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The Renaissance of Nuclear Technology in Central Europe

Following Russia's invasion of Ukraine in 2022, the countries of Central Europe were confronted with an unprecedented challenge of the urgent need to redefine the structure of their electricity supply in a permanent and strategic manner. The region's prior dependence on energy commodities from the Russian Federation has come to be perceived not merely as an economic vulnerability, but as a significant strategic risk. In this context, nuclear energy, which had seen a gradual decline in prominence within the European climate and energy discourse, has re-emerged as a viable and increasingly important option. Under the new geopolitical circumstances, nuclear technology is being reconsidered as a means to ensure long-term energy stability, national sovereignty, and substantial emissions reduction, thereby playing a critical role in the broader energy transition process.

Nuclear energy in Central Europe. Nuclear power plants are assuming an increasingly significant role in the energy systems of Central European countries, which are intensifying investment in this technology in response to growing energy demand, the need to reduce CO_2 emissions, and the strategic imperative of enhancing energy independence. Among the most advanced countries in the region in terms of nuclear energy deployment are the Czechia, Slovakia, Hungary, Bulgaria, and Romania. The Czechia operates two nuclear power plants: Dukovany (four reactors) and Temelín (two reactors), with a combined nominal capacity of 4,212 MWe. In 2023, these plants accounted for approximately 40% of the country's electricity generation. Plans are underway to expand both sites with the construction of additional units ("IEŚ Commentaries", no. 372). Slovakia runs reactors at Mochovce (three units) and Bohunice (two units), providing a total nominal capacity of 2,308 MWe. These plants generated about 61% of Slovakia's electricity in 2023. A new unit is also planned for the Bohunice site ("IEŚ Commentaries", no. 960). Hungary operates the Paks nuclear power plant, consisting of four reactors with a total nominal capacity of 1,916 MWe. In 2023, it supplied nearly 49% of the country's electricity. Hungary is currently implementing the Paks II project, which includes the construction of two new VVER-1200 reactors[1]. Bulgaria operates the Kozloduy nuclear power plant (two reactors) with a total nominal capacity of 2,006 MWe, responsible for around 40% of electricity production in 2023. By 2037, Bulgaria aims to bring four additional reactors online – two at the Kozloduy site and two at Belene. Romania operates the Cernavodă nuclear power plant (two reactors) with a combined nominal capacity of 1,300 MWe, contributing approximately 19% of the country's electricity in 2023. Construction of two additional units with a total capacity of 1,440 MW is scheduled for completion by 2031. Slovenia operates a single reactor at the Krško nuclear power plant with a nominal capacity of 688 MWe, covering about 37% of the country's electricity production in 2023. Plans are in place to build a second reactor with a capacity of 1,200 MWe after 2040. Meanwhile, Poland is advancing preparations for its first nuclear power plant in Lubiatowo-Kopalino, which will host three AP1000 reactors (each with a capacity of 1,250 MWe), provided by Westinghouse, USA ("IEŚ Commentaries", no. 293). The Baltic States, following the closure of Lithuania's Ignalina nuclear power plant in 2009, are also considering a return to nuclear energy through investments in small modular reactors (SMRs), reflecting a broader regional shift toward nuclear technology as a strategic pillar of energy transformation and resilience

Czech breakthrough, Latvian ambition and Hungarian dilemma. The Czechia energy sector has long been characterized by a high degree of stability, technical competence, and a substantial reliance on nuclear energy. In 2025, a significant political and industrial shift occurred when the government in Prague rejected an appeal

[1] D. Héjj, *Rozbudowa elektrowni atomowej w Paks – znaczenie i perspektywy*, "Prace IEŚ" 2021, no. 4.

from the French company EDF, thereby formally excluding it from the tender for a new reactor at the Dukovany nuclear power plant. While the official justification cited procedural shortcomings, unofficial sources pointed to underlying tensions in Czech-French relations and Prague's strategic reorientation toward a more diversified network of technological and resource partners. Currently, preferred cooperation partners include companies from the United States (Westinghouse), South Korea (KHNP), as well as suppliers from Kazakhstan and other Central Asian countries, particularly in the area of nuclear fuel provision. The Czechia's energy policy remains pragmatic: nuclear power is not only expected to remain the cornerstone of the national energy mix, but also to serve as a pillar of strategic security in light of ongoing European tensions and the broader energy transition. In parallel, the Czech Republic is actively investing in the development of next-generation reactors, including small modular reactors (SMRs), positioning itself at the forefront of technological innovation in the region.

In Latvia, despite the absence of nuclear power generation, a dynamic public debate is underway regarding the potential role of nuclear energy in the country's future energy architecture. The upcoming conference "Nuclear Energy for Latvia", scheduled for May 21, 2025, in Riga, is expected to serve not only as a platform for expert knowledge exchange but also as a catalyst for building broader social consensus around this issue. While the Latvian government currently does not intend to independently develop a nuclear power plant, it increasingly sees itself as a potential coordination hub for regional nuclear initiatives –particularly in collaboration with Estonia, Lithuania, and Finland.

Hungary, by contrast, is pursuing a markedly different approach. The Paks II project – entailing the construction of two VVER-1200 reactors with the involvement of the Russian state-owned company Rosatom – represents one of the most advanced nuclear undertakings in Central Europe. Preparatory construction work commenced in 2024, with full commissioning expected after 2030. However, following Russia's invasion of Ukraine, the project has come to symbolize Hungary's geopolitical tightrope: while Prime Minister Viktor Orbán's government remains committed to maintaining strategic energy cooperation with Russia, it simultaneously faces growing political pressure from both the European Union and NATO. In response, Hungary has initiated efforts to gradually reduce its dependence on Rosatom, including new agreements with countries such as Uzbekistan involving the transfer of nuclear technology, components, and fuel. At this stage, however, these moves remain largely symbolic and diplomatic in nature, rather than constituting substantive diversification of the supply chain.

Systemic challenges. The development of nuclear energy in Central Europe faces significant systemic challenges across financial, regulatory, and social dimensions. The capital costs associated with constructing modern nuclear power plants currently range from EUR 10 billion to as high as EUR 30 billion. Against the backdrop of constrained public budgets, exacerbated by rising expenditures on defense and energy transition efforts, this represents a substantial fiscal burden. Consequently, sustained support from the European Union, financial institutions, and private investors is essential, alongside robust long-term guarantee mechanisms to mitigate investment risks. Regulatory challenges are equally critical. New nuclear projects must comply with rigorous environmental standards, stringent cybersecurity protocols, and enhanced resilience requirements for critical infrastructure. A particularly sensitive issue remains the independence of nuclear fuel supplies, which have historically been predominantly sourced from Russia, as well as the secure storage of this fuel. Social acceptance of nuclear energy, although improving amid recent energy crises, continues to require dedicated educational initiatives and transparent communication strategies. In many Central European countries, nuclear energy has long been a taboo topic, often burdened by the historical legacy of the Soviet era. Shifting this perception demands not only effective narrative framing but also the rebuilding of trust in public institutions and scientific authorities. Simultaneously, despite the formal recognition of nuclear power as a "green" technology under the EU taxonomy, its role in Europe's energy transition remains a subject of controversy both within the European Parliament and among Member States.

Conclusions

- The war in Ukraine and the subsequent energy crisis have underscored the critical importance of energy sovereignty and the resilience of national power systems against external threats. The development of nuclear power contributes to mitigating the risk of energy coercion, enhances the security and stability

of national electricity grids, and facilitates more predictable energy pricing. A key factor in this context is the strategic selection of technology suppliers, as exemplified by Hungary's approach.

- For many years, the Russian company Rosatom held a dominant position in Central Europe's nuclear sector, providing reactors, fuel, and maintenance services. However, following the outbreak of war, several countries in the region – namely Czechia, Slovakia, and Bulgaria – have taken active measures to diversify their nuclear fuel supplies by fostering partnerships with Western companies. Hungary, while continuing its collaboration with Russia on the Paks II project, is concurrently pursuing new partnerships, such as with Uzbekistan, to reduce its reliance on Russian technology and fuel.
- Despite increasing support for nuclear energy in Central Europe, new investments continue to face significant financial and social challenges. The construction of large-scale nuclear power plants demands substantial capital expenditures, ranging from EUR 10 to 30 billion, extended implementation timelines of 10 to 15 years, and consistent political backing. Concurrently, comprehensive educational initiatives are essential to bolster public acceptance of nuclear technology, particularly in countries without prior domestic experience operating nuclear reactors.