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Strategies for supplying enterprises with energy in the context of changing coal prices on the Polish market - The effect of the war in Ukraine

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ABSTRACT

The primary fuel carrier of energy in the Polish economy is hard coal. Due to such a high share in the energy balance, it is important to guarantee stable and predictable prices for this raw material and to ensure the possibility of its availability. Climate and energy policy and the international context have a significant impact on shaping the framework of the national energy strategy. The long-term vision of striving for the EU climate neutrality by 2050 and stimulating regulatory mechanisms have an impact on the achievement of effects in the coming decades. The implementation of the 2030 climate and energy targets in the EU is crucial for a low-carbon energy transition. The objective of the article is to present, for the Polish domestic market, the PSCMI index of a group of indices for benchmark prices of thermal coal produced by domestic producers and sold in the domestic energy market and the domestic heat market. The article discusses indices for coal sold in the domestic market for power generation (PSCMI 1) and heating (PSCMI 2). Price trends and analysis of price changes for these indices between 2020 and 2022 are also analyzed. The adopted scope of the conducted research was taken into account in the period of the greatest boom in price and index changes, which was caused by various external factors.

1. Introduction

Energy security is a strategic issue for any business. For any country, electricity generation and transmission is the economic bloodstream that, along with the transportation system, determines the smooth functioning of the economy (Sovacool and Brown, 2010; Bello and Solarin, 2022; Wiśniewska and Markiewicz, 2021). Economic development depends on access to energy, and the global economy is projected to grow at an average rate of 2.8% per year until 2040 (Dunal and Bocheński, 2016). Taking into account the projected steady increase in efficiency in energy generation, the growth of the global energy sector will be 1.1% per year. A decline in the importance of conventional sources (energy from coal and oil - projected growth of 0.4% per year) can be seen, while the share of renewable sources (solar, wind and geothermal energy - growth of 7.4% per year) will increase. The development of renewable energy should contribute to its share of about 20% in energy generation in 2040. Gas, water and electricity supply projects, according to UNCTAD, accounted for about 8% of all global direct investment. Their value in 2021 increased by 43% from the previous year and by about 6% from the average level before the Covid - 19 pandemic (Dusiło, 2022).

The war in Ukraine has been shaping the situation of the Polish fossil fuel sector for a year now, due to the fact that Russia was still the most important supplier of hydrocarbons in 2021. The crimes committed have translated into the need to limit or halt cooperation with the Russian regime. Many European countries, including Poland, were forced to dynamically diversify the sources and directions of supply of strategic energy resources (Hebda, 2022). For this reason, it is necessary to modify the provisions of the Energy Policy of Poland until 2040 in such a way as to neutralize or limit the risks associated with potential crisis situations in the country and on the international arena, and at the same time allow to achieve the main goal of the energy policy, i.e.

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guaranteeing energy security, while ensuring the competitiveness of the economy and reducing the impact of the energy sector on the environment. The road to the implementation of common EU goals can be traveled in different ways, depending on the possibilities and national conditions and new, previously unforeseen circumstances. The undertaken revision of PEP2040 will aim to select the optimal national path in the new geopolitical and economic framework, also taking into account the protection of consumers against excessive increases in energy prices and deepening energy poverty.

The purpose of this article is to present and evaluate, for the domestic Polish market, the PSCMI index of a group of indices of benchmark prices of thermal coal produced by domestic producers and sold in the domestic power and domestic heat markets. The index of coal price volatility, presented by means of the PSCMI1(in PLN/ton and in PLN/GJ) index, reflects the price level of 20–23/1 grade fine coal in sales to the professional and industrial power industry, and the PSCMI 2 index (in PLN/ton and in PLN/GJ) reflecting the price level of 23–26/08 grade fine coal in sales to industrial, municipal and other industrial heat plants.

2. Overview of domestic and foreign research studies

The European Union (EU) climate and energy policy, including its long-term vision of aiming at EU climate neutrality by 2050 and regulatory mechanisms to stimulate the achievement of effects in the coming decades, has an important impact on the formation of Poland's energy strategy (Podmiotko, Ruszel, 2019). Achieving the 2020 and 2030 climate and energy targets in the EU is crucial for a low-carbon energy transition. In connection with the EU decarbonization ambitions, in December 2020 European Council approved a binding EU target to reduce net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels, thereby increasing the previous 40% reduction target. The new EU aspiration has been set as a collective target for the entire Community and will be implemented on the basis of the Member States' contributions, taking into account national circumstances, specific starting points, reduction potentials (Wolniak, 2018), the principle of sovereignty in shaping the national energy mix, the need to guarantee energy security (Grudziński, 2019) in the most cost-effective way possible in order to preserve affordable energy prices for households and EU competitiveness, as well as taking into account the principles of equity and solidarity. Following the EU dynamically accelerating climate and energy trends will pose a significant transformational challenge for Poland (Månsson et al., 2014). On the path of a long-term energy transition, the benchmark is the targets set for 2020. In 2009, a package of regulations was adopted setting three key targets for combating climate change by 2020. (the so-called 3 × 20% package), with the Member States participating according to their capabilities. Poland was obliged to:

- increase energy efficiency, by saving 13.6 Mt of primary energy consumption between 2010 and 2020 compared to the 2007 fuel and energy demand forecast,
- increase the share of energy from RES in gross final energy consumption to 15% by 2020,
- contributions in the EU-wide reduction of greenhouse gas emissions by 20% (compared to 1990 levels) by 2020 (converted to 2005 levels: 21% in EU ETS sectors and −10% in non-ETS).

In 2014 the European Council maintained the direction of the fight against climate change and approved four targets for the 2030 horizon for the entire European Union, which, when revised in 2018 and 2020, are as follows:

- reducing greenhouse gas (GHG) emissions by at least 55% compared to 1990 emissions,
- at least 32% share of renewable sources in gross final energy consumption;
- a 32.5% increase in energy efficiency,
- completion of the EU internal energy market (Stala-Szlugaj, 2018).

The above targets are the EU contribution to the implementation of climate agreements. Central to current policies and actions is the so-called Paris Agreement, concluded in December 2015 at the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (COP21) (Grondys et al., 2020). It stipulates the need to stop the rise in global average temperature at less than 2 °C from pre-industrial levels, and strive for no more than 1.5 °C. During the 24th Conference (COP24) in December 2018, during the Polish presidency, the so-called Katowice Climate Package implementing the Paris Agreement was signed. Special attention was paid to the fact that the transition resulting from the Paris Agreement must take place in a fair and solidarity-based manner (Grabara et al., 2021).

In 2019 the ongoing work on the Clean Energy for All Europeans regulatory package was completed at the EU level, which indicates the manner of operationalization of the EU 2030 climate and energy targets and is expected to contribute to the implementation of the Energy Union and the construction of a single EU energy market (Siksnelyte et al., 2018). The Polish Government took an active part in shaping the final wording of the regulations, as these regulations strongly influence the operation and determination of the future of the energy market model in Poland (European Commission, 2019). Prospectively, a further revision of the key EU regulations on the energy sector is assumed, which will refer to the objectives and tools of the EU energy and climate policy in the time horizon beyond 2030. This applies in particular to the settlements in relation to the long-term vision of reducing greenhouse gas emissions in the EU until 2050. For this reason, the perspective beyond 2030 (Turek, 2017) has been defined directionally, although the projections made for PEP2040 have a 2040 perspective in accordance with statutory requirements. In 2019 the European Commission published a communication on the European Green Deal, a strategy with the ambitious goal of the EU achieving climate neutrality by 2050 - as a world leader in this area. Poland supported this goal, however, working out a specific national derogation due to the difficult starting point of the Polish transition and its socioeconomic aspects (Festic et al., 2010). Poland has made tremendous progress in the last dozen years in reducing the environmental impact of the energy sector, in particular by modernizing generating capacity and diversifying the structure of energy generation. Still, Poland's dependence on coal fuels is much higher than the other EU Member States, which is why it is so important to have a fair transition, which means taking into account the starting point, the social context of the transition, and counteracting the uneven distribution of costs among countries, more burdensome for coal-intensive economies (Grudziński, 2022). It should be noted that the costs relate both to coal regions (mining and energy), as well as to entire economies, which in the short term incur expenditure on new capacity, often also on economically immature, more expensive technologies, network infrastructure (Kovács and Kot, 2016) which is also reflected in the price of energy (Młynarski and Tarnawski, 2016; Božić et al., 2020). In 2020, the world was hit by a coronavirus pandemic, affecting all global economies. This emergency situation also highlighted the important role of the energy sector, including energy security for the functioning of the economy of Poland and other European countries. In the coming years, the energy sector will face a number of post-pandemic challenges related to, among others, the reconstruction or substitution of supply chains to carry out investments, mobilization of financial resources in budgets strained by the effects of the epidemic, and sometimes - the revision of investment plans and accumulation of funds for key projects. It is important that investment decisions are made taking into account the aspect of green and low-carbon economic recovery (Filipović et al., 2018; Wilson and Staffell, 2018). Post-pandemic reconstruction activities are aimed at giving a quick and effective boost to growth and

creating new opportunities for the national economy. In addition to shielding tools and measures to mobilize domestic public resources, EU support will be used (Charciarek, 2021).

The boom in commodity markets continues. It includes mainly energy commodities, but also agricultural products and industrial metals. In the case of industrial metals, however, the situation is already more diverse. The CRB Index, which depicts the prosperity of commodity markets, is up more than 30% since the beginning of the year. In the last twelve months of 2022, the price of raw materials rose by 47%. and since the pandemic period it has risen by as much as 175%. The structure of the CRB index clearly shows that energy commodities have the greatest impact on its changes (Szturo, 2020). The continuing war in Ukraine means that their prices will remain high, and the sanctions imposed on Russia will have their consequences for an extended period. Events across Poland's eastern border are also strongly affecting agricultural commodity prices. Both Russia and Ukraine are among the world's largest producers and exporters of them. The price index calculated by the FAO, or Food and Agriculture Organization of the United Nations, is at its highest level since 1990, and there are many indications that it will not go down soon, with adverse weather conditions still contributing to the increase.

When assessing the trends of the raw materials market, one must also take into account the outlook for the economic situation in the global economy (Zamani, 2016). These, in turn, are not the best. Already the first quarter of 2020 showed a surprising decline in GDP in the United States. Even more dangerous is the slowdown in China and the resurgence of the coronavirus epidemic there. These phenomena are already making their mark on the commodity market.

The most emotional, for obvious reasons, is the situation in the energy commodity market. Quotations for natural gas, whose main supplier in Europe is Russia, have risen by more than 100% since the beginning of the year, by more than 150% in the last twelve months of 2022, and by almost 470% compared to June 2020 (Przasnyski, 2022). Its price has risen by more than 180% since the beginning of the year, by 260% over the twelve months of 2022, and by more than 180% since the end of autumn 2021, and in March the scale of the increase at times was much higher, reaching 380%. Globally, crude oil is, of course, the most significant. The price of US West Texas Intermediate (WTI) crude oil has risen by almost 40% since the beginning of the year, and in twelve months it has gone up by almost 60%. Currently, its price is six times higher than it was during the pandemic plunge of spring 2020, and in March 2022 it was approaching the historical maximum of 2008. Since October 2022, both gas, coal and oil have seen a slight downward correction.

The development of electricity markets requires strengthening the position and activation of electricity consumers. This is influenced not only by the development of the market, but also by more conscious use of energy and increasing energy efficiency through the use of local potential. There are significant challenges in this area, in particular in terms of improving the information policy and developing and promoting aggregation services through the implementation of the directive on common rules for the electricity market (Adamkiewicz, 2017). Energy-related costs are of particular importance to businesses. This is related to the energy intensity of the global market, which may encourage owners to look for cheaper commercial premises (Kruyt et al., 2009). This may result in a loss of capital and changes in local labor markets. In order to increase the operational efficiency of the national power system as a whole, efforts will be made to flatten the so-called daily electricity demand curve, i.e., the reduction in the difference between average and peak consumption and the increase in demand at night. Demand management using end-user activity is one way to increase system efficiency (Grossman, 2021).

In the context of changing coal prices on the Polish market, companies can use various energy supply strategies to minimize the impact of price increases on their operations. One solution could be to diversify energy sources so that companies are not solely dependent on coal. They can use different sources such as solar, wind, geothermal, hydro and biofuels. Investing in energy efficiency can also reduce energy costs for businesses. By modernizing lighting, ventilation, air conditioning and building insulation systems, companies can significantly reduce their energy needs and protect themselves against increases in energy prices. Companies can also sign long-term energy supply contracts, which allows them to obtain a fixed, long-term price for energy. In this way, they will be protected from sudden price increases. In order to become independent from changing energy prices, companies can invest in energy storage technologies, such as batteries or thermal energy storage solutions. Thanks to this, they can store energy during periods of lower prices and then use it during periods when prices are higher. Companies should regularly monitor energy markets to react to changes in prices and adapt their sourcing strategy. In the event of an increase in prices, they can counteract by switching suppliers or changing energy sources (Deutch, 2005).

To sum up, companies should approach the issue of energy supply in a strategic way and look for long-term solutions so as to guarantee themselves not only an affordable price, but also stability and independence from market changes. In the context of changing coal prices on the Polish market, companies can use various strategies for energy supplies to minimize the impact of price increases on their operations.

3. Methodology and results

The basis for the research methodology adopted is the analysis of coal prices for customers by evaluating the basic indicators of coal sales in the market, with reference to the time interval. The interpretation of the data based on stock exchange information from 2020 to 2022 has been carried out. The indicators presented are determined on a monthly basis, based on the data processed by the Agency for the Development of Industries S.A. branch in Katowice, from domestic hard coal producers. The agency obtains the data within the framework of the Survey of Public Statistics "Hard coal and lignite mining," the body in charge of which is the minister responsible for energy. The indices provide rationalized and algorithmized price information, which makes it possible to estimate and compare coal production and sales costs.

Since January 2022, the average price of coal has risen by more than 100%. As shown in Table 1 for the PSCMI1 index (in PLN/T and in PLN/GJ) it reflects the price level of 20–23/1 grade fines in sales to the commercial and industrial power industry.

Calculated as a weighted average of monthly deliveries, meeting the quality criterion of the index (parameters in working condition): calorific value: $20 \leq$ Qir<24 MJ/kg, total sulfur content below 1% (Str $<1\%$). The price of the monthly product is determined as a weighted average of transactions carried out in the Polish thermal coal market, invoiced in a given calendar month. The data for determining the PSCMI 1 index, are subject to selection according to the following criteria:

- only data on fines are selected,
- data on sales to the commercial and industrial power industry are selected,
- records on total sulfur content are selected: Srt $<1\%$,
- records on calorific value (calorific value in working condition) are selected Qri [MJ/kg]: $20 \leq Q < 24$,
- for records selected in this way that meet the quality criterion, the average price in PLN/GJ is calculated (dividing the unit price in PLN/ton by the corresponding calorific Q),
- data in these records are sorted, e.g., by quantity, or price, thus minimizing the possibility of identifying unit data,
- the share of supplies that meet the quality criterion of the PSCMI 1 index in the total supply of fines to commercial and industrial power plants is calculated.

In Table 1, one can observe a continuous increase in the price of energy coal, which dynamically increased from May 2022 to October

Table 1
PSCMI 1 index (in PLN/T and in PLN/GJ).

	11.21	12.21	01.22	02.22	03.22	04.22	05.22	06.22	07.22	08.22	09.22	10.22
PSCMI 1/T [PLN/T].	237.41	253.47	290.64	294.1	290.19	300.9	334.74	345.8	344.23	641.36	628.20	545.13
PSCMI 1/Q [PLN/GJ].	11.02	11.68	13.52	13.65	13.61	13.61	15.20	16.15	16.20	30.36	29.34	25.82

2022. The range of growth was presented from PLN 334.74 per ton to PLN 628.20 per ton in September 2022. In October 2022, the price lower by almost PLN 90 was observed, and it was exactly PLN 545.13. This is the ex-mine base price, i.e., the net price without excise tax, under FCA conditions, i.e., "on the wagon" at the point of loading, excluding insurance costs and delivery costs on the main transportation route.

Figs. 1 and 2 show the PSCMI 1/T quotations and PSCMI 1/Q quotations of the Polish Thermal Coal Market Index in sales to the commercial and industrial power industry from November 2021 to October 2022. The upward trend shows the volatility of prices and their increase, which is most evident in August/September 2022.

The defined criteria made it possible to verify the dynamics of the variables PSCMI 1/T and PSCMI 1/Q of the Polish Energy Coal Market Index in sales to the professional power industry and industrial as presented in Table 2.

The dynamics of the variable price indices of benchmark thermal coal produced by domestic producers and sold in the domestic energy market from November 2021 presents us with variable dynamics, the largest coefficient being in August 2022.

Another index analyzed is the PSCMI 2 index (in PLN/ton and in PLN/GJ). It reflects the price level of 23–26/08 grade fines in sales to industrial and municipal heating plants, other industrial customers and other domestic customers. Calculated as a weighted average of monthly deliveries meeting the quality criterion of the index as shown in Table 3.

The index calculation methodology allowed for ranking the data presented in Table 4 as an index of heat in the domestic market from September 2021 to October 2022. Prices at the end of 2021 show stability in the market until August 2022, where an increase of almost 150% in prices for energy in sales to industrial and district heating plants is noted. In the data presented and analyzed, a further minimal downward trend to PLN 1051.11 per ton of heat in October 2022 was observed (see Table 5).

A graphical representation of the volatility of heat prices is shown in Figs. 3 and 4. The prices oscillating between PLN350 and PLN450/ton until a noticeable jump to PLN1,500/ton in sales to industrial and municipal heating plants can be noticed.

The dynamics of the variable indices of benchmark prices of thermal coal produced by domestic producers and sold in the domestic energy market in the index PSCMI 2 from November 2021 shows the variable dynamic, with the highest coefficient in August 2022 and the lowest in October 2022.

The Polish index of the group of indices of benchmark prices of thermal coal produced by domestic producers and sold on the domestic energy market depends on price quotations on world stock exchanges.

4. Discussion

The information presented in this article makes it possible to raise some conclusions that are relevant to solving the title problem. The situation in the coal market, like the economic situation, is constantly changing. The magnitude of the dynamics of these changes is best visualized over longer time horizons. Indices allow buyers and sellers to assess investment risks in areas related to power generation. Correctly verified price indices allow the possibility of using, in long-term transactions, an index price, variable over time, recalculated based on formulas agreed upon by the parties to the transaction. This increases the financial security of the executed transaction and the attractiveness of the market to all participants. Using index information, producers and customers can directly influence the price of coal, taking into account information from the market, including the price of imported coal. For this reason, it seems reasonable to monitor the correlations in question, which is likely to provide a better recognition of the issues raised in this article over time.

When analyzing price volatility in the analyzed period, it is worth referring to price changes after the assumed period of observation. The PSCMI1 index in March 2023 improved its result by 2.5% compared to the previous month and amounted to PLN 707.90/T and PLN 32.99/GJ. Compared to March 2022, this result is better by 143.9%. The PSCMI2 index in March 2023 decreased by 8.5% compared to the previous month and amounted to PLN 1004.92/T and PLN 41.67/GJ. Compared to March 2022, this result is better by 163.4%. The average PSCMI1 index in the first quarter of 2023 was PLN 700.22/T and PLN 32.17/GJ. Compared to the first quarter of the previous year, an increase of 140.1% can be noticed. The average PSCMI2 index in the first quarter of 2023 was PLN 1055.19/T and PLN 43.35/GJ). Compared to the first quarter of last year, an increase of 190.6% can be seen.

The future demand for hard coal in Poland will be influenced by a number of factors, so its determination is a breakneck exercise with a high probability of error. An important determinant of demand will be the planned introduction of nuclear power. Coal consumption in the future will depend both on factors related to the EU climate policy, the price of emission allowances, CO2 or the Winter Package, as well as on

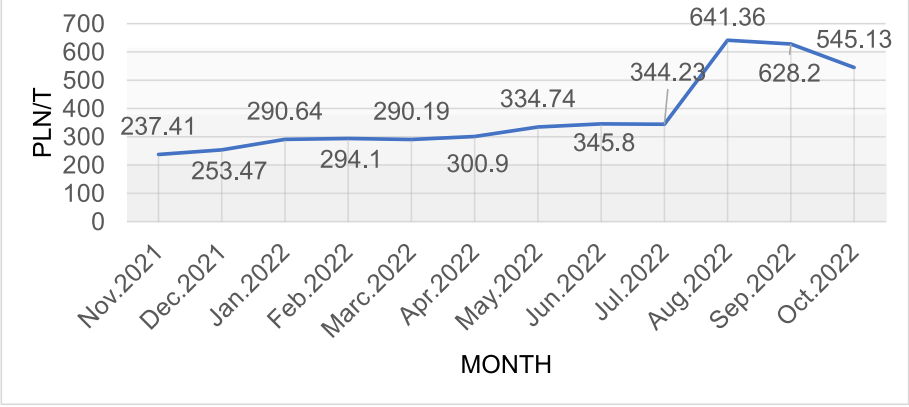

Chart 1. PSCMI 1/T quotations.

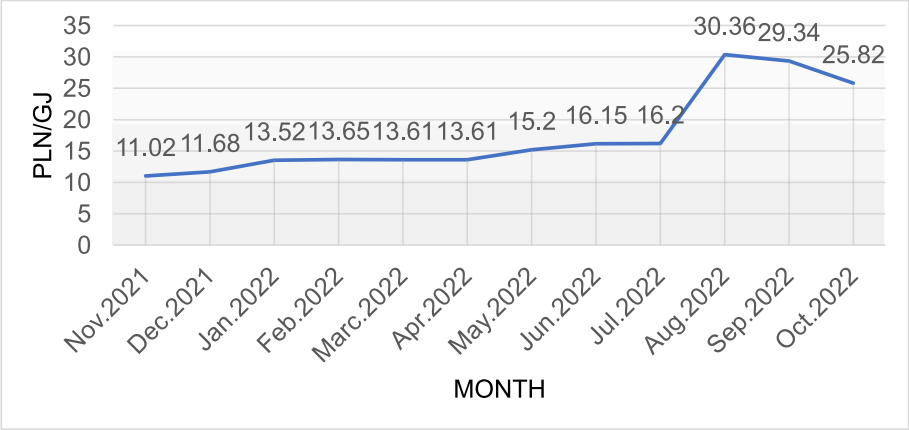

Chart 2. PSCMI 1/Q quotes.

Table 2
Variable dynamics of PSCMI 1/T and PSCMI 1/Q.

Date	Dynamics m/m PSCMI 1/T [PLN/T].	PSCMI 1/Q m/m dynamics [PLN/GJ].
11.2021	96.3632	97.1781
12.2021	106.7647	105.9891
01.2022	114.6645	115.7534
02.2022	101.1905	100.9615
03.2022	98.6705	98.1685
04.2022	103.6907	101.5672
05.2022	111.2463	111.6826
06.2022	103.3041	106.25
07.2022	99.546	100.3096
08.2022	186.3173	187.4074
09.2022	97.9481	96.6403
10.2022	86.78	88.00

Table 3
PSCMI 2 index calculation methodology (in PLN/T and in PLN/GJ).

Index Name	PSCMI 2/T index, weighted average price in PLN/T,
Index Name	PSCMI 2/Q index, weighted average price in PLN/GJ,
Delivery terms	Coal in sales to statistical groups of customers: industrial and municipal heating plants, other industrial customers, other domestic customers
Volume	No minimum volume of deliveries is specified. The weight standard is the amount of coal that meets the quality criterion of the index during the period under review
Coal sorting	Energetic mills (grain size 20 - 0 mm)
Calorific value	Q_i^r [MJ/kg]: $23 \leq Q < 27$,
Total sulfur content	Less than 0.8% ($S_t^r < 08\%$)

internal factors, which include, among others, forecasts for the development of the domestic power and heating sectors, efforts to improve energy efficiency, the development of renewable energy or fuel prices.

In the perspective of the proposed changes, until 2040, the energy policy will work towards a low-emission transformation, taking into account the way energy is used, the cost-benefit method and assistance in ensuring energy security, economic development and environmental pressure studies. National conditions cause that the transformation must be carried out in an evolutionary, fair, and socially acceptable manner - with support for regions, sectors and social groups bearing the greatest burden of change. As part of the diversification of the energy mix, a decrease in the share of coal in the management energy production balance will be noticed, i.e., to no more than 56% by 2030, and in the scenario of a specific increase in the prices of CO2 emission allowances even to the level of approx. 37%.

5. Conclusions

The three main energy resources, coal, oil, and natural gas are currently used to produce 87% of the world's energy. This share of energy raw materials in energy production is expected to be maintained over the next few decades. In addition, oil is, and will remain in the coming years, a hard-to-replace fuel used in road, air, and sea transportation. The functioning of modern economies depends not only on the continuity of supply, but also on the price at which energy resources are purchased (Maftei, 2012). As of June 2022, inflation in Poland was as high as 15.6%, and it is expected to rise further by the end of the year. Unfortunately, raw materials are some of the commodities the prices of which are rising the most.

Energy consumption for heating and cooling accounts for the highest volume of energy use among the three energy sectors, and for more than 80% of primary energy consumption in households. Therefore, meeting heat demand is an important element of energy security. Measures in

Table 5
Variable dynamics of PSCMI 2/T and PSCMI 2/Q.

Date	Dynamics m/m PSCMI 2/T [PLN/T].	PSCMI 2/Q m/m dynamics [PLN/GJ].
11.2021	107.07	107.48
12.2021	102.03	103.09
01.2022	102.02	102.44
02.2022	97.13	96.74
03.2022	110.03	110.05
04.2022	126.25	126.31
05.2022	90.17	96.19
06.2022	97.12	96.19
07.2022	107.93	108.38
08.2022	294.00	289.99
09.2022	112.75	114.26
10.2022	69.99	69.61

Table 4
PSCMI 2 index (in PLN/T and in PLN/GJ).

	11.21	12.21	01.22	02.22	03.22	04.22	05.22	06.22	07.22	08.22	09.22	10.22
PSCMI 2/T [PLN/T]	342.95	349.90	356.96	346.721	381.49	481.63	334.74	421.78	455.22	1338.35	1508.95	1051.11
PSCMI 2/Q [PLN/G]	13.93	14.36	14.71	14.23	15.66	19.78	15.20	17.42	18.88	54.75	62.56	43.55

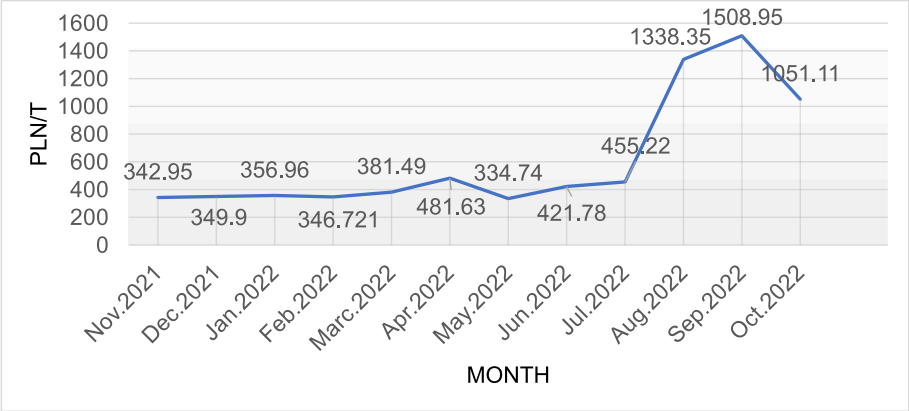

Chart 3. PSCMI 2/T quotations.

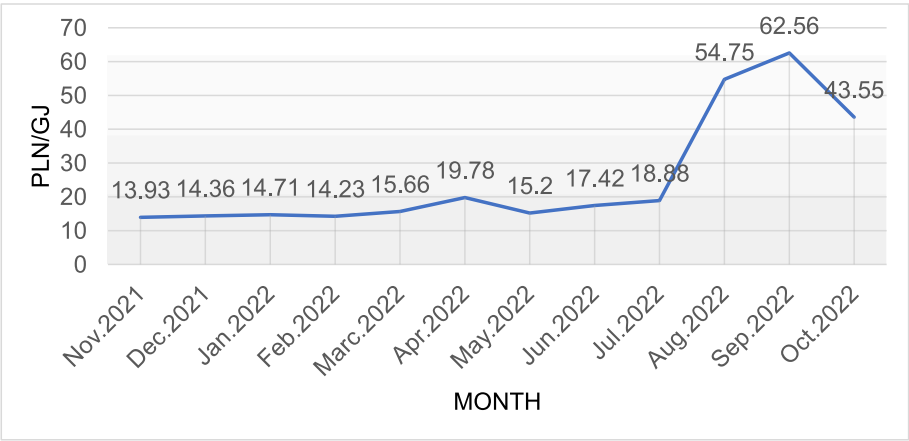

Chart 4. PSCMI 2/Q quotes.

this area serve to make efficient use of primary energy for space and water heating, as well as to reduce energy poverty. They contribute to the reduction in pollution both in the professional and industrial energy industry obliged to meet strict emission standards, and in households. The savings and benefits to be gained from the implementation of low-carbon heating solutions will benefit the entire economy in the long run. The expenses incurred will be compensated not only by lower costs of heat use at the end-user level, but also by improved air quality, improved thermal comfort and reduced health costs. Covering heat needs, wherever possible, should be done primarily through the use of system heat. Such a model allows high efficiency in the use of raw materials, improves the living comfort of citizens, and reduces the problem of so-called low emissions. Due to widespread pro-efficiency measures, the total demand for heat is decreasing, but the number of system heat consumers should increase. If connection to a district heating network is not possible, it is necessary to use other sources with the lowest possible emissions. It seems that the initiated and planned activities in the broad field of energy will have a positive impact on Poland's energy security for the coming years. Nevertheless, this issue is particularly related to the political and economic situation. Therefore, the military conflict in Ukraine will still have a significant impact on Polish energy security. From the perspective of recent months, it seems that the biggest problem has been to maintain stability in the coal sector. A slight reduction was planned; however, the Russian-Ukrainian war has translated into increased hard coal production and this process is likely to be maintained in the long term. Currently, coal is mainly obtained for the needs of utility power plants, so imports for households have become necessary.

All these issues represent a huge systemic challenge. Fundamental questions need to be answered again. How to ensure profitability or spread the cost of fossil-related projects that will have a relatively short lifespan or will be used mainly as reserve assets. It is also worth noting that market mechanisms, which gained importance after the previous energy crisis, are not fully capable of ensuring rapid adjustments in the economy. High volatility of prices and the scale of their increase in unbalanced situations turn out to be high. Steam coal prices will remain high in the coming period as rising natural gas prices have made coal power even more competitive than before.

Author statement

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The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Beata Slusarczyk reports article publishing charges was provided by Czestochowa University of Technology and WSB University.

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