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MINING AND THE GREEN ENERGY TRANSITION

REVIEW OF INTERNATIONAL DEVELOPMENT CHALLENGES AND OPPORTUNITIES

Summary for Policymakers

NOVEMBER 2021

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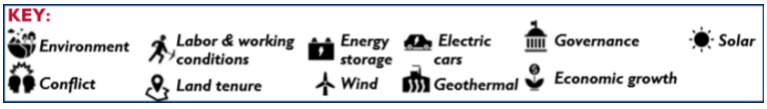
This report is a *Summary for Policymakers*. It draws on a larger USAID *report published in 2021* *Mining and the Green Energy Transition: Review of International Development Challenges and Opportunities*

SIGNIFICANCE OF MINING FOR THE GREEN ENERGY TRANSITION

In order to meet the 2015 Paris Agreement goal of keeping global warming between 1.5 and 2 degrees, the world's energy systems need to be transformed away from fossil fuels. The technological solutions that make up green energy—from photovoltaic cells to lithium-ion batteries—use more materials, including minerals, compared to traditional fossil-fuel energy technologies (Drexhage et al., 2017, p. 58). Recent global studies (Drexhage et al., 2017; Hund et al., 2020; IEA, 2021) have predicted demand increases of up to five times current production levels for minerals like cobalt, graphite, and lithium.

Table 1. Key minerals used in the green energy transition with 2050 demand projections

Mineral ** Denotes minerals on the US Critical Minerals List at the time of writing (nickel and zinc under consideration)*	**Uses in green energy technologies** *(in descending order of importance)*	**Demand by 2050 under 2-degree scenario**[1] *GREEN: % increase of volume needed relative to 2018 BLUE: Annual volume needed in thousands of tons*
Aluminum*		9% 5500
Chromium*		1% 366
Cobalt*		460% 644
Copper		7% 1380
Graphite*		494% 4500
Iron		1% 7500
Lead		18% 781
Lithium*		488% 415
Manganese*		4% 694
Molybdenum		11% 33
Nickel		99% 2268
Rare Earth Elements*		37% 84
Silver		56% 15
Titanium*		0% 34
Vanadium*		189% 138
Zinc		9% 1200



[1] Data sourced from Hund et al., 2020, pp. 73 and 103.

The demand from green energy for these materials, especially minerals, will have significant impacts. Unlike fossil fuels concentrated in a handful of countries, there are over two dozen minerals that are mined to varying degrees in 70 countries. Although a mining boom could foster growth and employment benefitting millions, it also carries significant environmental, governance, and social risks. Failure to address these risks could lead to increased fragility, poverty, and conflict in many developing countries. In addition, because these effects could create bottlenecks and affect global mineral supply, failure to address mining's challenges could create market uncertainty and ultimately slow down the green energy transition (IEA, 2021, p. 192).

Just as fossil fuels have been the backbone of global energy needs for over a century, several dozen minerals will make possible the green technologies of tomorrow's energy systems. Addressing the development challenges of more mining is vital for a low-carbon future.

Importantly, while there is growing consensus on the important role of mining in the green energy transition, there is significant uncertainty over the exact types and quantities of metals that will be required 30 years from now. Factors that will shape future mineral demand from green energy include:

- The **aggressiveness of greenhouse gas (GHG) emissions reductions targets**, and the corollary green technologies (and associated minerals) needed to meet them. The above chart presents demand projections under a two-degree scenario, but more minerals will be required for more aggressive targets.
- **Material performance and innovation** could dramatically change demand for particular metals. For example, alternative battery technologies that do not rely on cobalt could gain market share and change the dynamics around the Democratic Republic of Congo (DRC)'s cobalt sector.
- **Mineral market speculation** will also affect the mineral mix. For example, a sustained surge in the price of lithium could accelerate efforts to find lithium-ion battery substitutes. While market speculation drives many mineral prices, the fundamentals of the mine cycle and its inertia in responding to supply and demand changes are also key drivers of price movements.
- **Supply chain vulnerabilities** ranging from investor and consumer concern over labor conditions to political uncertainty in top producing countries can cause manufacturers to invest in alternative technologies to reduce risk. It follows that the extent to which governance and security challenges are addressed in key countries will affect mineral demand and prices.
- **China's dominance in mineral processing** can undermine efforts to diversify mining sources—since much ends up in China for processing and manufacturing regardless of source. The extent to which China maintains this position and/or other countries expand processing capacity will affect the supply chain and affect the availability and demand for certain minerals.
- **Exploration investment and data availability** could affect the future mineral demand picture. Existing data is limited especially in parts of Africa and Asia that may have undiscovered reserves. New discoveries and improved data availability could affect supply and demand dynamics, as well as choices of where to mine.
- **The extent of recycling** is a final uncertainty that will shape future mineral needs for green energy technology. While recycling is set to increase and the circular economy offers new opportunities, no projections anticipate that recycling can offset all increased demand for any mineral used in green energy technologies (Hund et al., 2020, p. 95). Conversely, it will be difficult to succeed in the green energy transition without increasing recycling.

In summary, it is difficult to predict precisely how the future mineral demand will shape up, as the factors are multifaceted. However, there is broad consensus that mining will increase dramatically and that it will play a vital role in successfully decarbonizing the world economy.

KEY DYNAMICS, TRENDS, AND DRIVERS OF MINING AND MINERAL SUPPLY CHAINS

It is simplistic to assume that the increased demand for green energy minerals will automatically translate into increased mining in all United States Agency for International Development (USAID)-presence countries with mining potential. Investment decisions depend on various factors. To better understand the development challenges and opportunities, it is vital for policymakers to understand these factors and the broader industry dynamics.

Mining is at once very **local and site-specific while also global and globalized** across diverse cultural, social, and political contexts. This tension makes it challenging to strike the right balance between local or group-specific issues and international policy objectives. Indeed, mining is characterized by the diversity of interests of various actors in complex and global value chains. These interests can be in balance when investment, permitting, sales and taxation are orchestrated to create consensus.

Mining is also characterized by inherent risks including uncertainty around the exact nature of a deposit, the long lifecycle of mining, competition due to the strategic nature of metals and minerals, and the use of minerals in industries that can shift rapidly based on technology and consumption patterns. As a result, **mining is notoriously cyclical** with volatile prices and investment patterns. Mining also must contend with significant political, legal, environmental, and social uncertainties where it occurs.

Decisions about where and whether to mine are affected by different factors, including:

- *The existence and quality of mineral resources and reserves*. A mineral resource is mineralization presenting reasonable prospects for eventual economic extraction, while a mineral reserve (probably or proven) is the sub-set of mineral resources that are economically mineable. It takes time and exploration investment to determine if resources are in fact reserves. In many developing countries there is lack of data due to under-investment in exploration and research.
- *Assessment of risk in the potential mining country*. Political and social risks weigh heavily on investment decisions, a fact that illustrates the importance of good governance and stability for developing countries to take advantage of the potential green minerals boom.
- *Financing and internal business dynamics*. The exploration timeline is often long and erratic. Projects can be suspended for lack of funds, access, or alignment with a company's priorities, or due to technological changes in downstream markets. It is vital for developing country governments to understand these dynamics, which are both general and mineral-specific, in order to reduce risks and take advantage of opportunities.

Another important feature of mining is **how mineral rights are defined**. In general, they are distinct from land or surface rights and derived from a principle of government ownership of minerals and jurisdiction over sub-surface rights. The basic principle of traditional mineral tenure regimes is precedence of mineral title, or the assumption that mining is a more valuable land use.

These **tenurial arrangements can contribute to conflicts** between miners, landowners, and local communities. Recognition of the multiple values and economic, social, environmental, and cultural benefits of other land uses is generally lacking in the mining industry and mineral policies, but awareness is increasing on the importance to do so to avoid conflict and other negative outcomes.

Box 1. Artisanal and small-scale mining

ASM is low-tech, labor-intensive mineral extraction and processing performed by individuals, groups, families, or cooperatives across 80 countries worldwide (World Bank, 2021). Among minerals used in green energy technologies, ASM is vital for cobalt (contributing 15-30% of supply) and is also found in the chromium and copper sectors.

ASM miners are the world's largest mining workforce providing direct employment for an estimated 44.75 million people (World Bank, 2021). Despite its importance, ASM is more often associated with its negative social and environmental impacts. These include hazardous working conditions, child labor, money laundering and human rights abuses. However, these problems are generally considered expressions of the sector's informality rather than inherent.

Indeed, the informal nature of ASM can cause governments and development partners to overlook its contribution to growth and economic development. Through increased formalization, ASM operators can benefit from legal protection, access support services, and provide decent working conditions. However, there is generally a lack of commitment by governments and partners to grant ASM its legitimate place (World Bank, 2021).

The mining industry is often tacitly understood to mean multinational corporations with headquarters in traditional centers of mining finance like Australia, the UK and Canada. However, this ignores a diversity of actors. Artisanal and small-scale mining (ASM), for example, is a vital part of the broader mining sector (see Box 1) though distinct from large-scale mining (LSM).

In addition, Chinese mining companies and investments are increasingly important, especially in developing countries. While public data is limited, Chinese investments have been dominated by state-owned enterprises and government-backed banks, but private companies are increasing their involvement. So-called "resource for infrastructure" deals have been documented in Peru, Ghana, and the DRC (Scungio, 2021, p. 21) which involve major infrastructure investments in exchange for mineral rights. Looking ahead, China will continue to invest in mining to secure its resource base.

China remains the most important green energy mineral consumer and processor because of its dominant position in processing minerals like cobalt, lithium, rare earths, and nickel, as well as manufacturing green technology components (including steel) and final products (like solar panels and batteries).

KEY TRENDS TO UNDERSTAND MINING AND MINERAL SUPPLY CHAINS

The following are key trends in the mining industry of relevance to policymakers:

1) **Increasing vertical integration**. While major multinational mining conglomerates have vertically integrated for years, there are increasingly cases where downstream actors are full or part owners of upstream mines. This is becoming especially common among users of batteries and battery metals, such as car manufacturers.

2) **Commodity "supercycle."** Despite the Coronavirus Disease 2019 (COVID-19), 2020 saw metal prices and mining finance reach nearly decade-long highs. While there is uncertainty around global economic recovery, the consensus is that the mining cycle has farther to run, with little risk of over-supply as four key elements drive prices high: underinvestment in exploration and mining, synchronized infrastructure spending across the world, inflation, and net-zero CO_2 emissions targets.

3) **Protectionism and resource nationalism**. The shifting geopolitical landscape and commodity market speculation is changing dynamics in the industry while also bolstering resource nationalism, with governments continuing to position themselves around gaining a "fair share of resource wealth," especially in South America.

4) **Increasing demand for higher environmental, social, and governance performance**. While social and community relations are often treated by miners as a threat or problem, investors

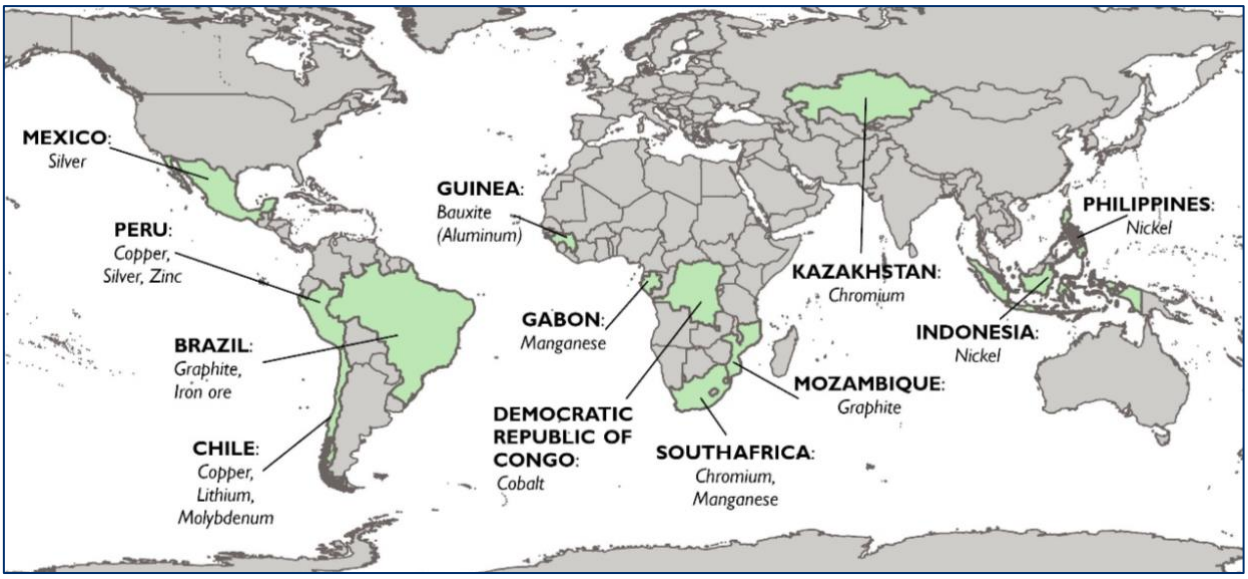
and other stakeholders are increasingly demanding that mining companies build and maintain positive relations with communities and consider risks more holistically. Indeed, pressure from shareholders as well as downstream supply chain actors is behind a variety of new standards and reporting requirements.

5) **Geopolitics and resource competition**. The key feature of strategic thinking of the US and EU on critical minerals revolves around reducing dependency on adversaries through some collaboration with allies but mainly building as much independence as possible and competing for supplies as needed. This is in a sense an attempt at deglobalizing mineral supply chains. In addition, while investments to find alternatives to "problematic" minerals like cobalt make sense on several levels, the underlying premise that countries can isolate themselves from the broader supply chain is unrealistic. Nevertheless, geopolitical competition is a rising feature in mining.

In summary, the combination of industry trends and policy choices around critical minerals sets up many developing countries for a time of opportunity but also risk as high mineral prices and geopolitical competition will put pressure on already fragile governance contexts. While competition over these resources may be difficult to tamp down, coordination and collaboration over performance standards and addressing development challenges is vital and in the best interests of all.

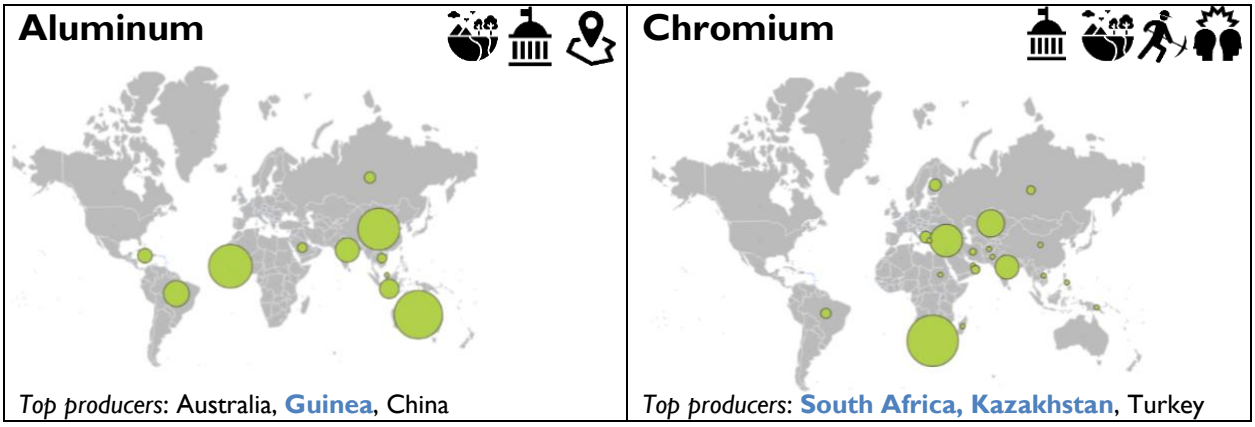
GREEN ENERGY MINERALS AND USAID-PRESENCE COUNTRIES

Figure 1. Current top producers of green energy minerals among USAID-presence countries



Source: USGS data / Tetra Tech

Figure 2. Top producers of key green energy minerals in 2018



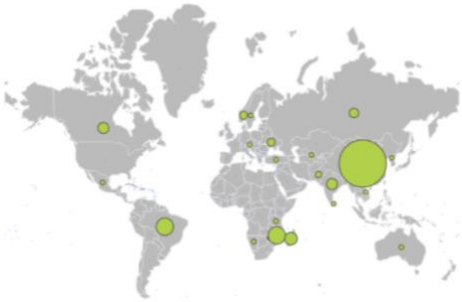
Cobalt

Top producers: **Democratic Republic of Congo**

Copper

Top producers: **Chile, Peru,** China

Graphite



Top producers: China, **Mozambique, Brazil**

Iron

Top producers: Australia, **Brazil**, China

Lead

Top producers: China, Australia, **Peru**

Lithium

Top producers: Australia, **Chile**, China

Manganese

Top producers: **South Africa**, Australia, **Gabon**

Molybdenum

Top producers: China, **Chile,** USA

Nickel

Top producers: **Indonesia, Philippines**, Russia

Rare Earths

Top producers: China, USA, **Burma**

Silver

Top producers: **Mexico, Peru**, China

Titanium

Top producers: China, **South Africa**, Australia

Vanadium

Top producers: China, Russia, **South Africa**

Zinc

Top producers: China, Australia, **Peru**

(Source: OECD/USGS)

Figure 3. Green energy mineral production in USAID-presence countries

(countries with no current mining not include; star denotes the country is a current top producer of a given mineral)

* limited presence country	Aluminum	Chromium	Cobalt	Copper	Graphite	Iron	Lead	Lithium	Manganese	Molybdenum	Nickel	Silver	Titanium	Vanadium	Zinc	Rare Earths
Albania		✓		✓							✓					
Angola																✓
Armenia				✓						✓		✓			✓	
Azerbaijan				✓								✓				
Bolivia*				✓		✓	✓	✓	✓			✓			✓	
Bosnia and Herzegovina	✓					✓	✓								✓	
Botswana			✓	✓												
Brazil	✓	✓		✓	★	★	✓	✓	✓		✓	✓	✓	✓		✓
Burkina Faso												✓			✓	
Burma				✓			✓		✓		✓				✓	★
Burundi													✓			✓
Cameroon	✓															
Chile*				★		✓		★		★		✓			✓	
Colombia	✓			✓							✓	✓				
Côte d'Ivoire									✓		✓	✓				
Cuba		✓	✓				✓				✓				✓	
DRC			★	✓				✓				✓			✓	
Dominican Republic				✓							✓	✓				
Ecuador				✓								✓				
Ethiopia												✓				
Gabon*									★							
Georgia				✓					✓							
Ghana	✓							✓	✓			✓				
Guatemala							✓				✓					
Guinea	★					✓								✓		
Guyana	✓															
Honduras							✓					✓			✓	
India	✓	✓		✓	✓	✓	✓		✓			✓	✓		✓	✓
Indonesia	✓		✓	✓		✓	✓		✓		★	✓			✓	
Jamaica	✓															
Kazakhstan	✓	★		✓		✓	✓	✓	✓	✓		✓	✓		✓	
Kenya									✓				✓			
Kosovo							✓				✓				✓	
Kyrgyz Republic				✓								✓				
Laos				✓		✓						✓				
Liberia						✓										
Madagascar		✓	✓		✓						✓		✓			✓
Malawi													✓			✓
Mali								✓				✓				
Mauritania				✓		✓										
Mexico		✓		✓	✓	✓	✓	✓	✓	✓		★			✓	
Mongolia				✓		✓	✓			✓		✓			✓	
Montenegro	✓						✓								✓	
Morocco			✓	✓			✓					✓			✓	
Mozambique	✓				★								✓	✓		

* limited presence country	Aluminum	Chromium	Cobalt	Copper	Graphite	Iron	Lead	Lithium	Manganese	Molybdenum	Nickel	Silver	Titanium	Vanadium	Zinc	Rare Earths
Namibia			✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓
Nicaragua												✓				
Nigeria						✓	✓								✓	
North Macedonia				✓			✓					✓			✓	
Pakistan	✓	✓		✓	✓	✓	✓								✓	
Panama				✓								✓				
Papua New Guinea*			✓	✓							✓	✓				
Peru				★		✓	★	✓	✓	✓		★			★	
Philippines		✓	✓	✓							✓	★				
Republic of the Congo						✓										
Senegal						✓						✓	✓			
Serbia															✓	
Sierra Leone	✓					✓							✓			
Solomon Islands*	✓															
South Africa		★	✓	✓		✓	✓		★		✓	✓	★	★	✓	
Sri Lanka					✓								✓			
Sudan		✓														
Tajikistan				✓			✓					✓			✓	
Tanzania	✓			✓								✓				
Thailand						✓										✓
Ukraine						✓			✓				✓			
Uzbekistan				✓	✓		✓			✓		✓			✓	
Vietnam	✓	✓		✓	✓	✓	✓		✓				✓		✓	✓
Zambia			✓	✓					✓		✓					
Zimbabwe		✓	✓	✓	✓			✓			✓					

DEVELOPMENT CHALLENGES AND PROGRAMMING OPPORTUNITIES

MINING GOVERNANCE

If harnessed properly, mineral wealth and increasing demand for energy transition minerals can increase public revenue, contribute to sustainable economic growth, and benefit national governments, companies, and communities. Many mineral-rich countries, however, have experienced a so-called "resource curse": they fail to benefit from their resources due to corruption, rent-seeking behavior by government, weak institutions, and a tendency to become or remain authoritarian (NRGI, 2015).

Mining in countries with low governance scores presents additional risks related to money laundering, tax evasion, terrorism finance, and transnational organized crime. These challenges are more substantial where regulatory safeguards are inadequate and systemic governance issues persist, such as in ASM (IEA, 2021, p. 192). Around 10-15% of copper, lithium, and cobalt production and almost half of nickel production in 2019 came from regions with low governance scores (IEA, 2021, p. 131).

Besides general governance challenges related to mining, there are also technical capacity gaps with respect to mineral governance. For example, mining officials may be experienced in managing certain types of mining but less familiar with project life cycles and other dynamics around minerals new for that country. This could lead to suboptimal mining conventions or difficulties in tax recovery. Other mining governance technical problems include lack of data management and mining cadasters. Additionally, many countries experience problems with coordination and information sharing.

Governance programming can consist of mining-focused interventions, or mining can be built into other governance activities. Given how multisectoral mining issues are—touching on the environment, human rights, security, land tenure, conflict, and economic growth—mining can become an entry-point or an anchor issue to obtain broader outcomes like greater civic engagement, a more diversified economy, and better environmental management. Conversely, a failure in mining governance will have negative impacts on the broader governance and economic landscape. This makes it critical to address mining in countries where extractives are important or ascendant. The below offers engagement ideas.

Mining Governance Programming Opportunities

Legal, Policy, and Regulatory Reform

- Support studies and assessments involving as much as possible national experts along with external experts as a strategy to increase buy-in and ownership of recommendations.
- Embed technical advisors into government ministries for sufficient periods of time so they can build relationships and understand and leverage an understanding of the institutional dynamics.
- Support national industry advocacy and working groups, such as an association of women miners, an association of ASM and a mining chamber of commerce. This helps create platforms for unified industry voices to participate in public policy discussions.
- Encourage and fund experience-sharing and exchanges at a regional or international level as part of a reform process, as well facilitating study tours within countries for government officials to better understand mining issues first-hand. This can also help foster intra-government coordination and information-exchange (such as between environment and mining officials).

Transparency and Public Accountability

- Build the capacity of civil society and investigative journalists to better understand the mining sector, including local and international study tours and trainings, prizes, and media.
- When information on concessions and licenses are available to the public, this provides a vital tool for accountability. Technical assistance for mining cadasters and license management can help. Other

Mining Governance Programming Opportunities

information can also be published such as mining conventions, the names of local suppliers, trade and export data and beneficial ownership information. Technical assistance should be combined with policy reform to manage dynamics around champions and spoilers for more transparency.

- Encourage and support government and civil society organization (CSO) participation in multi-stakeholder transparency initiatives including the Extractive Industries Transparency Initiative (EITI), the Financial Action Task Force (FATF), the Open Government Partnership (OGP), the Organization for Economic Cooperation and Development (OECD) Due Diligence Guidance (DDG) on Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas (CAHRAs), and the Voluntary Principles on Security and Human Rights.

Government Capacity-Building

- Support cross-agency training that focuses on specific issues, such as training for revenue, tax, and financial crime stakeholders on tax evasion and profit shifting, including transfer pricing. Another example could be a training with environmental, mining, and finance stakeholders on specific mine environmental practices for a new type of mining for the country. This approach fosters intra-governmental coordination.
- Support mining schools and training institutes for the next generation of mining professionals, including curriculum development and development of activities that encourage women to join the mining profession or mining government oversight agencies.
- Support activities that build the capacity of geological research and data management agencies, including support for scientific data management, geophysical surveys, and geological record-keeping.

Community and Stakeholder Dialogue

- Support inter-agency coordination through joint projects and information-sharing platforms, notably between environmental regulators, mining regulators, and revenue officials.
- Support participatory processes to get private sector and community input, including grievance mechanisms and management of royalty percentages attributed for community development.
- Support regional information-sharing and experience-sharing mechanisms, both between neighboring countries and between the national capitals and regions/municipalities.
- Support CSOs and industry groups in efforts to foster policy dialogue.
- Ensure that under-represented groups (women, migrants, and indigenous peoples) are given sufficient voice in all efforts to support multistakeholder coordination.

Financial and Other Crimes Related to Mining

- Support investigative studies by local and international researchers on illicit financial flows and corruption related to mining and encourage law enforcement strategies to focus on midstream and downstream rather than on the miners/laborers alone in the case of ASM.
- Support existing law enforcement coordination efforts and activities to ensure they have an accurate understanding of mining dynamics, including cross-participation in activities (law enforcement in multistakeholder mining groups and mining stakeholders in law enforcement).
- Support access to formal finance for ASM as an alternative to informal finance, which is highly vulnerable to financial crimes.
- Build the capacity of financial intelligence units (FIUs) with respect to mining, and of mining authorities with respect to anti money laundering/terrorist financing.
- Integrate law enforcement into mainstream mining and ASM policy-making processes and encourage a balanced and coordinated approach to crackdowns on illegal mining that clearly differentiates informal from criminal mining.

LAND TENURE AND PROPERTY RIGHTS

Many conflicts related to mining, whether ASM or LSM, are land related. Mining affects up to 50 million square kilometers of Earth's surface, with 8% coinciding with protected areas, 7% with key biodiversity

areas, and 16% with remaining wilderness; 82% of these mining areas target minerals needed for renewable energy production (Sonter et al., 2020).

This land use can disrupt the activities of local communities by displacing villages or creating long-term loss of agricultural land. Declining ore grades and expansion of mines can also lead to increased land occupation by the mining industry (IEA, 2021, p. 210). Land use change and land conflicts can manifest themselves in several ways such as intercommunity conflict, conflict between impacted communities and the mining industry, and conflicts between ASM communities and LSM companies.

Conflicts can also arise as a result of different interpretations of who owns the land. This particularly applies to rural land areas where customary land practices prevail over statutory. As noted above, because many countries' legal systems vest mineral rights in the government irrespective of land ownership, this can create tensions and conflicts. This is especially true when it comes to distribution of benefits like development funds and jobs to impacted communities.

Land and resource governance (LRG) is an area of practice that can help address these challenges. LRG englobes mining governance, insofar as LRG encompasses the "rules, rights, policies, processes, institutions and structures created to manage the use, allocation of, access to, control, ownership, management, and transfer of land and land-related natural resources" (Stevens et al., 2020, p. 13). Unlike mining governance programming, however, LRG activities include specific approaches relevant to mining.

Land Tenure Programming Opportunities

Land Use Planning

- Land use planning can help achieve the so-called "*social license to operate*" for mining by creating a holistic and inclusive process for communities to understand the mine's impacts and articulate and defend their interests. This can avert future conflict if issues like corollary infrastructure development and environmental waste are clarified from the outset and if there is an ongoing process of communication and adjustment.
- A subset of land use planning called *territorial development planning* is vital for directing investments from community mining funds derived from mining taxes and royalties. When there is an existing development plan which identifies priority investments (such as schools, roads, commerce), this reduces conflict and increases efficiency around the use of these funds.
- At a regional or national level, land use planning can create a *framework for policy trade-offs* and dialogue, such as between mining, agriculture, and other uses. This type of planning is facilitated by accurate geological information as it helps predict future mining zones and enables active mine development through competitive tenders of pre-identified exploration blocks rather than passive development based on open access and direct negotiation. It can also avert overlapping rights such as forestry concessions and industrial agriculture. In some cases, regional and national governments may decide not to develop mining due to community opposition or other economic interests; land use planning creates a technical and social framework for that type of complex decision-making.
- *Post-mining land use planning* is also a key part of the mining development process that is often overlooked, including the ownership and use of land after remediation. In the case of land that remains damaged, post-mining planning can identify ways to reclaim through agricultural support and other investments

Community Land Rights Formalization

- The formalization of community land rights, especially if combined with capacity-building and training, can help protect vulnerable populations from arbitrary evictions and loss of land important for cultural and economic reasons. While most mining laws require various levels of free and prior informed consent as well as community compensation, legislations tend to give primacy to mineral rights.
- Depending on the regulatory framework, projects can help communities obtain titles or other forms of recognition of their rights. This can empower communities to better negotiate compensation around large land-based investments, including mining, as well as stand up to powerful interests. When rights formalization also involves legal education, awareness-raising and grassroots organizing, this can help foster a balance of power.

Land Tenure Programming Opportunities

Land Administration and Titling

- Supporting land administration and titling in mining areas can reduce conflict and uncertainty around mining investments. Often mining companies find it difficult to identify the owners of farms and other land-based assets that are affected by their operations. Property rights clarification and formalization can help.
- However, titling programs will generally be beneficial only prior to mining; if speculation has already begun, titling land can be a tool for elite land grabbing and can exacerbate inequalities. It is therefore important for titling and land administration programs to ensure safeguards in areas where mining is occurring or is imminent. These safeguards can be built into land administration program design.

ENVIRONMENT

Mining's inherently disruptive nature almost inevitably results in a significant environmental footprint. Common environmental impacts of mining include deforestation and degradation of land, air pollution from mine dust, noise pollution due to blasting and transporting activities, soil contamination, and erosion and other forms of land degradation.

There are environmental impacts related to certain minerals needed for the green energy transition. For example, the processing of lateritic deposits for nickel mining in Southeast Asia and Africa require acid leaching and deep-sea tailings disposal. Water stress is another environmental issue especially in South American lithium and copper production areas. Lithium mining in the high desert requires large quantities of water for processing.

Significant GHG emissions arise from energy intensive mining and processing activities. While these emissions do not negate the climate advantages of clean energy technologies, energy transition minerals involve higher GHG emission intensities compare to other minerals, particularly the mining and processing related to cobalt, rare earths, bauxite (aluminum), and steel alloys.

Finally, mine closure is a particular conundrum, especially as companies change hands during long project life cycles. There is often insufficient resources and regulations for restoration. As numerous major mines close in the coming decades, the effects of improper closures will be felt in many developing countries, not to mention new mines being likely to open due to strong demands for green minerals.

Reducing and mitigating environmental impact is one of mining's most difficult challenges, but the following intervention areas can help.

Environment Programming Opportunities

Environment and Social Impact Assessments (ESIA)

- ESIAs are the primary mechanism in many countries to manage potential damage from a large-scale investment such as mining. When done well, ESIAs help articulate community concerns and present potential future consequences of proposed actions during and after mining. ESIAs are a vital governance tool to foresee and forestall negative impacts.
- However, ESIAs have limitations and problems in implementation that can be the subject of programming. For example, ESIAs can be expert driven instead of participatory, can be well-done but left unimplemented, and, in the case of small-scale mining, can become an administrative hurdle that hinders formalization and opens the door to rent seeking. Moreover, there are often dysfunctional relationships between environmental protection agencies and mining authorities.
- Capacity-building for better implementation of ESIAs and better institutional coordination is therefore a programming opportunity. Activities that help community, government, and CSO monitoring of the implementation of ESIAs are also a key part of transparency and accountability.

GHG Emissions in Mining Industry

- As part of climate change programming, GHG emissions by the mining industry should be addressed. For example, the Andean highlands where the "lithium triangle" is located is also among the world's best locations for wind and solar energy. In Chile, for example, investments in solar energy by copper mining companies has increased low-carbon electricity in the country's grid (IEA, 2021). There are therefore synergies between increased mining needed for the green energy transition as well as opportunities to increase renewable energy generation capacity.
- It is also important to identify renewable energy opportunities around smelters and refineries in locations like South Africa and Indonesia which use large amounts of energy, the majority of which is derived from coal. Partnerships with the many major mining companies that have committed to reducing GHG emissions through low-carbon electricity could also be an opportunity.
- ASM can also contribute to GHG emissions through deforestation as a direct effect of mining and as a secondary effect of miners moving into forest areas. Land use planning, community engagement, and coordination with law enforcement efforts to crack down on criminal mining are all important strategies.

Recycling/Circular Economy

- Recycling will be a key to reduce the overall negative impacts from mining and the green energy transition. While this has been a focus in developed countries, most USAID-presence countries have recycling markets that include metals covered under this report. Ensuring their integration into global recycling efforts will be important.
- In addition, green energy demand could pull more people into informal waste collection, potentially exposing more people to hazardous working conditions. Exposure to toxic materials including heavy metals in waste dumps is particularly damaging for children working in the sector. Supporting best practices like organizing waste-pickers into micro-enterprises, or creating private-public partnerships, could help generate employment and reduce the need for new mining.

Water Quality and Water Management

- Technical assistance for watershed and water management in water-stressed mining regions like the Andean highlands is a potential programming opportunity. Engaging with communities with respect to monitoring and compliance is also important.
- Building capacity of communities, research institutions, and CSOs on water management issues could be helpful. This capacity-building and monitoring can also include awareness-raising and testing of heavy metal levels in drinking water which is common not only in LSM but also in ASM.

Waste Management, Mine Closure, and Reclamation

- As part of government capacity-building, authorities can undergo training in best practices on waste management and mine closure. This can increase the capacity for monitoring and compliance.
- In ASM, remediation is trickier but no less important. Best practices involve preventive measures like better mining techniques and prospection so that resources are mined more efficiently, and so that backfilling is integrated into ore extraction. Post-mining rehabilitation is often best done in the context of livelihood and land tenure programming, as it gives incentives for reclamation.
- Building a community of practice around land reclamation as well as innovative models to finance the cost of reclamation is key, as the costs of reclamation generally surpass the amounts set aside by mining companies or governments. As community concerns around reclamation increase, it is important to also improve the standards and accountability of LSM mining companies.

Biodiversity and Protected Areas

- High-quality ESIAs are particularly important to identify endangered species and ecosystems that can be affected by mining. Building capacity of government and CSOs to monitor implementation of all mitigation measures is also important, as is adequately consulting and involving local communities. Monitoring can include classic species counts or satellite monitoring or more cutting-edge techniques like metagenomics to measure and monitor species diversity periodically.
- In the case of protected areas, mining companies often lack the time and expertise to engage, creating opportunities for synergies with development partners. ASM in or near protected areas is a particular

Environment Programming Opportunities

challenge because it is hard to control. Approaches like artisanal mining zones, community rule-setting, conditional support to miners who respect boundaries. and targeted enforcement can yield results.

CONFLICT AND HUMAN RIGHTS

Mining can be linked to armed conflict financing, modern slavery, human trafficking, and other gross human rights abuses. These risks can be particularly profound in so-called conflict-affected and high-risk areas (CAHRAs) because of the presence of armed conflict, widespread violence, or other risks of harm to people. While none of the green economy minerals identified in this report can be considered conflict minerals, many are mined in countries considered to be conflict-affected and high-risk.

More broadly, human rights abuses in the mining sector have been reported across numerous countries and different types of operations. While these issues have been more widely reported and are perhaps more prevalent in the precious metals and minerals sectors, they remain of concern for green energy minerals as well, with cases documented in the DRC, Zimbabwe, South Africa, and Burma to name a few.

In addition to supporting supply chain initiatives related to the OECD Due Diligence Guidelines framework and the US Dodd-Frank legislation, some ways in which governance and conflict-related programming can better consider the specific risks associated with mining are outlined below.

Conflict and Human Rights Programming Opportunities

Armed Conflict and Gross Human Rights Abuses

- Monitoring and assessments related to rebel movements and violent extremism can track if and how governance issues in mining or the extractives sector more broadly can create the conditions for financing or complicity with communities/criminal networks.
- Capacity building and support to CSOs with respect to human rights monitoring and advocacy can include modules and trainings focused specially on mining.
- Conflict prevention and mitigation strategies can ensure to include mining-related triggers and grievances that could escalate violence. For example, environmental mismanagement, land expropriation, and abuses by private security can all create and contribute to conflict dynamics.
- Advocacy and programming related to sexual and gender-based violence as well as human trafficking and modern slavery can examine the mining sector for risks. Gender-based violence and human trafficking is more prevalent in ASM diamonds and gold but could develop in other mineral supply chains.

Conflicts Related to ASM and Community Relations

- Conflicts between large- and small-scale mining are particularly common in gold mining, but among the minerals examined in this report, such conflicts exist in cobalt and potentially chromite. Addressing underlying causes of ASM-LSM conflict requires improvements in mining governance, especially with developing an ASM policy that gives ASM a legitimate place alongside LSM.
- In some cases, support for ASM-LSM cohabitation and collaboration can also aid in formalization and conflict reduction, such as in the DRC where an industrial cobalt mine/processor allows formalized ASM in designated areas of its concessions. Organizing forums and exchanges on best practices in ASM-LSM cohabitation can help identify solutions tailored to each circumstance.
- Conflicts between mining companies and communities similarly requires addressing underlying governance causes including the legislative framework and how it is applied in practice. LRG approaches like multi-stakeholder dialogue, land use planning, and alternative dispute resolution are also important tools that can be used in activities with governments, partnerships with mining companies, and/or CSOs.

LABOR AND WORKING CONDITIONS

Generally speaking, the LSM sector operates under strict health and safety standards to avoid accidents that may incur costs from lost productivity, civil liability, and damage to public relations. The degree of performance depends on the existence of adequate laws and regulations, stakeholder pressure, investor pressure, integrated occupational health and safety management rules, and organizational culture (Chen & Zorigt, 2013). Private and state-owned companies not subject to investor pressure might have a higher risk of labor issues.

On the other hand, the ASM sector faces challenges of child labor and occupational health and safety due to its informality and poverty-driven nature. Among green energy minerals, cobalt is the most problematic, with high levels of child labor and workplace accidents among DRC's miners. Disengagement from the sector as a result of consumer pressure tends to exacerbate the problem by pushing more children into mining. It is therefore vital to specifically focus on engaging with all stakeholders on complex poverty-driven issues like child labor.

Labor and Working Conditions Programming Opportunities

Child Labor

- Assessments to understand the specifics of child labor in a given context—the role of children in mining, social norms, and underlying economic incentives and constraints.
- Awareness-raising, education, and social behavior change communication tailored to each circumstance.
- Special education models and curriculums for children transitioning from mining.
- Collaboration with local leaders and mining authorities/companies on formalization and enforcement.
- Focusing programming on women miners and their needs, notably with respect to childcare.

Occupational Health and Safety

- As part of capacity-building of government authorities, best practices with respect to occupational health and safety can be covered to ensure their inclusion in government mine site monitoring.
- With respect to ASM, safety should be integrated into programming aimed at supporting miner formalization. Activities can include training and support on benching/terracing, tunnel support engineering, and other aspects.

Public Health

- Miners and mining communities are vulnerable to specific disease burdens. Depending on the intervention, public health programming can integrate mining-related aspects. For example, ASM and LSM mining towns can be vectors of diseases like tuberculosis and sexually transmitted diseases.
- Mining can also contribute to emerging pandemics and zoonotic diseases especially in West and Central Africa due to risks of spillover from animals to miners working in remote forest areas. The specific needs of miners are therefore important in public health programming aimed at preventing pandemics.

NATIONAL AND LOCAL ECONOMIC GROWTH

Many of the most mineral-rich countries are also at the bottom of the UN Human Development Index. The disappointing social and economic development experienced in mineral-rich countries is often explained by the lack of linkages between the mineral wealth and the broader economy (Hilson, 2019). These linkages can take various forms, including promotion of local service providers, increasing local employment, increasing consumption by mining workers, and increasing in-country processing and value-addition. Together, many of these practices are increasingly termed *local content policies.*

Other challenges related to economic growth are the generation and use of tax and royalties. Many countries mandate percentages and funds dedicated to development. The management of these funds in low-capacity and low-governance countries can lead to missed opportunities, corruption, and conflict. In ASM, informal local taxation practices by communities are also sources of opportunity and risk.

While the following activities can be considered a subset of governance, they are specifically aimed at promoting increased economic benefits from mining, including green energy minerals.

National and Local Economic Growth Programming Opportunities

Community Development

- Most mining legislations foresee percentages of royalties and/or taxes earmarked for community development. To address the issues of mismanagement and conflict around these funds, programs can support governments to integrate best practices and experience sharing in legislative and policy reviews to identify improvements to their models and learn from others.
- Additionally, programs can support territorial development planning, capacity-building, and implementation to create participatory and transparent processes for identifying investments from mining funds.
- Support cost-sharing or partnership models that leverage funds between development projects, mining company corporate social responsibility, and government-managed development funds.
- Support investments that focus on women, including women-led businesses.
- Strengthen the capacity of CSOs and communities to fully participate in decision-making around the use of these funds.

Economic Linkages and Diversification

- Support policies and projects that build diversification and linkages to the broader economy is important for economic stability and long-term development. Supporting economic studies that examine and quantify the potential value from different types of linkages is a good programmatic starting point.
- Support policy development, such as local content policies (aimed at generating local employment and service provision) and infrastructure strategies that maximize gains from linkages.
- Invest in education and vocational training to create the conditions for increased local workforce development in mining and sectors like equipment manufacturing and servicing.
- Support the development of viable ASM sectors as a strategy to increase employment and develop resources that may be sub-economic for LSM.
- Support women-owned businesses linked to mining as well as a dedicated community development fund targeting women.

PUBLIC-PRIVATE PARTNERSHIPS

Addressing the challenges and taking advantage of the opportunities afforded by the likely green energy mining boom in developing countries requires holistic and multistakeholder programming approaches. Mineral-exporting governments, mineral-processing governments, mineral-importing governments, major companies, junior companies, manufacturers, communities, and civil society organizations all have different interests and roles. Strategic development programming in the context of broader multistakeholder initiatives can help avert working in silos and leverage opportunities.

Public-Private Partnerships Programming Opportunities

Supply Chain Initiatives

- Mineral supply chain actors—commodity traders, battery manufacturers, and consumer product retailers—are driving many of the changed expectations with respect to conflict and human rights. The OECD Due Diligence Guidance and the various industry standards and norms driven by the private sector are therefore key tools for addressing some of the development challenges associated with mining. Donors play a key role in field implementation of these standards through pilot programs and capacity-building, for example, as well as addressing challenges that may be difficult to address with responsible sourcing alone.
- Donors also play a role in supporting multistakeholder platforms for learning, experience-sharing, and contributions from the private sector. Future programming could go beyond current conflict minerals and support evolving supply chain standards and norms related to green energy minerals. Future PPAs could also consider approaches like the European Raw Materials Alliance that bring together private and public stakeholders with the aim of increasing collaboration around critical minerals.

Public-Private Partnerships Programming Opportunities

Partnerships with Private Sector

- Mining companies working in countries with green energy minerals often lack capacity and dedicated resources to deal with issues including conflict with communities and implementing local content policies. This is especially the case with junior companies who often lack dedicated in-house community relations specialists. In addition, at the stage of exploration, there is often little investment in community outreach. Partnerships with development actors like USAID can build capacity while leveraging company resources. Collaboration could include project coordination to more formal public-private partnerships or GDAs.
- Besides mining companies, downstream commodity traders and actors are increasingly funding development-related projects. Partnerships with donors like USAID could leverage these resources for greater impact.
- Finally, partnerships with financial institutions like banks can also play an important role. At an international level, partnerships on implementing environmental, social and governance criteria in lending could create unique opportunities. At a national level, loan guarantees can open financing to responsible small-scale mining related to green energy minerals.

CONCLUSION

The tradeoffs, risks, and inequities around increased mining needed for the green energy transition require critical reflection and choices around the world. In wealthier countries investing heavily in the transition to renewables, policymakers should determine how the urgent need to transform energy systems and secure supply chains could negatively impact poorer countries where minerals are extracted, many of which will be the same countries to undergo impacts from climate change.

Ensuring that the green energy transition does not lead to greater instability, environmental devastation, and human rights abuses is a responsibility, but also a necessity; without these countries, the green energy transition may be harder to achieve. While finding substitutes for certain "problematic" minerals may help limit some of the most egregious impacts, it is not possible nor desirable to disengage given the sheer volume of minerals and countries that feed the global supply chains needed for the transition.

Governments must therefore work together with industry stakeholders to support these countries to mitigate impacts, as well as support avenues for citizen engagement and participation in these countries around these hard decisions. This will increase the chances that well-governed and accountable mining and mineral supply chains can play a positive role not only in combatting climate change but in the countries whose resources help make that shift possible.

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