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CHAPTER 5

Polish import of natural gas from the perspective of complex interdependence

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Abstract: The Russian invasion of Ukraine not only destabilised international security but also triggered a significant supply shock in fossil fuel markets, including natural gas. This disruption has resulted in a complex economic situation in countries dependent on Russian imports such as Poland, highlighting the urgent need to diversify supply routes and enhance energy security. This chapter examines Poland's natural gas imports from Russia through the lens of the theory of complex interdependence and, on this basis, draws conclusions regarding the country's geopolitical position and sovereignty.

Keywords: complex interdependence, natural gas, Poland, sensitivity, vulnerability.

1. INTRODUCTION

In the world of limited resources, the public sector has to ensure the state's energy security, which is defined by International Energy Agency (IEA) as having uninterrupted access to energy at an affordable price (IEA, n.d.). In this context natural gas plays a major role in heating, electricity production, and in automobiles and chemical industry. Nonetheless, it should be noted that natural gas is a fossil fuel that generates greenhouse gas emissions (GHG), albeit to a lesser extent than coal (PGNiG

Grupa ORLEN, n.d.). Poland, located in Central Eastern Europe (CEE) and a member of the European Union (EU), has long faced challenges in its gas sector due to import dependency, particularly from the East. This situation, present also within other EU countries, reached its critical point after February 24, 2022, marking the full-scale Russian invasion of Ukraine and the subsequent cessation of the majority of Russian pipeline gas export to Europe. Deliveries to Poland, Bulgaria, Finland, Denmark and the Netherlands stopped completely when those to Germany, Italy, France and others were reduced (Di Bella et al., 2024, p. 3). The unilateral, aggressive actions of Russia – one of the biggest global gas producers and exporters – resulted in a sudden reduction of supply, heightening geopolitical tensions and soaring gas prices, especially across European stock exchanges (Gradzewicz et al., 2024, p. 1). However, signs of Russian unreliability and the use of energy policy as a tool of influence had surfaced earlier. Already in 2021 there were issues with flow through the Yamal pipeline,[1] and eventually it became clear that Gazprom would not fulfil its contract with Poland. Even earlier examples include the 2006–2009 gas crises (Hebda, 2023, p. 116 & 120). The events of 2022 only confirmed the position that Russia uses raw materials as tools of coercion and hybrid warfare. Given the situation of Poland, which had to completely revamp its energy policy, including its gas policy, in face of potential interruptions of supply and skyrocketing prices, it can be concluded that there was an asymmetrical interdependence in the gas sector between Poland and Russia. According to Robert Keohane and Joseph

[1] In order to provide more context, it is necessary to introduce the structure of interconnections in the Polish natural gas sector before 2022. The most important part of it was the Yamal-Europe gas pipeline running from Russia through Belarus (Kondratki entry point), Poland and Germany (Mallnow entry point), which was one of the main transport routes for Russian natural gas to Europe. Furthermore, with Germany, Poland had an additional GCP GAZ-SYSTEM/ONTRAS interconnector in Lasów. In the case of Belarus, there were two additional interconnectors – Vysokoye and Tietierovka. Other interconnectors operated on the border with the Czech Republic (Cieszyn) and Ukraine (GCP GAZ-SYSTEM/UA TSO). The last major component of the structure was the LNG terminal in Świnoujście (Urząd Regulacji Energetyki, 2022).

Nye (2011, pp. 3–4 & p. 8), interdependence occurs when interconnectedness between countries or other actors generates reciprocal, costly effects of transactions. Additionally, interdependence is complex, which means, that although states still play a major role, they operate in a multidimensional environment composed of non-state actors and encompassing many spheres, such as military, economic, social and ecological. Interdependence can be a source of both benefits and losses. Asymmetry in this regard, as seen in the case of Russia and Poland, can be a source of power[2] in international relations. However, it should be taken into consideration, that complex interdependence is composed of two dimensions, namely sensitivity and vulnerability. Sensitivity refers to costs in the short term, occurring within a fixed policy framework, thus tied to some event before the policy change. Vulnerability, on the other hand, addresses long term costs and the relative availability and affordability of alternative choices. Therefore, vulnerability is more important in determining the distribution of power and the conceptualisation of interdependence between actors (Keohane & Nye, 2011, pp. 10–13). The main purpose of this chapter is to examine how Poland's natural gas import after the onset of the Russian-Ukrainian war fits into the concept of complex interdependence. The answer to this question is important as it will allow the degree of Polish gas and energy security to be approximated, and conclusions about Poland's geopolitical position in CEE to be formulated. The author adopts the following research hypothesis: in the context of interdependence with Russia in the gas sector, Poland's sensitivity outweighed its vulnerability. To verify it, he will answer the following research questions: what was the supply structure of the Polish gas sector before February 2024? What were the immediate effects of the Russian invasion of Ukraine on the Polish gas sector? Was Poland able to quickly and effectively diversify its supply routes and ensure an adequate level of natural gas? The research methods used in the chapter are comparative

[2] Power in this context is understood as the ability of an actor to get others to do something they otherwise would not do (and at an acceptable cost to the actor) (Keohane & Nye, 2011, p. 10).

and qualitative analysis of academic and press articles, government websites, reports, research papers and think-tank resources. The paper is structured as follows. Section 1 is an introduction. Section 2 provides the background and context to identify Polish sensitivity. Section 3 contains the main analysis relevant to outlining vulnerability. Section 4 is a discussion on the chapter's findings and includes recommendations for further action. Lastly, section 5 concludes the chapter.

2. BACKGROUND AND CONTEXT

Natural gas has played an increasingly important role in the Polish economy in recent years. This is reflected in its consumption, which increased by about 25% between 2012 and 2022 (Hebda, 2022a, p. 1). Additionally, Poland is undergoing an energy transformation towards decarbonisation and an increased share of renewable energy sources (RES) in the energy mix. This aligns more broadly with EU policy and law – more specifically with the European Green Deal (EGD) – which aims to reduce GHG emission by 55% by 2030 and achieve climate neutrality by 2050 (Sajniak, 2022, p. 123). However, due to the preponderance of coal in the energy sector, transformation requires a transitional period to maintain stability. Natural gas is designated to serve as a "bridge fuel", as emphasised by the Energy Policy of Poland until 2040 (EPP 2040) (Hebda, 2022a, pp. 1–2). That indicates a continuation of the growing demand for this raw material in the future. In 2021, Poland's gas consumption totalled 23.3 billion cubic metres (BCM), and Polish dependence rate on gas imports stood at 83.6%. Polskie Górnictwo Naftowe i Gazownictwo (PGNiG)[3] imports from Russia via the Yamal pipeline amounted to about 9.9 BCM. Liquefied natural gas (LNG) supplied via the Świnoujście terminal accounted for about 20% of imports (3.9 BCM). Domestic

[3] State-owned company PGNiG, part of the Orlen Group, is the most important player in the Polish natural gas market. It is responsible for the majority of the import. In addition to trade, it is also involved in production and services.

production amounted to 3.7 BCM, while imports from western and southern directions reached 2.3 BCM (INFOR, 2022). Thus, the share of Russian gas in PGNiG imports amounted to approximately 60%. It should be noted that presented situation still seemed better than in the past – between 2014 and 2021 Poland managed to reduce imports from Russia by 14% (Rzeczycki, 2023, p. 5). This unfavourable supply structure was due to several decades-long existence of transmission infrastructure (the Yamal pipeline) and an agreement between PGNiG and Gazprom (Hebda, 2025, p. 4).

When Russia attacked Ukraine on February 24, 2022, both Polish and European gas markets suffered a severe supply shock. Even though gas supplies to Europe began declining as early as the second half of 2021 due to unilateral actions by Russia,[4] this could not match the 56% drop in 2022. Initially, Gazprom reduced volumes under existing contracts only with countries that did not want to pay for gas according to the ruble scheme (e.g., Poland) but later extended it even to countries that complied with it (Łoskot-Strachota, 2023, pp. 1–2). In the case of Poland, the flow of gas ceased completely on April 27, 2022, and subsequently in May 2022 the Polish side terminated the Yamal contract (Hebda, 2023, p. 120).

Russia's actions have destabilised the gas market in Europe and led to its partial and temporary disintegration due to infrastructural bottlenecks and low filling of storage facilities. This was evident through the clear spread between prices in the various European gas hubs (Di Bella et al., 2024, p. 4). The scale of the crisis was also reflected in soaring and volatile gas prices on the Title Transfer Facility (TTF) exchange – up several hundred per cent from standard prices (Gradzewicz et al., 2024, pp. 1–2). The Polish Towarowa Giełda Energii (TGE) market exhibited a similarly adverse trend. From February to March 2022, prices increased from 375zł to 726zł per MWh. They then temporarily declined to 427zł in May, reaching a record high of 1,100zł per MWh within three

[4] In 2021, Gazprom stopped selling gas through stock exchanges.

months in August 2022 (Energy.instrat, 2025). Furthermore, data on average quarterly purchase prices of natural gas imported from EU member states or member states of the European Free Trade Agreement (EFTA), published by the President of the Energy Regulatory Office, are instrumental in illustrating the situation. In the first and second quarters of 2022, they averaged 440zł per MWh. However, in the third quarter they rose sharply and ranked at 886zł per MWh (Urząd Regulacji Energetyki, 2025). Soaring energy prices coupled with rising food prices and disruptions in global value chains, resulted in an increase in inflation (from 5.2% in 2021 to 13.2% in 2022) and slowdown of Poland's GDP growth (from 6.9% in 2021 to 5.6% in 2022) (Gradzewicz et al., 2024, p. 1).

The analysis in this section allows us to answer the first and second research questions. Firstly, Poland's natural gas supply structure before February 2022 was dominated by imports from Russia. The main importing company was 60% dependent on that direction. Secondly, the beginning of the Russian invasion on Ukraine destabilised European and Polish gas markets, leading to a dramatic increase in prices, which in turn brought about severe macroeconomic consequences. These findings enable the formulation of an important conclusion – Poland exhibited a relatively high degree of sensitivity in the context of gas interdependence with Russia.

3. POLISH RESPONSE ANALYSIS

This section examines the Polish response to the supply shock described above, thus outlining Poland's vulnerability. This will allow conclusions about the state's position in the region and how natural gas supplies affect energy security and economic sovereignty to be developed.

Even prior to the outbreak of the war in Ukraine, Poland was taking steps to diversify its gas supply. In 2015, the LNG gas terminal in Świnoujście was commissioned, and over the years its regasification capacity has been gradually increasing. As a result of this investment, LNG

import from global suppliers became possible. Furthermore, in 2016, the Polish government revisited the Baltic Pipe concept,[5] which had been abandoned in the early 2000s. Work had been progressing even before the Russian aggression, and the project was originally scheduled to be completed in the autumn of 2022. Another initiative aimed at eliminating dependence on Russian gas is the North-South Gas Corridor (NSGC), which being a major regional project, aims to integrate the transmission systems of CEE countries through the development of interconnectors. It is based on several gas entry points – namely the Polish, Lithuanian and Croatian LNG terminals. (Hebda, 2022b, pp. 2–5). Poland had already embarked on a path towards diversification of its gas supply even before February 2022. Nevertheless, the Russian invasion significantly accelerated this effort. The implementation of the Baltic Pipe project occurred within the expected timeframe. Its official launch took place on September 27, 2022, and two months later it reached its full capacity. The pipeline allows imports of 10 BCM of gas per year, which accounts for more than 60% of Poland's domestic demand. In addition, construction of several NSGC components has been completed. A Polish-Lithuanian interconnector with a capacity of 2 BCM was launched in May 2022, providing access to the Klaipeda terminal. This was followed six months later by the commissioning of the Poland-Slovakia interconnector with a capacity of 5.7 BCM (Hebda, 2023, p. 120). Already at this stage, it is evident that the completed projects allowed Poland to achieve the goal of developing infrastructure, enabling transmission from directions other than the East. Nevertheless, Poland's efforts did not end there. In January 2025, the expansion of the LNG terminal in Świnoujście was completed. As of 2025, its regasification capacity amounts to 8.3 BCM (Stachura, 2025). There are

[5] The Baltic Pipe is a pipeline allowing natural gas imports to Poland from the Norwegian Continental Shelf. Already in 2000, Poland's PGNiG, Norway's Statoil and Denmark's DONG had reached an agreement on the project. The pipeline was supposed to be built by 2003, but the Polish government cancelled the deal due to concerns about an oversupply of natural gas (Hebda, 2022b, p. 5).

also projects still under construction, including the second interconnector with the Czech Republic (STORK II) (Hebda, 2024, p. 5) and the Floating Storage Regasification Unit (FSRU), a permanently moored vessel designed to unload, store and regasify LNG. Its capacity will be at least 6.1 BCM per year. The terminal will be located in the Gdańsk region and will become operational in 2027 or 2028 (GAZ-SYSTEM, n.d.). In summary, Poland's response to the crisis in terms of transmission infrastructure adjustment has been relatively swift and effective. This was largely possible due to the fact that Poland's actions were not completely ad hoc but were rooted in earlier gas policy directions aimed at gradual diversification.

Another important element of the Polish reaction to the energy crisis was the amendment of EPP 2040. This strategy came into force at the beginning of 2021, so it had to be adjusted to the rapid change in the geopolitical situation. On March 29, 2022, the Polish government adopted the guidelines for updating EPP 2040. A fourth pillar of energy policy was added – energy sovereignty – the concept of which entails a rapid decoupling of the national economy from imported fossil fuels and their derivatives from the Russian Federation and other sanctioned countries. The updated strategy further lists the tools necessary to achieve this goal. These are diversification of supply and investment in domestic production, storage and alternative fuels. In this context, new technological solutions, the dynamic development of RES and improvement of energy efficiency are of great significance. The strategy also emphasises the need to temporarily increase the use of coal in electricity generation, among other things, in the event of a reduction in gas supplies. It also draws attention to the necessity of accelerating investment in nuclear energy. Undeniably, EPP 2040 in certain aspects does not correspond to the goals of the EU's climate policy and EGD. Nevertheless, this is due to the priority given to security of electricity supply (Hebda, 2023, pp. 117–118). The analysis carried out in this part of the chapter shows that in response to the sudden crisis caused by the Russian invasion of Ukraine, Poland

swiftly updated its energy policy, focusing on the most important issue in the short term: energy security and reliability of supply.

An important question arises: how did infrastructural adjustment and policy revamp translate into the actual gas supply structure? In 2022, the gas supply structure was as follows. The largest volume of gas – 7.29 BCM – was imported from the northern direction (LNG, Baltic Pipe, interconnector with Lithuania). LNG definitely dominated here with a volume of 6.04 BCM. More than half of this value was imported from the United States. It should be emphasised that for the first two months the Baltic Pipe operated with limited capacity due to the need to complete technical work. The amount of natural gas imported through this source was therefore limited and amounted to 0.7 BCM. The interconnector with Lithuania enabling access to the Klaipeda terminal accounted for 0.55 BCM. The second major source of gas was domestic production, amounting to 3.43 BCM. 3.4 BCM was imported from the western direction and 2.9 BCM from the eastern direction, i.e., from Russia. Small volumes of gas (0.03 BCM) also arrived from the south, via an interconnector with Slovakia (Grupa ORLEN, n.d.; Hebda, 2024, p. 4). Comparing these figures to those presented in the previous section, the deep restructuring of supplies and the marginalisation of the Russian direction is visible. It should be recalled that on April 27, 2022, supplies via the Yamal pipeline ceased completely. Thus, since 2023, Poland has no longer imported any Russian gas, and even LNG has come from other sources, which is quite significant in the broader European context. This is particularly important given that Russia remains one of the largest suppliers of LNG to the EU (Paszkowski, 2025, pp. 1–2). In 2023, additional changes occurred in the supply mix. The volume of LNG rose slightly to 6.5 BCM. Additionally, the importance of the Baltic Pipe increased prominently, with 6.2 BCM being imported.[6] For this reason, imports from

[6] Natural gas brought in by the Baltic Pipe comes both from contracts with contractors operating on the Norwegian Continental Shelf and from PGNiG's own production. The term "own production" refers to both domestic sources and those extraction assets abroad.

the western and southern directions decreased significantly – together they amounted to 0.9 BCM and were supplementary in nature. 0.2 BCM each were imported from Lithuania and Ukraine. Domestic production experienced a slight decline and amounted to about 3.3 BCM (PGNiG Grupa ORLEN, 2024). A notable achievement in 2024 was the substantial increase in gas production from PGNiG's own sources. While domestic production remained at 3.3 BCM, production in Norway increased by as much as 45% to 4.5 BCM. Moreover, the company plans to further increase it over the coming years (PGNiG Grupa ORLEN, 2025).

The next aspect to examine is gas prices. Market conditions of TGE have stabilised considerably since 2023 compared to the sharp surges in 2022. Prices have largely stabilised from month to month, although minor fluctuations have persisted. The highest average gas price – about 315zł per MWh – was in January 2023, while the lowest – about 137zł per MWh – in February 2024. Average annual gas prices in 2023, 2024 and so far in 2025, were 215zł, 178zł and 219zł per MWh, respectively. This marks a significant difference compared to the 2022 level of 557zł per MWh (Energy.instrat, 2025). In the case of average quarterly purchase prices for natural gas imported from EU or European Free Trade Association (EFTA) member states, a significant decline was already observed in Q4 2022 – from about 886zł to 473zł per MWh. This trend continued in subsequent quarters. The average price in 2023 and 2024 was around 210zł and 171zł per MWh, respectively (Urząd Regulacji Energetyki, 2025). In addition to the supply diversification described above, several additional factors likely contributed to the stabilisation of gas prices. At the EU level, emergency regulations were implemented, such as mandatory gas storage requirements and energy-saving targets. Additional instruments were introduced to intervene in market operations in the form of joint purchases and price caps on stock exchanges (Łoskot-Strachota, 2023, p. 1). Furthermore, the supply shock resulting from the Russian invasion did not lead to a total, but only a partial disintegration of the European market, thus avoiding an even bigger crisis. This occurred for two main reasons.

Firstly, the European cessation of Russian pipeline gas supplies was gradual and did not cover the entire supply, but only most of it. Secondly, the decrease in European gas demand was greater than anticipated (Di Bella et al., 2024, pp. 9–10).[7]

The data presented lead to optimistic conclusions, although several challenges remain that warrant attention. While diversification of supply and expansion of transmission infrastructure has been a definite success, the problem is capacity. This is particularly concerning the NSGC and related interconnectors. Moreover, Poland's neighbours are not as well integrated into the system, which can lead to infrastructural bottlenecks (Hebda, 2024, p. 10). Consequently, Poland has little chance of importing more gas from the southern direction as a part of further diversification. In addition to that, the anticipated rise in gas demand may present a growing challenge.

The analysis in this section provides an answer to the third research question. Thanks to the fact that for many years it had been making efforts to secure new gas supply routes and diversify suppliers, Poland was able to finish its infrastructural expansion and cut itself off from Russian natural gas. It also made efforts to expand its own gas sources. Moreover, the update to its energy strategy was executed appropriately in response to the crisis. Furthermore, Poland's success in this regard is reflected in gas prices, which have stabilised and fallen to acceptable levels. Undoubtedly, there are still several issues such as bottlenecks, difficulties with broader CEE energy sector integration and growing gas demand. However, it can be concluded that Poland was indeed able to quickly and effectively diversify its supply routes and ensure an adequate supply of natural gas. This leaves us with another important conclusion – Polish vulnerability in the context of gas interdependence with Russia was relatively low.

[7] The author does not delve deeper into the issues of these other factors. However, their specific impact on the Polish gas sector may be a promising area for further research.

4. DISCUSSION

Before presenting the final conclusions, it is important to discuss some of the implications of the findings and identify the main challenges and opportunities. At the outset, it should be emphasised that efficient diversification of the gas sector, effective decoupling from Russian supplies, alleviation of the gas prices and existing infrastructure, particularly NSGC,[8] increased Poland's regional importance and strengthened its energy sovereignty. Considering these factors, along with Poland's geographical location, this country has a chance of becoming a major hub for the transmission of LNG and Norwegian gas to CEE. This could contribute to the reduction of CEE countries' dependence on Russian gas – especially those that have no access to the sea. However, existing bottlenecks in the NSGC are a major threat in this context. These include, on the one hand, the low capacity of interconnectors and their poor integration with the transmission systems of CEE countries, and, on the other hand, Poland's marginalisation of alternative gas supply routes. A potential lack of consensus among CEE countries on the directions of gas imports, which would undoubtedly hinder Poland's effective regional policy, may represent a significant obstacle. Therefore, the author agrees with Hebda's (2023, p. 121) position that Poland and neighbouring EU countries should pursue a common energy policy geared toward reducing dependence on Russia and increasing EU funding for modernisation and expansion of energy infrastructure.

Moreover, the current situation does not guarantee that Poland's vulnerability will remain low in the future in the face of possible new threats. One such threat could be potential sabotage or direct attacks targeting key infrastructure supplying gas from the northern direction. In this hypothetical situation, the main challenge to maintaining energy security would be the infrastructural bottlenecks discussed earlier,

[8] These factors can be collectively called "vulnerability lower than sensitivity".

and the lack of significant gas supply contracts from directions other than the north.

Another issue is the projected growing demand for natural gas, partly resulting from the ongoing energy transition. Due to geographical constraints, some volume of natural gas will inevitably have to be imported or extracted abroad. This precludes the possibility of continuous and absolute supply security. In this context, it is important to develop RES and nuclear power more quickly to prevent an extended transition period. Potential ideas of prolonging reliance on gas in the energy sector seem inappropriate, considering Poland's climate commitments under EU law and global agreements, as well as its lack of gas production self-sufficiency. These commitments are legally binding and relatively strict. In the Paris Agreement adopted in 2015 under the United Nations Framework Convention on Climate Change (UNFCCC), parties committed to create long-term greenhouse gas emission development strategies to limit global warming to 1.5°C above pre-industrial levels (UNFCCC, n.d.). Subsequently, in 2018 the EU, as one of the parties to the convention, adopted its strategy titled, "Clean Planet for All". Based on this strategy, among other things, in 2019 the European Commission published a communication on the EGD – a comprehensive strategy outlining a pathway to achieve climate neutrality by 2050. In addition, in 2020 the European Council approved an ambitious goal of reducing net GHG emissions by at least 55% by 2030 compared to 1990 levels (Ministerstwo Rolnictwa i Rozwoju Wsi, n.d.). Poland as a member of the EU and a party to the Paris Agreement, ought to follow its obligations in accordance with international law. Nonetheless, in the short to medium term, Poland should seek to take advantage of its favourable conditions to become a natural gas transmission hub and, as a result, bolster energy security in CEE. This may contribute to strengthening its geopolitical position in the region and ensuring energy sovereignty.

5. CONCLUSION

Concluding the chapter's findings, the author successfully answered all the research questions. Prior to February 2022, the structure of natural gas supplies to Poland was dominated by imports from Russia. The Russian invasion of Ukraine destabilised European and Polish gas markets triggering a dramatic increase in prices and causing serious macroeconomic consequences. Nevertheless, Poland was able to swiftly sever its dependence on Russian supplies. It also made progress in increasing domestic production and updating its energy strategy. Infrastructural development significantly contributed to those efforts. Poland's actions subsequently contributed to the decline in gas prices. These findings confirm the validity of the adopted research hypothesis: in the context of interdependence with Russia in the gas sector, Poland's sensitivity outweighed its vulnerability. Areas requiring further research include infrastructural bottlenecks in NSGC and potential threats to Polish transmission infrastructure in the north. Additionally, a detailed study of the impact of EU-level instruments on the Polish gas sector and price reductions would be valuable. Nevertheless, this chapter provides insight into the interplay between natural resources and regional power dynamics through an analysis conducted within the framework of complex interdependence. It outlines the state's position in a world of limited resources and enables conclusions about energy sovereignty and geopolitical standing.

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