



Annual Mining Report 2024

Reshaping the Mining Landscape: Future
Transformations and Global Energy Impact

January 2024

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Contents

Over the last few years, the global mining industry has progressively increased its significance within the global economic landscape, playing a pivotal role in facilitating the world's shift towards green energy.

Following the disruptions brought by geopolitical and economic shifts in 2022, the mining sector has reverted to its strategic emphasis on energy transition minerals throughout 2023.

Securing their position within the carbon-neutral concept, mining enterprises continue a consolidation trajectory, showing a consistent uptrend in M&A value over the past three years. At the same time, rising exploration endeavours, supported by global government investments, aim to ensure an ongoing supply of metals essential for the clean energy sector.

However, a global investor community increasingly prioritises the robust financial standing and ESG development of mining entities, calling on them to accelerate the pace of decarbonisation. The mining industry, proactive in its response, has strategically shifted towards renewable energy adoption and harnessed cutting-edge technologies. Nevertheless, the rising costs associated with this energy transition pose a potential concerns into the sector's capacity to meet the resource demands essential for achieving global net-zero emissions.



Matt Crane - Head of Natural Resources and Energy



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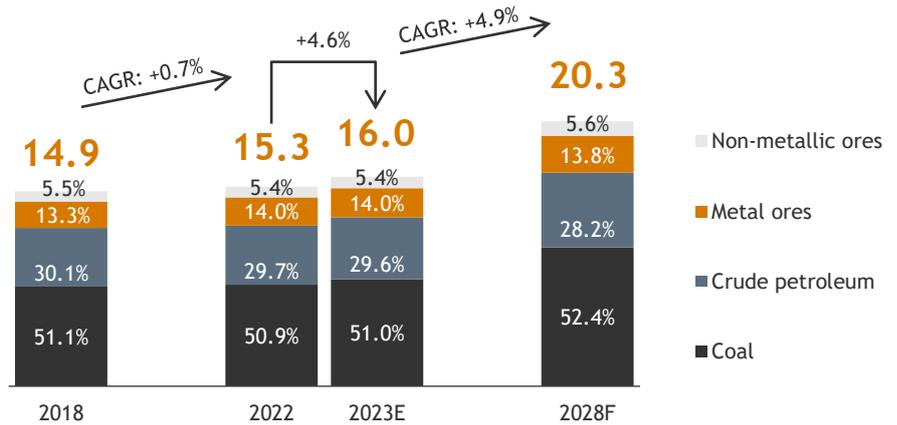
The mining industry views energy transition metals and sustainability as pivotal focal areas

The global mining industry is undergoing a profound transformation shaped by the twin imperatives of sustainable development and meeting the evolving expectations of society. Sustainable development, energy security, and affordability of commodities have been the critical focus points alongside the evolution of the global mining industry over the last five years.

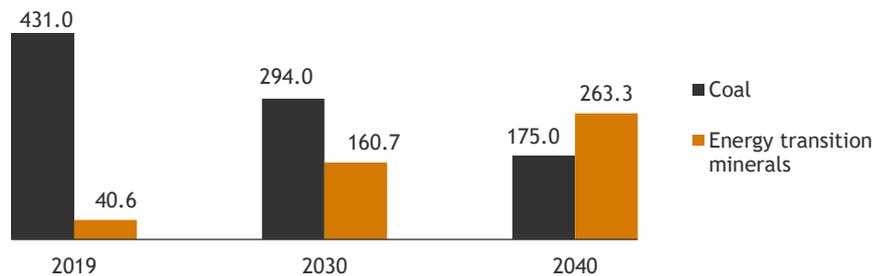
In 2022, the downward trend in reliance on coal was interrupted by a confluence of the global energy crisis and escalating geopolitical tensions. This year, global coal demand surged to an unprecedented historical peak, surpassing the eight billion tonnes mark due to its higher availability and relatively low price compared to gas. China, India, and Indonesia exhibited sustained demand for coal throughout 2023, driving its higher production, while the EU, the USA, Japan, and other developed economies came back on a descending trajectory.

Looking ahead, the industry anticipates a transformative shift. The global demand for coal is projected to decrease slightly to six billion tonnes in 2030 before sharply relinquishing its dominance to the ascendancy of metal ores. For instance, by 2050, the demand for coal dwindling to a forecasted one billion tonnes.

Global mining industry size by production volume, in trillion kilogrammes



Revenue from production of coal and energy transition minerals, \$billions



Key trends in the global mining industry

Shifting focus to minerals for sustainable energy

The mining industry is playing a crucial role in the global energy transition, driving investments in critical minerals, such as cobalt, nickel, copper, lithium, zinc, etc. Despite coal still dominating the production volumes and revenues of mining companies globally in 2022, this lead is expected to shift towards energy transition minerals. By 2050, these minerals are projected to exceed coal in terms of revenue by 51%.

Increased exposure to high-value M&A transactions

Over the last decade, the global mining industry showed intense M&A activity with an average annual deal value of nearly \$20 bn. During 2021-2023, the M&A activity experienced a downward trend in the number of deals, although their value grew. The availability of cash flow, driven by the rising metal prices, allowed mining companies to increase deal value and focus more on big purchases to benefit from higher returns.

Growing investor interest in sustainability

In line with its contribution to the world's low-carbon transition, the mining industry is increasingly paying attention to ESG concerns in its operations. As of 2022, around 69% of investors preferred to avoid investments in mining companies failing to meet their decarbonisation targets. Thus, the electrification of mining equipment and renewable energy are at the forefront of efforts to achieve net-zero goals.

Source: Statista website; McKinsey & Company – Global Energy Perspective 2023 – [October 2023]; IEA – Coal Market Update – [July 2023]; S&P Global – Mining M&A in 2022 – [March 2023]; IEA – The role of critical minerals in clean energy transition – [March 2022]; Accenture – How investors view mining's new role as a champion of decarbonisation – [2022].

Green energy technologies will drive transformational changes in metal demand

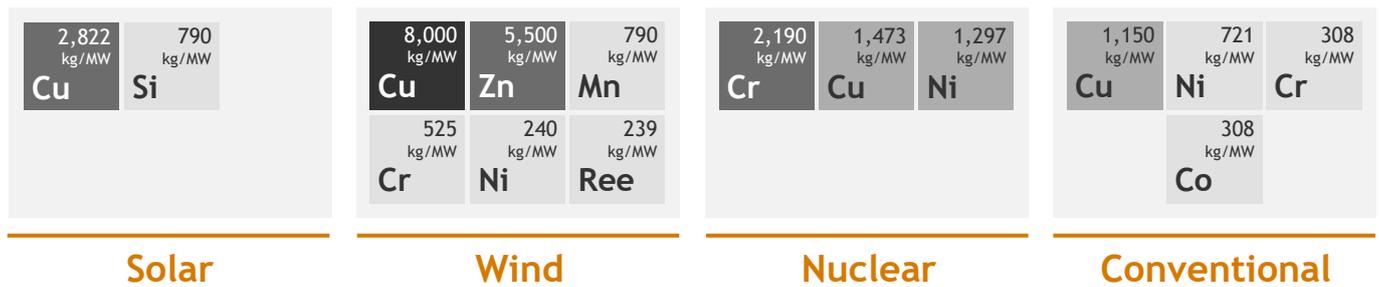
Due to the accelerating decarbonisation trend across industries and the global energy transition, the world is rapidly shifting to renewable energy sources, expected to cover 70%-90% of power generation by 2050, with solar being the most significant supply source.

The shift to green energy is set to drive a massive increase in the demand for a wide range of metals and minerals, including lithium (Li), cobalt (Co), nickel (Ni), copper (Cu), rare earth elements (Ree), which play a pivotal role in powering electric vehicles, production of solar panels, wind turbines, and other clean energy equipment. By 2040, the total mineral demand from clean energy technologies will at least double¹.

Share in the global energy mix², %



Critical minerals used for power generation, kg/MW⁴



Solar generation is expected to play a pivotal role in the energy transition path, setting to lead the pack, contingent on the availability of copper and silicon. Meanwhile, wind power emerges as a key player, dictating global demand for copper and zinc. Additionally, the increase in EV fleets within the following decades will drive the demand for the commodities required in EV production.

Total electric vehicle (EV) fleet



Critical minerals used in electric cars, kg/vehicle



Au Gold: In an era of economic unpredictability and global uncertainty, there is an additional trend towards a discernible increase in demand for gold as a secure and highly liquid asset

The recent geopolitical tensions, high inflation, and global energy crisis have driven gold demand to its highest level in a decade, reaching 4.7 thousand metric tonnes in 2022. This surge was primarily attributed to central banks' acquisition of precious metals for portfolio diversification and increased interest from private investors seeking a hedge against high inflation.

Source: Statista website; IEA – Critical minerals Market Review 2023 – [2023]; IEA – Critical minerals Data Explorer – [July 2023]; IEA – The role of critical minerals in the clean energy transition – [March 2022]; World Gold Council website.

Notes: (1) Due to the Stated Policies Scenario; (2) Total global energy mix comprises both unabated and abated fossil fuels, solar, wind, nuclear, hydro, bioenergy and other renewables; (3) Due to the Net Zero Scenario; (4) Kilogram per megawatt.



Green energy technologies will drive transformational changes in metal demand

Top-countries¹ by reserves and production of main critical minerals in 2022²



Proportion of
■ Reserves³ ■ Mine production⁴

Country	Reserves ³	Mine production ⁴
Canada	Au	
USA	Cu, Ree	
Peru	Cu, Cu, Zn	
Chile	Cu, Cu	
Brazil	Ree, Mn, Ni, Si	
South Africa	Mn, Cr, Au	Mn, Cr
Turkey		Cr
Gabon		Mn
DRC		Cu
India		Cr
Indonesia		Ni, Ni
Kazakhstan		Cr, Cr
Russia	Au, Zn, Ree	Au, Ni, Zi
China	Mn, Zn, Ree, Au	Mn, Zn, Ree, Au
Vietnam		Ree
Philippines		Ni
Australia	Mn, Zn, Au, Cu, Ni	Mn, Zn, Au, Ree

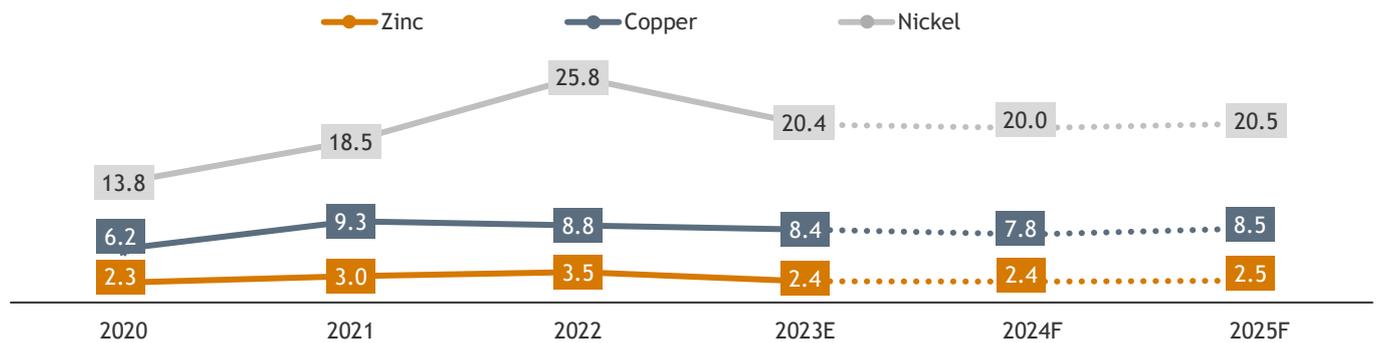
The notable surge in **global reserves for copper, nickel, rare earth elements, and manganese** during 2018-2022 was propelled by a robust escalation in exploration spending, particularly during 2021-2022, as industries endeavoured to meet the rising demands for critical minerals. Australia and China, emerging as frontrunners, dominated the reserves of various mineral commodities in 2022. At the same time, the **production of most energy transition minerals also increased**, fuelled by a widespread embrace of clean energy technologies and rising investments in their development. Notably, rare earth elements, nickel, and silicon experienced the **most considerable production growth**. In contrast, zinc output displayed slight fluctuations, primarily influenced by soaring energy prices and a concomitant dip in economic activity within China. Additionally, gold exhibited a year-on-year rise in production in 2022, with **China, Australia, and Russia** remaining top suppliers.

Source: Trading economics website; USGS – Mineral Commodity Summaries – [2018-2023]; IEA – Critical minerals Market Review 2023 – [2023]; IEA – Critical minerals Data Explorer – [July 2023]; World Gold Council website.

Notes: (1) Represent each of the Top-3 countries in terms of reserves and mine production as of 2022; (2) Metric tonnes; (3) The country was highlighted in red in case of a higher number of leading positions in critical minerals reserves; (4) The country was highlighted in grey in case of a higher number of leading positions in critical minerals mine production.

Green energy technologies will drive transformational changes in metal demand

Global prices for minerals, \$k per mt



Nickel prices saw a significant decline in 2023 following oversupply, weak demand, and increased production capacity, as well as are expected to drop in 2024 as production in Indonesia and the Philippines continues to grow. Rising demand for EV batteries is expected to support a rebound in prices in 2025 and will be the main future demand driver.

As of 2023, copper prices fluctuated, mainly due to the lack of solid demand growth in China amidst low investment and construction activity. Prices are forecast to fall further in 2024, reflecting weakening global demand and strong supply growth. Prices should rebound in 2025 as global demand recovers and the green transition intensifies.

Zinc prices dropped in 2023Q³ and are expected to further fall in 2024 on weak demand and rising inventories. Slowing industrial activity in China and other major economies curtailed demand for zinc. While in 2025 zinc prices are expected to increase due to recovering global demand.



Global price for Gold, \$/t.oz²



As of December 2023, average gold prices reached 2,026 \$/t.oz and are expected to increase in 2024 but recede in 2025 as inflation and recession fears fade. An escalation of the conflict in the Middle East could result in sharply higher prices due to increased demand for safe-haven assets.

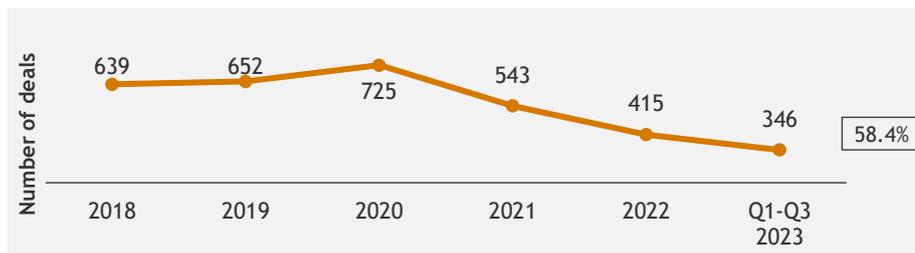
Source: Trading economics website; USGS – Mineral Commodity Summaries – [2018-2023]; IEA – Critical minerals Market Review 2023 – [2023]; IEA – Critical minerals Data Explorer – [July 2023]; World Gold Council website.

Notes: (2) Troy ounce; (3) Average Q3 2023; (4) World Bank's forecast.

To fortify long-term developmental prospects, mining companies pursue consolidation

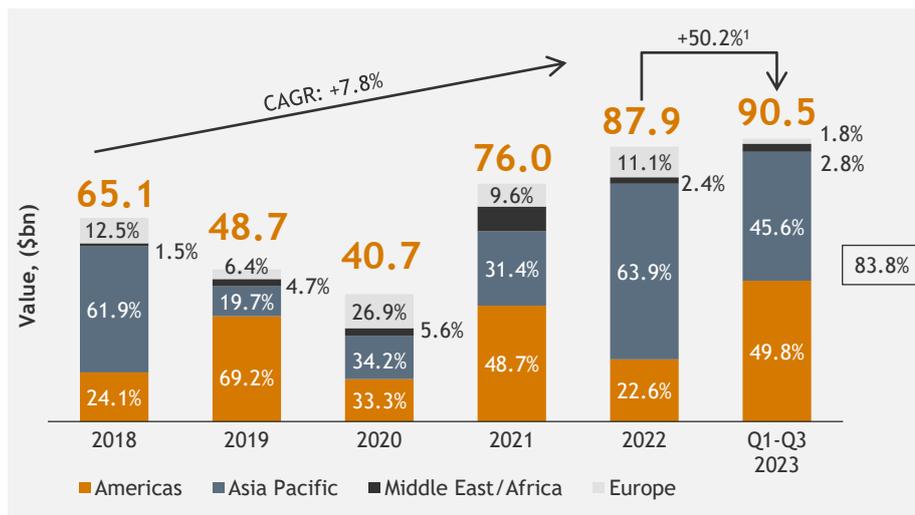
As of November 2023, the mining sector is experiencing an upward trend, recovering after the COVID-19 downturn, propelled by factors such as global economic recovery, elevated prices of premium commodities, and a heightened focus on sustainable practices within the industry. To capitalise on these favourable growth prospects, mining enterprises are actively exploring strategic agreements to foster long-term synergies and enhance overall value.

M&A activity in the global mining industry



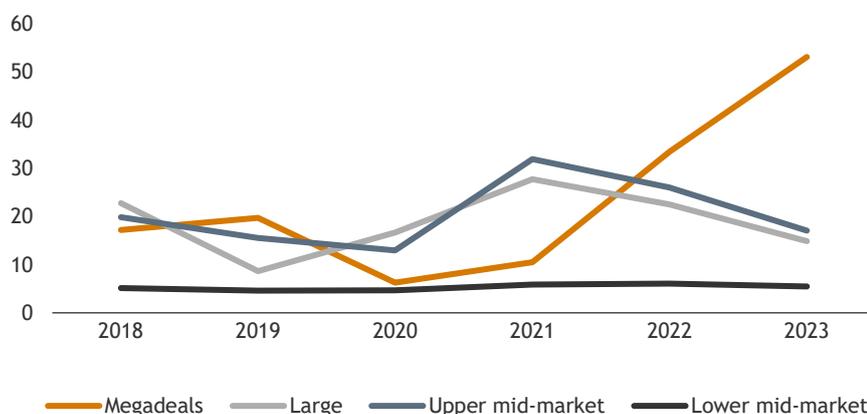
Top-3 countries as of Q1-Q3 2023¹

Australia	76	+28 Deals
Canada	74	+7 Deals
China	52	+6 Deals



Canada	\$37.1 billions	+462.1%
Australia	\$29.8 billions	+204.1%
China	\$8.9 billions	(-62.4%)

M&A activity by size of the deal



Over the past five years, M&A activity in the global mining industry has shown contrasting dynamics in values and the quantity of deals. The overall value of M&A deals has exhibited a robust upward trajectory, rebounding from a decline in 2020 during the COVID-19 pandemic, while the total number of deals has conversely decreased since 2020. While the top countries by the number of deals experienced an increase in M&A activity, this rise was predominantly driven by the surge in upper mid-market² and lower mid-market³ transactions, which did not alter the overall trend of a decreasing number of deals. At the same time, the total value grew significantly over the last years due to a substantial increase in the value of megadeals⁴.

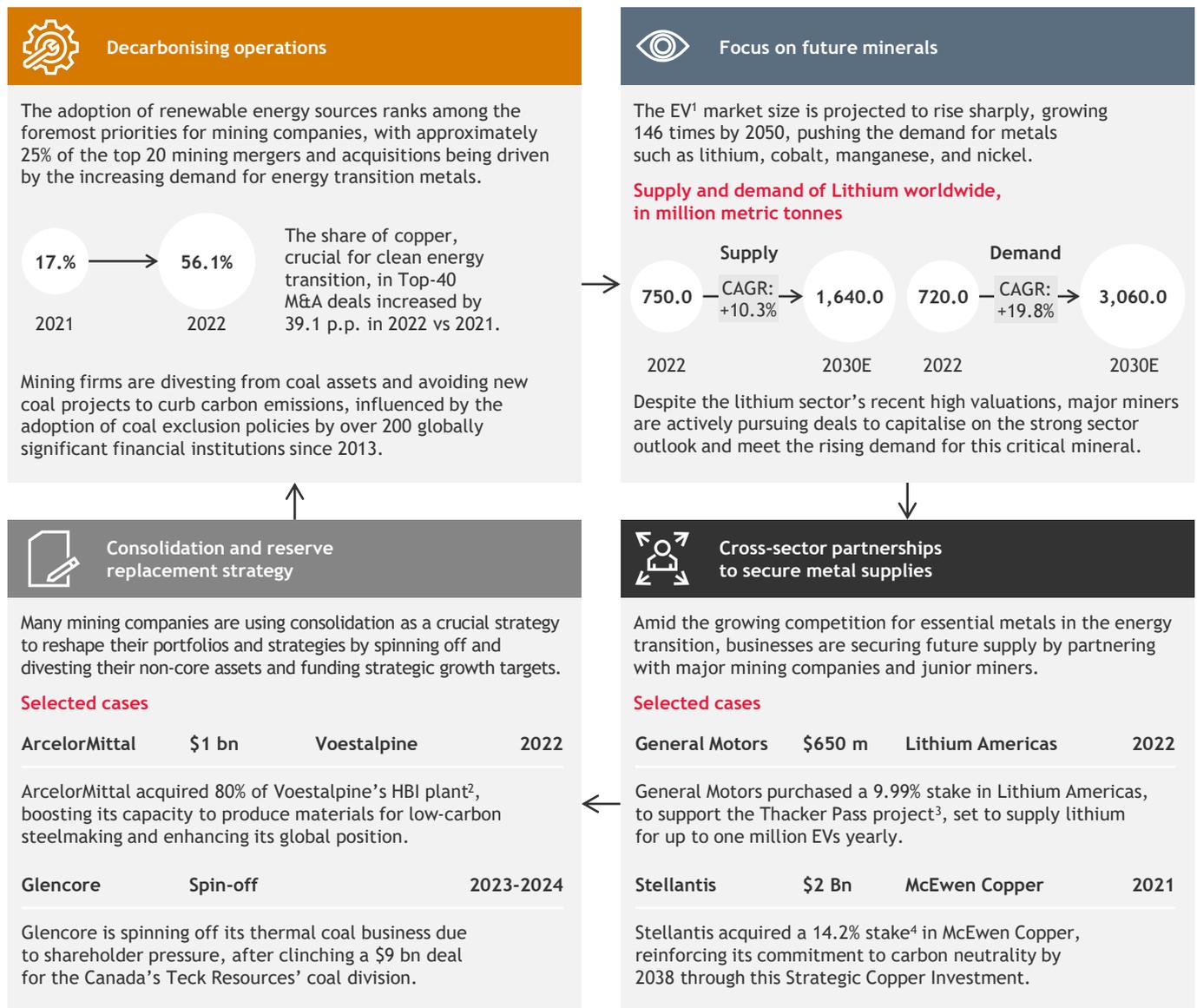
Source: Which&Case website; Evalueserve – Outlook: M&A Trends in the Mining Sector – [2021].

Notes: (1) Compared to Q1-Q3 2022; (2) Deals for \$0.1-1.0 bn; (3) Deals for \$5.0-99.0 m; (4) Deals for more than \$5.0 bn; (5) Deals for \$1.0-5.0 bn.

To secure long-term development, mining companies pursue consolidation

M&A deals' focus in the mining sector is experiencing a shift towards sustainability, including decarbonising operations, business consolidation, and partnerships to secure the supply of minerals increasing in demand.

M&A trends in mining



Source: GlobalData – Mining Industry Mergers and Acquisitions Deals by Top Themes in 2022 – [2023]; Evalueserve – M&A Trends in the Mining Sector – [2021]; Lithium Americas – Corporate presentation – [2023]; IEEFA – 200 and counting: Global financial institutions are exiting coal – [2023]; Visual Capitalist – The Lithium Rush: Can We Meet Tomorrow's Lithium Demand? – [2023]; Stellantis website; Statista website; General Motors website; Mining Technology website

Notes: (1) Electrical vehicles; (2) Hot Briquetted Iron plant, located near Corpus Christi, Texas; (3) The largest known lithium resource in the USA; (4) Increasing its ownership to 19.4% stake of McEwen Copper, a subsidiary of Canadian mining company McEwen Mining.

Gold and copper have been the most prevalent metals in the largest M&A deals since 2022

Current M&A activities within the mining sector hold the power to create large mining conglomerates globally, possessing the potential of lasting influence on the industry. While expanding global market share remains the primary motive for major M&A deals, a crucial driver for such activity is the emphasis on sustainable development. Notably, objectives centred around reducing carbon emissions and promoting clean energy generation stand out as the top reasons for M&A in the past two years.

Top-5 M&A deals by value in the mining industry since 2022

<p>Cannington project – \$19.2 bn Mar 2023</p> <p> </p> <p>Metals¹: Copper, Gold</p> <p>Coolabah Metals acquired the Cannington Project in Queensland, Australia, encompassing two exploration licences spanning 113.4 square kilometres from Thomson Resources Ltd. Despite the proximity to the silver, lead, and zinc deposits of the Cannington and Pegmont mines, the primary focus within the Cannington project pertains to Brumby. This copper-gold project exhibits a spatial correlation with a robust magnetic high, suggesting its interpretation as an Iron Oxide Copper Gold (IOCG) style target. This strategic move aimed to enhance Coolabah's position in exploring the promising tenements under its ownership.</p>	<p>Newcrest Mining Ltd – \$19.1 bn Feb 2023</p> <p> </p> <p>Metals¹: Gold, Copper</p> <p>Newcrest Mining Limited consists of six operating mines in total (two – in Australia, two – in Canada, two – in Papua New Guinea), and one mine under construction in Australia. The acquisition of Newcrest Mining allowed Newmont, already the world's biggest gold miner, to expand its global scope of mining operations further. Such a strategic move aimed to strengthen Newmont's position through a combination of high-quality operations, projects, and reserves concentrated in low-risk jurisdictions, as well as to support decades of safe, profitable, and responsible gold and copper production.</p>	
<p>OZ Minerals – \$6.4 bn Dec 2022</p> <p> </p> <p>Metals¹: Copper, Nickel</p> <p>BHP acquired OZ Minerals, known for its copper, gold, and silver projects in Australia, to strengthen BHP's copper and nickel portfolio. This strategic move aims to address the rising demand for critical minerals crucial for EVs², wind turbines, and solar panels, thus supporting clean energy generation.</p>	<p>Polyus – \$6.3 bn Apr 2022</p> <p> </p> <p>Metals¹: Gold</p> <p>AKROPOL GROUP LTD acquired a 29.99% stake in the PJSC³ Polyus, a fully-owned subsidiary of Wandle Holdings Limited, with gold mines in Russia.</p>	<p>Yamana Gold – \$4.8 bn Nov 2022</p> <p>  </p> <p>Metals¹: Gold, Silver</p> <p>Pan American Silver (PAAS) acquired all shares of Yamana Gold Inc. after Yamana Gold sold its Canadian assets to Agnico Eagle Mines Limited. PAAS aimed to expand its Latin American presence by adding Brazil and Chile and to boost silver and gold production.</p>

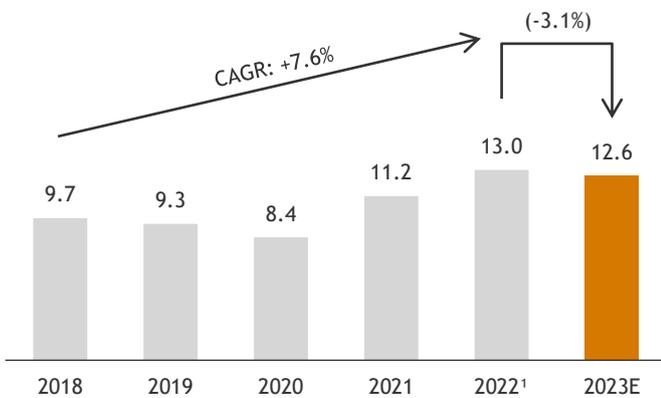
Source: Coolabah metals website; Newcrest Mining Limited website; OZ Minerals website; GlobalData Mining Intelligence Center; BHP – Completion of OZ Minerals acquisition – [2023]; War & Sanctions website; Pan American Silver website; Media overview.

Notes: (1) Primary mining focus of the acquiring company; (2) Electric vehicles; (3) Public Joint Stock Company; (4) It might be speculated that selling and donating all his shares by Mr Said Kerimov could be a result of sanctions imposed on him.

Mining companies' efforts to bolster their positions via exploration face funding issues

The growing pace of green energy transition around the globe caused the necessity of exploring new mines to boost the production of energy-critical minerals. As global demand for critical minerals is expected to almost quadruple by 2030, mining companies are trying to refocus on finding these resources.

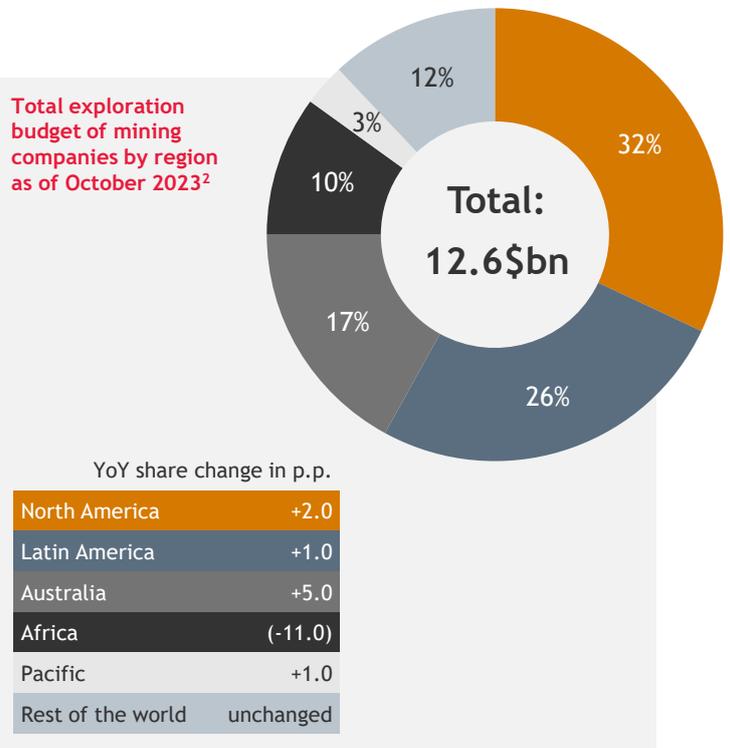
Total exploration budget of mining companies around the globe (\$bn)¹



In 2022, the surge in metal prices and favourable financing conditions led to a significant increase in exploration budgets, which reached a nine-year record. That year, the fundraising challenges for African mining companies amid high political risks, such as tax pressure, rising interest rates, and sovereign debt crises, affected the role of Africa as an exploration destination. In addition, a 32% YoY drop in Russia's exploration budget due to its invasion of Ukraine has caused a considerable decline in the value of the rest of the world region.

Out of the top five targeted metals³, the exploration budget for lithium experienced the most rapid growth, rising by 88% YoY in 2022. This rise is attributed to lithium's pivotal role in battery production, essential for storing electricity from solar and wind power plants. Nonetheless, gold remained a primary focus for mining companies, representing 53% of the total exploration budgets in 2022 due to its robust operating leverage.

Despite the number of mining companies conducting exploration activities increasing by 2% YoY in 2023, the total exploration budget of these companies worldwide is estimated to decline. The reduction in budgets for exploration projects is caused by the weaker financial contribution of junior mining companies and a downturn in metal prices to pre-2021 levels, affecting the availability of cash flow for investments.



Yearly funds raised by mining companies⁴ as of June 2023

\$5.3 bn YoY (-18.5%)

Estimated total capital spending of mining companies in 2023

\$104.2 bn YoY (-4.0%)

In 2022, the exploration activity of mining companies has become a less important criterion for investors in capital allocation. Specifically, almost 30 p.p. fewer investors emphasised the importance of a mining company's exploration endeavours compared to the solidity of its financial position. This inclination of investors to receive near-term share buybacks instead of waiting for a long-term investment return led to a gradual decline in funds raised by mining companies during 2022-2023. Difficulties in raising funds, coupled with construction delays and the lack of approval for new projects, are expected to result in a nearly 26% reduction YoY in total capital spending of mining companies in 2027 compared to 2023.

Source: S&P Global Commodity Insights; Reuters website; S&P Global – Corporate exploration strategies 2023 – [October 2023]; S&P Global – World exploration trends 2023 – [March 2023]; Accenture – How investors view mining's new role as a champion of decarbonisation – [2022].

Notes: (1) Estimation of S&P Global as of October 2022; (2) Includes maritime countries to the south of China and island countries and archipelagos in the Pacific; (3) Includes lithium, nickel, copper, gold, and silver; (4) Based on the data from junior and intermediate mining companies around the globe.

Governments endorse the mining industry to guarantee the provision of critical minerals



Over the last few years, state policies around critical minerals have almost doubled globally. More substantial political involvement in the mining industry operations is driven by the common goal of ensuring an abundant and sustained supply of energy-transition minerals in the face of political and economic uncertainty.

Although the methods of achieving a common goal vary, each remains focused on diversification of the current highly concentrated supply chain from emerging markets.

Governments are actively investing in the exploration, development, and production of domestic critical mineral resources and launching incentives to support innovations in the mining sector.

Government’s support of critical minerals in selected countries, as of 2022

Selected countries	Public investments ¹	Direct financing ²	Tax incentives	Innovation funding
Australia	Available	Available	Available	Available
Canada	Available	Available	Available	Available
Chile	Available	Not available	Available	Available
China	Available	Not available	Available	Available
DR Congo	Available	Not available	Available	Available
Ecuador	Available	Not available	Available	Available
The EU	Available	Not available	Available	Available
Japan	Available	Available	Available	Available
South Africa	Available	Available	Available	Available
The UK	Available	Not available	Available	Available
The USA	Available	Available	Available	Available

Available (Orange) Not available (Grey)

Selected government investments in the mining industry

Australia 2023

Investment of **\$57.1 bn** by 2030 to support critical mineral projects and secure their new supply chains.

The UK 2022

Funding research projects of 16 mining companies, totalling **\$8.2 m**, to strengthen critical mineral supply chains over 2022-2025.

France 2022

Public support of **\$1 bn** to critical mineral projects, in which 50% are grants and 50% are equity investments.

Selected government incentives for innovations in the mining industry

Japan 2022

Establishment of a special **tax credit** for critical mineral exploration, which covers 100% of expenses.

The USA 2022

Setting a clean vehicle credit of up to **\$7,500** per vehicle to accelerate the adoption of EVs by companies.

Canada 2022

Introduction of a new **30% tax credit** for establishing electric and hydrogen equipment by mining companies.

While other countries are struggling to build new secure supply chains, resource-rich countries have continued to disrupt existing ones by nationalising critical mineral assets or placing export restrictions on them. During the last two years, Mexico has nationalised its lithium assets, Namibia and Zimbabwe have banned lithium exports, and China has restricted gallium exports. The OECD has identified a fivefold increase³ in export restrictions on critical raw materials over the past decade, highlighting the need for changes in the current supply model.

Source: Official governments’ websites; IEA – Critical Mineral Market Review 2023 – [July 2023]; OECD – Raw materials critical for the green transition – [April 2023]; IEA – Critical Mineral Policy Tracker – [November 2022].

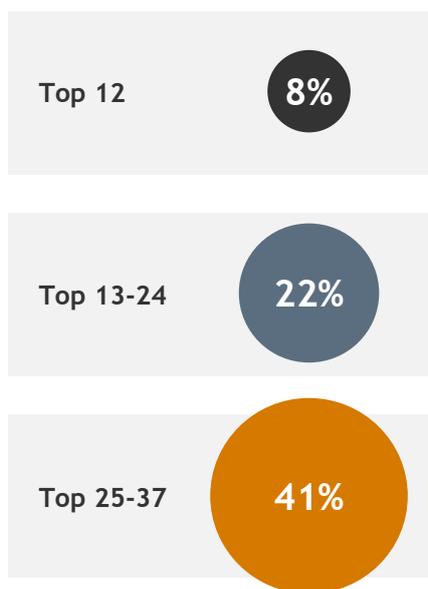
Notes: (1) Public equity investments in private companies or projects; (2) Financing projects through grants or loans; (3) According to the ‘Raw materials critical for the green transition’ study of the OECD from April 2023, covering the period of 2009-2020.

A full transition to net-zero emissions by 2050 will require \$2 trillion from the mining industry

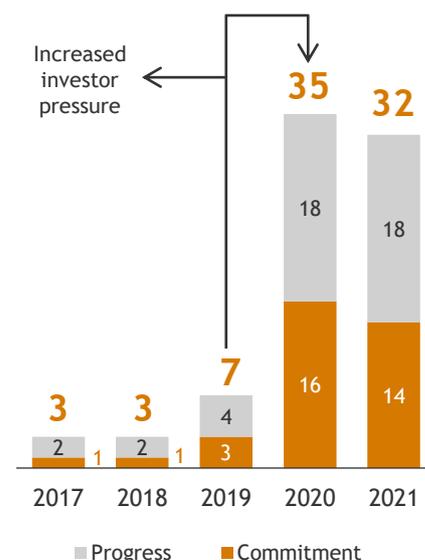
In addition to growing government attention, private sector investors are also involved in imposing their demands on the mining sector, owing to its indispensability for the global energy transition. As of 2022, 59% of investors pressed mining companies to pursue decarbonisation, considering the historically weak reputation of the industry regarding ESG. For instance, CO₂ emissions from the mining industry account for 4% to 8% of the world's total per year, resulting in nearly \$3 trillion in economic burden.

However, over the past few years, mining companies worldwide have been steadily improving their ESG performance, resulting in one of the highest ESG scores among all sectors, amounting to almost 55 out of 100 points as of 2022. Furthermore, the number of decarbonisation progress announcements by mining companies grew nine times from 2017 to 2021. These improvements, in line with the emergence of new challenges, have moved the ESG theme from first to third place in the mining industry's risk ranking.

Average increase in ESG results¹ of Top-37² mining companies globally in 2022 vs 2020



Number of net-zero goal announcements in the mining sector globally



Top-3 risks for the mining sector in 2023 vs 2022, % of respondents³

18%
+14 p.p.

Inflationary cost pressures

16%
+16 p.p.

Geopolitics

11%
-13 p.p.

ESG

Sustainability-linked finance (SLF)⁴ issuance by the global mining industry, (\$bn)



Mining companies continue to explore the possibility of issuing green debt to attract investors to finance ESG projects. Although the number of green debt transactions in the mining industry grew considerably over 2019-2021, it accounted for only 2% of the total number of deals across all industries around the globe in 2021. Thus, to increase ESG funds, mining companies started to link their debts to specific projects as opposed to general goals.

BDO has increasingly helped mining companies align their financial strategies to ESG targets and enhance sustainability-linked funding opportunities.

A stronger focus on ESG-linked debts is expected to accelerate from 2024 onwards, given that most green projects of mining companies were only at the development or pilot stage during 2020-2023. The required investments range from \$250 million to \$5 billion per project, depending on its goal.

In total, the mining industry demands approximately \$2 trillion of investment to achieve the net-zero goal by 2050. Meanwhile, the decarbonised mining industry will be highly energy-intensive, raising concerns about its potential to provide resources for ensuring the world's energy transition.

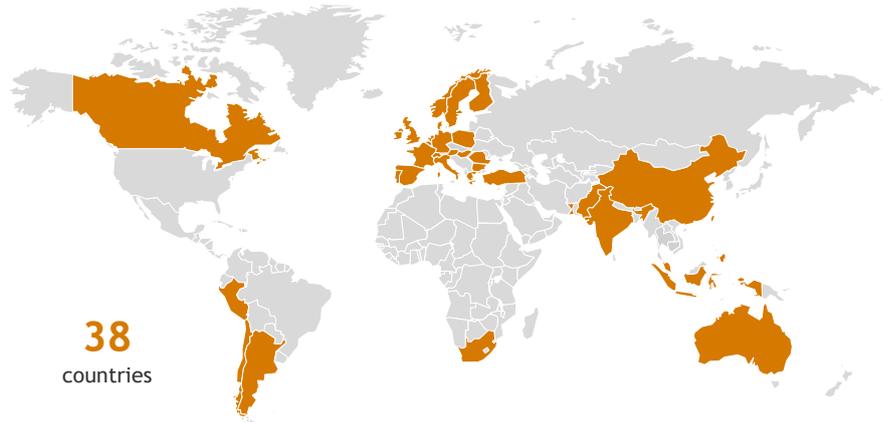
Source: ING website; Wood Mackenzie website; White & Case LLP – Mining & Metals 2023: Lifting the fog of uncertainty – [January 2023]; Elsevier – Journal of Cleaner Production – [August 2022]; Responsible Mining Foundation – RMI Report 2022 – [February 2022]; Accenture – How investors view mining's new role as a champion of decarbonisation – [2022].

Notes: (1) Out of 100% score based on commitment and management of ESG topics; (2) By ESG results as of 2020, among Top-37 mining companies by market capitalisation around the globe; (3) According to the Mining & Metals survey conducted by White & Case LLP among 156 mining decision makers worldwide in January 2023; (4) Borrowings linked to environmental or social goals.

Lack of specific ESG reporting standards for mining companies limits investor confidence

The most significant barrier in ESG investments across all industries is the inconsistency and incompleteness of data, as cited by 71% of investors¹ around the globe in 2023. Challenges in collecting proper ESG data arise primarily from the lack of industry-specific standards and regulations. Although the number of ESG disclosure provisions of governmental bodies has grown by 74% globally over the last four years, they remain more focused on ethical business behaviour and do not define a single standardised approach to reporting. Many global sustainability initiatives attempt to engage companies in standardised ESG reporting, yet they struggle to ensure audits and completeness of data.

Countries worldwide with a mandatory ESG disclosure, as of November 2023



Key global initiatives for ESG reporting



Global Sustainability Standards Board (GSSB)



Sustainability Accounting Standards Board



UN Global Compact

Selected ESG themes	Share of companies ²
● GHG emissions	72.0%
● Water management	70.5%
● Workplace health & safety	70.0%
● Energy management	63.5%
● Business ethics	57.0%
● Waste	50.0%
● Biodiversity	50.0%
● Impact on local communities	47.0%
● Air quality	45.0%

ESG pillars: ● Respect for the Planet ● Respect for People ● Respect for Prosperity

The lack of a defined and mandatory ESG theme list for the mining industry allows mining companies to neglect industry-specific indicators. For instance, only 36% of mining companies disclosed their energy intensity by volume of ore mined as of October 2022. In addition, most mining players focus on general corporate reporting rather than site-specific disclosures, which is valuable given the diversity of stakeholders and impacts across different mining sites.

In June 2021, the GSSB approved the GRI³ Sector Standards Project for Mining as part of its GRI Sector Programme, aiming to develop 25 specific ESG material topics that reflect the mining industry’s impacts. The Sector Standard is expected to be presented in Q4 2023. In mining experts’ estimation⁴, many jurisdictions can provide mandatory status for these standards from 2025 due to the endorsement by the G20⁵ and strong investor support for them.

The expected improvements in the ESG reporting standardisation could lead to another challenge for the mining companies. The introduction of AI technologies, CO₂ emissions calculation, and software solutions for collecting ESG data will require higher expenditures. It may further impact the growing need for mining companies to attract investors to cover these expenses. BDO provides strategic advisory to architect an ESG reporting framework and digital data solutions that are cost-efficient and tailored to mitigate risk exposure.

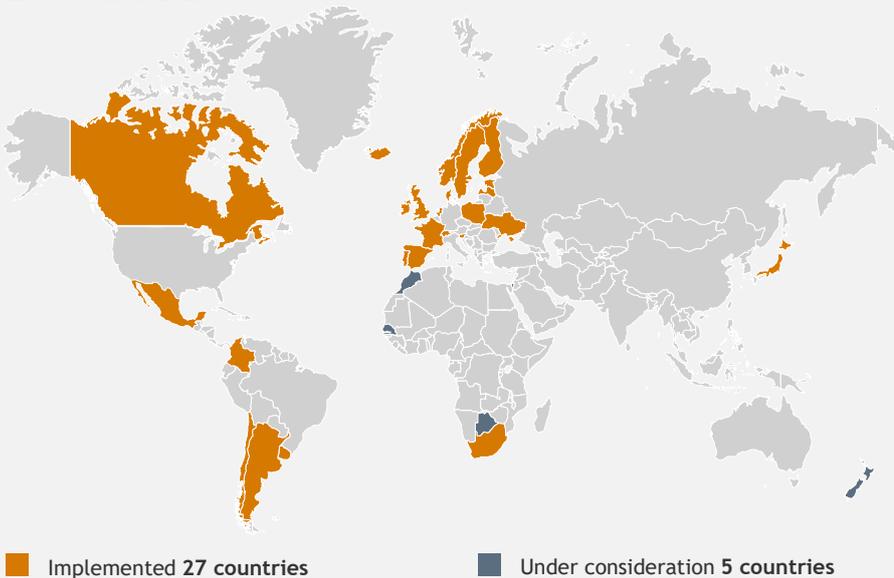
Source: Global Sustainability Standards Board website; Glacier Media Group website; Swiss Finance Institute – The effects of mandatory ESG disclosure around the world – [November 2023]; BNP Paribas – ESG Global Survey 2023 – [September 2023]; MineSpider AG – The most commonly used ESG Metrics in the Metals and Mining Sector – [October 2022].
 Notes: (1) According to BNP Paribas survey in 2023 among 420 institutional investors around the globe; (2) Share of companies reporting based on annual reports of 22 large mining companies selected by MineSpider AG from different metal groups; (3) Global Reporting Initiative; (4) The experts of Glacier Media Group; (5) The intergovernmental forum comprising largest economies around the globe.

Mining sector can support a global carbon tax to benefit from demand for critical minerals

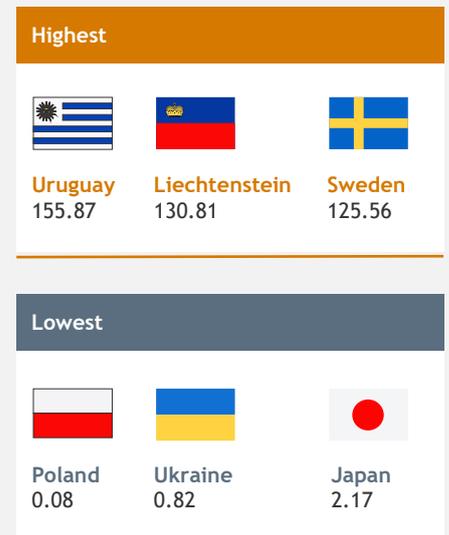
Carbon pricing initiatives, including carbon taxes¹, ETS², carbon credits³, and others, have been introduced by governments since 1990. Still, a real boom has emerged during the last decade to ensure achieving net-zero emissions by 2050. The carbon tax is the most controversial carbon pricing instrument for mining companies, as the value of mining products per tonne of CO₂ is higher than that of products of other industries, which may affect the mining sector’s appeal to investors.

As of 31 March 2023, only five countries among 27 countries that implemented carbon tax worldwide were mining leaders by mineral production value⁴ in 2022. As a result, mining companies are concerned about a potential deterioration in competitiveness due to higher commodity prices amid the carbon tax compared to mining companies from countries without tax on CO₂ emissions.

Countries worldwide with a carbon tax implemented or under consideration, as of 31 March 2023



Top-3 countries worldwide by carbon tax price, \$ per tonne of CO₂



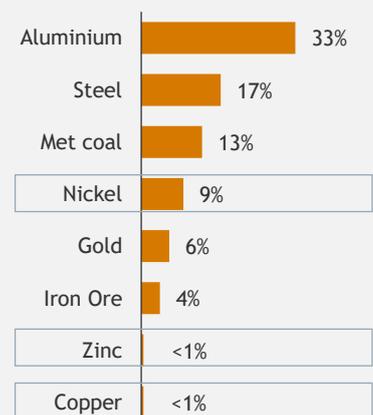
The marginal cash costs of companies producing energy transition metals may suffer less from the global carbon tax than companies specialising in other metals. In addition, the further increase in the number of carbon tax regulations is expected to boost the global demand for energy-critical metals and accelerate the energy transition, which should bring more benefits than losses to miners of these metals. The anticipated acceleration in the global energy transition also results from the highly unfavourable position of coal with the launching of carbon taxes globally. For instance, the production of copper and nickel yields \$1,111 and \$740 in revenue per one tonne of CO₂ emissions, respectively, whereas coal generates only \$74 in revenue per same amount of CO₂.

Thus, by supporting the introduction of a global carbon tax, mining companies specialising in energy transition metals could stimulate additional demand for their products and demonstrate to investors their commitment to sustainability. At the same time, these companies will have to address their energy transition.

Source: The World Bank Carbon Pricing Dashboard; S&P Global website; Wood Mackenzie website; The University of British Columbia website; Cox, B., Innis, S., Kunz, N.C. – The mining industry as a net beneficiary of a global tax on carbon emissions – [February 2022].

Notes: (1) Direct price on carbon by defining a tax rate on CO₂ emissions; (2) An emissions trading system allowing emitters to trade their emission units; (3) CO₂ reduction from project-based activities; (4) According to ‘Mineral Commodity Summaries’ of USGS, launched in 2023; (5) Based on the Wood Mackenzie estimation in July 2021.

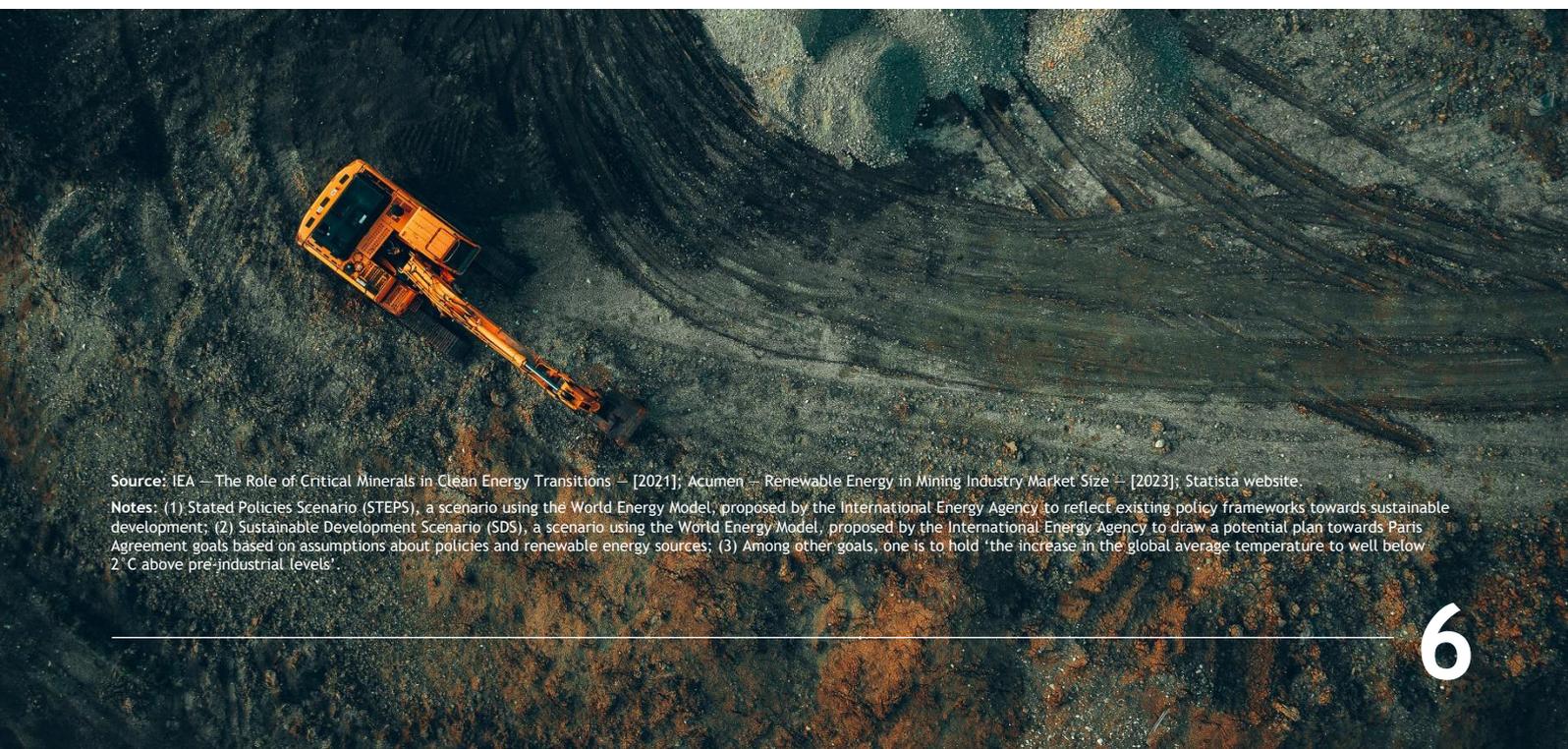
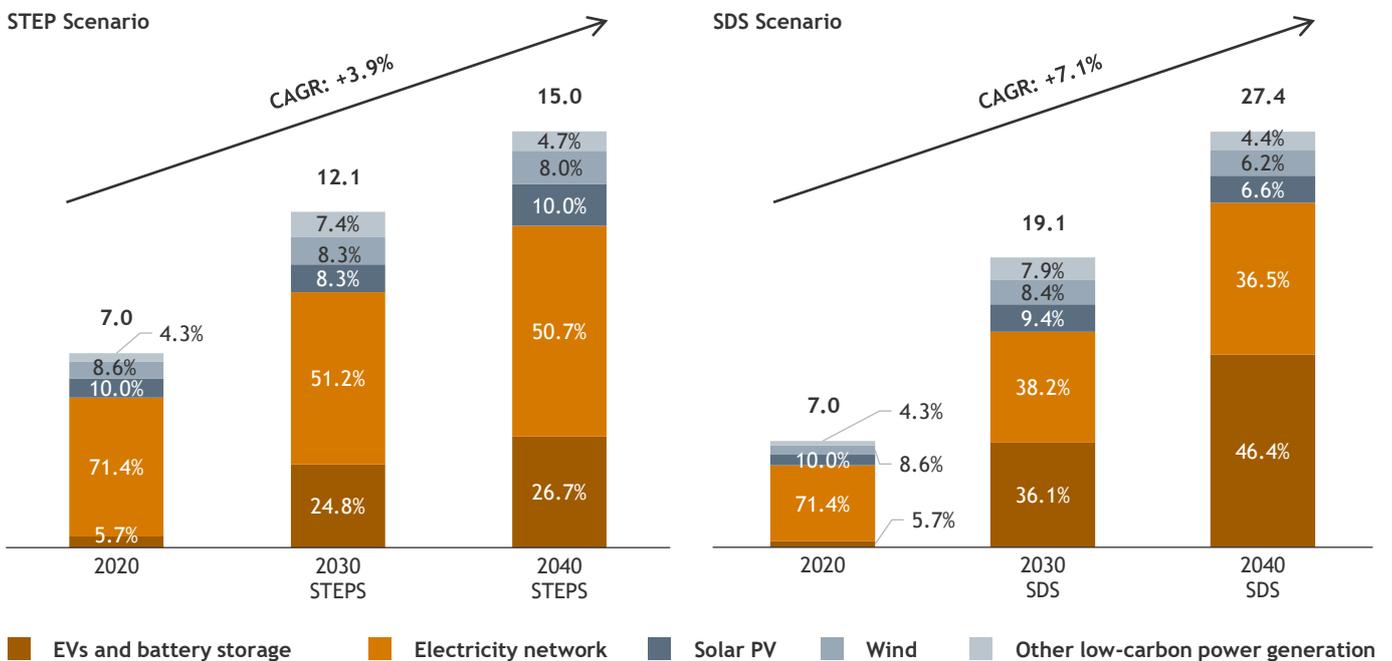
Growth in marginal cash costs⁵ due to a global carbon tax of \$150 per tonne CO₂ required to achieve net-zero goal



Mining plays a vital role in the transition to green energy and sustainable growth globally

By 2040, the total mineral demand for clean energy technologies is expected to double in the STEPS¹ scenario, which reflects the impact of countries' existing policy frameworks and those that were officially announced. Simultaneously, the global mineral demand for green energy technologies is predicted to quadruple in the SDS² scenario, which maps a route to 2040 to align Paris Agreement goals³ based on assumptions about policies and renewable energy sources. According to the SDS scenario, E-mobility and battery storage are expected to contribute approximately half of the mineral demand growth from clean energy technologies in the coming decades. Graphite, copper, and nickel are projected to dominate mineral demand by weight by 2040, while lithium exhibiting the fastest growth rate, with demand increasing by over 40 times in the SDS scenario.

Total critical mineral demand for clean energy technologies by scenario, Mt



Source: IEA – The Role of Critical Minerals in Clean Energy Transitions – [2021]; Acumen – Renewable Energy in Mining Industry Market Size – [2023]; Statista website.
 Notes: (1) Stated Policies Scenario (STEPS), a scenario using the World Energy Model, proposed by the International Energy Agency to reflect existing policy frameworks towards sustainable development; (2) Sustainable Development Scenario (SDS), a scenario using the World Energy Model, proposed by the International Energy Agency to draw a potential plan towards Paris Agreement goals based on assumptions about policies and renewable energy sources; (3) Among other goals, one is to hold 'the increase in the global average temperature to well below 2 °C above pre-industrial levels'.

Mining plays a vital role in the transition to green energy and sustainable growth globally cont.

Mining companies will play a crucial role in supporting the transition to clean energy and decarbonisation despite their own carbon emissions. This importance is underscored by their global supply of essential raw materials necessary for the renewable energy technologies' advancement and deployment, as well as via:



Incorporation of renewable energy sources to reduce reliance on fossil fuels and cut carbon emissions.



Innovation in extraction and efficiency improvement to reduce the overall carbon footprint of the extraction process.



Promotion of recycling within the mining industry to reduce the need for continuous extraction of new resources.

The global renewable energy sector in the mining industry is estimated to rise at a CAGR of +8.4% over 2022-2032, reaching \$3.4 bn by 2032. As of 2022, Asia-Pacific dominated the renewable energy market in mining, comprising 39.2% of the total market. This dominance can be attributed to the region's significant demand for minerals and metals, which created a need for more sustainable and cost-effective energy solutions, and the region's favourable solar and wind resources. Europe is projected to remain the fastest-growing region of the renewable energy market in the mining industry during 2023-2032. In terms of types, the solar energy segment showed significant growth in renewable energy in mining over recent years due to improved solar technology and decreased solar panel costs.

Selected key players of the global renewable energy market in the mining industry

 ABB	 ABB
 	 
 	 
 	 



Utilising renewable energy enables efficient, sustainable, cost-effective mining operations

The usage of renewable energy sources in the mining industry allows mining companies to lower carbon emissions, increase energy efficiency on mine sites and make mining operations cheaper, as well as support and promote sustainable development globally by creating a circular economy in the mining sector, while providing more employment opportunities for engineers. Advancements in renewable energy technologies, such as thin-film cells and bifacial panels in solar tech, as well as floating offshore and vertical-axis turbines in wind energy, expand the range of clean energy options available for mining sites.

Renewable energy sources in the mining industry

↑ +XX.X% = Change YoY

1. Solar

In 2023, the solar energy complex of the Brazilian mining company Vale's Sol do Cerrado reached a full installed capacity of 766MW, supplying 16% of all the energy consumed by Vale in Brazil.



1.2 TW² ↑ +25.0% Global installed solar capacity in 2022.

2. Biodiesel

In 2022, Rio Tinto, partnered with Neste and Rolls-Royce to trial Neste MY Renewable Diesel in a haul truck, aiming for a 75% reduction in GHG emissions.



84% GHG emissions reduction, using palm oil biodiesel vs fossil diesel⁴.

3. Wind

Over 2023-2024, Seriti Resources, headquartered in South Africa, plans to invest in a 155 MW wind farm that will cover 75% of power for its Mpumalanga coal mines.



975.6 GW² ↑ +11.4% Global installed wind capacity in 2023³.

4. Geothermal power

In 2023, Indonesian firms Archi Indonesia and Ormat Geothermal Indonesia conducted an assessment of a Toka Tindung site for a 30 MW renewable project feasibility.



16.1 GW ↑ +1.8% Geothermal power generation capacity⁵.

5. Hydro

In 2023, Swedish company Mine Storage partnered with UK-based Anglesey Mining to explore designs for a 15 MW operational pilot pumped storage at the Grängesberg mine.



1.4 TW ↑ +2.7% Global hydropower capacity in 2022.

6. Hydrogen fuel cells

In 2020, Australian firms BHP and Fortescue, UK-based Anglo American, and Canadian Hatch formed the Green Hydrogen Consortium to boost renewable hydrogen production.



600.0 GW ↑ +109.7% Global Electrolysis capacity^{6,7}.

Challenges in implementing renewable sources in the mining industry

Capital investments

The high upfront costs of adopting green energy pose a financial challenge for mining companies.

Renewables availability

Solar and wind renewable energy's intermittent nature presents challenges in ensuring a stable power supply for mining.

Energy storage

Time-specific generation of renewable energy poses a drawback for mining companies, lacking sufficient power storage.

Retraining the workforce

Shifting to green energy necessitates retraining the workforce for sustainable systems, posing a human resource challenge.

Source: IEA – The Role of Critical Minerals in Clean Energy Transitions – [2021]; WWEA – Half-year Report 2023: Additional Momentum for Windpower in 2023 – [2023]; IEA – Hydropower Special Market Report – [2021]; IHA – 2022 Hydropower Status Report – [2022]; IEA – Biofuels in Emerging Markets – [2023]; ThinkGeoEnergy website; Statista website.

Notes: (1) Terawatt; (2) Gigawatts; (3) As of June 2023; (4) According to the IEA Bioenergy report 2023; (5) As of 2022; (6) As of 2021; (7) For hydrogen production.

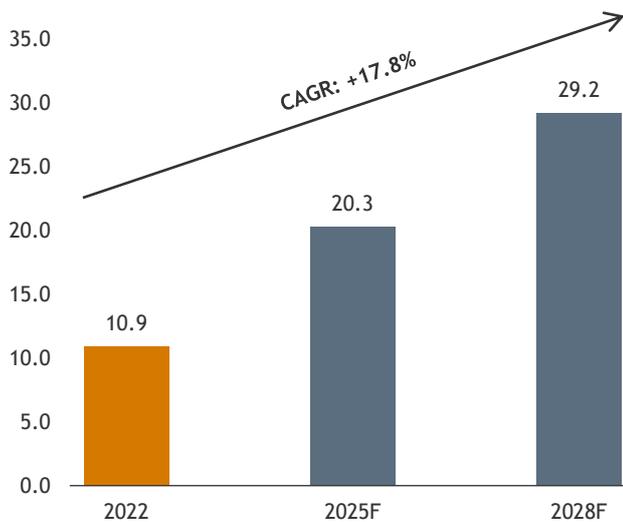
Advanced technologies could reshape the mining industry, addressing its main challenges



Growing sustainability challenges, intensifying competition, the importance of cost optimisation, and a high need to accelerate exploration activities amid the inevitable global demand for critical minerals drives mining companies to transform their operations with advanced technologies. The introduction of AI, the switch to e-mobility, the use of drones, and the automation of processes allow mining companies to improve their operations by nearly 50%.

Despite tremendous opportunities arising from technology adoption, only 10% of mining companies worldwide introduced at least one technology as of 2021. This level makes the mining industry 30% to 40% less digitally mature than other industries.

Global smart mining market size (\$bn)



By improving the economic and environmental conditions of the mining industry's production, the introduction of technologies can trigger more social challenges. To maintain the right balance of alignment with ESG issues, mining companies can consider BDO to support them in developing successful strategies.

Selected advanced technologies for mining companies



AI



The advanced analytics and predictive capabilities of AI can optimise the entire value chain of miners. For example, mining companies that have deployed AI improved their mining output by nearly 20% and reduced CO₂ emissions by 15% to 30%.

GOLDCORP



2019

Goldcorp Inc., a Canadian gold producer, partnered with IMB¹ to predict the gold reserves at the Red Lake mine in Ontario, Canada, using AI software.



EV



Mining companies tend to decarbonise by purchasing new mining EVs or electrifying existing diesel vehicle fleets. Electrification can reduce energy costs of mining companies by up to 70%, although it increases electricity consumption by 175%.

BOLIDEN



2023

Boliden AB, a Swedish mining company, has started its long-term collaboration with the Volvo Group², receiving two EVs for underground mining.



Drones



To streamline exploration activities and avoid involving employees in hazardous work, the mining industry leverages the power of drones. By replacing piloted aircraft with drones, mining companies could save nearly 90% of their costs per hour of working.



2023

Newcrest Mining Limited, an Australian mining company, started using advanced drones³ in 2023 to locate broken parts of equipment at its mines.



Process automation



Self-drive ore tracks, automated drill rigs, autonomous railways, control systems, and other robotic solutions represent the most innovative trends in the mining industry. Over 2020-2022, more than 48,000 patents on automated systems were granted to miners globally.



2023

Anglo-American PLC, the UK-based mining company, will deploy the autonomous haulage system of Komatsu⁴ in 2024 to enhance safety and productivity.

Selected benefits from technology adoption

- Higher energy-efficiency
- Better use of capital
- Cost reduction
- More effective exploration
- Faster working process
- Improved safety
- Decarbonisation
- Selected cases

Key challenges for technology adoption



Difficulties in raising the required budget for investments.



Need to attract technology talents or provide employee training.



Lack of updates to legislation on the use of technology in mining.



Hard to balance the protection of human rights and the replacement of staff with technology.

Source: Baker McKenzie website; McKinsey & Company website; IMARC Group website; Global Data website; S&P Global website; Companies' websites; Hitachi ABB Power Grids – The smart mine blueprint – [2021]; BCG – Racing towards a digital future in metals and mining – [February 2021].

Notes: (1) The US-based technology company; (2) Sweden automotive manufacturer; (3) Drones with introduced onboard computer, magnetometer, and control software, provided by Latvian technology company, SPH Engineering; (4) Japanese manufacturer of construction and mining equipment.

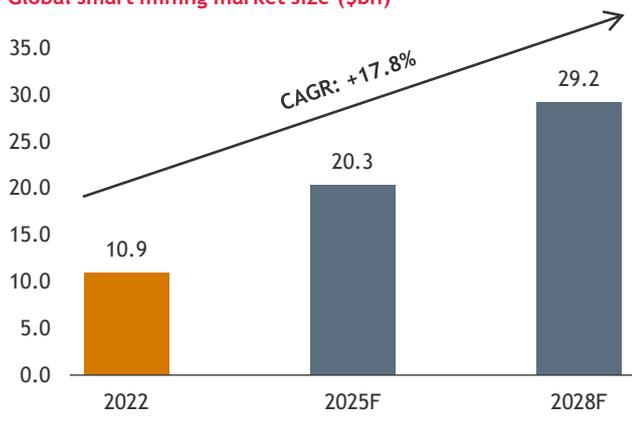
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