reach gradually the minimum capacity margin available for cross-zonal trade (MACZT) by the end of 2025 at the latest.

In December 2019, the Ministry of Economic Affairs and Climate Policy of the Netherlands has established an action plan[4] pursuant to Article 15 of the Electricity Regulation. The action plan has established a linear trajectory for the minimum capacity available for cross-zonal trade to be compliant with Article 16(8) of the Electricity Regulation. The action plan establishes an individual linear trajectory for every Critical Network Element (CNE) which is included in CWE and (thereafter) CORE Flow-Based Day-Ahead Capacity Calculation (CWE and CORE FB DACC). The geographical boundaries of CWE and CORE have a slightly deviation official naming. CWE capacity calculation area is referred to as CWE CCA, while CORE is a capacity calculation region (CCR).

The other (HVDC-based) bidding zone borders of the Netherlands are not specifically included in the action plan and for these borders no linear trajectory is established. Therefore, for these borders the minimum value of 70% as established in article 16(8) of the electricity Regulation already applies per 1/1/2020.

Table 1 shows a full overview of the applicable target minimum capacity margins ($MACZT_{target}$) per Capacity Calculation Area/Region. Details on how the linear trajectory values have been determined can be found in the action plan itself[4]. The applicable values per Dutch CNE are included in annex 2.

Table 1: Overview of the $MACZT_{target}$ values from the linear trajectory per Area/Region for the year 2022

Relevant Capacity Calculation Area/Region	Bidding Zone Borders and/or CNECs	Point of linear trajectory for target minimum capacity ($MACZT_{target}$) in relative MACZT [%][5]
CWE CCA and CORE CCR	NL-BE; NL-DE; and Dutch CNECs included in CWE/CORE FB DA CC	Differs per CNE. Minimum: 37% Maximum: 70% Mean: 38% Average: 41%

[4] The action plan has been published by the Ministry of Economic Affairs and Climate Policy on its website.
[5] Relative MACZT means the percentage of the MACZT relative to the maximum admissible flow (Fmax)

DK-NL (NL side)	NL-DK1	70% (as no linear trajectory established)
NL-NO (NL side)	NL-NO2 / NL-NO2a[6]	70% (as no linear trajectory established)

2.2 Derogation for the Netherlands

In July 2021, TenneT applied for a derogation from the minimum level of capacity to be made available for cross-zonal trade in accordance with article 16(9) of the Electricity Regulation. This request for derogation was approved by the Dutch national regulatory Authority for Consumers and Markets (hereinafter "ACM") on December 1, 2021 for the duration of 1 year from January 1, 2022 up to and including December 31, 2022.[7]

The main elements of the derogation are summarised in Table 2.

Table 2: Summary of derogation in accordance with article 16(9) of the Electricity Regulation applicable for NL in 2022

Reason for derogation	Remedy	Duration
Loop flows on Dutch CNECs that cannot be contained to an acceptable level	Application of a methodology to reduce the $MACZT_{target}$ values in case loop flows exceed a certain predefined threshold.	1 year
Possible lack of redispatching potential when the grid is in an outage situation	In principle, even when one or several CNEs are in outage, TenneT aims to provide the required level of minimum capacity by using if needed non-costly and costly remedial actions. However, in case operational security limits cannot be respected due to a lack of available remedial actions when one or more critical network elements are in outage, TenneT is allowed to reduce the available capacity for cross-zonal trade to a level that respects operational security limits.	1 year

In accordance with article 16(9) of the Electricity Regulation, in June 2022 TenneT sent a report on methodologies and projects that shall provide a long-term solution to the operational security risks which the derogation granted to TenneT seeks to address.[8]

In the following subsection, the methodology applied to reduce the $MACZT_{target}$ values in case loop flows exceed a certain threshold is described in more detail.

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[6] Statnett has implemented a virtual market area 'NO2a', which has gone live per BD 10/11/21. The NorNed interconnector connects to this area per that BD. For the sake of simplicity, this report refers to NO2 as the bidding zone border to which the NorNed interconnector connects.

[7] The approval of the derogation including the derogation itself is available at: https://www.acm.nl/nl/publicaties/acm-verleent-een-derogatie-voor-lusstromen-en-uitvalsituaties-0

[8] Available at: https://www.acm.nl/nl/publicaties/rapport-tennet-derogatie-artikel-16-negende-lid-verordening-2019/943

2.2.1 Applied methodological approach to deal with Loop Flows above an acceptable level

Article 4(4) of the request for derogation[9] contains the following formula to determine the minimum capacity margin that TenneT needs to make available for cross-zonal trade ($MACZT_{min}$) on a CNEC in CWE/CORE FB DA CC:

(1) $$MACZT_{min}^{CNEC} = MACZT_{target}^{CNEC} - max(0; LF_{calc}^{CNEC} - LF_{accept}^{CNEC})$$

Where:

- $MACZT_{target}^{CNEC}$ is the level of minimum capacity to be made available for cross-zonal trade on the given CNEC according to the linear trajectory, given in % of the maximum flow on the CNEC (F_{max}^{CNEC})
- LF_{calc}^{CNEC} is the loop flow on the CNEC in % of F_{max}^{CNEC}
- LF_{accept}^{CNEC} is the threshold value of "acceptable" loop flows in % of F_{max}^{CNEC},, which differs per CNE:
  - o LF_{accept}^{CNEC} is 30%-FRM^{CNEC} for cross-zonal CNEs
  - o LF_{accept}^{CNEC} is 0.5*(30%-FRM^{CNEC}) for internal CNEs

  With FRM^{CNEC} being the Flow Reliability Margin of the CNEC

As result of the methodology applied in the derogation, the methodological minimum level of the MACZT ($MACZT_{min}$) can thus lead in certain hours to capacities lower than the target values as prescribed by the linear trajectory ($MACZT_{target}$).

Further details about the calculation of the loop flows and the process followed, can be found in annex 5.

2.3 The Flow-Based Day-Ahead Capacity Calculation Documents

Since Business Day 26 April 2018, within CWE FB DACC a minimum Remaining Available Margin (minRAM) of 20% has been implemented by all CWE TSOs. This means that for all CNECs included in CWE FB DACC, the Remaining Available Margin (RAM) is at minimum 20% of the maximum admissible flow (Fmax) of this network element. In the context of the terminology, as introduced by ACER in its Recommendation 01-2019[10], the RAM made available in CWE FB DACC is to be regarded as MCCC (Margin from Coordinated Capacity Calculation).

Originally, this 20% minRAM was a voluntary commitment from CWE TSOs, but with the approval of CWE NRAs[11] of the documentation of the CWE Flow-Based Market Coupling (CWE FB MC) version 3.0 of June 2018, this has become an obligatory provision.

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[9] The request for derogation is available at: https://www.acm.nl/nl/publicaties/derogatieverzoek-tennet-artikel-16-negende-lid-van-verordening-2019-943

[10] See: https://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Recommendations/ACER%20Recommendation%2001-2019.pdf

[11] ACM approved the proposal on 31/08/2018, see: https://www.acm.nl/nl/publicaties/goedkeuring-voorstel-van-tennet-voor-de-wijziging-van-cwe-flow-based-da

Translating this obligation to a formula, this leads to an obligation for a minimum MCCC ($MCCC_{min}$) of:

(2) $$MCCC_{min} = 20\%$$

In CORE Flow-based Market Coupling the formal obligation on a minimal margin from the coordinated capacity calculation process is designed differently. The CORE day-ahead capacity calculation methodology[12] contains the following provisions:

- In Article 17 it is prescribed that the intermediate flow-based calculation the CORE CC tool shall guarantee the minRAM for each CNEC according to the linear trajectory or applied derogations on the action plan. Therefore minRAM in CORE FB DACC is equal to $MACZT_{min}$. The minRAM provision is mathematically fulfilled during the intermediate flowbased computation.
- The definition of minRAM in CORE FB DACC is provided in article 17(6): $RAM + F_{uaf} = minRAM$.
  In contrast to CWE FB DACC, the flow that results from exchanges outside the CCR (F_{uaf}) factor is thus added to fulfil the minRAM inequality requirement in CORE FB DACC. This has the following consequence on the interpretation of minRAM in the context of MACZT for CORE FB DACC compared to CWE FB DACC:
  - For CWE: minRAM = $MCCC_{min}$
  - For CORE: minRAM = $MACZT_{min}$
- Article 17(7) ensures that the minRAM/MACZTmin in CORE FB DACC can never go below 20% of F_{max} during the intermediate flow-based computation. Translating this obligation to a formula leads to the following equation:

(3) $$MACZT_{min} = 20\%$$

Since the determined $MACZT_{min}$ values that result from the application of the derogation on the Netherlands (NL) linear trajectory action plan are input for the intermediate flowbased computation, TenneT ensures the minRAM/$MACZT_{min}$ for NL CNECs to not drop below 20% of F_{max}. Both in CWE and CORE the minRAM could not drop below 20%. However in CWE the MACZT could still be below 20% due to the loopflow derogation. In CORE a minimum MACZT of 20% is implemented. . In practice this implies that in CWE FB DACC the loopflow derogation could reduce cross zonal capacity on a CNEC without a limit, until zero, while in CORE FB DACC there always is a minimum of 20% of Fmax available on each CNEC for cross zonal capacitiy.

[12] CORE day-ahead capacity calculation methodology, see: https://consultations.entsoe.eu/markets/core_2nd_dafb_ccm/supporting_documents/Core%20DA%20CCM%20%20TrackChange%20%20AHC.pdf

3. Implementation of minimum capacity obligations by TenneT TSO B.V.

3.1 Implementation of minimum capacities in the CWE Capacity Calculation Area

As set out in chapter 2, TenneT simultaneously needs to comply with several provisions related to the minimum levels of capacity margins that TenneT needs to make available for cross-zonal trade (MACZT). The obligations as set out in formula (1) and (2) are the relevant formulas determining the capacity margins that TenneT needs to make at minimum available for cross zonal trade within CWE FB DACC.

As set out in ACER recommendation No 01-2019, for AC network elements the MACZT consists of both a margin from capacity calculation *within* a capacity calculation area/region (MCCC), as a margin from non-coordinated capacity calculation *outside* the capacity calculation area/region (MNCC):

$$(4) \qquad MACZT = MCCC + MNCC$$

In this context, the Remaining Available Margin (RAM) made available within CWE FB DA CC is to be regarded as MCCC made available in the CCA of CWE. Flows on Dutch CNEs resulting from exchanges outside the CWE region or exchanges between a CWE country and a non-CWE country, such as exchanges over the Dutch HVDC interconnectors, are to be regarded as MNCC in the CCA of CWE.

Within the CWE FB DA CC process, the MCCC is an output which is calculated by the CWE TSO common system (i.e. the tooling that CWE TSOs use for performing the CWE day-ahead capacity calculations). In contrast, MNCC is calculated by each TSO individually and included as input to the CWE FB DA CC process as part of the Reference Flow[13]. As a consequence, within the CWE CCA the $MACZT_{min}$ of formula (1) can only be met by determining what minimum value needs to be provided for MCCC while taking into account the MNCC as explicit input. Also, TenneT needs to comply with both formula (1) and formula (2) at the same time, meaning that the larger of these two determines the minimum amount of capacity margin that needs to be made available by TenneT. Combining (1), (2) and (4) in a single calculation, this leads to the following formula of the minimum MCCC ($MCCC_{min}$) that needs to be made available in CWE FB DA CC:

$$(5) \qquad MCCC_{min,CWE}^{CNEC} = max\,\{20;\; MACZT_{target}^{CNEC} - MNCC^{CNEC} - max\left(0; LF_{calc}^{CNEC} - LF_{accept}^{CNEC}\right)\}$$

Where:

- $MACZT_{target}^{CNEC}$ is the level of minimum capacity to be made available for cross-zonal trade on the given CNEC according to the linear trajectory, given in % of the maximum flow on the CNEC (F_{max}^{CNEC})
- $MNCC^{CNEC}$ is the Non-CWE cross-zonal flow on the CNEC in % of F_{max}^{CNEC}
- LF_{calc}^{CNEC} is the loop flow on the CNEC in % of F_{max}^{CNEC}
- LF_{accept}^{CNEC} is the threshold value of "acceptable" loop flows on the CNEC in % of F_{max}^{CNEC}
- F_{max}^{CNEC} is the maximum flow on the CNEC

Since 1/4/2020, this formula is implemented in the daily operation within CWE FB MC. In case the RAM

[13] The flow per CNEC resulting from expected commercial exchanges

(MCCC) as calculated within CWE FB DA CC is lower than the $MCCC_{min}^{CNEC}$, an Adjustment for Minimum RAM (AMR) is calculated in the minRAM process. This adjustment is then applied to the CNEC to set the RAM (MCCC) of the CNEC to $MCCC_{min}^{CNEC}$. Further details about the calculation of MNCC and loop flows, can be found in annex 5.

3.2 Implementation of minimum capacities in the CORE Capacity Calculation Region

Similar to CWE, formula 4 also applies to calculated available cross zonal capacities on network elements in the CORE region. In this context, the Remaining Available Margin (RAM) made available within CORE FB DACC is to be regarded as MCCC made available in the CCR of CORE. Flows on CNEs resulting from exchanges outside the CORE region are to be regarded as MNCC in the CORE region.

Within the CORE FB DACC process, the MCCC and MNCC are outputs which are calculated by the central TSO CORE Capacity Calculation tool (CCCt). TenneT needs to comply to both equation (1) and (3) minimum amount of capacity margin that needs to be made available by TenneT. Combining equation (1) and (3) results in a minimum available cross zonal trade ($MACZT_{min,CORE}$) to be made available by TenneT in CORE FB MC:

$$MACZT_{min,CORE}^{CNEC} = max\,\{20;\ MACZT_{target}^{CNEC} - max\left(0; LF_{calc}^{CNEC} - LF_{accept}^{CNEC}\right)\} \quad (6)$$

Where

- $MACZT_{target}^{CNEC}$ is the level of minimum capacity to be made available for cross-zonal trade on the given CNEC according to the linear trajectory, corrected for those MTUs with IVA application, given in % of the maximum flow on the CNEC (F_{max}^{CNEC})
- LF_{calc}^{CNEC} is the loop flow on the CNEC in % of F_{max}^{CNEC}
- LF_{accept}^{CNEC} is the threshold value of "acceptable" loop flows on the CNEC in % of F_{max}^{CNEC}
- F_{max}^{CNEC} is the maximum flow on the CNEC

Since 9/6/2022, this formula is implemented in the daily operation within CORE FB MC. In case RAM (MCCC) + F_{uaf} (MNCC) within CORE FB DA CC is lower than the $MACZT_{min,CORE}^{CNEC}$, an Adjustment for Minimum RAM (AMR) is calculated in the minRAM process. This AMR is then added to the RAM of the CNEC to fulfil the required minRAM/$MACZT_{min,CORE}^{CNEC}$.

MACZT compliance is the figure after the minRAM inclusion step. In practice the value can be lower due the the individual validation process that checks operational security (see DA CCM article 20(5)[12]). Therefore, the $MACZT_{target}^{CNEC}$ is adjusted for specifically those MTUs for which the action plan target values are out of reach for reasons of operational security. The application of IVAs does not conflict with the minimum available margins from a regulatory perspective. However, the actual percentage of MACZT might still drop below 20% of Fmax as a result of reductions by IVA. Therefore, TenneT adjusts the $MACZT_{target}^{CNEC}$ of MTUs with IVA to represent this in the CEP compliance. TenneT presented this approach to ACER, who acknowledged this conditionally to TenneT approaching all CORE TSOs for a harmonized approach for the year 2023.

3.3 Implementation of minimum capacities on HVDC bidding zone borders

In line with ACER recommendation 01-2019[10], the (oriented) Net Transfer Capacity (NTC) that is made available for the HVDC bidding zone borders is to be considered fully as the MACZT made available on these bidding zone borders. Therefore, no additional tooling/calculations had to be implemented to be able to determine the level of MACZT on these interconnectors.

In a planned or unplanned outage situation, the grid capacity is reduced and flows on the remaining critical network elements increase compared to the grid situation where the outage is not present. It can occur, that in such situations some internal network elements do not have sufficient capacity to facilitate an expected level of internal flows, loop flows, cross-zonal flows via AC interconnectors as well as the maximum level of cross-zonal flows over the HVDC interconnectors.

When one or more critical network elements are in outage, TenneT aims to still respect the minimum capacity to be made available for cross-zonal trade as defined by the relevant obligations as set out in chapter 2, by using if needed non-costly and costly remedial actions. However, in case operational security limits cannot be respected due to a lack of available effective remedial actions when one or more critical network elements are in outage, TenneT is allowed to reduce capacity available for cross-zonal trade to a level that respects operational security limits.

In practice, TenneT has implemented the following process to make this evaluation:

1. If during <u>the week-ahead</u> grid security assessment,
    a. it becomes apparent that operational security limits are expected to be violated due to planned outages for required maintenance or grid enforcements, or due to longer duration unexpected outages; and/or
    b. the application of redispatching during the day-ahead and intraday timeframe as remedial actions is not expected to be sufficient or appropriate to resolve the expected violations of security limits, because amongst others:
        i. The application of redispatching before D-1 as only remedial action would exhaust redispatch potential in the day-ahead and intraday timeframe, such that insufficient remedial actions would remain available to solve potential later violations of security limits; or
        ii. There is expected to be insufficient upward redispatching potential for the required redispatching volume in the day-ahead or intraday timeframe; or
        iii. Restrictions on generation due to other operational security aspects, such as dynamic stability of the system, voltage control or obligations on generators to generate a certain amount of short circuit power for adequate detection of short circuits;

       and
    c. a reduction of capacity made available for cross-zonal trade is deemed an effective measure to reduce or resolve the violation of the operational security limits;

   then a set of remedial actions including a reduction of available capacity for cross-zonal trade on some critical network elements (incl. HVDC interconnectors) is prepared. The set will then consist of a combination of the application of one-sided redispatch prior to the DA market coupling for the respective region (via negotiated restriction agreements with some generators[14]) and reductions of available cross-zonal capacity proportionate to the impact of prepared (costly) remedial actions but limited to the extent needed to safeguard grid security.

2. During the operational security assessments performed day-ahead and intraday after the DA market coupling, the applied remedial actions from the week-ahead grid security assessment are taken into account on the basis of updated forecasts integrated in the day-ahead resp. intraday congestion forecasts.[15] If this assessment indicates that operational security limits are still expected to be violated, more RAs (for example redispatching) will be applied. If the application of RAs is not possible or sufficient, additional reductions of available capacity for cross-zonal trade on some critical network elements is applied to the extent needed to safeguard grid security.

3.4 Consideration of flows with third countries

On European level, there is not yet consensus in CORE whether or not third country flows are to be included within MNCC and MACZT. For the assessment in this report, TenneT has included flows with third countries in its calculation of MNCC in CWE (like previous years) and loop flows in both CWE and CORE. In CORE the MNCC is a direct CCCt output. TenneT has done this because exchanges of electricity with third countries do exist and TSOs must include them in day-to-day operations. Electricity exchanges with third countries will therefore contribute to overall capacity margins made available for cross-zonal trade.

For CWE CCA in 2022 the TenneT tool that determines the MNCC contained a wrongly configured set of third countries, resulting in invalid values for the MNCC excluding third countries. After the go-live of CORE DACC this local tool was decommissioned, prohibiting TenneT from recalculating the MNCC excluding third countries.

For CORE CCR in 2022 TenneT deems it infeasible to exclude the impact of exchanges with third countries in the MACZT. Primarily because the locally calculated values of the MNCC excluding third countries cannot be compared with the final MNCC after final FB computation. As the MNCC excluding third countries is not calculated centrally, TenneT determines these values locally during the loop flow calculation. Time wise, this is done prior to the intermediate FB computation, while the centrally determined MNCC is calculated later in time and is therefore based on more recent information.

In annex 5 it is specified which countries are regarded as third countries. Flows with Norway are not considered as third country flows, because TenneT and Statnett have agreed on a coordinated capacity calculation process for the NL-NO2 bidding zone border. The existence of this process has also been acknowledged by Core NRAs.

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[14] Besides the application of redispatch, TenneT also resolves congestion problems through restriction agreements with market participants in the case of insufficient bids or frequent congestion problems in a specific area. The involved market participants limit their electricity generation or offtake in a specific region when called upon by TenneT, in return for a negotiated compensation.

[15] This step is part of the regular operational security assessments, taking place on the basis of the day-ahead Congestion Forecast (DACF) and IntraDay Congestion Forecast (IDCF) network models.

4. Methodology of the assessment

4.1 Introduction of parameter $MACZT_{margin}$

As set out in chapter 2, the minimum MACZT that TenneT needs to make available on a CNEC differs per CNEC and per MTU, depending on the individual $MACZT_{target}$ values of the CNECs and the level of loop flows (see also formula (1)). Therefore, the absolute levels of MACZT made available on CNECs cannot be used to assess whether the minimum capacity margins have been met.

In order to allow for an easy and intuitive way to assess whether sufficient MACZT was made available on an individual CNEC, TenneT introduced the parameter $MACZT_{margin}$:

$$(7)\ MACZT_{Margin}^{CNEC} = MACZT^{CNEC} - MACZT_{min}^{CNEC}$$

where $MACZT_{Margin}^{CNEC}$ is the amount of MACZT made available above or below the minimum level, given in % of F_{max}^{CNEC}.

$MACZT_{margin}$ serves as indicator whether sufficient MACZT was made available for a CNEC for a specific MTU:

- If $MACZT_{margin} > 0\%$, more than the minimum required amount of cross zonal capacity was made available;
- If $MACZT_{margin} = 0\%$, exactly the minimum required amount of capacity was made available; and
- If $MACZT_{margin} < 0\%$, less capacity was made available than is at minimum required. However, if the cause was due to external factors or in line with the ground for derogation because of a lack of remedial actions, TenneT might still have met the applicable obligations and regulations. Therefore, these CNECs and MTUs with a negative $MACZT_{margin}$ require additional investigation.

4.2 Assessment of MACZT compliance in the CWE CCA and CORE CCR

4.2.1 Compliance with action plan and derogation

In order to assess whether TenneT complied with the applicable provisions related to the minimum levels of capacity margins that TenneT needs to make available for cross-zonal trade (MACZT) within the CWE CCA and CORE CCR, following from the action plan and derogation, TenneT performed the following steps.

For each MTU:

1) Calculate $MACZT_{min}^{CNEC}$ for each CNEC per direction, based on formula (1)
2) Calculate $MACZT^{CNEC}$ for each CNEC per direction, based on formula (4)
3) Calculate $MACZT_{margin}^{CNEC}$ for each CNEC per direction, based on formula (7)
4) Evaluate the $MACZT_{margin}^{CNEC}$ for each CNEC
   a. In case $MACZT_{margin}^{CNEC} \geq 0$ for all CNECs for both directions, the minimum capacity margins have been met for that MTU[16].
   b. In case $MACZT_{margin}^{CNEC} < 0$ for one or more CNECs in that MTU, TenneT potentially did not meet the minimum capacity margin obligations and a more detailed analysis needs to be performed. E.g. if there was a reduction of capacity on these CNECs due to a lack of remedial actions when the grid is in an outage situation (= ground of the derogation), the minimum capacity margins could still have been met for that MTU.

4.2.2 CWE - Compliance with 20% minRAM

In order to assess whether TenneT complied with the applicable provision to make a minimum level of MCCC ($MCCC_{min}$) available of 20% in the CWE CCA, TenneT performed the following steps specifically for CWE business days (until June 9, 2022).

For each MTU:

1. Select the CNEC which has the lowest $MCCC^{CNEC}$
2. Compare this lowest $MCCC^{CNEC}$ to the $MCCC_{min}$ target value of 20%
   - In case the lowest $MCCC^{CNEC} \geq 20\%$, TenneT has been compliant for that MTU;
   - In case the lowest $MCCC^{CNEC} < 20\%$, one needs to evaluate whether the reduction was appropriate for reasons of operational security. This is done on the basis on whether minRAM exclusion was justified. If that was the case, TenneT was compliant for that MTU;
   - In case the lowest $MCCC^{CNEC} < 20\%$, and the reduction was not appropriate for reasons of operational security, TenneT was not compliant for that MTU

4.2.3 CORE – Compliance with 20% minRAM

In order to assess whether TenneT complied with the applicable provision to make a minimum level of MACZT available of 20% in the CORE CCR, TenneT performed the following steps specifically for business days in CORE FB DACC.

For each MTU:

1. Select the CNEC which has the lowest $MACZT^{CNEC}$
2. Compare this lowest $MACZT^{CNEC}$ to the $MACZT_{min}$ target value of 20%

[16] In line with the approach as applied by ACER, the compliance assessment is based on whole percentages and TenneT rounds all results to two decimals in order to get whole percentages. As result, a CNEC with a $MACZT_{margin}$ between -0.49% and 0% qualifies as $MACZT_{margin} \geq 0\%$

- In case the lowest $MACZT^{CNEC} \geq 20\%$, TenneT has been compliant for that MTU;
- In case the lowest $MZCZT^{CNEC} < 20\%$, one needs to evaluate whether the reduction was appropriate for reasons of operational security. For this purpose, in CORE FB DACC it is allowed to lower the RAM by means of IVA. If that was the case, TenneT was compliant for that MTU;
- In case the lowest $MACZT^{CNEC} < 20\%$, and the reduction was not appropriate for reasons of operational security, TenneT was not compliant for that MTU.

4.3 Assessment of compliance of HVDC bidding zone borders

In order to assess whether TenneT complied with the applicable provisions related to the minimum levels of capacity margins that TenneT needs to make available for cross-zonal trade (MACZT) on the HVDC bidding zone borders, TenneT performed the following steps.

For each MTU:

1) Calculate $MACZT^{BZB}$ for each bidding zone border for both directions, by dividing the Net Transfer Capacity (NTC) of the bidding zone border per direction as offered by TenneT by the available physical capacity (Fmax) of the interconnector forming the bidding zone border:

$$MACZT^{BZB} = \frac{NTC^{BZB}_{TenneT}}{Fmax^{BZB}}$$

2) Compare $MACZT^{BZB}$ with $MACZT^{BZB}_{min}$ for both directions[17]
   a. In case $MACZT^{BZB} \geq MACZT^{BZB}_{min}$ for both directions TenneT has been compliant for that bidding zone border for that MTU.
   b. In case $MACZT^{BZB} < MACZT^{BZB}_{min}$ for one or both of the directions, then go to step 3
3) In case the MACZT is below the target level for one of both of the direction, the cause for that needs to be assessed:
   a. In case the reduction was not triggered by TenneT, but by 'the other' TSO (i.e. Statnett for NL-NO2 or Energinet for NL-DK1), TenneT was considered compliant for this MTU.
   b. In case the reduction is triggered by TenneT due to a lack of remedial actions when the grid is in an outage situation, TenneT was compliant for that MTU.
   c. In case the reduction is triggered by TenneT because of a disturbance in the NL grid, maintenance in the NL grid and/or another reason while other remedial actions could have been taken, TenneT was not compliant for that MTU.

[17] In case the interconnector itself was not available because of an outage or maintenance, the Fmax of that interconnector is put to 0. In such a situation, providing 0 NTC capacity is regarded as being compliant for that interconnector for that MTU.

4.4 Differences in methodology compared to the ACER MACZT monitoring

Within this report, TenneT has generally followed the approach and principles as ACER has set out in its Recommendation No 01-2019 and which have also been used in ACER's MACZT monitoring reports.

A notable distinction is that TenneT makes use of the parameter $MACZT_{margin}$ as defined in formula (7) to evaluate whether the MACZT made available met the minimum requirements. TenneT considers this a helpful parameter because for Dutch CNECs the $MACZT_{min}$ varies per CNEC per MTU.

5. Results

In this chapter, the results of the MACZT assessment will be described. The chapter is divided into three sections:

- Results of the MACZT compliance assessment for CWE and CORE CCR
- Additional assessments of the MACZT offered in CWE and CORE CCR
- Results of the MACZT compliance assessment for the HVDC bidding zone borders

5.1 Results of the MACZT compliance assessment for the CWE and CORE CCR

For CWE, the process for evaluation as set out in subsection 4.2.2 has been carried out. The results of that evaluation are included in paragraph 5.1.1. For CORE, the evaluation from 4.2.3 has been performed, for which the outcomes are included in paragraph 5.1.2.

5.1.1 CWE - Assessment of the MACZTmargin

In Figure 1, the overall percentage of time when the minimum capacity margins have been met is given for the period until June 9, 2022. The figure shows that:

- for 99% of the time, the minimum capacity margins have been met for all CNECs in those MTUs.
- For 1% of the time the minimum capacity margins have not been met for at least one CNEC in those MTUs.

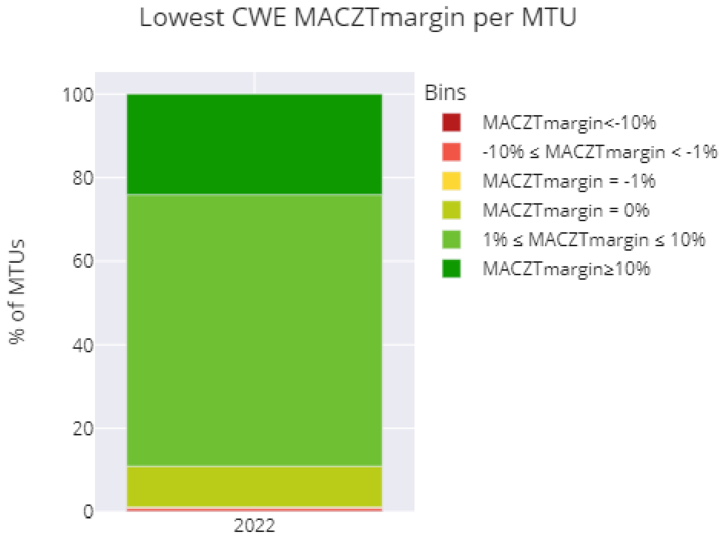

Figure 1: Percentage of time when the minimum capacity margins[18] have been met (green), and how much capacity was provided above or below the minimum margin. For each MTU, the CNEC with the lowest MACZT$_{margin}$ was selected and categorised to one of the ranges. CWE CCR, considering third countries. Period Jan 1-Jun 8, 2022.

[18] Zero percent indicates that Tennet exactly complies to the minimum capacity requirement

The underlying reason why the results have improved significantly compared to 2021 is due to local tooling that TenneT used to calculate MNCC. In 2021 this tool provided erroneous MNCC values, which was corrected per Business day 2/10/2021 thereby ensuring correct MNCC values for 2022. For the remaining MTUs with negative a $MACZT_{margin}$, the following explanation applies: Firstly, on two business days human errors caused the output of the local loop flow derogation tool to be overwritten. This resulted in a negative $MACZT_{margin}$ < -1% for a total of 24 MTU on these two business days. Important to note is that none of the violating CNECs where active nor presolved in the CWE FB DACC. As these errors are CWE specific, recurrence in CORE is impossible. Secondly, on a small number of MTUs the required minRAM in CWE as outlined in paragraph 3.1 would be >100%. As an operational safety rule TenneT caps the minRAM at 100% (like in the previous years). This resulted in 18 individual MTUs spread among several business days which had at least one CNEC with negative $MACZT_{margin}$ <-1%. None of the violating CNECs where active nor presolved in the CWE FB DACC.

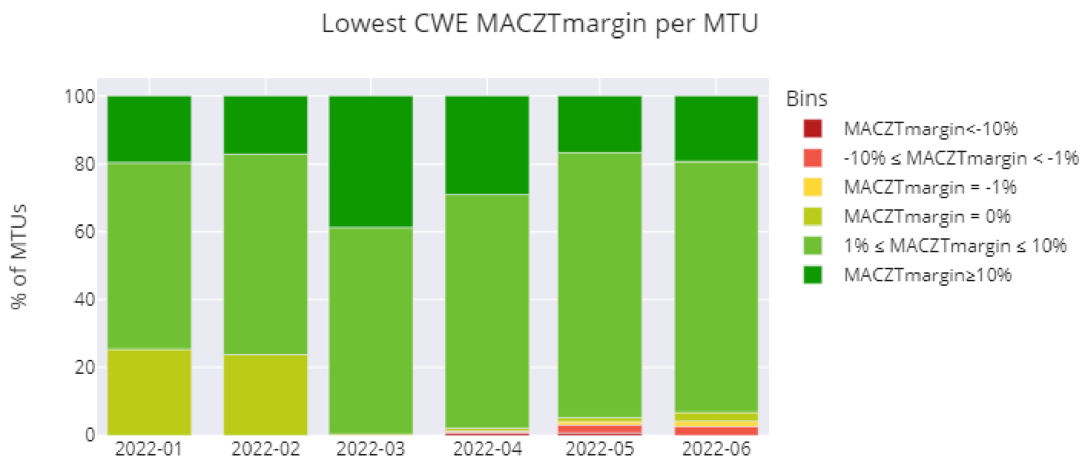

Figure 2: Percentage of time when the minimum capacity margins[18] have been met (green), and how much capacity was provided above or below the minimum margin, per month of 2022 (until June 8). For each MTU, the CNEC with the lowest $MACZT_{margin}$ was selected and categorised to one of the ranges. CWE CCR, considering third countries.

5.1.2 CORE - Assessment of the MACZTmargin

In Figure 3 the overall percentage of time when the minimum capacity margins in CORE CCR have been met for the given for the period June 9 – December 31, 2022. The figure shows that:

- for 97% of the time, the minimum capacity margins have been met for all CNECs in those MTUs.
- For 3% of the time there was at least one CNEC for which the minimum capacity margins $MACZT_{margin}$ was between 0 and -1% in those MTUs. This error of 1% deficit is caused by numerical rounding in the Core CC tool.

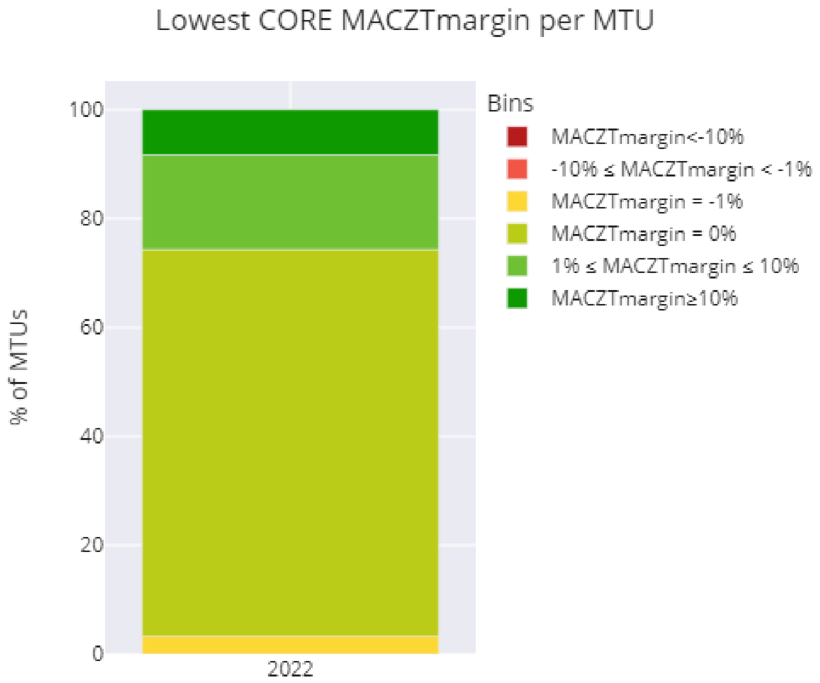

Figure 3: Percentage of time when the minimum capacity margins[18] have been met (green), and how much capacity was provided above or below the minimum margin. For each MTU, the CNEC with the lowest $MACZT_{margin}$ was selected and categorised to one of the ranges. CORE CCR, considering third countries. Period Jun 9-Dec 31, 2022.

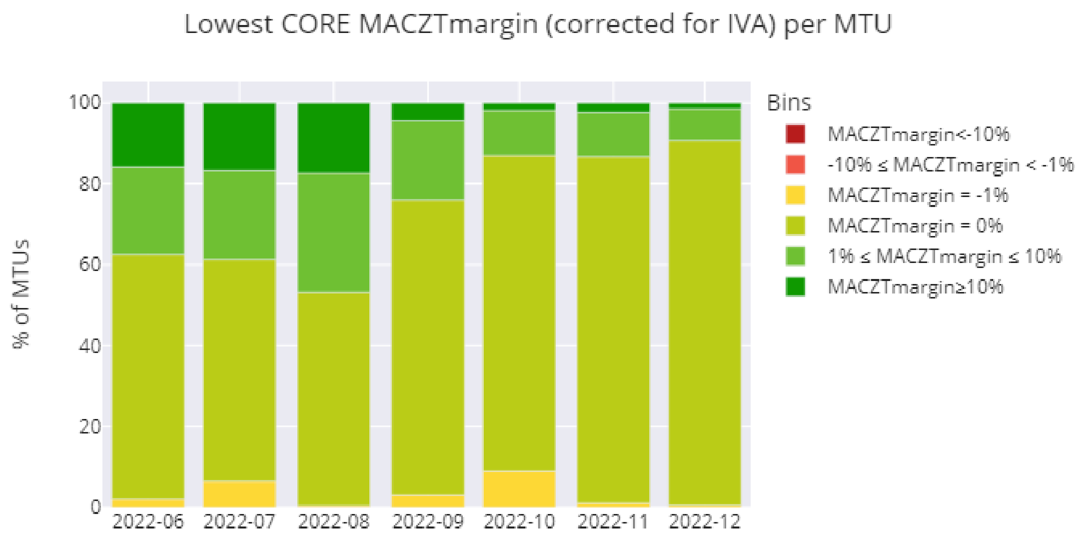

Figure 4: Percentage of time when the minimum capacity margins[18] have been met (green), and how much capacity was provided above or below the minimum margin, per month of 2022 (June 9-December 31). For each MTU, the CNEC with the lowest $MACZT_{margin}$ was selected and categorised to one of the ranges. CORE CCR, considering third countries.

5.1.3 Assessment of the offered MACZT

The figures of $MACZT_{margin}$ are helpful to evaluate the compliance of TenneT, but as such do not provide information on the level of MACZT which was provided. Therefore, also the 'standard' categorisation as introduced by ACER showing the percentage of time when the relative MACZT was within a certain range, is given in Figure 5. The figure shows that for most months in CWE, the lowest relative MACZT was below 20% of F_{max} for 30% of the time, except for February (65% of the time).

Please note that this figure cannot be used as basis to assess the compliance, as this figure does not take into account the linear trajectory of the action plan and derogation applicable in NL.

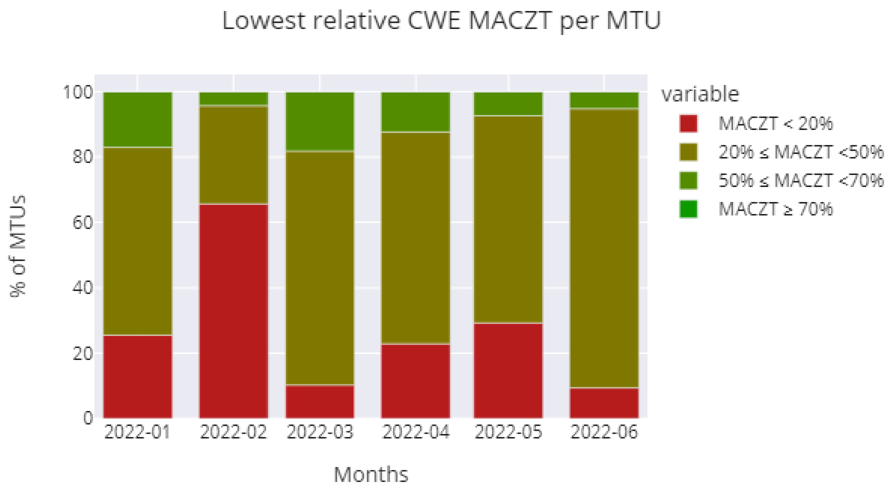

Figure 5: Percentage of time when the minimum MACZT in CWE CCA is met on all CNECs. For each MTU, the CNEC with the lowest relative MACZT was selected and categorised to one of the ranges. Graph is considering third countries, period is January 1-June 8 2022.

As per go-live of CORE day-ahead capacity calculation for most months the CNEC with lowest relative MACZT per MTU was between a range of 0-20%. A modest peak was noted in November at 30%. Overall, the lowest MACZT for CORE does less frequently end below 20% compared to CWE.

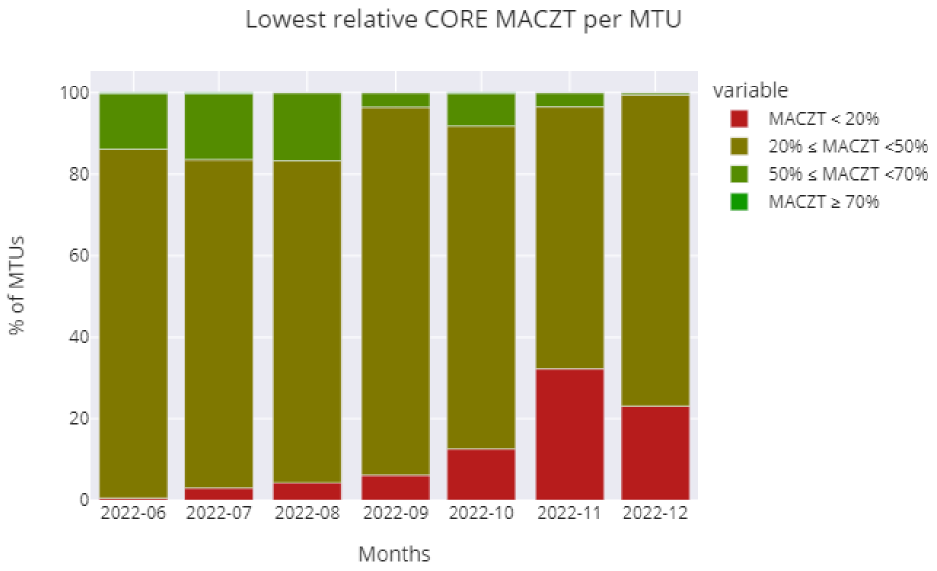

Figure 6: Percentage of time when the minimum MACZT in CORE CCR is met on all CNECs. For each MTU, the CNEC with the lowest relative MACZT was selected and categorised to one of the ranges. Graph considering third countries, period is June 9-December 31 2022.

5.1.4 Assessment of the offered MCCC

For assessing the compliance with the CWE 20% minRAM, the process for evaluation as set out in subsection 4.2.2 has been carried out. The results of that evaluation are included in this section. In Figure 7 the distribution of the lowest relative MCCC per MTU is given. No MTU has been recorded with a MCCC <20%. Therefore, it is considered that the 20% minRAM obligation has been fully complied with within 2022 for CWE.

A separate CORE figure is added to allow for comparison with CWE. Figure 8 depicts the lowest relative MCCC as of CORE DACC go-live. The application of IVA is the single reason for the MCCC to drop below 20%.

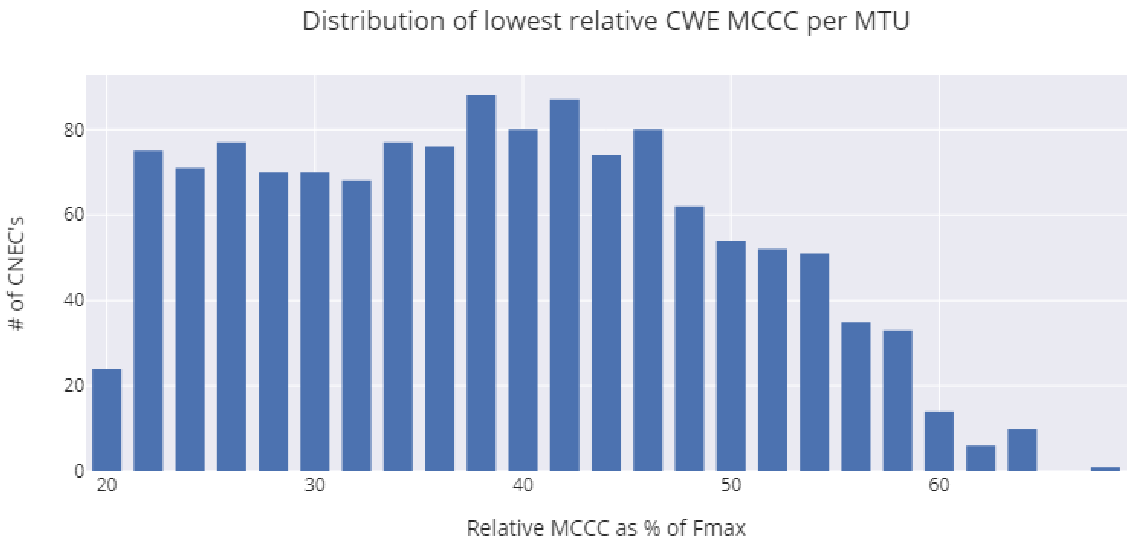

Figure 7: Distribution of the lowest hourly relative MCCC of the Netherlands for the CWE CCA, considering third countries. Period Jan 1-Jun 8, 2022.

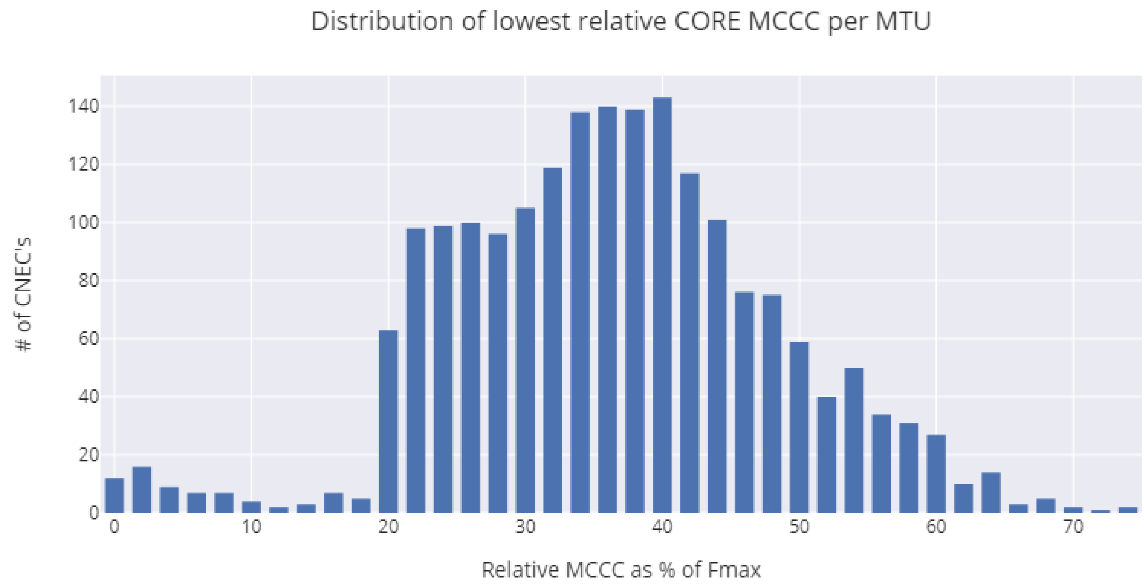

Figure 8: Distribution of the lowest hourly relative MCCC of the Netherlands for the CORE CCR, considering third countries. Period Jun 9-Dec 31, 2022

5.2 Additional assessment of the MACZT offered in CWE and CORE CCR

Next to the main assessments required to evaluate the compliance with the minimum capacity margins that needed to be made available in CWE and CORE, this section contains some additional assessments which have been carried out on the basis of the MACZT data. The data from this section is not strictly required to assess the compliance, but it provides some additional insights in the amount of MACZT that has been provided on the Dutch CNECs included in CWE and CORE FB DA CC.

5.2.1 Distributions of MACZT for all CNECs

The figures in the previous section each looked at the least performing CNEC, with respect to either $MACZT_{margin}$ or MACZT, and classified this into large categories. In this subsection, histograms are included with the results of:

- Lowest hourly relative MACZT for all MTUs in 2022: Figure 9 for CWE CCA and Figure 10 for CORE CCR
- Relative MACZT of all CNECs for all MTUs in 2022: Figure 11 for CWE CCA and Figure 12 for CORE CCR
- $MACZT_{margin}$ of all CNECs for all MTUs in 2022: Figure 13 for CWE CCA and Figure 14 for CORE CCR

Figure 9 depicts that for CWE the majority of MTUs the CNEC with the lowest hourly relative MACZT is spread across a -10 to 60% range, with a peak at the minimum $MACZT_{target}$ value of 37% (see Table 1). For CORE, the CNEC with lowest relative MACZT shows a clear cut-off point at a MACZT of 20% (Figure 10). This can be explained as the CCCt ensures that the minRAM/$MACZT_{min}$ on a CNEC can never go below 20% of Fmax during the AMR inclusion of the intermediate flowbased computation (as explained in paragraph 2.3), while for CWE the $MACZT_{min}$ could drop below 20% of F_{max} due to the different definition of minRAM.

When looking at all CNECs for CWE in Figure 11, it can be observed that the majority of CNECs actually have a much higher relative MACZT. The average relative MACZT of all CNECs in CWE is 90%, which is significantly above the Electricity Regulation target of 70%, and the peak of the distribution for all CNECs also lies around a relative MACZT of 90%, Similar to CWE, also the CORE results depict a 90% average relative MACZT.

Furthermore, Figure 13 shows that the vast majority of CNECs in CWE have had a positive $MACZT_{margin}$, and thus comply with the minimum margins for cross-zonal trade that have to be offered. For CORE only positive MACZTmargins were present.

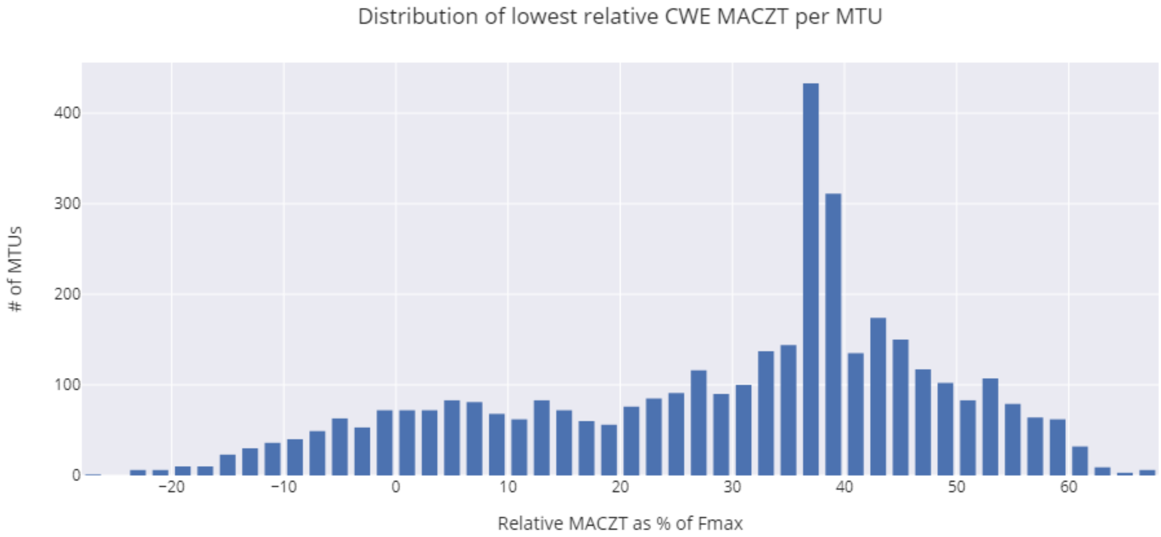

Figure 9: Distribution of the lowest hourly relative MACZT of the Netherlands for the CWE CCA, considering third countries. Period Jan 1-June 8 2022.

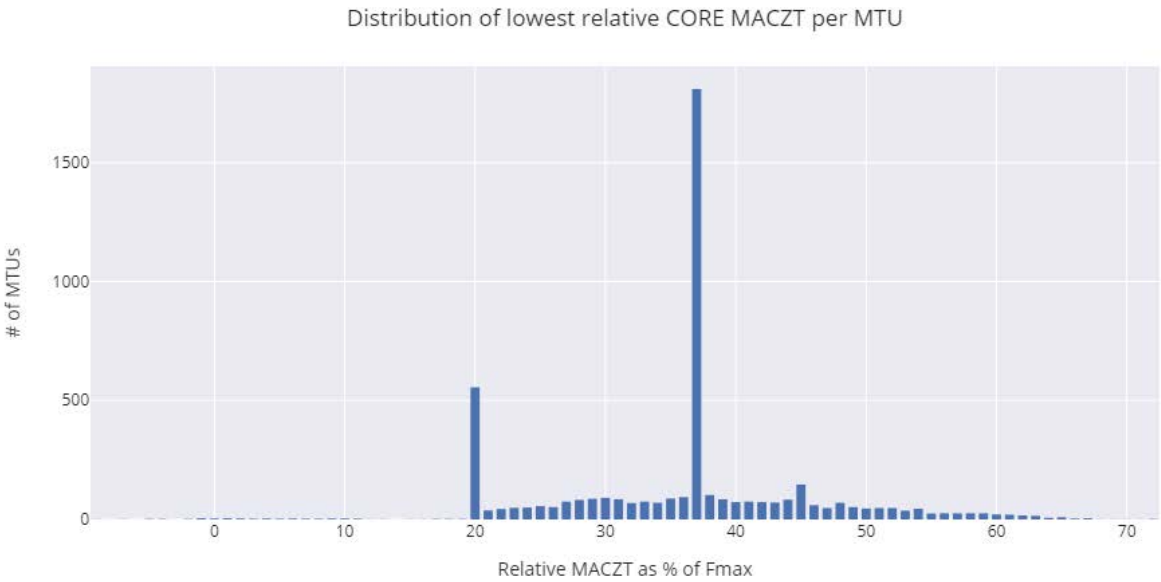

Figure 10: Distribution of the lowest hourly relative MACZT of the Netherlands for the CORE CCR, considering third countries. Period June 9-December 31, 2022.

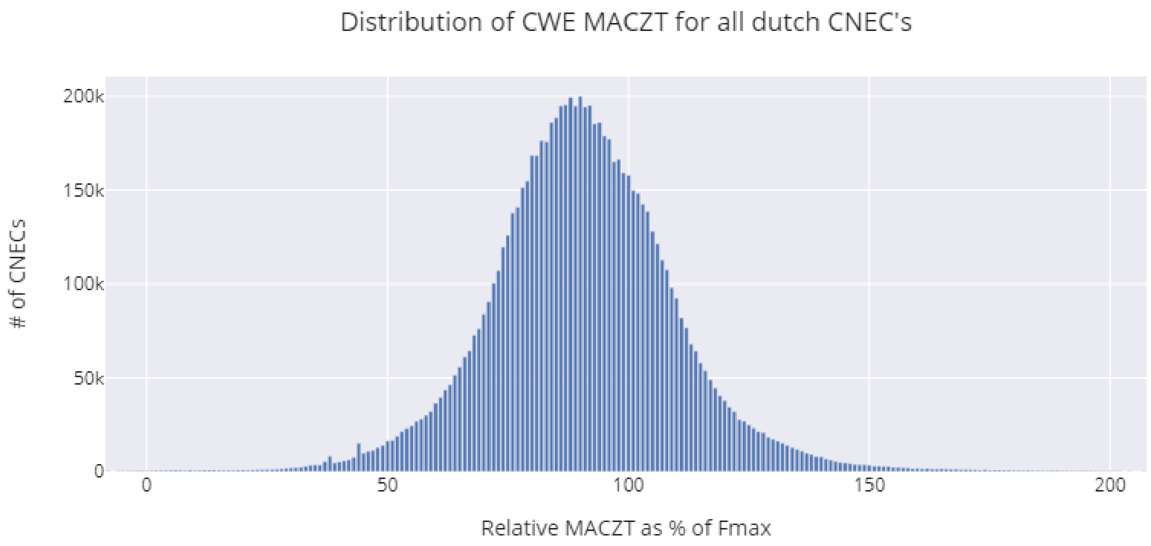

Figure 11: Distribution of the relative MACZT for all CNECs and all MTUs of the Netherlands for the CWE CCA, considering third countries. Period Jan 1-June 8, 2022

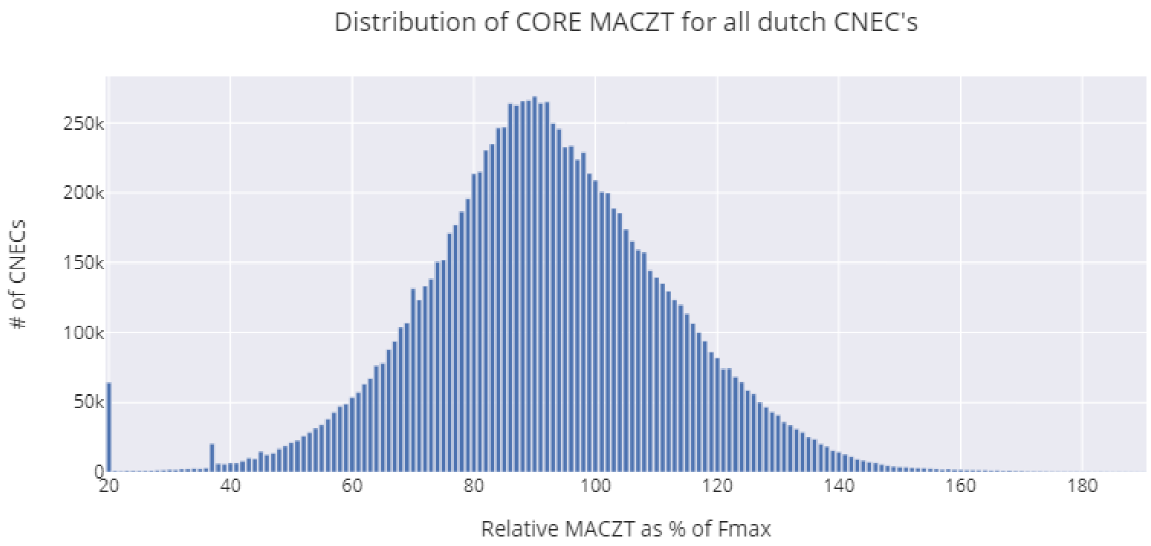

Figure 12: Distribution of the relative MACZT for all CNECs and MTUs of the Netherlands for the CORE CCR, considering third countries. Period June 9-December 31, 2022.

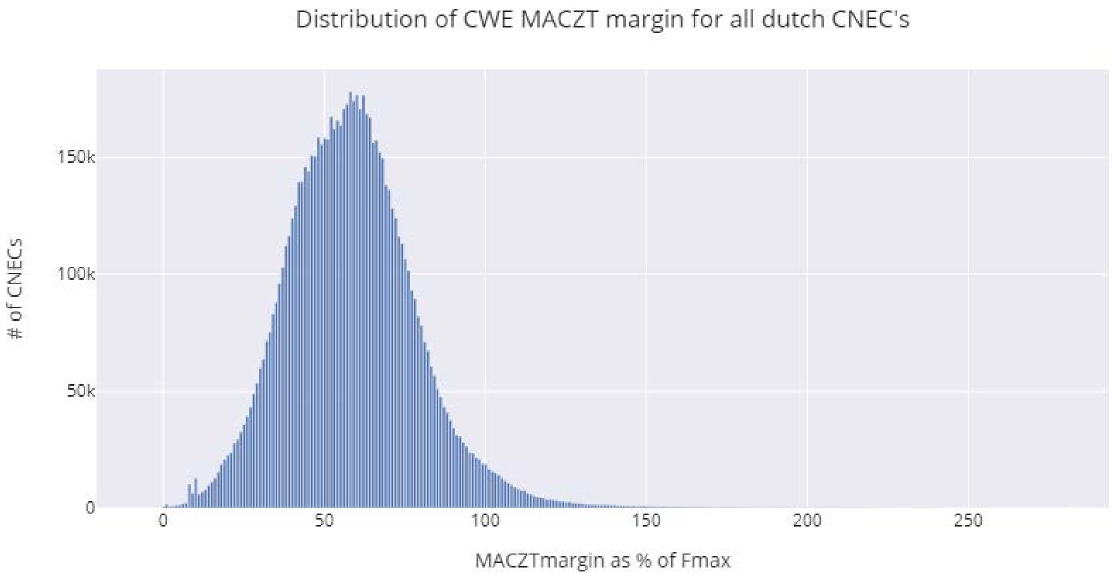

Figure 13: Distribution of the $MACZT_{margin}$ for all CNECs of the Netherlands for the CWE CCA, considering third countries. Period Jan 1-Jun 8, 2022.

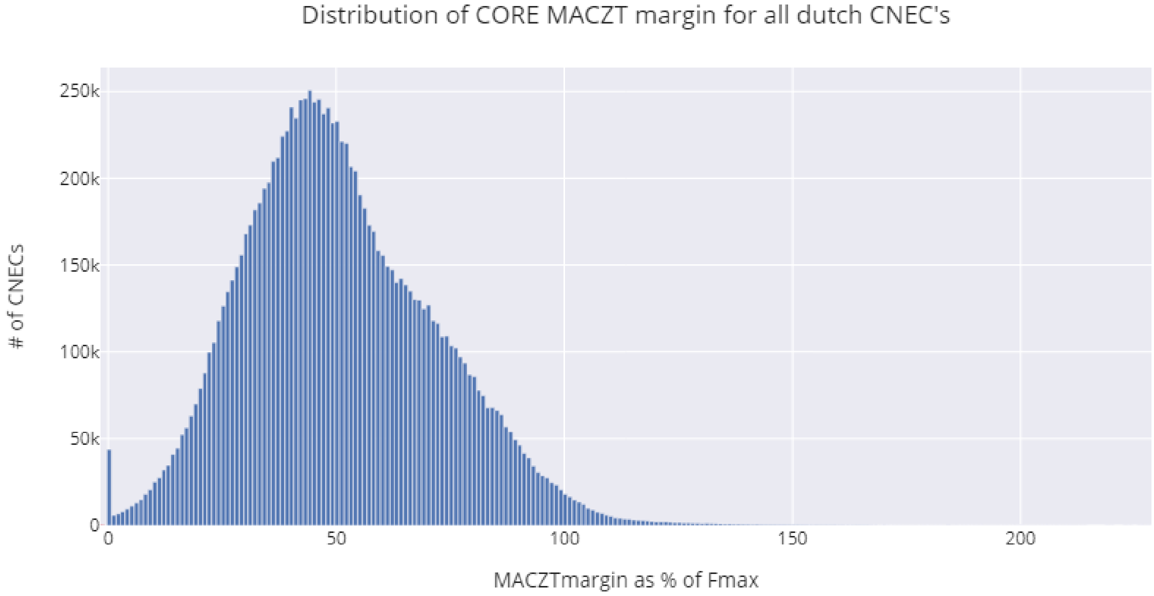

Figure 14: Distribution of the $MACZT_{margin}$ for all CNECs of the Netherlands for the CORE CCR, considering third countries. Period Jun 9-Dec 31, 2022.

5.2.2 MACZT breakdown per CNE

Based on the action plan, individual $MACZT_{target}$ values have been established per CNE. In order to provide more insight into what level of capacity is made available per CNE, a breakdown of the lowest hourly relative MACZT per CNE per direction is given in Figure 15 and Figure 17 for CWE and Figure 16 and Figure 18 for CORE.

An explanation how to read the figures is given in the box below the figures. A list with the full names of the network elements is given in Table 4 of annex 3. Most of the time, between two high voltage substations there are pairs of high voltage lines, where the individual lines have the same names but are denoted with a different suffix (‘W’, ‘Z’ etc.). Each high voltage line is individually included as CNE in the CWE and CORE FB DA CC, and therefore also individually depicted in Figure 15, Figure 16, Figure 17 and Figure 18. Typically, these CNEs are connected in parallel between the same substations and have the same grid characteristics, and therefore the flows and MACZT for both CNEs are also very comparable.

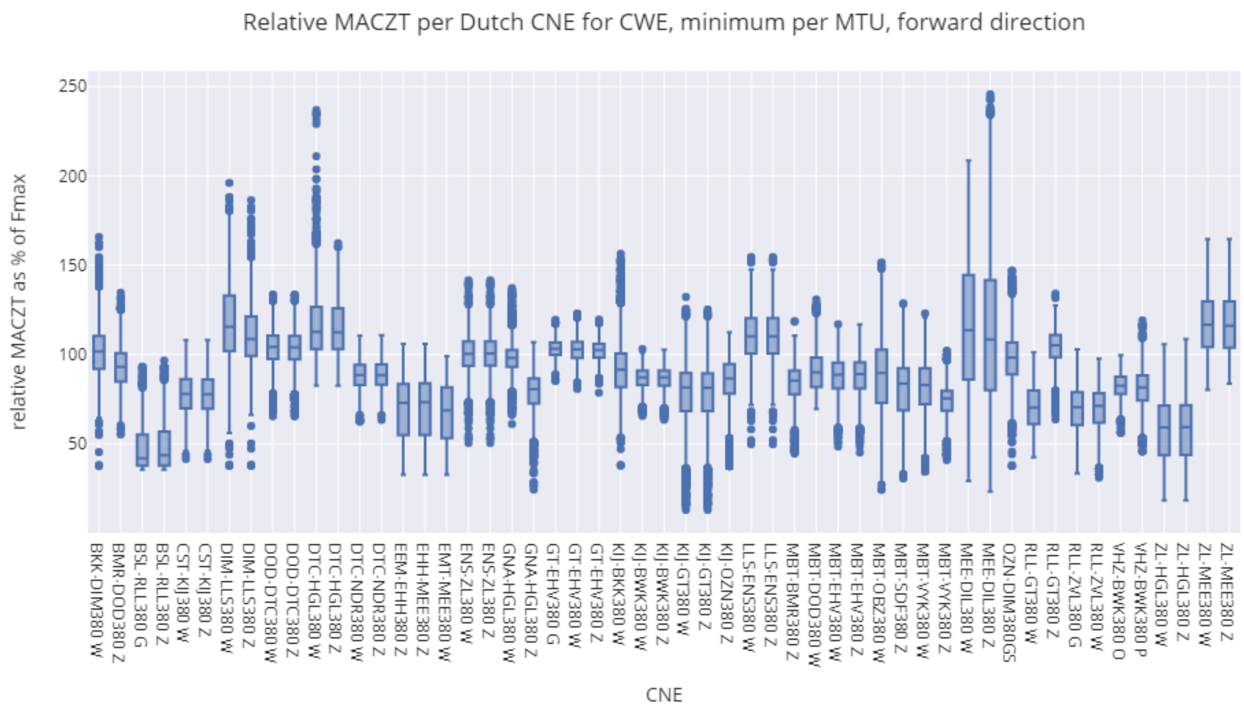

Figure 15: Relative MACZT per Dutch CNE included in CWE CCA in the forward direction, based on the lowest relative MACZT per CNE per MTU, considering third countries. Period Jan 1-Jun 8, 2022.

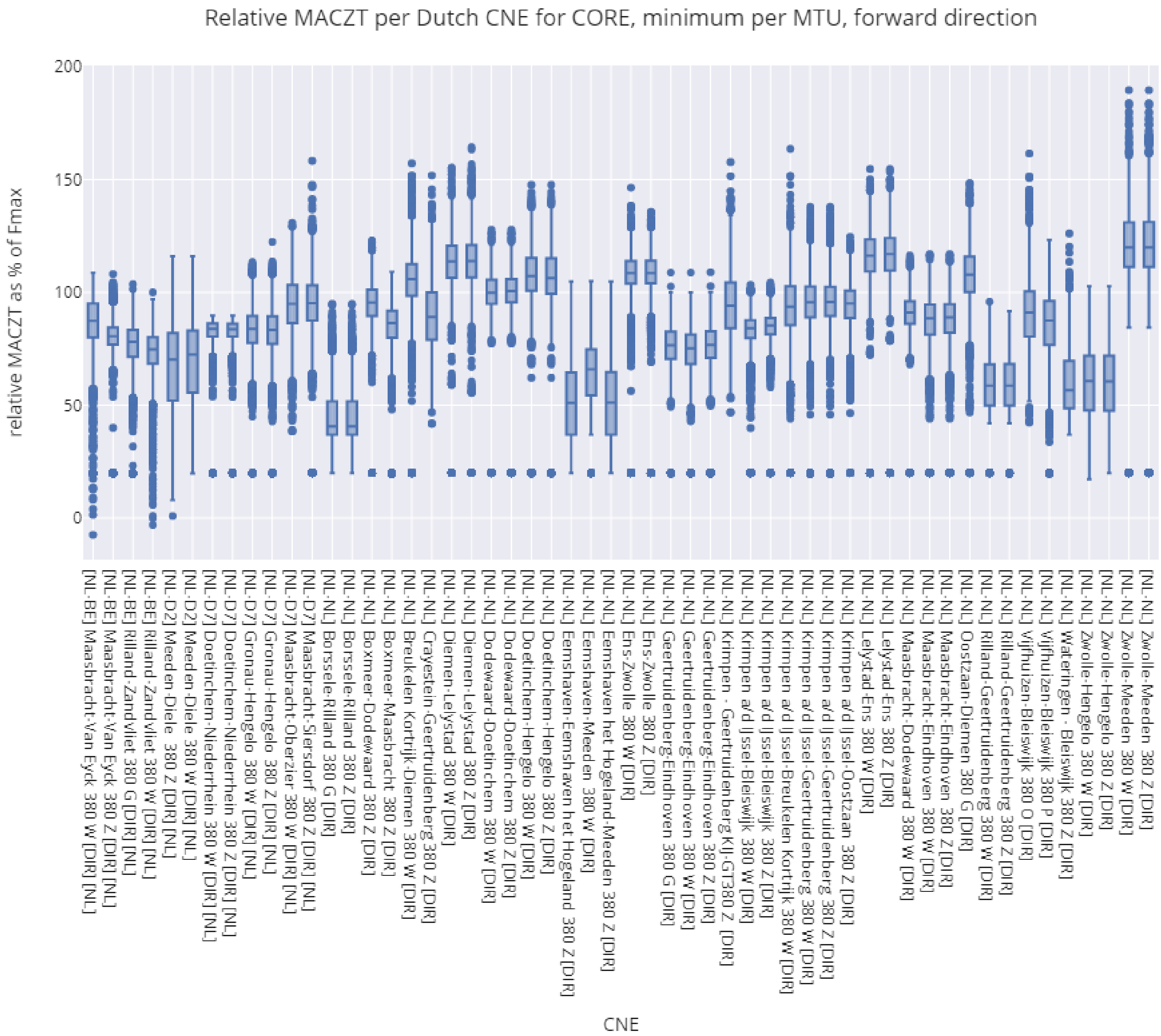

Figure 16: Relative MACZT per Dutch CNE included in CORE CCR in the forward direction, based on the lowest relative MACZT per CNE per MTU, considering third countries. Period June 9-December 31, 2022.

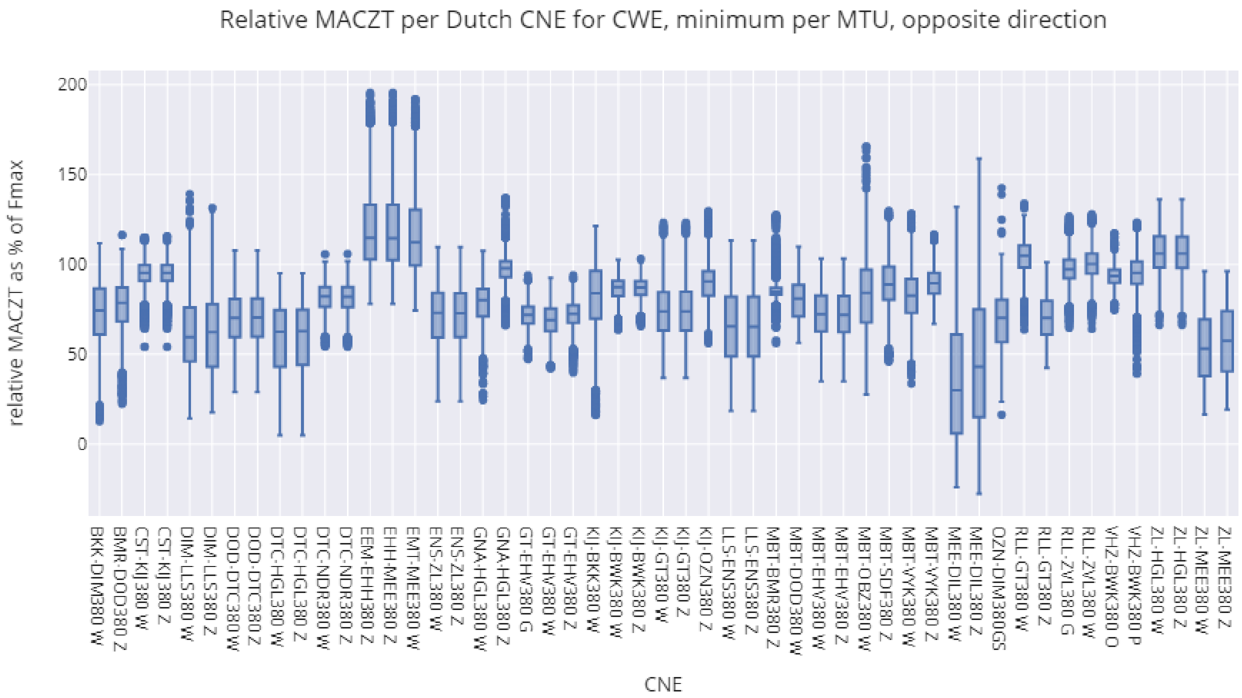

Figure 17: Relative MACZT per Dutch CNE included in CWE CCA in the opposite direction, based on the lowest relative MACZT per CNE per MTU, considering third countries. Period Jan-Jun 8, 2022.

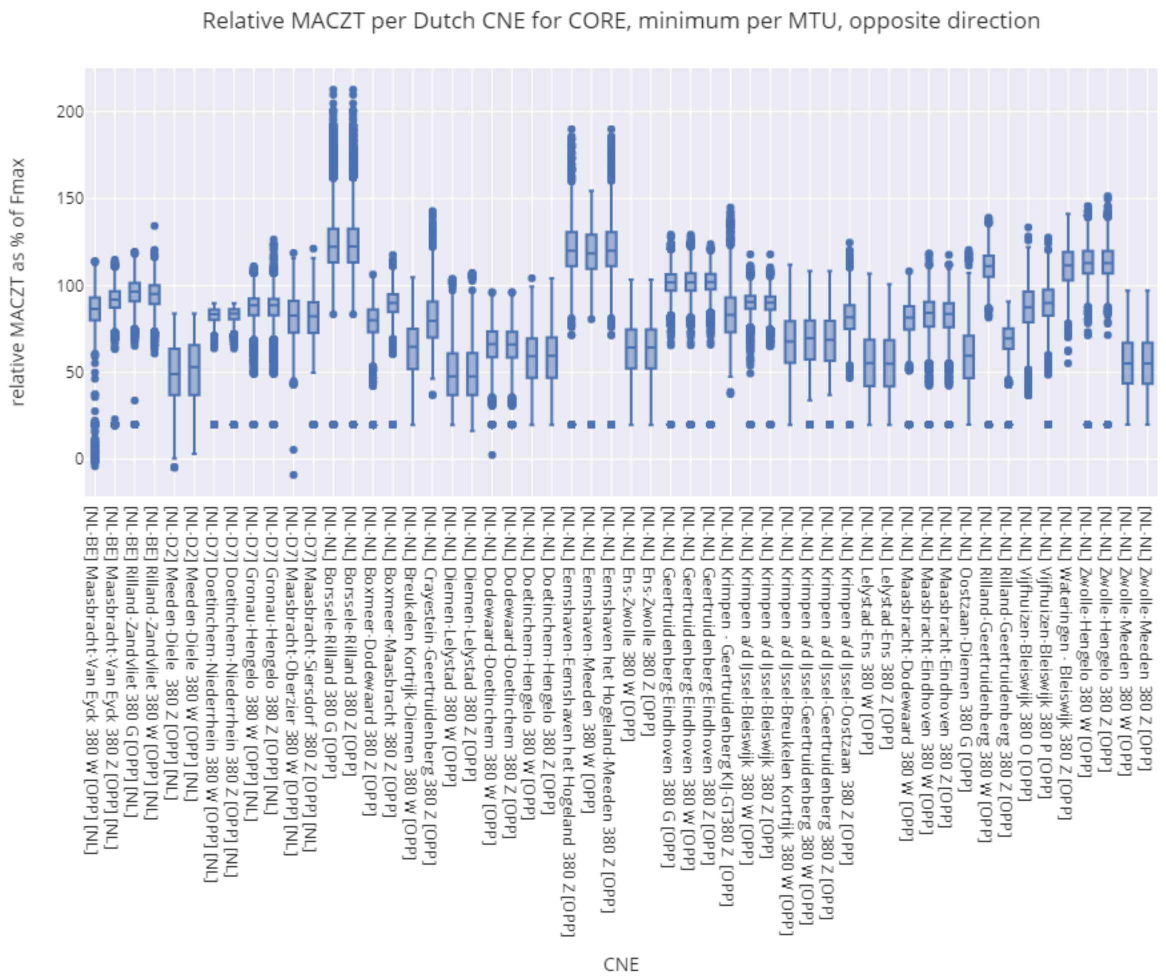

Figure 18: Relative MACZT per Dutch CNE included in CORE CCR in the opposite direction, based on the lowest relative MACZT per CNE per MTU, considering third countries. Period Jun 9-Dec 31, 2022.

Box plot explanation

- Each box + whiskers represent the data for a single CNE. For each CNE per direction, the CNEC with the lowest relative MACZT per MTU is taken.
- The box shows the range of the first quartile (Q1) to third quartile (Q3) of the data. (thus 25% - 75% of the data points is included in the box
- The blue horizontal line per CNE is the median of the data (the line which splits the dataset in half)
- Whiskers show the total range of the data, capped to a maximum of 1.5 * IQR from Q1 to Q3, where IQR is the inter-quartile range of Q3-Q1. Outliers are plotted as separate dots.

5.2.3 Overview of least performing CNECs w.r.t MACZT and MACZTmargin

Figure 19 (CWE) and Figure 20 (CORE) show what percentage of time a certain CNE has been the least performing CNE with respect to $MACZT_{margin}$, including whether they had a positive $MACZT_{margin}$ (green bar) or a negative $MACZT_{margin}$ (red bar). These are the elements which have actually set the performance with respect to $MACZT_{margin}$, as shown in Figure 1 and Figure 2.

One network element in particular pops up in both CWE and CORE. The CNE Maasbracht-Dodewaard 380 Wit has been the defining CNE for $MACZT_{margin}$ in CWE for more than 62% of the time. In CORE this CNE is also most significant, but at just 17%. Despite its significance as least performing CNE for MACZT performance, this CNE is actually hardly ever popping up as active constraint in the day-ahead market coupling and therefore in practice has no impact on the market. The reason is that this CNE already has a $MACZT_{target}$ value of 70% which is significantly above the $MACZT_{target}$ values of all other Dutch CNEs included in CWE FB DA CC. Still, for the majority of the time, it had a positive $MACZT_{margin}$.

In CORE the CNE Borssele-Rilland 380 Grijs is showing an almost identical performance as Maasbracht-Dodewaard 380 Wit. This CNE is also often the defining CNEs for $MACZT_{margin}$ because it carries a relatively large amount of internal flows, which originate from generators feeding in in the Borssele substation and which flow to the rest of the Netherlands or to Belgium. However, also these CNEs hardly ever pop up as active constraints in the day-ahead market coupling.

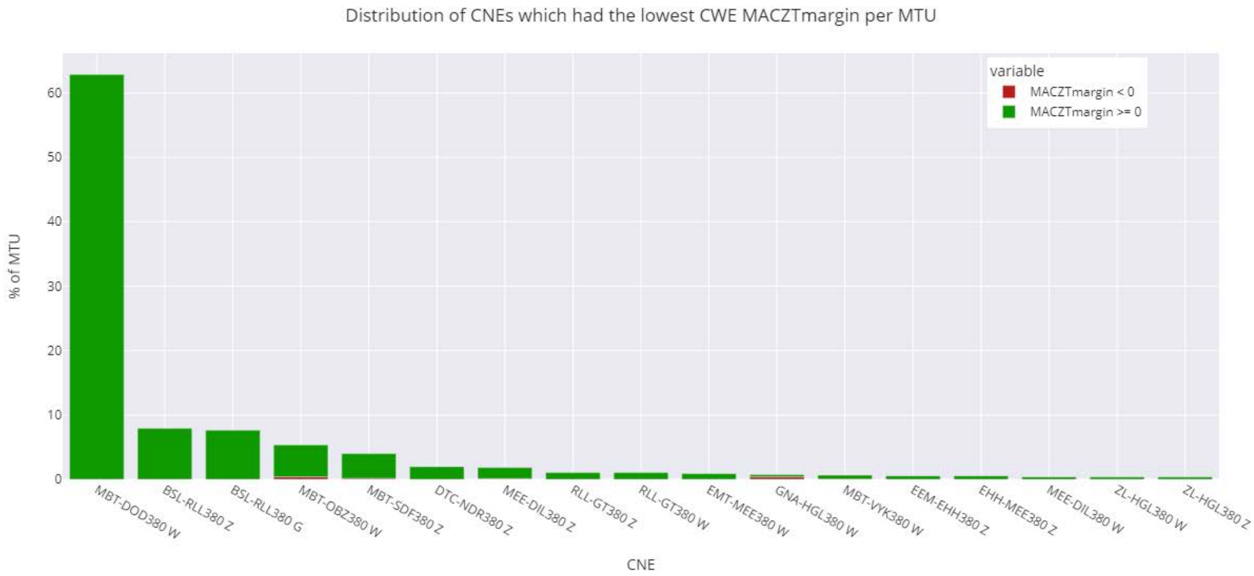

Figure 19: Overview of least performing CNEs in CWE CCA w.r.t. MACZTmargin. It has been determined what percentage of time an individual CNE has been the CNEC with the lowest $MACZT_{margin}$ per MTU. The green part of the bar indicates the percentage of time that the CNE had a positive $MACZT_{margin}$ the red part indicates the time that the CNE had a $MACZT_{margin}$ <0. Considering third countries. All CNEs occurring <1% of the time are excluded from the graph. Period Jan 1-June 8 2022.

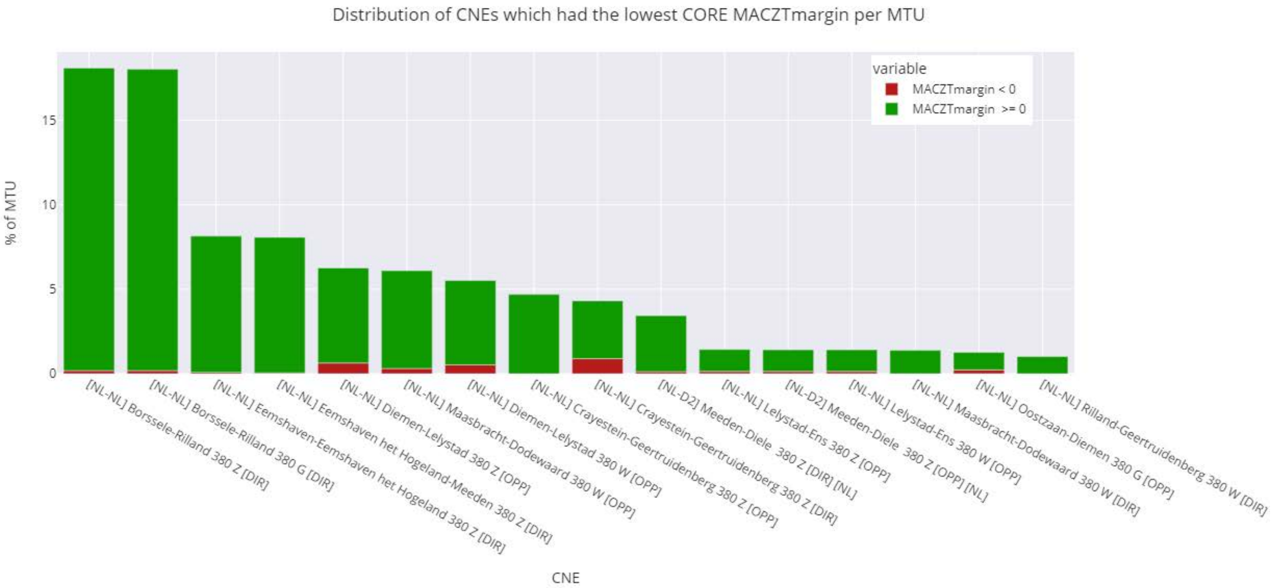

Figure 20: Overview of least performing CNEs in CORE CCR w.r.t. MACZTmargin. It has been determined what percentage of time an individual CNE has been the CNEC with the lowest $MACZT_{margin}$ per MTU. The green part of the bar indicates the percentage of time that the CNE had a positive $MACZT_{margin}$ the red part indicates the time that the CNE had a $MACZT_{margin}$ <0. All CNEs occurring <1% of the time are excluded from the graph. Considering third countries. Period Jun 8-Dec 31, 2022.

Figure 21 shows what percentage of time a certain CNE has been the least performing CNE with respect to MACZT. Just as in Figure 19, the CNEs of Borssele-Rilland 380 Grijs and Zwart pop up as second and third defining elements. So next to often containing the lowest $MACZT_{margin}$ values, these also typically contain the lowest MACZT values. However, the first and fourth defining CNE are different from Figure 19. With respect to the lowest level of MACZT, the cross-border CNEs Meeden-Diele 380 Wit and Zwart are together the most defining elements with respect to MACZT for around 14-16% of the time. This is not surprising, given that these CNEs have a relatively low Fmax (1053 MW) and typically carry a high amount of loop flows, which is shown in the next subsection.

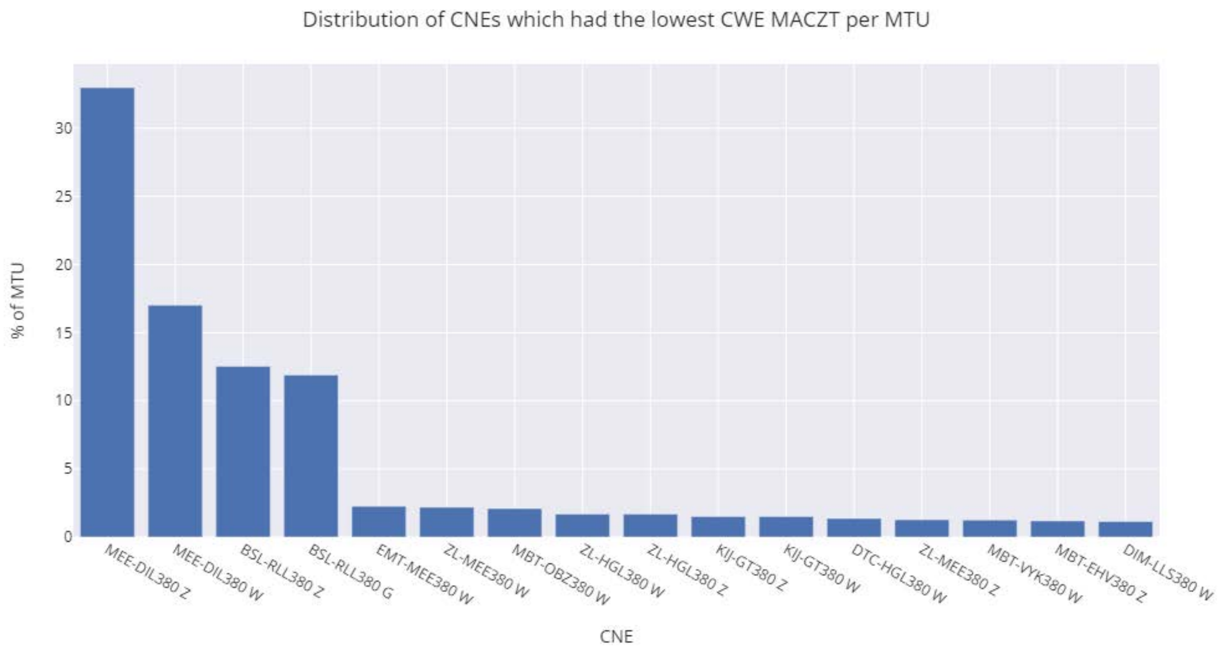

Figure 21: Overview of least performing CNEs in CWE CCA w.r.t. MACZT. It has been counted how often individual CNEs have been the CNEC with the lowest MACZT per MTU. Considering third countries. All CNEs occurring <1,1% of the time are excluded from the graph. Period Jan 1-Jun 8, 2022

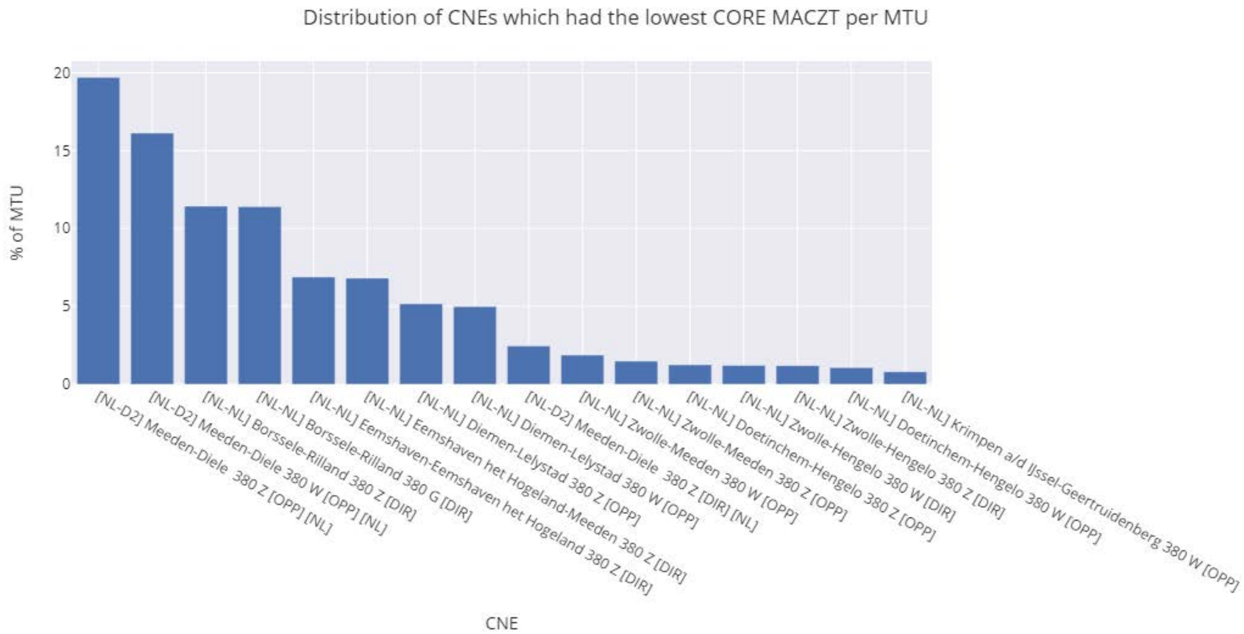

Figure 22: Overview of least performing CNEs in CORE CCR w.r.t. MACZT. It has been counted how often individual CNEs have been the CNEC with the lowest MACZT per MTU. All CNEs occurring <0,8% of the time are excluded from the graph. Considering third countries. Period Jun 9-Dec 31, 2022.

5.2.4 Loop flow breakdown per CNE

One of the key elements from the applicable derogation is that it reduces the minimum margins that TenneT needs to make available for cross-zonal trade, in case loop flows exceed a certain predefined threshold (see section 2.2). In order to make the impact of this derogation more clear, a breakdown of the calculated loop flows per CNE is given in Figure 23 for CWE CCA and Figure 24 for CORE CCR. There is no figure included for the opposite direction, as the figure contains average loop flows and the average loop flows in the opposite direction would just be a mirror of this picture.

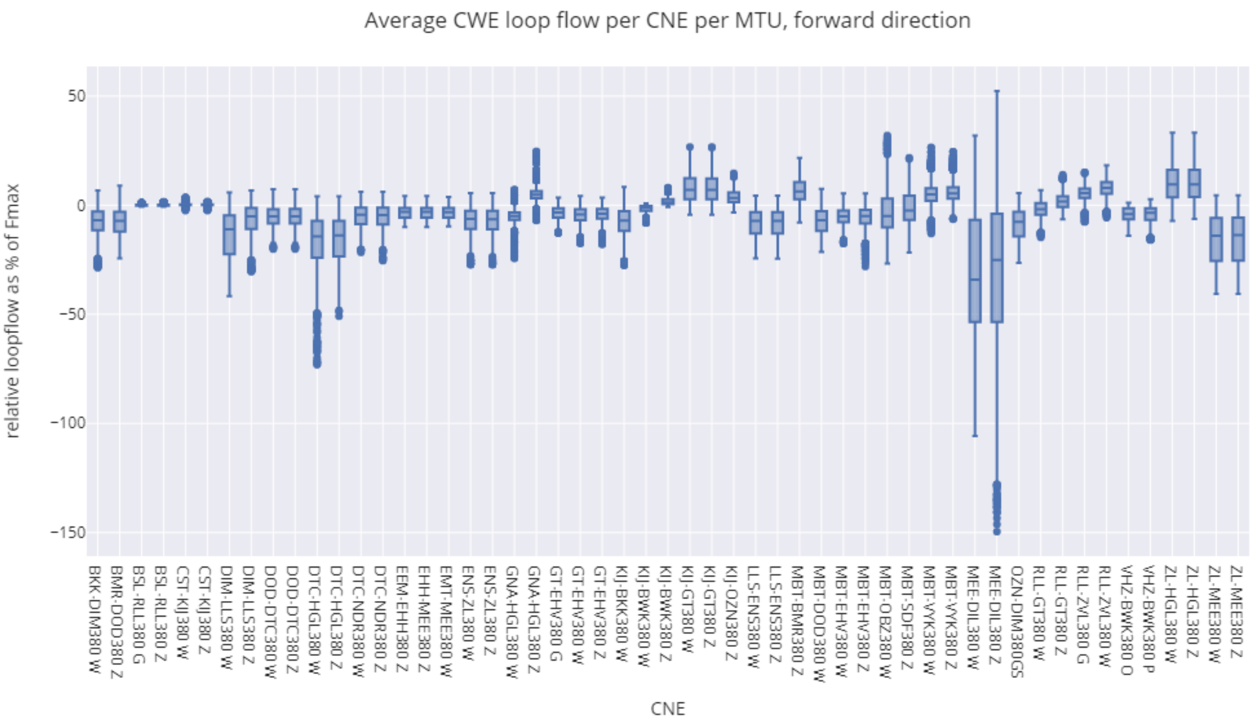

Figure 23: Average relative loop flow per Dutch CNE per MTU. Positive values indicate loop flows in the forward direction, negative values indicate loop flows in the opposite direction. CWE CCR, considering third countries. Period Jan 1-June 8, 2022.

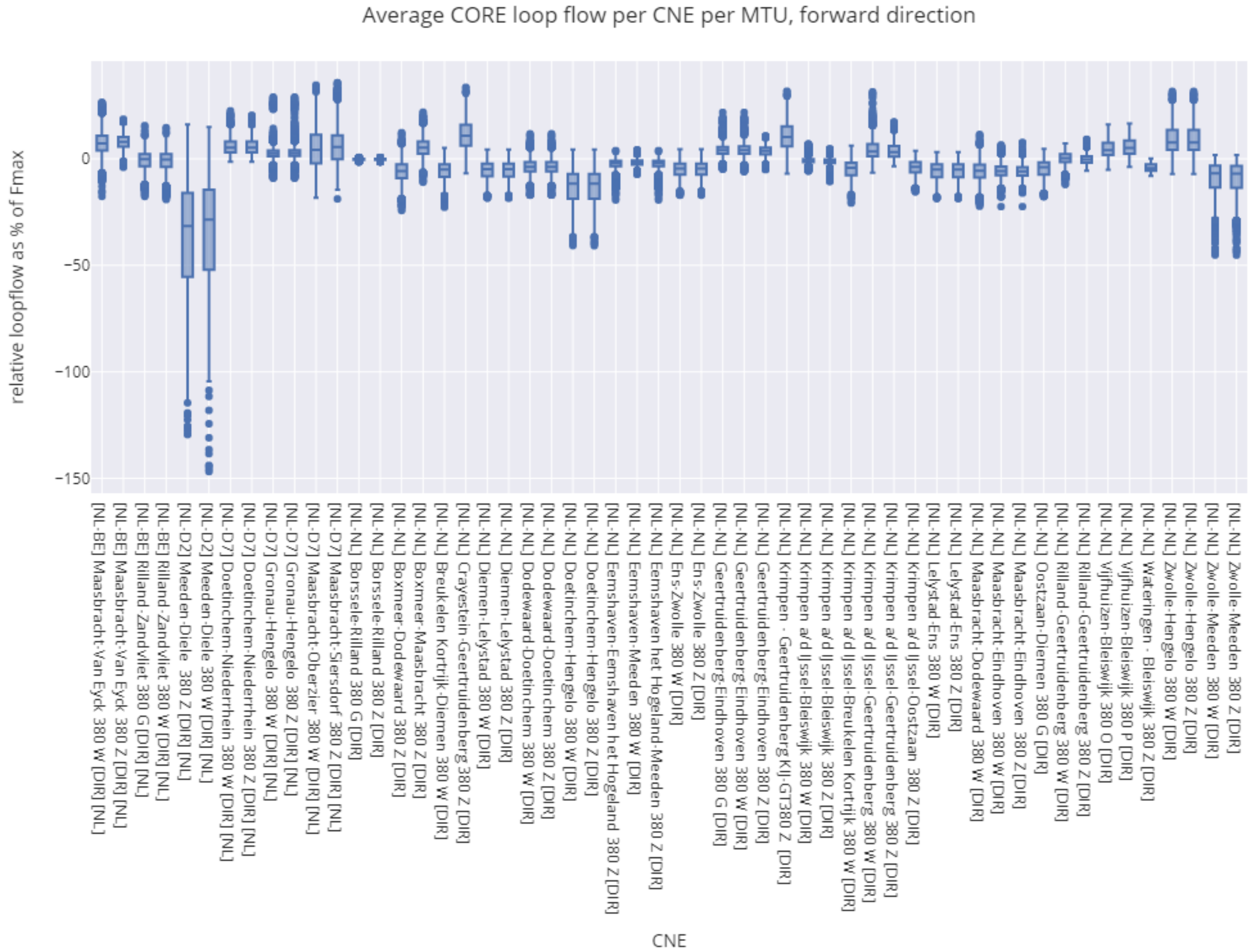

Figure 24: Average relative loop flow per Dutch CNE per MTU. Positive values indicate loop flows in the forward direction, negative values indicate loop flows in the opposite direction. CORE CCR, considering third countries. Period Jun 9-Dec 31, 2022.

In particular, the very high level of loop flows on the cross-border CNE Meeden-Diele 380 W and Z really stand out from the rest. These CNEs stand out because they have a relatively low amount of Fmax (1053 MW), and are in a place in the grid where they carry a relatively high amount of loop flows which typically originate from wind in Northern Germany and flow to loads in southern Germany via the Dutch transmission network. The variability of wind can also be seen in the variability of the loop flow, as the bar is also relatively long for these CNEs. In operations, TenneT deals with these loop flows via the operation of Phase Shifting Transformers (PSTs) which are installed at the substation of Meeden and which can reduce the amount of loop flows. But even with the operation of PSTs, a significant amount of loop flows remain in the system, which is why the loop flow derogation is crucial for TenneT to be able to respect the minimum capacity margins and maintain operational security

When looking at the other network elements, it can generally be observed that loop flows enter the Netherlands from Germany at the substation of Meeden and then flow to Zwolle. At Zwolle, the loop flows separate in two paths:

- A path southwards via the eastern part of the TenneT 380 kV transmission network via Zwolle → Hengelo → Doetinchem → Dodewaard → Maasbracht. A significant share of the loop flows on this path exit the Netherlands again via the interconnectors Doetinchem-Niederrhein or Maasbracht-Siersdorf / Maasbracht-Oberzier, but there is also a part that flows to Belgium via Maasbracht – van Eyck.
- The second path is via the western part of the TenneT 380 kV transmission network via the path Zwolle → Ens → Lelystad → Diemen and then southwards to exit the Netherlands via the interconnector Rilland – Zandvliet towards Belgium and eventually back to Germany.

5.3 HVDC Bidding Zone borders

5.3.1 Result of the MACZT compliance assessment for the HVDC bidding zone borders

For the HVDC bidding zone borders, the process for evaluation as set out in section 4.3 has been followed. In Figure 25 the percentage of time when the relative MACZT is above 70%, is given for the HVDC bidding zone borders. The figure shows that in 2022 for 100% of the time that the HVDC cables were in operation, for both HVDC bidding zone borders, TenneT offered a MACZT equal or larger than the required minimum level of 70%.

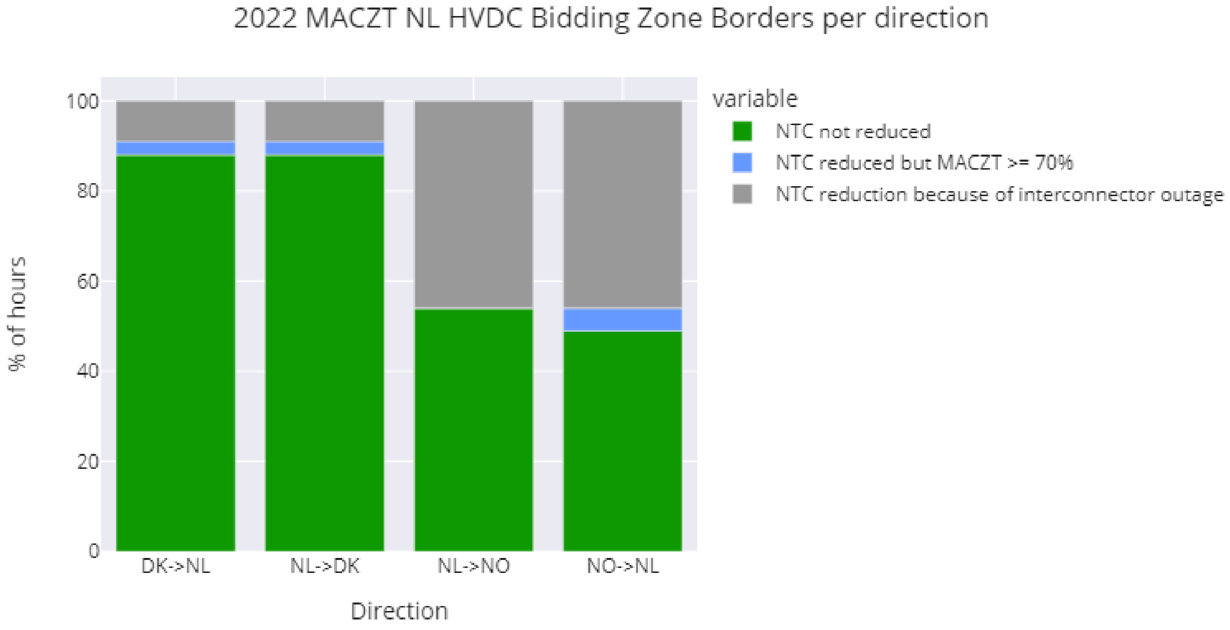

Figure 25: Percentage of the time when the relative MACZT is above 70% on the NL HVDC borders, per direction, for the full year 2022

Within 2022 TenneT has still at times reduced the NTC capacity on HVDC bidding zone borders during significant and longer duration outage situations on critical network elements in order to prevent violation of operational security limits in the Dutch transmission network. All of the reductions that took place in 2022 respected the 70% MACZT target. A more in depth overview on the reductions is given in the next subsection.

5.3.2 Overview of reductions applied on the HVDC bidding zone borders

A detailed overview of the available NTC per bidding zone border as offered throughout the year is given in Figure 26 and Figure 27. The majority of the reductions on Cobra and NorNed took place in January and February. All of these reductions respected the minimum MACZT of 70%.

For the period of May until October the NorNed cable was in outage due to the detection of defects during an inspection. The found defects do not allow the interconnector to operate at its original F_{max} of 700 MW. TenneT and Stattnet decided to lower the maximum allowable loading to 613 MW to increase the probability of sustainable operation of the cable, after which the interconnector was put back into operation on October 17, 2022. TenneT considers the lowered maximum allowable loading to be equal to a 100% MACZT score.

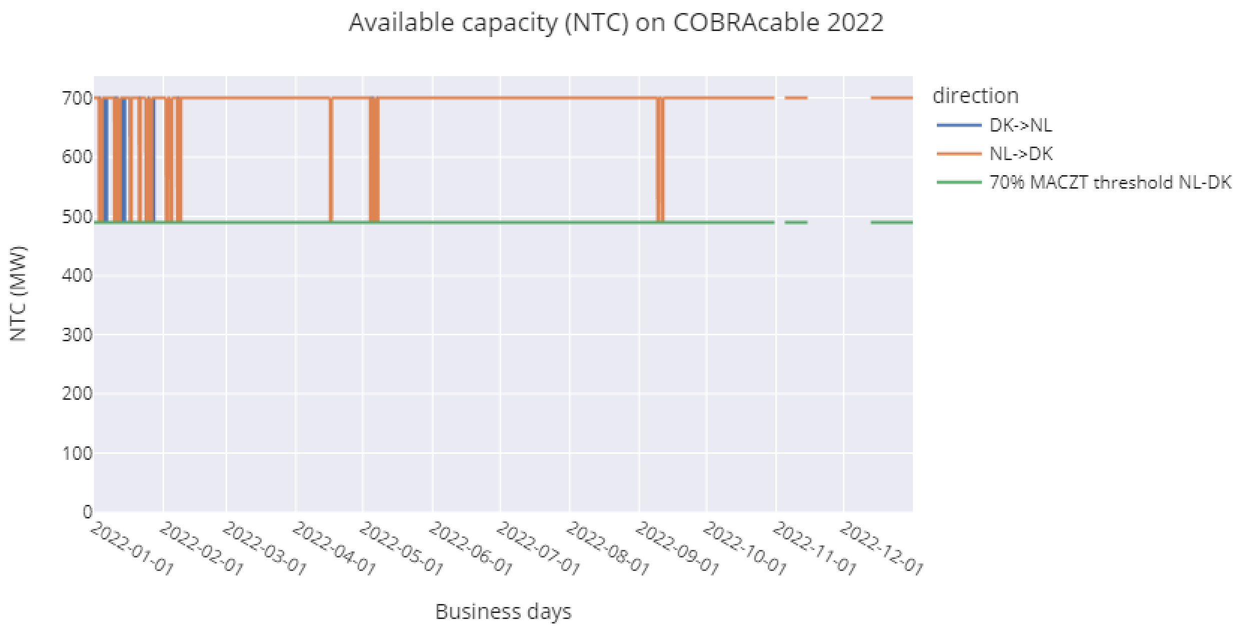

Figure 26: Available capacity (NTC) on the NL-DK1 bidding zone border. Outages are filtered out of the dataset. Period Jan-Dec 2022

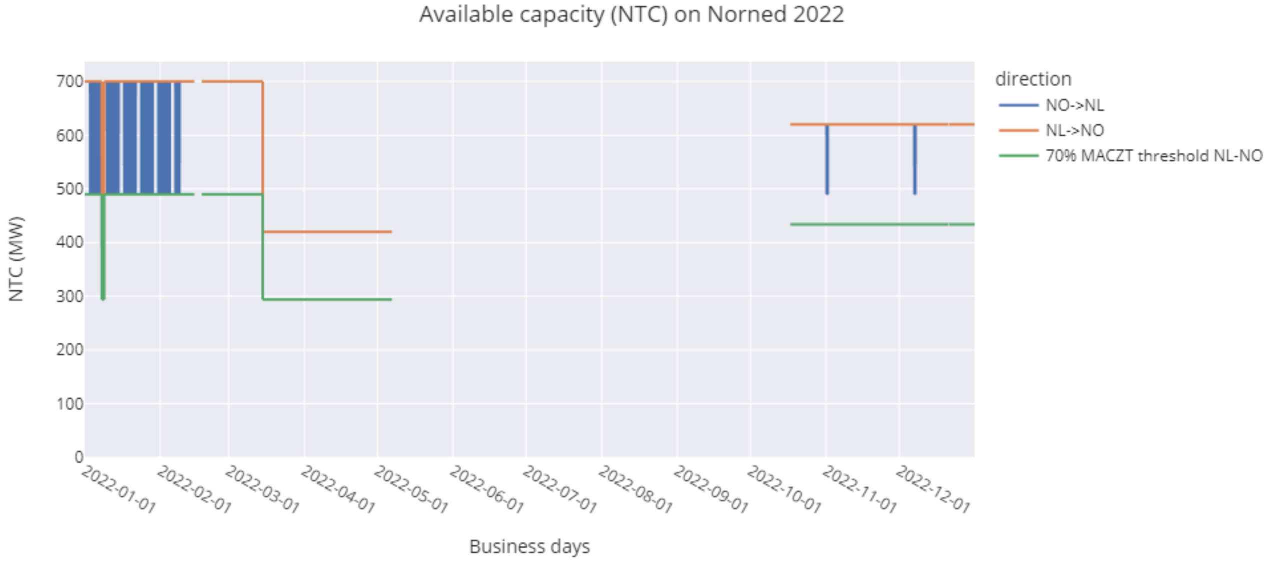

Figure 27: Available capacity (NTC) on the NL-NO2 bidding zone border. The values as included in the figure are including a correction for the application of implicit loss handling. Outages are filtered out of the dataset. Period Jan-Dec 2022

6. Conclusions

Based on the results as set out in chapter 5, TenneT has arrived at the following conclusions for the relevant capacity calculation areas/regions:

For the Central **West Europe (CWE) area:**

- For **99%** of the time, **TenneT has provided capacity margins at or above the required minimum levels** on all its network elements.
- For 1**%** of the time, **TenneT has offered insufficient capacity margins**. The main underlying reason is erroneous human intervention on two business days and local tool configuration impacting some MTUs.

For the **CORE region**:

- For **100%** of the time, **TenneT has provided capacity margins at or above the required minimum levels** on all its network elements

For the **HVDC bidding zone borders (NL-DK1, NL-NO2)**:

- For **100%** of the time**, TenneT has provided capacity margins at or above the required minimum level** of 70% for the NL-DK1 and NL-NO2 bidding zone border.

TenneT expects that – with the applicable derogation for loopflows – for 2023 a continuation of the 2022 capacity margins is realistic. Also, after the go-live of Core flow-based day-ahead capacity calculation the need for a separate local tooling for the calculation of capacity from outside the coordination area became obsolete, as this is calculated as an integral part of the central CORE tooling. This increased the robustness of the capacity calculation process.

7. Annex 1: List of Abbreviations

Acronym	Meaning
AC	Alternating Current
ACER	Agency for the Cooperation of Energy Regulators
ACM	the Dutch national regulatory Authority for Consumers and Markets
BD	Business Day, meaning the day for which the (capacity calculation) results are applicable
BE	(the Bidding Zone of) Belgium
CACM	Capacity Allocation and Congestion Management (electricity)
CCA	Capacity calculation area
CCM	Capacity calculation methodology
CCR	Capacity calculation region
CEP	Clean Energy (for all Europeans) Package
CNE	Critical Network Element
CNEC	Critical Network Element with contingencies
cNTC	Coordinated Net Transfer Capacity
CORE DA CCM	The day-ahead flow-based capacity calculation methodology for the Core Capacity Calculation Region.
CORE FB DACC	The day-ahead capacity calculation process taking place in the CORE region
CWE	Central West Europe (electricity region)
CWE FB DACC	The day-ahead capacity calculation process taking place in the Central West Europe electricity area
CWE FB MC	The day-ahead flow-based market coupling taking place in the Central West Europe electricity region
D2CF	Two Day ahead Congestion Forecast
DACF	Day-Ahead Congestion Forecast
DC	Direct Current
DE	(the Bidding Zone of) Germany
DK1	Bidding Zone DK1 in Denmark
EC	European Commission
EEA	European Economic Area
ENTSO-E	European Network of Transmission System Operators for Electricity
EU	European Union
FB	Flow-based
FLD	Full Line Decomposition (methodology)
Fmax	Maximum admissible flow on critical network elements, respecting operational security limits
FRM	Flow Reliability margin applied on a CNEC in flow-based capacity calculation
GB	(the Bidding Zone of) Great Britain

GSK	Generation Shift Key
HVDC	High-voltage direct current
LF	Loop Flow
LTA	Long-Term Allocated Capacities
MACZT	Margin available for cross-zonal trade
$MACZT_{margin}$	The amount of MACZT made available above or below the minimum level of MACZT
$MACZT_{min}$	Minimum level of MACZT
$MACZT_{target}$	Target minimum level of MACZT
MCCC	Margin from coordinated capacity calculation
$MCCC_{min}$	Minimum level of MCCC
minRAM	Minimum Remaining Available Margin
MNCC	Margin from non-coordinated capacity calculation
MS	Member State
MTU	Market Time Unit. In this report, 1 hour given that the MTU for the day-ahead market in 2020 was 1 hour.
NL	(the Bidding Zone of) The Netherlands.
NO2	Bidding Zone NO2 in Norway
NTC	Net Transfer Capacity
PST	Phase shifting transformer
PTDF	Power Transfer Distribution Factor
RAM	Remaining Available Margin
TSO	Transmission System Operator

8. Annex 2: Linear Trajectory

Table 3: Overview of $MACZT_{target}$ values per Dutch CNE of the linear trajectory as set by the Dutch Action plan. See Table 4 of Annex 3 for full names of the abbreviations, used in the CNE name.

CNE	type	2020	2021	2022	2023	2024	2025	2026
BKK-DIM380	internal	20%	28%	37%	45%	53%	62%	70%
BMR-DOD380	internal	20%	28%	37%	45%	53%	62%	70%
BSL-GT380	internal	25%	33%	40%	48%	55%	63%	70%
BSL-RLL380	internal	20%	28%	37%	45%	53%	62%	70%
CST-KIJ380	internal	20%	28%	37%	45%	53%	62%	70%
DIM-LLS380	internal	20%	28%	37%	45%	53%	62%	70%
DOD-DTC380	internal	20%	28%	37%	45%	53%	62%	70%
DTC-HGL380	internal	20%	28%	37%	45%	53%	62%	70%
DTC-NDR380	cross-border	58%	60%	62%	64%	66%	68%	70%
EEM-EOS380	internal	20%	28%	37%	45%	53%	62%	70%
EEM-EHH380 / EEM-MEE380 / EEH-MEE380 / EHH-MEE380[19]	internal	20%	28%	37%	45%	53%	62%	70%
ENS-ZL380	internal	21%	30%	38%	46%	54%	62%	70%
GNA-HGL380	cross-border	39%	44%	49%	54%	60%	65%	70%
GT-EHV380	internal	29%	36%	43%	50%	56%	63%	70%
KIJ-BKK380	internal	20%	28%	37%	45%	53%	62%	70%
KIJ-BWK380	internal	20%	28%	37%	45%	53%	62%	70%
KIJ-GT380	internal	20%	28%	37%	45%	53%	62%	70%
KIJ-OZN380	internal	20%	28%	37%	45%	53%	62%	70%
LLS-ENS380	internal	20%	28%	37%	45%	53%	62%	70%
MBT-BMR380	internal	20%	28%	37%	45%	53%	62%	70%
MBT-DOD380	internal	70%	70%	70%	70%	70%	70%	70%
MBT-EHV380	internal	30%	37%	44%	50%	57%	63%	70%
MBT-OBZ380	cross-border	30%	36%	43%	50%	57%	63%	70%
MBT-SDF380	cross-border	41%	46%	50%	55%	60%	65%	70%
MBT-VYK380	cross-border	29%	36%	43%	50%	56%	63%	70%
MEE-DIL380	cross-border	20%	28%	37%	45%	53%	62%	70%
OZN-DIM380	internal	20%	28%	37%	45%	53%	62%	70%
RLL-GT380	internal	29%	36%	43%	50%	56%	63%	70%
RLL-ZVL380	cross-border	20%	28%	37%	45%	53%	62%	70%
VHZ-BWK380	internal	20%	28%	37%	45%	53%	62%	70%
ZL-HGL380	internal	20%	28%	37%	45%	53%	62%	70%
ZL-MEE380	internal	20%	28%	37%	45%	53%	62%	70%

[19] In December 2020, the CNE of EEM-MEE380 was split into 2 when a transformer was looped into the high voltage line at substation Eemshaven het Hogeland. This substation was initially abbreviated as EEH, and per 26/12/20 as EHH.

9. Annex 3: Full names of abbreviations used in network element names

A network element is depicted by its name from a certain substation to another substation. In general, the following notation for CNEs is used throughout this report:

[substation A] – [substation B] [Voltage level] [Circuit symbol]

Where:

- Typically, three letter abbreviations for the substation names are used. In Table 4, the full names for the substations (nodes) belonging to the abbreviations is given.
- The voltage level is in kV, and in this report only 380 kV network elements are included
- A symbol is used to identify individual circuits, where:
  - 'W' stands for 'Wit' (white)
  - 'Z' stands for 'Zwart' (black)
  - 'P' stands for 'Paars' (purple)
  - 'O' stands for 'Oranje' (orange)
  - 'G' or 'GS' stands for 'Grijs' (grey)

Within the report, also the term 'direction' is used to denote whether flows / capacity is from substation A to substation B, or vice versa

- In case of 'forward direction', the (capacity for) flows in the direction from 'substation A' to 'substation B' are meant.
- In case of 'opposite direction', the (capacity for) flows in the direction from 'substation B' to 'substation A' are meant.

Table 4: Full names for the abbreviations of substations as used in the network element names

Abbreviation	Full name	Remarks
BKK	Breukelen Kortrijk	
BMR	Boxmeer	
BSL	Borssele	
BWK	Bleiswijk	
CST	Crayestein	
DIL	Diele	German substation
DIM	Diemen	
DOD	Dodewaard	
DTC	Doetinchem	
EHH	Eemshaven Het Hogeland	
EHV	Eindhoven	
ENS	Ens	
GNA	Gronau	German substation
GT	Geertruidenberg	
HGL	Hengelo	
KIJ	Krimpen aan den IJssel	

LLS	Lelystad	
MBT	Maasbracht	
MEE	Meeden	
NDR	Niederrhein	German substation
OBZ	Oberzier	German substation
OZN	Oostzaan	
RLL	Rilland	
SDF	Siersdorf	German substation
VHZ	Vijfhuizen	
VYK	Van Eyck	Belgian substation
ZL	Zwolle	
ZVL	Zandvliet	Belgian substation

10. Annex 4: Source data

This annex clarifies what data is used to perform the MACZT assessment for the Netherlands as included in this report.

10.1 CWE Capacity Calculation Area

10.1.1 Source data

In Table 5 an overview is given what data is used to assess the compliance for the CWE capacity Calculation Area. This data is also publicly available via the JAO Utility Tool.[20] A description of the source files is given in Table 6.

Table 5: Source data used for assessing compliance of the CWE Capacity Calculation area

Data	Name under which this is published in JAO Utility Tool	Source file
CNE name and EIC code	CriticalBranchName	F206 files
Contingency name and EIC code	OutageName	F109+F206 files
Fmax	Fmax	F206 files
$MACZT_{target}^{CNEC}$	MACZTmin[21]	F206 files
$MCCC^{CNEC}$	RemainingAvailableMargin (MW)	F206 files
$MNCC^{CNEC}$	MNCC	F206 files Recalculations
$MCCC_{min}^{CNEC}$	MinRAM Factor	F206 files Recalculations
LF_{calc}^{CNEC}	LFcalc inside minramjustification	F206 files Recalculations
LF_{accept}^{CNEC}	LFaccept inside minramjustification	F206 files
Data on minRAM exclusions	JAO TSO message board	F204 files

Table 6: Explanation of dataflow files from CWE FB DA CC

Dataflow file	Source description
F104	CNEC definition file (input to CWE flow-based capacity calculation)
F109	D2CF grid models in UCTE (input to CWE FB DA CC)
F204	Flow-based domain before LTA inclusion (output of CWE FB DA CC)
F206	Final flow-based domain (output of CWE FB DA CC)

[20] http://utilitytool.jao.eu/Util
[21] Until BD 05-02-2021, this was reported in the JAO utility tool under the name of MACZTtarget. This was adjusted to bring it in line with the terminology used in other places, including this monitoring report.

10.1.2 Missing data / time stamps

For the CWE CCA, in 2022 the TSO Common System failed to produce full results for one MTU. This was caused because during those MTUs in operation, either:

- Default flow-based parameters have been applied when data for a full Business Day or several MTUs could not be calculated; or
- 'Spanning' was applied to interpolate flow-based results when data for some MTUs was missing

In both cases, not all data from the TSO Common System that is necessary as input for the local tooling was available. And as result, not all the necessary data from the local tooling to assess compliance could be determined. Therefore, these MTUs were excluded from the assessment performed in this report. The MTUs for which the local tooling failed and the cause why, are given in Table 7.

Table 7: Business days in CWE CCA excluded from the NL MACZT assessment

MTU (UTC)	Reason
6-3-2022 08:00	Spanning

10.1.3 Processing of CNECs with LTA Inclusion

In this assessment, for assessing the compliance of TenneT for the CWE CCA the dataset of CWE FB DA CC after the application of LTA inclusion has been taken.

LTA corners and minRAM exclusion CNECs are considered special cases, and have a different naming in the publication on JAO. For this assessment, their names have been converted to "normal" CNECs, in order to be able to map them to these CNECs for the assessments as performed in chapter 5. All other data for these 'special' CNECs are handled in the same way as data for "normal" CNECs.

10.2 CORE Capacity Calculation Region

10.2.1 Source data

In overview is given what data is used to assess the compliance for the CORE CCR. This data is also publicly available via the JAO Publication Tool[22].

Table 8: Source data used for assessing compliance of the CORE Capacity Calculation region

Data	Name under which this is published in JAO Publication Tool	Source file
CNE name and EIC code	CriticalBranchName	F316
Contingency name and EIC code	OutageName	F142
Fmax	Fmax	F316
Minimum MACZT		F316
$MCCC^{CNEC}$	RemainingAvailableMargin (MW)	F316
$MNCC^{CNEC}$	Fuaf	F316
LF_{calc}^{CNEC}	LFcalc inside minramjustification	Internal minRAM application
LF_{accept}^{CNEC}	LFaccept inside minramjustification	
PTDFs	PTDFs	F316
Shadow prices		F249
Data on IVA application		

10.2.2 Missing data and timestamps

For the CORE CCR, in 2022 the TSO Common System failed to produce full results for in total 12 MTUs (0.14% of all MTUs in CORE CCR in 2022). This was caused because during those MTUs in operation, either:

- Default flow-based parameters have been applied when data for a full Business Day or several MTUs could not be calculated; or
- ‘Spanning’ was applied to interpolate flow-based results when data for some MTUs was missing.

In both cases, not all data from the Core CC tool that is necessary as input for the local tooling was available. And as result, not all the necessary data from the local tooling to assess compliance could be determined. Therefore, these MTUs (Table 9) were excluded from the assessment performed in this report. Th

Table 9: Business days in CORE CCR excluded from the NL MACZT assessment

MTU (UTC)	Reason
22-7-2022 17:00	Spanning

[22] https://publicationtool.jao.eu/core/

22-7-2022 18:00	Spanning
24-8-2022 16:00	Spanning
6-11-2022 23:00	DFP
7-11-2022 00:00	DFP
7-11-2022 01:00	DFP
7-11-2022 02:00	DFP
7-11-2022 03:00	DFP
7-11-2022 04:00	DFP
7-11-2022 05:00	DFP
22-12-2022 16:00	Spanning
25-12-2022 22:00	DFP

10.2.3 Other Data corrections

In order to on time have the 2023 $MACZT_{target}$ values from the linear trajectory of the action plan in operation, the $MACZT_{target}$ values were already adjusted to the 2023 values per Business Day 16/12/2022.[23] For the assessment in this report, the data has been adapted to take into account the applicable 2022 $MACZT_{target}$ values.

10.3 HVDC bidding zone borders

Table 10 provides an overview what data is used to assess the compliance of the HVDC bidding zone borders NL-DK1 and NL-NO2:

Table 10: Source data used for assessing compliance of the HVDC bidding zone borders

Data	Source description
Hourly NTC values	Export of historical NTC data for the bidding zone borders from the PCR Simulation Facility Tool. This data is also available as 'Implicit Allocations – Day-Ahead' on the ENTSO-E Transparency Platform[24]
Cause for reductions	In order to determine what was the cause for reductions, information was gathered from internal systems as well as information published in operational messages which party triggered a reduction and for what cause.
Hourly Fmax	This parameter was manually determined, based on the hourly NTC values and explanations published for reductions via TenneT Operational Messages[25] and unavailability published on ENTSO-E Transparency Platform[26] The following principle was followed for reconstructing the Fmax: • Fmax was set at 0, if NTC was 0, as reductions of NTC capacity to 0 MW

[23] https://www.jao.eu/news/implementation-linear-trajectory-cep-action-plan
[24] https://transparency.entsoe.eu/transmission-domain/r2/implicitAllocationsDayAhead/show
[25] https://www.tennet.org/english/operational_management/Operationalreports.aspx
[26] https://transparency.entsoe.eu/outage-domain/r2/unavailabilityInTransmissionGrid/show

	typically only takes place in case the HVDC link and/or their convertor stations are in outage. • For other time stamps with NTC >0, the Fmax was set at the maximum technical capacity of the HVDC interconnectors (i.e. 700 MW for the COBRAcable and 700 MW for NorNed until March 14 and 613 MW onwards), unless there was a specific technical reason why only part of the physical capacity was available on the HVDC interconnector.

11. Annex 5: Calculation of MNCC and loop flows

11.1 MNCC in CWE

As part of the calculation of $MCCC_{min}^{CNEC}$, also $MNCC^{CNEC}$needs to be calculated.

Article 4(5) of the applicable derogation stipulates that TenneT calculates the MNCC for CWE FB DA CC following the method as defined in Article 17(4) of the Core DA CCM. Article 17(4) of the Core DA CCM prescribes that the flow assumed to result from commercial exchanges outside the Core CCR is calculated for each CNEC by formula:

$$(8)\ \vec{F}_{uaf} = \vec{F}_{0,Core} - \vec{F}_{0,all}$$

Where

$\vec{F}_{uaf}$	flow per CNEC assumed to result from commercial exchanges outside Core CCR
$\vec{F}_{0,Core}$	flow per CNEC in the situation without commercial exchanges within the Core CCR
$\vec{F}_{0,all}$	flow per CNEC in a situation without any commercial exchange between bidding zones within Continental Europe and between bidding zones within Continental Europe and bidding zones of other synchronous areas

Within the context of this report and the application of this concept for the CWE CCR:

- $\vec{F}_{uaf}$ is equal to $MNCC^{CNEC}$
- The applicable capacity calculation region is both CWE and CORE.

Therefore, in the local tooling for CWE FB CC, formula (8) is adjusted as follows to determine MNCC:

$$(9)\qquad MNCC^{CNEC} = \vec{F}_{0,CWE} - \vec{F}_{0,all}$$

For the calculation of $\vec{F}_{0,CWE}$, CWE Net Positions are determined by summing all exchanges on CWE borders in the RefProg (programme of expected exchanges per border on D-2). The CWE bidding zones are then shifted by these CWE Net Positions in the opposite direction (e.g. if Germany has a CWE net position of +8000 MW it is shifted by -8000 MW), according to their GSKs as submitted for use in the operational CWE FB DA CC process.

For the calculation of $\vec{F}_{0,all}$, Net Positions of all bidding zones in Continental Europe are taken from the CWE 'refprog' file which contains data of expected scheduled exchanges and net positions.[27] Zones are then shifted by these Net Positions in the opposite direction:

- CWE bidding zones according to their GSKs as submitted for use in the operational CWE FB DA CC process;
- non-CWE zones according to a "country GSK" (where each generator participates proportionally to its share in the country's swing capacity, according to the original dispatch values in the D2CF model).

11.2 Loop Flows

The loop flow LF_{calc}^{CNEC} on each CNEC included in CWE FB DA CC is calculated by applying the Full Line Decomposition (FLD) methodology[28] on the $\vec{F}_{0,CWE}$ network model. The FLD methodology applies the following calculation steps:

- The $\vec{F}_{0,CWE}$ load flow serves as input.
- A nodal power exchange matrix for the full network is determined based on flow-tracing.
- Node-to-node PTDFs are calculated for all CNECs.
- The nodal power exchange matrix multiplied with the node-to-node PTDFs provides the flow over each CNEC as result of each nodal exchange.
- The nodal exchanges within the same zone, but different than the zone where the CNEC is located, result in loop flow over the considered CNEC.
- Aggregating the nodal results define the total loop flow over each CNEC.
- For each CNEC, LF_{calc}^{CNEC} is equal to the loop flow computed following the above, divided by the Fmax of that CNEC.

NB: the FLD methodology is developed to calculate all ENTSO-E flow types (internal flows, loop flows, import/export flows and transit flows) as well as flows caused by PSTs (PST cycle flow) and HVDC connections (HVDC cycle flow), but in this particular application of FLD only loop flow is of relevance.

11.3 Specification of third countries

The following countries are considered as third countries:

RU - BY - UA - MD - RS - BA - ME - KS - AL - TR - CH - MK - UK

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[27] In 2020, the net positions were calculated by TenneT individually by running a DC loadflow computation on the D-2 Congestion Forecast (D2CF) grid model. However, this led in 2021 to erroneous results for MNCC (see annex 6) and therefore in the course of 2021 the calculation approach was changed. The reason that TenneT did not yet apply this approach is because early 2020 when TenneT developed the local tooling, net positions of non-CWE countries were not yet available to TenneT in the CWE refprog file and therefore had to be calculated by TenneT individually.

[28] A detailed explanation of the FLD method is published in "CIGRE Science & Engineering, issue 9 (CSE 009)"