Methodology of parameters calculation for Lithuanian Capacity Mechanism

Part 3: Methodology for the allocation of Auction Target 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 3 and focuses on the Auction Target 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
   - **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.
   - **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: Auction Target Capacity principles

Article 3: Auction Target Capacity and auction demand parameters reference year

6. The Auction Target Capacity as well as other parameters of the auction demand curve shall be determined separately for each Capacity Auction with reference to the auction delivery year.

Article 4: Target Capacity for a given demand scenario

7. Target Capacity is the total volume of de-rated capacity that is expected to allow Lithuanian power system to reach the reliability standard as applied by Lithuanian national regulation or Reliability Standard[1] as considered in terms of Article 25 of the Electricity Regulation 2019/943, which ever prevails expressed in terms of target hours of LOLE. For a given projection of demand in the delivery period, such target capacity can be assessed as a sum of the de-rated capacity of each national unit and Maximum Entry expected in the adequate portfolio. To the extent the de-rated capacity is calculated differently for different adequate portfolios, an average across the considered adequate portfolios should be taken.

8. The calculated Target Capacity will be different for each scenario of demand projection in the auction delivery period. This methodology focuses on the welfare analysis used to select the demand projection for setting a single Target Capacity.

Article 5: Welfare analysis to identify the optimal demand scenario to set the Target Capacity

9. The Electricity Regulation 2019/943 requires the capacity mechanism to be based on realistic yet not overly pessimistic assumptions in order not to lead to inefficient over-procurement of capacity. In particular, Article 22 (1) (c) states that a capacity mechanism "*shall not go beyond what is necessary to address the adequacy concerns referred to in Article 20*".

10. To meet this requirement, a welfare approach shall be applied to choose between the demand scenarios in setting the auction target capacity for a given delivery year. The approach is based on the principle of maximisation of the social welfare (minimisation of costs for customers related to capacity procurement and power outages) of the Lithuanian power system under the uncertainty about the future scenarios. The social welfare maximization aims to find the trade-off between the following options:

    i. If the Target Capacity is set based on the lowest scenario, it could be that the system will fall short of the Reliability Standard in terms of a target hours of LOLE resulting in an increased cost of power outages for customers, while providing savings on capacity costs.

[1] The Reliability Standard is considered in terms of Article 25 of the Electricity Regulation 2019/943.

ii. On the other hand, if the Target Capacity is based on the highest scenario, the system will likely reach a higher than the Reliability Standard expressed in terms of a target hours of LOLE. The cost of outages for consumers will be low, but the cost of procurement of excess capacity will be high.

11. The principle of selection of the demand projection to set the Target Capacity is to maximize the social welfare (or minimize the cost to consumers) under possible uncertainties of the future demand.

Article 6: Auction Target Capacity and auction demand curve parameters

12. The Operator shall determine the Auction Demand Curve based on:

    a. Auction Target Capacity (ATC), defined as the Target Capacity according Article 5 reduced by:

        i. previously awarded Capacity Obligations with respect to the relevant Delivery Period;

        ii. the value of De-rated Capacity that will not participate in the Capacity Auction and is not previously awarded Capacity Obligation, which the Operator expects to be operational during the Delivery Period;

        iii. in case of a T-5 auction, a [5%] of Target Capacity reserved for the T-1 auction for the given Delivery Period; and

        iv. Maximum Entry Capacity, for each border, less the combined volume of Foreign Units on the relevant border if this difference is positive.

    b. The Net Cost of New Entry (Net CONE), as calculated by a methodology developed by the Regulatory Authority[2] setting the price level where the demand curve reaches the Auction Target Capacity.

    c. The parameter A, that is a multiplier coefficient defining the Auction Price Cap as the product of A and Net CONE.

    d. The volume of capacity below the Auction Target Capacity for which the price achieves the Auction Price Cap. The ratio between this capacity and Auction Target Capacity determines parameter X%.

    e. The volume of capacity above the Auction Target Capacity for which the price achieves the minimum value of Euro 0.01/kW/year. The ratio between this capacity and Auction Target Capacity determines parameter Y%.

[2] Nutarimas dėl pajėgumų aukciono dalyvių pasiūlymų ir aukciono didžiausių kainų nustatymo metodikos patvirtinimo, 2020

TITLE 3: Target Capacity calculation

Article 7: Scenario matrix

13. In the first step, a matrix of scenarios is defined representing the combinations of

    - **Expected Scenarios**, that is, demand scenarios expected at the time of the auction and the considered adequate portfolios allowing to reach the Reliability Standard in terms of target hours of LOLE under the expected demand scenario.
    - **Realised Scenarios**, that is, scenarios of demand that may realise in the delivery period.

14. This matrix of scenarios is presented in Table 1 below. The matrix shows the range of expected scenarios in terms of Expected Demand (ED_{1-N}) and adequate portfolios for each Expected Demand value, $AP_{1\text{-}K,1\text{-}N}$. The matrix also shows the Realised Scenarios in terms of Realised Demand $RD_{1\text{-}N}$.

Table 1: Scenario matrix

		Expected scenarios					
		ED_1		,,,		ED_N	
		$AP_{1,1}$	$AP_{1,K}$	…	…	$AP_{N,1}$	$AP_{N,K}$
Realised scenarios	RD_1						
	RD_2						
	…						
	RD_N						

Article 8: Cost of Expected Energy not Served

15. If the realised demand is higher than the demand in the Expected Scenario used for setting the capacity target, this would lead to an increase of the MWh level of Expected Energy Not Served (EENS). The cost of EENS should then be assessed as the EENS estimated assuming capacity need is procured based on the Expected Scenario, under demand of the Realised Scenarios.

16. The Expected Energy Not Served is then multiplied by VOLL to represent the Cost of EENS:

$$Cost\ of\ EENS_{ES,RS} = EENS_{ES,RS} \cdot VOLL$$

17. Where:

    - $EENS_{ES,RS}$ represents the EENS estimated using the adequacy analysis assuming capacity need is procured based on the Expected Scenario, under the demand reflecting the given Realised Scenario.
    - VOLL is the Value of Loss of Load in €/MWh. The VOLL is estimated and periodically updated according to the methodology developed by ENTSO-E and approved by ACER according to Electricity Regulation 2019/943, Article 23(6).

Article 9: Cost of Capacity

18. The Expected Scenarios correspond to the assumptions made ex-ante to derive the capacity necessary to achieve the Reliability Standard expressed in terms of expected LOLE target hours

per year. When compared to the Realised Scenarios, the capacity procured ex ante may represent a deficit or a surplus as compared to the realised capacity need.

19. This Capacity necessary to achieve the LOLE target multiplied by the Cost of New Entry would represent the cost of excess capacity that an Expected Scenario may produce under each Realised Scenario:

$$Cost\ of\ Capacity_{ES} = Capacity\ Need_{ES} \cdot CONE\ ,$$

20. Where:

    - $Capacity\ Need_{ES}$ represents the volume of additional capacity in MW needed to be procured to reach the LOLE target in the Expected Scenario.
    - CONE is the Cost of New Entry in €/MW. A CONE value is estimated and periodically updated according to Lithuanian national regulation or the methodology developed by ENTSO-E and approved by ACER according to Electricity Regulation 2019/943, Article 23(6), whichever prevails.

Article 10: Selection of the demand scenario to set the Target Capacity

21. The estimated Costs of Capacity and EENS are used to identify the Expected Scenario to be used to set the auction target capacity in the following two steps:

    i. First, the **Maximum Cost** is calculated for each Expected Scenario. That is, for each Expected Scenario *ES*, the maximum of the sum of Cost of Capacity and Cost of EENS is calculated across all Realised Scenarios *RS:*

$$Maximum\ Cost_{\ ES} = max_{RS}(Cost\ of\ Capacity_{ES} + Cost\ of\ EENS_{ES.RS})$$

    ii. Second, the **Expected Scenario used to set the Target Capacity** is determined as the one that minimises the Maximum Cost:

$$Expected\ Scenario\ for\ Target\ Capacity = argmin_{ES}\ (Maximum\ Cost_{\ ES})$$

Article 11: Calculation of the Target Capacity

22. The Target Capacity for a specific auction and auction delivery year is set by applying the calculated marginal de-rated capacity to each national unit and interconnector under the selected Expected Scenario of demand. An average Target Capacity will be calculated across adequate portfolios.

23. In addition to the Target Capacity, a $Target\ Capacity_{APC}$ is calculated for the selected Expected scenario of demand as de-rated capacity necessary to reach a LOLE level higher than the Reliability Standard by the ratio between the Auction Price Cap and the net CONE. The approved methodology by the National Energy Regulatory Council of Lithuania[3] sets the Auction Price Cap this ratio at 1.5.

[3] Nutarimas dėl pajėgumų aukciono dalyvių pasiūlymų ir aukciono didžiausių kainų nustatymo metodikos patvirtinimo, 2020

Article 12: Auction Target Capacity

24. According to Article 6, Auction Target Capacity for a given Capacity Auction is calculated by reducing Target Capacity by elements, listed in paragraph 12a.

Article 13: Parameters of auction demand curve determining the volumes of capacity below and above the Auction Target Capacity

25. The Auction Target Capacity will determine the middle point of the demand curve to be reached at the price level equal to the Net CONE as determined in the methodology of demand curve parameters.[4] A downward sloping demand curve around this middle point should be determined with two additional points:

    1. Volume of capacity to be reached at the price level of Auction Price Cap. This Volume should be lower than the Auction Target Capacity by X%, and
    2. Volume of capacity to be reached at the price level of 0.01€/MW. This volume should be higher than the Auction Target Capacity by Y%.

26. Parameter X% is then calculated as:

$$X\% = \frac{Target\ Capacity - \ Target\ Capacity\ _{APC}}{Auction\ Target\ Capacity} \cdot 100\%$$

27. Since the auction demand curve is linear, the $Capacity\ Volume_0$ is determined by linear extrapolation using the points of $Capacity\ Volume_{APC}$ reached at the Auction Price Cap determined at 1.5 of net CONE and Auction target Capacity reached at net CONE. Such linear extrapolation suggests the following formula for the parameter Y%:

$$Y\% = 2 \cdot \frac{Target\ Capacity - \ Target\ Capacity\ _{APC}}{Auction\ Target\ Capacity} \cdot 100\%$$

[4] Nutarimas dėl pajėgumų aukciono dalyvių pasiūlymų ir aukciono didžiausių kainų nustatymo metodikos patvirtinimo, 2020

Appendix

A Auction Target Capacity and demand curve parameters calculation for the 2025 delivery auction

Inputs and assumptions used for the calculation of Auction Target Parameters 2025

A.1 Below we provide sample calculations of the Auction Target Capacity calculation and parameters X% and Y% for the auction with delivery in 2025 based on the Adequacy Study[5] and derating calculation performed by KTU for this delivery year.

A.2 We use the Reliability Target defined for Lithuania at 8 hours of LOLE. In absence of the VOLL and CONE values defined in accordance with the ENTSO-E methodologies, we assume the values of 60,000€/MW for CONE and 7,500€/MWh for VOLL. Such values CONE are in line with the European CONE benchmarks and the CONE and VOLL values together are consistent with the reliability target of 8 hours of LOLE. We verify that the findings in this section are valid for a wide range of values of CONE and VOLL.

Selection of the demand scenario for setting 2025 Auction Target Capacity

A.3 The matrix of scenarios defined according to Article 7 is as follows:

- **Expected Scenarios.** According to the current Adequacy Study and analysis of marginal de-rating, two demand scenarios are considered for 2025: 1930MW and 2190MW depending on the progress of the rail electrification. For each expected demand the Adequacy Study considers two scenarios of adequate portfolios (1 or 2 conventional units and storage with 200MW/600MWh capacity).
- **Realised Scenarios**. We assume the same two demand scenarios considered in the Adequacy Study as possible realisations of demand.

A.4 This matrix of scenarios for 2025 is presented in Table 1 below. The table also shows the estimated EENS for each scenario of realised demand assuming the adequate portfolio for a given expected demand.

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Table 2: Scenario matrix for 2025 and the expected EENS (MWh)

		Expected demand			
		Low demand		High demand	
Capacity to meet 8h LOLE, MW		1x280	2x140	2x260	2x225 + 200/600
Realised scenarios	Low Demand	1,545	1,609	263	250
	High Demand	8,249	8,592	1,583	2,040

Source: Adequacy Study, FTI-CL Analysis

A.5 Table 3 below presents the costs of EENS estimated according to Article 8 based on the VOLL value as mentioned in A.2 and the EENS values from Table 2.

Table 3: The Cost of EENS per year, thousand €

		Expected demand			
		Low demand		High demand	
Realised scenarios	Low Demand	11,588	12,068	1,973	1,875
	High Demand	61,868	64,440	11,873	15,300

Source: Adequacy Study, FTI-CL Analysis

A.6 Table 4 below presents the Cost of Capacity estimated according to Article 9 based on the CONE value as mentioned in A.2 and the capacity values from Table 2.

Table 4: The Cost of Capacity per year, thousand €

		Expected demand			
		Low demand		High demand	
Realised scenarios	Low Demand	16,800	16,800	31,200	39,000
	High Demand	16,800	16,800	31,200	39,000

Source: Adequacy Study, FTI-CL Analysis

A.7 Table 5 below presents the total cost calculated as the sum of the cost of EENS and capacity presented in Table 3 and Table 4. It also shows for each expected scenario the maximum cost across the possible realised scenarios.

Table 5: The total cost and Maximum Cost per year, thousand €

		Expected demand			
		Low demand		High demand	
Realised scenarios	Low Demand	28,388	28,868	33,173	40,875
	High Demand	78,668	81,240	43,073	54,300
Maximum Cost across realised scenarios		78,668	81,240	43,073	54,300

Source: Adequacy Study, FTI-CL Analysis

A.8 The table suggests that the Maximum Cost can be minimised by setting the Target Capacity at the High demand scenario. We verify that this result holds for any value of VOLL and CONE that are consistent with 8 hours LOLE Reliability Standard.

Calculation of the Target Capacity for 2025 delivery auction

A.9 Based on the preliminary results of de-rating of national capacity presented in Part 1 of the methodologies and the Maximum Entry Capacity presented in Part 2 of the methodologies, the Target Capacity for 2025 is estimated in Table 6 to be 3,029MW.

Table 6: Target Capacity calculation for 2025 delivery year

	Available capacity, MW		De-rated capacity, MW	
Capacity unit	**A1a0**	**A1a2**	**A1a0**	**A1a2**
New Unit 1	255	225	223	197
New Unit 2	255	225	223	197
New batteries		200		71
KCB	435	435	337	337
NordBalt	700	700	399	399
Harmony Link	700	700	252	252
LV – LT	950	950	760	760
KHAE G1	200	200	105	105
KHAE G2	200	200	105	105
Mažeikiai CHP G1	73	73	69	69
Mažeikiai CHP G2	73	73	69	69
Panevėžys CHP	30	30	25	25
Wind onshore	1506	1506	90	90
Wind offshore	0	0	0	0
Solar	625	625	31	31
Hydro	128	128	13	13
Biofuel PPs	177	177	147	147
Waste PPs	70	70	58	58
Other	136	136	113	113
Total de-rated capacity			3,020	3,038
Average across adequate portfolios				**3,029**

Source: *Part 1 - methodologies for de-rating capacity calculation for national generation capacity and foreign capacity participating in Lithuanian CRM, Part 2 - methodology for Maximum Entry Capacity*

A.10 Consistently with Target Capacity, we provide an estimation of $Target\ Capacity_{APC}$ that should be reached at the price level of the Auction Price Cap. Given that the Target Capacity is set to meet the Reliability Target of 8 hours of LOLE in Lithuania, $Target\ Capacity_{APC}$ and that the Auction Price Cap is set at 1.5 of the net CONE, the $Target\ Capacity_{APC}$ value should be set to reach 1.5 times the target LOLE of 8 hours, which is 12 hours. The value of such $Target\ Capacity_{APC}$ is 2,981MW.

Calculation of Auction Target Capacity, and X% and Y% parameters

A.11 According to Article 6 and Article 12, The Auction Target Capacity for a given Capacity Auction should be calculated based on Target Capacity and adjustments listed in paragraph 12a.

A.12 In the first 2025 delivery auction, no previously awarder Capacity Obligations should be expected and one could assume that the entire Maximum Entry Capacity is allocated for Foreign Capacity. In this case, the necessary adjustments should be a) reduction of the Target

Capacity by non-participating RES de-rated capacity and b) reduction by 5% reserved for T-1 auction. The Auction Target Capacity then becomes:

$$Auction\ Target\ Capacity = 0.95\% \cdot (Target\ Capacity - Derated\ RES\ capacity) = 2762\ \text{MW}$$

A.13 Based on the estimated value of $Target\ Capacity_{APC}$ and the formulas in paragraphs 26 and 27, the value of X% parameter of 2% and the value of Y% parameter of 4%.