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2020 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 of the Council of 5 June 2019 on the internal market for electricity (recast)

Table of Contents

1. Executive summary

With the establishment of the Electricity Regulation - part of the Clean Energy package - several new provisions related to the minimum levels of capacity margins that TSOs need to make available for cross-zonal trade entered into force. 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 and a derogation were adopted as transitory measures to reach gradually the minimum capacity margin of 70% on the critical network elements included in CWE flow-based day-ahead capacity calculation. As a consequence, TenneT is obliged to assess on an annual basis whether the available cross-border capacity has reached the required minimum levels. This report provides the results for the first assessment on the transmission capacity made available for cross-zonal trade in the year 2020. 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 and on which the target capacity margin of 70% already applies.

Because of the interplay between action plan, derogation and CWE flow-based capacity calculation methodology, 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 generally followed the approach and principles as set out by ACER and applied in ACER's EU MACZT monitoring report. However, in comparison this report provides much 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 clarity and transparency on its performance to its stakeholders.

The outcome of this assessment is that for the **Central West Europe (CWE) region**:

- For **84%** of the time, **TenneT has provided capacity margins at or above the required minimum levels** on all its network elements.
- For **15%** of the time, TenneT has not provided capacity at or above the required minimum levels for a few network elements. However, **the capacity margins provided on the least performing network** element **were very close to the required minimum levels** as the deficit was only less than 1% below its required minimum level.
- For the **remaining 1%** of the time, TenneT has offered **insufficient capacity margins**. However, the effect on cross-zonal trade has been almost negligible as only for a single hour cross-zonal trade has been limited.

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

- For **100%** of the time for the **NL→DK1** (COBRAcable) and **NL→NO2** (NorNed) bidding zone border, TenneT has provided capacity margins at or above the required minimum level of 70%.
- For **81%** of the time for the **DK1→NL** and **86%** of the time for the **NO2→NL** bidding zone border, TenneT has provided capacity margins at or above the required minimum level of 70%. For the remaining period of time, insufficient capacity margins were provided due to reductions by TenneT.
- The **reductions** on NorNed and COBRAcable were for the vast majority of the time related to the fact that throughout 2020 there have been **several planned long duration outages** in the north of the Netherlands, related to investments of TenneT following our grid investment plan. Also, TenneT faced a **long duration unplanned outage** on a critical network element in the north of the Netherlands
- As a **consequence** of these outages **insufficient capacity** was available on the remaining internal Dutch network elements **to accommodate the full extent of cross-zonal and internal flows**. In order to respect operational security limits, TenneT had to take measures including the reduction of cross-zonal capacity on the interconnectors.
- TenneT regards these reductions as an **unavoidable consequence in the process of upgrading its grid** to be able to make more cross-zonal capacity available in the future.

There are still various open points on how to exactly assess compliance with the minimum levels of capacity that need to be made available. Future clarifications and adaptations to the monitoring methodology might potentially require an adjustment of the levels of compliance for 2020 as stated in this report.

2. 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 2020, and whether this was in accordance with the various provisions on minimum capacities that were applicable to TenneT in the year 2020.

The outline of the report is as follows:

- First in section 3, TenneT sets out the various obligations on minimum capacities that were applicable for TenneT in the year 2020
- Then in section 4, TenneT sets out how those various obligations have been implemented in its daily operations
- Section 5 describes the methodology applied behind the assessment as performed for this report
- Section 6 contains the results from the assessment
- Section 7 provides the main conclusions resulting from the assessment
- Section 8 contains a discussion on the results, several elements to consider for future monitoring reports and a brief outlook for 2021.

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

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

In the year 2020, 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 CWE Flow-Based Market Coupling Approval Documents

3.1 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 the Electricity 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[2] 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 Flow-Based Day-Ahead Capacity Calculation (CWE FB DA CC).

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 (CCA). Details on how the linear trajectory values have been determined can be found in the action plan itself[2]. The applicable values per Dutch CNE are included in annex 2.

Table 1: Overview of the $MACZT_{target}$ values from the linear trajectory per CCA for the year 2020

Relevant Capacity Calculation Area	Bidding Zone Borders and/or CNECs	Point of linear trajectory for target minimum capacity ($MACZT_{target}$) in relative MACZT [%][3]
CWE	NL-BE; NL-DE; and Dutch CNECs included in CWE FB DA CC	Minimum: 20% Maximum: 70% Mean: 26% Median: 20%
DK-NL (NL side)	NL-DK1	70% (as no linear trajectory established)
NL-NO (NL side)	NL-NO2	70% (as no linear trajectory established)
GB-NL (NL side)[4]	NL-GB	70% (as no linear trajectory established)

[2] The action plan has been published by the Ministry of Economic Affairs and Climate Policy on its website.
[3] Relative MACZT means the percentage of the MACZT relative to the maximum admissible flow (Fmax)
[4] Primary responsibility for compliance on the GB-NL bidding zone border with respect to minimum capacity to be made available for cross-zonal trade lies with BritNed Development Ltd and not with TenneT TSO B.V.,

3.2 Derogation

In October 2019, TenneT applied for two derogations in accordance with article 16(9) of the Electricity Regulation. In anticipation of a decision of the Ministry of Economic Affairs and Climate Policy of the Netherlands to establish an action plan, TenneT retracted one of the two applications for derogation on 18 December 2020. The other application for a derogation was approved by the Dutch national regulatory Authority for Consumers and Markets (hereinafter "ACM") on 20 December 2020, for the duration of 1 year from 1 January 2020 up to and including 31 December 2020.[5] 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 2020

Reason for derogation	Remedy	Duration
Loop flows on Dutch CNECs that cannot be contained to an acceptable level	Introduction of a methodology to reduce the $MACZT_{target}$ values in case loop flows exceed a certain 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, TenneT is allowed to reduce capacity to a level that respects operational security limits.	1 year
Development of new processes and tools	A 3 month transition period to acquire the required experience on the processes and to complete the implementation and testing of the tools. This period is required to ensure the quality and stability of the new processes and results. During the transition period: • A **parallel run** is set up for the new CWE FB DA CC process for which the tools are tested. • TenneT continues to apply the applicable methodology and practices in the CWE region to the operational day-ahead capacity calculation process in CWE. (see also section 3.3)	3 months

In the following section, 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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but the CCA is included in the table for the sake of completeness and transparency.

[5] The approval of the derogation including the derogation itself is available at: https://www.acm.nl/nl/publicaties/verlening-derogatie-tennet-artikel-16-negende-lid-van-verordening-2019-943

3.2.1 Derogation for Loop Flows

Article 4 of the derogation[5] contains the following formula[6] to determine the minimum capacity margin that TenneT needs to make available for cross-zonal trade ($MACZT_{min}$) on a CNEC in CWE 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:
  - LF_{accept}^{CNEC} is 30%-FRM^{CNEC} for cross-zonal CNEs
  - 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.

3.3 CWE Flow-Based Day-Ahead Capacity Calculation

Since Business Day 26 April 2018, within CWE FB DA CC 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 DA CC, 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[7], the RAM made available in CWE FB DA CC 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[8] 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.

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

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

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[6] The formula as included in this assessment report is an adapted version of the formula as included in the applicable derogation. The parameter names are adjusted in order clarify the relationship between the linear trajectory of the action plan and the loop flow derogation, and to bring it in line with the terminology as introduced by ACER in its recommendation 01-2019.

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

[8] 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

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

4.1 Parallel run

On the basis of the approved derogation, in the period January to March 2020, a transition period applied where TenneT continued the status quo within the CWE region.

In this period, only the obligation to make a minimum RAM ($MCCC_{min}$) of 20% (as described in formula (2)) was applicable. The implementation of this 20% was arranged via its implementation in the CWE common system, by which it applied to all CWE TSOs. The TSO common system only allowed for the provision of capacities lower than 20%, in case of so-called 'minRAM-exclusions' , which are reported by CWE TSOs via the JAO Message Board[9]. During those hours, the $MCCC_{min}$ is set to 0% instead of 20%, and in those MTUs the obligation from formula (2) is thus not by definition respected.

During this period, TenneT performed a parallel run for the new day-ahead capacity calculation process in CWE. After a period of stabilization of the new process and tools, resolving detected errors and issues and extensive verification of the outcomes of the tools, finally the results were considered of sufficient quality and representative for the situation per 1/4/2020.

Although the derogation did not require TenneT to publish the results of the parallel run, TenneT has decided to do so in order to provide transparency to market parties and other stakeholders on the effects of the Action plan and derogation for the Netherlands. The publication of the parallel run results has been started per Business Day (BD) 22/02/2020, and has continued until BD 31/03/2020. The results of the parallel run from BD 22/02/2020 until 31/03/2020 have been published on a dedicated page of the JAO website.[10]

4.2 Implementation of minimum capacities in CWE FB

As set out in chapter, 3, 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 DA CC.

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 (MCCC), as a margin from non-coordinated capacity calculation *outside* the capacity calculation areas (MNCC):

(3) $$MACZT = MCCC + MNCC$$

In this context, for the capacity margin made available on Dutch CNEs within CWE FB DA CC (the RAM) 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.

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[9] See: https://www.jao.eu/news/messageboard/overview, 'TSO Messages'
[10] See: https://www.jao.eu/support/resourcecenter/overview?parameters=%7B%22IsCEP%22%3A%22True%22%7D

Given the distinction between MCCC and MNCC, the $MACZT_{min}$ of formula (1) need to be translated to a minimum RAM ($MCCC_{min}$) to be used in CWE FB DA CC. 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) and (2) in a single calculation, this leads to the following formula of the minimum RAM (MCCC) that needs to be made available in CWE FB DA CC:

$$(4)\ MCCC_{min}^{CNEC} = max\{20;\ MACZT_{target}^{CNEC} - MNCC^{CNEC} - max\left(0; LF_{calc}^{CNEC} - LF_{accept}^{CNEC}\right)$$

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, after the transition period granted via the derogation ended, this formula is implemented in the daily operation within CWE FB MC. In case the RAM (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 $MCCC_{min}^{CNEC}$.

There is not yet consensus whether or not third country flows are to be included within MNCC and MACZT. TenneT has included flows with third countries in its calculation of MNCC and loop flows. Further details about the calculation of MNCC and loop flows, can be found in annex 5.

4.3 Implementation of minimum capacities on HVDC bidding zone borders

In line with ACER recommendation 01-2019[7], 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 section 3, 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, TenneT is allowed to reduce capacity available for cross-zonal trade to a level that respects operational security limits. This is also confirmed by article 5 of the derogation applicable for 2020.

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

1. If during the week-ahead 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
   b. the application of only 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 fully exhaust redispatching potential in the day-ahead and intraday timeframe, such that no remedial actions would remain available to solve other potential 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 D-1 for the respective region (via negotiated restriction agreements with some generators[11]) 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, 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.[12] If this assessment indicates that operational security limits are still expected to be violated, more redispatching/restrictions will be applied. If that 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.

[11] 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.

[12] 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.

5. Methodology of the assessment

5.1 Time period assessed

In Table 3, an overview per CCA is given for what time period is considered in the figures and results included in this report.

Table 3: Overview of time periods assessed in this report

CCA	Period	Comment
CWE	1 January – 31 March 2020	A Transition period applied. This period is assessed separately in section 6.1
	1 April – 31 December 2020	This is the period which is being assessed in the figures of section 6.2 Unfortunately, data for three business days (4 June, 25 Oct and 4 Nov) was not available, see section 12.1.2). In total 6.528 MTUs are included.
HVDC Bidding Zone borders (DK-NL & NL-NO)	1 January – 31 December 2020	For the HVDC borders, data for all MTUs has been obtained. (in total 8.784 MTUs)

5.2 Assessment of compliance in CWE during Q1 2020 (transition phase)

On the basis of the approved derogation, in the period January to March 2020, a transition period applied (see section 3.2) where TenneT continued the status quo within the CWE region and TenneT only had to comply with the obligation to provide a minimum RAM ($MCCC_{min}$) of 20% (see formula (3)).

In order to assess the compliance of TenneT with the status quo during this period, it is relevant to evaluate for time stamps where TenneT did not comply with the minimum capacity (minRAM) of 20% in CWE. Given that the 20% minRAM was implemented via the CWE TSO common system, and could only be deviated from if a TSO actively enables a 'minRAM exclusion' (see section 4.1), the compliance of TenneT with the applicable obligations can easily be assessed on whether minRAM exclusions have taken place in this period.

5.3 Assessment of compliance in CWE during Q2-Q4 2020

5.3.1 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, 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 (3)
3) Per CNE per direction, select the CNEC which has the lowest relative $MACZT^{CNEC}$ (see Figure 1)
4) Compare the relative $MACZT^{CNEC}$ with $MACZT_{min}^{CNEC}$ for the selected CNECs
    a. In case the relative $MACZT^{CNEC} \geq MACZT_{min}^{CNEC}$ for all selected CNECs for both directions, TenneT has been compliant for that MTU.
    b. In case the relative $MACZT^{CNEC}$ was not equal or larger than $MACZT_{min}^{CNEC}$ for all selected CNECs in that MTU, it is relevant to look on whether there was a reduction of capacity due to a lack of remedial actions when the grid is in an outage situation (ground of the derogation). If that was the case and was properly justified, TenneT was compliant for that MTU
    c. In case the relative $MACZT^{CNEC}$ was not equal or larger than $MACZT_{min}^{CNEC}$ for all selected CNECs in that MTU and there was no reduction of capacity due to a lack of remedial actions, TenneT was potentially not compliant for that MTU. For these MTUs, some more in-depth analyses would need to take place to fully assess the level of compliance.[13]

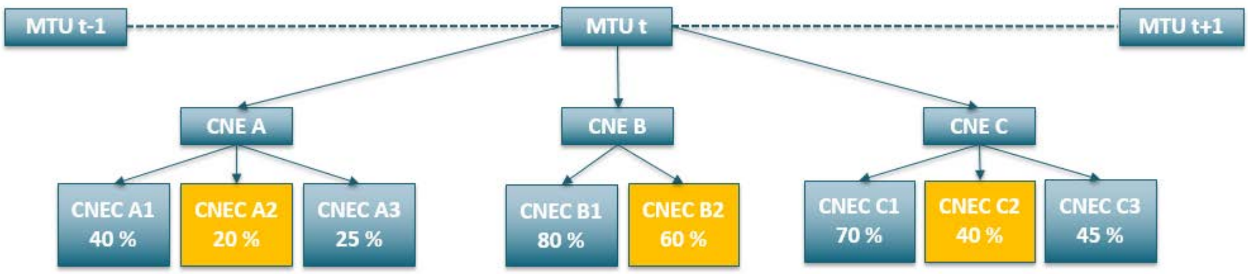


Figure 1: Filtering step applied for each MTU to select for each CNE the related CNEC which has the lowest relative MACZT

In order to compare the delta between $MACZT^{CNEC}$ and $MACZT_{min}^{CNEC}$ of a CNEC and make this visible in figures, the parameter $MACZT_{Margin}^{CNEC}$ given in % of F_{max}^{CNEC}, has been determined based on the following formula:

$$(5)\ MACZT_{Margin}^{CNEC} = MACZT^{CNEC} - MACZT_{min}^{CNEC}$$

A *negative* $MACZT_{margin}$ means that for that CNEC not sufficient capacity was made available, a $MACZT_{margin}$ of *0* means that exactly the minimum amount of capacity was made available, and a *positive* $MACZT_{margin}$ indicates that more capacity was made available than was at minimum required.

[13] In principal it can still be the case that that TenneT would be compliant due to the application of LTA inclusion. However, as there is not yet a methodology to assess this, this was not performed in this report. For more information, see discussion section 8.4.

5.3.2 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.

For each MTU:

1. Select the CNEC which has the lowest $MCCC^{CNEC}$ [14]
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

5.4 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 by the available physical capacity (Fmax) of the interconnector forming the bidding zone border:

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

2) Compare $MACZT^{BZB}$ with $MACZT^{BZB}_{min}$ for both directions[15]
   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.

[14] This dataset is also the basis behind the curve of MCCC in Figure 4
[15] 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.

5.5 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 clear distinction between the two reports is mostly the filtering applied to reduce the full dataset to a dataset with single values per CNE per MTU (see step 3, section 5.3.1), instead of a full dataset with all CNECs. For Figure 3 an additional filtering was applied to create a dataset with per MTU only the CNEC with the lowest MACZT which allows for comparison with comparable figures from the ACER MACZT monitoring report.

6. Results

6.1 CWE, period January – March 2020

On the basis of the approved derogation, in the period January to March 2020, a transition period applied where TenneT continued the status quo within the CWE region (see section 3.2). In order to assess the compliance of TenneT with the status quo during this period, it is relevant to look for time stamps where TenneT did not comply with the minimum capacity (minRAM) of 20% in CWE.

In this period, TenneT did not apply any minRAM exclusion. Therefore, via the CWE TSO common system, the 20% minRAM was applied for every CNEC and every MTU, and for 100% of the MTUs compliance was reached with the applicable targets.

6.2 CWE, April - December 2020

6.2.1 Overall assessment of the offered MACZT and MCCC within the CWE CCA

For the period April – December 2020, the process for evaluation as set out in section 5.3.1 is followed.

In Figure 2 the percentage of time when the relative MACZT is above its minimum level $MACZT_{min}$ is given. The figure shows that for 84% of the time, TenneT has provided the required minimum level of capacity. The remaining 16% of the MTUs where MACZT was below the $MACZT_{min}$ for one or more CNEs were categorized in three different groups to illustrate 'how far' TenneT was from the $MACZT_{min}$.

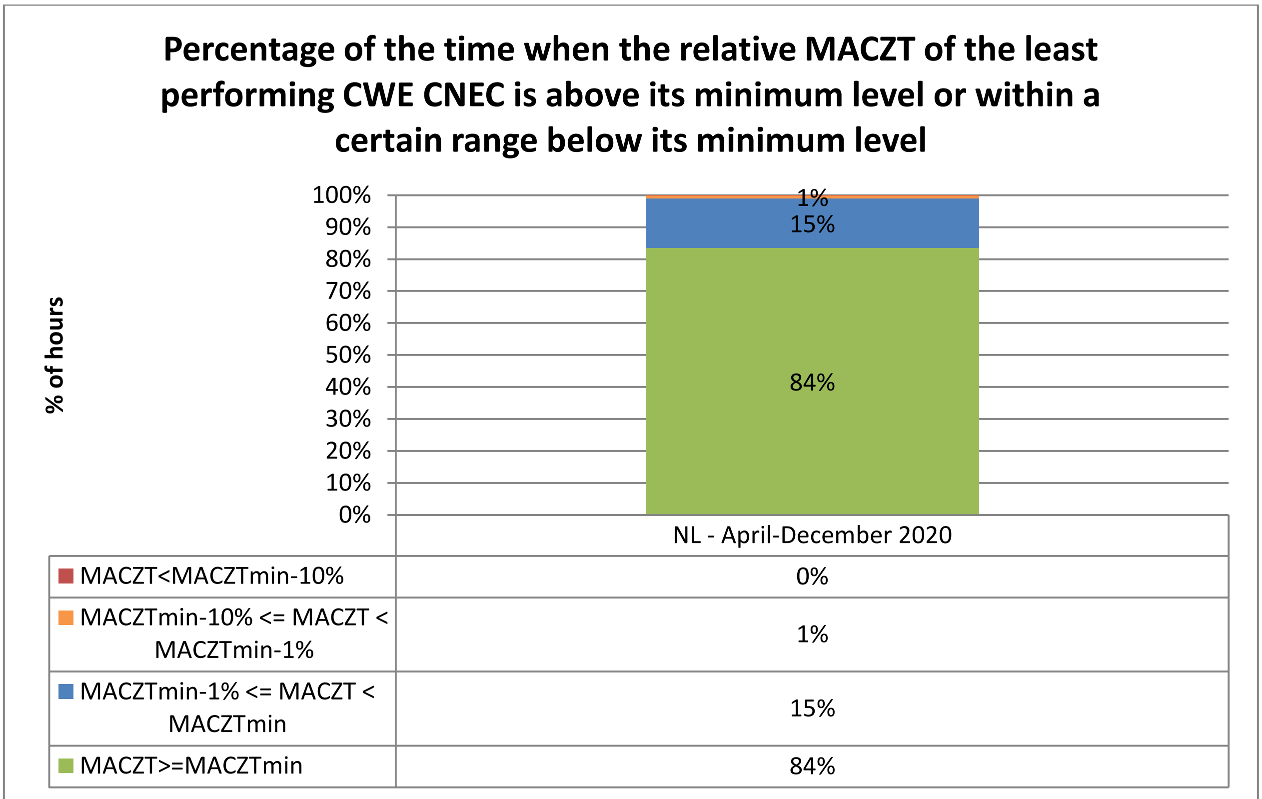
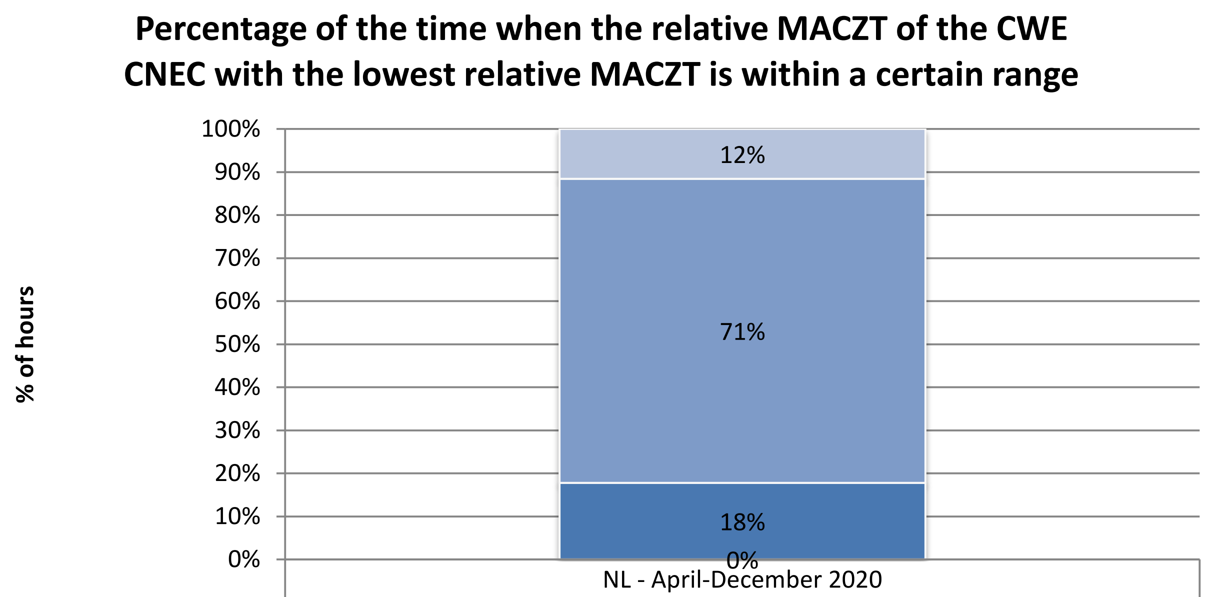


Figure 2: Percentage of time when the relative MACZT of the least performing CNEC in the coordination area of CWE is above its minimum MACZT or within a certain range below its minimum MACZT. For each MTU the CNEC with the lowest $MACZT_{margin}$ was selected and categorised to one of the ranges. Period April-December 2020.

Via the categorisation of Figure 2 it becomes clear that for 15% of the time, the relative MACZT was less than 1% below the $MACZT_{min}$. For these MTUs, TenneT attributes the fact that the $MACZT_{min}$ has (just) not been met to numerical effects and small deviations introduced in the various calculation steps for Loop flows, MNCC etc. Overall, TenneT regards the level of MACZT as offered so close to the level of $MACZT_{min}$ that for these MTUs TenneT also should be considered compliant. A further breakdown of the MTUs where the lowest MACZT was more than 1% below the $MACZT_{min}$ is given in 6.2.2. Via this breakdown TenneT shows that only for four MTUs (0,06% of the time) TenneT could have potentially had limited cross-zonal trade, and that only for a single MTU (0,015% of the time) cross-zonal trade was limited because the CNEC became an active constraint in day-ahead market coupling.

In order to make comparison with the MACZT monitoring reports of ACER[16] possible, also a different categorisation showing the percentage of time when the relative MACZT was within a certain range, is given in Figure 3. Please note that this figure cannot be used as basis to assess the compliance, as this figure does not take into account the action plan and derogation applicable in NL.



	NL - April-December 2020
MACZT<20%	12%
20% <= MACZT <50%	71%
50%<=MACZT<70%	18%
MACZT>=70%	0%

Figure 3 Percentage of time when the relative MACZT is within a certain range in the coordination area of CWE within the period April-December 2020. For each MTU, the CNEC with the lowest relative MACZT was selected. The ranges are comparable to the ranges as used by ACER in its MACZT monitoring report[16]

[16] See: https://www.acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/MACZT%20report%20-%20S1%202020.pdf

Further insight into the distribution of the lowest relative MACZT per MTU, can be found in Figure 4. In this figure, a duration curve for the period April-December 2020 is plotted where the lowest MACZT per MTU are sorted from high to low. Next to the lowest relative MACZT, also a duration curve for the lowest relative MCCC (i.e. the RAM offered in CWE FB DA CC in % of Fmax) is plotted in this figure. This curve for MCCC can be used to assess the compliance with the obligation to offer a minimum MCCC of 20% in CWE FB DA CC (see section 3.3). The difference between the MACZT and MCCC curve, is the result of MNCC.

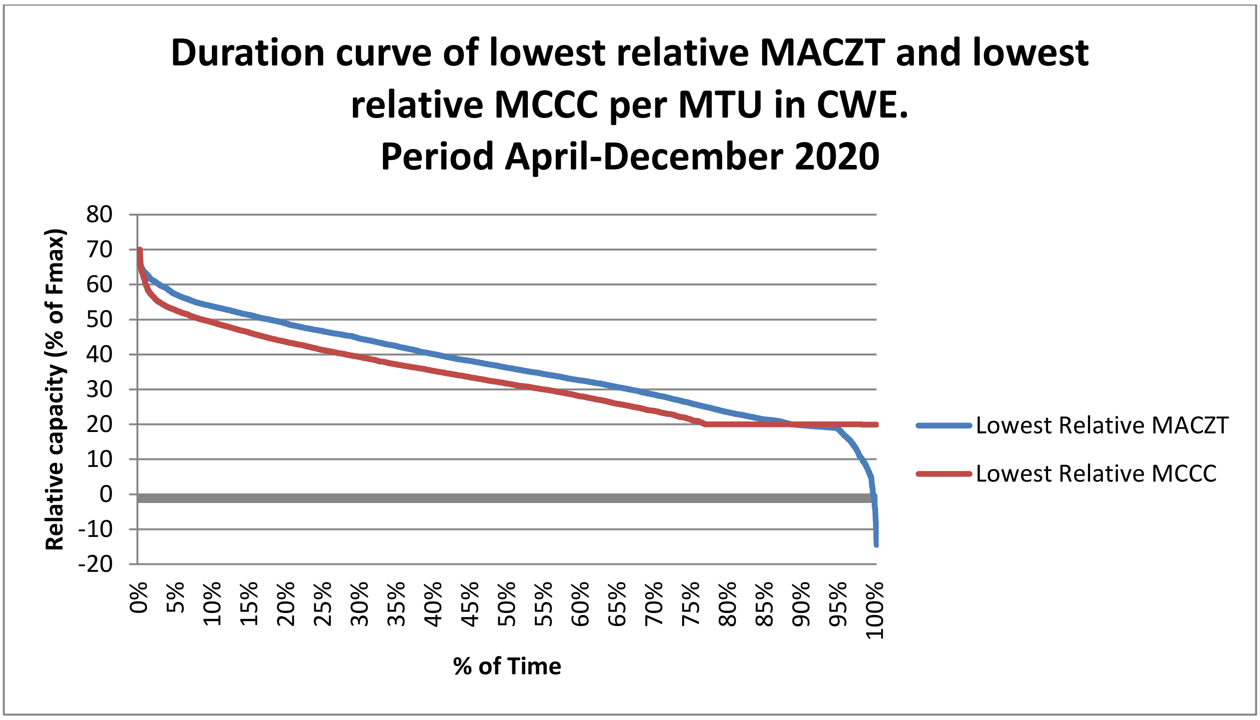


Figure 4: Duration curves showing the lowest relative MACZT of all CNECs per MTU and the lowest relative MCCC of all CNECs per MTU for the coordination area of CWE within the period April-December 2020

The curve for the lowest relative MACZT in Figure 4 shows that for about 11% of all MTUs, the lowest relative MACZT drops below the lowest $MACZT_{target}$ of 20%. For 32 MTUs (0.5% of the time), there was even a negative lowest MACZT. The cause for the lowest relative MACZT dropping below 20% is a combination of negative MNCC and loop flows exceeding their accepted levels. In situations of high loop flows on the CNECs with a $MACZT_{target}$ value of 20%, TenneT is allowed to reduce their MACZT below the MACZTtarget on the basis of the approved derogation (see formula (1)). In combination with negative MNCC, the MACZT values can then end up below the MCCC values.

The horizontal part at 20% of the curve for MCCC in Figure 4 shows that for all MTUs, the 20% minRAM requirement has been complied with. This may be surprising, given that in 80 hours minRAM exclusions have taken place. We discuss this further in section 6.2.5.

Even though for several MTUs the lowest relative MACZT has been on very low levels, the lowest MCCC curve shows that the market actually did have access to a minimum amount of capacity within the CWE CCA of at least 20%. There is some debate between TSOs, NRAs and ACER on whether the MACZT in such cases actually does rightly reflect what level of capacity was offered for cross-zonal trade, as it is the MCCC which is made available within a CCA and not the fictive MACZT, see section 8.3 of the discussion chapter.

6.2.2 In-depth look at MTUs where MACZT was more than 1% below the $MACZT_{min}$

For 1% of the MTUs - 64 MTUs in total - the MACZT lies more than 1% below the required minimum level $MACZT_{min}$. In order to assess whether the market has (potentially) experienced a negative effect of this, the involved timestamps have been assessed in more detail.

For the MTUs where one or more CNEs had a MACZT more than 1% below the $MACZT_{min}$, it was assessed:

1. Whether for the MTUs one of the CNECs related to these CNEs were included as 'presolved' CNEC in CWE FB DA CC. This is relevant, as in the final step of the CWE FB DA CC only the presolved CNECs are being included in the final capacity domain and can potentially limit the market, while all other CNECs will be discarded; and
2. Whether for the MTU one of the CNECs related to these CNEs have been an active constraint limiting cross-zonal exchanges in day-ahead market coupling.

The results of these two steps are given in Figure 5.

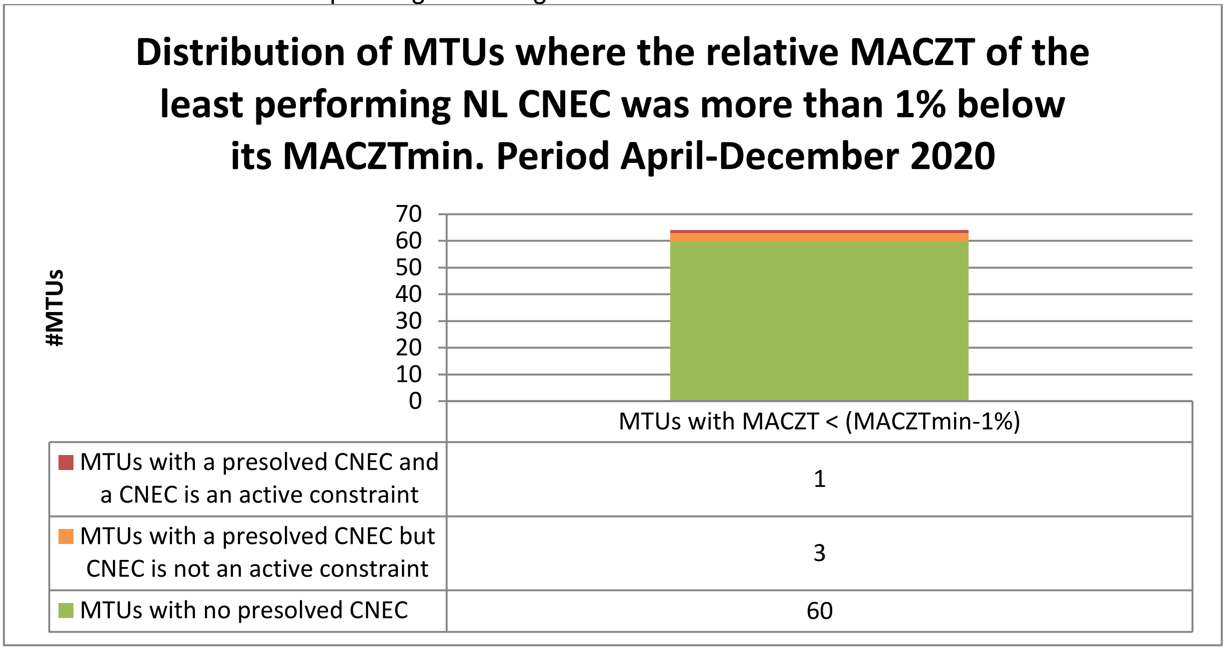


Figure 5: Distribution of MTUs with presolved and/or active constraints for MTUs where the relative MACZT of the least performing CNEC in CWE CCA was more than 1% below its MACZTmin. Period April-December 2020

From the 64 MTUs, for only 4 MTUs there was a presolved CNEC based on the violating CNEs. This means that for 60 MTUs, despite that TenneT did offer MACZT below the required minimum level, the related CNECs would not be able to limit cross-zonal flows as they would be discarded in the final step of CWE FB DA CC. Of the 4 MTUs where a CNEC related to the violating CNEs was presolved, it appeared that only for 1 MTU the presolved CNEC also was an active constraint, limiting cross-zonal exchanges in day-ahead market coupling.

Overall, TenneT hereby concludes that despite that for about 1% of the time it did not offer an amount of capacity in accordance with all the applicable obligations for the minimum capacity margin which was to be offered, this limited cross-zonal trade only for a single MTU.

6.2.3 MACZT breakdowns per CNE

Based on the action plan, individual $MACZT_{target}$ values have been established per CNE, included in CWE FB DA CC (see section 3.1). In order to provide more insight into what level of capacity is made available per CNE, a breakdown of the lowest MACZT per CNE per direction is given in Figure 6 and Figure 7.

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 6 of annex 3.

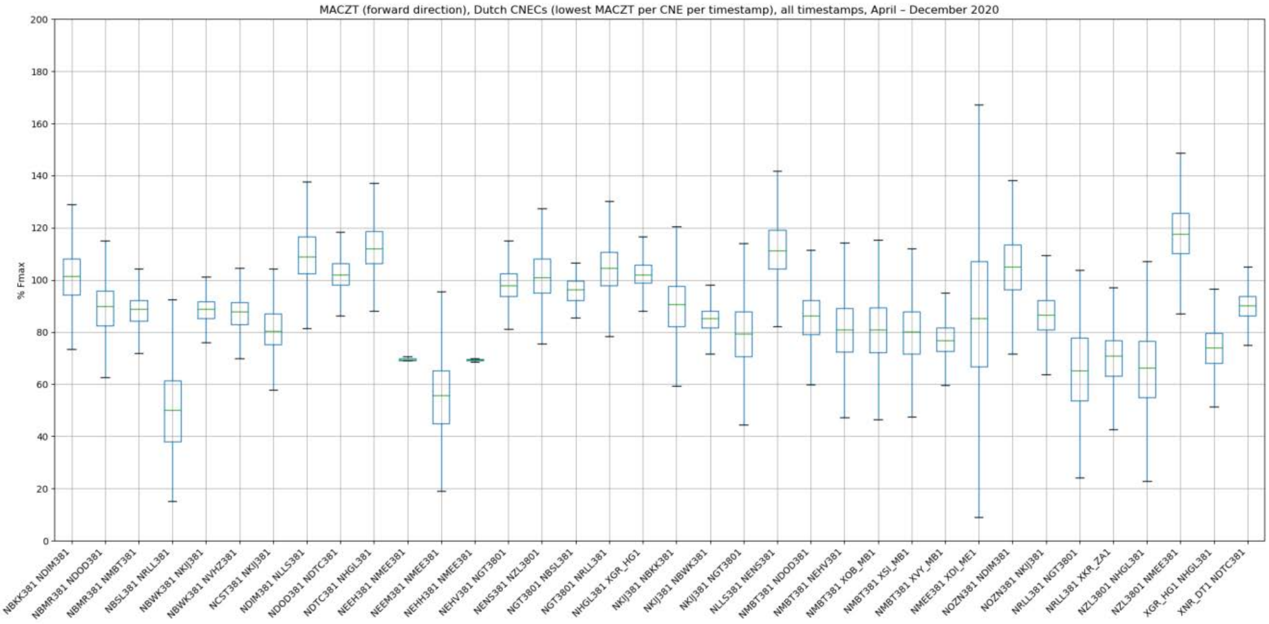


Figure 6: Relative MACZT per Dutch CNE included in CWE CCA in the forward direction, based on the lowest relative MACZT per CNE per MTU, for the period April-December 2020

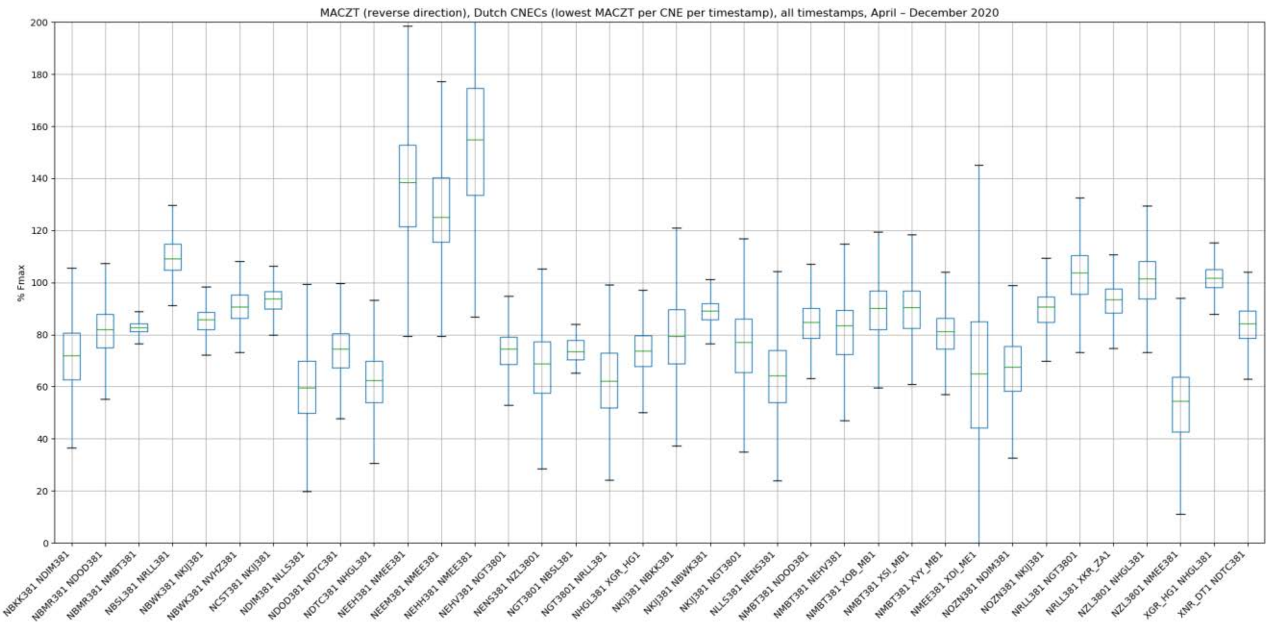


Figure 7: Relative MACZT per Dutch CNE included in CWE CCA in the opposite direction, based on the lowest relative MACZT per CNE per MTU, for the period April-December 2020

Box plot explanation

- Each box + whiskers represent the data for a single CNE, based on the filtered dataset (see Figure 1 in section 5.3.1)
- 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 green line 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. Values above Q3 + 1.5*IQR or below Q1-1.5*IQR are considered outliers and are not displayed.

These figures show significant differences for individual CNEs, where for some CNEs significantly more capacity was made available for cross-zonal trade than for other CNEs. Interestingly, the figures also show that for a majority of the CNEs on average much higher amounts of capacity margins have been made available than the lowest values as depicted in Figure 3 and Figure 4.

Figure 6 and Figure 7 also show that on several CNEs, TenneT often made more than 100% of the physical capacity available for cross-zonal trade. This might seem counterintuitive, but it because within the grid models used for CWE FB DA CC, these CNEs already have a certain extent of 'pre-loading' resulting from commercial exchanges within the Netherlands (internal flows) or commercial exchanges outside the CWE region (MNCC flows). In such situations, more than 100% of the physical capacity can be offered in the opposite direction, as these flows would first cancel out this pre-loading, before starting to use physical capacity within that particular direction.

6.2.4 $MACZT_{margin}$ per CNE

In the previous section a breakdown of MACZT per CNE was given. However, based on these figures it is not possible to see directly how much capacity was offered 'more' than what should at minimum had to be offered, as the $MACZT_{min}$ per CNE is not a fixed value but also depends on the level of loop flows on that CNE (see formula (1)). To enable this insight, the parameter $MACZT_{margin}$ was introduced in formula (5).

Box plots of the $MACZT_{margin}$ per CNE per direction are included in Figure 8 and Figure 9. These figures show that for a majority of the CNEs, the MACZT offered is significantly above the $MACZT_{min}$, while for some other CNEs the margin is much smaller.

Please note that there is no clear trend, that CNEs with the lowest $MACZT_{target}$ also have the lowest MACZT margins. In particular, some of the CNEs with rather low MACZT margins already have relatively high $MACZT_{target}$ values (such as MBT-DOD which has a $MACZT_{target}$ of 70%). Therefore, it is not a given that the challenge to follow the linear trajectory and raise the capacity margins without compromising operational security only lies with those network elements which have the lowest $MACZT_{target}$ values, but this can also be a significant challenge for CNEs with higher $MACZT_{target}$ values.

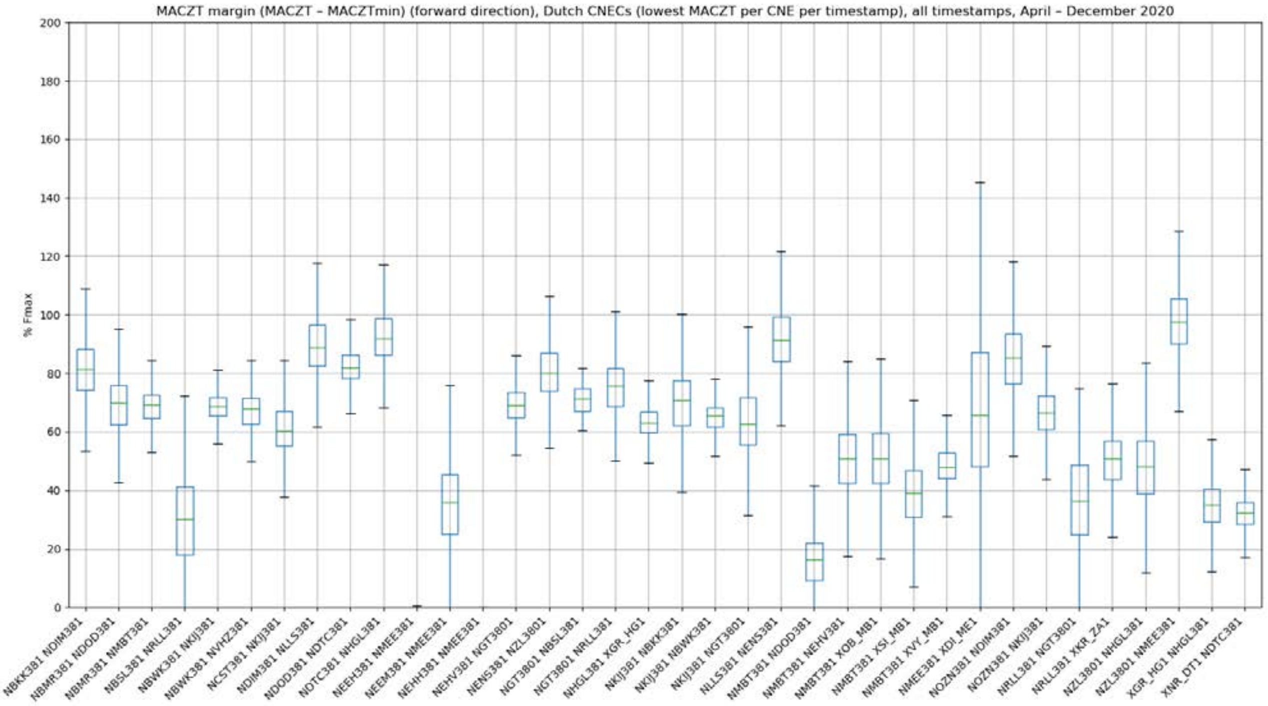


Figure 8: MACZT$_{margin}$ per Dutch CNE included in CWE CCA for the <u>forward</u> direction, per CNE per MTU, for the period April-December 2020[17]

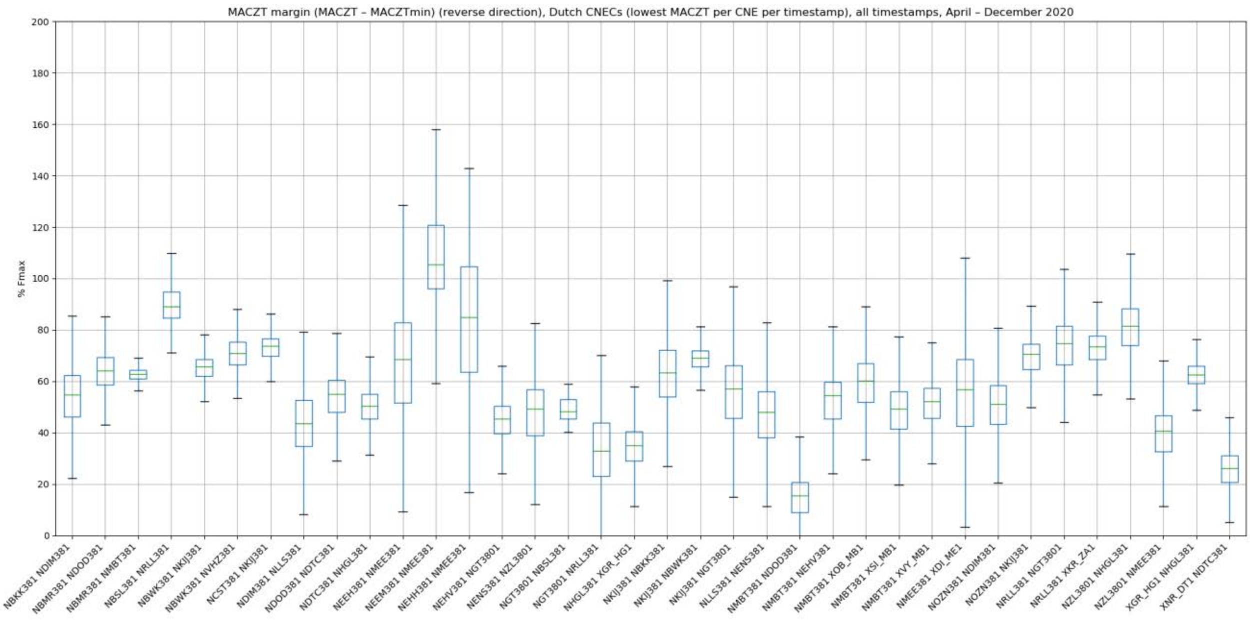


Figure 9: MACZT$_{margin}$ per Dutch CNE included in CWE CCA for the <u>opposite</u> direction, per CNE per MTU, for the period April-December 2020[17]

[17] The values for NEEH381 NMEE381 are not correct, as in operations wrong values for MACZTtarget have been used for this CNE (see also section 12.1.3)

TenneT TSO B.V.

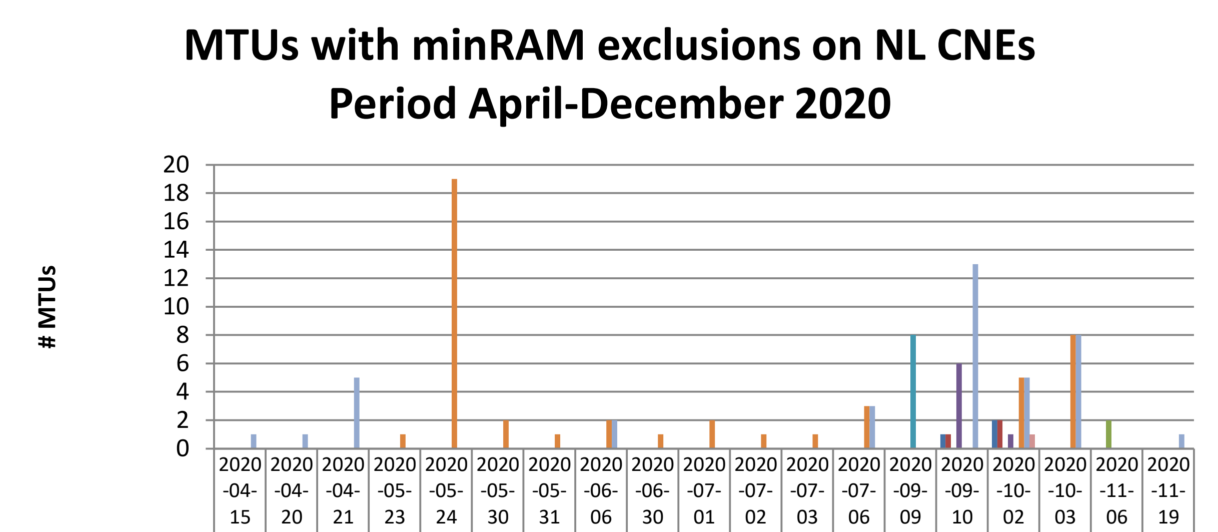
6.2.5 minRAM exclusions

The first step to check compliance with the obligation to offer a minimum MCCC of 20% in CWE FB DA CC is to per MTU evaluate whether the lowest MCCC was above or equal to the target value of 20%.

The curve for MCCC in Figure 4 can be used to assess the compliance with the obligation to offer a minimum MCCC of 20% in the CWE CCA. The horizontal part at 20% of the curve for MCCC in Figure 4 shows that for all MTUs, the 20% minRAM requirement has been complied with.

This is a bit surprising, as during 2020 TenneT did apply minRAM exclusions. Figure 10 shows that in total during 80 MTUs minRAM exclusions were applied on eight different CNEs in the period April – December 2020. The minRAM exclusions are the result of an automated internal process in case the expected flow across a CNEC minus its FRM, exceeds 125% of its Fmax for the likely edge of the flow-based domain.

However, these minRAM exclusions thus didn't result to MCCC going below the target value of 20%. The most likely cause for this is that the CNECs on which a minRAM exclusion was applied were removed from the final dataset as a result of the LTA inclusion process which also enlarged the capacity domain. Given that there is not yet a clear way how the effect of LTA inclusion is to be assessed, it is not possible to make clear statements on the compliance for the MTUs where minRAM exclusions were applied. We reflect upon the limitations due LTA inclusions in section 8.4.



	2020-04-15	2020-04-20	2020-04-21	2020-05-23	2020-05-24	2020-05-30	2020-05-31	2020-06-06	2020-06-30	2020-07-01	2020-07-02	2020-07-03	2020-07-06	2020-09-09	2020-09-10	2020-10-02	2020-10-03	2020-11-06	2020-11-19
DIM-LLS380 W															1	2			
DIM-LLS380 Z															1	2			
EEM-MEE380 W																		2	
EEM-MEE380 Z															6	1			
LLS-ENS380 Z														8					
MEE-DIL380 W				1	19	2	1	2	1	2	1	1	3			5	8		
MEE-DIL380 Z	1	1	5					2					3		13	5	8		1
OZN-DIM380GS																1			

Business Day

Figure 10: MTUs with minRAM exclusions in CWE FB DA CC on Dutch CNEs. Period April-December 2020

6.3 HVDC bidding zone borders

On the basis of the approved derogation, for the period January – December 2020, the results of the evaluation as set out in section 5.4 is as follows. In Figure 11 the percentage of time when the relative MACZT is above 70%, is given for the HVDC bidding zone borders.

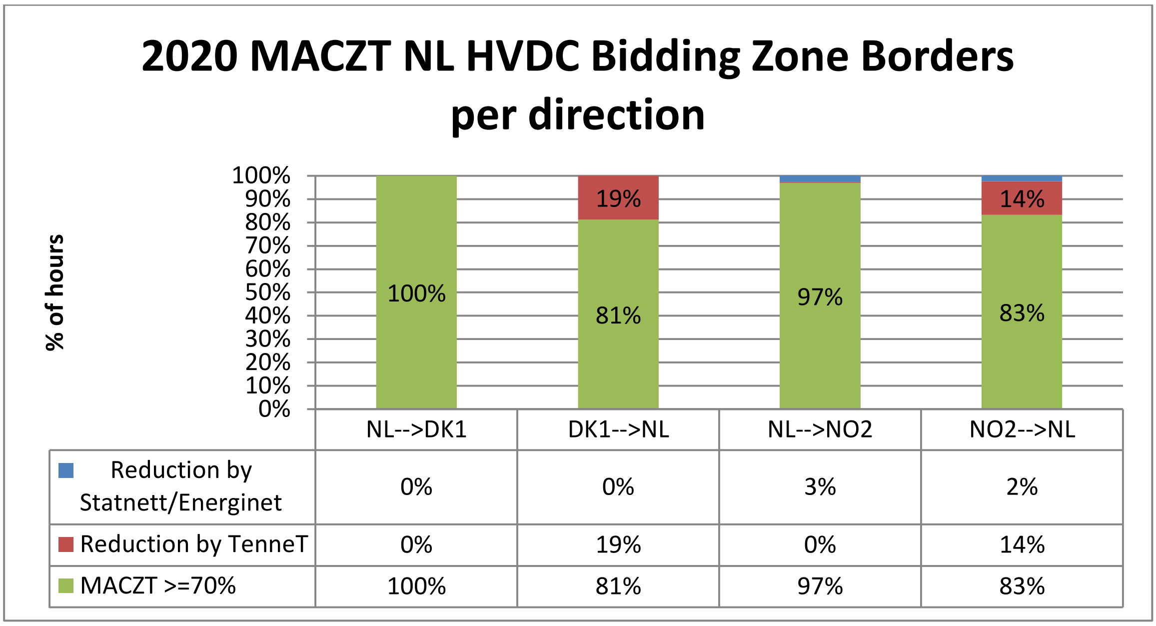


Figure 11: Percentage of the time when the relative MACZT is above 70% on the NL HVDC borders, per direction, for the full year 2020

The figure shows that in 2020:

- For 100% of the time for the NL->DK1 (COBRAcable) and NL->NO2 (NorNed) bidding zone border, TenneT has provided a MAZT equal or larger than the required minimum level of 70%.
- For 81% of the time for the DK1→NL bidding zone border and 86% of the time[18] for the NO2→NL bidding zone border, TenneT has provided a MACZT equal or larger than 70%.
- For 19% of MTUs for DK1->NL and 14% of MTUs for NO2->NL, the MACZT was below the $MACZT_{min}$ due to a reduction by TenneT. A further explanation for the reasons behind these reductions follows hereafter.

In Figure 12 the relative MACZT has been plotted for each HVDC connection and direction against the percentage of time, to provide an insight in the relative MACZT applied in time.

[18] For NO2->NL, for about 2% of the MTUs NTC reductions were triggered by Statnett, while TenneT offered a MACZT equal or larger than 70%. Given that the NTC reductions were not triggered by TenneT TenneT considers that it should be regarded as having offered the required minimum level of capacity for these MTUs. Due to rounding, the MTUs that TenneT offered a MACZT >= 70% end up at a level of 86% of the time.

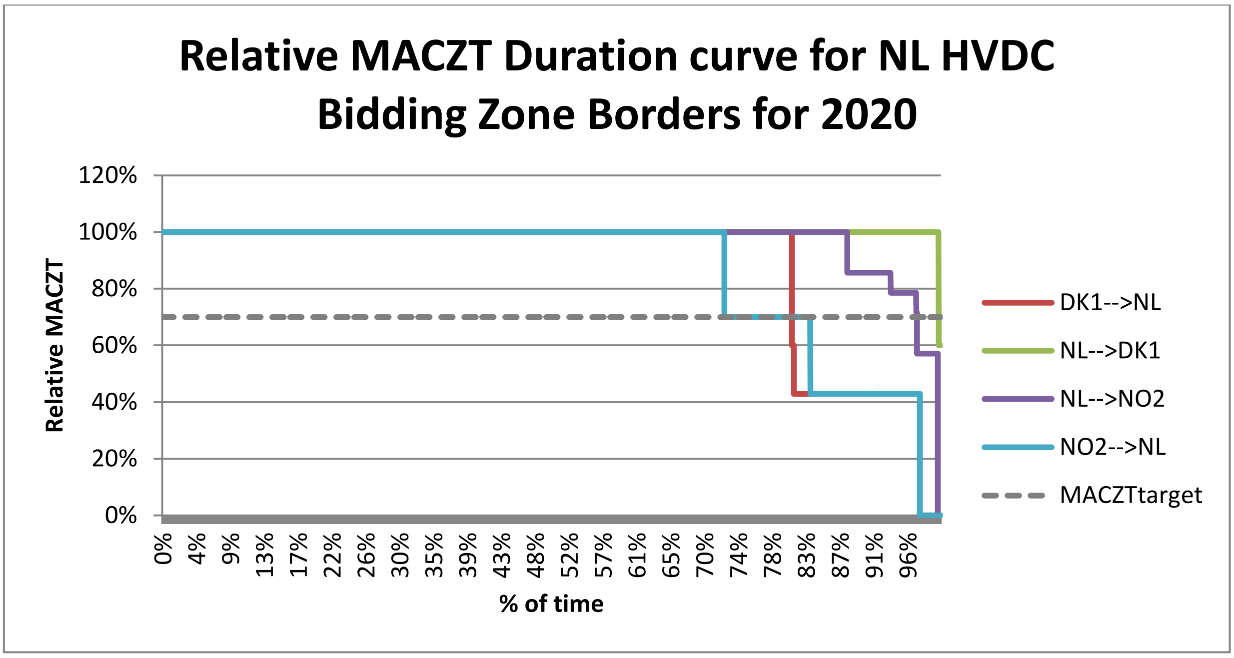


Figure 12: Duration curve of relative MACZT per HVDC bidding zone border per direction for the full year 2020

As indicated in section 4.3 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.

In the past year, TenneT has at times reduced the NTC capacity on HVDC bidding zone borders during significant and longer duration outage situations on critical network elements as otherwise operational security limits would be violated. The reductions for NorNed and COBRAcable below 70% relative MACZT as shown in Figure 11 and Figure 12 were for the vast majority of the time related to the fact that throughout 2020 there have been several planned and unplanned outages in the 380 kV grid of North of the Netherlands (Eemshaven area). These outages have led to a reduction of capacity on the remaining internal Dutch network elements of 1900 to 2650 MVA. This was clearly not sufficient to be able to transport all possible infeed at the Eemshaven 380 kV grid area, consisting of 5790 MVA of total installed generation capacity which includes for example conventional generation units, wind farms and the 1400 MW of total interconnector capacity of the NorNed and COBRAcable interconnectors. Based on the security processes, as set out in section 4.3, TenneT determined that a reduction on the DK1->NL and NO2->NL border were required to respect operational security limits.

An overview of the planned and unplanned outages that resulted in reductions for the NorNed and COBRAcable below 70% relative MACZT is listed in Table 4. These reductions are typically related to the limited remaining available capacity margin of the network elements that are in parallel of the network elements described in Table 4.[19]

[19] E.g. Typically when EEM-MEE380 Zwart is in outage, it is EEM-MEE380 Wit which is the limiting CNE.

Table 4: Overview of time periods in 2020 with expected and unexpected outages based on which it was decided to offer MACZT on the DK1->NL (COBRAcable) and NO2-->NL (NorNed) below a relative MACZT of 70%.

Period / Business Days	Outage type	Network element in outage
29/01/2020 to 01/02/2020	Unplanned outage	EEM TR402
16/3/2020	Planned Outage	ZL-MEE380 zwart
16/5/2020	Planned Outage	EEM-MEE380 zwart
23/5/2020 to 24/5/2020	Planned Outage	EEM-MEE380 zwart
26/5/2020 to 27/5/2020	Planned Outage	EEM380 rail A / B EEM380 tak C4 EEM380 TR402 EEM380 EDC (NorNed cable)
29/5/2020 to 19/7/2020[20]	Unplanned Outage	MEE-ZL380 wit
06/6/2020	Planned Outage	EEM-MEE380 zwart
08/6/2020 to 10/6/2020	Planned Outage	EEM380 tak C2 EEM380 TR401 ZL-MEE380 wit ZL380 rail B
11/6/2020 to 19/6/2020	Planned Outage	ZL-MEE380 wit ZL380 rail B
24/8/2020 to 4/9/2020	Planned Outage	ZL-MEE380 zwart
21/9/2020 to 22/9/2020	Planned Outage	ZL380 rail

Next to the reductions as listed in Table 4, some other reductions have been applied during the day-ahead and intraday grid security assessment. This was the case for 46 MTUs (0.5% of the time) for DK1->NL and for 0 MTUs (0% of the time) for NO2->NL. For DK1 → NL this was related to a failing temperature measurement for COBRA from 15/01/2020 to 16/01/2020 which led to a reduction of the NTC value. On 04/02/2020 – 05/02/2020 there was a decoupling of the COBRA cable, which means that an area or one or more borders do not participate in the market coupling. On February 5, 2020, one of the exchanges had problems with the delivery of the order books, which meant that no trade could be conducted with the entire Nordic region (Norway, Sweden, Finland and Denmark) via the DA Market coupling. The capacity of the COBRA was then taken from the DA Market coupling and offered via the fallback procedure (Shadow Auctions).

Whether the reductions of MACZT below the 70% have been appropriate, is not an aspect that is easy to answer. Given that there have been solid reasons related to investments and expansion of the grid, in order to be able to make more capacity available for cross-zonal trade time, TenneT regards the reductions that have taken place in 2020 as unavoidable consequence to reach the desired target situation of being able to make more cross-zonal capacity available in the mid to longer term. We further elaborate upon this in section 8.5 of the discussion.

[20] During the period 29-5-2020 - 19-7-2020 there was a significant unplanned outage causing the maximum production capacity on 380 kV in the Eemshaven area to be reduced, in parallel planned outages have been applied during this period as indicated in the above table.

7. Conclusions

Based on the results as set out in chapter 6, TenneT has arrived at the following conclusions for the relevant capacity calculation areas:

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

- For 84% of the time, TenneT has provided capacity margins at or above the required minimum levels on all its network elements.
- For 15% of the time, TenneT has not provided capacity at or above the required minimum levels for a few network elements. However, the capacity margins provided on the least performing network element were very close to the required minimum levels as the deficit was only less than 1% below its required minimum level. TenneT attributes this deficit to numerical effects and small deviations introduced in the various calculation steps.
- For 1% of the time, TenneT has offered insufficient capacity margins. However, the effect on cross-zonal trade has been almost negligible as only for four hours the related CNECs were included in the final capacity domain and could potentially limit the market, and only for a single hour a related CNEC has limited cross-zonal exchanges in day-ahead market coupling
- Despite that for 80 hours minRAM exclusions have been applied, meaning that the capacity made available within CWE could go below the level of 20%, the 20% limit was nevertheless always respected due to the enlargement which takes place to respect the allocated long-term capacities.

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

- For 100% of the time for the NL→DK1 (COBRAcable) and NL→NO2 (NorNed) bidding zone border, TenneT has provided capacity margins at or above the required minimum level of 70%.
- For 81% of the time for the DK1→NL and 86% of the time for the NO2→NL bidding zone border, TenneT has provided capacity margins at or above the required minimum level of 70%. For the remaining period of time, insufficient capacity margins were provided due to reductions by TenneT.
- The reductions on NorNed and COBRAcable were for the vast majority of the time related to the fact that throughout 2020 there have been several planned and unplanned outages in the 380 kV grid of the North of the Netherlands (Eemshaven area).
- These outages have led to reduced capacity on the internal Dutch network elements that were still in operation, which was not sufficient to be able to transport all possible infeed at the Eemshaven 380 kV grid area including maximum flows on the interconnectors, while respecting operational security limits. Therefore, TenneT had to take measures including the reduction of cross-zonal capacity on the interconnectors.
- Whether the full extent of the capacity reductions has been appropriate is not an aspect that is easy to answer. Given that there have been solid reasons related to upgrades of the network to in due time be able to make more capacity available for cross-zonal trade, TenneT regards the reductions that have taken place in 2020 as an unavoidable consequence in the process of upgrading its grid to be able to make more cross-zonal capacity available in the future.

There are still various open points on how to exactly assess compliance with the minimum levels of capacity that need to be made available. Future clarifications and adaptations to the monitoring methodology might potentially require an adjustment of the levels of compliance for 2020 as stated in this report.

8. Discussion

8.1 Reflection on differences between the methodology from this report, and methodology applied by ACER in its MACZT monitoring reports

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 clear distinction between the two reports is mostly the filtering applied to reduce the full dataset to a dataset with single values per CNE per MTU (see section 5.3.1), instead of either a dataset with all CNECs or a dataset with only the CNEC with the lowest MACZT per MTU. TenneT believes this approach is helpful as it enables to create insight in the margins provided on a per CNE level, while also allows to draw conclusions with respect to compliance as it focuses on the lowest margins of capacity made available, on the network elements. Therefore TenneT believes this filtering is beneficial with respect to providing transparency on the performance of TenneT.

8.2 Reflection on differences between the results of the ACER MACZT monitoring reports and this report

At the time of writing the ACER MACZT monitoring report for H2 2020 was not yet available. Therefore, TenneT was not able to make a comparison between the results as included in this report, and the results of as included in the ACER MACZT monitoring reports for the first and second half of 2020. However, given that the methodology as followed in this report is largely the same as the methodology as established by ACER, the results are expected to be comparable.

8.3 There is not yet full consensus amongst TSOs, NRAs and ACER on how to exactly assess compliance with the minimum levels of capacity margins to be made available for cross-zonal trade

For this report, TenneT has strived to apply a methodology in line with the principles as set by ACER. However, TenneT would also like to stress that this is not a full endorsement of the methodology, as there is not yet full consensus amongst TSOs, NRAs and ACER on how to exactly assess and monitor compliance with the minimum levels of capacity margins to be made available for cross-zonal trade.

Some of the elements which are still under discussion are:

a) The methodology does not take into account the effect of LTA inclusion
   This is one of the key elements for which TenneT believes some changes to the methodology are required. Please see section 8.4 for further elaboration.
b) Whether or not it is appropriate to include negative MNCC values in the monitoring
   In the current methodology, the fictive MACZT is constructed on the basis of calculated MNCC and actual capacity offered for cross-zonal trade MCCC. Currently, the MNCC is negative if the flow is in the opposing direction compared to MCCC. This then leads to levels of MACZT, which are below the levels of MCCC.
   However, in daily operation, it is the MCCC which is made available for cross-zonal trade within a certain CCA and not the *fictive* MACZT. Therefore, in cases where MACZT lies below MCCC, it is questionable whether the MACZT is actually the right margin to monitor what capacity has in

operations been made available for cross-zonal trade.
In this respect, TenneT would like to point out that in Germany the monitoring takes place on the basis that only positive MNCC is taken into account in the MACZT assessment, which has a significant positive effect on the level of compliance

c) The inclusion of third country flows within MNCC / MACZT.
The fact that there is not yet consensus whether or not these flows are to be included is reflected in the fact that ACER currently reports two sets of figures, one without and one with third country flows. For clarity: in this report TenneT has included third country flows for the calculation of MCCC and loop flows.

d) The focus on the day-ahead market
TSOs also make capacity available for cross-zonal trade in other time-frames than the day-ahead market. They make also capacity available in intraday and in the long-term timeframes. The methodology currently only focusses on the capacity made available in day-ahead, but that is not the full picture of capacity made available by the TSOs. A future methodology should aim to also take into account the capacity which is made available in all the time frames.

e) Whether all CNECs, or only the presolved CNECs would have to be taken into account for assessing compliance
As set out in section 6.2.2, only the CNECs which are included as presolved CNECs in the final flow-based domain potentially limit cross-zonal exchanges. All the other CNECs are discarded before flow-based day-ahead market coupling takes place, and those CNECs can therefore not limit the cross-zonal exchanges in the market coupling. Having this in mind, it seems to make sense to only assess compliancy with the required minimum levels of capacity margins of only the set of presolved CNECs, instead of the full set of CNECs.
For clarity, in this report TenneT has assessed (a filtered set if, see Figure 1 of section 5.3.1) all CNECs for assessing the compliance with the applicable obligations on minimum capacity margins.

Given that there is not yet full consensus on the elements above, based on new insights it is very likely that for future reports the monitoring methodology will require some adaptations. This potentially will also have an effect on the levels of compliance for 2020 as stated in this report.

8.4 Limitations due to LTA inclusion

ACER's concept of MCCC for flow-based regions monitors only the day-ahead RAM as provided on CNECs, before the inclusion of long-term capacities (i.e. the green space in Figure 13). Yet, exchanges (respectively net positions in FB) can be much higher due to the inclusion of long-term capacities (i.e. the red lines in Figure 13).

In case the flow-based domain based on the RAM from the CNECs is not fully encompassing the Long-Term capacity domain (i.e. the orange space in Figure 13), the domain is artificially enlarged and virtual constraints are introduced to ensure that the orange domain is fully included in the flow-based domain. The CNECs from which these virtual constraints were derived are removed from the domain file to ensure they do not supersede the virtual constraints.[21] However, those virtual constraints cannot be monitored in a comparable

[21] More information on how LTA inclusion is exactly applied within CWE FB DA CC can be found in annex 14.29 of the CWE FB MC Approval Document, available at:

way as physical CNECs as they do not contain a maximum capacity of Fmax and thus no MCCC or MACZT can be established on those elements. They are also irrelevant for the monitoring purposes of this report, as the underlying mechanism is very different from the flow-based calculation to which concepts like MACZT apply.

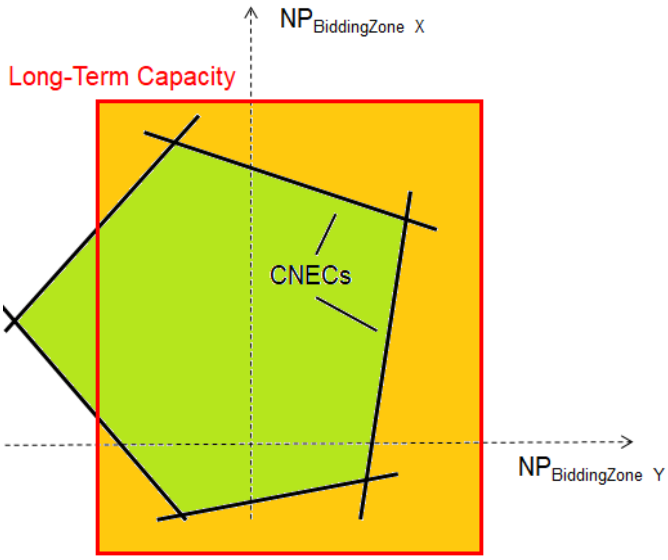


Figure 13: LT domain versus FB domain

As result, in operation the orange+green space is offered by TSOs for the day-ahead market, while only the green domain is monitored via MACZT/MCCC. The monitoring based on MACZT / MCCC is therefore an underestimation of the MACZT and MCCC as provided in a flow-based region. As consequence, it could be that due to LTA inclusion TSOs have been compliant with the required levels of capacity that are to be made available, despite that the MACZT shows that this would not have been the case.

TenneT unfortunately also does not have a solution how to take LTA inclusion into account. **TenneT recommends TSOs, NRAs and ACER to investigate and develop a solution on how LTA inclusion can be incorporated into monitoring of compliance with provisions on providing minimum margins of capacity for cross-zonal trade.**

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https://www.jao.eu/support/resourcecenter/overview?parameters=%7B%22IsCWEFBMCRelevantDocumentation%22%3A%22True%22%7D

8.5 Reflection on TenneT's level of compliance for the HVDC bidding zone borders

For the period January – December 2020, the process for evaluation is set out in section 5.3 and the results for this period are provided in section 6.3. From these results, it became clear that TenneT reduced cross-zonal capacity below 70% of relative MACZT for a significant amount of MTUs.

When one or more critical network elements are in outage, TenneT aims to apply the minimum capacity available for cross-zonal trade as defined by the relevant obligations as set out in section 3, by using if needed non-costly and costly remedial actions. The general process for that has been set out in section 4.3. However, during 2020 several planned long duration outages, related to investments of TenneT following our grid investment plan, took place. These investments include upgrades of existing corridors in the TenneT network, in order to be able to make more capacity available in the mid to longer term. However, in 2020 they thus also had the consequence of reducing cross-zonal capacity on the shorter term.

Whether the full extent of capacity reductions has been appropriate, is not an aspect that is easy to answer. Given that there have been solid reasons related to upgrades of the network to in due time be able to make more capacity available for cross-zonal trade, TenneT regards the reductions that have taken place in 2020 as justified and unavoidable consequence to reach the desired target situation of being able to make more cross-zonal capacity available in the mid to longer term.

Throughout 2020, the implementation of the internal policies dealing with ensuring operational security at times of long duration grid outages described in section 4.3 have been monitored and have gradually been refined. At the beginning of 2020 an intermediate form was applied where first a large volume was redispatched and/or dealt with via restriction agreements with market participants, however also reductions of HVDC bidding zone borders below 70% relative MACZT have been decided upon due to the related costs of redispatching and restriction agreements. This process was later in the year changed to use the CEP 70% relative MACZT as a minimal value, accepting the related increase of redispatching cost.

TenneT is dedicated to continue to monitor and develop its internal processes on how to deal with ensuring operational security at times of long duration grid outages and will continue to adjust and improve it based on the circumstances and latest insights.

8.6 Outlook for 2021 for the CWE CCA

Within this report, TenneT has looked back at the levels of capacity made available for cross-zonal trade in 2020. In this section, we briefly look forward to 2021.

First of all, for 2021 the $MACZT_{target}$ values for the CNECs included in CWE FB DA CC, that were not yet at the final target level of 70%, will be increased in accordance with the linear trajectory of the action plan.

Second, TenneT has submitted a comparable derogation as the derogation for 2020, as it considers that the same foreseeable grounds for the derogation that were applicable in 2020 still apply in 2021. ACM has approved this derogation in November 2020[22], and based on the derogation TenneT is again allowed to reduce $MACZT_{target}$ values in case loop flows exceed a certain threshold or in case there is a possible lack of redispatching potential when the grid is an outage situation. TenneT will continue to monitor compliance against the derogation that was received.

Thirdly, TenneT considers that the results for 2020 have shown that in principal the formulas and tools that were implemented early 2020 have been effective to ensure compliance with all the applicable provisions on minimum capacity, and that therefore there is no need to adjust the implementation.

Therefore, for the CWE FB DA CC the implementation of the minimum capacity obligations by TenneT for 2021 have been done by a simple update of the $MACZT_{target}$ as used in formula (4).

However, TenneT would like to point out that the formulas ensure compliance by adding a *virtual* capacity to CNECs, in case their MCCC is not sufficient to meet the applicable $MACZT_{min}$. In principle, this leads to additional security risks and potentially more extensive use of costly remedial actions, if the additional virtual capacity is also allocated via the day-ahead market coupling.

Still, the $MACZT_{margin}$ depicted in Figure 8 and Figure 9 show that an increase of the $MACZT_{target}$ values for 2021 in line with the linear trajectory of the action plan seems possible without seemingly unacceptable risks for maintaining operational security as for most CNECs for most MTUs no virtual capacity has to be added to reach the $MACZT_{min}$.

Also for 2022 there still seems to be sufficient capacity to meet that year's $MACZT_{target}$ values, under the condition that for 2022 a comparable derogation will be granted as was granted for 2020 and 2021.

[22] https://www.acm.nl/nl/publicaties/acm-verleent-een-derogatie-voor-lusstromen-en-uitvalsituaties

9. Annex 1: List of acronyms

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.
CWE	Central West Europe (electricity region)
CWE FB DA CC	The day-ahead capacity calculation process taking place in the Central West Europe electricity region
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 delta between MACZT and $MACZT_{min}$
$MACZT_{min}$	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, term used within CWE FB DA CC
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

10. Annex 2: Linear Trajectory

Table 5: Overview of $MACZT_{target}$ values per Dutch CNE of the linear trajectory as set by the Dutch Action plan. See Table 6 of Annex 3 for full names of the abbreviations, used in the CNE name.

CNE	status	type	2020	2021	2022	2023	2024	2025	2026
DTC-NDR380	existing	cross-border	58%	60%	62%	64%	66%	68%	70%
GNA-HGL380	existing	cross-border	39%	44%	49%	54%	60%	65%	70%
MBT-OBZ380	existing	cross-border	30%	36%	43%	50%	57%	63%	70%
MBT-SDF380	existing	cross-border	41%	46%	50%	55%	60%	65%	70%
MBT-VYK380	existing	cross-border	29%	36%	43%	50%	56%	63%	70%
MEE-DIL380	existing	cross-border	20%	28%	37%	45%	53%	62%	70%
BKK-DIM380	existing	internal	20%	28%	37%	45%	53%	62%	70%
BMR-DOD380	existing	internal	20%	28%	37%	45%	53%	62%	70%
BSL-GT380	existing	internal	25%	33%	40%	48%	55%	63%	70%
CST-KIJ380	existing	internal	20%	28%	37%	45%	53%	62%	70%
DIM-LLS380	existing	internal	20%	28%	37%	45%	53%	62%	70%
DOD-DTC380	existing	internal	20%	28%	37%	45%	53%	62%	70%
DTC-HGL380	existing	internal	20%	28%	37%	45%	53%	62%	70%
EEM-EOS380	existing	internal	20%	28%	37%	45%	53%	62%	70%
EEM-MEE380 / EEH-MEE380 / EHH-MEE380[23]	existing	internal	20%	28%	37%	45%	53%	62%	70%
ENS-ZL380	existing	internal	21%	30%	38%	46%	54%	62%	70%
GT-EHV380	existing	internal	29%	36%	43%	50%	56%	63%	70%
KIJ-BKK380	existing	internal	20%	28%	37%	45%	53%	62%	70%
KIJ-GT380	existing	internal	20%	28%	37%	45%	53%	62%	70%
LLS-ENS380	existing	internal	20%	28%	37%	45%	53%	62%	70%
MBT-BMR380	existing	internal	20%	28%	37%	45%	53%	62%	70%
MBT-DOD380	existing	internal	70%	70%	70%	70%	70%	70%	70%
MBT-EHV380	existing	internal	30%	37%	44%	50%	57%	63%	70%
ZL-HGL380	existing	internal	20%	28%	37%	45%	53%	62%	70%
ZL-MEE380	existing	internal	20%	28%	37%	45%	53%	62%	70%
RLL-ZVL380	new	cross-border	20%	28%	37%	45%	53%	62%	70%
BSL-RLL380	new	internal	20%	28%	37%	45%	53%	62%	70%
KIJ-BWK380	new	internal	20%	28%	37%	45%	53%	62%	70%
KIJ-OZN380	new	internal	20%	28%	37%	45%	53%	62%	70%
OZN-DIM380	new	internal	20%	28%	37%	45%	53%	62%	70%
RLL-GT380	new	internal	29%	36%	43%	50%	56%	63%	70%
VHZ-BWK380	new	internal	20%	28%	37%	45%	53%	62%	70%

[23] 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 26/10/12 as EHH.

11. 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. Typically, abbreviations for the substation names. In Table 6, the full names for the substations (nodes) belonging to the abbreviations is given.

A CNE name can be broken down in various parts. For example:

- The CNE "NBKK381 NDIM381" stands for:
  - A high voltage line, starting at the Dutch (N) substation of BKK (Breukelen Kortrijk) with voltage 380 KV, going to the Dutch (N) substation of DIM (Diemen) with voltage 380 KV.
- The CNE NHGL381 XGR_HG1 stands for:
  - A high voltage line, starting at the Dutch (N) substation of HGL (Hengelo) with voltage 380 KV, going to the German substation of Gronau.

Table 6: Full names for the abbreviations of substations as used in the network element names

Abbreviation	Full name	Notes
BKK	Breukelen Kortrijk	
BMR	Boxmeer	
BSL	Borssele	
BWK	Bleiswijk	
CST	Crayestein	
DIL	Diele	German node; relevant X-node is XDI_ME1
DIM	Diemen	
DOD	Dodewaard	
DTC	Doetinchem	
EEH/EHH	Eemshaven Het Hogeland	Transformer looped into EEM-MEE380 Z in December 2020; initially abbreviated as EEH, from 26-12-2020 as EHH
EHV	Eindhoven	
ENS	Ens	
GNA	Gronau	German node; relevant X-node is XGR_HG1
GT	Geertruidenberg	
HGL	Hengelo	
KIJ	Krimpen aan den IJssel	
LLS	Lelystad	
MBT	Maasbracht	
MEE	Meeden	
NDR	Niederrhein	German node; relevant X-node is XNR_DT1
OBZ	Oberzier	German node; relevant X-node is XOB_MB1
OZN	Oostzaan	
RLL	Rilland	
SDF	Siersdorf	German node; relevant X-node is XSI_MB1
VHZ	Vijfhuizen	
VYK	Van Eyck	Belgian node; relevant X-node is XVY_MB1
ZL	Zwolle	
ZVL	Zandvliet	Belgian node; relevant X-node is XKR_ZA1

12. Annex 4: Source data

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

12.1 CWE Capacity Calculation Area

12.1.1 Source data

In Table 7 an overview is given what data is used to assess the compliance for the CWE capacity Calculation Areas. This data is also publicly available via the JAO Utility Tool.[24] A description of the source files is given in Table 8.

Table 7: 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	F206 files
Fmax	Fmax	F206 files
$MACZT_{target}^{CNEC}$	MACZTmin[25]	F206 files
$MCCC^{CNEC}$	RemainingAvailableMargin (MW)	F206 files
$MNCC^{CNEC}$	MNCC	F206 files
$MNCC_{min}^{CNEC}$	MinRAMFactor	F206 files
LF_{calc}^{CNEC}	LFcalc	F206 files
LF_{accept}^{CNEC}	LFaccept	F206 files
Data on minRAM exclusions	-	F204 files

For a number of business days, the necessary data to calculate Minimum MACZT and MNCC was missing from the F206 files. These data was recovered via a data matching procedure between the F104 and F109 files and the monitoring logs of our local tooling. The business days are: 2020-04-10, 2020-05-22, 2020-05-23, 2020-08-08; 2020-08-16; 2020-09-03; 2020-09-26; 2020-09-27; 2020-10-28; 2020-11-05; 2020-12-14; and 2020-12-18.

Table 8: 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)

[24] http://utilitytool.jao.eu/Util
[25] When drafting this report, TenneT concluded that this term is confusing and not in line with the terms used in other places. Therefore, this term has been replaced by MACZTtarget per BD 05-02-2021

12.1.2 Missing data / time stamps

For the CWE CCA, in the period of April 1 until 31 December 2020 days the local tooling failed to produce results for two business. At these business days, default CWE flow-based parameters (i.e. use of 20% minRAM) have been used in operation. As for these days, the necessary data to assess compliance was not available, these days were excluded from the assessment performed in this report. The business days for which the local tooling failed and the cause why, are given in Table 9.

Table 9: Business days excluded from the NL MACZT assessment

Business Day	Cause for failing of the local tooling
4 June	F206 file not available due to application of default flow-based parameters on this day (for the full CWE region)
25 Oct	Failure of local tooling due to clock shift day
4 Nov	Failure of local tooling due to Go-live of ALEGrO.

12.1.3 Data corrections

During the assessment performed for this report, it was concluded that there was an error in the data for the CNEs EEH-MEE380 and EHH-MEE380. For this CNE, $MACZT_{target}$ value of 70% was included in the data as published for CWE FB CC. However, as these CNEs are an adaption of the CNE EEM-MEE380[23], the CNEs should have received the $MACZT_{target}$ value applicable for this CNE, which is 20%. Adaptations in the dataset to correct the $MACZT_{target}$ for these specific CNEs have been made, but unfortunately this was only discovered after Figure 8 and Figure 9 were produced for this report.

12.1.4 Disclaimer w.r.t. 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. This has some limitations when it comes to assessing compliance, because due to LTA inclusion some CNECs are removed and virtual constraints are added instead. For more details, see the discussion in section 8.4.

12.2 HVDC bidding zone borders

For the HVDC bidding zone borders NL-DK1 and NL-NO2, data has been used for:

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[26]
Hourly Fmax	This parameter was manually determined, based on the hourly NTC values and explanations published for reductions via TenneT Operational Messages[27] and

[26] https://transparency.entsoe.eu/transmission-domain/r2/implicitAllocationsDayAhead/show
[27] https://www.tennet.org/english/operational_management/Operationalreports.aspx

	unavailability published on ENTSO-E Transparency Platform[28] 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 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), unless there was a specific technical reason why only part of the physical capacity was available on the HVDC interconnector. Specifically, a Fmax of 420 MW was established on the NorNed interconnector in the period 1/1/2020 until 29/2/2020 15h.

[28] https://transparency.entsoe.eu/outage-domain/r2/unavailabilityInTransmissionGrid/show

13. Annex 5: Calculation of MNCC and loop flows

13.1 MNCC

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:

$$(6)\ \vec{F}_{uaf} = \vec{F}_{0,Core} - \vec{F}_{0,all}$$

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 CCA:

- $\vec{F}_{uaf}$ is equal to $MNCC^{CNEC}$
- The applicable capacity calculation area is CWE, and not Core.

Therefore, in the local tooling for CWE FB CC, formula (6) is adjusted as follows to determine MNCC:

$$(7)\qquad MNCC^{CNEC} = \vec{F}_{0,CWE} - \vec{F}_{0,all}$$

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 calculated by running a DC loadflow computation on the D-2 Congestion Forecast (D2CF) grid model. 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).

13.2 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[29] 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.

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