Infrastructure

Environment • Geology II

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Poland has no policy on raw materials.
A discussion over such a policy is only beginning now.
The Government's approach to the raw materials policy is full
of legal confusion and chaos in decision making process.
Problems related to this policy are almost totally unnoticed in strategic documents.
Many decisions concerning deposits of strategic importance
for the nation belong to municipal authorities.

Report „Poland's policy on raw materials: a paper on what does not exist but is badly needed".

Politicians must realize that raw materials management is a truly long-term and international business

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Politicians must realize that raw materials management is a truly long-term and international business.

Statement by Janusz Steinhoff, Ph.D., a co-author of the report „Poland's policy on raw materials: a paper on what does not exist but is badly needed".

AM/TADEUSZ KLEPCZYŃSKI

Authors of the report (from left to right): Janusz Steinhoff, Ph. D., Eng., and Professor Jerzy Hausner, Ph.D. at a press conference in Warsaw on 10.03.2015.

The policy on raw materials should be a long-range public policy pursued at the national level enabling industry to access raw materials at affordable prices. At the same time, it should protect our natural and social environment at each phase of the raw material treatment, and to ensure the current and long-term economic security of the country.

Key objectives:

• Expansion of reconnaissance into the geological structure and documentation of new deposits. Protection of the documented but not managed deposits or prospective deposits.
• Allowing investors extraction of minerals in accordance with the Concept of the National Development Strategy in a way guaranteeing environmental and social sustainability.
• Supporting the national production forces by giving them access to raw materials, including strategic minerals, on terms allowing them to preserve their competitiveness.

• Promoting research and education implementing economically, socially, and environmentally balanced technologies for the management and recovery of mineral raw materials.
• Initiating such forms of international collaboration, especially within the European Union, **that will increase the security and development of Polish economy.**

Barriers to the policy on raw materials:

• Silo type public administration.
• Low (very technical) analytical competence of decision-makers.
• Lack of efficient, professional Government agencies.
• Insufficient range of financial instruments.
• Low level of savings and investment.
• Reactive style of government.
• Wrong law and inefficient regulations.

Investment in extraction of minerals and fossil fuels is very capital-intensive and stretched in time. This involves high spatial, ecological, and social costs. Heavy investment in mining generates a long business cycle which may interrupt the market cycle. Economic policy must skilfully address these factors. Therefore, the involvement of public authorities should always be associated with long-term structural objectives, not temporary political and business aims.

The Government may confine itself just to funding only selected mining projects but it should pay for new geological studies and for the protection of resources which have not been explored yet.

Like in the case of infrastructure, a shortage of long-term capital may be a major barrier to investment in mining industry. This is why public-private partnership is highly recommended in this sector. And this requires, among other things, special solutions of financial engineering type.

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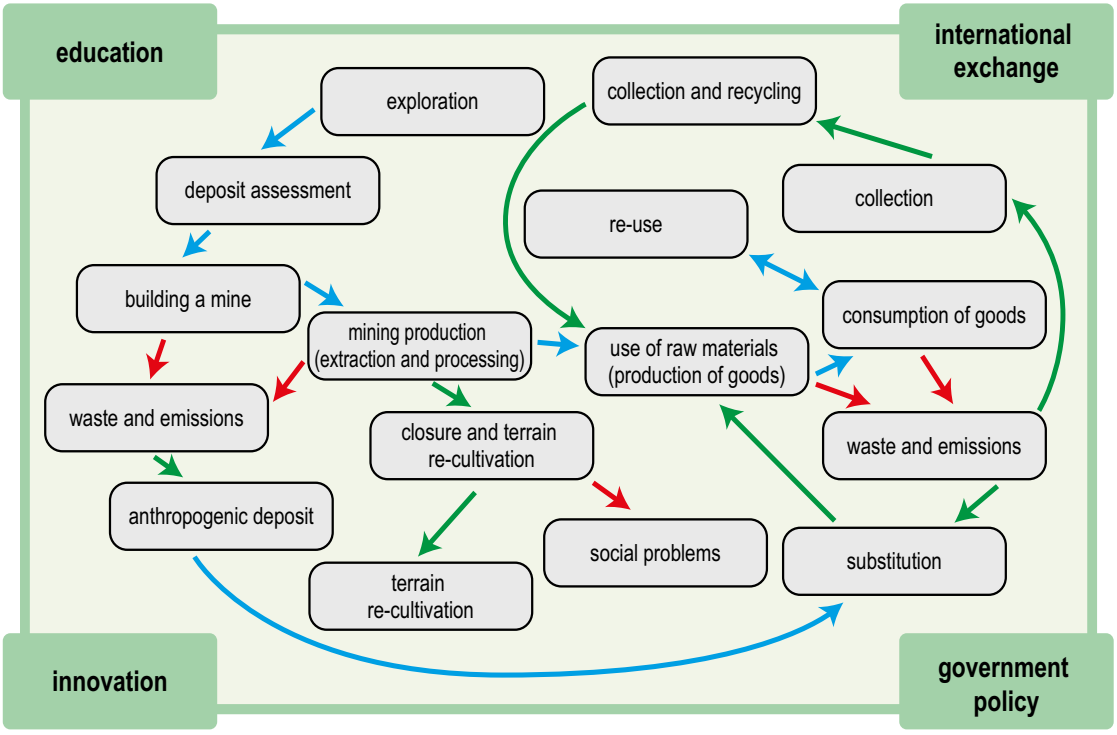
The policy on raw materials may be successful only if it takes a comprehensive approach which includes many different aspects of raw materials management. Such an approach requires expert knowledge and adequate instruments, e.g., the right formulas for macro- and micro-economic accounts. These accounts must include the costs of phasing down extraction.

Raw materials management must be covered by specific and stable regimes of concessions and taxes. **Traditional fiscalism strangles this policy while instability puts off serious and genuine investors.**

Entrepreneurs are being surprised with new regulations which make their business difficult often by overnight changes in the rules of the game on the market. Much too often we see the process of spoiling the law. Frequent amendments to the law causes major problems with its interpretation. Current regulations and the practices of public authorities hardly provide a friendly environment for new ventures in the mining business. The scale and procedures of tax collection from the mining business and a variety of other charges, as well as the duration of administrative procedures applicable for the particular phases of investment process



The main line of policy on minerals is determined by the raw materials cycle from cradle to cradle, whose part is the deposit management cycle

especially need to be sorted out. This is also true for obtaining minerals from secondary sources and for the regulation that should promote recycling.

The new regulations are often proposed without prior analysis of their consequences. Legislators working on new laws are often preoccupied with short-sighted fiscalism and, in a longer perspective, the law not only fails to generate the expected budgetary revenue but often hampers the development of enterprises or puts restrictions on their business operations causing obvious negative effects on the labour market.

From the viewpoint of economic needs and requirements of environmental protection, a significant development of the recycling of used minerals is highly necessary.

Representatives of the mining industry and academic circles expect their knowledge to be applied in practice and their proposals to be carefully listened to by Government agencies when they make their strategic plans.

What deserves criticism is that Poland, a country rich in valuable mineral raw materials, has no strategy for their management and, in particular, no effective protection of documented but not exploited resources.

A press conference on „Poland's policy on raw materials: a paper on what does not exist but is badly needed" was held at the AGH University of Science and Technology in Kraków on March 11, 2015.

The aim of the conference was to present the results of the study and a discussion on its key findings (see text on the same page). It is also important to define the final objective and rules of this policy and the optimum legal, economic, social, and environmental conditions for obtaining mineral raw materials from primary and secondary sources in Poland.

In the paper, the experts criticise the government not only for the lack of a long-term strategy for domestic deposits but also for the lack of efficient professional government agencies, incompetence of staff, instability of law, and saddling the mining companies with excessive tax burdens.

Prices of many minerals are going down on the global market now but a decade or so ago they were rocketing. – **Poland missed the raw materials boom**, which you can see on the example of the dramatic condition of coal mining industry – Jerzy Hausner claimed and pointed to some countries which took advantage of the good times at the right time. – We are again witnessing a global competition in raw materials. The winners are those who had precisely defined their raw materials policy well in advance – said Jerzy Hausner.

As an example, he mentioned the United States which has changed its position on the global market by going ahead with shale gas extraction.

Experts are pointing out **that the state does not necessarily have to be a direct and, especially, a dominating owner and investor when it wants to pursue its policy on raw materials**.

Hope for change

The Report contains a number of recommendations for the Polish government. The first one says that the government should urgently produce a long-term policy on raw materials. Such a document should carry decisions on budgetary financing of the recognition and protection of the most valuable mineral deposits and a list of critical minerals which are vital for the competitiveness and innovativeness of Polish economy. These include minerals which are indispensable in developing new technologies and other applications.

Further recommendations should address the development of a modern geological and mining Code of Laws, **simplification of the concessioning procedures**, improvement of the competence of administration staff, ensuring the stability of law, reduction of tax burden on mining, implementation of new, break-through technologies in the extraction industry.

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*The text uses materials from the report **Poland's policy on raw materials**.*

Future of Polish economy is born in campuses

Mining in Poland – innovation, social responsibility, environmental protection

Poland is a country rich in deposits of various minerals. The country is a major producer of fuels (hard coal, lignite) and of other raw materials, such as, copper and silver, it continues to turn out zinc and lead and, in the recent years, rhenium but also various chemical raw materials and a lot of other industrial materials. Yet, whenever the key national strategic documents mention minerals at all, they focus on fuels above all, stressing the necessity to ensure energy security.

Joanna Kulczycka, Ph.D., Professor at AGH University of Science and Technology in Kraków, Department of Management, Head of the Strategic Studies Department, Institute of Mineral Raw Materials and Energy Management, Polish Academy of Sciences.

Not only coal

A growing demand for minerals other than fuels and the threat of their potential depletion have been noticed by the European Commission which in 2013 appointed the European Innovation Partnership on raw materials (EIP RM), developed and implemented the EIP Strategic Implementation Plan. It defined a catalogue of actions related to technology, regulatory frameworks and international collaboration. At the same time, the European Commission provided financial support for the consolidation of these actions through, i.e., the programme Horizon 2020, Era-min, and what is known as KIC Raw Materials. The consortium RawMatTERS, which won the KIC competition in December 2014, was established by 116 partners – 45 of them industrial – as well as campuses and research centres from 22 countries, 10 of those from Poland, and all operating in the mineral raw materials sector. The project provides that KIC financing will reach about EUR40 million/year in the period 2016-2022. While providing various forms of support for research, the European Commission expects that the mining industry will introduce innovative solutions offered by research and development programmes, new concepts, ideas, and inventions in order to improve the competitive edge of mining companies and the whole EU economy. It should be noted that introduction of innovative solutions is not desired only in the traditional extraction business obtaining raw materials from underground or open-cast mines using documented resources but also from new sources, such as, the ocean floor, sub-polar areas like Greenland or outer space. Polish companies are joining these research programmes. Poland has a deposit area of 75,000 km^2 in the Pacific Ocean since 1991 as a partner to the Interoceanmetal Joint Organisation established in 1987.

Responsible development

The performance of mines largely depends on the ups and downs on global market because many minerals are these days part of broad international trade, also being quoted on commodity exchanges all over the world. This is true, in the first place, for the fluctuating prices of raw materials and for the US dollar exchange rates. Also, the high costs of launching the extraction process force the investors who are pondering a new project to look carefully not only on access to the deposit, its quality and size, but on the political, environmental, and social conditions as well.

We want to consolidate the academic world and industry to the benefit of key disciplines of science which are of crucial importance to our state.

Professor Tadeusz Więckowski, Ph.D. Rector of the Wrocław University of Technology

Big mining companies in Poland introduce increasingly advanced technical, environmental, and organisational solutions meant as part of their mission to build a responsible business where management decisions and effort of workers are streamlined for co-operation, integration, development, and social responsibility of business. The CSR reports of mining companies offer, information about the impact of mining on human health, labour safety, natural environment, and plans for the management of post-mining areas. They also describe actions influencing the development of regions, rules and directions of collaboration with various entities, including ones belonging to the SME sector, sponsoring, and also the planned and finished investment projects and the innovations introduced. Innovative solutions are first of all applied to improve the processes of getting minerals from increasingly deeper and more difficult deposits of complex geological structure but also to reduce machinery breakdowns and increase automation, process control and monitoring. Some innovations are introduced in pro-ecology products, such as, the eco-pea coal and raw materials recovered from waste, and also in improving the management system by adopting the Lean

Time has come to stop competing and start working together on getting ample funds and carrying out investment projects which are absolutely important to this country.

Professor Tadeusz Słomka, Ph.D., Eng., Rector of the AGH University of Science and Technology in Kraków

Management method at KGHM Polska Miedź S.A. or new ways of products purchasing and sale. Nevertheless, even the introduction of the sustainable management rules in the mining sector does not stop protests of local communities and ecological organisations against launching new mining projects (or expansion of current operations). These protesters often wield ungrounded and void arguments as if mining had bad effects on the environment and human health but they often manage to freeze such projects completely or to make the investment cycle much longer. They belittle the facts that well before a mining company can launch extraction, it must identify and describe its future impact on the natural environment and produce a number of documents, obtain the required decisions and permits, such as, the analysis of environmental impact, the permission to produce waste, the mining waste management programme, the water quality impact assessment for

post-extraction waters, the intake of water, the noise analysis, the emission of gases and dusts into atmosphere, the zoning approval, and the permits to remove trees and bushes. Entrepreneurs who have managed to start extraction process are trying, especially in the recent years, to keep the public informed on the effects their operations have on the community and stakeholders in regular reports on social responsibility of business which clearly improve the image of their business, especially as the on-going production in Poland is inseparably connected with areas where mineral deposits are found. In this situation, an entrepreneur running mining company should be seen as a stable employer offering jobs also in other businesses related to mining (1 job in a mine usually equals 4 jobs in associated industries). Mining industry is also a strong regional development factor which can be seen in the list of the richest municipalities in Poland compiled by the Finance Ministry in 2014 (using adjusted data from 2012).


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KGHM is proud not only of the top quality of its products but also of its care for the natural environment, the local community, and all its employees.

Mining is one of the most advanced sectors of national economy which, despite technological and technical progress, has not managed to develop and introduce non-collision extraction methods (still using traditional extraction processes). However, when we consider the fact that:

– every person living in Europe uses the average of 17 tonnes of various materials every year and throws away 6 tonnes of that,

– increasingly more of various elements are present in the high-tech devices of daily use,

– minerals are used in non-industrial practices, such as, health services (medicines, mineral waters), environmental protection (sorbents removing contaminants from industrial gases, water treatments, etc.), architecture, construction, art, tourism

the government should provide conditions for a balanced and permanent development of the mining industry.

Waste. A new source of raw materials

The problem of getting raw materials from waste, including the waste electrical and electronic equipment (WEEE) also requires special position in politics and research. Unlike raw materials obtained from primary sources, the secondary sources are renewable and they are, sometimes, called urban mining. This industry has been rapidly developing in several recent years when new laws used economic instruments to force higher recovery and recycling volumes. In terms of recycling, Poland is far behind many highly developed

countries of the world, although official data from the Chief Inspectorate of Environmental Protection GIOS show that 486 thousand tonnes of WEEE were put on the Polish market in 2013, of which 171.7 thousand tonnes were collected (35%) of which 160.2 thousand tonnes were refurbished and 129.7 thousand tonnes were recycled. The collected WEEE per capita is constantly growing to reach 4.25 kg per capita in 2013, (0.7 kg in 2007, 2.8 kg in 2010) but this rate is even 4 times higher in some EU countries. There are lots of reasons for this, like no incentives for a true recovery and recycling of material from WEEE, a sizeable shadow economy and corruption, low public awareness, constantly changing legislation, the fact that the EU law on used electronic equipment and waste management has not been transposed into Polish law yet. In this situation, it is worthwhile to look for solutions that will encourage a recycling free of bureaucracy and check which of the existing companies are making profit on this status quo and are not very keen on seeing it changed.

Anyway, whatever the sources of minerals, mining companies encounter the well-identified barriers which hamper the introduction of innovations. These barriers stem from their financial condition, motivation to take the risk involved in applying innovations, market fluctuations, and from the specific nature of this industry.

Supporting the industry of non-ferrous metals

A joint venture named CuBR was started as a result of an agreement between NCBR and KGHM Polska Miedź S.A. in order to provide support to scientific research and development serving the industry of non-ferrous metals.

Its main aim is to commence joint work on developing and implementing innovative technologies, equipment, materials, and products to strengthen the competitiveness of Poland's industry of non-ferrous metals as a player on the global market and participant in the global economy. This in turn, should contribute to reaching the position of a world leader by the Polish industry of non-ferrous metals, especially in the field of the production of copper. The budget allocated for subsidizing the joint-venture's projects accounts for PLN200 million. The enterprise covers areas related to mining, processing, metallurgy, and the impacts of non-ferrous industry on the natural environment: **• Mining and geology • Metal ores processing • Metallurgy, processing, new materials • Environmental protection, risk management, business performance.**

KGHM is a member of a consortium of international firms, universities, and scientific research institutes which has won a competition for a new Knowledge and Innovation Community. The competition was held by the European Institute of Innovation and Technology EIT to improve security in raw materials and strengthen the competitiveness of the European Union's economy.

The winner in the competition was the European consortium RawMatTERS Tackling European Resources Sustainably which has over a hundred counterparties in twenty-two countries of the European Union. Poland is represented there by ten institutions, among them, KGHM Polska Miedź S.A. which has played a key role in building the strong position of the consortium, the KGHM Zanam, the AGH University of Science and Technology in Kraków, the Wrocław University of Technology, the Institute of Non Ferrous Metals in Gliwice, and the Wrocław Research Centre EIT+. The work on the organisation of the consortium took two years.

The task of the new Knowledge and Innovation Community RawMatTERS is to integrate and strengthen the innovative potential in the sector of raw materials by way of introducing new solutions, products, and services for the benefit of balanced prospecting, extraction, processing, and recycling of the natural resources. All the partners involved will provide technologies and services adequate for the evolving social needs, as well as education, development of enterprise, providing new jobs, and active handling of challenges which result from the shortage of raw materials in Europe.

Pracodawcy RP 25 LAT

The Forum of the Mining Industry Employers of the Republic of Poland was established on October 5, 2006. Its signatories are representatives of the mining industry – the biggest mining companies and organisations of employers which affiliate mining companies. The intention of the Forum is to work for the development of this industry and for providing better environment for business operations with respect to the relevant rules of environmental protection and co-ordination of actions carried out by all representatives of the mining industry, exchange of opinions, experience, implementation of new technologies, technological progress, and free flow of information. Its main objective is to present the joint position reached by a consensus of all the Signatories on matters important for the industry by exerting active influence on decision-making processes within the legislative, executive, and local-government authorities.

ZWIĄZEK PRACODAWCÓW POLSKA MIEDŹ

Union of Employers Polska Miedź • Established in 1996, it operates under the Employers' Organisations Act of May 23, 1991, and on the grounds of its Statute. A member of the Employers of Poland, it was founded by KGHM Polska Miedź S.A. in Lubin, its branches, and companies of the capital group KGHM Polska Miedź S.A. – one of the largest producers of copper and silver in the world. Right now, it associates over 100 business entities from the Lower Silesia which altogether employ more than 30,000 people.

The Union monitors and opines draft laws important to the national economy in order to protect and represent the interests of employers. The Union also provides training in, among other subjects, management, business negotiation, HR development, mediation, and public relations. Each year it organises conferences and seminars on enterprise development, occupational medicine in market economy, finance, and labour law.

IATI Autostrada Technologii i Innowacji

The Institute of Technology and Innovation IATI

• 18 universities, 2 research institutes, and 3 companies from all over Poland set up the IATI consortium on July 15, 2014. It will consolidate teams willing to do large research and development projects, especially ones for the European Union. Leaders of this project are the Wrocław University of Technology and AGH University of Science and Technology in Kraków. IATI is, in its essence, a platform for collaboration between business and research centres, a catalyst of joint research and implementation initiatives. Currently, nearly 40 entities are working for IATI to implement innovations in 50 competence centres.

The Mineral and Energy Economy Research Institute of the Polish Academy of Sciences PAN • Research done by the Institute is interdisciplinary and comprehensive, covering the full cycle from basic studies down to practical application. The Institute specialises in: studies into efficient use of minerals, energy policy, mineral policy, prognosing energy and mineral needs with their economic aspects, environmental protection in industrial areas, underground storage of hazardous waste.

Klaster Gospodarki Odpadowej i Recyklingu

The Waste Treatment and Recycling Cluster includes business companies, research institutes, business-related institutions, consultants, and a foundation dedicated to ecological education. The core of the Cluster are companies whose business is to collect, neutralise, process, recycle, and transport all sorts of industrial waste. Its members are also two prestigious scientific research institutes carrying out comprehensive studies in the broadly defined management of mineral resources.

Polska Platforma Technologiczna Surowców Mineralnych

The Polish Technology Platform for Mineral Resources integrates the key scientific partners and those representing the mineral industry. The mission of this organisation is to establish long-term active collaboration in support of an efficient use of mineral resources with respect to the adopted rules of sustainable development, through the application of innovative, advanced solutions, techniques, and technologies, and also through initiating and implementing business projects and promotion campaigns.

Challenges to the policy on raw materials in the context of protecting mineral deposits

Statement of Sławomir Marek Brodziński, Undersecretary of State at the Ministry of Environment, the Chief Geologist of Poland.

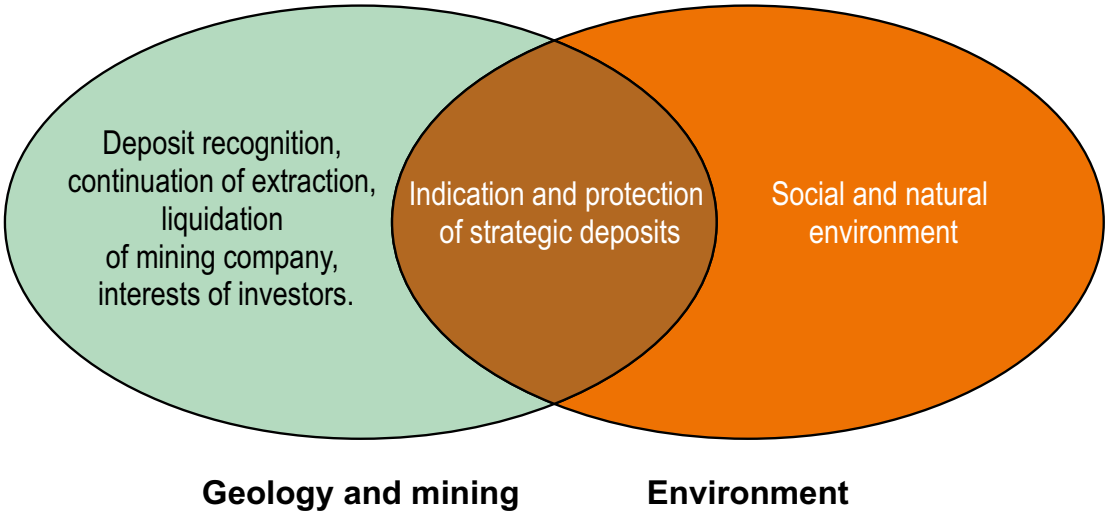
FOTOTAXI.PL/MARIUSZ SZACHO

The obligation to protect mineral deposits through their reasonable management follows out of article 125 Environmental Protection Act. According to this regulation, „mineral deposits are subject to protection by way of a rational management of their resources and comprehensive use of the minerals, including associate minerals." This article is addressed, first of all, to the Minister of Environment as an authority shaping the concession policy and an institution of geological administration.

However, a law regulating the protection of deposits in a systemic way is not available at the moment. Protection of prospective deposits, in this, the most important, strategic ones, is an area shared by the interests of the state, self-government of investors, environmental protection, and the citizens. This area is shared but conflict-prone.

This is probably the reason why none of the cabinets in power after 1989 took the challenge of designing a policy (strategy) on Poland's minerals. Nonetheless, the problems of deposit protection is partially addressed in a number of government strategic documents. For instance, the National Security Strategy of the Republic of Poland (2014) says that „it is necessary to step up supervision and control over the wealth of the state's geological resources."

The crucial role of the mineral deposits protection system



On the other hand, the Concept of the National Development Strategy (2011) reads that „in order to ensure proper protection of deposits, it is necessary to make a list of fuel deposits which are of strategic importance to the state, define the area under which they are stretching, and precisely define the degree and form of protection of the identified areas."

At the same time, the Energy Security and Environment Strategy (2014) includes the following statement: „identification of strategic deposits of fuels and protecting them against infrastructural development is among the priorities of the energy sector. This particularly applies to lignite and shale gas."

Meanwhile, the current Polish Energy Policy until 2030 (2009) recognizes the protection of „coal deposit areas against further overground development which is not connected with power industry and including in the concept of national development, local land use plans and in the long-term development strategy."

Potential conflicts between the postulate of deposit protection and other values may occur only in the following situations:

• When an open-cast lignite mine is built in an area dominated by farming, its operation may affect adjacent fields by, for example, draining water away from the rock mass.

• When extensive infrastructural facilities are built, such as, motorways, the deposits are trapped in the mining protection areas underneath those facilities.

• When rock extraction process is going on, there is a risk of, say, destroying bird habitats within the extraction area or very close to it.

• When hard coal is extracted from underground, overground structures are at risk of mining damage.

These examples show the necessity to build a legal basis that will balance the state's long-term interest to protect the deposits with other important values. The Ministry of Environment believes that the ***White Paper of Mineral Deposit*** Protection is a vehicle permitting the development of solutions to the above-mentioned problems.

The White Paper will provide a public procedure of reaching a compromise between the interested parties. It will contain an analysis of the problem of protecting prospective strategic deposits (fuels and other minerals) in this, a description and diagnosis of the situation, selection of strategic minerals for their ranking, definition of valorisation criteria, definition of weighs for the criteria/definition of ranking, and description of the method of financing the deposit protection. The document will also contain an analysis of the best international practices and the available variants of national solutions. It will be published and subject to consultation. When the consultation is over, in particular, the consultation on the very concept of deposit protection, a political decision will be made on what, where, when, and for what money can be protected as an underground resource present on the land and sea territory of the Republic of Poland.

What after White Paper – procedures

Political decision on protecting strategic deposits ⇨ Compilation of a list of prospective deposits subject to protection ⇨ Selection of a legal protection mechanism ⇨ Preparation for the evaluation of the consequences of regulation, in this, evaluation of the budgetary and investors' cost of deposit protection ⇨ Broad public consultation, in this, agreements with the Joint Committee of Central and Local Government ⇨ Further legislative path depending on conclusions from the consultation.

The Ministry of Environment is currently working on organisational aspects addressing the development of alternative legislative solutions, methodology of selection and valorisation of deposits, and financial evaluation of the deposit protection consequences.

Assumptions for the Plan of action

Poland's security in non-fuel minerals

Statement by Deputy Prime Minister, Minister of Economy Janusz Piechociński

DARIUSZ IWAŃSKI

*The Ministry of Economy has developed **Assumptions for the Plan of Action to ensure Poland's security in non-fuel minerals**. The document has already been approved by the Ministry authorities. Its main purpose is to ensure Polish business companies better access to non-fuel minerals of both, primary and secondary types.*

I want to emphasize that non-fuel minerals are the basic materials used in advanced industry and they play an important role in the policy of re-industrialisation. A global growth of demand for non-fuel minerals will be generated by the expected growth of world population, urbanisation, and the increasingly higher living standards combined with higher consumption.

According to forecasts by McKinsey Global Institute, the middle class population will grow by more than 3 billion consumers in the coming 20 years (mainly in the developing BRICS countries). The problem is that demand keeps growing with time, while finding new raw materials and their extraction becomes increasingly difficult and expensive. Investment in extraction and production of many raw materials in the world are additionally hampered by environmental restrictions. In the first decade of the 21st century alone, prices of many non-fuel minerals were tripled because of a rapid growth of the emerging economies, chiefly China, India, and Brazil. Please note that although the raw material prices have stabilised recently, **we should remember that the resources of non-fuel minerals are limited**, even if some of them can be recovered from waste products.

The awareness of the role of fuels has been widespread for a long time now but non-fuel minerals are only recently emerging to sight from their „shadow." This is because many of those are used in advanced technologies. The latest products, e.g., LED screens, are made of indium, cerium, and europium, while various types of batteries use lithium, and cobalt. There are a lot more examples for this.

Raw materials – initiative

It is worthwhile to note that the importance of non-fuel minerals is growing also on the EU agenda. Since the publication of the communiqué on Raw Materials Initiative in 2008, Poland is taking part, as one of the eight representatives of member-states, in a group that works on defining the directions of work for the

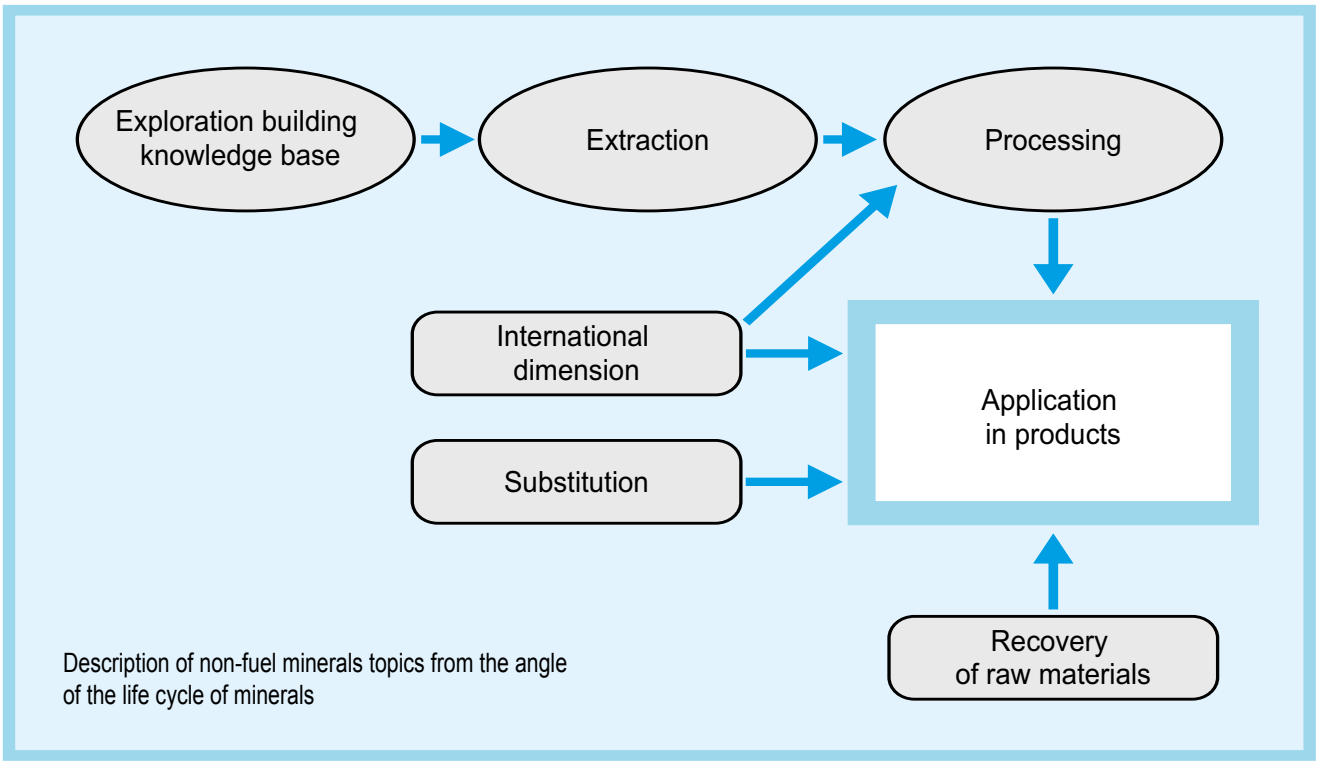
European Innovation Partnership on Raw Materials. This initiative will gather ideas of innovative solutions in the area of raw materials. The activity of Polish companies in this work should be noted: out of the 90 submitted proposals, 30 consortiums include Polish entities and 12 include more than one Polish entity.

Recognising the importance of non-fuel minerals and the need for ensuring raw materials security to Polish industry, and in response to the demand of various stakeholders, among them, participants in the Polish Technology Platform for Mineral Resources, the Ministry of Economy has commenced work on a draft of *Assumptions for the Plan of Action to ensure Poland's security in non-fuel minerals*. This work includes collaboration with four other ministries relevant for raw materials issues: the Ministry of Environment, the Ministry of Science and Higher Education, the Ministry of Foreign Affairs, and the Ministry of Infrastructure and Development. The project has also been consulted with a broad group of stakeholders, among them, representatives of industrial and academic world. Many of their comments were included in the final document.

Raw materials – cycle

The *Assumptions* identify the main phases of the raw materials cycle (from exploration to extraction, processing, recovery from waste, to substitution) to which the areas of activity and recommendations have been subordinated. This approach refers to the circular economy concept which puts special emphasis on multiple use of the same raw materials. It also contains an analysis of the possibility to improve access to raw materials through the intensification of international collaboration.

I expect that a draft Plan of Actions should be agreed with the other ministries and consulted with the stakeholders by the end of 2015 as has been planned in the time schedule given in the *Assumptions*.



Description of non-fuel minerals topics from the angle of the life cycle of minerals

The strategic goal of KGHM Polska Miedź S.A. is to work out advanced technologies for the development of the world's first smart extraction plant based on neural networks and apply them in the industry

Project – smart extraction plant

Interview with Ryszard Biernacki, Eng., Chief Executive responsible for production engineering at KGHM Polska Miedź S.A.

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Miners working with pickaxes are history now. Today we are talking about smart mining enterprises. What are the sources of this project, what is behind its name and what is its size?

Miners with pickaxes are the history and tradition we cherish but for KGHM, a smart mining enterprise is a challenge and necessity. Two factors are the source of this project – security and economics. And they should be discussed in this order.

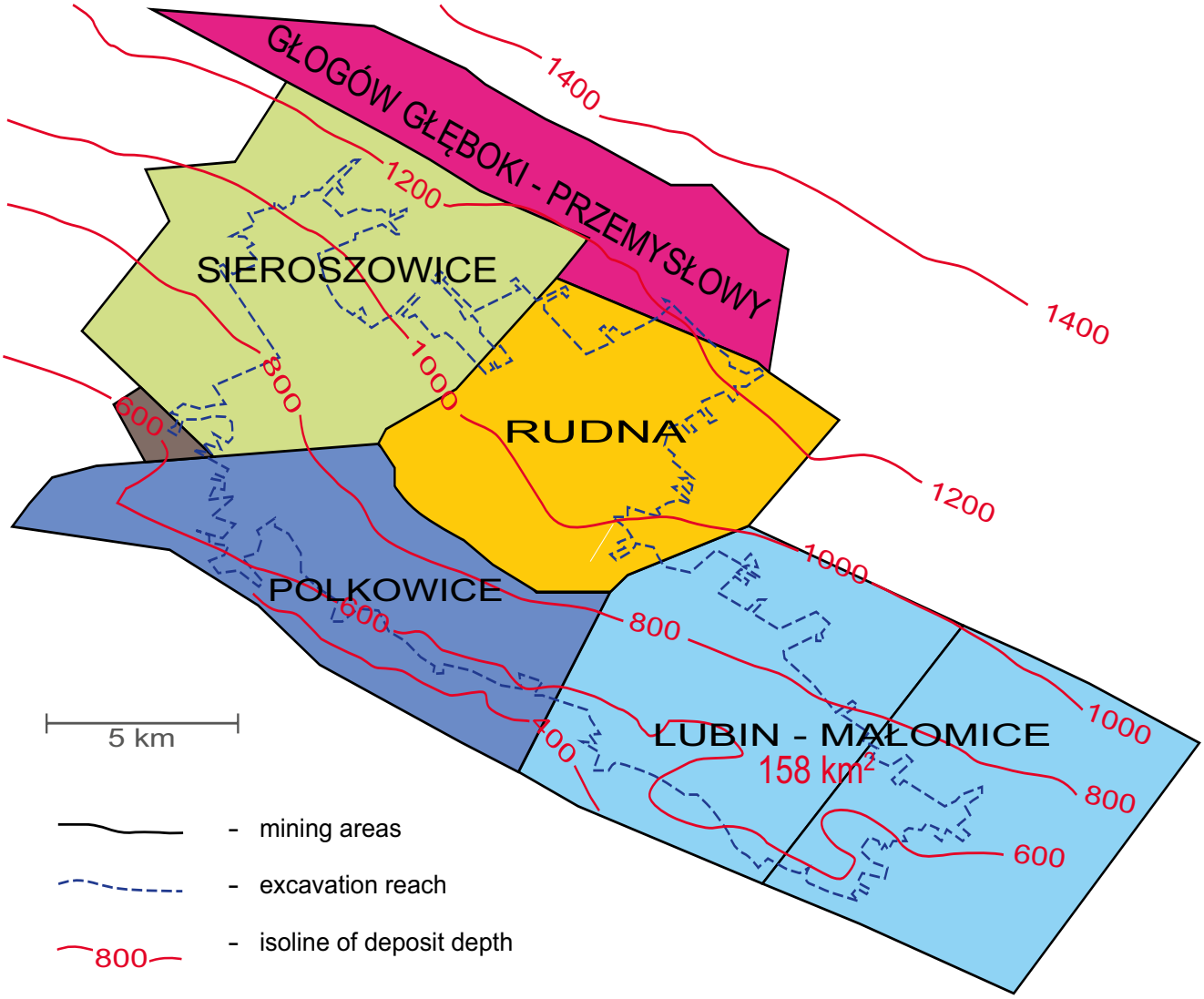
Our strategy assumes that mining must be safe and human life is priceless. These days, copper ore is hoisted from deposits found deeper than 1,200 metres. The rock temperature down there reaches 50^{O}C. The mining area for which we have a concession covers 466 km^2 (the capital city of Warsaw covers about 520 km^2). Up to 5,000 people are working in our underground mines on each shift and they use about 1,260 self-propelled mining machines.

No wonder that when our extraction reaches deeper and deeper amidst an increasing number of factors potentially dangerous for the life and health of our people, we are looking for ways to rule out those hazards and get the people out of there. We are providing conditions for safe work without compromising the planned extraction targets. This is why our mines are running dozens of projects and research programmes whose main goal is to introduce new technologies, work organisation systems, machines and equipment which, at the end of the day, will remove human workers from places where work is dangerous because of natural conditions and hazards.

A smart extraction plant is safe. It uses little human labour force but a lot of human intellect.

Herbert Wirth, Ph.D. Professor at the Wrocław University of Technology, Chairman of the KGHM Polska Miedź S.A. Management Board.

All our employees are involved in this process. Crews directly working in extraction areas monitor the place and report all accident-prone situations and events, they test new machines, protective clothing fitted with body cooling systems, systems monitoring the critical body parameters, etc. Their findings, comments, initiatives and proposals are studied by supervision and managerial staff who then decide whether to include new technologies in the testing process or even introduce new solutions on industrial scale. It should be clearly said that permanent search for new technical solutions improving labour safety and its productivity



has become a KGHM standard supported by people of high competence and, most importantly, people of high commitment.

Being sure that the competence of our crew is very high and that we face increasingly bigger challenges of extraction from deeper and deeper layers, we have included – in the Strategy of KGHM Polska Miedź S.A. for the years 2015-2020 with a perspective to 2040 – such challenging goals as automation of production lines and smart mining enterprise based on neural networks. The principal objective in both cases is to withdraw humans from work in hazardous places and replace them with machines. The workers, who are gradually improving their experience and acquiring new competences, will eventually control the machinery from a safe place (perhaps overground) or will take part in programming the machines, designing special control algorithms, or in building models and standards of their operation. Some people will, of course, continue working underground because they will have to implement the new technologies there, repair breakdowns, and do maintenance jobs, but the risk of accident or exposure to harmful environmental factors will be ruled out completely or a lot smaller than now.

When did the work on smart mining enterprise start?

We can say that KGHM is a company whose innovativeness, use of advanced technologies, and permanent drive for work safety improvement, and higher productivity began back in 1963 when the first tonne of copper was produced. The quarrying technology and machines used in coal mining did not prove suitable for our extraction process. We had to apply other technologies, usually developed by ourselves, the people of KGHM and collaborating scientists from universities. This situation, the need for new machines, equipment, and technologies gave birth some 40-50 years ago to such companies as KGHM ZANAM, now one of Poland's biggest manufacturer of mining machines and equipment, CIT Inova, KGHM Cuprum – Research and Development Centre. The names of those companies were different at the time but they are the same companies which had turned into practice the ideas of KGHM engineers and their own solutions by which they commenced the process of building Polish smart copper ore extraction plant.

You have mentioned KGHM ZANAM Sp z o.o. Are the engineering ideas implemented in new machines Polish or imported?

As I have said, when we were starting extraction in the 1960s and 1970s, we had to learn a lot all the time. Surely, we would closely examine solutions invented by others, buy machines and equipment made by other manufacturers to gain new knowledge and competence. But today, KGHM is a company with experience longer than 50 years and we can legitimately claim we have developed our own high standards.

Aims of the project „Smart extraction plant"

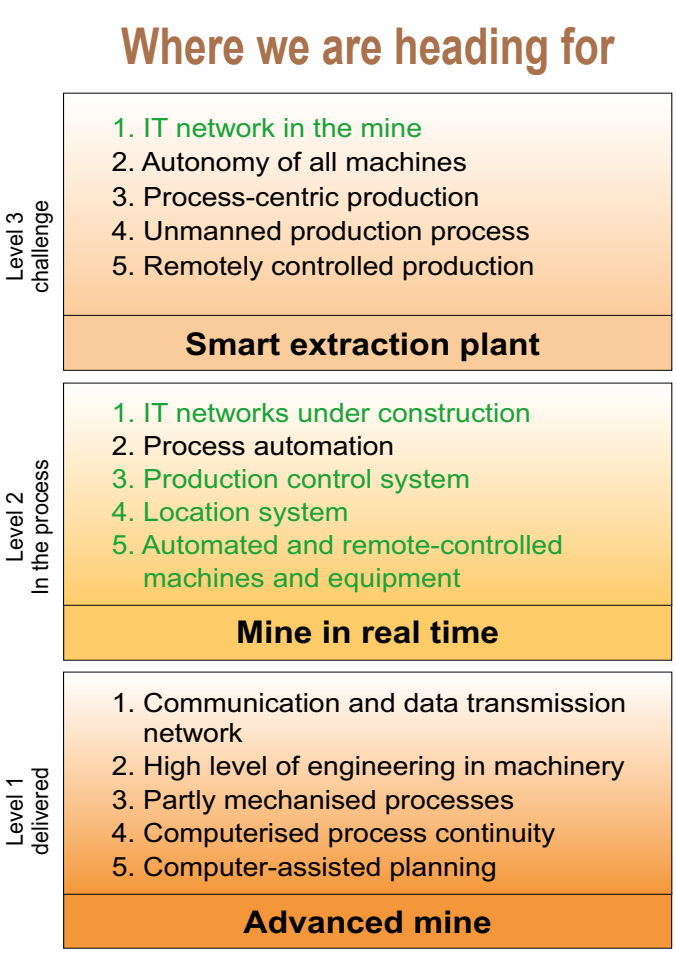
1. *Ensuring safety by way of:*
   - *reducing to the necessary minimum the number of workers operating equipment in difficult environments,*
   - *cutting the time workers spend at underground digging areas.*
2. *Increasing the use of the technical potential of production infrastructures by introducing advanced monitoring, tele-mechanics, and automatic machinery equipped with artificial intelligence.*
3. *Winning competitive edge thanks to implementation of new technologies.*
4. *Overall improvement of safety and reduction of operation costs.*

We are a global company with very high competence in extracting hard rock from great depth. We have a clearly defined strategy and aims. The challenges we are facing are very ambitious but we are sure we can handle them also thanks to having KGHM ZANAM as a partner. I doubt there is another company among the suppliers of mining machines and equipment which has ever managed to test and then manufacture at least one new machine or equipment underground every year for several recent years now. The efficient conveyer now installed in the Mining Company Lubin, the remotely-controlled wheel loader LKP-1601B, the self-propelled drilling machine WIR-170, the self-propelled roof bolter SWWK-2L, the carrier ROBUST – these

are just a few examples of advanced mining machines and equipment which largely improve work safety and productivity. They are also examples of very close collaboration between the mining companies and engineers from ZANAM. Operators, foremen, and chief foremen working in each mine generate a package of expectations addressed to the manufacturer but they also co-operate with the latter at all phases from design to practical application during which they propose improvements and examine the performance of prototypes. In this way, we are getting advanced and, most importantly, very functional and safe solutions which successfully compete against solutions offered by other world-known machinery manufacturers.

Extraction goes on deeper than 1,200 metres these days. What is the limit below which you cannot go, even with a smart extraction plant?

Do you know why we at KGHM are so realistic and serious about the challenge of building a smart extraction plant? Because we consider it a very ambitious though realistic challenge for engineers. Today, man is working on technologies which open ocean floor and other planets to mineral extraction. Man reaches for resources which are found a lot farther and deeper than our 1,200 metres. I think, this is not a problem of depth but the problem of imagination, knowledge, and determination. Surely, quarrying rock at an environment of ocean floor or some other planet with technologies available today is hardly possible but once we are now employing technologies in which unmanned machine is exposed to danger and extraction continues to be profitable, we can also start planning a mine of that type. This is exactly what KGHM does. We are designing our smart plant based on our experience and vision which mobilises us to taking this ambitious engineering challenge. We are known for our maverick approach and permanent push for change. We get enormous satisfaction from working for a company which is modern and well managed, a company that is not only today but also in future will be an attractive workplace for our children and their children.



Intelligent Mine Implementation - Prof. Pekka Särkkä

Will the vision of smart extraction plant that replaces people with machines involve employment cuts? What is the next step to take after launching such a smart plant?

We have not seen employment cuts at KGHM for years. We are well into the process of upgrading our people's competence to new and

increasingly demanding requirements of our technological process. It is obvious that when we extract ores deeper than 1,200 metres where temperatures are extremely high, there is a risk of hazardous gases, etc., this company which highly values the safety of its workers is obliged to reduce the risks to which their lives and health are exposed. Having applied the technology of data transmission, machinery control and monitoring several years ago, we started a process of withdrawing human operators from belt conveyors, ore unloading points (screening), electricians from places where working conditions were too hard or even prevented work at all. In this way, we have built underground remote control centres managing machines and equipment (dispatchers) and some similar stations overground. So, instead of giving a sack to our people, we move their work posts to safe places. As a result, the same worker can now operate not just a single machine or equipment but, assisted by monitoring and remote control systems, he can operate two or even more of them. Similarly, activities related to prediction and repairs are also done based on information obtained from installed sensors or monitoring devices so that permanent human supervision underground where conditions are extremely difficult and unsafe is no longer necessary. We introduce respective organisational changes, expand people's job descriptions and competence, improve their working conditions and safety without compromising the productivity or cost discipline.

Thank you very much for the conversation.

Interview by Tomasz Rabenda