UBS Asset Management
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For global professional / qualified / institutional clients and investors

Unblocking the copper pipeline

Enhancing the role of responsible mining standards to meet the demands of an electrified future

UBS

Introduction

Copper is an essential ingredient in enabling the increased electrification of our energy systems. Henry Russell argues that a shortage of it could delay this at the very moment when energy demand is projected to grow significantly. He examines the limitations inherent to the responsible mining process and proposes actions for stakeholders to unblock supply for our low carbon electrified future.

The development of new copper mines is critical to meet increasing demand for electrification from urbanization, population growth and the growth in artificial intelligence (AI). To capture this opportunity, navigating multi-stakeholder interests is key.

Despite the widespread adoption of responsible mining standards, including those specific to copper mining, the industry remains vulnerable to project delays due to environmental and social concerns. We believe that responsible mining standards are currently underutilized, plagued by fragmented requirements, divergent approaches, and poor integration into regulatory frameworks. While standards have developed over the last three decades, we identify that this is largely from a downstream transparency lens, rather than focusing on upstream responsible mine design.

To ensure secure and resilient supply chains for critical minerals like copper, policymakers must fully leverage existing standards in the permitting process, standard setters need to harmonize requirements and address reporting fatigue, miners must focus on implementing these standards to demonstrate their ability to manage operations responsibly, and investors should exercise good stewardship practices to ensure companies have appropriate governance structures to mitigate these risks.

We would like to acknowledge the Initiative for Responsible Mining Assurance (IRMA) and the International Council on Mining and Metals (ICMM) for sharing their deep knowledge on the topic of responsible mining standards.

Copper: A backbone of the energy transition

Data centers, transmission and distribution networks, renewables; these are all key to our increasingly electrified future.

What connects them? They all require lots of copper. In fact, the production of renewable energy infrastructure is five times more copper intensive than conventional energy systems.[1] And data center demand will require six times more copper to meet the growth of AI.[2]

This reliance on copper is due to it being the cheapest, most readily available and effective conductor of electricity we have[3], and is therefore broadly un-substitutable. We need copper to meet growing energy demand and for the energy transition, but recognizing this does not make mining for copper any easier. While global demand for copper is set to grow by 1.5%-2.5% per year[4], its supply is set to fall behind demand towards the end of this decade.[5]

Bottlenecks in the production process of copper are preventing companies from mining this critical mineral at the scale needed to keep up with growing demand. We surveyed five of the largest copper miners to uncover the main bottlenecks they are facing in increasing their supply of copper. The results put "permitting and regulation" challenges the highest, which are often tied to delays in environmental impact assessments or community stakeholder concerns over mining operations. The aggregated ranking is as follows (1st = highest concern):

Copper mining company survey

Q) Rank the below criteria in order of urgency/importance/materiality to the ability of your company to expand copper production from now until 2035.

Results in rank order:

1. Permitting and regulation
2. Social and community concerns
3. Environmental concerns
4. Technology
5. Financing
6. Discovery of new reserves

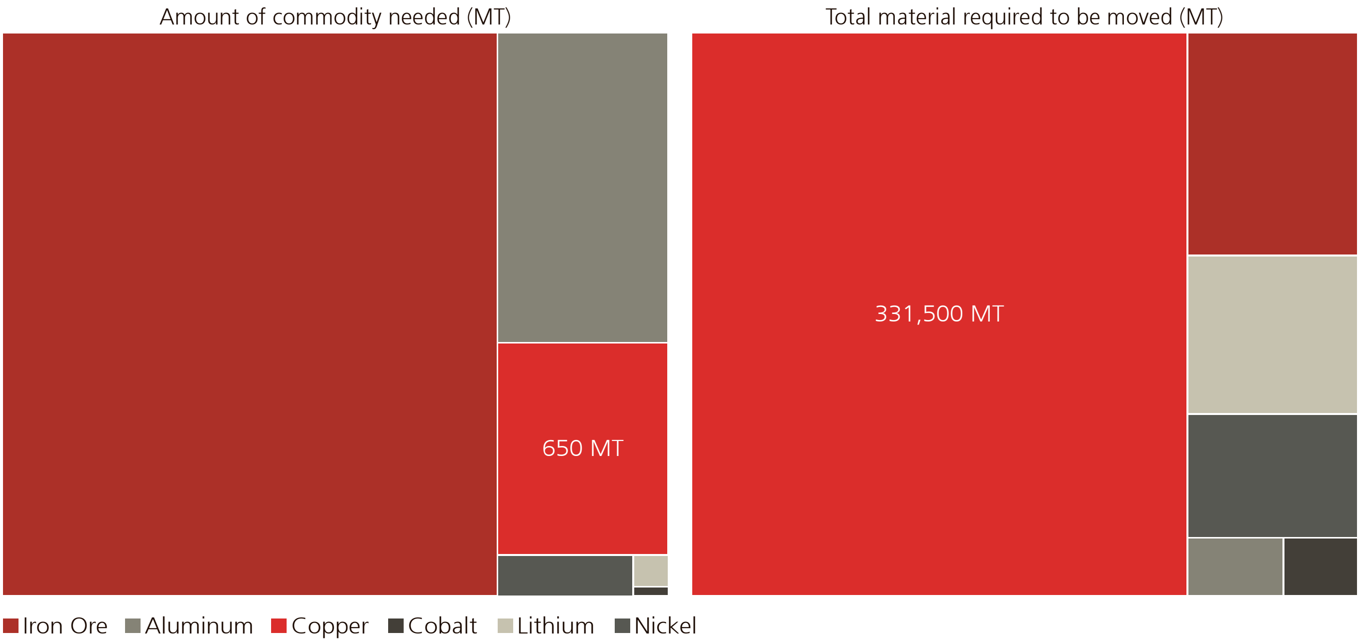
We use copper as a proxy for the broader challenges facing the mining industry in developing critical mineral supply. The environmental and social issues that copper mining faces are broadly similar across the mining industry. The solutions are equally applicable to ensure best practice in mining operations in order to meet demand growth and reduce reputation and financial risks for investors.

1 Copper: Driving the Green Energy Revolution, Visual Capitalist, Jeff Desjardins, (2018). https://www.visualcapitalist.com/copper-driving-green-energy-revolution/
2 BHP, Why AI tools and data centres are driving copper demand, 2025.
3 Only silver is a marginally better conductor but it is much more expensive.
4 https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/metals/101023-global-copper-demand-to-rise-20-by-2035-to-30-million-mtyear-nornickel
5 Copper: Why looking at AI datacentres misses the forest for the trees, Bob Brackett, Ph.D., Andrianto Guntoro, Bernstein Research, 2024.

The environmental and social costs of copper mining

Copper is the third most essential mineral by quantity (million tons) needed to achieve the energy transition by 2050 (figure 1). Copper mining also requires far larger quantities of material to be mined per kilogram of the mineral obtained than other minerals also critical to the energy transition (figure 1). Moving more material means larger-scale mining projects, which increases the overall impact of the mining operations due to the size of area required for the mine. To obtain 1 kg of copper, approximately 160 kg of copper ore, and 510 kg of total material needs to be moved. Compare this with steel (iron ore), where although the total amount of steel needed is approx. 7.7x that of copper, only 2kg of iron ore is mined, and only 9 kg or total material is moved to obtain 1 kg of iron. Similarly, with aluminium (bauxite) where the total amount expected to meet energy transition demands is approximately 1.5x that of copper, only 4 kg of Bauxite is mined, and only 7 kg of total material is moved to obtain 1 kg of Aluminium.[6] In other words, copper is one of the most necessary minerals, but also the one that has the largest impact on local communities and the environment through the scale of the activity taking place to obtain the mineral.

Figure 1: The quantity of metal needed versus the overall material moved to satisfy energy transition requirements



Source: Systemiq analysis for the ETC; BP (2022), Statistical review of world energy, Nassar et al. (2022), Rock-to-metal ratio: A foundational metric for understanding mine wastes, and UBS Asset Management

6 Material and Resource Requirements for the Energy Transition, The Energy Transition Commission, July 2023.

Compounding this issue, forecasts of declining copper ore grades will further increase the total material required to be moved. The average grade of copper mines has declined by around 40% since 1991[7], and with copper mining already accounting for approximately 46% of all mining tailings (waste rock deposits)[8], this will only increase with declining copper ore grades. These mining tailing pools require vast areas near the mine site to store this processed ore (tailings), and breaches/dam collapses have led to catastrophic events. In Brazil in 2015 the collapse of iron ore mine tailing dams in Mariana, and separately at Burmandinho in 2019, led to disaster and the deaths of 289 people, with Vale and BHP ordered to pay damages of $23 bn.[9]

Another example is the Grasberg copper mine in Papua, Indonesia which uses a 'riverine tailings management system' disposing an estimated 200,000 tonnes of mining waste a day directly into the downstream river delta. Non-governmental organizations (NGOs) and local communities claim fisheries have been degraded by suspended particulate matter (SPM) and traditional food sources have been severely affected by the poisonous tailing deposits.[10] In 2018, the Indonesian Financial Audit Agency estimated the financial losses incurred from environmental degradation to be $13 billion.

Around one fifth of copper mining uses leaching, a different technique to the concentrated method that results in tailings. Leaching uses toxic chemicals such as sulphuric acid which can contaminate local ecosystems if not responsibly managed and contained. Earlier this year at a Sino-Metals Leach Zambia mine near Kitwe, an acid spill occurred, potentially affecting millions of people along the Kafue River. The acid spill has led to the complete shutdown of the water supply in the city of Kitwe, home to approximately 700,000 people.[11]

Copper mining is concentrated in water-stressed regions (northern Chile and Argentina), which brings into conflict the mining operations and local communities reliant on freshwater for self-sufficiency. An example is Chile, where rainfall has decreased by on average 30% over the past 20 years, and in 2022 Antofagasta announced its copper output fell 10% as a result of water shortages at its Los Pelambres mine.[12]

Social issues in copper supply are similar to those in other commodities, albeit magnified by the larger scale of the mining operations. Mines are often situated in remote areas where indigenous communities have long settled, which causes disputes over land ownership rights and community resettlements. Free, prior and informed consent (FPIC) from these communities is paramount to safeguarding their rights and vital to obtaining stakeholder support. The Resolution Copper project at Oak Flat in Arizona, US, has been contested for 30 years by the Apache indigenous people. The proposed mine sits on a sacred site for worship, and subsequent US administrations have flip-flopped on approving the land-swap deal which has been escalated to the Supreme Court.

The mining industry continues to encounter environmental and social risks with financial consequences, underscoring the need to enhance the current responsible mining standards to ensure they are fit for purpose and utilised to maximum effect.

7 BHP Insights: how copper will shape our future, BHP Group, (2024).

8 Visualizing the size of mine tailings, Nicholas LePan – VC Elements, Mining.com, May 2021.

9 BHP and Vale agree landmark USD 23bn settlement over Brazil dam disaster, FT, 2024.

10 PT Freeport Indonesia and its tail of violations in Papua: human, labour and environmental rights, Special Report compiled by the International Coalition for Papua (ICP) Rudolfstr. 137, 42285 Wuppertal, Germany.

11 New Indian Express, Zambia faces environmental crisis after acid spill in major river, March 2025, https://www.newindianexpress.com/world/2025/Mar/15/zambia-faces-environmental-crisis-after-acid-spill-in-major-river

12 Antofagasta PLC, NEWS RELEASE - 19.04.23, Quarterly Production Report – Q1 2023.

Introducing Responsible Mining Standards

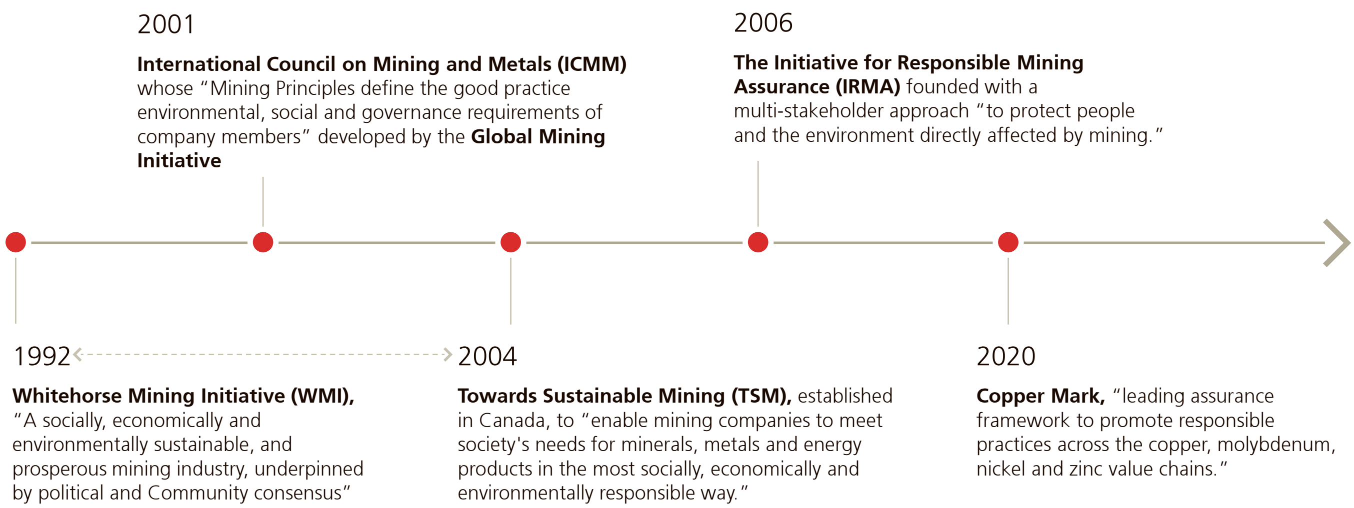
Responsible mining standards can be categorized into three types:[13]

1. Supply chain due diligence, which focus on the responsible sourcing of minerals
2. Performance/compliance, which focus on project-level ESG performance
3. Principle-based, which focus on overarching ethical principles.

Various standards were created by the mining industry, international organizations and mining stakeholders, with either a focus on a specific commodity, geography, or issue.[14] For over three decades, initiatives have been developed to provide miners with frameworks to increase stakeholder confidence that their minerals are produced responsibly, minimizing the negative effects on the environment and local communities.

The growth of responsible mining standards has resulted in increased transparency over environmental and social management practices through corporate reporting. A report by Turley et al identified 158 different responsible mining standards in circulation in 2018,[15] but despite the proliferation of mineral specific standards since their introduction over three decades ago, constructing new mines has only become more difficult with permitting times extending to 18 years on average, up from 6 years in the 1990s.[16] The development of new mines, especially new copper mines, have been few and far between.

Figure 2: Timeline illustrating some of the key developments in responsible mining standards



13 International Organization for Standardization. (2024). Sustainable critical minerals supply chains (IWA 45:2024).

14 Sustainability Standard Systems for Mineral Resources, 2022.

15 Turley, L., Potts, J., Wenban-Smith, M., & Lynch, M. (2018, September 10). State of Sustainability Initiatives review: Standards and the extractive economy. International Institute for Sustainable Development.

16 S&P Global, From 6 years to 18 years: The increasing trend of mine lead times, April 2025. https://www.spglobal.com/market-intelligence/en/news-insights/research/from-6years-to-18years-the-increasing-trend-of-mine-lead-times

Are responsible mining standards misfiring?

While responsible mining standards have increased transparency, their proliferation has led to significant challenges for stakeholders, particularly mining companies. As illustrated by the timeline above, the creation of new standards over the years, each with similar missions, has created a significant amount of repetition.

After reviewing various responsible mining standards and engaging with mining companies and standard setters, we have identified 3 primary reasons that could explain why more standards haven't led to reduced permitting times:

1. Standards proliferation leading to confusion and "reporting fatigue"
2. Standards not sufficiently integrated into national mining regulations
3. Responsible practices are not integrated into initial project licencing requirements

Addressing these challenges is crucial to ensuring the continued usefulness and advancement of responsible mining practices which we believe will support the opportunity for companies to meet the significant demand to support an electrified future.

1. **Standards proliferation is leading to confusion and reporting fatigue:**

Mining companies, which operate large machinery in complex natural environments, have long had a focus on worker health and safety and local environmental impacts. Stakeholders and investors have increasingly called for greater reporting and insight into company strategies to manage these and other prevalent risks.

The goal of increasing transparency and providing assurance to mining practices in the mining industry has led to the existence of multiple standards that vary across mineral type, region, and stringency over certification and auditing processes. This has created a burden for miners and other stakeholders, requiring a duplication of efforts to complete, and increased confusion and costs and has led to reporting fatigue. This issue has been recognized and efforts are underway to streamline the standards, such as with the Consolidated Mining Standards Initiative, which brings together the Copper Mark, ICMM, TSM and World Gold Council standards to reduce complexity and increase interoperability.[17]

However, different standards place differing levels of emphasis on the underlying topics covered, such as FPIC, the level of independent assurance required, the disclosure of audit results, inclusion of complaints processes, and the involvement of multiple stakeholder groups in the design and governance of the standards, etc. This has led to what appears to be a bifurcation of the standards landscape, namely between the Initiative for Responsible Mining Assurance (IRMA) and the Consolidated Mining Standard Initiative (CMSI), that are taking diverging paths towards requirements for demonstrating responsible mining practices.

17 Consolidated Mining Standard Initiative, https://miningstandardinitiative.org/

1. **Lack of integration into national regulatory frameworks:**

Responsible mining standards are one of many mechanisms used to ensure responsible practices in mining; national regulatory frameworks and inter- and intra-governmental organizations each have their own differentiated approaches. National regulations tend to lag responsible mining standards on sustainability topics, with the institutional strength and governance of countries continuing to play a large role.[18] Standards tend to fill governance gaps by privatizing governance, and allow for self-regulation, which cannot guarantee responsible mining practices alone, the quality of public institutions remains the elephant in the room.[19]

If standards remain atop national regulations without being sufficiently integrated, they will continue to be used mainly by customers and stakeholders for supply chain due diligence certification, rather than receiving the backing of enforceable, mandatory regulations. Leaving out best practice standards may seem rather trivial as there are often hundreds of regulations already in situ, but the second-order effects set the tone for the culture of mining operations within a country. If these regulations don't sufficiently integrate responsible mining best practices, this can lead to 'bad' operators tainting the industry and lowering society's confidence in the sector. Poorly managed mining projects not only negatively impact surrounding local communities, but can result in mistrust which can develop into broader opposition for all mining projects in a region or country for fear of similar conditions reoccurring. This opposition then stalls access to key minerals required for electrification, having knock-on investment implications, heightening uncertainty and reducing invest-ability for companies operating in these jurisdictions.

18 Franken, Gudrun & Schütte, Philip. (2022). Current trends in addressing environmental and social risks in mining and mineral supply chains by regulatory and voluntary approaches. Mineral Economics. 35. 10.1007/s13563-022-00309-3.

19 Diego I. Murguía, Ana E. Bastida, The elephant in the mine: Why voluntary sustainability standards are insufficient to ensure responsible mining, The Extractive Industries and Society, Volume 19, 2024, 101485, ISSN 2214-790X.

1. **Integrating responsible mining into initial project licencing requirements:**

Most national mining regulations do not require mining standards to support transparency and responsible practices during the permitting process and mine design phase.

The process for initially obtaining the rights to mine an area of land often doesn't require any responsible practices to be considered at inception. Integrating the ethos of responsible mining standards into this initial claim making process, requiring at least minimum standards adherence to new resource development is vital, as this is when the tone for the mining project is set and when local stakeholders first interact with a project.

For example, in the US, staking a claim under the General Mining Act of 1872, which is still in place today, gives the owner priority over conservation and other public uses.[20] Adding responsible practice considerations should be a key focal point in the process of making a project more 'bankable' by avoiding the unintended consequences of mining which can result in disruption and delays, lowering a project's exit valuation.

20 Tollefson, Hannah. Staking a Claim: Mineral Mining, Prospecting Logics, and Settler Infrastructures. Canadian Journal of Communication 46(2), 177–199.

Accelerating the use of Responsible Mining Standards

We see a clear opportunity for standard setters, policymakers, miners and investors to break down the barriers discussed above with a view to expanding best practice approaches, demonstrating their application to affected communities and key stakeholders, and reducing operational and licence-to-operate risks in mining operations.

Standard setters
We welcome the work of the Consolidated Mining Standard (access here), which will have the broadest coverage of any responsible mining standard.[21] Although this is a step in reducing fragmentation, repetitive efforts and reporting fatigue, the next step of integrating these into national regulations in the project design phase is crucial. Working with national mining authorities to enhance the permitting process and integrating a universal basis for responsible mining promises two important benefits. First, it will support mining companies to design new mines with these considerations implemented earlier in the process. Second, it will increase the use of responsible mining standards and avoid them becoming a tick-box exercise once a project is fully operational to assure customers.

We also believe there are key components of responsible mining standards that must be present to provide sufficient transparency to mining operations. These include the governance of the standard; the credibility and transparency of the assurance/ accreditation process; the role of impacted rights holders in this process; requirements regarding corrective actions for instances of non-conformance and/or human rights or environmental harms identified during the audit process; and the existence of effective and accessible grievance mechanisms.[22]

Policymakers
To disentangle the regulatory barriers with the aim of increasing copper and critical mineral production while providing the incentives and support to rebuild mine development capabilities. The *Sustainable and Responsible Critical Mineral Supply Chains Guidance for Policy Makers*[23] recommends a robust legal and regulatory protections for the environment, workers and communities, to channel public spending to encourage the development of better practices, strengthen the collection and reporting of granular and standardized data to enable benchmarking and progress tracking, encourage or require companies to improve transparency throughout the supply chain, and to encourage harmonized approaches consistent with international standards.

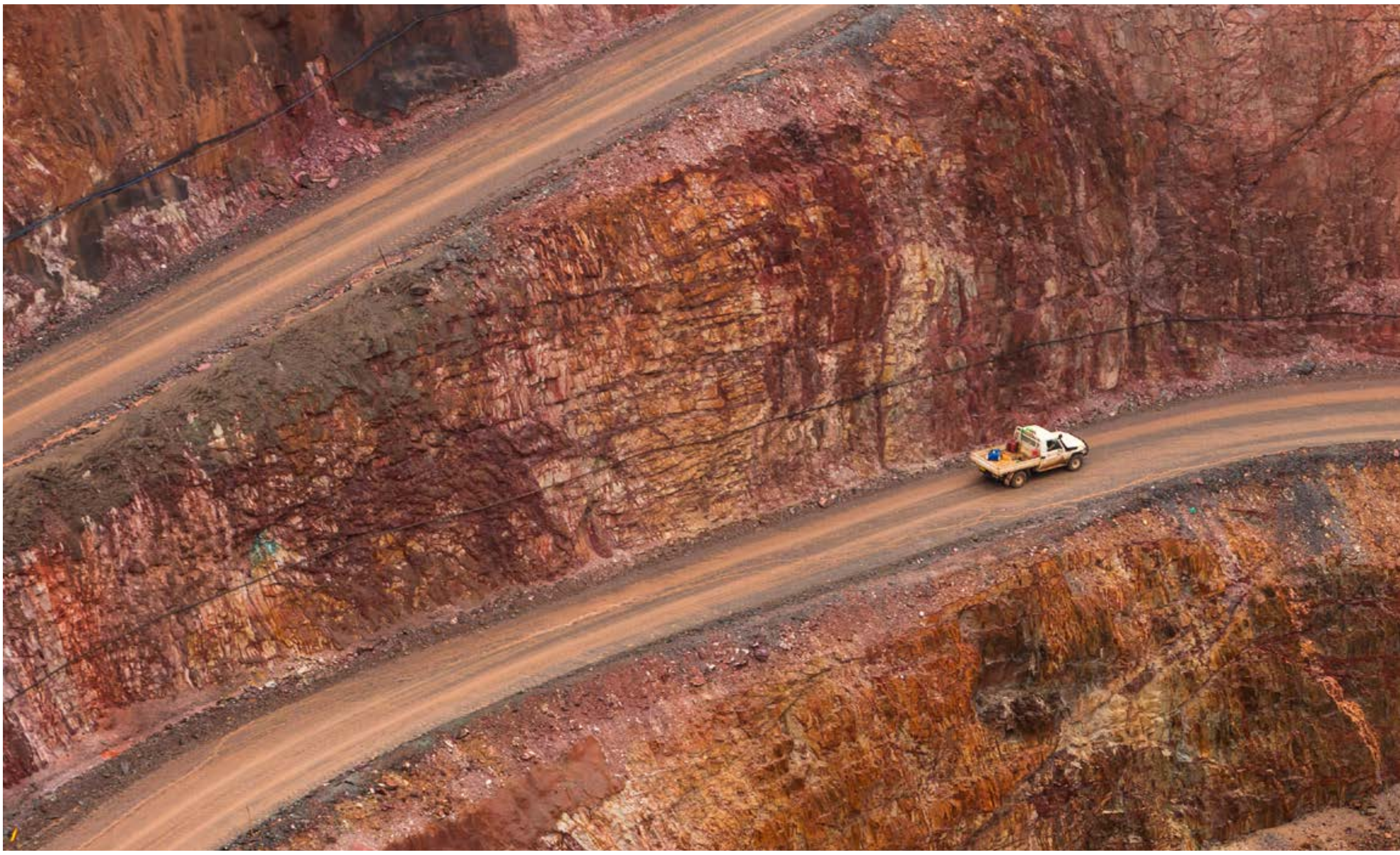
Further, the EU Platform on Sustainable Finance's proposed amendments to the EU Taxonomy to include mining for transition-critical minerals has positive potential. Including mining activities that can substantially contribute to the Climate Change Mitigation objective for select transition minerals under EU Taxonomy-eligible activities would expand the ability of European investors to invest in mining companies in sustainable labelled funds. This inclusion may increase the pool of potential investors in the sector, incentivizing miners to implement responsible practices.

21 ICMM Newsletter: Changing the mining industry for the better, ICMM, 18 October 2024.
22 Lead the Charge, An Assessment of Third-Party Assurance and Accreditation Schemes in the Minerals, Steel and Aluminium Sectors, 2024.
23 IEA (2023), Sustainable and Responsible Critical Mineral Supply Chains, IEA, Paris.

Mining companies and operators
Continuing to improve company reputations and local trust is paramount for building confidence in mining. Working alongside stakeholders to tackle the inevitable impacts from mining projects and ensuring fairness throughout the mine design and permitting process should help all stakeholders work towards a common goal. This is best where mining companies and operators are able to implement the highest standards and assurances the mining industry bodies and environmental and social experts provide. This includes demonstrating adherence to responsible practices. We encourage mining companies to implement those standards that require:

- Independent third-party site-specific audits
- Full results of audits, information on audit processes and findings of non-compliance to be made available for all stakeholders to review
- Strong multi-stakeholder governance structure of mining standards (including affected communities and representative NGOs)
- Public dissemination of corrective action plans for stakeholders to review

Investors
Using their voices as owners of, or lenders to companies, investors should exercise good stewardship practices, ensuring companies have the appropriate governance structures in place to mitigate against risks in their operations that ultimately impact upon a company's valuation. The mining sector is a key focus under our active ownership approach as part of our engagement program at UBS-AM which identifies key companies where we see financially material risks and opportunities presented by the energy transition. We use our relationships with these companies as long-term investors to engage with management and board directors on financially material sustainability topics. In the mining sector we focus on transition strategies, water and heat stress, natural capital, social license-to-operate and worker safety topics. We seek to understand how mining companies manage their operations responsibly and how they utilise the standards discussed above. We also interact with the mining standards setters, aiming to understand best practices when assessing mining companies' operations.



Going forward

Permitting times for copper mines have continued to extend over the past two decades, with increased focus on environmental and social impacts, constraining our ability to obtain this key component of the energy transition. Meanwhile, responsible mining standards have developed to assure downstream customers of adherence to best practices when managing environmental and social impacts. While these standards have proliferated, they have tended to sit atop of national regulations, treated as certification for customer due diligence, rather than being integrated into the mine design. If responsible mining standards are to be most effective, they should be integrated into national regulations to ensure projects are, from the very start, mandated to integrate responsible design and management practices. This should help create a higher universal global baseline for mining, removing some of the barriers new mining projects face, improving mining companies' social license to operate by better managing environmental and social impacts, and reducing the financially material risks encountered.

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