

ISS ESG

Critical Mineral Series

Sustainability Considerations for Investors in Copper Mining

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Key Takeaways

- The transition to a more resilient energy sector largely relies on an increasing use of renewable energy sources and the adoption of new technologies. Both require extensive use of minerals, particularly critical minerals. Copper, being one of the most conductive non-precious metals, is vital for many industries necessary for the energy transition.
- Global copper demand is projected to surge by approximately 70% by 2050, with large-scale uses in power delivery and electrification, expansion of electric vehicles, and other renewable energy technologies.
- Our data shows that sustainability issues, such as access to water, pollution, and human rights, present potential risks to investors in the metals and mining industry, particularly copper mining.
- Institutional investors can benefit from having a better understanding of the sustainability profile of the copper-mining companies in their portfolio and help assess which companies are best positioned to manage sustainability risk and meet international global standards and regulations around responsible mining.

Critical Minerals and Their Role in Achieving Energy Security

Global economic players remain committed to ensuring energy security, particularly in an environment of rising geopolitical instability.

The transition to a more resilient energy sector, which includes the rise of renewables, requires extensive mineral resources to construct new electricity grids, fabricate solar panels, and build batteries, among other activities. Critical minerals — lithium, copper, cobalt, rare earth elements, and others — are essential to renewable energy systems, as well as electric vehicles and other advanced technologies. As UNEP notes, the consumption of these crucial raw minerals could increase sixfold by 2050, with their market value reaching USD400 billion, exceeding the value of all coal mined in 2020.

As the sector is set to attract further capital, the mining industry is increasingly expected to assess, manage, and disclose its sustainability-related impacts, dependencies, risks, and opportunities. To this end, ISS STOXX's Natural Capital Research Institute, in collaboration with colleagues across the ESG research and product teams, is launching a publication series that examines the sustainability profile of mining companies, leveraging data from various solutions, including the ESG Corporate Rating, Biodiversity Impact Assessment Tool, Modern Slavery Solution, Norm-Based Research, and Economic Value Added. This first publication focuses on copper mining.

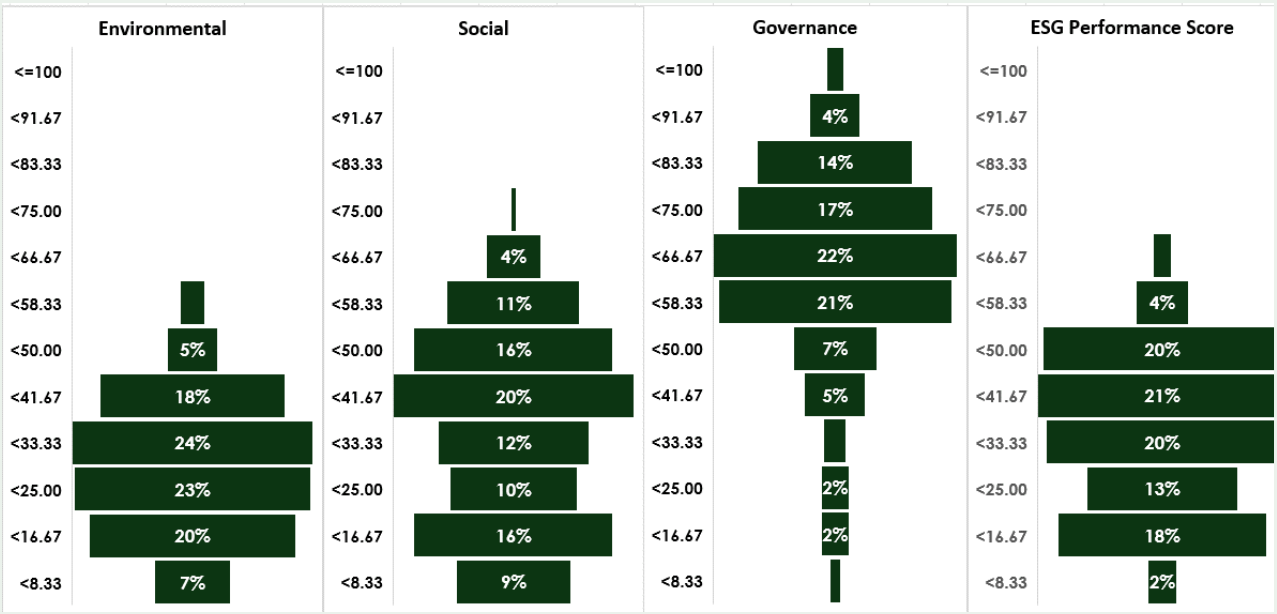
Box 1: Mining Companies Have a Relatively Stronger Governance Profile

The ISS ESG Corporate Rating provides an overview of the sustainability profile of publicly listed mining companies today. It analyzes more than 200 mining companies.

Of the total universe of mining companies, around 6% have achieved the "Prime" status, which is granted to companies that have a demonstrated ability to adequately manage material ESG risks, mitigate negative and generate positive social and environmental impacts, and capitalize on opportunities offered by transformation towards sustainable development. The overall Prime threshold for the Mining industry is "B-" (with an ESG performance score of 50).

Figure 1 shows an overview of the overall performance of mining companies across the Environmental, Social, and Governance pillars, with a clear outperformance for Governance.

Figure 1: ESG Performance of Mining Companies



Note: As of April 2025, 203 Mining Companies were assessed.
Source: *ISS STOXX Natural Capital Research Institute, based on ISS ESG Corporate Rating*

The mining industry may perform better on the Governance pillar for various reasons. Mining projects are inherently risky for investors and need time to become operational and then profitable. Increased transparency on Governance was historically used to mitigate some of these inherent risks and attract investment.

In addition, due to the size of the mining sector and the potential impacts of poor governance in the sector on countries' economies through possible corruption, lobbying, and certain tax practices, mining is heavily regulated. For example, in Canada, the sector is required by the Extractive Sector Transparency Measures Act (ESTMA) to report any payments to governments.

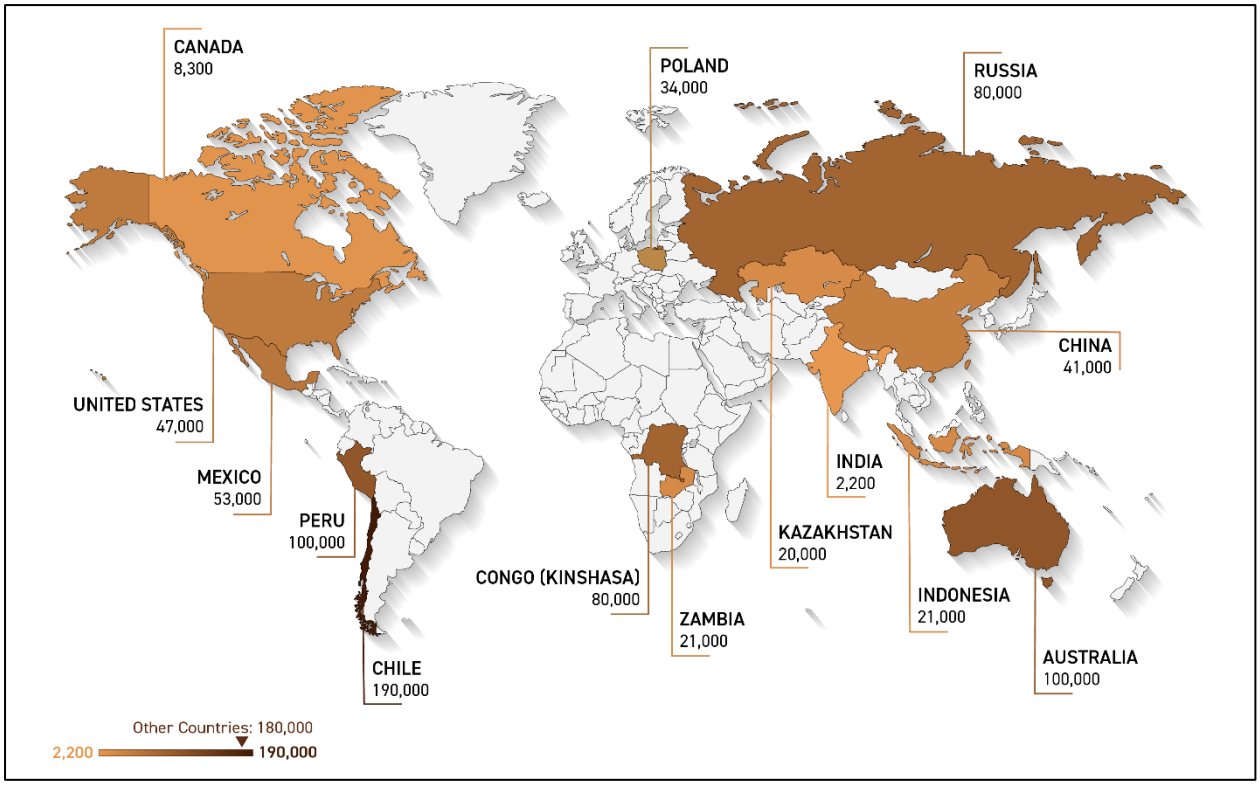
Copper: The Metal of Electrification

Copper is a vital metal known for its malleability and exceptional electrical and thermal conductivity. Due to its wide range of applications (electronics, connectivity, artificial intelligence, construction, transport, etc.), global copper consumption is substantial. This high demand exerts considerable strain on the world's copper reserves.

The most recent U.S. Geological Survey assessment of global copper resources indicated that, as of 2015, identified copper resources consist of 2.1 billion metric tons (Mt) while undiscovered resources amount to at least 3.5 billion Mt of copper.

Figure 2 shows the USGS estimate of global copper reserve distribution as of January 2025.

Figure 2: World Copper Reserve



Note: Data in 1,000 metric tons.
Source: *ISS STOXX Natural Capital Research Institute, based on U.S. Geological Survey, Mineral Commodity Summaries, January 2025.*

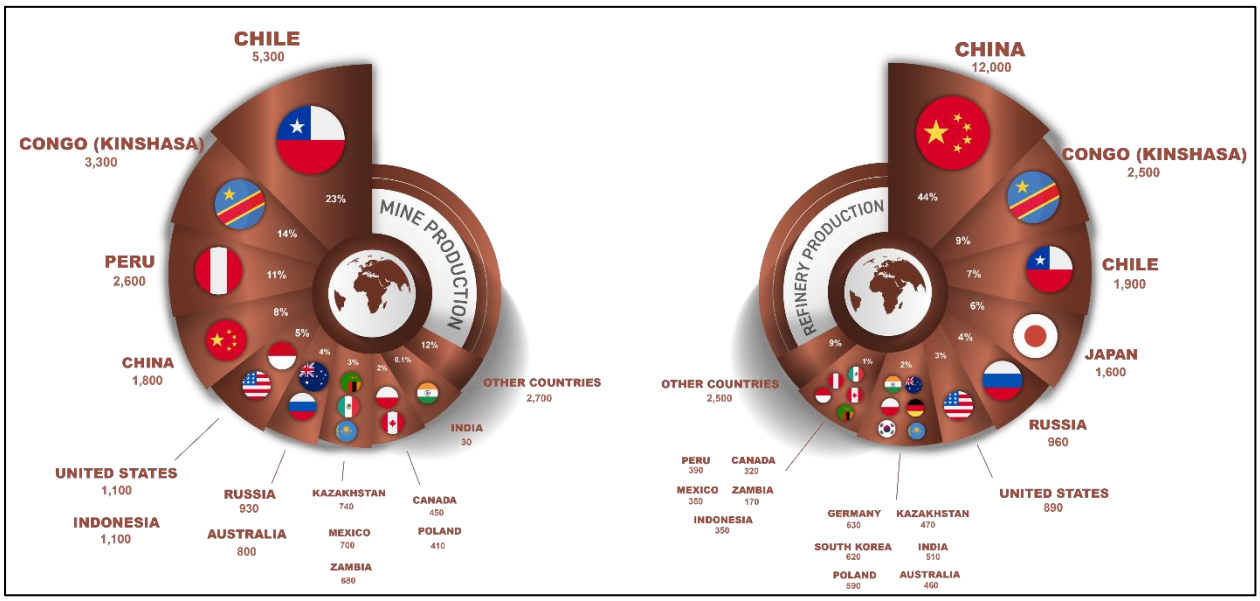
Being the most conductive non-precious metal, copper is vital for many industries, as reflected by the approximately 30% increase in global copper consumption from 2010 to 2022.

In 2023, global refined copper usage reached a record high of nearly 27 million Mt since 2010, of which 70% is used in electrical/conductivity applications and communications.

Figure 3 shows the highest copper-producing countries as well as the highest copper refinery-production countries. Chile is the highest copper producer, followed by the

Democratic Republic of Congo (DRC) and Peru, while China dominates the copper refinery-producing country list.

Figure 3: Countries with the Highest Copper Mine Production and Highest Copper Refinery Production



Note: Data in 1,000 metric tons.
***Source:** ISS STOXX Natural Capital Research Institute, based on U.S. Geological Survey, Mineral Commodity Summaries, January 2025.*

Global copper demand is projected to surge by approximately 70% by 2050, with large-scale deployment in power and automotive applications needed to meet 2050 Net Zero targets.

Box 2: Opportunities for Copper "Circularity"

Millions of tons of e-waste are currently deposited in landfills each year, representing a lost opportunity to recover critical materials, including copper. Copper is a 100% recyclable material that can be reused without any loss of its chemical or physical properties, making it an ideal candidate for circular economy practices.

Recycled or secondary copper could meet 50% of the total copper demand by 2050. Recycling copper extends the efficiency of its use and can help ensure a sustainable supply of the metal for future generations.

Recycling copper is considered a highly efficient way of reintroducing a valuable material back into the economy. The environmental benefits of recycling include saving energy, reducing emissions of greenhouse gases and other air pollutants linked to primary copper production, and keeping valuable land from use as landfills.

By 2040, renewable energy technologies are predicted to require 61% of the total global share of copper.

Impact and Dependencies of Copper Mining on Nature

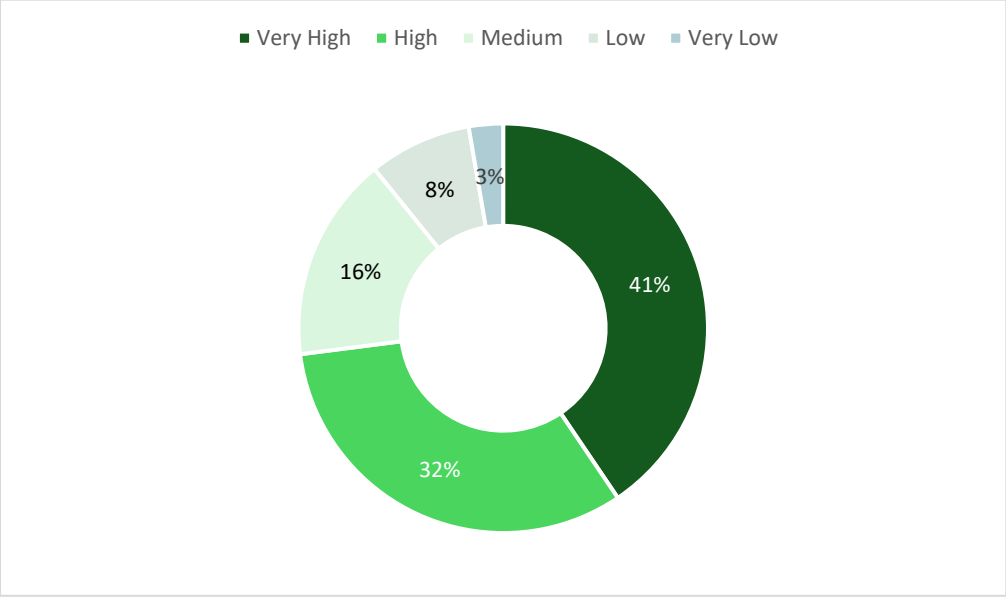
The impacts of mining activities on nature occur at multiple levels—site, landscape, regional, and global levels—and through direct means (such as mineral extraction) and indirect means (such as industries that support mining operations).

The environmental impact of the copper industry has been well documented, prompting concerns about sustainable copper production and its long-term effects on biodiversity and ecosystems. Mining operations also lead to a decline in the groundwater level, resulting in a decrease in groundwater resources for the community.

ISS ESG's proprietary Biodiversity Impact Assessment Tool (BIAT) analyzes the impact and dependencies of copper mining companies on nature. The BIAT is based on LCIA (Lifecycle Impact Assessment), the output of which is PDF (Potentially Disappeared Fraction of Species). The PDF quantifies the potential loss of species richness due to adverse environmental pressures, relative to species richness in undisturbed ecosystems, often referred to as the "pristine state."

Among the 42 copper mining companies analyzed, more than 27 companies (> 70 %) have a high or very high impact on biodiversity (Figure 4). This biodiversity impact classification considers both the intensity of biodiversity impact and scale of impact.

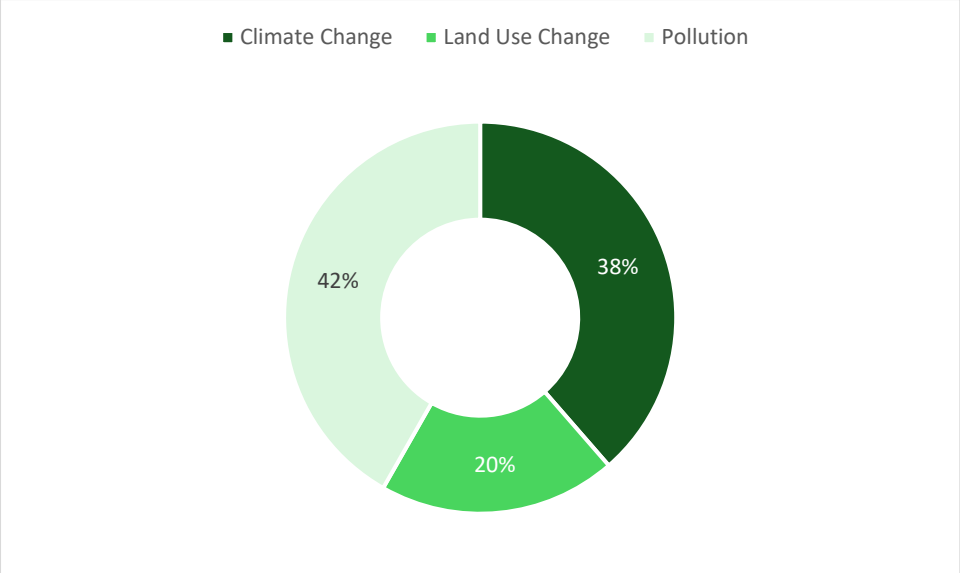
Figure 4: Revenue-Adjusted Biodiversity Impact Classification of Selected Copper Mining Companies



Note: As of April 2025, 42 copper mining companies were assessed.
***Source:** ISS STOXX Natural Capital Research Institute, based on ISS ESG Biodiversity Impact Assessment Tool (BIAT) data*

The direct IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) impact drivers for nature loss due to copper mining are pollution, land use changes, and changes in climatic conditions. As per BIAT analysis (Figure 5), pollution contributes the most to copper mining's direct impact on nature, followed by climate change and land use and land change.

Figure 5: Nature Loss Impact Drivers for Copper Mining Companies



Note: As of April 2025, 42 copper mining companies were assessed. Model assumes 1MM EUR is invested in all the copper mining companies equally. Impact drivers for nature loss are from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.
***Source:** ISS STOXX Natural Capital Research Institute, based on ISS ESG-Biodiversity Impact Assessment Tool (BIAT) data*

Pollution includes both air pollution (toxic fumes from copper mines such as SO2 and particulate matter, both fine and ultrafine) and water pollution (acid mine drainage into both surface and ground water).

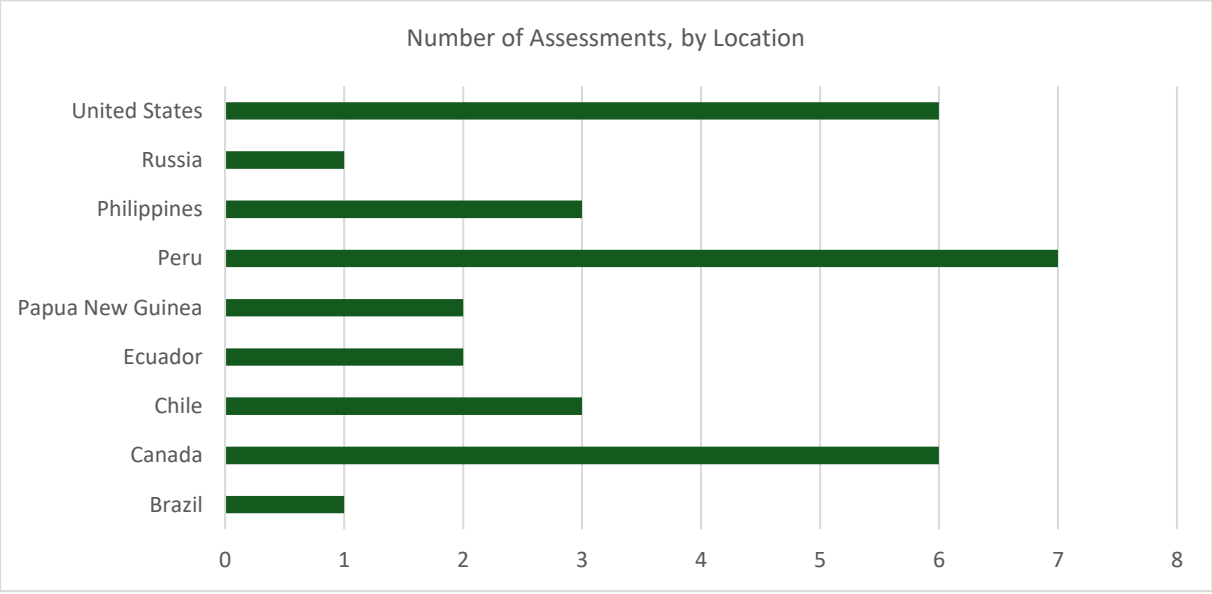
When looking at ecosystem services dependencies, the BIAT analysis shows that almost two-thirds of the copper mining companies depend on regulation & maintenance services, such as climate regulation, erosion control, water flow maintenance, and flood protection. One-third of the companies are dependent on provisioning services, such as surface and ground water.

Copper Mining and Human Rights Implications: Indigenous Populations and Modern Slavery

The copper mining sector poses serious human rights concerns, including exploitation of workers and environmental degradation in local areas. Furthermore, indigenous populations can suffer displacement and loss of their traditional livelihoods due to mining operations. Meeting these human rights challenges requires rigorous due diligence and sustainable practices to safeguard vulnerable communities.

ISS ESG Norm-Based Research (NBR) assesses companies' adherence to international norms, including those specific to Indigenous Peoples' rights such as the ILO Convention No. 169 and the United Nations Declaration on the Rights of Indigenous Peoples. As of May 2025, ISS ESG NBR maintains 31 assessments for 29 companies which were or are currently involved in an alleged failure to respect indigenous rights in connection to mining projects or ongoing activities related to copper production (Figure 6).

Figure 6: ISS ESG NBR Assessments Involving an Alleged Failure to Respect Indigenous Rights Related to Copper Activities by Controversy Location



Source: *ISS STOXX Natural Capital Research Institute, based on ISS ESG Norm-Based Research Data, May 12, 2025*

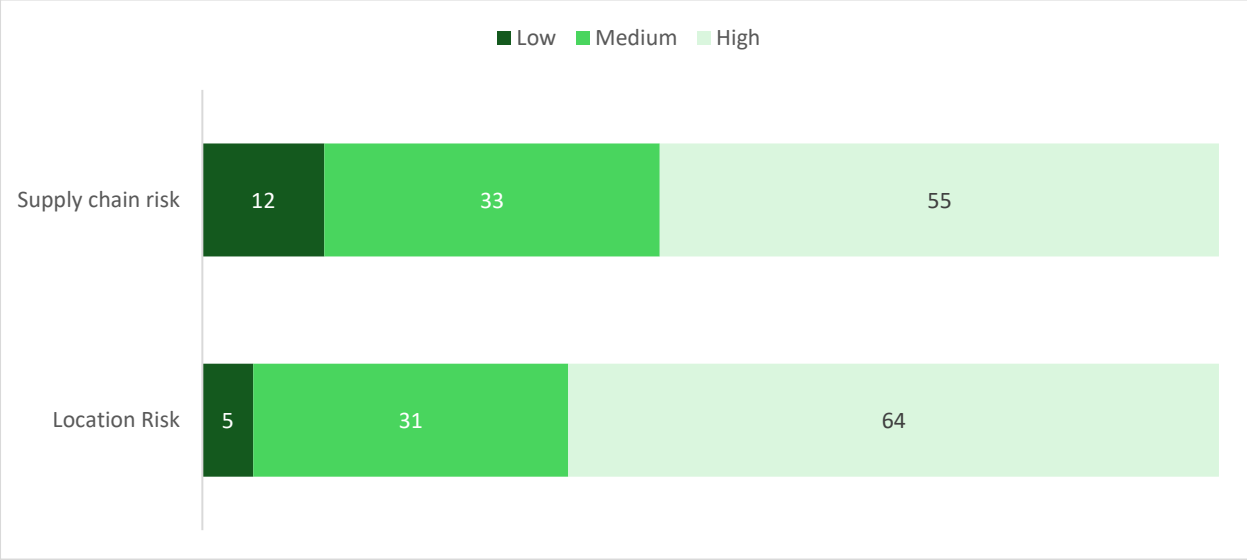
The assessments underline the companies' potential or material impacts on indigenous communities and the companies' measures to address these controversies. The most common allegations are the companies' lack of adequate and meaningful consultation and non-compliance with the principle of Free, Prior and Informed Consent (FPIC), as well as impacts on Indigenous People's lands and, consequently, on their livelihoods.

Of the companies involved in the most severe controversies identified by NBR, 43% have been responsive to engagement outreach by ISS ESG's Norm-Based Engagement (NBE), which facilitates engagement with companies on behalf of participating investors.

The Modern Slavery Solution (MSS) is an ISS ESG tool that allows investors to recognize, assess, and address modern slavery risks; and offers a comprehensive evaluation of a portfolio company's modern slavery risks within its operations and supply chain, its involvement in modern slavery controversies, and its efforts to mitigate those risks.

The MSS data shows that out of the 42 copper mining companies assessed, 69% are considered high risk and the remaining 31% medium risk. When looking at both supply and location risk specifically, location risk seems slightly more prevalent for copper mining companies, as seen in Figure 7.

Figure 7: Modern Slavery Risk Assessment among Copper Mining Companies

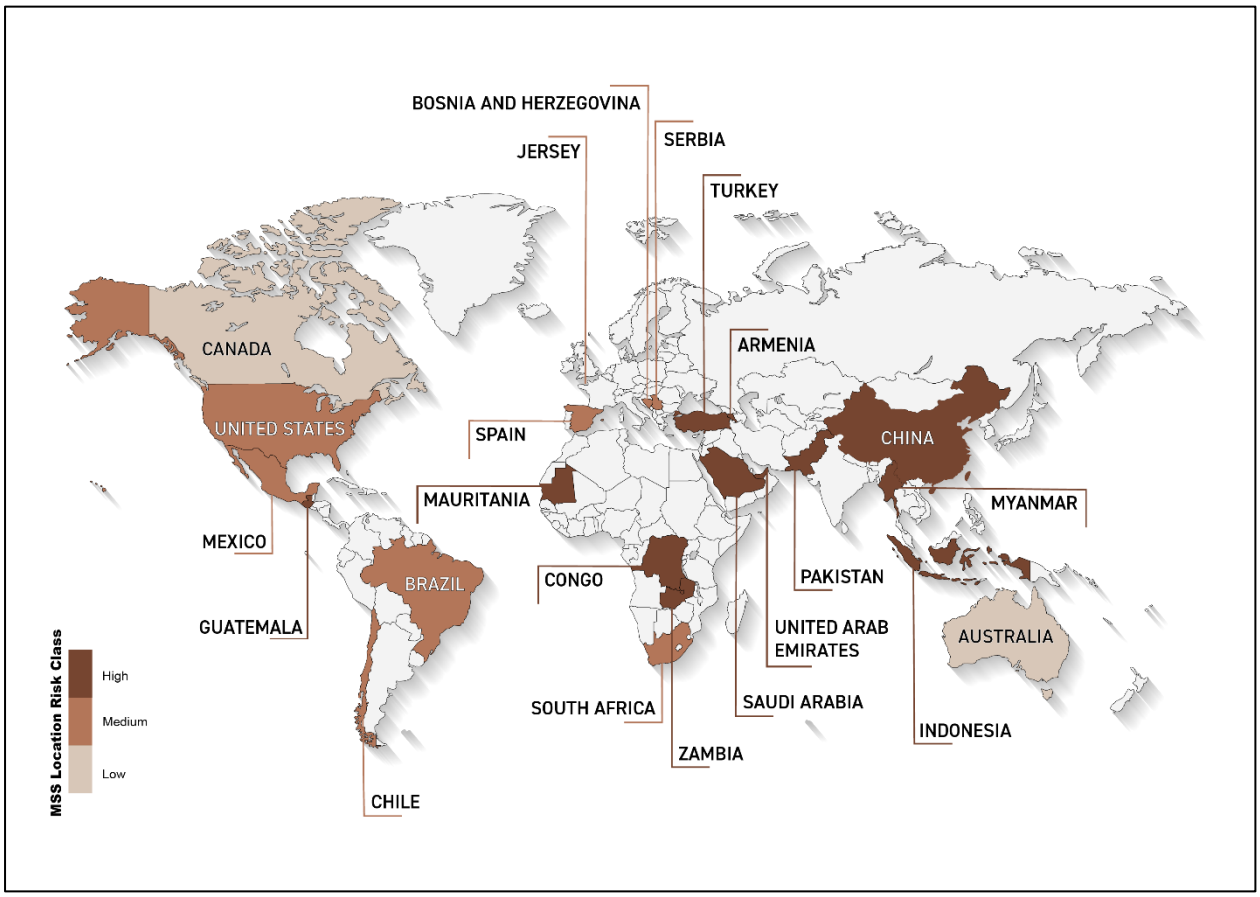


Note: As of April 2025, 42 copper mining companies were assessed.
Source: *ISS STOXX Natural Capital Research Institute, based on ISS ESG Modern Slavery Solution data*

"Location risk" reflects a company's vulnerability to modern slavery in its countries of operation, based on key factors that enable exploitative work, undermine support services, and impede access to justice.

Modern Slavery Solution research identifies 23 countries to be under the location risk category from copper mining (Figure 8), with 12 countries being in the high-risk category.

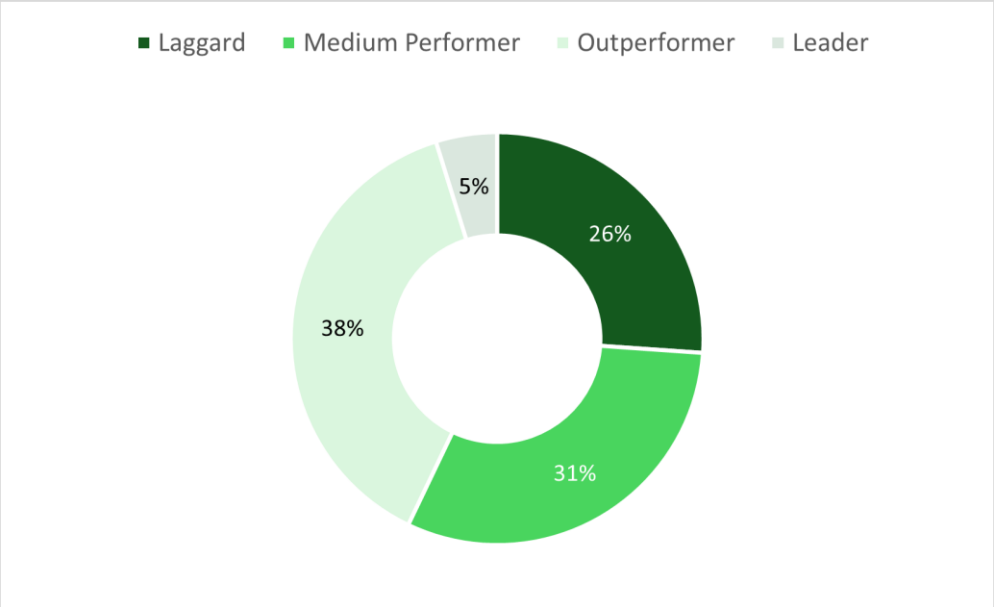
Figure 8: Companies with Operations in Potential Risk Locations



Source: *ISS STOXX Natural Capital Research Institute, based on ISS ESG Modern Slavery Solution data*

In regards to managing modern slavery risk, ISS ESG MSS shows that 38% of the copper mining companies have outperformed on disclosure and the quality of their policies and procedures to identify and mitigate modern slavery risks in their operations and supply chains (Figure 9).

Figure 9: Modern Slavery Risk Management Assessment among Copper Mining Companies



Note: As of April 2025, 42 copper mining companies were assessed.
Source: *ISS STOXX Natural Capital Research Institute, based on ISS ESG Modern Slavery Solution data*

According to the ISS ESG Modern Slavery Controversies assessment, 23 labor rights cases have been recorded within all 42 copper mining companies. These cases include child labor, forced labor, union rights, workplace discrimination, working conditions, and workplace health and safety. Among the companies assessed, 95% of the companies (40 companies) have no allegations regarding Modern Slavery Controversies, whereas 5% of the companies had past controversies that are either beyond the scope of the company to address or are undergoing remediation or are under observation by the companies.

Copper Mining and International Standards

Global efforts to address copper mining's environmental and social challenges are led by international standards established to promote responsible mining practices. These standards intend to cover broad-range issues, including environmental conservation, worker safety, community involvement, and ethical business conduct.

For instance, the International Council on Mining and Metals (ICMM) principles outline comprehensive performance expectations for ICMM members, with a focus on sustainable development and ethical practices. In January 2024, ICMM introduced nature-positive commitments to assist companies in expanding their existing initiatives and driving local and regional collaborations to protect and restore natural environments.

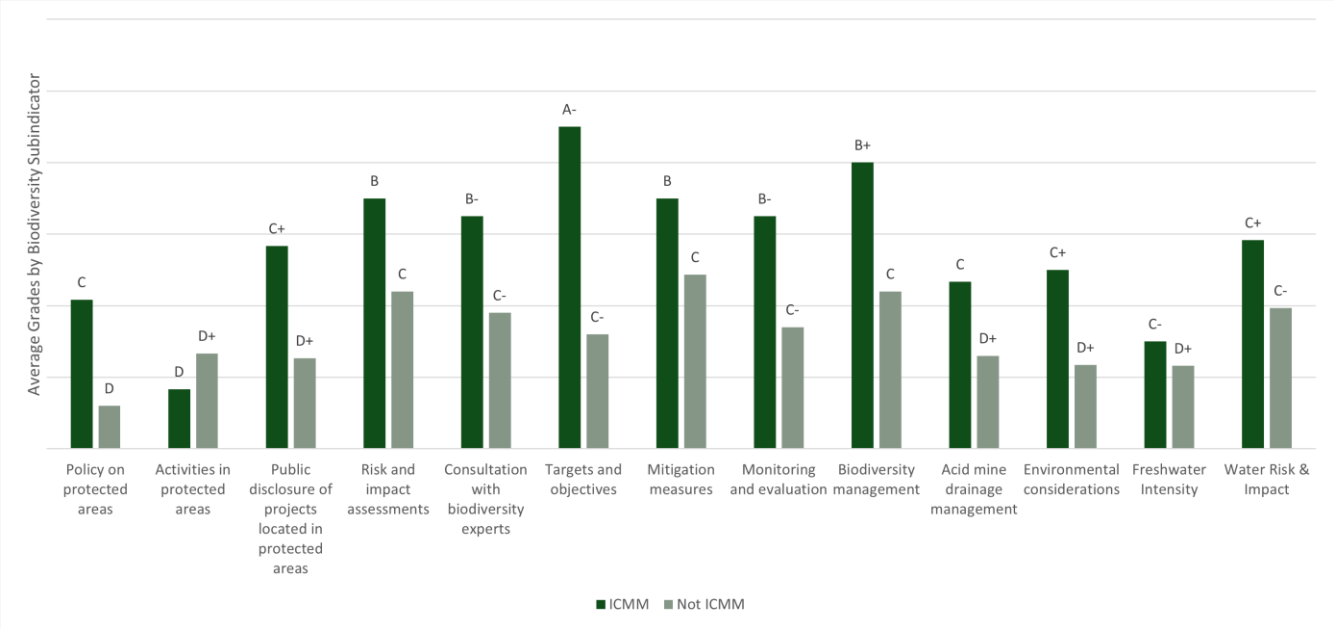
ICMM's nature-positive commitments are guided by the Global Biodiversity Framework. ICMM also partners with TNFD and IUCN to promote sustainable mining and nature-positive outcomes.

ICMM is a partner of the Committee for Mineral Reserves International Reporting Standards (CRIRSCO), an international organization accredited by the United Nations Economic Commission for Europe (UNECE) and the International Accounting Standards Board (IASB).

International Standards and Sustainability Performance

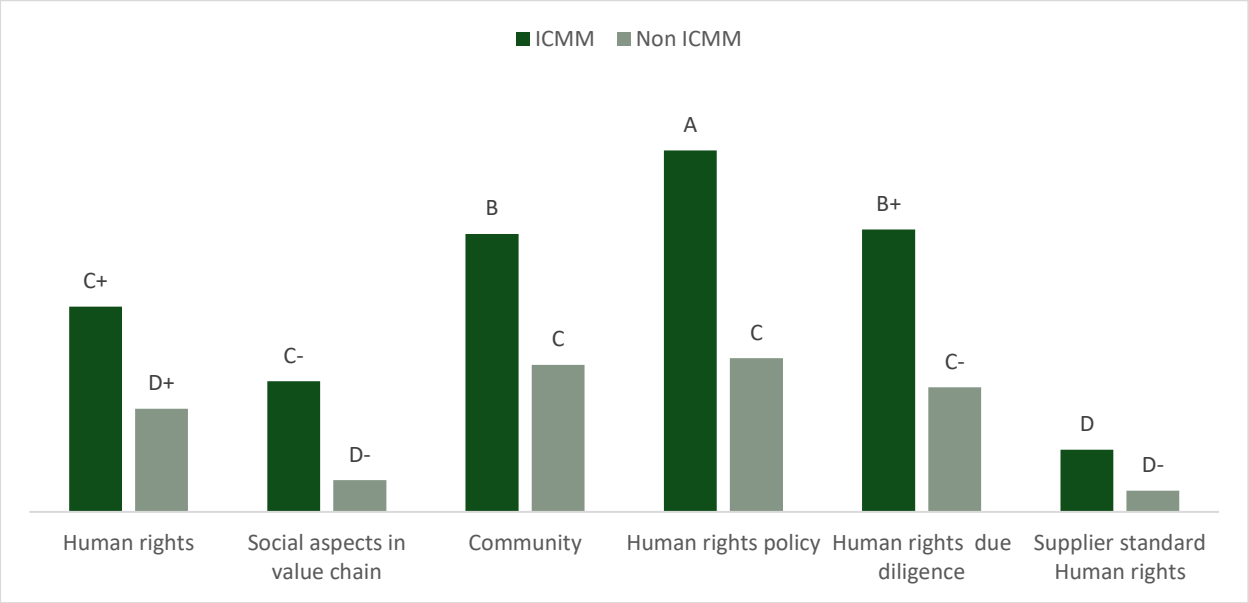
An analysis of companies in the ISS ESG Corporate Rating universe engaged in copper mining (n=42) shows, based on 13 biodiversity indicators and 6 social indicators, that companies in ICMM have better biodiversity scores (Figure 10) and social scores (Figure 11) than non-ICMM member companies.

Figure 10: Comparison of Biodiversity Indicators for Both ICMM and Non-ICMM Copper Mining Companies



Note: As of April 2025, 42 copper mining companies were assessed.
Source: *ISS STOXX Natural Capital Research Institute, based on ISS ESG Corporate Rating data*

Figure 11: Comparison of Social Indicators for Both ICMM and Non-ICMM Copper Mining Companies



Note: As of April 2025, 42 copper mining companies were assessed.
Source: *ISS STOXX Natural Capital Research Institute, based on ISS ESG Corporate Rating data*

The only metric on which ICMM members appear to be underperforming is the biodiversity indicator "Activities in Protected Areas." This underperformance is most likely because ICMM members are on average larger and have more operations and therefore more probability of having operations in or near protected areas.

Apart from biodiversity and social indicators, two water topic indicators were also analyzed: freshwater intensity and water risk impact. Member companies of ICMM outperform non-member companies on these indicators.

In regions with high water stress, mines frequently utilize shared water resources with local communities. This shared usage results in conflicts, especially in areas experiencing severe water shortages, and may lead to community unrest and interruptions in mining operations. Out of the top 20 copper mines by capacity, half are in high or extremely high water-stress areas or in arid climates where there are not many water sources.

Given that ESG factors are considered the primary risks for the mining and metals' industry, adherence to international standards may be an important consideration for investors in this space.

Box 3: Sustainability Considerations for Copper Mining Companies

The mining of copper has various implications for investors in regard to its sustainability and governance risks. Those risks are summarized in Table 1.

Table 1: Copper Mining and Environmental, Social, and Governance Risks

Environmental Impact	▪ The scale of open-pit mining requires significant land use, resulting in loss of biodiversity, habitat fragmentation, and deforestation. ▪ Copper mining generates significant waste, including tailings and slag, which leads to soil and water contamination if not properly managed. ▪ Mining operations require large amounts of water, leading to depletion of local water resources and potential conflicts with local communities.
Social Issues	▪ Copper mining leads to the displacement of local communities, causing social and economic disruptions, particularly in mines located in remote and ecologically fragile areas and local indigenous protected areas. ▪ Fair labor practices and concerns of modern slavery remain a critical challenge in the copper mining industry.
Governance Challenges	▪ Mining operations in politically unstable regions face higher risks of disruptions and conflict, which can lead to bribery and corruption practices that further impact the market valuation of companies. Corruption can prevent citizens from benefiting from their country's resource wealth.

Global Regulatory Developments in the Mining Industry

Globally, mining regulations are becoming more stringent, with a strong emphasis on environmental protection and sustainability. For example, proposed changes to the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves ("the JORC code") would include ESG metrics and considerations as mandatory reporting for mining companies from the earliest stages of projects.

In developing nations, there is also a movement towards more rigorous regulations, although the speed and execution can differ. Numerous countries in Africa, Latin America, and Asia are revising their mining laws to draw foreign investment while maintaining environmental and social protections.

These updated regulations are intended to ensure that the communities involved in mining operations are not infringed upon. These regulations might include the right to control and use land; to clean water, a safe environment, and a livelihood; to be free from intimidation and violence; and to be fairly compensated for loss.

Complying with these evolving regulations requires a strong commitment by companies to develop and execute a solid compliance program and improve operational efficiencies. This could involve implementing advanced technologies, such as energy-efficient systems, waste management solutions, or using AI in mining for targeted exploration and predictive modelling.

As stringent regulations become standard, mining companies might experience increased operational costs, potentially impacting profit margins and operational sustainability. Companies that do not adapt to these changes risk facing significant fines or damaging their reputation, which could further affect their market standing.

Box 4: Sustainability Performance and EVA Profile of Copper Mining Companies

ISS STOXX Economic Value Added (EVA) data is based on a firm's underlying economic profit rather than its bookkeeping profit. This article uses components of the EVA analytics solution to illustrate EVA components of the top vs. the bottom quartile of copper mining companies according to their ESG performance score, which measures their sustainability performance profile.

Table 2 shows the companies' Financial Risk Scores, which are the percentile rankings of the companies' EVA volatility and vulnerability (their ability to service their debt); their Profitability scores, which are the percentile rankings of their profitability and trend scores; and their Quality scores, which are the combination of their Profitability Scores and Financial Risk Scores.

Table 2: ESG Performance Scores and EVA Scores for Copper Mining Companies

Quartile	ESG Performance Score	Risk Score	Profitability Score	Quality Score
1	50.5	70.4	38.8	31.3
4	21.1	72.3	33.6	27.9

Note: As of April 2025, 27 copper mining companies that have been generating revenues for at least 5 years, and are not under sanctions, were assessed.
Source: *ISS STOXX Natural Capital Research Institute, based on ISS ESG Corporate Rating and ISS EVA data*

Table 2 compares the EVA scores of the top and bottom quartiles of copper miners according to their ESG Performance Scores. The companies in both quartiles have distinctly diverging levels of sustainability performance, while the top quartile has a better percentile ranking than the bottom quartile in each scoring category.

The top quartile has fewer companies ranking better in terms of risk vs. the bottom quartile, and it has on average a higher level of profitability, which results in an overall higher Quality score. Combining EVA data with detailed sustainability data provides a more holistic perspective with which to gauge the credibility of a company's ability to mitigate sustainability risks and possibly capture sustainability opportunities.

Conclusion

Copper is one of the most critical commodities in the global transition towards a more resilient energy future. With demand and production likely to exponentially increase, there is also a concern by governments, investors, business, and civil society on the extensive environmental and social effects of copper mining documented in this report.

Understanding responsible extraction and sourcing practices, as well as new technologies, can help investors identify copper mining companies that have a stronger sustainability profile and that could be best positioned to help meet global energy needs and, ultimately, achieve more resilient investment returns.

Acknowledgements

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