INTERGOVERNMENTAL FORUM
on Mining, Minerals, Metals and
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THE IMPACTS OF CLIMATE CHANGE ON THE MINING SECTOR

Climate change is a threat to economies, populations, and life on Earth. Its effects are already noticeable and are expected to grow with the increasing intensity and frequency of meteorological events. Since the 1800s, human activity has been the main driver of climate change, primarily due to the pervasive consumption of all forms of fossil fuels, including coal, oil, and gas.

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To tackle climate change, governments, businesses, and civil society are all working together on commitments and actions. In 2015, 196 parties signed on to the Paris Agreement to acknowledge global warming and take action to limit it to 2°C compared to the preindustrial era by mid-century, while pursuing efforts to limit the increase even further to 1.5°C. This commitment, widely shared by businesses worldwide, will have many consequences for the mining industry, on top of the effects of climate change.

First, the transition to a low-carbon economy requires huge amounts of raw materials that the mining industry is responsible for supplying. Second, the mining sector itself needs to play a role in self-decarbonizing. Finally, as climate change is already happening, mining companies need to consider how they adapt to these new environmental conditions.

Supply of Minerals for the Energy Transition

The energy transition from fossil resources to renewables (also called the “green” transition) will require enormous efforts from the mining industry to supply the world with raw materials, especially minerals and metals, at a pace never seen before. Indeed, an electric vehicle typically requires six times more metals than a conventional car, and an onshore wind plant requires nine times more mineral resources than a gas-fired power plant. For the last decade, the rising share of renewables has been associated with a 50% increase in the average amount of minerals needed for a new unit of power generation (International Energy Agency, 2021). With ore grades being lower, higher volumes will need to be mined—resulting in both a challenge and an opportunity for the mining industry.

This surge in demand for minerals and metals highlights the need for the industry to do more geological exploration to identify new deposits, although general spending in exploration is still just above half of the overall 2012 exploration budget (S&P Global, 2022).

Paradoxically, extracting this large amount of raw materials will require the development of new mines with a larger overall environmental footprint, creating potential conflicts with local communities over scarce resources (i.e., land and water). Mining activities are energy intensive, and in most cases, that energy is supplied by fossil fuels. Rising demand for more minerals will necessarily be associated with increases in energy needs. A sustainable energy plan will be needed to avoid deepening the challenges related to climate change.

New Sources of Raw Materials

Artisanal and small-scale mining (ASM) will be a key source of raw materials in the short term and will play an essential role in the overall mining sector. For example, the ASM sector currently accounts for an estimated 10%–15% of global cobalt production (Cobalt Institute, 2022). Where applicable, the ASM sector has the unique capacity to rapidly ramp up its production, compared to traditional large-scale mining, which requires from 10 to 20 years to move from exploration to production.

Another potential source of supply lies on the old tailings that still contain substantial amounts of minerals that have not been extracted previously due to technical constraints and low prices. The exploitation of these tailings can become profitable due to technological development and a rise in the prices of raw materials. Indeed such re-exploitation of old tailings is already performed in some areas, such as in South Africa by the company DRD Gold (DRD Gold, 2021). New material can be extracted from the tailings of former storage facilities that have not necessarily been safely closed, or not according to most recent internationally recognized best practices. Reprocessing tailings should, however, be highly controlled and monitored to avoid disastrous tailings' dams' breaches, such as the September 2022 event in Jagersfontein, South Africa (Eligon, 2022).

This increase in overall metal demand is accompanied by a shift in the metals needed. Indeed, the elements required for renewable energy production and batteries are different from those needed in a fossil fuel-powered economy. Critical or strategic minerals needed for the energy transition include copper, cobalt, lithium, nickel, manganese, and rare earth elements, among others. Rising demand for some elements will depend on technology development and policy support.

Mining new kinds of minerals could result in a redistribution of mining locations, providing mining opportunities for new countries. However, this would entail extensive exploration work as most critical minerals' production and processing capacities are currently even more geographically concentrated than in the case of oil and gas (International Energy Agency, 2021).

New frontiers of exploration—including deep-sea and arctic mining—are already being considered. Both frontiers have controversial environmental risks and present potential legal issues when it comes to extracting resources from seabeds located in international waters.

Recycling (or urban mining) will also become part of the supply mix for the energy transition. Its role will depend on the development, establishment, and reinforcement of efficient recycling chains, as well as the embedding of life-cycle considerations into the design and manufacturing of new products.

Finally, energy-saving policies should become an essential consideration of this energy transition. This will be reached by limiting energy consumption, developing more efficient renewable technologies, and researching less metal-intensive ways of producing energy. The mining sector should then contemplate its role in the reduction of greenhouse gas (GHG) emissions.

The Decarbonization of Mining Activities: A role for industry

The mining industry accounts for 2%–3% of global carbon emissions and therefore has an important role to play in limiting its own GHG emissions. The industry has a duty to act responsibly, and pressure is increasing from all stakeholders. Indeed, all corners of society have raised their expectations on environmental, social and governance (ESG) issues, pushing mining companies toward more transparency and taking responsibility for the overall environment they are operating in. Companies with a good ESG rating are already benefitting from more favourable financial conditions.

Many of the largest mining companies in the world have taken action by setting increasingly ambitious targets for limiting their GHG emissions. For example, members of the International Council on Mining and Metals (2021) have collectively committed to a goal of net-zero Scope 1 and Scope 2 GHG emissions by 2050 or sooner. Some companies, such as BHP and Vale, have committed to even shorter-term goals, targeting a 30% reduction by 2030; Rio Tinto has set a 15% reduction target (McKinsey, 2021).

What are GHG scope emissions?

GHG emissions can be broken down into three main categories or scopes. Scope 1 emissions are direct GHG emissions from sources controlled or owned by an organization, such as emissions associated with fuel consumption in vehicles. Scope 2 covers indirect GHG emissions associated with the purchase of energy. Scope 3 emissions, also referred to as value-chain emissions, result from activities neither owned nor controlled by an organization but that the organization indirectly impacts in its value chain; this scope includes all emissions outside Scope 1 and 2 boundaries (World Resources Institute & World Business Council for Sustainable Development, 2004).

In the mining industry, Scope 1 refers to direct emissions from fuel and diesel consumption from mobile equipment; Scope 2 refers to direct emissions from electricity generation on mine sites for mining processing; and Scope 3 refers to indirect emissions from the supply chain and transport.

There are diverse ways for mining companies to decarbonize. Companies tend to first assess where their biggest emissions lie. The easiest option is to divest from coal operations. However, this action is simply a shift of ownership and responsibilities to companies that might have even fewer environmental requirements and less monitoring of their mine sites. The overall footprint of the industry would not change drastically as coal would continue to be mined.

Currently, general numbers for the mining industry show that 40%–50% of GHG emissions come from diesel used in mobile equipment (i.e., Scope 1 emissions); another 30%–35% come from non-renewable electricity (McKinsey, 2021). Actions are already in place to convert truck fleets in mining to electric vehicles when the electricity source is clean from a GHG emissions point view (e.g., hydroelectricity) (Mining Association of Canada, 2022).

The second main source of emissions is processing plants and the energy required to crush the ore before processing (i.e., Scope 2). In many remote locations, only heavy-fuel power plants were considered, producing a huge carbon footprint. New plants are now installing clean, renewable energy sources, such as solar panels (Mining Association of Canada, 2019).

On the ESG agenda, the rehabilitation of mining sites is a very important issue, and companies have the opportunity to align it with climate change considerations. For example, former mining sites can become sites for reforestation, helping a company offset its carbon emissions, or they can become sites for renewable energy production, such as solar panels (Teck, 2020).

Adapting to Climate Change: Crucial to building resilience

As discussed, the mining industry should decarbonize and supply the world with the elements necessary to the transition to a less carbon-intensive energy economy. It should also react and adapt to the existing and expected consequences of climate change. Although climate change overall could be described as global warming for the whole Earth system, it is translated locally into long-term changes (drying up of water streams, desertification, wildfires, loss of permafrost, etc.) and more frequent and intense extreme events, such as droughts, heavy rains, or hurricanes.

Water management will become challenging, especially in areas where water is already a scarce resource. Indeed, water resources can be affected by mining in numerous ways. Mining operations need water to crush ores into separate minerals, as well as for washing or transporting materials, drilling, controlling dust, cooling machinery, pit flooding, properly executing mine closure, and supporting the needs of workers (Timlick et al., 2022). Companies will need to improve their recycling, and in situations where resources are limited, they will need to restrict water intake to continue operations and limit potential conflicts with communities.

Extreme events have an impact on the integrity of mining installations, the slopes of open pits, and tailings storage facilities. Breaches in these tailing dams have potentially disastrous consequences,[1] and the frequency of dam failure is not diminishing (Lazenby, 2022). In addition to companies adapting their tailings storage facilities to these new events, the industry at large should study the estimated 15,000+ closed tailings dams (Church of England, 2022) to assess risks to environment, communities, and workers, and take adjusted mitigation measures. New designs and additional monitoring requirements (Global Tailings Review et al., 2020) highlight the need for new skills to handle such new environments.

Building local infrastructure, such as roads, electricity networks, or schools, for example, sometimes falls within companies' responsibilities as part of their corporate and social responsibility activities. They also have an obligation to provide decent housing for relocated communities or for their own workers. Furthermore, the development of mining infrastructure networks (roads, electric lines, and railroads) has off-site impacts. Companies need to build resilient infrastructure that considers climate change risks adaptation from conception to realization (sea-level rise, desertification, intense climatic events) and that will last beyond the life of the mine as a legacy that benefits local communities and the whole country.

Implications for Policy-Makers

Synergies with achieving nationally determined contributions (NDCs): Although the mining sector only accounts for 2%–3% of global GHG emissions globally, this percentage rises significantly in countries where the mining sector represents a large part of the economy. Governments can engage with mining companies to align their GHG emission reduction commitments with their own commitments, as detailed in their NDCs. Synergies between governments and mining companies could result in the industry becoming a primary partner in reaching NDC targets.

Partnerships for resilient infrastructure: Policy-makers should also engage with mining companies to look for alignment and partnerships on green and more resistant infrastructure development. Indeed, as the footprint of mining infrastructure extends outside the mine site's borders, governments can influence construction decisions to better align with their own development strategies, adaptation plans, and transition pathways. This will allow policy-makers to promote the construction of sustainable and resilient infrastructure whose lifetimes would extend beyond the duration of mining activities to benefit development in the country.

[1] Examples of these incidents are Brumadinho tailings dam in Brazil in 2019 (https://www.wise-uranium.org/mdafbr.html), the Fundão mine tailings dam in Brazil in 2015 (https://www.mining-technology.com/analysis/samarco-dam-disaster-dealing-fallout-tragedy/), and the Mount Polley mine disaster in Canada in 2014 (https://www.cbc.ca/news/canada/british-columbia/mount-polley-mine-disaster-5-years-later-emotions-accountability-unresolved-1.5236160).

Direct action through state-owned companies: Many countries go further than regulating the mining industry: many have or are developing their own mining capacities through state-owned companies. Policy-makers then have the capacity to act directly and make decisions about exploration and development strategies for minerals that they deem strategic. The development of mining projects by state-owned companies can facilitate long-term and resilient considerations in business decisions and become an efficient tool for sustainable development.

Resilient mine closure and rehabilitation: When considering a mine's life cycle, closure and relinquishment often involve the requirement to rehabilitate and restore the site as close as possible to its original state. Mine reclamation plans should accommodate climate change and, rather than simply returning the site to its original state, consider current and anticipated climate conditions when exploring regenerative agricultural practices, revegetation, water availability, and exposure to extreme events.

Support and formalization of ASM: Since ASM will play a growing role in supplying minerals for the energy transition, at least in the short term, policy-makers should advance efforts to provide a sound legal and environmental framework for ASM activities, which could involve formalization and capacity building.

Research facilitation: Policy-makers can also encourage fundamental research on new technologies to shift from fossil fuel-based energy generation to renewable energy with less intensive critical mineral requirements. Public research institutions should partner with the industry to apply research to practical needs.

Encouraging responsible consumption and energy-saving policies: Finally, the best approach to limiting the impacts of climate change is to change consumption patterns. Responsible consumption and energy-saving policies should be employed to encourage end-users, industries that use raw materials, and the mining industry to use less energy and less water throughout the entire life cycle of minerals and metals. This will help limit the industry's overall footprint.

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