

WIKTOR HEBDA¹

The fossil fuel market in Germany and Poland in the aftermath of the Russian–Ukrainian war

Introduction

The war between Russia and Ukraine has serious implications for energy security, especially for European countries. One of the parties to the war – the Russian Federation – is still a global player in the market for energy resources such as coal, crude oil, and natural gas. There is no doubt that for some countries, Russia has been a crucial supplier for decades, which resulted in those countries' undesirable dependency on a single source. A region that has particularly suffered and continues to suffer the consequences of over-dependence on Russian energy resources is Central and Eastern Europe. It should be noted that this is significantly influenced by the crude oil and gas transmission infrastructure built back in the 20th century, but also by subsequent investments. The largest customers for Russian hydrocarbons in this part of Europe were Germany and Poland. Over the past decade or so, the two countries have defined their energy transition goals and the extent of their cooperation with the Russian Federation in this regard in different ways.

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Poland has successively pursued the goal of diversifying its sources of strategic commodities, aiming to cut off the supplies coming from the East. As a result of huge investments in alternative transmission infrastructure, the goal had already been achieved before the outbreak of the war in Ukraine. Germany's approach to cooperation with Russia has been markedly different. Not only did Germany want to keep importing large quantities of energy resources, but it also wanted to increase these imports in some sectors, such as natural gas. For this purpose, a decision was made to build a new gas pipeline directly connecting Russia and Germany (Nord Stream). As a result, at the start of the Russian-Ukrainian war, Germany was in a difficult position due to its inability to import Russian commodities. One of the key responses of the European Union to Russian crimes in Ukraine was to impose economic sanctions on, among other things, the imports of energy resources by EU member states. This raised questions about the consequences of sanctions on the energy sector of countries dependent on Russian hydrocarbons. The countries most affected were, among others, Germany and Poland.

This article presents a comparative analysis of the German and Polish fossil fuel markets in the aftermath of the Russian-Ukrainian war. The analysis covers the period of 2021–2024. The aim was to determine how the sanctions imposed on Russia affected the fossil fuel markets of Germany and Poland. The analysis covers the coal, crude oil, and natural gas sectors.

The first part of the article refers to the concept of energy transition, with particular emphasis on the place and role of fossil fuels. The following sections discuss the issue of Russian energy resources in the fossil fuel markets in Poland and Germany before the outbreak of the war in Ukraine and the issue of EU sanctions against Russian energy resources. This was followed by a comparative analysis of the fossil fuel markets in Poland and Germany following the outbreak of war in Ukraine, with a particular focus on the imports of Russian commodities such as coal, crude oil, and natural gas.

1. Fossil fuels in the context of the energy transition – selected theoretical aspects

Fossil fuels, i.e., coal, crude oil and natural gas, continue to be indispensable for the economic development of most countries in the world. Today, it is difficult to imagine a highly industrialised society without the consumption of strategic energy resources. The world's largest economies, i.e., the USA, China, Germany, Japan, and India, are heavily dependent on these commodities. However, it should not be overlooked that in the last two decades, significant differences have been observed with regard to the changes in fossil fuel consumption, especially in the context of the energy transition and the decarbonisation of the power generation sector.

Energy transition is an ambiguous concept, and its understanding varies. According to Edenhofer, it is a structural shift toward a world energy system that is mainly based

on renewable energy (Edenhofer et al. 2011). Carley and Konisky's understanding of the concept is slightly broader: a shift from one dominant energy resource – or set of resources – to another (Carley and Konisky 2020). Hirsh and Jones, as well as Miller, argue that energy transition is a change in fuels and their associated technologies (Hirsh and Jones 2014; Miller et al. 2015). Some authors focus not on fuels but on the economy, recognising that an energy transition is a switch from an economic system dependent on one or a series of energy sources and technologies to another (Fouquet and Pearson 2012). Other authors refer to the goal of energy transition: the adoption of a socio-technical systems shift to more sustainable modes of production and consumption (Coenena et al. 2012; Chen et al. 2019). With this in mind, it can be assumed, following Sovacool, that energy transition is a multi-faceted, permanent, and structural evolution within energy systems (Sovacool 2016). On the one hand, it is a change within the use of energy carriers, which suggests that a widespread adoption of a particular type of new energy marks the beginning of a transition. On the other hand, the modification of energy mixes is important, emphasising that the energy transition process involves a series of transitions in energy production and consumption structures (Yang et al. 2024). There is no doubt that in the current geopolitical realities, this process in practice means increasing the share of renewable energy while phasing out the consumption of fossil fuels. This raises a legitimate question about the role of fossil fuels over the next few decades from the perspective of both consumer and producer countries whose economies are based on trade in energy resources.

It is also worth looking at the energy transition from the perspective of the state, the region, and international organisations. The EU defines it as the transition of the economy and society towards the achievement of climate and environmental goals, in line with the European Green Deal. As energy accounts for 75% of the EU's total greenhouse gas emissions, it plays a central role in this process. One of the key goals is the decarbonisation of the energy system, which requires a structural transition of the way energy is produced and consumed, phasing out fossil fuels and replacing them with renewable and low-carbon energy sources. The aforementioned European Green Deal is the EU's development strategy with the key objective of achieving climate neutrality by 2050 (European Commission 2021). It should be unequivocally stressed that in this process fossil fuels, i.e., coal, crude oil, and natural gas, are to be progressively reduced and eventually excluded from the EU's energy mix. Energy transition is framed broadly and applies not only to the power generation sector, but also to transport (Chiaromonti 2021; Tsemekidi Tzeiranaki et al. 2023), industry (Åhman and Nilsson 2015; Gerres 2019), and agriculture (Matthews 2023).

In their energy transition, the United States of America and China point first and foremost to flexible adaptation to economic possibilities. Undoubtedly, economic development as well as energy stability and security in the broadest sense are crucial. In contrast to the EU, climate issues are not prioritised, although in the USA under President J. Biden, the issue also gained in importance. The American approach is characterised by the premise of achieving “energy independence” by increasing the share of clean energy (including nuclear, renewable energy, natural gas, and clean coal, etc.), with a particular focus on

supporting research and development of advanced energy technologies (Abbasi et al. 2024). The above assumptions have been consistently realised, with coal's share in electricity generation reduced by 58% between 2005 and 2022 (IEA 2024). The Trump administration has abandoned green policies while improving the extraction of key minerals and promoting fossil fuels (Deberdt et al. 2025). Whereas China, promotes clean, low-carbon, safe, and efficient energy use, accelerates the digital and smart development of the energy industry, advocates the integrated development of the gas and power generation sectors along with renewable energy sources and seeks to strengthen international energy cooperation under the Belt and Road Initiative (Wu et al. 2020; Ahmend et al. 2024; Li et al. 2024). It is noteworthy that China has become a world leader in the development of solar and wind power, not only in terms of increasing its own power generation capacity, but also technologically, becoming the largest producer and exporter of photovoltaic panels and wind turbines (Ye et al. 2024).

The three main objectives of German energy policy are energy security, economic efficiency, and sustainability. Energy transition is understood differently than in the USA or China and means not only increasing energy efficiency and the share of RES in the energy mix, but also reducing energy consumption and abandoning nuclear power (Wiertz et al. 2024). As a result, in recent years, Germany has pursued not only decarbonisation but also denuclearisation of its power generation sector, which in the current geopolitical realities poses a major challenge to ensuring energy security (Glynos and Scharf 2024). In the case of Poland, the energy transition primarily means decarbonising the power generation sector by increasing the share of green energy and natural gas (Hebda et al. 2025). In contrast to Germany, the phasing out of coal is to be compensated by nuclear power, which will become a key source in electricity generation within two decades (Hebda and Mišík 2024).

The energy transition of most of the world's countries, and certainly of the developed and developing ones, defines future fossil fuel consumption differently. Nevertheless, most countries are reducing or planning to reduce their consumption of hydrocarbons, i.e., coal, crude oil, and natural gas, in the coming decades in favour of clean, environmentally friendly renewable energy. This issue primarily involves the power generation sector, followed by other areas of human activity. During the 28th UN Climate Conference held in Dubai in November/December 2023, a gradual transition away from fossil fuels in the energy sector by 2050 was confirmed. More governments and organisations joined the Powering Past Coal Alliance, which aims to phase out coal-fired power plants. It is noteworthy that the Alliance of just over 50 countries was joined by the US, which declared a coal phase-out by 2035 (Borenstein 2023). In addition, the Oil and Gas Decarbonisation Charter was signed, in light of which the signatories (52 oil and gas companies with more than 40% of global production) pledged to accelerate decarbonisation by supporting efforts to move away from fossil fuels by, among other things, committing to reduce greenhouse gas emissions (UAE Consensus 2023). These international initiatives, but also national energy transition programmes, indicate that fossil fuels will gradually be replaced by other energy sources.

2. Russian energy resources on the fossil fuel markets in Poland and Germany before the outbreak of war in Ukraine – an outline of the problem

Russian energy resources have been an important element in ensuring the stability and energy security of many countries, particularly in Central and Eastern Europe. Suffice it to mention that the rate of dependence on Russian coal, natural gas, and crude oil imports in 2021 was equal to approx. 62%, 55%, and 61% for Poland (Hebda et al. 2024) and 53%, 55% and 34% for Germany (Wettengel 2024) (Figure 1). However, following the outbreak of the Russian-Ukrainian war in February 2022, this situation changed dramatically. There is no doubt that the energy security of many central and eastern European countries was seriously threatened, and the situation called for fast changes in energy policy and strategy. To varying degrees, countries dependent on Russian hydrocarbons were forced to seek new supply sources (Kayani et al. 2024; Sun et al. 2024). In order to understand the influences of Russian policies regarding the sales of commodities, it is worth noting how Europe's dependence in this regard was shaped and the reasons behind it (Colgan et al. 2023). Undoubtedly, the example of Poland and Germany supports the claim that Russia had been effectively building and consolidating its influence in the energy sector in this part of Europe virtually until the outbreak of the war in Ukraine.

For many decades, Poland had been excessively dependent on Russian energy resources. This was due, among other things, to the construction of crude oil transition infrastructure

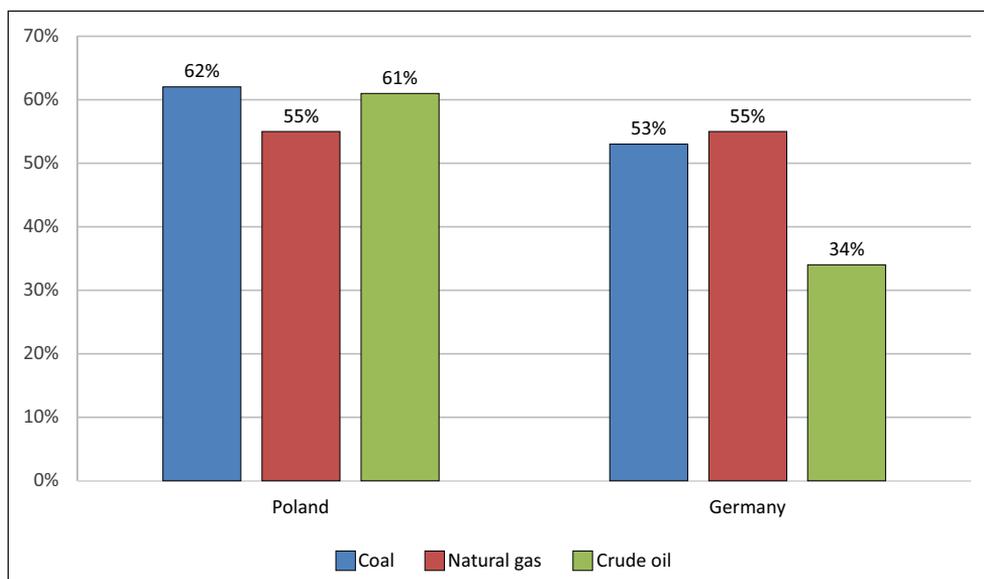


Fig. 1. Dependence on Russian fossil fuels of Poland and Germany in 2021 (in percent)
Own work based on: (Hebda et al. 2024; Wettengel 2024)

Rys. 1. Uzależnienie od rosyjskich paliw kopalnych Polski i Niemiec w 2021 r. (w procentach)

(Druzhba pipeline) under the USSR and then natural gas infrastructure in the 1990s (Yamal). Not only were oil and natural gas imported into Poland, but also hard coal. Diversification of the sources of these commodities began only in the last decade. The Świnoujście gas port was commissioned in 2015, followed by the Baltic Pipe gas pipeline in 2022. Gas interconnectors were also consistently built as part of the North-South gas corridor project (connecting Poland to Lithuania, Slovakia, and Czech Republic) (Hebda 2021). In the case of crude oil, receiving capacity was expanded at the oil terminal in Gdańsk. Suffice it to mention that imports of crude oil by sea tripled between 2017 and 2023 (from around 12 million to 36 million tonnes) (Naftoport 2023). As for hard coal imports, increasing dependence on Russian supplies was noticeable. This issue was directly related to the reduction in domestic production resulting from the decarbonisation of the power generation and heating industries (Bijańska and Wodarski 2024). Until 2022, as much as 75% of Poland's total imports were from Russia. This represents an almost twelvefold increase, from 0.8 million tonnes in 2000 to 9.4 million tonnes in 2020 (Carmona and Dąbkowska 2024).

Dependence on Russian energy resources was no different in Germany, although the differences in individual sectors are worth highlighting. As in the case of Poland, this dependence was due, among other things, to the transmission infrastructure built over the past decades and the energy policy pursued. In the oil sector, the Druzhba oil pipeline, which supplied refineries in the former German Democratic Republic and later in eastern Germany, was of key importance. Nevertheless, the division of the country after World War II meant that Germany imported crude oil from various countries (West Germany imported oil from outside the USSR). After Germany's reunification, the diversification of crude oil imports was maintained, and Russia, despite becoming the most important source, was not responsible for such a high level of dependence as in other countries of Central and Eastern Europe (Konopelko et al. 2023). Germany's dependence on Russian natural gas was far less favourable. The gas infrastructure projects carried out over the past two decades definitely contributed to the deepening of German-Russian cooperation. This issue relates not only to the aforementioned Yamal pipeline, but most importantly to the Nord Stream I pipeline, commissioned in 2011, and the Nord Stream II pipeline, built in the following years. This transmission infrastructure made Germany (and other EU countries more broadly) highly dependent on imports from Russia (Eser et al. 2019) and significantly blocked the construction of LNG terminals (Brauers et al. 2021). The commissioning of Nord Stream I resulted in an increase in the share of gas imported from Russia from around 40% to over 50% in the following years (Westphal 2020). The planned commissioning of Nord Stream II would have increased the volume of Russian gas even more. In the case of coal, Germany has been steadily reducing its own production, with the biggest decline taking place during the 1990s (Brauers et al. 2020). Suffice it to mention that in 2010, production was just over 182 million tonnes, and in 2021, it amounted to only around 126 million tonnes (Statista 2024a). In 2018, the last hard coal mine was closed in Germany (only lignite mines continue operation). Since coal is still used in the power generation industry, the demand for this commodity is satisfied with imported coal.

In recent years, Russia has been the key supplier of hard coal, covering 30–50% of German annual imports (Wettengel 2024).

3. EU sanctions imposed on Russian energy resources following the outbreak of war in Ukraine and Russian methods of preventing them

One of the most important mechanisms for the European Union's response to Russian aggression against Ukraine is the economic sanctions imposed on Russia. Sanctions targeting Russian energy exports to European Union member states were clearly a priority (Nosko and Ušiak 2025). In the case of hard coal, the ban on imports into EU countries was imposed relatively quickly, as early as the fifth sanction package adopted on 8 April 2022, but it took effect only on 10 August of that year. It should be noted that this commodity has been imported in recent years by many EU countries, including the Netherlands, Germany, Poland, Italy, France, and Spain. Some countries, including Poland and Germany, were significantly dependent on the Russian source (Makushin 2023).

Far more challenging for the EU were the sanctions imposed on the imports of Russian crude oil and natural gas. Sanctions on the energy sector were announced as early as the second sanctions package adopted on February 25, 2022, which was to prohibit the sale, supply, transfer, and export to Russia of certain oil refining goods and technologies and to introduce a restriction on the provision of related services. However, as part of the package adopted on June 3, 2022, Russian crude oil and petroleum products were to be gradually phased out of the EU market over the next 6 months (8 months for petroleum products). Those EU member states that lacked the necessary infrastructure were, as an exception, allowed to use Russian oil for a longer period, but could not distribute it to other EU or non-EU markets. Slovakia, Hungary, Czechia, and Bulgaria, among others, took advantage of this possibility (Batzella 2024). The eighth sanctions package of October 6, 2022, which set a so-called price cap for Russian oil, was also important. In light of the agreement reached between the EU and the G7, the price cap set at USD 60 per barrel took effect on December 5, 2022 (from February 5, 2023, the price cap for petroleum products, i.e., diesel, paraffin and gasoline was USD 100 per barrel, and that for fuel oil and naphtha was USD 45 per barrel). The price cap for Russian oil was intended to limit price increases caused by extraordinary market conditions and to drastically reduce Russia's revenue from oil sales. It is also worth noting that on December 5, 2022, a ban took effect in the EU on the transport of Russian oil by sea to third countries (European Commission 2022). Further restrictions on Russian oil were imposed as part of the eleventh package adopted on June 23, 2023. It was of particular importance for Germany and Poland, as the import of Russian oil via the Druzhba oil pipeline (northern branch passing via Belarus and Poland to Germany) was banned. Nonetheless, these measures were taken post factum, due to the fact that by the end of February 2023, the infrastructure in question was already unused as a result of Russia's decision to suspend oil supplies (Hebda 2023a). At the end of 2023, the applicable measures were tightened in

terms of detailed monitoring of tankers supplying oil to third countries. The aim was to address the problem of the so-called shadow fleet used by Russia to circumvent the price cap (Prezanti and Levi 2024). In the third year of the invasion, Russia relied on 558 Russian shadow vessels to transport 167 mln tonnes, or 61%, of its total seaborne oil exports, valued at EUR 83 bn. The fleet handled 78% of Russian seaborne crude oil shipments, worth EUR 57 bn, and 37% of refined oil products, valued at EUR 26 bn (Raghunandan et al. 2025). Sanctions imposed on the Russian shadow fleet were intensified only in the second half of 2024. As of March 2025, among the 343 operational shadow fleet vessels, 264 have been sanctioned by the EU, UK, and US, while 79 are still unsanctioned. It is important to note that the expansion of the shadow fleet is fuelled by sales from shipowners in EU nations. Since early 2022, Greece has been the dominant source of shadow fleet tankers, accounting for 28%, which is more than twice the share from the rest of Europe (13%). Russia has been a significant supplier of shadow fleet vessels (24%), as numerous former Sovcomflot ships have moved to the shadow fleet to assist Russian exporters in evading Western sanctions (Brooks and Harris 2025).

In general, most EU member states stopped importing Russian oil, but it should be noted that some continue to do so. As mentioned before, this is due to a lack of alternative transmission infrastructure in such countries as Slovakia and Hungary. As a result, for these countries, the prospect of halting the transit of Russian oil through Ukraine is quite worrying (Herasimova 2024). The situation is problematic in the case of Russian petroleum products, which are imported by many EU member states. Russia is exploiting the so-called “refinery loophole”, whereby countries that have not imposed sanctions on Russia, i.e., India, China, and Turkey, legally import Russian oil, refine it and produce petroleum products, i.e., jet fuel and diesel, and then export these products to the EU. For example, between February 2023 and February 2024, the EU imported more than EUR 3 billion worth of petroleum products from three Turkish ports (Ceyhan, Marmara Ereğlisi and Mersin), which have no refining hubs, and, in the same period, 86% of petroleum products entered these ports from Russia (Raghunandan et al. 2024). The EU is the largest buyer of oil products from the refineries in India and Turkey; about 13% of the overall output from these refineries is aimed at exports to the EU in the third year of the Ukrainian-Russian conflict (Raghunandan et al. 2025).

Another tactic used by Russia to evade Western sanctions and maintain oil exports is ship-to-ship (STS) transfers. It should be emphasized that STS is a legal method used in the shipping sector to speed up the transportation of cargo (Astrov et al. 2024). Carrying out transshipments in international waters enables tanker operators to hide the oil’s source, making enforcement and inspections more challenging (Caprile and Leclerc 2024). Since 2022, 17 million tonnes of Russian oil valued at EUR 11 billion have been transferred via STS operations in EU territorial waters and the exclusive economic zone. Various areas in EU waters, particularly near Greece (54%), Romania (31%), Italy (11%), and Malta (4%), have emerged as vital centers for these activities (Raghunandan et al. 2025). Additionally, Russia’s shadow fleet employs both automatic identification system (AIS) blackouts and spoofing, complicating efforts for authorities to track its oil deliveries and uphold the price cap. Vessels

in Russia's shadow fleet occasionally switch off or deactivate their AIS transponders, thereby "going dark" at sea and rendering ships undetectable to satellite and land-based monitoring systems. Blackouts typically happen when a ship nears a high-risk activity zone, like STS transfer areas, or when arriving at certain destinations where authorities might not inspect oil from Russia. Once the transfer is completed or the ship approaches the port, vessels may reactivate their AIS to seem compliant, resulting in discrepancies in the tracking information. Whereas spoofing is the deliberate broadcasting of false AIS signals to disguise a vessel's true location, identity, or journey. It allows a Russian-linked ship to seem located in one area while it is genuinely functioning elsewhere (Caprile and Leclerc 2024). It is worth emphasizing that nearly half of the Russian seaborne oil was exported from Baltic and Black Sea ports by the shadow fleet. From January to August 2024, there was a 277% increase in the number of shadow tankers passing through the Danish Straits and 355% increase through Dover and Gibraltar Straits compared with the same timeframe in 2022 (Hilgenstock et al. 2024). In June 2023, as part of the eleventh sanctions package, the EU prohibited the entry of ships into its ports if they are involved in STS transfers believed to breach the Russian oil import ban or the price cap. This ban also extended to ships that alter or turn off their AIS while carrying Russian crude oil and petroleum products (European Commission 2023a). With the twelfth sanctions package, approved in December 2023, the EU implemented measures to closely oversee the sale of tankers to third countries to stop their use for transporting oil beyond the price cap. Thus, the sale of tankers by EU operators must be disclosed to national authorities, and any transactions involving Russian individuals or entities, or for purposes in Russia, need approval (European Commission 2023b). In June 2024, the EU implemented the 14th package of sanctions, which included the listing of vessels under sanctions related to Russia's conflict with Ukraine. These listings may result from a range of activities, but the sanctions specifically focus on tankers associated with Russia's shadow fleet (European Commission 2024).

As for Russian natural gas, the sanctions imposed by the EU are also limited. It should be noted that the EU's first major move to reduce gas imports from Russia was only the fourteenth sanctions package adopted on June 24, 2024. As part of this package, the provision of reloading services for LNG transshipment operations from Russia within the European Union was prohibited since February 2025. Restrictions also apply to the financing of similar activities and the provision of technical assistance and brokerage for them (European Commission 2024). In practice, this means no resale of Russian liquefied natural gas outside the EU and a ban on investment in the construction of liquefied natural gas facilities in Russia. In this context, it is worth noting that in 2023, almost a quarter of EU's LNG imports from Russia (22%) were transhipped to be further sold on global markets. The largest importers of Russian LNG have been Spain, France and Belgium. Gas that reaches LNG terminals does not necessarily remain in these countries. The EU gas network allows the distribution of regasified LNG to other states. Unfortunately, the scale of the problem is demonstrated by the fact that the EU was the largest buyer of Russian LNG between December 2022 and the end of April 2024 (48% of Russian exports), followed by China (20%) and Japan (19%)

(Sullivan 2024). Thus, the ban on transshipment of Russian LNG by EU countries is intended to limit the mechanism in place. It should be emphasized that Russia, similarly to the case of oil trade, uses a shadow fleet for LNG distribution. Unknown entities, often based in non-sanctioning jurisdictions, were acquiring and registering aging LNG carriers, with suggestions that Russian firms would provide insurance coverage for them. The US Department of the Office of Foreign Assets Control (OFAC) quickly took action to dismantle Russia's emerging LNG shadow fleet. Through observation of shipping activities, ownership changes, and cargo, OFAC pinpointed and classified the ships participating in sanctions evasion. This decisive action interrupted Russia's plans for LNG exports (Raghunandan et al. 2025). In contrast, in terms of reducing the imports of Russian gas supplied through pipelines, the EU has not taken any concrete action. In 2022, Russia itself restricted the sales of natural gas to EU countries. This involved the decision to stop deliveries via the Yamal pipeline (via Belarus to Poland and Germany), but also to the Nord Stream pipeline being disabled as a consequence of its breakdown in September 2022 (Henderson et al. 2024). In contrast, the Brotherhood pipeline (via Ukraine to Central European countries) operated by the end 2024, supplying Russian gas to countries such as Slovakia, Hungary and Czechia (also to Austria until mid-November 2024). On January 1, 2025, Ukraine ceased the transit of Russian gas to Europe after a five-year deal between Russian Gazprom and Ukrainian Naftogaz ended (Le Coq 2025). The EU's actions in relation to the Russian LPG are also quite belated. It was not until the twelfth sanctions package adopted on December 18, 2023, that LPG imports from Russia (with an annual value of more than EUR 1 billion) were banned, with a derogation for contracts already in place for a maximum of 12 months (until December, 20, 2024) (European Commission 2023b).

It is clear that the sanctions imposed by the EU on Russian energy commodities have reduced their volumes sold on the markets of EU countries, but did not completely exclude them. The biggest success was clearly the shutdown of hard coal supplies. In the case of oil and gas, dependence has been reduced, but the idea of stopping imports from Russia completely still seems remote. Consequently, the EU continues to purchase Russian fossil fuels: suffice it to say that between February 24, 2022, and May 28, 2024, as many as six EU member states were among the top ten importers of Russian energy resources: Germany (4th place, imports worth EUR 28.7 billion), the Netherlands (5th place, EUR 18.6 billion), Italy (6th place, EUR 18.1 billion), Hungary (8th place, EUR 16.1 billion), France (9th place, EUR 15 billion) and Belgium (10th place, EUR 14.4 billion) (Statista 2024b).

4. The fossil fuel markets in Poland and Germany after the outbreak of war in Ukraine – a comparative analysis

The war in Ukraine (and before that, the COVID-19 pandemic) has clearly compromised the energy security of many countries, particularly in Europe. Both Poland and Germany were dependent on Russian fossil fuels before the outbreak of the war. The sanctions imposed

by the EU, but most importantly the refreshed energy policies of both countries, have led to profound and fast changes in the imports of such commodities as coal, crude oil, and natural gas from Russia. Poland and Germany were among the countries that were most affected by the negative impact of the war in Ukraine, especially from the perspective of the so-called financial contagion of the oil and gas sector (Xue et al. 2024). It is worth emphasising, however, that during the three years after the outbreak of the war, the situation of both countries in terms of dependence on Russian fossil fuels changed fundamentally.

As for the imports of hard coal, the scenario was similar. Both Germany and Poland imported Russian coal in significant quantities. These imports totalled more than 100 million tonnes between 2018 and 2021 (62.2 million tonnes in Germany and 41.5 million tonnes in Poland) (Figure. 2). The EU's embargo on Russian coal came into effect in August 2022, by which time Germany and Poland had imported 11.5 and 1.3 million tonnes in that year, respectively. It should be noted that the ban on the import and transit of Russian coal to Poland was introduced a few months earlier, on the basis of the Act of April 13, 2022, on special solutions to prevent support for the aggression against Ukraine and to protect national security. Consequently, the volume of Russian coal imported into Poland decreased significantly compared to 2021. The termination of supplies from Russia required imports from alternative destinations. Poland expanded or opened new supply channels from Colombia, Indonesia, South Africa, Kazakhstan and Australia (Hebda 2023b). In contrast, Germany covered its needs with coal imported from the US, Colombia, Australia, Canada,

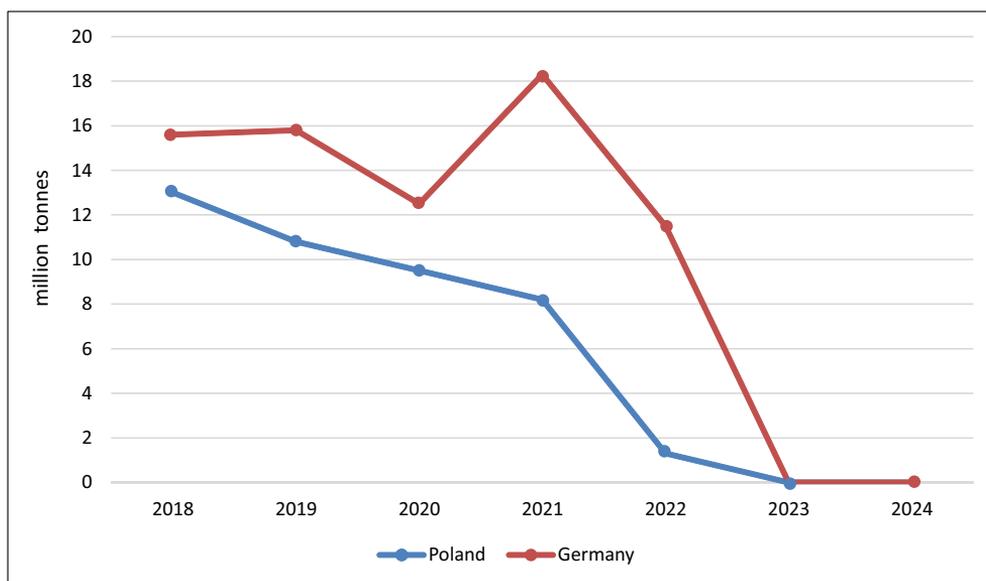


Fig. 2. Russian hard coal import to Poland and Germany 2018–2024 (in million tonnes)
Own work based on: (GUS; Przedlacki 2024)

Rys. 2. Import rosyjskiego węgla do Polski i Niemiec w latach 2018–2024 (w milionach ton)

and South Africa (Reuters 2024a). As a result, as early as the first months of the war in Ukraine, Russian coal imports to Poland and Germany were effectively stopped.

The imports of Russian gas to the German and Polish fossil fuel markets were more problematic than the imports of hard coal. Notably, both countries were quite heavily dependent on Russia, which was due to the transmission infrastructure built several decades earlier and the supply contracts that had been signed in the past. A key role in this aspect was played by the Yamal gas pipeline, launched at the turn of the 21st century, stretching over a distance of 4,000 km and connecting Russian gas deposits via Belarus with the receiving countries of Poland and Germany. The project that made Germany even more dependent on Russian gas was the Nord Stream, an offshore gas pipeline bypassing the transit countries, i.e., Belarus and Poland. In the successive years, there was a noticeable difference between the gas strategies of Germany and Poland, especially after 2015, when Chancellor A. Merkel deepened gas cooperation with Russia by, among other things, enlarging Nord Stream by adding two more lines (Nord Stream II). In contrast, Poland focused on the construction of alternative infrastructure in the form of the Świnoujście LNG gas terminal (from 2015), the Baltic Pipe (from 2022), and gas interconnectors with neighbouring countries as part of the North-South Gas Corridor (with Lithuania in 2022 and Slovakia in 2022) (Hebda 2024). As a consequence of the different energy policies in the natural gas sector, the trend between 2018 and the outbreak of the war in Ukraine was of increasing Russian gas imports to Germany (from 43.1 bcm in 2018 to 55.4 bcm in 2021) and stagnation in the supplies to Poland (from 9 to 9.9 bcm between 2018 and 2021). Following the outbreak of the war, there was a significant reduction in the supply of natural gas from Russia to both countries. In 2022, Polish imports amounted to 2.9 bcm (about 70% less than in 2021) and German imports dropped to 29.5 bcm (about 47% less than in 2021) (Figure 3). Poland, thanks to the increased capacity of the LNG port in Świnoujście and the launch of the Baltic Pipe, was able to stop importing Russian natural gas completely without jeopardising its energy security. Germany's situation was much more difficult as a consequence of the lack of alternative transmission infrastructure, the lack of LNG terminals, and the stop in the operation of the Nord Stream (26 September 2022). It is worth emphasising, however, that gas supplies to Poland and Germany were stopped by the Russians and not forced by EU sanctions or decisions of the Polish or German authorities. On April 27, 2022, Gazprom decided to suspend the transfer of natural gas via the Yamal pipeline to Poland (CIRE 2022). The supply to Germany via the Nord Stream pipeline was initially curtailed (in July and August 2022) and then halted in late August/early September 2022, a few weeks before the pipeline's breakdown (BBC 2022). 2023 was the breakthrough year for the German and Polish natural gas markets. For the first time in several decades, the two countries did not distribute Russian gas directly, i.e., through pipelines. Poland had quickly diversified its sources, covering as much as 92% of its needs through the LNG port (6.5 bcm) and the Baltic Pipe (6.2 bcm). The most important suppliers of natural gas to Poland were the USA, Norway, and Qatar (Orlen 2024). Germany also switched the sources of its supply and imported approx. 93% from three countries: Norway (43%), the Netherlands (26%),

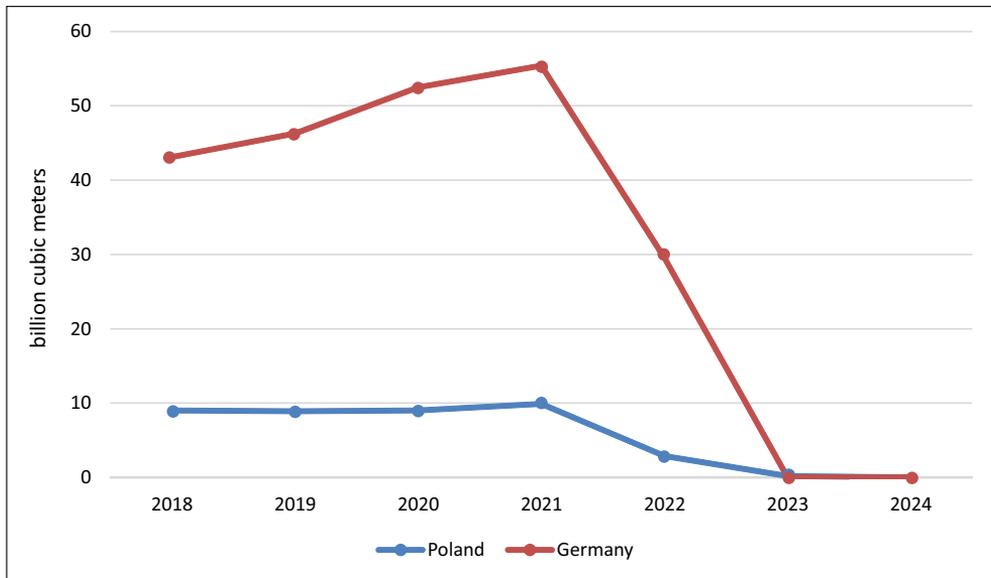


Fig. 3. Russian natural gas import to Poland and Germany 2018–2024 (in bcm)
Own work based on: (PGNiG, Statista)

Rys. 3. Import rosyjskiego gazu ziemnego do Polski i Niemiec w latach 2018–2024 (w mld m³)

and Belgium (22%) (Statista 2024c). It is worth noting that Germany's first liquefied natural gas (LNG) terminal at Wilhelmshaven did not start operation until December 2022. This was followed by the commissioning of a further three FSRUs at Lubmin, Brunsbüttel, and Stade in January, March, and December 2023, respectively (ACER 2024). It should also not be overlooked that, despite halting direct imports of Russian natural gas, significant volumes continue to reach Germany via neighbouring countries. The second and third largest suppliers of natural gas, i.e., the Netherlands and Belgium, import LNG from the Russian Yamal LNG terminal. These supplies then reach Germany as part of cross-border pipeline gas supplies (Humpert 2024). This phenomenon illustrates the ineffectiveness of EU sanctions imposed on Russian gas.

As for oil imports, before the outbreak of war in Ukraine, Germany, as well as Poland, was significantly dependent on Russia. As with the gas sector, this was associated with the presence of transmission infrastructure, among other things. The Druzhba oil pipeline, built back in the 1960s and 1970s, transported crude oil from Russia to the countries of Central and Eastern Europe. Refineries in Germany and Poland were its largest customers, but it should be noted that both countries had alternative supply routes. Germany expanded land connections with neighbouring countries (TAL, MERO, RRP pipeline) and put three oil terminals in ports into operation (Rostock, Wilhelmshaven, Brunsbüttel). Poland, on the other hand, opened an oil terminal in the Gdańsk port as early as in the 1990s.

Between 2018 and the outbreak of the war in Ukraine, there was a noticeable trend of declining imports of Russian oil to Germany (from 31 million tonnes (mt) in 2018 to 27.7 mt in 2021) and to Poland (from 18 mt in 2018 to 9 mt in 2021). It is worth noting that Poland reduced these imports by half in four years, which was also due to the increased capacity of the oil terminal in Gdańsk. In 2020, almost 13 mt of oil and liquid fuels came through Gdańsk, in 2021 it was almost 18 mt, and in 2022 the volume exceeded 24 mt (87% of which came from outside Russia). Despite the outbreak of the war in Ukraine, both Germany and Poland continued to import Russian oil: in the case of Germany at the end of 2022 the volume was slightly lower than in the previous year (22.4 mt), while Polish imports were slightly higher (10 mt) (Figure 4). The situation changed in 2023, as both countries switched their imports to non-Russian sources. For Poland, Saudi Arabia was the most important supplier (over 45%), followed by Norway (over 35%) and the USA (over 5%). In contrast, Russian supplies accounted for only 2% (compared to almost 61% in 2021) (POPiHN 2024). The German economy utilised mainly oil imported from Norway (13.3%), the USA (13.3%), Kazakhstan (8.5%) and the UK (7.9%), but it is nevertheless worth noting that it imported oil from as many as 36 countries (EfD 2024). Russia accounted for only 0.2% of German oil imports, compared to 26% in 2022 and 34% in 2021 (Reuters 2024b). The decrease in oil supply from Russia recorded in 2023 was mainly due to increased purchases of oil from Africa, the Middle East (particularly the United Arab Emirates), and North America.

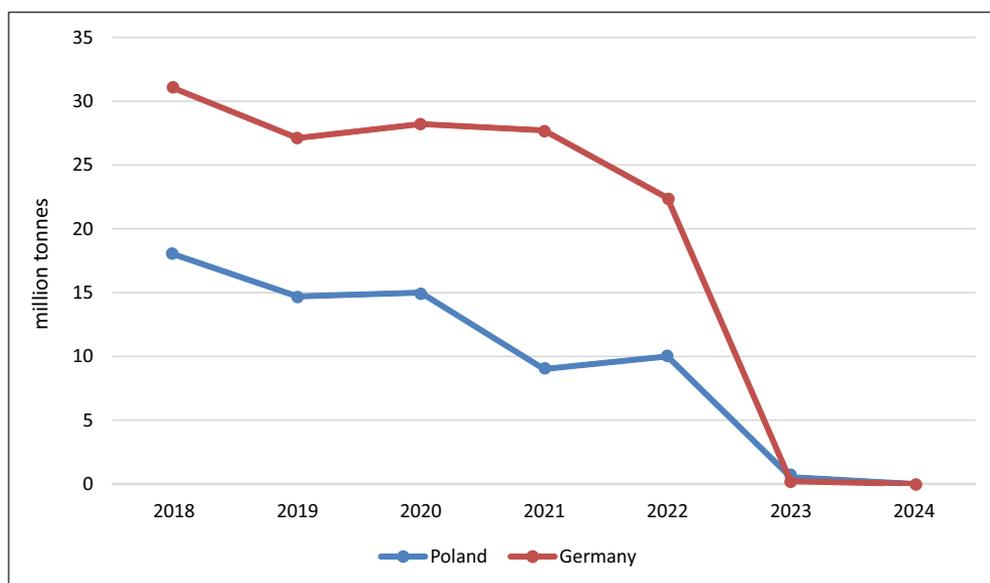


Fig. 4. Russian crude oil import to Poland and Germany 2018–2024 (in million tonnes)
Own work based on: (POPiH, EUROSTAT, Trading Economics)

Rys. 4. Import rosyjskiej ropy naftowej do Polski i Niemiec w latach 2018–2024 (w milionach ton)

As with natural gas, Russian oil enters Germany indirectly, i.e., via third countries that have clearly increased their purchases. This includes India, for which Russia became the main oil supplier in 2023 (in previous years, these imports were marginal due to, among other reasons, high transport costs) (Henderson et al. 2024). In March 2023, Russia's largest oil producer Rosneft signed an agreement with Indian Oil Corp (India's leading refinery) to significantly increase and diversify the grades of oil supplied to India (Astakhova 2023). Thus, Indian refineries process Russian oil, and then their petroleum products (diesel, jet fuel, etc.) are purchased by EU countries, including Germany.

Conclusions

The war in Ukraine has brought about serious challenges to the energy security of many European countries. Its consequences are being felt in particular by countries in Central and Eastern Europe that had been significantly dependent on Russian fossil fuels. In a relatively short period of time, many of them have had to adapt to new geopolitical realities and, in particular, to ensure stability in their energy sectors. It should not be forgotten that the EU's energy transition, which aims at zero carbon dioxide emissions, has already been underway for many years. However, decarbonisation takes time, and therefore in the 2020s, in countries such as Poland and Germany, this process was to be carried out by shifting away from coal in the power generation sector towards sources causing less emissions, such as natural gas. The commissioning of new transmission infrastructure supplying natural gas to both countries (Nord Stream, Baltic Pipe, North-South gas corridor) was supposed to ensure energy security and support the transition. Immediately prior to the outbreak of the war in Ukraine, both Poland and Germany were clearly dependent on Russian supplies not only of gas, but also of coal and crude oil, and therefore, the sanctions gradually introduced by the EU were designed to disrupt both economies as little as possible. This has not quite worked out for Germany. There is no doubt that the EU's embargo on Russian hydrocarbons is not fully effective, but the situation is linked to the need to ensure energy security, especially in the countries of Central and Eastern Europe.

The fossil fuel markets of Germany and Poland have seen major changes in the context of the sources and directions of supply of strategic commodities in recent years (2021–2024). Russia's armed aggression against Ukraine and the EU's sanctions imposed on Russian energy resources have required a fast change in the approach to trade with Russia, in particular imports of fossil fuels such as coal, crude oil, and natural gas. Over a period of 2–3 years, both Germany and Poland significantly diversified their sources and directions of supply. It must be emphasized that Russia, a key partner in this area, which was still satisfying a large portion of German and Polish needs for energy commodities as recently as in 2021, has been completely excluded. In 2023, both countries stopped their imports of Russian fossil fuels. Of course, this process has occurred in different ways. Many years before the outbreak of the war in Ukraine, Poland made investments aimed at reducing its dependence

on Russia and building alternative transmission infrastructure. As a result, Poland was able to flexibly adapt to the new geopolitical realities and switch to other sources of crude oil and gas imports. For Germany, the situation was much more complicated, especially in the natural gas sector. The country did not have an alternative infrastructure in place to quickly switch to other supply routes. For this reason, intensive investments in, among other things, LNG terminals were necessary.

The fossil fuel market in both countries has undergone a profound transformation. The Russian Federation – a long-standing partner and key supplier of hydrocarbons – has lost its export opportunities in this part of Europe. Cooperation with other countries, such as the USA, Norway, and countries of the Middle East, which have effectively replaced the Russian supplies, has been strengthened. The examples of Germany or Poland show that the energy transition requires a flexible approach, especially in the fossil fuel sectors, which still provide the basis for the functioning of societies. Transformation of the energy sector, not only in these two countries, requires an appropriate time frame and, importantly, should be adapted to the geopolitical realities at hand.

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**THE FOSSIL FUEL MARKET IN GERMANY AND POLAND
IN THE AFTERMATH OF THE RUSSIAN-UKRAINIAN WAR****Keywords**

fossil fuels, Germany, Poland, war in Ukraine

Abstract

Fossil fuels such as coal, crude oil, and natural gas are still key to ensuring energy security. Due to limited resources, most European countries must import strategic raw materials, making their security dependent on the geopolitical situation. The war in Ukraine has serious consequences for the fossil fuel market in Central and Eastern Europe. The Russian Federation, being a world leader in hydrocarbon production, was a key supplier to most countries located in this region. As the armed conflict in Ukraine developed, it became obvious that ensuring energy security would be a priority for the European countries. Diversifying the sources of strategic fossil fuels was undoubtedly one of the most challenging ventures during this time. As a result of EU sanctions against Russian raw materials, the Central and Eastern European countries were forced to review and amend their energy policies, as well as look for new suppliers of hydrocarbons. Unfortunately, for many countries, achieving these targets turned out to be a great challenge due to their significant dependence on Russia and the lack of alternative transmission infrastructure. The Russia-Ukraine conflict has led to significant changes in the fossil fuel market, primarily in Germany and Poland. This article presents a comparative analysis of the German and Polish fossil fuel markets in the aftermath of the Russian-Ukrainian war. The analysis covers the period of 2021-2024. The aim was to determine how the sanctions imposed on Russia affected the fossil fuel markets of Germany and Poland. The analysis covers the coal, oil, and natural gas sectors.

**RYNEK PALIW KOPALNYCH W NIEMCZECH I POLSCE
W NASTĘPSTWIE KONFLIKTU ROSYJSKO-UKRAIŃSKIEGO****Słowa kluczowe**

paliwa kopalne, Niemcy, Polska, wojna w Ukrainie

Streszczenie

Paliwa kopalne tj. węgiel, ropa naftowa oraz gaz ziemny, wciąż są kluczowe dla zapewnienia bezpieczeństwa energetycznego. Większość państw europejskich ze względu na ograniczone własne zasoby jest zmuszona importować strategiczne surowce, przez co ich bezpieczeństwo jest uzależnione od sytuacji geopolitycznej. Wojna w Ukrainie niesie ze sobą poważne konsekwencje dla rynku paliw kopalnych w Europie Środkowo-Wschodniej. Federacja Rosyjska, będąc światowym liderem w produkcji węglowodorów, była kluczowym dostawcą dla większości państw zlokalizowanych w tym regionie. Wraz z rozwojem konfliktu zbrojnego w Ukrainie stało się oczywiste, że priorytetowe

znaczenie dla państw europejskich będzie miało zapewnienie bezpieczeństwa energetycznego. Z pewnością jednym z najtrudniejszych przedsięwzięć w tym okresie stała się dywersyfikacja źródeł strategicznych paliw kopalnych. W następstwie unijnych sankcji wobec rosyjskich surowców państwa Europy Środkowo-Wschodniej zostały zmuszone do weryfikacji i nowelizacji polityki energetycznej oraz poszukiwania nowych dostawców węglowodorów. Niestety, dla wielu państw osiągnięcie tych celów okazało się wielkim wyzwaniem ze względu na znaczne uzależnienie od Rosji oraz brak alternatywnej infrastruktury przesyłowej. Konflikt rosyjsko-ukraiński stał się przyczyną istotnych zmian na rynku paliw kopalnych przede wszystkim w Niemczech i Polsce. W artykule dokonano analizy porównawczej rynku paliw kopalnych Niemiec i Polski w następstwie wojny rosyjsko-ukraińskiej. Analizą zostały objęte lata 2021–2024. Poszukiwano odpowiedzi na pytania, w jaki sposób sankcje nałożone na Rosję wpłynęły na rynek paliw kopalnych Niemiec i Polski. Uwzględniono sektor węgla kamiennego, ropy naftowej i gazu ziemnego.