РОЗДІЛ V. МІЖНАРОДНІ ЕКОНОМІЧНІ ВІДНОСИНИ

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SECURITY OF NATURAL GAS SUPPLY TO CONSUMERS IN UKRAINE AND POLAND IN THE FACE OF OPEN RUSSIAN MILITARY AGGRESSION IN 2022 (COMPARATIVE STUDY)

Security of natural gas supply to consumers in Ukraine and Poland in the face of open Russian military aggression in 2022 (comparative study).
Military operations, including Russian attacks on natural gas production sites controlled by Ukraine and network restrictions, have led to a 7 % year-on-year decline in natural gas production and the temporary loss of natural gas access for hundreds of thousands of Ukrainian consumers. In 2022, 18,5 bcm of natural gas is likely to have been produced. The autumn successes on the frontline allowed Ukraine to start clearing damage on recovered territories and increase the number of new drillings.
The extensive damage to companies using natural gas in production that was caused by Russian attacks and the scale of emigration reduced natural gas consumption in Ukraine by a quarter. Nevertheless, imports were necessary. It was most profitable for the government in Kyiv to bypass transit costs and buy part of the natural gas supplied from Russia via Ukraine to the EU.
Due to the cost of transit, a smaller part of the gas acquired by Ukraine was from other countries (e.g. Norway). The amount of natural gas (owned and owned by foreign companies) in storage in Ukraine at the end of October was 14,2 bcm. In the end, from its western partners Ukraine probably imported a total of only 1,5 bcm. Likely, some of the natural gas owned by

foreign counterparties stored in Ukrainian storage facilities was purchased. As of 2021, the demand for Polish customers was lower than for Ukrainian needs. According to preliminary data, some 16,15 bcm of natural gas was sent to Polish consumers in 2022. Probably mainly due to the authorities' protective moves towards households, natural gas transmission to domestic consumers in Poland fell by only less than 17,5 % compared to 2021. Industrial use of natural gas has decreased more.

The Polish authorities have completed many investments (or made progress in this area) in natural gas infrastructure long postulated by experts. The degree of depletion of deposits and the high capital intensity of natural gas exploration and production requires a significant increase in investment in natural gas exploration and production to stop the further decline in natural gas production in both countries.

Key words: energy security of Ukraine, energy security of Poland, natural gas, consequences of Russia's military aggression against Ukraine.

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БЕЗПЕКА ПОСТАЧАННЯ ПРИРОДНОГО ГАЗУ СПОЖИВАЧАМ УКРАЇНИ ТА ПОЛЬЩІ В УМОВАХ ВІДКРИТОЇ РОСІЙСЬКОЇ ВІЙСЬКОВОЇ АГРЕСІЇ У 2022 РОЦІ (ПОРІВНЯЛЬНЕ ДОСЛІДЖЕННЯ)

Військові дії, у тому числі російські атаки на об'єкти видобутку природного газу, які контролюються Україною, і мережеві обмеження призвели до падіння видобутку природного газу на 7 % у порівнянні з минулим роком і до тимчасової втрати доступу до природного газу для сотень тисяч українських споживачів. У 2022 р., імовірно, буде видобуто 18,5 млрд кубометрів природного газу.

Осінні успіхи на передовій дали змогу Україні розпочати ліквідацію пошкоджень на відновлених територіях і збільшити кількість нових бурових робіт.

Значна шкода компаніям, які використовують природний газ у виробництві, спричинена нападами росії та масштабами еміграції ,зменшила споживання природного газу в Україні на чверть. Проте імпорт був необхідний. Уряду в Києві було найвигідніше обійти витрати

на транзит і закупити частину природного газу, що постачається з росії через Україну в ЄС.
Через вартість транзиту зменшилася частина газу, який Україна отримувала з інших країн (наприклад, Норвегії).
Обсяг природного газу (у власності та власності іноземних компаній) у сховищах України на кінець жовтня становив 14,2 млрд куб.
Зрештою, від своїх західних партнерів Україна імпортувала всього лише 1,5 млрд куб. Імовірно, куплена частина природного газу, що належить іноземним контрагентам і зберігається в українських сховищах.
Станом на 2021 р. попит для польських клієнтів був меншим, ніж для українських. За попередніми даними, у 2022 р. польським споживачам відправлено близько 16,15 млрд кубометрів природного газу. Імовірно, переважно через захисні заходи влади щодо домогосподарств, транспортування природного газу внутрішнім споживачам у Польщі знизилося менше ніж на 17,5 % у порівнянні з 2021 р. Більше скоротилося промислове використання природного газу.
Польська влада завершила багато інвестицій (або досягла прогресу в цій сфері) в інфраструктуру природного газу, про яку давно говорили експерти. Ступінь виснаження родовищ і висока капіталомісткість розвідки та видобутку природного газу вимагає значного збільшення інвестицій у розвідку та видобуток природного газу, щоб зупинити подальше падіння видобутку природного газу в обох країнах.
Ключові слова: енергетична безпека України, енергетична безпека Польщі, природний газ, наслідки військової агресії росії проти України.

1. INTRODUCTION

Problem Formulation. Russia's military aggression against Ukraine on 24 February 2022 has resulted in a radical transformation of energy security. This is particularly true for natural gas. In the EU and Ukraine, the price of natural gas supplied to consumers has been further affected by uneven global economic growth in 2021; under-investment in natural gas infrastructure in the EU (due to the planned resignation from natural gas to RES); the shutdown of some nuclear power plants in France, the closure of nuclear power plants in Germany and the reduction in hydropower production in the EU resulting from the record drought.

Analysis of Recent Studies and Publications. The energy security of individual countries regarding natural gas in 2022 has been the subject of se-

veral publications. Regarding Ukraine, among other things, the energy security system and ways to further optimise it was described in depth [1]. The security of Ukraine's oil and natural gas market was analysed [2]. The implementation of EU energy acts in Ukrainian legislation and related problems were discussed [3]. The system of underground natural gas storage in Ukraine – the third largest in the world, accounting for 22 % of the storage capacity of European countries (31 bcm) [4] – was extensively analysed.

Issues related to Poland's energy security received less attention from researchers. The possibilities of Poland's cooperation in this field with selected Central and Eastern European countries were analysed [5]. A study comparing energy security about the supplies to Poland and Germany has been published [6]. The costs of natural gas use concerning Poland's transition to RES are described [7].

Despite the massive changes brought about by the Russian aggression in February, some earlier publications have also retained their important scientific value. The most important is, published in spring 2021, a comprehensive discussion of the natural gas sector in Poland and Ukraine and an analysis of the rationale and prospects for their cooperation. Given the two countries' tense relations with Russia, it was rightly pointed out at that time, among other things, that the connections between Ukraine and Poland should be fully converted to a two-way relationship [8]. Among other things, the wholesale of natural gas within the EU and in Ukraine was assessed, pointing to Ukraine's aspirations to use many of the solutions applied within the EU [9].

Purpose of the Article. In 2021 Ukraine and Poland had a similar scale of demand for natural gas and they were important intermediaries in the supply of natural gas to Western Europe; they remained dependent on imports of this commodity and had a significant share of coal-fired power plants in energy production (and associated emissions). Hence, a comparative analysis of the security of natural gas supply to consumers in these countries was attempted. Due to the availability of data, the analysis covered the period from 24 February to 31 December 2022. Due to the coordination of activities in many energy policy sectors on an EU scale and their serious impact on the energy security of Ukraine and Poland, it was necessary to show selected aspects of EU energy security in general.

Research Methodology. The study prepared was based on a critical analysis of the literature on the subject and published, sometimes preliminary, data. A relative approach was used given the frequent lack of high-quality data that could be directly compared in value. In order not to make the invasion easier for the aggressor, much of the data for Ukraine for 2021 and 2022 is not available (e.g. Eurostat; newtransparency.entsoe.eu).

2. RESEARCH RESULTS

Despite a multi-year decline in natural gas production in the EU, the share of natural gas in the electricity mix increased from 13 % in 2000 to almost 20 % in 2022 [10, p. 61]. At the end of this period, the consumption of natural gas was one of the main ways of providing electricity in the EU at times of peak demand. At the same time, natural gas was used to produce 42 % of the energy for households [11, p. 3].

Compared to 2020, the EU's demand for natural gas in 2021 increased by 4,3 % and production decreased by 7.6 %. The EU's dependence on natural gas imports then reached 83 %. According to IEA data, in 2021, imports from Russia covered almost 40 % of the EU countries' total natural gas consumption and around 45 % of its natural gas imports. The largest importer of natural gas from EU countries at the time was Ukraine.

In 2020, natural gas was the most important primary energy supply for Ukraine (with a share of 27,5 %) [12]. By mid-February 2022. However, Ukraine depended on natural gas imports to a degree several times less than the EU [13, p. 71, 72]. In 2020, for example, its imports were reduced by 38,2 %, to 7,3 bcm. At the same time, however, there were also less favourable trends. Gross natural gas production decreased by 3,7 % to 13,666 bcm in 2020.

The decline in production would have been greater had it not been for investment. For example, Ukrgaz, which dominates the natural gas exploration market (2/3 of exploration), drilled 50 wells in 2021. Increasing production from its resources was hampered by, among other things, the scale of depletion and the location of some of the deposits under Ukrainian territories controlled by Russia since 2014 [9, p. 132]. The level of determination of the Ukrainian authorities is evidenced by the fact that, despite the lack of prospects for major discoveries, in August 2021 Ukrainian and Polish companies began a joint exploration of the resource in the western part of the Lviv region. Estimates can be found that for the first 10 months of 2021, 16,4 bcm of natural gas was produced in Ukraine.

To maintain its commodity independence from an aggressive neighbour waging a hybrid war [14], since 2015 Ukraine has not imported natural gas from Russia. Due to infrastructure constraints, it purchased it from EU countries dependent on natural gas imports [4, p. 2]. In doing so, Ukraine benefited from its status as the most important intermediary for onshore natural gas supplies to these EU countries. However, the commodity was obtained at higher prices than the long-term contracts [9, p. 132], which hurt the Ukrainian economy. More importantly, this created an indirect dependence on an aggressive neighbour – Russia's supplies to the EU.

Not surprisingly, the Ukrainian authorities were planning to build an LNG terminal in the Odesa region. In early 2020, the idea was further encouraged by the scale of US natural gas exports to the EU [4, p. 21]. The implementation of this project had to be suspended given the pandemic and the scale of the vulnerability of such a facility to Russian attack. Due to the short timeframe since the commissioning of the LNG import terminal apparatus in the Krk Island area and Hungary's attitude, Ukraine's efforts to import natural gas from the Croatian terminal did not bring the expected results. At the end of January 2022, i.e. just before the Russian military aggression, Ukraine bought a second supply of natural gas to be supplied via the Polish terminal in Świnoujście (the previous such purchase was in 2019).

There have also been attempts to substitute the commodity. For example, in October 2021, the Ukrainian parliament created a legal framework for the rapid development of biomethane and hydrogen production [15, p. 65].

Ukraine's energy security in terms of natural gas supply was seriously enhanced, by the use of Ukraine's huge storage capacity by EU countries. On 15 October 2020, a record amount of 28.4 bcm was in storage. Of this, 2/3 was Ukrainian natural gas.

The above situation and Ukraine's desire for closer cooperation with the EU favoured the development of the LLC Ukrainian Energy Exchange.

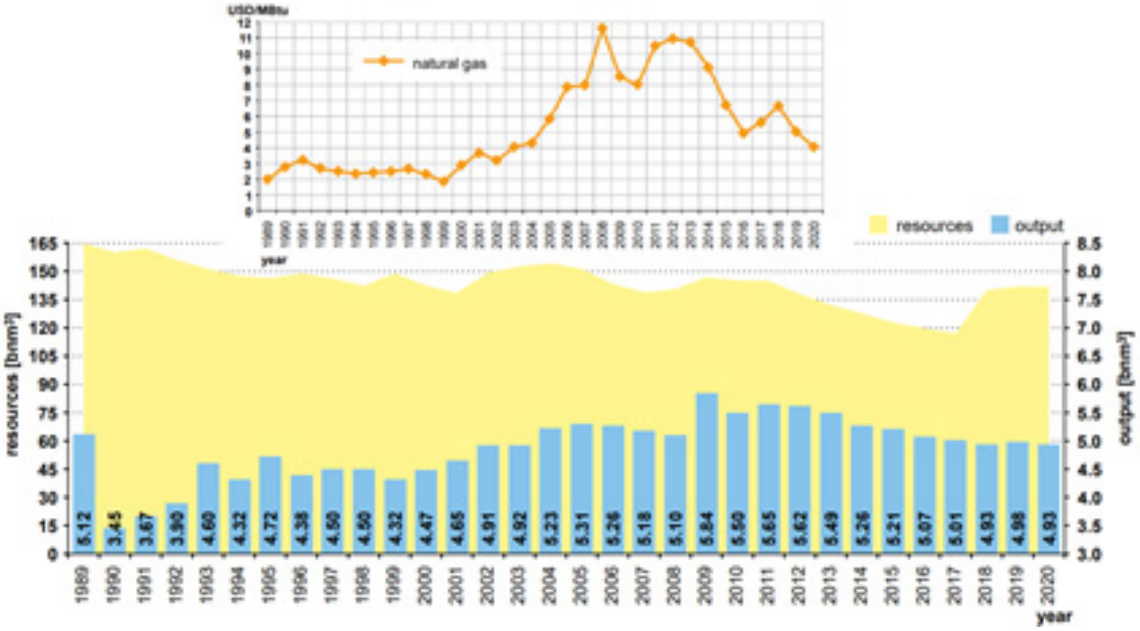
High natural gas prices in the second half of 2021 not only worsened Ukraine's energy security. An example is the radical increase in fertiliser prices. This issue was of great importance for the EU market (and thus indirectly also for the Polish market) given that in 2021, Ukraine accounted for 28,8 % of EU cereal imports (worth €1.7 billion and 9,9 % of imports of oilseeds and oleaginous fruits (worth €1.4 billion); 14,5 % of EU imports of vegetable/animal oils and fats. It should also be remembered that Ukraine is one of the most significant importers of fertilisers from Poland.

In the case of Poland, the declining level of natural gas production (see Figure 1 – in 2021 it was 3,5 bcm) and the lack of a significant increase in storage capacity, geographically favourably located but with small capacities compared to the country's demand [16], [4, p. 27], contrasted with a steady (despite the pandemic) increase in natural gas consumption (from 17,865 bcm in 2014 to 23,542 bcm in 2021). In 2021, there was a year-on-year increase in consumption here of 6,03 % (by 1,419 bcm), which was below the EU average at the time [17]. Poland was then ranked first in the part of the EU to the east of Germany in terms of natural gas consumption and the volume of LNG imports by sea.

At the same time, Poland's multi-annual energy strategy of February 2021 assumed a significant increase in natural gas consumption in the economy by

Charts 1 and 2

Anticipated Economic Resources and Output and Annual Prices of Natural Gas in 1989–2020



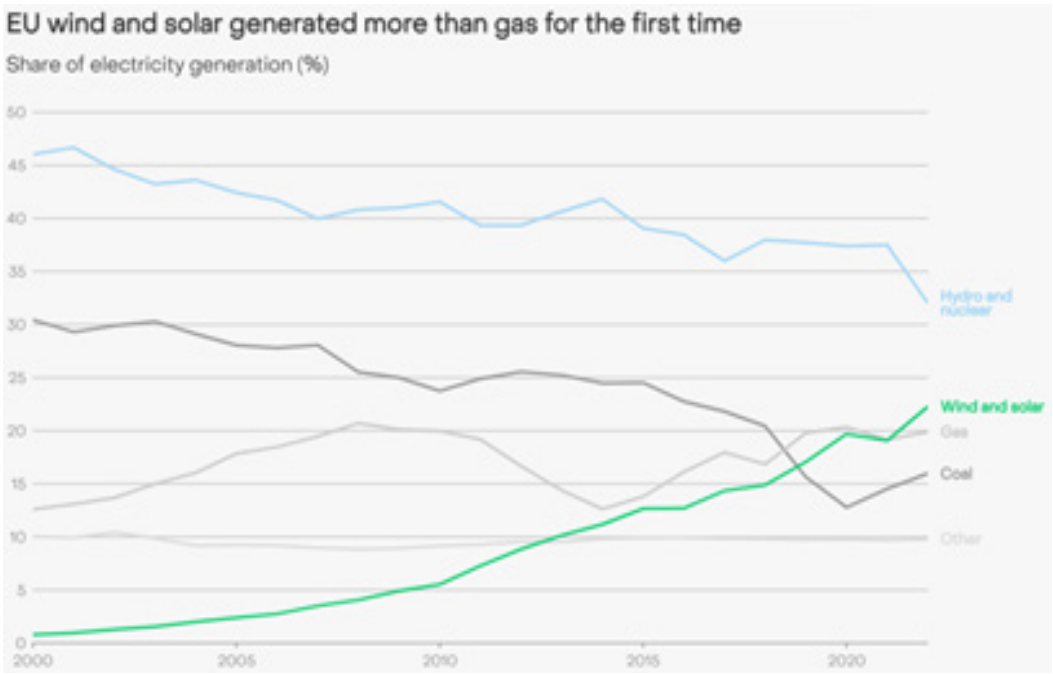
Source: [19, p. 74].

2035. Regardless of the assessment of the feasibility of achieving the objectives of this document (more on this: [18]), acting by this strategy risked a rapid, significant increase in the level of Poland's dependence on natural gas imports.

The EU policy, aimed at liberalising the natural gas market and temporarily increasing the share of natural gas in the energy mix, made the year 2021 (for the 6th consecutive year) a record year in terms of natural gas trading on the Polish Power Exchange in Warsaw. It covered more than ¾ of all natural gas consumption in the Polish economy in 2021. The futures market continued to dominate [20, p. 7, 42]. Its operations were adversely affected by the reduction of natural gas deliveries to the EU market by Gazprom in the second half of 2021.

In 2022, natural gas production in Western, Southern, and Central Europe was likely to increase by only around 3 % (mainly due to higher production in Norway and the UK) [15, p. 109]. Thanks to lower imports to the Far East, including China in particular, and a mild winter, the EU was then able to dramatically increase LNG imports [210]. At the same time, demand for natural gas in the EU was reduced by around 50 bcm and Russian pipeline natural gas imports to the EU were reduced by 45 %, compared to 2021. In the second half of 2022, Ukraine's pipeline natural gas imports mostly remained at 1.3 bcm per month [22].

Chart 3



Source: https://ember-climate.org/insights/research/european-electricity-review-2023/

Despite the high prices, there was a slight increase in natural gas consumption in electricity generation in the EU from 19,1 % to 19,91 % (fig. 3). This was due to a 7 % gap in total EU electricity demand in 2022.

In the second quarter of 2022, EU natural gas prices were five times higher than the five-year average for these three months. Given this, it is not surprising that natural gas prices for industry and households increased in 2022 in both countries analysed. In both countries, various measures were taken to reduce consumer energy and natural gas prices. Nominally, they were therefore still clearly below the EU average. For households in Poland, for example, prices in the first half of 2022 were 68,6 % of the EU average [23]. Things look different, however, if one compares these prices with real wages in Ukraine (cf. [2]).

Compared to the EU average, natural gas accounted for a small share of the raw materials burned by Ukrainian thermal power plants and energy production. However, Russian attacks on infrastructure quickly led to the temporary loss of access to natural gas for hundreds of thousands of Ukrainian consumers. In this situation, producers in Ukraine were temporarily forced to reduce natural gas production by 40–60 %. To alleviate their situation, the Ukrainian authorities, inter alia, postponed the deadline for payment of the tax until after the sale of the extracted natural gas and allowed them to store the commodity in storage facilities until that time during (and immediately after) the war. On 3 March, the Ukrainian authorities also introduced a ban on the shipment of natural gas outside the country [1, p. 51].

There have also been aggressor attacks on natural gas infrastructure under Ukrainian control. For example, in April 2022, it attempted to destroy upstream infrastructure in the szebieliński concession block [1, p. 53] in the Dnieprowsko-Donieckie cave-in. Arguably, Russia's more serious attack against natural gas production infrastructure occurred on 17 November. Russian troops then attacked around 10 facilities accounting for around 30 % of Ukraine's natural gas production. Losses probably exceeded USD 700 million at the time [22]. The intensity and destructive power of these Russian attacks were, however, far less than that of the energy infrastructure.

In Poland, the state authorities also facilitated the operation of natural gas suppliers. An example is the Polish compensation mechanism dedicated to natural gas distribution system operators and natural gas sellers in the face of the introduction, just before the Russian aggression at the beginning of 2022, of maximum prices for tariffed end-users.

To reduce natural gas consumption, after 24 February, the Polish authorities had the opportunity to take measures beyond the financial reach of Ukraine, struggling with the Russian invasion. For example, they favoured citizens' purchase of heat pumps, continued to increase network efficiency, and invest in RES. Poland's actions to reduce natural gas consumption in 2022 took into account the European Commission's May proposals for action to allow an additional 13 bcm [11, p. 1, 5] reduction in EU natural gas imports in 2022.

The significant damage caused by Russian attacks on companies using natural gas in production and the scale of emigration has reduced natural gas consumption in Ukraine. According to preliminary data, this has fallen by a quarter year-on-year to 20,1 bcm in 2022.

Russia's actions in Ukraine's natural gas-rich regions (particularly the Kharkiv region) and the aforementioned aggressor attacks on Ukrainian-controlled natural gas production sites and network restrictions led to a 7 percent year-on-year decline in natural gas production. According to preliminary data, 18,5 bcm of natural gas was exploited in 2022 [22].

The autumn successes at the front allowed Ukraine to start clearing damage and drilling new wells in the recovered areas and to continue to do so in areas far from the front (e.g. in the Poltava region) [1, p. 52].

The problem was the high capital intensity of natural gas exploration and production. Failure to increase investment in natural gas exploration and production threatened Ukraine with a rapid decline in output. By comparison, globally, investments in infrastructure to enable the extraction, transport, and storage of natural gas, between 2016 and 2021, «account for 36 % of investments in the electricity sector and 51 % in the natural gas sector» [24]. The 47 wells [22]

drilled by Ukrgaz were largely replacing' those from which production declined or became unprofitable in 2022.

In terms of imports, during the first months of Russia's open aggression, it was most profitable for the government in Kyiv to bypass transit costs and buy a portion of the natural gas supplied using transmission pipelines from Russia via Ukraine to the EU [2, p. 59]. According to some sources, gas was bought in this way from Hungary, Slovakia, Austria, and Poland. This was facilitated by the high level of natural gas pipeline transport controlled by Ukraine at the time. This situation made it easier for the government in Kyiv to lift the ban in April on the shipment outside Ukraine of natural gas stored in Ukrainian storage facilities belonging to 27 countries including the US, Canada, China, the United Arab Emirates, and Singapore [4, p. 18].

However, in April and May, Russia reduced natural gas transit via Ukraine from an average of 158 million m3/day to 63 million m3/day (15, p. 109).

A much smaller part of the natural gas purchased by Ukraine was from countries exporting it to Germany (e.g. Norway). For this part of imports, Ukraine had to pay extra for transit, which was allegedly up to 1/3 of its price.

Given these realities, in June the Ukrainian government ordered the stockpiling of 19 bcm of the commodity before winter. Given the level of filling of storage facilities, imports of 4–5 bcm were considered necessary. Despite the favourable geographical distribution of the storage facilities (Figure 1), the implementation of these plans proved difficult. Obstacles included commodity prices on world markets, Russia's drastic restriction of natural gas exports via pipelines to the EU, fighting near some of the storage facilities, and the withdrawal of some natural gas stocks from Ukrainian storage facilities by foreign companies. In the end, Russia took control of only one of the smaller storage facilities (Krasnopopivske in the Luhansk region). The amount of natural gas (owned and owned by foreign customers) stored in Ukrainian storage facilities at the end of October was 14,2 bcm.

In the end, as much as 92 % of Ukraine's production was used to meet the demand of its consumers. A total of 1.5 bcm was probably imported from Western partners. According to Sławomir Matuszak's calculations, this represents a 42 % decrease in Ukraine's imports year-on-year [22]. A likely separate category was the purchase by Ukraine of some of the natural gas owned by foreign counterparties stored in Ukrainian storage facilities. Therefore, despite the dramatic increase in natural gas prices (and inflation in the USA), the value of Ukraine's imports of 'gaseous hydrocarbons' decreased from $4.98bn to $2.24bn compared to 2021. At the end of January 2023, some 11 bcm of natural gas was held in storage facilities.

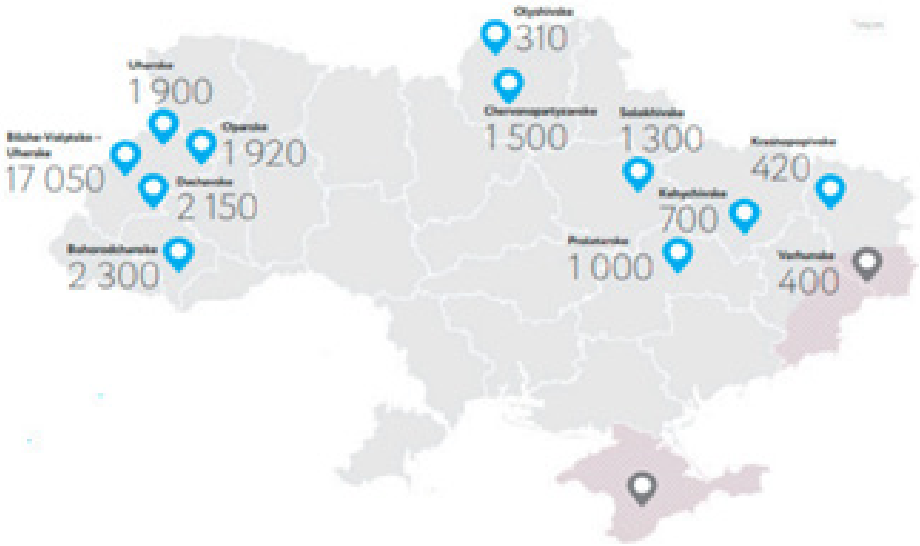


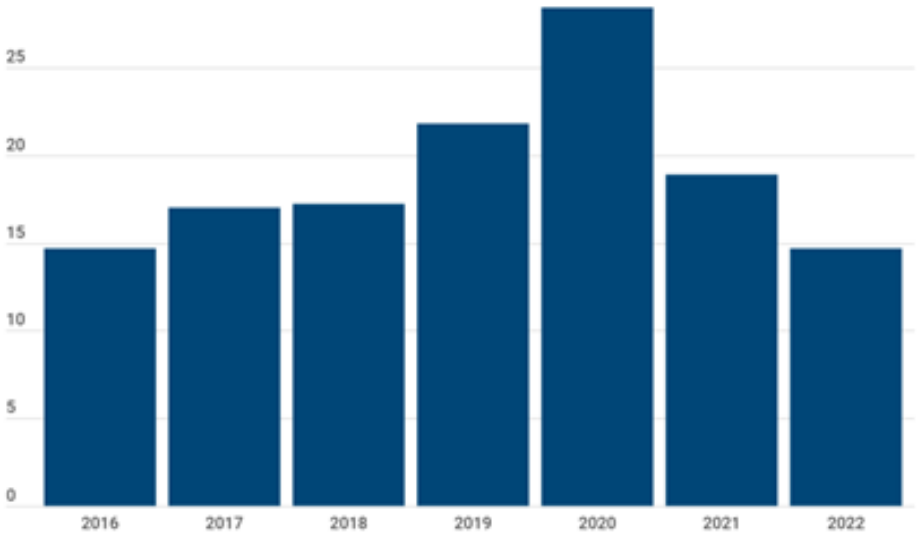
Fig. 1

Characteristics of Underground Natural Gas Storage Facilities in Ukraine (as of 24 February 2022)

Source: [4, p. 10].

Chart 4

Natural Gas Stocks in Ukraine's Underground Storage Facilities at the Beginning of the Heating Period in the Years 2016–2022 (in bcm)



Source: [22]

The relatively minor damage to the natural gas transmission and distribution network (with some minor national exceptions in the Kharkiv region) indicates that Russia was probably counting on a change of attitude from the economic spheres of Germany and Italy – the largest natural gas-fired power producers in the EU in 2022 [10, p. 59] – and future natural gas exports to these countries via Ukrainian territory.

The war accelerated the integration of Ukraine's energy system into the EU, which began in 2017. Back in February, with the support of energy ministers in EU countries, Ukrenergo made an urgent request to support the stability of Ukraine's electricity system through emergency synchronisation with the electricity system covering the EU and its neighbours in Western and Southern Europe (European Network of Transmission System Operators for Electricity). On 16 March 2022, the trial synchronisation started. A very important aspect was to cooperate on the cyber security of the network and to provide support for attempts by a Russian aggressor to destabilise Ukraine's energy system.

Faced with success in keeping the system functioning under wartime conditions and confronted with huge financial problems, the Ukrainian authorities sought to export electricity. Taking advantage of a significant drop in domestic demand in this area, Ukraine began efforts in the EU at the end of April to resume electricity trade with countries belonging to the European Network of Transmission System Operators for Electricity. After the details were agreed upon at the EU level, the European Network of Transmission System Operators for Electricity gave its consent on 7 June. On 28 June 2022, Western partners confirmed that the technical conditions to enable the commercial exchange of electricity were met. Arguably, it started with the commercial exchange of electricity with Poland (if it was interrupted at all after the Russian aggression started). On 30 June, the interconnection with Romania was launched, and then successively with Slovakia and (probably) Hungary. 20 September 2022. The European Network of Transmission System Operators for Electricity agreed to further scale up trade with Ukraine [25]. This resulted in an increase in Ukraine's electricity exports in 2022 compared to 2021. A decisive influence on its final result (USD 0.59 billion) was the massive Russian attacks on the energy infrastructure.

The final demand of Polish consumers was lower than Ukrainian needs. According to preliminary data, approximately 16,15 bcm of natural gas was transmitted to Polish consumers in 2022.

Compared to 2021, natural gas supplies to domestic consumers decreased by almost 17,5 %. Probably mainly due to the authorities' protective moves towards households, it was seriously internally diversified in 2022. Consumers using distribution networks received almost 13 % less natural gas (12,7 bcm). In contrast, the largest industrial plants (including power plants, CHP plants, and large chemical plants) used more than 30 % less (3,45 bcm) [26].

Natural gas production in Poland was relatively high only in the first quarter. According to preliminary estimates, for the year as a whole, it decreased by around 1 % compared to 2021. According to Michał Paszkowski, in 2022, the Polish authorities considered the deposits under the bottom of the Baltic Sea to be the most promising [27].

Russia's confrontational policy has forced the Polish authorities to allocate significant funds to bring to completion projects, sometimes planned for decades, to diversify the country's natural gas supply routes. Most of these investments have been completed.

The full operational level of the Baltic Pipe and the pipeline connection to Slovakia were launched in November 2022. In May, the connection to Lithuania was opened. At the same time, almost 1 000 km of natural gas pipelines were also put into operation. An agreement with the Czech Republic to build another transmission pipeline connection between the two countries and EU financial support for its construction was successfully obtained. In 2022, the regasification capacity of the LNG terminal was also increased by 24 % (and the second phase of its expansion started). As a result, the liquefied equivalent of 5,83 bcm of natural gas was received at Świnoujście in 2022. The utilisation rate of this import route was also increased (from 78 % to 94 % of regasification capacity). The largest number of LNG carriers came from the USA (up 125 % y-o-y) and Qatar [28]. In cooperation with companies from Norway and South Korea, work on the long-term chartering of LNG carriers (with a capacity of about 70,000 tonnes of LNG) was seriously advanced.

Work was also progressing on the EU-funded project to create an FSRU in the Gdańsk area.

In May 2022, imports of natural gas from the LNG terminal in Klaipeda (Lithuania) [6] to Poland began. By December, the equivalent of 0,7 bcm of the commodity had been sourced via this route.

Against Russia's long-term interest [29], Poland still did not import this commodity from the second largest LNG supplier to the EU in 2022 – Russia [28].

To increase the resilience of the natural gas sector, the authorities partially withdrew from liberalising this part of the economy. In 2022, they completed consolidation in this part of the economy (Orlen Group) and weakened the importance of natural gas trading on the Polish Power Exchange in Warsaw.

In 2022, the production of electricity in Poland increased by 0,91 %, which, with a decrease in consumption of 0,53 %, allowed a surplus of exports over imports, not seen for several years. Only 6 % of the electricity produced was generated by natural gas-fired power plants (down 25 % year-on-year). This was replaced by an increase in RES. As a result of the greater emphasis on the use of other energy sources, in 2022 Poland was only in 13th place in terms of the share of natural gas in electricity production (less than 9 %) and 10th place in terms of the volume of electricity produced from natural gas in the EU (less than 8 %) [10, p. 59].

As the capacity of Poland's natural gas storage facilities is more than 2 times too small in relation to its needs, it was very important for its energy security that the other EU countries successfully filled their storage facilities.

3. CONCLUSIONS AND PROSPECTS FOR FUTURE RESEARCH

Contrary to Russia's plans, the open war that began in February and its consequences have resulted in Ukraine and Poland becoming less dependent on natural gas imports.

With the current economic difficulties, it is a challenge for both countries under consideration to allocate sufficiently large resources for investment in domestic exploration. Assuming an imminent reduction in natural gas prices to pre-pandemic levels, with the further development of the Polish industry and the recovery of the Ukrainian economy, business demand for this commodity will rise above 2019 levels.

The satisfaction of the natural gas demand of both countries analysed in 2023 through imports is not certain.

The aggressor attacks on energy infrastructure carried out in late 2022 increase the likelihood that Russia may interrupt natural gas transit via Ukraine and attempt to paralyse its transmission and distribution network as well as its production with a series of massive attacks on infrastructure [22].

Their likelihood is, however, reduced by Russia's thus preventing itself for the future (or at least very seriously postponing it) from economically beneficial natural gas exports via Ukrainian territory. To this must be added the aggravation of the aggressor's relations with countries from Europe, America, and Asia storing natural gas in underground storage facilities in Ukraine.

Considering the deterioration of the EU's relations with Russia as a permanent consequence of the current military confrontation, the continuing huge share of LNG imports in securing supplies to Poland and (indirectly) to Ukraine is certain. Indeed, within the EU (including Poland), the level of natural gas imports is much higher than its use in the production of electricity and heat. Apart from the current price level, there is no indication that, except for the energy sector (which is gradually switching to RES), there will be a permanent radical reduction in natural gas consumption by industry in the coming years. Hence, experts rightly postulate, once the war is over, the construction of LNG terminals in Ukraine [1, p. 51; 4, p. 25].

The EU was able to dramatically increase its LNG imports in 2022 thanks to significantly lower natural gas demand in the Far East, particularly China, and

a mild winter. It is uncertain whether similar circumstances will be repeated in 2023.

It is unlikely that the drought and the number of nuclear plant shutdowns in France will be repeated quickly in these dimensions.

Despite problems with semiconductor supply and the financial difficulties of natural gas buyers, the amount of electricity generated by RES and the use of heat pumps will increase in Poland.

As the setbacks in this regard in the EU in 2021 have shown, the amount of energy generated by weather-dependent sources is difficult to plan for [20, p. 9, 10]. A very significant increase in the use of geothermal energy within the EU is unlikely due to geological and financial considerations.

Despite the attractive price conditions offered by Ukraine, due to the far-reaching reorientation of supply routes, there is no indication that these storage facilities will be used on a large scale for storage purposes by the EU in the near future [4, p. 16].

Due to the geographical distribution of storage facilities, the exception may be the closest neighbours, especially Poland due to its modest storage capacities compared to Ukraine's other western neighbours.

Given that Ukraine only has storage facilities in former natural gas and oil fields - as the filling level of the storage facilities decreases, the withdrawal capacity of the stored commodity during prolonged periods of low temperatures will become an increasingly serious problem.

The above interpretations do not allow the rejection of estimates that Ukraine will be forced to import around 5 bcm of natural gas in 2023. It is therefore not surprising that its government maintains the ban on exporting its natural gas outside Ukraine and plans to increase its production by 1 bcm in 2023.

It is difficult to estimate how much effect the Polish authorities'0 plans to increase natural gas exploration, increase energy efficiency, reduce methane emissions from the grid, support the development of biogas plants, accelerate the implementation of RES, further electrify heating and encourage citizens to change their energy market habits will have in 2023. Due to a lack of economic maturity, hydrogen projects will only benefit in the years to come. Due to the severity of Russian attacks and the scale of expenditure for war needs, it is much more difficult to implement similar projects within Ukraine (e.g. to increase natural gas production).

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