How incorporating ESG concepts is reshaping Chilean mining projects

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Abstract

Nature and environmental conservancy and social impacts consideration are among the main concerns regarding the present and looking into the future. Thus, they have become ineludibly elements to consider when assessing and developing mining projects and are increasingly becoming embedding business development.

Due to its scale, intensity and the extractive profile, the mining industry is considered a critical sector in terms of environmental and social impacts. This is particularly sensitive in Chile because of the high economic dependence in the extractive activity, and a novel environmental legislation. An early assessment of ESG (Environmental, Social and Governance) components during the engineering design of mining projects, contribute to the prompt identification of potential risks and enhances the decision-making processes towards sustainable solutions. Additionally, following global trends, incorporating ESG concepts into mining project such as the hydric and carbon footprint or its impact on communities, is highly relevant for investors.

The purpose of this paper is to build a case based in real experiences from Chile, incorporating ESG components beyond legal national EIA requirements. The case will help to illustrate how Environmental; Social and Governance issues are reshaping the engineering designs of the mining industry.

Introduction

The mining industry is facing dramatically changing market expectations on disclosure and transparency regarding the environmental and social impacts of projects. Companies are being increasingly questioned end expected to deliver on their governance procedures to ensure they are effectively managing social and environmental risk. This Environmental, Social and Governance analysis is referred to as ESG performance by the investment community.

In the last decades, companies are investing in resources to create a positive impact in the communities where they operate, and even beyond, while avoiding or minimizing possible environmental impacts.

The European Union is playing a key role in demanding and advancing the development and usage of ESG frameworks and standards. Through the European Green Deal (2022), the European Commission is reviewing the Non-Financial Reporting Directive (NFRD) which requires large, listed companies, banks and insurance companies with more than 500 employees to disclose non-financial information on their ESG performance, including environmental protection, fair treatment of the employees, respect for human rights, anti-corruption and bribery initiatives, and diversity and inclusion into company boards. If these companies avoid disclosing ESG information, they may find themselves at risk of exclusion from investment portfolios. This risk will grow as sustainability information becomes ever more important throughout the financial system.

Other worldwide initiatives are also in line with reinforcing the importance of implementing ESG concepts in mining projects and operations: the Responsible Minerals Initiative ESG Standard, published in 2021 by the Responsible Minerals Initiative, the Minerals Council of Australia's framework for sustainable development guideline (2015), the London Metal Exchange (LME) Sustainability disclosures on LME passport (2021) and the 10 ICMM Mining principles (2003). Likewise, certifications for specific commodities have emerged: Aluminum Stewardship Initiative, The Copper Mark, The Cobalt - Responsible Assessment Framework and the International Zinc Association Sustainable Development Goals (SDG) Sector Roadmap.

In this context, it is necessary to integrate sustainable development principles into decision-making relating to the design, operation, maintenance, protection of physical assets and facilities, and closure stages (Litivinenko et al, 2022). Today, getting funding for mining companies relates with responsible investment where investors consider how ESG factors affect the environment, society, as well corporate governance (see Table 1) (Frolova, 2021).

Table 1. ESG factors

Factors	Directions
Environmental	Changes in climatic conditions, the impact of pollution, waste, greenhouse gases, depletion of natural resources, green spaces, drinking water supplies, energy efficiency, renewable energy, sources, climate adaptation, environmental protection.
Social	Regional development, working conditions, gender composition, of workers, labor protection, social guarantees, affordable, housing, construction of social, educational, medical institutions, production safety, public organizations.
Governing /Corporate Management	The strategy of the companies, the goals of the company, agency relations, the interest of the parties, the level of competence, anticorruption.

Source: Frolova, 2021

Currently, the main ESG indicators in mining projects have a relation with the following areas: water consumption and water resource, energy consumption GHG emissions, community and indigenous relationship, mine closure plans, and waste management. All of them aligned with concepts that have been increasingly introduced in the global mining industry: energy transition, climate change adaptation[1], circular economy, and the incorporation of closure and post-closure of a project from its early design[2].

Investment in mining projects

Mining projects investments can be characterized by three main elements. First, projects involve high capital costs; second, one of the decisive factors to move forward with a mining project is transport and energy availability. Third, the mining industry operates with high levels of hazards and complex of risks of different nature (technical, technological, infrastructural, socio-ecological and others) (Frolova, 2021).

The current expectation from investors, financial institutions and governments is companies aligning their values and objectives with concrete, measurable positive impacts to solve some of the world's most pressing environmental, social and governance issues both at the local and global scale, such as deforestation, economic diversification and taxes' transparency. Stakeholders such as investors, governments and society, recognize that corporations are uniquely positioned to reshape the future of corporate finance and investment as a catalyst for growth, value creation and social impact. As investors increasingly seek ESG transparency, companies are called to reset, readjust and refocus business propositions.

Investment decision-making is subjective, and relates to the investor's risk appetite, including if they are focused on fast and high income or moderate long-term. When assessing the investment attractiveness, methods based on the analysis of the financial condition, the value of companies, the determination of discounting indicators, the calculation of maximum need for funds, operational and financial leverage, investment duration, internal rate of return, ratings and benchmarking can be applied. R/S analysis, simulation, game theory, expert review, assessment of the compliance of project goals with the prospects of the business environment – all these methods for assessing investment attractiveness are diverse, and the indicators used are variable. For example, the terms and approaches to determining the discount rate are not unambiguous (Frolova et al, 2021).

Shareholders and financiers of mining companies are aware that ESG failures can result in major disruptions and significant losses. These groups are demanding greater transparency and reporting of mining company's ESG risk exposure and their risk management processes. For example, the Equator Principles Association has created an ESG risk management framework where participating financial institutions declare if they will restrict project financing to firms that fail to meet minimum ESG standards and due diligence requirements (Bruce, 2014).

These changes over time have made "technical" risks significantly more manageable, but have increased importance of the less manageable Environmental, Social, and Government (Bruce 2014). Accordingly, to ICMM (2012), ESG issues have emerged from relatively low-level concerns to become significant issues that nearly all mining firms take actions to address.

[1] On March 3th 2022, the Chilean Senate approved the Climate Change Framework Law, which is waiting for the president's signature. Among other objectives, this Law establishes a goal of carbon neutrality by the year 2050.

[2] In several countries of the world, including Chile, there is specific mine closure legislation with objectives in this direction.

The solution of environmental problems remains an urgent problem, primarily for the mining industry. ESG finance is developed in the context of financial market integration and innovative, responsible corporate governance. Innovation and a conscious focus on ESG have enabled mining companies to become more efficient, green, socially responsible and therefore sustainable despite fluctuated business environment (Frolova et al, 2021).

Morgan Stanley Capital International (MSCI) focused on understanding the connection between ESG performance and finance. They concluded that those with a strong ESG profile are more competitive than their peers. This advantage may be due to a more efficient use of resources, better human capital development or improved management. In addition, they tend to develop superior long-term business plans and long-term incentive plans for senior management. Highly ESG rated companies use their competitive advantage to generate exceptional returns, which leads to increased profitability resulting in higher dividends. In fact, in Chile, according to PricewaterhouseCoopers (2021), Companies with higher ESG ratings had an average total shareholder return of 34% over the past 3 years— 10% higher than the general market index.

Accordingly, to Frolova et al (2021), ESG investments in the mining industry are associated with the following challenges:

- Environmental protection, provision of biodiversity, ecosystem services, management of water resources, waste and mine tailings, air pollution and purification, noise absorption, conservation and renewal of energy, adaptation and elimination of the consequences of climate change (carbon footprint, greenhouse gas), hazardous emissions and substances, as well as the closure of mines;
- Ensuring social guarantees and development of workers in the mining industry and the entire region as a whole, guaranteeing human rights and responsible land use, resettlement of the population, vulnerability of certain categories of the population and workers, health and safety of workers of various categories;
- Responsible corporate governance, compliance with legal norms, ethics, anti-bribery and corruption, ensuring transparency of activities and reporting.

Historical participation of environmental teams in mining projects

Mining has been one of the main drivers of the Chilean economy in the 20th Century, representing only during the last decade 59% of exports of the country, 15% of gross national product and has generated 20% of tax collection (Cochilco, 2013). Chile's modern mining history is over a century old (El Teniente 1904, Chuquicamata 1915, Salitre 1884, Carbón 1852). However, its development hasn't always been harmonious, finding itself with shortfalls in areas such as the environment, community relations and water management (Sanzana, et al). These challenges, along with others, motivated the publication of the Environmental General Law in 1994 (Law N°19.300). Based on this Law, the Environmental Impact Assessment System was created with the requirements to obtain an environmental license to operate.

Since the Law N°19.300 was published, the Chilean environmental institution has strengthened with different modifications (Law N°20.417, Law N°20.600). Additionally, the different actors involved in large scale mining development projects in Chile - mining companies, suppliers and engineering consulting companies – have become more professional and experiences, consolidating world class teams.

The participation of environmental professionals in the development of mining engineering projects has become increasingly relevant. Environmental teams have positioned themselves as a key discipline within projects, focusing on obtaining socioenvironmental information and informing risks through all project's phases, including knowledge about protected areas, presence of native forest or fauna, biodiversity conservation areas or archaeological sites within the project's facilities.

Likewise, their participation relates to identifying required formal permits to operate, producing the documentation required by national regulations alongside the engineering and support during the Authority review process. This includes creating an Environmental Impact Statement or an Environmental Impact Assessment (depending on the project), evaluating the risks and defining mitigation measures, and /or compensation actions suitable to the project.

Although engineering teams are increasingly aware of incorporating solid environmental content, there is still a far road ahead. Currently, environmental aspects accompany, guide or propose solutions that aim to minimize, mitigate and/or control the potential environmental impacts in order to obtain and optimize the permits and licenses to build and operate the project. Environmental teams have been usually involved when the project has already begun, aiming to assess the environmental impacts based on the design, and facilitate the obtention of the required permits for construction and operation.

The focus of the environmental teams' participation in the development of mining projects in Chile changed due to different factors such as: investors worries, public opinion and community's empowerment, and is shifting and reshaping Chilean mining industry into a new model of engineering development.

The current ESG approach to mining projects

Mining companies worldwide are rapidly adapting to new requirements from stakeholders and investors. Mining companies were already taking action, and the uptake of Environmental, Social, and Governance (ESG) considerations by investment decision-makers over the last couple of years has speed motivated by, among other economic factors, the increasing implementation of the Principles of Responsible Investment (PRI). The PRI is a voluntary initiative of responsible investment that works to understand the investment implications of environmental, social and governance (ESG) factors and to support its international network of investor signatories in incorporating these factors into their investment and ownership decisions. The United Nations (UN) has been supporting the Principles for Responsible Investment ever since their launch in 2006, and signatories duplicated since 2018 (PRI, 2022).

The mining industry is understanding the importance of performing an ESG analysis to identify potential challenges in the early stages of a project. In fact, ESG criteria is driving projects' adaptations by anticipating risks and avoiding them at design stages what can be referred as "ESG in design". Some considerations related to reducing the carbon footprint and greenhouse gases and energy consumption, optimizing water stewardship or incorporating renewable energy solutions, by providing conscious and lean designs. Others aim avoiding negative impacts or maximizing positive outcomes and effective engagement regarding communities and indigenous people, or considering social aspects into mine closure plans, reducing impacted land areas, implementing progressive closure and post-closure economic plans. This reflects how ESG has permeated into business decisions to the point of how projects are conceived.

Environmental areas of companies have a key role in early ESG analysis helping identify ESG criteria that are critical for the continuity and execution of a project. These can be done applying a methodology of multidisciplinary workshops, organized by the following 6 stages:

1. Based on site conditions, project characteristics, existence of nearby communities, ESG critical criteria to be considered are identified.
2. Indicators to measure ESG criteria performance are then defined.
3. Through "brainstorming" initiatives to approach the ESG criteria are proposed.
4. A score is assigned to those initiatives with a positive impact and a ranking is generated. Some measures will be a simple short-term implementation (for example, materiality change, new technology or, layout adjustments), and others may correspond to an alternative to the engineering or trade-ff that will require a deeper analysis and whose scores would be defined later on.
5. An analysis at the engineering level is performed based on the modifications, quantifying the impact of the ESG indicators from the different alternatives in order to make a decision.
6. The ranking is reviewed one more time, incorporating the trade-offs and assigning a final score in order to make a decision.

However, incorporating ESG indicators in projects is not exclusive of one discipline, area or team. All the organisation is responsible for ESG success by incorporating ESG in the projects' process flows, costs and trainings, in order to assess best practices and technologies for designing more sustainable projects with a subsequent higher added value.

Case Study

The case study corresponds to a copper operation located north of Chile at 2,500 masl with a community located at 5km from the mine site. The process plant is a leaching operation consisting of one main pit, a processing plant with crushing, agglomeration, heap leaching, SX-EW, waste and spent leached ore dumps, and related facilities.

The operating company wishes to consider alternatives for the operations continuity developing a conceptual assessment of the mine site life extension, considering two options:

- Alternative 1: Change to a better lixiviation technology that has a 60-year life for the mine.
- Alternative 2: Constructing a concentration plant and a tailings deposit with an extra 20 years of life for the mine.

So, even if the Alternative 2 means developing additional facilities, the impacts of alternative 1 will last longer in time.

At the beginning, an ESG analysis was performed through workshops with the participation of the owner's teams and a consultant providing the methodology previously described. As a result, taking in consideration the project's specifications and the sensibility of the involved area, a comparative analysis of greenhouse gas emissions was performed.

For the atmospheric emissions calculation and the greenhouse gases regarding both alternatives, the information considered was energy consumption, fuel consumption, supplies, vehicles transit and the operations of equipment to be used, as well as emissions factors recommended by the U.S. Environmental Protection Agency (US EPA) and the Intergovernmental Panel on Climate Change (IPCC). The results are presented in Tables 2 and Table 3.

Estimated Alternative 1 emissions (tonnes/year)

Source	TSP	PM_{10}	$PM_{2,5}$	CO	NO_x	SO_2	GHG
Crushing/screening	402	28,6	8,4	-	-	-	-
Nonroad vehicles and equipment	8,2	8,2	8,0	23,1	653,0	1,1	132.926
Boilers	4,0	4,0	4,0	6,0	24,2	2,1	28.586
Road dust	8.646	2.334	233	-	-	-	-
Electricty consumption	-	-	-	-	-	-	39.788
Total, annual emissions	9.060	2.375	254	29,1	677	3,3	201.301
Total emissions over lifetime (kt) (*)	544	142	15,2	1,7	40,6	0,2	12.078

(*) Total emissions are based on a lifetime of 60 years

Estimated Alternative 2 emissions (tonnes/year)

Source	TSP	PM10	PM2,5	CO	NOx	SO2	GHG
Crushing/screening	1.229	99,0	29,1	-	-	-	-
Nonroad vehicles and equipment	22,8	22,8	22,1	64,2	1.836,0	3,0	353.791
Boilers	2,6	2,6	2,6	3,9	15,5	1,4	18.371
Road dust	24.164	6.523	652	-	-	-	-
Electricty consumption	-	-	-	-	-	-	255.448
Total, annual emissions	25.418	6.648	706	68,1	1.852	4,4	627.610
Total emissions over lifetime (kt) (*)	508	133	14,1	1,4	37,0	0,1	12.552

(*) Total emissions are based on a lifetime of 20 years

Future project alternative will require a new environmental permit and it is expected that standard industry dust control practices will be adopted to meet current permitting requirements. The most common dust control technique at mineral processing plant is local ventilation systems which capture dust from the crushing and screening processes and the transport of this dust via ductwork to a dust collection filtering device. While there are many different types of dust collection systems available for use, including electrostatic precipitators, wet scrubbers, centrifugal devices, and fabric collectors, a canister-type fabric filter is often the best choice for the majority of the minerals processing industry (CDC, 2010). A control efficiency of 99% was assumed. Also, a control efficiency of 75% was assumed for road watering in both alternatives.

Considering dust control measures for both alternatives, the emissions study found that due to the addition of the concentrator and additional trucking requirements expected for Alternative 2, annual emissions of CAC´s and GHG´s will be considerably higher for this scenario. Therefore, Alternative 1 represents the preferred option for life extension of the mine site, which was finally the chosen alternative for engineering development.

Conclusions

ESG parameter considerations in the different project stages are aligned with ensuring an economic development that respects the preservation of nature and a sustainable social development. Incorporating ESG implies a cultural change for companies and becomes an essential part of the business, cascading from the corporate governance strategy, defining the strategy and actions, and permeating in assessment processes, allocation of resources and design decisions.

In order to remain competitive in today's business scenario, companies are expected to understand, enhance, and leverage their ESG performance. They can provide sustainability information applying guidelines, standards and ESG measurement tools, but to be successful they need to incorporate effective and tangible results that become visible through coherent implementation along operations and projects. ESG risks considered in upfront project stages, such as conceptual studies, will better inform mitigation plans unlocking time wise decisions for long-term term results, enhancing ESG positive impacts.

An early consideration of ESG topics from the project's perspective helps identifying risks and challenges that might otherwise slow down or stop project approval and that will affect ESG performance, increasing uncertainty and jeopardizing financing. Therefore, governance structures should ensure that environmental, social and ethical risks are identified and managed, including coherent monitoring methods.

Incorporating ESG indicators in projects is not exclusive of one discipline, area or team. All the organisation is responsible for ESG success by incorporating ESG in the projects' process flows, costs and trainings, in order to assess best practices and technologies for designing more sustainable projects with a subsequent higher added value.

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