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Mining Industry in Poland

Key words: mining, mineral resources, raw material production

Abstract

The presence and size of resources of major Polish minerals with regard of raw material groups are characterized in the paper. The present volume of production in every raw material group as well as employment level in different branches of Polish mining industry are given. The attention was paid on the development trends in mining industry with reference to the market situation and proprietary transformation in this branch of industry.

Introduction

Poland is a country relatively rich in natural resources. There are numerous deposits which may be categorized in four groups: energy, metallic, chemical and stone raw materials. The economic importance of those groups is different, however the role of energy raw material is especially vital due to providing the primary energy for the national economy. The raw materials capacity of Poland considering their four groups and the most important ones is presented in table 1.

Location of the most important regions of raw materials occurrence in Poland is showed on Fig. 1. Distribution of stone raw materials is not presented there. Most of them occurs evenly on the area of the whole country. The location of the most important regions of power, metallic and chemical raw materials is related with the geological structure of Poland. Across the area of central and east Poland, along the line connecting Koszalin and Lublin, runs one of the major tectonic borders in Europe, being the deep geofracture, defined as the Teisseyre-Tornquist (T-T) zone. East from T-T zone there is a wide-spread area of East-Europe platform built of Precambrian crystalline rocks, on which lay, almost horizontally, the Paleozoic and Mesozoic sediments. The area west from the T-T zone is composed of tectonic blocks built of different age Paleozoic rocks, which are deformed by folds and faults network covered by the Variscan rock-mass. Many important deposit area are placed on the west side of this tectonic fracture.

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Table 1
Number of deposits, indicated mineral resources and production of the most important minerals in Poland in 2010 (million tons, natural gas billion m³)
[2 – changed]

Raw material	Number of deposits			Mineral resources			production	
	total	operated		as for 31.12.2010	operated	+ increase - loss	as for 31.12.2011 [6]	
		number	2009=100				number	2010=100
Energy								
Natural gas	280	190	101	145.15	120.89	-1.66	5.50	94.18
Crude oil	82	66	97	25.24	24.66	-0.64	0.61	101.0
Lignite	86	11	100	19 818.88	1 686.54	+4 959.92	62.84	109.50
Hard coal	143	48	102	45 143.86	16 851.68	+ 914.39	75.552	106.90
Coal bed methane	52	23	100	90.00	25.73	+ 0.05	0.30	93.00
Metallic	35	9	100	2 383.58	1 457.58	-39.57	24.90	97.61
Zinc and lead ores	20	3	100	79.87	20.28	-10.54	2.46	104.21
Copper ores	14	6	100	1 752.88	1 437.30	-29.03	31.24	134.40
Chemical	49	10	100	86 523.71	12 606.24	-31.33	4.30	112.86
Sulfur	18	5	100	513.89	28.01	-1.13	0.68	234.47
Rock salt	19	4	100	85 334.51	12 506.14	-30.18	3.97	128.32
Stones and other	11 075	3 760	108	57 646.97	17 599.14	+1 003.22	291.00	112.83

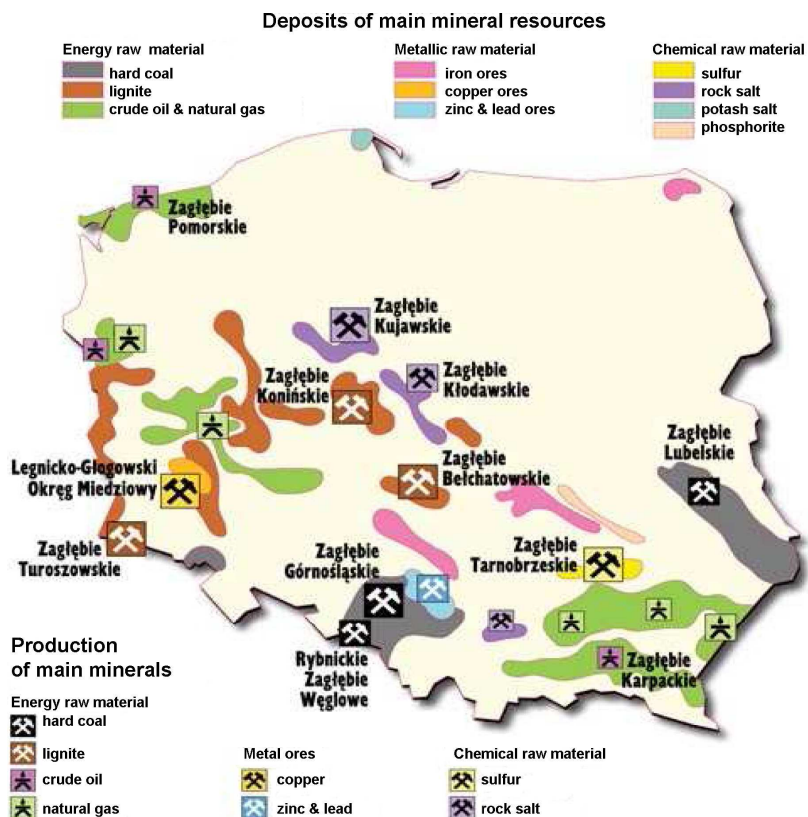


Fig. 1. Location of the major areas of natural resources occurrence in Poland [4]

Hard coal

Intrinsically economic resources of hard coal in Poland amount over 45.1 billion tons, while the resources of 48 deposits being mined – over 16.8 billion tons [1]. At present the hard coal is mined in thirty mines of Upper Silesian Coal Basin and in one mine of Lublin Coal Basin. Until 2000 the hard coal was also mined in the Lower Silesian Basin, but the extraction was stopped due to difficult geological and mining conditions, resulting in the mining unprofitability. About 3/4 of hard coal reserves are the power station coals while 1/4 – are the coke coals. Hard coal production increased during the last year and in 2011 amounted 75.5 million tons [6]. The hard coal mines since the beginning of political changes are restructured, what is combined with employment reduction. The current level of employment is about 111 000 people [6]. At the same time the import of hard coal rises (14 million tons in 2010), while the export volume declines successively.

Lignite

Indicated mineral resources of lignite in Poland in 2010 amounted 19.8 billion tons, including 0.8 billion tons of bituminous coal, about 2 513 million tons of briquette coal and about 1 496 million tons of carbonized coal, however the whole reserves are used and found as power station coals. The biggest and the most important lignite deposit is Bełchatów, located close to Piotrków Trybunalski. More than 58% of domestic production comes from this place. The remaining country demand for the lignite covers the production from Turów deposit (near Bogatynia) and from open pits (deposits) Pątnów and Adamów located near Konin. In 2011 the lignite output was 62.8 million tons, at the employment of 12 800 people.

Natural gas

The major region of natural gas deposits occurrence is the Polish Lowland (over 69% of resources). Natural gas deposits are also known from the Carpathian foreland (25.5% of resources). Small reserves occurs also in small deposits in Carpathian Mountains and in Polish Baltic economic zone. In 2010 the level of mineable resources of natural gas were 147 393 billion m³ and in comparison with the previous year they were smaller by 1 664 billion m³. In 2011 the natural gas production from the deposits with confirmed and estimated reserves was 5.5 billion m³. The gas production covers about 40% of domestic demand and there are opportunities for its increase.

Currently in Poland the initial explorations and prospecting works aimed to find and confirm the shale gas and tight gas deposits are carried out. Preliminary, possible errors laden forecasts concerning the reserves of both types of gas

are promising but they must be verified by test results. The reliable figures have to be based on the analyses of the decrease of gas inflow into the boreholes during at least 1-2 years of the concession block working.

Crude oil

In 2010, 82 crude oil fields – 29 in the Carpathian Mountains, 11 on the Carpathian foreland (foredeep), 40 on the Polish Lowland and 2 in Polish Baltic economic zone, were explored in Poland. Deposits occurring in the Carpathian Mountains and on its foreland have very long pastness, it is the area of the oldest crude oil mining in the world. Now the reserves of those fields are almost exhausted. Currently the most economic importance have the crude oil fields occurring on the Polish Lowland. In 2010 the mineable reserves of the fields on the Polish Lowland accounted for almost 74.5%, and reserves of Polish Baltic economic zone represented 20.5% of domestic reserves. In some crude oil fields the gas components, forming the oil condensate, are dissolved.

In 2010 the level of mineable, indicated resources of crude oil and oil condensate was 25.78 million tons and was lower than in previous year by 0.51 million tons, mainly as a result of extraction.

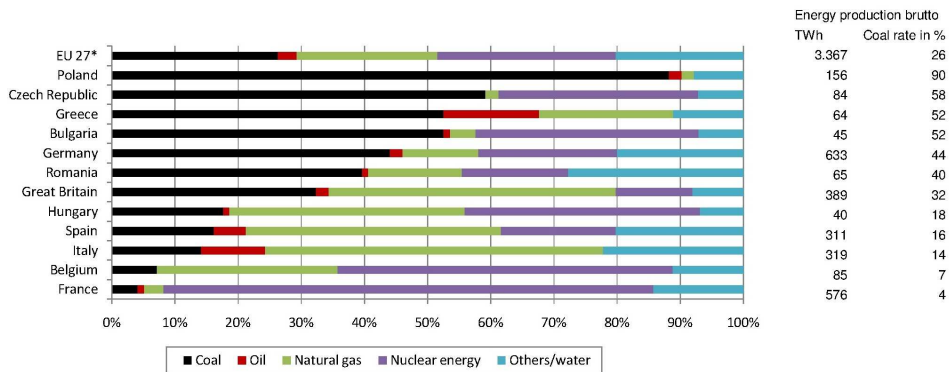
Production of crude oil and oil condensate in 2011, from the fields on the land and on Polish Baltic economic zone (off shore), was about 611 000 tons. In 2010 import of crude oil reached 22 088 million tons and was bigger than in the previous year by 2 138 million tons. Over 4250 people are employed in the Polish crude oil and gas industry.

Coal bed methane

Coal bed methane (CBM) occurs in 52 deposits of the Upper Silesian Coal Basin, in the form of gas particles absorbed on coal grains. During last years the technology of winning the methane using the surface boreholes was developed and it is regarded as acquisition of gas from unconventional source. Mineable reserves amount 90.0 billion m³. In 2011 the methane production was 300 million m³. At the same time the volume of methane emitted to the atmosphere from the hard coal deposits of the Upper Silesian Coal Basin, having the proven methane reserves, was about 481.5 million m³.

In 2009 gross power energy production in Poland was 152 TWh. Over 88% (about 133.8 TWh) came from combusting the coal in professional power plants, what means the fall by 2% in relation to the previous year. More than 55% (83.6 TWh) is the energy from combusting the hard coal, while 33% (50.2 TWh) from the brown coal. In the same year the share of coal combustion in European Union for producing 3210 TWh of gross power energy was 26% and did not change in relation to 2008. Figure 2 presents the structure of power energy production in some EU countries in 2008.

Due to the known problems in natural gas and crude oil import and only initial stage of prospecting the unconventional gas resources as well as no real perspectives for finding the big own crude oil fields, the same proportions in fuels consumption will be maintained during the next dozen years. In the face of predicted increase of Polish economy demand for power energy (even at constant decrease of its energy consumption) it means the necessity of maintaining and developing the coal production level and introducing new, high efficient and environment save combusting methods or other technologies.



*Peat and bituminous shale included in the item "Others/water"

Status: 06/2010

Source: EUROSTAT - Energy/Statistical Yearbook 2008

Fig. 2. Structure of power energy production in selected European Union countries [3]

Copper and silver ores

Polish copper deposits are of the sedimentary type and occur in Lower Silesia on the Foresudetic Monocline and in northern Sudetic syncline. The deposits occur in Zechstein formation of copper bearing shales. Copper mineralization is related with Zechstein Kupferschiefer, underlying sandstones and upperlying dolomites. The deposit area (60 km long and 20 km wide) on the Foresudetic Monocline extends from Lubin on the south-east to Bytom Odrzański. It is practically one deposit extracted by four mines – Lubin, Polkowice-Sieroszowice and Rudna, owned by KGHM Polska Miedź S.A., the biggest employer of the Lower Silesia, employing in the core operations (mines, smelters and refineries, processing plants, tailings pond, the total of 12 500 people, and in the whole KGHM capital group – 31 000 people [5].

In 2010 copper ore extraction was 31 249 000 tons. The following metals are recovered from the copper ores during their processing: Cu, Ag, Au, Ni, Pb, Pt-Pd, Se, Re. The biggest economic importance has the recovery of copper and silver. Most of silver is exported. According to the information from KGHM Polska Miedź S.A. [5] in 2010 electrolytic copper production was 547 100 tons. More over 1 161 tons of silver, 902 kg of gold and 23 700 tons of lead were produced. It must be mentioned that KGHM Polska Miedź S.A. is the world's second silver producer.

Zinc and lead ores

The traditional region of zinc and lead deposits, having the occurrences of economic importance, is the north and north-east periphery of the Upper Silesian Coal Basin. The industrial importance have mainly the ores connected with so called ore-bearing dolomites of Middle Triassic (Muschelkalk). The ores occur as pseudobeds, horizontal lentils and nests. Silesian-Cracow region is considered as the world's biggest area of Missisipi Valley type (MVT) Zn-Pb ores occurrence.

In 2011 zinc and lead ores production in Poland was 2 460 000 tons, containing 89 000 tons of zinc and 35 000 tons of lead at the employment amounting 1150 people. Domestic mine zinc and lead production is not sufficient for the demand of processing industry thus there is a need of importing the concentrates.

Iron, titanium and vanadium ores

In the 20th century iron ores were extracted in Poland in many mines located near Częstochowa, Kielce and Łęczyca. They were the ores occurring in sedimentary rock in the form of siderites or iron bearing sandstones. They were mined out or considered as not potentially economic due to not meeting the criteria requirements.

In the Suwałki Proterozoic massive occur the deposit of vanadium bearing magnetite-ilmenite ores. They were found and explored in seventies of 20th century on the depth of 850-2300 m. The discovery of huge resources of that type ores all over the world, occurring on the small depth, especially in RSA indicated that possible management of Suwałki ores cannot be taken into consideration in the predictable future. Possible mining is considered as highly dangerous for the environment. The deposit must be regarded as an interesting geological object without any practical meaning. Thus in Poland there are not practically any iron ores.

Sulfur

Deposits of native sulfur occur in the north part of the Carpathian Foredeep close to Tarnobrzeg (Osiek, Baranów, Machów, Jeziórko deposits), Staszów (Solec and Grzybów deposits) and Lubaczów (Basznia deposit). Sulfur occurs in Tertiary sediments (Miocene-Tortonian), mainly in post-gypsum limestones, in the form of filling small caverns and cracks. The average content of sulfur in the rock 25-30% (max. 70%). Until recently Poland was one of the world's major sulfur producers. However the development of method of sulfur recovery from the sulfated gas and crude oil fields reduced substantially the importance of native sulfur deposits. Production of native sulfur is now carried out only from Osiek deposit using the borehole method. It is the last big mine of native sulfur in the world, employing about 460 people. Except that mine the small amounts of native sulfur are won from the volcanic deposits. Four fields of sulfated crude oil and natural gas were found in Poland. Their total reserves amount 678 000 tons of sulfur.

Rock salt

Rock salt occurs in Poland in two saline formations: Miocene and Zechstein. The basic source of rock salt is now the Zechstein salt bearing formation, spread on the 2/3 of Poland area mainly on Polish Lowland. Bed deposits of rock salt were explored to the depth of 1000 m on the periphery of this basin, on Łeba elevation and in the foresudetic region. Estimated reserves of those deposits are almost 25 billion tons, what is 29.2% of the domestic rock salt resources. In the axial part of the basin (central Poland), salt formations covered by the up to 7 km overburden, were locally uplifted forming the zone of salt dome structures spread from Wolin to Bełchatów surroundings. In numerous, the most shallow structures, the rock salt and potassium and magnesium salt were explored. The confirmed reserves of Zechstein salt are 56.02 billion tons, what is 65.6% of domestic resources. 94% of the domestic rock salt production comes now from those deposits. Bed deposits of Zechstein rock salt were found in the copper deposit cover on the Foresudetic Monocline (for example Sieroszowice deposit). In explored there Kaźmierzów deposit, mining of the rock salt from the oldest bed is currently carried out during the prospecting and opening works. In 2010 over 525 270 tons of rock salt were mined there. In 2011 2 713 700 tons of salt were extracted from the mines winning the brine using the borehole method (Góra i Mogilno), what is 65.7% of domestic rock salt production and 1 254 500 tons of crushed salt were extracted from Kłodawa mine. Employment in rock salt industry in Poland is 981 people.

On the area of Poland, within the Zechstein salt bearing formation, the potassium and magnesium salts occur as well. The reserves of 5 explored deposits are over 669 million tons, most of them (4) are of sulfate type (polyhalite), occurring close to Gulf of Puck. These deposit are not mined.

Stone raw materials

Hard rocks (i.e. dolomites, gypsum and anhydrite, building and road stones, magnesite, feldspar raw materials, limestone and marl for cement and lime industry), aggregates (including sands and gravels), clay raw materials (for building ceramic production, kaolin) are recon within this group of raw materials in Poland.

Industry of stone raw materials mining is the branch with the highest level of privatization in Poland. Big, often owned by large international corporations (Lafarge, Heidelberg Cement, Colas and others) as well as (mostly) medium and small companies operate in this branch. Privatization and consolidation process forced the organizational and technological changes what resulted in its high up-to-dateness and efficiency.

Dolomite

Most of pure dolomite deposits occur on the areas of Silesia, Lower Silesia and Małopolska provinces. The raw material from that deposits has the highest quality parameters and meets the economic criteria of metallurgical industry. These are bed deposits of Devonian or Triassic age like for example Żelatowa, Brudzowice, Żąbkowice Będzińskie. Deposits of dolomite used in ceramic industry occur also on Lower Silesia. Those dolomites occur in the form of lentils in metamorphic schist. The most know deposits are located close to Jelenia Góra (Rędziny) and on the area of Kłodzko Valley. Dolomites production in 2010 was 3 102 000 tons and increased in relations to previous year by 163 000 tons.

Gypsum and anhydrites

Calcium sulfates (gypsum and anhydrite) deposits occur in Poland in Miocene and Zechstein evaporate formations, together with salt deposits (rock salt and potassium-magnesium salts). Their intrinsically economic resources in 15 explored deposits were over 257 million tons in 2010 while the reserves in 5 deposits being extracted – almost 125 million tons. Deposits of Miocene gypsum having the economic importance are located mainly along the north edge of the Carpathian Foredeep (especially in Nida valley). Among the currently mined deposits of this region are Borków-Chwałowice and Leszcze. Explored deposits of Zechstein calcium sulfates

occur also on Lower Silesia. Three deposits, i.e. Lubichów, Nowy Łąd and Nowy Łąd-Pole Radłówka, are extracted currently. Gypsum and anhydrites production in 2010 was about 1 179 000 tons (gypsum from 3 deposits – ca. 1 012 200 tons and anhydrite from 3 deposits – ca. 167 065 tons). Moreover the waste gypsum is produced during the process of exhaust gases desulfurization in power plants.

Building and road stones

This group of stone raw materials included 33 lithological types of magmatic, sedimentary and metamorphic rocks, having the specific properties which determine their economic usage. From the stones meeting the special criteria the crushed aggregates are produced for road and building industry as well as stone elements for roads construction (bricks, flags, kerbs) and building industry (blocks, slabs, wall stones). Magmatic and metamorphic rocks occur mainly on the area of Lower Silesia (basalts, granites, gabbros, syenites, melaphyres, porphyries, amphibolites, gneisses, migmatites, serpentinites, marbles) and in some deposits in Małopolska province (diabases, melaphyres, porphyries, phytic tuffs). Much more common are sedimentary rocks. Limestones and dolomites occur in numerous deposit of Holly Cross Mountains region and on Silesian-Cracow Upland. Sandstone deposits were explored in Carpathian and Holly Cross region and in Lower Silesia. Limestones, gaizes and marls occur on Lublin Upland.

Intrinsically economic resources found in 707 deposit, were 10 173.79 million tons by the end of 2010. Production of building and road stones in 2010 reached 63.22 million tons and was higher by 7.94 million tons than in 2009. The biggest increase was in reference to the deposits extracted for the needs of road industry (crushed aggregates production). It is related with implementing in Poland the highways and express roads construction program. This branch of industry employs about 3000 workers.

Feldspar raw materials

Deposits of feldspar raw materials are the natural agglomerations of different feldspar and feldspar-quartz rocks rich in alkalis (at least 6.5% $\text{Na}_2\text{O} + \text{K}_2\text{O}$). These rocks are leucogranites occurring in different parts of Lower Silesia, for example close to Strzeblów (Pagórki Wschodnie) and in Izerskie Mountains (Kopaniec). Feldspars from porphyry type Karkonosze granite occurring in Jelenia Góra valley (Karpniki, Maciejowa, Góra Sośnia) is also a feldspar raw material. Mineral reserves of managed deposits in 2010 were 2.77 million tons. The production of feldspar material fell in comparison with the previous year and was 45 000 tons. Major users of the feldspar raw materials are ceramic tile producers.

Limestones and marls

Raw materials for cement and lime industries occur quite commonly in different geological formations, mainly in south and central Poland. Intrinsically economic resources of limestones and marls deposits totaled 18 344.12 million tons in 2010. In 73 deposits explored for cement industry were 12 693.83 million tons, in 115 deposits for lime industry – 5 650.29 million ton. Production of those raw materials in 2010 was higher than in previous year by 4.86 million tons and totaled up 40.02 million tons.

Sands and gravels

Natural sand-gravel aggregates divide in two main groups: coarse aggregates – including gravels and sand-gravel mix and fine aggregates – sands. Natural aggregates are used mainly in building industry for example as a fill for concretes and in road industry as a construction material of road embankments and component of road surface.

Being especially in demand the coarse natural aggregate is distributed irregularly on the area of the country. Central provinces experience the deficiency of that raw material. While the distribution of sand deposits is quite uniform. Intrinsically economic resources of natural aggregates in 7997 deposit as for the end of 2010 totaled up 16 752.42 million tons. Production of natural sands and gravels from deposits in 2926 mines in 2010 was 163.44 million tons, at the employment of 15 417 workers. The increase in relation to previous year was 22.4 million tons, i.e. 15.9%. It is related with evident economic recovery in building industry after 2007 year's crisis.

Clay raw materials for building ceramics

In building ceramics industry minerals of age different and genesis are used. Currently in Poland Permian, Triassic, Jurassic, Tertiary and Quaternary deposits are mined. They are located all over the country, but generally the south part of Poland is more rich in those raw materials. Also with regard of minerals diversity the southern Poland is much more wealthy. Intrinsically economic resources in 1229 deposits amount 2 020.07 million m³. Economic resources determined for 173 deposits totaled 165.04 million m³ i.e. about 330.08 million tons. Production in 2010 was 2.16 million m³ (ca. 4.32 million tons). It was lower than in 2009 by about 0.48 million m³.

Kaolin

Intrinsically economic resources of kaolin raw materials in 14 deposits on the area of Lower Silesia, by the end of 2010 r. were 213.44 million tons. Production of kaolin raw materials from Maria III deposit, near Bolesławiec, was 237 000 tons.

Summary

Polish mining industry, basing on relatively big resources of 50 most important raw materials, mines and produces the substantial amounts of hard and brown coal, natural gas, copper, silver, zinc and lead, rock salt, sulfur, stone and ceramic raw materials. The total number of about 175 000 people work for this industry. In 2009, nine minerals production in Poland placed the country within the first ten of world's producers: silver and brown coal (7), palladium (8), cadmium and coke coal (9) and lead, sulfur, hard coal and copper (10). Share of output of major raw materials in Polish mining production in 2011 is presented on fig. 3.

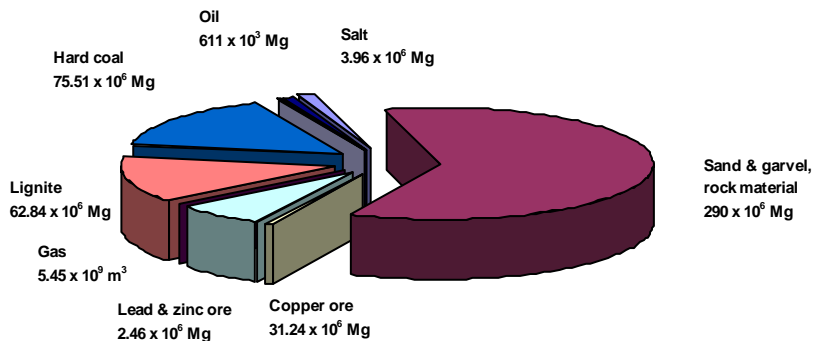


Fig. 3. Production of major raw materials in Poland in 2011 [6]

Current problem, which must be solved in Polish mining industry in the nearest future concerns both ensuring the power energy safety (further restructuring the hard coal mining and making a decision about developing 'clean' power energy based on coal, seeking alternative sources of natural gas and crude oil import and starting the exploration of unconventional sources of natural gas), and – meeting the requirements of world's raw materials supply. The significance of that problem with regard of existence and operation of many mining industry branches evidences the constantly growing negative balance of natural resources turnover (import/export). Taking

into consideration the number of employees working directly in mining industry and in cooperating companies, the risk related with possible drastic reduction of employment, may cause problems and social tensions. Solving these problems in branches still owned (in different legal forms) by the Treasury (fuels and metal ores mining) is all along a domain of government. In branches with high level of privatization (different forms), market rules and efficient management decide foremost about the position of the company and its workers.

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Przemysł wydobywczy w Polsce

Słowa kluczowe: górnictwo, surowce naturalne, produkcja surowców

W artykule scharakteryzowano występowanie i wielkość zasobów głównych polskich kopalin w podziale na grupy surowcowe. Podano aktualną wielkość produkcji poszczególnych grup surowców oraz wielkość zatrudnienia w poszczególnych branżach polskiego górnictwa. Zwrócono uwagę na trendy rozwojowe w górnictwie w odniesieniu do sytuacji rynkowej i przekształceń własnościowych w tej gałęzi przemysłu.