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PRESENT CONDITION AND PROSPECTS FOR POLISH COAL MINING

Arek Przybyłka¹, Andriy Manko²

¹ *University of Economics in Katowice,
1-go Maja St., 50, PL – 40-287 Katowice, Poland,
e-mail: arekp@ue.katowice.pl*

² *Ivan Franko National University of Lviv,
P. Doroshenko St., 41, UA – 79007 Lviv, Ukraine,
e-mail: manko_a@ukr.net*

Coal is the basis of energy production in Poland. Its production, however, has been steadily decreasing. Falling prices on world markets, which make their extraction in Poland, continues to pay off. You can not forget, however, that the country's energy security is based on this raw material all the time. Actions should be taken to limit the cost of extraction. It is necessary to start to use advanced technologies in coal combustion process and be aware of its other applications. With this in mind it is necessary not only to lead efforts to liquidate mines, but also to take corrective actions. Nowadays, coal mining is experiencing a setback. However, the resources that are in Poland do not allow you to abandon this energy source. In the coming years we can expect an increase in demand for coal. Polish power industry in the coming decades will be based, as at present, on carbon. In line with the Polish Energy Policy until 2050 Poland should strive for energy independence and therefore the indigenous resources of coal and lignite will stabilize country's energy security. Consumption of coal will remain at current levels, due to improvements in the efficiency of new generation units. Therefore, the aim of the suggested actions should be providing both the security of energy and the rational use of available resources of coal.

Key words: coal, energy, Polish mining.

Coal besides lignite, natural gas and crude oil is the primary source of energy not only in Poland but also around the world. It is the most accessible fossil fuel on the international energy market. Coal is mined in 50 countries and identified resources are in 70 countries. Proven energy reserves of this resource are 5 times larger than oil and almost 2,5 times larger than the reserves of oil and natural gas combined [11, p. 19]. According to the conservative estimates by the International Energy Agency at the current rate of extraction of proved reserves, this raw material should be sufficient for at least 150 years. Moreover, forecasts indicate that the oil reserves will be exhausted in the next 40 years while natural gas over the next 65 years [12, p. 39]. China is a leading producer of this raw material in the world. However, the largest resources are found in the USA. Poland in the European Union is the largest manufacturer having extraction higher than in all other member states put together.

Poland because of its considerable resources of coal based its just-carbon energy on coal, mainly on hard coal [7, p. 28]. Poland is a country which has one of the world's highest shares of coal in electricity production. Coal provides 87 % of energy produced in Poland including most of the coal. Research shows this structure in the coming years will not change. To the European Union countries where the share of coal in power generation is very large we include: the Czech Republic – 51 %, Greece – 54 % and Germany – 41 % [13]. In addition, we must remember that coal accounts for about 30 % of global demand for primary energy. It is made

into 41 % of the world's electricity and is used for the preparation of 70 % of the world's steel. High share of coal in electricity generation is a strong current and future dependence on this commodity because the changes in energy production are long-term, capital intensive and difficult to carry out in the whole economy. The existence of markets depending on the supply of coal is in turn a guarantee of at least several years to maintain demand for this raw material [1, p. 53].

World production of hard coal shows a steady growth. In the postwar period since 1946 till 2009, it increased almost five fold [2, p. 9]. In 2013, the world production of coal increased by 2,9 %, compared to 2012, and Poland found itself in the 11th place among coal producers [14].

Despite limited resources of other energy sources in the European Union, it is expected that coal will maintain its position. Production of electricity from coal is also relatively cheap. According to the Massachusetts Institute of Technology, coal is the cheapest source of electricity generation. 1 MWh costs in the case of coal 62 \$, nuclear energy is the cost of 84 \$, while in the case of renewable energy it is over 100 [15].

In terms of primary energy, the European Union ranks the third in the world after the USA and China. However, in recent years in the European Union has been reduced extraction of coal mining and natural gas, therefore the level of dependence on external energy supply increased. Confirmation of this fact is change in index level of dependence on imports of all energy resources: in 1999 – 45,1 %, in 2012 – 53 %. In connection with the systematic decline in coal mining, the European Union countries with each successive step increase its import. It is shown in Table 1.

Table 1
Import of hard coal by countries of the European Union in the years 2009–2011

Country	2009	2010	2011
Germany	36,8	40,0	44,2
Great Britain	38,1	25,9	31,7
Italy	22,0	22,7	24,0
France	16,2	19,3	15,3
Spain	17,1	12,8	15,3
Poland	10,0	10,0	15,1
Netherlands	10,8	11,8	11,1
Finland	6,0	5,9	7,0
Denmark	4,4	4,1	6,1
Belgium	4,1	3,5	4,0
Austria	4,0	4,0	3,8
Portugal	3,1	2,7	3,6
Slovakia	3,2	3,5	3,4
Bulgaria	3,5	2,9	3,3
Sweden	2,4	3,0	2,7
Czech Republic	1,7	1,9	2,4
Ireland	2,3	2,2	1,9
Hungary	1,4	1,8	1,5
Romania	1,2	1,4	1,2
Other countries	1,2	2,3	0,3
Total imports to the EU 27	189,5	181,7	197,9

Source: <http://www.giph.com.pl/giph/index.php/wydawnictwa/archiwum-materialy/202-swiatowe-gornictwo-wegla-kamiennego>

The largest amount of coal is imported from Russia. The largest importers in the European Union are Germany and the UK. Poland also imports coal. Polish participation in coal production in the European Union amounts to 62 %. Poland, however, due to high costs of production of this raw material, limits coal production that makes the European Union countries increase import from other regions where coal can be bought cheaply. Outside our country the mainstream of mining can be found in among the countries of the European Union in the UK, Germany and the Czech Republic [10, p. 252]. Russia is one of the major European producers in the world. At present Russia is on the 7th position in the world. In 2014, in the framework of export to the European Union countries and to countries outside the European Union, Poland has sold more than 7 million tones of coal. It has sold mainly energy coal. Structure of export in 2014 to the markets of the European Union is shown in Table 2.

Table 2

The export of hard coal from Poland to the European Union counties in 2014 (in tones)

Country	Coal Total	In this	
		for energy purposes	for cooking
Austria	882 419	667 551	214 868
Belgium	436	436	0
Czech Republic	2 036 536	674 514	1 362 022
Demark	364 754	364 754	0
Finland	182 652	182 652	0
Spain	13 365	13 365	0
France	175	175	0
Ireland	139 830	139 830	0
Germany	2 256 947	2 256 947	0
Romania	36 423	36 423	0
Slovakia	450 403	175 169	275 234
Slovenia	5 423	5 423	0
Sweden	73 100	73 100	0
Hungary	45 297	7 986	37 311
Great Britain	144 526	144 526	0
Italy	25	25	0
TOTAL EXPORTS	6 687 278	4 797 843	1 889 435

Source: *Informacja o funkcjonowaniu górnictwa węgla kamiennego w grudniu oraz w 2014 roku*. Ministerstwo Gospodarki, Warszawa 2015, s. 10.

In 2014, the largest recipient of Polish hard coal among the European Union countries was Germany. Outside the European Union we exported 1 083 835 tones (from this 979 246 tones of energy coal and 104 579 tones of coke coal). Among countries outside the European Union, the largest amount of coal from Poland bought Morocco and Ukraine. The role of the Polish hard coal in the European Union will depend on Polish producers. However, maintaining an adequate level of costs will allow on the competition on the common European Union market with imported coal by the countries of the European Union from other directions as well as to compete with other energy sources. This should prompt to take action that could increase the efficiency of Polish mining because of its rich natural resources of coal as an important element of the energy security of both the country and the entire European Union.

The Commission of the Council and the European Parliament suggest that coal will cover 25 % of global demand for primary energy. Referring to estimates according to which the demand for energy will increase over the next twenty years over 60 %, an increase in the exploitation of this raw material should be similar [8, p. 3]. Therefore, it can be assumed the role of hard coal in the fuel and energy of Polish balance will be decisive in the nearest future, and in further term it will not lose so much of its meaning. This will depend on the European Union policy to reduce emissions of carbon dioxide and other gases through the realization of the so-called climate-energy package, which envisages the following objectives for the European Union by 2020:

- reduce emissions of greenhouse gases by at least 20 %,
- increase the share of energy from renewable sources in final energy consumption to 20 %,
- increase energy efficiency by 20 % [1, p. 54].

In Poland it is recognized, however, that considerable coal resources will serve as a vital stabilizer of national energy security, which is of particular importance to the Polish economy from dependence on gas imports (over 70 %) and crude oil (over 95 %). Energy policy will focus on the diversification of supply of raw materials and fuels, understood as diversification of technology rather than as a recent diversification of supply. The development of technology will be supported by enabling to obtain liquid and gaseous fuels from domestic raw materials. Due to the gradual depletion of coal and lignite in the currently producing fields it is planned to 2030, preparation and commencement of operation of new deposits. For this reason, it is necessary to secure access to strategic resources of coal, among other, by protecting areas where they occur before further infrastructural development not related to energy and the recognition of the concept of national spatial planning, local zoning plans and long-term development strategy [9, p. 9].

Development of coal mining, however, depends on many factors among which are:

- the availability of the resource base,
- risks conditioning the safe extraction of coal,
- technical and organizational state mines,
- the social impact of mine operations,
- the economic viability of mining production [3, p. 39].

Basis for building energy strategy should provide access to energy sources and use of existing potential. State's energy policy thus assumes the use of coal as the main fuel for the power sector in order to guarantee a degree of energy security of the country. Specific objectives in this area are:

- ensuring the energy security of the country by satisfying the domestic demand for coal, guaranteeing stable supplies for customers and the required quality parameters,
- the use of coal by using efficient and low-carbon technologies including coal gasification and processing into liquid or gaseous fuels,
- use of modern technologies in the coal sector to increase the competitiveness, work safety, environmental protection, and to underpin the technological and scientific development,
- maximum utilization of methane released during coal extraction in mines.

To meet these aims the following activities will be taken:

- introducing regulations taking into account objectives of the proposed energy policy and in particular incentive instruments to carry out the preparatory work and maintain appropriate extraction capacity,
- development of modernized coal preparation technologies for energy use,

- the abolition of legal barriers in order to make available new deposits of coal and lignite,
- identification of national strategic resources of coal and lignite and their inclusion in spatial planning,
- securing access to coal reserves through implementation of projects in the range of industrial development of new proved reserves as a strategic public purpose investments of local significance,
- intensification of geological research in order to increase the resource base of coal using modern techniques of exploration and reconnaissance,
- completion of existing structural and organizational changes, where economically justified allowing the possibility of creating capital groups on the basis of coal and energy companies with the principals of social dialogue,
- support for economic utilization of methane released during coal extraction in coal mines,
- the introduction of technological solutions for the use of methane from the ventilation air discharged from coal mines,
- raising funds for the development of mining through privatization of coal companies after consultation with the social sphere. The legitimacy of privatization, volume and time of debut will be analysed in terms of achieving the objectives of energy policy,
- supporting research and development on technologies to use coal to produce liquid and gaseous fuels, reducing the environmental impact of processes of obtaining energy from coal and in terms of carbon fuel cells,
- maintaining by the Minister of Economy of existing competence of the minister responsible for the Treasury in relation to mining companies [9, p. 10–11].

Large reserves of coal give as already mentioned a sense of energy security but also the disadvantages are high costs resulting from its combustion. Coal mining rises a number of environmental challenges including soil erosion, dust, noise, water pollution and the impact on local biodiversity. The disadvantage is also a low efficiency of chemical energy into thermal energy as well as irreparable damage of raw material that in the future could be used for other purposes. Steps are taken to modernize coal mining and to minimize the negative effects. Therefore, we are looking for other solutions among other by improving efficiency in existing energy systems and the search for clean coal technologies. Clean coal technologies can concern the following interrelated sub-areas:

- extraction of coal mining and its processing,
- transport and its storage,
- the use of coal,
- recycling from the extraction and the use of coal.

According to the World Coal Institute, reduction of emissions of CO₂ during combustion can be made in the following way:

- reduction to 5 % is possible by improving the quality of coal (enrichment processes),
- reduction to 22 % can be achieved by improving the efficiency of existing power plants,
- reduction to 25 % can be obtained by the use of new technologies in power plants,
- reduction to 99 % it is expected with the use of zero emission technology where rising carbon dioxide is captured and stored [2, p. 38-39].

In Poland the transition from a central planned economy to a market economy it was associated with numerous changes which effectively showed very low profitability of Polish mining. Since 1989, there were undertaken various recovery programs which resulted in reduction of employment in mining up to one hundred thousand persons in 2014, from over

415 thousand in 1989. Reforming meant closing further coal mines even those with significant reserves of coal. In recent years, the production of coal in Poland decreased by several million tones per year. Now the size of mining approached the level of production from the mid-20th century. Like coal mining throughout Europe has been dropped. In years 2000 – 2011, in the European Union the extraction of coal decreased by 20 %, in Poland by 14 % [6, p. 204]. It was aimed at improving economic efficiency in industry. These actions caused that the extraction of coal in Poland decreased to 70,5 million tones in 2014, from over 177 million tones in 1989. Main reasons for the decline of coal mining in Poland are following:

- closing unprofitable mines,
- the use of energy-efficient technologies and raw materials saving in different industries and exploitation different sources of energy,
- more costly domestic coal in comparison with exports,
- the cause of political and populist (significant increase in wages miners unresponsive to increase to their performance of works),
- relatively low labour productivity miners,
- environmental considerations (reduction carbon dioxide emissions) [11, p. 24].

At present there are 48 coal deposits as reserves developed whose resources are 16,9 billion tones which represents 37,4 % of the balance sheet (balance resources are 451 billion tones). This represents a 70 % of deposits located in the countries of the European Union. Resources are located in two basins:

- Upper Silesian Coal Basin which covers an area of about 5600 square kilometres thus constituting 79,1 % of proved reserves balance in Poland,
- Lublin Coal Basin extending the area of 9100 square kilometres thus constituting 20,9 % of proved reserve balance of coal [7, p. 32].

As a result of many years of industry transformation and subordination by the Ministry of Economy remained several entities currently engaged in mining activity. Coal Company which is now Europe's largest mining company. It was established in 2003. It takes the 14th place in the ranking of the largest Polish enterprises. It comprises of 15 coal mines. The second place in terms of size takes JSW (Polish coal mining company), which was established in 1993. It occupies the 19th place on the list of the biggest Polish companies. Its membership includes 4 mines. Another entity is Katowice Coal Holding, which was established in 1993. At present it includes 4 mines and one belonging to the Capital Group Katowice.

Apart from these entities extraction of hard coal in Poland is still led by:

- South Coal Concern SA established in 2005. It includes two mines,
- Lublin Coal Bogdanka SA,
- Mining Plant Siltech limited liability company – the first private coal mine extracting coal since 2002,
- EKO-PLUS limited liability company operating since 2001,
- The mining company "Silesia".

The main elements that disturbed the process of reforming the structure of mining are the customers and the network of informal links between the main customers of the branch [4, p. 205]. It causes that the costs in mining continue to grow. The cost of production in 2014, rose by 2,2 % in relation to 2013. Looking at the cost structure in operating coal mining its prominent role have salaries with social security and other benefits. They absorb almost 48,7 % of costs. Apart from the remuneration the largest proportion on production costs of coal have external services 17,6 % [5, p. 20]. Cheaper coal from other countries forces mines to rationalize costs.

Therefore, properly carried out restructuring has a huge impact on the effective functioning of this sector. Mining capabilities must be adjusted to market conditions. However, in the case of Poland restructuring of the industry that was related to the limited resources allocated to investments contributed to a significant reduction in coal extraction. It is important that such preparatory work should be conducted in such a way to make it possible for a flexible response to market demand. For the next few years, considerable investments have been planned in order to reduce the price of coal. However, the economic slowdown could cause the failure of these plans. The net financial result of coal mining for 2014, was negative and amounted 1 342,7 million PLN. Compared to the same period in 2013, in which net profit for coal mining was also negative and amounted to -292,7 million PLN, there was deterioration of 1 050,0 million PLN [5, p. 27]. Current goal of state policy in relation to the mining sector should be rational and effective management of deposits located on the territory of the Republic of Poland, in such a way that these resources could be used by next generations of Poles. In order to obtain the objectives of such a strategy it is predicted among other:

- ensuring energy security for the country by satisfying the domestic demand for coal to produce liquid and gaseous fuels,
- maintaining the competitiveness of Polish hard coal in the free market economy,
- ensuring stable supply of hard coal of good quality to domestic and foreign customers,
- the use of modern technologies in the coal sector to increase price competitiveness, work safety, environmental protection and to create a basis for the technological and scientific development in particular the region of Silesia and Lesser Poland [5, p. 1].

Coal has an important role to play in meeting the demand for safe energy. Domestic coal resources enable economic development and can be transformed to protect against import dependency and price fluctuations of other sources of energy. Coal is in fact quite affordable source of energy. Coal prices are cheaper and more stable in the long term than the prices of oil and gas. Coal is likely to remain the cheapest fuel for electricity production in many developed countries over the next few decades.

The functioning of Polish hard coal mining is not just an internal matter of our country. Polish mining became a part of the global economy. Poland has the sovereign right to decide about the fate of mining but as a member state should be guided by the European Union policy. Rate energy security understood as a ratio of energy produced from indigenous raw materials rather than energy from imported fuel in Poland it is definitely better than in the European Union. We should not give up our resources through increasingly bigger limiting production and closing consecutive mines. We must remember that beyond undisputed benefits flowing from coal as still the most effective, the cheapest source of energy supporting on coal as a primary source of energy, it is not only jobs in the energy sector but also in mining. It can be assumed with high probability that with the current technological advancement and the other energy resources coal will continue to be one of the main energy products in Poland in the coming years.

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СУЧАСНИЙ СТАН ТА ПЕРСПЕКТИВИ ВИДОБУТКУ КАМ'ЯНОГО ВУГІЛЛЯ В ПОЛЬЩІ

Арек Пшибилка¹, Андрій Манько²

¹ Економічний університет в Катовіцах,
вул. 1-го Мая, 50, 40-287, м. Катовіце, Польща,
e-mail: arekr@ue.katowice.pl

² Львівський національний університет імені Івана Франка,
вул. П. Дорошенка, 41, 79007, м. Львів, Україна,
e-mail: manko_a@ukr.net

Вугілля є основою виробництва енергії в Польщі. Однак його виробництво неухильно скорочується. З урахуванням зниження цін на вугілля на світових ринках необхідно вжити заходів, які б забезпечили видобуток вугілля в Польщі на економічно вигідних умовах. Не можна забувати, що енергетична безпека Польщі досі залежить від цієї сировини.

Потрібно вжити заходів щодо обмеження вартості видобутку вугілля, перейти на використання передових технологій у процесі його спалювання тощо, не тільки ліквідувати шахти, а й приймати превентивні дії щодо виправлення негативного стану. Сьогодні видобуток вугілля

зменшується. Проте ресурси, які є в Польщі, не дають змоги відмовитися від цього джерела енергії. Найближчими роками можна очікувати збільшення попиту на вугілля. Польська енергетика в найближчі десятиліття працюватиме на вугіллі. Відповідно до енергетичної політики держави до 2050 р. Польща повинна прагнути до енергетичної незалежності, тому власні ресурси вугілля та лігніту стабілізують енергетичну безпеку країни. Споживання вугілля буде на нинішньому рівні, що пов'язано з підвищенням ефективності його видобутку і переробки. Отже, метою запропонованих заходів має бути забезпечення енергетичної незалежності і раціонального використання наявних ресурсів вугілля.

Ключові слова: вугілля, енергетика, гірничодобувна промисловість Польщі.