Methodology of parameters calculation for Lithuanian Capacity Mechanism

Part 2: Methodology for the calculation of Maximum Entry Capacity

TITLE 1: General Provisions

Article 1: Subject matter and scope

1. The objective of this document is to develop detailed methodologies for calculation of parameters in the Lithuanian capacity remuneration mechanism (CRM) that will be used by LitGrid to calculate parameters necessary for the implementation of Lithuanian CRM, as laid out in Article 4. Amendment of Article 9 of the Law on Electricity of The Republic of Lithuania:
   - 24) approve the methodology for calculating de-rated capacity;
   - 25) approve the methodology for calculating the Maximum Entry capacity of interconnectors (Item 25);
   - 26) approve the methodology for the allocation of congestion rent; and
   - 27) approve the methodology for the calculation of allocated capacity.
2. The methodologies are split this into four Parts presented in separate documents:
   - Part 1 presents the methodologies for de-rating capacity calculation for national generation capacity and foreign capacity participating in Lithuanian CRM;
   - Part 2 presents on the methodology for Maximum Entry Capacity;
   - Part 3 presents the methodology to calculate the Auction Target Capacity; and
   - Part 4 presents the methodology for allocation of the Congestion Rent.

3. The present document addresses Part 2 and focuses on methodology of calculation of Maximum Entry Capacity.

Article 2: Definitions and interpretation

4. For the purposes of the present methodology, the terms used in this document shall have the meaning of the definitions included in Article 2 of Regulation (EU) 2019/943 and Article 1. Amendment of Article 2 of the Law on Electricity of The Republic of Lithuania.

5. In addition, in this methodology, the following definitions and their interpretations shall be used:

- **Auction Clearing Price** is the Price in the Capacity Auction determined by the Price Setting Bid
- **Auction Target Capacity** is the volume of De-rated Capacity that could be awarded in a Capacity Auction
- **Capacity Mechanism** is defined in accordance with Article 2(22) of Regulation (EU) 2019/943.
- **Capacity Mechanism Contract** means the contract between the CM operator and the capacity provider enabling the capacity provider to get a remuneration for its availability during the Reference period.
- **Cross-border Physical Unit** is a Generating Physical Unit or DSR located in a Member State of the European Union, the electricity system of which is interconnected directly with the electricity system of Lithuania
- **Electrical neighbour** means a Member state or a bidding zone which is part of a Member State that has a direct network connection with the bidding zone for which the maximum entry capacity is computed.
- **Entry Capacity** means the capacity, expressed in MW, that can be allocated to eligible foreign capacity for participation in a capacity mechanism. Its total amount can never exceed the Maximum Entry Capacity.
- **Foreign Capacity** means a capacity located in a Member State different from the Member State applying the capacity mechanism.
- **Maximum Entry Capacity** means the maximum allowed foreign capacity (expressed in MW) considered between two Member States that can participate in a capacity mechanism during a certain Delivery Period.t.
- **Energy Not Served (ENS)** means the amount of energy demand – measured in MWh – which is not supplied in a given zone and in a given time period due to insufficient resources to meet demand.
- **Physical Unit** is a separate set of technical apparatus with metering points assigned to them in the Lithuanian electricity system.
- **Scarcity**, also named 'system stress' refers to a situation during which ENS is strictly greater than zero in a given system and in a given time period because national production, demand reduction measures and total possible imports are insufficient to meet demand.
- **Scarcity hours** for a given bidding zone are defined as hours during which the corresponding bidding zone has an importing position after market clearing coupling and

for which the value of the hourly Energy Not Served (ENS) is strictly greater than 0 MWh/hour, after considering the effect of curtailment sharing within the market coupling algorithm. This is based on perfect foresight model as defined in ERAA.

- **Scarce asset** means either the transmission capacity or the electricity resources of neighbouring systems that are operating at their maximum capacity and hence limiting the management by the market of a scarcity situation.
- **Target Capacity** is the volume of De-rated capacity deemed necessary by Operator to achieve adopted standard of electricity supply security in the System.
- **Net Transfer Capacity (NTC)** model means a capacity calculation method based on the principle of assessing and defining ex-ante a maximum energy exchange between adjacent bidding zones as referred to in Article 2 of Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management.

TITLE 2: Principles of Maximum Entry Capacity

Article 3: Maximum Entry Capacity

6. According to the current draft of the Lithuanian capacity market rules as well as with the EU target model on cross-border participation in CRM mechanisms, Foreign Physical Units can participate explicitly in the Lithuanian capacity auctions.
7. According to Regulation 2019/943 Article 26 (2), "*Member States may require foreign capacity to be located in a member State that has a direct network connection with the Member State applying the mechanism.*" For Lithuania this implies that the CRM should be open for participation from Poland, Latvia and Sweden.
8. According to Law amending articles 2, 6, 7, 9, 18, 31, 33, 78 and the annex of the law on electricity of the republic of Lithuania and adding chapter ten Article 70^2 (2), The pre-auction shall be open to persons of the Member States whose electricity systems are connected to that of Lithuania via an interconnector(s) and whose transmission system *operator* has entered into the agreement referred to in Article 70^8 of this Law. Such persons shall own or otherwise operate existing capacity facilities in that Member State[…].
9. According to Article 26(7) of Regulation (EU) 2019/943 and the ENTSO-E draft methodology (3 July 2020), the cross-border participation to capacity mechanisms shall be limited to the Maximum Entry Capacity which takes into account the two factors
    - the expected availability of interconnections and
    - the likely concurrence of system stress between the concerned Member States. System stress is manifested by scarcity hours during which a country or bidding zone activates all available market-based production and market-based demand reduction measures and import is at its maximum level.

Article 4: Simultaneous scarcity assessment

10. Indeed, in case scarcity situations happen simultaneously in Lithuania and in one (or several) foreign country, the market-based production in the foreign country may not be sufficient to

ensure export to Lithuania up to Net Transfer Capacity of the interconnector or may induce export from Lithuania. Then, coincidental stress events shall be considered when assessing the Maximum Entry Capacity of interconnector.

11. According to Article 7 of the ENTSO-E draft methodology (3 July 2020), the general principle for calculating contribution (maximum entry capacity) of a neighbouring bidding zone or country to adequacy is based on the average hourly contribution of the exports from the electrical neighbour to Lithuania during all modelled scarcity hours (single and simultaneous) and expressed in MW. If the average export during scarcity hours is negative its contribution and therefore its maximum entry capacity is 0 MW.
12. The modelled scarcity hours are based on the forward-looking, probabilistic and simulation-based European Resource Adequacy Assessment (ERAA) modelling pursuant to Article 23 of Regulation (EU) 2019/943 considering the available "Scenarios with Capacity Mechanism" [1].
13. Most importantly the simultaneous scarcity hours based on the proposed ENTSO-E draft methodology using the ERAA model are based on the Expected Energy Not Served (EENS) of the CM market and the interconnected bidding zones (countries).

[1] Cf. https://consultations.entsoe.eu/markets/proposal-for-cross-border-participation-in-capacit/

Appendix

A Maximum Entry Capacity calculation for the 2025 delivery auction

Transitory methodology of Maximum Entry Capacity calculation

A.1 The current Adequacy Assessment model employed by LitGrid does not consider a regional perspective that would derive ex-ante EENS values for neighbouring Member States. As a result, a direct application of the approach outlined in Article 4 above is not possible. Therefore, a transitory methodology for the calculation of Maximum Entry Capacity of interconnectors is proposed.

The transitory methodology of the Maximum Entry Capacity proposed below is aligned with the principles presented in the ENTSO-E draft methodology accounting for both the availability of the interconnector and the likely concurrence of system stress.

A.2 Because of the national scope of the current Adequacy Assessment model described in Part 1, a two-step approach is proposed:

- In the first step, the impact of simultaneous scarcity situations is calculated based on historical day-ahead price and power flow data. This impact will be reflected in the interconnector's adjusted cross-border capacities used in the subsequent step.
- In the second step, the marginal approach described in Part 1 is applied to the adjusted NTC values obtained in the first step. This step allows to assess the impact of the technical unavailability and of the size of the interconnector on the Lithuanian adequacy.

A.3 Below we present in more detail each of the two steps of the approach.

Assessment of NTC adjusted for the simultaneous scarcity situations

A.4 To calculate the impact of the coincident stress, we propose to analyse the historical day-ahead hourly prices and flows in Lithuania and the neighbouring countries: Poland, Sweden and Latvia based on the available ENTSO-E transparency data in the period from 2016-2019. The proposed methodology has already been applied in the context of the Capacity Mechanism of the UK.[2]

A.5 First, historical peak periods (hours) are defined as the highest 50% of Lithuanian peak demand periods during the winter quarter from 2016-2019. The winter peak period is defined by business day hours from 7am-7pm in December, January and February. The Lithuanian peak demand periods identified this way represent about 7% of the hours and can be considered as representative of the conditions of the national system stress.

A.6 Second, for each studied year and within the peak periods as defined above, the following two conditions are assessed:

- The price difference between Lithuania and the neighbouring Member State is positive, and

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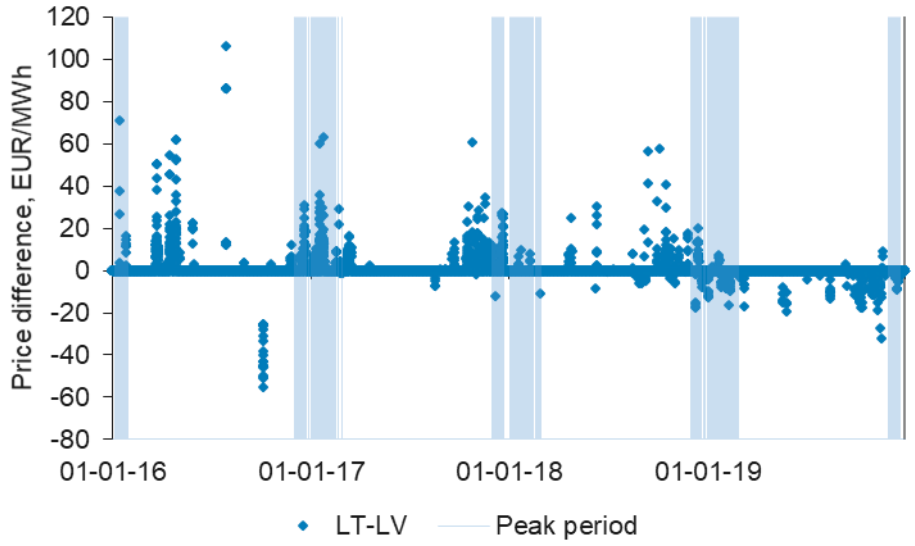
[2] https://www.gov.uk/government/publications/capacity-market-2019-update-of-historical-de-rating-factors-for-great-britain-interconnectors

- Lithuania imports from the neighbouring Member State.

A.7 These two conditions serve as proxies of the simultaneous scarcity situation between Lithuania and the interconnected Member State. The price in the neighbouring Member State higher than in Lithuania could indicate a likely scarcity in the neighbouring Member State in the period when Lithuania has a scarcity situation. The direction of the imports during these periods should further confirm the availability of market-based production in the neighbouring Member State to provide exports towards Lithuania during the scarcity period, especially in case of price equality between Member States.

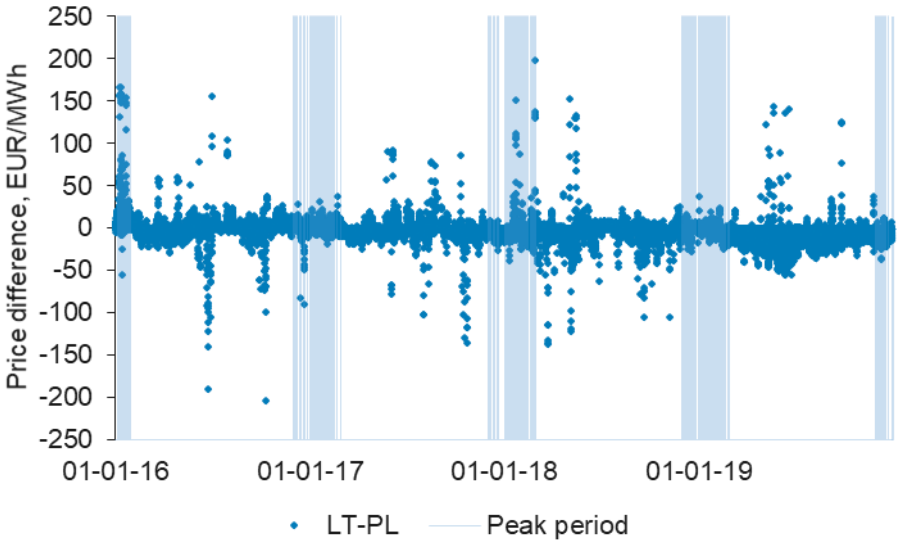
A.8 Figure 1, Figure 2, and Figure 3 below show an example of the price differences between Lithuania and the three interconnected countries together with highlighted peak periods from 2016-2019. The price differences between Lithuanian and Sweden are calculated using the Swedish bidding zone 4 (SE4) which is directly interconnected with Lithuania. Using SE4 bidding zone data removes the effect of transmission congestion among other bidding zones in Sweden which are not directly interconnected with Lithuania.

Figure 1: Price differences between LT and LV, 2016-2019



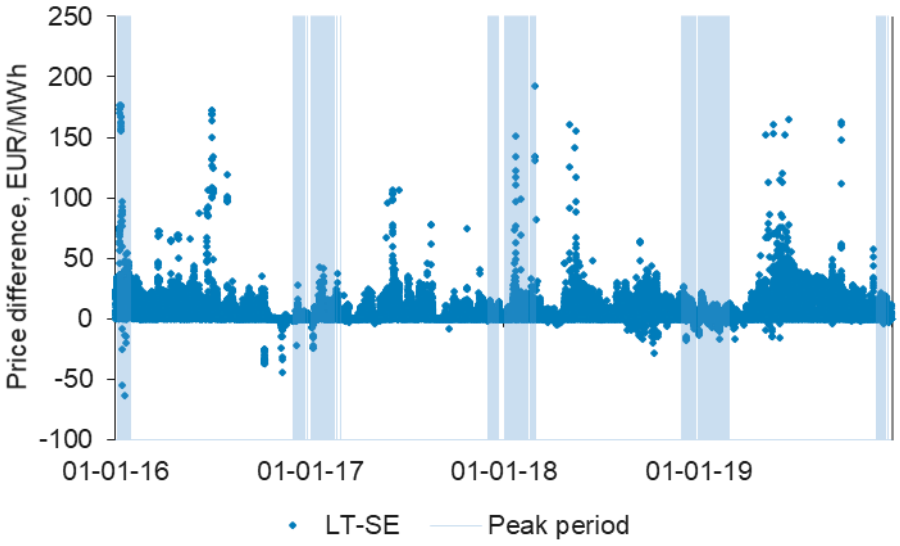
Source: CL analysis, ENTSO-E Transparency data

Figure 2: Price differences between LT and PL, 2016-2019



Source: CL analysis, ENTSO-E Transparency data

Figure 3: Price differences between LT and SE4, 2016-2019



Source: CL analysis, ENTSO-E Transparency data

A.9 In the examples above, the interconnectors with Sweden and Latvia are characterized by zero or mostly positive price differences, i.e. Lithuania having equal or higher prices, but the price differentials on the Polish interconnector are distributed more equally between positive, zero, and negative differentials

A.10 Table 1 below provides example result of the described calculation which shows the number of hours out of the total peak period hours during which Lithuania was the higher price area and was simultaneously importing, presented per interconnector and per year.

Table 1: Peak period hours during 50th percentile of Lithuanian prices, with non-negative price difference and import flow to Lithuania, 2016-2019

Year	N peak hours	N peak hours, PL price not missing	N hours non-negative price difference and positive import			% hours non-negative price difference and positive import		
			SE	PL	LV	SE	PL	LV
2016	407	349	34	129	403	8%	37%	99%
2017	365	337	210	39	360	58%	12%	99%
2018	715	541	641	124	547	90%	23%	77%
2019	860	690	773	85	651	90%	12%	76%
2016-2019	2347	1917	1658	377	1961	71%	20%	**84%**
2018-2019	1575	1231	1414	209	1198	90%	17%	76%
2017-2019	1940	1568	1624	248	1558	**84%**	16%	**80%**

Source: CL analysis, ENTSO-E Transparency data

A.11 It should be noted that the interconnector between Sweden and Lithuania was commissioned at the end of 2015 and the year 2016 may not be a representative year of typical commercial power exchanges between the two areas. For this reason, a shorter sample of 2017-2019 is used to define the adjusted NTC for the Swedish-Lithuanian interconnector.

A.12 We propose that for the 2025 capacity auction in Lithuania the adjustment factor for the simultaneous scarcity situations is set at **84% for LT-SE** interconnector based on 2017-2019 and at **84% for LT-LV** interconnector based on time period 2016-2019 or 80% based on the 2017-2019 period consistently with the LT-SE interconnector.

A.13 The Polish-Lithuanian interconnector, however, requires a different approach. The historical flows on the Polish-Lithuanian interconnectors have been often inefficient, that is, even during hours with very high price differences the available NTC is frequently not used fully in the adequate direction. Therefore, the import flow condition for the Polish-Lithuanian interconnector should be dropped considering only at the non-negative price spread in the peak periods. This approach assumes that in the future CRM delivery period the flow inefficiencies between Poland and Lithuania will be removed and the price differences will be an accurate indicator of the likely flows.

A.14 The result of this approach is presented in Table 2. We propose that for the 2025 capacity auction in Lithuania the de-rating factor of the LT-PL interconnector reflecting the coincidence stress events is **51%** based on the time period 2016-2019 or 41% considering the 2017-2019 period consistently with LT-SE interconnector.

Table 2: Peak period hours during 50th percentile of Lithuanian prices, with positive price difference, 2016-2019

Year	N peak hours	N peak hours, PL price not missing	N hours non-negative price difference			% hours non-negative price difference		
			SE	PL	LV	SE	PL	LV
2016	407	349	399	333	407	98%	95%	100%
2017	365	337	365	274	365	100%	81%	100%
2018	715	541	715	200	715	100%	37%	100%
2019	860	690	857	176	844	100%	26%	98%
2016-2019	2347	1917	2336	983	2331	100%	**51%**	99%
2018-2019	1575	1231	1572	376	1559	100%	31%	99%
2017-2019	1940	1568	1937	650	1924	100%	**41%**	99%

Source: CL analysis, ENTSO-E Transparency data

Assessment of the impact of marginal de-rating

A.15 In the second step of the Maximum Entry Capacity methodology the marginal de-rating approach is applied to the adjusted NTC values obtained in the first step. This step allows to assess the impact of the technical unavailability and of the size of the interconnector on Lithuanian adequacy. The details of the marginal de-rating methodology are presented in Part 1 of these methodologies.

A.16 Table 3 below presents the results of the application of the two-step approach to the calculation of Maximum Entry Capacity of Lithuanian interconnectors to be used in the 2025 capacity auction in Lithuania. First, it presents the initial NTC values and NTC adjustment for simultaneous stress as derived in A.4 to A.14 above. Second the table shows the expected forced outage rate of the DC interconnectors and the Maximum Entry Capacity calculated according from adjusted NTC using the marginal de-rating methodology presented in Part 1. In particular, it suggests an overall de-rating of 57% for the SE-LT interconnector, 36% for PL-LT interconnector and 80% for the LV-LT interconnector.

Table 3: Maximum Entry Capacity for Lithuanian interconnectors

	NTC, MW	NTC adjustment for simultaneous stress, %	NTC adjusted for simultaneous stress, MW	FOR, %	Maximum Entry Capacity, MW	Maximum Entry Capacity, %
SE-LT	700	84%	588	3%	397	57%
PL-LT	700	41%	287	3%	251	36%
LV- LT	950	80%	760	0%	760	80%

Source: CL and Adequacy assessment study for 2025 auction (KTU, 2020)