MINING IN THE 21ST CENTURY

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Motto: In the beginning there was the Rock.
It contains mineral resources.
Much has been done with It,
and without It nothing would have been done.
(Paraphrase of the Gospel of John I: 1-3).

Abstract: *Given the bleak forecasts of the Earth's mineral reserves in the 21st century and their effects on the "health" of mining, the paper demonstrates that the alarming predictions of some researchers should not be neglected, but should not be taken ad literam.*
Key words: *mineral resources, mining, threats, future actions*

1. Introduction

Natural resources are components of the natural environment used in the production process to meet the material and cultural needs of a society. They inherently have a physical origin, but in the process of their use they become an economic resource.

Natural resources are divided into *inexhaustible* (agro-climatic, geothermal, hydropower) and *depletable*. In turn, *depletable* resources are divided into non-renewable (minerals) and renewable (soil, water, biological, recreational). Based on this classification, the following types of natural resources can be identified: mineral (terrestrial and aquatic), biological, agro-climatic (light, heat, humidity) and recreational.

When considering natural resources, it is important to assess their availability, i.e. the correlation between the reserves of resources explored and the quantities used from them. The supply of non-renewable *depletable* resources is estimated based on the number of years for which these resources will be sufficient at the current level of production. For renewable resources, their quantity per capita is determined.

In the following we will refer only to non-renewable mineral resources, which are the subject of mining, although an overall assessment of the health of the Earth from all points of view (economic, social, environmental) cannot be done without considering the effect of exploitation by man of all natural resources.

For the economy of any state, mineral resources are of particular importance. They are the basis of material production and are used in all its branches. These include natural substances of mineral origin used for the production of energy, raw materials and materials. About 160 types of mineral resources are mined in the world. Some have already lost their greatness and no market demand (e.g. nitrates), while others are becoming increasingly important and finding new uses (e.g. metal ores and mineral fuels).

Like any natural resource, mineral resources are unevenly distributed on Earth. There are regions where a huge number of various minerals are concentrated. There are regions rich in a single type of mineral raw material and there are territories where virtually any raw material is absent. Fortunately, every year, new mineral deposits are discovered and developed. There are only a few countries in the world with significant mineral reserves. Leaders include Russia, the United States and China.

Mineral resources are the basis of modern industry and scientific and technological progress. Without them, it is impossible to imagine the existence of most industries: chemistry, construction, food, light, ferrous and non-ferrous. Engineering with its many branches is also based on the use of mineral raw materials.

Minerals are essential for development and therefore for quality of life and the creation of sustainable communities. Non-energy minerals are basic elements in everyday life: a house contains up to *150 tons of minerals*, incorporated in: cement, clay, gypsum, calcium carbonate, composite materials, glass, paint, ceramics, tiles and tons of metals; a car contains up to *150 kilograms of minerals* (rubber, plastics, glass and *over a ton of metals*); 50% of paints and paper are made up of minerals; ceramics and glass also contain up to 100% minerals. Mining planning ensures that the coverage of social and economic needs, as well as the effects of extraction and processing on humans and the environment, is managed in an integrated way, taking into account the entire mine/quarry life cycle, from the beginning of the extraction process, and including maintenance closure and after closure in the planning process. In the context of globalization and increasingly strong competition in

the raw materials market, the strategic value of the mining sector is constantly growing. In terms of extraction technology, Europe has become a world leader, but this position needs to be strengthened for further development.

Therefore, without mining the other industries cannot develop.

The World Mining Congress in Las Vegas (USA) in 2000 had as its motto *everything begins with mining* a motto that expresses the economic goals of a significant group worldwide - the group of miners - but which often it contradicts another doctrinal group, first of all, the group of ecologists. Within the first group there are two camps, one of the "ignorant technician" and the other of the "greedy economist". If the two camps do not harmonize the environment in which they operate results in pollution. On the other hand, the opposition group must have an attitude that, starting from the concrete data of the deterioration of human relations with the environment, to accept a coherent set of ideas, likely to promote the desire to provide humanity with mineral resources, without which it can't there is /2/.

2. The situation of mineral resources in the 21st century /4/

Mineral fuel resources are unevenly distributed and limited to the sedimentary coverings of the platform structures. Of the three major fuel resources - oil, natural gas and coal, which produce more than 80% of the world's energy, reliable global geological reserves of *caloric coal* are estimated at approx. 500 billion tons (and still less calories). Today, coal is extracted in about 80 countries of which the USA (28%), Russia (18%), China (13%), Australia (9%), India (7%) and Germany (5%) are the most rich in this resource. If we evaluate the reserves of high quality coal (for coke), then Australia, Germany, China and the USA are in the first places. At the same time, the global annual coal consumption is approx. 5 billion tons, leading to the conclusion that these coal reserves will be depleted in the next 100 years. However, taking into account the low-calorie coal reserves, its use can be appreciated for a maximum of 200 years.

Uranium ores are often referred to as mineral fuel resources, because the main purpose of uranium is fuel for nuclear reactors installed at nuclear power plants. The estimates of the geological reserves of uranium ores are very different, although reliable reserves, according to the International Atomic Energy Agency (IAEA), are determined quite accurately: 3.6 million tons and are concentrated in 44 countries around the world. Australia ranks first - approx. 30% of world reserves, followed by Kazakhstan - 17%, Canada - approx. 12%, South Africa - 10%, then Namibia, Brazil, Russia, etc. At the same time, the extraction of uranium and the production of concentrates from it is slightly different. Uranium ore is mined in 25 countries of the world: Kazakhstan (33% of world production), Canada (18%), Australia (11%), as well as Namibia and Niger (8% each), Russia (7%), Uzbekistan, USA, South Africa and Gabon.

A relatively recent forecast /3/, regarding the energy situation for 21st century estimated energy consumption for 2050 at 24 TW, which is expected to remain stable for a long time, based on the following conventional fuel reserves and estimating consumption for each of them:

- *oil*: 1200 TW-year = 50 years;
- *gas*: 1200 TW-year = 50 years;
- *coal*: 4800 TW-year = 200 years;
- *nuclear neutron lens* (U235): 300 TW-year = 12 years;
- *nuclear with fast neutrons* (U238, Th232) 30,000 TW-year = 1200 years;
- *deuterium-tritium thermonuclear fusion* (d-t): not developed. Profitability? Several thousand years; limited by the amount of lithium;
- *deuterium-deuterium thermonuclear fusion* (d-d): much more difficult than the previous one. Utopian? Billions of years.

Instead, unconventional energies: hydraulic, wind, solar heating, photovoltaic, etc. have a lifespan of billions of years, but for now their energy efficiency is still very low. For the year 2100, an almost equal diversification of energy sources is assumed to reach 24 TW when:

- fossil fuels: depleted (greenhouse effect: heating with several degrees);
- nuclear with slow neutrons: exhausted;
- fast neutron nuclear: 10,000 reactors (100 / year of an experimental model: super-generator / rubbiatron / hydrogen fusion/) that could be perfectly developed against accidents and terrorism and accepted by the public;
- wind farms: 10 million worldwide;
- solar heating, photovoltaic cells: developed technology; panels in space: technologies not developed. A scenario is also foreseen which, at the scale of the solar system, can be considered in the medium term (year 4000) when the nuclear program is practically exhausted (except, perhaps, of fusion d-d), but unconventional (inexhaustible) energies will still be present. It is known, however, that predictions are always dangerous and questionable.

Ores and other mineral resources, unlike sedimentary fuels, have, with rare exceptions, a magmatic or metamorphic origin /4/.

Iron ores are scattered in the earth's crust, and their proven reserves are estimated at 160 billion tons. The iron content of these varies greatly - from

20% to 68%. Ukraine dominates in terms of proven iron ore reserves (45% of world reserves), followed by Australia (20%), Brazil (17%), Russia (15%), China, India and the USA. However, the iron content of the ores does not correspond to the indicated range - the richest ores are supplied by Liberia, India, Australia, Brazil, Venezuela - the ores from these countries contain more than 60% of the useful component.

The largest developers of iron ore are China (43% of world production), Australia (20%), Brazil (17%), India, Russia, Ukraine - all iron ore is mined in 43 countries, including for export. A number of countries that previously focused on their own iron ore are importing it, and this applies primarily to the EU.

The most common metal in the earth's crust is aluminium and is concentrated in sedimentary rocks. The world's explored reserves of bauxite are estimated at 30 billion tons. Light ores of non-ferrous metals, including bauxite, are characterized by a high content of useful component - in bauxite, its content is 30-60%. Guinea (27% of the world's proven reserves), Australia (25%), Brazil, Jamaica, China, India, Vietnam have the largest reserves of bauxite, although the latter, due to new divorced reserves, may rank first in ranking. The largest developers of bauxite are Australia (33% of world production), China (19%), Brazil (15%), India, Guinea, Jamaica - a total of about 30 countries. Some developed countries, such as the USA, France, Greece, Hungary, have stopped completely extracting bauxite or significantly reduced it. Russia is also focusing on bauxite imports.

Heavy non-ferrous metal ores contain a significantly less useful component. Thus, *the copper* content of ores is usually less than 5%. The largest copper ore producing countries are Chile (36% of world production), USA, Peru, China, Australia, Russia, and Indonesia (about 50 countries in total). A small number of countries occupy leading positions in reserves and production of other mineral resources. Thus, over 70% of world *manganese* production is concentrated in China, South Africa, Australia, Gabon, Kazakhstan and India; *chromium* - in South Africa, Kazakhstan, India, Zimbabwe, Finland; *lead* - in Australia, China, USA, Peru, Canada; *zinc* - in China, Australia, Peru, Canada, USA, Mexico; *tin* - in China, Peru, Indonesia, Brazil, Bolivia, Australia, Malaysia, Russia; *nickel* - in Russia (25% of world production), Canada, Australia, Indonesia, France (New Caledonia), Colombia; *cobalt* - in R.D. Congo (53% of world production), Canada, China, Russia, Zambia; *tungsten* - in China (85% of world production), Russia, Canada, Austria.

Among the non-metallic raw materials, the chemical raw materials must be distinguished: phosphorites, apatites, salts (sodium, potassium), sulphur. Phosphorites are mined in almost 30 countries around the world, including the leaders of the USA, China, Morocco, Tunisia. USA, China, Germany, India, Canada stand out for the extraction of sodium salt; potassium salt - Canada, Belarus, Germany, Russia, Israel.

A forecast, from the middle of the twentieth century, estimated the lifespan of several mineral resources taking into account their reserves and consumption rate: salt - 2130; coal - 2125; phosphates - 2200; manganese - 2090; iron - 2060; bauxite - 2045; nickel - 2040; copper - 2035; molybdenum - 2025; cobalt - 2018; lead - 2010; zinc - 2008; asbestos - 2005; tungsten - 2000; tin - 2019; mercury - 2003.

As can be seen, some of these resources should already be depleted by 2020, which is not confirmed in reality because much attention is paid to geological exploration, and the extraction of resources is still done with an eye to the future.

Thus, enormous reserves of mineral resources are concentrated in the oceans. Some of them have already found wide applications. These are table salt (more than 1/3 of the world's extracted salt), magnesium, bromine and iodine, obtained from seawater. A mineral deposit is the bottom of the oceans. Coal (UK, Canada, Japan and China) and sulphur (USA) are mined in the rift area. Enormous reserves of iron, manganese, nickel, cobalt, copper and other metals are concentrated in pheromanganese nodules on the ocean floor. Nodules predominate mainly in the Pacific Ocean. In the Indian and Atlantic oceans, their area is much smaller. Mining technologies have already been developed, but are not yet widely used. In the areas of ridges in the middle of the oceans where hot springs appear, very large reserves of zinc ores, lead, copper and other metals are concentrated. The extraction of these minerals on an industrial scale is a problem for the future.

If, at present, the reserves of useful mineral substances in Europe are in a relative decrease compared to other continents and their exploitation is unprofitable, Latin America is very rich in mineral resources and has a considerable share of world production. area being the world's leading producers of various raw materials such as niobium, manganese, iron, bauxite, copper, rhenium, molybdenum, lithium, gold, silver, zinc and lead tungstate; instead, it faces an acute shortage of coal. Asia, with the largest reserves of oil and natural gas, also leads in reserves of fossil coal and iron ore.

The reserves of many types of mineral resources on Earth, at first glance, are quite large.

The consumption of many types of mineral resources in the world is growing rapidly. There are two possible reasons for this increase:
1) the increase of the Earth's population;
2) improving the standard of living of people with the consequent need for more raw materials.

Theoretically, if the population and living standards of people are stabilized, the consumption curves of all types of natural resources should remain at a constant level per capita.

Humanity, however, continues to steadily increase the rate of use of Earth's resources. Only in the first half of the twentieth century was the total amount of minerals extracted several times greater than that used by the human race for its entire existence. At the same time, the need for resources continues to grow.

If the high extraction rate of most types of mineral resources is taken into account, their depletion will be in the near future.

In 1970, the Club of Rome published the book The Limits of Growth which stated the message: resources are not infinite and humanity will reach their limits in a finite time; an exponential increase is unjustified in relation to a finite resource.

However, the history of the development of the world economy in the last century shows that we should not talk about the depletion of most types of mineral raw materials, but about a qualitative change in their processing and use. Extraction of increasingly poor ores has become possible. One type of mineral resource can be replaced by another, for example, the billions of tons of so-called tailings from mining companies can be processed as secondary ore; some minerals can be used as artificial materials. Of course, for all this, the production technology will have to change.

3. Mining in the 21st century

At the beginning of the third millennium, the global mining industry has faced and faces many challenges, including:

• continuous depletion of mineral deposits,

• largely unresolved economic efforts,

• serious damage to the environment and water sources,

• the negative impact on the health of neighbouring communities,

• the ecological measures that humanity must take in order to avoid self-destruction,

• increasing amounts of waste (sterile rocks) resulting from the processing of mineral raw materials, which must be stored according to environmental regulations in force. Statistics show that in a population of 7.5 billion people, approx. $3 \cdot 10^{10}$ tons of raw materials: energy fuels, ferrous and non-ferrous ores, industrial ores, useful and ornamental rocks, sand and gravel, etc. To obtain these quantities, the global mining industry had to exploit and remove about ten times more rocks ($3 \cdot 10^{11}$ tons), of which about 90% are waste rock (residual material).

• although the mining sector can bring important direct or collateral benefits to local and national economic development (job creation, new infrastructure generation or contribution to the development of local capacities and enterprises), nevertheless, these benefits often do not benefit local people. get to materialize,

All this creates - sometimes - huge pressures on mining.

Naturally, the question arises *what to do?* to maintain the health of mining and beyond, because in addition to the exclusive role of providing mankind with the mineral resources of the subsoil, without which it cannot exist, it brings income to states and enterprises, is an important source of employment, both directly and indirectly and can play an important role in combating poverty. The mining sector could and should also contribute to combating climate change through technology transfer and responsible investment.

I will try to answer the above question based not only on my own arguments, but especially the well-argued opinions of some personalities from our country and the world, from our mining guild, to which are added the recommendations of international bodies concerned about the fate of the mining world.

It must be said that *Mining Revue*, which we celebrate this year at the age of 70, has hosted many debates on this topic and in its pages we find not only solutions to *Happy Birthday, mining !*, but also a revolt against those who for the last 30 years have sought, on behalf of regional and international *strategies*, to curb, or in some areas to eliminate, the exploitation of mineral resources, although there are no realistic arguments.

Thus, for a long mining life the following actions /5/ must be performed:

• the rational use of the mineral resources of our planet by improving the methods of extraction and processing of all minerals. It is important not only to extract as many mineral raw materials as possible, but also to make the most of them and to take care of the complete disposal of environmentally friendly waste: atmosphere, soil, water, vegetation and fauna,

• the elaboration of synthetic materials - analogous - that can replace the rarest minerals, thus preserving their reserves,

• giving priority attention to geological exploration in order to create potential reserves of mineral resources,

• humanity's search for alternative ways of addressing production and economic needs to prevent a global catastrophe,

• the increasing use of non-waste technologies, which would lead to a reduction in the consumption of raw mineral resources,

• balanced distribution of the benefits of mining to society at large, local communities and mining enterprises, and the prevention and treatment of potential social conflicts,

• the establishment of a transparent, clear and concrete legal and regulatory framework covering all phases of mining, in particular the post-closure phase of mining and land rehabilitation,

• creating working conditions in the mining sector, in compliance with international and national labour and environmental standards,

• promoting health and safety at work, as well as research in these areas, as basic necessities for the sustainability of the mineral resources sector,

• paying special attention to reducing occupational hazards and preventive medical measures,

• the initiation and intensification by governments of support programs for the mining sector so as to maximize social and economic benefits and have a direct impact on the development of the local population,

• empowering local authorities to manage mining resources responsibly and transparently, boosting long-term projects and promoting sustainable development,

• the development by governments of transparent procedures for the granting of concessions, based on the principle of legal certainty, in order to limit issues related to land use and ownership rights,

• improving the image of mining in order to attract young people and new people, to maintain the existing workforce and to improve its capacity to cope with the modernization of the mining industry,

• the development, with national or international support, of a skills development program for the existing specialized workforce requiring additional training and education, as well as an effective policy for lifelong learning,

• investments in universities and educational programs, in order to increase the overall capacity of the sector by reviewing the current national support for mining and mineral processing, as well as geology departments, in order to attract more students to this field and to promote research activities in these disciplines,

• encouraging decision-makers to develop clusters and technology parks within mining areas, given that the extractive industry interacts to a large extent with other industrial sectors and service providers and is known to create jobs in the sector. Mining in turn creates four additional jobs,

• raising awareness of the role of minerals and the sustainability of industries, through educational courses, workshops, debates, conferences, in an interdisciplinary approach: for example, promoting in schools and universities concepts such as eco-mining, economic geology, responsible use of mineral resources, etc.,

• creating conditions to stimulate the competitiveness of the extractive industry, by making the most of research and innovation and by promoting investment,

• promoting the participation of this industrial sector in national and international research and development programs aimed at increasing the sustainability of extraction, as well as in a program on the use of raw materials through technological improvements,

• giving priority to security of supply and demand for raw materials in the context of free market forces. Today, 70% of European manufacturing depends on extracted substances, while the EU-27 is facing a major restructuring of the mining industry and the price of metals in the global market is constantly rising. Security of supply for industries can be improved by substantial investments in the mining sector by states with geological potential,

• improving sustainable access to raw materials through achievable, realistic and useful actions. This is particularly important as industries face significant supply challenges: the reduction of accessible deposits suitable for mining, due to insufficient or short-term land use planning or poor use of geological knowledge; burdensome administrative burdens and costs for obtaining extraction permits, as a result of additional regulations and lengthy preliminary studies; difficulties in obtaining extraction permits, both for new quarries and mining activities and for the extension of existing ones,

• implementation of existing best practices and methods of exploitation at the level of some states, in order to develop and promote them at Community level, taking into account not only the technological aspects, but also the experience gained by these states in conducting geological studies and mine management and careers,

• the development of a GIS-based information system on the location, nature, resources and reserves of minerals, both terrestrial and maritime, to facilitate the integration of mineral potential in spatial planning, in order to select and define protected areas, inter alia,

• improving the effectiveness and efficiency of social and environmental impact assessments by developing better and clearer guidelines,

• improving the quality of information on minerals by: ensuring the access of policy makers to more comprehensive data on resources: production, employees, revenue generated, land used for mining and land used for other uses, to ensure decision-making based on the most accurate data available; paying greater attention, both at European and national level, to the growing importance of European metals, industrial minerals and aggregates, at political and legislative level; taking into account geological information in spatial planning.

4. Mining in Romania in the 21st century

In Romania, mining is a traditional occupation, attested since antiquity.

An analysis of Romanian mining is excellently made in the work of Professor Dumitru Fodor (Mining Revue no. 4/2016) /1/, very current and present, and therefore here I will refer only to the intentions of the rulers on the future of mining in Romania.

Romania has undergone a major industrial restructuring in the last 30 years, including the decrease in domestic production and the operational closure of most mines, which has led to job losses, economic-social and environmental effects that have seriously affected the quality of the lives of the inhabitants of the communities in the mining areas.

The closure of mines in Romania was a natural consequence of the evolution of the Romanian economy after 1989, when investments in the national economy were reduced, which generated a significant decrease in the need for raw materials (including mineral resources) and consequently, mining production. (the amount of useful mineral substances extracted) did not sell.

Another reason for the initiation and development of mine closure programs was the unprofitability of the exploitation of mineral resources, their economic inefficiency, due to reasons related in particular to the technical conditions of access to the deposit and its increasingly difficult exploitation, moral wear and tear and physics of the machinery and equipment used.

The closure of the mines led both to a decrease in the income of the population in the respective regions, with restrictive consequences on the local economy, and to a decrease in the income of the local budgets. The impact of the cessation of mineral resources on the living standards of the population manifests itself in several ways, namely: the difficulty of finding a job according to professional training, difficult access to basic services and declining financial support from the government.

As a consequence of these changes and the pressures to modernize its industrial sectors, the government has closely analysed the role of mining in the Romanian economy and the long-term contribution it can make to the process of sustainable development and through

The Ministry of Economy, Trade and Business Relations elaborated the *Mining Strategy of Romania 2017 – 2035 /6/* thus creating the opportunity to substantiate a national development strategy, starting from the knowledge and capitalization of the mineral resources potential and taking into account the size socio-economic and environmental protection.

The Strategy proposes to reconsider the position and the way of involvement of the state and the communities in the mining field, by gradually relinquishing the attributions of economic operators and administrators, in favour of emphasizing the regulatory role and promoting policies for developing and stimulating a viable system, in which the private entities have mainly the right of exploitation, operation and administration of the mineral resources and to ensure the financing and the management of the mining activities.

In the European context, the European Union (of which Romania has been a part since 2007) has developed a strategic plan – Strategic Implementation Plan for the European Innovation Partnership on Raw Materials (EIP), as well as the Raw Materials Initiative (RMI), where the field of resources minerals is a priority area. It is based on three pillars (guaranteeing access to raw materials, determining the conditions for a sustainable supply of raw materials from European sources, boosting resource efficiency and promoting recycling in order to reduce raw material consumption and reduce dependence on imports). Actions have been proposed to define essential raw materials, provide legal measures for access to and sustainable management of raw materials, expand the knowledge base at EU level, focus research on innovative technologies for exploration, exploitation, recycling, identification of substitution and efficiency materials.

The establishment of *the Strategy* took into account, first of all, the base of solid mineral raw materials existing on the territory of our country. A summary of the reserves estimated on 01.01.2016 and the productions made in 2015 in the Romanian mines / quarries is given in table 1/6 /. In addition to what is presented in the Strategy, we have added an additional column with the life of these reserves to the production of 2015. Of course, these durations will not be realistic because they were related to

extremely small productions made in that year, practically a non-existent mining.

The above can also be confirmed by the situation of licenses / permits for continued operation in Romania (table 2) /6/.

The extraction of mineral resources is under the strong influence of the environment, technological changes and capital investments necessary both to maintain current production capacities and to open new mines. It should be noted that, even where mineral resources are relatively abundant; their extraction will become more expensive in the future, because as acceptable reserves are depleted, deeper levels begin to be exploited, which involve higher extraction costs. This can be changed to some extent by increasing the efficiency of mineral extraction and by discovering new reserves with a high degree of productivity.

Table 1. Useful minerals analysed in the *Strategy* /6/

Substance or group of mineral substances	Reserve on 01.01.2016		Net production in 2015		Lifetime, years
	U.M.	Quantity	U.M.	Quantity	
Metalliferous mineral resources					
Gold-silver ores	tones	760	kg	81.5	9325
Copper ores	mill. tones	443	thousand tones	40.26	11003
Poly-metallic ores (Pb – Zn)	mill. tones	67	thousand tones	0	∞ ?
Non-metallic mineral resources					
Rock salt	mill. tones	4390	thousand tones	2079.59	2111
Industrial minerals and useful rocks					
- Ornamental	mill. tones	80	thousand m^3	26.9	1062
- Sand and gravel	mill. tones	1250	thousand m^3	38830.33	15
- Others	mill. tones	9789	thousand m^3	40091.39	101
Energy resources					
Coal	mill. tones	3898	thousand tones	26705.767	146
Uranium ore	*	* limited	*	*	*
Secondary resources					
tailings ponds	mill. m^3	?appreciable	?	?	?
waste dumps	mill. m^3	?appreciable	?	?	?

Table 2. Situation of licences/permits-solids /6 /

Type of authorization	Licences / permits in	
	force	approval
Operating licences	387	376
Exploration licences	67	-
Prospecting permits	14	-
Operating permits	935	-
Licences with approved closure	60	-

The Strategy performs a SWOT analysis (strengths, weaknesses, opportunities and risks) of solid non-energy mineral resources (metallliferous, non-metalliferous, industrial minerals, useful rocks, and ornamental rocks) and energy mineral resources (coal, uranium).

From this analysis some general conclusions can be drawn:

a. Non-metallic resources (salt):

- appreciable quantitative and qualitative reserves;
- difficult deposit conditions;
- the existence of a potential for the exploitation of activities related to basic production such as: tourist, spa, sports and leisure activities, religious, natural gas storage in caves created as a result of salt exploitation in solution, the possibility of natural gas storage, or waste in salt mines, a.o.;
- reducing the demand for rock salt for the food industry, narrowing the internal market due to the decline of the chemical industry and fluctuating demand for road snow removal.

b. Resources of industrial minerals, useful rocks and ornamental rocks:
- considerable geological reserves;
- lack of post-extraction processing industries;
- lack of adequate and coherent legal regulations for access to land within the perimeters of exploitation;
- water and soil pollution;
- the deposit conditions allow the introduction of modern technologies;
- global abundance and diversity.

c. Metalliferous resources (Pb + Zn):
- relatively important qualitative resources and with diverse chemical composition;
- difficult mining conditions, the ore bodies are at great depths;
- the lack of the post-extraction industry (metallurgical, pyro-metallurgical), which restricted or stopped its activity;
- the appearance on the market of synthetic materials that replace traditional products.

d. Au + Ag resources:
- considerable resources;
- the mines are closed and the post-mining industry has ceased operations;
- the gold ore market is fluctuating;
- the risk of hostile perception of the use of cyanide in the processing.

e. Copper (Cu) resources:
- appreciable reserves;
- application of modern exploitation technologies in quarries;
- favourable copper ore market;
- the risk of hostile perception due to the impact on the environment.

f. Coal resources:
- appreciable reserves concentrated in a single deposit;
- contribution to energy security in crisis situations;
- existing surface and underground infrastructure;
- there are environmental permits and operating licenses;
- difficult geological-mining conditions of exploitation;
- high production cost;
- the possibility of implementing modern technologies for capturing methane from coal and methane emissions from deposits in operation;
- degassing of coal;
- the dependence of coal production on the operation of a small number of energy production capacities.

g. Lignite resources:
- appreciable reserves concentrated in a small area;
- contribution to energy security in crisis situations;
- qualified staff, a lot of professional experience;
- limited possibilities to improve production quality;
- the increase of production costs generated by the obligation to comply with the additional conditions of environmental protection;
- the dependence of coal production on the operation of a small number of energy production capacities.

h. Uranium resources:
- limited national uranium supply;
- the existence of a research and design infrastructure at national level;
- advanced experience in the field and in the adjacent sectors;
- the possibility of introducing uranium resources into the economic circuit from abroad and their processing / processing and refining in domestic installations with advanced technology;
- the construction of units 3 and 4 at Cernavodă will provide a favourable outlook for the uranium mining, processing and refining sector for the purpose of nuclear fuel producers.

i. Secondary resources:
- there are appreciable secondary resources located in tailings ponds and some tailings dumps;
- there are technologies for the exploitation and processing of these types of materials;
- there is no legislative framework on the exploitation of secondary resources;
- the need to build new processing plants;
- the processing of waste from old tailings ponds and poor ore dumps leads to the greening of large areas occupied by these landfills;
- positive social consequences on the communities in relation to the exploitation activity.

The Strategy sets out the following general objectives /6/:

1. Repositioning the mining field in the perspective of ensuring the mineral resources necessary for the sustainable development of the country, with priority from domestic production;

2. Harmonization of the national interest of increasing the activities of the mining sector with the requirements of sustainable development;

3. Sustainable use of the country's mineral resources in harmony with the environment, protection of natural and cultural objectives in the European context;

4. Responsible participation of communities in areas with mining potential in decisions and actions carried out throughout the life cycle of mining projects, in a transparent manner.

Taking into account the general objectives set, the following measures and actions are identified:

• For goal 1:
- redefining and updating the mineral resource base;
- increasing the country's budget revenue base;
- creating new jobs and increasing the number of employees;

- development of geographical areas carrying mineral resources with limited economic alternatives;
- changing the institutional framework in the field by reorganizing some agencies and services;
- correlating the mining legislative framework with domestic and European legislation;
- stimulating research, development, innovation;
- ensuring transparency and access to data in the field of mineral resources;
- increasing resource efficiency;
- framework conditions for research and innovation for competition and development.

• For goal 2:
- improving the regulatory framework to ensure predictability and fiscal stability for attracting new investments by creating the operational manual of the investor in the field of mineral resources;
- create a framework of regulations on public-private partnership for mining activities by amending and supplementing the Law on Public-Private Partnership;
- the approach to sustainable mining on free market principles through the analysis with a view to deregulating the prices of mining products in accordance with European legislation.

• For goal 3:
- achieving environmental protection through biodiversity conservation measures, air quality monitoring and decontamination of historically polluted mining sites;
- sustainable development of mining communities;
- providing financial resources and guarantees for the restoration and rehabilitation of the post-operation environment;
- the closure of mines in accordance with international best practices and the management of green lands;
- ensuring the socio-economic regeneration of the affected communities following the mine closure process;
- risk management and climate change adaptation;
- improving dialogue and relations with other industries through consultation between the various stakeholders and the mining industry during the licensing process;
- harmonization of mining areas with natural and cultural environments.

• For goal 4:
- integration of the package of information and regulations in the field of mineral resources in the participatory strategic planning for the local and regional socio-economic development;
- creation of a network for information transfer and exchange of experience between similar structures in the country and abroad;
- promoting societal development and regional growth;
- cooperation between government institutions, academia and research, professional, trade union, employers' organizations, NGOs and the business community by including all institutions and organizations interested in finding new technologies in the field or in drafting new legislative documents;
- the establishment of a National Advisory Council, a body with an advisory role to monitor the implementation of the provisions of the Mining Strategy;
- transposition into the Mining Law of the provisions of Directive 2013/34 / EU on transparency rules for the mining field.

The Strategy reiterates that such measures are likely to guarantee both now and in the future the observance of basic principles of ethics, accountability and transparency, likely to provide the citizen with the necessary peace and security, to discourage illegal, immoral practices. or dangerous in the extractive industry and to promote the safe, efficient and profitable exploitation of our country's natural resources.

Based on this *Strategy*, the following public policies will be developed, which must be approved by the government:
- the socio-economic reconstruction of the localities in the areas most affected by the mining restructuring in order to transform them into development poles and implicitly for job creation for the adjacent areas as well;
- capitalization of lignite resources from the mining basin of Oltenia;
- capitalization of coal resources from the Jiu Valley mining basin;
- capitalization of internal uranium resources by developing the extraction activity, preparation of uranium ores and refining of technical concentrates and stocks of technical concentrates;
- capitalizing on the resources of non-metallic substances and useful rocks;
- capitalizing on salt resources and related tourism potential;
- capitalization of the resources of useful metalliferous mineral substances, in parallel with the identification of the industrial patrimony.

5. Conclusions

To cope with globalization and climate change, governments' energy policy and integrated mining policy are vital strategic elements. The states of the world must support efforts to promote renewable energy sources and the efficient use of energy. This can only be achieved if industries have secure access to non-energy minerals, especially base metals and

those used in high technology, as well as minerals essential for green economies.

Behaviour change, energy efficiency and renewable energy sources have led to a proliferation of technologies and research and development activities. It is well known that technological equipment incorporates large quantities of metals, of which a significant proportion are rare and precious metals, which, we must be aware, are almost unavailable in Europe.

Major mineral resources are available in Eastern European countries, where the geological structure has always allowed mining to take place. However, in the new EU countries this sector has been insufficiently funded by the state, so the current situation does not reflect the real potential of the non-energy mining industry. From this perspective, it is essential to invest private capital in these enterprises, in order to provide the financial resources that have so far been provided mostly by the state.

The extractive industry interacts with many industrial sectors, such as technology and use providers, research, financial services, consulting and environmental protection, etc. Because of this, in regulation, an extraction operation creates, on average, four times more indirect than direct jobs in the region where it is located. The regional growth potential is considerable, especially in areas where other forms of economic development are not accessible.

Romania, rich in poor deposits, with millennial experience in mining, goes through a critical period after 1989 in addition to objective arguments regarding its restructuring were also wrong decisions taken by both the governor who have an alternative to the country's leadership, but must either we say it, and an indifference on the part of the mining guild which has not proved capable of opposing some disastrous measures to the development of mining activities on the territory of the country.

We are 4 years after the elaboration of the Mining Strategy of Romania and we find that it has not yet come to life: mines / quarries are still closed, prospecting/exploration activities of new deposits are missing, the greening of post-closure areas is difficult or not at all, increases the import of raw materials for industry with access to non-energy minerals and even energy for thermal power plants (coal), secondary resource reserves are not yet well known and the examples can continue.

We are all obliged to do - according to our intelligence, professionalism and will - the world of tomorrow - the next generation - not to admire, not to thank and, why not?, to appreciate our efforts, sometimes superhuman, to create their conditions to perpetuate life on this planet - the home of the peoples.

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