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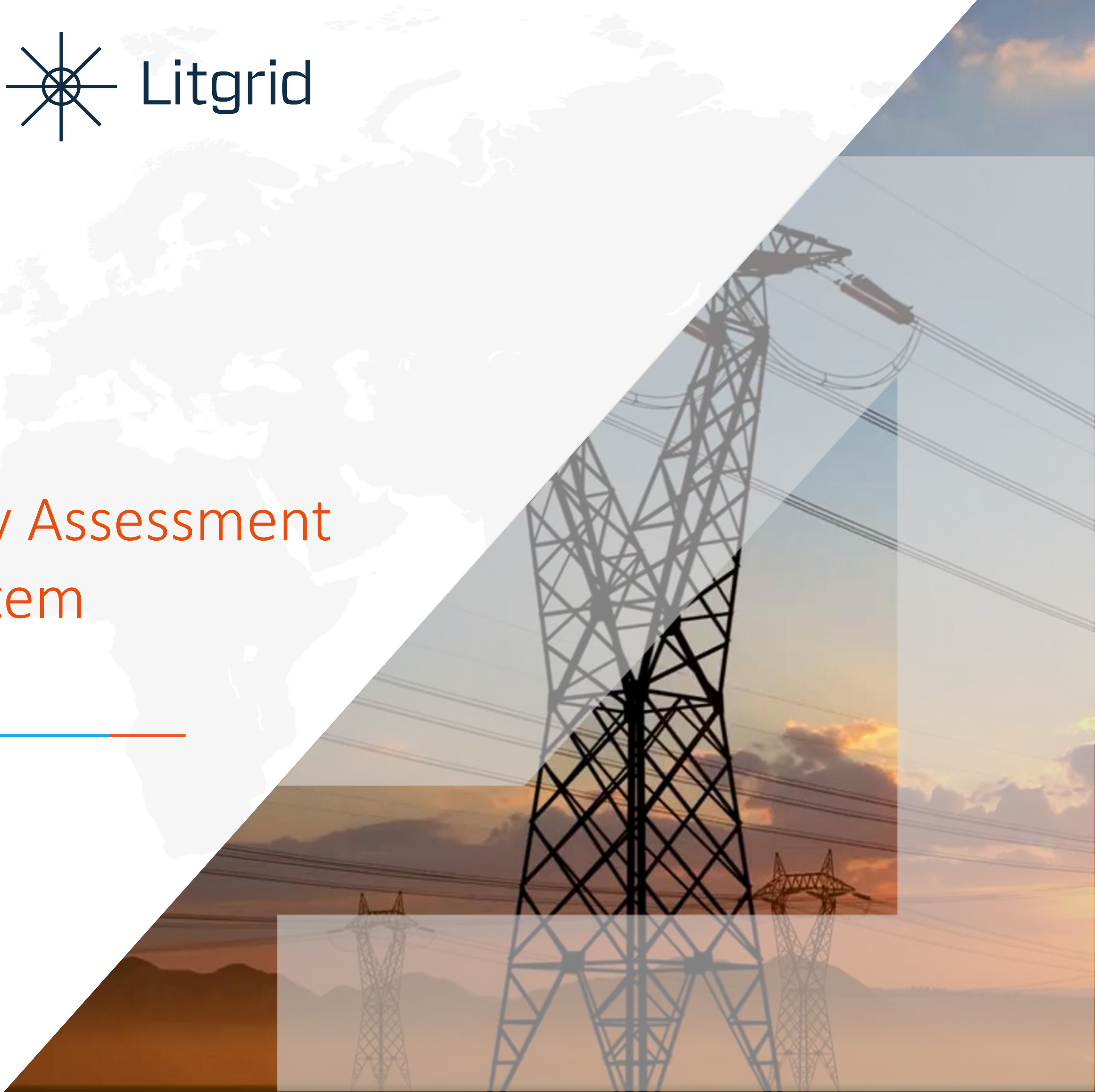


National Resource Adequacy Assessment of the Lithuanian power system for 2028-2035

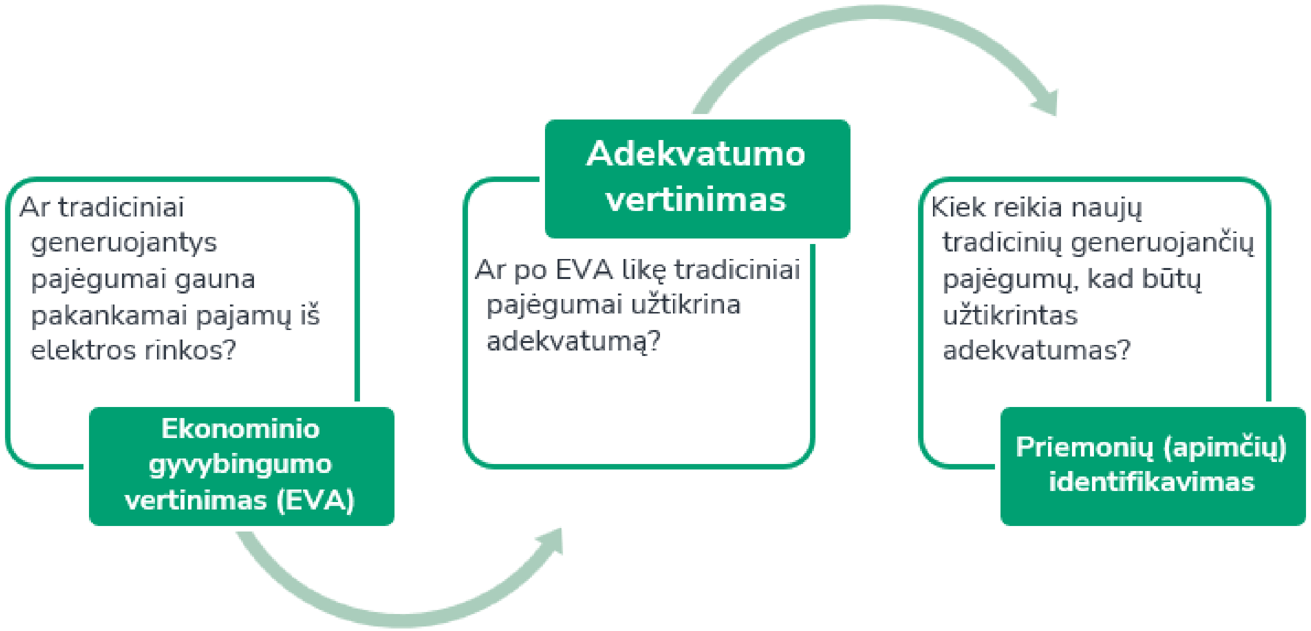
Public presentation of the key results

www.artelys.com 2026.06.22

Sistemos adekvatumo vertinimo studijos pagrindinė informacija

Aspektas	Aprašymas
Sutartis	2025-11-17 pasirašyta su Artelys SAS (Prancūzija)
Studijos tikslai	Generuojančių pajėgumų adekvatumo vertinimas aktualiais jautrumo scenarijais 2028, 2030, 2033, 2035 m. ir lanksčios generacijos poreikio nustatymas
Rezultatas	Nustatyti sistemos adekvatumo rodikliai: - *Tikėtina nepatiekta energija ENS, (GWh)* - *Vidutinė apkrovos praradimo trukmė LOLE, (h)* Identifikuotas lanksčios generacijos pajėgumų apimties poreikis labiausiai tikėtinais scenarijais
Statusas	Studijos pabaiga 2026-06-08

Studijos etapai



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Objectives of Study

- This presentation sets out the findings of the **National Resource Adequacy Assessment (NRAA)** conducted by Artelys for Litgrid, covering the Lithuanian power system over the 10-year period 2028–2037.
- The broader study also encompasses a **Flexibility Needs Assessment (FNA)** (not presented today) the findings of which are presented separately. Both assessments are conducted in accordance with the methodologies established by ENTSO-E and ACER.
  - A public technical note will be published and will include key results from the FNA
- The NRAA pursues **three main objectives**

1. Identify **economically viable generation and flexibility assets** through the Economic Viability Assessment (EVA), and **assess the adequacy of the resulting capacity mix against the 8-hour Loss of Load Hours** reliability criterion,

2. Analyse the **sensitivity of adequacy outcomes** to **interconnection availability**, in particular under short- and long-duration outages of NordBalt and Estlink, as well as to the pace of **RES deployment**

3. Evaluate the **impacts on adequacy of additional thermal capacities** and **estimate capacity needs to ensure adequacy** for the reference scenario and under a range of interconnection stress scenarios.

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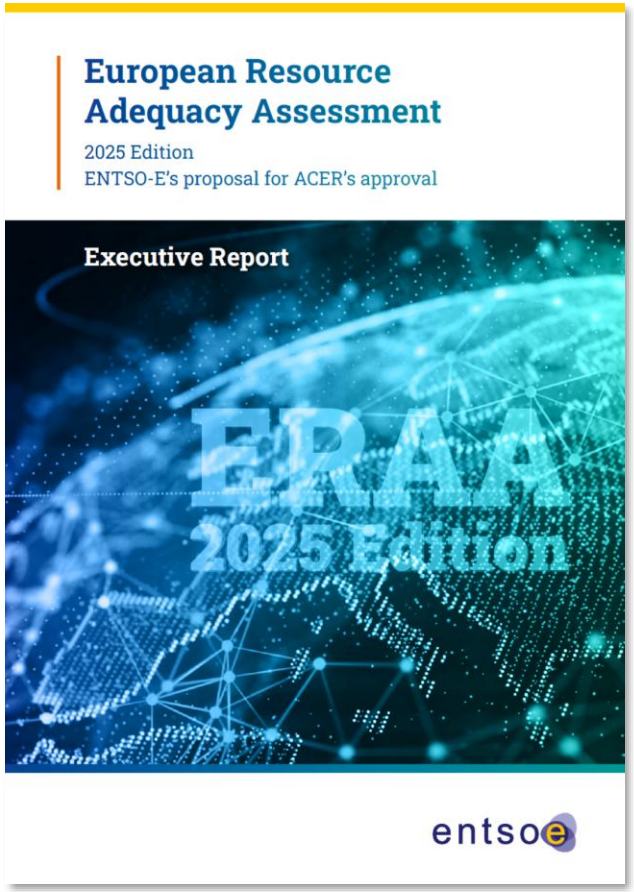
General Methodology

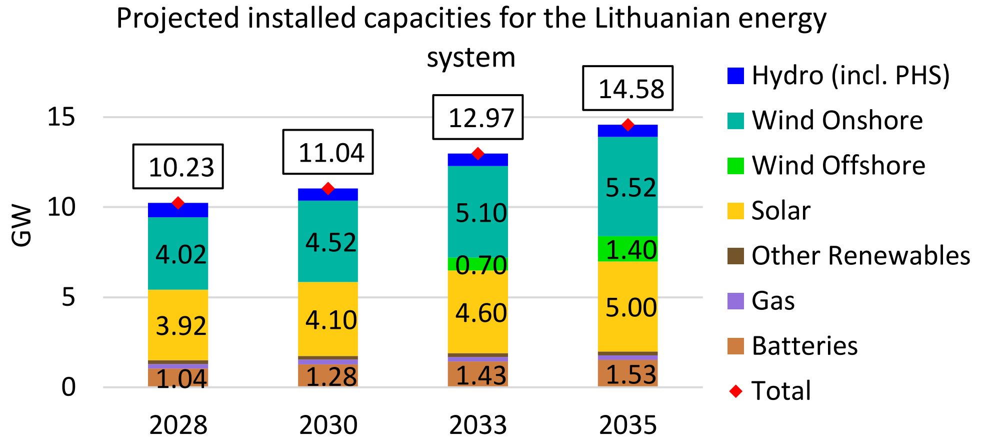
- The study provides Lithuania's **National Resource Adequacy Assessment**, which evaluates the country's ability to ensure a secure electricity supply over the next decade.
  - The analysis relies on the **ERAA Methodology** published by ENTSO-E and on the ERAA 2025 dataset, provided by European TSOs.
  - **Litgrid-specific data** has been incorporated for the modelling of the Lithuanian energy system.
- The methodology includes the **four following steps**:
  1. **Characterisation and parametrisation** of the Lithuanian energy system and the European electrical system based on the provided datasets.
  2. **Economic Viability Assessment** (EVA) of thermal units, complemented by additional explicit demand-side response and battery investment options in Lithuania
  3. **Adequacy simulations over the Central Scenario**
  4. **Sensitivity** adequacy analysis and **Remedial Actions** impact across these various configurations

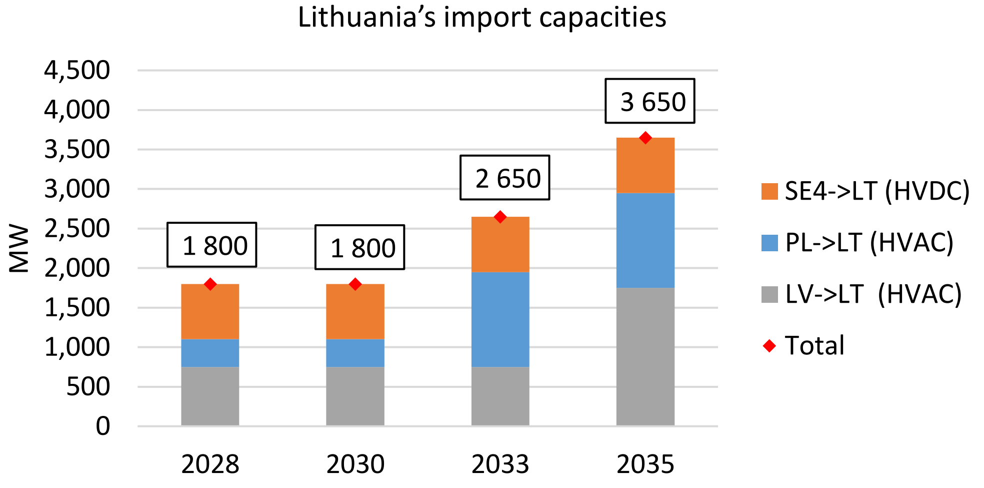


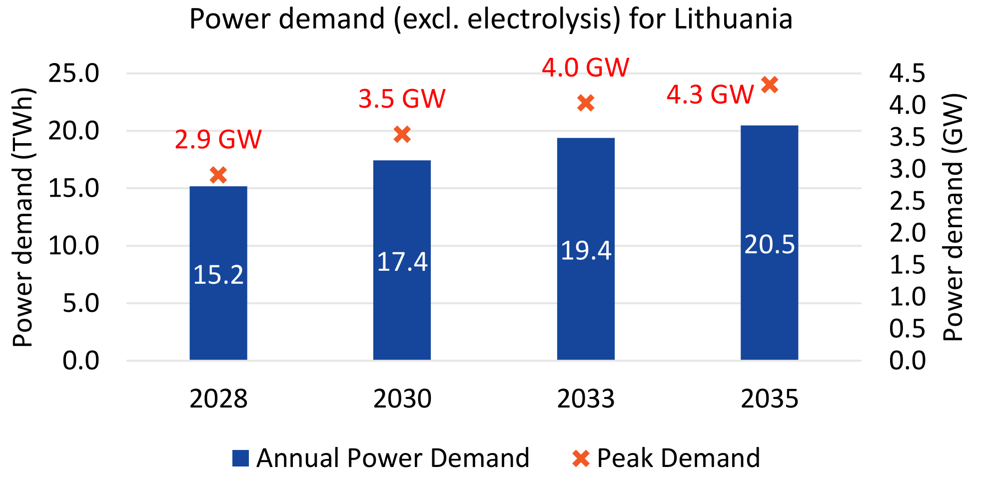
Assumptions of Central scenario

The modelling work focuses on the analysis of a Central scenario which includes **projections for installed capacity and demand** from 2028 to 2035 based on **data provided by Litgrid**.

- The Central scenario integrates the **results of the EVA**, i.e. the **withdrawal of unprofitable thermal** and the **exploitation of additional DSR potential** from 2033 onwards.
- This scenario includes **renewable deployment** from 7,94GW in 2028 to 11,92GW in 2035. The analysis also considers that **interconnection capacities** are also reinforced through the years from **1800MW** to **3650MW** for **imports.**
- **In the Central Scenario, HVAC and HVDC lines** have been modelled based on ERAA dataset with a **0% forced outage rate** of interconnectors.







Overview of Sensitivities and Remedial Actions scenarios

Central Scenario

- **CENTRAL_RA1** — *Retain LE_KCB until 2035*
- **CENTRAL_RA2** — *Retain LE_KCB until 2035, extend LE_B7, LE_B8, KTE + 372 MW CCGT from 2033*

Interconnection Outages sensitivities

- **STRANS0** — *short-term random HVDC outages (forced outages)*
  - **STRANS0_RA3** — *Retain LE_KCB + 372 MW CCGT + **400 MW CCGT***
- **STRANS1** — *Long-duration HVDC outages (forced outages)*
  - **STRANS1_RA4** — *Retain LE_KCB + add 372 MW CCGT from 2033*
  - **STRANS1_RA5** — *Retain LE_KCB + add 372 MW OCGT from 2033 (instead of CCGT)*
  - **STRANS1_RA6** — *Retain LE_KCB until 2035, extend LE_B7, LE_B8, KTE*
  - **STRANS1_RA7** — *Retain LE_KCB + 372 MW CCGT + **2200 MW CCGT***
- **STRANS2** — *Baltic isolated operation*
- **STRANS3** — *LT isolated operation*

Remedial actions = Thermal capacities addition/prolongation

RES Delays sensitivities

- **SRES1** — moderated RES, delayed offshore wind, reduced BESS energy and electrolysis
- **SRES2** — Strong RES reduction, no offshore wind nor electrolysis, reduced BESS power & energy, lower demand

Sensitivities

Sensitivities have been designed to evaluate the impact of both **short-term and extended interconnection outages**, as well as **delays in renewable capacity deployment**.

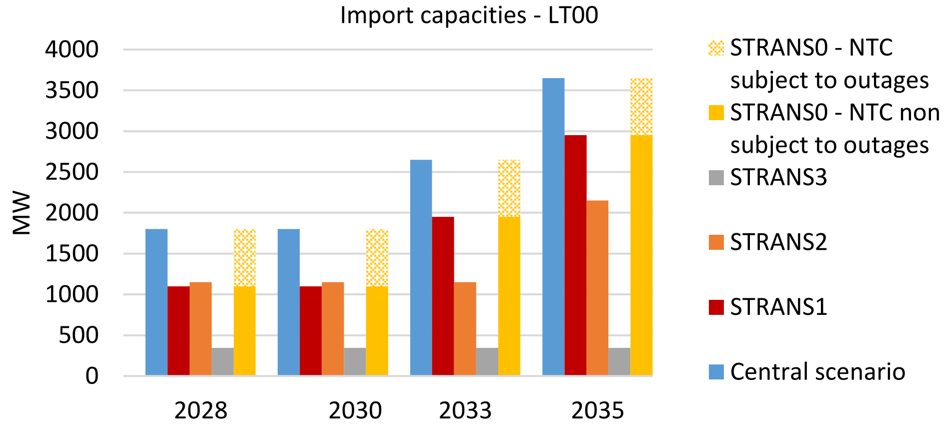
Four sensitivities have been assessed regarding **interconnection outages**

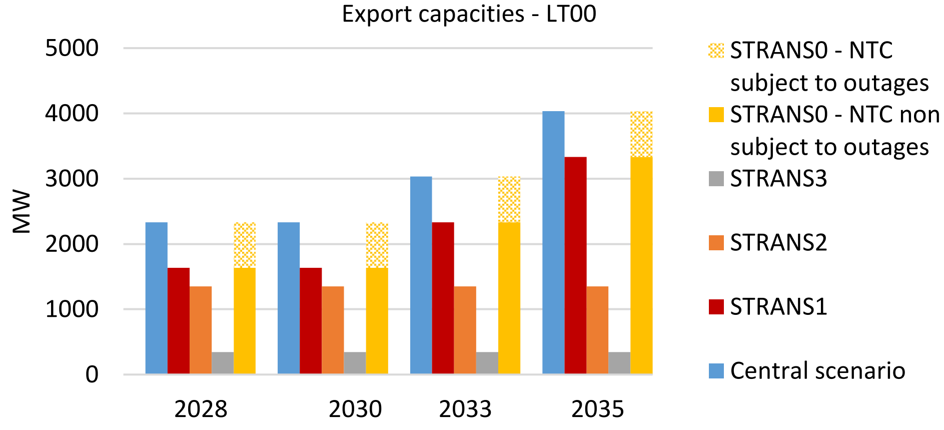
- **STRANS0**: short-term random HVDC outages (forced outages) on top of Central scenario.
- **STRANS1**: long-duration loss of key HVDC link (NordBalt → set to zero).
- **STRANS2**: widespread prolonged outages across multiple interconnections (Baltics effectively isolated).
- **STRANS3**: extreme case with almost all LT interconnections shut, only limited NordBalt capacity remaining.

Two sensitivities are designed to assess **renewable deployment delays**

- **SRES1:** moderated RES rollout (−6% → −15%), delayed offshore wind (2035 only), reduced BESS energy (2h) and electrolysis, demand unchanged
- **SRES2:** strong RES reduction (−21% → −29%), no offshore wind nor electrolysis, reduced BESS power & energy, and structurally lower demand (−8% to −13%)

Exchange capacities for the interconnection outages sensitivities





Remedial Actions

Sensitivities have been designed to evaluate the impact of both **short-term and extended interconnection outages**, as well as **delays in renewable capacity deployment**.

2 sensitivities designed **based on the Central Scenario**:

- **CENTRAL_RA1:** retain LE_KCB until 2035
- **CENTRAL_RA2:** retain LE_KCB, extend LE_B7, LE_B8, KTE and add new 372 MW CCGT from 2033

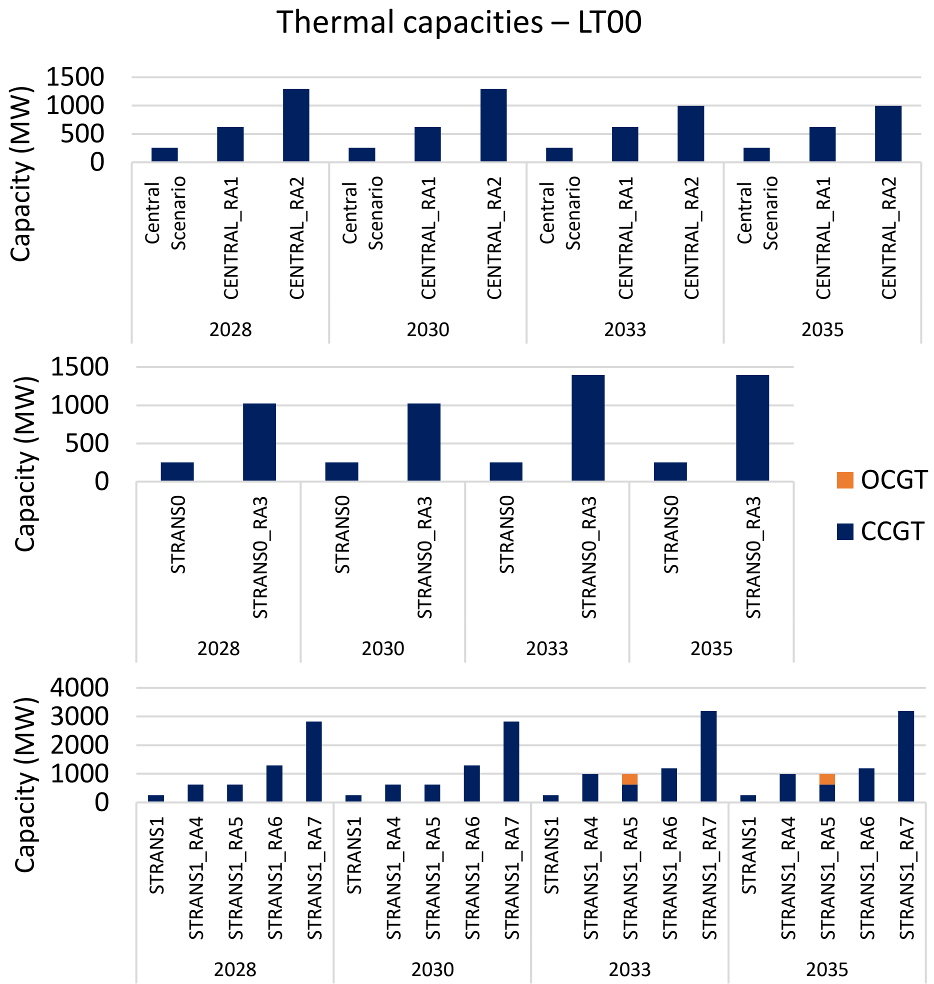
1 sensitivity designed **based on STRANS0**:

- **STRANS0_RA3:** retain LE_KCB + 372 MW CCGT + **400 MW CCGT**

4 sensitivities designed **based on STRANS1**:

- **STRANS1_RA4:** retain LE_KCB + add 372 MW CCGT from 2033
- **STRANS1_RA5:** retain LE_KCB + add 372 MW OCGT (instead of CCGT)
- **STRANS1_RA6:** retain LE_KCB + extend LE_B7, LE_B8 (to 2035) and KTE (to 2030)
- **STRANS1_RA7:** retain LE_KCB + 372 MW CCGT + **2200 MW CCGT**

STRANS0_RA3 and STRANS1_RA7 additional capacities (400 MW and 2200 MW, respectively) have been calibrated to ensure compliance with the 8-hour LOLE criterion over the entire period.



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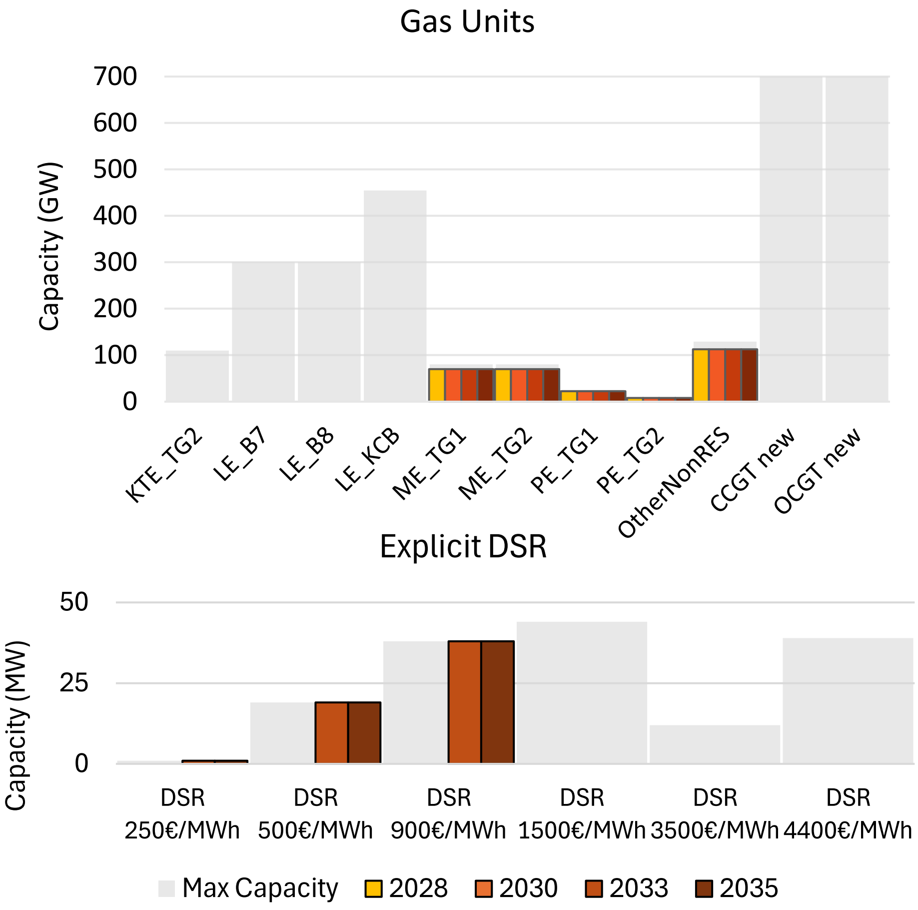
Economic Viability Analysis (EVA)

The EVA shows that new thermal and battery investments are not viable, low costs demand-side potentials are viable, some existing thermal units should not be extended, while most thermal plants remain profitable (excl. LE_KCB).

- The economic viability assessment of thermal power plants and of potential investments in batteries and demand-side flexibility in Lithuania, leads to the following conclusions.
- **Additional Investments**
  - **Investments** in **new thermal** power plants or **battery** are **not economically viable** over the assessed period.
  - **Investments** in **demand-side flexibility** show economic interest, with up to **58 MW** proving cost-effective from 2033
- **Existing Thermal Units**
  - **Extending the lifetime** or **maintaining** LE_B7, LE_B8 and KTE_TG2 are not economically viable options.
  - **LE_KCB does not generate sufficient revenues** to cover its costs—particularly capacity-related costs—and is therefore not profitable.
  - The **other thermal plants** (ME_TG1, ME_TG2, PE_TG1, PE_TG2 and other non-renewable units) remain **economically profitable**.



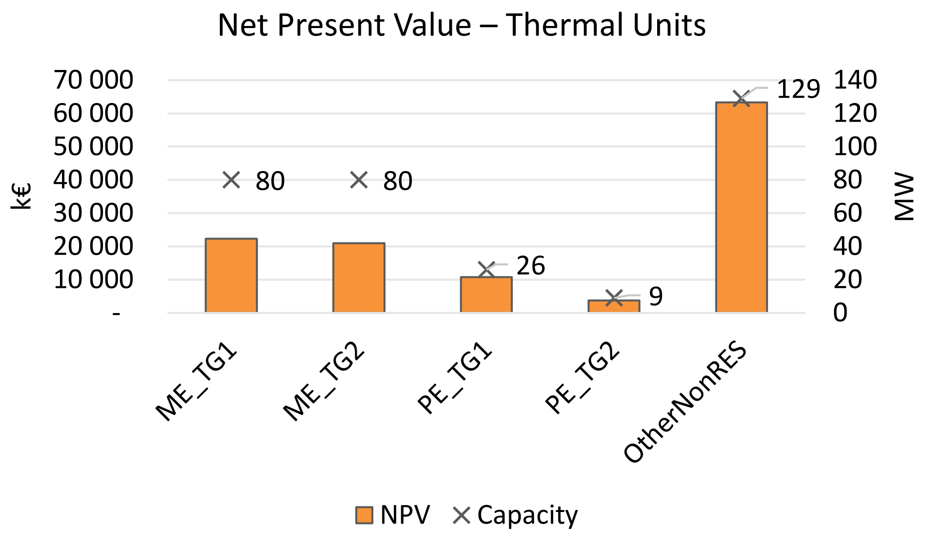
No additional batteries are installed

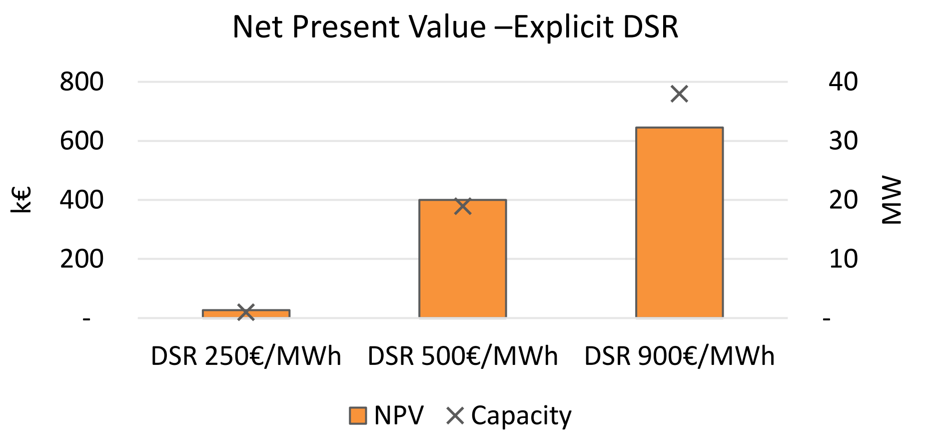
Economic Viability Analysis (EVA)

For the different assets retained within the EVA, the **Net Present Values** have been computed

- The EVA results are based on a net present value (NPV) calculation for each unit over the period 2028–2037[1]. This computations relies on :
  - Estimates of **capacity costs (CAPEX & FOC),** which are related to the capacity and type of each unit.
  - **Revenues and operation costs** of each unit, which is based on simulation results and depends on the marginal costs of each unit. Overall, the lower the marginal costs, the more frequent the power plant is used, and the higher the revenues
  - A discount rate specific to each asset
- **Within the assets selected in the EVA, thermal units' NPV** range from €3.7M to €63.3M, while **explicit DSR NPV** fluctuate between €27k and €645k over the ten-year period.
- Note that the NPV is not normalised per MW and **depends heavily on its capacity.**

[1]NPV is calculated over a 10-year horizon; years 2036–2037 are extrapolated from 2035.

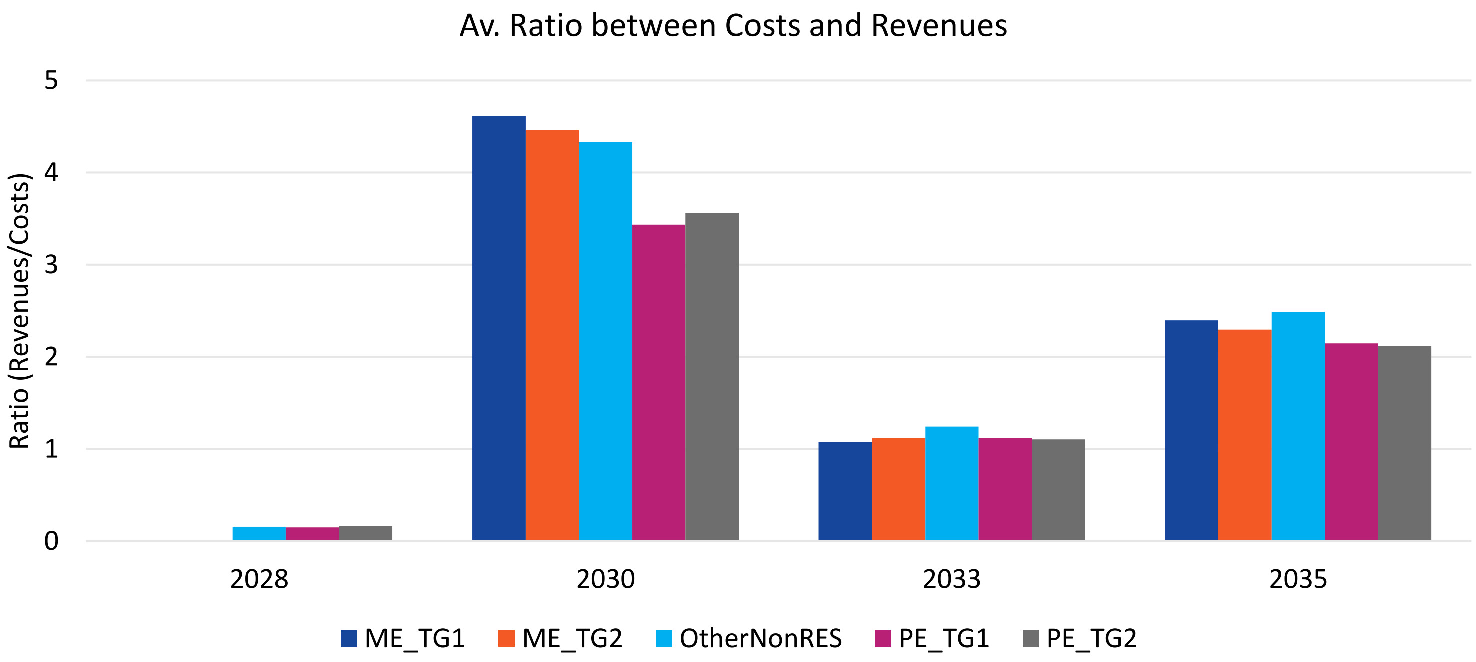




Economic Viability Analysis (EVA)

While thermal unit costs are high, their revenues are limited with a low usage, this results in low profitability.

- Revenues remain limited compared to costs across the different years, as demonstrated by the ratio between revenues and costs. This is due to the low usage of thermal power plants.
  - 2030 stands out as the year in which thermal power stations are both the most profitable and the most heavily used. This reflects **higher system stress** and **more frequent operation opportunities**



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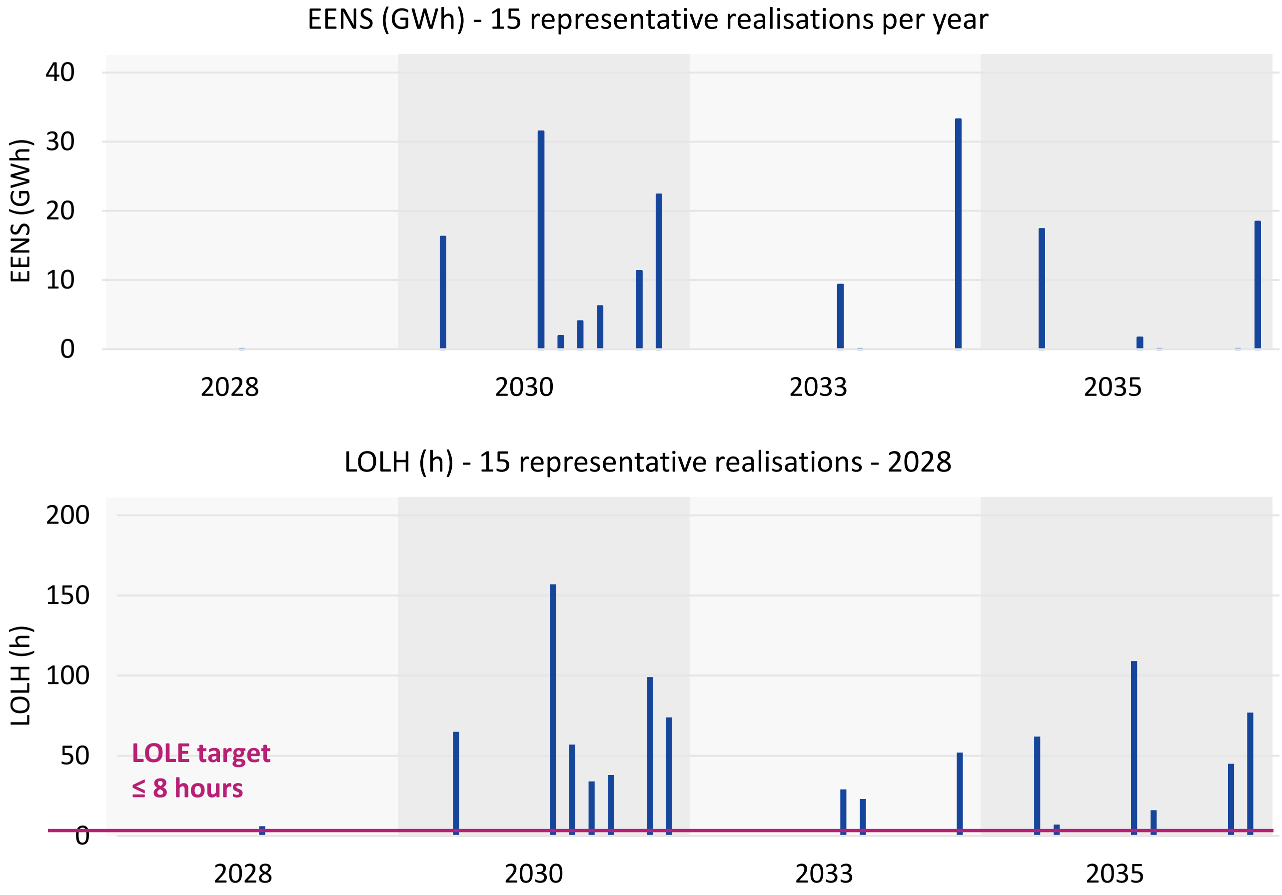
Main Findings

The results show that in the Central Scenario, Adequacy is satisfactory in 2028, but from 2030 onwards, average LOLH exceeds the 8-hours criterion. The analysis also shows that adequacy outcomes are primarily driven by weather conditions, with limited influence from outage patterns.

- With only the capacity evaluated as economically viable in the EVA, **security of supply is not guaranteed** in all situations.
  - In most climate scenarios, security of supply is not threatened, but in **certain extreme scenarios**, the volume of **curtailed demand** could rise up to above 30 GWh in 2030/2033 (about 0.1% of electricity demand).
- The year 2030 stands out, with more than 25% of realisations exceeding 9 GWh of EENS.
- Some extreme scenarios **result in up to 157 hours of Loss of Load by 2030**. **The average Loss of Load criteria of 8 hours is respected in 2028 and 2033 but not in 2030 and 2035.**



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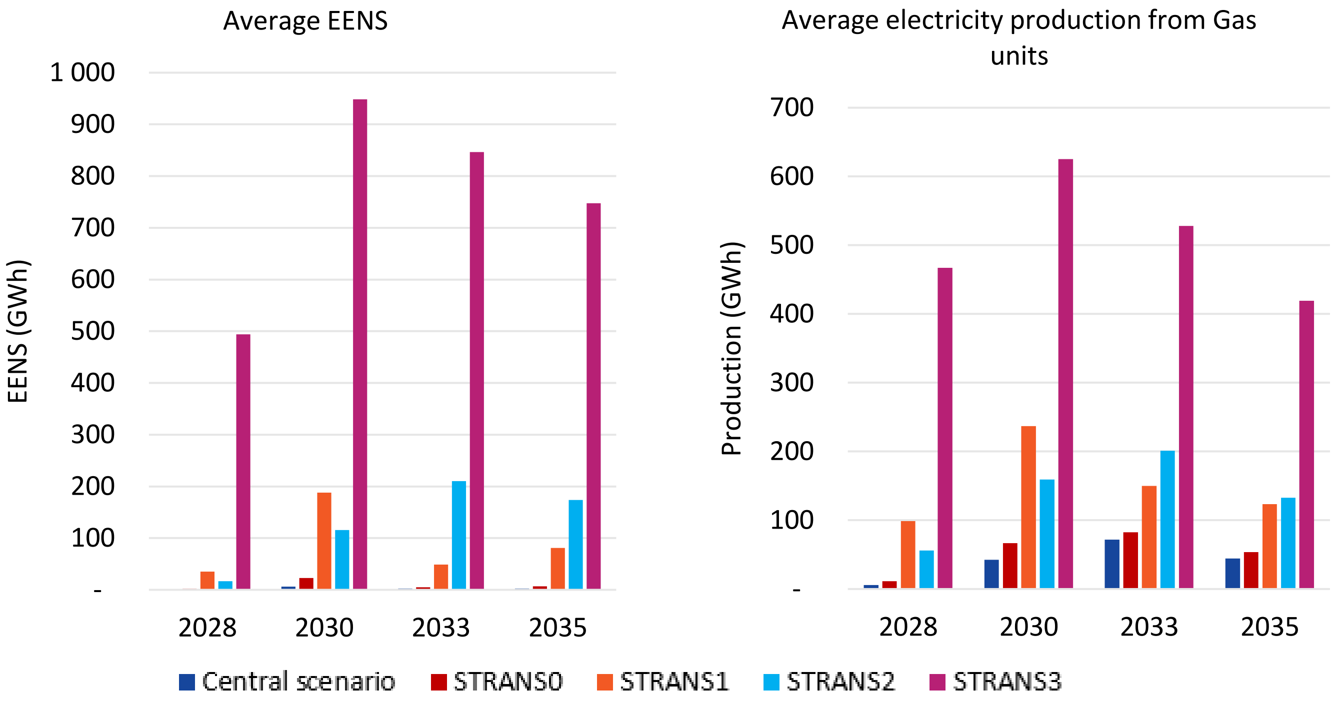
Interconnection outages sensitivities

Interconnections are **essential** for Lithuania's **security of supply**, and the generation fleet from the EVA is **not sufficient to ensure security of supply** in the event of large cross-border interconnection losses/outages.

STRANS0	STRANS1	STRANS2	STRANS3
short-term random HVDC outages (forced outages)	*Long-duration HVDC outages (forced outages)*	*Baltic isolated operation*	*LT isolated operation*

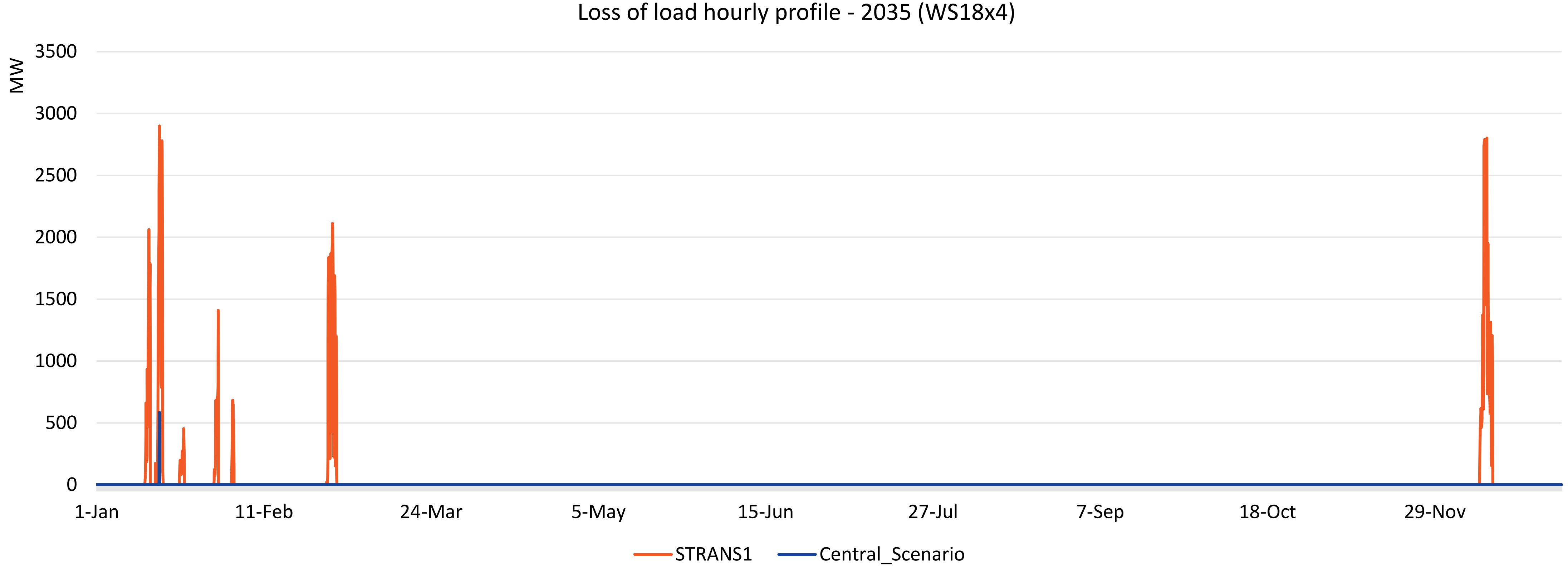
- Loss of interconnections leads to **higher EENS** and **increased gas-fired electricity generation**
- In STRANS3 (LT isolated operation) where Lithuania is connected only to SE04, **EENS** reaches 949 GWh in 2030, equivalent to **5% of national demand**.
- Considering short-term HVDC outages on Baltic interconnections in STRANS0 results in a **slight increase in EENS** compared to the Central scenario, but this remains **small compared to interconnection losses.**
- **The 8-hour criteria is respected over the 10-year period for none of the sensitivities. Remedial actions are required to ensure adequacy is such events**



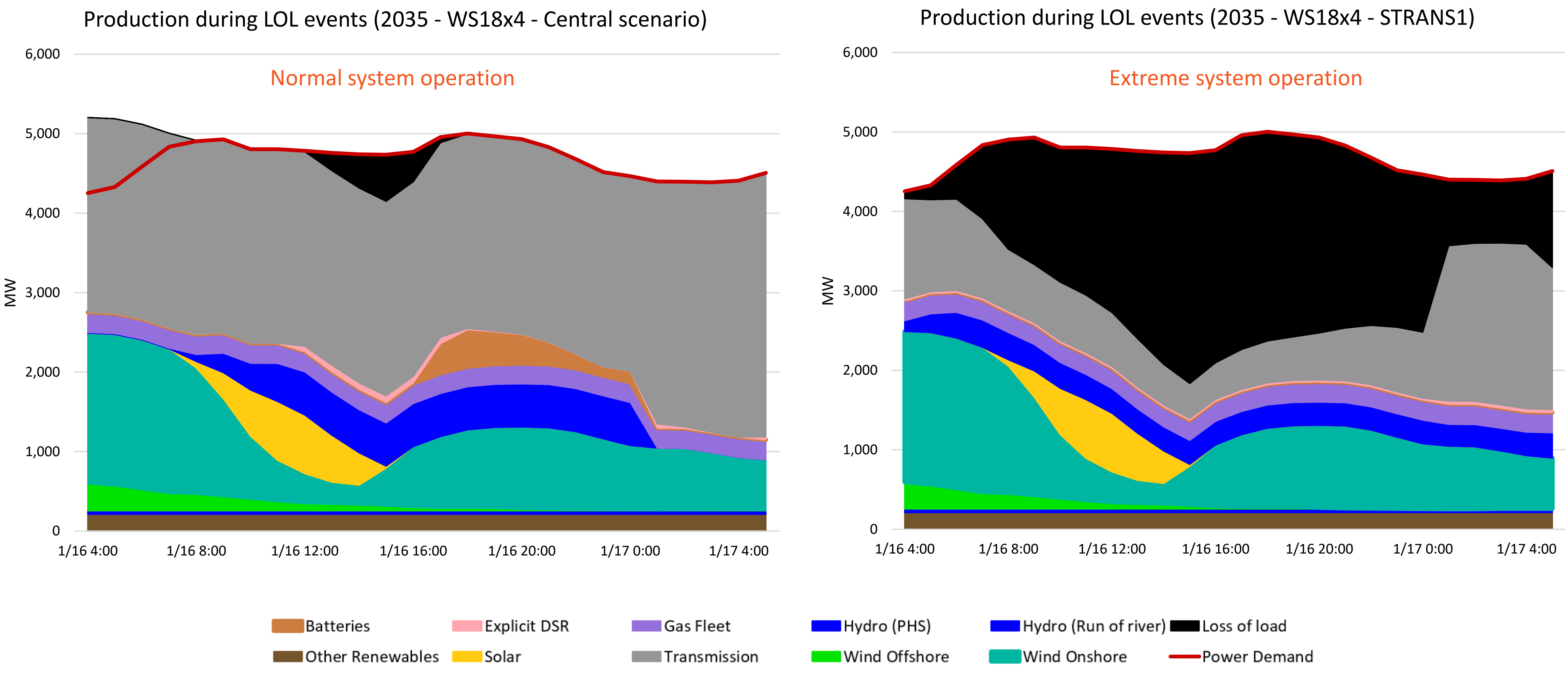
Example of Loss of Load profile

The graph below illustrates, for the Central Scenario and STRANS1 (long-duration HVDC outages), an **example of annual hourly Loss of Load profile** for one realisation in 2035.

- Loss of Load events are concentrated in winter, with 5–10 events in STRANS1 compared to a single event in the Central Scenario.
- In the Central Scenario, the Loss of Load peak reaches around 500 MW. In STRANS1, peak load reaches about 3,000 MW, this increase is caused by HVDC transmission capacity losses.



Focus on one Loss of Load event



RES and BESS deployment sensitivities

RES and batteries play a **minor role** in Lithuania's **security of supply** while thermal units seem to be decisive. However, they **strongly** shape the country's **energy mix and balance**.

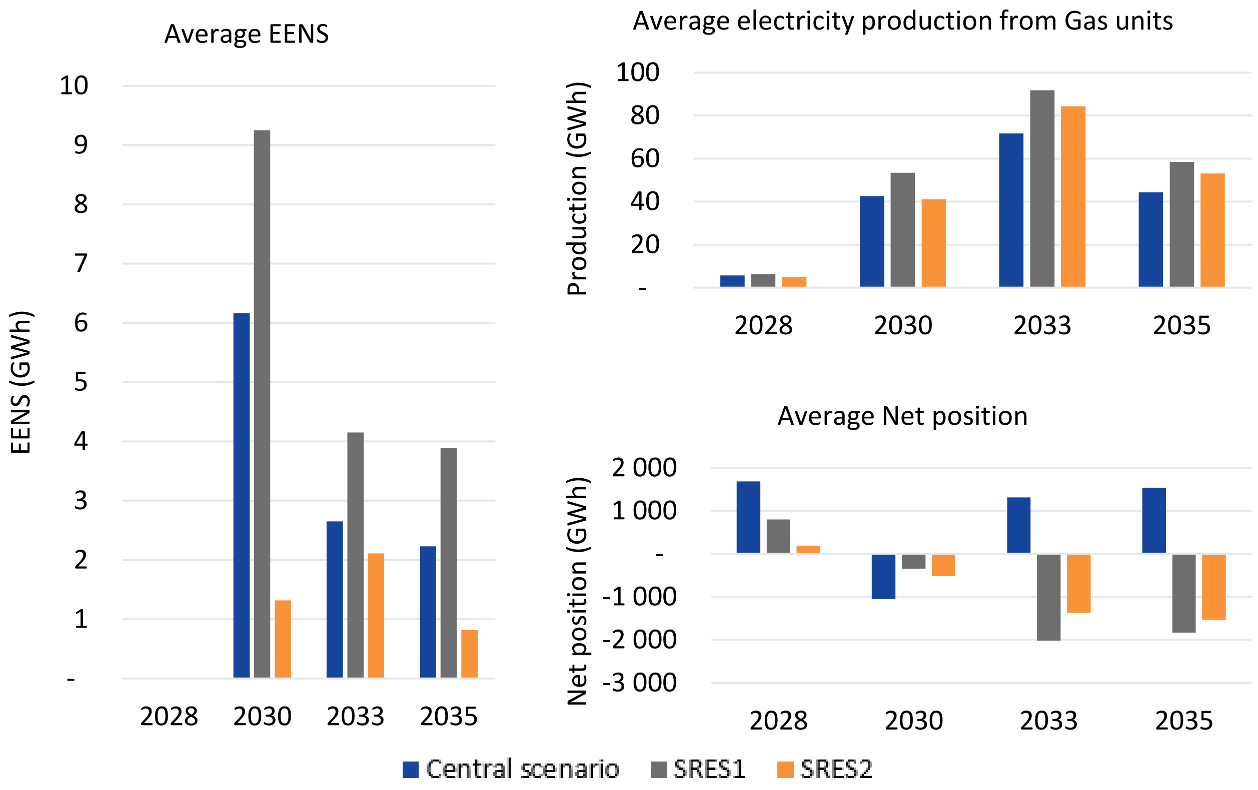
SRES1

moderated RES, delayed offshore wind, reduced BESS energy and electrolysis

SRES2

Strong RES reduction, no offshore wind nor electrolysis, reduced BESS power & energy, lower demand

- Overall, the combined reductions in battery & RES capacity and of power demand only **slightly affect EENS.**
- In contrast, reduced **RES generation** has a **major effect** on the Lithuanian energy system's **supply-demand balance**.
  - It leads to a significant **increase in thermal production** and a strong **decrease** in **exports** across all years.
- Lowering demand/electrolysers slightly reduces imports.



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Remedial Actions on the Central Scenario

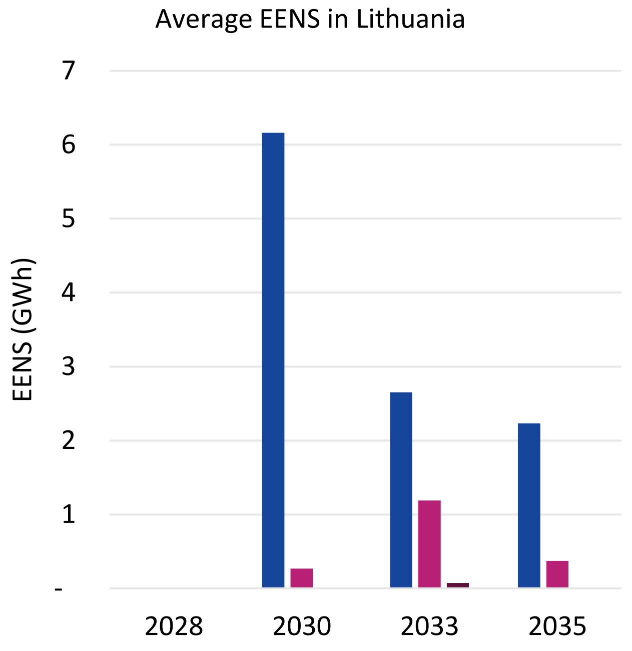
Additional thermal capacities improve adequacy : in the Central Scenario, it is necessary to retain LE_KCB, extend LE_B7, LE_B8 and KTE and add new 372 MW of CCGTs to respect the 8-hours criteria in Lithuania.

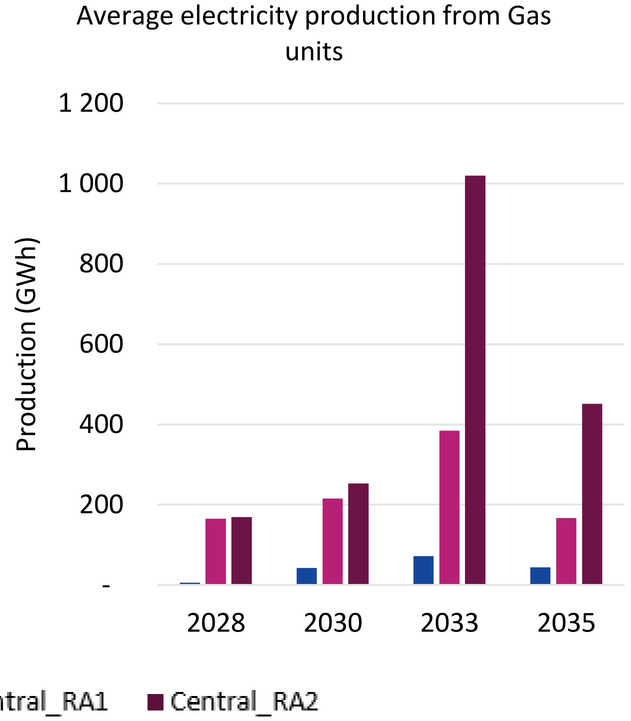
Central Scenario — CENTRAL_RA1 — CENTRAL_RA2

CENTRAL_RA1: *Retain LE_KCB until 2035*

CENTRAL_RA2: *Retain LE_KCB until 2035, extend LE_B7, LE_B8, KTE + 372 MW CCGT from 2033*

- Increasing gas-fired unit capacities reduces significantly the EENS volumes. The **security of supply criteria** is respected in CENTRAL_RA2.
- The prolongation of LE_KCB enables to reduce the EENS in 2030 to 0.25GWh, while CENTRAL_RA2 enables to reduce EENS to 0 in 2030.
- Higher gas-fired capacities lead to further decrease of EENS in Lithuania but also to **increased gas-fired generation**, impacted EENS volumes in neighbouring countries. These additional units also impact the Lithuanian supply mix by reducing Lithuanian imports (up to 1TWh in 2033)





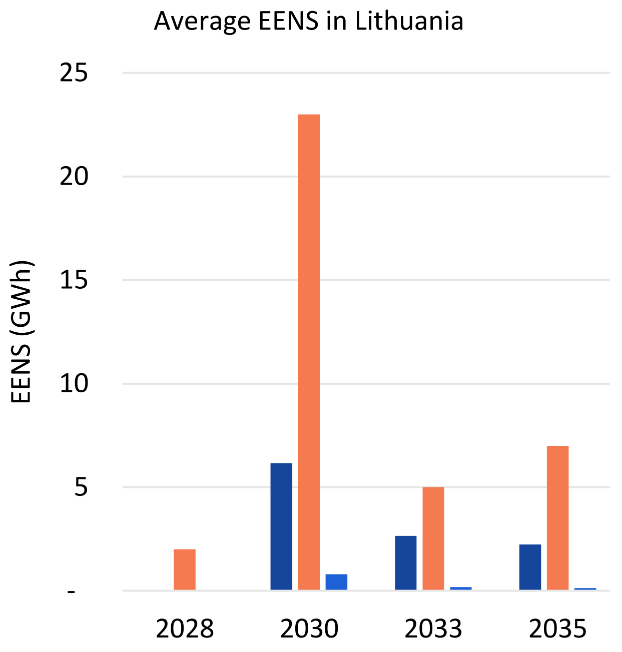
Remedial Actions on STRANS0 (HVDC short-term outages)

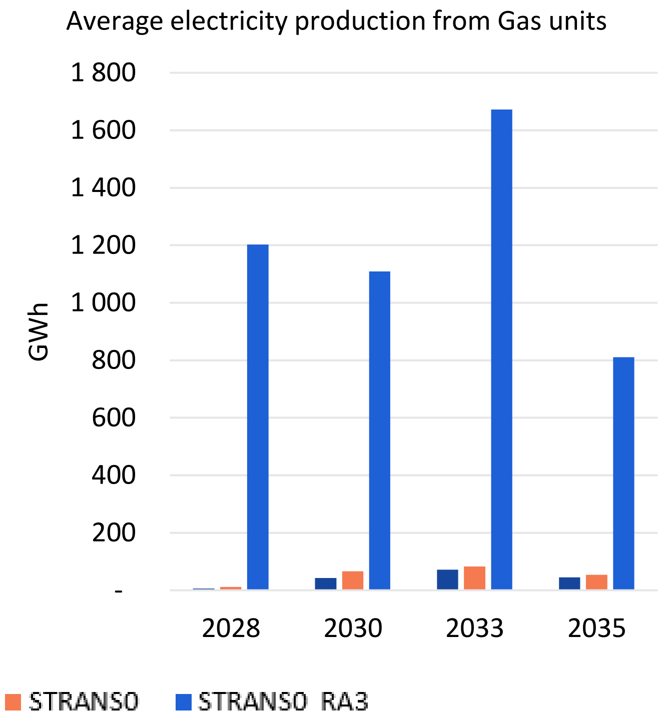
In case of time-limited HVDC interconnections unavailability, maintaining or adding thermal capacity is required to respect the security of supply criteria: the capacity gap required is 0.4GW (+LE_KCB and 372MW of CCGTs)

STRANS0 — *short-term random HVDC outages (forced outages)*

STRANS0_RA3 — *Retain LE_KCB + 372 MW CCGT + **400 MW CCGT***

- Considering short-term HVDC outages on Baltic interconnections in STRANS0 results in a slight increase in EENS compared to the Central scenario, but this remains small compared to interconnection losses.
- Under these conditions, an additional 400MW of thermal capacity is required to respect **8 hours criteria in each target year**.
- The additional thermal capacity ensures the supply–demand balance when interconnections are unavailable or insufficient. In this configuration, gas-fired generation also enables to reduce Lithuanian imports, reaching up to 8.8% of demand in 2033.





Remedial Actions on STRANS1 (HVDC long-term outages)

In case of long-duration HVDC interconnections unavailability, **a larger amount of thermal capacity** is **required** to respect the **security** of supply criteria: the capacity gap required is **2.2GW** (+LE_KCB and 372MW of CCGTs)

STRANS1
Long-duration HVDC outages (forced outages)

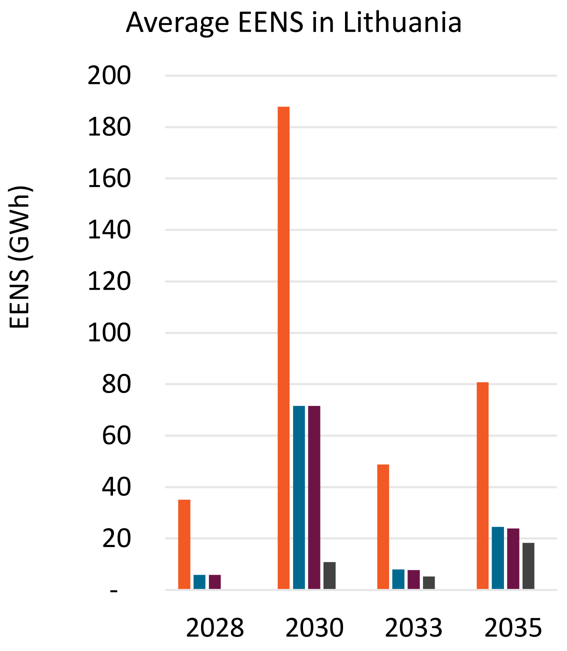
STRANS1_RA4
Retain LE_KCB + add 372 MW CCGT from 2033

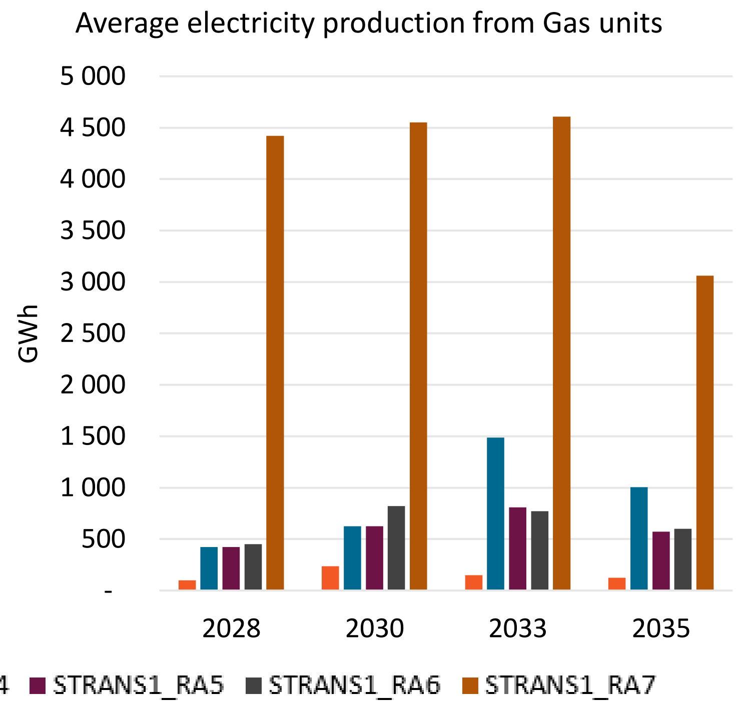
STRANS1_RA5
Retain LE_KCB + add 372 MW OCGT from 2033 (instead of CCGT)

STRANS1_RA6
Retain LE_KCB until 2035, extend LE_B7, LE_B8, KTE

STRANS1_RA7
*Retain LE_KCB + 372 MW CCGT **+ 2200 MW CCGT***

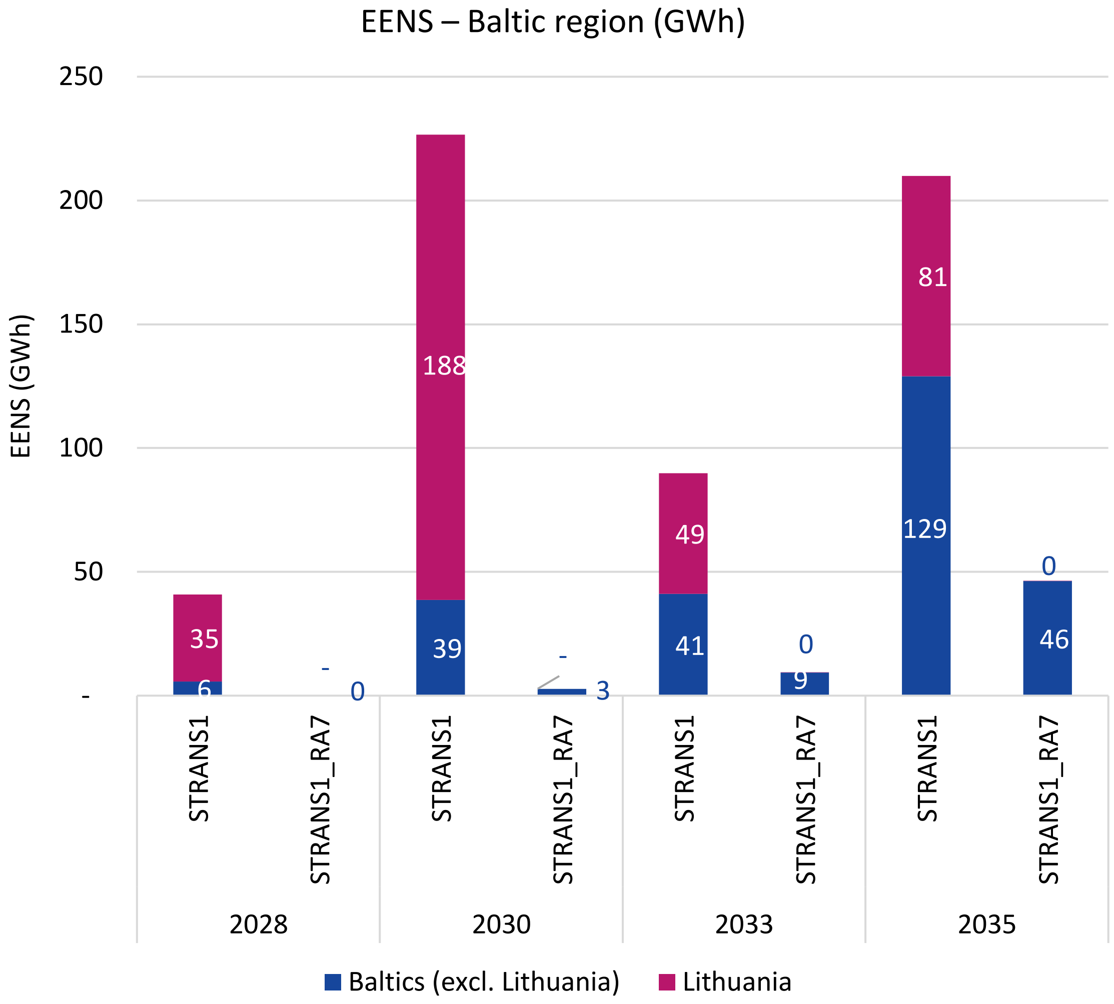
- Deploying additional thermal capacity greatly **improves security of supply**, cutting EENS by over 60% in 2030 (STRANS1_RA4 & STRANS1_RA5) and even more in other years.
- With the loss of HVDC interconnections in the STRANS1 scenario, it is necessary to **install 2,200 MW of additional capacity** (and to maintain LE_KCB plus an additional 372 MW) in order to comply with the 8-hour Loss of Load criterion. This capacity almost correspond to the total HVDC capacity removed in 2035 (700MW for PL-LT and 1400MW EE-FI).
- CCGT and OCGT provide **similar benefits in terms of adequacy**, but the new **CCGT** is more efficient and thus **more competitive for exports**.





Focus on Baltic adequacy - STRANS1_RA7

- STRANS1_RA7 is designed through an **iterative increase of thermal capacity in Lithuania** to meet the 8-hour adequacy criterion, but the optimisation framework minimises total European system costs rather than prioritising Lithuanian Loss of Load avoidance.
  - As a result, the **additional thermal units contribute not only to Lithuanian adequacy** but more broadly to the **adequacy of the Baltic region**.
- The deployment of +2.2 GW of thermal capacity enables compliance with the 8-hour criterion in Lithuania.
- This capacity addition also **significantly reduces EENS at the Baltic region** (excluding Lithuania), highlighting strong cross-border adequacy benefits.
  - In particular, EENS decreases in the Baltic region, by **36GWh**, i.e. 99% of EENS in the Baltics (excl. Lithuania) in 2030 and up to **83GWh** in 2035 (65%).



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Thermal Units – Capacity Factors

The capacity factors of the different thermal units are generally **low**, highlighting that their **primary role** is to **ensure security of supply** rather than to provide large volumes of electricity to the system.

- The **loss of HVDC interconnection** (from Central Scenario to STRAN0 and STRANS1) **increases the use of thermal plants** due to reduced import capabilities.
- Deploying **additional thermal units** leads to an **overall decrease in average utilisation** of the fleet: increasing the total installed capacity does not translate into a proportional rise in thermal generation as they are only few adequacy events to handle.
- The thermal units are **more used in 2030**, as this is the **most stressful target year**.
- For all target years and both scenarios, **ME_TG1 and ME_TG2 are used less frequently**. This is because the **marginal cost** of these power plants is over **1.8 times higher** than that of PE_TG1, PE_TG2 and OtherNonRES (Industrial Power Plants)

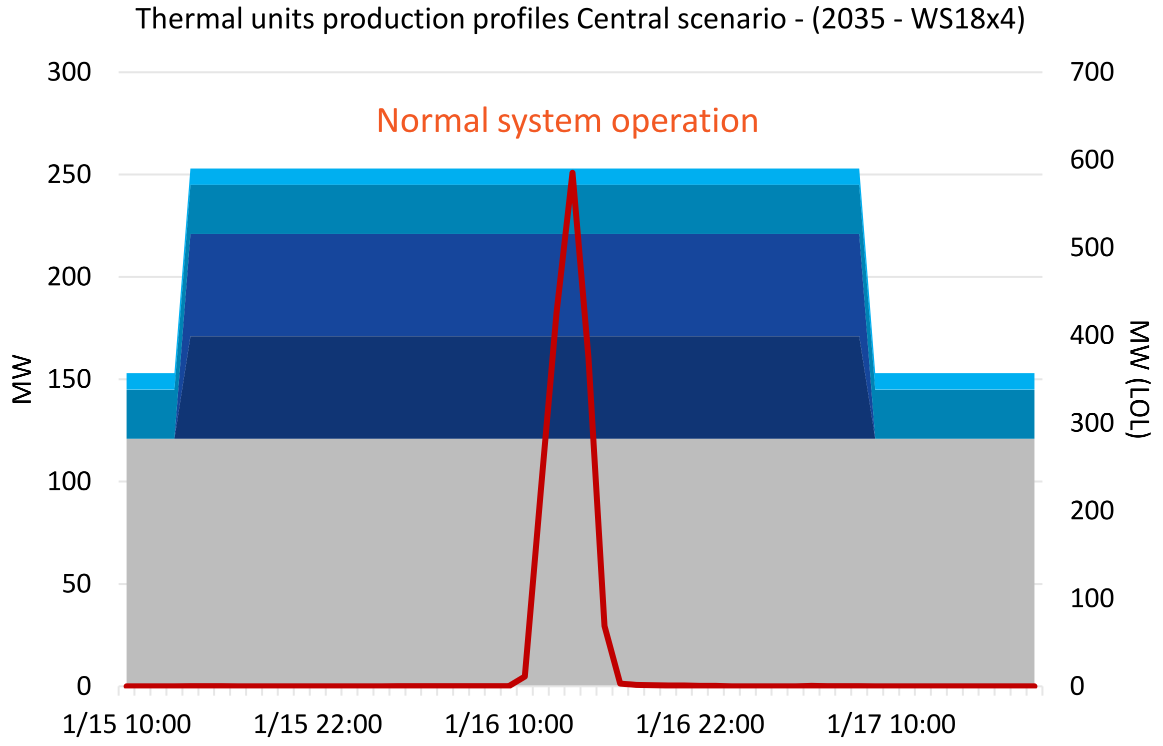
Av. Thermal Capacity Factor (%)	2028	2030	2033	2035
Central Scenario	0,29	2,35	3,86	2,24
CENTRAL_RA1	0,96	2,17	4,32	2,10
CENTRAL_RA2	0,65	1,60	6,14	2,82

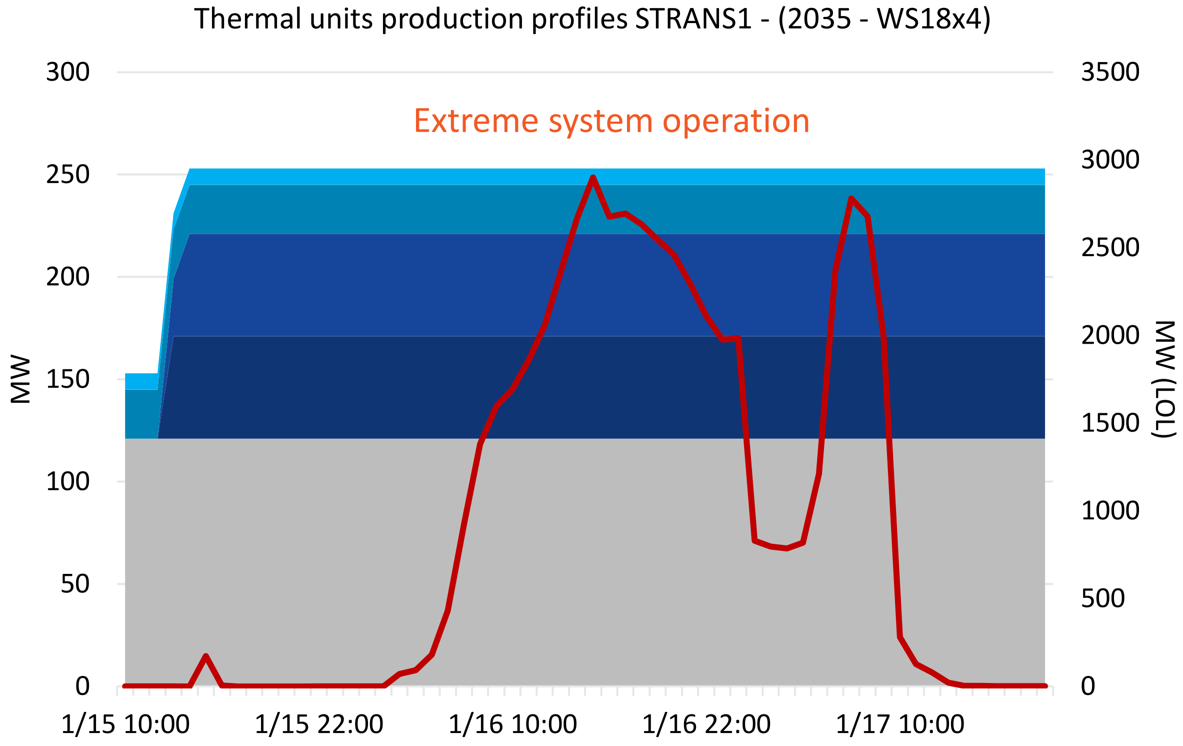
Av. Thermal Capacity Factor (%)	2028	2030	2033	2035
STRANS0	0,57	3,19	4,11	2,57
STRANS0_RA3	5,03	5,34	5,51	2,74

Av. Thermal Capacity Factor (%)	2028	2030	2033	2035
STRANS1	4,73	10,90	7,24	5,71
STRANS1_RA4	3,55	8,00	9,36	6,78
STRANS1_RA5	3,55	8,00	6,49	4,96
STRANS1_RA6	2,33	5,69	6,03	4,89
STRANS1_RA7	3,29	3,62	4,02	2,94

Thermal units

During LOL events, **the available thermal power stations operate at 100%** of their respective capacities to prevent LOL.





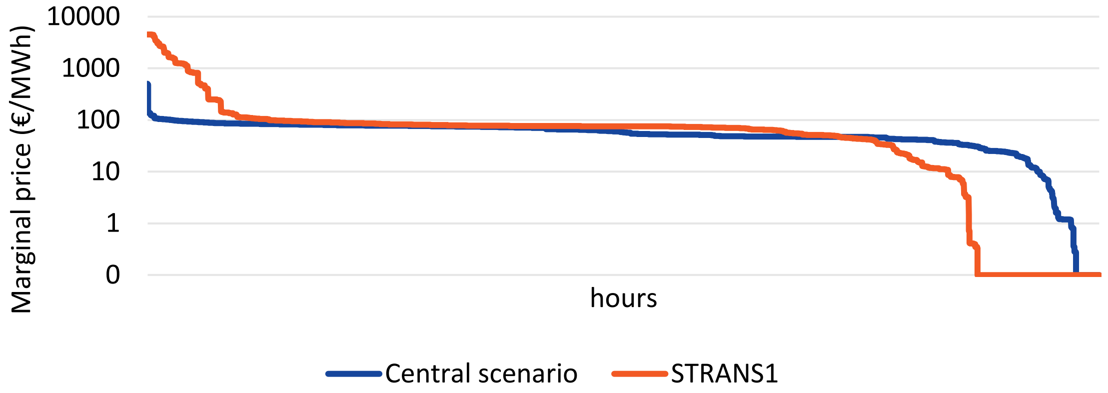
OtherNonRES   Mazeikiai E TG1   Mazeikiai E TG2   Panevezio E TG1   Panevezio E TG2   Loss of load LT00

Market prices

Occurrences of high prices are more frequent in scenarios with lower available interconnections, as the reduced import capacities increases the number of stress events.

- The level of interconnection with neighboring countries strongly impacts electricity prices (even excluding LoL hours) : **lower interconnection capacity leads to higher prices**.
- In the **remedial action** scenarios designed for STRANS0 and STRANS1, **additional thermal units** contribute to **lowering electricity prices** (offering low-marginal cost production)
- The level of **RES deployment** does **not show a distinctive impact on electricity prices** over the years.

Marginal cost (€/MWh) in 2028



Av. marginal cost excluding LOL hours (€/MWh)	2028	2030	2033	2035
Central Scenario	58,1	83,0	87,9	68,1
CENTRAL_RA1	57,9	76,8	87,2	65,3
CENTRAL_RA2	57,8	78,4	85,6	60,9

Av. marginal cost excluding LOL hours (€/MWh)	2028	2030	2033	2035
STRANS0	59,5	88,6	89,3	69,9
STRANS0_RA3	57,6	77,4	85,2	63,1

Av. marginal cost excluding LOL hours (€/MWh)	2028	2030	2033	2035
STRANS1	78,5	131,0	110,2	95,8
STRANS1_RA4	65,1	109,5	92,6	84,9
STRANS1_RA5	65,1	109,5	93,7	83,7
STRANS1_RA6	62,2	89,2	93,2	87,7
STRANS1_RA7	56,0	74,4	85,7	70,6

Conclusion and Recommendations

Conclusions

- Under current conditions, the economic viability analysis (EVA) indicates that **only existing thermal units that would not need a lifetime extension remain economically viable** (except LE_KCB) **over the period 2028-2037**, in conjunction with new explicit DSR activations starting in 2033.
  - Potential **investments** in new thermal power plants, as well as the **continued operation of plants requiring lifetime extensions and LE_KCB**, are **not economically viable**.
- In the Central Scenario resulting from the EVA, **the 8-hours LOLH security of supply criterion is respected in 2028 but not in the subsequent modelled years (2030, 2033, 2035)**. In most climate scenarios, security of supply is not threatened, but in **certain extreme scenarios**, the volume of **curtailed demand** could rise up to above 30 GWh in 2030/2033.
- The security of supply can be **significantly improved by the extension of thermal units** or the installation of **new thermal capacities**. However, in the presence of long-duration interconnection outages, the respect of Loss of Load criterion requires very large increase of thermal capacities compared to the Central Scenario.
- Sensitivity analyses around the Central scenario highlight the **dependence on cross-border interconnections with neighbouring countries for security of supply of the Lithuanian system**. In 2030, loss of load hours increase (in average) from 35 hours in the Central scenario to 79 hours under short-duration interconnection outages, and to 459 hours under long-duration interconnection outages (extreme system operation).
- On the contrary, slower development of RES capacities and BESS do not appear to play a significant role in this security but rather in Lithuania's energy balance.

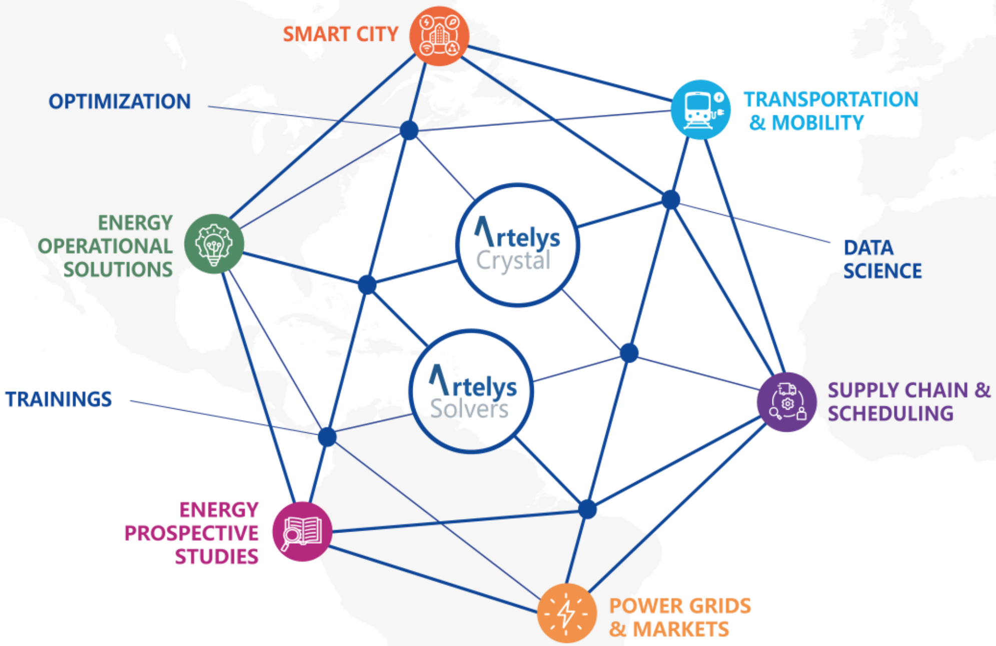
Recommendations

- In the Central scenario, compliance with the 8-hours failure criterion over the entire 2028-2037 time-horizon can be ensured by **extending the operation of LE7, LE8, KTE_TG2 (until 2030) and LE_KCB (until 2035) and by adding of about 0,4 GW of additional new thermal capacity in 2033-2035**
- Under **short-term interconnection outage conditions** (STRANS0), the **addition of around 0,8 GW of new thermal capacity**, is necessary from a system perspective to ensure compliance with the 8-hours criterion under normal system operation.
- Under extreme system operation (**long-duration interconnection outages**, STRANS1), addressing system adequacy issues would require to maintain **around 2,6 GW of new thermal capacities**.
  - The **2,6 GW requirement reflects system adequacy conditions at the Baltic regional level** rather than strictly at the Lithuanian level. As such, **it should not be interpreted** as a standalone national procurement target.
- The findings of this assessment consistently identify **interconnection capability as a primary driver of both adequacy and flexibility** in the Lithuanian power system, with system performance shown to be highly sensitive to the availability of cross-border exchanges. The results further suggest that the **development of additional interconnection infrastructure would enhance the regional adequacy outlook** beyond the current assessment horizon.

Thanks for your listening

Do you have any questions ?

Contact



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