

MARIAN CZESŁAW TUREK<sup>1</sup>, PATRYCJA BĄK<sup>2</sup>

## The production capacity of hard-coal mines in terms of meeting the needs of the domestic energy sector

### Introduction

For over twenty years, European Union member states have been increasingly taking steps to reduce the amount of gases emitted into the atmosphere, contributing to the growth of the so-called the greenhouse effect. From December 2020, the goal is to achieve climate neutrality of the European economy by 2050, which means that the use of fossil fuels in industry and by individual users is to be almost completely discontinued.

For Poland, where approximately 70% of the electricity and heat is still generated using coal, especially hard coal, taking action in this area is an extremely difficult challenge. At the same time, both the energy sector and the coal-mining industry must undergo transformations, and a situation in which it is not possible to obtain the required amounts of energy must not be allowed. On the one hand, it is necessary to obtain less emission (and ultimately non-emission) energy sources, withholding the operation of coal-fired power plants, heating

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✉ Corresponding Author: Patrycja Bąk; e-mail: pbak@agh.edu.pl

<sup>1</sup> Central Mining Institute, Katowice, Poland; e-mail: mturek@gig.eu

<sup>2</sup> AGH University of Science and Technology, Kraków, Poland; ORCID iD: 0000-0001-9109-3369;  
Scopus iD: 55651726700; e-mail: pbak@agh.edu.pl



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plants and mines, and on the other hand, the scope and pace of changes must not disturb the provision of the required amounts of energy and raw materials for its production. In particular, in the aspect of avoiding the necessity to import coal, it is important to consider issues related to the possibility of satisfying specific raw material needs by domestic mining enterprises.

## 1. Active hard-coal mines and coal resources at their disposal

Since 1990, the domestic hard-coal-mining industry has been subject to continuous restructuring measures aimed at enabling economically effective functioning. One such activity was the introduction of various organizational changes, including, the merger of certain plants and the liquidation of unprofitable mines. Currently, there are seventeen large mines and two small private mining plants operating in various mining enterprises (Figure 1).



Fig. 1. Polish mining enterprises in 2021  
Source: own study based on ([Balance 2021](#))

Rys. 1. Polskie przedsiębiorstwa górnicze w 2021 r.

The exploitation of domestic hard-coal deposits is carried out in two basins: Górnśląskie and Lubelskie. The Upper Silesian Coal Basin (GZW) is the main coal basin of Poland – almost 80% of the documented balance resources are found there. Its area within the borders of Poland is estimated at around 5,600 km<sup>2</sup>. There is a full range of technological types of hard coal – from energy type 31 to coking coal type 37, and anthracite in trace amounts (Type 42). There are eighteen active mines of various sizes in the GZW. In the Lublin Coal Basin (LZW), approximately 4,730 km<sup>2</sup> is assumed as an area with defined deposit prospects, while the area of approximately 1,200 km<sup>2</sup> is covered by documented deposits. There is one mine operating there.

According to a study by the Polish Geological Institute ([Balance... 2021](#)), at the end of 2020:

- ◆ at GZW, 145 deposits were filled with over 51.5 billion tons of balance resources, including almost 4.2 billion tons of industrial resources;
- ◆ at LZW, 11 deposits were filled with almost 12.5 billion tons of balance resources, including over 612 million tons of industrial resources.

In total, domestic hard-coal resources of all types were estimated at over 64.4 billion tons, including over 4.8 billion tons of industrial resources (Table 1).

Table 1. The volume of domestic hard-coal resources – as of December 31, 2020 (million Mg)

Tabela 1. Wielkość krajowych zasobów węgla kamiennego – stan na 31.12.2020 r. [mln Mg]

Item	Number of deposits	Geological resources					Industrial resources
		balance				non-balance	
		total	A+B	C1	C2+D	$\frac{\text{group a}}{\text{group b}}$	
Total resources, including coals	163	64,422.38	6,413.32	23,538.09	34,470.98	$\frac{12,825.33}{525.68}$	4,809.84
Type 31–33		45,578.50	4,092.62	15,652.47	25,833.41	$\frac{9,645.91}{328.28}$	2,712.15
Type 34–37		18,058.53	2,312.80	7,841.11	7,904.62	$\frac{3,142.59}{197.40}$	2,097.57
Other		785.35	7.90	44.51	732.94	$\frac{36.84}{-}$	0.11
Including the resources of undeveloped deposits							
Total	49	28,409.26	4,436.68	13,881.38	10,091.20	$\frac{2,729.19}{324.75}$	4,388.72
Including the resources of undeveloped deposits							
Total	59	30,585.70	486.05	7,463.31	22,636.35	$\frac{8,516.61}{199.85}$	347.01
Including resources of deposits where exploitation has been abandoned							
Total	55	5,427.42	1,490.59	2,193.40	1,723.13	$\frac{1,476.74}{87.65}$	74.11

Source: own study based on ([Balance... 2021](#)).

In order to function, each company must have different resources. In the case of a mining enterprise, the most important are geological resources – a mine can only exist where there are coal deposits. The next reasons are human, material and financial resources (Figure 2).

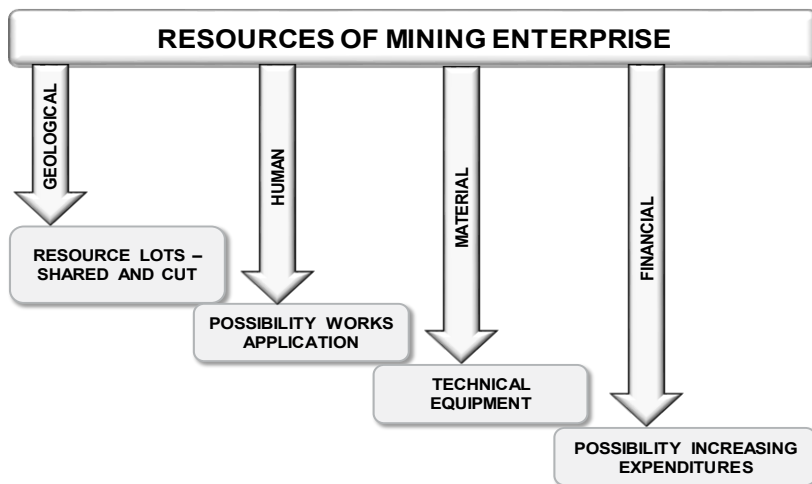


Fig. 2. Resources of a mining enterprise  
Source: own study

Rys. 2. Zasoby przedsiębiorstwa górniczego

Each mining company (mine) has a license to exploit a deposit in a precisely defined part of the deposit, having at its disposal a specific amount of geological resources, including balance, industrial and operational resources. The size of industrial coal resources of individual companies that are steam-coal producers is presented in the diagram in Figure 3.

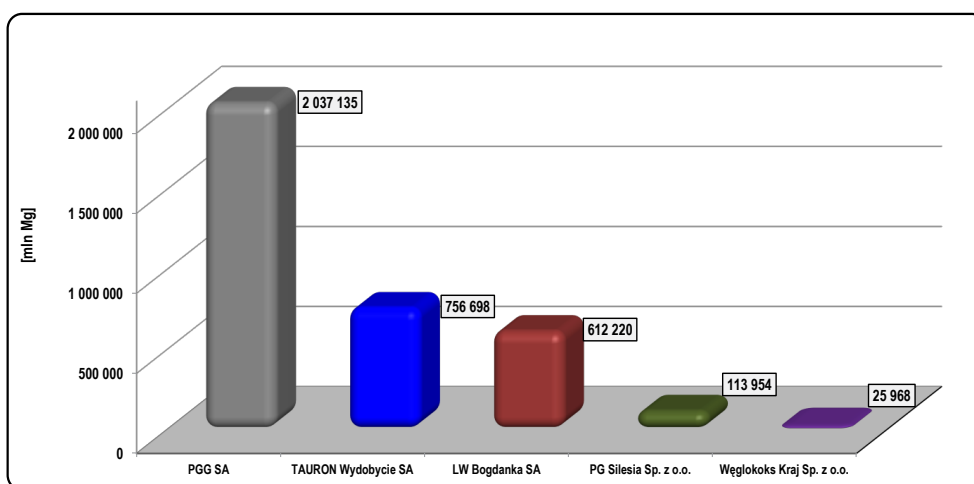


Fig. 3. The size of industrial resources of Polish mining enterprises – as of December 31 2020  
Source: own study based on ([Balance 2021](#))

Rys. 3. Wielkość zasobów przemysłowych polskich przedsiębiorstw górniczych – stan na 31 grudnia 2020 r.

The diagram does not include the size of the resources of Jastrzębska Spółka Węglowa SA mines, which mainly extract coking coal.

When considering the production capabilities of individual mining enterprises and mines, one should also take into account the fact that, on the one hand, they result from the size of resources, the state of their cutting and availability, and the technical and technological conditions in which production (exploitation) is to be carried out, and on the other hand, they are determined or limited by the demand for a specific product (Figure 4). It should be noted that many production factors are independent of the entrepreneur and cannot be freely shaped (Jonek-Kowalska 2012).

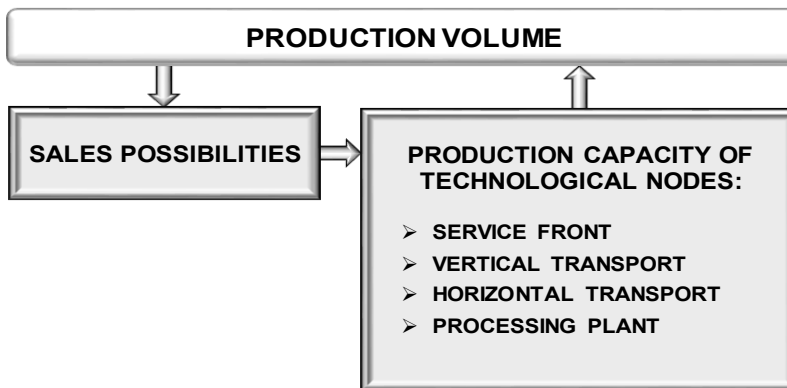


Fig. 4. Determinants of the production volume of a mining enterprise (mine)  
Source: own study

Rys. 4. Determinanty wielkości produkcji przedsiębiorstwa górniczego (kopalni)

### 3. Forecast production volumes and demand for hard coal until 2040

The basis for the proper assessment of the possibilities of satisfying the needs of the energy industry in the field of hard-coal supplies is the development of reliable forecasts in terms of both the needs and the production volumes of mining enterprises. In the scientific approach, forecasting is the prediction of future events based on taking into account all conditions and circumstances that may affect their occurrence or course (Bąk 2018). Forecasts about a specific event or phenomenon use a set of variables called forecast variables. These can be quantitative variables, expressed in numbers (e.g. production volume) or qualitative variables, described in words (Dittmann 2003).

In scientific literature, you can find many items on the issue of planning and forecasting the volume of mining production (coal extraction). In the period before Poland's

accession to the European Union, the main focus was on issues related to geology and mining systems (Przybyła 1991; Karbownik and Chroszcz 1994; Karbownik et al. 1999; Fuksa 2004). However, works that have been carried out in recent years focus to a significant extent on the analysis of the requirements of the directives of the European Parliament and the European Council on climate policy, energy efficiency and the transition to a low-carbon economy, and the related issue of energy security of the country (Dubiński and Turek 2007a, 2007b; Gawlik et al. 2010; Turek and Jonek-Kowalska 2015; Fuksa 2016; Gawlik et al. 2016; Manowska 2017; Stala-Szlugaj 2018; Rybak and Manowska 2019; Peplowska 2021).

With Resolution No. 22/2021 of February 2, 2021, the Council of Ministers adopted the document (PEP 2040), which is ... *a clear vision of Poland's energy transformation strategy*... Two attachments are an integral part of the document. In Annex 2, entitled “Conclusions from prognostic analyses for the fuel and energy sector” includes forecasts for the production (extraction) and demand for hard coal until 2040 (Table 2, Figure 5).

Table 2. Forecasts of the production volume and demand for thermal coal according to PEP 2040 (million Mg)

Tabela 2. Prognozy wielkości produkcji i zapotrzebowania na węgiel energetyczny wg PEP 2040 [mln Mg]

Item	2025	2030	2035	2040
Production	50.4	41.6	34.6	29.8
Demand	44.7	35.7	28.9	24.3

Source: Annex 2 to PEP 2040.

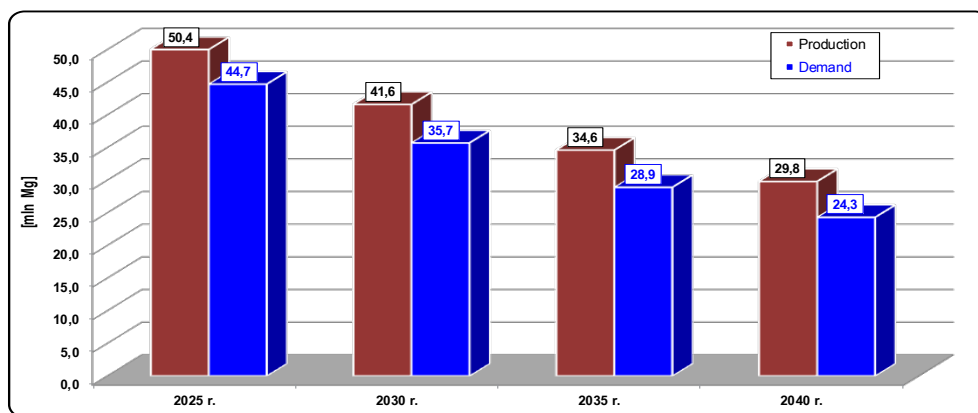


Fig. 5. Forecasts of the production volume and demand for thermal coal according to PEP 2040

Source: own study based on Annex 2 to PEP 2040

Rys. 5. Prognozy wielkości produkcji i zapotrzebowania na węgiel energetyczny

The authors, based on their own knowledge, literature analysis and available data resources, prepared a forecast of the volume of steam coal extraction (production) by individual mining companies until 2040. While developing it, the assumptions specified in the work (Dubiński and Turek 2007a) were followed. The following factors were taken into account: the condition of the resource base of individual mines (including, in particular, data on operational resources), the existing production capacities of individual mines, the levels of natural hazards that determine the safe operation of the deposit, and environmental conditions of the exploitation.

In addition, information included in the available plans for the further operation of individual mines in the coming years and in the provisions of the agreement on the further operation of the hard-coal-mining sector, in particular the largest mining enterprise – Polska Grupa Górnicza SA (PGG SA) – signed an agreement with government representatives in September 2020 (Agreement... 2020). In addition, each year also includes the volume of three million tons of coal of this type, coming from the mines of Jastrzębska Spółka Węglowa SA (JSW SA), which mainly extracts coking coal. The obtained results are presented in Figure 6 and Table 3.

As can be seen, the production volume decreases each year, and in 2040, you can expect the output to be almost 20 million tons lower than in 2022. This is mainly due to the gradual stoppage of the operation and liquidation of individual movements and mines of the largest mining company (PGG SA). The schedule of their decommissioning has been specified in

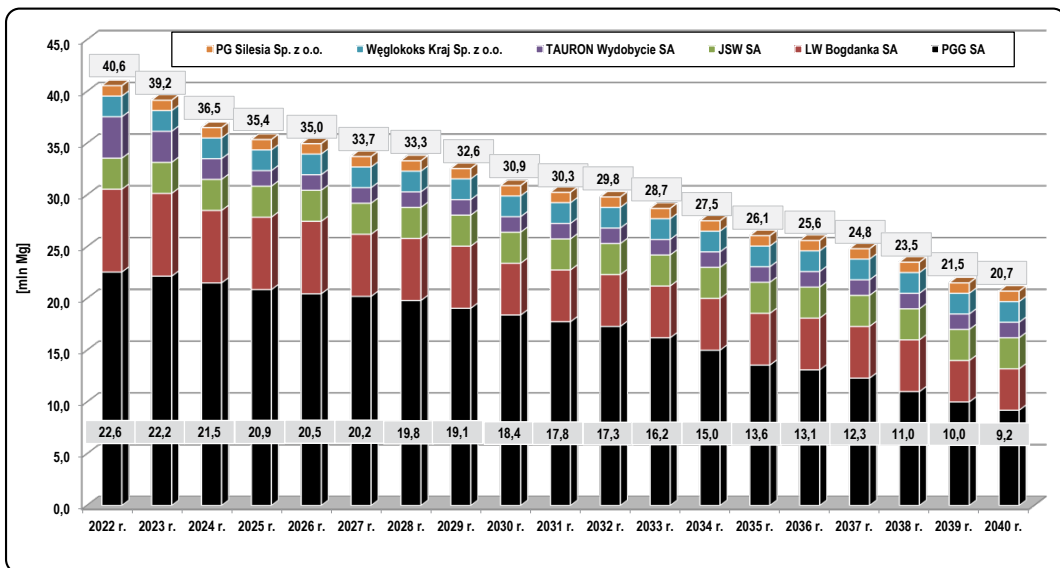


Fig. 6. Forecast of the national volume of steam coal production in 2022–2040 according to the GIG study

Rys. 6. Prognoza wielkości krajowej produkcji węgla energetycznego w latach 2022–2040 według opracowania GIG

Table 3. Forecast of power coal production volume by individual mining enterprises in 2022–2040 according to the original forecast of the Central Mining Institute (million Mg)

Tabela 3. Prognoza wielkości produkcji węgla energetycznego przez poszczególne przedsiębiorstwa górnictwa w latach 2022–2040 według pierwotnej prognozy GIG [mln Mg]

Mining enterprise	Year																		
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
PGG SA	22.6	22.2	21.5	20.9	20.5	20.2	19.8	19.1	18.4	17.8	17.3	16.2	15.0	13.6	13.1	12.3	11.0	10.0	9.2
LW Bogdanka SA	8.0	8.0	7.0	7.0	7.0	6.0	6.0	6.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	4.0	4.0
JSW SA	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
TAURON Wydobycie SA	4.0	3.0	2.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Węglokoks Kraj sp. z o.o.	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PG Silesia sp. z o.o.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total	40.6	39.2	36.5	35.4	35.0	33.7	33.3	32.6	30.9	30.3	29.8	28.7	27.5	26.1	25.6	24.8	23.5	21.5	20.7



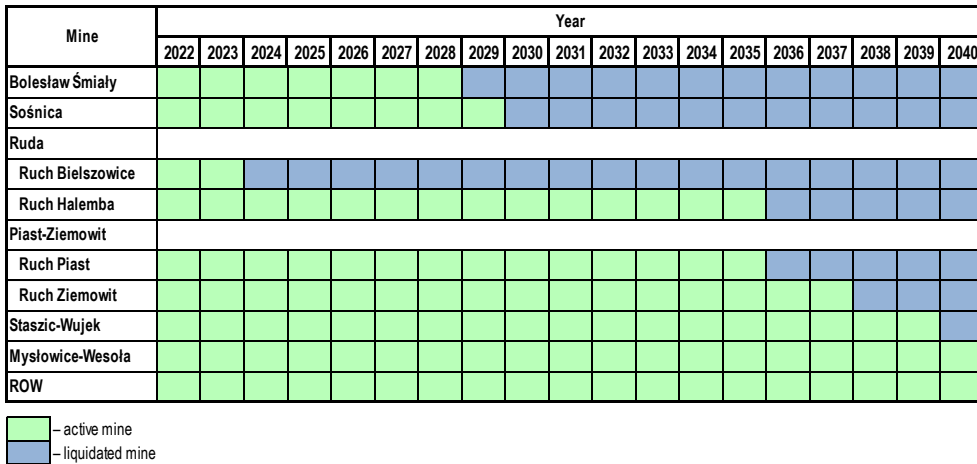


Fig. 7. Periods of further operation of the mines of Polska Grupa Górnicza SA  
 Source: own study based on (Agreement... 2020)

Rys. 7. Okresy dalszej eksploatacji kopalń Polskiej Grupy Górniczej SA

the annex to (Agreement... 2020); from 2040, only two mines are to be operational – Mysłowice-Wesoła and ROW (Figure 7).

From the monograph (Tokarski 2021), which is an expert attempt to verify the current forecasts of demand for primary energy sources and to present possible scenarios for further energy transformation in Poland, data was taken on the demand for hard coal in the years 2025–2040.

Table 4. Levels of demand for hard coal according to expert assessment (million Mg)

Tabela 4. Poziomy zapotrzebowania na węgiel kamienny wg oceny eksperckiej [mln Mg]

Item	2025	2030	2040
Production of electricity and system heat (power plants and combined heat and power plants)	38.1	29.7	21.4
Production of non-system (individual) heat	14.4	9.9	5.5
Total	52.5	39.6	26.9

Source: own study based on the results of the survey.

#### 4. The reasons for the differences in the forecasts of the production volume and demand for thermal coal

In order to assess the ability of mining enterprises to meet the demand of the national power and heating systems for coal, Table 5 summarizes the individual values in total (expert assessments are missing for 2035).

Table 5. Comparison of the production volume and the demand for hard coal according to the provisions of PEP 2040 (Tokarski 2021) (million Mg)

Tabela 5. Porównanie wielkości produkcji i zapotrzebowania na węgiel kamienny wg przepisów PEP 2040

Item	2025	2030	2035	2040
Production				
According to PEP 2040	50.4	41.6	34.6	29.8
According to GIG	35.4	30.9	26.1	20.7
Difference PEP 2040 – GIG	+15.0	+10.7	+8.5	+9.1
Demand				
According to PEP 2040	44.7	35.7	28.9	24.3
According to expert assessments	52.5	39.6	–	26.9
Difference of PEP 2040 – expert assessments	–7.8	–3.9	–	–2.6

Source: own study.

The above data indicates that in all analyzed years, there are many differences compared to the data included in PEP 2040. In terms of the production volume, the data from PEP 2040 seems to be overestimated by 15 to at least 8.5 million tons, while in terms of demand, it is understated from 7.8 to 2.6 million tons.

The main reason for the above discrepancies, apart from the differences in the forecasts for the production of thermal coal, lies in the predicted models of the future shape of the energy mix in terms of generating both electricity and heat. This is illustrated on the example of the year 2040.

With regard to electricity, in both cases it is anticipated that the net electricity demand will be around 204 TWh. However, the assumptions regarding the sources of its production are very different (Figure 8).

A similar comparison cannot be made for heat production forecasts. In PEP 2040, only the figures for system heat (258.7 PJ in 2040) are given, without providing assumptions regarding the sources of its generation. The issue of non-systemic (individual) heat generation was not addressed at all. However, the summary of expert assessments predicted that in

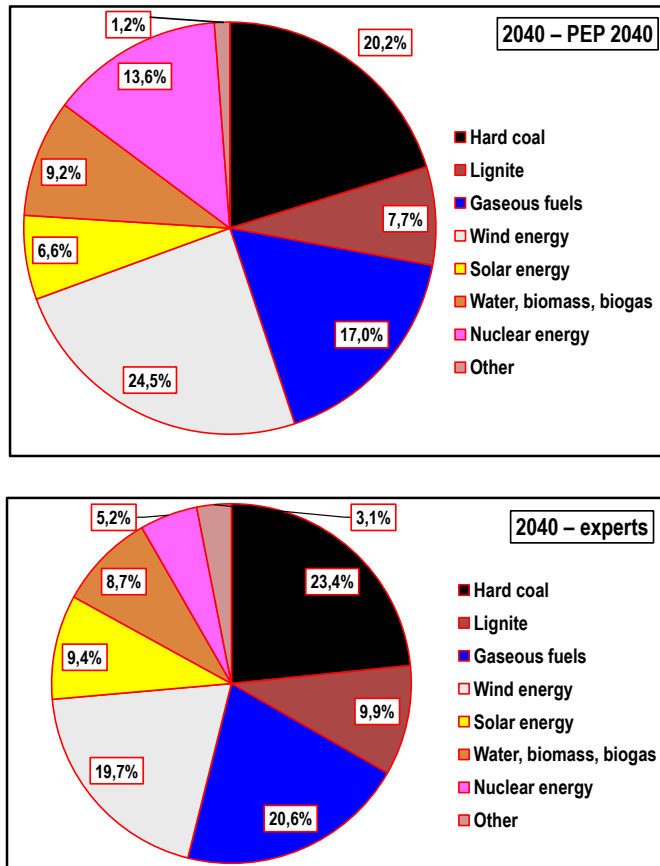


Fig. 8. Energy mix – the percentage share of individual sources of electricity production in 2040 according to the assumptions of PEP 2040 and expert assessment

Source: own study based on (Tokarski 2021; Poland's... 2021)

Rys. 8. Miks energetyczny – procentowy udział poszczególnych źródeł produkcji energii elektrycznej w 2040 r. według założeń PEP 2040 i ekspertyzy

2040, 204.3 PJ of system heat (31.4% from hard coal) and as much as 470.7 PJ of non-system heat (20.2% from hard coal) will be produced.

The reason for the discrepancy in forecasts regarding the share of individual energy sources in its production (and the volume of demand for power coal) is the fact that experts, in their opinion, take into account two significant risks related to nuclear energy and the construction of offshore wind farms. According to the provisions of PEP 2040, in 2040 they would have a share of over 27% in the production of electricity.

In justifying their opinions, the experts emphasized the need to take into account the experiences of other countries related to the development of nuclear energy in the forecasts; in particular, this should apply to the lengthy and capital-intensive investment processes re-

lated to the construction of power plants. Due to the fact that the exact location of the future nuclear power plant has not even been specified, according to the vast majority of them, it is completely unrealistic to start up the first unit in 2033, followed by more units in order that in 2040, the share of nuclear energy in electricity generation will reach almost 14%.

Significant reservations were also raised with regard to offshore wind energy. Doubts are raised by the applicable legal status (a ban on the construction of wind farms in internal sea waters and territorial sea), the lack of specific wind farm locations, the lack of adaptation of port infrastructure to the conditions enabling the construction and operation of offshore wind turbines, the lack of electricity transmission infrastructure and finally, the appropriate number of specialists from various fields related to this type of energy. Taking this into account, it must be stated that also in this case, the assumption of an almost 14% share of offshore wind farms in electricity generation in 2040 is too optimistic.

## 5. Possibilities of meeting the demand by domestic mining enterprises

Bearing in mind the issues raised so far, a question should be asked about the possibility of satisfying the needs for power coal by domestic mining enterprises, which is necessary for the production of electricity and heat.

Based on the provisions contained in PEP 2040, it could be concluded that there are no threats in this regard – they still show an excess of around five million surplus of production over needs. However, if we take into account the figures presented in the study (Tokarski 2021) and the authors' assessment, the situation is completely different – there are still significant shortages of coal in amounts ranging from over 17 to over 6 million tons (Table 6).

Table 6. List of differences between the forecast production volumes and demand for hard coal (million Mg)

Tabela 6. Zestawienie różnic pomiędzy prognozowanymi wielkościami produkcji a zapotrzebowaniem na węgiel kamienny [mln Mg]

Source	2025	2030	2035	2040
PEP 2040	+5.7	+5.9	+5.7	+5.5
(Tokarski 2021)	-17.1	-8.7	-	-6.2

Source: Tokarski 2021; own study.

The data in Tables 5 and 6 show that the projected production volumes provided for PEP in 2040 are overestimated. Even if the demand for coal were in line with those presented in this document, and even so with the planned schedule of liquidation of PGG SA mines,

it is not possible for domestic producers to satisfy them. This situation additionally worsens in the case of a demand consistent with the opinions of experts included in the study (Tokarski 2021).

It should be clearly emphasized that the need to modernize the national power system, which is currently largely based on the use of fossil fuels, is irreversible. In PEP 2040, it is assumed, inter alia, to introduce thorough changes with regard to electricity generation sources as well as heating systems and distributed heating sources. Undertaking changes in this area is additionally “facilitated” by the fact that many coal-fired power plants are reaching the end of their technical capacity for further operation, so replacing them with new energy sources may even be economically profitable. It was assumed that the introduced changes are to be based primarily on the generation of electricity from wind and solar sources as well as from nuclear energy.

However, as it has been shown in considerations to date, it is problematic to adopt the scale and schedule for implementing the changes proposed for implementation by 2040. The existing threats of their delays may result in significant power shortages in the national power system. A summary of expert analyses regarding the planned transformation of this system (Tokarski 2021), also presents three alternative scenarios of activities aimed at preventing its functioning from being disrupted. The following two activities in the transitional period, provide for the possibility of the longer use of coal-fired power plants:

- ◆ where it is still technically possible, the operation of the coal-fired units planned for decommissioning will be extended;
- ◆ at selected coal-fired power plants, new units with a capacity of 1,000 MW or 500 MW, equipped with CCSU carbon dioxide capture installations, may be built.

In the third scenario, it was proposed to replace the retained coal-fired units with gas units and to also increase the amount of imported electricity.

The list of possible alternative actions and the negative effects of their implementation is presented schematically in Figure 9.

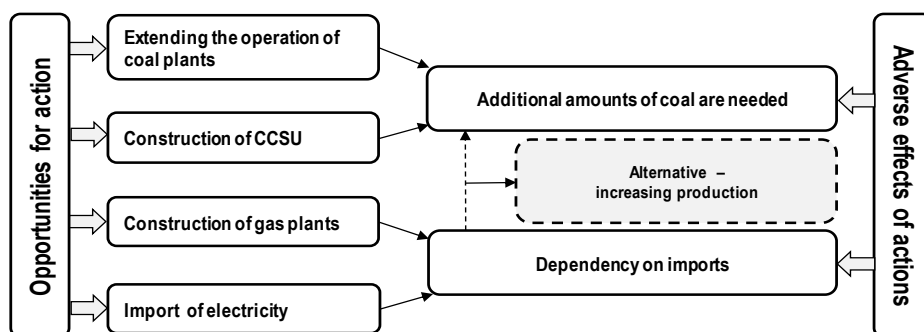


Fig. 9. Possibilities of actions reducing the effects of delays in modernization actions included in PEP 2040

Source: own study

Rys. 9. Możliwości działań redukujących skutki opóźnień w działaniach modernizacyjnych zawartych w PEP 2040

As can be seen, each of the measures proposed in the alternative scenarios implemented in the event of delays in the implementation of the assumptions of PEP 2040 entails the following negative effects:

- ◆ the need to increase the dependence of the national energy system on electricity or gas imports, the prices of which continue to rise significantly,
- ◆ the need to produce additional amounts of coal.

In the latter case, the gap between the levels of the demand and production of thermal coal, which has already been mentioned, would further deepen.

Despite the fact that relatively little time has passed since the adoption of PEP 2040, it seems that it would be necessary to analyze its provisions regarding the schedule and scope of the implementation of individual activities in the field of the transformation of the national power system and the volume of demand and coal production, together with appropriate changes to them. The consequence of this should be the development of changed assumptions for the further functioning of the hard-coal-mining industry. Failure to do so may result in significant disruptions in the operation of the national energy system.

## Summary

The efforts of European Union countries to achieve energy neutrality by 2050 will ultimately lead to the virtually complete elimination of the use of fossil fuels as the raw materials of energy generation. The adoption of such a target is primarily associated with the closure of power plants and heating plants burning steam coal.

In Poland, there is also growing awareness of the need to change the sources of electricity and heat. An expression of this is last year's adoption of the document entitled *Poland's Energy Policy until 2040*, in which the previous assumptions of the state's long-term energy policy were amended and an increase in the use of low- or non-emission sources was declared. One of the planned strategies are that blocks of coal-fired power plants will be decommissioned and, in their place, there will be the expansion of solar and wind energy and the commissioning of the first blocks of a nuclear power plant. Such activities, which will cause a decrease in the demand for coal, are also related to the plans of changes in the functioning of mining enterprises – there will be a gradual liquidation of individual mines and mining enterprises.

If the assumed implementation schedule of individual projects were to be carried out in accordance with the provisions of PEP 2040, there would be no risk of disturbances in the functioning of the national energy system. However, the assessments of experts from the energy and mining industries regarding the assumptions of PEP 204 and the author's analysis of the production capabilities of the mines raise doubts with regard to the course of the planned transformation. It may turn out that the assumed production volumes of the mines are overestimated, and the scope and pace of introducing changes are too high. In the event of delays in starting new energy sources, particularly controllable sources (nuclear power), in order to avoid disruptions to the energy system, the decommissioning of coal-fired power

plants and heating plants may be carried out over a longer period than assumed. However, if the mines are closed in accordance with the adopted assumptions, the domestic mining companies will be absolutely unable to deliver the required amounts of coal. The more that the developed forecasts of the extraction (production) volume already indicate the possibility of such a situation. Therefore, it seems necessary to update the assumptions adopted in relation to the hard-coal-mining industry and link them with adjusting to the production capacities of mining enterprises. The article was prepared according to the state of the Polish energy industry as of December 31, 2021. The current situation on the coal market, which has emerged as a result of Russia's aggression against Ukraine, will be analyzed in another article in the Mineral Resources Management magazine.

*The paper presents results of research conducted in AGH University of Science and Technology no. 16.16.100.215.*

## REFERENCES

- Agreement... 2020 – *Agreement between the representatives of the Government and the Inter-Union Protest and Strike Committee of the Śląsko-Dąbrowski Region, Katowice (Porozumienie pomiędzy przedstawicielami Rządu a Międzyzwiązkowym Komitetem Protestacyjno-Strajkowym Regionu Śląsko-Dąbrowskiego, Katowice) (in Polish)*. [Online:] <https://www.gov.pl/web/aktywa-panstwowe/porozumienie-w-sprawie-transformacji-i-przyszlosci-gornictwa-podpisane> [Accessed: 2021-12-08].
- Balance... 2021 – *Balance of mineral resources in Poland as of 31.12.2020 (Bilans zasobów złóż kopalin w Polsce wg stanu na 31.XII.2020 r.)* Warszawa: PIG-PIB (in Polish). [Online:] [http://geoportal.pgi.gov.pl/css/surowce/images/2020/bilans\\_2020.pdf](http://geoportal.pgi.gov.pl/css/surowce/images/2020/bilans_2020.pdf) [Accessed: 2021-12-08].
- Bąk, P. 2018. *Technical and economic planning of mining production in strategic terms – selected issues (Planowanie techniczno-ekonomiczne produkcji górniczej w ujęciu strategicznym – wybrane zagadnienia)*. Kraków: AGH (in Polish).
- Dittmann, P. 2003. *Forecasting in the enterprise. Methods and their application (Prognozowanie w przedsiębiorstwie. Metody i ich zastosowanie)*. Kraków: Oficyna Ekonomiczna, Oddział Polskich Wydawnictw Profesjonalnych (in Polish).
- Dubiński, J. and Turek, M. 2007a. *Hard coal mining forecast for the power industry (Prognoza wydobycia węgla kamiennego dla energetyki)*. [In:] Ściażko, M. ed. *Conditions for the implementation of zero-emission coal technologies in the energy sector (Uwarunkowania wdrożenia zero-emisyjnych technologii węglowych w energetyce)*. Zabrze: Wydawnictwo Instytutu Chemicznej Przeróbki Węgla (in Polish).
- Dubiński, J. and Turek, M. 2007b. *Accessibility of coal resources for the Polish power industry (Dostępność zasobów węgla dla polskiej energetyki)*. *Prace Naukowe GIG. Górnictwo i Środowisko 2* (in Polish).
- Fuksa, D. 2004. *Correction of the optimum production plan of a coal company with the use of post optimal analysis (Korekta optymalnego planu produkcji spółki węglowej z wykorzystaniem analizy postoptymalnej)*. *Wiadomości Górnicze* 55(10), pp. 429–434 (in Polish).
- Fuksa, D. 2016. *The forecast amount of extracted coal mine (Prognoza wielkości wydobycia kopalni węgla kamiennego)*. *Przegląd Górniczy* 72(8), pp. 29–32 (in Polish).
- Gawlik et al. 2010 – Gawlik, L., Majchrzak, H., Mokrzycki, E. and Uliasz-Bocheńczyk, A. 2010. *Prospects of hard and brown coal in Poland and in European Union (Perspektywy węgla kamiennego i brunatnego w Polsce i w Unii Europejskiej)*. *Przegląd Górniczy* 66(3/4) (in Polish).
- Gawlik et al. 2016 – Gawlik, L., Kaliski, M., Kamiński, J., Sikora, A. and Szurlej, A. 2016. *Hard coal in the fuel-mix of Poland: the long-term perspective*. *Archives of Mining Sciences* 61(2), pp. 335–350, DOI: 10.1515/amsc-2016-0025.

- Jonek-Kowalska, I. 2012. *Assessment of the possibilities of improving the efficiency of hard coal mining (Ocena możliwości poprawy efektywności wydobywania węgla kamiennego)*. [In:] Turek, M. ed. *Analysis and evaluation of costs in the hard coal mining industry in Poland in terms of improving the efficiency of extraction (Analiza i ocena kosztów w górnictwie węgla kamiennego w Polsce w aspekcie poprawy efektywności wydobywania)*. Warszawa: Wyd. Difin (in Polish).
- Karbownik, A. and Chroszcz, H. 1994. Production, sale and quality of hard coal in 1988–1993 and forecast for 1994–2003 (*Produkcja, sprzedaż i jakość węgla kamiennego w latach 1988–1993 i prognoza na lata 1994–2003*). [In:] Energy. Between supply and demand (*Energia. Pomiędzy popytem i podażą*) (in Polish).
- Karbownik et al. 1999 – Karbownik, A., Turek, M. and Starzak, Z. 1999. Prognosis of requirement on hard coal to the year 2002 (2020) in the light of inquiries (*Prognoza zapotrzebowania i sprzedaży węgla kamiennego do 2002 (2020) roku na podstawie badań ankietowych*). *Karbo* 1, pp. 10–15 (in Polish).
- Manowska, A. 2017. Analysis of the role of coal in ensuring the country's energy security and Poland's energy policy until 2050 (*Analiza roli węgla w zapewnieniu bezpieczeństwa energetycznego kraju a polityka energetyczna Polski do roku 2050*). *Przegląd Górniczy* 73(9), pp. 45–51 (in Polish).
- Peplowska, M. 2021. Coal supply prospects in Poland and Selected European Union Countries. *Gospodarka Surowcami Mineralnymi – Mineral Resources Management* 37(3), pp. 31–52, DOI: 10.24425/gsm.2021.138657.
- Poland's... 2021 – *Poland's Energy Policy until 2040 (Polityka Energetyczna Polski do 2040 r.)*, Warszawa: Ministerstwo Klimatu i Środowiska (in Polish). [Online:] <https://www.gov.pl/web/klimat/polityka-energetyczna-polski> [Accessed: 2021-12-08].
- Przybyła, H. 1991. The role of risk in mining production planning and its relationship with the strategy of mining works (*Rola ryzyka w planowaniu produkcji górniczej i jego związku ze strategią prowadzenia robót górniczych*). *Przegląd Górniczy* 4 (in Polish).
- Rybak, A. and Manowska, A. 2019. The forecast of coal sales taking the factors influencing the demand for hard coal into account. *Gospodarka Surowcami Mineralnymi – Mineral Resources Management* 35(1), pp. 129–140, DOI: 10.24425/gsm.2019.128203.
- Stala-Szlugaj, K. 2018. The demand for hard coal for households in Poland and the anti-smog bill. *Archives of Mining Sciences* 63(3), DOI: 10.24425/123692.
- Tokarski, S. red. 2021. *Energy transformation – the demand for primary energy sources by 2040 (Transformacja energetyczna – zapotrzebowanie na źródła energii pierwotnej do 2040 roku)*. Katowice: GIG (in Polish).
- Turek, M. and Jonek-Kowalska I. 2015. Development of Polish Coal Mining in the Light of Energy Demand Forecasts (*Rozwój polskiego górnictwa węglowego w świetle prognozowanych potrzeb energetycznych*). *Zeszyty Naukowe Politechniki Śląskiej, Seria Organizacja i Zarządzanie* 83, pp. 691–701 (in Polish).

#### THE PRODUCTION CAPACITY OF HARD-COAL MINES IN TERMS OF MEETING THE NEEDS OF THE DOMESTIC ENERGY SECTOR

##### Keywords

steam coal, transformation, forecast, demand, production

##### Abstract

In Poland, there is a growing awareness of the need to change the sources of electricity and heat. An expression of this is the adoption of the document entitled Poland's Energy Policy until 2040 (PEP 2040) in February 2020 by the Council of Ministers. The goal of the Polish Energy Policy until 2040 is “energy security – ensuring the competitiveness of the economy, energy efficiency and reducing the environmental impact of the energy sector – taking into account the optimal use of own



energy resources”. In PEP 2040, the previous assumptions of the state’s long-term energy policy were amended and an increase in the use of low- or non-emission sources was declared. In addition, the energy policy guidelines contain forecasts for the production of steam coal and the demand for this raw material.

Based on the provisions of the document, as well as forecasts of the coal-production volume prepared by the authors and the assessments of experts in the fields related to energy and mining, the article contains considerations on the validity of the developed forecasts together with the determination of the production capacity of domestic mining enterprises in terms of covering the demand for steam coal used for the production of electricity and heat. It is planned, inter alia, that blocks of coal-fired power plants will be decommissioned and, in their place, there is to be the expansion of solar and wind energy and the commissioning of the first blocks of a nuclear power plant. Such activities, which cause a decrease in the demand for coal, are also related to the plans of changes in the functioning of mining enterprises – there will be successive closures of individual mines and mining plants.

#### MOŻLIWOŚCI PRODUKCYJNE KOPALŃ WĘGLA KAMIENNEGO W ZAKRESIE ZASPOKOJENIA POTRZEB KRAJOWEJ ENERGETYKI

##### Słowa kluczowe

prognoza, produkcja, zapotrzebowanie, transformacja, węgiel energetyczny

##### Streszczenie

W Polsce narasta świadomość potrzeby zmian w zakresie źródeł pozyskiwania energii elektrycznej i ciepłej. Wyrazem tego jest przyjęcie w lutym 2020 roku przez Radę Ministrów dokumentu pn. Polityka Energetyczna Polski do 2040 r (PEP 2040). Celem Polityki Energetycznej Polski do 2040 r. jest „bezpieczeństwo energetyczne – przy zapewnieniu konkurencyjności gospodarki, efektywności energetycznej i zmniejszenia oddziaływania sektora energii na środowisko – biorąc pod uwagę optymalne wykorzystanie własnych zasobów energetycznych”.

W oparciu o zapisy dokumentu, a także prognozy wielkości produkcji węgla opracowane przez autorów oraz oceny ekspertów z dziedzin związanych z energetyką i górnictwem, w artykule zawarto rozważania dotyczące zasadności opracowanych prognoz, w połączeniu z określeniem możliwości produkcyjnych krajowych przedsiębiorstw górniczych, w aspekcie pokrycia zapotrzebowania na węgiel energetyczny wykorzystywany do produkcji energii elektrycznej i ciepłej. Przewiduje się, między innymi, wycofywanie z eksploatacji bloków elektrowni węglowych, a w ich miejsce rozbudowę energetyki solarnej i wiatrowej oraz uruchomienie pierwszych bloków elektrowni jądrowej. Działania takie, powodujące spadek zapotrzebowania na węgiel, są powiązane także z planami zmian w funkcjonowaniu przedsiębiorstw górniczych – dojdzie do sukcesywnej likwidacji poszczególnych kopalń i zakładów górniczych.

Artykuł został opracowany według stanu polskiej energetyki na 31.12.2021 roku. Aktualna sytuacja na rynku węgla, która pojawiła się w wyniku agresji Rosji na Ukrainę będzie, przedmiotem analizy kolejnego artykułu w ramach czasopisma *Gospodarka Surowcami Mineralnymi – Mineral Resources Management*.

