



IMPORTANCE AND FUNDAMENTALS OF SUSTAINABLE MINING

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Mihajlović Slavica¹, Đorđević Nataša¹, Kašić Vladan¹,
Matijašević Srđan¹, Lozanović Šajić Jasmina²

¹Institute for Technology of Nuclear and Other Mineral Raw Materials, Belgrade, Serbia

²University of Applied Sciences, Campus Vienna, Department of Engineering, Vienna, Austria
s.mihajlovic@itmns.ac.rs

Abstract: *This article provides a definition and analysis of sustainable mining from the aspect of impact on the wider social community. The development of modern mining, more efficient technologies that are sustainable, raising awareness of the importance of a healthy environment, sustainable mining that contributes to positive social changes has been achieved. It is not only enough to comply with the regulations in this industry, but also to ensure business competitive advantage on the market on the basis of sustainability. Mining is sustainable only if it bases its environmental and social policy on the law, competitive business advantage and good business practice. The Mining industry recognizes the need for changes and, accordingly, is actively working in the field of ecological and ethical mining. According to the objective set in the mining industry, several ways have been adopted to achieve sustainable mining based on sustainable solutions at different levels such as: practical solutions, supporting the transition to renewable energy sources in order to reduce CO₂ emissions and sustainable technological innovation. Practical solutions as part of mining activities should highlight several key positions that contribute to sustainable mining: the use of tailings materials as waste from previous ore processing processes, which contributes to reducing the amount of deposited tailings, efficient and safe management of unused waste, land reclamation after the mine is closed and bringing it to level before the start of exploitation, water conservation, afforestation of the land with plants suitable for the terrain, which creates conditions for the settlement of animal species and prevention of illegal mining activities. Direct cooperation with the local community on the territory of which the mine is located is extremely important in order to reduce the negative effects of mining activities and extract as many benefits as possible for the local population, proactive management of the economic transition of the local community, inclusion of local companies in the supply chain of services that operate within mine. The world on a global level is faced with sustainable technologies, as well as product needs arising*

from the mining sector. The development of renewable energy source technologies requires large amounts of metals and non-metals that are mining products. It can be said that mining is of fundamental importance for the transition of the energy sector and the transition to renewable sources. Also, mining has a big role to play in the fight against climate change.

Key words: SUSTAINABLE MINING, SUSTAINABLE TECHNOLOGIES, ENVIRONMENTAL PROTECTION, RENEWABLE ENERGY SOURCES, CLIMATE CHANGES

INTRODUCTION

Mining and activities related to this branch of industry have a significant impact on the environment. In order to protect nature, the working and living environment, renewable energy sources are increasingly being switched over. However, the development of renewable energy technologies requires large amounts of metals and non-metals that are mining products. Mining actually provides input raw materials for the so-called "green" technologies. On a global level, the world is faced with sustainable technologies, on the one hand, and the need for products arising from the mining sector, on the other [1-3].

The question is how and in what way to make a balance in making mining sustainable in order to meet the needs of sustainable technologies. The fact is that without mining there are no raw materials necessary for the development of sustainable technologies. It can be said that mining is of fundamental importance for the transition of the energy sector and the transition to renewable sources. Also, mining plays a major role in the fight against climate change. If mining, as an important industry branch, wants to contribute to the fight against climate change and reduce global warming, it must reduce gas emissions [4, 5].

In accordance with that, this industry must ensure the smallest possible emission of gases that affect climate change in all meridians. The transition from fossil fuels, as an energy source, to renewable sources is an imperative of modern business. However, in order for this to be realized and put into practice, metals such as Cu, Ni, Co, Li, etc. are necessary, which are obtained in mining and metallurgy. As a consequence, the mining and metallurgical industry was created, which is characterized by large emissions of gases into the atmosphere. In the last few years, these industries have been trying to improve the management of all by-products created during production by developing unique strategies with joint efforts. They focus on the development of innovative technologies that provide sustainable solutions. This is how the concept of circular economy came about, which aims to improve the environmental sustainability of mining operations by recycling and reusing generated waste as raw materials for the production of other new products [6].

Experts and the professional public have been facing a great challenge for a long time to achieve a balance between sustainable technologies and sustainable mining as the basis of these technologies. It should be emphasized that the mining industry recognizes the need for changes and, accordingly, is actively working in the field of ecological and ethical mining. For sustainable mining companies, optimizing environmental

performance and social impact is not only a matter of ethics and compliance with laws and regulations, but also good business practice [7, 8].

THE CONCEPT OF SUSTAINABLE MINING AND ITS FUNDAMENTALS

Sustainable mining is one that operates to have minimal impact on the environment by ensuring that mine sites are left in a condition suitable for human reuse and the re-establishment of a suitable ecosystem. The application of new technologies enables the mining industry to reduce the negative impact on the environment, increase its efficiency, reduce production costs and improve its competitiveness on the world market. Sustainable technologies based on advanced management strategies are the foundation for a sustainable mining industry in the future. Sustainability is not only an obligation of companies, but also a social responsibility that establishes a balance between the exploitation of mineral raw materials and care for the environment [9-11].

In line with the goals set in the mining industry, several ways have been adopted to achieve sustainable mining based on sustainable solutions at different levels such as:

Practical decisions:

- The use of material that is already in the tailings dump as waste from previous ore processing processes, which contributes to the reduction of the amount of deposited tailings;
- Effective and safe management of unused waste;
- Land reclamation after mine closure and bringing it to the level before the start of exploitation;
- Water conservation by using modern technologies for water purification from biological processes to desalination, evaporation and crystallization, then by introducing a continuous return water process that leads to zero discharge of waste water, clearly defining the process of remediation of formed acidic mine water rich in heavy metals, continuous work on reducing consumption of reagents through constant optimization and investment in mine water purification technology, etc.;
- Afforestation of the terrain with plant species that are appropriate for the terrain, which creates conditions for the settlement of animal species;
- Direct cooperation with the local community in order to reduce the negative effects of mining activities and extract as many benefits as possible for the local population, proactive management of the economic transition of the local community, inclusion of local companies in the supply chain of services operating within the mine;
- Prevention of illegal mining activities (exploitation of various stones, non-metals such as limestone and zeolite, then sand from rivers, etc.) that are outside the legal framework and do not respect environmental protection measures; activities aimed at raising awareness of the dangers of unprofessional exploitation for the local community and environment, etc.

Support for the transition to renewable energy sources with the aim of reducing CO₂ emissions:

- Wind energy - wind parks (Figure 1).



Figure 1, (Wind park, Source: <https://www.linkedin.com/pulse/mining-sustainability-shared-value-between-united-oscar-mendoza-gallo> (Accessed 03.06.2024))

- Solar energy - solar panels (Figure 2).



Figure 2, (Solar panels, Source: <https://www.linkedin.com/pulse/weekly-news-digest-26-november-2-december-2022-golubyatnikov> (Accessed 03.06.2024))

- Water energy - hydroelectric power plants;
- General energy savings in the field of mining through the application of modern technologies in all operations such as high efficiency engines, compressors and pumps.

Technological Innovation:

- Sustainable technology contributes to sustainable mining;
- Technological improvement of transport of both mined ore and obtained concentrates.
- Advanced technologies contribute to improving environmental protection through waste management and controlled use of water and energy.

All the mentioned levels of monitoring the sustainability of mining enable transparency in the work of mining companies, which is crucial for implementing social and environmental goals in practice. The progress of mankind in terms of technology requires an increasing need, both for metals and non-metals, which play a key role in the production of various finished items for general purposes, parts that are installed in vehicles, machines, tools, equipment for factory halls, for the needs construction and others. All of the above indicates that due to their high demand, the very process of valorization and extraction of metals and non-metals in the context of sustainable mining is extremely important. Generally speaking, the energy transition itself depends on the support given to mining through the creation of policies and the improvement of practical solutions [12].

When we talk about the support of the wider social community for sustainable mining, the importance of controlling the implementation of laws, regulations and standards that regulate this area should also be emphasized. The practical ways in which government bodies and civil society can monitor and improve the implementation of laws and regulations are extremely important. The development of new mechanisms and the improvement of old ones make a great contribution to the improvement and improvement of the quality of life of every community member, including better environmental protection [13].

CONCLUSION

Analyzing the historical development of mining, from the ecological aspects and the impact on the environment, it is noted that earlier the negative impact would have been much greater than today. With the development of modern mining, more efficient technologies that are sustainable, raising awareness of the importance of a healthy environment, sustainable mining has been achieved that contributes to positive social changes. It is no longer only imperative to comply with the legal framework in this industry, but to ensure business competitive advantage on the market on the basis of sustainability. Mining activities, i.e. mining, is sustainable only if it bases its environmental and social policy on the law, competitive business advantage and good business practice. In accordance with the set objectives in the mining industry, several ways have been adopted to achieve sustainable mining based on sustainable solutions at different levels such as: practical solutions, supporting the transition to renewable energy sources in order to reduce CO₂ emissions and sustainable technological innovation.

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