FOREST DECLARATION ASSESSMENT SPECIAL REPORT

The role of voluntary sustainability initiatives in addressing impacts of mining on forests

Forest Declaration Assessment

ABOUT

The Forest Declaration Assessment is a collaborative initiative carried out by civil society organizations and researchers, known as the Forest Declaration Assessment Partners. Since 2015, the Assessment has published annual updates on progress toward global forest goals. All publications undergo a rigorous peer review process conducted by experts across the globe. To learn more, please visit www.forestdeclaration.org/about/assessment.

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Forest Declaration Assessment

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Executive summary

Mining occupies a small fraction of land—but disproportionately drives deforestation in the world's most ecologically sensitive regions.

Mining activities have profound impacts on the world's forests - from direct tree cover loss at mine sites to widespread indirect and cumulative effects that endanger high-integrity forests, biodiversity hotspots, and forest-dependent communities. Although mining occupies a small fraction of global land, its operations disproportionately affect ecologically sensitive regions, exacerbating deforestation and degradation in critical areas.

This briefing paper examines the capacity of voluntary sustainability initiatives (VSIs) to mitigate these harmful forest impacts. Drawing on a comprehensive literature review, an analysis of 26 standards and guidance documents from 20 VSIs, and insights gathered from interviews with representatives of 14 VSIs, the study identifies key challenges facing VSIs. These include:

- **Limited coverage and specificity of forest issues:** VSI guidance is often global in scope and includes only broad, non-biome-specific language on managing risks and impacts. Neither the specific risks to forests nor the full lifecycle of forest-risk activities inherent to mining activities, from exploration through site closure, are usually addressed.
- **Inadequate representation of forest-related perspectives in VSI governance:** Forest, nature, and biodiversity experts, as well as Indigenous voices and representatives from low- and middle-income countries, are not included in board-level or stakeholder perspectives of many VSIs, resulting in standards that do not sufficiently account for related issues.
- **Weak business case for sustainability:** VSIs alone face challenges in incentivizing companies to surpass regulatory minimum performance standards, a challenge compounded by limited market demand and low willingness to pay a premium for more responsibly produced goods.
- **Supply chain complexity and data limitations:** The opacity of global mineral supply chains and inconsistent methodologies for measuring forest impacts hinder insight into mining's true forest impacts and therefore limit accountability.

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To address forest risks, mining VSIs must go beyond broad, global sustainability language and integrate more specific, biome-relevant criteria throughout the full lifecycle of mining activities.

In response to these challenges, this paper outlines key opportunities for VSIs to strengthen their coverage of forest issues and to leverage their influence over mining sector companies. VSIs in the mining sector have grown during the past several years in membership, geographic spread, and commodity coverage. VSIs are closely embedded in the mining industry, and they have the potential to play a greater role in influencing and guiding companies to more responsible approaches.

Moreover, non-VSI stakeholders—such as upstream and downstream companies, financial institutions, governments, international political bodies, and development finance institutions—are called upon to support VSI efforts. Their roles include engaging in integrating enhanced VSI standards into contractual and investment conditions, aligning public policies with robust forest conservation goals, and funding capacity-building initiatives that drive measurable improvements in forest outcomes.

To improve on addressing forest risks (and other sustainability issues), the mining sector must adopt a more holistic understanding of the risks and impacts of its operations across not just forests, but environmental impacts more broadly, as well as their connection to human rights and the sector's long-term financial viability. By addressing the identified challenges with targeted, collaborative solutions, stakeholders can work collectively to advance a more accountable, transparent, and forest-friendly mining sector.

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1. Introduction

Mining's impact on forests

Mining is estimated to impact up to one-third of the world's forest ecosystems.

Conservative estimates suggest that from 2001 to 2020, the world saw 1.4 million hectares of mining-related tree cover loss[1] – but this doesn't tell the whole story. Mining can harm forests directly, indirectly, or cumulatively (Table 1), with indirect and cumulative impacts thought to pose a significantly greater risk than direct impacts.[2] When indirect effects are considered, mining is estimated to affect up to one-third of the world's forest ecosystems,[3] highlighting the true (and often hidden) scale of mining's impacts.

Direct forest impacts are also a growing threat and are heavily concentrated in countries like Indonesia and Brazil[4] – home to many of the world's invaluable tropical forests – with other hotspots of direct mining-related tree cover loss present in Russia, the United States, and Canada.[5,6,7] More than half of all operational mines are in low- or middle-income countries, where the institutional, technical and financial capacity to regulate mining is generally weak.[8]

Table 1. Types of ecological impacts on forests from mining

DIRECT IMPACTS	INDIRECT IMPACTS	CUMULATIVE IMPACTS
Land-use change at mine sites, and downstream pollution and environmental damage. e.g., Permanent forest clearing within a mine site (including to make way for mineral processing infrastructure adjacent to the point of extraction, such as smelters and refineries), or to expand mine sites.	Deforestation or forest degradation associated with but not immediately caused by mine site activities. e.g., Mining companies build infrastructure (e.g., access roads, smelters, refineries, etc.) into remote forests, making these areas accessible for illegal loggers and settlers.	Additive disturbances caused by multiple mine sites (and/or other economic activities) in proximity to each other. e.g., Several individual mine sites (and/or other land-use activities, such as agricultural production) in an area may each be contributing to relatively insignificant ecosystem fragmentation on their own, but in combination the cumulative impact on the ecosystem is significant.

The mining sector's impacts on biodiversity and forest-dwelling communities are disproportionate compared to its land use footprint. While mine sites cover less than 1% of the world's land, mining's negative impacts on biodiversity, availability and quality of water, and human health are significant and may be larger than those from agriculture.[9] While the sector accounts for a smaller share of total global deforestation compared to other drivers of deforestation (e.g., agriculture, infrastructure, urban expansion), mining-related deforestation disproportionately occurs in ecologically sensitive areas. These include biodiversity-rich tropical forests and culturally-sensitive areas such as the lands of Indigenous Peoples and local communities.[10,11] For instance, nearly 80% of all mines globally are located within 50 kilometers of key biodiversity areas.[12] Tropical

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Demand for minerals used in clean energy technologies may quadruple by 2040.

rainforests – among the most biodiverse ecosystems on the planet – bear much of the burden of mining's impacts. Despite accounting for just 29% of global mining land, tropical rainforests experienced 62% of direct mining-related deforestation from 2001–2020.[13] This destruction is accelerating, with over 35% of direct mining-related deforestation in tropical rainforests occurring in just the last five years of that period (2016–2020).[14] These figures underestimate mining's full impact, as indirect forest losses remain unaccounted for.

Mining's impact on forests and forest-dependent communities is poised to grow in the coming years in part to the growing demand for metals to supply the energy and digital transitions.[15] Under the current trajectory of renewable energy production, total demand for minerals used in clean energy technologies is projected to double by 2040; to meet the goals of the Paris Agreement, inputs of these minerals may need to quadruple by 2040 .[16] Similarly, demand for construction sector minerals – whose extraction is associated with the largest deforestation footprint globally of any downstream sector in mineral supply chains – is generally expected to increase as well.[17] For example, by 2050 demand for bauxite (aluminum) is projected to increase by 215% relative to 2010, and demand for iron is projected to increase by 100% relative to 2010.[18]

Importantly, meeting projected demand of critical minerals for the energy transition does not depend on expanding raw mineral extraction: estimates find that demand for critical minerals for the energy transition can be reduced 58% from now to 2050 through increased recycling and recovery of minerals and improved technological efficiency.[19] However, the demand projections – alongside recent trends in mine site expansion and the mining sector's slow progress on mainstreaming of responsible practices – point to a real and rising threat to forest areas and other ecosystems that overlap with critical mineral deposits.[20,21,22,23] This rising threat is especially concerning when the impacts beyond deforestation are considered. Mining also often leads to other environmental consequences, like soil, air and water pollution and contamination,[24] as well as human rights infringements, like the right to a healthy environment and the right to be protected against being arbitrarily displaced.[25]

The role of voluntary sustainability initiatives (VSIs)

As mining-related forest risks grow, VSIs have emerged as a key — but contested — tool for advancing a more responsible minerals sector.

Mining poses profound environmental and social challenges yet remains deeply embedded in the global economy — making it essential to confront how it can be made more sustainable and minimize harm to forests, communities, and the planet.[i] As mining-related threats to forests intensify, governments, the private sector, and other industry stakeholders must coordinate an "all hands on deck" approach to address the sector's growing forest risks. And as larger debates over the roles of regulatory and voluntary action continue, voluntary sustainability initiatives (VSIs) have emerged as an important area of investigation for addressing mining's impacts and developing a more responsible mining sector. While VSIs are promoted as a mechanism for improving practices within the mining sector, their efficacy is contested (see section on *Evidence of VSIs' effectiveness in driving sustainability*). This paper examines their potential and limitations as part of a broader effort to develop a more socially and environmentally responsible minerals sector.

Led by industry associations, NGOs, or other multi-stakeholder organizations, VSIs aim to promote responsible supply chain practices through setting standards (often termed voluntary sustainability standards, or VSS) and/or other forms of guidance.[26] They can be developed by a range of groups, such as private, public, civil society, or multi-stakeholder institutions.[27] Notably, VSIs range widely in quality across areas such as governance, transparency, clarity of criteria/guidance, and in their overall ability to ensure due diligence obligations have been successfully implemented.[28,29,30]

VSIs serve many functions in the mining sector. Broadly, the standards and guidance developed by VSIs are used by industry actors (e.g., miners, mineral offtakers, investors) to assess and/or certify environmental and social practices at a given point in time and encourage improved performance along the value chain. They can serve as a possible lever for accountability, alongside government regulations, stock exchange regulations, and scrutiny from the media and civil society. Several factors can drive their development and uptake including, in some cases, the intention by industry actors to use them as a mechanism to "self-regulate" and avoid being subject to statutory regulations.[31] However, they may also be used to demonstrate performance that exceeds levels mandated by formal regulations; for example, in jurisdictions where strong regulations are lacking, VSIs can help fill policy gaps and act as de facto regulators.

VSIs can also support corporate efforts to demonstrate compliance with existing regulations and can complement regulation by addressing highly technical aspects of mining that are difficult to regulate effectively.[32] For example, the EU's recently enacted Critical Raw Materials Act allows projects to demonstrate their compliance through certification with a recognized scheme.[33,34] Similar rules that support the use of recognized, third-party certification schemes or standards are integrated into other related EU legislation, including the Batteries Regulation,[35] Conflict Minerals Regulation,[36] Corporate Sustainability

[i] It's worth noting that this paper examines the role of VSIs in addressing forest risks from mining, including a consideration of their limitations. However, it does not engage with broader (though equally important) conversations around sustainable resource use, such as approaches for reducing overall demand/consumption of mined materials or transitioning to circular economy models. This paper's focus on VSIs should not be interpreted as an endorsement of increasing or sustaining current levels of mining activity as the only or preferred path forward. Rather, as an examination of how existing practices might be improved within the current production models.

In jurisdictions lacking strong regulation, VSIs can help fill policy gaps and act as de facto regulators — but their quality and impact vary widely.

Reporting Directive (CSRD),[37] and Corporate Sustainability Due Diligence Directive (CSDDD).[38] In the United States, the Interagency Working Group on Mining Laws, Regulations, and Permitting[39] recommended use of voluntary certification schemes to prioritize funding for projects with strong social and environmental practices.[40]

Beyond setting performance standards and certifying/auditing practices, VSIs can also act as platforms for consensus-building and as convenors of collective action on shared sectoral objectives. This function can, in theory, help to build political capital and momentum for addressing forest issues in the minerals sector.

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Research objectives

The central questions guiding the research for this briefing paper include:

1. How effective are VSIs in mitigating forest impacts?[ii]
2. What can be done to improve their performance in a rapidly evolving mining landscape?

Even with growing attention on VSIs in the mining sector, there is limited information on the challenges VSIs face in addressing mining-related forest impacts, as well as potential solutions for improving their effectiveness. This briefing paper seeks to help fill this knowledge gap. We first assess the extent to which VSIs address forest issues within their standards and guidance. We then identify both the major challenges they encounter in mitigating mining's impact on forests, and timely opportunities for strengthening their approach. Finally, we provide an overview of actionable recommendations for VSIs and other stakeholders to strengthen the influence and effectiveness of VSIs in promoting forest risk awareness and action in the mining sector.

The paper is organized according to the following sections, and draw from methodological approaches including literature review, assessment of VSI documents, and semi-structured interviews with representatives of VSIs:

[ii] In this context, we define "effectiveness" as the ability of VSIs to mitigate forest risks through inclusion of clear and specific language to address forest issues in their standard requirements and guidance. Further, we also consider existing evidence in the literature on whether VSI adoption has led to improved performance and outcomes on forest issues.

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SECTION & SCOPE	METHODOLOGY
Section 2: Overview of VSIs in the mining sector Provides context on VSIs and their role in mining governance and other sectors, and a review of available evidence on the effectiveness of VSIs across sectors to address sustainability issues, including forest risks	Literature review
Section 3: Coverage of forest issues in assessed VSIs Assesses the extent to which many of the major mining-sector VSIs address forest risks, both directly and indirectly	Review of 26 standards and guidance documents from 20 VSIs covering various mined commodities and supply chain levels. The review focuses on forest-relevant criteria, including recognition of forest impacts, alignment with the mitigation hierarchy, restrictions on high-risk areas (e.g., protected lands), Indigenous and local community rights, impact reporting, and third-party verification. Tables 4a and 4b in the Annex categorize the VSIs by scope, commodities covered, and standard level, also noting the reviewed documents and interviewed VSIs.
Section 4: Challenges facing VSIs Outlines key challenges facing VSIs in design and implementation of standards that mitigate forest impacts	Literature review & semi-structured interviews with representatives from 14 VSIs, gathering insights on their approach to forest issues, challenges faced, and future outlook.
Section 5: Opportunities for improvement Outlines opportunities and emerging actions among VSIs that may serve to more effectively address forest impacts	
Section 6: Recommendations Offers recommendations for VSIs and other sector stakeholders	Synthesis of literature review, document analysis, and interview findings.

2. Overview of VSIs in the mining sector

VSIs emerged in the 1990s as mining's social license to operate came under threat.

The history of VSIs targeting the mining sector dates to the mid-to-late 1990s, when the industry faced an economic and social crisis that threatened its "social license to operate."[41] Previously, "responsible mining" was seen primarily as a legal compliance issue, to be governed by a mix of public regulations, concession agreements, and relevant labor laws.[42] However, industry groups began to recognize that this approach was not enough to mitigate mining's harmful social and environmental impacts and protect the sector from related reputational issues. This led to the commissioning of the Global Mining Initiative in 1998, organized by the largest global mining companies to critically examine the sector's performance on issues of sustainable development and social responsibility and to identify ways forward.[43] The Global Mining Initiative led to the creation of the ICMM, and various other industry initiatives to promote more sustainable mining were established in the following years, including other voluntary standards and certification systems.

VSIs across all sectors have proliferated since the 1990s. Factors driving the proliferation of VSIs include (among others): increased consumer demand for ethically- and sustainably-sourced products; use by companies to meet their sustainability commitments; support from governments and donors; use of standards as a tool in transnational sustainability governance to avoid a "race to the bottom" on ESG performance across jurisdictions; promotion by "norm entrepreneurs" (i.e., NGOs and other groups interested in spreading the voluntary certification model across different sectors); and the rise of public-private partnerships as a policy tool for sustainable commodity production.[44] Additionally, industries have sought to use VSIs as a way to avoid the introduction of legislation by demonstrating to governments that they can achieve higher levels of sustainability through self-organization. More critically, they have been accused of serving industries to greenwash and placate discontent over harmful impacts to communities and the environment caused by industrial activities.[45]

In the mining sector, VSIs have expanded in membership, geographic spread, and commodity coverage over the last several years.[46] A 2022 assessment found that, as of 2019, 14 of the 20 largest mining companies globally by production value of metals and minerals had adopted at least one voluntary sustainability scheme.[47,iii] The growing volume and diversity of mining sector VSIs has led to calls for increased clarity and alignment to maximize their potential.[48]

[iii] Companies on the list not adopting at least one voluntary sustainability scheme: Nornickel (Russia), Southern Copper Corp (United States), Hancock Prospecting Pty Ltd (Australia), Zijin Mining Group Co. Ltd (China), Mitsui & Co. Ltd (Japan), and KGHM Polska Miedz S.A. (Poland)

BOX 1. VSIS WITHIN THE CONTEXT OF CORPORATE SUSTAINABILITY

The growth in prominence of mining sector VSIs comes in the context of a growing movement led both by regulatory authorities and others (e.g., investors, media, civil society, and in some cases mining companies/associations themselves) to build a more responsible mining sector and increase transparency of the impacts for which it is responsible. Companies often address these demands through development of corporate social responsibility (CSR) or environmental, social, and governance (ESG) frameworks.[49] Often, companies opt to report ESG data through independent organizations providing disclosure platforms such as CDP. Other organizations, such as the Science Based Targets Initiative (SBTI), the Global Reporting Initiative (GRI), the International Sustainability Standards Board (ISSB), and the Taskforce on Nature-related Financial Disclosures (TNFD) provide guidance and standards for sustainability disclosures. An emerging principle of corporate sustainability disclosure is "double materiality," where companies report both the risks and impacts of their operations on sustainability (e.g., biodiversity loss) as well as the risks and impacts that sustainability issues may pose to the company (i.e., biodiversity loss may lead to lost revenue or collapse of supply).[50]

VSIs for the mining sector can be classified according to four main categories[51]:

1. Responsible mining standards: Provide requirements for upstream mining activities (LSM or ASM)
2. Responsible sourcing standards: Provide requirements for the downstream supply chain to promote responsible sourcing from LSM, ASM and/or recycled provenances
3. Financial market influencer standards: Provide requirements on responsible investment
4. Product specification standards: Provide requirements for final manufactured products

Responsible mining standards and sourcing standards can vary widely in scope according to mineral(s) covered, geographic coverage, level of coverage (i.e., mine-site, refining, entire supply chain, etc.), whereas financial market influencer standards and product specification standards generally apply a global scope and cover a broader range of minerals and supply chain levels.[52]

This briefing paper primarily assesses VSIs targeted towards large-scale mining (LSM). Relatively few VSIs are specifically designed to address medium-scale mining (MSM) or artisanal and small-scale mining (ASM). ASM is a quickly growing sub-sector which currently accounts for 15-20% of global non-fuel mineral production.[53] Globally, ASM contributes a significant proportion of production of a diverse range of mineral and metal supply chains, including gold, cobalt, copper, rare earths, gemstones, salt, and gravel.[54] While ASM is associated with less overall forest impacts than large-scale mining (LSM) – which occurs at much greater scales globally – ASM poses a distinct and growing threat to tropical forests due to its high degree of informality, limited regulation, and alarming levels of social and environmental damages.[55] LSM and ASM often interact directly or indirectly along the same landscapes, combining to cause cumulative forest impacts.[56] MSM, despite its larger scope of operation as compared to ASM, is frequently under-regulated and under-professionalized and is also responsible for significant environmental harm.

The mining sector's growing array of standards has triggered calls for greater clarity and alignment.

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Different VSIs take different approaches to achieving impact. Broadly, they could be categorized into 1) those that set "high bar" or "best practice" standards to encourage levels of sustainability performance much higher than those mandated by government regulations, while 2) others focus on setting a minimum baseline of performance – above levels mandated by government regulations – to encourage uptake of responsible practices while still encouraging and incentivizing progress towards higher levels of performance over time. Standards could also be categorized according to how prescriptive they are – some provide greater specificity on what is expected of members to achieve compliance, whereas others are less prescriptive and allow for greater flexibility and room for adaptation to local operating realities.

Evidence of VSIs' effectiveness in driving sustainability

Voluntary standards alone are not sufficient to address forest impacts.

Literature suggests that while voluntary certification systems across all sectors can, in some contexts, bring positive sustainability impacts (e.g., increased tree cover, improved biodiversity outcomes, improved public health[57]) – particularly in the absence of other regulatory systems – their impacts are heterogeneous, and voluntary schemes are not sufficient on their own for addressing forest impacts or other sustainability issues.[58,59]

There is a lack of data on the effectiveness of mining sector-specific VSIs to address forest risks, but studies of voluntary standards for non-mining sectors (e.g., forestry, soy, palm oil, cocoa, coffee, etc.) indicate that they have brought mixed, context-specific results in addressing deforestation and other forest impacts.[60] Dröge et al. (2024) assessed voluntary standards for five commodities (cocoa, coffee, tea, palm oil, and bananas) and found they have no effect on tree cover loss in primary forests across 67 tropical countries.[61] Similarly, a 2021 analysis from Greenpeace found that certification for several land-based commodities has not led to companies meeting their deforestation-free supply chain commitments, concluding that certification is a weak tool to address forest and ecosystem impacts.[62] In at least some cases, voluntary standards could improve in terms of rigor, comprehensiveness and alignment with public policies: Elias Cosimo et al. (2024) assessed five major agricultural and forestry VSS against their ability to cope with the European Union regulation on deforestation-free products (EUDR), and found that the schemes lacked comprehensive criteria for prohibiting deforestation and forest degradation as well as sufficient systems to ensure compliance.[63]

Most mining VSIs focus on the operational phase, missing the mine design and development stages where environmental and social impacts are often locked in.

Several challenges likely blunt VSIs' full potential to mitigate forest risks. Significant structural barriers to improving forest outcomes from VSIs in non-mining sectors include lack of high-quality, supportive public policies; low adoption rates, and selection bias (i.e., higher uptake by producers who can more easily comply).[64] A key structural barrier to addressing forest risks among mining sector VSIs is that they tend to only cover the operational phase of mining, but environmental and social outcomes are often locked in at the point of mine design and development.[65] Additionally, relatively few VSIs are specifically designed to address MSM or ASM. This is concerning considering the significant and growing forest risks posed by these forms of mining.

Beyond structural barriers, the literature identifies weaknesses and gaps among voluntary mining standards that, given the right adjustments, could be addressed by VSIs to improve their effectiveness in mitigating forest risks. An analysis of the biodiversity- and deforestation-relevant criteria of six of the leading voluntary mining standards found a lack of explicit language to identify impacts on natural forests, deforestation and/or land use change.66 Further, it found that while all the assessed schemes contain requirements to adhere to the mitigation hierarchy and the No Net Loss of biodiversity, they have not yet issued, in many cases, sufficient supporting guidance on which indicators or methods to use to achieve compliance. Other recent assessments have found that many mining sector VSIs fall short on ensuring synergies with regulatory/policy frameworks,[67,68] tackling corruption,[69] and on overall credibility and robustness.[70,71] The literature also reveals significant room for improvement (and in some cases, outright failures) in the ability of VSIs to address related mineral supply chain issues such as transparency, traceability, and enforcement.[72,73,74]

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3. Coverage of forest issues in assessed VSIs

Explicit references to forests in VSI standards signal not only awareness of forest risks but an opportunity to improve the mining sector's contribution to forest conservation.

Given the significant impacts of mining on global forests and forest peoples – and the increasing attention given to VSIs as a key actor in governing the sustainability of mineral supply chains – it is critical to understand how the standards and guidance set by VSIs acknowledge and address forest risks. While VSIs often design their standards and guidance to be broadly applicable rather than tailoring them to particular biomes or operating realities, explicit mention of forests and forest issues within their standards and/or guidance can signal an awareness of forest risks posed by the sector and an intention to improve the mining sector's contribution to forest conservation. Further, it is an opportunity for VSIs to contribute to shifting the narrative in the sector towards an emphasis on recognizing not just the financial risks that forest and biodiversity loss pose to the mining sector, but the sector's contribution to that loss (double materiality), and the need for higher prioritization of forest issues (and risks to natural capital more generally).

Our review demonstrates the extent to which 26 standards and guidance documents from 20 VSIs (including equivalent standard/guidance-setting organizations, such as the OECD) integrate forest issues. The full list of standards can be found in **Tables 4a** and **4b** in the **Annex**. Our full assessment of standards and guidance documents against our criteria can be found in an external document; this document also includes additional methodological notes.

Below, **Table 2** summarizes our assessment findings. Importantly, references to forest-related issues in VSI standards do not on their own guarantee strong implementation or improved practices among member companies. Our review did not cover on-the-ground implementation. For challenges related to implementation, see **Section 4**.

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Table 2. Summary of forest-relevant criteria among reviewed VSI standards and guidance

CRITERIA	OVERVIEW OF FINDINGS	SUMMARY OF ASSESSMENT
Explicit recognition of forests / deforestation / forest degradation	Around half (12 out of 26) of standards/guidance do not explicitly recognize forest impacts.	VSIs (or other standard/guidance-setters) explicitly recognizing forest impacts in at least one of their standards/guidance: ARM; GBA; GRI; planetGOLD; PDAC-DRE; RJC; RMI; ResponsibleSteel; OECD; IRMA; WGC. VSIs (or other standard/guidance-setters) that do not explicitly recognize forest impacts in at least one of their standards/guidance: ARM; ASI; Bettercoal; CORE; CMSI; GemFair; ICMM; LBMA; TSM; RJC; RMI; CCCMC.
Reference to forests implicitly (e.g., through "biodiversity," "habitats," "ecosystems," etc.)	Virtually all standards/guidance (22 out of 26) at least implicitly reference forest impacts by covering related environmental issues.	VSIs (or other standard/guidance-setters) at least implicitly referencing forest impacts by covering related environmental issues in at least one of their standards/guidance: ARM; ASI; Bettercoal; CORE; CMSI; GemFair; GBA; GRI; ICMM; TSM; planetGOLD; PDAC-DRE; RJC; RMI; ResponsibleSteel; CCCMC; OECD; IRMA; WGC. VSIs (or other standard/guidance-setters) that do not implicitly reference forest impacts by covering related environmental issues in at least one of their standards/guidance: LBMA; RMI; CCCMC.
Alignment with mitigation hierarchy	Most standards/guidance (18 out of 26) either explicitly or implicitly reference (and provide requirements or guidance to follow) the mitigation hierarchy. However, when it is referenced and/or required, the concrete actions to be in alignment with the mitigation hierarchy are generally left open to interpretation in order to allow flexibility to do what is most appropriate to local operating realities, including the specific sensitivities of the local biome. In these cases, it is critical for the guidance to support tailoring of the more generic responsible mining criteria in the standard document to diverse operating realities.	VSIs (or other standard/guidance-setters) explicitly or implicitly including (and providing requirements or guidance to follow) the mitigation hierarchy in at least one of their standards/guidance: ARM; ASI; Bettercoal; CMSI; GemFair; GBA; GRI; ICMM; TSM; RJC; RMI; ResponsibleSteel; CCMC; OECD; IRMA; WGC. VSIs (or other standard/guidance-setters) that do not explicitly or implicitly include the mitigation hierarchy in at least one of their standards/guidance: ARM; CORE; LBMA; planetGOLD; PDAC-DRE; RMI; CCMC.

Coverage of direct / indirect / cumulative impacts	Most standards/guidance (15 out of 26) do not distinguish between direct forest impacts and the other types of impacts (i.e., indirect and cumulative) on forests (and other landscapes)	VSIs (or other standard/guidance-setters) that distinguish between direct forest impacts and other types of impacts (i.e., indirect and cumulative) on forests (and other landscapes) in at least one of their standards/guidance: ASI; Bettercoal; GBA; GRI; RJC; ResponsibleSteel; CCCMC; OECD; IRMA; WGC. VSIs (or other standard/guidance-setters) that do not distinguish between direct forest impacts and other types of impacts (i.e., indirect and cumulative) on forests (and other landscapes) in at least one of their standards/guidance: ARM; CORE; CMSI; GemFair; ICMM; LBMA; TSM; planetGOLD; PDAC-DRE; RMI; CCCMC.
Reference to protected areas, World Heritage Sites, Key Biodiversity Areas, or High-Conservation Value areas	Virtually all standards/guidance (24 out of 26) include requirements to avoid working in and/or sourcing from protected areas, World Heritage Sites, Key Biodiversity Areas, or High-Conservation Value areas.	VSIs (or other standard/guidance-setters) that include requirements to avoid working in and/or sourcing from protected areas, World Heritage Sites, Key Biodiversity Areas,[iv] or High-Conservation Value areas in at least one of their standards/guidance: ARM; ASI; Bettercoal; CORE; CMSI; GemFair; GBA; GRI; ICMM; LBMA; TSM; planetGOLD; PDAC-DRE; RJC; RMI; ResponsibleSteel; CCCMC; OECD; IRMA; WGC. VSIs (or other standard/guidance-setters) that do not include requirements to avoid working in and/or sourcing from protected areas, World Heritage Sites, Key Biodiversity Areas, or High-Conservation Value areas in at least one of their standards/guidance: RMI; CCCMC.
Requirements/ guidance for risk management and/or assessment of forest-relevant impacts	Virtually all standards/guidance (24 out of 26) include requirements or guidance for risk management and/or assessment of forest-relevant impacts.	VSIs (or other standard/guidance-setters) that include requirements or guidance for risk management and/or assessment of forest-relevant impacts: ARM; ASI; Bettercoal; CMSI; GemFair; GBA; GRI; ICMM; LBMA; TSM; planetGOLD; PDAC-DRE; RJC; RMI; ResponsibleSteel; CCCMC; OECD; IRMA; WGC. VSIs (or other standard/guidance-setters) that do not include requirements or guidance for risk management and/or assessment of forest-relevant impacts in at least one of their standards/guidance: CORE; RMI.
Rights of Indigenous Peoples and local communities, including territorial rights & FPIC	All standards/guidance (26 out of 26) include key terms related to rights and interests of Indigenous Peoples and local communities, such as FPIC, stakeholder engagement, etc. However, requirements referencing these terms come with varying levels of commitment and expectations.	VSIs (or other standard/guidance-setters) that include key terms related to rights and interests of Indigenous Peoples and local communities, such as FPIC, stakeholder engagement, etc. in at least one of their standards/guidance: ARM; ASI; Bettercoal; CORE; CMSI; GemFair; GBA; GRI; ICMM; LBMA; TSM; planetGOLD; PDAC-DRE; RJC; RMI; ResponsibleSteel; CCCMC; OECD; IRMA; WGC.

[iv] VSIs specifically referencing Key Biodiversity Areas (KBAs) in their requirements include CMSI, GRI, RJC, ResponsibleSteel, and CCCMC.

Requires proactive reporting / transparency on conformance to at least some criteria	All standards/guidance (25 out of 25)[v] include at least some requirements (or guidance) to publicly report on conformance to the standard/guidance, but the comprehensiveness of that reporting – and the extent to which rigorous, comprehensive reporting is incentivized – vary greatly.	VSIs (or other standard/guidance-setters) that include at least some requirements (or guidance) to publicly report on conformance to the standard/guidance in at least one of their standards/guidance: ARM; ASI; Bettercoal; CORE; CMSI; GemFair; GBA; ICMM; LBMA; TSM; planetGOLD; PDAC-DRE; RJC; RMI; ResponsibleSteel; CCCMC; OECD; IRMA; WGC.
Require (or provide guidance for) third-party assurance & verification	Virtually all standards/guidance (23 out of 26) require (or provide guidance for) third-party verification/auditing. Those that do not are designed for ASM or are guidance documents.	VSIs (or other standard/guidance-setters) that require (or provide guidance for) third-party verification/auditing in at least one of their standards/guidance: ARM; ASI; Bettercoal; CORE; CMSI; GemFair; GBA; GRI; ICMM; LBMA; TSM; RJC; RMI; ResponsibleSteel; CCCMC; OECD; IRMA; WGC. VSIs (or other standard/guidance-setters) that do not require (or provide guidance for) third-party verification/auditing in at least one of their standards/guidance: ARM; planetGOLD; PDAC-DRE.

While our review finds gaps in coverage of key forest-relevant criteria, it is important to acknowledge that even if VSIs often do not explicitly reference forests nor provide performance requirements, they can contribute to forest conservation indirectly by driving higher performance on other issues. As expressed to us by VSIs in our interviews, they often set criteria that are not specific to any one type of biome, ecosystem, or biodiversity issue to ensure more workable and broadly applicable standards.

BOX 2. INDIRECT PERFORMANCE MEASURES SUPPORTING FOREST CONSERVATION

Performance issues addressed by VSIs that can support forest conservation but that may not explicitly be targeted towards this end can include (among others):

- Minimization of land-use change
- Pollution management (air, water, soil, noise)
- Dust suppression
- Circular processes across the mining life cycle
- Tailings reprocessing
- Protection of water bodies
- Use of renewable energy
- Use of "water smart" measures to minimize impacts on availability and quality of water
- Waste management (esp. tailings)
- Nature-based solutions (e.g., wetland restoration as a pathway to water purification)
- Sourcing of biogenic materials
- Community-based monitoring of environmental impacts
- Protection of environmental defenders
- Meaningful stakeholder engagement
- Anti-corruption measures
- Respecting Indigenous Peoples' rights, including full FPIC implementation

[v] This criterion is not applicable to the GRI, as it is itself a framework for reporting and transparency.

Even when forests are not explicitly mentioned, VSIs can still support forest conservation indirectly.

Additionally, it should be noted that many voluntary mining standards have been developed in alignment with the 2011 OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas,[75] which was designed without consideration of forests or the management of environmental risks. Therefore, while most standards have since evolved to take these issues more into consideration, they have not historically prioritized forest risks (nor environmental risks more broadly) and their contribution to addressing forest impacts has historically been very limited. In 2023, the OECD published their Handbook on Environmental Due Diligence in Mineral Supply Chains to help bridge this gap, but adoption has been piecemeal partly because the OECD does not have funding to promote it.[76]

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4. Challenges facing VSIs in addressing forest risks and impacts

Forest and biodiversity issues remain sidelined in many VSIs, as standards-setters continue to prioritize "hot button issues" like human rights and carbon footprints.

While our review of VSI standards and guidance reveals that most acknowledge forest issues to some extent, they face additional challenges in prioritizing forest issues and encouraging companies to change their practices. As articulated by multiple VSIs in our interviews, forests and biodiversity have historically been viewed as secondary in mining sustainability efforts to more "hot button issues" (e.g., human rights, carbon footprint, etc.).[vi] For many of the leading members of the industry, they are still in the early stages of understanding forest and biodiversity issues and creating policies to address them. Advancing the mainstreaming of forest issues into mining sector practices is inhibited, according to our VSI interviewees, by limited representation of forests perspectives in VSI governance, difficulty in articulating the business case for responsible practices, inherent complexities of the mining sector, and a lack of clear and actionable data on the extent and severity of forest impacts.

Governance and representation

For VSIs to address forest issues effectively they must also have strong governance structures and mechanisms. The literature suggests wide-ranging governance issues among VSIs, such as a lack of transparency, conflicts of interest in the auditing process, and an unbalanced representation of interests and stakeholders.[77,78] Our interviews confirmed these findings to some extent, especially related to perspectives on forest issues, with interviewees sharing that few VSIs have stakeholders representing forest perspectives on their boards or stakeholder groups. However, we find that some VSIs do include groups with related perspectives, such as conservation groups and Indigenous groups. Additionally, the literature suggests that VSIs often do not sufficiently integrate perspectives from low- and middle-income countries and smallholders into their governance procedures (e.g., standard-setting and strategic planning).[79]


MiningWatch Portugal / Unsplash

[vi] It's worth noting that this is not the case for all VSIs. For example, ICMM issued its first biodiversity commitment in 2003 through its Mining and Protected Areas Position Statement, followed by the Good Practice Guidance for Mining and Biodiversity in 2006. ICMM's commitments on human rights and climate came later.

Making the business case for responsible practices

Without market demand or price premiums for certified minerals, companies have little incentive to exceed regulatory baselines.

A challenge broadly cited by VSIs is the difficulty in convincing mining companies of the value in surpassing the minimum sustainability requirements set by public regulations. Interviewees highlighted challenges in persuading upstream suppliers – especially those operating in regions with weak regulations – to invest in responsible practices that would allow their products to meet voluntary certification standards, when these suppliers can still sell to markets with less stringent environmental demands.

Interviewees stressed that while there is significant advocacy from civil society and environmental groups to address mining's environmental impacts, this has not translated into increased market demand. In general, buyers show very little willingness to pay a premium for certified minerals; in turn, without consumer and investor demand, there is equally little incentive for standards to become more comprehensive in their coverage of environmental impacts, or for companies to adopt more rigorous standards.

Supply chain complexity and traceability issues

Opacity in mineral supply chains – and the structuring of international minerals markets to support anonymization of provenance in the interest of commoditization and economies of scale (e.g., through spot market trading on exchanges) – makes it difficult to track the flow of minerals and enforce accountability for their associated social and environmental impacts. Interviewees specifically highlighted the issue of laundering of conflict minerals or minerals with links to environmental destruction. These materials are often channeled to smelters or refineries in jurisdictions with limited due diligence requirements, where they can be processed and later sold back into the global market as recycled, conflict-free and sustainable products. Traditional supply chain and mineral market structures therefore present a barrier to transversal value chain participation in driving positive impacts for forests.

Lack of data & methodological consensus

Many interviewees highlighted issues around the availability, strength, and comparability of data on forest and biodiversity impacts as a barrier to understanding and acting on forest risks and impacts. For example, one major gap is the lack of location-specific data in biodiversity reporting. Available data often comes from the corporate level (rather than the site level), and lacks transparency, granularity, and comparability. This prevents companies from understanding where and how they are causing forest impacts and from communicating their forest impacts effectively to stakeholders such as investors, the public sector, and civil society. One interviewee noted that, despite the growth of VSIs in the minerals sector over the past two decades, the lack of visibility around mining's impacts – especially compared to more visible forest-risk sectors, such as agriculture – has resulted in relatively less pressure, accountability, and incentives within mineral supply chains.

Chronic resource constraints prevents many VSIs from meaningfully raising ambition or supporting members beyond minimum compliance.

However, there was disagreement amongst interviewees on the extent to which the diversity in data collection, aggregation, and analysis methodologies presents a barrier to effective action. Some interviewees expressed that there is less scientific consensus on measuring environmental impacts such as biodiversity and forest loss, compared to the relatively robust and universal methods for estimating other types of impacts (e.g., carbon emissions). Another interviewee, however, contested this notion and asserted that nature-related metrics were well established in relation to mine site restoration and rehabilitation, and as part of environmental impact assessments. The same interviewee asserted that there is value in diverse methodologies that reflect local biomes and sensitivities, suggesting that "one-size fits all global indicators aren't necessarily appropriate for biodiversity in the local context."

Resource constraints and overcrowdedness

VSIs are often vulnerable to financial cycles and insufficient resources.[80] Multiple VSI interviewees cited resource constraints as a challenge, expressing that they often face limited financial and human resources to conduct their core activities, much less to increase ambition. This complicates their efforts to address challenges such as the broad lack of corporate awareness and capacity around effectively conducting due diligence (e.g., there is a lack of understanding amongst downstream buyers of how to collect data from their upstream suppliers in a way that is not burdensome or impedes investment in other due diligence activities, including prevention and remedy). As expressed to us, the focus for many VSIs is now on supporting member companies in meeting their current minimum levels of rigor, as it is difficult to expect members to achieve beyond that.

The effectiveness of VSIs may also be hindered by an "overcrowded" VSI landscape, where numerous VSIs compete for limited resources and to promote their own agenda,[81] and where mineral supply chain companies struggle to determine which voluntary standards they should follow, if any. In some cases, groups such as mineral offtakers, investors, and regulators may differ in their demands, pressuring mineral supply chain companies to demonstrate conformance with a suite of voluntary standards.

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5. Opportunities for improvement

Enhancing forest-specific coverage and supporting implementation

VSIs have a crucial opportunity to expand their standards beyond operational phases to emphasize avoidance and reduction; also stepping up technical support and training for companies.

The release of the OECD's 2023 Handbook on Environmental Due Diligence in Mineral Supply Chains[82] supplements the OECD's 2018 Due Diligence Guidance for Responsible Business Conduct[83] as well as the OECD's 2011 Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas.[84] This handbook aims to ensure businesses understand how to conduct due diligence on environmental issues, including forest conservation. Further, it presents an opportunity for VSIs to align with updated best practices. However, this new OECD Handbook is not yet widely incorporated into minerals sector voluntary sustainability standards. It is critical to translate this momentum into actionable change, and for VSIs to focus on designing standards that provide practical, comprehensive criteria for mineral supply chain companies to follow.

One particularly impactful improvement would be for VSIs to expand their guidance to address all phases of mining, applying ecosystem and biodiversity risk and impact criteria as soon as exploration begins, not just at operational stages. Though environmental impact assessments (EIAs) generally require mining companies to anticipate and account for potential impacts, VSIs have an opportunity to raise the bar. For example, through anticipating indirect and cumulative impacts, not just direct impacts, and by emphasizing the avoidance and reduction stages of the mitigation hierarchy.

Several interviewees noted that their organizations are increasingly aware of the interconnectedness of sustainability issues and are currently making general improvements in their standards' and guidance's coverage of forest key issues with this holistic context in mind. For instance, one interviewee mentioned that there is an opportunity for VSIs to improve their standards and guidance on remediation, yet many VSIs have yet to figure out their role in addressing remedy or what they should be requiring of companies. Others mentioned they are actively collaborating with nature- and biodiversity-focused NGOs who are pushing them to adapt their standards to take these issues into greater consideration. However, most VSIs interviewed did not express that these kinds of perspectives are prioritized in the design and revision of their standards/guidance.

Beyond simply adding more forest-specific criteria to their standards and guidance, VSIs can play a significant role in directly supporting companies to comply with existing guidance. Many of our interviewees see additional opportunities to strengthen their VSIs on-the-ground activities, even if in some cases these are still in the ideation phase. Many expressed that they are already providing technical support to members and other forms of direct engagement to guide implementation, auditing, and reporting against their standards. They also discussed other types of support they are providing, such as setting up training initiatives, workshops, and peer-to-peer learning fora to improve knowledge of forest and biodiversity issues, share related

best practices, and connect members to related landscape-level or systems-transformation initiatives. Some expressed that even if they are already engaging in these types of activities, there is an opportunity to further their support to increase their reach and impact.

Particularly for ASM and MSM miners, VSIs emphasized the need to guide them toward better integration of long-term planning and sustainability issues. Since compliance with basic levels of performance is already a challenge for ASM miners, several VSIs stressed the importance of encouraging behavioral change and improvement of low-performing actors by getting them on the "improvement escalator," rather than introducing new requirements that may "spook the horse" and push them away from any engagement whatsoever. They also emphasized the importance of companies that procure minerals from ASM miners treating them as genuine business partners and taking on the responsibilities that come with such relationships (e.g., integrating them into their risk management approach, supporting their professionalization, working with local authorities to address sustainability risks). One VSI pointed out that while education is essential for this transformation, ASM miners will ultimately need financial support and incentives that can make this transformation a reality.

Strengthening the business case and leveling the playing field

By working with governments to strengthen regulations and aligning with the Global Biodiversity Framework, VSIs can help create a level playing field that encourages all mining companies to raise their environmental performance.

As influential actors familiar with best practices for responsible mining, VSIs could be well positioned to help governments strengthen mining sector regulations, which would level the playing field for all companies and reduce disparities in environmental performance between laggard and leading companies. Most of our interviewees emphasized the need for better coordination with governments and greater alignment of voluntary standards with public regulations. This could be done by engaging countries with strong forest conservation commitments but significant room for improvement (e.g., China). Several VSIs expressed that the public sector should set a minimum performance standard, which voluntary standards can then build upon to raise sustainability efforts. They also expressed that they could work with governments to get their regulatory frameworks up to speed, possibly by directly drawing from standards or learning from trends revealed by analysis of audit reports. This would also enable them to more effectively address cumulative impacts, as voluntary certification schemes are generally focused on more site-level impacts.

Our conversations also revealed varying degrees and approaches to which VSIs advocate for improved mining policies from governments. Some have roles specifically for this (e.g. IRMA, GRI, and ResponsibleSteel) and some do not have specific roles in place but consider policy engagement to be one of their functions (e.g., ICMM). For example, RMI (through the RBA Foundation) regularly engages in dialogue with policymakers in the US, EU, and key producer countries around the implementation of international due diligence standards and related policies, providing technical support on matters such as the alignment of local law with international standards. In the case of the GBA, they see engagement with producer countries as a key priority going forward and aim to work with countries to align national standards, regulations and requirements with international

expectations. Some VSIs that do not directly engage in policy advocacy (e.g., advocating for their contents to be included in host country regulations) may still do so indirectly through other means (e.g., partners and members may leverage their association with the VSI while engaging in different forms of policy advocacy).

In addition to alignment with governmental policies and regulations, VSIs have an opportunity to further align themselves with international agreements. For example, by integrating the targets and goals of the Global Biodiversity Framework (GBF) into their standards/guidance, they can support governments and mineral sector companies to mainstream biodiversity-positive practices and policies. Adopted in 2022 during the 15th UN Biodiversity Conference, the GBF sets out a framework for achieving a global vision of living in harmony with nature by 2050. The GBF lays out 23 urgent targets for 2030 that will enable achievement of four long-term goals by 2050.[85] VSIs such as ICMM are already taking advantage of this opportunity by integrating the GBF into their Nature Position Statement.[86]

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Improving supply chain traceability and transparency

Enhancing supply chain data collection requirements can increase accountability for forest impacts across all actors in the value chain.

VSIs can play a role in improving the availability of data on forest impacts at all stages of the supply chain. Indeed, many interviewees expressed a need for greater accountability by all actors along the mineral value chain. For example, they suggested VSIs could draw greater attention to forest impacts along the supply chain by enhancing their reporting requirements. VSIs could include requirements or guidance to leverage new tools such as blockchain and product passports to facilitate the collection and sharing of data and increase the reliability of supply chain data. Additionally, several of the VSIs we spoke to have adopted, are in the process of adopting or are considering adopting chain of custody standards to track the origins and characteristics of a product in its path from upstream to downstream, ensuring accountability for forest impacts.[87] Enhanced data collection and reporting could support VSIs in pressuring downstream companies to be more accountable for their impacts (e.g., impacts linked to ASM suppliers who downstream companies are often hesitant to admit they are linked to), including allocating resources to addressing these impacts and risks. It could also help those companies that are already looking for ways to drive on-the-ground impact in their connected landscapes to do so with certainty of the nature of their connection, the extent of adverse impacts and thus reasonable responses.

Consolidation and alignment of standards and enhancing data availability

Consolidation and alignment efforts can reduce duplication and costs while increasing data comparability - but care must be taken to avoid lowering performance expectations.

The literature and our interviewees both point to a trend of increasing consolidation, coordination, and alignment among VSIs, across both supply chain levels (i.e., both upstream and downstream) and across sustainability issues, which may help to alleviate resource constraints and the overcrowdedness of the VSI landscape.[88,89]

The most prominent example of the consolidation trend is the Consolidated Mining Standard Initiative (CMSI), a collaboration between the Copper Mark, ICMM, TSM, and WGC – four large responsible mining industry associations that have developed their own voluntary standards – working to merge their standards into one. The CMSI aims to increase uptake by being open to all mining companies, regardless of prior membership to any of the four partner organizations. Some of the interviewed VSIs suggested that the consolidation of standards could, in theory, raise ambitions, increase uptake of best practices, and improve data comparability. Consolidation could also make responsible sourcing easier and less costly for downstream actors, as multiple metals will be covered by a single common standard.

However, other VSIs expressed concerns that the CMSI risks "lowering the bar" by providing an overall weaker standard that decreases ambition and performance on environmental and human rights issues. The Lead the Charge initiative (a coalition of organizations advocating for an equitable, sustainable, and fossil-free auto supply chain) and organizations like Human Rights Watch and Public Citizen have echoed this sentiment, criticizing the CMSI for lacking a rigorous standard that falls below existing requirements under international law and performance expectations set in other industry standards. They argue

that the CMSI rolls back progress and lacks the mechanisms to hold companies accountable to high ESG performance.[90,91,92]

Some VSIs have proposed or are already working on other forms of collaboration beyond the CMSI, both amongst VSIs (to ensure their standards are aligned and complementary) and with other sector stakeholders like biodiversity-focused NGOs (to share expertise and insights). The Mining, Minerals, and Metals (M3) Standards Partnership, for example, was formed to establish and test an operating model for the alignment and collaboration between standards initiatives.[93]

Several VSIs offered insights into how they are already engaging in alignment efforts. One expressed that the principle of standard equivalency and common requirements is built into their methodology and mentioned that they convene working groups to discuss interoperability with voluntary standards.[94] They believe that this approach will lower costs of reporting to various schemes, aid stakeholders to navigate the VSI landscape, and increase comparability for buyers, and therefore ultimately support greater adoption of good practices. Another VSI mentioned that they are collaborating with other standard-setting organizations to map how their frameworks align and complement each other, and they maintain an open dialogue with other standard-setters to share knowledge, expertise, and insights.

Relatedly, interviewees also highlighted the need for stronger, more easily applicable risk-based approaches to guide corporate due diligence and reporting. They stressed that risk-based approaches in LSM standards should better account for ASM-related impacts and interactions between LSM and ASM. Additionally, they called for a greater focus on landscape-level dynamics, such as the cumulative impacts of multiple mining operations and the combined effects of mining and other economic activities, like agriculture, across a landscape.

Michail Dementiev / Unsplash

6. Recommendations

As long as mining sector regulations remain 'forest-blind,' VSIs must fill this gap by developing stronger mechanisms to address forest impacts and lead the sector toward more responsible practices.

Moving forward, the world's forests and forest peoples will face increasing pressures from mining activities. The global mining sector has thus far not been able to adequately mitigate forest impacts, raising concerns for the future. It is vital for forest and biodiversity impacts to be taken more into consideration, and for the sector to develop stronger mechanisms to mitigate these issues.

Overall, VSIs demonstrate potential as a key actor to support forest conservation efforts, as one of a "smart mix" of measures[95] that together can better incentivize more responsible practices by miners. Yet, VSIs have not yet fully embraced this opportunity. As influential initiatives that are often closely embedded and aligned with mineral supply chain companies themselves, VSIs are well-positioned to provide thought leadership and demonstrate ambition for the mining sector to contribute to addressing the critical development and environmental challenges of the 21st century, without exacerbating those same challenges along the way.

As long as regulatory frameworks of the mining sector in many countries remain largely "forest-blind," or as these regulations are pared back due to political shifts, voluntary standards will maintain their relevance within the governance of the sector. It is therefore essential that they adapt to this responsibility and develop stronger mechanisms to address forest issues. At the same time, other stakeholders can play a role in supporting VSIs' contribution to a more responsible path forward for the sector.

Table 3 below provides concrete actions for major stakeholders to contribute to achieving a more responsible mineral sector. By focusing on these essential, targeted actions, VSIs can significantly strengthen their capacity to mitigate the forest impacts of mining. At the same time, non-VSI stakeholders can play a crucial role in reinforcing and amplifying these efforts through active engagement, improved reporting, supportive policies, and financial incentives. Together, these recommendations offer a clear, actionable roadmap toward a more accountable, transparent, and forest-friendly mining sector.

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Table 3. Concrete actions stakeholders could take to help address forest impacts from the mining sector, organized according to the challenges identified in the text.

STAKEHOLDER: VSIs	
Enhancing forest-specific coverage and supporting implementation	**Strengthening the business case and leveling the playing field**
- Provide clear, actionable, forest-specific guidance and performance indicators for companies to achieve positive outcomes for forests and avoid potential greenwashing claims. - Include the perspectives of all stakeholders in the design, implementation, and governance of their standards, including stakeholders who may be most impacted by negative forest outcomes and/or those most attuned to these issues (e.g., environmental NGOs and local communities).[96] - Provide localized technical support and educational materials to improve implementation of standards on the ground and enhance understanding of their intent.	- Design certification schemes to encourage and reward the gradual improvement of certified entities. - Explore ways for quantifying conformance to requirements to establish a basis for assigning a financial value to good performance; this could facilitate access to nature credits by certified / assured businesses. - Coordinate with governments of jurisdictions where the VSI is active to strengthen minimum performance requirements in public regulations to level the playing field for high-performing companies. - Align guidance and requirements with goals and targets of the Global Biodiversity Framework (GBF).
Improving supply chain traceability and transparency	**Consolidation and alignment of standards and enhancing data availability**
- Work with initiatives focused on traceability, ESG data management/reporting, product passports, etc. to facilitate data sharing/reporting and enhance the role of these initiatives in helping members to achieve compliance with VSS. - Introduce chain of custody standards. - Incorporate requirements that lead to greater disclosure of actions that may enhance forest protection. For example: disclosure of licenses, permits and contract terms; environmental sanctioning processes and incidents; mine closure plans; circularity strategies and plans; methodologies used to assess nature-related dependences, impacts, risks, and opportunities; environmental monitoring practices; grievance mechanisms and management; emergency preparedness strategies; implementation of and respect for FPIC; sustainability investments; anti-corruption measures and incidents; responsible sourcing requirements for suppliers; emissions and contamination rates and incident management; stakeholder engagement practices, etc.[97]	- Collaborate with other VSIs on the development of forest-specific guidance (in addition to other biome-specific guidance materials). - Include requirements to assess and disclose forest impacts, risks, and opportunities in line with existing guidance such as GRI or TNFD, and utilizing a double materiality approach. - Incorporate the OECD's Handbook on Environmental Due Diligence in Mineral Supply Chains into requirements and guidance.

STAKEHOLDER: UPSTREAM COMPANIES IN MINERAL SUPPLY CHAINS	
Enhancing forest-specific coverage and supporting implementation	**Strengthening the business case and leveling the playing field**
- Engage with VSIs to strengthen forest-related standards and criteria. - Actively participate in VSI governance and consultation processes, providing feedback and sharing relevant data.	- Publicly commit to continuous improvement in nature-based and forest-smart mining practices,[98,99,100] aligning with VSI standards and sharing concrete transition plans. - Publicly commit to nature-positive actions, in alignment with ICMM's 2024 Nature Position Statement[101]
Improving supply chain traceability and transparency	**Consolidation and alignment of standards and enhancing data availability**
- Work with VSIs to adopt consistent reporting frameworks (e.g., GRI/TNFD) to build a shared, high-quality data pool that reflects on-the-ground realities and allows for comparability, interoperability of systems, and ease of use by interested stakeholders.	- Support VSIs' efforts to align and consolidate standards by participating in consultations and providing constructive input to maintain high levels of ambition in consolidated guidance.

STAKEHOLDER: DOWNSTREAM COMPANIES IN MINERAL SUPPLY CHAINS	
Enhancing forest-specific coverage and supporting implementation	**Strengthening the business case and leveling the playing field**
- Encourage and support VSIs to adopt more comprehensive requirements that will more effectively conserve and improve forest health, for example by participating in their governance bodies, standards committees and standards consultation processes.	- Leverage market influence to favor suppliers that meet enhanced VSI standards, thus reinforcing the business case for better forest stewardship. - Advocate for the inclusion of strong forest protections in mineral trade agreements and due diligence requirements. - Invest in programs to strengthen forest governance, regenerate forests and improve environmental due diligence in forested territories to which they are connected.[102]
Improving supply chain traceability and transparency	**Consolidation and alignment of standards and enhancing data availability**
- Embed forest conservation requirements into contracts with upstream suppliers, ensuring that these standards align with improved VSI criteria. - Incentivize suppliers to report on their nature-related impacts, risks, and opportunities in accordance with guidance such as GRI or TNFD, and utilizing a double materiality approach.	- Support VSIs' efforts to align and consolidate standards by participating in consultations and providing constructive input to maintain high levels of ambition in consolidated guidance.

STAKEHOLDER: FINANCIAL INSTITUTIONS AND INVESTORS	
Enhancing forest-specific coverage and supporting implementation	**Strengthening the business case and leveling the playing field**
- Encourage VSIs to adopt more comprehensive requirements that will more effectively conserve and improve forest health, for example by participating in their governance bodies, standards committees and standards consultation processes. - Provide funding and technical support to VSIs for developing robust, science-based forest impact metrics and reporting tools.	- Make adherence to stringent VSI standards a condition for investment or lending and use contractual mechanisms to enforce this commitment. - Support investees that need help to improve their adherence to enhanced VSI standards over time, e.g. Enhanced Human Rights Due Diligence (eHRDD) implementation.
Improving supply chain traceability and transparency	**Consolidation and alignment of standards and enhancing data availability**
- Promote transparency by requiring investees to disclose their nature-related risks and impacts in accordance with guidance such as GRI or TNFD, and utilizing a double materiality approach as standard. - Put in place whistleblowing and operational grievance mechanisms to support affected rights holders to access remedy by reporting investees' impacts to their investors and financiers (e.g., ABN Amro).[103]	- Support VSIs' efforts to align and consolidate standards by participating in consultations and providing constructive input to maintain high levels of ambition in consolidated guidance. - Support alignment of scope between financial reporting standards (entity / HQ level) and mining VSS (typically site-level) to allow for greater dependence by financial institutions on mining and mineral value chain VSIs and thus reduce the reporting / audit burden on miners and their supply chain partners.

STAKEHOLDER: GOVERNMENTS (PRODUCER COUNTRIES)	
Enhancing forest-specific coverage and supporting implementation	**Strengthening the business case and leveling the playing field**
- Engage with VSIs to support ground-level implementation of standards - Become involved in governance of VSIs operating within their jurisdiction. - Support access to relevant government-generated data by auditors.	- Collaborate with VSIs to understand the common weaknesses and challenges that exist for miners in their jurisdiction, and to use these learnings to strengthen policy, law and technical assistance. For example, by taking learnings from audit findings and VSIs' localization initiatives. - Set a minimum performance standard via regulation, which voluntary standards can then build upon to raise sustainability efforts. - Consider rewarding companies that demonstrate compliance with VSS that go beyond regulatory compliance (e.g., through preferential licensing processes, concessions on fiscal rates, etc.).
Improving supply chain traceability and transparency	**Consolidation and alignment of standards and enhancing data availability**
- Provide technical assistance and real-time monitoring (e.g., deforestation alert systems) to help ensure that VSI standards are effectively implemented on the ground. - Enhance capacity of public regulatory agencies (i.e., through allocating sufficient budget) to provide oversight of mining activities and avoid over-reliance on VSIs.[104]	- Require companies operating within their jurisdiction (or importing into their markets) to disclose forest risks and impacts according to internationally recognized frameworks, utilizing a double materiality approach.

STAKEHOLDER: GOVERNMENTS (CONSUMER COUNTRIES)	
Enhancing forest-specific coverage and supporting implementation	**Strengthening the business case and leveling the playing field**
- Become involved in governance of VSIs adopted by companies that export into their consumer market.	- Mandate companies selling into their markets to report in accordance with guidance such as GRI or TNFD, utilizing a double materiality approach, as a condition of market entry. - If mineral sector companies and projects are allowed to demonstrate their compliance with public regulations through certification with a recognized scheme, the regulations should set minimum requirements that voluntary schemes must meet to be eligible to validate compliance.
Improving supply chain traceability and transparency	**Consolidation and alignment of standards and enhancing data availability**
- Incentivize and enable insetting to finance forest conservation and restoration as part of downstream companies' strategies for addressing climate change, biodiversity, and human rights issues in their supply chains.	- Lobby trading partners to become members of the Extractive Industries Transparency Initiative (EITI). - Through bilateral donor relationships, support producer countries to adopt systems for disclosing information on their minerals sectors (e.g., publicly available databases).

STAKEHOLDER: INTERNATIONAL POLITICAL INSTITUTIONS (E.G., UNITED NATIONS ENVIRONMENT PROGRAMME)	
Enhancing forest-specific coverage and supporting implementation	**Strengthening the business case and leveling the playing field**
- Promote awareness among VSIs, mineral sector companies and other relevant sectoral stakeholders of best practices in forest- and biodiversity-smart mining, including an emphasis on how to avoid greenwashing.	- Facilitate dialogue between governments, companies, VSIs, local communities, and other relevant groups to share knowledge and coordinate actions in the interest of balancing forest and mining interests. - Raise awareness and disseminate success stories in forest- and biodiversity-smart mining, helping to drive global adoption of robust VSI standards.
Improving supply chain traceability and transparency	**Consolidation and alignment of standards and enhancing data availability**
- Promote uptake of double materiality in corporate sustainability disclosure, including through encouraging VSIs to adopt related requirements and/or guidance.	- Help fund and technically support initiatives that drive VSI alignment with GBF targets and improved data methodologies.

STAKEHOLDER: DEVELOPMENT FINANCE INSTITUTIONS	
Enhancing forest-specific coverage and supporting implementation	**Strengthening the business case and leveling the playing field**
- Work directly with VSIs that have a national or regional presence to provide capacity-building support, focusing on technical assistance and standardized data collection. - Support financing for projects that adhere to forest-smart mining principles and demonstrate clear, measurable improvements in forest conservation aligned with enhanced VSI criteria.	- Support the adoption of VSIs by industry in jurisdictions with high-value forests and where the mining and minerals sector is in fast development (e.g., Indonesia, DRC, Brazil, Zambia, Myanmar, Ghana, etc.).
Improving supply chain traceability and transparency	**Consolidation and alignment of standards and enhancing data availability**
- Promote uptake of double materiality in corporate sustainability disclosure, including through encouraging VSIs to adopt related requirements and/or guidance.	- Provide financial assistance so that producer country governments and civil society organizations can participate in VSI governance, standard-setting, auditing and reporting processes.

Annex

Table 4a. Summary of VSIs targeting LSM, reviewed according to their overall scope (listed alphabetically).

VSI (STANDARD/ GUIDANCE SETTERS)	TYPE OF VSI	COMMODITIES COVERED	LEVEL AT WHICH STANDARD/GUIDANCE APPLIES	VERSION OF STANDARD(S)/GUIDANCE REVIEWED	INTERVIEWED FOR THIS PAPER (Y/N)
Aluminium Stewardship Initiative (ASI)	Responsible mining standard	Aluminum (+ bauxite, alumina)	Entire supply chain	ASI Performance Standard – Guidance (Version 3.2)	Y
Bettercoal	Responsible metallurgy and sourcing standard	Coal	- The principal activities and facilities associated with the mining and extraction of coal; - All sites and facilities for the management of waste, storing and maintenance of equipment, offices and administration, and other auxiliary activities; and - Activities and facilities critical to the viability of the Bettercoal Supplier's mine site operation, such as the transport of coal to points of sale and storage facilities at ports and terminals.	Bettercoal Code 2.0	N
Code of Responsible Mineral Extraction (CORE)	Responsible mining standard	Twelve industrial minerals	Mine site	CORE (not available publicly)	Y
Consolidated Mining Standard Initiative (CMSI) DRAFT STANDARD NOT YET OPERATIONAL	Responsible mining standard	All minerals	Primarily implemented at the Facility level, though a minority of performance areas are assessed, in part or in full, at a corporate level. A Facility includes the footprint of all operational activities (i.e. mine, ancillary Facilities such as power plants, smelter, etc.) under the operational control of the company and typically located in geographic proximity.	Consolidated Mining Standard: PUBLIC CONSULTATION DRAFT	N
Global Battery Alliance (GBA)	Product-level sustainability certification scheme	All minerals, metals, and other materials along the entire battery value chain	Any battery manufacturer can seek a GBA Battery Passport certification for its product. In the future, any site along the battery value chain will be able to seek a site-level certification	Biodiversity Rulebook Indigenous Peoples' Rights Rulebook	Y
Global Reporting Initiative (GRI)	Sustainability reporting standard	All types of minerals, metallic and nonmetallic, except for oil, gas, and coal	Exploration, extraction (including quarrying), and primary processing	GRI 14: Mining Sector 2024 GRI 101: Biodiversity 2024	Y
International Council on Mining and Metals (ICMM)	Responsible mining standard	All mineral resources	Asset level (mining or metals) as well as corporate level	Mining Principles (November 2024) Position Statement on Nature	Y

VSI (STANDARD/ GUIDANCE SETTERS)	TYPE OF VSI	COMMODITIES COVERED	LEVEL AT WHICH STANDARD/GUIDANCE APPLIES	VERSION OF STANDARD(S)/GUIDANCE REVIEWED	INTERVIEWED FOR THIS PAPER (Y/N)
London Bullion Market Association (LBMA)	Responsible metallurgy and sourcing standard	Gold and silver	Refining	LBMA Responsible Gold Guidance: Version 9 LBMA Responsible Silver Guidance: Version 2	Y
Towards Sustainable Mining (TSM)	Responsible mining standard	All mineral resources	Upstream (Mine site, on-site processing, smelting/refining)	Towards Sustainable Mining: Biodiversity Conservation Management Protocol (Version CAN 2.0) Towards Sustainable Mining: Indigenous and Community Relationships Protocol (Version CAN 3.0)	Y
Prospectors & Developers Association of Canada (PDAC) - Driving Responsible Exploration (DRE)	Responsible mineral exploration	All mineral commodities	Mineral exploration	Environmental Stewardship e-Toolkit: Version 2.0 Methodology to Assess Mining-Related Land Disturbance	Y
Responsible Jewellery Council (RJC)	Responsible metallurgy and sourcing standard	Gold, silver, PGM, diamond and coloured gemstones	Mine to retail	Code of Practices Standard (Version 1.2)	N
Responsible Minerals Initiative (RMI)	1-3: Responsible metallurgy and sourcing standards	1-3: All mineral commodities, with exceptions specified in each individual standard/ guidance document	1: Any upstream stage, from processors all the way to the mining stage included 2: Any upstream stage, from processors all the way to the mining stage included. 3: Applicable to smelters, refiners, metal processors, recyclers, and downstream facilities	1: Global Responsible Sourcing Due Diligence Standard for Mineral Supply Chains: All Minerals (Version 1.1) 2: ESG Standard for mineral supply chains (June 2021) 3: ESG Facility-Level Performance Standard (Draft for Public Consultation)	Y
ResponsibleSteel	Responsible metallurgy and sourcing standard	Steel	Operational steelmaking sites and related sites that process input materials for steelmaking, or that produce steel products. It does not apply to service providers, mine sites, or to sites producing products made with multiple components. At the highest levels of certification, it requires high levels of upstream certification via recognized VSIs.	ResponsibleSteel International Production Standard (Version 2.1)	Y

VSI (STANDARD/ GUIDANCE SETTERS)	TYPE OF VSI	COMMODITIES COVERED	LEVEL AT WHICH STANDARD/GUIDANCE APPLIES	VERSION OF STANDARD(S)/GUIDANCE REVIEWED	INTERVIEWED FOR THIS PAPER (Y/N)
Chinese Chamber of Commerce of Metals, Minerals and Chemicals (CCCMC)	1: Responsible sourcing 2: Responsible mining	1: 3TG minerals (tin, tantalum, tungsten, and gold) 2: All mineral commodities	1: Companies which are extracting and/or using mineral resources and their related products and are engaged at any point in the supply chain of minerals. 2: These Guidelines apply to all mineral exploration, extraction, processing and investment cooperation projects in which Chinese companies have invested. They are also applicable for exploration, extraction, processing and investment cooperation of mineral and energy resources inside and outside of China, as well as mining-related infrastructure construction.	1. Chinese Due Diligence Guidelines for Responsible Mineral Supply Chains 2. Guidelines for Social Responsibility in Outbound Mining Investments	N
Organisation for Economic Co-operation and Development (OECD)	1: Responsible mining 2: Responsible mining and sourcing	1-2: All mineral commodities	Both are guidelines, not standards; they apply at the corporate level	1. OECD Due Diligence Guidance for Responsible Business Conduct 2. Handbook on Environmental Due Diligence in Mineral Supply Chains	N
The Initiative for Responsible Mining Assurance (IRMA)	Responsible mining	All mined materials (e.g., minerals, metals), with the exception of energy fuels	Mine site	Draft Standard 2.0 for Responsible Mining and Mineral Processing	Y
World Gold Council (WGC)	Responsible mining	Gold	Consumers, investors and the downstream supply chain	Responsible Gold Mining Principles	N

Table 4b. Summary of VSIs targeting ASM, reviewed according to their overall scope (listed alphabetically).

VSI (STANDARD/ GUIDANCE SETTERS)	TYPE OF VSI	COMMODITIES COVERED	LEVEL AT WHICH STANDARD APPLIES	VERSION OF STANDARD(S)/GUIDANCE REVIEWED	INTERVIEWED AS PART OF RESEARCH FOR THIS PAPER (Y/N)
Alliance for Responsible Mining (ARM)	Responsible mining	Gold and associated precious metals	Mine site	Fairmined Standard For Gold From Artisanal and Small-Scale Mining, Including Associated Precious Metals (Version 2.0) CRAFT 2.1	Y
GemFair	Responsible mining standard	Diamonds	Mine site	Artisanal and Small-Scale Mining Standard: Requirements 2021	Y
planetGOLD (not a voluntary standard, it is required as part of international law)	Responsible mining standard	Gold	Mine site	planetGOLD Criteria for Environmentally and Socially Responsible Operations: Version 2.0	Y

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