

REKK POLICY BRIEF

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HIGH PRICES IN THE REGION – IS FLOW-BASED MARKET COUPLING TO BLAME?

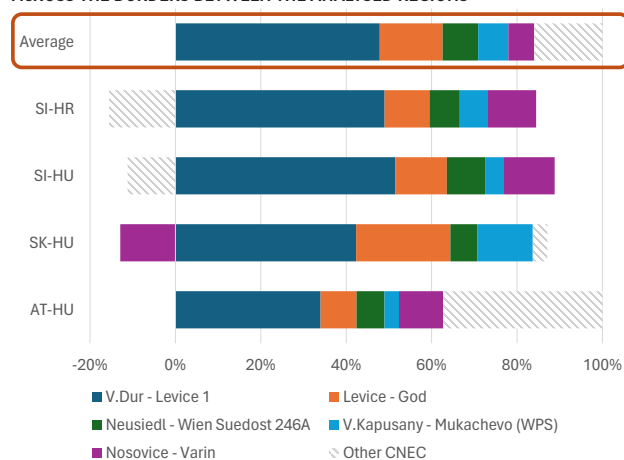
The introduction of flow-based market coupling (FBMC) within the Core region represented a major step forward in European power market integration. Under the flow-based market coupling mechanism, transmission system operators manage transmission capacity using Critical Network Elements with Contingencies (CNECs) – specific transmission lines and their associated outage scenarios. These CNECs define the physical constraints that determine the range of feasible power exchanges within the Core region. Instead of relying on fixed transfer capacities, FBMC dynamically adjusts market coupling results to ensure that network flows remain within these operational limits. In theory, this mechanism should enhance price convergence and promote efficient cross-border electricity trading. In practice, however, throughout 2024 and 2025, the High-Price Region – comprising Hungary, Romania, Serbia, Bulgaria, Greece, and Croatia – has faced persistently higher prices than its Central European neighbours.

Several sources, including Nagy et.al. (2025)¹ and ACER (2025)², have examined the drivers behind high price spreads at bidding zone borders in this region. Their findings highlight that, beyond electricity market fundamentals, the availability of cross-zonal capacity plays a key role in determining its level. This policy brief explores the extent to which the flow-based allocation mechanism has contributed to the observed price divergence between Central and South-Eastern Europe.

An analysis of Core region market data reveals that a small number of CNECs cause regional price peaks. The analysed period was 1 January 2024 to 31 July 2025. The data used were collected from the tables published by JAO³, primarily from the Active FB Constraints and the Final Computation data. The price differences caused by the CNECs were determined using the publicly available shadow prices, which can be used to calculate the contribution of various network elements to

price differences between bidding zones. Along the borders separating the High-Price and Central-European Regions (AT-HU, SK-HU, SI-HU, and SI-HR), the five most influential CNECs account for approximately 84% of the observed price differences. Among these, two internal network elements – the V. Ďur-Levice line in Slovakia and the Neusiedl-Wien line in Austria – together explain nearly 60% of all congestion-related effects. The remaining three critical elements are cross-border lines located on the Czech-Slovak, Slovak-Hungarian, and Slovak-Ukrainian borders.

**FIGURE 1. IMPACT OF CRITICAL NETWORK ELEMENTS ON PRICE SPREADS
ACROSS THE BORDERS BETWEEN THE ANALYSED REGIONS**



Source: REKK calculation based on JAO database

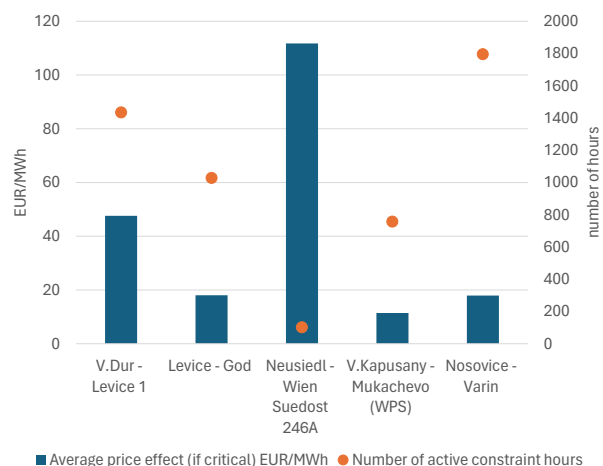
The detailed examination of border-level price spreads also shows that congestion does not always increase price divergence directly. In some cases, certain constraints may even reduce the price difference between two neighbouring markets. For example, congestion on the Czech-Slovak interconnector tends to narrow the Slovak-Hungarian price gap, since it prevents Slovak prices from falling to the lower levels observed in Western Europe. However, it simultaneously amplifies the overall price difference between Central and South-Eastern Europe, as it limits the inflow of cheaper electricity from the West into the region.

¹ Nagy et.al (2025) Day-Ahead Flow-Based Capacity Calculation and Market Coupling in Core CCR, in Estermann, Schrade and Anderson (2025), European Electricity Market Coupling, Springer Nature Switzerland, pp. 219-258.

² ACER (2025) [Transmission capacities for cross-zonal trade of electricity and congestion management in the EU](#), accessed: 10. 10. 2025.

³ JAO: [Active FB constraints](#) accessed: 10. 09. 2025.

FIGURE 2. THE IMPACT OF THE CNECS ON THE DE-HU PRICE DIFFERENCE



Source: REKK calculation based on JAO database

The five most influential CNECs differ greatly in both their frequency and their impact on price formation. The V. Ďur-Levice (SK) line proved to be the most influential overall, constraining trade for more than 1,400 hours during the analysed period and associated with an average DE-HU price spread of 48 €/MWh. In contrast, Neusiedl-Wien (AT) was binding in fewer than 100 hours, yet its impact was extreme – average spreads exceeded 110 €/MWh whenever it became critical. The Nosovice-Varín (CZ-SK) element displayed the opposite pattern: it was binding relatively often (around 13% of hours), but generated a more moderate spread of about 18 €/MWh on average.

The set of critical transmission lines driving price formation in the region has changed considerably over time. The V. Ďur-Levice line in Slovakia was highly influential, particularly during summer 2024 and again around year-end 2024, when it frequently constrained cross-border flows and contributed to sustained price differentials. The Neusiedl-Wien connection in Austria had a rare but severe impact, most notably in late June and July 2024, when it coincided with exceptionally high price spreads. The Levice-Göd (SK-HU) line emerged as another key element, exerting recurrent and substantial effects across multiple periods, especially in

summer 2024 and spring-summer 2025. In contrast, the Nosovice-Varín (CZ-SK) line appeared frequently but generated only modest price impacts, reflecting its relatively limited influence on overall congestion patterns. Finally, the V. Kapušany-Mukachevo (SK-UA) interconnector exhibited sporadic but pronounced constraints, particularly during winter 2024/25 and mid-2025.

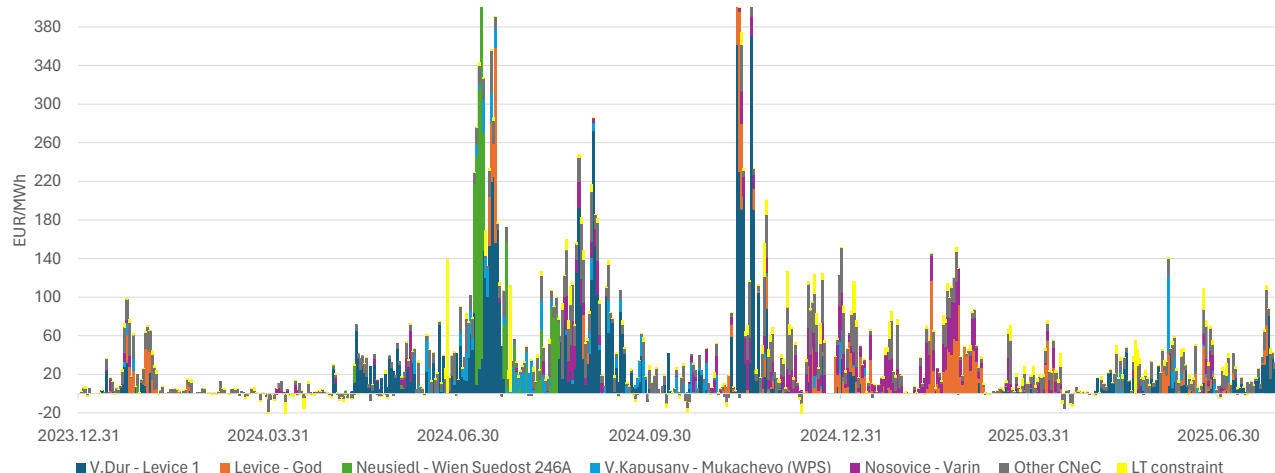
In the flow-based market coupling framework, Remaining Available Margin (RAM) is the portion of a transmission line's capacity that remains available for commercial exchanges after accounting for base flows, reliability margins, and long-term commitments. A reduction in RAM consistently leads to larger price spreads between bidding zones.

Empirical analysis confirms this strong correlation between RAM and price differences on the key CNECs. In July 2024, capacity scarcity was most apparent in the afternoon across almost all critical elements – except Levice-Göd – coinciding with episodes of extreme price spreads. In September 2024, RAM scarcity was particularly pronounced on the Nosovice-Varín and V. Ďur-Levice lines, primarily during afternoon hours. During January-February 2025, the Levice-Göd line showed the lowest RAM values, aligning with the largest price differentials of the period. By summer 2025, afternoon price peaks re-emerged, albeit less extreme than in 2024, once again driven by recurring RAM scarcity on the same network elements.

Another important dimension is RAM volatility. Intra-day fluctuations of 20-25% are common, and even consecutive days at the same hour can exhibit twofold differences in available capacity. Such instability increases uncertainty for traders, system operators, and regulators underscoring the need for more predictable and transparent capacity allocation within the FBMC framework. RAM values are only announced few hours before DAM closure, further increasing trade uncertainties.

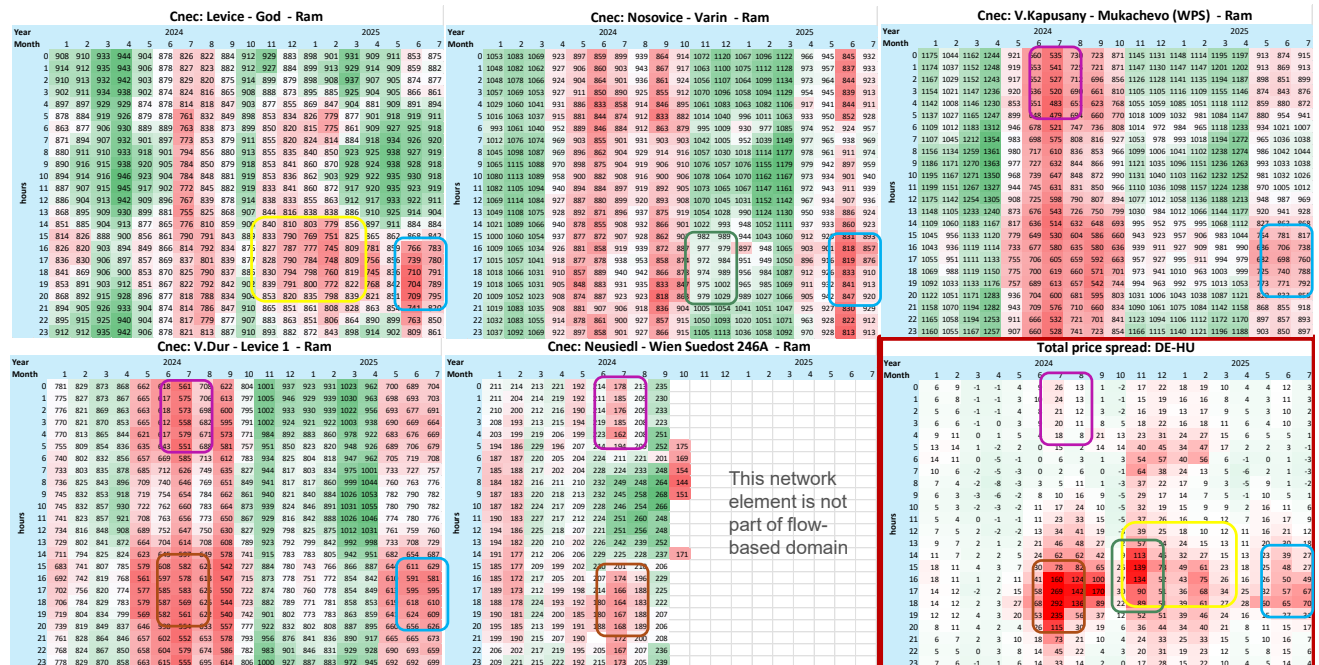
A closer quantitative look at July 2024 provides clear empirical evidence of the strong relationship between RAM scarcity and price divergence.

FIGURE 3. AVERAGE DAILY DE-HU PRICE DIFFERENCE CAUSED BY A GIVEN NETWORK ELEMENT



Source: REKK calculation based on JAO database

FIGURE 4. THE DEVELOPMENT AND CO-MOVEMENT OF CRITICAL NETWORK ELEMENT'S RAM AND THE HUNGARIAN-GERMAN PRICE DIFFERENCE



Source: REKK calculation based on JAO database

For both elements, the contrast between binding and non-binding hours is striking. During periods when these CNECs are not active constraints, average RAM levels are substantially higher, and DE-HU price spreads remain moderate. In contrast, when the V. Ďur-Levice line becomes binding, average RAM falls by more than 20%, while the corresponding price spread rises by roughly 170%. Similarly, during hours when the Neusiedl-Wien line is active, available capacity is around 25% lower, and the associated DE-HU price difference increases sixfold compared to unconstrained hours.

TABLE 1. PRICE DIFFERENCE AND RAM DEVELOPMENT WHEN THE CRITICAL NETWORK ELEMENTS REPRESENT AN ACTIVE CONSTRAINT AND WHEN THEY DO NOT

2024 July	DE-HU Price spread (€/MWh)	Dur-Levice 1 RAM (MWh)	2024 July	DE-HU Price spread (€/MWh)	Neusiedl-Wien RAM (MWh)
Active FB constraint-average	118	500	Active FB constraint-average	265	158
Non active FB constraint-average	43	637	Non active FB constraint-average	38	211

Source: REKK calculation based on JAO database

The 70% minimum RAM rule was introduced by EU regulation 2019/943 to ensure that transmission system operators (TSOs) make at least 70% of each critical network element's physical capacity available for cross-zonal electricity trade. This requirement will become fully binding from January 2026, although temporary derogations and national action plans may apply in cases where full compliance is not yet feasible.

In practice, however, as it can be seen in Table 2, compliance with the 70% rule remains uneven, particularly on high-impact internal network elements. The minimum required allocated capacity (MinRAM factor) on the two most

TABLE 2. RAM FACTOR VALUES IN CASE OF MOST CRITICAL NETWORK ELEMENTS

	V.Dur - Levice 1	Levice - God	Neusiedl - Wien Suedost 246A	V.Kapusany - Mukachevo (WPS)	Nosovice - Varin
MinRAM Factor	50%	70%	40%	70%	70%
Calculated RAM Factor: active constraint	49%	63%	60%	85%	81%
Calculated RAM Factor: no constraint	52%	69%	68%	88%	81%

Source: REKK calculation based on JAO database

A multivariate linear regression analysis was conducted to examine the impact of RAM values on the price difference between Germany and the High-Price Region for the most relevant network elements. Regressions were run for two time periods: the 'entire period' from 1 January 2024 to 31 July 2025, and the 'high-price period' from 31 March 2024 to 1 April 2025. Two different specifications were tested for each period, and the results proved to be robust across the variants. This policy brief only presents the variant with the greatest explanatory power for both periods. The following variables are included in the model:

The dependent variable is the difference between the DAM price in Germany and the weighted average of DAM prices in the High-price Region [EUR/MWh], with the national load values serving as weights.

The explanatory variables include the

- regional load - the total electricity consumption in the High-Price Region [MWh], (Load_Regional)
- generation data - PV, wind, hydro and nuclear production in the High-Price Region [MWh], (PV_Regional, Wind_Regional, Nuclear_Regional, and Hydro_Regional)
- the level of German DAM price [EUR/MWh] (DAM_DE)
- weather-dependent (wind plus solar) renewable generation in Germany [MWh], (DE_VRES)
- the RAM value of critical network elements in the FB domain affecting the price difference [MW], (Levice_God_RAM, Dur_Levice_RAM, Nosovice_Varín_RAM)

The most relevant network elements (CNECs) for the analysis were the Nosovice-Varín, V. Ďur-Levice and Levice-Göd lines. The other important network elements, the Neusiedl-Wien Südost and V. Kapusany-Mukachevo lines, were not incorporated into the model: the former due to its infrequent inclusion in the FB domain as a critical network element and the latter due to its location on the border of the CORE Region. Please note that only cases with RAMs greater than zero for all three network elements were included in the regressions.

TABLE 3. RESULTS OF THE REGRESSION ANALYSIS

Dependent variable	Price difference between DE and the region, [EUR/MWh]	
	Entire period	High-price period
Number of observations	12725	7877
R Square	0.334	0.380
Adjusted R Square	0.334	0.379
(Constant)	33.5720***	-26.8921***
Load_Regional	0.0059***	0.0073***
PV_Regional	-0.0054***	-0.0067***
Wind_Regional	-0.0077***	-0.0087***
Nuclear_Regional	-0.0095***	-0.0084***
Hydro_Regional	-0.0026***	0.0010***
DAM_DE	-0.2974***	-0.4160***
DE_VRES	0.0003***	0.0004***
Levice_God_RAM	-0.0348***	-0.0208***
Dur_Levice_RAM	-0.0111***	-0.0212***
Nosovice_Varín_RAM	-0.0277***	-0.0065

Significance levels: *** $p \leq 0.001$, ** $p \leq 0.01$, * $p \leq 0.05$

Source: REKK calculation based on JAO database, ENTSO-E Transparency Platform

As Table 3 indicates, the R^2 values of the regressions are 0.33 for the entire period and around 0.38 for the high-price period, showing that the model can predict the price differences

The estimated coefficients, indicating highly significant relationships between the included factors and the price differential, reveal the following effects when other factors are held constant:

- Regional load has a positive effect, indicating that increases in regional consumption are associated with a greater price difference. An increase of 1 GWh in regional load raises prices by 5.9 EUR/MWh in the entire period, whereas in the high-price period, the effect was 7.3 EUR/MWh.
- Among the generation types, the coefficients suggest that increases in production correspond to reductions in the price difference. In the case of the entire period, an increase of 1 GWh in PV, wind, nuclear and hydro generation in the region lowered prices by -5.4, -7.7, -9.5 and -2.6 EUR/MWh respectively. During the high-price period, the effects were somewhat larger for PV, wind and nuclear generation: -6.7, -8.7 and -8.4 EUR/MWh, respectively. Meanwhile, regional hydroelectric generation had a smaller reducing effect of -1 EUR/MWh.
- As regards the German day-ahead price, the larger the price, the smaller the price difference. A rise of 1 EUR/MWh reduced the price difference by -0.297 EUR/MWh over the entire period, whereas the effect was greater during the high-price period: -0.416 EUR/MWh.
- The RAMs of the three analysed network lines exhibit negative coefficients, suggesting that transmission capacity constraints play a significant role in price convergence between the region and Germany. During the entire period, a 100 MW increase in RAM of the critical network elements reduced price differences by -3.48 EUR/MWh in case of the Levice-Göd line, -1.1 EUR/MWh in case of the V. Ďur-Levice line, and -2.7 EUR/MWh in case of the Nosovice-Varín line. Looking at the high-price period, these effects amounted to -2.08, -0.65 and -2.12 EUR/MWh respectively. These findings highlight the importance of available capacity in shaping regional electricity price disparities.

As we have already mentioned, the model's overall fit, measured by the R-squared value, was above 33% for the entire period. This suggests that the included variables explained 33% of the variation in price differences, while factors we could not control for caused the remaining variation.

FIGURE 5. THE RELATIVE IMPORTANCE OF THE EXPLANATORY VARIABLES (ENTIRE PERIOD)

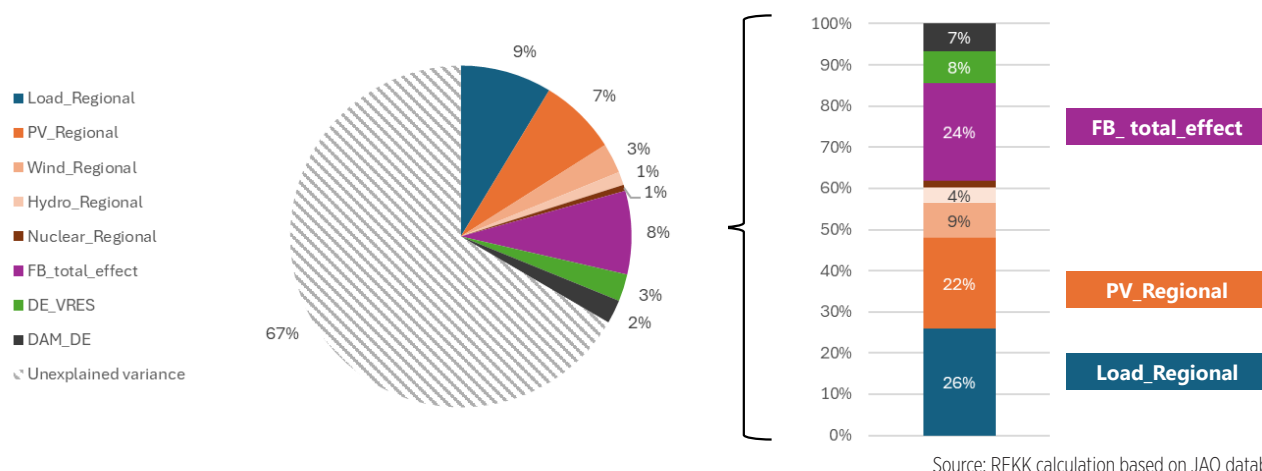


Figure 5 illustrates the contribution of the independent variables in explaining the observed price difference. Of the 33% variance explained by the model, the most significant contributors were regional load (26%), RAM values across the three evaluated network elements (24%), and photovoltaic (PV) generation within the high-price region (22%)

POLICY CONCLUSIONS

The persistent price divergence between Central and South-Eastern Europe is the result of the combined effect of the regional consumption patterns, the supply characteristics, and the transmission bottlenecks. While the flow-based market coupling framework has improved the overall European efficiency, its benefits remain unevenly distributed: the High-Price Region faces systematically higher wholesale prices, driven not only by cross-border constraints but also by internal grid limitations that now shape regional price formation.

Despite its welfare-maximising intent, the flow-based system often operates as a “black box” for market participants. Compared with the previous NTC-based allocation method, the FBMC’s complexity and limited transparency make it difficult for stakeholders to interpret or anticipate the market outcomes. Improved transparency in the calculation of RAM and earlier disclosure of RAM values would help market participants better understand and forecast sudden RAM swings and congestion patterns.

Furthermore, enforcement of the 70% minimum RAM rule must be prioritised where it matters most. Compliance is particularly critical on high-impact CNECs such as V. Āur-Levice and Neusiedl-Wien, which have a disproportionate influence on regional price spreads. Targeted monitoring by ACER and ENTSO-E, combined with transparent penalties for non-compliance would ensure consistent application of the rule and strengthen confidence in the FBMC system.

The 5% PTDF threshold in the capacity calculation methodology also requires review. While designed to simplify the flow-based domain, it can introduce discontinuities that distort results and might result in sub-optimal welfare maximisation. Sensitivity analyses on alternative PTDF thresholds should be carried out to balance methodological simplicity with physical accuracy.

Economic incentives for internal grid reinforcement should also be reconsidered. Current arrangements create an investment incentive gap: while internal CNECs often deliver cross-border benefits, their upgrade costs are borne nationally. A European-level cost-sharing or compensation mechanism would help ensure that countries hosting critical internal bottlenecks are incentivised to make investments primarily enhancing regional welfare. In parallel, PCI and PMI selection processes should prioritise true welfare bottlenecks, ranking candidate projects based on persistent shadow prices, measured welfare losses, and their potential to reduce structural price spreads.

Finally, enhancing system flexibility is crucial to mitigate the effects of binding constraints. Storage (particularly batteries) and demand-side response (DSR) should be incentivised to provide peak-hour relief when flow-based limits are most restrictive. Dynamic or time-of-use tariffs could encourage consumers to shift demand away from the 17:00–21:00 peak window, easing network congestion and improving welfare. Fast, flexible generation capacity – including hybrid wind-plus-storage solutions – can complement these measures, providing cost-effective coverage during high-stress hours.

REKK FOUNDATION

The goal of the REKK Foundation is to contribute to the formation of sustainable energy systems in Central Europe, both from a business and environmental perspective. Its mission statement is to provide a platform for open-ended, European-wide dialogue between government and business actors, infrastructure operators, energy producers and traders, regulators and consumers, professional journalists and other interested private entities. The Foundation will develop policy briefs and issue papers with forward-looking proposals concerning challenges posed by energy and infrastructure systems and organize regional forums allowing stakeholders to become familiar with the latest technological and regulatory developments within the industry.



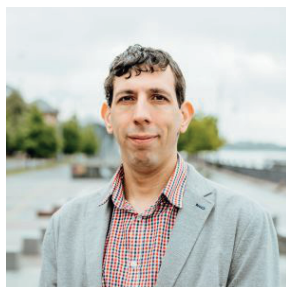
Mária Bartek-Lesi is a research associate at the Regional Center for Energy Policy Research (REKK). From 2000 until 2012 she was a teaching assistant and later an assistant professor at the Institute of Business Economics at the Corvinus University of Budapest. Previously, she participated in the work of the

Department of Economics and Environmental Protection of the Hungarian Energy Office, and worked as a research assistant at the Labor Project of the Economics Department of the Central European University. She received her PhD in 2005 from the Faculty of Business Administration of the Corvinus University of Budapest. She holds an M.A. in Economics from the Central European University, Prague, and a degree in agricultural mechanical engineering from the University of Agricultural Sciences, Gödöllő.



Gábor Horváth joined REKK as a research associate in September 2019. He completed his bachelor degree at Corvinus University of Budapest in Business Administration and Management. After that he started his MA degree in economics at ELTE and absolved in 2019. During his university studies he was also a

member of Rajk László College for Advanced Studies, a college of BCE. Before joining REKK he was working as a data analyst and research assistant at various projects.



András Mezősi is a Senior Research Associate at the Regional Centre for Energy Policy Research. He received PhD from the Corvinus University of Budapest in economics in 2014 and graduated from the Corvinus University of Budapest in Economics in 2006. He joined REKK as a intern in 2005, since

then he has become a senior researcher working on projects related in renewable energy markets, renewable investment analyses, emission trading and electricity market modelling. He participated in several projects related to energy economics of buildings, including modelling the energy consumption of residential buildings. He also investigated the regulation of renewable energy sources in Hungary and also in the wider region.



Adrienn Selei has been working for REKK since 2011. Her work especially includes gas market modelling, but she has been also involved in different works in the field of electricity markets (mainly analysing system reserves market and topics of market integration). She has already finished her Phd studies in Economics. Due to her studies and teaching ex-

perience she has a profound knowledge in industrial economics and market modelling.



László Szabó is the director of REKK. He received PhD from the Corvinus University of Budapest in economics. After his studies, he held several positions in the Hungarian public administration: at the Ministry of Economic Affairs and also at the Hungarian Energy Office. Between 2002 and 2010 he was a researcher and scientific officer at the

Institute for Prospective Technological Studies, DG JRC and European Commission, where he specialised in modelling energy intensive sectors and climate change related issues. He participated in several EU projects dealing with climate change mitigation and adaptation issues and also investigated energy efficiency measures, publishing the results in several peer-reviewed journals. Since 2010 his work at REKK focuses on various energy related topics, amongst them the regulation of renewable energy sources in Hungary and also in the wider region, energy economics of buildings, and analysing electricity market developments in the short and medium term with a regional context.