SUSTAINABILITY CRITERIA GUIDE FOR MINE CLOSURE

Good practices for mitigating social, environmental and economic impacts arising from mine closure

IBRAM
BRAZILIAN MINING

A&M INFRA
& CAPITAL PROJECTS
BY ALVAREZ & MARSAL

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SUMÁRIO

IBRAM Presentation

Planning for the closure of a mine is a complex process. From the planning horizon measured in decades to the social, economic and environmental parameters that tend to change from one generation to the next. Issues related to governance within mines, integration of the planning process and operational engineering, as well as the increasingly present participation of communities around operations, add different contours to the planning for the closure of a mineral operation.

The way in which these closures are planned and managed has a decisive influence on the dialogue about the costs and benefits of mining for society – which may, in turn, influence new governance structures for the sector. Well-executed measures increase the level of credibility and establish successful partnerships, thus creating a legitimate legacy for the mining sector.

Recognizing this, the Brazilian Mining Institute (IBRAM) in partnership with Alvarez & Marsal is launching this **Sustainability Criteria Guide for Mine Closure Planning**. Through a set of good sustainability practices and performance assessment indicators, this Guide assists companies in determining the main sustainability criteria that must be verified when closing an operation.

The current concept, which includes socio-economic and environmental issues, presents the vision of post-mining legacy. To plan the closure of a mine, everyone must be involved – company, government, academia, communities – when defining the scope of the challenge. This integration in the planning process is an important mechanism for the mining project to create lasting value, even when the mining company is no longer present.

For the closure process to be successful, it is essential to also consider the closure of the mine as an essential part of our business. This Guide was developed to help in decision-making, based on the holistic analysis of the closure aspects and the evaluation of performance and continuous improvement of its processes and procedures.

With this Guide, IBRAM reinforces its commitment to the sustainability agenda in the mining business and to contributing to balanced, responsible and long-term development in the regions where mining activities are located.

Have a nice reading!

Raul Jungmann
Chief Executive Officer

ALVAREZ & MARSAL Presentation

In 2023, Alvarez & Marsal, one of the world's leading management consulting firms, through its infrastructure business unit A&M Infra, partnered with IBRAM to launch a publication that would combine sustainability concepts with the mine closure planning process. The partnership between A&M Infra and IBRAM reflects a joint commitment to raising standards and practices in the mining industry.

In 2024, we announced the **Sustainability Criteria Guide for Mine Closure Planning**, a document that provides good sustainability practices and aims to guide companies on the main sustainability criteria that should be considered throughout the mine lifecycle, and especially during the closure phase.

Environmental, social and governance (ESG) sustainability has become a central principle in the operations of several sectors, and mining is no exception. In the context of mine closure, the integration of ESG principles is essential to ensure that the decommissioning of a mine is conducted in a responsible and sustainable manner. This approach not only helps to minimize negative impacts and enhance attractiveness for investors, but also promotes the recovery of affected areas and ensures compliance with global best practices.

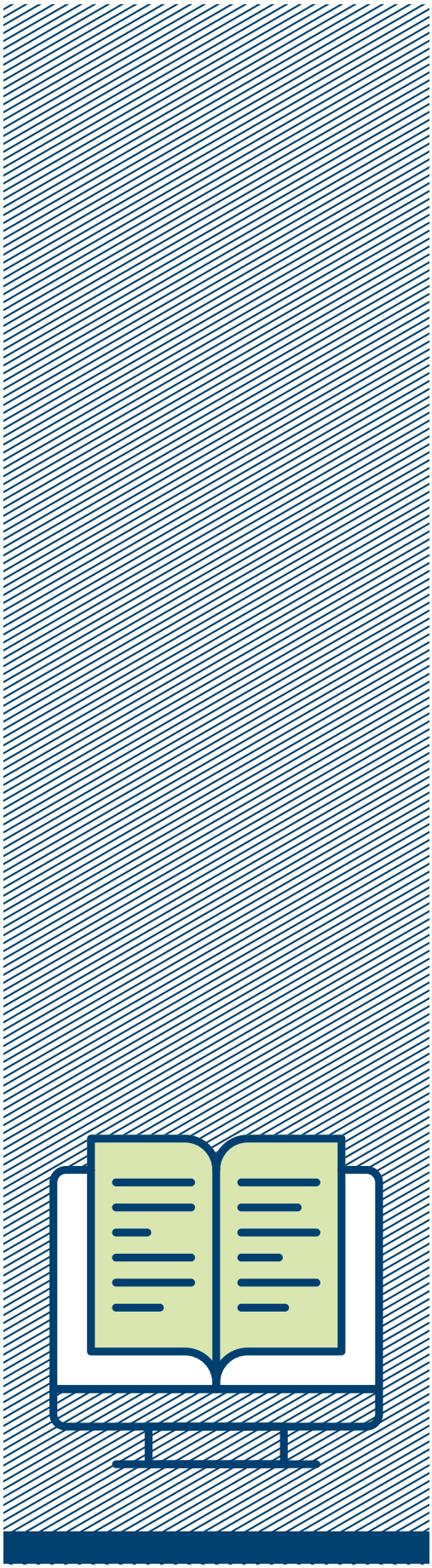
Sustainable best practices for closure planning therefore become key elements for the effective management of the mine decommissioning process. Sustainability is not just a regulatory requirement, but also a strategic element that contributes to the long-term success of the company.

By adopting a comprehensive ESG approach, mining companies foster a positive legacy that reinforces their reputation and strengthens their relationships with stakeholders. Commitment to ESG is therefore a fundamental pillar of corporate strategy to ensure effective mine closure and to build a sustainable future for society.

We hope that this document will contribute to the improvement of the mining sector in Brazil and guide companies on the importance of adopting sustainable practices in their processes, aiming to promote a conscious and responsible future in mining.

Have a nice reading!

Rafael Aveiro Marchi
Managing Partner of A&M Infra



1 PURPOSE OF THE DOCUMENT

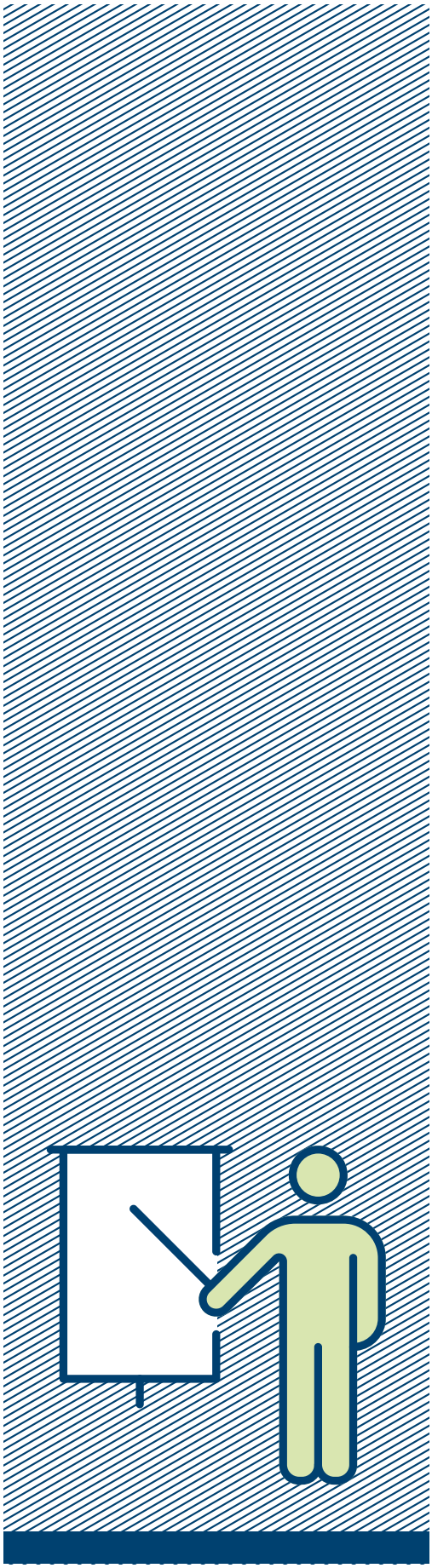
This document is based on the Guide for Mine Closure Planning (Sánchez, 2013) and aims to present complementary best practices that can be applied in the closure processes of mining projects, using a set of sustainability criteria.

The best practices were developed to assist mining companies in identifying sustainability criteria that should be considered in the closure processes throughout the mine's useful life. In addition, the implementation of these best practices can guide strategic decisions related to sustainability in the mine closure phase.

By considering sustainability criteria, mining companies have the potential to achieve greater operational efficiency in their production processes and achieve numerous results, including:

1. Optimization of technical, human and financial resources throughout the life of the operation;
2. Implementation of a safe and efficient mine closure;
3. Control and mitigation of social and environmental impacts involving the entire operational chain;
4. Mitigating the occurrence of unexpected costs at the end of the mines' operations

The best practices presented are for guidance purposes only and mining companies must adapt these practices to the culture and specific characteristics of each project.

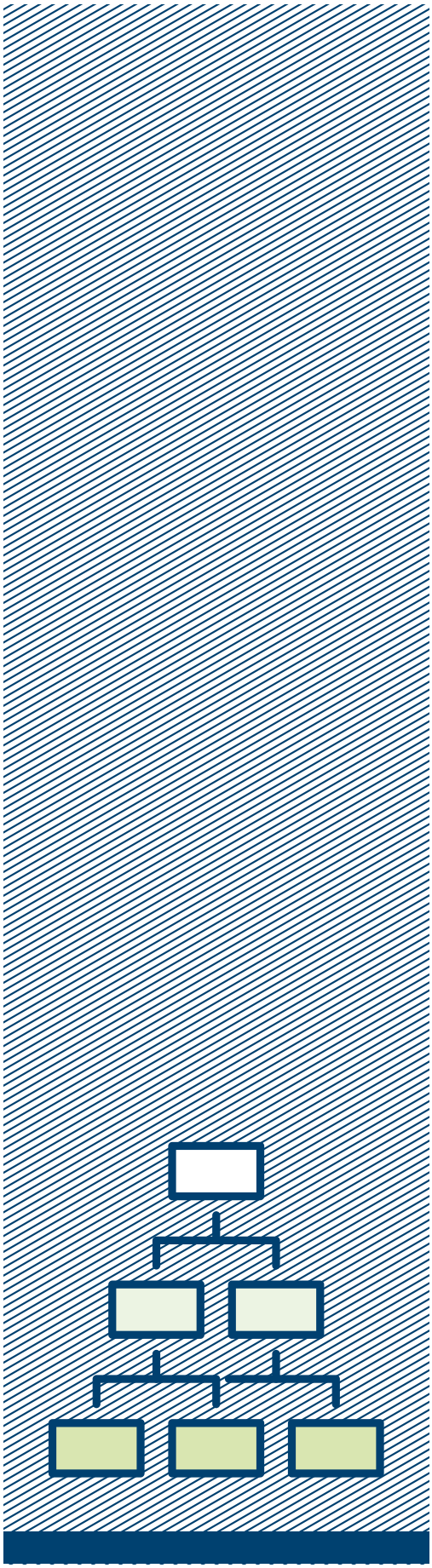


2 METHODOLOGICAL PROCESS

This document is an initiative of the Environmental Impact Mitigation Working Group, part of the Brazilian Mining ESG Agenda, with the technical support of the consulting firm Alvarez & Marsal.

The document's construction process involved the participation of mining companies and different stakeholders, including open consultation rounds, workshops with mining companies, workshops with academics and interviews with mining companies. During the construction process, several suggestions and recommendations from various professionals and members of the Environmental Impact Mitigation Working Group were taken into consideration.

The full list of participants in the open consultations can be found in Annex 5.



3 DOCUMENT STRUCTURE

This document consists of six best practices that contribute to the inclusion of sustainability concepts in Mine Closure processes throughout all phases of the project's life cycle. The best practices are listed below

1. Implement GOVERNANCE FOR MINE CLOSURE INCLUDING ESG ASPECTS;
2. Identify socio-environmental impacts in the mine closure process;
3. Establish a socio-environmental risk management plan for mine closure;
4. Implement TSM as a best practice for the mining sector and for mine closure;
5. Structure the ESG strategy for mine closure using materiality aspects;
6. Obtain economic gains with the implementation of sustainability criteria in mine closure processes.

Each best practice consists of a conceptual description aimed at providing a clear understanding of the need for the topic to be applied and the possible results to be achieved.

In addition, this document has an Appendix, containing the following annexes:

- **ANNEX 1:**
  Frequently Asked Questions: Users should consult this annex to address any questions they may have regarding the topic of mine closure.

- **ANNEX 2:**
  Glossary: provides definitions of various terms used in the document.

- **ANNEX 3:**
  Self-Assessment Checklist: list of indicators associated with the good practices established in the document and compliance checklist. Users should use the checklist to assess the classification level of each indicator.

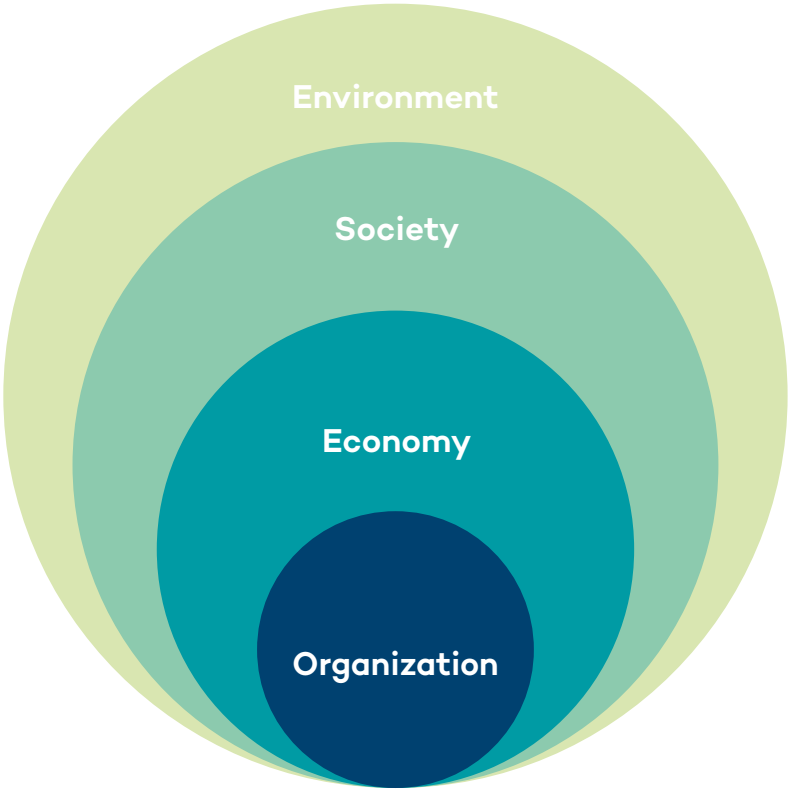
- **ANNEX 4:**
  Action Plan Model: users should use the action plan model to address the weaknesses mapped.

- **ANNEX 5:**
  List of participants in the open consultations.

4 CONTEXTUALIZATION

According to **Harvard Business School** (2018), sustainability can be seen as the conduct of a company's operations without negatively impacting the environment, the community or society as a whole. Thus, the objective of a sustainable business strategy is to cause a positive impact on at least one of these fronts. The concept of sustainability involves a systemic view of the organization and deals with the environment, society and the economy in an integrated manner, as shown in Figure 1.

Figure 1 – The integrative role of sustainability in an organization



Source: Adapted from Green Swan (2021)

ESG, in turn, is an acronym for Environmental, Social and Governance and emerged through an initiative of the UN with the World Bank, to guide companies and investors regarding the integration of environmental, social and governance aspects into their business models. The acronym, therefore, can be translated as a business perspective in relation to sustainability.

In general, the expanded view of ESG allows us to understand that sustainability is fundamental to the success and sustainability of organizations' businesses. It is also critical for their customers, surrounding communities, broader stakeholders and the environment.

The global development agenda is increasingly dependent on business to drive positive change, as evidenced by robust regulations and rising market disclosure expectations.

Over the years, there has been a notable shift in corporate awareness of the significant impact of business on society and the planet, both positive and negative.

Companies that adopt an ESG-aligned strategy and promote disciplined disclosure of sustainable results perform better financially. According to an MSCI analysis, companies with strong sustainability practices outperform their peers with low ESG scores in terms of total return on investment and market value. Furthermore, a good ESG strategy reduces investors' perception of risk, which can generate lower capital costs for organizations.

A market study conducted by MSCI (2020) demonstrated a direct correlation between ESG scores (ESG MSCI score) and Cost of Capital (WACC). It was noted that companies that demonstrate a commitment to ESG issues are more attractive to investors, reducing the cost of raising funds, whether through financing or issuing bonds, providing significant financial advantages. This fact highlights the growing importance of ESG metrics, not only for corporate responsibility, but also for the financial performance of companies.

Also, according to the UN Global Compact, 83% of the companies that are part of the ISE (Corporate Sustainability Index) of the Brazilian Stock Exchange (B3) have processes for integrating the ODS into their strategies, goals and results. Therefore, companies from different sectors have recognized that their operations can profoundly influence environmental, social and governance factors, and that unsustainable practices can result in reputational risks, legal challenges and financial consequences.

As a result, companies are more proactively identifying and addressing negative impacts arising from their operations, while seeking opportunities to contribute positively to society and the environment.

Strong governance, including policies, processes and oversight, is key to successful ESG integration. By embracing it, organizations can deliver on their intended contribution to the global development agenda, while also unlocking new opportunities for growth and resilience.

In practice, ESG follows the guidelines of standards from institutions that govern the implementation of the topic, in its regional or global scope. The main standards and normative organizations for ESG are listed below:

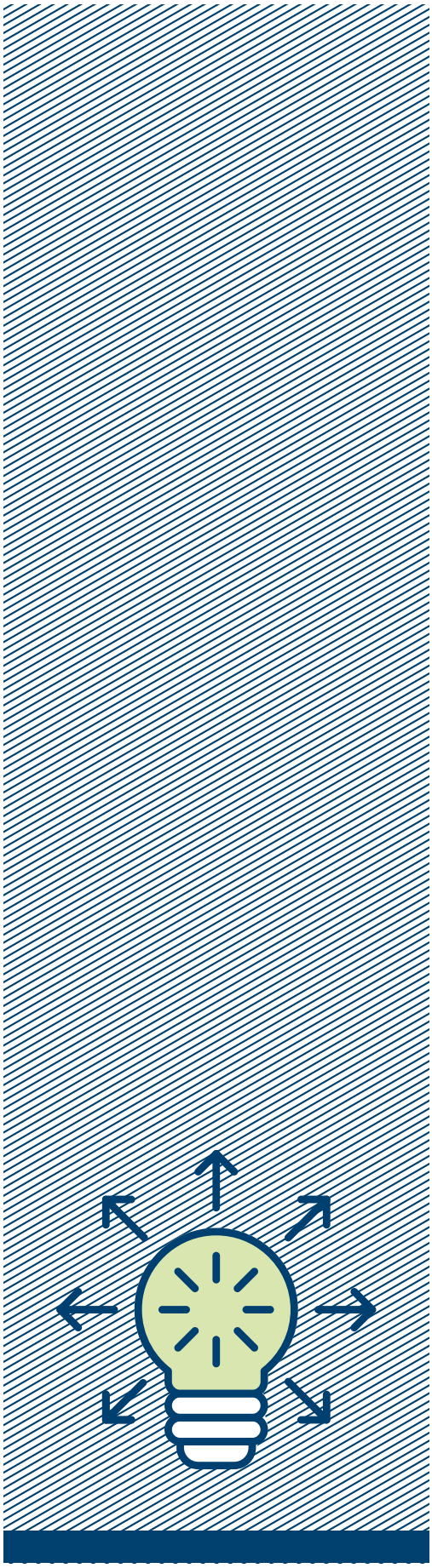
Table 1 – Sustainability Standards and Good Practices

STANDARD	DESCRIPTION	SCOPE
Sustainable Accounting Standards Board *(SASB)*	Organization that directs specific industry standards to disclose sustainability risks and opportunities.	Global
Global Reporting Initiative *(GRI)*	Independent international organization that develops and promotes standards for disclosure of information in sustainability reports.	Global
International Sustainability Standards Board *(ISSB)*	Global financial reporting standard. The IFRS s1 and IFRS s2 standards were recently launched, representing one of the most significant changes for publicly traded companies, connecting the reporting of financial information related to sustainability with the financial statements.	Global
***GHG* Protocol**	Developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), the GHG Protocol provides detailed guidelines and standards for identifying, measuring, and managing greenhouse gas emissions, assisting companies and governments in setting emission reduction targets and preparing sustainability reports.	Global
Brazilian Securities and Exchange Commission (CVM)	Directs mandatory ESG criteria for publicly traded companies.	National
Towards Sustainable Mining *(TSM)*	Guides and supports mining companies in managing environmental and social risks combined with meeting the goals established in the ESG Mining Agenda in Brazil.	National

Source: Alvarez & Marsal (2024).

In the mining sector, this trend is also growing and companies are increasingly establishing methods and criteria that seek to ensure the continuous improvement of their projects, with environmental control and social responsibility.

Therefore, considering sustainability criteria in the closure processes of mining projects can provide more efficient performance, generating satisfactory results for the external and internal scope of the business, through the best use of available resources throughout the mine's useful life.



5 GOOD PRACTICES

5.1 Good Practices 1

Implementing GOVERNANCE FOR MINE CLOSURE INCLUDING ESG ASPECTS

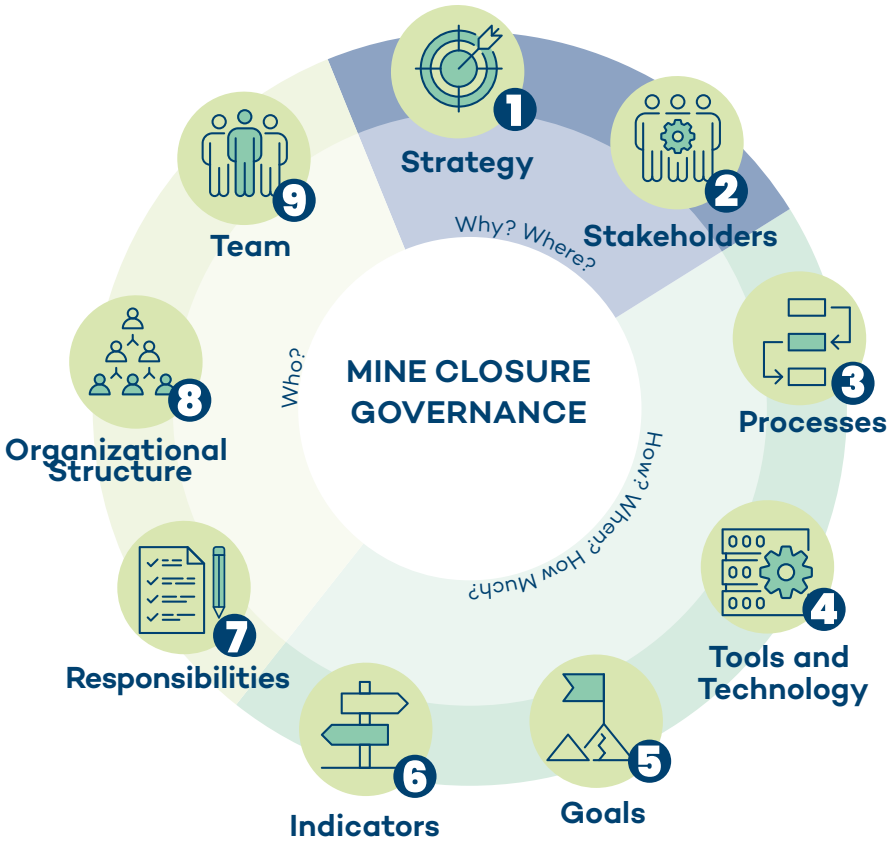
As an initial step, governance plays a key role in the successful integration of environmental, social and governance aspects into the mine closure process, ensuring transparency and effective measurement of the effectiveness of this process. A robust governance structure establishes clear policies, procedures and responsibilities for all parties involved, from senior management to local stakeholders.

This ensures that ESG considerations are incorporated from the initial phase of the project and implemented early in the planning for the execution of the mine closure, addressing issues such as environmental remediation, resettlement of affected communities, worker safety and optimization of the use of physical, human and consequently financial resources.

Furthermore, effective governance establishes monitoring mechanisms that allow for continuous assessment of the performance of the mine closure process in relation to the established ESG objectives, promoting transparency and accountability of the parties involved.

This approach not only mitigates the risks associated with mine closure, but also promotes sustainable development, the creation of long-term value for the affected communities and environment, and fosters investor confidence. The implementation of mine closure governance is based on nine pillars, as shown in Figure 2.

Figure 2 – Pillars of Mine Closure Governance



Source: Alvarez & Marsal (2024)

Each pillar is described below:

1. **Strategy:** alignment and definition of short, medium and long-term strategic objectives focused on sustainability and defined after the materiality process (Good Practice 5), together with the structuring and design of the business value chain.

2. **Stakeholders:** identification, classification and management of all stakeholders involved in the business. This pillar is also complementary to the materiality process (Good Practice 5), given that to build the mine closure materiality matrix, the main stakeholders are mapped and contact is made to identify and measure the impact of the mine closure process on the respective stakeholders.

3. **Processes:** mapping of business processes at all stages of the project (studies and projects, implementation, operation, closure and post-closure) in order to consider sustainability aspects in activities related to mine closure, to identify bottlenecks and propose improvements, optimizations and automations.

4. **Tools and Technology:** structuring of management and planning tools, digital solutions and automations to improve performance and monitor the integration of sustainability pillars in mine closure and greater agility in terms of data and results and transparency for stakeholders.

5. **Goals:** alignment of strategic objectives and mapped processes with business goals,

connecting sustainability criteria and mine closure processes to the results expected by the company. This breakdown of goals should occur from the strategic level to the tactical and operational levels.

6. **Indicators:** definition of performance indicators that reflect the expected results based on the company's strategic objective for measuring results, quantitatively or qualitatively, in order to ensure high performance of teams and the business.

7. **Responsibilities:** definition of roles and responsibilities of the interface areas and stakeholders involved, allowing for clarity of assignments and assertive communication.

8. **Organizational Structure:** design of the ideal organizational structure, to allow good integration with the operation and interface areas throughout the useful life of the project.

9. **Team:** involvement of a multidisciplinary team that can analyze the various processes involving the sustainability theme in mine closure throughout the useful life of the project.

When designing and implementing corporate governance, the company must establish a board of directors composed of people with diverse technical skills whose main objective is to make decisions impartially and that generate value for the business.

Since mine closure requires a broad and multidisciplinary analysis, it is recommended to establish tactical committees and strategic committees with the involvement of multidisciplinary areas, in order to consolidate the actions and results of closure, directing decisions throughout the useful life of the mining project, as shown in the figure below:

Figure 3: Committee Structure for Mine Closure Governance

	Goal	Areas involved	Sponsors	Outputs	Frequency
EXECUTIVE COMMITTEE	Alignment with senior leaders for strategic decisions on Mine Closure and Future Use	• Mine Closure • Future Use	Focal points who lead the Executive Committee's agendas and organize discussions with the Integration Committee	• **Prioritization:** prioritization of territory/sector execution and use of Closure funds • **Deliberations:** solution of complex problems and impediments to closure • **Definitions:** business model of the territory after closure	• Quarterly
INTEGRATION COMMITTEE	Forum for tactical/ operational discussions on Mine Closure and Future Use actions	• Mine Closure • Future Use • Operation • Planning • Licensing • Relationship with the community	Focal points who lead the Integration Committee's agendas and act as an interface between the areas involved	• **Validation:** closure planning • **Indicators**: monitoring project execution (% progress and adherence to closure) • **Approvals:** approval of project execution and new studies • **New studies:** update of ANN No. 68, financial guarantee, social license and TSM	• Monthly

Source: Alvarez & Marsal (2024)

The Integration Committee should be structured by a working group that aims to promote tactical and operational discussions on closing initiatives with the areas involved in the process and monitor performance indicators. This Committee monitors the progress of closure actions regularly and supervises the progress of the initiatives, consolidating the results that will be presented to the Executive Committee.

The Executive Committee should be structured by a working group composed of members of senior leadership, encouraging discussions for strategic decision-making based on the reports presented by the Integration Committee.

The committees' work seeks to strengthen governance of the closure process, encouraging the prioritization of initiatives and bringing greater transparency to the allocation of resources required for closure actions. In addition, collaboration between the tactical and operational levels with the strategic layer promotes greater clarity in the progress of closure initiatives and in problem-solving.

Governance in mine closure processes and the integration of sustainability can promote a series of benefits for the organization, including:

i. i. Better integration with operations and assertive communication between interface areas;

ii. Transparency of data, through the provision of closure and sustainability results;

iii. Assertiveness and reliability of data, through the validation process at various levels;

iv. Greater adherence to planning, minimizing the occurrence of physical, economic and financial deviations;

v. Risk control, through the enhancement of preventive actions;

vi. Alignment of objectives with the interests of stakeholders (community, professionals, investors, public bodies).

Identificação de oportunidades para a mitigação dos impactos sociais, ambientais e econômicos.

5.2 Good Practices 2

Identify the socio-environmental impacts in the Mine closure process

Mining plays a relevant role in Brazil's economy, generating direct and indirect jobs, as well as tax contributions. However, by destabilizing the physical environment of the explored territory, mining brings a series of impacts associated with its operations.

As presented in the Mine Closure Planning Guide (Sánchez, 2013), a new mining project must contain the definition of socio-environmental actions to be implemented throughout the operational development to mitigate and control the possible impacts that may occur during the process of ceasing activities and closing the mine. Mines that are already in operation and do not include defined socio-environmental actions must begin a survey of related impacts and, with an established governance, implement mitigation and control.

Therefore, the need to structure processes for identifying, mitigating and compensating for the impacts of closure throughout the mine's life cycle, connecting them with opportunities for future use, becomes evident. The guide directs three important activities for this process, namely:

i. Environmental diagnosis;

ii. Identification, forecast and assessment of impacts;

iii. Management programs.

Socio-environmental impacts can occur at three times: during the operational phase, during mine closure and after closure. The following table presents the various potential impacts and their occurrence relationships:

Table 2: Impactos Socioambientais que podem ocorrer ao longo da vida útil da mina

			Period of Occurrence			
Impact	**Description**	**Category**	**During the operational phase**	**During the mine closure phase**	**After the mine closure or shutdown**	**The following must be considered in the mine closure processes:**
Vegetation Suppression	Removal of areas that directly impact the loss of natural habitats, affecting local biological diversity and reducing the availability of resources for fauna and flora.	Environmental	x			x

			Period of Occurrence			
Impact	**Description**	**Category**	**During the operational phase**	**During the mine closure phase**	**After the mine closure or shutdown**	**The following must be considered in the mine closure processes:**
Wildlife scaring	Movement of machinery, noise and human presence during installation tend to scare away local wildlife.	Environmental	x			
Occurrence of erosion processes	Removal of vegetation and soil movement during the installation phase can increase susceptibility to erosion processes, such as water and wind erosion.	Environmental	x		x	x
Landscape alteration	The creation of excavations, tailings piles and earthworks alters the topography and natural aesthetics of the environment, impacting the landscape and local visual scenery.	Environmental	x			x
Water resources	The report Perspectives and Advances in Water Resources Management in Mining 2024, published by IBRAM in partnership with the National Water and Basic Sanitation Agency, lists the main activities in mining that impact water resources, including: mining process, mine drainage, waste disposal, lowering for mining purposes, construction, ore processing and washing, among others.	Socio-environmental	x	x	x	x
Sediment carryover and silting of water-courses	During the installation phase, excavation, earthmoving and infrastructure construction activities can cause sediment carryover into nearby watercourses	Environmental	x			x
Alteration of surface water quality	Mining project activities can directly influence surface water quality due to potential improper waste disposal, leaks of chemicals used in extraction processes and inadequate material handling.	Environmental	x	x	x	x

			Period of Occurrence			
Impact	**Description**	**Category**	**During the operational phase**	**During the mine closure phase**	**After the mine closure or shutdown**	**The following must be considered in the mine closure processes:**
Emission of particulate matter and other substances	During the installation phase, construction, earthmoving and soil movement activities can generate dust and suspended particles, contributing to an increase in the concentration of particulate matter in the air. During the mine's operating phase, sources of air pollution are generally associated with the processes of extraction, crushing, transportation and processing of minerals. In addition, pollutant gases such as sulfur dioxide, nitrogen oxides and particulate matter from vehicles, equipment and combustion processes may be released.	Environmental	x	x		
Generation of tailings and solid waste:	• Solid waste from extraction, generally left in the mine area itself, known as waste rock; • Waste from treatment/ processing, known as tailings; • Other non-mining waste resulting from plant operations are: effluents from treatment plants, tires, batteries used in vehicles and machinery, as well as scrap and oil waste in general.	Environmental	x	x		x
GHG Emissions	Mining operations generate direct greenhouse gas (GHG) emissions, including carbon dioxide from fuel use during mining and ore processing activities. The main potential sources of GHG emissions are energy consumption in beneficiation and fuel consumption used to transport ore within the mine and to its final destination.	Environmental	x	x		

			Period of Occurrence			
Impact	**Description**	**Category**	**During the operational phase**	**During the mine closure phase**	**After the mine closure or shutdown**	**The following must be considered in the mine closure processes:**
Consumption of electricity and other energy sources in operations	Electricity will be used to power equipment essential to the mining process, while fuel will be used to power vehicles and machinery used to move materials and transport personnel. While the combustion of fuel at the site of operation contributes to direct greenhouse gas emissions (Scope 1), purchasing electricity from the grid can generate indirect emissions, which	Environmental	x	x		
Human health safety	Health problems can arise due to air and water contamination	Social	x	x	x	x
Noise Pollution	The impacts of mining activities are not limited to extraction, but can extend to the area of influence of companies operations (Milanez, 2017).	Social	x	x		
Social conflicts	Mining activities can impact neighboring communities, causing changes in local demographics, displacement of communities and pressures on infrastructure. The local economy can become dependent on mining, affecting the labor market during all phases of the project, especially at mine closure. In addition, cultural and social aspects of local communities can be affected, causing changes in traditional ways of life.	Social	x	x	x	x

			Period of Occurrence			
Impact	**Description**	**Category**	**During the operational phase**	**During the mine closure phase**	**After the mine closure or shutdown**	**The following must be considered in the mine closure processes:**
Human Rights	Throughout the entire lifecycle of a mineral exploration project, companies must be careful to prevent any and all instances of child or forced labor; inadequate living and working conditions for migrant and immigrant labor; and inadequate treatment of indigenous groups and local communities.	Social	x			
Labor practices	Risky working conditions, excessive physical and emotional demands, and occupational safety challenges. In addition, gender and age restrictions can be commonly seen in access to certain roles, due to specific regulations or cultural stigmas within the industry.	Social	x			

Source: Alvarez & Marsal (2024)

Mine closure processes must be considered at all stages of a mining project, regardless of how close the project is to its operational end. These processes must include all concepts and studies that provide positive results for the company and all those involved.

Considering socio-environmental criteria in studies, identifying the risks of occurrence and mapping control and mitigation actions, is a fundamental part of ensuring the success of the business for external results (environment and society) and internal results (economic viability and reputation).

5.3 Good Practices 3

Establish a socio-environmental risk management plan for Mine Closure

In addition to identifying and diagnosing the socio-environmental risks of a project, it is necessary to implement management mechanisms to control and manage these risks. A risk management plan is a practice that consolidates knowledge, tools, policies and procedures related to all mapped risks to guide prioritization and investment decisions, in addition to reducing the possibility of potential losses for the company.

The risk management plan for mine closure must consider the correlation of the company's strategic objectives with socio-environmental impacts, in addition to being incorporated into the business' strategic planning. This methodology promotes the breakdown of risks associated with each area of the company, promoting better understanding and engagement of leaders regarding the relevance of their contributions in promoting mine closure with positive results for the company and stakeholders.

To obtain a risk management plan, it is initially necessary to understand, identify and assess business risks. ABNT NBR ISO 31000 (2018) describes that the risk assessment process should follow the following steps:

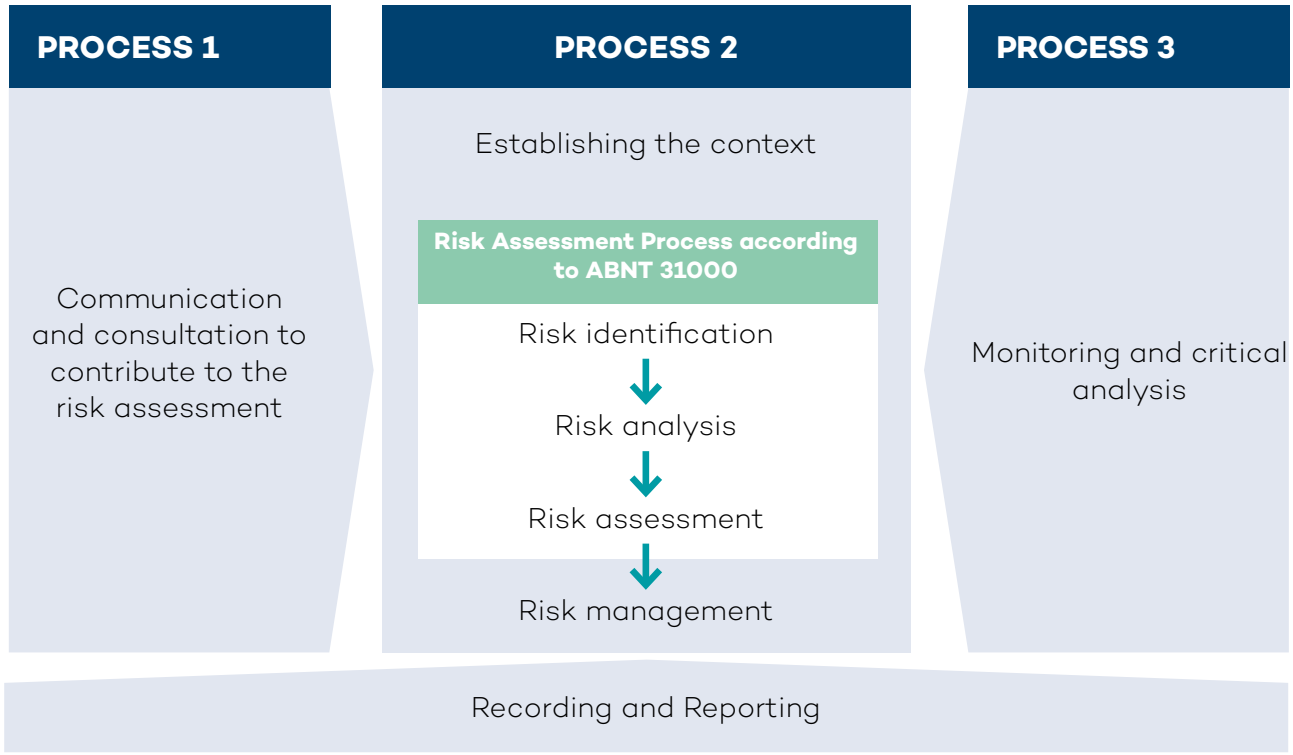
Figure 4: Risk assessment **process established by ISO 31000**

Source: Alvarez & Marsal (2024)

Following the risk assessment process, as directed by ABNT 31000, it is necessary to measure the risk levels, classifying them as high, medium and low risks.

The result of the risk identification and measurement processes will be visible through the implementation of the risk management plan that consolidates all analyses and directs actions, as shown in Figure 5.

Figure 5: Risk management process



Source: Adapted from ISO 3100:2018

For mine closure, the risk management process must follow the same methodology adopted for the corporate bias, taking into account strategic, operational and socio-environmental impact criteria to guide effective decision-making regarding correlated factors. Some risks that may occur at the operational end of the mine:

i. **Environmental impacts:** some mining projects may continue to generate environmental impacts after the operational end;

ii. **Water and soil pollution:** the lack of control and mitigation of water and soil pollution may make the operational closure of the mine unfeasible, such as the occurrence of acid drainage;

iii. **Regulations:** the lack of control and legal compliance may require investments at the operational end and surprises with fines or unexpected conditions at the operational end;

iv. **Costs:** additional costs may occur when mine closure activities are not included throughout the operational process;

v. **Conflicts with communities and indigenous peoples:** failure to verify and meet the needs of communities and indigenous peoples adjacent to the mining project;

vi. **Social and corporate responsibility:** failure to comply with social responsibilities and sustainable practices throughout the operation.

The risks that can impact the efficiency of mine closure are diverse and vary according to the peculiarities of each project. These risks can also be modified and reduced in terms of their level of impact, as the company's risk management and mitigation maturity advances.

5.4 Good Practices 4

Implementing TSM as a best practice for the mineral sector and for mine closure

The mining sector is made up of operational processes that generate high social and environmental impacts, which can undermine shareholders' interests. The integration of ESG practices in mining seeks to promote the mitigation and control of all impacts generated and contribute to operational improvements and the implementation of risk management.

The Mining Association of Canada (MAC) has developed a self-assessment program for ESG practices consisting of a methodology for verifying the operational performance of facilities. The program is called Towards Sustainable Mining (TSM) and aims to encourage and guide mining companies to adopt sustainable practices in their operations, aiming to minimize environmental and social impacts and promote transparency and accountability.

In Brazil, the Brazilian Mining Institute (IBRAM) adopted the TSM in 2019 as a strategy to develop sustainability and operational safety in the mining sector. Composed of a set of protocols that are divided into the concepts of Community and People and Environment and Climate, the TSM can also drive guidelines for mine closure with a view to mitigating operational impacts generated throughout the life cycle of the mining enterprise.

The eight TSM protocols published by IBRAM are listed below:

i. Prevention of Child and Forced Labor;

ii. Biodiversity Conservation Management;

iii. Sustainable Water Management;

iv. Tailings Management;

v. Climate Change;

vi. Safety and Health;

vii. Crisis Management and Communication Planning

viii. Indigenous, Quilombola and Community Relations.

Each protocol is composed of indicators that contribute to the identification and control of possible impacts. The closure process, whether of a new project or an operating project, must include analyses of the following TSM protocols:

Table 3: Correlation between TSM protocols and mine closure

Impact	Description	Analysis
Biodiversity Conservation Management	Corporate commitment to conservation, responsibility and communication related to biodiversity	Does the Closure Plan consider the implementation of commitments made regarding biodiversity for the closure of the project?
Tailings Management	Annual review of Tailings Management	Is the Closure Plan updated annually, considering the tailings management process and includes the stability of the structures, ensuring their safe closure?
Crisis Management and Communication Planning	Management Preparation and Crisis Communication	Is there a Mine Closure Risk Analysis? Are the risks mapped in this analysis considered in the crisis management process?
Relationship with Indigenous Quilombolas and Communities	Identification of Communities of Interest (CDI)	Does the closure process identify which CDIs and related impacts should be mitigated at the operational end?
Noise Pollution	Effective Engagement with the CDI and Dialogue	Does the closure process consider the requirements arising from the relationship with the CDI throughout the operation?
Respect for Human Rights	Effective Engagement with Indigenous and Quilombola Peoples	Does the closure process consider the requirements arising from the relationship with the Indigenous and Quilombola community throughout the operation?

Source: Alvarez & Marsal (2024)

In order to guide mining companies on the implementation of TSM, ICMM has published a supplementary document on the subject to be applied voluntarily by companies that are adopting this practice. The application of this supplementary analysis allows companies, in addition to meeting the TSM requirements, to also meet the requirements of the ICMM Mining Principles, Risk Readiness Assessment of the Responsible Minerals Initiative (RMI), including the Copper Mark of the International Copper Alliance (ICA).

The supplementary document to the TSM prepared with ICMM addresses three guidelines for Mine Closure based on the following analysis questions:

i. Has a plan been developed for the social and environmental aspects of mine closure?

ii. Has the plan been developed in consultation with authorities, staff, affected communities and other relevant stakeholders?

iii. Are there financial and technical arrangements in place to ensure that planned closure and post-closure commitments are met, including land rehabilitation, future beneficial land use, preservation of water sources and prevention of acid rock drainage and metal leaching? Note: The security deposit provided in accordance with regulatory requirements satisfies this requirement.

For the operational end of mines to be efficient and for the impacts of processes to be minimized, it is essential that sustainability criteria are integrated into the closure studies and that these are implemented throughout the useful life of the mining operation, keeping up with its operational dynamism and changes in the aptitudes for the final destination of the territories of the projects.

The closure plans must function as consolidators of the multidisciplinary studies, including socio-environmental analyses and programs, and as a guide for operational execution, connecting production planning with closure activities. This connection contributes significantly to the business's financial balance and to the opportunities for a closure aligned with stakeholders' expectations.

By integrating sustainability criteria into closure studies, the company ensures compliance with environmental requirements, contributes to returning value to society and enables the structuring of a legacy for the region. In addition, robust governance allows the process to occur in a transparent and efficient manner, and ensures that all stakeholders have a relevant role in the mine closure.

5.5 Good Practices 5

Structuring the ESG strategy for mine closure using materiality aspects

ESG materiality refers to the identification and prioritization of the environmental, social and governance issues that are most relevant to an organization and its stakeholders.

The goal is to focus on the issues that have the greatest impact on the company's financial results and reputation. Incorporating ESG materiality into the mine closure process is an opportunity to ensure the sustainability of the project, minimize adverse impacts and promote good business practices.

According to Barnett et al. (2020), mine closure should be seen as an opportunity to implement effective environmental strategies. The International Council on Mining and Metals (ICMM, 2019) Report reinforces that incorporating governance and sustainability aspects during mine closure not only meets regulatory requirements, but also fosters the building of lasting relationships with the community.

These factors contribute to the justification that, by considering the ESG materiality process in the mine closure process, companies will have greater direction to integrate sustainability and governance factors, which provides a competitive advantage and strengthens the company's reputation before communities and other affected stakeholders, contributing to the future of mining and society.

To consider materiality in the mine closure process, the methodology described in Figure 6 should be used.

The methodology illustrated in Figure 6 is executed according to the following guidelines:

i. Stakeholder identification: Identify stakeholders relevant to mine closure, including local communities, non-governmental organizations (NGOs), regulators, investors, and other partners.

ii. Mapping priority ESG issues for mine closure: Conduct a materiality analysis to identify and map the most relevant ESG issues for mine closure.

Considere questões ambientais, sociais e de governança que podem impactar a sustentabilidade do projeto ao longo do ciclo de vida da mina. Além disso, devem ser analisadas as características específicas da região da mina em questão, levando em consideração fatores econômicos, culturais e demográficos.

For example, the link between the employability level of the community population and the mine should be analyzed and, consequently, opportunities should be identified to relocate this segment of the population to the labor market or to map out entrepreneurship initiatives to influence the growth of local commerce and foster economic development.

iii. Stakeholder consultation: engage stakeholders through consultations, workshops or interviews to understand their expectations and concerns regarding the closure of the mine. It helps to prioritize the identified ESG issues.

This consultation should be carried out periodically throughout the mine life cycle to analyze whether the material topics established for the mine closure process are still the same. This process is related to the dynamic materiality and mutability of the project characteristics and the factors that should be prioritized in the evolution of the mine closure. Therefore, the stakeholders' considerations should be analyzed and incorporated into the Closure Plan verification.

iv. Risk and Opportunity Assessment: Conduct a detailed assessment of the risks and opportunities associated with the identified ESG issues. Consider the potential impacts of mine closure on biodiversity, water quality, local communities, among others.

As with material issues, risks and opportunities should be reviewed periodically as the mine evolves.

v. Develop an ESG-Integrated Mine Closure Plan: Integrate priority ESG issues into the mine closure plan, considering specific measures to mitigate risks and optimize opportunities. It may include implementing sustainable technologies, environmental rehabilitation practices and community development programmes.

vi. Establishing Performance Indicators: Define key performance indicators (KPIs) related to ESG issues to monitor progress over time. It enables ongoing assessment and accountability to stakeholders.

vii. Implementing Monitoring Mechanisms: Develop robust monitoring systems to track environmental, social and governance performance throughout all phases of mine closure. Ensure these systems are transparent and include feedback from stakeholders.

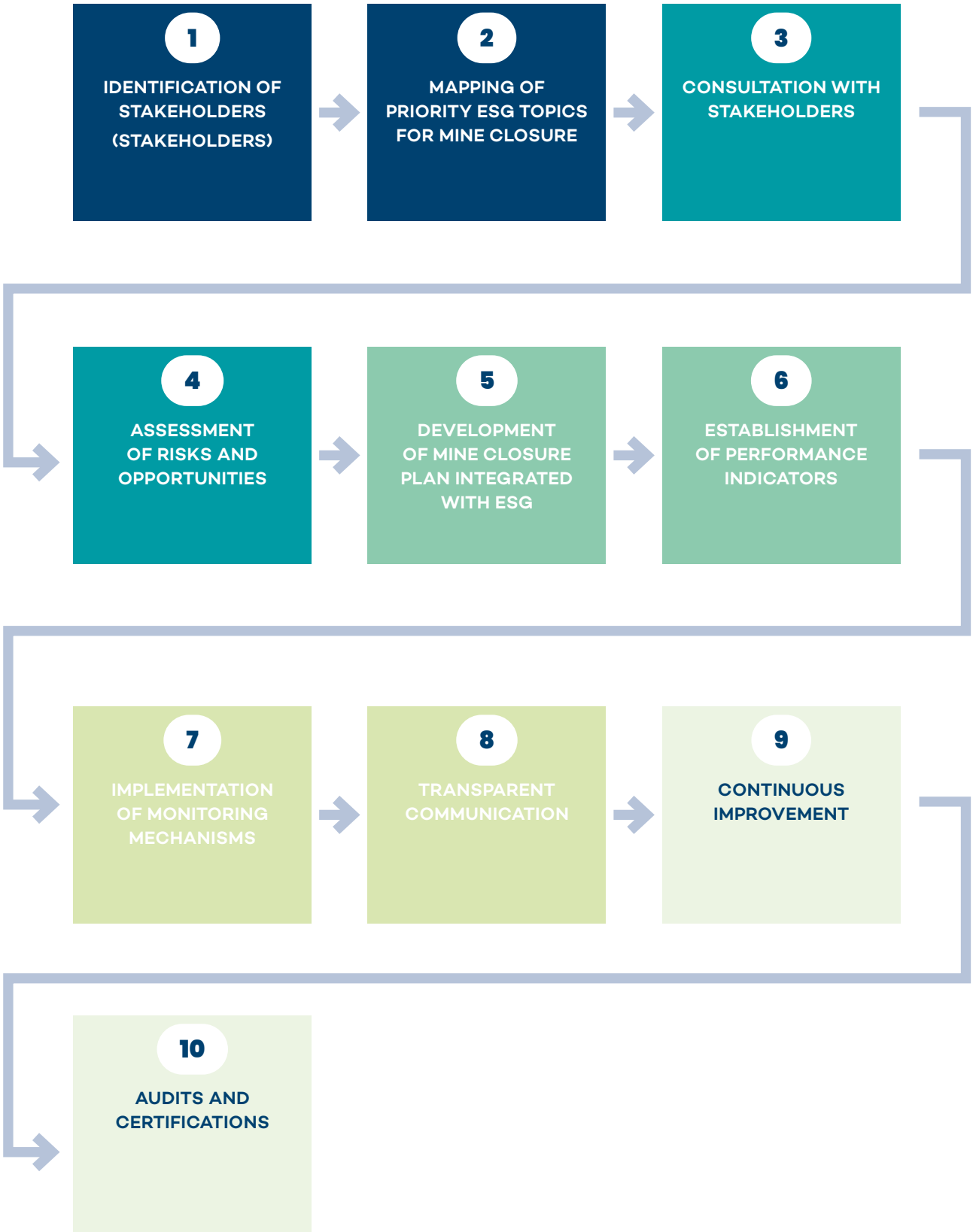
viii. Transparent Communication: Establish effective communication channels to regularly report progress to stakeholders. It includes publishing sustainability reports, public consultations and other means of interaction.

ix. Continuous Improvement: Implement a culture of continuous improvement by regularly assessing performance against KPIs and adjusting the mine closure plan as necessary.

x. Audits and Certifications: Subject the mine closure process to independent audits and, if applicable, seek certifications that validate the company's commitment to sustainable practices.

Each step described will lead to the completion of the material aspects related to the mine closure of a given mining project. Determining the material aspects will define the main themes and approaches that will leverage the strategic objectives within the company.

Figure 6: Structuring of ESG strategy considering aspects of impact materiality



Source: Alvarez & Marsal (2024)

5.6 Good Practices 6

Obtain economic gains by implementing sustainability criteria in mine closure processes

In 2004, UN Secretary-General Kofi Annan challenged 50 CEOs of major financial institutions on how to integrate social, environmental and corporate governance factors into the capital markets and invited them to participate in the UN Global Compact (UN, 2004).

The report resulting from this invitation, called "Who Cares Wins", established the acronym ESG and the foundations of socially responsible investments (Bialkowski, Starks, & Wagner, 2021).

This event spread ESG worldwide as a guideline for evaluating business practices in relation to environmental, social and governance criteria.

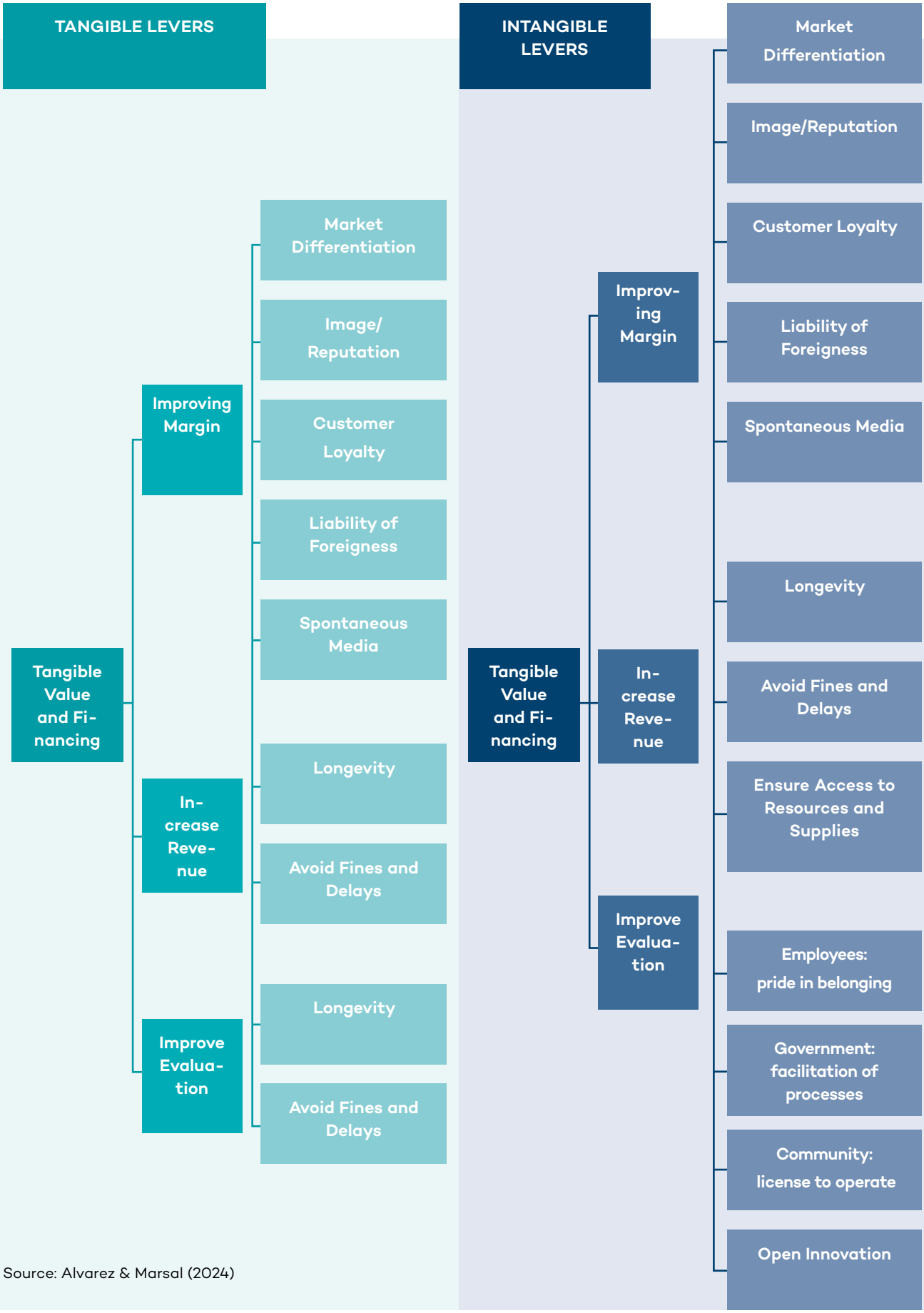
The contributions of ESG to mitigating economic and financial impacts became more evident after the dam collapses that occurred in the state of Minas Gerais in 2015 and 2019. Companies had to invest high costs in a short period of time to repair various damages and pay environmental fines.

In addition, it is becoming increasingly clear that acting in accordance with ESG standards increases the competitiveness of the mineral sector, both in the domestic and international markets.

In today's world, where companies are monitored by their various stakeholders, high ESG maturity is an indication of solidity, lower costs, better reputation and greater resilience amid uncertainties and vulnerabilities.

ESG enables tangible and intangible levers that generate value directly and indirectly for the business, as shown in Figure 7.

Figure 7: Levers that drive economic viability



Source: Alvarez & Marsal (2024)

Identifying risks throughout the operational process is extremely important for the financial health of the business. ESG can contribute to financial opportunities in three areas, namely:

i. Costs with impacts associated with the business: the clear definition of risks and opportunities based on ESG criteria directs the correct investments to mitigate impacts, eliminating unexpected costs in the event of an incident.

ii. Lines of credit for investments: companies that develop sustainable projects have the opportunity to acquire investment bonds with tax benefits and reduced taxes. Example of bonds:

- **Green Bonds:** projects that contribute to the goals of climate change, biodiversity, energy efficiency, green buildings, renewable energy, water management, circular economy, pollution prevention and control, and clean transportation;

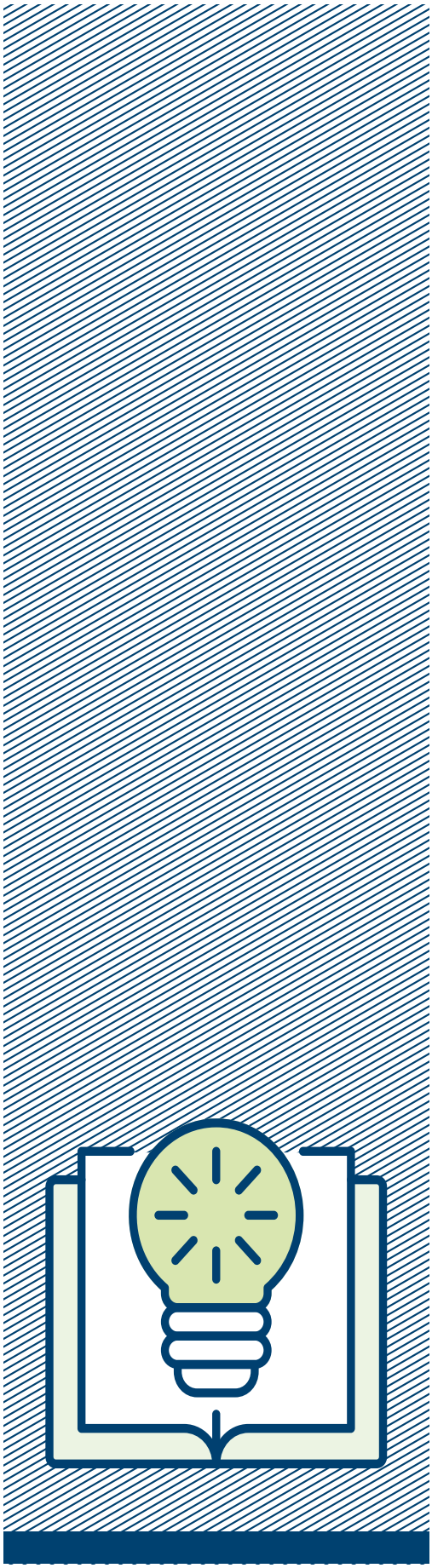
- **Social Bonds:** projects that contribute to job creation and socioeconomic programs, affordable housing, basic infrastructure, food security and sustainable food systems, and access to social services;

- **Sustentability Bonds:** projects that contribute to social and environmental combined;

- **Sustantability-Linked Bonds:** projects that contribute to reducing the intensity of greenhouse gas emissions, waste management and renewable energy.

- **Attractiveness for investors:** the application of ESG practices in publicly traded companies is increasingly being demanded by shareholders. Some sustainability indexes have been developed to assess the performance of companies in adopting sustainable practices. This result is reported on the stock exchange.

The implementation of ESG criteria in the mine closure process can contribute to mitigating the impacts generated throughout the operation, making business costs viable through financial incentives available on the market.



6 PRACTICAL CASES

6.1 Case of Lusatia (Germany): "Industrial landscape transformed into a new cultural landscape"

Lignite mining in Lusatia began in 1844 and has been in operation for over 150 years. Extraction has always been vital to industry in Germany, which was once the world's largest producer, having mined over 300 million tonnes, around a third of the world's annual production. The Lusatia region alone mined 200 million tonnes.

After the reunification of Germany, almost all processing plants in the region closed, which raised the unemployment rate to 25% and triggered a population exodus. Since the closure, the *Internationale Bauaussttellung* (IBA) has been working on projects to restore the Lusatia area (Accioly, 2012).

The projects' proposals go beyond rehabilitation, including the rescue of Lusatia's industrial heritage. Their conception is based on partnerships between the community, government and private entities for tourism use and increased possibilities for local investments.

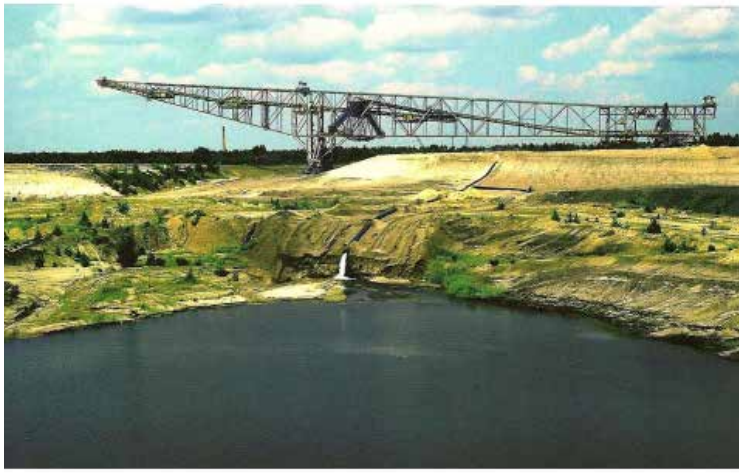
Some examples of groupings of the projects' central topics are:

i. i. Industrial heritage: encouraging the preservation and reuse of examples of the region's industrial history, giving the region an identity and new development. Examples of this conceptual line include the F60 Mine (Figure 8), the Plessa Power Plant and the Lusatia Industrial and Cultural Heritage Route, ENERGIE (Figure 9);

ii. Lusatia Water World or Aquatic Landscapes: refers to the old mining pits that, after rehabilitation works, created aquatic landscapes, also transforming the face of the region, bringing new opportunities for regional and economic development, with new business and tourism possibilities;

iii. Border landscapes: Lusatia is located on the border with Poland, which represents a major challenge in terms of regional development. With the Second World War, this former unified border was broken. Since 2004, when Poland joined the European Union and with the opening of its border in 2007, the prospect of shared work has been expanded, with projects that have expanded their concepts and allowed the borders of Poland and Germany to be crossed, such as the Geopark Muskauer Faltenbogen (Figure 10):

Figure 8: F60 Mine



Source: Internationale Bauausstellung, 2010, p. 91.

Figure 9: Museum in Cottbus

Source: Internationale Bauausstellung, 2010, p. 263.

Figure 10: Muskauer Park

Source: Internationale Bauausstellung, 2010, p. 173.

6.2 6.2 Case of Curitiba
Pedreiras Park, the Zaninelli forest and the Tanguá Park

The examples of Pedreiras Park, the Zaninelli forest and Tanguá Park are the result of the use of inactive quarries, which bear the mark of the industrial past as an element of the history of each one, used as an integral part of the local identity (Accioly, 2012).

Each space has its own characteristics, but they carry common issues, such as tourism, cultural and historical appreciation, recorded as a structural part of the particularity and identity of each region.

Specificities of each space:

- **PEDREIRAS PARK**
  - It has 107 lakes, waterfalls and an araucaria forest;
  - Ópera de Arame: it has a stage of approximately 400 m², with capacity for approximately 2,400 people. The building is partially surrounded by a lake and refers to famous opera houses around the world, such as the one in Paris and the Scala in Milan (Figure 11);
  - Pedreira Paulo Leminski: an area designed for open-air shows, with a capacity of 30,000 people. It is surrounded by a 30-meter rock wall, which helps with its acoustic quality.

Figure 11: Opera de Arame, in Curitiba/PR

Source: GUIA GEOGRÁFICO CURITIBA, [20-?].

- **TANGUÁ PARK**

  - It has a total area of 450 thousand m², with leisure facilities such as a tunnel, two lakes, a bike path, a running track, a dock, and parking lot;
  - Poty Lazzarotto Garden: located in the park, it has a lookout point 65 meters above the lake in the lower area, a waterfall and water features, as well as a metal deck, bistros, public restrooms, shops, and observation towers (Figure 12);
  - The park contributes to the preservation of the springs of the Barigui River.

Figure 12: Poty Lazzarotto Garden

Source: PARQUES E PRAÇAS DE CURITIBA, [20-?].

- **ZANINELLI FOREST**

  - Approximately 37 thousand m² of area, which houses attractions such as the preserved native forest around the old quarry, a walkway that leads to the quarry and a lake, whose water surface is 120 m²;
  - Universidade Livre do Meio Ambiente is located in this forest (Figure 13).

Figure 13: Universidade Livre do Meio Ambiente

Source: PARQUES E PRAÇAS DE CURITIBA, [20-?].

6.3 Lousal mine case
Centro de Ciência Viva do Lousal

The Lousal mine, located in the Iberian Pyrite Belt, ceased its activities in 1988 for economic reasons. The main resource mined was pyrite, from which sulfuric acid was produced, and, in some periods, copper from chalcopyrite (copper and iron sulfide). Gold was also extracted from gold-bearing pyrites (Dias, 2016).

The name of the ReLousal program was created with the aim of highlighting the aspects of REvitalization, REdynamization, REcovery and REhabilitation of the community. This project was the origin of the ReLousal program, which, in less than ten years after the closure of the mines, promoted an integrated development project in Lousal, which brought together multiple actors who bring together the social, economic and cultural life of the place, through integrated actions. The museological, cultural and educational issues were also emphasized, also oriented towards tourism activities.

- The following are some of the program's actions:
- Professional training;
- Support for local crafts;
- Promotion of public facilities;
- Valuation of the mining heritage;
- Environmental recovery through soil decontamination and reforestation of land;
- Museological facilities;
- Requalification of urban space;
- Promotion of the site;
- Internationalization of Lousal.

Figure 14: *Centro de Ciência Viva*: The cars show the types of materials used in their manufacture

Source: Personal collection - Personal collection - Accioly, 2012

Figure 15: *Centro de Ciência Viva*: Recreation of the stages of mining for children

Source: Personal collection - Personal collection - Accioly, 2012

Figure 16: Old industrial unit of the mine that will be rehabilitated for future visits

Source: Personal collection - Accioly, 2012

The most obvious result has been the creation of the Mining Museum, the Lousal Urbanization Plan, and the rehousing of the resident population and tourism projects. Centro de Ciência Viva is considered one of the most important factors in the revitalization process of Lousal.

6.4 Bodelva Case (England)
Eden Project

The Eden Project is located in Bodelva, in the southwest region of England, Cornwall. The project was implemented in a pit of an old porcelain clay mine. Clay mining is part of the history of the Eden Project, which is considered one of the largest rehabilitation projects (Dias, 2016).

The Eden Project has been an instrument of economic transformation and new perspectives in the Cornwall region. The Eden Project originated from the desire to create a garden with the aim of showcasing the diversity of the world's biomes, through the construction of the largest greenhouse in the world. Several fundamental aspects were considered in the project, such as proximity to good infrastructure, the possibility of maximum use of natural light and the availability of a large parking area (Figure 17).

Characteristics of the Eden Project:

- In addition to tourism, the project aims to be an educational project, by recreating different climate zones of the world, with their native vegetation, in an area of 15 hectares outdoors and in two large greenhouses or biomes;
- Humid tropic biome: the first greenhouse houses a wide variety of species, from West Africa, Malaysia, Oceania and the Amazon;
- Warm temperate climate biome: the greenhouse is home to species from the Mediterranean climate, from California and South Africa;
- The area also has an arena, which hosts events such as musical concerts and other artistic performances, as well as uses such as a skating rink;
- The main function of the Eden Project is environmental education through workshops, exhibitions and events;
- The Cornwall Mining World Heritage Area was recognized by UNESCO in 2006;
- The project generates impacts at the national and international levels, as it is an innovative and creative project, in addition to strengthening local economic diversity.

Figure 17: Largest greenhouse in the Eden Project

Source: EDEN PROJECT, [20-?].

6.5 Kidston Gold Mine Case
Renewable Energy Generation

An example of renewable energy generation in future use projects following mine closure is the former Kidston gold mine, about 275 km northwest of Townsville in Queensland, Australia (Figure 18).

The Kidston gold mine is Australia's largest open-pit gold mine, having closed in 2001 after 90 years of operation (Kyan, 2022). Genex, an energy company, is transforming the site into a clean energy hub, combining solar, wind and pumped hydro (Figure 19). It is Australia's first pumped hydro project in over 40 years and will be the country's third largest electricity storage facility once commissioned.

Characteristics of the project:

- The conversion of the inactive gold mine will have the potential to generate electricity to power approximately 143,000 homes for 8 hours. The project has a high electrical efficiency and can support 2,000MWh of continuous power generation in a single generation cycle (250MW of peak power generation over an 8-hour period);

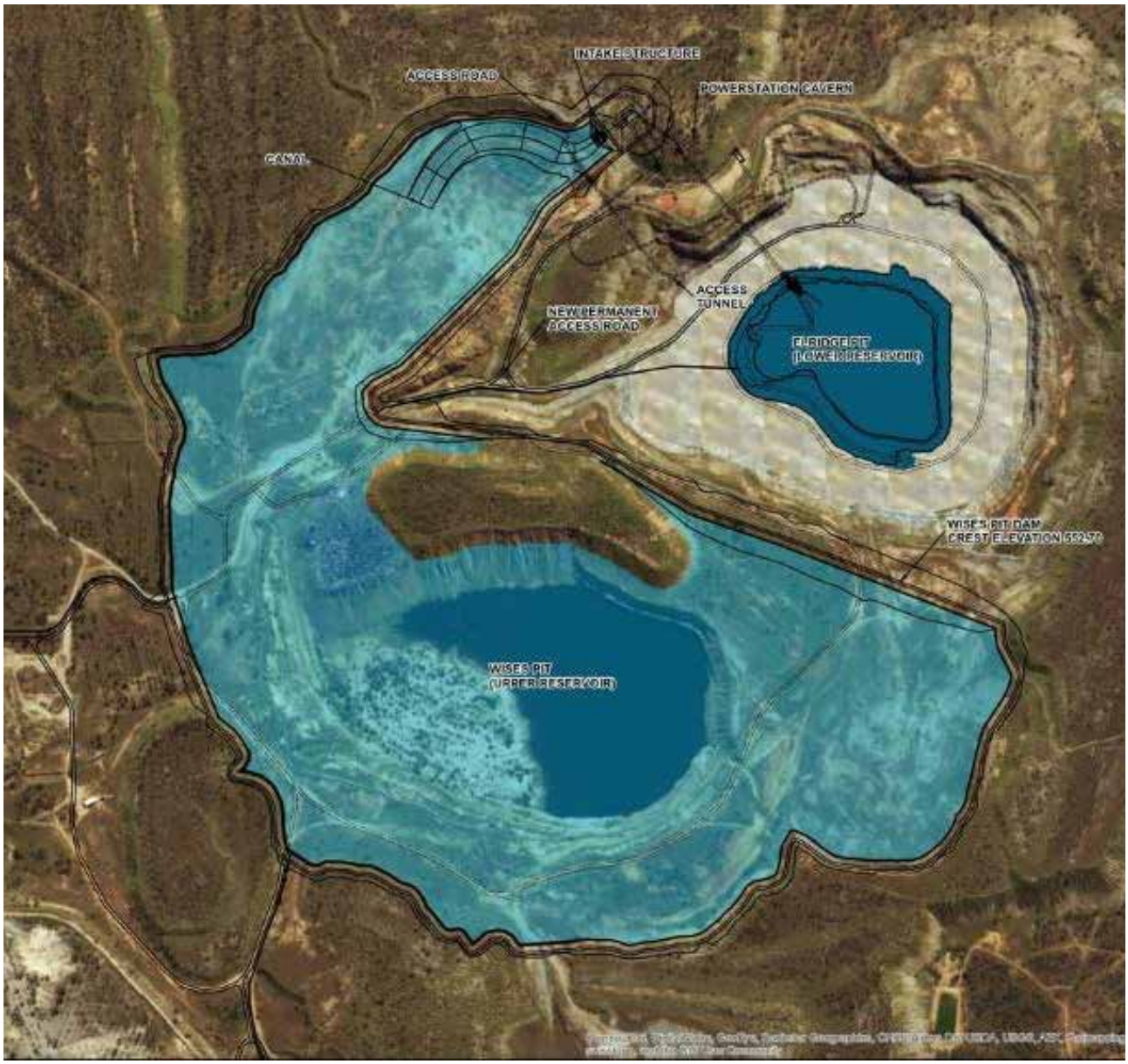
- The new development is expected to generate at least 500 jobs during the construction phase;

Figure 18: Former Kidston mine site.

Source: Genex, 2021

- • The Kidston Pumped Storage Project is designed to turn the mine's large open pits into a giant battery, pumping water into an upper energy storage reservoir when energy prices are low. It will then release the water through reversible turbines into the lower reservoir, generating power at times when energy demand is high;
- The facility will store energy from an operational 50 megawatts (MW) solar farm, which will be expanded in a second phase.
- There will also be a planned 150 MW wind farm, scheduled for completion in 2024;
- The Australian Renewable Energy Agency (ARENA) has provided USD 47 million in funding for the project.

Figure 19: Kidston Pumped Storage Hydroelectric Project



Source: Trimble Geospatial, 2023

6.6 Cases of Valorization
Historical-Cultural and Tourism in Europe

Two projects in inactive coal mines in Europe, one in the city of Lens, in northern France, and the other in the city of Essen, in Germany, were developed to enhance local history and culture, and minimize the negative image that can be associated with mining (Dias, 2016).

Projects focused on tourism and historical and cultural enhancement in inactive coal mining areas bring socioeconomic benefits to the communities that suffered the impacts of the end of industrial activities.

Specificities of each space:

- Second Branch of the Louvre Museum in Lens, France (Figure 20).
- A branch of the Louvre Museum built on abandoned coal mines in the city of Lens, with the main objective of revitalizing the post-industrial city.
- Inaugurated in 2012, with the expectation of contributing to revitalizing the area, which was hit by the economic crisis after the end of mining.

Figure 20 - Louvre, city of Lens

Source: www.archdaily.com.br

- The goal was for the Louvre-Lens to attract 500,000 visitors per year, a significant number compared to the total population of the city, around 35,000, and where the unemployment rate is over 16%.

- Horizontal structure, closely rooted in its specific context, composed of five buildings, Yesple structures built in steel and glass. Considerations on tourism and historical-cultural appreciation in Essen, Germany:

- The Zollverein Coal Mine Industrial Complex is a former industrial park in the city of Essen (Figure 21).

- The coal mine was founded in 1847, and its extractive life lasted from 1851 to 1986.

- The Zollverein Coke Plant, closed in 1993, was among the largest of its kind in Europe.

- After recovery, preservation is done through alternative uses, such as museums, parks and other attractions.

- The buildings and facilities have been officially listed as historical monuments since 2000, which was followed in 2001 by their inscription as a UNESCO World Heritage Site.

Figure 21 - Zollverein Complex

Source: www.archdaily.com.br/br/625857/uma-jornada-fotografica-por-zollverein-a-transformacao-de-uma-paisagem-pos-industrial.

6.7 6.7 Ecological Park Cases for Cultural Exploration

Mangabeiras Park in Belo Horizonte

Mauricio Campos Mangabeiras Park is located in Belo Horizonte, a region of the state of Minas Gerais, and is a cultural heritage site of the city. The park area was used for iron mining exploration in the 1960s and mining activities were deactivated in 1979. The park was inaugurated three years after the mine was deactivated and in 1991 it became a municipal cultural heritage site (Belo Horizonte City Hall, 2018).

The park is composed of an area of 2.4 million m² and 59 springs of the Serra Stream. It is located at one of the highest points in the city, providing a pleasant outdoor climate and a complete view of the city of Minas Gerais. It is currently one of the city's main tourist attractions.

Considerations on tourism and historical and cultural appreciation:

- Environmental preservation covering approximately 2.4 million square meters of Atlantic Forest;
- The park is made up of trails, multi-sports courts, playgrounds, and an arena for theater and shows.
- Contributing to the generation of local employment, the park has kiosks selling food and drinks.
- During the month, the park receives around 30 thousand people for leisure, rest and sports
- Some areas and industrial equipment were preserved to represent the history of the place, leaving the legacy of a conscious and urban transition.

Figure 21 – Mauricio Campos Mangabeiras

Source: www.minasgerais.com.br

6.8 Power Generation Case Copelmi

In 2015, Copelmi, a private-sector coal mining company in Brazil, in partnership with Grupo Solví and Biotérmica Energia, opened a plant that uses waste to transform it into energy (Saneamento Ambiental, 2015). The plant was built in the city of Minas do Leão in Rio Grande do Sul, which receives approximately 3,500 tons of urban waste per day.

The initial power generation capacity will be 8.5 MW, with a total expected generation capacity of 15 MW, which is enough to supply a city with up to 80,000 inhabitants. The Minas do Leão landfill was created due to the company's need to drain the open-pit coal mine in the area. In addition to the need for the mining enterprise, waste from 130 cities in the state is deposited in the landfill.

The power generation plant was built in the Recreio mine and the investment was BRL 30 million.

Figure 22 – Geração de energia a partir de lixo urbano

Source: osepeense.com

6.9 Ongoing cases - Vazantes Minerais NEXA
Development of agricultural, socio-environmental, research and tourism activities

The mining company Nexa is developing a Strategic Multiple Use Plan (PEGUM) as a best practice for mine closure. According to IBRAM (2023), PEGUM is an initiative by NEXA in conjunction with Universidade Federal de Uberlândia (UFU) and in partnership with the Reservas Votorantim group, for initial implementation in the city of Vazantes, Minas Gerais. The study is composed of four pillars of action for the development of closure and future use, namely:

- **Tourism:** The Vazantes Mineiras project aims to implement a Tourist Assistance Center (CAT), with the aim of proposing tourist activities and developing historical and cultural potential;
- **Research:** In partnership with universities and researchers, a proposal will be developed for the conservation of the Cerrado biome, preservation of local biodiversity, development of agriculture and livestock farming, and proposals for more opportunities for mining and for the city of Vazantes
- **Planting and Production:** Initiatives such as the implementation of cattle farming and agroforestry, planting of coffee, fruits from the Cerrado and regenerative agriculture are being planned. In addition to the study of opportunities for the implementation of solar energy, production of biofuel and processing of chestnuts from the Cerrado;
- **Socio-environmental:** The project is committed to developing programs aligned with NEXA's social management, incorporating the production chain of the municipality of Vazante.

The Vazantes Mineiras project aims to highlight the positive aspects of the city of Vazante, including local biodiversity, the production chain and the community.

Figure 23 - NEXA Vazantes Mineiras Project Figure

Source: Made available by NEXA at the IBRAM Mine Closure workshop.

6.10 Ongoing cases – Nova Vila AngloGold Ashanti

Historical and cultural valorization and future use of former mining area

A former industrial area of the AngloGold Ashanti mining company will be transformed into a space for cultural centers, social spaces, green areas, commerce, services, housing, areas for outdoor sports, educational activities and the creative economy, as well as areas focused on innovation in the industry (AngloGold Ashanti, 2023).

The project is being implemented in partnership with a construction company and will cover a total area of 260,000 m², an area that was used for mining activities between 1834 and 2003. A total of 25% of the total area of the project will be allocated to ecological spaces and the preservation of the Atlantic Forest.

Considerations about the project:

- The revitalization of more than 19.6 thousand m² of historic structures is planned, in addition to environmental preservation and care in developing a construction project that preserves local history;
- The project considered the needs of urban mobility with the inclusion of a new 2 km long road and a cycle path
- A research study was developed to minimize the existing impacts in the region related to housing; the project will also include a park for visitors and residents.

Figure 24 – Nova Vila AngloGold Ashanti Project

Source: Revista Mineração

ANNEX 1 – FREQUENTLY ASKED QUESTIONS

WHAT IS SUSTAINABILITY?

Sustainability is a concept generated for the principle of actions that aim to balance the exploration and use of natural resources.

WHAT IS ESG?

ESG was implemented through an initiative by the UN Secretary General and the World Bank to encourage companies to implement the concept of sustainability in their processes and decisions. The acronym ESG refers to the dimensions environmental, social and corporate governance, translated into Portuguese it means environmental, social and corporate governance.

WHAT ARE SUSTAINABLE FINANCIAL INCENTIVES?

After implementing ESG, financial institutions provided credit lines with tax reductions for companies that develop projects that provide more sustainable results.

WHAT IS A MATERIALITY MATRIX?

A materiality matrix is the consolidation of the main issues that can affect the business in terms of balancing the exploration and use of natural resources, that is, that can affect the sustainability of the enterprise.

ANNEX 2 – GLOSSARY

- **Carbon Credits**

Certificates issued to companies that reduce their greenhouse gas (GHG) emissions.

- **Environmental Laws**

Laws established to protect the environment and reduce the impacts related to the exploitation of natural resources.

- **ISE B3**

Corporate Sustainability Index (ISE B3) is an indicator created by the Brazilian stock exchange that evaluates the average financial performance of companies committed to sustainability practices.

ANNEX 3 – SELF-ASSESSMENT FORM

Header:

Mine Identification		Company Name	
Evaluator		Evaluation Date	

Supporting Documents and Evidences:

Document Name	Responsible Department	Storage Location

Interviewees:

Interviewee Name	Department	Position

Indicator 1: GOVERNANÇA PARA O FECHAMENTO DE MINA INCLUINDO ASPECTOS ESG

Indicator	Level	Question	Yes	No	N/A	Description and evidences
GOVERNANCE FOR MINE CLOSURE INCLUDING ESG ASPECTS	C	Is there a governance process for mine closure that does not consider ESG aspects (does it have professionals with ESG expertise, does it monitor socio-environmental initiatives)?				
	B	Is the process of integrating ESG aspects into the closure governance being refined (professionals being hired, roles and responsibilities being assigned)?				
	A	Does the governance structure for closure already have professionals dedicated to ESG and do they effectively monitor socio-environmental aspects?				
	AA	Are there well-defined processes, roles and responsibilities related to sustainability, and ESG monitoring indicators?				
	AAA	Is there robust governance, with all the aspects mentioned in the AA, continuous improvement processes and that is connected to the company's sustainability strategies?				

To assess the performance of the indicator, consider the highest level at which the company obtained the answer "Yes" in its entirety.

Evaluated Performance of the Indicator: Level _____

Indicator 2: IDENTIFICATION OF SOCIAL AND ENVIRONMENTAL IMPACTS IN THE MINE CLOSURE PROCESS

Indicator	Level	Question	Yes	No	N/A	Description and evidences
IDENTIFICATION OF SOCIAL AND ENVIRONMENTAL IMPACTS IN THE MINE CLOSURE PROCESS	C	Is there a process to identify the socio-environmental impacts of closure?				
	B	Is the process for identifying socio-environmental impacts part of a detailed diagnosis that assesses impacts from the design phase to the operational end?				
	A	Is there a process for categorizing impacts and defining potential mitigation measures?				
	AA	Are mitigation measures mapped and integrated into a management plan?				
	AAA	Is the management plan for mitigation actions integrated into the company's sustainability strategy and monitored by senior management?				

To assess the performance of the indicator, consider the highest level at which the company obtained the answer "Yes" in its entirety.

Evaluated Performance of the Indicator: Level _____

Indicator 3: SOCIO-ENVIRONMENTAL RISK MANAGEMENT FOR MINE CLOSURE

Indicator	Level	Question	Yes	No	N/A	Description and evidences
SOCIO-ENVIRONMENTAL RISK MANAGEMENT FOR MINE CLOSURE	C	Is there a process for identifying and managing mine closure risks that includes ESG criteria?				
	B	Is the ESG risk management system related to closure aligned with the diagnosis of socio-environmental impacts?				
	A	Does the ESG risk management system have prevention and mitigation measures associated with each risk?				
	AA	Is the closure ESG risk management system robust, covering the aspects mentioned above and with continuous improvement initiatives established?				
	AAA	Is the closure ESG risk management system updated frequently and integrated into the company's strategic decision-making?				

To assess the performance of the indicator, consider the highest level at which the company obtained the answer "Yes" in its entirety.

Evaluated Performance of the Indicator: Level _____

Indicator 4: INTEGRATION OF TSM GUIDELINES INTO MINE CLOSURE

Indicator	Level	Question	Yes	No	N/A	Description and evidences
INTEGRATION OF TSM GUIDELINES INTO MINE CLOSURE	C	Does the company currently have knowledge of TSM, its methodology and protocols?				
	B	Does the company have knowledge of TSM but has not yet conducted any type of assessment related to mine closure?				
	A	Does the company know the TSM system and protocols and use them as a reference for analyzing ESG maturity and for good mine closure practices in its processes?				
	AA	Has a maturity assessment based on TSM already been conducted and has the company used the results to direct its efforts related to ESG and mine closure?				
	AAA	Does the company conduct periodic assessments based on the TSM system and use the results to analyze performance in relation to the ESG strategy and mine closure, addressing opportunities for improvement?				

To assess the performance of the indicator, consider the highest level at which the company obtained the answer "Yes" in its entirety.

Evaluated Performance of the Indicator: Level _____

Indicator 5: STRUCTURING THE ESG STRATEGY FOR MINE CLOSURE USING MATERIALITY ASPECTS

Indicator	Level	Question	Yes	No	N/A	Description and evidences
INTEGRATION OF TSM GUIDELINES INTO MINE CLOSURE	C	Does the company have any strategy or direction for integrating sustainability into closure?				
	B	Has the company conducted a materiality analysis (more details in Chapter 8.5) focused on mine closure?				
	A	Has the company conducted an ESG materiality analysis and is it integrating the results into an ESG strategy for closure?				
	AA	Has ESG materiality been thoroughly implemented and integrated into the strategy, with commitments established to integrate sustainability into the closure process?				
	AAA	Is the ESG strategy based on materiality already robust, with well-defined governance and performance results already measured?				

To assess the performance of the indicator, consider the highest level at which the company obtained the answer "Yes" in its entirety.

Evaluated Performance of the Indicator: Level _____

Indicator 6: ECONOMIC AND FINANCIAL GAINS FROM THE IMPLEMENTATION OF SUSTAINABILITY CRITERIA IN MINE CLOSURE PROCESSES

Indicator	Level	Question	Yes	No	N/A	Description and evidences
ECONOMIC AND FINANCIAL GAINS FROM THE IMPLEMENTATION OF SUSTAINABILITY CRITERIA IN MINE CLOSURE PROCESSES	C	Does the company evaluate its economic performance based on the implementation of good ESG practices?				
	B	Does the company map opportunities for mine closure projects, connecting ESG opportunities with economic and financial gains for the business?				
	A	Does the company develop sustainable mine closure or post-closure projects that will bring economic and financial gains to the business?				
	AA	Does the company have projects in place, with a process for monitoring and measuring economic and financial gains?				
	AAA	Are the projects already robust and is there an ongoing process for identifying new opportunities?				

To assess the performance of the indicator, consider the highest level at which the company obtained the answer "Yes" in its entirety.

Evaluated Performance of the Indicator: Level _____

ANNEX 4 – ACTION PLAN MODEL

The action plan model should be used by companies that aim to address the weaknesses identified, aiming to obtain a better classification level for the indicators with low performance.

Indicator	
Level Achieved	
Level Desired	
Corrective Action Plan	
Responsible Department	
Planned Implementation	
Date	
Status	
Results Achieved	

ANNEX 5 – LIST OF OPEN CONSULTATION PARTICIPANTS

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