Report on the result of monitoring the margin available for cross-zonal electricity trade in the Baltic States in 2024

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Introduction

The Regulation (EU) 2019/943 of the European Parliament and of the Council on the internal market for electricity (hereinafter – Regulation 2019/943) imposes a set of obligations on European transmission system operators (hereinafter – TSOs) with the aim to increase the transmission capacities made available for cross-zonal exchanges. These increases in capacities were identified as an efficient means to facilitate cross-zonal trade and to further integrate the electricity markets into the European Internal Energy Market.

Article 16(8) of Regulation 2019/943 establishes the minimum values for the capacity of the interconnection to be made available by TSOs for cross-zonal trade:

"8. Transmission system operators shall not limit the volume of interconnection capacity to be made available to market participants as a means of solving congestion inside their own bidding zone or as a means of managing flows resulting from transactions internal to bidding zones. Without prejudice to the application of the derogations under paragraphs 3 and 9 of this Article and to the application of Article 15(2), this paragraph shall be considered to be complied with where the following minimum levels of available capacity for cross-zonal trade are reached:

(a) for borders using a coordinated net transmission capacity approach, the minimum capacity shall be 70% of the transmission capacity respecting operational security limits after deduction of contingencies, as determined in accordance with the capacity allocation and congestion management guideline adopted on the basis of Article 18(5) of Regulation (EC) No 714/2009;

(b) for borders using a flow-based approach, the minimum capacity shall be a margin set in the capacity calculation process as available for flows induced by cross-zonal exchange. The margin shall be 70% of the capacity respecting operational security limits of internal and cross-zonal critical network elements, taking into account contingencies, as determined in accordance with the capacity allocation and congestion management guideline adopted on the basis of Article 18(5) of Regulation (EC) No 714/2009.

The total amount of 30% can be used for the reliability margins, loop flows and internal flows on each critical network element."

Article 59(1)(h) of Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market in electricity provides that the regulatory authority of each Member State is responsible for "Ensuring that transmission system operators make available interconnector capacities to the utmost extent pursuant to Article 16 of Regulation (EU) 2019/943".

Baltic national regulatory authorities (hereinafter – NRAs) – Public Utilities Commission, Estonian Competition Authority, National Energy Regulatory Council prepared the report based on the data presented by the Baltic TSOs – AS Augstsprieguma tīkls (AST), AS Elering and AB Litgrid on 5 June, 2025 on margin

available for cross-zonal electricity trade (hereinafter – *MACZT*) between the Baltic States electricity systems for the day-ahead market on alternating current (hereinafter – AC) lines, and give the evaluation on the extent to which *MACZT* has been complied with the provisions of Article 16(8) of the Regulation 2019/943 – if the 70% *MACZT* target have been reached.

Method used for monitoring cross-border *MACZT*

Baltic capacity calculation region (hereinafter – Baltic CCR) TSOs, according to Article 20(2) of Regulation 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management (hereafter – Regulation 2015/1222), have developed and Baltic CCR NRAs have approved Capacity calculation methodology for the day-ahead and intraday market timeframes within the Baltic CCR on 23 September 2024[1], which is not taken into account in this *MACZT* Report. Baltic CCR TSOs earlier developed and Baltic CCR NRAs have earlier approved Capacity calculation methodology (hereafter – CCM) within the Baltic CCR in 2018[2] and CCM in 2015[3]. The *MACZT* Report 2024 is based on mentioned CCM on 2018. In 2024, the Baltic CCR NRAs approved the latest version of the CCM[4] which was not implemented during 2024 but came into effect starting from the synchronization of the Baltic power system with Continental European Synchronous Area (hereinafter – CESA) on 9 February 2025. Therefore, the preparation of this report has not been based on the latest approved version of the CCM.

Cross-zonal capacities calculated for Baltic CCR borders are not affected by capacities calculated for trading with 3rd countries and therefore capacities provided to Baltic CCR borders shall be evaluated independently from capacities provided to 3rd countries.

According to Article 23 of Regulation 2015/1222, during capacity calculation each TSO shall respect the operational security limits and contingencies used in operational security analysis. In CCM Baltic CCR TSOs referred to Article 25, 32 and 38 of Regulation 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation, as well as Methodical guidelines for stable operation in BRELL Loop (synchronous operation area consisting of power systems of Belarus, Russia, Estonia, Latvia and Lithuania), in order to define operational security limits. These limits are voltage limits, short-circuit current limits, current limits in terms of

[1] https://www.sprk.gov.lv/sites/default/files/editor/ED/Kodeksi/2025/Baltic%20DA%20ID%20CCM.%202024.11.21%20-%20Final%20Clean%20version.pdf

[2] https://ast.lv/sites/default/files/editor/metodikas/Capacity_calculation_methodology_within_the_Baltic_Capacity_Calculation_Region21112018.pdf

[3] https://elering.ee/node/262

[4] https://elering.ee/sites/default/files/public/Elektriturg/Baltic%20DA%20ID%20CCM.%202024.11.21%20-%20Final%20Clean%20version.pdf

thermal rating, stability limits, emergency reserves availability. Thermal limits of critical network elements are only one of several operational security limits, while other limits (e.g., voltage and stability limits) are not applicable/transformable to individual critical network elements, but to whole power system and therefore are applied to the cross-border interconnection – in such way representing allocation constraints of the respective border.

Article 16(8) of Regulation 2019/943 prescribes that for cross-zonal capacity determination using a coordinated net transmission capacity approach, applicable in Baltic CCR, the minimum capacity shall be 70% of the transmission capacity, respecting operational security limits after deduction of contingencies, as determined in accordance with the Regulation 2015/1222.

According to both – 2015 and 2018 CCM – Baltic CCR TSOs calculate maximum possible cross-zonal capacity for each AC interconnections (cross-borders) by taking into account all operational security limits, but not only thermal limits. Maximum possible cross-zonal capacity for each AC interconnections (cross-borders) is called Total Transfer Capacity (hereinafter – *TTC*). *TTC* of the designated cross-border interconnection is the maximum transmission of active power, which is permitted in transmission cross-border interconnection compatible with operational security standards and is calculated using common power system's grid model of Baltic TSOs, as well as Russia and Belarus power systems, with application of various contingencies from Baltic, Russian and Belarus power systems. Coordinated *TTC* value is used by power system dispatchers to control physical flows on the border. On the other hand, Baltic CCR TSOs allocate to electricity market coordinated Net Transfer Capacity (hereinafter – *NTC*) values which are calculated according to CCM reducing coordinated *TTC* value by Transmission Reliability Margin (hereinafter – *TRM*) value. Coordinated *TTC* value represents the maximum power exchange which is possible between two power systems through respective cross-border interconnection.

Baltic TSOs operated in synchronous area together with Russian and Belarus power systems until the 9th February 2025, and, in real time operation, part of power was not transferred directly through cross-border interconnections between bidding zones, but was instead routed around – also through Russian and Belarus grids. At the same time exchanges between Russian and Belarus power systems, resulting from 3rd countries power market operation, similarly like energy of European Union (hereinafter – EU) power market, were partly transited also through power systems of the Baltic states. In such situation, the limitation of power exchange between bidding zones on the market to the respective maximum transmission of active power of a specific cross-border interconnection (and not considering possible capacity increase due to loop flows through neighbouring power systems) was used to maintain *status quo* of transmission infrastructure usage and to avoid exploitation of the infrastructure by one power market at the expense of another. It should be mentioned that there are no more market operations with either Russia or Belarus.

Agency for the Cooperation of Energy Regulators (hereinafter – ACER) Recommendation No 01/2019 of 08 August 2019 on the implementation of the *MACZT*

pursuant to Article 16(8) of Regulation 2019/943 [5] (hereafter – ACER Recommendation) provides approach for calculation and monitoring the *MACZT*.

From the ACER Recommendation follows that the maximum flow on critical network element (hereinafter – *CNE*), as referred to in Articles 23(3)(a) and 29(7)(a) of the Regulation 2015/1222, means the capacity respecting operational security limits taking into account (or after deduction of) contingencies of *CNE* as referred to in Article 16(8) of Regulation (EU) 2019/943 (hereinafter – F_{max}) is based on *CNE* thermal limits. Additionally, to that point 6.2 of ACER Recommendation stated that when constraints are needed to maintain the transmission system within operational security limits, and when such constraints cannot be transformed efficiently into F_{max} on *CNEs*, TSOs may introduce additional constraints ('allocation constraints') to be respected during capacity allocation.

TSOs have obligation and practical need to use all operational security limits during capacity calculation, not only thermal limits of *CNEs*, as the result can be misleading by showing not acceptable high theoretical cross-zonal capacities. To perform correct evaluation of compliance with 70% target threshold, all operational security limits are taken into account.

In Baltic CCR the coordinated *TTC* values for cross-border, which shall be calculated according to CCM and which takes into account all operational security limits, represent the maximum possible power flow on the cross-border (and at the same time is also maximum possible energy exchange between bidding zones), the correct and straightforward way of checking compliance with Regulation 2019/943 Article 16(8) for Baltic CCR AC borders is comparison of *NTCs* provided to the market with coordinated *TTC* value. Evaluation of compliance to 70% target shall be performed using the following formula:

$$MACZT(MTU) = NTC(MTU) \geq 70\% \, TTC \, (MTU), \quad (1)$$

where

MTU – Market Time Unit;

TTC – Total Transfer Capacity of the designated cross-border interconnections is the maximum transmission of active power, which is permitted in transmission cross-border interconnections compatible with operational security standards applicable for each TSO;

NTC – coordinated Net Transmission Capacity of the designated cross-border interconnections is the maximum Trading Capacity, which is permitted in transmission cross-border interconnections compatible with Operational Security standards and considering the technical uncertainties on planned network conditions for each TSO.

[5] https://www.acer.europa.eu/sites/default/files/documents/Recommendations/ACER%20Recommendation%2001-2019.pdf

Baltic CCR CCM presents the following formulas of calculation of respective values. ***NTC* value for Estonia-Latvia Cross-Border Interconnection** shall be calculated using following formula:

$$NTC = \min(((TTC_1 + \sum^{n}_{i=1} K_i P_i) - TRM); TTC_2 - TRM), \quad (2)$$

where

TTC_1 – Total Transfer Capacity after *N*-1 situation has occurred from actual power system network status according to Instruction for parallel operation in the cross-border interconnection between Estonian, Russian and Latvian power systems. The "*N*" in "*N-1*" represents the total number of components or elements that need to be operational for the transmission system to function properly. The "*-1*" signifies that the system should still be able to operate safely and reliably even if one of those components fails. The value of TTC_1 is independent on influence of ambient temperatures – values at *0* (zero) temperature shall be used;

TTC_2 – Total Transfer Capacity value for actual power system network status, according to Instruction for parallel operation in the cross-border interconnection between Estonian, Russian and Latvian power systems. The value of TTC_2 is dependent from the influence of ambient temperature of particular capacity calculation time period to transmission line conductors;

P_i – amount of assured emergency power reserves for respective power system *i* taking into account operational security of all Baltic CCR and interconnected AC power systems;

n – number of power systems;

K_i – reserve power distribution coefficient considering location of the assured emergency power reserve P_i;

TRM – Transmission Reliability Margin value calculated according to the methodology described in Article 7 of the CCM.

TTC on Estonia-Latvia border may be affected by amount of assured emergency power reserves and ambient temperature.

***NTC* values for Lithuania-Latvia Cross-Border Interconnection** shall be calculated using following formula:

$$NTC = (TTC_1 + \sum^{n}_{i=1} K_i P_i) - TRM, \quad (3)$$

where

$$TTC_1 + \sum^{n}_{i=1} K_i P_i \leq TTC, \quad (4)$$

where

TTC_1 – Total Transfer Capacity after *N-1* situation has occurred from actual power system network status according to Instruction for parallel operation in the Lithuania-Latvia cross-border interconnection. The "*N*" in "*N*-1" represents the total number of components or elements that need to be operational for the transmission system to function properly. The "*-1*" signifies that the system should still be able to operate safely and reliably even if one of those components fails;

P_i – amount of assured emergency power reserves for respective power system *i* taking into account operational security of all Baltic CCR and interconnected AC power systems;

K_i – reserve power distribution coefficient considering location of the assured emergency power reserve P_i;

n – number of power systems;

TTC – Total Transfer Capacity in actual power system network status according to Instruction for parallel operation in the Lithuania-Latvia cross-border interconnection;

TRM – Transmission Reliability Margin calculated according to the methodology described in Section 7 of the CCM.

Analysis of *MACZT*

On 22 May 2025 Baltic NRAs requested Baltic TSOs the day-ahead Total Transfer Capacity (*TTC*) and coordinated Net Transfer Capacity (*NTC*) data for evaluation in accordance with Article 16(8) of the Regulation 2019/943 and 70% target monitoring, and if in place the reasoning for limitations such as outage(s) causing the limitation, critical network element, outdoor temperature used for calculations, *TTC* and *NTC* coordination process.

On 2 and 4 June 2025 the Baltic NRAs received electronical letter with Annexes of each cross-border section between the Baltic States electrical systems from Baltic TSOs:

- Annex 1 – 70% *NTC* target monitoring table EE-LV both directions

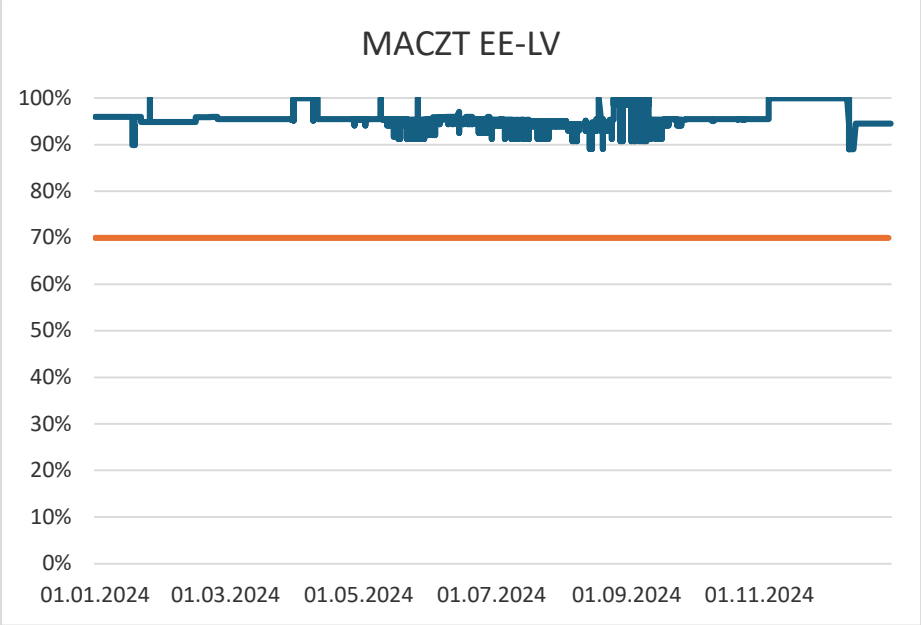
  Elering – AST data of 2024.

- Annex 2 – 70% *NTC* target monitoring table LV-LT both directions

  Litgrid – AST data of 2024.

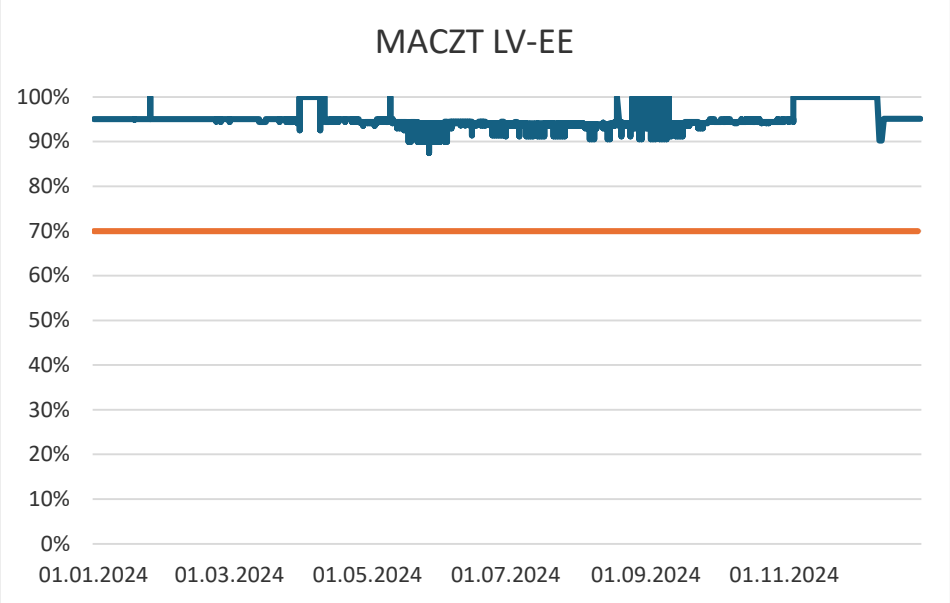
1. Cross-border trade between Latvia (LV) and Estonia (EE)

Figure 1: Development of percentage of the *MACZT* (*NTC*/*TTC*) for the day-ahead market direction EE-LV in a year 2024



NTC on the cross-borders EE-LV was not lower than 89%.

Figure 2: Percentage of the *MACZT* for the day-ahead market direction LV-EE in a year 2024



NTC on the cross-borders LV-EE was not lower than 88%.

<u>On the direction from EE to LV</u>

The *MACZT* on EE to LV is frequently 95% and in some cases 100%. The lowest level 89% of *MACZ*T have been on 05 August 2024 for 12 days from (01:00) until 17 August 2024 (01:00) mentioned in UMM[6]. In UMM remarks was mentioned about coordinated capacities (capacities are calculated according to the CCM that considers limitations due to outages and allowed power line ratings) for lines as L354, L353, renovation

[6] https://umm.nordpoolgroup.com/#/messages/1ae786be-bf58-4b1f-9dd5-7341022cfabb/1

works for lines as L347 Sindi (EE) – Sopi (EE), Tsirguliina (EE) – Viru (EE), Tsirguliina (EE) – Valmiera (LV). Maintenance on 330kV lines L310 Liksna (LV) – Rezekne (LV).

The second lowest level 89% of *MACZT* have been on 17 August 2024 for 2 days and 7 hours from (01:00) until 19 August 2024 (08:00) mentioned in UMM[7]. In UMM remarks was mentioned about coordinated capacities (capacities are calculated according to the CCM that considers limitations due to outages and allowed power line ratings) for lines as L354, L353 and renovation works in line L346 Sopi (EE) – Paide (EE), Tsirguliina (EE) – Viru (EE), Tsirguliina (EE) – Valmiera (LV).

The level 92% of *MACZT* have been on 4 June 2024 for 2 days from (01:00) until 06 June 2024 (01:00) mentioned in UMM[8]. In UMM remarks was mentioned about coordinated capacities (capacities are calculated according to the CCM that considers limitations due to outages and allowed power line ratings) for lines as L354, L353 and renovation works in line L347 Sindi (EE) – Sopi (EE), L301 Tartu (EE) Valmiera (LV), Tsirguliina (EE) – Viru (EE), Tsirguliina (EE) – Valmiera (LV).

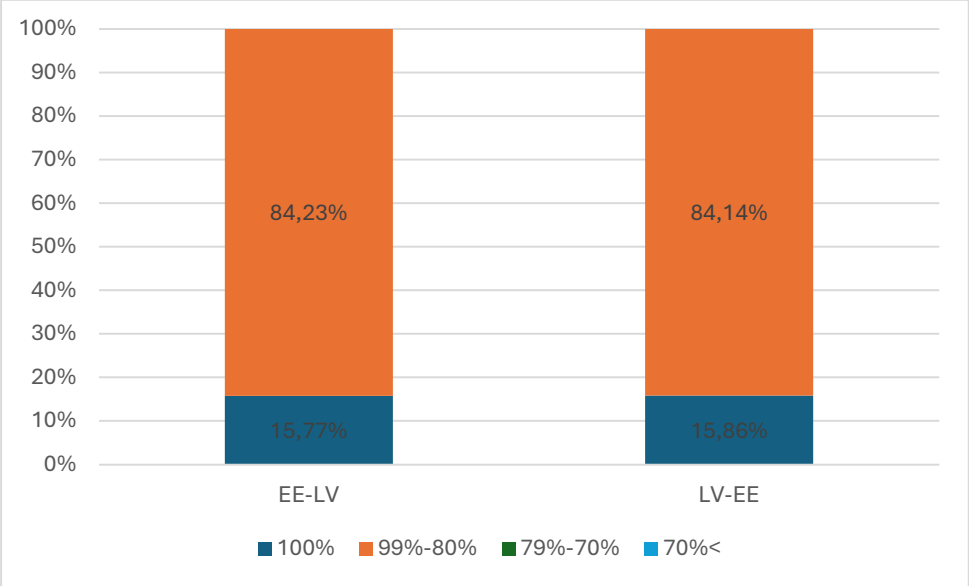
<u>On the direction from LV to EE</u>

The *MACZT* on LV to EE is frequently 95% and in some cases 100%. The lowest level 88% of *MACZT* have been on 11 May 2024 for 12 hours (08:00-20:00) mentioned in UMM[9]. In UMM remarks was mentioned about coordinated capacities (capacities are calculated according to the CCM that considers limitations due to outages and allowed power line ratings) for lines as L354, L353 and renovation works in line L347 Sopi (EE) – Sopi (EE), in line L301 Tartu (EE) – Valmiera (LV), Tsirguliina (EE) – Valmiera (LV), Tsirguliina (EE) –Viru (EE).

The level 90% of *MACZT* have been on 04 December 2024 for 2 days and 9 hours from (8:00) until 06 December 2024 (17:00) mentioned in UMM[10]. In UMM remarks was mentioned about outages and renovation works on lines as L346 Sopi (EE) – Paide (EE), L356 Paide (EE) –Viru (EE), L502 Kilingi (EE) – Nõmme (EE) – Riga (LV).

[7] https://umm.nordpoolgroup.com/#/messages/c0916d8c-6ac5-4ba3-be57-3003c73952bb/6
[8] https://umm.nordpoolgroup.com/#/messages/0f0e7094-b263-4ea9-956c-c8f33da577a2/2
[9] https://umm.nordpoolgroup.com/#/messages/0f0e7094-b263-4ea9-956c-c8f33da577a2/7
[10] https://umm.nordpoolgroup.com/#/messages/30b8dc03-ff2d-42a0-bbaf-e4f4e00a039b/15

Figure 3. Percentage of the time for the available *MACZT* for the EE-LV cross-border in both directions (% of hours)



2. **Cross-border trade between Latvia (LV) and Lithuania (LT)**

Figure 4: Percentage of the *MACZT* for the day-ahead market direction LV-LT in a year 2024

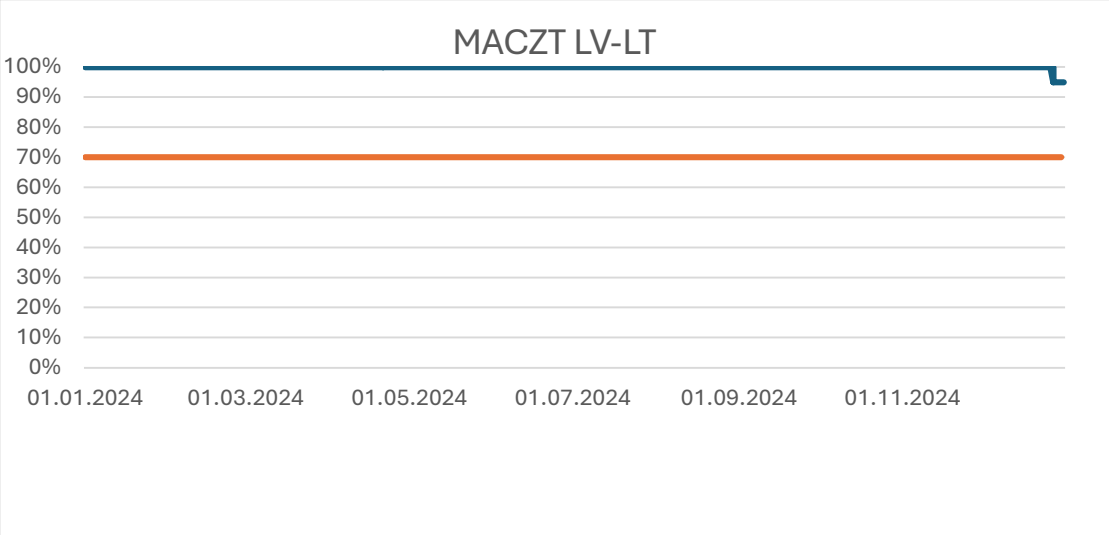
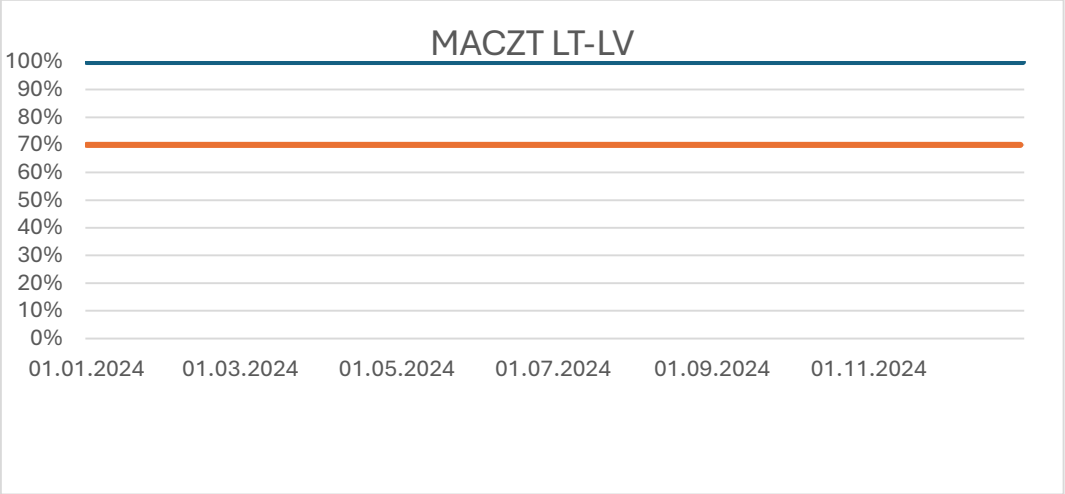


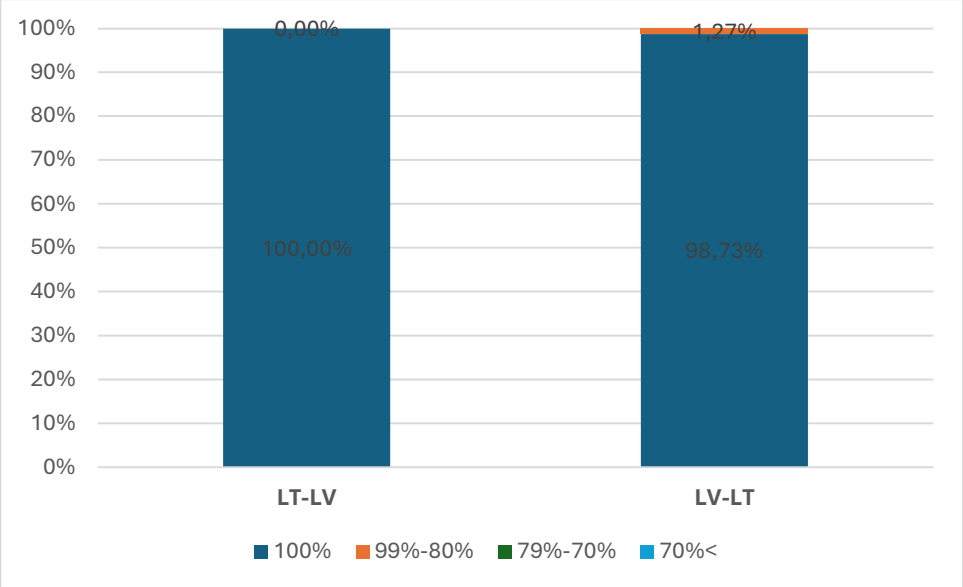
Figure 5: Percentage of the *MACZT* for the day-ahead market direction LT-LV in a year 2024



On the direction from LV to LT

The *MACZT* on LV to LT is frequently 100%. The lowest level 95% of *MACZT* have been only in the end of the year on 28 December 2024 (10:00-14:00) for 4 hours mentioned in UMM[11]. On the hydro pumped storage Kruonis (LT) was foreseen maintenance regarding of urgent technical works on the lines LN318 Lietuvos E-Jonava (LT).

Figure 6. Percentage of the time for the available *MACZT* for the LV-LT cross-border



[11] https://umm.nordpoolgroup.com/#/messages/5bf6eef1-380b-4fa4-95f4-daef16dd52bd/5

Conclusions and general remarks

- The report presents the Baltic NRAs monitoring of *MACZT* using the specific approach as described before, explaining the method of calculation of *MACZT*, taking into regard the specifics of the Baltic States power systems operating within the BRELL.

- *MACZT* for the interconnections between the Baltic States electricity systems is in line with Regulation 2019/943. For cross-border Latvia – Estonia 100% of *MACZT* is available (~16% of hours direction EE-LV and ~16% of hours direction LV-EE). For Latvia – Lithuania cross-border in direction LT-LV *MACZT* for the most of time *MACZT* was 100%.

- Baltic CCM does not foresee common power transfer distribution factor (hereinafter – *PTDF*) calculation and *CNECs* identification process for each MTU. *PTDF* calculation, regarding to information provision to ENTSO-E and ACER pursuant to Article 82 of Regulation 2015/1222, is not required for NTC approach. Moreover, *PTDF* calculation and *CNECs*' identification and monitoring for Baltic CCR cross-borders were not available until the synchronization of the Baltic States power systems with the Continental Europe`s power systems. Baltic CCR TSOs informed that they are not capable to provide any historical information on *CNECs* F_{max} as well as scheduled commercial cross-border flows with the third countries.

- Baltic TSOs reporting quality regarding the transparency is sufficient, TSOs have included the reasons of unavailable capacity in most cases, as well as the outdoor temperature in case of border between Lithuania and Latvia.

- All the necessary data in accordance with ACER Recommendation on all the *CNEs* associated with a contingency used in capacity calculation are available only for the period after the Baltic States electricity systems synchronization with CESA. The common grid models were not available for the period preceding the desynchronisation from BRELL either.

- The Baltic countries (Estonia, Latvia, and Lithuania) successfully synchronized the electricity systems with the CESA on 9 February 2025. The Baltic TSOs developed the new CCM, which applies after the synchronization in 2025. Starting from February 2025, the Baltic TSOs will provide the data requested by ACER. This *MACZT* Report for 2024 will be the final one, and a separate assessment will no longer be required.