



About the harmonization of the European markets

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*Powering those who power the world*

*How do the XB capacities across continental Europe get allocated in the different time horizons, from D-2 to the delivery?  
How does the algorithm Euphemia work and how does it include the Flow-based Market Coupling optimization?  
What can be the impact of specific grid investments when it comes to welfare optimization?*

*We discussed these and other crucial topics in a panel with experts and TSOs from all over Europe at E-world.*

*A recap of the main take-aways in the present slides.*



## Where are we now, when it comes to the harmonization of the European markets?

*“ Over the last decade Europe has implemented a well-integrated series of electricity markets from long-term explicit auctions via day-ahead and intraday auctions to continuous trading and balancing platforms.*

*Recent improvements have been the additional three European-wide intraday auctions (IDAs) in June 2024 and the transition to 15min market time units in the day-ahead market. TSOs have successfully implemented flow-based capacity calculation mechanisms in the day-ahead and intraday timeframe.*

*Core TSOs expect to run the first long-term flow-based capacity calculation and allocation processes end of the year.*

*The next years will bring further improvements with regards to flow-based implementation in IDAs and continuous trading, the co-optimization between day-ahead and balancing capacities, and the possible extension of the European markets to Energy Community countries, Switzerland, and the UK. “*



Source: Marius Schrade



## About the benefits of a pan-European integration

*"It goes without doubt that the efforts of the past decade to couple and integrate European electricity markets has delivered enormous value, but still today socio-economic welfare is limited by structural bottlenecks that constrain increased cross-zonal capacity and exchanges.*

*Efficient, harmonized and coherent capacity calculation and market coupling mechanisms, from day-ahead over intraday to balancing, are crucial to alleviate price spikes and cross-zonal spreads, liquidity issues and extreme price events in the balancing markets.*

*Delivering these will go a long way in ensuring non-discriminatory and transparent market coupling mechanisms that foster trust and predictability for market participants."*



Source: Nico Schoutteet

— CREG —

Commission for Electricity and Gas Regulation

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## How does Euphemia work?

*"Euphemia is powering the European Day-ahead market, coupling 26 countries and moving yearly a traded volume of 1840 TWh (2024).*

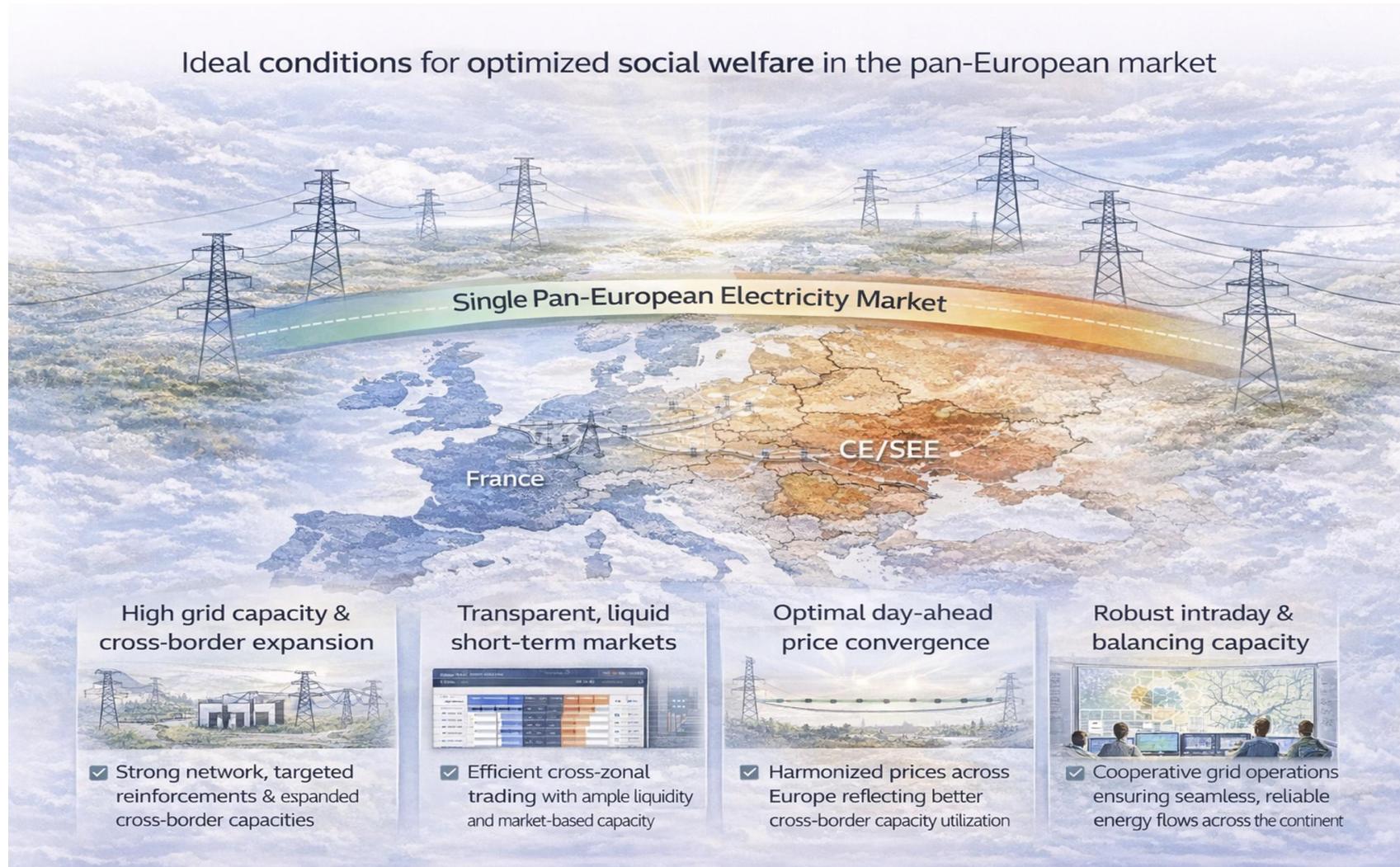
*This is the largest coupled energy market in the world by far. Euphemia is a robust and scalable solution which supports various order types as well as ATC and flow-based network models as input and provides an average welfare of 11.8 B€ per day.*

*The introduction of Nordic FB in 2024, 15' market time unit in 2025, and Core AHC scheduled for 2026 highlights the evolution of the internal energy market to further increase the benefits of European citizens and industries."*



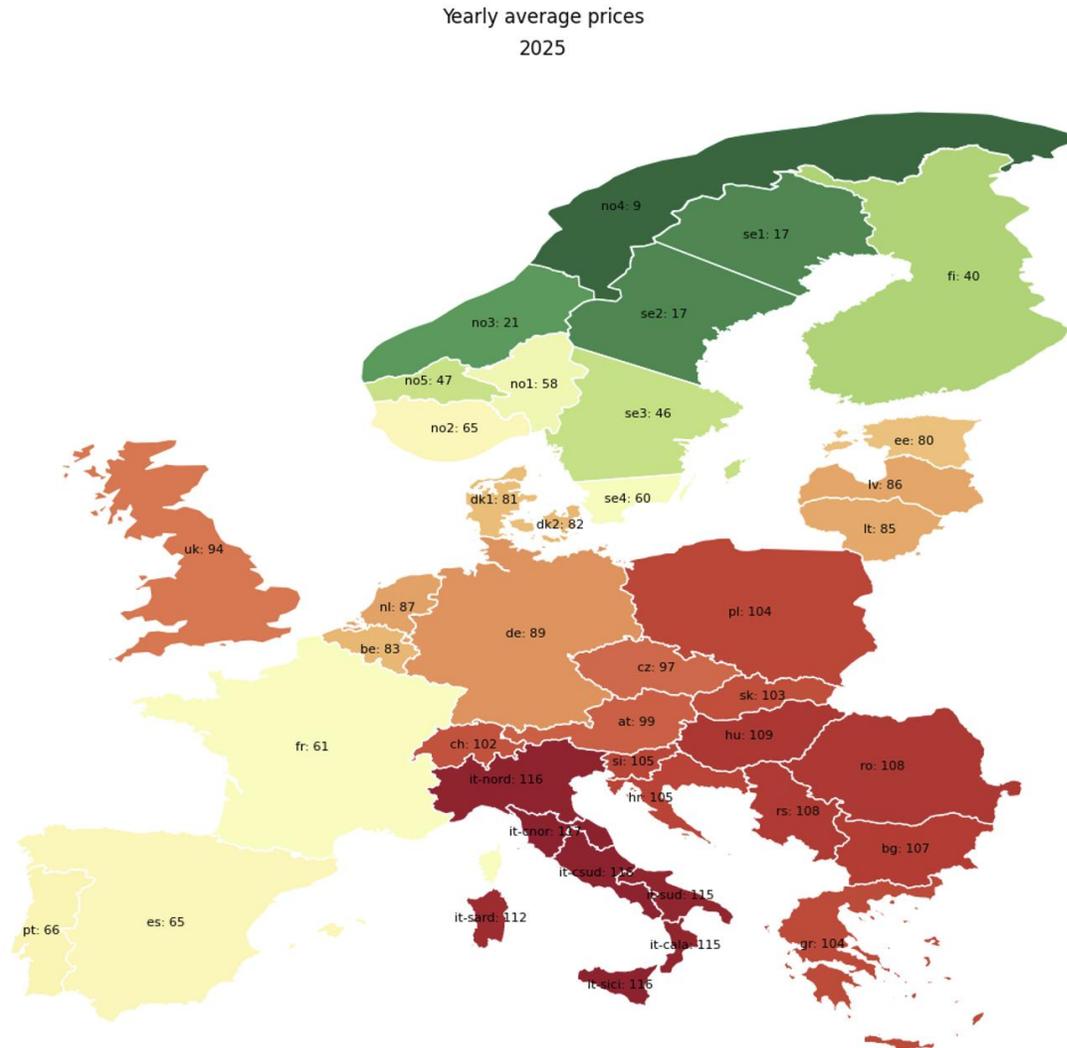
**Yves Langer**  
Power Market  
Design Expert

# The vision of the optimal pan-European Market

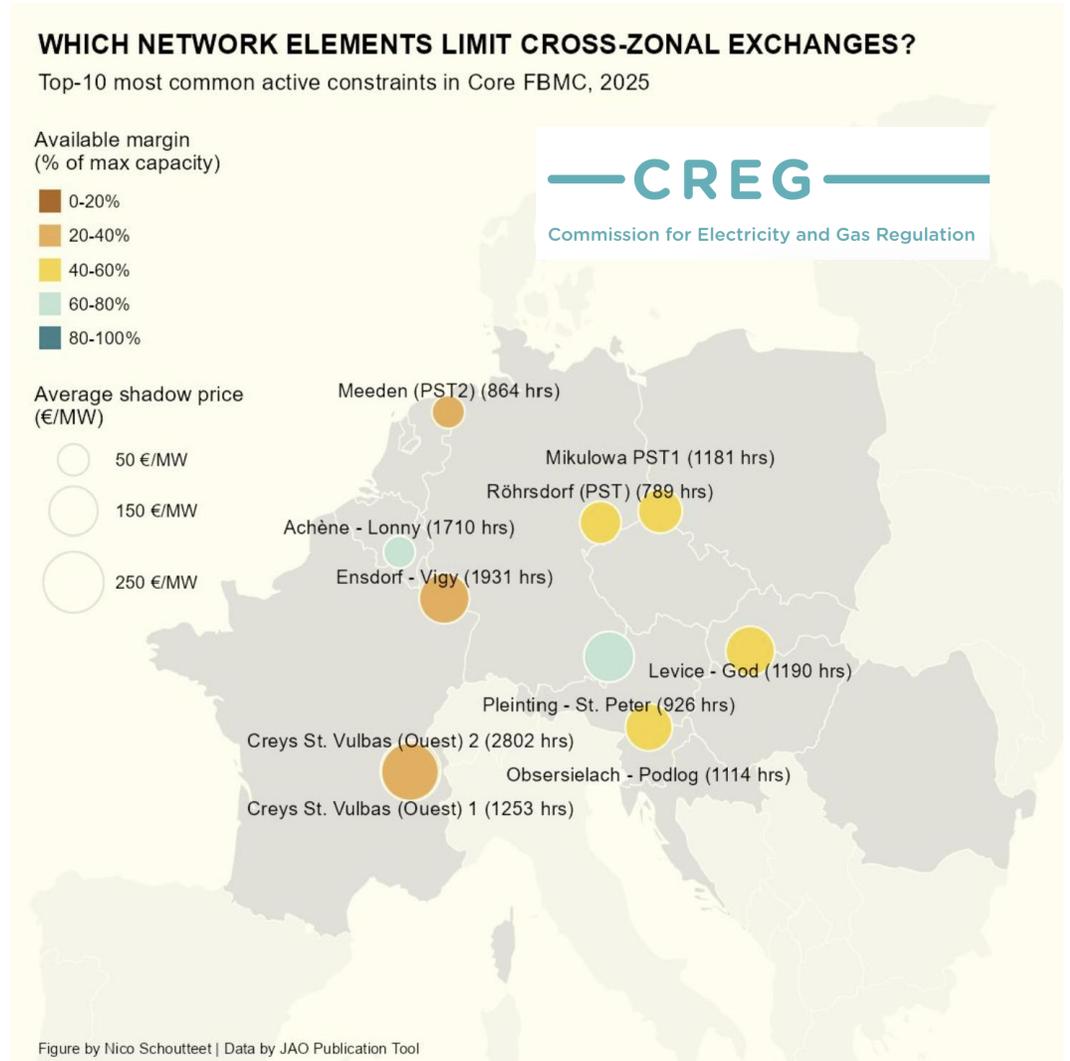


Source: Davor Bosnjak - HEP

# The reality: European prices and active CNECs Map – cal25



Source: VOLUE - JAO

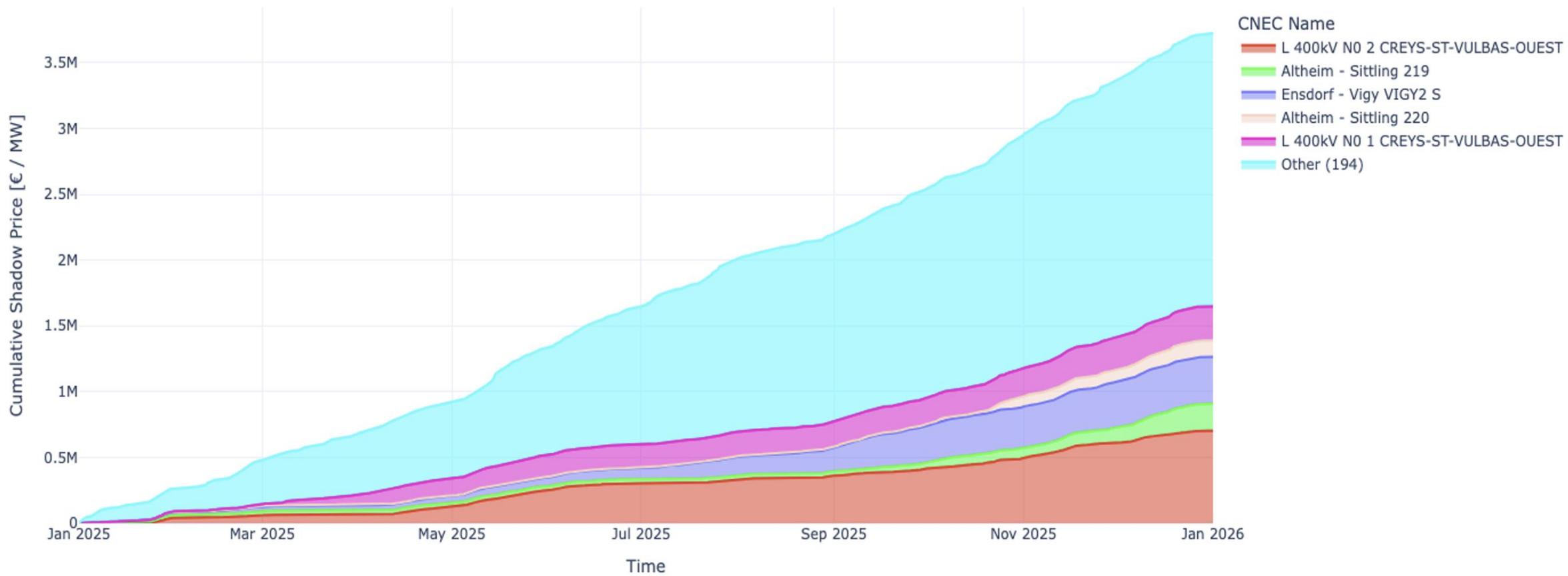


Source: Nico Schoutteet - CREG

# Cumulative Shadow Prices – cal25

Cumulative Shadow Price over time for top 5 CNECs in **CORE**

Note: 15min MTU values downscaled by factor of 4.



Source: VOLUE - JAO

## How are we from your vision of the optimal pan- European markets?

*„Integration is key but welfare is currently capped by structural constraints: from the day ahead down to the balancing markets. My wish is to unlock usable capacity with the bridge-measures like DLR (dynamic line rating), HTLS (high-temperature low-sag), OPC (outage planning coordination), both preventive and curative efficient RAs (remedial actions) and better grid/power system models, together with building appropriate new interconnectors where structural congestions are the most obvious.*

*To achieve this we need to bridge gaps not only in the existing grid and regulations but also in daily processes by making proactive communication between all 3 layers at market participants side, TSOs&DSOs, NEMO's, regulators, ministries, and other included representatives:*

- *system operations (rowers of a large sailing ship)*
- *adequacy teams (navigators and sail-masters)*
- *TYNDP and other development teams (shipbuilders)*



**Davor Bošnjak**  
Head of Intraday  
Trading & Planning Unit



## What about the integration of the balancing markets?

*“ Following day-ahead and intraday, balancing markets are the next frontier of electricity market integration.*

*We made a lot progress in balancing energy markets now that most TSOs are operational on MARI and PICASSO platforms and we already see strong internationalization effects with tendentially lower aFRR and mFRR prices but higher volatility and strong impacts of liquidity situation at the neighbors.*

*But there is a still a long way to go. For one, balancing capacity markets are not either integrated or harmonized. Second, actual integration is limited by often very limited cross-zonal capacity left for balancing markets.*

*The aFRR market is the last in capacity-allocation chain and you can squeeze the “lemon of scarce cross-zonal capacity” as much. So the key reason why it gets more difficult to predict balancing energy prices is because they more often depend on the cross-zonal-capacity situation at the borders. ”*



**Ksenia Tolstrup**

Director Technical Advisory

**MAGNUS**  
energy

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## How does a TSO evaluate new grid investments?

*“ Grid investments demonstrate the potential for removing active network constraints in the flow-based market coupling if they are targeted at the identified network constraints regardless of whether they are internal or cross-border network constraints.*

*While this may lead to the network congestions being shifted to other parts of the region due to new active network constraints, an overall net gain of the social welfare is realized.*

*The recent N-SIDE case study with MAVIR, however, points to additional important factors such as scarcity in power supply which can play a key role in volatile prices. A combination of measures such as target grid investments and dispatchable capacity (generation or storage) are needed to most effectively tackle volatile price spikes.*

*The following slides show the results of the analysis that Mavir conducted with N-SIDE to evaluate different scenarios of new grid investments“*



**Ferenc Nagy**  
Senior Power Systems Expert



How potential grid investments  
can decrease price spreads in  
the European Single Day-Ahead  
Flow-Based Market Coupling

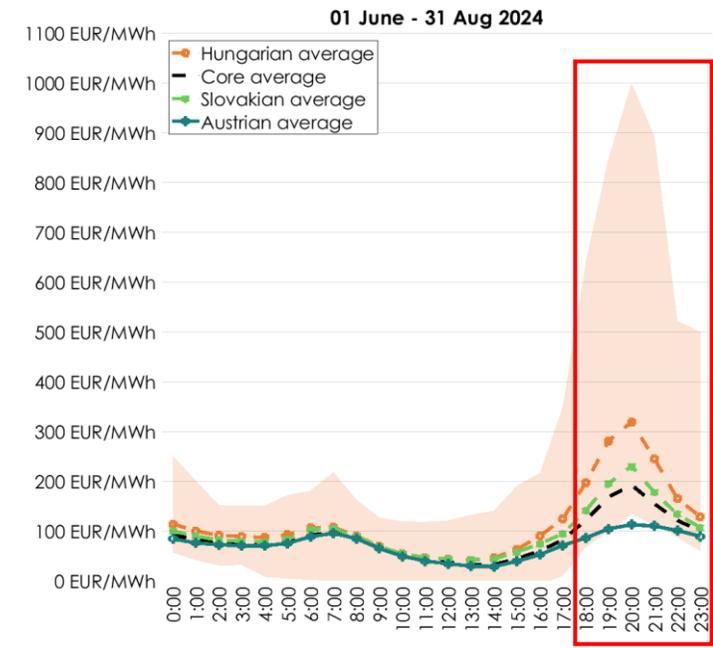
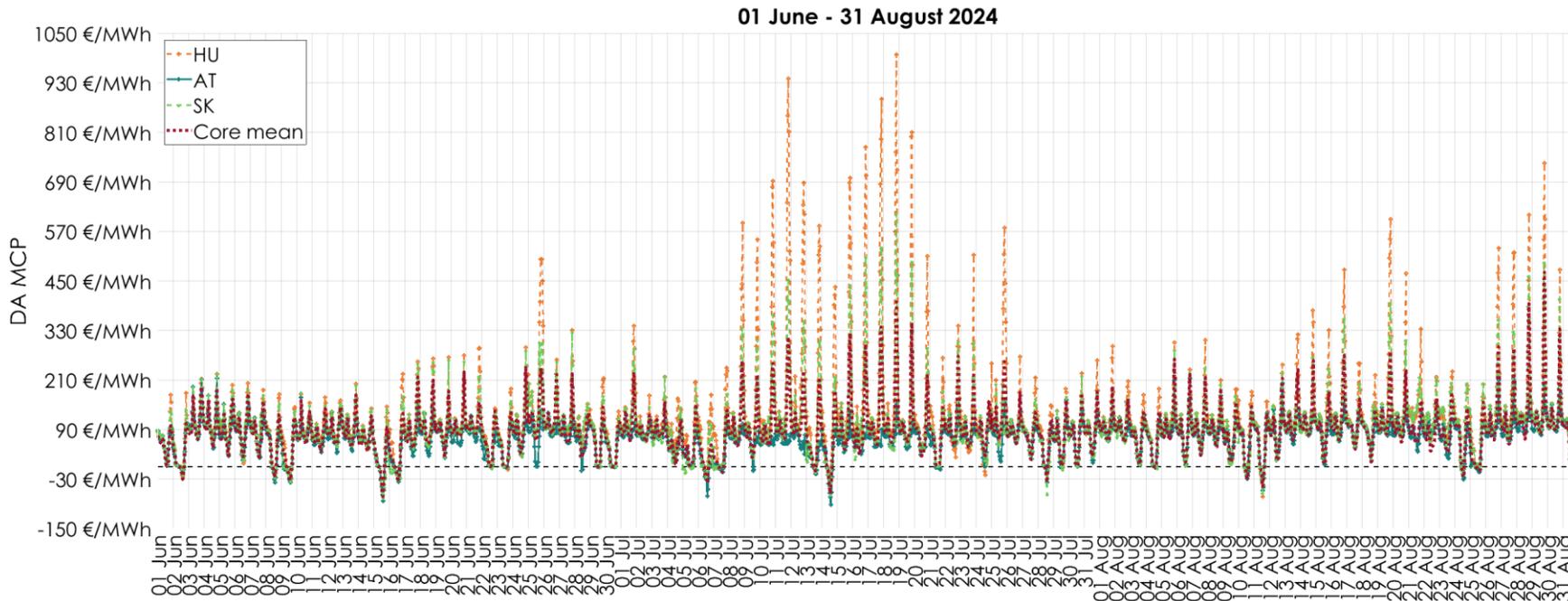
11.02.2026



MAGYAR VILLAMOSENERGIA-IPARI  
ÁTVITELI RENDSZERIRÁNYÍTÓ ZRT.

# Introduction

- Extreme prices in the Hungarian bidding zone in June - August 2024
- High demand in the evening hours provoked extreme day-ahead price spikes in Hungary and some of its neighboring bidding zones in 2024 July.
- Methodology (1): **analyse 11 business days with high prices and spreads, and ...** ⇨



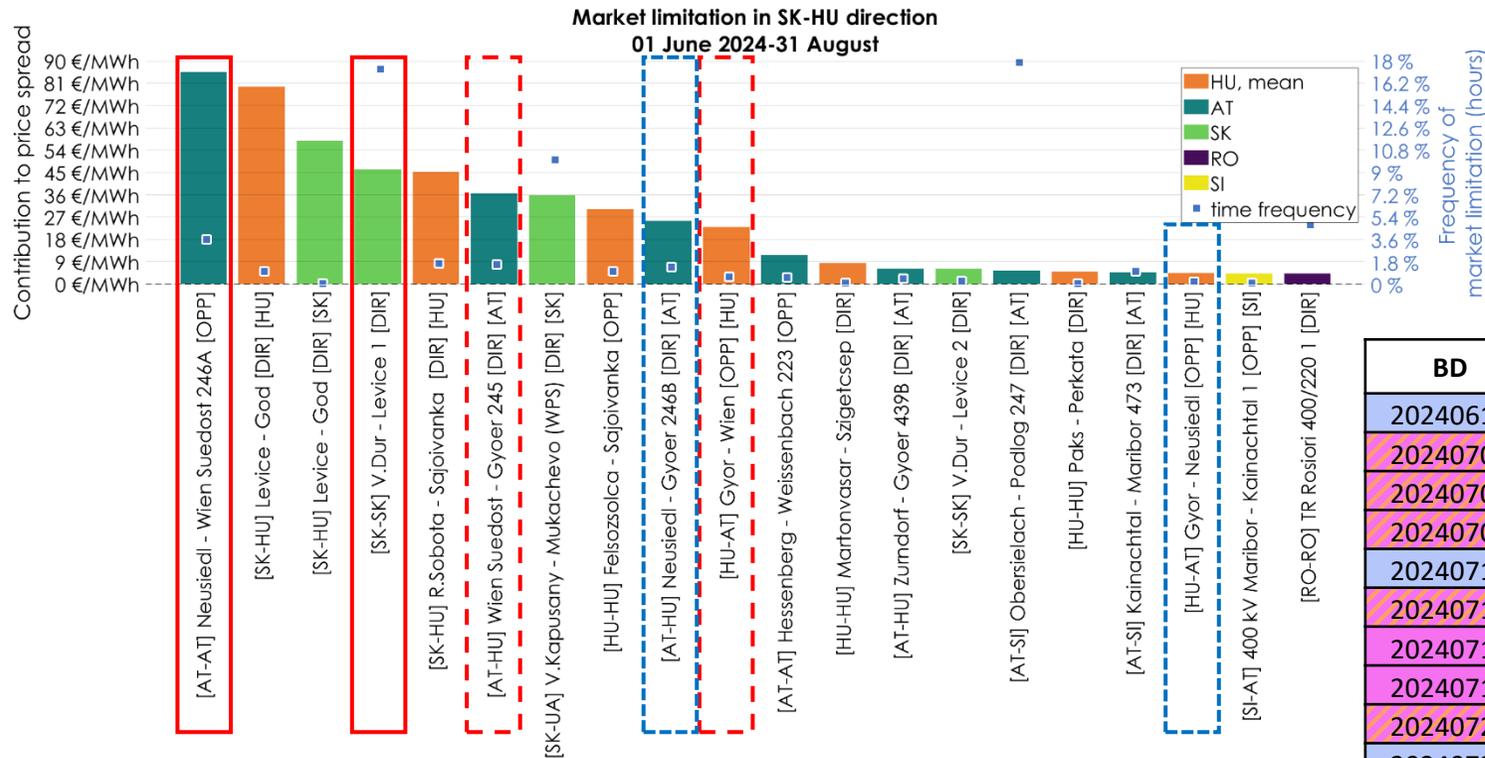
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# Network Elements with High Contribution to Price Spread

The formula that relates to the zonal price spreads to shadow prices

$$P_z - P_y = \sum_k (PTDF_{y,k} - PTDF_{z,k}) * shadow\ price_k \geq 0$$

(Calculation of individual CNEC contribution is also possible)

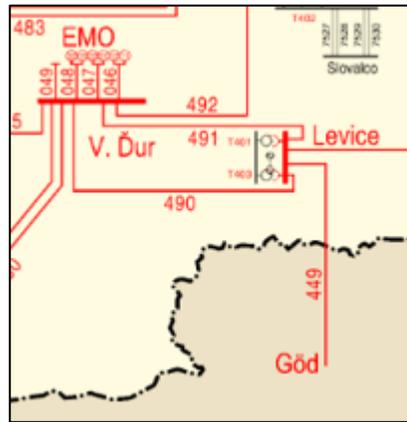


- Top 20 CNEs limiting SK-HU trades.
- Active constraints with most significant impact in both AT-HU and SK-HU directions are internal elements of neighbouring TSOs.
- Methodology (2):
  - Analyse 11 business days when extreme shadow prices occurred in the AT and (or) SK internal grid and (or) HU-AT cross-border elements.
  - Use a case study approach based on upcoming grid investments:
    - CCTool simulations for capacity calculation with topological changes
    - Simulation Facility tests for market impact examination

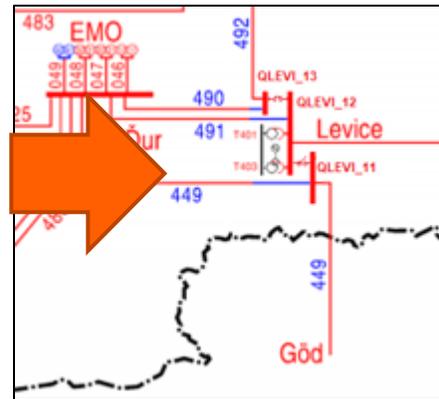
| BD       | Count |
|----------|-------|
| 20240616 | 8     |
| 20240706 | 17    |
| 20240707 | 14    |
| 20240709 | 15    |
| 20240710 | 14    |
| 20240711 | 21    |
| 20240713 | 16    |
| 20240719 | 11    |
| 20240722 | 8     |
| 20240723 | 10    |
| 20240727 | 9     |

| Day        | Maximum DA Price (HU Bidding zone), EUR/MWh | Maximum DA Price Spread (HU-DE), EUR/MWh |
|------------|---|--|
| 16/06/2024 | 225.09                                      | 100.81                                   |
| 06/07/2024 | 174.34                                      | 167.65                                   |
| 07/07/2024 | 240.01                                      | 133.22                                   |
| 09/07/2024 | 550.33                                      | 402.65                                   |
| 10/07/2024 | 692.83                                      | 577.25                                   |
| 11/07/2024 | 940.16                                      | 755.83                                   |
| 13/07/2024 | 582.84                                      | 507.39                                   |
| 19/07/2024 | 810.66                                      | 679.00                                   |
| 22/07/2024 | 340.57                                      | 193.51                                   |
| 23/07/2024 | 512.90                                      | 394.38                                   |
| 27/07/2024 | 216.44                                      | 93.34                                    |

Topological changes in Slovakia  
in the area of Veľký Ďur – Levice



2024



2028

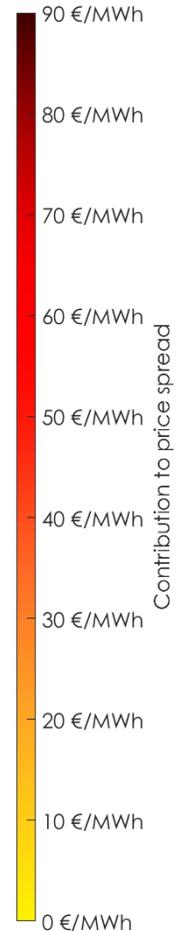
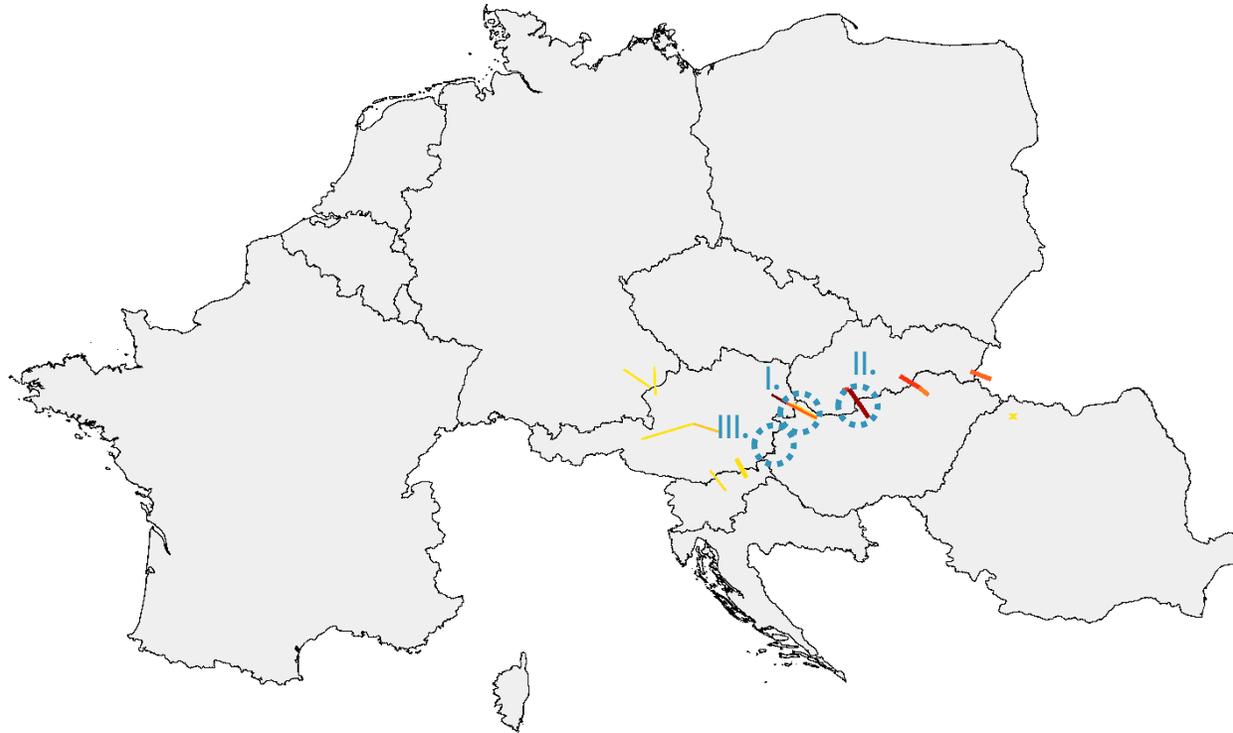
Elements causing high AT-HU price differences  
(08.07.2024-23.07.2024)



# | Scenarios with potential grid investments

**Case study approach** – analysed scenarios based on the presented daily monitoring results

Market limitation in SK-HU direction  
01 June 2024-31 August



## Scenario I:

Possible investment in the replacement of conventional conductors with HTLS over the 220kV AT-HU cross-border elements.

## Scenario II:

Internal ongoing SK investment in topological upgrade in the vicinity of SK-HU border.

## Scenario I+II:

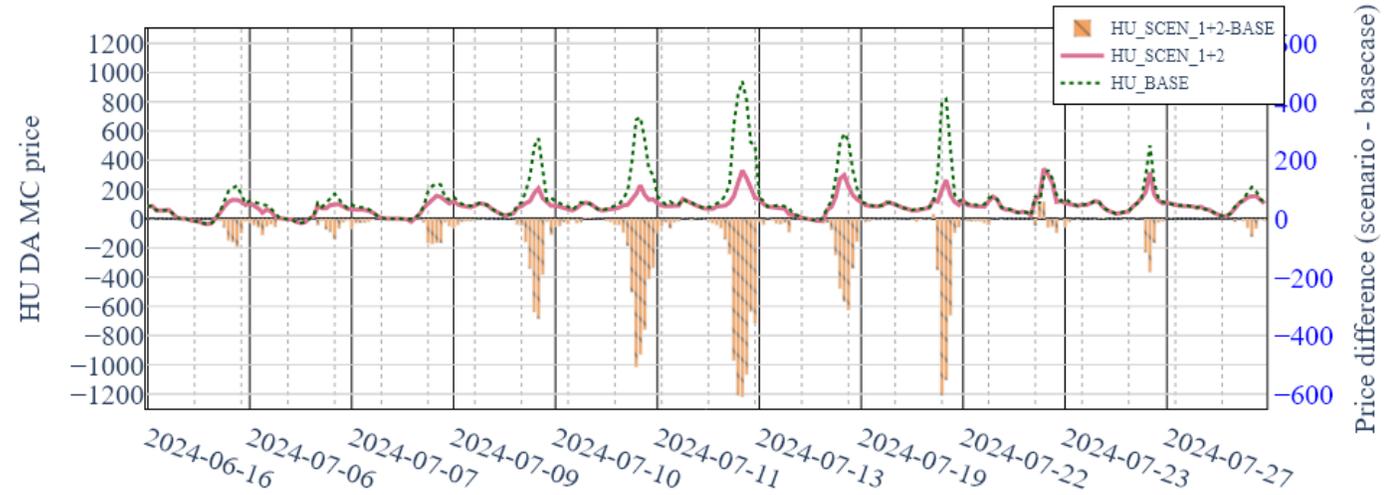
Combination of the previous two in order to see the conjunct potential of these scenarios.

## Scenario III:

Possible grid investment in the installation of a new AT-HU 400 kV cross-border element.

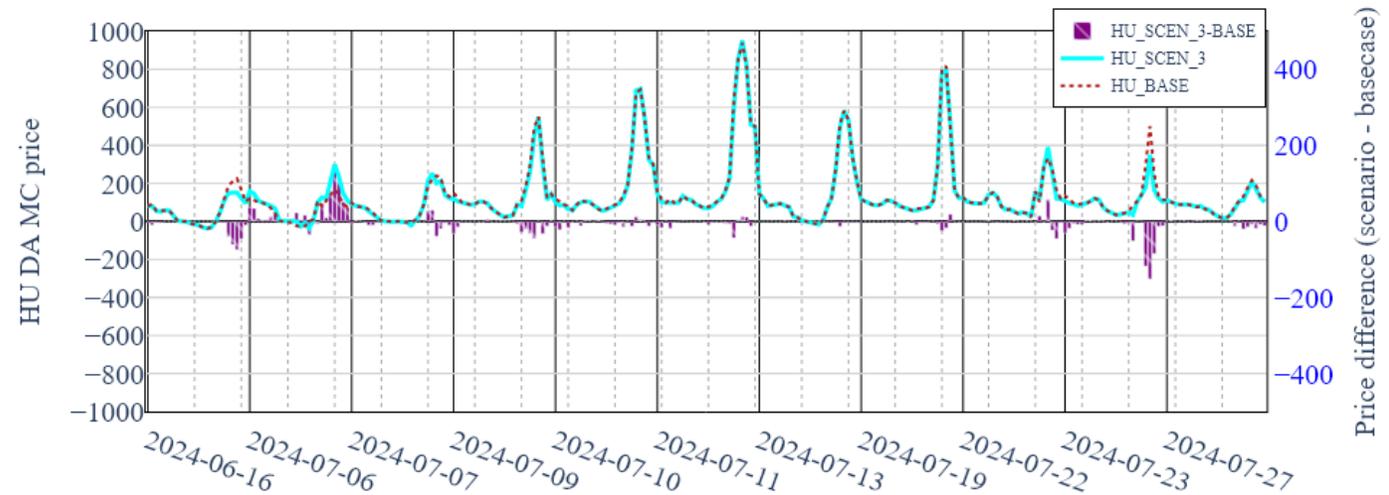
## Optimal solution: Scenario I+II.

- Highest lowering effect on DAM prices during each business days.
- High impact potential, seen in Hungarian net positions
- Decreased total shadow price



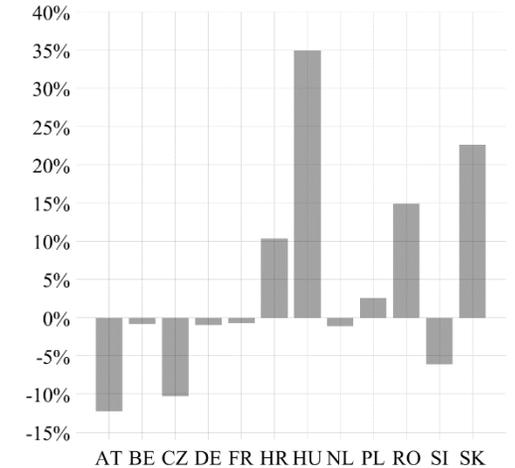
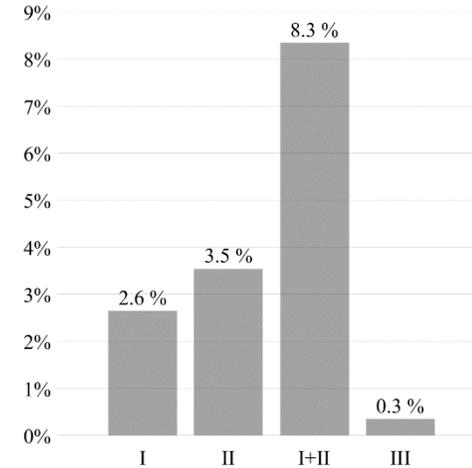
## Least beneficial solution: Scenario III.

- No significant impact or even higher DAM prices in some days.
- No significant elevation in import possibilities
- Increased total shadow price

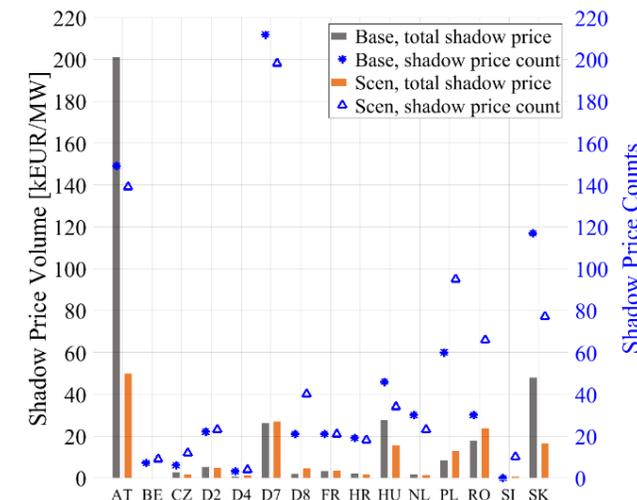
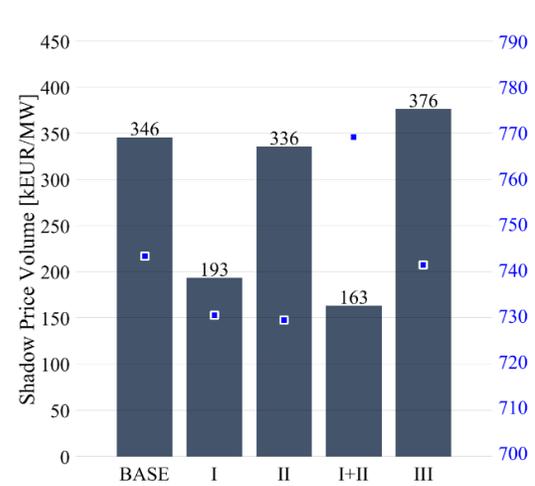


# | Results and Conclusion

- Targeted grid investments have positive impact (welfare gain) not only on one bidding zone, but also on the entire Core region, seen in:
  - ✓ Average DAM prices
  - ✓ Total shadow price amount ~ market limitation by network elements
- Grid investments must target actual network constraints – i.e. Combined Scenario
- A new cross-border network investment does not necessarily have a meaningful positive result – i.e. Scenario III.



Total price decrease of the average price per scenario across Core CCR (left) and zonal price change for Scenario I+II.

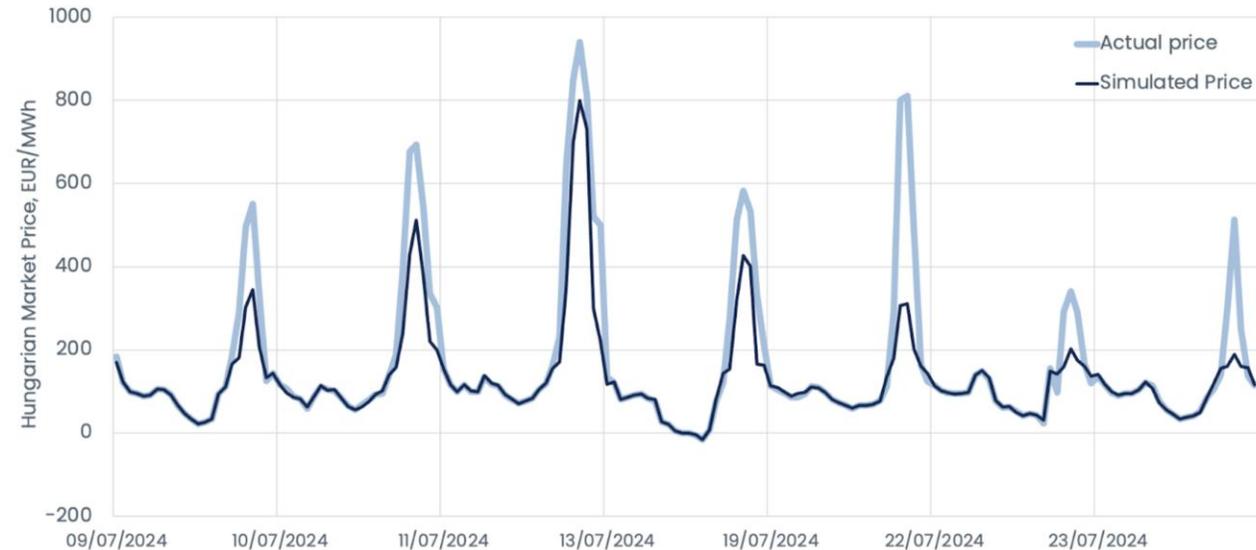


Sum of the shadow prices per scenario and their frequency (left) and the comparison of results of Base and Scenario I+II.

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- I. High prices are clearly **scarcity in power supply** in the South-Eastern European and Hungarian market in particular
- II. Substantial measures would be required to keep prices at typical levels if similar conditions arise in the future
  - i. **Extensive expansion in transmission capacity** further integrating South-Eastern Europe with Central Europe
  - ii. **An increase in dispatchable capacity** (generation, storage, or demand-response).
- III. It is important to recognize that, while this study focused on the consumer (price) benefits of different mitigating actions, **high prices can also generate profits for producers (producer welfare)**.
  - i. **These prices can act as investment signals**, attracting private capital into dispatchable capacity in South-Eastern Europe and helping to alleviate scarcity.

Impact of 3 GW additional peaker capacity  
(priced at 165 EUR/MWh; equally distributed over Hungary, Bulgaria and Greece; selected days)



**!** Power flows towards Romania or Croatia (despite these bidding zones having a lower market price) can be observed in the peak hours of every studied day. This occurs because the flow factors of Romania and Hungary are such that a cross-zonal trade from Hungary to Romania releases transmission capacity elsewhere – i.e. HU→RO exchange frees up transmission capacity.



Thank you

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