GLOBAL COUNCIL
FOR RESPONSIBLE
TRANSITION MINERALS

GLOBAL COUNCIL
DISCUSSION BRIEFS

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GLOBAL COUNCIL FOR RESPONSIBLE TRANSITION MINERALS

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GLOBAL COUNCIL FOR RESPONSIBLE TRANSITION MINERALS

General Mandate

Assisted by advisors from the Transition Minerals Initiative, the Global Council for Responsible Transition Minerals will:

- Consider governance, environmental, economic and social implications associated with the scale of projected demand for transition minerals, from extraction to end-use, especially in relation to strategic competition, resource scarcity and financial constraints that could undermine the achievement of global net-zero objectives;

- Review the existing global governance framework on transition minerals to spotlight opportunities for alignment among complementary approaches, amplify the most relevant common principles and identify key governance gaps, in view of fostering resilient and responsible supply chains, minimizing negative impacts on communities and ecosystems, promoting economic opportunities for producing countries and addressing market and policy failures that could hinder global access to transition minerals;

- Articulate the range of policy options to balance increasing demand with supply capacities, from promoting technological innovation to increasing resource efficiency, to fostering sustainable consumption models and incentivizing optimization and life cycle extension of transition minerals, reflecting varying political and economic perspectives;

- Engage in transparent consultation, including stakeholder consultation on policy options and policy integration, with the goal of gaining a wider and deeper understanding from all relevant actors along the supply chains and beyond; and

- Develop regular sets of recommendations, working towards collaborative solutions and building on relevant opportunities to foster political awareness.

GLOBAL COUNCIL FOR RESPONSIBLE TRANSITION MINERALS

Framework and Objectives

With the acceleration of the green transition towards net-zero, demand for minerals essential to the manufacturing of technologies such as wind turbines, solar panels and electric batteries is projected to steeply increase. Also called "critical minerals" because of the expected mismatch between projected demand and future supply capacities, these minerals are the focus of global attention and competition. To adopt a more universal approach, the Paris Peace Forum has chosen to focus on "transition minerals," which refers to the minerals essential for our shared goal of achieving the energy transition.

Geopolitical tensions and lack of international coordination are preventing us from addressing the urgent economic, environmental and societal challenges associated with their global extraction, use and reuse: responsibility of the supply chains, environmental and social impacts of the mining industry, over-proliferation of norms and risks of ineffective implementation, obstacles in financing, insufficient political awareness, demand management and recycling etc.

In this context, the members of the Global Council for Responsible Transition Minerals will use their experience and influence to raise political awareness around the crucial importance of these minerals to reach the Paris Agreement goals, and address the issues around their responsible supply by making global recommendations and proposing collaborative solutions.

The Global Council members will be guided and assisted in their tasks by a brain trust composed of Special Advisors. Their first policy recommendations will be made public by the end of the year.

DISCUSSION BRIEFS

DISCUSSION BRIEFS

1. Addressing the Fragmentation of Multilateral Approaches on Transition Minerals

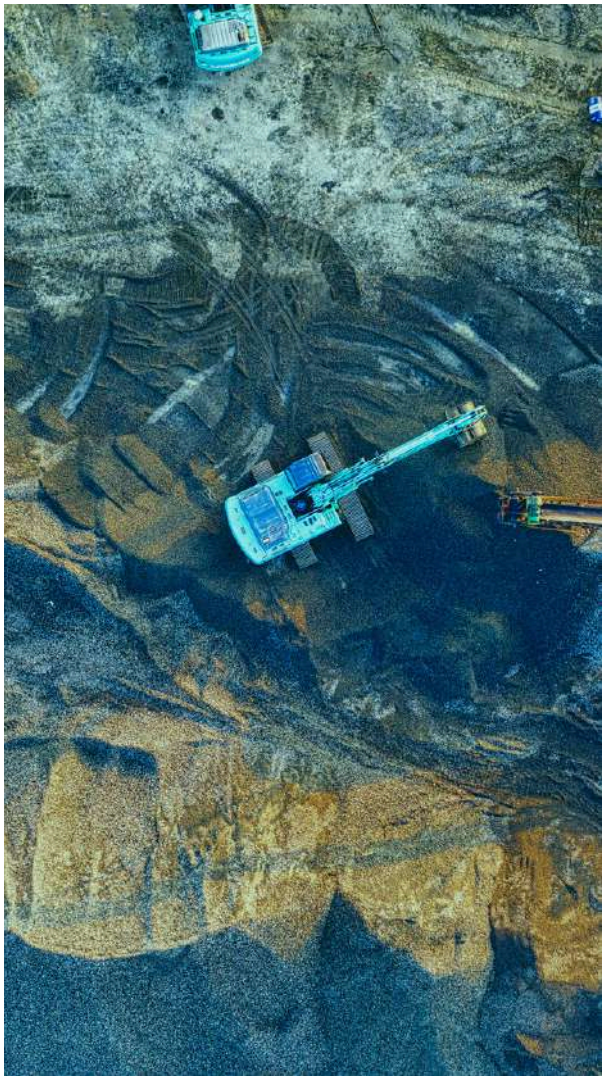
Authored by ***Solange Harpham****, edited by* ***Ludivine Wouters***

Summary:

Despite numerous United Nations agencies and international organizations, including UNEP, UNCTAD, UNDP, UNIDO, IGF, OECD, IEA, and IRENA, working to address the various challenges related to the supply of transition minerals critical for the energy transition, the fragmentation of efforts has led to significant challenges such as a lack of coordination and information exchange and inadequate capacity. Potential solutions include integrating minerals into the Sustainable Development Goals, establishing a new global framework like the "Sustainable Development Licence to Operate" proposed by the International Resource Panel, and creating a dedicated international agency for minerals.

Fragmented multilateral responses to challenges around minerals and other extractives are mostly a consequence of a legacy of limited interest from the most developed economies: as mineral operations increased in (mining), or relocated to (processing), emerging markets including China, the issues that arose became programmatic priorities of various agencies and organizations in different ways, leading to siloed interventions.

The rise of the criticality agenda, linked to energy transition ambitions as well as geostrategic tensions, is changing the paradigm: because minerals-relating issues are interlinked and all ultimately influence reliability and responsibility of mineral supply, the need for strategic intervention requires more systemic approaches. This will be key in enabling multilateral institutions to fully play their role in leveling the playing field, guiding all parties through a fair transition and possibly redesigning fundamental principles to meet global and existential stakes for humanity.



1.1. International Collaboration on Transition Minerals: UN Agencies and Key Organizations' Contributions

United Nations Agencies and Initiatives Addressing Transition Minerals

Numerous United Nations agencies are actively engaged in addressing the complexities surrounding transition minerals. These include the United Nations Environment Programme (UNEP) [1], the United Nations Development Programme (UNDP) [2], the Regional Economic Commissions [3] [4] [5], the United Nations Conference on Trade and Development (UNCTAD) [6], the United Nations Industrial Development Organization (UNIDO) [7], and the Intergovernmental Forum on Mining, Minerals, Metals, and Sustainable Development (IGF) [8]. Each agency focuses on various facets of transition minerals, ranging from environmental considerations (UNEP) to the intersection with economic development (UNDP) and support for mining governance in developing nations (IGF). The International Resource Panel (IRP), established in 2007 as part of the UNEP, has been studying management of minerals resources as part of its mandate on global resource practices [9].

To enhance coordination and streamline efforts, the **"Transforming the Extractive Industries for Sustainable Development" working group** was established in January 2022 under the UN Secretary-General's purview [10]. Co-chaired by UNEP, UNDP, and the Regional Economic Commissions, this group aims to coordinate the UN's work concerning extractive industries. In April 2024, the working group launched **the Panel on Critical Energy Transition Minerals** [11] as part of a larger initiative "Harnessing Critical Energy Transition Minerals for Sustainable Development in Least Developed and Land-Locked Developing Countries – Just Transitions in Low Carbon Technologies". This Panel aims to craft global voluntary guidelines for more responsible mining, to be presented at the UN General Assembly in September 2024.

Advancing Responsible Mineral Practices: Contributions of OECD, IEA, and IRENA

The **Organization for Economic Co-Operation and Development (OECD)** has been a pivotal actor in addressing issues surrounding mineral supply chains since the publication of its Due Diligence Guidance for Responsible Supply Chains of Minerals in 2011 as part of its promotion of responsible business conduct across borders (multinational enterprises) and value chain functions (risk-based due diligence guidance) [12]. Originally focused on minerals contributing to armed conflicts and human rights violations, the OECD has expanded its purview to encompass social and environmental impacts [13] leveraging its track record in fostering responsible practices and leadership in systemic, value-chains based approaches to sustainability and governance.

In recent years, the **International Energy Agency (IEA)** has intensified its attention on transition minerals, recognizing their integral role in clean energy technologies. The release of their 2021 report, "The Role of Critical Minerals in Clean Energy Transitions" [14] was instrumental in raising awareness of the exponential demand growth projected over the next two decades. The IEA responded to the 2023 G7 Ministers' Meeting on Climate, Energy, and Environment's request for more comprehensive information by publishing its inaugural Critical Minerals Market Review [15] and convened the first international Ministerial Summit on critical minerals and their role in clean energy transitions on September 28, 2023 [16]. A Voluntary Critical Mineral Security Programme was announced in the

2022 IEA Ministerial Communique, which would include national stockpiling and other measures designed to ensure resilient supply chains [17].

The **International Renewable Energy Agency (IRENA)** launched the Collaborative Framework on Critical Materials for the Energy Transition in March 2022, as a platform for dialogue, exchanges and collaboration on the gaps and solutions for the energy transition that relies on critical materials [18]. Following a number of technical papers on specific transition minerals, they published a comprehensive report on the geopolitical implications of mineral supply chains in July 2023 titled "Geopolitics of the Energy Transition – Critical Minerals" [19].

1.2. Barriers to Effective Governance of Transition Minerals: Coordination, Representation, and Capacity Issues

Lack of Coordination and Information Exchange

The current landscape of institutions addressing mineral-related issues is marked by a **lack of coordination and integration**. The UN Secretary-General's working group on extractive minerals fails to encompass the full spectrum of UN agencies engaged in mineral-related initiatives. Some of these agencies, such as the IGF (UN type 2 agency) which assists their over 80 Member States in developing mining frameworks and offers technical assistance for more sustainable mining practices, have overlapping mandates with other agencies, such as UNDP and UNEP, and/or with highly-recognized civil society organizations with significant influence and partial funding from other agencies or multilateral institutions.

The lack of coordination within the UN system **is compounded by the lack of coordination within each Member State's Ministries**. The Environment Ministers might not coordinate with the Mining and Energy Ministers, each representing their country in separate assemblies. This fragmentation of mineral-related work among various actors hampers the flow of information.

Furthermore, UN agencies have been known to **operate in silos**, sometimes launching bilateral initiatives with member States with little to no coordination with other relevant organizations [20]. Member States sometimes address the same requests to different agencies, also posing a risk of duplication of efforts. This disjointed approach hampers the effectiveness of interventions and impedes progress toward addressing complex mineral-related challenges on a global scale.

Lack of Inclusive Representation

The current framework for addressing mineral-related issues is deficient, particularly in terms of representation and inclusivity. For example, despite efforts by the IEA to position itself as a pivotal technical player on mineral matters, its full-fledged members are predominantly from developed countries. Although the IEA has been working to expand its membership and engage a wider set of mineral-producing countries, there is much more to be done to adequately represent the diverse interests and perspectives of all stakeholders across the globe.

Furthermore, while numerous international organizations purport to engage with civil society, their operations remain entrenched within a traditional Westphalian framework that privileges **nation-states as the primary actors**. Within this paradigm, non-governmental actors, including civil society organizations and the private sector, often find themselves relegated to peripheral roles, limited to mere observers or consultants without substantive integration into the decision-making process.

This hierarchical structure **marginalizes the voices and perspectives of non-state actors**, constraining their ability to influence policies and initiatives that directly affect them and the communities they represent. Despite efforts to create avenues for consultation and participation, the inherent power dynamics within these organizations perpetuate a system where state interests take precedence. This is evident in the recent Panel on Critical Energy Transition Minerals, where the overwhelming presence of states, numbering over 100 when accounting for all countries within the African Union and the European Union, contrasts sharply with the limited representation of civil society actors, totaling just 17.

Moreover, the dominance of state-centric approaches overlooks the valuable expertise, resources, and perspectives that non-state actors, particularly civil society organizations and the private sector, bring to the table. These actors often possess invaluable insights and on-the-ground experience that can enrich policy discussions and contribute to more effective and inclusive decision-making processes.

Lack of Effective Capacity

Existing international organizations and agencies are facing significant challenges as they endeavor to address the escalating awareness of the critical importance of transition minerals. This emergent field represents a paradigm shift, **necessitating a substantial allocation of human resources and time by organizations that may not have initially prioritized this issue**. For instance, the IEA, originally established as an energy security organisation, now finds its mandate expanded to transition minerals – a topic that falls outside its original mandate. The task of addressing this emerging topic **may strain already limited financial and human resources**. The teams dedicated to tackling these issues within each institution are notably small (though expanding) and operate with modest resources, particularly when considering the vast scope and complexity of the challenges involved.

The limitations in resources also have broader repercussions, as they result in critical aspects of mineral-related issues remaining unaddressed. For instance, challenges related to market opacity for certain minerals and trade barriers, which traditionally fall under the purview of the Bretton Woods system, often go overlooked. The International Monetary Fund (IMF) has maintained a low profile on these issues, occasionally publishing reports [21] but otherwise remaining discreet. Notably, the World Trade Organization (WTO) appears to be largely absent from discussions surrounding mineral-related challenges, leaving a significant gap in global governance efforts in this domain.

1.3. Avenues for Reflection: Exploring Ideas for a More Robust Global Framework on Transition Minerals

Reframing: Integrating Minerals into Sustainable Development Goals

Despite being omnipresent in our daily lives, minerals are conspicuously absent from the UN Sustainable Development Goals (SDGs) and Agenda 2030. The lack of terms such as "mine" or "mineral" within the SDGs not only mirrors the negative perception of the mining industry but also results in overlooking the crucial role minerals play in the energy transition. Additionally, it fails to adequately address the challenges related to their extraction, processing, and utilization.

Several experts have suggested that minerals could be added to the future SDGs through the concept of "mineral security" akin to "food security," within the UN system, as to acknowledge their role in a multitude of essential functions, including shelter, transportation, agriculture, green industrialization, and energy production, as well as their importance in achieving sustainable development objectives [22].

Another conceptual framework for considering transition minerals is the "common goods" framework. Because of their catalyst role to the global energy transition, access to minerals and minerals themselves could be considered as a resource so important that the focus would have to shift from private or even national interests to the collective well-being of humanity or the planet. This designation could motivate increased action and raise awareness about the importance of responsible mineral management and sustainable resource use. It could also pave the way for the establishment of governance frameworks and policies focused on the long-term sustainable use and preservation of transition minerals for the benefit of current and future generations. International organizations could play a crucial role in holding actors accountable and act as guardians of these resources through the management of certain projects in "hotspots of biodiversity" or taking place on indigenous land.

Addressing the Normative Gap: the Need for a New Global Framework on Minerals

The existence of a "normative gap" concerning global challenges related to minerals and the fragmented institutional landscape to tackle these issues is acknowledged by numerous stakeholders, including the UN. It is in response to these shortcomings that the UN Secretary-General announced the establishment of a Panel on Critical Transition Minerals during COP28 to develop a set of global common and voluntary principles.

Within the UN, the IRP in particular is advocating for a holistic approach: a comprehensive and cohesive global framework to address the challenges associated with transition minerals. Named "Sustainable Development Licence to Operate", this would be a governance framework with consensus-based principles and best practices aligned with the SDGs [23]. This would require (i) establishing an international consensus, through existing forums, on the content and structure of a Sustainable Development License to Operate, (ii) forming bilateral and plurilateral agreements among governments to ensure security of supply of raw materials and promote resource-driven development, as well as (iii) implementing regular reporting mechanisms to track progress towards sustainable development, such as a global "State of the Extractive Sector" review or similar process.

A new International Agency of Minerals & Metals

There has been ongoing discussion within the international community regarding the establishment of a new International Agency or Organization dedicated solely to minerals and metals. The IRP has put forward a proposal for the creation of such an entity as part of the Sustainable Development Licence to Operate [24]. This entity would serve to facilitate data sharing and foster bilateral and plurilateral agreements on resource security and development. Similarly, the French Institute of International Relations (IFRI) has advocated for the establishment of an independent international agency as the primary means to ensure responsible mineral supply chains and uphold high international standards in production and processing [25]. Such an agency would also aim to secure development benefits for producing countries and promote technological innovations in extraction, production, and recycling.

The case for establishing a new International Organization dedicated to minerals underscores the need for a global integrated structure to tackle challenges such as environmental and social impacts along the supply chains and price volatility. By consolidating efforts under a single entity, there is potential to foster enhanced international cooperation and data sharing, leading to improved transparency and informed decision-making. Moreover, such an organization could play a pivotal role in assisting developing countries in building capacity and implementing sustainable practices for the management of their mineral resources.

Conversely, critics argue that the establishment of a new agency may result in duplication of existing efforts and initiatives. They contend that resources might be better allocated towards reinforcing the work of existing bodies and enhancing coordination among them. While the prospect of a new International Organization offers promising opportunities for addressing the complexities of mineral governance, careful consideration of potential redundancies and the optimization of existing frameworks are essential aspects to weigh in the decision-making process.

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2. Reshaping Mineral Markets for Global Trade

Authored by ***Solange Harpham*** *and* ***Brenda Yeong****, edited by* ***Ludivine Wouters***

Summary:

Mineral markets present unique challenges due to their size, lack of transparency, and complex trade practices. Despite growing demand, the market for transition minerals remains relatively small and fragmented, with limited liquidity and transparency. Market concentration among a few key players exacerbates vulnerabilities to geopolitical shocks and export restrictions. To address these challenges, this paper suggests enhancing transparency through international cooperation, regulating mid-stream commodity trading, and revitalizing international trade governance amidst dispute settlement challenges.

2.1. Mineral Markets and their Complexities

Commodity markets are often dominated by a few large, interconnected participants, which makes them susceptible to rapid shock propagation. However, the lack of transparency in some of these markets, particularly those involving critical minerals, limits the ability of authorities and counterparties to detect and assess emerging risks. Not only does this increase the vulnerability of certain minerals to supply shocks, it also creates systemic risk: past disruptions have highlighted how vulnerabilities within commodity markets and interconnections with the wider financial system could amplify macroeconomic shocks [1].

Challenges and Dynamics in the Minerals Market: Size, Transparency, and Trade Practices

Despite the increasing demand for transition minerals, **their market size remains small**, especially compared to other commodities. For example, global crude steel production in 2022 was 1,885 million tons [2], compared to copper at 22 million tons [3], nickel at 3.3 million tons [4], cobalt at 0.19 million tons [5], and lithium at 0.15 million tons [6]. This is further exacerbated by the heterogeneity of mineral products: chemical compositions, purity and quality, highly dependent on seller processes and buyer specifications, are rarely fungible.

Minerals can be subject to (in order of increasing transparency): (1) producer pricing, through direct negotiation with buyers, (2) agency-reported pricing, particularly in illiquid markets, and (3) exchange pricing, where prices are discovered by buyers and sellers on a regulated marketplace, which entails more liquidity.

With the exception of copper and nickel which are mature markets, most transition minerals are not traded on established exchanges due to their limited volumes and liquidity, leading to **a lack of transparency on production, inventories, prices and sale conditions**. Trading is largely done through Over the Counter (OTC) transactions, generally through private, opaque, long-term offtake agreements, allowing buyers to secure future supplies at an agreed price, and sellers to secure funding for project development. The volume of minerals available for spot trading is thus very small - only 10-20% of production supply is available outside of such contracts, typically to account for production fluctuations [7].

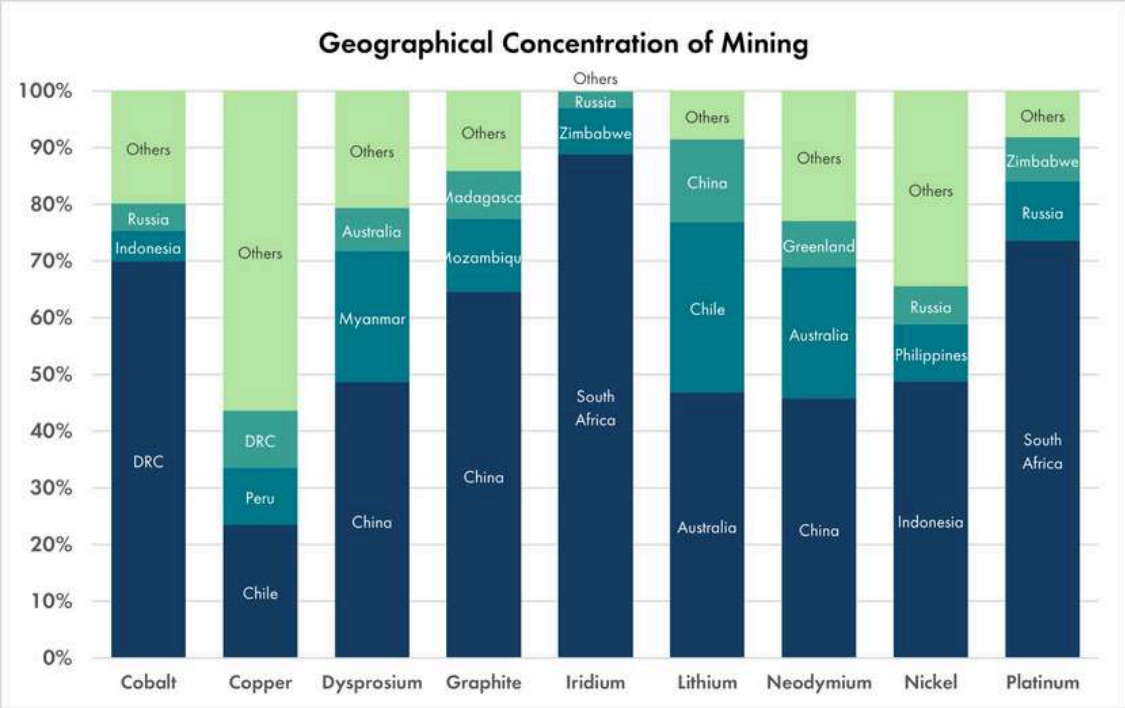
Commodity traders play a key role in creating a market for specialty mineral products such as lithium, graphite, manganese and rare earths, connecting producers and consumers and informing parties on market context. Price reporting agencies such as Benchmark Minerals, Fastmarkets and Argus provide highly-recognized benchmark prices, but even those do not necessarily allow for smooth indexed pricing, considering product specificity, information asymmetry and imbalance of bargaining power in most trades.

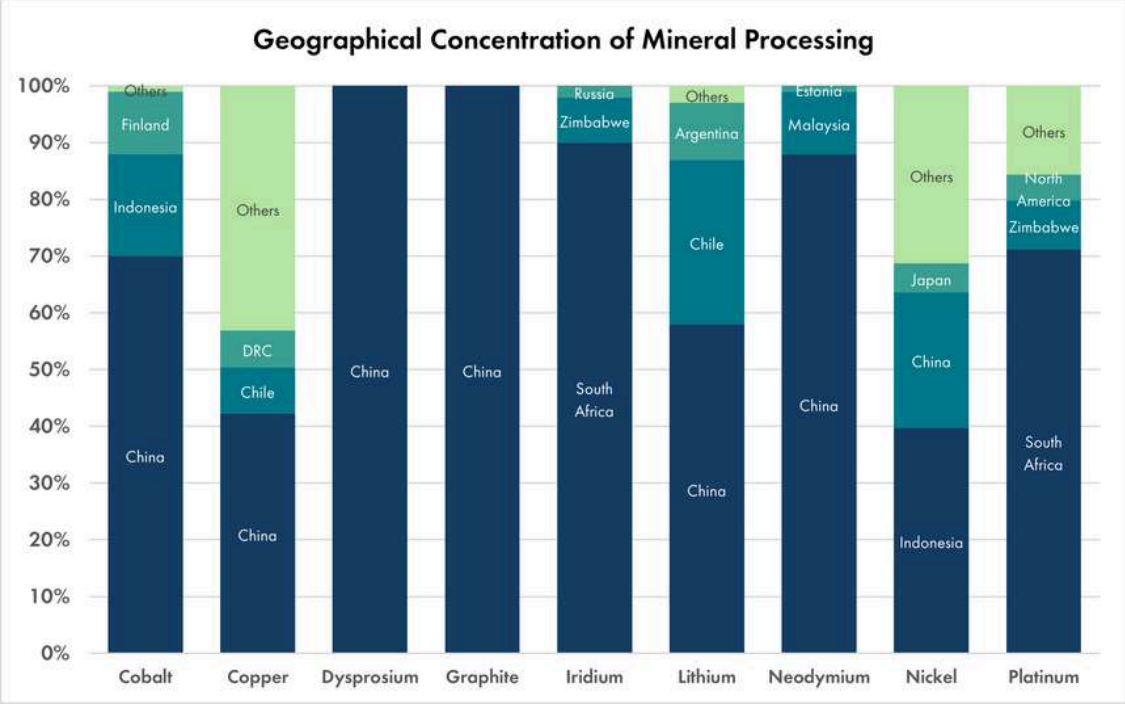
High Market Concentration and Geopolitical Vulnerabilities in Transition Minerals Markets

A second challenge for transition minerals markets is their **high market concentration**. The industry is dominated by a handful of large

multinational corporations and state-owned enterprises, such as Glencore in cobalt and nickel, with market shares of 22% and 13% respectively, and Albermarle (21%) and Sociedad Química y Minera de Chile (SQM, 19%) in lithium [8].

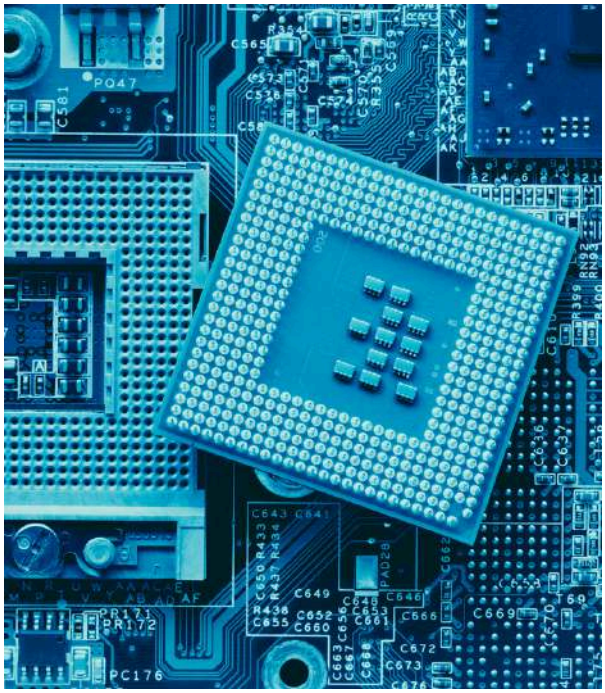
Markets are also **highly geographically concentrated** – in 2023, the Democratic Republic of Congo produced 70% of the global cobalt supply, Indonesia produced 49% of global nickel, China produced 49% of global dysprosium and 46% of global neodymium, and Australia produced 47% of global lithium. This geographical concentration is even more pronounced in refining and processing, with China accounting for 100% of dysprosium, 88% of neodymium and 70% of cobalt processing [9].

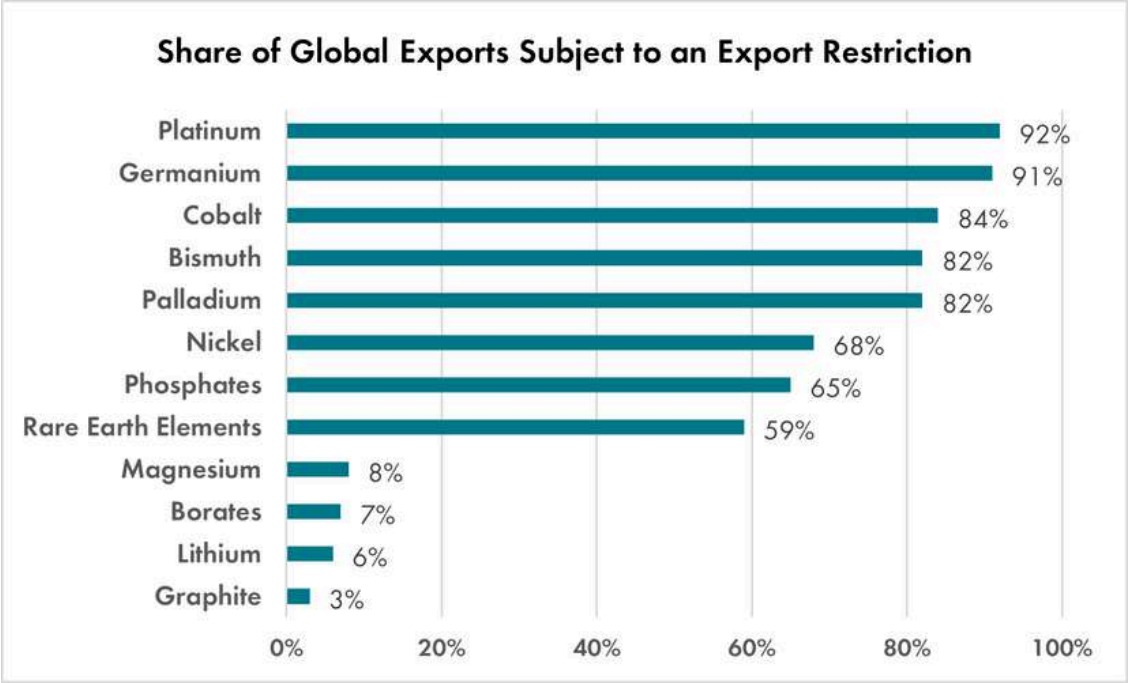




Source: "Geopolitics of the Energy Transition: Critical Materials" by Van de Graaf et al. (2023)

As a result, market leaders have **significant market power and influence over prices and quantities** available, and **transition minerals are therefore vulnerable to shocks, particularly on the geopolitical front**. According to the OCED, export restrictions have grown more than five-fold from January 2009 to December 2020, and about 10% of global exports of transition minerals by value faced at least one export restriction measure [10]. Chinese export controls on gallium and germanium, in response to American and European chip export restrictions, have resulted in a 44% increase in gallium ingot prices and a 9% increase in germanium ingot prices [11]. Such supply uncertainties and price volatility further reduce the liquidity and transparency of minerals markets.





Source: "Geopolitics of the Energy Transition: Critical Materials" by Van de Graaf et al. (2023), adapted from Kowalski & Legendre (2023) and the OECD Inventory of Export Restrictions on Industrial Raw Materials

Resource-rich nations may implement export restrictions to enhance value addition by prohibiting the export of raw materials and encouraging domestic processing of extracted minerals. However, achieving the desired results requires enabling conditions that may be

difficult to achieve. For instance, Indonesia implemented a ban on nickel ore exports in 2020 which resulted in significant increase in its processing capacity because operators leverage captive coal resources for cheap power, while Zimbabwe prohibited raw lithium exports in 2022, subsequently expanding the ban to include all raw base mineral ores in 2023, with no clear industrialization industrialization outcomes to date. *[See Discussion Paper on "Creating and Leveraging Opportunities for Resource-Rich Countries"]*

The Role of Derivatives Markets in Trading Transition Minerals: Benefits and Challenges

Some minerals, due to their tangible nature and the absence of standardization, find their trading ground not in traditional markets but in derivatives markets. Derivatives represent an underlying reference entity: one example of this is a "futures" contract, obligating the purchase and delivery of an asset at a predetermined price on a future date.

While many other transition minerals do not have derivatives markets, demand is increasing. The London Metal Exchange introduced copper in 1877, and began trading nickel in 1979, cobalt in 2010, and lithium in 2021. In September 2022, the Singapore Exchange launched a set of battery raw materials derivatives, including contracts for cobalt metal, cobalt hydroxide, lithium carbonate and lithium hydroxide. While trading volumes are small – no cobalt, cobalt hydroxide or lithium carbonate futures were traded in April 2024, and only nine lithium hydroxide futures were traded [12] – market participants have been optimistic about the development, and it is expected that such derivatives markets will develop over time as well as include more complex products.

	FY2024 Q2	FY2024 Q3	Feb. 2024	Mar. 2024	Apr. 2024	FYTD 2024	CYTD 2024
SGX FM Cobalt Hydroxide CIF China Futures	0	0	0	0	0	0	0
SGX FM Cobalt Hydroxide CIF China Swaps	0	0	0	0	0	0	0
SGX FM Cobalt Metal In-whs Rotterdam (Standard Grade) Futures	0	0	0	0	0	12	0
SGX FM Cobalt Metal In-whs Rotterdam (Standard Grade) Swaps	0	0	0	0	0	0	0
SGX FM Lithium Carbonate CIF CJK (Battery Grade) Futures	0	0	0	0	0	0	0
SGX FM Lithium Carbonate CIF CJK (Battery Grade) Swaps	0	0	0	0	0	0	0
SGX FM Lithium Hydroxide CIF CJK (Battery Grade) Futures	18	30	30	0	9	57	39
SGX FM Lithium Hydroxide CIF CJK (Battery Grade) Swaps	0	0	0	0	0	0	0
Total	18	30	30	0	9	69	39

Source: "Market Statistics Report" by the SGX Group (2024)

2.2. Pathways to an Open Market for Transition Minerals: Strategies for Promoting Transparency and Cooperation in Mineral Trading

There have already been calls to address information uncertainty and asymmetry in critical minerals markets globally, through *inter alia* refinement of trade codes, use of "materials passports" and international collaborations, including across disparate trading blocs [13].

Promoting Transparency in Transition Mineral Markets

Encouraging actors to transition from private long-term contract and trades to established marketplaces requires international collaboration to improve accessibility and reliability of trading data. An international centralized platform such as the OECD's Global Forum on Transparency and Exchange of Information for Tax Purposes could be instituted, facilitating information sharing and verification and associated to an annual report such as the IEA Critical Minerals Market Review launched in 2023. These instruments would have to gather wider membership than OECD countries and offer technical assistance and capacity building to those States which have difficulty assessing their resources and their trade flows.

The members could collaborate to **require the public disclosure of mineral production, trade and revenue data to enable monitoring and cross-verification as per the EITI standard** which requires the mandatory disclosure of payments made by companies to governments. This would entail developing standardized reporting templates and digital platforms for sharing mineral trade data between countries and establishing multi-stakeholder monitoring mechanisms involving governments, companies and civil society to scrutinize mineral flows and trades [14].

Enhancing Transparency and Regulation in Mid-Stream Commodity Trading

Mineral supply chains are particularly opaque at the mid-stream point, where commodity traders are at play. Commodity trading is a largely opaque sector with little public disclosure of information, involving multiple actors orchestrating transactions across borders. This complexity makes it difficult to trace the provenance of minerals and ensure comprehensive due diligence, particularly for commodity traders operating across borders. This lack of transparency makes it challenging for regulators to monitor activities and identify potential risks or wrongdoing. The commodity trading industry has traditionally been secretive and resistant to enhanced transparency and regulatory measures that could impact its profitability and operating models [15].

To improve the regulation of commodity traders in opaque mineral supply chains, several measures could be implemented. First, due diligence should be mandated through binding regulation, as is increasingly the case in the European Union through supply chain legislation (Corporate Sustainability Due Diligence Directive) and critical mineral and technology regulation (Critical Raw Materials Act, Battery Regulation). Currently, the OECD Due Diligence Guidance for Responsible Mineral Supply Chains is voluntary for many traders outside certain jurisdictions. Due diligence obligations could be imposed by expanding on and/or generalizing the requirement of supply chain due diligence in key mineral markets, including mandating third-

party audits and verification at "choke points" such as refineries and smelters [16].

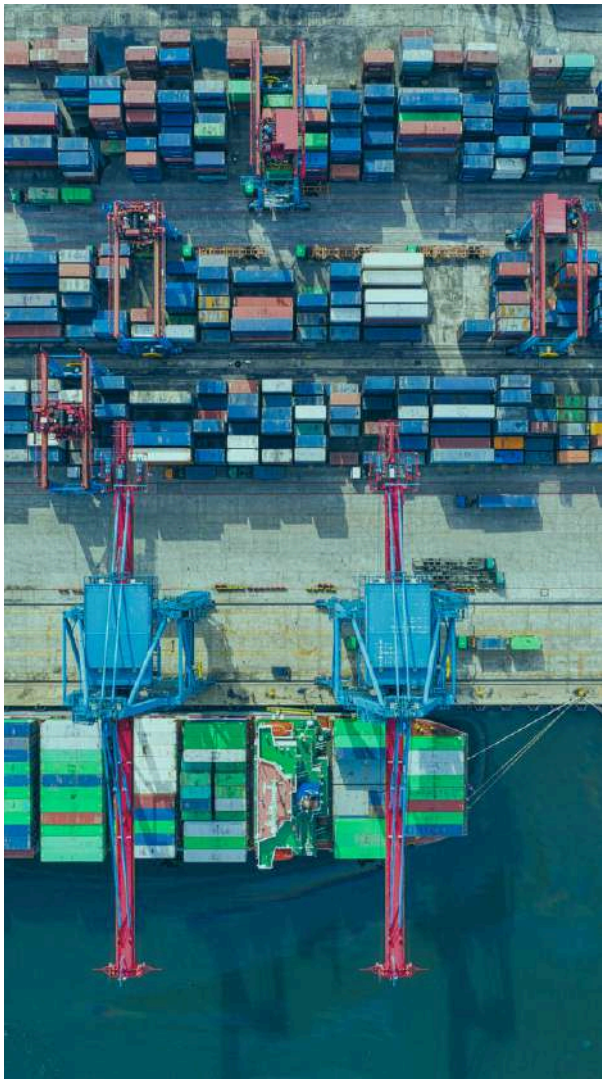
To enhance transparency and traceability, **commodity traders could be required to disclose payments, contracts, beneficial ownership information, and supply chain due diligence reports**. This increased transparency would help identify risks such as corruption, money laundering, and conflict financing. Furthermore, oversight and monitoring mechanisms for OTC trades conducted by commodity traders would need to be strengthened.

Finally, **cross-border collaboration** would be essential to harmonize regulations and data-sharing standards for transition mineral trading activities. Such collaboration would prevent regulatory arbitrage and improve monitoring across borders.

Revitalizing International Trade Governance: Strategies Amidst Dispute Settlement Challenges

On trade barriers and disputes, **the Appellate Body of the WTO's dispute settlement mechanism, has been paralyzed** due to the United States blocking new appointments since December 2019. Without a functioning Appellate Body, the system cannot issue final, binding rulings that are enforceable. WTO members recognized the urgency of reviving the system at the 2022 Ministerial Conference, committing to have it "fully and well-functioning" by 2024. Intensive negotiations are ongoing through the "Molina Process" to unblock Appellate Body appointments. Additionally, over 50 WTO members, including the EU, have joined the Multi-Party Interim Appeal Arbitration Arrangement (MPIA) as a temporary alternative appeal mechanism until the Appellate Body is restored. The United States is not member of the MPIA and its effectiveness has been disputed.

Until the WTO's dispute settlement mechanism is restored, a possible strategy to limit trade barriers while ensuring mineral producing nations profit from their resource wealth with be to support them in developing their processing industries. One example is the strategic partnership between the EU and Kazakhstan on sustainable raw materials, batteries and renewable hydrogen value chains, which will involve developing value chains, creating added value in the mining, processing, manufacturing and recycling sectors, and facilitating investments and funding opportunities [17]. In such partnerships, it is key that emphasis is put on transparency and avoiding trade distortion, and not simply on securing supply through exclusive agreements, as that would compromise the goal of improved market fluidity and transparency [see *paper "Equitable Opportunities for Mineral-Rich Countries"*].



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3. Creating and Leveraging Opportunities for Mineral-Rich Countries

Authored by ***Solange Harpham****, edited by* ***Ludivine Wouters***

Summary:

Increasing demand for transition minerals is perceived by many resource-rich countries as a new opportunity to boost revenue and advance towards industrialization. While these resources present substantial economic opportunities, countries often remain limited to raw material extraction due to infrastructure, investment, and governance challenges and/or market dynamics which do not support the emergence of new or localized clusters of operations.

Efforts to move down the value chain through processing localization mandates and/or export bans, as seen in Zimbabwe's lithium policies, have had mixed results, mostly leading to inefficiencies and reduced production. Examples like Indonesia's nickel sector must also be considered carefully, balancing socio-economic benefits with environmental impacts. Nationalization efforts, such as Chile's new lithium strategy, also illustrate the difficulty of driving sustainable and positive outcomes from such policies.

International partnerships, North-South collaborations, and regional integration efforts also aim to enhance processing capabilities and increase industrialization. However, these endeavors face significant hurdles, including weak institutions, political instability, and the need for substantial investment and capacity building. Robust regulatory frameworks, capacity building, and regional cooperation to harness the full potential of mineral resources while ensuring sustainable development and equitable benefits for local communities are crucial.

3.1. Navigating Economic Opportunities and Challenges in Mineral-Rich Countries

Amidst the rush to access critical minerals in the energy transition, resource-rich countries are hoping to capitalize by adding value to raw materials through refining, smelting, and manufacturing components of batteries and other green technologies. This is not the first attempt for many of these countries at developing such forward linkages. However, in many mineral-rich developing countries there are often far more economic development opportunities in the short to medium term in backward linkages – mining companies purchasing goods and services – fostered by local content policies, and in optimizing mineral governance and resource management. Adding value through refining and creating finished goods from minerals could remain a long- term goal in some cases, but local procurement and employment are often mining's most effective developmental contribution.

Moving down the Mineral Value-Chain

Mineral deposits crucial for the energy transition are often exploited in concentrated clusters in **emerging economies**. The Lithium triangle (Bolivia, Chile, Argentina) holds around 54% of the world's lithium [1], an essential component in batteries for electric vehicles and energy storage systems. In Southeast Asia, Indonesia represents 40% of global nickel production [2]. Approximately 30% of the world's transition minerals are believed to be situated within the African continent [3].

Although resource-rich countries are integrated into the global value chains, their role continues to be generally **limited to extraction and exportation of raw materials**. Advancing to processing industries can present an opportunity to industrialize and develop, increasing fiscal revenue as exports gain in value, creating new and highly technical employment opportunities, and fostering an ecosystem of supplier and product-consuming industries. In addition to diversifying their economies and reducing their exposure to price volatility commonly associated with raw commodity production, moving down the value chain could bring higher revenues, higher-skilled jobs training for local communities as well as positive technological spillovers. The International Monetary Fund projects that the extraction of select minerals could boost the African region's GDP by 12% or more by 2050 [4].

Furthermore, the processing of most minerals, including those most critical to energy and industrial transitions, is highly concentrated, increasing supply chain risk and creating bottlenecks that are vulnerable to economic or geopolitical shocks. As a result, this leverage can be used to flex political muscle [5]. Diversifying the location and control of processing and other downstream operations could foster more efficient and possibly more transparent markets, unlocking opportunities for partners of the relevant resource-rich countries – an ecosystem approach necessarily entails consideration of partnerships at industrial and policy levels.

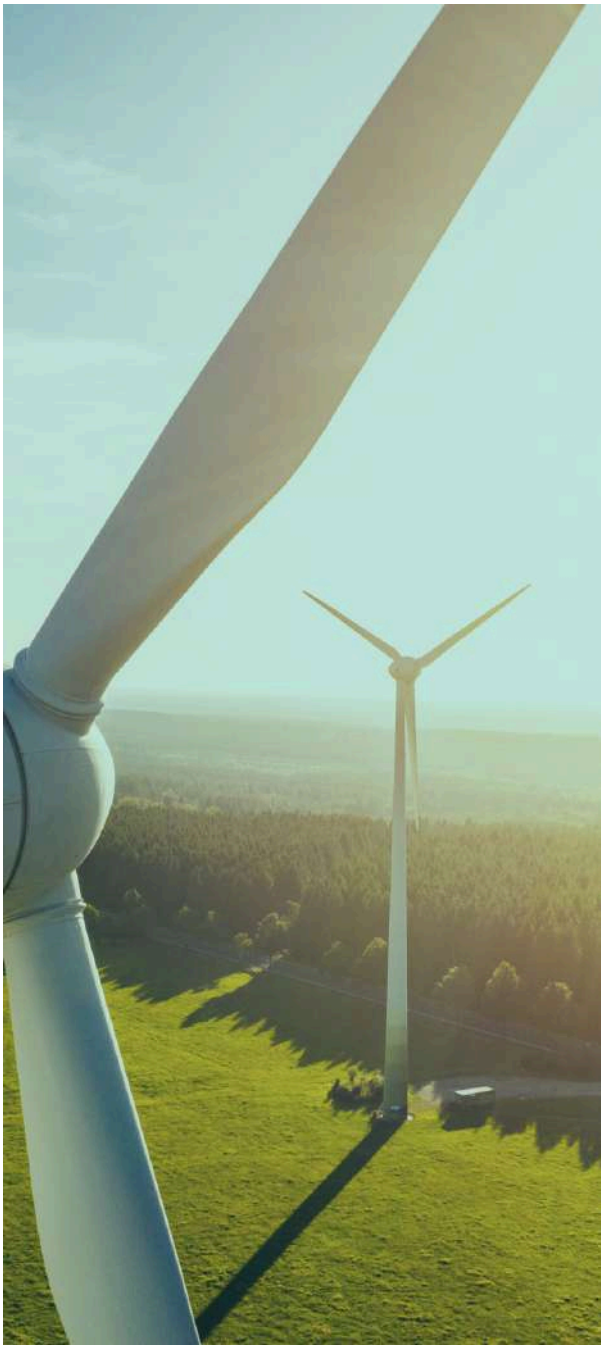
Challenges in Establishing Value-Added Industries

Mining and processing both demand enabling conditions including infrastructure, skills, commercial relevance of their product, and substantial investment. For example, beyond meeting the high energy demands of processing plants, a comprehensive transport network – trains, containers, trucks, and ample storage space, all integrated with custom port facilities – is vital for the efficient movement of many minerals and the equipment and consumables necessary to process them [6]. As such, a major hurdle is financing mineral transformation operations in countries which may not present sufficient downstream markets or connect to global value chains easily. Public finances have been especially under strain post-Covid, and domestic firms mostly lack technical and financial capacity for new processing operations, while capital pools focusing on these operations are mostly reluctant to take on the operational and political risk of operating in frontier countries.

Numerous resource-rich States have nonetheless expressed their objective of moving down the value chain, not only to processing but also manufacturing, and have adopted policies generally associated with resource nationalism: processing localization mandates, export bans and/or nationalization policies. However, these policies often incur high costs and are difficult to enforce, sometimes leading to inefficiency and rent-seeking behavior. Notably, past mineral export bans in countries like Tanzania and Zambia have paradoxically resulted in decreased local production of both processed and raw minerals [7]. Studies on export control measures found that such measures, despite

their goal of enhancing local processing, often fall short. They can even negatively impact the industry by reducing mineral exports.

Furthermore, it is also notable that "green" or sustainable refining remains an emerging field for which relatively few standards and studies have been developed to date, and for which best practice is scarce, leading stakeholders to question whether processing actually constitutes "value addition" when considering both the uncertainty of the business case and the environmental and social impacts this industry can have.



Indonesia's Nickel Export Ban: Successes & Challenges

Indonesia's ban on nickel ore exports in 2014 in a bid to grow a domestic processing industry has been hailed as a success in terms of export revenue gains. It enabled it to attract more than $15bn of foreign investment in nickel processing, primarily from China, and to build an extensive domestic smelting industry, as well as battery plants and several electric vehicle factories [8]. However, while the export revenue gains are evident, the extent to which this revenue is retained and equitably shared within the country remains uncertain. This is mostly due to the capital-intensive nature of the nickel sector, the high share of foreign equity and the sector's limited linkage with other parts of the economy beyond the primary sector. Moving down the value chain has not concretely translated into development gains for the Indonesian populations.

Furthermore, the ecological impact of this new industry heavily reliant on coal-fired power has caused international and stakeholder concern: even as Indonesia produces the vast majority of nickel so necessary to a global energy transition, it is doing so by burning huge quantities of fossil fuels, thereby exacerbating the climate stakes the same transition aims to address. This incoherence is both a mar on transition policies in consumer regions and a significant failure of global governance to mitigate climate impacts. Nevertheless, Jakarta is planning taxes on exports of intermediate nickel products, with the goal of encouraging the development of a full electric vehicle supply chain [9] [10].

Finally, a few countries have turned towards the **nationalization of their mining industries** in the hope of controlling and managing valuable mineral resources. In April 2023, President Gabriel Boric announced plans to nationalize Chile's lithium industry [11], with the state taking a majority stake in all new lithium contracts and exploration/extraction areas. This announcement builds on Chile's strong institutions and its successful nationalization of its copper resources in the 1960s and 70s, with the creation of the national company Codelco [12]. However, Chile stands out as an exception – **most countries having attempted nationalization of their resources were unsuccessful**. Examples such as Zambia and Peru also attempted to nationalize their mining industries in the same time period and ran into corruption and mismanagement issues [13] [14]. Whether Chile can replicate its success with copper in the lithium sector remains to be seen – several companies have shown interest in developing new lithium projects and are awaiting clarification on the 2023 lithium strategy to pursue them [15].

3.2. Transforming Resource Wealth: Opportunities for Mineral-Rich Nations

North-South Partnerships for Added-Value

In recent years, partnerships between resource-rich nations aiming to advance down the value chain and those requiring minerals for their energy transition have multiplied. These partnerships all encompass some form of commitment from "buyer" partners to bolster smelting and transformation capacities in "producer" partner countries, as well as to enhance expertise and capabilities. The European Union (EU) has now entered into 12 such "Strategic Partnerships" with Argentina, Australia, Canada, Chile, the Democratic Republic of the Congo, Greenland, Kazakhstan, Namibia, Norway, Rwanda, Ukraine and Zambia, all including a pillar on local value addition, and is similarly refocusing aspects of its relations with Brazil, China, Colombia, Japan, Mexico, Peru, the United States (US), Uruguay, the EuroMed countries and the African Union around critical minerals [16]. The US is orchestrating the Mineral Security Partnership (MSP), a collaboration of fourteen countries and the EU to catalyze public and private investment in responsible critical minerals supply chains globally, which will continue to expand its outreach to resource-rich countries with the newly formed MSP Forum [17]. Another significant example is the MoU

between the US, the Democratic Republic of Congo (DRC), and Zambia, aimed at bolstering electric vehicle battery production in these nations [18].

There are several limitations to these partnerships. For processing industries to emerge and support sustainable economic development, a number of **enabling** conditions must be met, including a skilled workforce, technical expertise, consistent policies, and strong institutions and frameworks. In-depth understanding of market dynamics and strategic positioning of industrial opportunities are also essential to harness the full potential of processing facilities and drive sustainable industrial growth – unfounded assumptions as to the economics of processing cannot drive political ambitions. Attempts to add value to mineral exports may not be economically viable or competitive on a global scale, leading to the erosion of existing industries and potential deindustrialization. Value-added products may face stiff competition from established producers in global markets, making it challenging for resource-rich countries to capture market share and achieve sustainable profitability.

Without these enabling conditions and concerted efforts, processing industries risk becoming yet another source of environmental destruction and social disruption, generating unreliable revenue without fostering long-term industrialization and development gains.

Finally, one of the key expectations associated with moving down the value chain is the opportunity to access new technologies and acquire advanced skills. As industries advance along the value chain, the demand for new technologies and a diverse range of competencies escalates. However, whether this progression will truly benefit the country and its population hinges on a holistic approach, encompassing not only the acquisition of new technology but also the maintenance and reproduction of this technology domestically. Additionally, creating an environment that uplifts locally trained individuals will be essential to prevent any adverse consequences of brain drain.

Capacity Building for Responsible Mining in Resource-Rich Countries

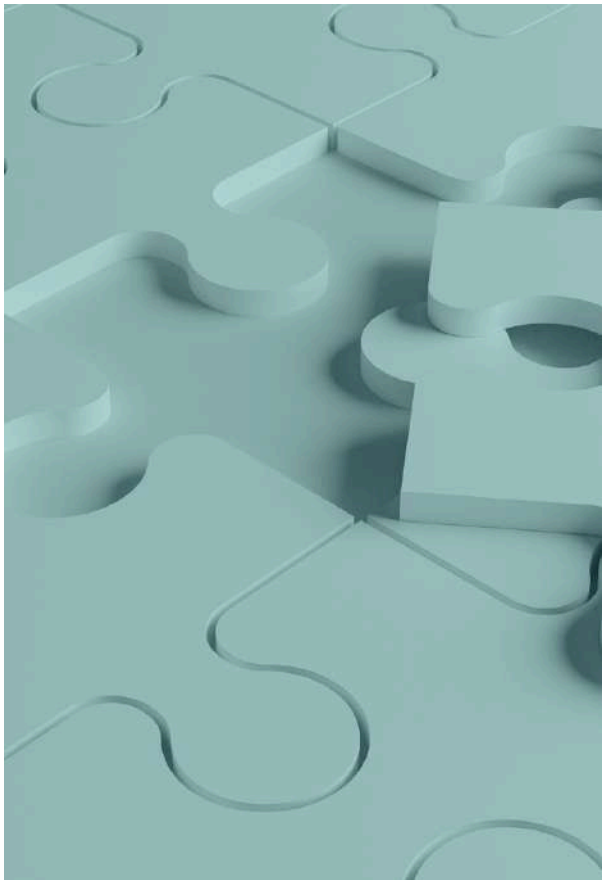
Developing resource-rich countries often lack the **human, financial, and expertise resources** to fully implement their own mineral governance frameworks, negotiate contracts with multinational corporations, and monitor and hold mining companies accountable. Additional challenges stem from the fact that substantial reserves of minerals are found in hotspots for biodiversity, as well as lands traditionally belonging to indigenous peoples.

Establishing robust regulatory frameworks and institutions for responsible mining management is vital for instilling confidence among investors, companies and local communities. This involves integrating strong environmental and social safeguards, transparent revenue management, and benefit sharing with the population. Numerous organizations, including the Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development, the Extractive Industries Transparency Initiative, and the World Bank, are dedicated to supporting resource-rich countries in developing these frameworks. Assistance is also available through various channels, including training programs and knowledge-sharing initiatives to help with the implementation of these norms as countries face obstacles such as limited institutional capacity, corruption, and political instability [19].

Capacity building should also be directed towards assisting **resource-rich countries in understanding the scope of their own resources**. Private companies often boast a deeper technical and geological understanding

of the reserves they plan to exploit compared to the resource-rich nations themselves, which can lead to unequal contract negotiations. Therefore, centralizing and disseminating geological data on a country's underground reserves is always essential to sound resource management. However, funding is indispensable for such initiatives, and resource-rich countries typically lack the financial means to spearhead costly exploration projects without any assurance of returns, robust regulatory frameworks and institutions [20].

Finally, with the numerous actors dedicated to capacity building efforts in resource-rich countries, there is generally a **lack of coordination among the various actors involved in the capacity-building initiatives**, as governments may not have the capacity to coordinate or map ongoing efforts in different sectors. This can therefore lead to duplication of efforts, inefficient use of resources, and confusion among stakeholders.



3.2. The Possibilities of Deeper Regional Integration

Regional policy approaches that leverage the diversity in minerals, expand often narrow and/or shallow markets, and pool resources can tackle challenges more effectively than isolated efforts. At the country level, structural reforms can complement these regional efforts, nurturing domestic firms in both the processing sector and its supportive industries. This presents an opportunity for these countries to capitalize on their combined mineral resources and collective bargaining power. Through such collaboration, transaction costs could be minimized, intra-regional synergies fostered, competitiveness enhanced, and economies of scale realized.

Africa

Capacity building and North-South partnerships could focus on capitalizing and investing in existing regional frameworks for the governance of mineral resources on the African continent, the most notable of which is the **African Mining Vision (AMV)** published in 2009 by the African Union [21]. An African Development Minerals Center (AMDC) was set up to implement the AMV, and is now developing an **African Green Minerals Strategy (AGMS)** in partnership with the African Development Bank, African Legal Support Facility (ALSF), United Nations Economic Commission for Africa (UNECA), and United Nations Development Programme (UNDP) [22] [23]. However, these frameworks lack capacity (the AMDC currently employs four to five people) and buy-in from many resource-rich African states, and implementation has barely progressed in the last fifteen years.

Another promising African regional framework is the **African Continental Free Trade Area (AfCFTA)** which is entering into its operational phase in April 2024 [24]. This free trade area could potentially create a larger and more interconnected market for minerals, enhancing the region's investment appeal. Simplifying bureaucratic procedures and harmonizing mining regulations across borders would foster a stable, predictable investment environment.

Furthermore, the operationalization of the AfCFTA could potentially unite fragmented mineral markets for larger-scale operations and **form regional value chains** that draw on both raw and processed mineral inputs. A 2021 report by BloombergNEF found that the DRC, in partnership with South Africa, Gabon (manganese) and Madagascar (nickel), could leverage its cobalt resources and its hydroelectric power to become a low-cost and low-emissions producer of lithium-ion battery cathode precursor materials [25]. It estimates that it would be three times cheaper to build a cathode pre-cursor plant in the DRC than in the US; and similarly,much cheaper and less polluting than in China and Poland. In line with this study, the DRC and Zambia have started to collaborate on electric battery production for two- and three-wheeled electric vehicles for Africa [26]. Success in these smaller regional initiatives can pave the way for larger, more comprehensive hubs for regional mineral processing and manufacturing.

However, a combination of political, economic, infrastructural and institutional challenges has **hindered deeper regional integration in Africa** despite the numerous regional economic communities and the African Union's push for continental integration [27]. Political instability, civil wars, and conflicts in some African countries have severely disrupted regional economic integration efforts. The strong desire to preserve national sovereignty and identity, especially among the newly independent African nations in the 1960s, has also made countries reluctant to cede authority to regional bodies [28]. Lastly, as aforementioned, the lack of human, institutional and financial capacities in many African countries and regional bodies has hampered efforts to effectively implement and sustain regional integration initiatives.

Latin America

Since at least July 2022, ministers and officials from Chile, Argentina and Bolivia have been engaged in talks about potentially **coordinating their policies and production of lithium resources** through some form of strategic alliance or cartel-like organization, similar to OPEC for oil. The main motivations appear to be increasing their collective bargaining power over lithium prices, controlling the pace of extraction to align with national development goals, and capturing more value from their lithium reserves amid soaring global demand. However, several obstacles exist, including **historical tensions and mistrust between the countries**, diverging national interests, competition from other lithium sources, potential resistance from industry, and the unique nature of lithium as a specialty product rather than a commodity like copper. While concrete details are lacking, the foreign ministers have reportedly been in "advanced talks", and Bolivia's president has indicated openness to a common lithium policy for the region [29] [30].

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4. International Cooperation for Financing Responsible Mining

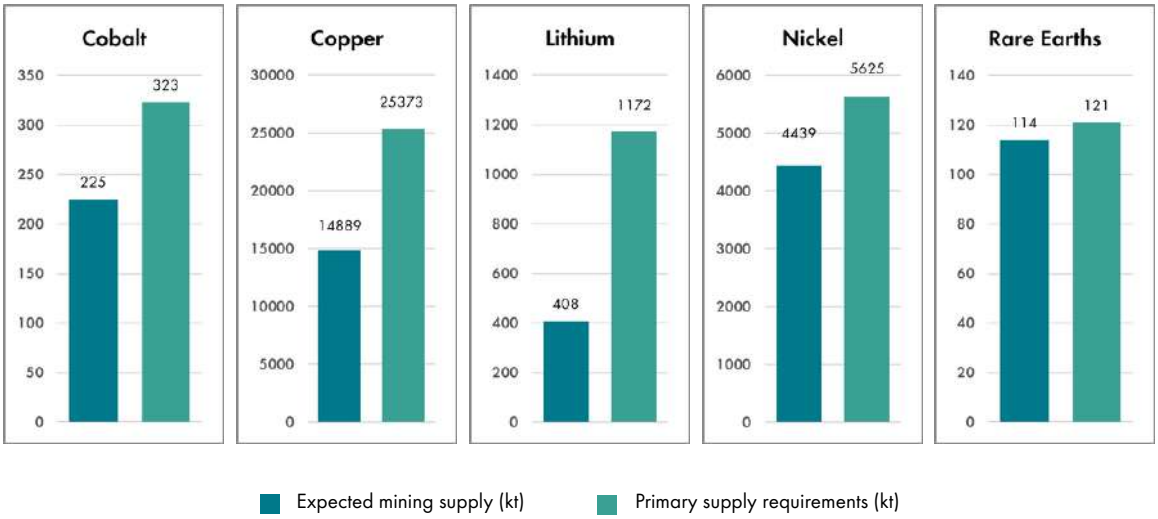
Authored by ***Solange Harpham*** *and* ***Brenda Yeong****, edited by* ***Ludivine Wouters***

Summary:

Mining finance is driven by specialist capital concentrated in a small number of financial centers and has shrunk dramatically over the last decade in Western markets. Attracting non-specialist finance to mining is proving extremely difficult due to the sector's challenges including commodity pricing cyclicality and volatility, operations' long lead times and increasing costs, ESG risks and their reputational impacts, and geopolitical uncertainty exacerbating concentration risks. Considering the limited mining finance pools available in Western markets and strategic focus on industrial and defense stakes, government intervention, previously a hallmark of China's positioning on critical minerals domestically and abroad, is on the rise. Responsibility is a key pillar of critical mineral strategies, aligning with societal expectations of responsible business conduct across borders and value chain levels, and with fair transition principles: ESG criteria should be viewed as a bolster to responsible investment and improving governance. Unlocking responsible financing for mining will require actioning international collaboration tools, amplifying public-private initiatives and better communication of minerals' critical role in addressing global sustainability stakes.

4.1. Challenges to Investment in Transition Minerals Projects

The market size for key transition minerals has doubled over the past six years to reach USD 325 billion in 2023, with investment and exploration spending continuing to increase by 10% and 15% respectively [1]. Yet, supply is still expected to be insufficient to meet market demand from the mid-term, much less net-zero requirements. In order to secure the supply of minerals for the energy transition, **an estimated US$1.7 trillion over the next 15 years investment in mining will be needed** [2].



Source: "Global Critical Minerals Outlook 2024" by the International Energy Agency (2024)

Key Obstacles in Financing Mining Projects

Mining finance is driven by specialist capital concentrated in a small number of financial centers led by Canada, Australia, the United Kingdom (UK), and China. Western mining finance has shrunk considerably over the last decade: mining specialist capital is estimated to have fallen by 60% in the UK and 80% in Canada between 2010 and 2022, and many financial institutions significantly decreased or even closed their mining debt portfolio over the same period. Although alternative finance is more available and has now integrated the mining landscape, it has not filled the gap [3]. Attracting non-specialist finance to mining is proving extremely difficult, considering some of the key challenges of the sector compared to other asset classes, including:

- **Cyclical and volatile prices**: Mining valuations are highly correlated with spot prices, with market capitalization having a 93% correlation with commodity prices, higher than industries such as oil and gas and steel. Companies find that they underinvest in downcycles and overinvest in upcycles, and investors are deterred by the unpredictable prices and returns [4].
- **Long and uncertain lead times**: The development of new mining projects involves obtaining permits, conducting exploration and feasibility studies, and carrying out mine construction before extraction can occur. This process has become increasingly lengthy, with an average lead time of **17.9 years** [5]. This long, bureaucratic and uncertain process can not only deter investors from investing at all, but also exacerbate the risk of timing mismatches in the investment cycle.
- **Increasing production costs**: Given that high-quality deposits are exploited first, declining ore quality and deteriorating mine conditions are resulting in escalating production costs. For example, the average Chilean copper ore grade has decreased by 30% over the past 15 years [6]. As deposits in major mines are depleted, activity moves to the fringes of exploited deposits, necessitating more complex, energy intensive and costly extraction and processing of minerals from lower grade ores.

- **Environmental, social and governance (ESG) risks**: Mining projects are often located in developing countries struggling with poor governance, and subject to a range of supply-side risks that can disrupt production, including extreme climate phenomena, water shortages, and social conflict. Investors recognize that ESG performance is closely tied to such risks, with some divesting from mining entirely due in part to their reputational impacts. While governments are putting forth stricter regulations, compliance – reporting on ESG performance, conducting audits, and implementing mitigation measures – will also increase costs, and can limit the number of deposits that can be exploited.

- **Geopolitical uncertainty exacerbating concentration risks**: The transition minerals reserves are highly concentrated, with China dominating graphite and rare earths extraction, the Democratic Republic of Congo (DRC) dominating cobalt, and Indonesia dominating nickel. This concentration has left prices more vulnerable to supply shocks. For example, the current oversupply of cheap Indonesian nickel has affected the profitability of Australian nickel, resulting in numerous mine closures. Increased resource nationalism, friend-shoring, as well as potential cartelization, such as between the "lithium triangle" countries of Argentina, Bolivia and Chile, pose further threats to the transition mineral supply chain and price stability. Geopolitical uncertainty, foreign intervention and social manipulation, particularly in fragile states, are also amplifying the supply risk.

While the market uncertainties, high capital expenditures, long lead times, declining ore qualities, ESG issues and geopolitical tensions may deter investment, they also justify the need to take steps quickly to incentivize investment in order to secure the minerals supply necessary to enable the energy transition.

Challenges in Financing Mine Closure and Rehabilitation

Mine closure and rehabilitation are often overlooked, yet they are essential for **maintaining the social license for mining projects and represent the natural conclusion of the extraction process**. Over 80,000 inactive and unused mine sites can be found across Australia, with around 82% potentially requiring rehabilitation [7]. In South Africa, it was reported in 2021 that out of 2,322 mines classified as "high-risk" (including coal mines), only 27 mines (all mining asbestos) had been rehabilitated [8]. The increasing demand for transition minerals will lead to more mining activities, making it crucial to plan for the future to avoid ending up with abandoned mines. This is particularly relevant in a context where operators may become increasingly reluctant to trigger closure as technological innovation and shifting mineral priorities create opportunities to reprocess waste material: closure as a clearly defined moment in time may need to be reconsidered for a more holistic approach to rehabilitation throughout the life of mine.

The long timelines and uncertainty around the full extent and costs of rehabilitation, especially for long-term environmental impacts, make accurate financial planning difficult. Many companies fail to set aside adequate financial provisions during the operational phase, leading to a significant funding gap; States rarely plan and provision adequately from mining revenue for regional rehabilitation and reskilling solutions. The high costs associated with meeting environmental and safety standards, including land reclamation, decommissioning facilities, and long-term monitoring, peak at the end of a mine's life when cash flows are diminishing - by the time closure is needed, smaller mining firms

with limited financial resources might face the risk of insolvency or bankruptcy. Lastly, premature or unplanned closures due to factors like commodity price volatility can also leave insufficient time and resources for proper closure planning.

4.2. Exploring Existing Finance Channels for Transition Mineral Projects, and their Shortcomings

Financing needs and sources of mineral projects evolve throughout their lifecycle: whilst exploration is dominated by **equity funding** due to its singular risk profile, development of mines and facilities can be highly leveraged as cash flow expectations provide capacity for debt repayment. Additional funding sources can include **production-based financing** in the form of offtake royalty agreements, streaming or forward purchase and prepay agreements. Although **debt financing options** are starting to include green bonds, which fund environmentally sustainable projects, and sustainability-linked loans, whose terms depend on the borrower's sustainability performance, categorization of mining and minerals remains a limiting factor in its access to sustainability or transition finance pools.

Considering the limited mining finance pools available in Western markets and strategic focus on industrial and defense stakes globally, government intervention, previously a hallmark of China's positioning on critical minerals domestically and abroad, is on the rise.

Public Financing Tools

As awareness of the necessity of minerals for achieving net-zero transitions grows, **governments in consumer markets have developed financing tools and policies to secure mineral supply for their industries**. The Covid-19 pandemic (2020 – 2022) and the ongoing conflict in Ukraine (since 2022) have highlighted the vulnerability of global supply chains reliant on only a few suppliers. Recent financial initiatives by European and American governments primarily seek to reduce reliance on China's dominance in the mineral market and establish diversified supply chains worldwide. These efforts include:

- **Tax credits**: In the United States (US), the US Inflation Reduction Act (IRA) and its New Advanced Manufacturing Production Credit (2023) will grant a tax credit equal to 10% of the cost of production of transition minerals including cobalt, graphite, lithium and nickel. Furthermore, under the Title 17 Clean Energy Financing Program, the US Department of Energy's Loan Programs Office can support transition minerals mining and extraction activities with flexible, custom financing. This last IRA benefit is also being also extended to Canada. In Canada, the Critical Mineral Exploration Tax Credit and Clean Technology Manufacturing Tax (2024) Credit will support investments in transition mineral exploration, and extraction, processing and recycling respectively.

- **National funds**: Japan's Organization for Metals and Energy Security (JOGMEC) and the Japan Bank for International Cooperation (JBIC) have a strong track record in providing equity, loans and debt guarantees for overseas mineral projects, and have good standing in many resource-rich countries. National funds are emerging in other mineral-consuming countries, sometimes modelled on JOGMEC (Germany, EUR 1 billion sovereign fund announced), sometimes more focused on domestic or regional projects (France, EUR 2 billion public-private fund in progress). National financing examples in resource-rich countries include the Australian AUD 4 billion Critical Minerals Facility managed by Export Finance Australia (EFA) to support projects and related infrastructure.

The Importance of Long-Term Strategies for Public Funding

While government funding can be useful in mitigating some of the technical, project, and market risks inherent in mining, thereby fostering commercial viability and attracting investment, the European Union (EU) and the US have only recently begun to announce substantial investments in global mineral supply chains (USD 360 million to finance the Lobito Corridor, an infrastructure project spanning from copper-producing Zambia and the Democratic Republic of Congo to Angola). Additionally, **rising debts, financial crises, competing priorities and public opinion** are playing a part in dissuading European governments from investing in this perceived high-risk sector. No dedicated financial envelope has been announced to support the ambitious EU Critical Raw Materials Act.

Generally, it is widely acknowledged that western countries lag behind China in energy and mining projects – China is a clear example of strong industrial policy, financing, and government subsidies allowing for the development of strategic industries in the minerals and energy sectors. The Made in China 2025 initiative launched in 2015 aims to transform China into a "leading manufacturing power by the year 2049", and key sectors include energy-saving cars and new energy cars, as well as new materials such as permanent magnets and clean energy technology components [9]. A large range of financial tools are available to support its implementation, including national investment funds, ministerial special financial vehicles, and financing from state-owned banks such as the China Construction Bank, the Industrial and Commercial Bank of China and the China Development Bank. In March 2018, it was reported that there were more than 1,800 government industrial investment funds amounting to USD 450 billion [10]. These impressive investments, centralized decision-making and consistent practice of strategic vertical integration have allowed China to become a dominant actor in upstream and downstream mining supply chains.

Leveraging ESG Criteria in Mining Investments for Sustainable Growth

Responsibility is a key pillar of Western national critical mineral strategies. The IRA requires that projects avoid or reduce air pollutants or greenhouse gas (GHG) emissions, includes a Community Benefits Plan, and is subject to an environmental and socioeconomic impact review. The EFA applies the OECD Recommendation of the Council on Common Approaches for Officially Supported Export Credits and Environmental and Social Due Diligence, as well as the Equator Principles in environmental and social project risk assessment, while JOGMEC has specific health, safety and environment screening criteria for lending and debt guarantees in metallic minerals.

Application of ESG criteria to mining investment has been criticized for being overly restrictive, potentially deterring companies from investing in developing countries where many essential minerals are found. The European Investment Bank has, for example, been accused of imposing stringent ESG standards that create barriers for investments in these regions. The administrative barriers and burden of proof required to implement ESG criteria are often flagged as being unattainable for countries and companies with limited capacity.

However, **there is a strong argument that such a narrative dilutes accountability, which is no longer aligned with societal expectations of responsible business conduct across borders and value chain levels, nor with fair transition principles**. Mining companies that demonstrate robust ESG practices and reporting are more likely to attract longer-term capital from ESG-focused institutional and backing of financial institutions supportive of wider development stakes. Robust ESG practices enable companies to identify, assess, and manage environmental, social, and governance threats and opportunities, and mitigate the risk of liabilities, conflicts, lawsuits, reputational damage, and operational disruptions which can affect all stakeholders. Integrating ESG criteria helps optimize resource use, reduce waste and emissions, and drive operational efficiencies, resulting in significant cost savings for mining operations as well as good corporate citizenship. China has been working on its companies' ESG performance for these reasons, with the China Chamber of Commerce for Metals Minerals & Chemicals Importers & Exporters issuing their own Chinese Due Diligence Guidelines for Responsible Mineral Supply Chains in 2015 [11].

Furthermore, addressing social and community concerns is also essential to build trust and foster long-term relationships and wider economic development. The cost of reporting and verification is an issue, but this does not diminish the value of sound principles, practices and outcomes in pursuing responsible investment and mining [12].

Investors, lenders, and financiers are placing greater emphasis on ESG performance when making investment decisions for mining projects and companies world-wide. Applying high ESG expectations does not entail disengagement but rather increased focus on governance (corporate and mineral), deeper understanding and management of risks and consistent transparency with stakeholders.

4.3. Leveraging the Strengths of International Collaboration

Partnerships for Responsible Project Financing

To boost investor confidence, governments generally address **geopolitical uncertainty** by securing agreements with partner countries, through instruments such as free trade agreements (FTAs). Under the US Inflation Reduction Act, FTA partners are privileged and eligible for domestic tax credits. Commercial and strategic agreements between governments and industries can also attract capital, technology, skilled labor, and private-sector partnerships, and help the sector scale up quickly. Such international engagement would also be an opportunity to shape and embed ESG standards and other market norms such as transparency and traceability.

One such example is the **Minerals Security Partnership (MSP)** between Australia, Canada, Estonia, Finland, France, Germany, India, Italy, Japan, Norway, the Republic of Korea, Sweden, the UK, the US, and the EU which aims to "accelerate the development of diverse and sustainable critical energy minerals supply chains through working with host governments and industry to facilitate targeted financial and diplomatic support for strategic projects along the value chain". Supported projects must adhere to internationally recognized ESG standards – demonstrate responsible stewardship of the environment, ensure fair and safe working conditions, and provide economic benefits for local communities, among others.

However, **government partnerships such as the MSP run the risk of feeding into and being part of geopolitical tensions**, rather than assuaging them. The MSP is widely perceived as an anti-China endeavor for the US to build alternative supply chains, and while the MSP commits to consulting with mineral-rich countries, with countries such as Angola, Botswana, the DRC, South Africa, Tanzania, Uganda, and Zambia in attendance at the ESG Principles meeting in South Africa, these countries are not full-fledged members. Criticism has also been raised regarding "friend-shoring" and protectionism in the MSP, as well as its opacity [13].

A less controversial example of a strategic partnership is **Africamaval**, an EU-funded initiative aimed at fostering responsible sourcing of transition minerals from Africa through sustainable investments and knowledge-sharing between European and African stakeholders in the raw materials sector. One of their activities will be to evaluate 100 investment opportunities and disseminating results through their EU-Africa networks. Such partnerships, with their emphasis on networking and knowledge-sharing could be reassuring to investors, and have a wider positive impact on the mineral sector.

A Public-Private International Fund for Transition Minerals Mining Projects

Amid the competition to secure strategic transition minerals, nations have been setting up **national funds** that utilize public funds to attract private investors for financing their domestic supply chains. Examples include the French Fund (EUR 500 million public money and private firm Infravia Capital Partners raising additional funds to reach a total target of EUR 2 billion) [14], and the "Made in Italy" fund with EUR 1 billion from the government, and a mandate to attract at least an equal amount (EUR 1 billion) from private investors [15]. There has been concern that these separate national funds would compete with each other and that they would serve exclusively their national industrial interest.

A dedicated public-private international fund could focus on global transition mineral projects to ensure an ample supply of responsibly sourced minerals for the energy transition. This fund could also be dedicated to mining closure and rehabilitation, as aforementioned. This new international fund could be associated with an existing international organization such as the United Nations, the World Bank, or IRENA. Alternatively, it could involve expanding the scope of an existing fund like the World Bank Smart Mining Facility, the Green Climate Fund, or the Global Energy Efficiency and Renewable Energy Fund (GEEREF).

Such a fund could also serve to **finance exploration**. Junior miners are small companies generally focused on exploration, typically with market capitalizations under USD 500 million, that then sell discovered deposits to (or otherwise partner with) major miners to develop them [16]. Given the exhaustion of existing mines and the need for new mines to meet future demand, junior miners play a key role in supporting transition mineral supply. However, juniors face significant challenges in obtaining financing for their activities. Exploration is not only capital intensive, but also highly risky and subject to geological uncertainties and delays. Project viability is also sensitive to commodity price, and many transition mineral markets have been extremely volatile, exacerbated by the possibility of dominant players influencing prices to discourage new entrants. As such, despite the potential for high returns, market failure abounds and investor appetite is weak. A private-public international fund could therefore help in investing in technology such as data aggregation and artificial intelligence tools to increase the likelihood of exploration success, as well as absorb some of the financial risk when unsuccessful searches are conducted.

Global Communication on the Role of Transition Minerals

Despite increasing awareness of the critical role minerals play in the energy transition, the topic remains largely obscure to the general public and investors not connected to mining finance. This lack of public knowledge stems from several factors, including the complexity of the supply chains, the technical nature of mineral extraction and processing, and the negative imagery associated with mining. There is therefore a **need for increased education and outreach efforts that simplify and clarify the importance of minerals in the energy transition**. This could involve a global informative campaign, more accessible reporting from mining companies, and initiatives by governments and industry bodies to provide clear, reliable information, fostering **greater public and investor engagement**.

It will also require significant political courage to designate financing of mining and mineral projects as strategic to national and global stakes. This includes categorization of mining and processing as aligning with climate change mitigation and sustainability goals, for example within the EU taxonomy of economic activities that can be considered environmentally sustainable [17]. This will be an essential signal to financial markets, but also to stakeholders in resource-rich countries and in mineral-consuming markets, of the coherence of sustainability policies, expectations and actions in the critical minerals space.

Notes

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5. Environmental and Social Sustainability All Along the Supply Chain

Authored by ***Solange Harpham*** *and* ***Brenda Yeong****, edited by* ***Ludivine Wouters***

Summary:

Mineral industries are often perceived as polluting and socially disruptive. However, increasing demand for minerals essential to the energy transition means we will need to rely on mining and mineral industries more than ever in the future. Current efforts for strengthened sustainability along mineral supply chains are abundant: numerous voluntary industry standards exist, as well as efforts to strengthen due diligence and circularity at all levels of the supply chain. However, further international collaboration is needed to harmonize existing standards, ensure the economic viability of green mineral operations, develop a global framework for circularity and strengthen capacity building.

Sustainability is defined as "meeting the needs of the present without compromising the ability of future generations to meet their own needs". Ensuring this principle is upheld throughout mineral supply chains entails **implementing practices that minimize environmental degradation and promote social responsibility**. This includes responsibly sourcing raw materials, reducing energy consumption and emissions during extraction, processing and manufacturing, implementing fair labor practices, fostering community engagement and empowerment, and promoting transparency and accountability in governance. Additionally, it involves investing in research and innovation to develop more efficient and environmentally friendly technologies, as well as advocating for policies that support sustainable resource management and equitable distribution of benefits.

Although the urgency of addressing climate change could pressure stakeholders to disregard other aspects of environmental, social and governance (ESG) performance, these are crucial in enabling the smooth concretization of mining and industrial projects. **Ignoring local concerns and negative environmental impacts could fuel social resistance to a specific project and to mineral operations more widely.**

5.1. Evolving Scope of Sustainability Expectations

Although sustainability across the value chain is the intention, focus has mostly been at the upstream (extraction) level, with comparatively less definition of expectations and understanding of risks at midstream (processing) and downstream (manufacturing) levels. This can be linked to the visibility of mining operations, inherently tied to resource location, and to the scale of environmental and social fails in the sector, which concentrate public attention.

However, as the strategic value of mineral processing emerges in the context of the criticality agenda – the capacity to transform raw materials into valuable mineral products is the linchpin of mineral value chains and a key stake in geostrategic tensions – its environmental and social performance and responsible governance are attracting more consideration. There are also civil society movements advocating for drastic changes in industrial practices, from reduction of mineral consumption or 'material footprint', to designing for circularity and increasing resource efficiency across manufacturing, and hence redefining the scope of sustainability expectations [1].

As such, to design effective governance frameworks and improve stakeholder trust in the sector, it is essential to acknowledge the reality of the adverse impacts of mining that have shaped its poor perception [2].

Social Impacts of Mining

Because "mining" encompasses under a single word realities from artisanal diggings to "mega-pits" across all geographies and governance contexts, its social impacts reflect this diversity of circumstances and can include:

- **Poor working conditions**: Mining is frequently associated with health and safety hazards and human rights violations. Examples include exposure to hazardous substances and unsafe mine environments leading to work-related accidents and fatalities, inadequate wages, forced labor, as well as child labor.

- **Conflict**: Mining can lead to expropriation of land, displacement of local communities and/or temporary migration of workers into mining areas. The disruption of livelihoods, inadequate access to basic facilities, and the perceptions of increased inequalities from mining "boom and bust" cycles can lead to increased tensions and generate social conflict. It has been found that more than one-third of transition mineral projects are located on or near indigenous or peasant land facing a co-occurrence of water risk, conflict and food insecurity [3].

- **Corruption**: Given the close interaction between private actors and public sector regulators, governance of mining operations, mineral products and the revenue they generate for the State has proven a challenge. Corruption may manifest in bribery to obtain permits and licenses, opaque ownership structures, or misappropriation of government revenues or funds earmarked for local communities.

These phenomena are particularly rampant in areas with high concentrations of Artisanal and Small-scale Mining (ASM). ASM, as distinguished from large-scale or industrial mining, is characterized by its low levels of capital investment, high degree of labor intensity, as well as poor occupational health, safety and environmental standards. Approximately 45 million people are engaged

in ASM, producing significant amounts of minerals, including an estimated 12-24% of the global cobalt supply [4]. In addition to governments facing challenges in regulating this sector, ASM miners also largely do not have the means (in terms of skills or capital) to comply with regulation which was not designed for them. This problem is further exacerbated by overlaps with industrial mining operations, causing tensions or providing opportunities to bring illegal materials into global value chains by blending production from different sources.

However, it is worth noting that mining, when correctly regulated, also contributes to many positive social impacts, such as local employment, both direct and indirect, poverty alleviation, and economic development. Government revenues can be invested in infrastructure and human capital development, spurring sustainable, long-time growth. Chile, for example, the most mineral-dependent country in South America, has seen rapid economic growth and Human Development Index (HDI) improvement, with the highest HDI score in the region in 2022 [5].

Environmental Impacts of Mining

While critical minerals are key for the energy transition, they are also associated with negative environmental impacts that should be mitigated in order to ensure a sustainable and fair energy transition. These can include:

- **Biodiversity loss**: Mining often brings major land use change and damage to natural habitats and ecosystems. This can include deforestation for the construction of large open-pit mines, and soil contamination resulting from inadequate waste management practices. These impacts exacerbate the loss of flora and fauna within affected areas.

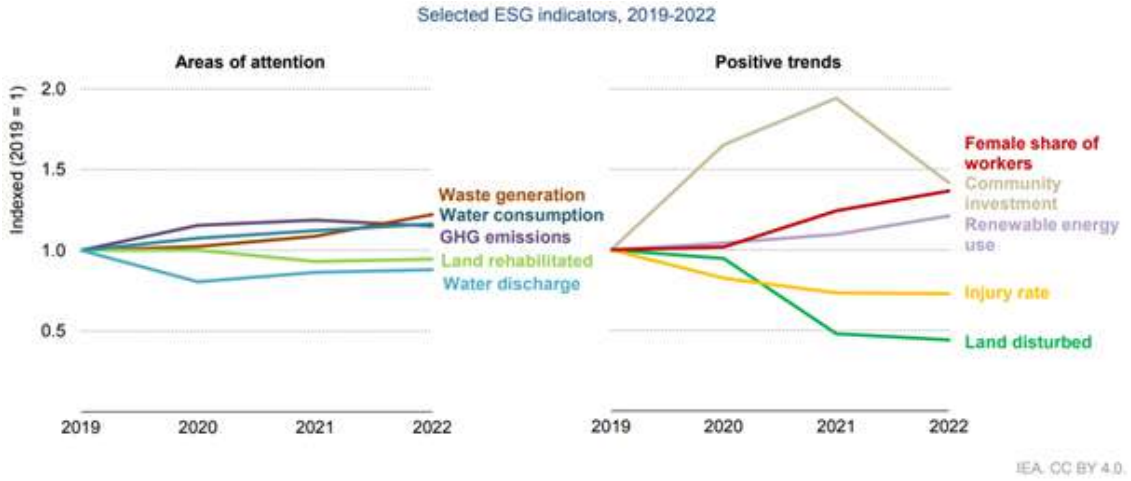
- **Water depletion and pollution**: Mining is highly water intensive, with water as a major input in extraction and processing activities. Yet mining of certain minerals is currently concentrated in high water-stress areas, with over 50% of lithium and copper production in areas in north-western Australia and northern Chile, for example [6]. Acid mine drainage (formation of acidic water from contact with sulfur-bearing minerals), tailing (waste) disposal, wastewater discharge, and mine dewatering (removal of groundwater to maintain access to the mine) can also cause contamination of water bodies and aggravate existing water stress.

- **Air pollution and GHG emissions**: Drilling, excavation, blasting, ore crushing, smelting and refining produce fumes and particulate matter, and hence air pollution threatening the environment and human health. Due to the industry's reliance on heavy equipment and fossil fuels, mineral processing is also highly energy and emissions intensive, with fuel combustion producing gaseous emissions such as sulfur, nitrogen and carbon oxides that contribute to climate change. It has been estimated that primary mineral and metal production was associated with 10% of the total global energy-related GHG emissions in 2018.

In recent years, the mining sector has responded to growing concerns and calls from civil society for more environmentally sustainable practices. Major mining companies such as BHP, Glencore, Rio Tinto and Vale have announced commitments to achieve net zero emissions by 2050 and improved public disclosure of ESG information. In an analysis of 25 major mining companies, the IEA found that almost all reported their total energy consumption and scope 1 and 2 GHG emissions. However, the reporting of other indicators is much less common – only 10

reported on land area disturbed and rehabilitated, for example [7]. Similarly, the Responsible Mining Index assessed the ESG policies and practices of 40 of the largest global mining companies and found an overall average environmental responsibility performance of only 29%. Furthermore, while companies may track and disclose ESG data such as biodiversity protection, tailing risk management, water consumption, water quality and GHG emissions; few conducted reviews or audits on the effectiveness of their management measures, and even fewer could provide evidence of having taken any action in response [8].

Therefore, while the increased reporting and transparency is encouraging, tangible progress is still lacking. The IEA report showed that, between 2019 and 2022, water use had in fact increased by 25%, while mining waste generation increased by 20%, and GHG emissions had stayed relatively constant [9].



Source: "Global Critical Minerals Outlook 2024" by the International Energy Agency (2024))

5.2. Efforts for Sustainability: Responsible Mining Standards, Vertical Integration and Circularity

Surveying the Current State of Responsible Mining Standards

Multiple international standards exist on responsible mining and processing, aligning with global frameworks including the OECD Due Diligence Guidance for Responsible Business Conduct, UN Guiding Principles on Business and Human Rights and the sustainable mining standards developed by the International Labor Organization.

In addition to binding policies, upwards of 400 voluntary initiatives and standards across all sectors are also available [10]. Key standards include the Copper Mark Criteria for Responsible Production, Extractive Industries Transparency Initiative (EITI) Standard, International Council on Mining and Metals (ICMM) Mining Principles, Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (IGF) Mining Policy Framework and Initiative for Responsible Mining Assurance (IRMA) Standard for Responsible Mining. While not specific to the mining sector, the International Finance Corporation (IFC) Performance Standards are also widely adopted.

In terms of the environment, these standards largely require members to avoid operating in World Heritage sites and legally protected areas, and to commit to the no net loss principle. The IRMA and Copper Mark standards cite the UN Convention on Biological Diversity, the World Heritage Convention and the Ramsar Convention on Wetlands; while the TSM Standard requires that companies report on their water stewardship. The ICMM Principles call for members to achieve net zero scope 1 and 2 emissions by 2050. The IGF Framework recommends that governments adopt policies on biodiversity management, water management and GHG emissions reduction.

Most standards also address human rights, health and safety standards and community engagement. The EITI Standard in particular aims to promote transparency, public and corporate governance, and accountability, requiring disclosure of information such as company expenditure, company payments, and government revenue allocations.

Where gaps in formal regulation and governance exist, voluntary standards help to play an important role. In comparison to traditional "command-and-control" regulations that may be perceived as expensive to comply with and may create legal liabilities for companies [11], voluntary standards are more accessible and flexible, and can be tailored to the company's needs, the local conditions, and stakeholder expectations. They can be an opportunity to transition into introducing legal requirements and are therefore an important starting point. However, voluntary standards are also subject to their own limitations:

- Existing voluntary standards are **not consistent in their diverse commitments**, as well as their level of detail, stringency, and measurement methodologies, **making measuring the impact and effectiveness of voluntary standards challenging**. For example, the TSM and IRMA standards require the establishment and continuous monitoring of site-specific and catchment-level water balances as well as the implementation of environmental protection and mitigation measures, whereas the Copper Mark primarily targets mitigation strategies, and the ICMM encourages their adoption without making them compulsory. Impact assessments are also largely anecdotal or in the form of self-assessments [12]. Data may be provided at a granular level across several categories and years, or only for certain sites, or even only at an aggregate, company-wide level, combining data from different minerals and different sites. Baseline data may or may not be available. Even if standards are adopted, the risk of a lack of proper compliance, and hence a "greenwashing" or "label-shopping" exercise, remains.
- While many standards cross-recognize other standards, **transparency is limited, and integration and alignment efforts with international due diligence instruments vary** [13]. These inconsistencies and lack of harmonization can result in increased costs and confusion for companies, uneven implementation and unpredictable environmental outcomes. Governments, investors, consumers, and other stakeholders may therefore find it more difficult to assess environmental sustainability using such standards.

The Rise of Vertical Integration in the Mining Value Chain: Enhanced Due Diligence?

Amid sustainability concerns, the need for due diligence, and increasing supply risk, some downstream companies are pursuing vertical integration of some of their mineral supply. Electric vehicle manufacturers like Tesla, Toyota, and Volkswagen are securing transition mineral supplies through partnerships with mining firms, while giants such as Rio Tinto, BHP, and Vale are investing in downstream operations like smelting and manufacturing. Joint ventures, like Rio Tinto and Alcoa's integrated aluminum operations, are on the rise [14]. Vertical integration not only ensures a stable resource supply and reduces price volatility, but can also **enhance sustainability by allowing stricter environmental standards and practices throughout the value chain**. By controlling multiple stages, companies can optimize processes, reduce waste, and improve energy efficiency. For instance, Nouveau Monde Graphite, a Canadian company, aims to minimize its carbon footprint by integrating hydroelectric-powered mining and processing operations [15].

Vertical integration provides companies with **greater transparency and traceability throughout a supply chain**. This visibility allows

them to ensure responsible sourcing, monitor environmental impacts, and implement sustainable practices from the sourcing of raw materials to the delivery of final products. By streamlining operations and logistics through vertical integration, companies can optimize resource utilization, reduce transportation needs, and minimize associated emissions and environmental impacts.

However, vertical integration has also proven very effective in increasing opacity and transfer pricing, negatively impacting prices, as well as in defining monopolies or oligopolies that can hinder companies' ability to adopt more sustainable alternatives, like battery chemistry substitutes, or increase supply constraints and criticality. Moreover, vertical integration does not directly mitigate a wide range of sustainability risks but rather offers companies avenues to enhance environmental sustainability and supply chain transparency should they choose to do so – corporate leadership, regulatory constraints and stakeholder scrutiny at key supply chain levels remain essential to drive sustainable choices.

Challenges and Opportunities in Advancing Circularity in Mining Supply Chains

A key strategy for reducing environmental impacts in mining supply chains is increased circularity. **Process circularity** refers to the reduction of emissions and mining wastes, whereas **product circularity** refers to the repair, reuse and recycling of products to extend product lifetimes and finally recover secondary material. Secondary raw materials are typically less water, energy and emissions intensive compared to primary raw materials [16], and recovery rates of more than 90% for copper, cobalt and nickel, and 80% for lithium, are technologically feasible [17].

Mineral	Recovery Rate (Current)	Recovery Rate (Best Available Technology)	Recovery Rate (Circular Economy)
Cobalt	32-74%	96-99%	95%
Copper	45-60%	100%	95%
Dysprosium	>1%	60%	60%
Lithium	>1%	80%	80%
Manganese	53%	95%	95%
Neodymium	>1%	95-99%	95%
Nickel	57%	90%	90%
Platinum	60-70%	95-99%	95%

Source: "Critical Minerals and the Green Energy Transition" by the Environmental Justice Foundation (2024), adapted from Simas et al. (2020)

Making productive use of mining waste could serve as a cornerstone of such a circular economy strategy. An estimated 100 billion tons of solid waste is generated from the primary production of minerals and metals, with waste produced ranging from several times the mass of elements extracted, such as for iron and aluminum ore, up to millions of times for elements such as gold ore [18]. Transition minerals have successfully been recovered from mining waste, with cobalt and copper recovered using flotation techniques, and iron, manganese, titanium and chromium using magnetic separation. However, the economic feasibility of these processes still presents a challenge for their widespread deployment.

With regards to product recycling, some regulatory efforts have been made at the regional level. The European Union (EU) has put forth a range of legislation such as the Waste Electrical and Electronic Equipment Directive, the End-of-Life Vehicles Directive and the EU Battery Regulation, that set targets for collection, recycling and recovery of the relevant products. The proposed Ecodesign for Sustainable Products Regulation will also see ecodesign requirements for specific product groups to improve their circularity and environmental sustainability, and the new Digital Product Passport will allow for the provision of information such as the recycled content of a product, and its durability and reparability.

Despite these technical advancements and regulatory efforts, however, actual recycling rates remain low – of the 34 critical raw materials identified in the European Commission's 2023 criticality report, only 10 had 10% or more of their EU demand met through secondary raw materials [19]. Key challenges to recycling include **low waste collection rates, contamination and mixing of different grades of scrap, inconvenient product design, lack of information on product composition, high cost of recycling, inadequate waste management regulations, and poor monitoring and enforcement systems.**

Moving from the traditional linear production model to a circular one would therefore necessitate systemic changes across the entire value chain, requiring **significant investment and political pressure**. In some cases, trade-offs may even need to be made between improving technology, cost and material efficiency, and facilitating recycling – for example, efforts to improve battery energy density and packaging may hinder ease of disassembly and recycling. Finally, it is noted that recycling can only be scaled up as transition mineral products reach end-of-life, such that many secondary minerals will not be available for decades. Hence, the level of circularity of the mineral supply chain is still limited, especially in the near term.

5.3. Envisioning the Future: Strengthened International Collaboration for Sustainable Mineral Supply Chains

Global Efforts to Harmonize Responsible Standards

As called for in the Declaration on Promoting and Enabling Responsible Business Conduct in the Global Economy at the 2023 OECD Ministerial Meeting on Responsible Business Conduct, there is the need for **the "coherence, alignment, and harmonization of responsible business conduct standards"**. This would encourage greater transparency and consistency across different standards, minimize duplication, improve their legitimacy among different stakeholders, and hence improve their efficiency.

Efforts have been made to consolidate diverse standards into one "gold standard", notably by ICMM which has launched the Principles for Responsible Investment as well as the Global Industry Standard on Tailings Management with the UN in the wake of the tailings facility failure in Brumadinho, Brazil, that resulted in the deaths of at least 259 people. The Copper Mark, Mining Association of Canada, ICMM and the World Gold Council are also working towards consolidating their individual voluntary responsible mining and metals standards into a single global responsible mining standard, and multi-stakeholder governance structure [20].

Another notable effort aiming to establish a comprehensive framework for evaluating standards in this domain is the work carried out by the International Social and Environmental Accreditation and Labelling (ISEAL) Alliance. They have defined Credibility Principles for sustainability standards and certification schemes, as well as a Code of Good Practice for Sustainability Systems. Sustainability systems and accreditation bodies that meet eligibility criteria, commit to continuous improvement and adhere to the ISEAL Code of Good Practice are recognized as ISEAL Code Compliant, and this has become a quality governance benchmark for standards.

Furthermore, the OECD has published alignment assessments with the OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas for 5 industry programs, and this methodology could also be applied to assess other standards. Other potential references for evaluating sustainability standards could include the UNEP environmental, social and sustainability framework, the UN Guiding Principles on Business and Human Rights, and the EU principles for sustainable raw materials.

Finally, to ensure accountability and diverse voices, **multi-stakeholder collaboration** is key. Given that most standards are industry-initiated, such as through national associations or global collaborations of mining companies [21], there is a need for non-industry stakeholders such as governments and civil society to participate in the conversation. One good example is IRMA, whose board is governed by representatives from mining companies, processing companies, non-governmental organizations, affected communities, organized labor, and investment and finance. International efforts in harmonizing standards must therefore take into account a similar range of voices and views to inform decisions.

Global Efforts to Establish a Viable Market for Sustainably Sourced Minerals

It is difficult to assess if **the costs of complying with more stringent environmental requirements, integrated into a "green**

premium" for minerals, would find a market and incentivize more sustainable production.

Different minerals will see different demand and supply outlooks that will affect the viability of a green market. For example, McKinsey has argued that since copper contributes a small share of overall cost and Scope 3 emissions for most end products, interest in low-CO2 copper will be limited [22]. Similarly, in response to calls for the introduction of a green premium for nickel, the London Metal Exchange (LME) has said that it believes that the market for green nickel is "not yet large enough" and would not attract sufficient stocks and trading volumes.

On the flip side, in 2020, the LME had announced plans to launch a platform for trading low-carbon aluminum, but was met with opposition from industry players that cited concerns about the lack of standardization in calculations of carbon content. However, the recent alignment of LME requirements with the European Carbon Border Adjustment Mechanism to compel aluminum producers to submit Scope 1 and 2 emissions data, as well as the roll out of the LME passport, a store of electronic certificates of analysis and sustainability data, may suggest a shift towards improved reporting that could form the basis of future green markets.

As such, there are still demand- and supply-side challenges in building bifurcated markets for responsible and sustainable minerals, and it is uncertain whether producers can count on a green premium to fund sustainability measures.

Global Efforts to Strengthen Circularity

Although some regions, such as the EU, have established regulatory frameworks for battery recycling, **regulatory safeguards and enforcement are inadequate in many parts of the world. The development of international common standards and guidelines** for the sustainable and responsible recycling of minerals used in batteries and renewable energy technologies is crucial to unlocking the full potential of mineral recycling in supporting the clean energy transition. This would **necessitate a platform or forum for coordinated efforts** involving governments, industry players, and relevant stakeholders.

Relevant areas of work could include:

- **Standardized Design of Designated Products**: Incentivizing product designs with greater material efficiency and durability, that are more easily disassembled and recycled. The EU ecodesign regulation is a promising policy that can be more widely applied globally, such that products containing recoverable transition minerals are well-labelled for the benefit of both consumers and waste processors.

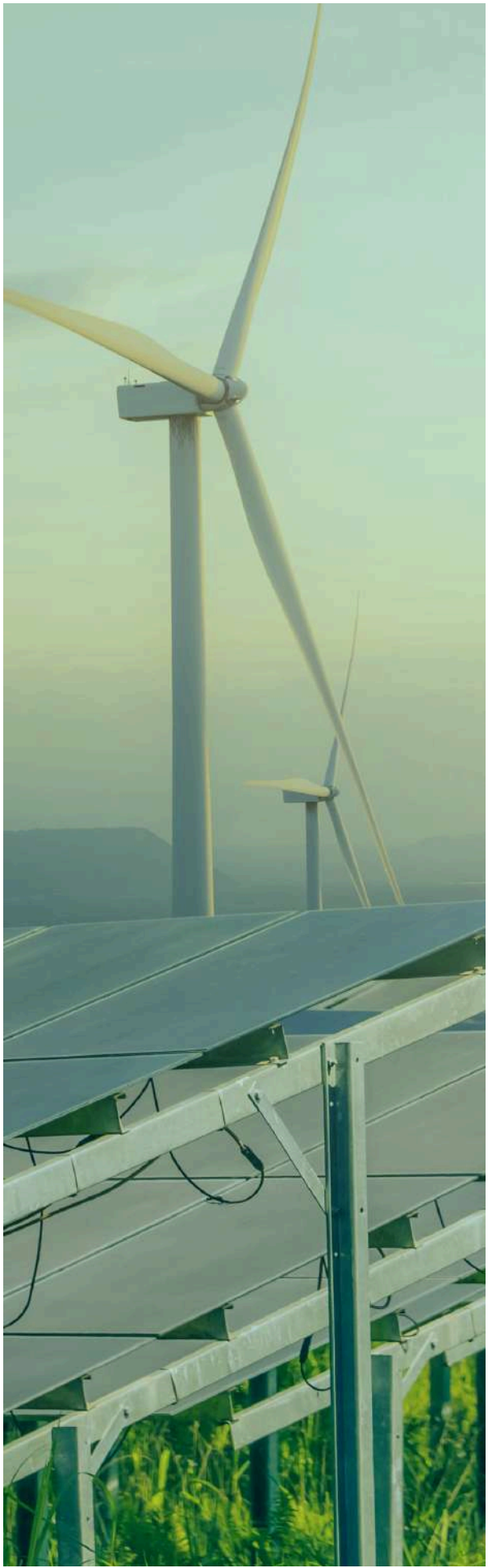
- **Standardized Product "Passports"**: Digital product passports can be used to "electronically register, process and share product-related information" such as **product composition, material origins, and carbon footprint** [23], and hence increase transparency and traceability along the value chain, and enable consumers and policymakers access to sustainability information. As a means for companies to monitor, report and compare against sustainability indicators, the product passport can encourage greater sustainability. Furthermore, by including information on product repair, disassembly, recycling and disposal, product passports can also be used to support circular economy strategies, as targeted by the EU Battery Passport. Product passport initiatives can already be found across a range of sectors, including construction, consumer goods, electronics and textiles, but have largely been a result of private sector efforts, and hence tailored to the specific sector or company [24]. A more international, standardized product passport for minerals could therefore be considered, allowing for interoperability while retaining set levels of stringency and legitimacy.

- **Studying the Use of New Technology for Traceability**: to improve transparency and traceability, the implementation of new technologies such as **blockchain** technology can be considered. Blockchain is a digital, decentralized ledger that stores data transactions in blocks that are chronologically linked in a chain. Each transaction is validated by the network and cannot be forged, and is also unmodifiable and therefore immutable. Furthermore, the ledger is accessible by all the parties in the network [25]. As a result, these tamper-proof, distributed data records can enable trustworthy and comprehensive reporting on products and their supply chain, and the tracking and tracing back to their basic raw material components [26]. This can not only encourage more responsible and sustainable production, but also furnish useful information that can aid in the reuse and recycling of products. One example of the application of blockchain in the mining industry is the **Everledger project** under the Australian Blockchain Pilot Grants program, that aimed to build supply chain integrity and contribute to the Critical Minerals National Ethical Certification Scheme.

Global Efforts to Assist Developing Countries in Sustainable Goals

Finally, as mentioned previously, **developing countries generally do not have sufficient human and financial capital to implement sustainability standards**. They are challenged with poorer transparency, accountability and reporting standards, and limited data, knowledge and institutional capacities. Given the complex geopolitical landscape inherent to mining, and to avoid the subcontracting or offshoring of unsustainable mining practices, it is necessary to ensure that sustainability policies and efforts are uniformly applied for both developed and developing countries, as well as both large-scale and small-scale mining.

Financial and technical assistance should therefore be provided by international bodies to meet these gaps, and enable the R&D and regulatory efforts discussed earlier. Technical assistance should also be provided to encourage compliance, transparency, as well as public, user-friendly reporting, such that information is available especially to the local communities that are directly impacted by mining activities. Given the diversity within the mining sector on both the global and national levels, there is also a need for context-specific governance solutions, and this will only be possible through multilateral conversations and partnerships between countries [see *paper on Equitable Opportunities for Resource-Rich Countries*].



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