DEBrief

IDB | IDB Invest

Development Effectiveness and Strategy Briefs N°34 / May 2025

The mining sector as a driver of energy and technological progress: Challenges and enabling factors for private investment and sustainability

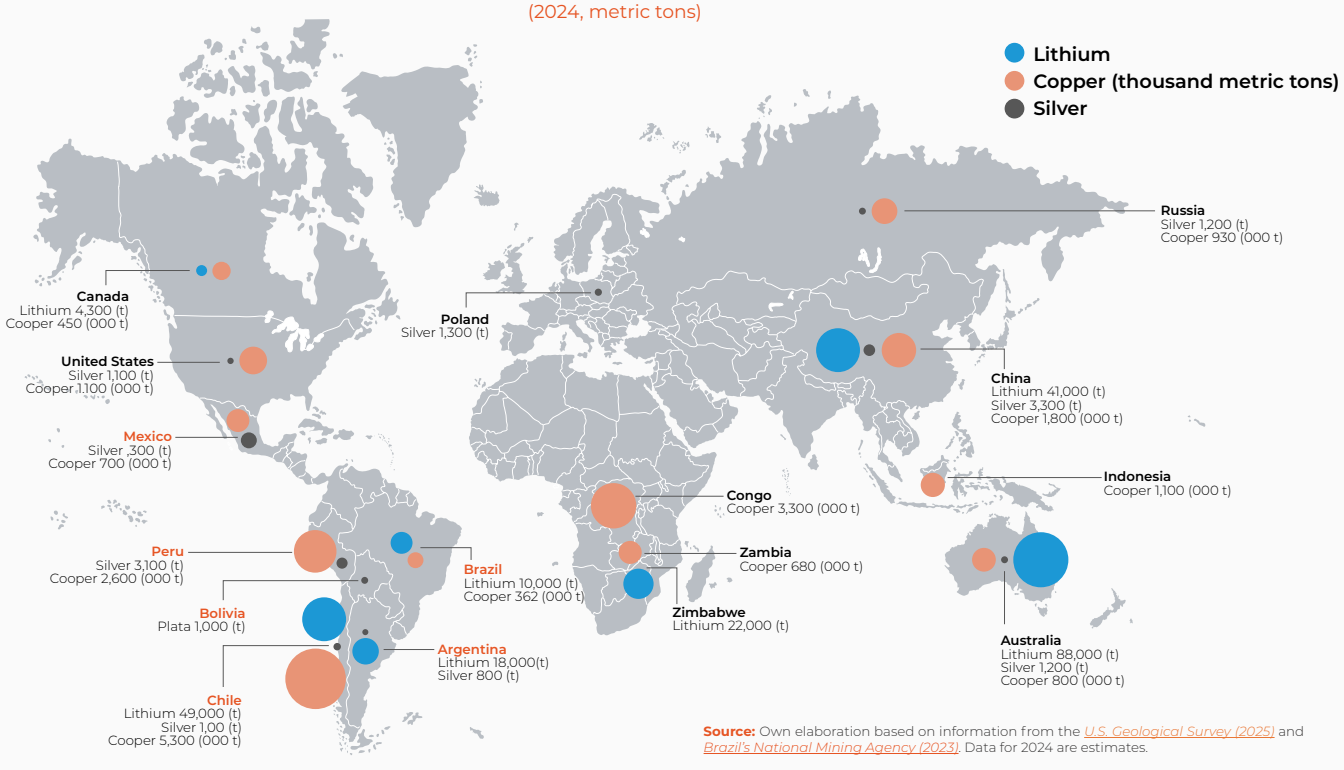
- **The mining sector is essential** for providing critical materials necessary for energy and technological progress.
- **It is crucial to overcome challenges related to environmental degradation and transparency** in revenue management.
- **The adoption of new technologies and digitalization is essential to minimizing environmental impacts** and improving operational efficiency in the extractive sector.
- **Private investment in the mining sector** depends on a clear regulatory framework, transparency and accountability mechanisms, fiscal and financial incentives, and access to technology and knowledge.

The importance of critical minerals and the role of Latin America

Without mining, advancements in energy and technology would not be possible. The mining sector plays a crucial role in energy and technological advancement, as it is a key supplier of lithium, copper, cobalt, and nickel, among other critical materials. Without a constant and sustainable supply of these resources, the development and use of various technologies, such as solar panels, batteries, robots, and the services we rely on that are provided by many electronic devices, would be severely compromised.

Latin America and the Caribbean, a region with abundant natural resources, is a global leader in producing these raw materials (Figure 1). The region accounts for one-fifth of the world's production of gold, tin, bauxite, and zinc, 13% of iron, and around one-tenth of lead and nickel. Chile, Peru, and Mexico together account for 40% of global copper production.[1] Chile is the world's leading copper producer and the second-largest lithium producer.[2] Additionally, Chile, Argentina, and Bolivia together hold over 60% of the world's lithium resources (Figure 2). Large mineral deposits are found in the Andes Mountain Range, with Peru ranking among the top global producers of copper, silver, zinc, and tin.[3] Brazil produces 91% of the world's niobium,[4] and other countries in the region also possess mineral resources that are of interest to global markets.[5]

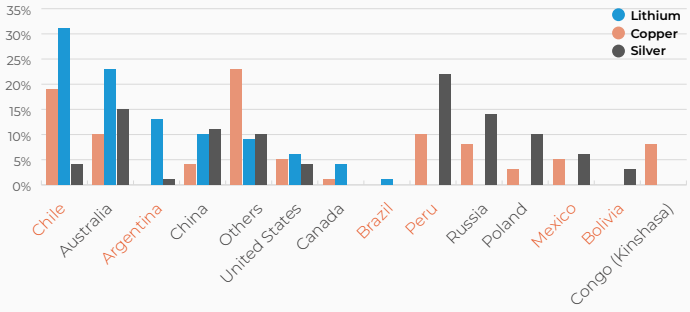
Figure 1: Principal Global Mining Producers of Lithium, Copper, and Silver[6]
(2024, metric tons)



Source: Own elaboration based on information from the U.S. Geological Survey (2025) and Brazil's National Mining Agency (2023). Data for 2024 are estimates.

1. JPMorgan, 2024.
2. Consejo Minero, 2024.
3. La República, 2024. Min. Energía y Minas, Perú, 2019.
4. USGS, 2025.
5. Mongabay, 2024; JPMorgan, 2024; USGS, 2025.
6. Silver plays an essential role in the production of solar panels and various industrial applications. In addition, Latin America has significant production of this mineral. While some countries consider it a critical mineral, others do not include it in their critical minerals lists.

Figure 2: Share of Global Reserves of Copper, Lithium, or Silver (%)



Source: Own elaboration based on information from the U.S. Geological Survey (2025), with 2024 data.
Note: Bolivia has estimated lithium resources of 23 million metric tons. Reserves are defined as having current or future viability (For definitions, see USGS, 2024).

The region faces significant obstacles, including inadequate infrastructure and the need for greater investments to increase the production and exportation of critical minerals such as lithium and copper. Overcoming these challenges and pursuing strategic partnerships could position the region to meet the increasing demand for these resources. However, the mere availability of resources does not ensure adequate conditions for their responsible exploitation or the generation of shared benefits. Efforts to strengthen institutions and improve infrastructure services in mining regions can be catalysts for private investments.

The increasing demand for critical minerals has led to the creation of lists ranking them in terms of relevance and essential functions for economic and national security, such as those developed by the United States and the European Union. This could result in the development of regulations and the mobilization of resources to incentivize the production of these critical materials[7,8] and accelerate strategic projects. Although some of the resources found in Latin America and the Caribbean are not on these critical minerals lists, the region has the potential to become a key supplier for nearby and/or allied countries.

The abundance of resources in Latin America and the Caribbean, along with the growing demand for them, presents an opportunity to be addressed responsibly by leveraging local human capital and technological advancements. The region has comparative advantages and can benefit from the technological developments outlined below. Adopting responsible and sustainable practices from the outset to the completion of operations will not only drive local economic development but also ensure the protection of the environment and the well-being of communities.

Technological developments

Innovation in extraction and processing techniques can mitigate the environmental impacts that have traditionally been associated with the extractive sector. These impacts have included soil degradation, water resource pollution, and general environmental pollution. Among the most notable innovations in the sector are the development of more efficient and less invasive mining methods, such as automated underground mining; the use of drones for exploration; the implementation of circular economy practices to reuse materials; and the more efficient use of resources such as water and energy.

Digitalization in the extractive sector provides numerous economic, environmental, and social benefits. Implementing digital technologies, such as automation, real-time data analysis, and artificial intelligence, enhances operational efficiency, lowers costs, and reduces environmental impact. Utilizing these technologies in the extractive sector promotes improved resource management by optimizing water and energy use and decreasing emissions. Furthermore, digitalization facilitates transparency and traceability in the supply chain and social monitoring of operations, which builds community trust and strengthens the social license to operate.

The private sector plays a vital role in innovating, developing, and implementing new technologies within the mining industry. Mining companies are starting to take the initiative in adopting digital solutions to enhance productivity and sustainability in their operations.

Challenges

The extractive sector faces several challenges that can be addressed by considering the lessons learned over the years. The IDB Group's experience in supporting comprehensive efforts in institutional reform, modernization, and environmental protection, along with the design and construction of significant projects in energy, water, transportation, and urban infrastructure, shows that many of these challenges are not exclusive to the mining sector, thus requiring cross-sectoral approaches.

Conflict management is one of the most pressing challenges that must be addressed to ensure that mining benefits both communities and the local economy. Proactive strategies are essential for anticipating and addressing issues in design and execution, considering all stakeholders involved, promoting consultation processes, and strengthening institutional capacities for systemic conflict management. Furthermore, strong intercultural dialogue must be established between governments, companies, and communities, fostering relationships based on trust and collaboration in decision-making. Community participation can turn conflicts into development opportunities. This transformation also requires capacity building and implementing educational programs for local communities.

Concerns regarding the distribution of revenues generated by the extractive sector constitute an additional challenge for achieving and maintaining the social license to operate. It is essential to establish clear and fair rules for distributing economic benefits. Mining revenues and royalties can be reinvested to improve community infrastructure, such as roads, energy, schools, and hospitals.[9] The smart utilization of resources generated by mining can expedite the discovery of new solutions for bridging development gaps in mining regions and bolster national and regional economies.

Governance and transparency are crucial for improving fiscal and environmental regulation, preventing corruption, and ensuring responsible management. The IDB collaborates with various national, state, and regional governments to improve regulations, streamline administrative processes, and enhance monitoring and auditing systems in the sector. By strengthening technical capacities and adopting new technologies, management efficiency, public trust in the industry, and the sector's economic and socio-environmental performance can be significantly increased.

7. USGS, 2022.
8. USCRS, 2024.
9. BID, 2024.

Best practices and strengthening value chains

Adopting best practices and international standards is essential for advancing sustainability. A comparative analysis of public policies and industry standards for green mining in Latin America and the Caribbean[10] identifies opportunities to improve local and national regulations by aligning them with global standards. This includes updating environmental regulations to incorporate stricter protection criteria, implementing more transparent monitoring and reporting systems, and adopting advanced industrial standards. The implementation of these measures, along with developing implementation capacities, will facilitate the integration of oversight mechanisms and the participation of local communities in decision-making.

It is crucial to promote the development of global value chains, supply chains, and local services while avoiding excessive reliance on the extractive sector.[11] Both the public and private sectors play a crucial role in strengthening value chains, including strengthening institutions at the subnational level to support local investment, expanding business opportunities for local companies, promoting the transfer of technology and knowledge from large companies, and fostering corporate social responsibility initiatives. Linkages with suppliers and service providers that deliver inputs and equipment, as well as those related to industries that use the extracted minerals, benefit construction, logistics, and service companies; promote the development of additional technologies; generate employment and consumption; produce tax revenues; and contribute to local and regional development.[12] Economic diversification is fundamental for the sustainable development of territories, from the initiation to the end of extractive activities.

Mining extraction and its associated value chains create business and investment opportunities. These activities require road and logistics infrastructure for access, as well as energy and water, which in turn drive the development of related services and generate both direct and indirect employment. The construction of roads and bridges, for instance, is essential for transporting minerals from mines to export ports. Additionally, mining operations require a constant supply of energy and water for mineral processing. In Peru and Brazil, mining companies are investing in renewable energy to reduce costs and minimize environmental impact. In arid regions such as northern Chile, mining companies are developing desalination plants to ensure a sustainable water supply. BID Invest, the private sector arm of the IDB Group, has facilitated financing to provide such infrastructure services to mining operations, such as solar energy in Brazil.[13]

The IDB Group can promote smarter industrial policies and foster public-private collaboration. IDB Invest offers a variety of products and tools that can support extractive sector projects and their value chains. Furthermore, IDB Invest can play a key role in financing new value-added industrial clusters in Latin America and the Caribbean. Specifically, it has the financial capacity and market credibility to lead the financing of complex projects. IDB Invest offers a broad range of financial products and a strong mobilization platform, which includes A/B loans, B-bonds, capital market instruments, trade and supply chain finance solutions, as well as equity and quasi-equity instruments. Some of these products can help mitigate project risk and enhance the mobilization of local and international resources that may not be accessible without IDB Invest's involvement. Furthermore, IDB Invest adheres to the highest environmental, social, and governance safeguard standards, which serve as a seal of approval for the projects it finances. It also offers a wide range of solutions—such as reverse factoring[14]—that can support the supply chains of extractive projects and benefit SMEs. IDB Invest also offers advisory services to assist in maximizing the positive impacts of projects and making mining initiatives more inclusive and sustainable.

10. BID, 2023.
11. BID, 2023.
12. Ibid.
13. BID Invest, 2021.
14. BID Invest, 2022.

Enabling factors for sustainable private sector investment

To ensure sustainable investment in the mining sector, it is essential to consider several enabling factors that foster a conducive environment for project development. Below are some key elements that can encourage private investment and ensure sustainability in the sector.

1. **Clear public policies and regulations.** A stable and predictable regulatory framework is crucial for attracting investment. Promoting green industrial policies is necessary to guide the transformation of the productive and extractive sectors[15] and to ensure environmental protection, resource use efficiency, and social responsibility.

2. **Transparency and accountability mechanisms.** The adoption of international transparency standards and the disclosure of information throughout the extractive sector value chain are crucial for fostering a safer and more reliable investment environment.[16] For example, the Extractive Industries Transparency Initiative (EITI) promotes transparency, good governance, and accountability in the use of revenues from oil, gas, and mining in resource-rich countries.[17] Additionally, the use of emerging technologies such as blockchain can enhance supply chain transparency by ensuring that minerals are extracted and traded ethically and sustainably.[18] Accountability must be rooted in corporate practices that adopt anticorruption policies and uphold high standards of business integrity.

3. **Fiscal and financial incentives.** Offering a competitive tax regime and financing options, along with royalty schemes that promote investment and adequately compensate mining regions, can motivate companies to invest in clean technologies and sustainable practices, without providing excessive benefits and with periodic reassessments.[19]

4. **Sustainability, along with environmental and social management.** Identifying and managing environmental and social impacts through the mitigation hierarchy and analyzing the environment's absorptive capacity is critical for preventing overexploitation. Companies must also take responsibility for and commit to the responsible closure of operations.

5. **Public-private collaboration.** Fostering partnerships between the public and private sectors can effectively share risks and benefits while developing projects more efficiently and sustainably.

6. **Access to technology and knowledge.** Facilitating access to advanced technologies and promoting knowledge transfer are essential for improving the efficiency and sustainability of mining operations.[20,21]

7. **Local capacity building.** Investing in training the local workforce creates shared benefits for both communities and companies, enhancing project implementation and social acceptance. Capacity building in key areas like monitoring and evaluation promotes more efficient and responsible resource management.

15. BID, 2024.
16. BID, 2019.
17. EITI is a public-private collaborative effort involving governments, companies, and civil society to improve governance and the management of natural resources.
18. Mining World, 2024.
19. Some countries have chosen to offer tax exemptions for exports, lower financing costs, and reduced income tax rates (Vieira do Prado and Moerenhout, 2024). When it comes to establishing the fiscal regime and tax burden, the key lies in having an optimal and appropriate design that takes into account the geology of the country and the specific project. This design should aim to extract resources efficiently while ensuring an adequate revenue stream for the government. (BID, Davis, and Smith, 2020).
20. BID, 2021.
21. BID, 2021.

Conclusions

The mining sector is crucial to energy and technological progress, supplying essential materials for developing advanced technologies. Latin America and the Caribbean, rich in resources, can emerge as a key driver of these processes—if challenges concerning environmental degradation, social integration, and transparency in revenue management are effectively addressed.

Technological innovation and digitalization, the attraction of private investment, and partnerships with governments and local communities will support the development of global value chains, supply chains, and local services to balance environmental protection with community well-being and ensure the fair and sustainable distribution of mining benefits.

The IDB Group will continue collaborating with governments and private sector clients to ensure responsible and sustainable management. Its support will aim to enhance governance and transparency, strengthen business capacities, improve productivity and quality, reduce the carbon footprint, and generate significant and positive social outcomes.

Additional information

Authors: Adriana M. Valencia J., Daniela Valdivia Llerena, Rodrigo Navas, Martín Walter

Editor: Norah Sullivan

Acknowledgments: We thank Maria Cecilia Acevedo, Andrés Afanador, Gian Franco Carassale, Marta Gutierrez F., Osmel E. Manzano, and Juan Carlos Paez Zamora for their contributions.

For more information, please contact: adrianava@iadb.org

This DEBrief summarizes the challenges and enabling factors for encouraging private sector investment in the sustainable extraction of critical minerals for energy and technological progress. It highlights key points from recent IDB publications such as **The Extractive Sector as a Lever for Productive Transformation** (2023), **Green Mining in Latin America and the Caribbean: Comparative Analysis of Public Policies and Industry Standards to Promote Sustainability in Mining** (2023), and **Atención a la conflictividad minera en América Latina y el Caribe: Una guía para la acción** (2024).

Photos: Shutterstock