POLITYKA ENERGETYCZNA – ENERGY POLICY JOURNAL

2024 ✦ Volume 27 ✦ Issue 3 ✦ 193–206

DOI: 10.33223/epj/192860

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The competitiveness of fuels in electricity generation

Abstract: In Poland, the main fossil fuel for electricity generation is thermal coal. In most countries of the EU, natural gas is used as a fuel. The aim of the article was to compare the competitiveness of electricity generation from thermal coal and natural gas, taking into account the costs incurred by power generators related to the purchase of fuel and the required CO_2 emission allowances. The calculations were carried out for the years 2022–2023, a period of very high volatility of energy carrier prices on international markets. Fossil fuels generated 31% of electricity in the EU in 2023, and 71% in Poland. In 2022, thermal coal prices were high and highly volatile, with maximum daily fluctuations reaching USD 104/ton, well above previous historical values.

The main factor causing coal prices to be so high in Europe was the extremely high gas prices resulting from Russia's invasion of Ukraine. Natural gas prices quoted in August 2022 reached EUR 350/kWh. CDS (Clean Dark Spread) simulations were carried out to assess the competitiveness of thermal coal generation relative to natural gas. In 2022, the cost of power generation from natural gas was higher than coal by an average of EUR 121/MWh. The situation was different in 2023. The dynamic fall in natural gas prices (TTF exchange) caused the costs of generating electricity from these two fuels to equalize. This comparison shows what price fluctuations energy carriers and energy producers have to be prepared for. Such large price fluctuations are most influenced by

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political factors. The question can be raised as to whether betting on gas as a transitional fuel for a country with a large coal production is the right thing to do.

Keywords: coal prices, gas prices, CDS analysis

Introduction

In Poland, the main fossil fuel for electricity generation is thermal coal. In most countries of the EU, natural gas is used as fuel. The share of these fuels in the energy mix is highly desirable as, together with energy from nuclear power plants, they ensure the stability of the operation of the entire energy system. Despite the increasing share of RES in electricity production, the share of fossil fuels is currently indispensable.

This article aims to compare the competitiveness of electricity generation from thermal coal and natural gas, taking into account fuel costs and costs related to the purchase of the required CO_2 emission allowances incurred by power generators. The objective thus defined was achieved in two stages. In the first step, the theoretical margins of a thermal coal-fired generator were calculated. The CDS (Clean Dark Spread) indicator was calculated. This takes into account the cost of purchasing fuel and the amount of EUAs needed. In the second stage, fuel costs and the costs of CO_2 emission allowances of power plants producing electricity from coal and gas were compared.

The calculations were carried out for the years 2022–2023, i.e., a period of very high volatility of energy carrier prices on international markets. The basic data for the calculations were taken as follows:

- thermal coal prices – these prices refer to CIF ARA spot market prices for 6000 kcal/kg coal. These data were taken from the following publications: (Platts 2021–2024a,b; Argus 2022);
- natural gas prices – these prices refer to spot market prices quoted on the TTF – Netherlands exchange. This data was taken from the online platform (Trading Economics 2022–2024);
- CO_2 EUA prices – prices quoted for (KOBIZE 2022–2023) based on EEX and ICE quotations.

1. Fuel prices on the international market

Coal and natural gas are the primary fuels for electricity generation. Despite the increasing share of renewable energy in the energy mix, they are the primary energy carriers ensuring the stability of the energy system's operation. Naturally, nuclear energy also belongs to this group of

carriers. Analyzing the structure of electricity production in Poland and the EU in 2023 (Fig. 1), it can be seen that fossil fuels produce 31% of electricity in the EU and 71% in Poland. In 2022, it was 38% and 69%, respectively. This situation makes energy prices extremely vulnerable to changes in the price of fossil fuels.

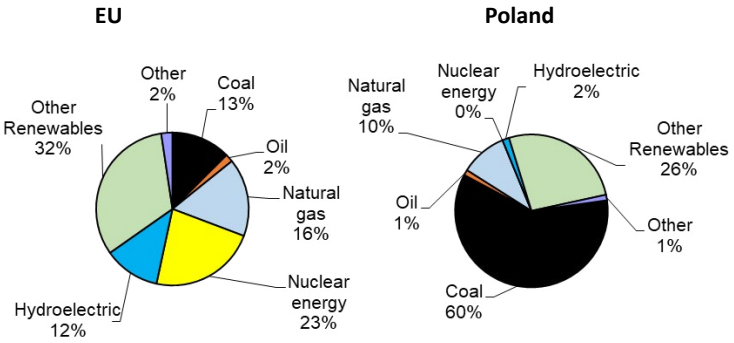

Fig. 1. The structure of electricity production in the EU and Poland in 2023
Source: own study based on data: (IE 2024)

Rys. 1. Struktura produkcji energii elektrycznej w UE i Polsce w 2023 r.

In 2022, thermal coal prices were not only high but also highly volatile, with maximum daily fluctuations reaching USD 104/ton, well above previous historical values (Grudziński 2023; Grudziński et al. 2023). CIF ARA daily price quotations fluctuated between USD 135 and 432 /ton in 2022. The highest prices were in July 2022, with an average of USD 395/ton for that month. This price index referred to coal with a calorific value of 6,000 kcal/kg (25.1 MJ/kg) and a sulphur content of less than 1% under working conditions – NAR. The price development from January 2021 to December 2023 is shown in Figure 2. In addition, Figure 2 shows the prices of imported thermal coal to Poland. In 2022 (according to IDA 2021–2024a), Poland imported 17.2 million tons of thermal coal.

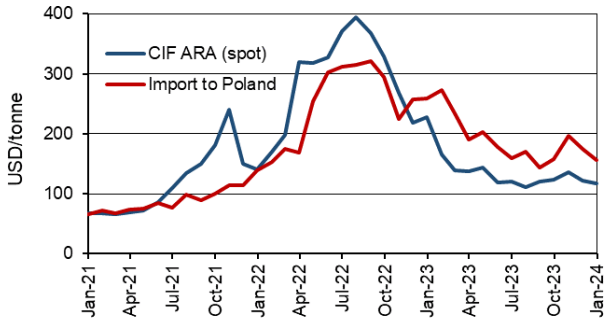

Fig. 2. Changes in monthly prices for thermal coal (6000 kcal/kg) in ARA ports and imports to Poland
Source: own study based on data: (Platts 2021–2024a,b; IDA 2021–2024b)

Rys. 2. Zmiany cen miesięcznych węgla energetycznego (6000 kcal/kg) w portach ARA oraz w imporcie do Polski

The main factor that caused coal prices to be so high in Europe was the extremely high gas prices resulting from Russia's military invasion of Ukraine (Platts 2021–2024a; IEA 2022, 2023; Grudziński 2023; Grudziński et al. 2023; Szczerbowski 2023). Natural gas prices quoted in August 2022 reached EUR 350/MWh. This situation had the effect of making coal-fired power generation in the EU more competitive than before. Margins for the combustion of coal for electricity generation remained at record levels, and this resulted in the commissioning of more coal-fired generating units that had previously been idled (Platts 2021–2024a; IEA 2022, 2023; Stala-Szlugaj 2023). Coal for these units had to be purchased on the spot market, as the companies managing these units did not have long-term contracts for coal supply. Margins from coal-fired generation were high and more competitive than from natural gas. The cancellation of Russian coal supplies meant that demand had to shift to other regions (Colombia and South Africa), and the availability of coal in these markets was limited, affecting coal price levels. The downward trend in coal prices started in July 2022 and continued throughout 2023, with prices falling to around USD 120/ton during this period.

The decline in coal prices on the European market resulted from a combination of factors. One of these was the accumulation of large coal stocks at coal terminals. The winter of 2023 turned out to be mild, and this caused demand for coal to fall. In addition, there was a large drop in natural gas prices. The price of gas on the Dutch TTF exchange fell by 85% from August 2022 to December 2023. Another factor was also the large energy production from RES.

A comparison of the prices of the main energy carriers between 2022 and 2023 (expressed in USD/GJ) is shown in Figure 3. In this figure, the massive price increase in 2022 is noteworthy. Between 2022 and 2023, the prices of all fuels used for electricity generation fluctuated widely and reached their historical maxima during this period. Figure 4 shows the price changes for selected energy carriers converted into USD/GJ, i.e., in comparable units. The largest changes

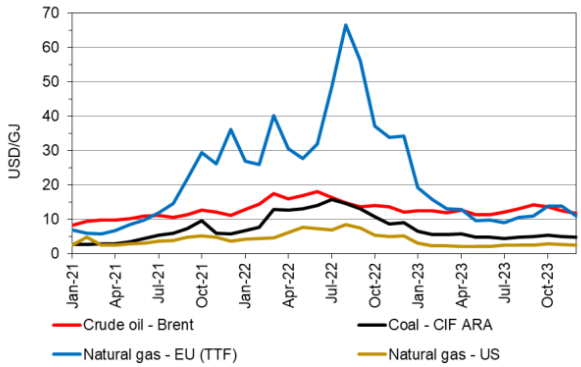

Fig. 3. Comparison of international market prices for coal, natural gas, and oil in USD/GJ; coal (6000 kcal/kg) CIF ARA, EU gas (TTF),US gas (Henry Hub), Brent crude (W. UK. 38° API)
Source: own study based on data: (WB 2024; Platts 2021–2024a,b)

Rys. 3. Porównanie cen węgla, gazu ziemnego i ropy naftowej na rynku międzynarodowym w USD/GJ; Węgiel CIF ARA (6000 kcal/kg), gaz UE (TTF),gaz USA (Henry Hub), ropa Brent (W. Brytania. 38° API)

were for natural gas listed on the TTF exchange in the Netherlands. The increase in gas prices in 2022 compared to 2021 was 5 times, and in the following year, prices rose by a further 2.5 times. Following these increases, prices fell by 70% in 2023. Coal, meanwhile, rose 2.4 times in 2022 before falling by 60% in 2023. These increases were very significant for the Polish market. In 2022, Poland's electricity generation was 79% dependent on coal, and in 2023 the dependency was 71%.

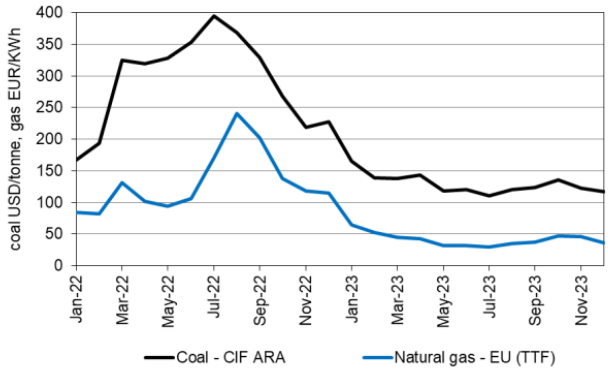

Fig. 4. Comparison of coal and gas price quotations in natural units – coal in USD/ton, gas in EUR/kWh
Source: own study based on data: (WB 2024; Platts 2021–2024a,b)

Rys. 4. Porównanie notowań cen węgla i gazu w jednostkach naturalny – węgiel w USD/tonę, gaz w EUR/kWh

3. CDS analysis – theoretical margin of electricity producers

In the next step of the analysis, CDS simulations were carried out based on 2023 market data. These data allow an assessment of the competitiveness of thermal coal generation in relation to natural gas and the price of electricity determined by quotations on the TGE exchange (TGE – Polish Power Exchange).

The price of electricity is influenced by many factors, among which are the price of the fuel used to generate it and the price of CO_2 emission permits, which play an important role. Therefore, this article analyses the difference between the market price of electricity and the price of the fuel used to generate it and the emission permits, which is referred to as the Clean Dark Spread (CDS), i.e., the theoretical margin of the generator. The CDS can be calculated according to equation (1):

$$CDS = C_{EE} - C_W - C_{CO2} \text{ [PLN/MWh]} \quad (1)$$

where:

C_{EE} – the electricity price [PLN/MWh],
C_W – the purchase price of the fuel [PLN/MWh] – in this case coal,
C_{CO2} – the price of emissions permits [PLN/MWh].

The calculations used emission factors published by the National Administrator of the Emissions Trading Scheme (KOBIZE 2023), which annually provides the heating values (WO) and CO_2 emission factors (EC) for fuels used in the national economy. Each time, for a given year, the values of the coefficients are calculated on the basis of the balances of the fuels consumed in the type of activity two years earlier. Thus, for 2023, these ratios are calculated on the basis of data for 2020 (they had to be determined before the end of 2021).

Table 1 and Figure 5 show the CDS values with assumed variable power plant efficiencies of: 35%, 40%, and 45%. The value of this CDS was calculated for each month of the year 2023. On average, for the year, the theoretical margin of the power generator (for a 35% efficiency power plant) was PLN 24/MWh. It varied from PLN 156/MWh to PLN –78/MWh in individual months. Throughout 2023, the CDS value had a decreasing trend. For the most efficient power plants (45%), the CDS value averaged PLN 137/MWh. At the end of 2023, CDS for the 35% and 40% power plants took on negative values. This means that the sum of the purchase costs of fuel and CO_2 emission allowances was higher than the price of electricity on the TGE exchange. In Table 1, the months in which CDS values were below the generation cost are highlighted in color.

Table 1. CDS value with variable power plant efficiencies of 35, 40, and 45%

Tabela 1. Wartość CDS przy zmiennych sprawnościach elektrowni na poziomie 35, 40, 45%

Month	DAM electricity price	UEA price		PSCMI index		CDS for power plant efficiency		
	PLN/MWh	EUR	PLN	PLN/GJ	PLN/Mg (22 MJ/kg)	35%	40%	45%
January	662	80	374	32.2	709	155	219	268
February	675	91	432	31.9	702	145	212	263
March	578	89	417	33.0	726	43	110	162
April	581	90	419	33.2	731	43	111	162
May	493	83	377	33.6	740	–30	36	86
June	551	87	388	34.2	752	18	85	136
July	551	86	383	33.6	738	27	93	143
August	517	85	380	33.2	730	–2	63	113
September	531	82	377	34.0	747	5	71	122
October	459	81	366	31.9	703	-41	22	70
November	472	76	334	31.0	681	–3	56	102
December	377	71	306	30.3	666	–78	–21	23
Year	537	84	381	32.7	719	23	87	137

Source: own calculations.

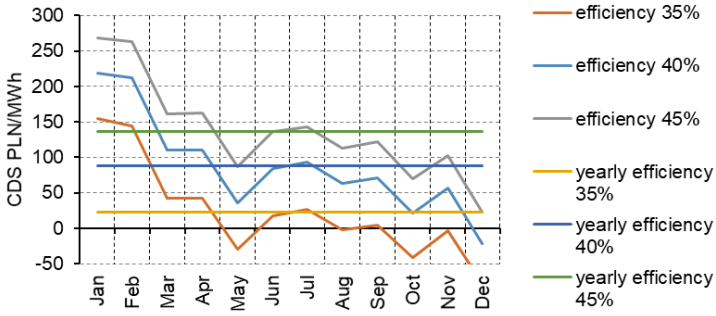

Fig. 5. Average CDS prices per month and per year at assumed power plant efficiencies
Source: own calculations

Rys. 5. Średnie ceny CDS miesięczne i roczne w przyjętych sprawnościach elektrowni

In the next step of the analysis, the value of the CDS was simulated as a function of changes in coal and electricity prices on the exchange, with a fixed assumed price for CO_2 emission rights.

In the performed analysis, the respective process efficiencies (in three variants) were taken into account, and the CO_2 emission factors were adopted from (KOBIZE 2023). Detailed input data for the calculations are presented in Table 2, and the simulation results are presented in Tables 3–5. Three calculation cases were taken into account in the simulations performed, which differed in the assumed power plant conversion efficiencies of 35% (Table 3), 40% (Table 4), and 45% (the newest units; Table 5). The ranges of changes in thermal coal and electricity prices were adopted based on an assessment of the current market trends. The assumed inputs to the analysis are in ranges of change characteristic of the period January–December 2023.

Table 2. Input data for CDS calculations

Tabela 2. Dane wejściowe do obliczeń CDS

Assumptions for CDS calculations	
Electricity price [PLN/MWh]	300 to 650
Coal price [PLN/GJ]	14 to 30
Net calorific value of coal [MJ/kg]	22
CO_2 emission allowance price [EUR/ton CO_2]	80
Efficiency in three variants [%]	35, 40 and 45
PLN/EUR exchange rate	4.5
WE emission factor (KASHUE) [tons CO_2/MWh]	0.9354

Source: developed on the basis of: (KOBIZE 2023, 2022–2023; TGE 2023).

The grey highlighted boxes in Tables 3–5 illustrate sets of parameters for which the CDS (Clean Dark Spread) takes negative values. This should be understood as meaning that energy production is completely unprofitable, and energy prices will not even cover fuel and allowance

costs. The areas highlighted in yellow are those taking values above PLN 85/MWh, as this is the amount of fixed costs of electricity production in hard coal power plants.

The simulations presented show how the value of the CDS changes with changes in coal prices and electricity prices, as well as the assumed level of the price of CO_2 emission allowances. Analyzing the quoted simulation results, it can be seen that it is only from an electricity price of PLN 650/MWh that the generator achieves a financial result above the cost of electricity generation.

Table 3. Results of CDS simulation calculations – 35% efficiency

Tabela 3. Wyniki symulacyjnych obliczeń CDS – sprawność 35%

Price of coal		Emission allowance price – EUR 80/ton of CO_2							
		Electricity price [PLN/MWh]							
PLN/GJ	PLN/MWh	300	350	400	450	500	550	600	650
14	144	–167	–117	–67	–17	33	83	133	183
16	165	–188	–138	–88	–38	12	62	112	162
18	185	–208	– 158	–108	–58	–8	42	92	142
20	206	–229	– 179	–129	–79	–29	21	71	121
22	226	–250	– 200	–150	–100	–50	0	50	100
24	247	–270	– 220	–170	–120	–70	–20	30	80
26	267	–291	– 241	–191	–141	–91	–41	9	59
28	288	–311	– 261	–211	–161	–111	–61	–11	39
30	309	–332	– 282	–232	–182	–132	–82	–32	18

Source: own calculations.

Table 4. Results of CDS simulation calculations – 40% efficiency

Tabela 4. Wyniki symulacyjnych obliczeń CDS – sprawność 40%

Price of coal		Emission allowance price – EUR 80/ton of CO_2							
		Electricity price [PLN/MWh]							
PLN/GJ	PLN/MWh	300	350	400	450	500	550	600	650
14	144	–109	–59	–9	41	91	141	191	241
16	165	–127	–77	–27	23	73	123	173	223
18	185	–145	–95	–45	5	55	105	155	205
20	206	–163	–113	–63	–13	37	87	137	187
22	226	–181	–131	–81	–31	19	69	119	169
24	247	–199	–149	–99	–49	1	51	101	151
26	267	–217	–167	–117	–67	–17	33	83	133
28	288	–235	–185	–135	–85	–35	15	65	115
30	309	–253	–203	–153	–103	–53	–3	47	97

Source: own calculations.

Table 5. Results of CDS simulation calculations – 45% efficiency

Tabela 5. Wyniki symulacyjnych obliczeń CDS – sprawność 45%

Price of coal		Emission allowance price – EUR 80/ton of CO_2							
		Electricity price [PLN/MWh]							
PLN/GJ	PLN/MWh	300	350	400	450	500	550	600	650
14	144	–63	–13	37	87	137	187	237	287
16	165	–79	–29	21	71	121	171	221	271
18	185	–95	–45	5	55	105	155	205	255
20	206	–111	–61	–11	39	89	139	189	239
22	226	–127	–77	–27	23	73	123	173	223
24	247	–143	–93	–43	7	57	107	157	207
26	267	–159	–109	–59	–9	41	91	141	191
28	288	–175	–125	–75	–25	25	75	125	175
30	309	–191	–141	–91	–41	9	59	109	159

Source: own calculations.

In the next step of the analysis, the production costs of coal-fired and natural gas-fired power plants were compared (Fig. 6). Only fuel costs were included in the comparison. Fuel costs are the costs associated with the purchase of fuel together with the necessary costs associated with the purchase of an appropriate amount of CO_2 allowances. The simulation assumes that the power plant consumes coal with a calorific value of 25.1 GJ/Mg and has an efficiency of 40%. In contrast, a gas-fired power plant has an efficiency of 55% and burns natural gas with a value of 36 GJ/Mg (the EC emission factor (KOBiZE 2023) for gas is 0.3631 tons CO_2/MWh). By comparing only the fuel-related costs, the competitiveness of one fuel over the other can be assessed. The fixed costs of the two types of power stations are similar and range between PLN 72–84/MWh. This means that they can be disregarded in this assessment.

In 2022, the cost of generating electricity from natural gas was, on average, EUR 121/MWh higher than coal. In August 2022, this value reached its maximum of EUR 517/MWh. The situation was different in 2023. The dynamic drop in the price of natural gas (TTF exchange) caused the production costs of electricity from these two fuels to equalize. Periodically, the production costs of gas-fired power stations were lower than those of coal-fired power stations. The low emission factor for gas-fired power plants and increasingly lower gas prices on the exchange made producing electricity from natural gas-fired power plants more cost-effective.

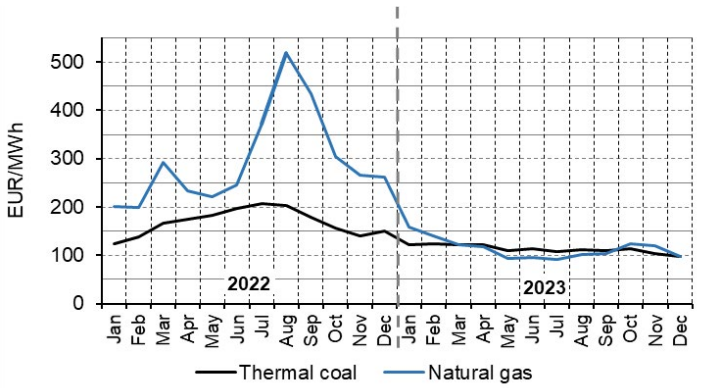

Fig. 6. Comparison of the costs of purchasing fuel and emission allowances for a power plant burning thermal coal or natural gas
Source: own calculations

Rys. 6. Porównanie kosztów zakupu paliwa i uprawnień do emisji w elektrowni spalającej węgiel energetyczny lub gaz ziemny

Summary

On the basis of the analysis of the thermal coal and natural gas market from 2022 to 2023, it was concluded that:

- In the EU as a whole, fossil fuels produced 31% of electricity in 2023, and 71% in Poland. In the previous year, it was 38% and 79%, respectively. This situation makes energy prices extremely vulnerable to changes in the price of these energy carriers. In 2023, Poland produced 60% of its energy from coal and only 10% from natural gas.
- A key factor for the international coal market is geopolitical factors and the uncertainty of China's import policy. Russia's invasion of Ukraine generated the highest energy prices in history. Listed daily CIF ARA coal prices fluctuated between USD 135–432/ton in 2022. The highest prices were in July 2022 and the average for that month was USD 395/ton. Prices increased 7-fold compared to quotations a year earlier. Natural gas prices in August 2022 reached EUR 350/MWh and were more than 10 times higher than a year ago.
- The situation was different in 2023, when price declines occurred. Prices in July and August 2023 fell to around USD 110–120/Mg. This was the result of large coal stocks and a mild winter, and this caused demand for coal to fall. In addition, there was also a large drop in natural gas prices. In August 2022, the maximum gas price on the Dutch TTF exchange was as high as EUR 350/MWh, and a year later, depending on the type of contract, prices were in the range of USD 35–50/MWh. A further factor for price declines was the large production of energy from RES.

- This paper aimed to compare the competitiveness of electricity generation from thermal coal and natural gas, taking into account fuel costs and the costs associated with the purchase of the required CO_2 emission allowances by power generators using the method. The Clean Dark Spread (CDS) indicator calculation method was chosen for this analysis. The CDS indicator simulations presented show how the CDS value changes with changes in coal prices and electricity prices, as well as the assumed CO_2 allowance price level. Analyzing the quoted simulation results, it can be seen that only from an electricity price of 650 PLN/MWh onwards, the generator achieves a financial result above electricity production costs, and the CDS attains a positive value.
- In 2022, the cost of generating electricity from natural gas was, on average, EUR 121/MWh higher than coal. In August 2022, this value reached its maximum of EUR 517/MWh. The situation was different in 2023. The dynamic drop in the price of natural gas (TTF exchange) caused the electricity production costs from these two fuels to equalize. Periodically, the production costs of gas-fired power plants were lower than those of coal-fired power plants. The low emission factor for gas-fired power plants and increasingly lower gas prices on the exchange made producing electricity from natural gas more profitable.
- This comparison shows the extent to which energy producers must be prepared for fluctuations in the price of energy carriers. Such large price fluctuations are mainly influenced by unpredictable political factors. The question can also be raised as to whether, in the case of a country with a large coal-fired electricity generation, relying on gas as a transitional fuel is the right thing to do.

Publication prepared within the statutory research of the Mineral and Energy Economy Research Institute, Polish Academy of Sciences.

The Authors have no conflicts of interest to declare.

References

Argus 2022. Argus Media Ltd. [Online] https://www.argusdirect.com [Accessed: 2022-01-30].

EI 2024. Energy Institute Statistical Review of World Energy 2024. [Online] https://www.energyinst.org/statistical-review [Accessed: 2024-07-01].

Grudziński, Z. 2023. Steam coal market – the impact of the Russian-Ukrainian war (*Rynek węgla energetycznego – skutki wojny rosyjsko-ukraińskiej*). *Zeszyty Naukowe Instytutu Gospodarki Surowcami Mineralnymi i Energią PAN* 1(111), pp. 7–20, DOI: 10.33223/zn/2023/01 (*in Polish*).

Grudziński et al. 2023 – Grudziński, Z., Ozga-Blaschke, U. and Stala-Szlugaj, K., 2023. International and domestic hard coal prices from 2000 to 2022 (*Ceny węgla kamiennego na międzynarodowym oraz krajowym rynku w latach 2000–2022*). [In:] Galos K. and Barszczowska B. (ed.) *Jak to z tym węglem było, jest i będzie*. Kraków: IGSMiE PAN, pp. 45–62.

IDA 2021–2024a. Basic information about the market and the hard coal sector in Poland. Industrial Development Agency JSC (ARP SA), Branch in Katowice, data processed on the basis of the results of the public statistical survey 'Mining of hard coal and lignite', conducted by the Minister of State Assets and implemented by The Katowice Branch of the ARP SA, Monthly studies 2021–2024.

IDA 2021–2024b. Imports and imports (intra-EU acquisitions) of hard coal. Industrial Development Agency JSC (ARP SA), Branch in Katowice, data processed on the basis of the results of the public statistical survey 'Mining of hard coal and lignite', conducted by the Minister of State Assets and implemented by The Katowice Branch of the ARP SA, Monthly studies 2021–2024.
IEA 2022. Coal 2022, IEA, Paris. [Online] https://www.iea.org/reports/coal-2022 [Accessed: 2024-05-26], Licence: CC BY 4.0.
IEA 2023. Coal 2023, IEA, Paris. [Online] https://www.iea.org/reports/coal-2023 [Accessed: 2024-05-26], Licence: CC BY 4.0.
KOBiZE 2022–2023. The National Centre for Emissions Management (KOBiZE). [Online] http://www.kobize.pl/ [Accessed: 2024-04-15].
KOBIZE 2023. Wartości opałowe (WO) i wskaźniki emisji CO_2 (WE) w roku 2020 do raportowania w ramach Systemu Handlu Uprawnieniami do Emisji za rok 2023. [Online] https://www.kobize.pl/pl/article/aktualnosci-2022/id/2231/wartosci-opalowe-wo-i-wskazniki-emisji-co2-we-w-roku-2020-do-raportowania-w-ramach-systemu-handlu-uprawnieniami-do-emisji-za-rok-2023 [Accessed: 15-04-2024].
Platts 2021–2024a. Platts – Coal Trader International. Publ. Platts – McGraw Hill Financial, England, 2021–2023.
Platts 2021–2024b. Platts – ICR Coal Statistics Monthly. Publ. Platts – McGraw Hill Financial, England, 2023–2024.
Stala-Szlugaj, K., 2023. Households in Poland vs. energy carriers: one year after Russia's February 2022 invasion of Ukraine. *Polityka Energetyczna – Energy Policy Journal* 26(4), pp. 5–18, DOI: 10.33223/epj/171879.
Szczerbowski, R. 2023. The Role of Coal in the Polish and European Energy Sector (*Rola węgla w polskiej i europejskiej energetyce*). [In:] Galos K. and Barszczowska B. (ed.) *Jak to z tym węglem było, jest i będzie*. Kraków: IGSMiE PAN, pp. 63–79.
TGE 2023. Raport miesięczny – PoIPX Monthly Report. Towarowa Giełda Energii, Polish Power Exchange (numbers: for 2023). [Online] https://tge.pl/statistic-data [Accessed: 2024-04-15].
Trading Economics 2022–2024. [Online] https://tradingeconomics.com/commodity/eu-natural-gas [Accessed: 2024-04-15].
WB 2024. World Bank – Global Commodity Markets. [Online] https://www.worldbank.org/en/research/commodity-markets [Accessed: 2024-04-15].

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Konkurencyjność paliw w produkcji energii elektrycznej

Streszczenie

W Polsce głównym paliwem kopalnym do produkcji energii elektrycznej jest węgiel energetyczny. W UE takim paliwem w większości krajów jest gaz ziemny. Celem artykułu było porównanie konkurencyjności wytwarzania energii elektrycznej z węgla energetycznego i gazu ziemnego, biorąc pod uwagę koszty ponoszone przez wytwórców energii, związane z zakupem paliwa oraz wymaganych uprawnień do emisji

CO_2. Obliczenia przeprowadzono dla lat 2022–2023, czyli dla okresu bardzo dużej zmienności cen nośników energii na rynkach międzynarodowych. Z paliw kopalnych w UE w 2023 r. wyprodukowano 31% energii elektrycznej, a w Polsce 71%. W 2022 r. ceny węgla energetycznego były nie tylko wysokie, ale również bardzo zmienne, a maksymalne wahania dzienne osiągały poziom 104 USD/tonę, znacznie przekraczając dotychczasowe wartości historyczne. Głównym czynnikiem powodującym, że ceny węgla były tak wysokie w Europie, były ekstremalnie wysokie ceny gazu będące efektem inwazji Rosji na Ukrainę. Ceny gazu ziemnego w notowaniach w sierpniu 2022 r. osiągnęły poziom 350 EUR/kWh. W celu oceny konkurencyjności wytwarzania energii z węgla energetycznego w stosunku do gazu ziemnego przeprowadzono symulacje CDS (*Clean Dark Spread*). W 2022 r. koszt wywarzania energii elektrycznej z gazu ziemnego był wyższy od energii z węgla średnio o 121 EUR/MWh. Odmienną sytuacją charakteryzował się rok 2023. Dynamiczny spadek cen gazu ziemnego (giełda TTF) spowodował, że koszty produkcji energii elektrycznej z tych dwóch paliw się zrównały. To porównanie pokazuje, na jakie zmiany cen nośników energii muszą być przygotowani producenci energii. Na tak duże wahania cen największy wpływ mają czynniki polityczne. Można postawić pytanie, czy w przypadku kraju o dużej produkcji węgla postawienie na gaz jako paliwo przejściowe jest słuszne?

Słowa kluczowe: ceny węgla, ceny gazu, analiza CDS