Assessment of sustainable and responsible mining standards and guidelines

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Abstract

Addressing climate change necessitates new technologies (e.g., e-mobility vehicles, renewable energy, etc.) that require numerous mineral resources. Consequently, extensive exploration and mining development projects are underway in remote regions around the world. These initiatives have notably increased in the Arctic Circle, Africa, Southeast Asia, and South America. This has created a significant dilemma. On one hand, combating climate change requires mineral resources, while on the other hand, mining activities contribute to serious environmental and social problems. In parallel to these trends, the mining industry includes tools to measure the sustainability and responsible performance of its operations.

In recent years, many voluntary sustainable/responsible mining standard initiatives have emerged (e.g., the Initiative for Responsible Mining Assurance, the Extractive Industries Transparency Initiative, the Global Reporting Initiative Standards, the Towards Sustainable Mining program, and the Sustainability Accounting Standards Board). These organizations issue certificates to mining corporations based on their performance regarding sustainability, transparency, business conduct, justice, social acceptance, health and safety, environmental impact, and community engagement. The merits of these standards have not been investigated in detail. The extent of acceptance of these initiatives among mining stakeholders is not yet fully known. This thesis investigates the merits and potential of voluntary standard initiatives through comparative content analysis. The objective is to compare voluntary standard efforts against each other and propose a plan to consolidate and potentially legislate these standards.

Each mining operation faces unique challenges depending on the jurisdiction, location, commodity type, proximity of local and Indigenous communities, biodiversity vulnerabilities, legal/regulatory frameworks, externalities, and social impacts. Therefore, mining stakeholders should be equipped with an in-depth understanding of these standards. This thesis will enhance the understanding of the standards that align with the specifics of mining operations.

Résumé

La lutte contre les changements climatiques nécessite de nouvelles technologies (par exemple, véhicules de mobilité électrique, énergies renouvelables, etc.) qui nécessitent de nombreuses ressources minérales. Par conséquent, de vastes projets d'exploration et de développement minier sont en cours dans des régions éloignées du monde entier. Ces initiatives se sont notamment multipliées dans le cercle polaire arctique, en Afrique, en Asie du Sud-Est et en Amérique du Sud. Ça a créé un dilemme important. D'un côté, la lutte contre les changements climatiques nécessite des ressources minérales, tandis que, de l'autre, les activités minières contribuent à de graves problèmes environnementaux et sociaux. Parallèlement à ces tendances, l'industrie minière comprend des outils pour mesurer la durabilité et la performance responsable de ses opérations.

Entre-temps, de nombreuses initiatives volontaires de normes d'exploitation minière durable/responsable ont vu le jour (par exemple, the Initiative for Responsible Mining Assurance, the Extractive Industries Transparency Initiative, the Global Reporting Initiative Standards, the Towards the Sustainable Mining, and the Sustainability Accounting Standards Board). Ces normes délivrent des certificats aux sociétés minières en fonction de leurs performances en matière de durabilité, de transparence, de conduite des affaires, de justice, d'acceptation sociale, de santé et de sécurité, d'impact environnemental et d'engagement communautaire. Les compétences de ces normes n'ont pas été étudiées en détail. Le degré d'acceptation de ces initiatives par les parties prenantes de l'industrie minière n'est pas encore totalement connu. Cet article étudie le potentiel et les compétences des initiatives de normes volontaires par le biais d'une analyse comparative du contenu. L'objectif est de comparer les efforts en matière de normes volontaires les uns par rapport aux autres et de proposer un plan pour consolider et éventuellement légaliser ces normes.

Chaque opération minière est unique en fonction de la juridiction, de l'emplacement, du type de produit, de la proximité des communautés locales et autochtones, des vulnérabilités de la biodiversité, des cadres juridiques/réglementaires, des externalités et de l'impact social. Par conséquent, les parties prenantes du secteur minier doivent connaître ces normes afin de pouvoir les interpréter correctement. Ce document émet également des hypothèses sur les indicateurs de cette connaissance. Cette thèse améliorera la compréhension des normes qui s'alignent sur les spécificités des opérations minières.

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List of abbreviations

AERI	Arctic Environmental Responsibility Index
ARM	Alliance for Responsible Mining
ASI	Aluminium Stewardship Initiative
CCCMC	China Chamber of Commerce of Metals, Minerals and Chemicals
CEO	Chief Executive Officer
CO2	Carbon Dioxide
COI	Community of Interest
COP21	21st Conference of the Parties
CSR	Corporate Social Responsibility
DRC	Democratic Republic of Congo
EITI	Extractive Industries Transparency Initiative
ESG	Environmental, Social, and Governance
EU	European Union
FPIC	Free Prior and Informed Consent
GHG	Greenhouse Gas
GMG	Global Mining Guidelines Group
GRI	Global Reporting Initiative
HFC	Hydrofluorocarbons
ICMM	International Council on Mining and Metals
IFC	International Finance Corporation
IRMA	Initiative for Responsible Mining Assurance
ISO	International Organization for Standardization
LME	London Metal Exchange
MAC	Mining Association of Canada
MMSD	Mining, Minerals, and Sustainable Development Project
MSI	Multi-Stakeholder Initiatives
NA	North America
NGO	Non-Governmental Organization
NRGI	Natural Resource Governance Institute
OECD	Organisation for Economic Co-operation and Development
OH&S	Occupational Health and Safety
PPE	Personal Protective Equipment
R&D	Research & Development
RGMP	Responsible Gold Mining Principles
RJC	Responsible Jewellery Council
RMAP	Responsible Minerals Assurance Process
RMF	Responsible Mining Foundation
RMI	Responsible Minerals Initiative

RRA	Risk Readiness Assessment
SASB	Sustainability Accounting Standards Board
SDG	Sustainable Development Goals
SSRR	Segmented String Relative Ranking
TSM	Towards Sustainable Mining
UK	United Kingdom
UN	United Nations
VSP	Validation Service Providers

1. Introduction

1.1 Background

Metals and minerals play a vital role in our daily lives and in energizing tomorrow's economy. Mineral resources supply essential raw materials for computers, cell phones, vehicles, public transit, buildings, and numerous emerging technologies *(MAC, 2023a).*

With our efforts to expand the use of clean energy technologies, such as wind and solar power, the demand for natural resources is exploding. Along with the increasing demand for renewable energy, the need for vital raw materials to support clean energy technologies is also on the rise.

However, the availability of these materials remains uncertain due to geological limitations and uncertainties, geopolitical concerns, trade regulations, environmental and societal repercussions, and other influences that impact different regions to varying extents (Barakos, 2022).

Historically, the mining industry has faced criticism for its environmental pollution and lack of community engagement. The industry requires sustainable and responsible standardization efforts. Consequently, numerous voluntary standards have emerged. Furthermore, the contents of these standards are frequently updated. The inclusiveness and proficiency of these standards should be investigated comparatively.

Critical minerals comprise essential elements necessary for renewable energy and clean technology applications, including batteries, solar panels, wind turbines, and advanced manufacturing sectors like defense, security technologies, and semiconductors.

In 2022, the Canadian government established and compiled a roster of 31 critical minerals (Figure 1).

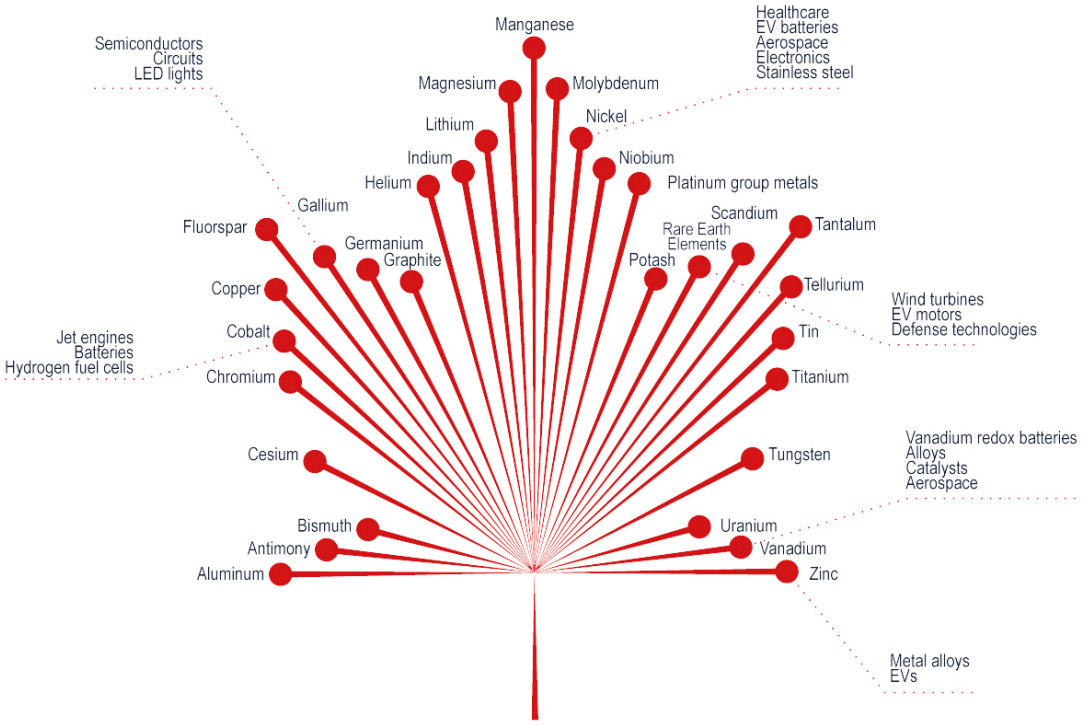


Figure 1: Canadian Critical Minerals and Sample Uses (Canada 2022).

Canada currently produces over 60 minerals and metals, excelling as a global leader in several critical minerals such as nickel, potash, aluminum, and uranium. This strength positions Canada to further contribute to both national and international markets (Canada 2022). However, without clear, concise, comprehensive, and well-communicated sustainable mining practices, Canada's critical minerals strategy faces three major risks:

(1) Prolonged delays in permitting process

The absence of clearly defined sustainable mining practices can inadvertently lead to extended delays in the permitting process. Inadequate alignment with environmental and social considerations might prompt regulatory bodies to scrutinize applications more rigorously. This could result in prolonged wait times for obtaining the necessary permits, subsequently impeding timely project initiation and progress.

(2) Ambiguous carbon policies

The absence of well-established sustainable mining practices can contribute to the ambiguity surrounding carbon policies. The evolving global focus on reducing carbon emissions necessitates a clear roadmap for the mining industry. Without robust sustainable practices, carbon reduction strategies might be unclear, leading to operational uncertainties, potential penalties, and a lack of alignment with international climate goals.

The question arises regarding whether the mining industry should have its own carbon policies or if it should be considered under the same framework as other heavy industries. As described throughout this paper, we believe that there are very clear specifications that need to be considered in carbon policies for the mining industry. Some of these differences, which justify the need for mining-specific carbon policies, include often remote locations that make access to electricity and other ressources more challenging, high capital investment with long payback periods, and a complex mine lifecycle that involves deforestation, land reclamation, reforestation, and community impact.

(3) Non-standardized responsible and sustainable operational practices

Drawing a parallel to safety standards, many of which are now codified in law, the lack of well-defined sustainable and responsible operational practices is a significant problem. Without explicit guidelines, there is a risk of varying interpretations of what constitutes sustainable mining, potentially leading to inconsistencies in practices across the industry. Environmentally and socially responsible mining practices must be clearly defined in regulations to avoid potential negative impacts on communities and ecosystems.

As illustrated by Table 1, low-carbon technologies, notably solar photovoltaic (PV), wind turbines and energy storage, require a higher mineral input compared to fossil fuel technologies.

This raises two questions:

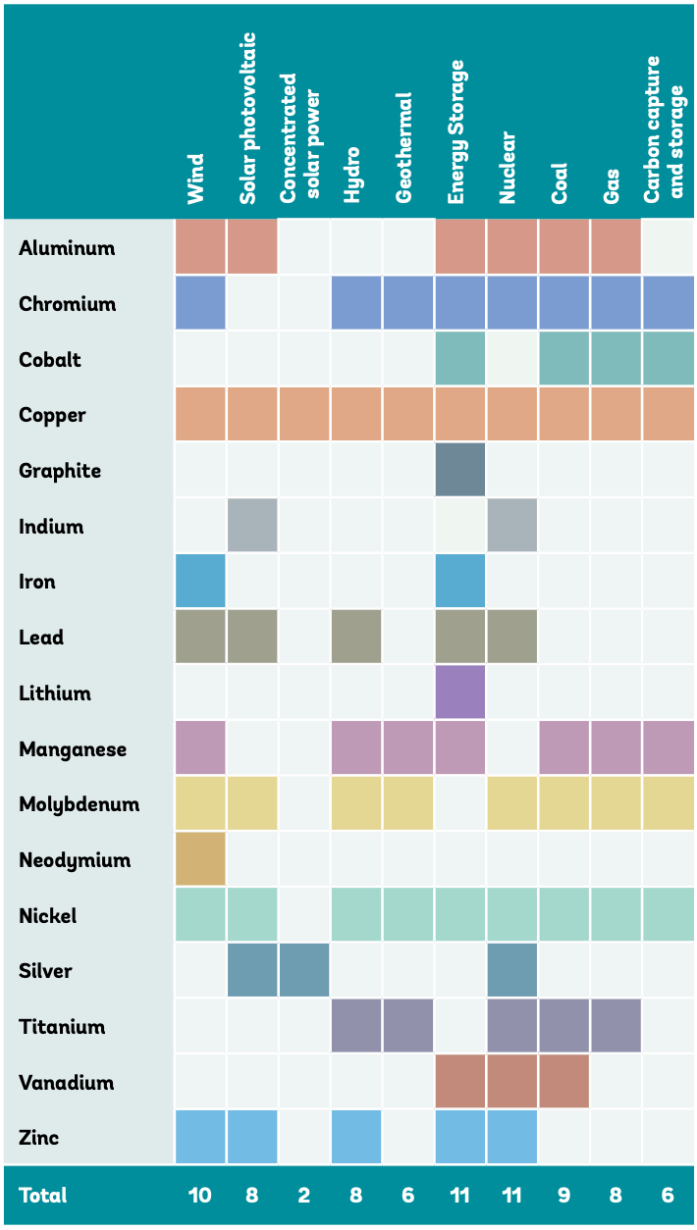
1. Is the mining of critical minerals and metals conducted in a sustainable manner?
2. If not, what measures can be taken to ensure sustainability?

The development of sustainable methods for procuring critical minerals and metals is still in its infancy. The imperative is to establish connections between various fields and generate collaborations, all aimed at ensuring a sustainable supply of these essential resources for the future, a necessity underscored by the current surge in demand.

The transition to a net-zero economy by 2025 will require various metals and minerals. The forecast for increased demand for these resources, based on today's technology and recycling capacity, has been estimated to be substantial. For example, according to Ivanhoe Mines Founder & Co-Chair Robert Friedland, who spoke at the Investing in African Mining Indaba 2022 on May 11, "*more than 700 million mt of copper will need to be mined in the next 22 years to maintain 3.5% GDP growth, without taking into account the electrification of the global economy, which is the same volume of copper ever mined*."

On the other hand, transitioning the world's passenger vehicles to electric vehicles alone would require mining more metals over the next 30 years than have ever been mined throughout history. However, these predictions are not final and are likely to decrease and stabilize at manageable levels, as they are based on assumptions that resources are infinite. They also depend on the current state of mining technologies, recycling capacities, and today's technology for building clean and renewable energy systems.

Table 1: Mapping Minerals with Relevant Low Carbon Technologies (WB, 2020)



1.2 Context: Climate Change and Decarbonization

The narrative around critical minerals begins with the 2015 Paris Agreement, a legally binding global treaty addressing climate change. This agreement was endorsed by 196 parties during the UN Climate Change Conference (COP21) in Paris, France, on December 12, 2015, and officially enacted on November 4, 2016 (UN Climate Change, 2016).

The primary objective of the Paris Agreement is to prevent the global average temperature from rising more than 2°C above pre-industrial levels through agreement among the signatory nations (UN Climate Change, 2016). It also contains the aspirational target of limiting the temperature increase to 1.5°C above pre-industrial levels, where the pre-industrial period is considered the years between 1850 and 1900 (Amos, 2017). These overarching goals are rooted in the agreement's commitment to combat the effects of climate change.

To limit global warming to 1.5°C, global greenhouse gas (GHG) emissions would have to drop by half by 2030 and reach net-zero emissions around 2050. Net-zero will be achieved when all GHG emissions released by human activities are counterbalanced by removing GHGs from the atmosphere in a process known as carbon removal (Levin et al, 2023).

Total greenhouse gas emissions are the sum of emissions of various gases: carbon dioxide, methane, nitrous oxide, and smaller trace gases such as hydrofluorocarbons (HFCs) and sulfur hexafluoride (SF_6) (Ritchie & Roser, 2020) (Figure 2).

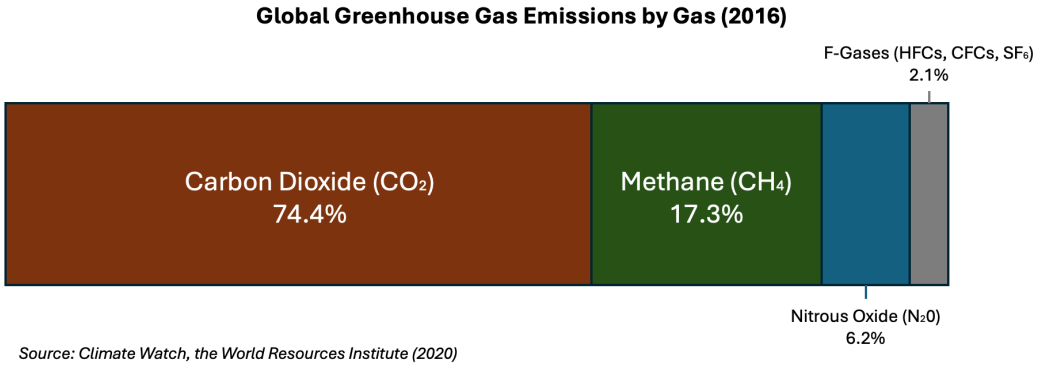


Figure 2: Global greenhouse gas emissions by gas (Ritchie & Roser, 2020)

Among the strategies gaining widespread support from the public and policymakers is decarbonization. Essentially, decarbonization is the removal or reduction of carbon dioxide (CO_2) in the atmosphere. Achieving decarbonization involves transitioning to energy sources characterized by low carbon content (TWI, 2023).

1.3 Sustainability in Mining

The mining industry faces a contradictory public perception. Due to the threats posed by climate change, environmental concerns, and transparency issues, the public opposes mining operations because they generate greenhouse gases along with large amounts of waste and tailings. A green economy urgently requires a significant and growing supply of certain raw materials. Therefore, the mining sector is paradoxically viewed as both a polluter and a potential contributor to a clean and sustainable environment.

Generally speaking, sustainability is a concept that focuses on meeting the needs of the present without compromising the ability of future generations to meet their own needs. The concept is based on three interrelated pillars: economic, environmental, and social—sometimes referred to as profits, planet, and people (UN, nd).

When applied to the mining industry, sustainability can be viewed through a similar lens. Sustainable mining refers to mining operations that prioritize environmentally friendly practices, social responsibility, and economic viability. These practices might include minimizing environmental degradation, promoting the wellbeing of local communities, and ensuring that operations are economically feasible in both the short and long term.

It is important to differentiate and define two types of sustainability for the following sections of this thesis. Pelenc and Ballet (2015) draw a useful distinction:

(1) Hard (Strong) Sustainability:

This perspective views the environment's natural capital (the world's stocks of natural assets including geology, soil, air, water, and all living organisms) as non-substitutable and emphasizes the need to preserve the stock of natural and physical capital. From a hard sustainability point of view, certain natural capital should not be depleted at any price. In the context of mining, this would mean that some resources should not be mined at all or that the methods of mining should not compromise the availability of these resources for future generations.

(2) Soft (Weak) Sustainability:

In contrast, Soft Sustainability views natural capital as substitutable by man-made capital to some extent. It accepts that some depletion or degradation of natural capital can occur as long as sufficient investments are made to compensate for it. This could mean that even if a particular mining activity damages the environment, it can be considered sustainable if the company invests in significant restoration activities or creates other forms of capital, like infrastructure in local communities.

In practical terms, the application of these concepts in mining would translate into strategies such as ensuring efficient use of resources, minimizing environmental impacts, investing in the wellbeing and development of local communities, and restoring land after mining activities. However, there is often a tension between these two concepts, and achieving the right balance is a key challenge in sustainable mining.

This study employs the term "sustainable mining" within the context of Soft (Weak) Sustainability.

1.4 Responsible vs. Sustainable Mining Practices

The terms "Sustainable Mining Practices" and "Responsible Mining Practices" are often used interchangeably, but there can be subtle differences in their implications depending on the context. While both emphasize ethical, environmental, and social considerations, the way they prioritize and implement these considerations may vary. For purposes of this study, we define them as follows:

(1) Sustainable Mining Practices:

Sustainable mining refers to mining operations conducted in a manner that meets the needs of the present without compromising the ability of future generations to meet their own needs. It is rooted in the principles of sustainable development, which includes economic prosperity, social equity, and environmental integrity. This term generally emphasizes long-term environmental and social impacts, such as preservation of biodiversity, minimization of waste and pollution, land

reclamation, and respect for Indigenous rights. It also calls for transparency and strong governance.

(2) Responsible Mining Practices:

Responsible mining, while also concerned with environmental and social impacts, generally places a stronger emphasis on ethical conduct, legal compliance, and corporate social responsibility (CSR) in the immediate term. This might include safe working conditions, fair wages, community engagement, respecting human rights, and adhering to all applicable regulations and standards. While sustainable mining looks at long-term impacts, responsible mining is more about the day-to-day operations and immediate effects.

These are summarized in Figure 3.

Figure 3: Responsible vs. sustainable mining practices

However, both terms advocate for a comprehensive and balanced approach to mining that acknowledges the need for mineral resources while ensuring minimal harm to the environment and maximum benefit to the communities affected. Furthermore, the extent to which a mining

operation is deemed “sustainable” or “responsible” can vary based on regional laws, standards, regulations, and socio-economic contexts.

1.5 A Practical Approach to Achieving Sustainability in Mining

In a prior work, we have described a framework to achieve sustainability in mining in three steps, visually represented below in Figure 4 (Bora, 2023).

Figure 4: AIM framework for achieving sustainability in mining (Bora, 2023)

This framework is denoted by the acronym AIM, which stands for Awareness, Investment, and Mindset shift. The book recommends a way for mining companies and professionals to lead the effort to build a sustainability culture within the mining and mineral processing industry.

(1) Awareness of the Impact of Mining

It is essential to widely communicate the mining industry's purpose, methods, and impact, especially to younger generations. Sharing mining stories beyond industry events, including with students, is crucial in fostering understanding and awareness about its significance and contributions.

(2) Investment in Innovation, Technology, and the New Generation

If mining is to continue to thrive in the coming decades, it needs to invest in attracting a new generation of workers. This can mean literally a new generation—millennials and Generation Z, for example—or it can mean new demographics and a more diverse workforce.

(3) Mindset Shift Toward Sustainability

Mining needs a mindset transformation toward sustainability. This shift should be all-encompassing, involving every worker level, ensuring a harmonious blend of purpose and profit for long-term viability, where social responsibility matches profit margins—a strategy beneficial to all in today's landscape.

1.6 Problem Statement

Standards are the guidelines that establishes baselines to ensure a process or service meets a set of quality, safety, best practices, and ethical requirements.

Since 2020, we have seen a great deal of positive progress in the industry's adoption of Environmental, Social, and Governance (ESG) standards. For instance, in 2021, the International Council on Mining and Metals (ICMM), an organization that represents a third of the global metals and mining industry, committed to a goal of net zero Scope 1 and 2 greenhouse gas (GHG) emissions by 2050 or sooner in line with the ambitions of the Paris Agreement (ICMM 2021).

While various certification schemes, membership requirements, and initiatives hold the potential to foster better practices and robust reporting, it is, however, crucial to acknowledge their limitations. ESG initiatives by industry bodies like ICMM might struggle with the tension between promoting members' interests and driving ESG improvement, potentially hindering progress.

Mining companies are also slow to embrace favorable practices, although formal ESG commitments are becoming common. However, actual performance lags behind, especially in effectiveness indicators that gauge efforts to enhance performance on specific ESG matters.

Without robust performance monitoring, demonstrating the impact of commitments on ESG issue management remains challenging for companies (RMF, 2022a).

The selection of the most appropriate standards arises a problem. How these standardization efforts are harmonized is also a question. Countries, local and Indigenous communities, legal framework, public, and companies have diverse dynamics. The content and emphasis of these standards should be examined to assist mining stakeholders in ensuring that sustainable and responsible mining practices are upheld at the highest level. Additionally, it is essential to analyze how these efforts will evolve and mature. Finally, the relationship between legislative frameworks and voluntary standardization efforts, as well as how they can inform each other, should be explored.

1.7 Research Questions

The fundamental question is: "How can the extraction and processing of mineral resources be conducted in a sustainable manner?" With multiple standards and governing bodies, the answer varies from one organization to another.

Consolidation and standardization of the guidelines are required to establish a clear definition of "sustainable mining practices."

Government-reinforced initiatives have significantly advanced industrial mining over the past few centuries. They have transformed mining practices from predominantly manual operations in medieval times to highly automated processes today. This shift has not only boosted productivity, efficiency, and safety but also reduced environmental and societal impacts and risks. This progress was encouraged by the advocacy of trade unions and governmental actions, responding to concerns raised by affected workers and other stakeholders (Sauer & Hiete, 2020).

Furthermore, as exemplified by the Responsible Mining Foundation's report, *Closing the Gaps*, the research indicates that national legislation is more effective than voluntary measures, in that

it significantly impacts ESG practices, including anti-corruption, human rights, gender equality, and responsible sourcing (RMF, 2022b).

The research questions are

- Given the historical experience, how can the mining industry adapt to emerging standards?
- Can these standards warrant the highest level of sustainable and responsible mining operations?
- Can these standards respond to the specific needs of regions, environments, local and Indigenous communities, governments, and other stakeholders?
- How can a blueprint be developed for corporations to select the most effective standards tailored to their necessities?

1.8 Original Contribution

With the increasing demand for metals and minerals, the topic of sustainability in mining has become top-of-mind for different stakeholders, from investors and producers to communities and consumers. This thesis includes a comprehensive review of volunteer multi-stakeholder initiatives (MSIs) that developed different standards and guidelines in their efforts to define responsibility and sustainability in the mining industry. MSI-based initiatives are considered a social innovation by integrating several groups of stakeholders, such as communities, non-governmental organizations (NGOs), investors, suppliers, producers, etc.

The original contribution of this thesis is a proposed approach to consolidating different criteria into one comprehensive set of frameworks. The thesis also explores various alternatives for consolidating these standards and discusses how they inform legislative frameworks aimed at a more sustainable future in the mining industry. Additionally, this thesis seeks to provide a tool that assists companies in selecting appropriate standards that fit their operations.

1.9 Thesis Organization

The aim of this research is to analyze emerging sustainability and responsible mining standards, compare different guidelines, and understand their limitations. With an industry-focused survey, the goal is to assess the perceptions and priorities of mining industry professionals regarding sustainability criteria and the role of organizations in promoting sustainability through standards and guidelines. Finally, I will conclude the thesis by proposing a possible path forward in the effort to consolidate and standardize guidelines in mining.

Chapter 2: Literature Review – Discusses the recent developments in efforts by various organizations promoting sustainable and responsible mining practices.

Chapter 3: Standards and Guidelines – Builds upon the organizational structure identified in Chapter 2; covers the strengths and weaknesses of select representative organizations and undertakes an evaluative analysis of these organizations.

Chapter 4: Sustainability Criteria Analysis – Reviews different criteria proposed by the organizations in Chapter 3 and defines a comprehensive set of criteria that covers sustainability and responsibility requirements. The chapter also contains the industry survey results to back up the proposed sustainability criteria.

Chapter 5: Deep Dive into ICMM – Covers the details of the ICMM organization, including their mission, board composition, objectives, and impact on the mining industry.

Chapter 6: Deep Dive into TSM – Covers the details of the TSM organization, including their mission, board composition, objectives, and impact on the mining industry.

Chapter 7: Deep Dive into IRMA – Covers the details of the IRMA organization, including their mission, board composition, objectives, and impact on the mining industry.

Chapter 8: Conclusions, Recommendations, and Future Work – Summarizes the results of the analysis in relation to the problem statement, discusses options for consolidating the sustainability standards, and proposes future work.

2. Literature Review

2.1 Introduction

"Standards" form a broader category than "laws." Typically, standards develop where regulatory gaps exist—for example, where certain aspects are not specifically regulated by law. A good example can be found in the mining industry with the rise of sustainable and responsible mining industry standards. Typically, laws will set minimum norms, while sustainable and responsible mining industry standards will impose higher standards. Laws are, by definition, imposed by governments, while standards may come from industry or may be multi-stakeholder based. Wickert and Risi (2023) identify three broad reasons for the rise of regulatory gaps, and the consequent introduction of standards: (1) companies, rather than governments, are now frequently fulfilling basic social needs as a consequence of privatization and deregulation; (2) especially in less-developed economies, governments may lack the resources to cater effectively to basic social needs; and (3) governments cannot address social problems beyond national boundaries. To these, Oehl (2024) adds a "per se" regulatory gap specific to the commodity sector: no regulatory framework exists at the global scale. All four of these conditions can be observed in relation to mining projects. The adherence by businesses to voluntary standards thus becomes an important risk mitigation measure under conditions of regulatory gaps and governance failures (Schneider & Scherer, 2012).

When it comes to sustainable and responsible mining industry practices, an excess of standards, principles, indexes, and goals is to be found (Erdmann & Franken, 2022). Historically, most of these standards have had their origins in industry initiatives or are industry-based. See, for instance, the "commodity-based industry standards" and the "multi-sectoral industry standards" in Table 2 below. Other industry standards include the Copper Mark, the Aluminium Stewardship Initiative (ASI), and Responsible Steel. One of the newer developments is the rise of civil society standards and multi-stakeholder standards, such as the International Finance Corporation's Equator Principles and the Initiative for Responsible Mining Assurance's Standard for Responsible Mining.

Efforts have long been underway to harmonize them, although, to date, these have not resulted in the actual merging of any of these initiatives (Franken et al, 2020). One approach that has been proposed is to map mining to the Sustainable Development Goals (SDGs) (CCSI et al, 2016; Watts et al, 2022). There is also a current endeavour to create an "interoperability platform" for voluntary sustainability initiatives, which involves Responsible Steel, the Responsible Jewellery Council (RJC), IRMA, and the Mining Association of Canada (MAC) (Franken et al, 2020).

While there have been occasional attempts to catalogue and/or evaluate the various sustainable and responsible initiatives, parameters have proven unwieldy. Thus Gorman & Dzombak (2018) endeavoured to move the conversation away from the life cycle of mining to that of minerals, while Franken & Schütte (2022) sought to divide initiatives between voluntary and normative measures. Another angle involved the development of a new qualitative index to analyze the CSR/ESG level of mine sites, with a view to involving all potential stakeholders (Bascompta et al, 2022).

Moomen et al (2020) have mapped sustainability initiatives in mining conceptually to (1) social dimensions, (2) environmental dimensions, and (3) governance dimensions. In this paradigm, development objects that promote the SDGs are located in the "governance" sphere.

Insofar as sustainability in the mineral resources field is concerned, Giurco & Cooper (2012) have developed a model that consists of five domains: (1) the *ecological domain*, that represents resources in the natural environment and the ecosystem processes; (2) the *technological domain*, that includes buildings, infrastructure, and technological innovations; (3) the *economic domain*, that involves both financial capital and economic systems; (4) the *social domain,* that unites social and human capital with political considerations; and (5) the *governance domain,* that contains voluntary governance arrangements in addition to legal and regulatory issues.

In the next section, an analysis of various types of standards will be undertaken. Below is a table summarizing the standards that will be discussed.

Table 2: Types of Mining Standards with Examples

TYPE OF STANDARD	EXAMPLES				
Geographically Targeted Standards	AERI The Arctic Environmental Responsibility Index				
Commodity Targeted Industry Standards	Fairmined Standard for Gold Alliance for Responsible Mining (ARM)	RJC Responsible Jewellery Council	The Copper Mark International Copper Association – Copper, molybdenum, nickel, and zinc value chains are targeted	ASI The Aluminium Stewardship Initiative	Responsible Steel Net-zero steel is targeted
Cross-Sectoral Industry Standards	ICMM's Mining Principles The International Council on Mining and Metals	RMAP The Conflict-Free Smelter Program/Responsible Minerals Assurance Process (RMAP)	TSM Towards Sustainable Mining, developed by the Mining Association of Canada (MAC)	CCCMC China Chamber of Commerce of Metals, Minerals and Chemicals Importers & Exporters (CCCMC) – Chinese Due Diligence Guidelines for Responsible Mineral Supply Chains	GMG Global Mining Guidelines Group

TYPE OF STANDARD	EXAMPLES				
Country Standards	OECD The Organization for Economic Cooperation and Development (OECD) Due Diligence Guidance for Responsible Business Supply Chains from Conflict-Affected and High-Risk Areas	NRGI Natural Resource Governance Initiative			
Civil Society Standards	IFC Equator Principles International Finance Corporation	RMI The Responsible Mining Index of the (now defunct) Responsible Mining Foundation (RMF)	SASB Metals & Mining Standard Sustainable Accounting Standards Board		
Multi-Stakeholder Standards	EITI Extractive Industry Transparency Initiative	GRI Mining Sector Standard Global Reporting Initiative – Consolidated Universal Standards	IRMA Standard for Responsible Mining Initiative for Responsible Mining Assurance		

TYPE OF STANDARD	EXAMPLES				
Normative Standards	EU Directives EU Battery Regulation EU Due Diligence Regulation EU Conflict Minerals Regulation	ISO Standards ISO 26000:2010 Guidance on Social Responsibility ISO 14001 for environmental management ISO 45001 for occupational health and safety issues	National Legislation US Dodd-Frank Act (regarding cobalt in the DRC) Modern Slavery Legislation in the UK, Australia, and Canada The French Due Diligence Legislation The German Supply Chain Legislation		

2.2 Geographically Targeted Standards

2.2.1 The Arctic Environmental Responsibility Index (AERI)

The methodological framework of AERI is based on the Segmented String Relative Ranking (SSRR) methodology. This approach involves collecting and analyzing expert opinions on environmental performance of companies in the Arctic. The SSRR method allows for a nuanced and relative comparison of companies based on various environmental criteria. It provides a systematic way to process and interpret expert assessments, enabling a ranking system that reflects the environmental responsibility of companies in the Arctic's oil, gas, and mining sectors. This framework aims to offer a comprehensive and reliable tool for assessing and comparing environmental governance in this sensitive and ecologically significant region (Overland et al, 2021; Bascompta et al, 2022).

2.3 Commodity Targeted Industry Standards

2.3.1 Fairmined Standard for Gold

The Oro Verde Initiative in Colombia was the first regional standard for the certification of sustainable, artisanal gold. It inspired the creation of the Alliance for Responsible Mining (ARM), which had a mandate for the creation of a global standard for the artisanal sector. This resulted in the Fairmined Standard in 2010 (Franken et al, 2020). The Fairmined Standard targets the certification of artisanal and small-scale mining operations based on environmental and social standards (Franken & Schütte, 2022).

2.3.2 The Responsible Jewellery Council RJC

RJC initiative focuses on assuring human rights and ethical social and environmental practices in the gold and diamond supply chain for industrial manufacturing (Franken & Schütte, 2022).

2.4 Cross-Sectoral Industry Standards

2.4.1 The International Council on Mining and Metals (ICMM)

ICMM's founding in 2001 led to the publication of the first industry standard that addressed negative social and environmental impacts in mining in 2003 (Franken & Schütte, 2022; Bascompta et al, 2022; Franken et al, 2020).

The ICMM Strategy and Action Plan 2022-2024 outlines its strategic priorities and initiatives. It focuses on enhancing sustainable development in the mining and metals industry. The strategy emphasizes environmental resilience, including commitments to net-zero emissions and improved water management. Social performance is another key area, with a focus on human rights, diversity, and community resilience. Governance and transparency are highlighted, advocating for responsible mining practices and the convergence of ESG standards. Innovation for sustainability is also a major theme, emphasizing advancements in tailings management and the circular economy. This plan represents ICMM's commitment to responsible and sustainable mining practices, aiming to drive positive change in the industry (ICMM, 2022).

ICMM's Mining Principles detail 39 Performance Expectations and nine associated Position Statements on a number of core industry challenges. The Performance Expectations are grouped into ten categories:

(1) ethical business;

(2) decision making;

(3) human rights;

(4) risk management;

(5) health and safety;

(6) environmental performance;

(7) conservation of biodiversity;

(8) responsible production;

(9) social performance; and

(10) stakeholder engagement.

The Position Statements deal with (1) nature; (2) diversity, equity, and inclusion; (3) transparency of mineral revenues; (4) climate change; (5) water stewardship; (6) tailings governance; (7) Indigenous peoples and mining; (8) mining partnerships for development; and (9) mercury risk management (ICMM, 2024a).

Importantly, ICMM provides six equivalency benchmarks with the objective of improving ESG practices at the operational level. These include:

- Aluminium Stewardship Initiative (ASI) Performance Standard (ICMM, 2024b);
- Copper Mark (ICMM, 2024c);

- World Gold Council's Responsible Gold Mining Principles (RGMPs) (ICMM, 2024d);
- Responsible Jewellery Council (RJC) Code of Practices (COP) 2019 Standard (ICMM, 2024e);
- Responsible Minerals Initiative (RMI) Risk Readiness Assessment (RRA) (ICMM, 2024f); and
- Towards Sustainable Mining (TSM) (ICMM, 2024g).

In each instance, similarities and differences between the benchmarked standards are pointed out by ICMM.

2.4.2 The Conflict-Free Smelter Program/Responsible Minerals Assurance Process (RMAP)

Initiated by the electronics industry around 2009, the Conflict-Free Smelter Program/Responsible Minerals Assurance Process (RMAP) program focuses on ensuring conflict-free sourcing of minerals, particularly from high-risk areas (Franken & Schütte, 2022). It is aligned with the Organisation for Economic Co-operation and Development (OECD) due diligence guidance (OECD 2016: Erdmann & Franken, 2022).

2.4.3 Towards Sustainable Mining (TSM)

Initiated by the Mining Association of Canada (MAC), TSM focuses on improving the mining industry's environmental and social performance. MAC released the first TSM Standard three years after the founding of ICMM, in 2004 (Franken & Schütte, 2022; Franken et al, 2020). This initiative focuses on a mine site reporting system that includes qualitative analysis. It has a transparent reporting system that analyzes sustainability performance on an annual basis at the hand of protocols that include biodiversity conservation management; climate change; crisis management; Indigenous and community relationships; prevention of child and forced labour; health and safety; tailings management; and water stewardship (Bascompta et al, 2022).

2.5 Country Standards

2.5.1 OECD

The OECD Due Diligence Guidance for Responsible Business Supply Chains from Conflict-Affected and High-Risk Areas (OECD 2016) helps businesses prevent human rights abuses and conflict financing in their supply chains, especially focusing on areas such as conflict minerals (Franken & Schütte, 2022; Erdmann & Franken, 2022). The OECD guidance is an internationally recognized document for good corporate practice. It targets the entire supply chain, addressing both upstream (extraction to smelter) and downstream (smelter to final product) actors (Franken et al, 2020).

2.6 Civil Society Standards

2.6.1 International Finance Corporation (IFC)

The IFC is the World Bank's arm that does private lending for development funding. As such, it sets standards for civil society. Its Equator Principles contain important lending terms that banks impose on resource development companies such as those in the extractive sector.

The Environmental and Social Performance Standards of IFC are used for environmental and social risk management in various sectors. These standards are considered a de-facto international benchmark for managing environmental and social performance, including project-level GHG accounting, in major infrastructure projects, including those in the mining and metals industry (Franken & Schütte, 2022).

2.6.2 Responsible Mining Foundation (RMF)

The now-defunct RMF was a mining-focussed civil society organization that reported annually on the sustainability metrics of the 40 largest mining companies. It had a system to evaluate companies and mine sites by means of the Responsible Mining Index (RMI), which analyzed mine companies according to 44 topics grouped into six thematic areas: (1) economic development; (2) business conduct; (3) lifecycle management; (4) community wellbeing; (5) working conditions; and (6) environmental responsibility. Mine site assessment was done according to 15 indicators: "*local employment, local procurement, air quality, water quality, water quantity, rehabilitation*

and post closure, tailings, safety of communities, community complaints and grievances, safety and health of workers, women workers, workplace deaths and injuries, training of workers, decent living wage, and worker complaints and grievances." (Bascompta et al, 2022).

2.6.3 Sustainability Accounting Standards Board (SASB)

The SASB Metals & Mining Standard presents comprehensive sustainability standards for the metals and mining industry, addressing various environmental, social, and governance (ESG) concerns. These standards aim at guiding the industry towards more responsible and sustainable practices, covering crucial areas such as greenhouse gas emissions, energy and water management, waste and hazardous materials handling, biodiversity conservation, and community relations. The document emphasizes the importance of ethical practices, including respect for human rights and Indigenous communities, labour relations, and anti-corruption measures. Additionally, it gives special attention to the management of tailings storage facilities, highlighting the need for effective governance, risk management, and emergency response planning in this critical area. The standards set forth in this document are designed to foster greater transparency, accountability, and sustainability within the metals and mining sector (SASB, 2021).

2.7 Multi-Stakeholder Standards

The standards discussed so far represent (or predominantly represent) the interests and points of view of a single stakeholder group, as follows in Table 3:

Table 3: Type of Standards and Interests Represented, with Examples

STANDARD TYPE	INTERESTS REPRESENTED	EXAMPLE
Geographically targeted standards	Only have regional application	AERI
Commodity-targeted industry standards	Predominantly industry driven	Responsible Steel
Cross-Sectoral Industry Standards	Predominantly industry driven	ICMM's Mining Principles
Country Standards	Standards for member countries	OECD Due Diligence Guidance for Responsible Business Supply Chains from Conflict-Affected and High-Risk Areas
Civil Society Standards	Standards applicable to non-state contract parties	IFC Equator Principles

True multi-stakeholder standards represent the interests and viewpoints of multiple stakeholders. For instance, the Extractive Industry Transparency Initiative (EITI) Standard was adopted by a range of countries, companies, and civil society organizations (see 2.7.1 below). The Initiative for Responsible Mining Assurance (IRMA) seeks to include the most comprehensive range of stakeholders, counting no fewer than six stakeholder groups among its constituent members (see 2.7.3 below).

2.7.1 Extractive Industry Transparency Initiative (EITI)

In 2003, an assortment of countries, companies, and civil society organizations adopted a Statement of Principles that became the cornerstone of the EITI. The EITI Standard comprises a global standard for good governance of oil, gas, and mineral resources (Franken et al, 2020). The Standard is designed to promote public understanding of natural resource revenue management and foster greater transparency and accountability in extractive sectors (Gorman & Dzombak, 2018). The document includes principles, requirements for implementing countries, and guidelines on multi-stakeholder oversight, legal frameworks, revenue collection, and social and economic spending. It emphasizes the disclosure of payments and revenues in the extractive industries, aiming to inform public debate and guide policymaking for sustainable development (EITI, 2019).

In June 2023, a new version of the EITI Standard was published. The 2023 EITI Standard has introduced several key changes compared to the 2019 version:

(1) Energy Transition Disclosures:

New requirements around disclosures on carbon taxes, pricing mechanisms, greenhouse gas emissions, production costs, reserves, and subsidies have been added. These changes aim to strengthen public understanding of expected revenues, investment decisions, and guide policymakers, citizens, and investors.

(2) Transparency in Transactions:

Enhanced transparency in transactions is the goal, especially in minerals supporting the energy transition, to ensure good governance and sustained supply.

(3) Strengthened Disclosure Requirements:

New and strengthened disclosure requirements focus on areas like gender equity, social and environmental monitoring and impact, artisanal and small-scale mining, and community consultations.

(4) Anti-Corruption Objectives:

Explicit anti-corruption objectives have been integrated, with strengthened disclosures identifying conflicts of interest and participation of politically engaged persons in the extractive sector.

(5) Public Disclosure of Anti-Corruption Policies:

All companies participating in EITI reporting, including state-owned enterprises, are expected to publicly disclose their anti-corruption policies.

These changes reflect a response to the evolving natural resources context, particularly focusing on the energy transition and addressing contemporary challenges and opportunities in resource governance (EITI, 2023).

2.7.2 Global Reporting Initiative (GRI)

The GRI, headquartered in Amsterdam, the Netherlands, is an "independent, international organization that helps businesses and other organizations take responsibility for their impacts, by providing them with the global common language to communicate those impacts" (GRI, 2024a). The updated Consolidated Universal Standards that took effect on January 1, 2023 are not mining-sector specific (GRI, 2024b), but a project is currently underway to develop 40 sectorial standards in priority sequence (GRI, 2024c). The sixth of these is the Mining Sector Standard, of which an exposure draft version has been published for public comment purposes. The text has been retracted while comments are being considered (GRI, 2024d).

2.7.3 Initiative for Responsible Mining Assurance (IRMA)

The Initiative for Responsible Mining Assurance (IRMA) Standard for Responsible Mining incorporates various principles that address aspects such as business integrity, social responsibility, environmental responsibility, and planning for positive legacies. The Standard offers a detailed methodology for mine site assessment, emphasizing rigorous, independent third-party assessments, transparency in audit results, and stakeholder engagement. The IRMA

Standard is a comprehensive tool for evaluating and certifying responsible mining practices, covering a broad range of environmental and social issues (Bascompta et al, 2022).

The Standard specifically outlines critical requirements that any mine site claiming to adhere to good practices must meet. These requirements are grouped into four main principles:

(1) Business Integrity:

Covering compliance with laws, stakeholder engagement, human rights policies, grievance mechanisms, and anti-corruption policies.

(2) Planning and Managing for Positive Legacies:

Including impact assessments, Free Prior and Informed Consent (FPIC) from Indigenous peoples, resettlement and livelihood restoration, emergency response plans, reclamation and closure plans, and financial surety for mine closure.

(3) Social Responsibility:

Emphasizing workers' rights, harassment prevention, grievance mechanisms, child labour prohibition, forced labour prevention, health and safety, community health and safety, conflict-free operations, and security force conduct.

(4) Environmental Responsibility:

Addressing mine waste management, water and air quality management, greenhouse gas emissions reduction, biodiversity and ecosystem services protection, avoidance of World Heritage Sites, compliance with the Cyanide Code, and mercury waste management.

These criteria set a comprehensive standard for responsible mining practices, addressing a wide range of environmental, social, and ethical issues. IRMA remains the standard with the most stringent requirements, despite having introduced "achievement levels with lower ambitions to facilitate uptake" (Erdmann & Franken, 2022).

2.8 Normative Standards

2.8.1 EU Directives

The EU Battery Regulation includes supply chain due diligence procedures for batteries. The EU Conflict Minerals Regulation aims to prevent the use of minerals that finance armed conflict. The EU Due Diligence Regulation targets minerals that are mined using forced labour (Franken & Schütte, 2022; Erdmann & Franken, 2022).

2.8.2 ISO Standards

The ISO 26000:2010 Guidance on Corporate Social Responsibility provides a normative framework by defining responsibilities related to seven core categories of sustainability issues: (1) organizational governance; (2) human rights; (3) labour practices; (4) environment; (5) community involvement and development; (6) fair operating practices; and (7) consumer issues (ISO 2010). It is defined not "by risks for the company itself (such as operational, financial or reputational risk), but rather a more outward-facing approach to risk." (Franken & Schütte, 2022). Of note is the fact that this standard is not mining-sector specific, but rather relates to social responsibility for organizations and businesses in general (ISO, 2010). ISO has published guidelines for combining ISO 26000 with both GRI reporting (ISO, 2014) and International Integrated Reporting (IR) (ISO, 2015)—neither of which is mining-specific. While this standard is not intended for certification purposes, it covers most aspects usually found under the CSR umbrella (Ranängen et al, 2014).

In 2022, social and environmental requirements in relation to compliance with ISO 14001 for environmental management and ISO 45001 for occupational health and safety issues became mandatory for London Metal Exchange (LME) brands (Erdmann & Franken, 2022).

2.8.3 National Legislation

Domestic legislation mostly relates to human rights-related risks, such as the US Dodd-Frank Act (US Congress 2010) and the modern slavery legislation in the UK, Australia, and Canada (Franken & Schütte, 2022). While Dodd-Frank specifically targets artisanal and small-scale mining in the

Democratic Republic of Congo (DRC) (Franken et al, 2020), modern slavery legislation in the latter three countries is not specific to the mining sector (Erdmann & Franken, 2022).

3. Content Analysis of Standards and Guidelines

3.1 Introduction

One goal for standardization efforts is to bring clarity in an area of uncertainty (Brueckner & Eabrasu, 2018). This is especially appropriate in the case of responsible and sustainable mining practices, where, as we have seen, there is a bewildering range of norms in existence, all vying for primacy. For example, with the introduction of the NI-43101, Canada became the first jurisdiction internationally to set such detailed disclosure standards for listed mining companies (Jensen, 1998).

Advancements in responsible and sustainable mining cannot rely solely on individual company endeavors. The role of those who have influence, whether directly or indirectly, over corporate practices is pivotal in driving transformation. This influential group encompasses industry associations, multi-stakeholder organizations, voluntary reporting framework initiatives, as well as investors, lenders, and customers engaged with mining entities and operations.

In this thesis, our focus is on standards that encompass multi-site, multi-commodity, and international mining operations, offering comprehensive guidelines. The following section will expand on standards first identified in Chapter 2, providing an overview of the strengths and weaknesses of a select list of industry and multi-stakeholder association standards that have engaged on the topic of ESG to date.

3.2 Strengths and Weaknesses of a Selection of Standards

3.2.1 Cross-Sectoral Industry Standards

3.2.1.1 The International Council on Mining and Metals (ICMM)

ICMM is an international organization dedicated to improving the social and environmental performance of the mining and metals industry. It brings together 28 mining and metals companies as well as over 35 national and regional mining associations to collaboratively work on issues like climate change, human rights, and the role of mining in society. Its main initiatives include setting guiding principles and performance expectations for member companies,

providing resources and best practice guidance, and fostering multi-stakeholder dialogue on sustainable development challenges (ICMM, 2023b).

(1) Strengths:

ICMM's member companies represent a significant portion of the global mining industry, making its potential impact significant. The organization's focus on both high-level principles and specific performance expectations provides a clear yet flexible framework for sustainability. ICMM's commitment to stakeholder engagement and transparency, including public reporting and independent assurance, enhances its credibility.

(2) Weaknesses:

ICMM is an industry-led organisation, which can lead to concerns about impartiality and effectiveness. Compliance with ICMM principles is based on self-assessment by member companies, which may not always be rigorous or accurate. The organization's efforts can be hindered by differing national regulations and enforcement practices around the world.

3.2.1.2 Towards Sustainable Mining (TSM)

TSM is an initiative established by the Mining Association of Canada (MAC). It aims to improve the mining sector's performance by aligning its actions with the priorities and values of society. The TSM's main work revolves around setting performance indicators and protocols that guide member companies in areas like tailings management, biodiversity conservation, community outreach, and energy use and greenhouse gas emissions reduction (MAC, 2023b).

(1) Strengths:

TSM is based on a solid framework of indicators and protocols, making it a practical tool for mining companies to improve their sustainability performance. It has a strong focus on transparency and accountability, with member companies expected to report their performance data annually, which is then subject to third-party validation. TSM's success in Canada has led to its adoption by

mining associations in several other countries, demonstrating its adaptability and international relevance.

(2) Weaknesses:

Participation in TSM is voluntary, which limits its impact to those companies that choose to participate. Some critics argue that the TSM initiative doesn't go far enough in certain areas, such as Indigenous rights and climate change. As TSM is an industry-led initiative, it could face skepticism from some stakeholders regarding its ability to objectively assess and improve the industry's performance.

3.2.1.3. Global Mining Guidelines Group (GMG)

GMG is a network of mining companies, suppliers, and experts that collaboratively develops guidelines and best practices for the mining industry. GMG focuses on technological innovation, safety, and sustainability in mining (GMG, n.d.).

(1) Strengths:

GMG's primary strength lies in its ability to bring together diverse stakeholders within the mining industry to collaborate on technological innovation, safety, and sustainability. GMG develops practical guidelines that can be readily implemented by mining companies, addressing key industry challenges. GMG places a strong emphasis on technological innovation, which is critical for improving mining practices and sustainability.

(2) Weaknesses:

GMG's focus on technology and innovation may not comprehensively address all sustainability issues associated with mining, such as social and environmental impacts. Since GMG is an industry-led organization, external stakeholders may question GMG's ability to objectively assess and address sustainability challenges. Adoption of GMG guidelines by mining companies is voluntary, which can lead to inconsistent implementation and limited impact if not widely embraced.

3.2.2 Country Standards

3.2.2.1. Natural Resource Governance Institute (NRGI)

NRGI is a non-profit organization dedicated to promoting good governance and responsible management of natural resources, including minerals and mining. NRGI provides policy advice, conducts research, and offers capacity-building programs to help countries manage their mineral resources sustainably (NRGI, n.d.).

(1) Strengths:

NRGI's strength lies in its expertise and capacity-building efforts. It provides valuable guidance to governments and civil society organizations on managing mineral resources effectively. NRGI conducts independent research, which can lead to evidence-based policy recommendations. This independence enhances its credibility. NRGI advocates for reforms in resource-rich countries to improve transparency, accountability, and governance, which can have long-term positive impacts on mining practices.

(2) Weaknesses:

NRGI's impact may be more indirect, as it primarily works through influencing policies and practices at the country level. This could result in slower progress and limited control over outcomes. As a non-profit organization, NRGI has finite resources, potentially limiting the number of countries it can assist and the scale of its interventions. NRGI's effectiveness depends on the willingness of governments to adopt its recommendations, which can vary significantly from one country to another.

3.2.3 Civil Society Standards

3.2.3.1 Sustainability Accounting Standards Board (SASB)

SASB is an organization that develops industry-specific sustainability accounting standards for publicly traded companies. While not specific to mining, SASB standards can be applied to the mining industry to assess and report on sustainability performance (SASB, n.d.).

(1) Strengths:

SASB's strength lies in its development of industry-specific sustainability standards, which can provide a tailored framework for assessing and reporting sustainability performance in the mining sector. SASB standards are designed to meet the needs of investors, making them particularly relevant for publicly traded mining companies seeking to attract responsible investors. SASB standards can be integrated into financial reporting, facilitating a holistic view of a company's financial and sustainability performance.

(2) Weaknesses:

SASB standards are not specific to the mining industry, which means they may not cover all unique challenges and issues faced by mining companies. Adoption of SASB standards is voluntary for companies, which may result in inconsistent reporting and limited comparability between companies. SASB standards lack a formal enforcement mechanism, which may limit their effectiveness in driving meaningful change in the mining sector.

3.2.4 Multi-Stakeholder Standards

3.2.4.1 Extractive Industries Transparency Initiative (EITI)

EITI is a global initiative that promotes transparency and accountability in the extractive industries, including mining. It focuses on ensuring that revenues generated from mining activities are properly disclosed, managed, and used for the benefit of the public. EITI's main work involves establishing reporting standards and guidelines for companies and governments to disclose payments and revenues related to mining activities (EITI, n.d.).

(1) Strengths:

EITI's primary strength lies in its emphasis on financial transparency. By requiring companies and governments to disclose financial information related to mining, it helps prevent corruption and ensure that mining revenues benefit local communities. EITI is a widely recognized and global initiative, with many countries and mining companies participating. This broad reach enhances its potential impact and fosters international cooperation. EITI involves various stakeholders,

including governments, mining companies, civil society organizations, and investors, in its decision-making processes, promoting a balanced and inclusive approach.

(2) Weaknesses:

EITI primarily focuses on financial transparency and revenue disclosure. While important, it may not address the full spectrum of social and environmental challenges associated with mining. EITI participation is voluntary for countries and companies, which may limit its effectiveness and coverage. Non-participation by key mining players could undermine its impact. EITI's core focus is on revenue transparency, which might not fully address other critical sustainability issues such as environmental impact and community welfare.

3.2.4.2 Global Reporting Initiative (GRI)

GRI is an international organization that develops sustainability reporting standards and guidelines. These standards can be used by mining companies to report on their sustainability performance and impacts (GRI, n.d.).

(1) Strengths:

GRI standards provide a comprehensive framework for reporting on various sustainability aspects, including social, environmental, and economic impacts, making them suitable for mining companies. GRI is widely recognized and used by companies worldwide, enhancing the comparability and transparency of sustainability reporting. GRI encourages stakeholder engagement in the reporting process, fostering transparency and accountability.

(2) Weaknesses:

GRI standards are generic and not specific to the mining industry, which may result in some mining-related issues being inadequately addressed. While widely adopted, GRI reporting is completely voluntary, which can lead to inconsistent reporting practices and limited enforcement (Dennis et al, 2015). GRI reporting can be complex and resource-intensive, which may deter smaller mining companies from full compliance and reporting.

3.2.4.3 Initiative for Responsible Mining Assurance (IRMA)

IRMA is a collaborative initiative focused on establishing best practice standards that improve social and environmental performance for mining. Its main work has been the development of the "Standard for Responsible Mining," which is a comprehensive definition of what constitutes responsible mining. The Standard covers a broad range of issues such as business integrity, planning and managing for positive legacies, working conditions, human rights, environmental impact, and more (IRMA, n.d. a).

(1) Strengths:

IRMA's Standard for Responsible Mining is among the most comprehensive and detailed available. The organization is a multi-stakeholder initiative, providing a platform for cooperation and dialogue between various interested parties, including mining companies, labour organizations, non-governmental organizations, impacted communities, and others. Its system of third-party auditing provides an additional layer of trust and accountability.

(2) Weaknesses:

As a relatively young initiative (launched in 2014), it may struggle with recognition and uptake in the global mining industry compared to more established programs. The comprehensiveness of its standard can be a double-edged sword, as some mining operations might find it overly complex or challenging to implement.

3.3 Evaluative Analysis

3.3.1 Cross-Sectoral Industry Standards

3.3.1.1 The International Council on Mining and Metals (ICMM)

ICMM's representation of a significant portion of the global mining industry and its focus on sustainability make it influential. However, being industry-led and relying on self-assessment by member companies may compromise its impartiality and rigor. Its policies and practices have been criticized for being "aspirational," with examples abounding of ICMM members who have "fallen short of aspired policies" (MacInnes et al, 2017).

3.3.1.2 Towards Sustainable Mining (TSM)

TSM has a successful track record in Canada and places a strong emphasis on transparency and accountability. Nevertheless, its voluntary participation and potential shortcomings in addressing Indigenous rights and climate change raise concerns about its overall impact.

3.3.1.3. Global Mining Guidelines Group (GMG)

GMG excels in fostering technological innovation and safety but may not comprehensively address all sustainability aspects. Being industry-led can raise questions about objectivity, and voluntary adoption may result in inconsistent implementation.

3.3.2 Country Standards

3.3.2.1. Natural Resource Governance Institute (NRGI)

NRGI offers valuable policy advice and advocates for reforms but primarily influences policies at the country level, leading to indirect impact. Its effectiveness depends on government willingness to adopt recommendations, and finite resources may restrict its reach.

3.3.3 Civil Society Standards

3.3.3.1 Sustainability Accounting Standards Board (SASB)

SASB's industry-specific standards cater to investor relevance but lack mining-specificity, rely on voluntary adoption, and lack a formal enforcement mechanism, potentially limiting their impact.

3.3.4 Multi-Stakeholder Standards

3.3.4.1 Extractive Industries Transparency Initiative (EITI)

EITI's strength lies in its emphasis on financial transparency, preventing corruption, and benefiting local communities. Yet, it primarily focuses on financial aspects and may not fully address other sustainability concerns. Voluntary participation and the risk of non-participation by key mining players may limit its effectiveness.

3.3.4.2 Global Reporting Initiative (GRI)

GRI offers a comprehensive framework for sustainability reporting that affords wide recognition. However, it is not mining-specific, it relies on voluntary reporting, and it can be complex and resource-intensive, potentially discouraging smaller mining companies from full compliance. Not all GRI-reporting is verified externally, raising the spectre of greenwashing (Jarvie-Eggart, 2015a).

3.3.4.3 Initiative for Responsible Mining Assurance (IRMA)

IRMA is known for its comprehensive standards and multi-stakeholder approach, promoting transparency and accountability in the mining industry. However, its relatively young age may hinder global recognition, and the comprehensiveness of its standards could pose challenges for some mining operations. Still, MacInnes et al (2017) evaluate the IRMA standard as being "the most promising of extractive industry multi-stakeholder initiatives involving indigenous peoples" and argue that it makes more sense to create high standards and then independently verify if companies can meet them.

4. Analysis of Sustainability Criteria

4.1 Introduction

In this section, we delve into various sustainability criteria and explore how they are perceived by diverse stakeholders within the mining industry. Through a comprehensive literature study and an analysis of existing standards, the criteria listed below have been meticulously selected. The selection process follows a mutually exclusive and collectively exhaustive approach, ensuring coverage of all stakeholders throughout the mining lifecycle, from exploration to exploitation and from mine to customer.

The chosen sustainability criteria are characterized by their mutually exclusive nature, signifying that they are distinctly separate and do not overlap. Conversely, these criteria are also collectively exhaustive, embodying an all-encompassing set of ideas that includes every conceivable option within the context of sustainable mining practices.

By adopting this rigorous approach to criterion selection, we aim to establish a robust framework that addresses the diverse concerns of stakeholders at every stage of the mining process. This framework reflects a commitment to inclusivity, providing a comprehensive foundation for the evaluation and enhancement of sustainable mining practices.

A. Economic growth
    a. Financial
    b. Taxes
    c. Procurement
    d. Sales
    e. Royalties
B. Climate change
    a. Mitigation
    b. Adaptation
    c. Resiliency

    d. Decarbonization

C. Environment stewardship
    a. Air
    b. Water
    c. Soil
    d. Land
    e. Biodiversity
    f. Deforestation
    g. Reclamation, remediation, and restoration

D. Indigenous rights & community wellbeing
    a. Indigenous rights
    b. Social acceptance
    c. Community engagement
    d. Impact-benefit agreements
    e. Cultural heritage and values
    f. Water rights and share
    g. Local development

E. Business conduct
    a. Transparency
    b. Accountability
    c. Anti-corruption
    d. Integrity
    e. Ethics

F. Rights of workers
    a. Slavery
    b. Working conditions
    c. Child labour
    d. Living conditions

G. Equity, Diversity, & Inclusion

    a. Fairness
    b. Equitable
    c. Gender issues

H. Security of supply
    a. Traceability

I. Health and safety
    a. Emergency management
    b. Employee certification
    c. Training
    d. Mine inspection
    e. Accident prevention

4.2 Survey

As an integral component of this thesis research, a survey was conducted to assess the perceptions and priorities of mining industry professionals regarding sustainability criteria and the role of organizations in promoting sustainability through standards and guidelines. The survey was aligned with the focus of this thesis which is to discuss the necessity of standardizing diverse guidelines and explore the pivotal role that governments can play in streamlining these standards for sustainable mining practices.

The survey engaged a diverse cohort of 81 participants from around the globe, representing various roles within the mining industry. Conducted online through Google Docs, the survey was completed during the months of November and December 2023. Participants were asked to rank pre-selected sustainability criteria, offering insights into their industry of work, job positions, years of experience, and geographical locations. The survey details are provided in the Appendix.

Participants were presented with eight pre-selected sustainability criteria, detailed in Section 4.1 of the thesis. Their task involved ranking these criteria based on the perceived importance assigned by industry professionals to each criterion.

In addition to sustainability criteria assessment, participants provided valuable demographic information. This included details about their industry of work, job positions within their respective sectors, years of professional experience, and their geographical locations. This comprehensive data helps contextualize the survey findings within the diverse landscape of the global mining industry.

A crucial aspect of the survey was gauging participants' familiarity with organizations reviewed in Section 3.2. Participants were asked to express their level of familiarity with these organizations on a scale ranging from 1 (No knowledge at all) to 5 (Very familiar). Particularly, commodity-specific organizations such as Copper Mark and Aluminium Stewardship Initiative were excluded from this assessment due to the overarching emphasis on standardizing guidelines across the entire mining industry.

The survey also contained a few open-ended questions, designed to capture the perspectives of industry professionals. Participants were encouraged to share their views on the challenges governments face in legislating sustainable mining practices. Furthermore, insights into the governance challenges associated with commodity-specific standards were solicited. This qualitative data aims to enrich the analysis by incorporating the firsthand experiences and viewpoints of professionals within the mining sector.

The subsequent analysis of this data will further refine our understanding and inform the recommendations for effective governance and standardization in the mining sector.

4.3 Survey Results and Analysis

Of the participants, 75% were directly associated with mining and mineral processing activities, categorizing themselves within the Mining or Mining Services sectors. The Mining sector comprised professionals employed by mining or mineral processing companies, while the Mining Services sector encompassed consultants and other professionals offering services to such companies. Additionally, 19% of participants opted for "Other," specifying job roles such as

lawyer, consultant, and executive. Lastly, 6% were affiliated with Academia, including students and professors (Table 4).

Table 4: Population's Distribution

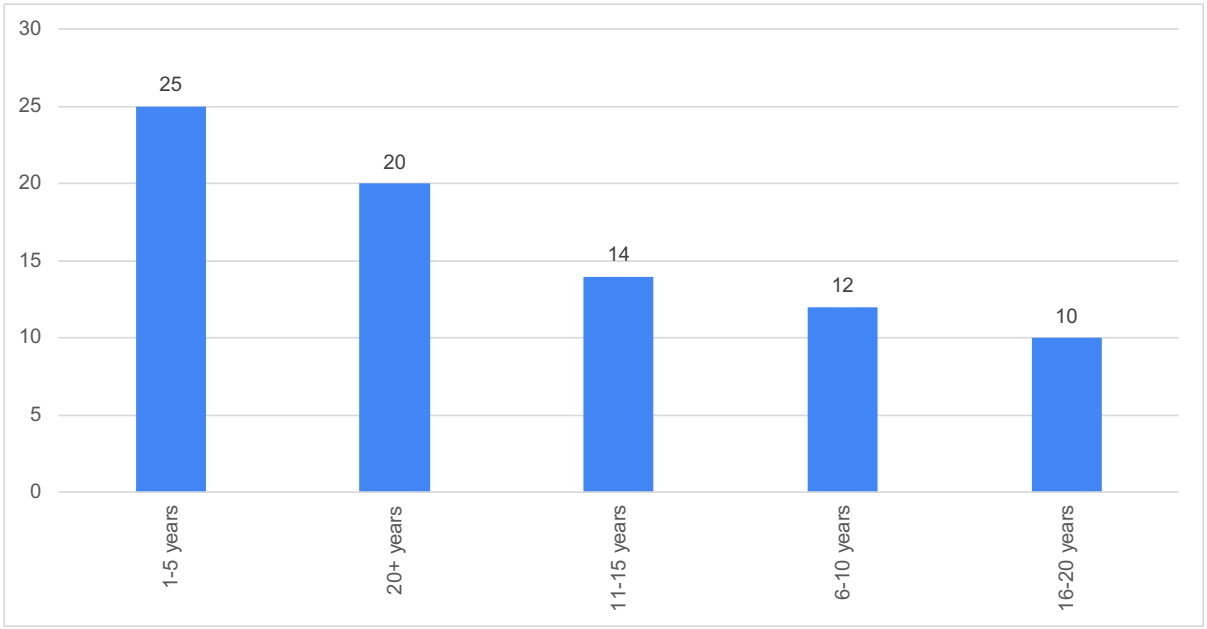
Sector	Count	Rate
Mining	31	38%
Mining Services	30	37%
Other	15	19%
Academia	5	6%

Most participants were situated in Canada and the United States, while a smaller number participated to the survey from Australia, South America, and Asia. The uneven distribution across regions underscores the importance of considering this factor in both the analysis and recommendations, especially given the substantial mining activities prevalent in these areas (Table 5).

Table 5: Population's Geographical Distribution

Region	Count	Rate
North America	59	73%
Africa	12	15%
South America	5	6%
Australia	2	2%
Europe	2	2%
Middle East	1	1%

A total of 25 participants out of 81 (30%) reported having between 1 and 5 years of experience in their respective fields. Conversely, 10 participants (12%) possessed over 15 years of professional experience. The outcomes indicate a successful coverage of workforce experience profiling, effectively capturing the perspectives of individuals across various age groups (Graph 1).



Graph 1: Population distribution / Field Experience

Among the 8 sustainability criteria evaluated against each other, Economic Growth (financial incentives) received the highest number of points, with Rights of Workers (human conditions) and Business Conduct (ethics and integrity) following closely behind.

Conversely, Security of Supply emerged as the least prioritized criterion when compared with others. It's noteworthy that Security of Supply, ironically, serves as the primary incentive behind the Critical Minerals initiative launched by North American governments (Table 6).

Table 6: Areas Global Importance Ranking

#	Sustainability Criteria	Priorities
1	Economic growth	1 – the most important
2	Rights of workers	2
3	Business conduct	3
4	Indigenous rights & community wellbeing	4
5	Diversity & Inclusion	5
6	Climate change adaptation & resiliency	6
7	Environment stewardship	7
8	Security of Supply	8 – the least important

Further analysis of the prioritization of sustainability criteria by different sectors provides additional insights (Table 7).

Table 7: Ranking of Importance per Sector, on a scale of 1 to 8, 1 being the most important

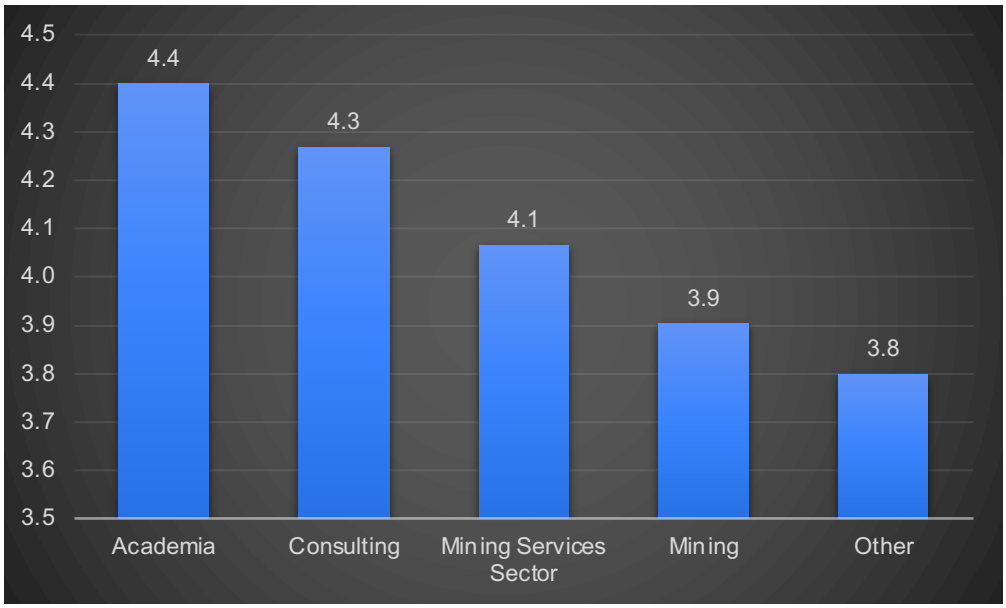
Sector / Area	Economic growth	Climate change	Environment stewardship	Community wellbeing	Business conduct	Rights of workers	Diversity & Inclusion	Security of supply
Academia	3	8	7	2	1	3	5	5
Mining	1	5	7	6	3	2	4	8
Other	6	8	3	7	3	1	2	3
Mining Services	1	2	5	4	2	6	8	7

It is important to note in Table 7 that participants from Mining and Mining Services ranked Economic Growth as the their top priority among eight criteria. This highlights the concerns from the industry professionals about the financial survival and competitiveness of the industry.

The participants were asked if they are supportive toward the government enacting legislation around sustainable mining. The scale was between 1 and 5, with 5 denoting the highest level of support).

The analysis revealed that the Academia and Mining Services sectors exhibited the highest support, while the Mining and Other sectors demonstrated comparatively lower levels of support (Graph 2).

The reasons why mining professionals showed the lowest support for the legislation of sustainability standards across the mining industry likely stem from the industry's reluctance due to the additional financial and operational challenges such legislation would create. The author's observation is that starting a mine—from overcoming technical and financial difficulties to securing the right conditions to exploit resources, obtaining permits, and engaging with communities—is already highly challenging in Canada. The addition of sustainability legislation would increase competitiveness risks in the sector, especially if such regulations are not adopted by all mining nations. Finally, uncertainty over regulatory stability and frequent policy changes could further decrease investment in an industry that is already capital-starved.



Graph 2: Average level of Support / Sector on a scale of 1 to 5

Participants were asked to name some of the challenges that the industry may face if the governments standardize and legislate sustainable mining practices. Based on the answers received, 4 main challenges were identified:

(1) Financial Challenges:

Participants voiced concerns about financial challenges, with one noting, “Flexibility for non-adopting countries is a worry, as economic dimensions might overshadow socio-environmental aspects.” Others highlighted specific issues such as “concerns about profitability, foreign investment, and competitiveness,” and expressed fears of “industry inertia, economic risks, and resistance to change.” Additionally, participants brought attention to the influence of “cost-cutting lobby groups and potential economic impacts,” including worries about “unattainable timelines and efficiency concerns.”

Naturally, the question arises as to how regulatory authorities (i.e., governments) can help alleviate the financial concerns of the mining sector, ensuring that the industry does not perceive itself as the sole bearer of the financial burden of implementing more sustainable policies. At the end of this paper, we will explore several alternatives for how governments and regulatory bodies can support the industry's transition toward sustainability.

(2) Regulatory and Legislative Issues:

In the realm of regulatory and legislative concerns, participants mentioned challenges such as “enforcement and combating lobbying.” Another participant remarked on the “inconsistency in legislation criteria, measurement, and implementation,” while others highlighted obstacles like “bureaucracy, red tape, and lack of integrated regulations.” There was a collective emphasis on the importance of “holding mining companies accountable,” along with a call for “comprehensive legal frameworks and human rights considerations.”

(3) Lack of Generally Accepted Global Standards:

Participants articulated concerns about the lack of generally accepted global standards. One participant observed, “There are too many different standards and criteria,” while others called

for a “standardized, worldwide implementation.” Challenges in “achieving consensus on legislated standards” were acknowledged, with participants pointing to factors like “transnational interests, supply chain implications, and competing interests.” The need for improved “integration between global business needs and policy decisions” was also emphasized.

(4) Stakeholder and Community Engagement Challenges:

Stakeholder and community engagement emerged as a significant concern, with participants noting challenges such as “the lack of support from the general public.” They stressed the importance of “input from First Nations and community governance” and recognized the complexities of “involving multiple stakeholders and diverse communities.” Balancing “local, regional, and national interests” was seen as a challenge, with participants acknowledging the “perception of elongating development timelines” and the necessity for “public education” to foster understanding and support for sustainable mining practices.

Participants were asked to compare Industry and multistakeholder associations, as introduced in Section 3.2.

The participants were asked to rate their knowledge of each organization. Based on the results, a majority of the participants were familiar with ICMM and TSM (Table 8).

Table 8: List of Organizations to be Ranked

Organization	Rate / Max Points
International Council on Mining and Metals (ICMM)	1
Towards Sustainable Mining (TSM)	2
Extractive Industries Transparency Initiative (EITI)	3
Global Reporting Initiative (GRI)	4
Initiative for Responsible Mining Assurance (IRMA)	5

5. Deep Dive into ICMM

5.1 ICMM's Scope and Board Composition

The International Council of Mining and Metals (ICMM) was established in 2001 to improve sustainable development performance in the mining and metals industry. It brings together 23 of the largest global miners in collaboration with 35 national and regional mining and global commodity associations. In addition to mining companies, the ICMM also has mining and minerals associations as members (Czoschke, 2015).

ICMM emerged out of a multi-stakeholder research initiative–the Mining, Minerals, and Sustainable Development (MMSD) project–which examined the role of mining in a sustainable future. From the research, ICMM emerged as a leadership-led association. ICMM currently engages with a broad range of stakeholders–governments, international organizations, mining communities, academicians and Indigenous people.

The ICMM has created a Sustainable Development Framework (SDF), centered on its "10 Principles for Sustainable Development," which all members are required to adopt and integrate into their business operations. To reinforce these principles, the ICMM has released position statements detailing member commitments on various issues, including climate change, development partnerships, transparency in mineral reporting, mercury risk management, Indigenous peoples, and protected areas. Additionally, the ICMM has established work programs focused on social and economic development, climate change and the environment, health and safety, and materials stewardship. To assist members in addressing these issues, the ICMM has published position statements and developed toolkits. Members must also adhere to the Global Reporting Initiative's guidelines for reporting their social, economic, and environmental impacts and obtain third-party assurance for their sustainability reporting (Czoschke, 2015).

ICMM's vision is to serve as an agent for change and continual improvement on issues relating to mining and sustainable development. Member companies have made a public commitment to improve their sustainability performance and are required to report against their progress on an annual basis. Figure 5 shows ICMM's vision, strategy, and purpose.

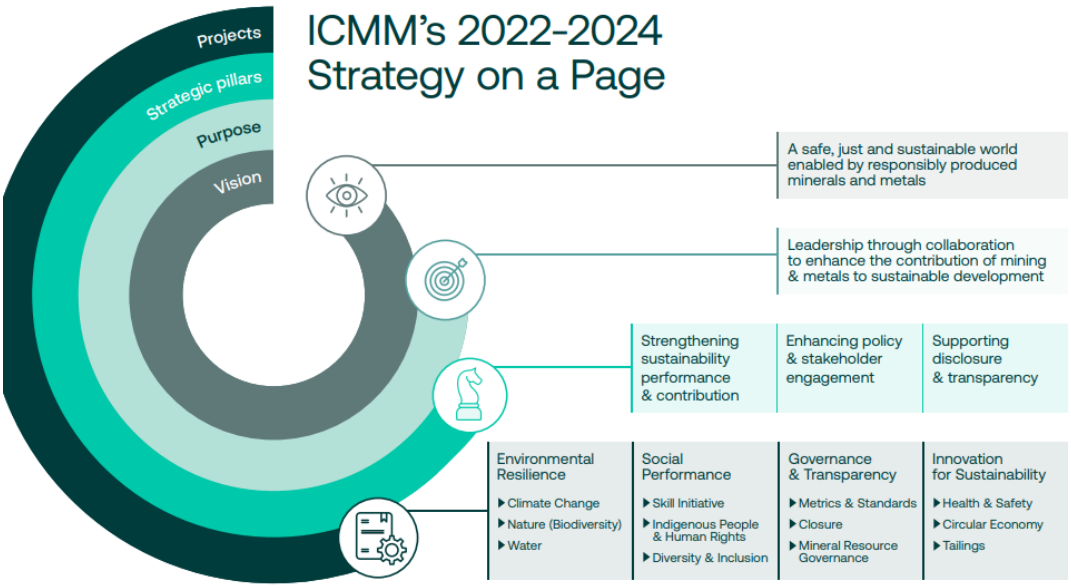


Figure 5: ICMM's vision, strategy, and purpose, 2022 – 2024 (Source: ICMM, 2022.)

The ICMM is composed of corporate members and associations. It unites members of 23 international mining companies such as Freeport McMoRan, Rio Tinto, Newmont, and Codelco, among others. In addition to mining companies, the ICMM has more than 30 member associations, including Minerals Council of Australia, the Mining Association of Canada, and the National Mining Association (in the United States) (ICMM, 2023a).

The ICMM is governed by a council composed of the CEOs of all member companies. The council meets twice each year and formulates policy, determines priorities, and sets the strategic direction of the ICMM (Figure 6).

Figure 6: ICMM membership (ICMM, 2023a)

Sharing the objectives of improving environmental, social, and governance practices at the operational level, different benchmarking agencies also work closely with the ICMM (ICMM, 2024a). These agencies include:

- Aluminium Stewardship Initiative (ASI)
- The Copper Mark
- World Gold Council's Responsible Gold Mining Principles
- Responsible Jewellery Council Code of Practices
- Responsible Minerals Initiative Risk Readiness Assessment
- Towards Sustainable Mining

5.2 ICMM's Principals and Standards for Sustainable Development

ICMM's Mining Principles outline the best practice requirements for ESG standards that its member companies must follow. Implementing these principles will help advance the global targets set by the UN Sustainable Development Goals and the Paris Agreement on climate change. By incorporating thorough site-level validation of performance expectations and ensuring credible assurance of corporate sustainability reports, ICMM's Mining Principles aim to maximize the industry's benefits to host communities while minimizing negative impacts and effectively managing societal concerns.

The 10 Principles for Sustainable Development and corresponding objectives are described as follows (ICMM 2013c):

- **Principle 1:** Implement and maintain ethical business practices and sound systems of corporate governance.
- **Principle 2:** Integrate sustainable development considerations within the corporate decision-making process.
- **Principle 3:** Uphold fundamental human rights and respect cultures, customs, and values in dealings with employees and others who are affected by our activities.
- **Principle 4:** Implement risk management strategies based on valid data and sound science.
- **Principle 5:** Seek continual improvement of our health and safety performance.
- **Principle 6:** Seek continual improvement of our environmental performance.
- **Principle 7:** Contribute to the conservation of biodiversity and integrated approaches to land-use planning.
- **Principle 8:** Facilitate and encourage responsible product design, use, re-use, recycling, and disposal.

- **Principle 9:** Contribute to the social, economic, and institutional development in the communities in which we operate.

- **Principle 10:** Implement effective and transparent engagement, communication, and independently verified reporting requirements with our stakeholders.

5.3 Performance and Assessment

In 2018, ICMM developed a comprehensive set of performance expectations (PE) for members to manage a broad range of sustainability issues, especially at the operational level. Assets subjected to PE validation include operations involved in the production or refining of minerals and metals over which the company exercises controls.

PE validation consists of the following elements (ICMM, 2023d):

- Self-assessment of all assets (member assets)
    - Company members are required to complete a self-assessment once every three years.
- Prioritisation of assets for third-party validation
    - The outcomes of PE validation are categorized as Meets, Partially Meets, and Does not Meet.
- Third-party validation
    - Conducted by qualified validation service providers (VSPs). VSPs are industry, technical, and subject matter experts, as well as consultants.
- Disclosure
    - Members are required to disclose, publicly, their PE validation activities on an annual basis and publish the information on relevant company member websites.

Mining companies are regularly judged on their ESG ratings based on the ten principles below (ICMM, 2023e; ICMM, 2024a):

- Ethical business
    - Apply ethical business practices and sound systems of corporate governance and transparency to support sustainable development.
- Decision making
    - Integrate sustainable development in company strategy and decision-making processes.
- Human rights
    - Respect human rights and the interests, cultures, customs, and values of workers and communities affected by our activities.
- Risk Management
    - Implement effective risk-management strategies and systems based on sound science and which account for stakeholder perception of risks.
- Health and Safety
    - Pursue continual improvement in physical and psychological health and safety performance with the ultimate goal of zero harm.
- Environmental performance
    - Pursue continual improvement in environmental performance issues, such as water stewardship, energy use, and climate change.
- Conservation of biodiversity
    - Contribute to the conservation of biodiversity and integrated approaches to land-use planning.
- Responsible production
    - Facilitate and support the knowledgebase and systems for responsible design, use, re-use, recycling, and disposal of products containing metals and minerals.
- Social performance
    - Pursue continual improvement in social performance and contribute to the social, economic, and institutional development of host countries and communities.

- Stakeholder Engagement
    - Proactively engage key stakeholders on sustainable development challenges and opportunities in an open and transparent manner. Effectively report and independently verify progress and performance.

6. Deep Dive into TSM

6.1 TSM's Scope and Board Composition

Towards Sustainable Mining (TSM) is a program, established in 2004, that is committed to responsible mining under the advocacy of the Mining Association of Canada (MAC). The primary objective of the program is to enable mining companies to meet society's needs for minerals, metals, and energy products in the most responsible way—socially, economically, and environmentally. At the same time, it provides communities with required information on how mining companies are performing in important areas, including community outreach, tailings management, and biodiversity. Participation in the TSM framework is mandatory for all MAC members for their operations in Canada. MAC encourages, but does not mandate, the implementation of the TSM program at member operations outside of Canada. MAC members include mining and mineral processing companies (Jarvie-Eggart, 2015b).

TSM provides a set of tools and indicators to mining companies that drive performance and ensures critical mining risks are identified and managed responsibly. TSM's protocols focus on three core areas: communities and people, environmental stewardship, and energy efficiency.

Participation in TSM, which drives evidence-based improvements, is helping build credibility within the global mining industry and data (information) is freely shared within the mining associations in other countries that are seeking tools to improve environmental and social performance.

TSM's governance and decision-making processes involve both external and internal members to MAC, ensuring credibility, transparency, accountability, and continual improvement of the program. TSM's governance team is outlined in Table 9.

Table 9: TSM's governance team (Source: MAC, 2021)

MAC Board of Directors	TSM Governance Team	Community of Interest Advisory Panel	TSM Initiative Leaders	Other MAC Committees	Public Comment Periods
Represented by each MAC member	Sub-committee of the MAC board	Independent, multi-disciplinary advisory panel (Indigenous groups / mining communities / NGOs	Mining company representatives (TSM champion)	Technical experts / ad-hoc group (such as MAC tailings working group)	Voice of the public–mining communities

The community of interest (COI) advisory panel is critical in the TSM's implementation and assurance process. Current TSM COI members include aboriginal representative, international development consultant, NGO representing social justice coalitions, Canada's labour representative, and finance investment committee. In addition, supporting the COI members are industry representatives–currently represented by Pan American Silver, Rio Tinto, Ring of Fire Metals, and Cameco (MAC, 2024a).

Outside of Canada, eight other national mining associations have adopted Towards Sustainable Mining (TSM). The eight mining associations include (MAC, 2023c; MAC, 2024b):

- CAEM – Argentinian Chamber of Mining Businesses
- Botswana Chamber of Mines
- IBRAM – Brazilian Mining Institute
- COMP – Chamber of Mines of The Philippines
- FMA – Finnish Mining Association
- Minerals Council of Australia
- Norwegian Mining and Quarrying Industries Association
- Asociación Colombiana de Minería

6.2 TSM's Standards

Community & People

- Indigenous and community relationships

- Crisis management and communications planning
- Health and safety
- Equitable, diverse, and inclusive workplaces
- Prevention of child and forced labour

Environment & Climate Change

- Tailings management
- Water stewardship
- Biodiversity conservation management
- Exploration
- Mine closure
- Climate change (energy efficiency)

(MAC, 2024c).

6.3 Assessments and Certifications

Regarding reporting on various standards, mining operations assign a letter grade to several performance indicators. For each standard, there are specific assessment criteria for grading, answers to frequently asked questions, guidelines for interpreting performance indicators, definitions of key terms, and self-assessment checklists. The performance indicators for all TSM protocols focus on institutional systems and management practices, rather than environmental or social outcomes. High grades indicate that a company has established systems and practices that comply with TSM standards. The TSM program is not intended to monitor the actual outcomes achieved by these systems and practices.

The MAC scoring system ranges from C (the lowest) to AAA (the highest). While each performance indicator has specific guidelines, the general scoring system is as follows (Jarvie-Eggart, 2015b):

- **Level C:** No systems in place; activities are reactive; procedures may exist but are not integrated into policies and management systems.

- **Level B:** Procedures may exist but are undocumented, inconsistent, or do not meet MAC's requirements; systems/processes are planned and in development.
- **Level A:** Systems/processes are developed and implemented according to MAC requirements.
- **Level AA:** Protocol requirements are integrated into management decisions and business functions.
- **Level AAA:** This level signifies excellence and leadership.

Since 2006, TSM has been a condition of membership for MAC members. The overarching goal of TSM is for all mining companies to achieve a Level A or higher, which indicates they are effectively managing their key social and environmental risks, and are adhering to good practices Figure 7 highlights the TSM's assurance framework.

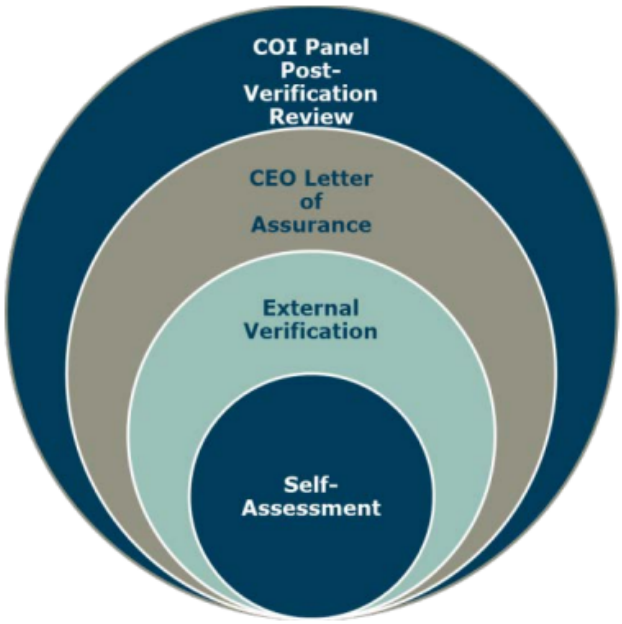


Figure 7: TSM Assurance Framework

Self- Assessment:

- Mining facilities self-assess their performance annually against 30 sustainability performance indicators.
- Based on the self-assessment, a letter grade to each indicator is provided from Level C to Level AAA.
- MAC members are given three years to publicly report their results.

External Verification:

Every three years, a company undergoes a third-party verification process. Once the verification is complete, the mining company CEO is required to submit a letter of assurance stating that the verification was conducted in accordance with the verifier terms of reference and the results are discussed, including training activities.

Dispute Resolution Process:

In the event a member company does not meet the minimum expectations of the TSM program, the following process is enforced (MAC, 2024d; MAC, 2024e).

- **Step 1:** Company initiative leader raises issues with the MAC staff.
- **Step 2:** MAC's president and/or the board chair discusses issues with the company board representative.
- **Step 3:** The issue is brought to the TSM governance team.
- **Step 4:** The issue is brought to the MAC executive committee.
- **Step 5:** The MAC executive committee develops a recommendation for the MAC board of directors.

7. Deep Dive into IRMA

7.1 IRMA's Scope and Board Composition

IRMA's "Standard for Responsible Mining" is the most comprehensive program we've analyzed. It covers various aspects of responsible mining, including social, environmental, and business integrity. Its multi-stakeholder approach—involving mining companies, labour organizations, non-governmental organizations, and impacted communities—fosters cooperation and diverse perspectives. Of the initiatives we've reviewed, we feel IRMA is best positioned to serve as a starting point for government legislation aimed at establishing sustainable and responsible mining standards.

However, as a relatively young initiative launched in 2006, IRMA may still be working on gaining recognition and widespread adoption in the global mining industry compared to more established programs like TSM or EITI.

Also, the comprehensiveness of IRMA's standards can be a double-edged sword. While it covers a wide range of issues, some mining operations might find it overly complex or challenging to implement, potentially leading to slower adoption.

IRMA was formed through collaboration among non-governmental organizations (NGOs), businesses utilizing minerals, organized labour, affected communities, and mining companies. The IRMA Steering Committee's mission was to create an independently verified responsible mining assurance system. This system aims to enhance social and environmental performance while generating value for prominent mine sites.

IRMA's board is composed of 6 houses with two representatives from each house serving on the board, as can be seen from Table 10 below:

Table 10: IRMA's Governance Structure (IRMA, n.d. b)

Mining	Purchasing	NGOs	Organized Labour	Affected Communities	Investors and Finance
Anglo American	Microsoft	Earthworks	IndustriALL Global Union	Mining Affected Communities United in Action	Royal London Asset Management
ArcelorMittal	BMW Group	Human Rights Watch	United Steelworkers	Batani Foundation	NEI Investments

The IRMA Standard is designed to be relevant for various forms of large-scale mining, encompassing surface, sub-surface, and solution mining, involving diverse mined materials except for energy fuels. While there's no specific lower limit on the mine's scale, the IRMA Standard isn't tailored for artisanal or small-scale mining operations. IRMA won't certify oil and gas activities, and further assessment is required before considering the inclusion of thermal coal and uranium (IRMA, 2018).

7.2 IRMA's Standard

The IRMA Standard comprises 4 main pillars (IRMA, 2018):

Business Integrity

- Legal compliance
- Stakeholder engagement
- Stakeholder grievance mechanism
- Human rights due diligence
- Revenue transparency / anti-corruption

Planning for Positive Legacies

- Environmental and social impact assessment and management
- Free, prior, and informed consent
- Community support and benefits
- Resettlement

- Emergency preparedness and response
- Planning and financing reclamation and closure

Social Responsibility

- Labour rights
- Worker health and safety
- Community health and safety
- Conflict-affected areas
- Security arrangements
- Cultural heritage protection
- Artisanal and small-scale mining

Environmental Responsibility

- Water management
- Water (tailings) management
- Air quality
- Greenhouse gas emissions
- Noise management
- Biodiversity, ecosystem services, protected areas
- Cyanide management
- Mercury management

7.3 Assessments and Certifications

IRMA evaluates the performance of individual mine sites through its assurance program. Here are some of the key aspects (IRMA n.d. c):

- Assessments are conducted at the mine site level, not the company level.
- A mining company can commit to enrolling a percentage of its mines in the program or aim to achieve a verified performance level at all its mines and can then make claims based on this commitment and achievement.
- The process begins with a self-assessment, followed by an independent third-party assessment and public reporting of performance.
- Independent audits include a desk review and on-site visits for every mine seeking assessment, along with stakeholder engagement throughout the process.
- The system is not pass/fail. While the IRMA Standard outlines global best practices for mines, it also recognizes and encourages continuous improvement at any level (see IRMA achievement levels below).
- Independent assessment results, including verified IRMA achievement levels, are valid for three years from the finalization of the audit report, after which the assessment cycle restarts.

In terms of IRMA Achievement Levels, all mines entering the IRMA system start with a self-assessment. Recognition is granted only through independent, third-party assessments and the publication of audit results (Figure 8).

There are four achievement levels in the IRMA system (IRMA n.d. c):

- **IRMA Transparency:** Requires mines to be audited by an IRMA-approved audit firm and publicly release their results.
- **IRMA 50, 75, and 100:** These levels reflect progressively higher performance across the four sections of the IRMA Standard (Business Integrity, Planning for Positive Legacies, Social Responsibility, and Environmental Responsibility). At these levels, mines must also meet critical requirements:

- **IRMA 50 and IRMA 75:** Minor non-conformities are allowed if there is a corrective action plan to achieve full conformity within 18 months.
- **IRMA 100:** All critical requirements must be fully met to achieve this level.

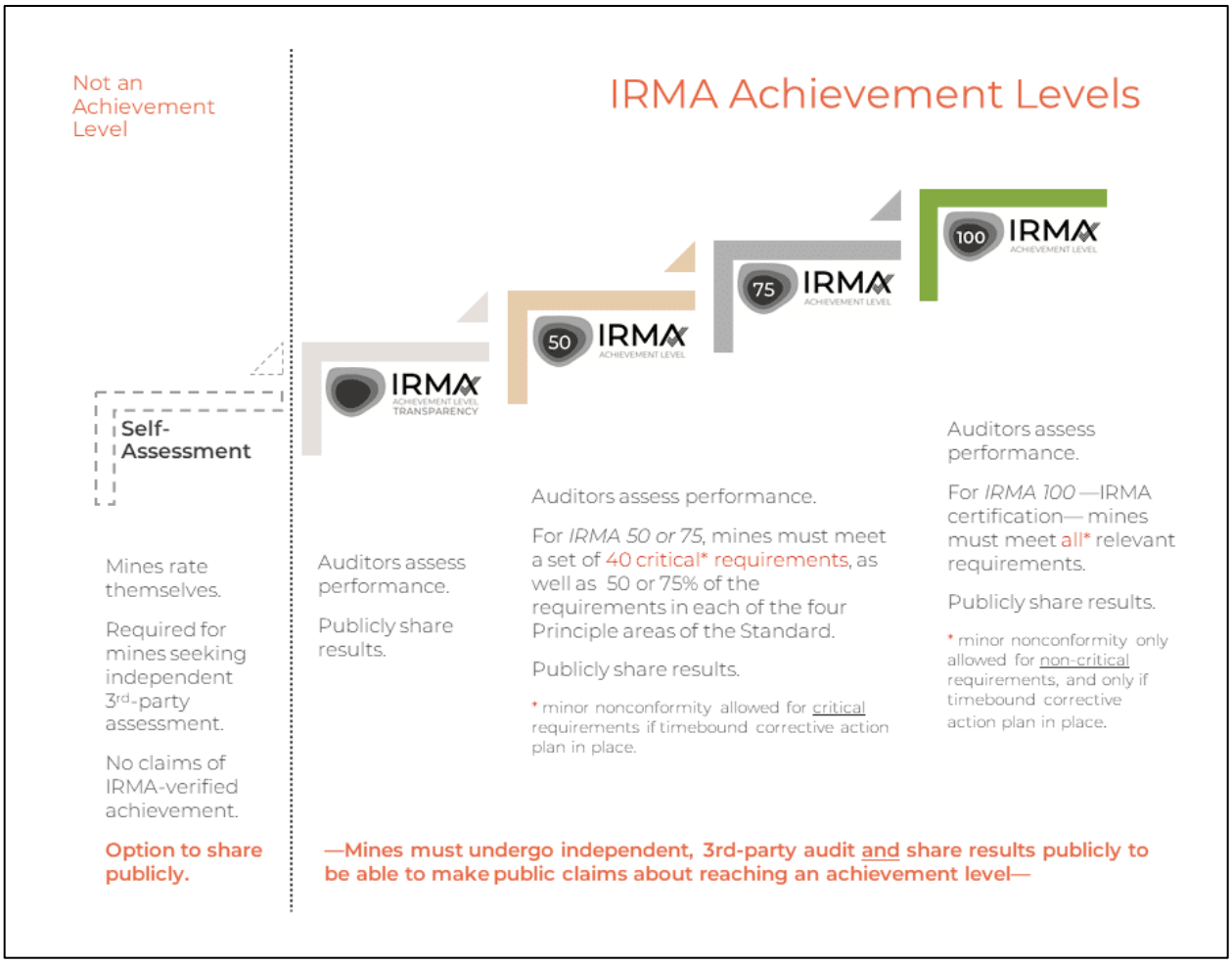


Figure 8: IRMA Achievement Levels (IRMA n.d. c)

8. Conclusions, Recommendations, and Future Work

8.1 Conclusions and Recommendations

The world is witnessing a significant shift in the way we think about the development and use of natural resources. This has given rise to the concept of environmental, social, and governance (ESG) practices, which emphasize responsible and sustainable approaches to business operations.

The mining industry is under intense scrutiny because of its direct impact on the natural environment and our increasing reliance on minerals and metals for renewable technology and agriculture. It is a double-edged sword. Mining is often seen as a "dirty" industry, yet it promises to be an integral part of a more sustainable future.

As part of the industry's efforts to be more transparent, ESG reporting or sustainability reporting are gaining traction. However, due to the absence of standardized data, investors face challenges in accurately evaluating companies' performance based on environmental, social, and governance criteria (Laidlaw, 2020).

The solution proposed involves establishing a shared standard for ESG definitions, potentially requiring policymakers and regulators to enforce mandatory compliance with these standards.

Given the hypothesis that national legislation is more effective in significantly impacting ESG practices, governments should enact and enforce legislation addressing key ESG issues in the mining industry, including anti-corruption, human rights, gender equality, responsible sourcing, and environmental impact. This legislation should align with global policy frameworks like the UN Guiding Principles for responsible mining (Figure 9).

Name	Climate	Sustain-ability	Responsible sourcing	Rights of workers	Fairness and inclusivity	Governance	Security of supply
World Bank Climate Smart Mining Initiative	●	●				●	●
European Battery Alliance							●
European Raw Materials Alliance							●
Extractive Industries Transparency Initiative						●	
Global Battery Alliance	●	●	●				
Energy Resource Governance Initiative		●	●	●		●	
Fair Cobalt Alliance				●	●		
International Council on Mining & Metals	●	●	●	●	●	●	
Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development		●	●	●	●	●	
Initiative for Responsible Mining Assurance	●	●	●	●	●	●	
Towards Sustainable Mining	●	●	●	●	●		
OECD Responsible Business Conduct			●	●	●	●	
Responsible Minerals Initiative			●	●			
Responsible Minerals Foundation	●	●	●	●	●	●	
Women's Rights and Mining			●		●		

Note: Primary activity type: ● = Technical assistance. ● = Industry standardisation. ● = Investment/funding. ● = Research and analysis.

Figure 9: IEA Selected initiatives categorised by activity area (IEA, 2022)

As shown in Figure 9, the International Energy Agency (IEA) presents a cross-section of different organizations and initiatives involved in responsible mining activities. There is a clear synergy between the IEA's findings and the analysis conducted in this thesis. Many organizations cover similar areas, each with its own definitions. This demonstrates the momentum within the industry to foster discussions on sustainability. However, it also highlights the need for standardization to streamline ESG and sustainability practices.

The majority of these organizations recognize the significant benefits of establishing a unified global standard for responsible mining. This alignment is deemed valuable because it would elevate ESG standards throughout the mining sector, alleviate the audit workload for companies, and eventually streamline the framework for stakeholders, including customers and investors (ICMM, 2024i).

For example, ICMM is proactively engaged in collaborative efforts with other standard-setting bodies to foster alignment. ICMM has built equivalency benchmarks with other organizations, including (ICMM 2024a):

- Aluminium Stewardship Initiative (ASI) Performance Standard
- The Copper Mark
- World Gold Council's Responsible Gold Mining Principles (RGMPs)
- Responsible Jewellery Council (RJC) Code of Practices (COP) 2019 Standard
- Responsible Minerals Initiative (RMI) Risk Readiness Assessment (RRA)
- Towards Sustainable Mining (TSM)

The challenges of navigating different stakeholder groups have been voiced by industry leaders. Aidan Davy, co-chief operating officer at ICMM, shared his opinion in early 2024: "Having been involved in the industry and standards development in the past, we've seen real organic growth in responsible mining standards initiatives. It's like a thousand flowers blooming, and in many respects that's a good and healthy thing until it isn't. Things are too complex and hard to navigate for different stakeholder groups, and that was the thing that motivated us to go down this route." (Rolfe, 2024).

Mining companies are also getting involved in development of and consolidation of the sustainability standards. Barrick Gold Corporation announced in a Nov. 28, 2023, press release that it was "actively involved" in the development of the standard. Mark Bristow, Barrick's president and chief executive officer, stated in the release that the company supports the initiative and has long been an advocate for standards consolidation: "Having one standard for responsible mining will not only provide clear direction on what good should look like but would reduce the complexity that exists with the numerous standards currently in circulation." (Barrick, 2023). However, in this context we should consider Smith's comments to corporate self-regulation by mining companies (2016):

> "Corporate efforts to respond to critics by adopting human rights policies will be viewed with scepticism without increased standardisation in reporting, and the success of these initiatives will depend on the quality of a firm's engagement with communities to address local concerns aside from greenhouse gas emissions. Strong state regulation, enforcement and democratic politics must accompany the growing panoply of guidelines, principles, codes of conduct and standards to ensure the promotion of human rights."

Considering different MSI organizations have varying membership requirements, including fees and certification structures, the consolidation of these standards pose a financial risk to the organizations.

As demand for metals and minerals sustains our current living standards and supports the development of renewable energy technologies, the need for mining is projected to increase. However, the scarcity of metals risks driving a significant rise in prices. Rising metal prices will either balance the market or trigger a push for alternative technologies. Higher prices, however, can have far-reaching implications for industries that rely heavily on metals, such as automotive, electronics, and renewable energy. This, in turn, may lead to increased costs for consumers and potential supply chain disruptions. This raises a critical question: are consumers willing to bear the cost of the transition to net-zero?

In addition to market uncertainty, skepticism toward increased regulation, and financial challenges observed in our survey, sustainability policies may impose an additional financial burden on the mining industry. To gain industry buy-in, government incentives can be leveraged to promote sustainability, such as carbon credits or tax breaks for companies investing in greener technologies, rather than relying solely on heavy-handed carbon taxes. Similarly, providing funding for R&D in cleaner mining practices and implementing phased transition timelines could help ease industry concerns.

However, the ultimate test will be measured on the international stage, where the competitiveness of mining companies will be scrutinized. International coordination of sustainability policies across all mining nations is essential to ensure that companies remain competitive without being disproportionately burdened by additional regulations. We are already witnessing such imbalances among nickel and steel producers worldwide.

One recommendation is to develop international guidelines, with the involvement of mining nations, to standardise the criteria surrounding sustainable mining practices. Similar to OH&S laws or Professional Engineer rules in Canada, these guidelines would consist of generally

accepted criteria to oversee mining practices, from the exploration and development to production and closure.

The vision for standardization rests on three key pillars. The first is to establish global standards by adapting existing comprehensive frameworks, such as IRMA, to create a unified approach to sustainable mining. However, a key challenge lies in ensuring that these standards remain practical and adaptable across different commodities without becoming overly burdensome. A well-balanced framework would provide clear sustainability criteria while allowing flexibility for industry-specific requirements.

Second, driving industry-wide adoption is essential. This requires collaboration between governments and international bodies, such as the UN and OPEC, to co-develop guidelines that align with national policies and economic realities. By fostering cooperation among key stakeholders, we can enhance industry acceptance and ensure that sustainability practices are integrated into the broader mining sector without compromising economic competitiveness.

Finally, ensuring rigorous global implementation is crucial. A standardized framework, developed in collaboration with mining nations and enforced on a global scale, would function similarly to OPEC's role in the oil industry. This approach would prevent regulatory arbitrage, maintain a level playing field for mining companies, and ensure the consistent application of sustainable mining practices worldwide.

Furthermore, compliance with standards can facilitate financing for mining projects. The mining industry has significant challenges accessing traditional finance mechanisms. Green (climate or sustainability) bonds arise as a new finance model. Companies with high compliance may access these bonds. To summarize, standardization efforts can be seen as a pathway for financing mining projects that comply with standards.

8.2 Research Limitations and Future Work

The study has certain limitations. Responsible and sustainable mining standards evolve over time and are frequently updated. Furthermore, new standards are developed by various institutions.

This thesis aims to demonstrate the need for greater standardization in the mining industry, which are not yet sufficiently mature. As a result, some of the information provided in this research can be outdated in the future.

Additionally, it is worth noting that regulations and legislative framework are different. The standardization efforts are non-governmental. Nevertheless, mining legislation should increase the emphasis on sustainable and responsible mining framework. The interaction between legislative framework and standardization efforts can be further explored.

The standards could examine specific commodity types and regional sensitivities. Additionally, the standards should be harmonized. Numerous efforts are currently underway, and new research can focus on how these standards are harmonized.

A future analysis should include a risk assessment regarding the competitive advantage in the global market. For instance, if certain mining nations do not adhere to international standards for sustainable mining, what geopolitical implications could arise? What safeguards can be implemented to address these potential challenges?

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APPENDIX 1

Google Form: https://docs.google.com/forms/d/e/1FAIpQLSexxoUWe1gURU3TLLO3C44NHNP-aMyxn17fO7JZTeeCHjCwEQ/viewform

Survey: Standardization of Responsible & Sustainable Mining Practices

(Duration: 5 minutes)

This survey is part of my thesis research, aiming to define sustainability criteria in mining and to examine various organizations promoting sustainability in the industry through standards and guidelines.

The focus of the thesis is to understand the necessity of standardizing different guidelines and how governments can play a pivotal role in streamlining these directives.

Thank you sincerely for dedicating your time and expertise to complete this survey.

Alp Bora

yigitalp.u@gmail.com Switch account

Not shared

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* Indicates required question

Responsible vs. Sustainable Mining Practices

What industry do you work in? *

Mining

How many years in the industry? *

- ○ 1-5 years
- ◉ 6-10 years
- ○ 11-15 years
- ○ 16-20 years
- ○ 20+ years

What is your current role? *

- ○ Executive
- ◉ Director/Manager of Operations
- ○ Director/Manager of Maintenance
- ○ Director/Manager of ESG or Sustainability
- ○ Supply Chain Professional
- ○ HSE Professional
- ○ Engineer
- ○ Consultant
- ○ Analyst
- ○ Academic
- ○ Other:

Which geographical region do you work in? *

Choose

Classify the areas of activity below from the most important to the least important for purposes of your position: *

Instructions:

- Please assign a **specific number** to each activity based on its importance to you
- Use the scale provided, with 1 indicating the **most important** and 8 indicating the **least important**
- Ensure that each factor receives a **unique** ranking to accurately reflect your priorities

	Most important	2	3	4	5	6	7	Least important
Economic growth	○	○	○	○	○	○	○	○
Climate change adaptation & resiliency	○	○	○	○	○	○	○	○
Environment stewardship	○	○	○	○	○	○	○	○
Indigenous rights & community wellbeing	○	○	○	○	○	○	○	○
Business conduct	○	○	○	○	○	○	○	○
Right of workers	○	○	○	○	○	○	○	○
Diversity & Inclusion	○	○	○	○	○	○	○	○
Security of supply	○	○	○	○	○	○	○	○

How familiar are you with the following organizations?

Note: *Commodity-specific organizations (e.g. Copper Mark, Aluminum Stewardship Initiative, etc.) are excluded due to the necessity of standardizing guidelines across the entire industry.*

1. Initiative for Responsible Mining Assurance (IRMA) *

	1	2	3	4	5	
No knowledge at all	○	○	○	○	○	Very familiar

2. Towards Sustainable Mining (TSM) *

	1	2	3	4	5	
No knowledge at all	○	○	○	○	○	Very familiar

3. International Council on Mining and Metals (ICMM) *

	1	2	3	4	5	
No knowledge at all	○	○	○	○	○	Very familiar

4. Extractive Industries Transparency Initiative (EITI) *

	1	2	3	4	5	
No knowledge at all	○	○	○	○	○	Very familiar

5. Natural Resource Governance Institute (NRGI) *

	1	2	3	4	5	
No knowledge at all	○	○	○	○	○	Very familiar

6. Sustainability Accounting Standards Board (SASB) *

	1	2	3	4	5	
No knowledge at all	○	○	○	○	○	Very familiar

7. Global Mining Guidelines Group (GMG) *

	1	2	3	4	5	
No knowledge at all	○	○	○	○	○	Very familiar

8. Global Reporting Initiative (GRI) *

	1	2	3	4	5	
No knowledge at all	○	○	○	○	○	Very familiar

How supportive are you toward streamlining the guidelines to create one comprehensive set of standards? *

	1	2	3	4	5	
Not supportive at all	○	○	○	○	○	Very supportive

How supportive are you toward the government enacting legislation around sustainable mining? *

	1	2	3	4	5	
Not supportive at all	○	○	○	○	○	Very supportive

From your perspective, what are the challenges for the government to legislate sustainable mining practices? *

Your answer

From your perspective, rather than industry-wide guidelines, should we encourage and further develop commodity-specific standards, such as Copper Mark, Aluminum Stewardship Initiative and World Gold Council? *

- ○ Yes
- ○ No

What would be the governance challenges of commodity-specific standards? *

Your answer

Is there anything you would like to comment on?

Your answer