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The Changing Energy Dependency of the V4 Countries between 2012 and 2022

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Abstract: The Visegrád Group (V4) countries – Czechia, Hungary, Poland, and Slovakia – entered the 2022 energy crisis with varying but generally significant exposure to Russian oil and natural gas. This exposure reflected inherited socialist-era infrastructure, geographical constraints, and long-term supplier relationships. Although the European Union introduced targeted sanctions after Russia's annexation of Crimea in 2014, energy trade and major infrastructure connections with Russia remained largely unaffected by these measures. This article examines how the primary energy-supply structures and diversification efforts of the four V4 countries changed between 2012 and 2022, focusing on EU policy instruments, infrastructure investment, Russian energy dependence, and the initial effects of Russia's invasion of Ukraine. It employs a comparative qualitative case-study design based on Eurostat energy-balance and trade data, EU policy documents, and relevant secondary literature. The findings show that diversification progressed unevenly across the region. Poland achieved the most substantial reduction in Russian gas dependence, supported by its maritime access, LNG infrastructure, and a more decisive policy orientation away from Russian energy. Czechia also developed significant diversification capacity, whereas Hungary and Slovakia retained greater exposure to Russian energy through existing infrastructure, supplier relationships, and national policy preferences. The evidence suggests that EU regulation, infrastructure funding, and market integration created opportunities for diversification, while how extensively those opportunities were used varied with national preferences. Hungary's 2022 expansion of Russian-built nuclear capacity further shows that diversification is multidimensional: dependence may decline in one dimension while deepening in another, such as technology and financing. Overall, the 2022 invasion coincides with a sharp acceleration of divergences that had emerged over the preceding decade.

Keywords: Visegrád Group, Energy Security, Energy Diversification, Russian Energy Dependence, EU Energy Policy, Energy Infrastructure, Central and Eastern Europe, Nuclear Energy

1. Introduction

This study analyzes the energy supply diversification efforts in the Visegrád Group (V4) countries – Czechia, Hungary, Poland, and Slovakia – between 2012 and 2022, including the first several months of Russia's large-scale invasion of Ukraine, which accelerated ongoing processes. Diversification is treated here as a multidimensional process, encompassing not only the composition of the energy mix but also the diversity of suppliers, import routes, and the technology and financing behind energy infrastructure. The study aims to identify the major factors shaping these efforts, such as EU-funded infrastructure investment (including FDI-like mechanisms through EU instruments), national political stances toward the EU,

NATO, and Russia, and the structural constraints created by inherited infrastructure and long-term supplier relationships.

The Visegrád Group was originally formed in 1991 by Hungary, Poland, and Czechoslovakia (Scott, 2022; Višňovský, 2020). Following the 1993 dissolution of Czechoslovakia into the Czech Republic (Czechia) and Slovakia, the group became the "Visegrád Four" (V4). Cooperation among the four states supported their integration into NATO and the European Union, and closer alignment promised further benefits: greater access to EU funding, more collective political weight within EU institutions, and improved energy-supply security through reduced dependence on Russian fossil fuels. Yet in recent years the V4 formation has become increasingly fragile because of divergent views toward the war in Ukraine and toward Russia. While the pro-Ukraine camp of Poland, Czechia, and (until its late-2023 change of government) Slovakia sought to distance itself from cooperation with Russia, Hungary's more neutral, even Russian-friendly stance emphasized Russia's role in providing "cheap" natural gas and oil, which it argued was vital to keeping fossil-fuel costs low, especially for heating and transportation.

Energy security is not a single, uncontested concept. Definitions differ according to the risks considered, the relevant impacts, and the thresholds used to identify insecurity (Winzer, 2012). In this article, energy security refers principally to the continuity of energy supplies relative to demand (Winzer, 2012) and, more broadly, to the vulnerability of the energy systems on which critical economic and social functions depend (Cherp & Jewell, 2014). This vulnerability reflects both exposure to risks – including dependence on concentrated suppliers, particular import routes, and geopolitical disruptions – and resilience capacities, such as diversified sources, interconnection, storage, and the ability to substitute between energy carriers. Countries that rely heavily on imported fossil fuels, particularly where supplies are concentrated in a small number of external sources or routes, may be especially vulnerable to supply disruptions and to the political or economic leverage exerted by external suppliers. To operationalize this concept for the V4 case, the analysis draws on Jurgilewicz et al.'s (2020) four-component framework – balancing supply and demand, sectoral reliability, functional economic mechanisms, and environmental impact – as the core dimensions of energy security in the region's natural gas sector; these four dimensions structure the synthesis of findings in the Discussion (Section 4). Within the EU, member states have diverse energy interests, which complicate collective action to strengthen energy security (Dyduch & Skorek, 2020). Although these interests could in principle be pursued more effectively through joint rather than individual efforts, aligning national priorities has proven difficult.

To support convergence, the EU provides funds for gas-infrastructure development. However, in the case of natural gas, these funds can mostly be used for Projects of Common Interest (PCIs) under the TEN-E Regulation (European Commission, 2022b). The Third Energy Package, adopted in 2009, unbundled production from transmission and introduced the so-called "Gazprom clause". The EU's 2010 Security of Gas Supply Regulation mandated reverse-flow capability on major interconnectors (detailed in Section 3.4). These instruments form the core of the EU's pre-2022 diversification toolkit in Central and Eastern Europe (Regulation (EU) No 994/2010, 2010).

This study asks three questions: (1) Do the series of Russian oil and gas imports to the V4 countries show a visible change after Russia's annexation of Crimea in 2014, when the EU introduced limited sanctions on Russia? (2) How did the primary energy mix of each V4 country change between 2012 and 2022? (3) To what extent did EU-supported infrastructure and market integration measures contribute to diversification away from Russian energy, and how did the invasion of Ukraine alter this trajectory? The remainder of the paper is organized in standard IMRAD form: Section 2 sets out the data and methods used; Section 3 presents the empirical results on the changing energy mix and diversification measures; Section 4

discusses these findings in relation to the existing literature and their policy implications; and Section 5 concludes with the study's limitations and directions for future research.

2. Materials and Methods

This study employs a comparative qualitative case-study design to examine changes in energy dependence and diversification in the four Visegrád Group (V4) countries – Czechia, Hungary, Poland, and Slovakia – between 2012 and 2022. The period covers the consolidation of EU instruments for energy security and market integration after the 2009 gas crisis, the political and geopolitical effects of Russia's annexation of Crimea in 2014, and the initial consequences of Russia's full-scale invasion of Ukraine in February 2022.

The four countries share several structural characteristics, including former membership in the socialist economic system, inherited east–west energy infrastructure, and historically significant dependence on Russian oil and natural gas. At the same time, they differ in geographical position, domestic energy resources, nuclear capacity, access to alternative import routes, energy-market organization, and political relations with Russia and the EU. These similarities and differences make the V4 a suitable regional case for examining how common EU measures interact with national conditions. The study addresses the three research questions outlined in the Introduction.

The analysis is exploratory and interpretive rather than econometric. It therefore does not claim to estimate the independent causal effect of EU sanctions, infrastructure funding, or individual national policies. Instead, it combines descriptive longitudinal evidence with document analysis to identify temporal associations, policy patterns, and differences among the four cases.

The analysis is based on three groups of sources. First, the study uses Eurostat energy-balance data to examine changes in the composition of primary energy supply. The quantitative component focuses on the principal energy categories used in the manuscript: solid fossil fuels, natural gas, oil and petroleum products, nuclear energy, and renewable energy sources. It also considers the combined share of conventional fossil fuels and the share of renewable energy sources and biofuels. These indicators make it possible to compare the direction and approximate magnitude of changes across the four countries over time. Second, the study examines European Union policy and institutional documents, including those relating to the Third Energy Package, the Energy Union, the Trans-European Networks for Energy framework, Projects of Common Interest, the Connecting Europe Facility, the European Green Deal, and the REPowerEU plan. These documents are used to identify the policy instruments through which the EU sought to improve energy security, increase market integration, support cross-border infrastructure, and facilitate diversification of supply routes. Third, the study reviews academic publications, policy reports, institutional analyses, and relevant country-level strategy documents dealing with energy security, Russian energy dependence, infrastructure, and the energy transition in Central and Eastern Europe. National policy documents are considered where they help clarify domestic priorities and the political interpretation of EU energy policy.

The analysis proceeded in four stages. First, Eurostat data were organized chronologically for each country and energy category, comparing each country's position in 2012 with its position in 2022, while also examining intermediate developments around 2014, 2017, 2020, and 2021. Particular attention was paid to whether the data show a sharp break after the 2014 annexation of Crimea or a more gradual change over the decade. Second, the study identified the main EU policy instruments relevant to diversification. These included regulatory measures intended to increase market access and competition, infrastructure measures intended to improve interconnection and reverse-flow capacity, and financial measures intended to support cross-border projects. Third, these policy developments were compared with country-level infrastructure and energy strategies, considering, among other

factors, Poland's Baltic Sea access and LNG capacity, Czechia's connections to Western European markets, and the continuing importance of Russian pipeline infrastructure and long-term contracts in Hungary and in Slovakia. Fourth, the four cases were compared across three dimensions: changes in the composition of primary energy supply; changes in the availability of alternative suppliers and import routes; and the relationship between diversification policy and national political preferences. This procedure allows the study to distinguish between energy-mix diversification and supplier diversification. The first concerns changes in the relative contribution of coal, gas, oil, nuclear energy, and renewables; the second concerns changes in the countries and routes from which imported energy is obtained. The two processes may occur simultaneously, but they are not identical. The 2022 endpoint is intended to capture the beginning of the major disruption in European energy relations with Russia, rather than the full post-2022 adjustment; the findings should therefore not be used to draw conclusions about the durability of subsequent diversification measures.

Several limitations should be acknowledged. First, the study relies primarily on secondary data and documentary sources and does not include interviews with government officials, energy companies, regulators, or infrastructure operators. Second, the Eurostat indicators describe the composition of energy supply but do not, on their own, identify the country of origin of every imported energy product. Third, the qualitative comparison cannot isolate the independent effect of sanctions from other factors, such as changing prices, domestic production, technological developments, infrastructure investment, contractual arrangements, or the COVID-19-related decline in energy demand. Accordingly, the findings should be understood as a comparative assessment of observable trends and policy processes. The study identifies plausible relationships between EU measures, national strategies, infrastructure development, and changes in energy dependence, but it does not present these relationships as statistically demonstrated causal effects.

3. Results

This section presents the study's findings in six parts. Section 3.1 examines changes in the composition of primary energy supply; Section 3.2 turns to the growth of renewable energy and biofuels. Section 3.3 then assesses each country's dependence on Russian oil and gas imports over the period, before Section 3.4 steps back to trace the EU regulatory and geopolitical developments – the 2009 gas crisis and the 2014 annexation of Crimea – that shaped the diversification instruments available to the V4. Section 3.5 examines how those instruments were used through EU-funded cross-border infrastructure, and Section 3.6 closes the Results with the policy and nuclear-energy responses that followed Russia's 2022 invasion.

3.1 Changes in the Energy Mix, 2012–2022

This subsection examines how the overall energy mix shifted over the decade. Table 1 presents the share of fossil fuels in gross available energy in the V4 countries between 2012 and 2022, based on Eurostat's nrg_ind_ffgae indicator, which covers the overall energy supply including transformation, transmission and distribution losses, final consumption, transport, and non-energy uses of fossil fuels – a broader measure than primary fuel consumption alone.

Table 1. Share of Fossil Fuels in Gross Available Energy in the V4 Countries, 2012–2022

Country	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Czechia	76.97	75.97	75.00	76.24	77.25	75.97	75.15	73.55	70.82	71.47	71.36
Hungary	69.22	66.55	66.63	67.50	67.99	69.37	69.90	69.98	69.31	69.43	67.61
Poland	91.36	91.58	90.57	90.50	90.96	91.21	88.40	87.18	86.33	88.02	87.27
Slovakia	64.21	64.34	63.16	62.04	62.60	63.79	64.94	62.43	62.18	63.78	61.65

Note. Data are based on Eurostat indicator *nrg_ind_ffgae* (Eurostat, 2026d).

The data show substantial differences in both the levels and trajectories. Poland recorded the highest share throughout the period and Slovakia the lowest, with Czechia and Hungary in intermediate positions; the decline between 2012 and 2022 was smallest in Hungary, moderate in Slovakia, and most pronounced in Poland and Czechia.

Czechia's fossil-fuel share declined from 76.97% in 2012 to 71.36% in 2022, a gradual but uneven reduction of 5.61 percentage points, interrupted by a rise to 77.25% in 2016 before falling more consistently through 2020 and drifting only marginally thereafter. This relatively high share is consistent with the continued importance of coal, oil products, and natural gas in the national energy balance.

Hungary's share declined only slightly, from 69.22% to 67.61%, and did not follow a continuous downward path – it rose after 2014 to a temporary maximum of 69.98% in 2019 before falling back by 2022. Its comparatively low level relative to Czechia and Poland is partly associated with the significance of nuclear energy in Hungary's energy mix and should not be read as evidence of low exposure to imported gas and oil (Section 3.3).

Poland remained the most fossil-fuel-dependent V4 country throughout the period, with its share falling from 91.36% to 87.27% – a reduction of 4.09 percentage points concentrated mainly after 2017. The persistence of a very high share reflects the continuing importance of coal in Poland's energy system; the data alone do not establish that the decline resulted from the Świnoujście LNG terminal or diversification of gas and oil routes (Section 3.5), only that it coincided with them.

Slovakia had the lowest fossil-fuel share among the four countries in both 2012 and 2022, declining from 64.21% to 61.65%. This reduction was smaller than Poland's or Czechia's, though larger than Hungary's – but non-monotonically: the series fell to 62.04% by 2015, rebounded to a period maximum of 64.94% in 2018, then declined again. This relatively low level is consistent with the importance of nuclear energy in Slovakia's energy mix, though the fluctuation suggests the underlying driver is less stable than in Czechia or Hungary.

None of the four series displays a common sharp break in 2014, when the EU introduced limited sanctions following Russia's annexation of Crimea: Czechia's 2014 decline was followed by a marked rise through 2016, Hungary's share increased rather than fell, Poland's remained broadly stable until 2017, and Slovakia's decline in 2014–2015 was later reversed by its 2018 peak. These divergent movements are difficult to reconcile with a single sanctions-driven explanation, and no immediate reorientation of the V4 energy mix is visible in the post-2014 period.

The differences among the four cases are more plausibly associated with country-specific factors: the role of nuclear energy, the continuing importance of coal, exposure to oil and gas imports, the structure of long-term contracts, and the timing of infrastructure investment. Poland's persistently high values point to its coal-based energy system; Hungary's and Slovakia's lower values are partly associated with nuclear generation; Czechia occupies an intermediate position, combining a substantial fossil-fuel component with a significant nuclear sector. The observed differences in the energy mix align more closely with these structural and policy-related factors than with the timing of the limited sanctions regime introduced in 2014.

3.2 Growth of Renewable Energy and Biofuels

This subsection turns to the renewable side of the energy mix. Table 2 shows the share of renewable energy sources and biofuels in gross available energy for all four V4 countries, 2012–2022. By 2022, all four countries had converged within a narrow band of roughly 13% (12.85–12.97%), despite starting from different levels and following distinct paths over the decade. None of the four countries, however, reached the average of roughly 20% recorded by the pre-2004 ("old") EU-15 member states over the same period, which is consistent with V4 economies' persistently lower share of renewables and biofuels relative to the EU-15

(Dyduch & Skorek, 2020; Eurostat, 2026c). This endpoint convergence conceals different trajectories, however: all four countries recorded net increases over the decade, but by sharply different margins – Czechia and Poland each gained roughly 4 percentage points, while Hungary and Slovakia gained less than one percentage point apiece.

Table 2. Share of Renewable Energy Sources and Biofuels in Gross Available Energy in the V4 Countries, 2012–2022

Country	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Czechia	8.69	9.51	10.16	10.43	10.64	10.44	10.46	11.44	12.70	12.82	12.94
Hungary	11.92	13.01	12.01	11.98	11.78	11.16	10.48	10.60	11.35	11.83	12.86
Poland	8.86	8.78	9.18	9.48	8.84	8.58	11.14	11.94	12.54	11.88	12.85
Slovakia	12.19	12.06	11.12	12.83	13.15	12.46	11.80	12.91	13.05	13.07	12.97

Note. Percentages were calculated from the underlying Eurostat values in GWh. Author's calculations based on Eurostat (2026c), dataset *nrg_bal_c__custom_22825929*. The calculation divides renewable energy sources and biofuels by total gross available energy.

Poland and Czechia recorded the lowest renewable shares among the four at the start of the period – Czechia marginally the lowest in 2012 (8.69%), Poland close behind and lowest in 2013 (8.78%) – but Poland's share then increased sharply between 2017 and 2018 – from 8.58% to 11.14%, a larger single-year increase than that recorded by any other V4 country in any year, bringing it into the same range as the other three by 2018. Poland's continued reliance on coal underscores the tension between supplier diversification and the persistence of carbon-intensive generation in its energy mix (Kochanek, 2021). In 2022, Poland and Czechia were the EU's only remaining hard-coal producers, Poland alone accounting for approximately 97% of total EU output (Eurostat, 2026e). Under the 2021 social agreement between the Polish government and the mining unions, the last hard coal mines are scheduled to operate until 2049 (International Energy Agency, 2022b), while the Bełchatów lignite plant is due to retire its final unit by 2036 under the Łódzkie Territorial Just Transition Plan (PGE, 2021) and the Turów mine's concession was extended in April 2021 to run until 2044 (Barteczko, 2021).

Czechia, Slovakia, and Hungary all operate substantial nuclear generating capacity, but their renewable-energy trajectories over the decade diverged sharply. Czechia's share rose from 8.69% in 2012 to 12.94% in 2022 (+4.25 percentage points), by far the largest net gain of the three nuclear-power countries and the steadiest path, with only a marginal dip in 2017. This is consistent with a national strategy that treats nuclear capacity as the primary vehicle for phasing out coal, with renewables expanding incrementally alongside it rather than substituting for planned nuclear investment (Barkhatov et al., 2019; International Energy Agency, 2021). Slovakia's renewable share increased only marginally overall from 12.19% to 12.97% (+0.78 percentage points), and the path was uneven, ranging from a low of 11.12% in 2014 to a high of 13.15% in 2016 – a swing of roughly two percentage points – rather than a smooth climb. Hungary's trajectory differed from both: despite comparable nuclear capacity, its renewable share fell for five consecutive years after 2013 before recovering, ending 2022 with a net increase of 0.94 percentage points over its 2012 level – a gain slightly larger than Slovakia's in absolute terms, but one attributable entirely to the post-2018 recovery rather than to sustained growth across the decade. Evaluating these patterns together, the three cases suggest that nuclear capacity eased the political urgency of renewables development in all three countries, but did so least in Czechia, where renewables and nuclear capacity expanded in tandem, and most in Slovakia and Hungary, where renewable-energy growth over the full period was minimal – non-monotonic in Slovakia's case, and dependent entirely on a late-decade rebound in Hungary's.

3.3 Dependence on Russian Oil and Gas Imports, 2012–2022

While the changes in the overall energy mix documented in Sections 3.1 and 3.2 indicate a gradual reduction in the role of fossil fuels, they do not directly capture the V4 countries' exposure to Russian energy. This subsection therefore examines trends in imports of crude oil, petroleum products, and natural gas from Russia as a share of each country's total imports of these fuels over the 2012–2022 period. As Dyduch and Skorek (2020) note, the diversification strategies of the V4 countries aim to change both the energy mix (increasing the share of nuclear fuel, renewables, and natural gas) and the group of supplier countries. The following analysis focuses on the latter dimension, that is, dependence on Russian oil and gas. Table 3 presents Russia's share of total natural-gas imports in the V4 countries, 2012–2022.

Table 3. Russia's Share of Total Natural-Gas Imports in the V4 Countries, 2012–2022

Country	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Czechia	99.96	99.95	90.36	99.81	99.98	99.19	99.51	99.73	100.00	100.00	79.40
Hungary	98.01	95.00	95.00	94.99	94.99	95.00	95.00	95.00	95.00	95.00	82.36
Poland	79.80	77.06	75.70	72.49	74.27	65.60	61.63	55.02	54.88	56.58	19.65
Slovakia	100.00	100.00	100.00	100.00	98.81	84.64	100.00	100.00	85.45	68.91	38.57

Note. Percentages were calculated as natural-gas imports from Russia divided by total natural-gas imports. Author's calculations based on Eurostat (2026a), dataset *nrg_ti_gas*.

It is worth noting that the 2022 figures in Table 3 are full-year averages rather than end-of-year snapshots, which can understate how completely imports had stopped by the end of the year. Poland's share of Russia-origin gas, for instance, fell sharply from 56.58% in 2021 to 19.65% in 2022 (Table 3), a decline that itself reflects several months of close to prewar import volumes in early 2022 blended with near-zero imports following the April cutoff, rather than a gradual reduction across the year. Czechia's decline from 100% in 2021 to 79.40% in 2022 follows the same pattern, tempered by continued flows via Nord Stream until its suspension mid-year. This reflects Eurostat's annual reporting convention, which sums volumes by ultimate country of origin across the full calendar year, so volumes delivered in the pre-halt months – concentrated in the high-demand winter period – are still counted in full. The sharper declines documented in contemporaneous reporting (e.g., Łoskot-Strachota et al., 2023) therefore only become visible in 2023 annual data, which fall outside the period covered here.

Data from the International Energy Agency's "National Reliance on Russian Fossil Fuel Imports" indicator and Eurostat's energy-trade statistics show that all four V4 countries entered the decade with a high dependence on Russian oil and gas, but that their trajectories diverged markedly (International Energy Agency, 2023). Before the war, Poland already had the most diversified sources of gas supply in the region, increasing LNG imports from global markets, mainly Qatar, thanks to the commissioning of the Świnoujście LNG terminal in 2015–2016. Even so, around 56.58% of Polish gas imports still came from Russia in 2021 (Table 3). Czechia, Hungary, and Slovakia were more dependent: in 2021, the majority of their gas imports still came from Russia, ranging from 69% in Slovakia to 100% in Czechia (Table 3). After Russia's large-scale invasion of Ukraine in February 2022, these patterns changed rapidly. Poland refused to accept Gazprom's unilateral changes to contractual terms and became one of the first EU countries to halt Russian gas imports completely in April 2022 (Łoskot-Strachota et al., 2023). The Świnoujście LNG terminal, subsequent capacity expansions, and the Baltic Pipe interconnector with Denmark – which became operational in late 2022 – enabled Poland to replace Russian pipeline gas with seaborne LNG and with gas from the Norwegian shelf. By early 2023, Poland was effectively independent of Russian gas.

Czechia's situation was different. Before the war, it imported Russian gas both via the traditional Ukrainian transit route and via the Nord Stream pipeline through Germany. When Nord Stream flows were suspended in 2022, access to German infrastructure and to LNG terminals in the Netherlands and Belgium allowed Czech traders to source gas from Western European hubs rather than directly from Gazprom. As a result, Czech dependence on Russian gas, which stood at 100% of gas imports in 2021 (Table 3), fell sharply during 2022 and reached only a few percent by early 2023 (Łoskot-Strachota et al., 2023).

Slovakia and Hungary both relied heavily on long-term contractual ties to Russia, though their gas-import profiles diverged sharply after 2021. Both governments prioritized supply stability and price predictability through long-term contracts, even at the cost of continued dependence on a single supplier – a policy orientation already evident by 2014, although expressed differently in the two countries (Groszkowski & Sadecki, 2014). In Slovakia, Russia's share of total natural-gas imports fell from 100.00% in 2019 to 85.45% in 2020, 68.91% in 2021, and 38.57% in 2022 (Table 3). The 2022 figure is a full-year average: Slovakia was still about 85% dependent on Russian gas at the time of Russia's February 2022 invasion, similar to its 2020 level, before the year's later decline brought the annual average down (Astrov & Hanzl-Weiss, 2025). This is consistent with the sharp fall recorded elsewhere in Russian pipeline flows reaching Slovakia through Ukraine over the same period (Keliauskaitė & Zachmann, 2024). Slovakia nonetheless remained tied to Gazprom through SPP's long-term supply contract and continued to rely on the Ukrainian transit corridor for a substantial share of its Russian gas supply (Łoskot-Strachota et al., 2023; Yafimava, 2024). Hungary, which retained access to Russian gas via the TurkStream pipeline through Türkiye and maintained a working political relationship with Moscow, saw Russia's share of its gas imports fall only from 95.00% in 2021 to 82.36% in 2022 (Table 3). Hungary continued to import substantial volumes of Russian gas and was the only V4 country whose Russian gas imports did not decline sharply in 2022 (Łoskot-Strachota et al., 2023).

In oil, a related but distinct pattern is visible (Table 4). Czechia had a lower share of Russian oil in total imports than the other three V4 countries in every year of the period, ranging from 45.44% in 2012 to a low of 29.29% in 2020. Slovakia, by contrast, remained the most dependent of the four from 2015 onward (73–78%), reflecting refineries historically configured for Russian crude delivered via the Druzhba pipeline. Hungary started at a similar level to Slovakia (81.13% in 2012), but its share fell steeply to 43.11% by 2017 and, after a temporary rise in 2018–2019, to 41.46% in 2021. Poland had the highest share of the four in 2012–2014 (82–85%) despite its more diversified gas supply, but it then declined steadily to 60.38% in 2021 apart from small increases in 2018 and 2020.

Unlike the V4's gas import profile, however, oil dependence moved in opposite directions across the group after 2022: Poland's Russian oil share fell by almost 20 percentage points, to 40.59%, extending its earlier decline, while Hungary's rose by about 17 points, to 58.08%, reversing its earlier decline. This divergence follows the structure of the EU's sixth sanctions package (June 2022), which banned seaborne Russian crude but granted a temporary exemption for pipeline deliveries via Druzhba to landlocked member states, allowing Hungary and Slovakia to keep importing Russian crude largely unconstrained, while Poland, with access to non-Russian crude via Baltic ports, shifted away more decisively (International Energy Agency, 2023). Czechia's share also rose in 2022 (from 30.68% to 36.76%; Table 4), although it remained the lowest of the four.

Table 4. Russia's Share of Total Oil and Petroleum-Product Imports in the V4 Countries, 2012–2022

Country	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Czechia	45.44	42.95	38.91	36.69	34.05	35.43	34.36	32.94	29.29	30.68	36.76
Hungary	81.13	77.46	69.53	59.96	55.14	43.11	47.34	51.98	45.06	41.46	58.08

Poland	84.38	84.58	81.79	77.87	73.32	68.66	69.06	63.93	67.67	60.38	40.59
Slovakia	81.16	81.26	80.37	78.22	76.86	74.02	74.31	74.00	78.39	76.70	73.34

Note. Percentages were calculated as oil and petroleum-product imports from Russia divided by total oil and petroleum-product imports, excluding biofuels. Author's calculations based on Eurostat (2026b), dataset nrg_ti_oil_custom_22825319.

These differences in import dependence were reinforced by divergent contractual arrangements. Poland's long-term Yamal contract with Gazprom was due to expire at the end of 2022 (Yafimava, 2024), whereas Hungary concluded a 15-year gas-supply agreement with Gazprom in 2021, extending to 2036 (Sabadus, 2022; Yafimava, 2024). Slovakia also remained tied to Gazprom through SPP's long-term supply contract, while its dependence on Russian gas was reinforced by its position on the Ukrainian transit corridor (Łoskot-Strachota et al., 2023; Yafimava, 2024). Czechia, by contrast, had greater access to Western European markets and alternative supplies through Germany, although the contractual basis of Russian gas deliveries to Czech buyers was less transparent (Yafimava, 2024).

Taken together, these import patterns show that the V4 countries' vulnerability to supply disruptions or political pressure from Russia remained high over much of the decade. By 2022, however, Russia's share of gas imports had fallen most in Slovakia and Poland (by about 61 and 60 percentage points since 2012) and least in Czechia and Hungary (about 21 and 16 points), whereas in oil the largest decline was in Poland (about 44 points) and the smallest in Slovakia and Czechia (about 8–9 points). The divergence in import reliance matches the differences observed in the energy-mix data: countries with greater access to non-Russian infrastructure and markets were able to reduce their exposure more quickly, while those constrained by pipeline configuration, refinery technology, and long-term contracts remained more dependent on Russian supplies up to 2022.

3.4 EU Regulatory and Geopolitical Background to V4 Diversification

The diversification efforts documented in the preceding sections did not emerge in a vacuum; they were shaped by a sequence of regulatory reforms and geopolitical shocks that unfolded before and alongside the 2012–2022 study period.

Pressure to reduce reliance on Russian gas transiting Ukraine first became acute during the Russia-Ukraine gas dispute of 2008–2009. Ukraine sought to retain preferential "brotherly" rates for its own gas purchases, while Gazprom moved to end these subsidies; the resulting standoff led to a complete shutdown of transit flows on January 7, 2009, restored roughly two weeks later once the two countries reached an agreement (Pirani et al., 2009). Although short-lived, the episode exposed the vulnerability of the V4 countries' near-total dependence on a single transit corridor and supplier; the crisis directly informed the Security of Gas Supply Regulation adopted in 2010.

The 2009 Third Energy Package addressed this vulnerability through two provisions of particular relevance to the V4. First, it required the unbundling of gas production from transmission, obliging pipeline operators historically aligned with Russian suppliers to grant third-party access to other market entrants. Second, Article 11 of the accompanying Gas Directive – informally termed the "Gazprom clause" – required national regulators to assess whether non-EU acquisitions of control over EU pipeline infrastructure would endanger security of supply, giving Poland and Czechia in particular a legal basis to resist further Russian ownership of domestic transmission assets. Complementing the package, the EU's 2010 Security of Gas Supply Regulation (Regulation (EU) No 994/2010) mandated reverse-flow capability on major interconnectors, ending the exclusively east-to-west orientation of most V4 pipelines and enabling Slovakia and Hungary to draw emergency supply from Germany and Austria. Together, these provisions established the legal and infrastructural prerequisites for the PCI-funded diversification projects examined in Section 3.5.

The annexation of Crimea in March 2014 marked a second turning point, though its immediate effects on the V4 were more political than physical. No V4 country experienced a supply shutdown as a direct consequence, but the annexation was widely read as a signal to accelerate diversification, since it demonstrated the risks of continued dependence on a geopolitically assertive supplier – consistent with the absence of a sharp break in the energy-mix data documented in Section 3.1. Hungary and Slovakia, the two countries most exposed to Russian pressure, responded differently: Slovakia's gas supply was reduced by approximately 50% as an indirect consequence of assistance extended to Ukraine, while Hungarian Prime Minister Viktor Orbán affirmed solidarity with Ukraine without endorsing measures that might jeopardize Hungary's energy security. Both governments avoided open criticism of Russia in order to preserve long-term supply contracts at stable prices rather than exposing themselves to volatile spot markets (Groszkowski & Sadecki, 2014). This pattern of contractual caution over confrontation, established in 2014, persisted through much of the following decade and helps explain the slower pace of diversification in Hungary and in Slovakia documented in Section 3.3.

3.5 EU Projects of Common Interest and Diversification Infrastructure in the V4

A second dimension of diversification efforts concerns the development of cross-border energy infrastructure co-financed and facilitated by the European Union. Since 2013, the EU has designated selected cross-border projects as Projects of Common Interest (PCIs) under the Trans-European Networks for Energy (TEN-E) Regulation. PCI status confers accelerated permitting, improved regulatory treatment, and eligibility for grants from the Connecting Europe Facility (CEF), with the explicit aim of enhancing security of supply through diversification of sources, counterparties, and routes (European Commission, n.d.-a; European Commission, n.d.-b). As discussed in Section 3.4, this approach builds on the regulatory foundation established by the EU's 2009 Third Energy Package and its 2010 Security of Gas Supply Regulation, whose unbundling, third-country-ownership, and reverse-flow provisions ended the one-directional, east-to-west orientation of most V4 pipelines and created the conditions for the PCI-funded projects examined below.

Between 2014 and 2020, the V4 region was particularly successful in securing CEF support for gas-infrastructure PCIs, reflecting the priority all four countries placed on reducing isolation from Western European markets. These grants supported a range of projects intended to create north–south and east–west alternatives to traditional Russian-supply routes.

Poland benefited from several high-profile PCIs. The Świnoujście LNG terminal and its subsequent expansion increased the country's regasification capacity and enabled seaborne imports from multiple global suppliers. The Baltic Pipe interconnector with Denmark, designated as a PCI since 2013 and supported by EUR 267 million in CEF funding, was commissioned at an opening ceremony in September 2022 and became fully operational that November, providing up to 10 billion cubic meters per year (bcm/year) of non-Russian gas from the Norwegian shelf (CINEA, 2022a). The GIPL interconnector with Lithuania and the Poland–Slovakia interconnection further integrated Poland into the regional gas network, enhancing both diversification and transit options.

Czechia's diversification infrastructure focused on westward connections, with mixed results. The EUGAL pipeline, running parallel to OPAL and linking the Nord Stream system to the Czech border, became operational in 2020, and the accompanying Capacity4Gas project – completed in December 2020, adding roughly 35 bcm/year of transmission capacity – extended Czech transmission capacity to connect with it. Both projects, however, were built specifically as onward infrastructure for Nord Stream 2, increasing rather than reducing the volume of Russian-origin gas able to reach Czechia via the Baltic Sea route (Groszkowski, 2017; International Energy Agency, 2022a). Their diversification value only became apparent after February 2022, when Nord Stream flows were suspended and the same

westward-facing infrastructure and German market integration that had carried Russian gas were instead used to import LNG and Norwegian gas via Dutch, Belgian, and German counterparties (Łoskot-Strachota et al., 2023). Although some planned interconnectors (such as the Czech–Polish STORK II project) were suspended, this westward orientation ultimately allowed Czechia to pivot quickly once Russian supplies stopped.

Hungary and Slovakia pursued diversification through a combination of reverse-flow interconnectors and access to southern supply options. Hungary secured approximately half of the available capacity at the Croatian LNG terminal on Krk, while the BRUA interconnector with Romania – intended to provide access to Romanian and, potentially, Caspian gas – was repeatedly delayed, and its incomplete build-out is cited as one of the factors that locked in Hungary's dependence on Russian gas in the years before the war (Łoskot-Strachota et al., 2023). Slovakia's main PCI in this period was the interconnector with Poland, co-financed by CEF, which created an additional north–south link and enhanced the possibility of receiving gas from Central European hubs (CINEA, 2022b). However, both countries continued to rely heavily on Russian pipeline gas, and several planned projects (including further BRUA stages and additional interconnectors) remained uncertain or delayed by 2022.

The observed pattern of PCI use in the V4 was thus heterogeneous. In Czechia's case, the infrastructure did not serve diversification until the wartime reorientation of 2022. In Poland, a measurable, pre-planned reduction in dependence on Russian gas followed the construction of PCI-supported infrastructure. In Hungary and Slovakia, PCI projects improved interconnection and provided some diversification options, but their use remained limited during the 2012–2022 period, as long-term contracts, infrastructure configuration, and national policy choices continued to favor existing Russian supply routes.

It is also important to note that the EU's approach to gas-infrastructure funding changed significantly after 2020. The revised TEN-E Regulation effectively ended support for new "traditional" natural gas projects, requiring future gas-related PCIs to demonstrate a contribution to decarbonization (for example, through hydrogen readiness) and to the phasing out of Russian fossil fuels (Regulation (EU) 2022/869). PCI status remains the main route through which gas projects can access grants from the Connecting Europe Facility (CEF), which can cover up to 50% – and in some cases 75% – of construction costs, and which confers "priority status" for permitting, legally obliging member states to fast-track administrative procedures. This combination of direct co-financing and accelerated permitting helps explain why V4 governments have repeatedly stressed the importance of PCI designation for cross-border transmission projects intended to improve energy security. The post-2020 shift implies that the wave of CEF-supported gas PCIs observed between 2014 and 2020 is unlikely to be repeated in the same form, and that future diversification efforts in the V4 will need to rely more on repurposing existing infrastructure and on non-gas solutions.

3.6 Post-2022 Policy Responses: REPowerEU and Nuclear Expansion in the V4

The energy mix and infrastructure trends documented in Sections 3.1–3.5 largely predate the European Union's most significant post-invasion policy response. On May 18, 2022, the European Commission presented the REPowerEU plan, built on three pillars – energy savings, supply diversification, and accelerated clean-energy deployment – with the explicit aim of ending the EU's dependence on Russian fossil fuels well before the end of the decade (European Commission, 2022a). The plan proposed raising the EU's binding 2030 renewable-energy target from 40 to 45%; after negotiation between the Parliament and Council, the revised Renewable Energy Directive (RED III), which entered into force in November 2023, set a binding target of 42.5% with an additional aspirational 2.5-percentage-point top-up toward 45% (Directive (EU) 2023/2413). Because the study period in this paper ends in 2022, these targets and their implementing legislation fall almost entirely outside the observed data; the modest final-year increases in Table 2 for Czechia, Hungary, and Poland

should therefore be read as preceding, rather than reflecting, this accelerated renewables agenda.

REPowerEU also redirected the infrastructure-funding mechanism examined in Section 3.5. In May 2022, the Commission opened a EUR 800 million Connecting Europe Facility call specifically for clean-energy infrastructure projects, drawn from the same Projects of Common Interest framework that had previously funded gas pipelines and LNG terminals (International Energy Agency, 2024). This reinforces the pattern already noted in Section 3.5: the EU's project-based funding instrument did not disappear after 2022, but its purpose shifted from gas-route diversification toward decarbonization-aligned infrastructure.

A parallel and less widely noted development was a wave of nuclear-capacity announcements across all four V4 countries within the same narrow 2022 window (Szymański, 2023, p. 3). In Slovakia, the long-delayed Mochovce 3 reactor received its final regulatory authorization in August 2022, was connected to the grid in January 2023, and entered full commercial operation in October 2023, lifting the share of nuclear energy in Slovak electricity generation toward roughly 65% (World Nuclear Association, 2026b). Czechia launched a tender that year for a fifth reactor unit at Dukovany, with Westinghouse, Korea Hydro & Nuclear Power (KHNP), and Électricité de France (EDF) as the bidders (World Nuclear Association, 2026d).

Poland, which operates no nuclear plants, saw its state-led program advance materially in 2022: In October, Polska Grupa Energetyczna (PGE) and KHNP signed a letter of intent for a plant at the Pątnów site, alongside the government's existing plan for a first large-scale reactor at Lubiatowo-Kopalino in the municipality of Choczewo. Commercial operation of that reactor is not expected before 2036, after a December 2024 schedule revision pushed the original 2033 target back by three years (World Nuclear Association, 2026a).

Hungary's case is the most consequential for the diversification narrative developed in this paper: in August 2022, the Hungarian Atomic Energy Authority issued the construction license for two new reactors at Paks II – to be built by Rosatom, the Russian state nuclear company, under financing arranged through a 2014 intergovernmental loan agreement with Russia (World Nuclear Association, 2026c). Unlike the 2022 nuclear announcements in the other three countries, Hungary's expansion does not reduce dependence on Russian-linked energy infrastructure; if anything, it extends that dependence into a new technology and a multi-decade construction and fuel-supply relationship, reinforcing the pattern of contractual continuity with Russia documented in Sections 3.3 and 3.4.

Overall, these developments suggest that 2022 was not only the year the V4 countries' Russian-gas exposure diverged sharply (Section 3.3) but also the year in which EU-level renewables policy and national nuclear strategy both reoriented explicitly around reducing – or, in Hungary's case, not reducing – dependence on Russia. Because most of these measures were only announced or licensed in 2022 and take effect over the following decade, their consequences lie beyond this study's data window and are noted here as a bridge to the Discussion rather than as a fully observed outcome.

4. Discussion

This study asked three questions: whether the series of Russian oil and gas imports to the V4 countries show a visible change after 2014, how the primary energy mix of each country changed between 2012 and 2022, and to what extent EU-supported infrastructure and market integration measures contributed to diversification away from Russian energy, and how the 2022 invasion altered that trajectory. The descriptive pattern is consistent across all three: no visible break in the series follows the 2014 sanctions, while the clearest changes coincide with infrastructure development, EU regulatory instruments, and differences in national political preference.

On the first question, the data in Section 3.1 show no sharp break in any country's fossil-fuel share around 2014, and Section 3.3's import data show that Russian gas shares stayed broadly stable through the mid-2010s in Czechia, Hungary, and Slovakia, with Poland's earlier decline the only exception; Russian oil shares, by contrast, fell markedly across all four countries over the same years. This is consistent with the limited scope of the EU's 2014 sanctions regime, which targeted specific technologies, financing instruments, and individuals rather than energy trade itself; the oil decline is more plausibly linked to falling global oil prices and refinery-level sourcing decisions than to sanctions (see Section 3.3). The one clear behavioral response to 2014 was political rather than physical: Hungary and Slovakia's deliberate avoidance of confrontation with Russia in order to preserve long-term supply contracts (Section 3.4; Groszkowski & Sadecki, 2014), a posture that, as Section 3.6 shows, persisted into 2022 in Hungary's decision to expand rather than reduce its Russian nuclear-technology dependence via Paks II.

On the second question, the energy-mix data show gradual, incremental change rather than a decade-defining transformation. Fossil-fuel shares fell by only a few percentage points in most countries (Section 3.1), and renewable-energy shares converged around 13% by 2022 – modest progress well short of the roughly 20% already achieved by the pre-2004 EU-15 member states over the same period (see Section 3.2). This lends support to Kochanek's (2021) characterization of the V4 energy transition as uneven and still at an early and incomplete stage, rather than a completed shift. Notably, Hungary and Slovakia's comparatively low renewables growth is at least partly explained by a nuclear-first strategy, whereas Czechia's substantial nuclear capacity did not displace renewable-energy development: the two expanded in tandem (Section 3.2). Section 3.6 shows this nuclear orientation hardening into concrete 2022 commitments in all four countries – though, as argued above, with sharply different implications for Russian dependence depending on the vendor and financing structure each country chose.

The third question is where the study's findings are most differentiated by country, and where EU regulatory and infrastructure instruments prove most consequential. The 2009 Third Energy Package's unbundling and Gazprom-clause provisions, together with the 2010 Security of Gas Supply Regulation's reverse-flow mandate (Section 3.4), created the legal prerequisites that later PCI-funded infrastructure (Section 3.5) built on. But having the prerequisites in place did not guarantee their use: Poland converted them into an early and deliberate diversification strategy, using its Baltic coastline, LNG capacity, and political resolve to end its Yamal contract pipeline deliveries within weeks of the 2022 invasion and to reach full independence from Russian gas by early 2023 (Section 3.3). Czechia's westward infrastructure was, ironically, built to extend Nord Stream's reach rather than to diversify away from it, yet this same infrastructure allowed a rapid pivot to Western European gas hubs once Nord Stream flows stopped (Section 3.5) – diversification realized through repurposing rather than original intent. Hungary and Slovakia, by contrast, had reverse-flow capability and PCI-funded interconnectors available for a decade but made comparatively little use of them, prioritizing contractual stability and political relations with Russia over the flexibility the EU's instruments offered (Sections 3.3–3.4). This divergence indicates that EU-level regulatory and financial instruments functioned as enabling conditions rather than guarantees of diversification: whether the available infrastructure was actually used to diversify varies systematically with national political preferences, a pattern consistent with Osička et al.'s (2018) argument that market integration reduces, but does not eliminate, structural dependence absent the political will to act on it.

The divergence in energy dependence also contributed to the weakening of V4 political cohesion after 2022. Poland and Czechia had stronger incentives and greater infrastructural capacity to support rapid disengagement from Russian energy, whereas Hungary and Slovakia faced higher short-term costs because of their continuing contractual and

infrastructural dependence. Energy policy therefore became one of the areas in which the V4's formally shared regional identity conflicted with divergent national interests. Russia's invasion of Ukraine exposed and sharpened these divisions. Poland, Czechia, and Slovakia adopted strongly pro-Ukrainian positions, supporting assistance to Ukraine and a firmer EU response toward Russia, whereas Hungary took a more restrained approach, resisted some sanctions measures, and sought to preserve economic relations with Russia. The resulting divergence weakened the V4's capacity to operate as a cohesive regional grouping (Bertani, 2022; Mesežnikov, 2022).

Finally, Section 3.6's discussion of REPowerEU and the 2022 nuclear announcements complicates a simple diversification narrative. The analysis in Sections 3.3–3.5 has so far traced one dimension of diversification: reducing dependence on Russian energy imports through suppliers and routes. Hungary's Paks II expansion shows why the multidimensional framing introduced at the outset matters in practice: a country can diversify along one dimension (fuel mix, by adding nuclear capacity) while simultaneously deepening its dependence on Russia along another (reactor technology, fuel supply, and financing). This suggests that future assessments of V4 energy security should treat diversification as multidimensional – supplier, route, fuel mix, and technology/financing – rather than as a single composite measure, since a country can move in different directions on different dimensions at once.

These findings can be organized around the four components of energy security (Jurgilewicz et al., 2020): balancing supply and demand, sectoral reliability, functional economic mechanisms, and environmental impact. Progress was most visible on reliability – Poland's and Czechia's new interconnectors and LNG capacity gave both countries credible alternative supply routes by 2022, materially reducing the risk of a single-point disruption. Progress on economic mechanisms was partial and asymmetric: the Third Energy Package's unbundling and third-party-access provisions were formally adopted across the region, but Hungary and Slovakia's continued reliance on long-term bilateral contracts with Gazprom shows the underlying market structure remained only lightly liberalized in practice. Progress toward balancing supply and demand was modest everywhere, reflected in the incremental rather than transformative fossil-fuel reductions documented in Section 3.1. Environmental impact was the least advanced of the four dimensions: renewable-energy shares converged at roughly 13% (Section 3.2), well below the EU-15 benchmark, and the region's continued dependence on nuclear expansion as a decarbonization strategy – rather than an accelerated deployment of renewable energy – leaves this dimension the most exposed to delay, cost overrun, and, in Hungary's case, continued reliance on Russian technology. In sum, the V4 countries advanced furthest on the dimension most directly tied to the 2022 crisis (reliability) and least on the dimension requiring the most sustained, low-salience policy attention (environmental impact) – a pattern consistent with crisis-driven rather than strategically planned energy transition.

These findings point to two concrete policy implications. First, EU infrastructure funding criteria for PCIs and REPowerEU-aligned projects currently assess technical and financial feasibility but not the likelihood that a completed project will actually be used to reduce Russian energy dependence; Hungary and Slovakia's decade-long underuse of reverse-flow capacity suggests that eligibility and monitoring frameworks could usefully track post-completion utilization, not just construction milestones, to identify cases where funded infrastructure is not achieving its stated security objective. Second, the Czech case suggests that repurposing existing infrastructure – rather than building new capacity – can be a faster and lower-cost diversification pathway when the underlying network already connects to diversified markets; EU funding instruments and national strategies alike might give greater explicit weight to repurposing options in future infrastructure planning, particularly for import-dependent regions where new construction faces long lead times.

5. Conclusion

This study contributes to the literature on Central and Eastern European energy security in three ways. First, it documents a decade-long record in which no measurable shift in the V4 countries' energy-supply structure or Russian oil and gas import shares is visible following the EU's 2014 sanctions, substantiating with longitudinal data what an earlier qualitative assessment (Groszkowski & Sadecki, 2014) suggested more provisionally. Second, it shows concretely – through the contrasting Czech and Hungarian/Slovak cases – that EU regulatory and infrastructure instruments made diversification possible but not automatic, extending Osička et al.'s (2018) market integration argument with country-level evidence through the early effects of the 2022 invasion. Third, it introduces a unified typology of energy diversification – distinguishing supplier, route, fuel mix, and technology/financing dimensions – that draws together aspects addressed separately in the V4 energy literature: Dyduch and Skorek (2020) on supplier and route diversification, and Kochanek (2021) on the renewable-energy, decarbonization, and efficiency dimensions of the broader energy transition.

Between 2012 and 2022, the V4 countries reduced their dependence on Russian fossil fuels only gradually, and no measurable acceleration of this process is visible in the series after the limited EU sanctions imposed following the 2014 annexation of Crimea. The most visible changes over time aligned with EU regulatory instruments dating to the 2009 Third Energy Package and EU-funded cross-border infrastructure under the TEN-E/PCI framework, while the differences among the four V4 member states mirrored each country's political orientation toward Russia. Poland had reduced its exposure substantially by 2022, and Czechia's westward infrastructure positioned it to complete the process rapidly once Nord Stream flows were halted, though its own measured exposure for full-year 2022 remained high (79.40% of gas imports; Table 3). Hungary and Slovakia entered 2022 still heavily dependent, a position that tracks documented policy choices sustained over the preceding decade rather than an absence of available alternatives.

Russia's large-scale invasion of Ukraine in February 2022 did not create this divergence; it exposed and accelerated a pattern that had been building for a decade. The EU's post-invasion policy response – REPowerEU's accelerated renewables targets and the redirection of infrastructure funding away from gas – together with a parallel wave of national nuclear investment, marks the beginning of a new phase whose outcomes fall outside this study's data window. Hungary's continued reliance on Russian nuclear technology for its Paks II expansion illustrates that this new phase will not necessarily produce uniform diversification across the V4, and may instead reproduce the same underlying divide in a new form.

This study has several limitations. Its qualitative, document-based design identifies temporal associations and policy patterns rather than statistically demonstrated causal effects; it relies on secondary Eurostat, EU institutional, and academic sources rather than primary interviews with policymakers or industry actors; and its 2022 endpoint captures only the earliest signs of the post-invasion reorientation, before REPowerEU's targets or the newly licensed nuclear projects could plausibly affect the energy mix. Future research should extend the dataset through the mid-2020s to assess whether Poland's and Czechia's diversification proves durable and whether Hungary and Slovakia's trajectories converge with or continue to diverge from the rest of the group; incorporate national energy and climate plans (NECPs) and REPowerEU national implementation plans as primary sources; and consider interview-based or quantitative causal designs – for example, a difference-in-differences approach around the 2014 and 2022 shocks – where sufficiently granular trade and investment data become available.

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