

The background of the entire page is a wide-angle photograph of a large-scale open-pit mine. The mine is characterized by deep, terraced levels of earth and rock, showing various shades of red, orange, and grey. A wide, light-colored gravel road winds through the lower levels of the mine. In the distance, a small cluster of buildings and a few vehicles are visible on a higher level. The sky is filled with heavy, grey clouds, suggesting an overcast day. The overall scene conveys a sense of industrial scale and natural resource extraction.

# Annual Mining Report 2025

Transforming the Industry with Sustainability,  
Innovation and Critical Minerals

January 2025

# Contents

<b>Executive summary</b>	<b>03</b>
<b>Global mining industry overview</b>	<b>04</b>
<b>African mining industry overview</b>	<b>06</b>
<b>Change in the global mix of commodities</b>	<b>08</b>
<b>Maximising on global critical minerals endowment</b>	<b>12</b>
<b>Embracing sustainability in the way to Net Zero</b>	<b>15</b>
<b>Development of global future-proofing mining communities</b>	<b>21</b>
<b>Giving a voice to future generations</b>	<b>23</b>
<b>Game-changing technologies transforming the industry</b>	<b>25</b>
<b>Health and safety priorities in the mining industry</b>	<b>29</b>
<b>Meet the team</b>	<b>31</b>
<b>How BDO can help</b>	<b>32</b>
<b>Glossary of terms</b>	<b>33</b>



# Executive summary

The mining industry is undergoing significant change due to the energy transition, with a growing focus on critical minerals essential for renewable energy technologies to meet the global demand for renewable technology. The demand for minerals such as copper, nickel, rare earths and lithium is projected to nearly triple by 2030 and quadruple by 2040.

BDO's Annual Mining Report 2025 highlights the industry's transformation and addresses the economic and social impacts of mining, health and safety concerns, and the future workforce challenges. These key themes emphasise the importance of securing critical supply with prioritising sustainability and fostering innovation to support the energy transition and broader economic growth.

Throughout the report we have identified four key growth opportunities for mining companies:

## Technological innovations

Technological advancements, particularly in robotics and automation, are expected to have a profound impact on the mining industry. The adoption of digital technologies, including AI, automation and data analytics is enhancing efficiency and productivity. These innovations are crucial for improving safety, mining throughput and reducing emissions.

## Regional focus

Africa is shifting its focus from fossil fuels to critical minerals, driven by global energy transition trends. The African Green Minerals Strategy aims to promote the development of critical minerals and address energy deficits and countries are launching national strategies to support this transition.

## Health and safety

Despite progress, mining remains one of the most hazardous industries. Positively, the industry is adopting advanced technologies to improve safety, such as drones for hazard identification and AI-powered monitoring systems. However, challenges like illegal mining and psychosocial problems persist. It is imperative for Boards to focus on a culture of safety and to have appropriate governance and controls in place to promote and monitor the importance of health and safety.

## Future workforce

The mining industry faces talent challenges, with a need to attract younger generations and address skills shortages. Companies are focusing on strategic workforce planning, enhancing employee value propositions and promoting diversity and inclusion to ensure a reliable future workforce.

This report highlights the transformative journey that the global mining industry is undergoing. As we navigate the energy transition the demand for critical minerals is set to soar, necessitating a balance between scaling supply and maintaining affordability. Technological advancements, particularly in digitalisation, are driving efficiency and productivity, while sustainability remains a strategic priority. The industry's commitment to decarbonisation, community investment and workforce development is crucial for long-term success. By embracing innovation and prioritising environmental and social governance, the mining sector can support economic growth and contribute to a sustainable future.



**Matt Crane**  
Audit Partner  
UK Head of Natural Resources & Energy



Critical minerals demand from clean energy technologies is expected to nearly triple by 2030 and quadruple by 2040.



By 2040 global revenue from energy transition minerals is expected to surpass coal production revenue by 1.5 times.



Critical minerals production is highly concentrated, with the top three countries accounting for 92% of the rare earth output in 2023.



Strong community relations are key to sustainable mining, with 31% of industry players making it a strategic focus.



14 out of 20 major mining companies reported on key ESG metrics in 2023.



71% of mining companies recognise robotics and automation as having the greatest future impact on mining, surpassing AI.



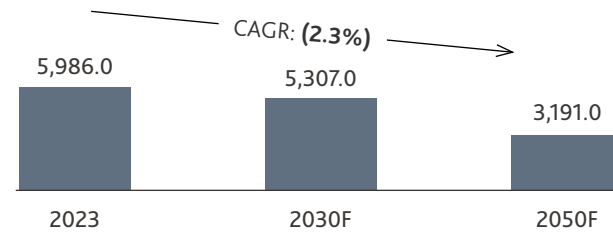
# Energy transition remains the main driving force transforming the global mining industry

As the world shifts toward cleaner energy technologies, the global mining industry is adapting to meet the growing demand for critical minerals.

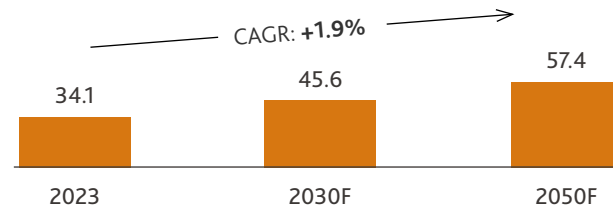
Copper, nickel, zinc, silicon, manganese, chromium, rare earth elements, and other critical minerals are key to the green energy transition fuelling innovations and supporting the development of renewable energy technologies. However, the global mining industry must balance the scaling of supply with affordability to support both the energy transition and broader economic growth while also prioritising sustainability to minimise environmental impact.

The long-term outlook for coal remains in decline but its timing and speed are closely tied to the progress on climate actions. The global coal demand is projected to drop to 3.2Gtce in 2050, replaced by the growth of renewable energy capacity, which will, in turn, increase the need for critical minerals. The combined market value of key energy transition minerals is estimated to grow more than twofold by 2040 in climate-driven scenarios and exceed revenue from the production of coal.

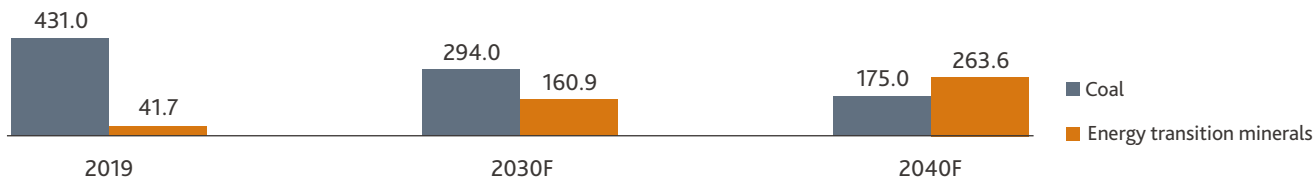
Global coal demand, Mtce<sup>1</sup>



Global critical minerals demand, million tonnes<sup>1,2</sup>



Global revenue from production of coal and energy transition minerals, \$bn



Source: IEA website; GlobalData website; Mining.com website; Fitch Solutions website; Consolidated Mining Standard Initiative website; McKinsey — Global Materials Perspective — [2024]; IEA — World Energy Outlook — [2024]; IEA — Global Critical Minerals Outlook — [2024]; Media overview

Notes: (1) The forecast is based on the IEA's Stated Policies Scenario which reflects the current policy landscape; (2) Critical minerals include Copper, Lithium, Nickel, Cobalt, Graphite, and REE; (3) Launched in November 2023, Consolidated Mining Standard Initiative is a collaboration between The Copper Mark, International Council on Mining and Metals, Mining Association of Canada, and World Gold Council to consolidate their different voluntary responsible mining standards into one global standard



# Energy transition remains the main driving force transforming the global mining industry

## Key trends in the global mining industry



### Accelerated progress towards harmonising ESG frameworks

Calls for harmonising ESG standards in mining have intensified in recent years. A new global standard under the Consolidated Mining Standard Initiative<sup>3</sup> went to the first public consultation in October 2024, with a planned release in 2025. Once adopted, it will be the most widely implemented voluntary mining ESG standard, covering almost 100 companies with 600 operations across nearly 60 countries, ensuring responsible production and boosting stakeholder confidence.



### Sustained momentum for critical minerals and gold M&A activity

Despite a decline in critical mineral prices throughout 2023, global mining M&A remained strong with deals exceeding \$121bn. In Q3 2024, the sector recorded deals worth \$23bn, a 42% increase compared to Q3 2023, following a subdued \$10.4bn in deal value in Q2 2024. Activity in the critical minerals sector is projected to remain high, fuelled by easing interest rates during 2024-2025, policy commitments, and the growing risk of supply shortages incentivising miners to expand their portfolios of critical mineral projects.



### Shift in battery chemistry reshaping minerals demand

By 2035, lithium iron phosphate and lithium manganese iron phosphate are set to dominate EV cathode chemistries due to their higher energy density. High-nickel chemistries are forecast to drop from 55% of the EV battery market in 2023 to 40% by 2040, displaced by manganese-rich alternatives. Along with other technological innovations, this shift might alter the demand outlook for several minerals, eg nickel demand may see a downward revision, while projections for graphite might rise.



**Sherif Andrawes**  
BDO Australia Partner, Deal Advisory  
Global Natural Resources & Energy Leader

The energy transition and the demand for critical minerals are reshaping the global mining industry. The global mining sector is placing a significant emphasis on securing stable supplies of critical minerals, which are essential for the energy transition and will support broader economic growth worldwide. By 2040, the market value of these key energy transition minerals is projected to more than double, surpassing coal production revenue.

We are witnessing a shift in the international investment landscape as governments, particularly in the US and EU, incentivise investments to diversify and expand critical minerals supply chains. These efforts aim to drive historic investments in clean energy supply chains, accelerate decarbonisation and transform the business environment globally.

The move away from fossil fuels will spur significant demand for various minerals that are required to build the solar, wind and nuclear power generation systems as well as in building the transmission lines needed to convey this power. This shift means that the demand for copper, nickel, and rare earths, as well as for uranium, will only increase. Simultaneously, geopolitical instability continues to drive demand for gold as a 'safe-haven' asset, boosting the gold price and the fundraising efforts for gold explorers globally. Ongoing geopolitical uncertainty is likely to see the demand for gold remain strong over the short to medium term, supporting continuing higher prices.

Merger and acquisition (M&A) activity in the global mining sector is projected to remain robust, fuelled by volatile commodity prices, larger mining companies, in effect, outsourcing their exploration to smaller exploration companies, and the growing risk of global supply shortages. This activity will lead to further market consolidation, providing companies with access to new resources and advanced technologies and helping to mitigate geopolitical risks by diversifying their geographical presence.

Source: IEA website; GlobalData website; Mining.com website; Fitch Solutions website; Consolidated Mining Standard Initiative website; McKinsey — Global Materials Perspective — [2024]; IEA — World Energy Outlook — [2024]; IEA — Global Critical Minerals Outlook — [2024]; Media overview

Notes: (1) The forecast is based on the IEA's Stated Policies Scenario which reflects the current policy landscape; (2) Critical minerals include Copper, Lithium, Nickel, Cobalt, Graphite, and REE; (3) Launched in November 2023, Consolidated Mining Standard Initiative is a collaboration between The Copper Mark, International Council on Mining and Metals, Mining Association of Canada, and World Gold Council to consolidate their different voluntary responsible mining standards into one global standard

# African mining industry is gradually changing focus from fossil fuels to critical minerals

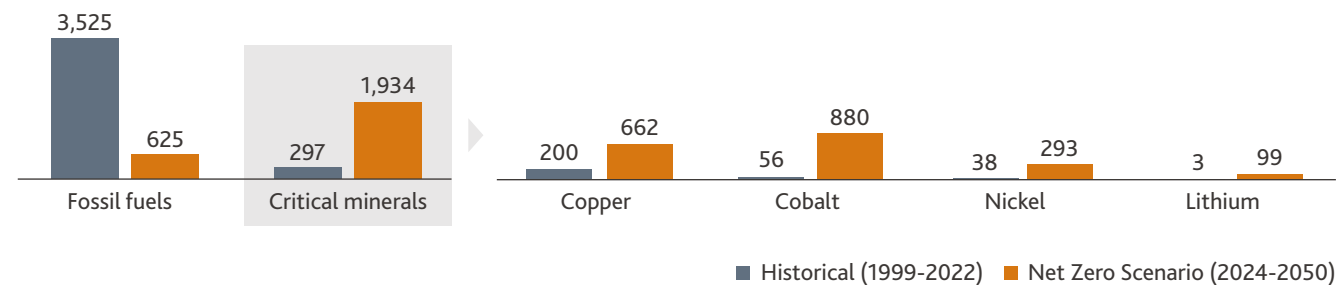
Africa is rich in minerals essential for renewable energy technologies. However, the continent's mining industry faces several challenges related to unreliable electricity grids and environmental and social concerns, such as land degradation, water and soil pollution, deforestation, human rights violations, as well as inadequate transportation infrastructure and high logistics costs. Alongside this there can sometimes be challenging and complex tax regimes that mining companies need to navigate.

By the end of the decade, coal output in Africa is projected to decline gradually due to a deliberate decrease in investments and new projects given the climate change focus. Driven by global energy transition trends, Africa's production of metal and non-metallic ores is projected to grow. African governments are promoting critical minerals development through targeted national and regional initiatives. The continent-wide African Green Minerals Strategy aims to increase upstream value addition, expand technical expertise, establish common external tariffs and address Africa's energy deficit.

At the country level, Zambia launched its critical minerals strategy in August 2024, while South Africa's release is expected imminently. Bilateral and multilateral partnerships are also gaining momentum. South Africa collaborates with the UK to promote responsible exploration, development, production and processing of minerals. The strategic partnership between the DRC and the EU focuses on sustainable mineral supply for the green transition. Furthermore, infrastructure investments, such as the Lobito Corridor expansion — under the Memorandum of Understanding between Angola, the DRC, Zambia, the African Development Bank, the Africa Finance Corporation, the EU and the USA — aim to connect regional mining hubs to global trade networks.

Between 2024 and 2050, cumulative revenue from four critical minerals — copper, nickel, cobalt and lithium — are forecast to exceed those from fossil fuels by 3.1 times, highlighting the shift from traditional energy sources toward Net Zero.

**Cumulative revenue of fossil fuels and selected critical minerals in Sub-Saharan Africa<sup>1</sup>, \$bn**



Source: Reuters website; IMF — Regional Economic Outlook. Sub-Saharan Africa — [2024]; IEA — World Energy Outlook — [2024]; IEA — Coal — [2023]; S&P — African Mining by the Numbers — [2024]; REN21 — Renewables Global Status Report — [2024]; IEA — Global Critical Minerals Outlook — [2024]; Media overview

Notes: (1) Due to the limited publicly available information for the whole continent, Sub-Saharan Africa was chosen for the analysis; (2) The numbers are converted from Euro to USD due to the average exchange rate by the ECB



# African mining industry is gradually changing focus from fossil fuels to critical minerals

## Key trends in the African mining industry



### Boosting local value addition through processing

African governments aim to capitalise on the energy transition opportunities by promoting domestic processing and securing more local participation in value chains. Since 2022, more than 12 African nations have banned or restricted the export of critical raw minerals. In late 2022, Zimbabwe prohibited raw lithium exports after identifying a loss of \$1.8bn<sup>2</sup> from exporting it unprocessed. Similarly, Namibia banned the export of unprocessed lithium, manganese, cobalt, graphite and REEs in mid-2023 to encourage local processing.



### Harnessing renewable energy to cut costs and secure power supply

With energy costs comprising 10-35% of mining expenses in Sub-Saharan Africa, companies are increasingly advancing energy efficiency. Mines are adopting hybrid microgrids that combine solar PV with energy storage to lessen reliance on national grids. In 2023, Mauritania's Tasiast gold mine installed a 34MW solar system, while Madagascar's Molo mine established a 2.7MW solar plant to meet peak energy needs. South African mines are also investing heavily, committing \$3.8bn as of 2023 to solar projects with a capacity of 3,900MW.



### Increased focus on ESG and improving mining safety

Despite progress over the last two decades, 2023 saw a concerning rise in mining fatalities, with Zimbabwe and South Africa recording 237 and 54 deaths, respectively. Safety is a top priority for both governments and companies; for example, Zimbabwe's government has pledged to tighten inspections in response to fatalities. Moreover, mining firms are adopting advanced technologies, e.g. drones, for emergency personnel location, hazard identification, and remote equipment inspections, with 36% of African mines now using drones for safety purposes.

Source: Reuters website; IMF — Regional Economic Outlook. Sub-Saharan Africa — [2024]; IEA — World Energy Outlook — [2024]; IEA — Coal — [2023]; S&P — African Mining by the Numbers — [2024]; REN21 — Renewables Global Status Report — [2024]; IEA — Global Critical Minerals Outlook — [2024]; Media overview

Notes: (1) Due to the limited publicly available information for the whole continent, Sub-Saharan Africa was chosen for the analysis; (2) The numbers are converted from Euro to USD due to the average exchange rate by the ECB



**Jacques Barradas**  
Audit Partner

BDO South Africa

Africa in general has been late to the ESG and local beneficiation party. It has however been at the forefront of renewable energy due to necessity. The safety of workers has been paramount to most mines but environmental and governance factors have lagged significantly.

Many African countries have actively tried to promote or regulate local beneficiation but there are unfortunately not many success stories. Examples of where difficulties are being experienced include refineries in Nigeria not operating due to neglect and lack of maintenance, as well as lack of gold, copper, diamond and platinum beneficiation in sub-Saharan Africa which is mostly due to lack of power and investor friendly environments.

Whilst Governments such as South Africa and Zimbabwe have tried to enforce local beneficiation, which has benefits such as a decrease in logistic costs and increase work creation, there is often a lack of investment, consistent energy supply and skilled labour.

There lies an opportunity for Africa as the use of renewable energy is wide amongst the population for household use. Use of renewable energy for large scale operations is currently limited but with decreasing costs, particularly in relation to solar energy and the increase in efficiency of battery technology for large scale operations, there is opportunity abound.

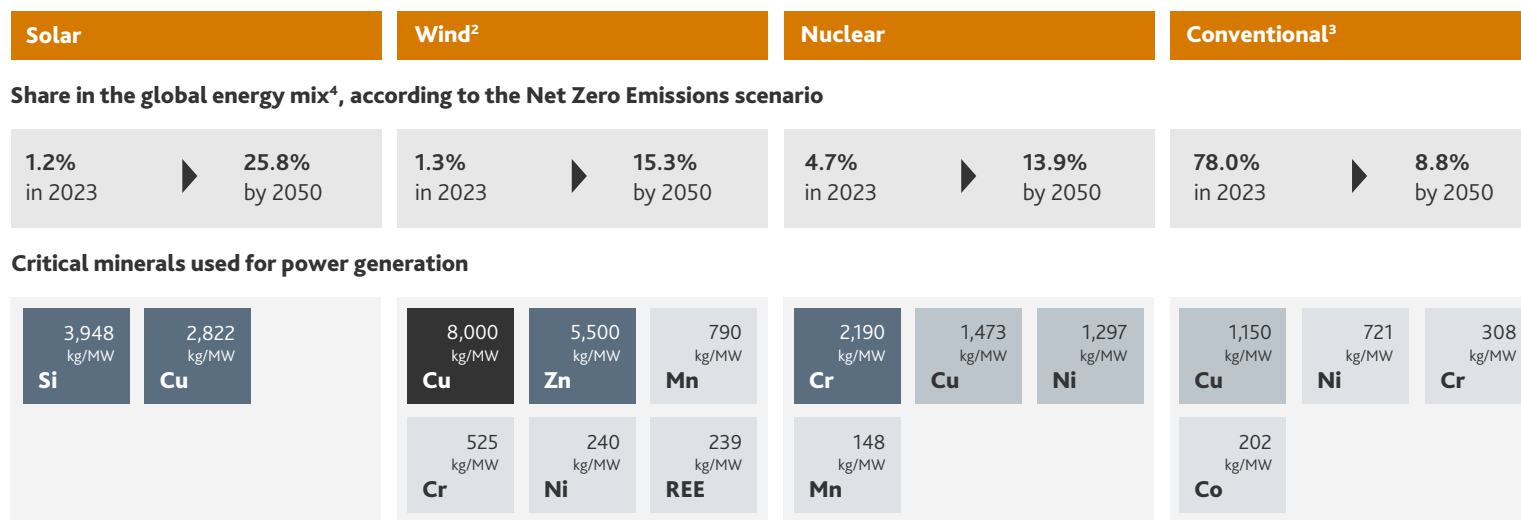
Africa is in pole position with an abundance of sunlight, natural resources and a positive population growth to be the major benefactor of the change from fossil fuel to renewable energy. It has a significant amount of Cobalt and battery grade Manganese as well as 90% of the world's platinum.

We need political will to ensure the governments of Africa meet the private sector in a business-friendly way and that the private sector be willing to not just invest in mine infrastructure but also the upskilling of the population to enable local beneficiation.

# Rapid expansion of green energy technologies will spur significant shifts in metal demand

The world's energy landscape is projected to undergo a significant transformation by 2050, with renewable energy sources expected to supply 71% of the global energy mix<sup>1</sup>.

Solar energy is anticipated to lead this shift, emerging as the dominant source. Driven by supportive policies globally, clean energy deployment continued its growth trajectory in 2023, with annual capacity additions for solar PV and wind expanding by 85% and 60% year-on-year, respectively. This surge fuelled higher consumption of critical minerals, with overall demand growth for nickel (Ni), cobalt (Co), graphite (C), and rare earth elements (REE) ranging from 8% to 15% year-on-year in 2023. Notably, demand for these minerals solely from clean technologies expanded at a significantly higher pace, ranging from 45% to 143% in 2023 compared to 2021. Mineral demand from clean energy technologies is expected to nearly triple by 2030 and quadruple by 2040, reaching 40 million tonnes<sup>1</sup>.



Source: IEA — Global Critical Minerals Outlook — [2024]; IEA — World Energy Outlook — [2024]; IEA — The Role of Critical Minerals in Clean Energy Transitions — [2021]; IEA — Global EV Outlook — [2024]; World Gold Council — Gold Demand Trends Full Year and Q3 2024 — [2024]; Media overview

Notes: (1) According to the IEA's Net Zero Emission scenario that shows a pathway for the global energy sector to achieve net zero CO2 emissions by 2050; (2) Offshore; (3) Coal; (4) Total global energy mix comprises both unabated and abated fossil fuels, solar, wind, nuclear, hydro, bioenergy, and other renewables; (5) According to the Stated Policies Scenario scenario; (6) The values are for the entire vehicle including batteries, motors and glider. Steel and aluminium are not included

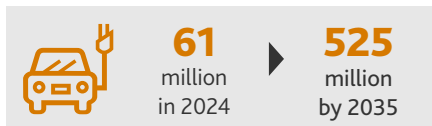


# Rapid expansion of green energy technologies will spur significant shifts in metal demand

Copper stands out as the only critical mineral used in all major clean energy technologies — EVs, solar PV, wind, and electricity grids — making security of copper supply essential for the energy transition.

Lithium demand experienced a strong growth in 2023, increasing by 30% year-on-year. EVs have already displaced consumer electronics to become the largest consumer of lithium, while also increased their share of nickel, cobalt, and graphite demand. By 2040, lithium demand is projected to experience substantial growth, increasing by almost nine times, driven by the growing demand for EV batteries.

## Total EV stock<sup>5</sup>



## Critical minerals used in electric cars<sup>6</sup>

<b>C</b> 8,000 kg/vehicle	<b>Cu</b> 53.2 kg/vehicle	<b>Ni</b> 39.9 kg/vehicle
<b>Mn</b> 24.5 kg/vehicle	<b>Co</b> 13.3 kg/vehicle	<b>Li</b> 8.9 kg/vehicle



## Au: Gold:

Amid the persistent geopolitical tensions in 2024, gold once again proved its role as a safe-haven liquid asset and a long-term store of value, serving as a stable hedge against economic instability.

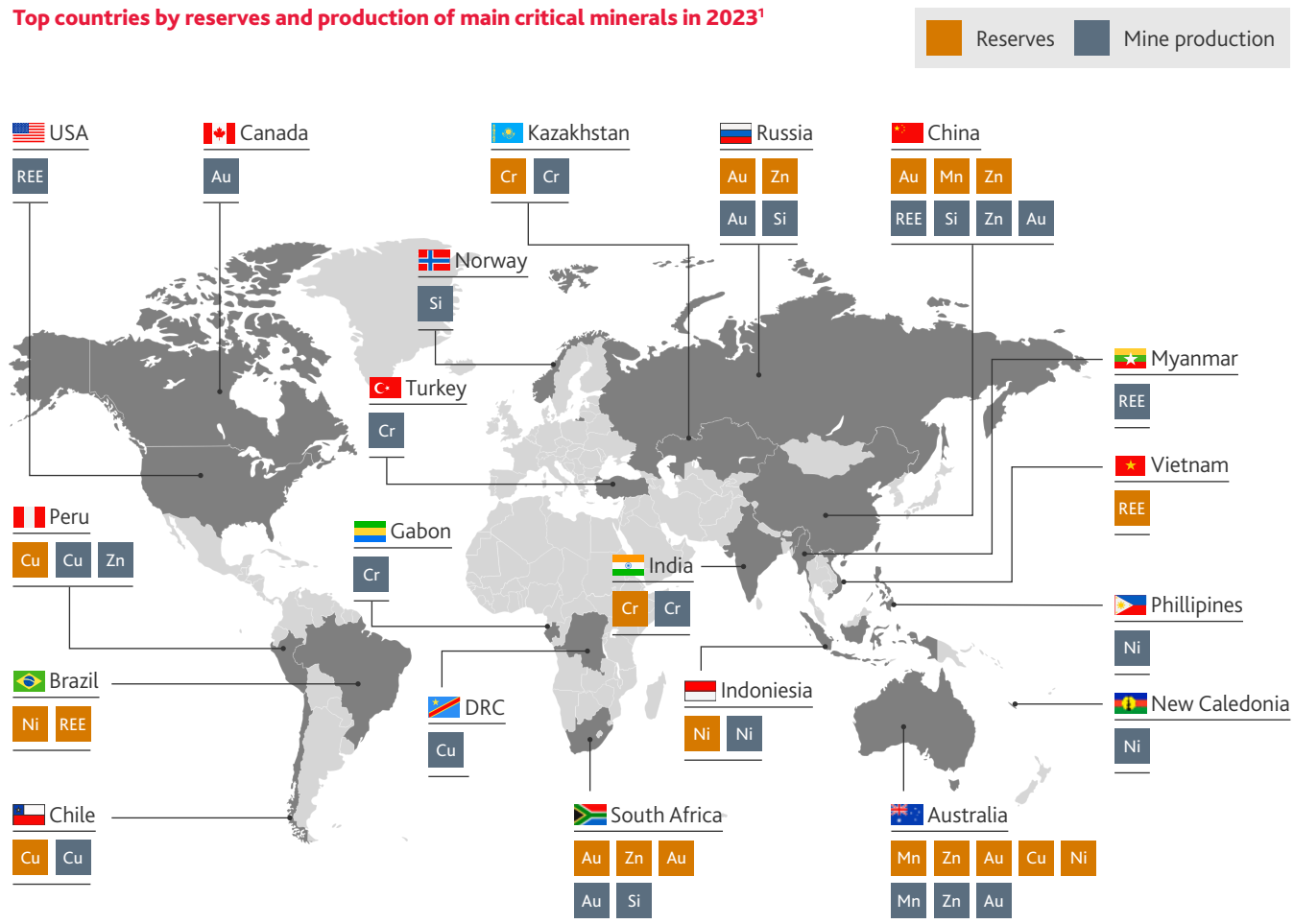
In Q3 2024, global gold demand reached 1.3 thousand metric tonnes, a 5.1% increase compared to Q3 2023. The growth was driven mainly by higher investment flows, supported by declining interest rates, geopolitical instability, portfolio diversification, and momentum trading. Central bank buying slowed in Q3 2024, down 48.8% compared to Q3 2023. By year-end, a resurgence in professional investment flows, coupled with robust bar and coin purchases, is projected to offset weaker consumer demand and lower central bank buying.

Source: IEA — Global Critical Minerals Outlook — [2024]; IEA — World Energy Outlook — [2024]; IEA — The Role of Critical Minerals in Clean Energy Transitions — [2021]; IEA — Global EV Outlook — [2024]; World Gold Council — Gold Demand Trends Full Year and Q3 2024 — [2024]; Media overview

Notes: (1) According to the IEA's Net Zero Emission scenario that shows a pathway for the global energy sector to achieve net zero CO2 emissions by 2050; (2) Offshore; (3) Coal; (4) Total global energy mix comprises both unabated and abated fossil fuels, solar, wind, nuclear, hydro, bioenergy, and other renewables; (5) According to the Stated Policies Scenario scenario; (6) The values are for the entire vehicle including batteries, motors and glider. Steel and aluminium are not included

# Australia and China continue to lead in both reserves and production of critical minerals

Top countries by reserves and production of main critical minerals in 2023<sup>1</sup>



Despite the rapid expansion of clean energy technologies boosting demand for critical minerals, geopolitical tensions, and lower metal prices constrained global exploration budgets in 2023.

The global nonferrous budget dropped 3.0% year-over-year to \$12.8bn, after a nine-year high in 2022. There followed a decrease in the production of several key energy transition minerals, including silicon, zinc and chromium. In contrast, rare earth elements (REE) and nickel saw 16.7% and 10.1% year-over-year production gains, respectively. The gold exploration budget experienced its steepest decline in a decade, down by \$1.1bn to \$5.9bn. Five out of the ten largest gold-producing countries saw gold output declines, although China, Australia and Russia remained the leading suppliers.

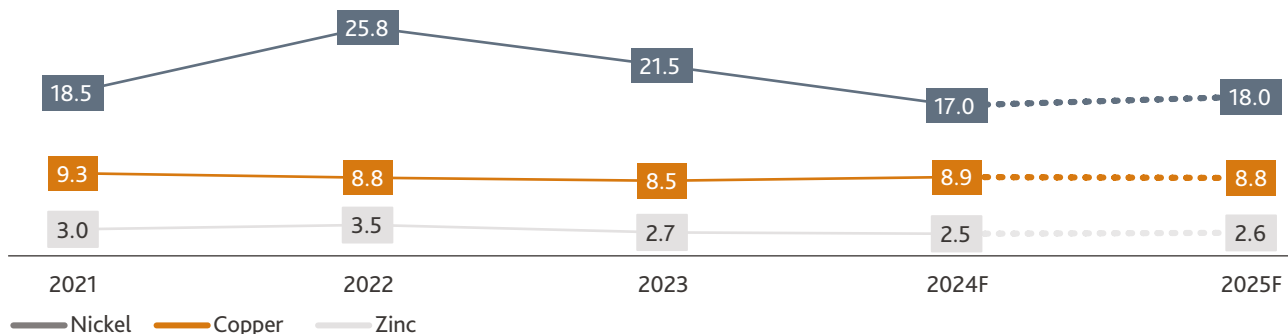
Nickel saw the highest rise (+30.0% year-over-year) in global reserves among the selected<sup>2</sup> critical minerals in 2023, while only REE registered a 15.4% drop. Australia and China remained dominant holders and producers of key energy transition minerals.



Source: S&P Global website; USGS — Mineral Commodity Summary — [2024]; Media overview  
 Notes: (1) Represents each of the Top-3 countries in terms of reserves and mine production as of 2023; (2) The selection includes Cu, Zn, Si, Cr, Ni, Mn, REE, and gold

# Macroeconomic and geopolitical challenges impacted critical mineral production and prices

Global price for minerals, \$/mt<sup>1</sup>

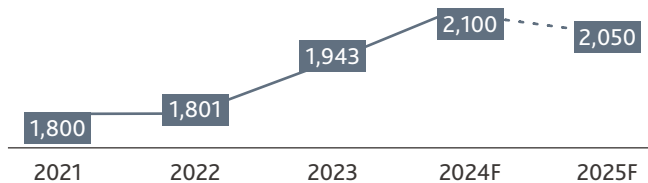


**Nickel** prices fell in 2024 due to oversupply from Indonesia and China, leading to mine closures, including those of Glencore in New Caledonia and BHP in Western Australia. A slight rebound is expected in 2025 as the surplus narrows, driven by persistent demand for EV batteries and renewable energy.

**Copper** prices hit a record high in May 2024 due to anticipated rate cuts and Chinese refinery reductions, before dropping in Q2. In 2025, copper prices are forecast to be constrained by the weak demand from the Chinese property market amid strong supply and high inventories.

**Zinc** prices were impacted by subdued industrial activity in H1 2024 but recovered in September, supported by China's extensive stimulus measures, which raised expectations for stronger demand. In 2025, prices are forecast to rebound further, driven by rising demand projections.

Global price for gold, \$/t.oz<sup>1</sup>



Gold prices hit an all-time high, averaging \$2,690/t.oz in October 2024. The increase was primarily supported by strong central bank purchases and expectations of interest rate cuts by the Federal Reserve. While the World Bank projects a slight moderation in gold prices for 2025 as inflation continues to ease, alternative forecasts<sup>2</sup> predict further increases, ranging from \$2,463 to \$2,973/t.oz, fuelled by expectations of additional interest rate cuts and higher central bank demand.

## Cu: Copper

Copper is becoming one of the most essential assets due to its key role in the energy transition. This is driving many companies to prioritise copper production to meet the growing demand for renewable energy amid the significant challenges of finding and building large new mines.

### Recent copper M&A developments

#### July 2024

BHP and Lundin Mining agreed to acquire Filo Corp., which owns the Filo del Sol copper project at the Argentina-Chile border, for \$3bn. The companies will form a joint venture for shared infrastructure and economies of scale.

#### July 2024

Lundin Mining raised its stake in SCM Minera Lumina Copper Chile, the owner of the Caserones mine, to 70% by acquiring an additional 19% for \$350m, following a 2023 purchase of a 51% stake for \$950m.

#### May 2024

BHP abandoned its \$49bn bid for Anglo American after three rejections. The deal aimed to secure Anglo American's copper assets in Latin America, potentially giving BHP around 10% of the global copper supply.

#### March 2024

MMG acquired Cuprous Capital, which owns the Khoemacau Copper Mine in Botswana, valued at \$1.9bn. The mine is among the largest African copper mines, with an estimated life of a minimum of 20 years.

Source: Reuters website; Goldman Sachs website; Fitch Ratings website; NASDAQ website; Bloomberg website; World Bank — Commodity Markets Outlook — [April 2024]; World Bank — Commodities Price Data (The Pink Sheet) — [October 2024]; Media overview

Notes: (1) World Bank's forecast; (2) Forecasts from Commerzbank, ANZ, Macquarie, Goldman Sachs, UBS, BofA, J.P. Morgan, and Citi Research

# Rising mineral demand offers significant growth opportunities for resource-rich nations

Critical minerals are vital to the global economy, driven not only by increasing demand from the energy transition, but also by their widespread use in key sectors ranging from manufacturing to electronics and medicine. Securing stable supply and future access to critical minerals has become a geopolitical priority as current production is highly concentrated in a few countries, increasing the risk of supply disruptions.

## Selected application of minerals and reliance on Top-3 producing countries

	Energy transition	Other sectors <sup>1</sup>	Share of Top-3 producing countries in 2023	
<b>Cu</b>	Solar, wind, power grids, EV & batteries, hydrogen electrolyzers	Industry, construction, electronics, wiring	<b>46%</b>	Chile, Peru, DRC
<b>Zn</b>	Wind, solar	Metal products, rubber	<b>54%</b>	China, Peru, Australia
<b>Si</b>	Solar	Alloys, lubricants, semiconductors	<b>84%</b>	China, Russia, Norway
<b>Cr</b>	Wind	Stainless and heat-resistant steels, alloys, pigments	<b>73%</b>	South Africa, Kazakhstan, Turkey
<b>Ni</b>	EV & batteries, hydrogen electrolyzers	Steel alloys	<b>68%</b>	Indonesia, Philippines, New Caledonia
<b>Mn</b>	Wind, solar	Steel alloys, fertilisers	<b>74%</b>	South Africa, Gabon, Australia
<b>REE</b>	Wind, EV & batteries	Magnets for industry, consumer electronics	<b>92%</b>	China, USA, Myanmar

Main driver of the demand<sup>2</sup> **XX%** Share of the Top-3 Producers in 2023

The geographic concentration of mining and refining operations is expected to deepen further by 2040, with China dominating copper and REE refining and Indonesia leading in nickel. This increases the risk of supply disruptions, potentially affecting energy security and slowing the transition to green energy. Given the importance of critical minerals to economic development and a sustainable future, increased cooperation is essential to mitigate geopolitical risks and accelerate the deployment of renewable energy.

## Share of Top-3 countries in refining of selected critical minerals in 2023

<b>Cu</b>	<b>57%</b>	China, Chile, Japan
<b>Zn</b>	<b>69%</b>	Indonesia, China, Russia
<b>Si</b>	<b>98%</b>	China, Malaysia, USA

Source: WEF — Critical minerals can pave the road to more robust international development — [2024]; IMF — Harnessing Sub-Saharan Africa's Critical Mineral Wealth — [2024]; ETC — Material and Resource Requirements for the Energy Transition — [2023]; IEA — Critical Minerals Data Explorer — [May 2024]; USGS — Mineral Commodity Summary — [2024]; IEA — World Energy Employment — [2024]; World Bank Blogs website; IEA — Global Critical Minerals Outlook — [2024]

Notes: (1) Selected examples; (2) Based on the IMF and IEA data, and media overview; (3) According to the IEA's Announced Pledges Scenario, which reflects announced ambitions and targets, and Net Zero Emission scenario; (4) Compared to a five-fold increase in non-FTA countries. The largest recipients were Canada, Chile, and Morocco. However, some developing countries lack preferential access to the US market via free trade agreements, preventing them from benefiting from the IRA. This highlights the need to expand market access, harmonise standards, and offer technical assistance to help these nations turn their mineral wealth into shared prosperity; (5) According to the IEA's Stated Policies Scenario and Net Zero Emission scenario

As resource-dependent countries implement supply diversification strategies, the growing demand for critical minerals offers significant transformational opportunities for mineral-rich countries.

Expected new capital investment forecasts to meet the rising demand are wide, ranging from \$590bn to \$800bn by 2040<sup>3</sup>. Developing countries can leverage their mineral wealth to attract investments, create jobs, boost exports and promote innovation, ensuring sustainable economic growth.



## Driving foreign direct investment (FDI)

After the Inflation Reduction Act adoption, countries with a Free Trade Agreement with the USA experienced an average tenfold increase<sup>4</sup> in greenfield FDI inflows into energy transition mineral value chains. Facilitating the participation of resource-rich developing countries in critical mineral supply chains might unlock major economic opportunities.



## Increasing GDP

Strategic management of mineral resources could be a key driver of economic prosperity for many developing countries. For instance, Sub-Saharan Africa is projected to capture over 10% of global revenues generated from copper, nickel, cobalt and lithium. This could correspond to an increase in the region's GDP by 12% or more by 2050.



## Creating jobs

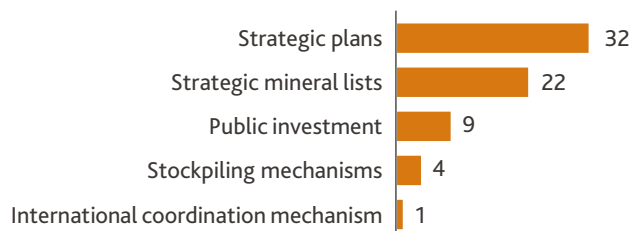
In 2023, critical minerals mining supported around 790,000 jobs worldwide, with Africa accounting for more than half, or 50.6%, of total employment. With sufficient supply to meet growing demand, the number of people employed in the mining of critical minerals is projected to grow further, reaching between 1.0 million and 1.3 million by 2030<sup>5</sup>.

# Despite both targeting secure critical minerals supply, producer and consumer policies differ

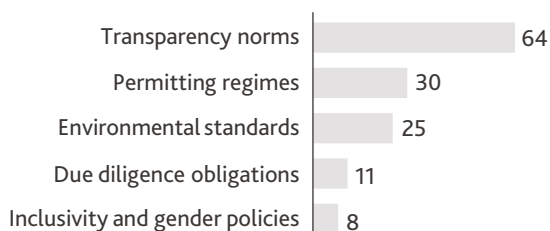
In recent years, critical minerals policy development has surged, driven by supply chain security and national interests, with 85 policies introduced globally in 2023 alone. As of July 2024, the USA led the charge with 49 critical mineral policies<sup>1</sup>, followed closely by Australia (48) and Canada (41).

## Focus areas of critical minerals-related policies

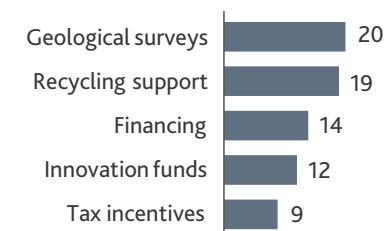
### Ensuring supply reliability and resiliency



### Encouraging sustainable and responsible practices



### Promoting exploration, production and innovation



The number of countries that adopted or announced a critical materials-related policy<sup>2</sup>



While the main goal of these policies is to secure access to critical materials, the approaches differ significantly between producer and consumer nations. In developed consumer countries, there is a strong focus on ESG standards, along with strategic cooperation agreements aimed at securing supply chains. In contrast, resource-rich producer countries are primarily concerned with maximising the economic benefits derived from their resources, often emphasising domestic value-added processes and local economic development.

### Key focus of producer policies and selected examples

- ▶ **Critical minerals strategies on exploitation of raw minerals**  
African Green Minerals strategy, 2024
- ▶ **Public strategic investment funds**  
Brazilian \$200m fund for exploration & ESG practices, 2024
- ▶ **Streamlining permitting processes**  
EU Critical Raw Materials Act, 2023
- ▶ **Promoting local value addition via export restrictions**  
Indonesian ban on bauxite ore and copper ore, 2023 and 2024.

### Key focus of consumer policies and selected examples

- ▶ **Sufficient supplies of critical minerals**  
Japanese policy on initiatives for ensuring stable supply, 2023
- ▶ **Financial support for overseas project**  
French critical minerals and metals equity fund<sup>3</sup>, 2023
- ▶ **Sourcing of responsibly produced minerals**  
EU CSRD and CSDDD, 2023 & 2022
- ▶ **Friendshoring<sup>4</sup> and multilateral agreements**  
Minerals Security Partnership of 14 countries<sup>5</sup> and the EU, 2022.

Source: UN — Harnessing the potential of critical minerals for sustainable development — [2024]; IEA — Critical Minerals Policy Tracker — [December 2023]; IEA — Policies database — [July 2024]; IEA — Global Critical Minerals Outlook — [2024]; Government of Canada — Canadian Critical Minerals Strategy Annual Report — [2024]; Media overview

Notes: (1) According to IEA Policies database as of July 2024; (2) As of December 2023; (3) Managed by InfraVia and backed by \$500m in government funds; (4) Trade practice where supply chain networks are focused on countries regarded as political and economic allies; (5) In 2024, Estonia was welcomed as the newest member of the partnership; (6) The numbers are converted from AUD to USD due to the average exchange rate by the FRÉD; (7) Also, via the Critical Minerals Research, Development and Demonstration Programme, and the Indigenous Natural Resources Partnerships

# Despite both targeting secure critical minerals supply, producer and consumer policies differ

To diversify value chains, governments have turned to a range of financial mechanisms coming from various sources, e.g. government departments, policy banks, sovereign wealth funds, development finance institutions and export credit / insurance agencies. These tools primarily focus on supporting capital and operational expenditures while de-risking investments to encourage private sector involvement.

### Capex financing

- ▶ Grants
- ▶ Concessional loans
- ▶ Equity investments.

### Opex support

- ▶ Tax credits
- ▶ Reduced royalties.

### Risk mitigation

- ▶ Loan guarantees
- ▶ Insurance products
- ▶ Interest rate reduction.

### Selected examples:



**Australia:** International Partnerships in Critical Minerals Grants (\$27m<sup>6</sup>)



**Australia:** nickel royalty assistance programme (50% rebate for 18 months)



**Japan:** Loan insurance for procurement and equity investment



**Germany:** KfW raw materials fund (\$1.1bn)



**Canada:** Critical Minerals Exploration Tax Credit (30%)



**South Korea:** Lower rates for strategic industries (up to 120 basis points)



**Canada:** Significant progress in mining achieved following the adoption of Critical Minerals Strategy.

Since adopting the Strategy in January 2023, Canada has committed \$3.1bn to critical minerals projects through various initiatives, including the Strategic Innovation Fund and the Critical Minerals Infrastructure Fund<sup>7</sup>. The Strategy also played a pivotal role in advancing job-creating projects, such as Marathon Palladium in Ontario, the Jansen Potash Mine in Saskatchewan and James Bay Lithium in Quebec. Through these efforts, Canada aims to stimulate economic growth, enhance Indigenous participation and reinforce its role as a reliable supplier amid unpredictable global markets. In 2024, Canada was recognised as the country with the highest potential to establish a secure and sustainable battery supply chain and was ranked the second most competitive country in critical minerals production in 2023. Further progress on the Strategy will contribute to reducing reliance on high-risk imports and strengthening supply security for Canada and its allies.

Source: UN — Harnessing the potential of critical minerals for sustainable development — [2024]; IEA — Critical Minerals Policy Tracker — [December 2023]; IEA — Policies database — [July 2024]; IEA — Global Critical Minerals Outlook — [2024]; Government of Canada — Canadian Critical Minerals Strategy Annual Report — [2024]; Media overview

Notes: (1) According to IEA Policies database as of July 2024; (2) As of December 2023; (3) Managed by InfraVia and backed by \$500m in government funds; (4) Trade practice where supply chain networks are focused on countries regarded as political and economic allies; (5) In 2024, Estonia was welcomed as the newest member of the partnership; (6) The numbers are converted from AUD to USD due to the average exchange rate by the FRED; (7) Also, via the Critical Minerals Research, Development and Demonstration Programme, and the Indigenous Natural Resources Partnerships

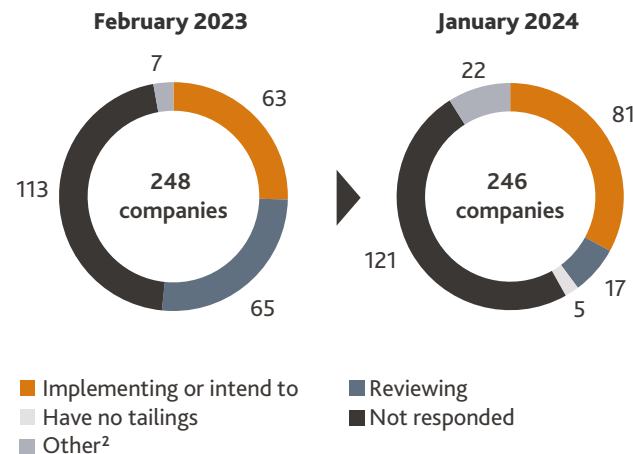


# Inconsistency in the enforcement of regulations necessitates industry-led standards

The impacts of mining, including ecosystem disruption and climate change, necessitate mitigation measures that enhance government involvement. Mining companies are often required to take specific actions before (Environmental impact Assessments) or during projects aimed at minimising environmental damage and supporting restoration by meeting standards, usually enforced through permitting. However, enforcement of regulations is often inconsistent, making uniform application difficult, highlighting the importance of voluntary or industry-led standards to promote responsible mining practices. Global initiatives such as ICMM's Mining Principles and the Responsible Minerals Initiative enhance ESG performance, while the Initiative for Responsible Mining Assurance, Global Industry Standard on Tailings Management (GISTM) and Copper Mark's Risk Readiness Assessment promote sustainable practices.

## Global Industry Standard on Tailings Management implementation

### Companies' responses to GISTM<sup>1</sup>



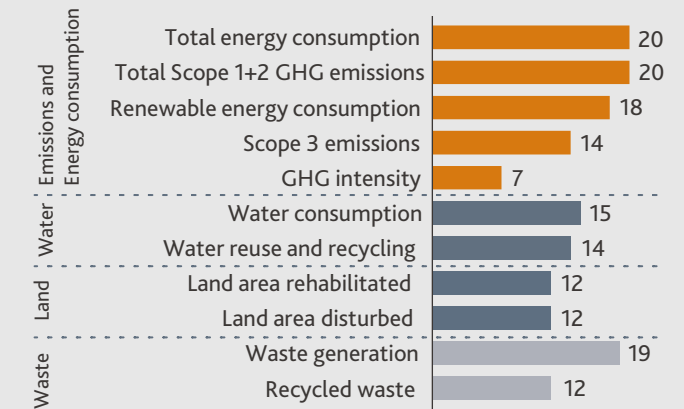
Mine waste and contamination, often underreported, displace communities and pose significant ecological and social challenges. Launched in 2020 by International Council on Mining and Metals, United Nations Environment Programme, and Principles for Responsible Investment, the Global Industry Standard on Tailings Management aims to achieve zero harm to people and the environment by preventing catastrophic failures, and enhancing transparency, accountability, and safety in mine tailings facilities worldwide. Through 2023, the mining industry made progress in tailings management with more companies implementing the GISTM and by the establishment of the Global Tailings Management Institute (GTMI) to oversee the implementation of the standard.

As of January 2024, over half of the mining sector (by market capitalisation) was committed to implement the GISTM. ICMM members' first alignment disclosures were well-received by the investors, marking a critical step toward addressing systemic risks.

Source: WEF website; GISTM website; Consolidated Mining Standard Initiative website; IEA — Critical Minerals Policy Tracker Encouraging sustainable and responsible practices — [December 2023]; IEA — Global Critical Minerals Outlook — [2024]; IEA — Sustainable and Responsible Critical Mineral Supply Chains Guidance for policy makers — [2023]; Sympact Advisory — Mining ESG: 2023 in review — [2023]

Notes: (1) Number of the mining companies contacted by the Investor Mining and Tailings Safety Initiative in 2023/2024 about their GISTM engagement; (2) Other companies include those applying different standard MAC/TSM, broadly equivalent to the GISTM; (3) The 20 major mining companies are Albemarle, Anglo American, BHP, CMO, Codelco, First Quantum Minerals, Freeport-McMoRan, Ganfeng Lithium, Glencore, IGO, Mineral Resources, Pilbara Minerals, Rio Tinto, South 32; Southern Copper, SQM, Teck Resources, Tianqi Lithium, Vale, and Zhejiang Huayou

## Reporting on selected ESG metrics by 20 major<sup>3</sup> mining companies in 2023



While there is growing recognition that reporting on ESG metrics is essential not only for investors but also for market access and social acceptability, some mining companies still do not report on sustainability. Voluntary and selective reporting with inconsistent metrics can distort industry performance evaluations, as companies are likely to highlight areas where they excel. Standards often differ in scope, compliance, and oversight; additionally, in order to improve effectiveness, greater harmonisation and incentives are needed.



# Inconsistency in the enforcement of regulations necessitates industry-led standards

## Consolidated Mining Standard Initiative to harmonies ESG standards

In November 2023, the International Council on Mining and Metals (ICMM), The Copper Mark, the Mining Association of Canada, and the World Gold Council announced plans to consolidate their four responsible mining standards into one global standard.

2023

### Phase 1: Feasibility, concept and draft zero

#### Goal

- ▶ Simplify the current mining standards landscape
- ▶ Streamline sustainability efforts
- ▶ Implement robust oversight through a multi-stakeholder model.

2024-H1 2025

### Phase 2: Development and Consultation

#### Structure

Comprises 24 Performance Areas, built on the attributes of the Partners' individual standards, each having three levels:

- ▶ Foundational practice
- ▶ Good practice
- ▶ Leading practice.

H2 2025

### Phase 3: Endorsement

#### Review

In October 2024, a draft of the consolidated standard, governance model, assurance process, related reporting, and claims policy were published, encouraging stakeholders to a 60-day public consultations.

2026

### Phase 4: Implementation

#### Adoption

Expected to be adopted by members of ICMM, the World Gold Council, the Mining Association of Canada, and The Copper Mark participants, covering almost 100 mining companies in 60 countries.

Source: WEF website; GISTM website; Consolidated Mining Standard Initiative website; IEA — Critical Minerals Policy Tracker Encouraging sustainable and responsible practices — [December 2023]; IEA — Global Critical Minerals Outlook — [2024]; IEA — Sustainable and Responsible Critical Mineral Supply Chains Guidance for policy makers — [2023]; Sympact Advisory — Mining ESG: 2023 in review — [2023]

Notes: (1) Number of the mining companies contacted by the Investor Mining and Tailings Safety Initiative in 2023/2024 about their GISTM engagement; (2) Other companies include those applying different standard MAC/TSM, broadly equivalent to the GISTM; (3) The 20 major mining companies are Albemarle, Anglo American, BHP, CMO, Codelco, First Quantum Minerals, Freeport-McMoRan, Ganfeng Lithium, Glencore, IGO, Mineral Resources, Pilbara Minerals, Rio Tinto, South 32, Southern Copper, SQM, Teck Resources, Tianqi Lithium, Vale, and Zhejiang Huayou





# Decarbonisation of mining can be achieved through technologies but challenges remain

The mining industry faces a major challenge as the world sharpens its focus on Net Zero targets.

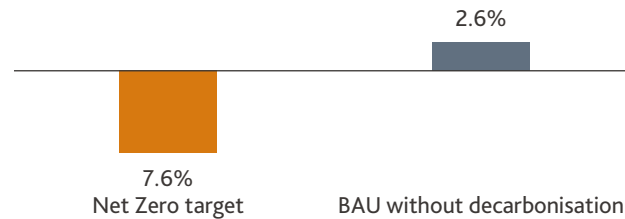
While minerals like aluminium, copper, lithium, nickel and zinc are essential for the energy transition, the carbon-intensive processes of mining, smelting and refining these minerals complicate sustainability efforts. For example, without decarbonisation, copper production emissions could more than double by 2050 and a one-year delay in action could result in a 10% annual deviation from Net Zero, which might require companies' more significant capital investment in decarbonisation if they start later, due to higher intensity of required measures and lost opportunities for gradual transitions<sup>1</sup>.

## Key focus areas for mining decarbonisation in 2024<sup>2</sup>

**40%** Of respondents are deploying newer technologies to improve efficiency and replace emissions-heavy equipment and processes, including transition to clean energy sources.

**26%** Of respondents have an increased focus and spending on energy transition materials.

Annual change in emissions from Net Zero vs Business as Usual (BAU) scenarios in copper production<sup>1</sup>



Achieving Net Zero in mining will require rethinking the industry's role and operations, challenging traditional practices and embracing opportunities to cut emissions, from enhancing efficiency to shifting how equipment and processes are powered. In 2024, technologies and decarbonisation investments were seen as the most effective responses to Net Zero policies and investor pressure. At the same time, cost competitiveness was considered the main challenge for mine electrification, followed by infrastructure issues<sup>3</sup>.

Source: IFC — Net Zero Roadmap to 2050 for Copper & Nickel Mining Value Chains — [2023]; White&Case — Mining & metals 2024: Geopolitics in the driver's seat — [2024]; EMC — Electric Mine Consortium: 2020 to 2024 — [2024]; Wood McKenzie — Top steps miners can take to reduce scope 3 emissions — [2023]; Media overview

Notes: (1) According to IFC Net Zero Roadmap to 2050 for Copper & Nickel Mining Value Chains; (2) According to White & Case 2024 survey of mining industry participants, in particular, senior decision-makers from EMEA (62%), Asia-Pacific (20%), Americas (18%), n=240; (3) According to Electric Mine Consortium 2024 survey, n=n/a



# Decarbonisation of mining can be achieved through technologies but challenges remain

## The development stage of key sustainable mining technologies throughout the mining process

Emissions abatement potential <sup>3</sup>	Technology	Readiness	Available at scale
	Battery-electric vehicles	●	Now
	Green hydrogen	◐	5-10 years
	Energy storage	◑	<5 years
	Renewable energy	●	Now
	Sustainable biofuels	●	Now
	Conveyors & Trolley assist	●	Now
	Process optimisation	◑	<5 years
	Efficient equipment	●	Now

### Recent case studies

#### Fortescue's BEV order, September 2024

Fortescue signed a \$2.8bn deal with Liebherr for 475 BEVs, aiming to reduce emissions and costs, with battery-powered trucks already saving the company up to \$400m annually in fuel expenses.

#### BHP to test new DET, September 2024

BHP plans to test Caterpillar's new Cat DET system, which enables energy transfer to diesel-electric and battery-electric mining trucks on-site, aiming to cut costs and emissions while boosting speed and efficiency.

#### Vale to trial haul trucks with ethanol, July 2024

Vale and Komatsu team with Cummins signed an agreement to develop and test the world's first large Dual Fuel haul trucks, retrofitted to run on up to 70% ethanol, potentially reducing direct CO2 emissions by up to 70%.

◐ Technology close to market    ◑ Some technologies ready / other close to market    ● Technology ready

Decarbonisation technologies are already being used in the industry, while large mining and tech companies are actively developing and testing new solutions that have yet to become widely available on the market.

## Barriers to address Scope 3 emissions



### Collaborative

- ▶ Assessing downstream partners' contribution to the product's carbon footprint
- ▶ Considering downstream partners' locations and regional carbon policies
- ▶ Evaluating feasibility of engaging with downstream partners based on options.



### Technological

- ▶ The challenge of selecting a decarbonisation technology from available options
- ▶ Evaluating the commercial viability and progress of the most advanced technologies
- ▶ Measuring the carbon costs of implementing a commercially viable technology.

Scope 3 emissions are a critical area of focus for the mining industry, representing up to 95% of a company's total emissions, compared to 75% in other sectors. The main challenge is that Scope 3 emissions are largely tied to downstream metal producers beyond miners' direct control. To address this, companies must overcome collaborative and technological barriers. Driving innovation and optimising supply chains will require strategic focus and targeted actions.

Source: IFC — Net Zero Roadmap to 2050 for Copper & Nickel Mining Value Chains — [2023]; White&Case — Mining & metals 2024: Geopolitics in the driver's seat — [2024]; EMC — Electric Mine Consortium: 2020 to 2024 — [2024]; Wood McKenzie — Top steps miners can take to reduce scope 3 emissions — [2023]; Media overview

Notes: (1) According to IFC Net Zero Roadmap to 2050 for Copper & Nickel Mining Value Chains; (2) According to White & Case 2024 survey of mining industry participants, in particular, senior decision-makers from EMEA (62%), Asia-Pacific (20%), Americas (18%), n=240; (3) According to Electric Mine Consortium 2024 survey, n=n/a

# Mining companies set Net Zero targets, but real action is needed to align with global goals

Companies cannot rely solely on ESG reporting; they must set clear sustainability targets and show measurable progress to align mining operations with global sustainability goals. By embedding sustainability into their value chain, companies ensure compliance with international regulations while positioning themselves as pioneers in sustainable practices. This proactive approach is crucial for maintaining legitimacy and trust with stakeholders, including investors, governments, and local communities.

## Most sustainable mining companies' decarbonisation commitments and performance in technologies

HQ	Company	RMI <sup>1,2</sup> rank 2022 vs 2020	Base year	GHG emissions target	Carbon neutrality/ Net Zero	Technologies <sup>3</sup>
	Anglo American	1 →	2016	30% absolute emissions reduction by 2030	2040 CN	
	Newmont	2 →	2018 2019	32% reduction in Scope 1+2 by 2030 30% reduction in Scope 3 by 2030	2050 CN	
	BHP	3 ↑ +1	2020	30% operational emissions reduction by 2030	2050 NZ	
	Teck	4 ↓ -1	2010	33% carbon intensity reduction by 2030	2050 NZ	
	AngloGold Ashanti	5 →	2021	30% operational emissions reduction by 2030	2050 NZ	
	Barrick Gold	6 →	2018	30% operational emissions reduction by 2030	2050 NZ	
	Gold Fields	7 →	2016	30% operational emissions reduction by 2030	2050 NZ	
	Rio Tinto	8 ↑ +2	2018	50% operational emissions reduction by 2030	2050 NZ	
	Glencore	9 →	2019	50% operational emissions reduction by 2035	2050 NZ	
	Vale	10 ↑ +4	2017	33% reduction in Scope 1+2 by 2030 15% reduction in Scope 3 by 2035	2050 NZ	

Companies pioneering in environmental sustainability    ↑ ↓ → Increase / decrease / no change in ranking

Renewables    Battery electric vehicles    Green hydrogen

Source: Responsible Mining Index website; Companies' websites; Companies' sustainability reports; Media overview

Notes: (1) The Responsible Mining Index Report 2022 seeks evidence of companies' policies and practices on economic, environmental, social, and governance issues, but does not seek to measure the actual outcomes achieved on EESG issues based on publicly available data. The 2022 edition is the latest available data; (2) Provide company's place in the Environmental Responsibility rank, which reflects company's measures to prevent, avoid, and mitigate the impact of its operations on natural resources and ecosystems; (3) Includes projects that are already in use or are being considered for implementation

All of the largest mining companies have set long-term goals, with most aiming to achieve Net Zero or carbon neutrality by 2050. In response to regulatory pressures, they are also establishing shorter-term targets for 2030-2035, often aiming for a 30% reduction. While GHG emissions are declining, greater efforts are required to meet the 2050 targets, prompting mining companies to engage in initiatives such as increasing renewable energy usage and decarbonising their fleets through electrification or green hydrogen.



# Mining companies set Net Zero targets, but real action is needed to align with global goals

## Cases of mining companies pioneering in sustainability



### Technology usage

Anglo American has developed an innovation-led FutureSmart Mining™ approach incorporating several proven and scalable technologies. For example, the company has applied Coarse Particle Recovery, an innovative flotation process that has increased copper production at El Soldado by 16% without the need for additional energy. Using SandLix™ method, the company has achieved initial results of over 70% copper recovery in half the time of traditional leaching methods.



### Scope 3 emissions reduction

Newmont aims to reduce Scope 3 GHG emissions by 30% by 2030. The company's strategy focuses on contract terms and regular meetings with key suppliers to discuss and support emission reduction efforts. In 2023, Newmont made significant progress, reducing Scope 3 emissions by 16% compared to the 2018 baseline. In 2024, Newmont became the only mining company to be included in Top-100 world's most sustainable companies by Time and Statista.



### Renewable energy consumption

BHP focuses its decarbonisation efforts on transitioning to RE. Most assets are grid-connected, allowing access to low to zero GHG emission electricity. Notably, in 2022 and 2023, BHP's Chilean operations achieved 100% renewable electricity use. In FY 2024, the company initiated market engagements to secure up to 500MW of off-grid renewable electricity generation and battery storage for its Western Australia Iron Ore operations.

Source: Responsible Mining Index website; Companies' websites; Companies' sustainability reports; Media overview

Notes: (1) The Responsible Mining Index Report 2022 seeks evidence of companies' policies and practices on economic, environmental, social, and governance issues, but does not seek to measure the actual outcomes achieved on ESG issues based on publicly available data. The 2022 edition is the latest available data; (2) Provide company's place in the Environmental Responsibility rank, which reflects company's measures to prevent, avoid, and mitigate the impact of its operations on natural resources and ecosystems; (3) Includes projects that are already in use or are being considered for implementation

# Driving economic wealth and social security in mining communities is vital for industry growth

Mining has long been associated with negative environmental and social impacts, such as pollution, deforestation and ecosystem degradation, which can directly and indirectly harm local residents' health. The industry is also often linked to forced relocations and the damage to cultural heritage. As of 2023, around 64% of all allegations in transition mineral mining involved local community and environmental impacts, with the most common issues being attacks on human rights defenders, land rights violations, health issues and adverse effects on livelihoods and Indigenous communities. As the industry moves towards sustainability, future-proofing mining communities is essential to society, investors, and other stakeholders to ensure mining operations contribute to local development and economic wealth without worsening social inequalities.

**31%** Of respondents<sup>1</sup> consider community relations the most important element of their strategy.

**17%** Of respondents<sup>1</sup> believe community sentiment is the biggest consideration when investing in mining projects.

The growing importance of promoting economic prosperity and social security for mining communities is evident in the surge of community investments, which rose from \$0.3bn to \$1bn globally over 2019–2022. However, while only 10% of mining companies<sup>1</sup> focus on communities in their innovation strategies, 24%<sup>1</sup> see community-related disruptions as a major risk along the mining value chain. To avoid future challenges and ensure sustainable industry development, mining players must prioritise investments in local infrastructure, employment and social services, ensuring long-term benefits for mining operations and surrounding areas.

Community opposition, including strikes and protests, can significantly disrupt mining operations, potentially leading to production shutdowns and global supply chain interruptions.

## Cobre Panamá mine case

In November 2023, large-scale protests forced the shutdown of Central America's largest copper mine, with First Quantum Minerals expecting to incur monthly maintenance costs of \$15–20m during the closure. Panama also significantly reduced its 2024 economic growth projections, as the mine accounted for around 5% of its GDP.

## Rio Tinto and Alcoa case

In June 2023, following local community pressure and over 1,500 complaints, Rio Tinto and Alcoa withdrew their permit requests to explore minerals under the Jarrah forests in Western Australia.

Mining companies face significant reputational, operational and legal risks, when they fail to address community interests. Proactive community engagement is essential for ensuring the long-term sustainability of their operations and mitigating disruptions that could arise from opposition.

## Investment opportunities in the mining communities



### Environment

Investing in sustainable practices, such as land restoration and pollution control, reduces environmental damage and promotes the long-term health of ecosystems.



### Health

Improving access to health care ensures the well-being of mining communities and mitigates health risks associated with mining activities.



### Infrastructure

Developing infrastructure that ensures safe access to water for local communities can help companies avoid conflicts where access to water is limited.



### Education, training, and skills

Investment in education and training programmes equips local people with the skills needed for mining jobs, ensuring a sustainable workforce.



### Community wellbeing

Sponsoring initiatives to protect and promote local cultural heritage, e.g. the arts, sports, or local traditions, fosters personal development.



### Indigenous empowerment

An estimated 54% of energy transition minerals located on or near indigenous lands underscores the need to build long-term relationships with local communities.

# Community development initiatives might significantly boost residents' quality of life

Mining companies aim to provide broad support to communities, often by investing in various areas of local development or adopting standardised global engagement practices to promote transparency. While mining communities worldwide face common issues such as environmental damage, displacement and health risks, certain challenges stand out more in specific regions. For example, Indigenous rights are among key concerns in Australia and Canada, whereas Latin American countries tend to focus more on environmental impacts due to strong local opposition, reflecting the unique socio-economic and cultural dynamics in these regions.

## Selected community issues and community development practices across regions<sup>1</sup>

**North America**

Limited infrastructure

Education and employment

Indigenous communities impact

**Canada:** In 2024, the Government launched a \$5bn Indigenous Loan Guarantee Programme and funded a study to improve wellbeing in mining communities in Northern Ontario.

**Canada:** Since 2008, Rio Tinto's Aluminium Fund Canada has been investing around \$7.4bn<sup>2</sup> annually in education, health, and other areas.

**Latin America**

Social investments

Health issues

Water contamination and limited access

**Chile:** \$55m of revenues derived from the Mining Royalty Law (updated in 2023) will be allocated to compensate mining communities directly affected by the negative mining impact.

**Colombia:** Together with the local authorities, Glencore participated in constructing the community health centre (opened in April 2024).

**Africa**

People displacement

Health issues

Limited water access and pollution

**South Africa:** Glencore is part of the Lebelelo Water Users project, aiming to provide drinking water to several hundred thousand people by 2030.

**Zimbabwe:** Anglo American cooperates with national institutions to support children and adolescents living with HIV to improve health outcomes.

**Europe**

Environmental impact

Sustainability of operations

Public perception

**Finland:** Anglo American strives to develop a remotely operated, low carbon underground mine, Sakatti, that will create zero waste.

**Spain:** First Quantum's Cobre Las Cruces mine is developing a new project incorporating the best environmental techniques<sup>3</sup>.

**Asia**

Indigenous communities impact

Water pollution

Land disturbance

**China:** Rio Tinto supports the China Development Research Foundation to construct a rural revitalisation zone in Bijie, Guizhou Province.

**Indonesia:** Freeport-McMoRan supports Indigenous cultural preservation and invests in education, health, and other community development programmes.

**Oceania**

Climate-related impact

Free, prior and informed consent

Dust, noise and air quality

**Australia:** BHP invested in the Pilbara Air Quality Programme, partnered with Greening Australia and installed wind fences to enhance air quality.

**Australia:** Glencore is actively engaged in consultations with Traditional Owners on an Indigenous Land Use Agreement and cultural initiatives.

Development of global future-proofing mining communities



Mining can improve the living standards of local residents by contributing to regional and national GDP, creating new job opportunities and developing infrastructure, as successfully demonstrated by several regions that have significantly driven economic wealth.

### Pilbara, Australia

Mining sector contributed 87% to the Pilbara's output as of June 2023, making the region 5th in terms of GDP per capita in Australia and supported exported-oriented infrastructure, including the country's largest port by tonnage.

### Antofagasta, Chile

Mining was instrumental in driving economic growth in the Antofagasta region, contributing 72% to its GDP and 39% of Chile's total exports as of March 2023, making the region's GDP per capita the highest in the country.

Source: Companies' websites; Companies' annual and sustainability reports; Business & Human Rights Resource Centre — Transition Minerals Tracker — [2024]; IEA — Global Critical Minerals Outlook — [2024]; OECD — Mining Regions and Cities Case of the Pilbara, Australia — [2023]; OECD — Mining Regions and Cities in the Region of Antofagasta, Chile — [2023]; Media overview

Notes: (1) Key issues were selected based on the Transition Minerals Tracker, BHP's annual report for 2024, and media overview; (2) The numbers are converted from AUD to USD due to the average exchange rate by the FRED; (3) Sustainable water use, encapsulated mining waste, a 90% reduction in carbon footprint compared to conventional metal production chains, and electrical and thermal supply through renewable energies, as well as the progressive environmental rehabilitation of all areas affected by mining operations

# The mining industry must upgrade its talent strategies to attract younger generations

Mining is navigating complex talent challenges, marked by a projected decline in coal jobs alongside the increasing demand for skilled workers in critical minerals by 2030. Ongoing issues around the industry's image and skills shortages underscore the need for serious progress to ensure a reliable future workforce.

## Key mining industry employment and talent challenges

### Lack of sector attractiveness

Negative perceptions of mining, largely driven by environmental concerns, result in limited interest from younger generations in pursuing mining careers.

### Highly-skilled labour shortage

The decline in mining engineering graduates and anticipated retirements over the next decade threaten the industry's access to a skilled workforce.

### Poor employee value proposition

The remote locations, limited infrastructure, low family-friendliness, and vaguely defined career progression hinder talent attraction and retention.



Of people aged 15-30 years would not consider working in mining<sup>1</sup>



Decline in mining engineering graduates in the USA (2022 vs 2016).



Believe talent attraction will have the biggest impact on mining over the next 15 years<sup>2</sup>.

Mining is on its way to disrupt traditional old-school techniques and embrace next-generation approaches, leveraging AI, automation and other cutting-edge technologies. This shift requires a changing skills profile with a growing demand for tech expertise, particularly in analytical thinking (54%<sup>3</sup>), AI, big data, and technological literacy (31%<sup>3</sup> each) for the next five years. However, competition for tech talents is intensified by other industries, perceived as more appealing employers.

Also, employment expectations among new generations, such as Gen Z and Millennials, have shifted significantly beyond traditional compensation. They put a greater emphasis on having purpose at work, a sustainable future, workplace culture, diversity and work-life balance. Considering the younger generation's perspectives, mining companies will need to focus on a clearer narrative of their role in a sustainable future, improving approaches to health and safety, and enhancing diversity and inclusion.

### Top focus areas to ensure oil & gas and mining are fit for the future<sup>4</sup>

- 51%** Play a major part in the overall energy transition.
- 32%** Promoting new science involved.
- 32%** Explaining the importance to clean energy.
- 30%** Improving the business thinking around HSE.
- 28%** Advertising positive sustainable changes.

Source: Data USA website; Odgers Berndtson website; Mining.com website; Companies' websites; IEA — World Energy Employment — [2023]; McKinsey — Has mining lost its luster? Why talent is moving elsewhere and how to bring them back — [2023]; State of Play — Unearthing Tomorrow: Trends shaping the future of mining — [2023]; WEF — Future of Jobs Report — [2023]; AUSMASA — Gen Z Perceptions of Mining — [2022]; BDO — Attracting The Next Generation: Turning Sceptics Into Changemakers — [2022]; Media overview

Notes: (1) According to McKinsey survey of Canadian mining companies, n=15; (2) According to The State of Play survey conducted among miners, suppliers, government, investors, and researchers in the mining industry from 50 countries, n=720; (3) According to WEF survey of Mining & Metals industry organisations, n=n/a; (4) According to BDO survey conducted among school and university students, n=440; (5) According to McKinsey survey (mining industry data set), n=331



# The mining industry must upgrade its talent strategies to attract younger generations



Effective leadership is critical to driving innovation and fostering a strong culture. A lack of inspiring leadership is a significant factor for 26% of mining employees<sup>5</sup> to seek new jobs, underscoring the need to invest in the next generation of leaders across all sites and offices. Leadership and social influence is a key reskilling and upskilling focus for 46% of respondents<sup>3</sup> in the next five years. Future-proof leaders will need diverse skills, including technological proficiency, sustainability awareness, risk management, stakeholder engagement, and cultural sensitivity to meet future challenges and ensure sustainable success.

Mining companies need to put talent strategy at the centre of their operations, emphasising strategic workforce planning to address future skills requirements. By building larger talent pools and developing tailored employee value propositions (EVP), they can effectively attract and retain the skilled workers essential for future success.

## Key strategies of leading global mining companies for attracting and retaining younger talent

### Guiding young talent in their development

Anglo American's Graduate Programme, available across multiple company locations, gives a chance to explore various roles and develop all of the foundational skills for a future career.

### Data-driven EVP for employee retention

BHP conducts regular Engagement and Perception Surveys twice a year to learn about areas for improvement and measure progress against a workforce wellbeing metric.

### Better work-life balance

Glencore offers extensive benefits beyond the working environment, such as relocation assistance for employees and their families, health and well-being discounts, and paid parental leave.

### Advancing a social agenda

Rio Tinto acknowledges they are not where they want to be on gender diversity, however they are focussing on better enabling an inclusive and diverse workforce by focusing on better representation of women and minorities in a workforce across all levels and ensuring equality through pay equity.

Source: Data USA website; Odgers Berndtson website; Mining.com website; Companies' websites; IEA — World Energy Employment — [2023]; McKinsey — Has mining lost its luster? Why talent is moving elsewhere and how to bring them back — [2023]; State of Play — Unearthing Tomorrow: Trends shaping the future of mining — [2023]; WEF — Future of Jobs Report — [2023]; AUSMASA — Gen Z Perceptions of Mining — [2022]; BDO — Attracting The Next Generation: Turning Sceptics Into Changemakers — [2022]; Media overview

Notes: (1) According to McKinsey survey of Canadian mining companies, n=15; (2) According to The State of Play survey conducted among miners, suppliers, government, investors, and researchers in the mining industry from 50 countries, n=720; (3) According to WEF survey of Mining & Metals industry organisations, n=n/a; (4) According to BDO survey conducted among school and university students, n=440; (5) According to McKinsey survey (mining industry data set), n=331



**Jill MacRae**  
Audit Partner  
BDO UK

The mining industry is not alone when it comes to facing a war on talent and the challenge of not only retaining current workforces but attracting younger generations into the industry. However, crucially, the mining industry must address two key challenges – diversity and climate change.

Whilst diversity has not always been a key focus, companies are now turning their attention to this – both in terms of hiring, training and upskilling local workforces to take on higher level management positions and reducing the level of expats and also in terms of actively working to increase the number of women in the workforce, which can be a challenge in certain cultures.

Secondly, the industry needs to overcome the negative connotations that the mining industry can have with regards to climate change and sustainability. In order to attract young talent, the industry must continue to focus on and promote its role in the energy transition. By continuing to educate the wider population on the role that mining plays in the energy transition and the leading technologies being developed and used, the mining industry can shift perceptions and attract those who may otherwise have not considered mining as an appealing industry.



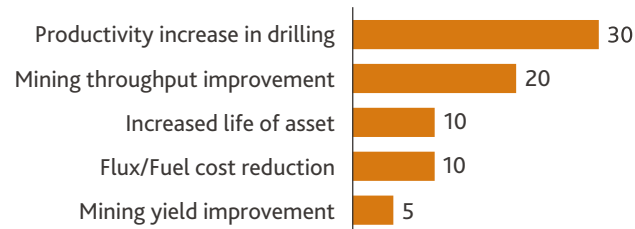


# Digital technologies in mining drive efficiency, through automation, AI and data analytics

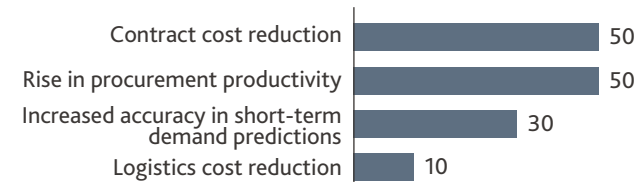
The transition from a fuel-based to an electricity-based operating model sped up, setting the stage for fully digital and automated mining. Digital transformation boosts mining productivity by equipping employees with tools for higher-value tasks, while intelligent workflows use data to drive efficiency, creating a competitive edge. Companies that execute digital strategies effectively can achieve benefits such as a 10% to 20% increase in mining throughput, up to 50% improvement in procurement productivity and a 15% to 30% reduction in emissions.

## Potential KPI improvements due to digital transformation of the global mining value chain, up to<sup>1</sup>

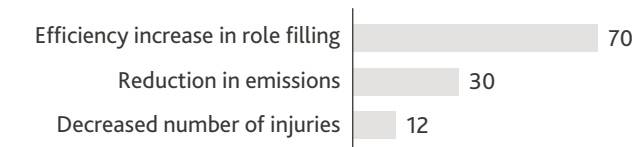
### Operations (%)



### Supply chain and procurement (%)



### Environment, safety, and staff (%)



 The global mining industry's digital maturity index still trails behind other sectors, reflecting slower adoption of advanced digital technologies. However, significant progress is being made. As of 2023, 40% of global mining projects incorporate digital technology, 54.5% of digital initiatives focus on copper mines, and nearly 15% of these projects are based in Africa.

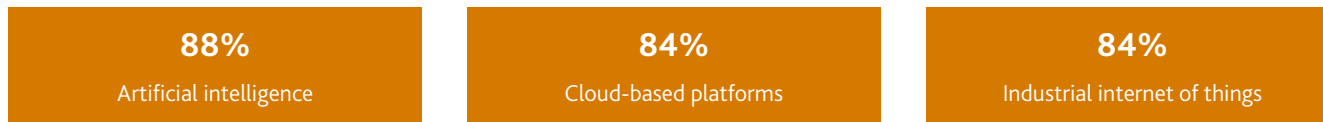
Source: Accenture — How investors view mining's new role as a champion of decarbonisation — [2022]; BCG — Racing Toward a Digital Future in Metals and Mining — [2021]; Mining Magazine Intelligence — Digitalisation Report 2023 — [2023]; Axora — Mining Technology Trends — [2023/2024]; State of Play — Unearthing Tomorrow: Trends shaping the future of mining — [2023]; MCA — Advantage Australia — [2021]; Media overview

Notes: (1) According to BCG's Digital Acceleration Index (DAI) analysis conducted in 2021, which measures the digital maturity of companies, industries, and countries by assessing digital readiness across 35 dimensions, using executive interviews and a four-point scale; (2) According to the Axora's survey of senior decision makers from metals and mining companies globally conducted in March-April 2023, n=160; (3) According to The State of Play survey conducted among miners, suppliers, government, investors, and researchers involved in the mining industry from 50 countries, n=720

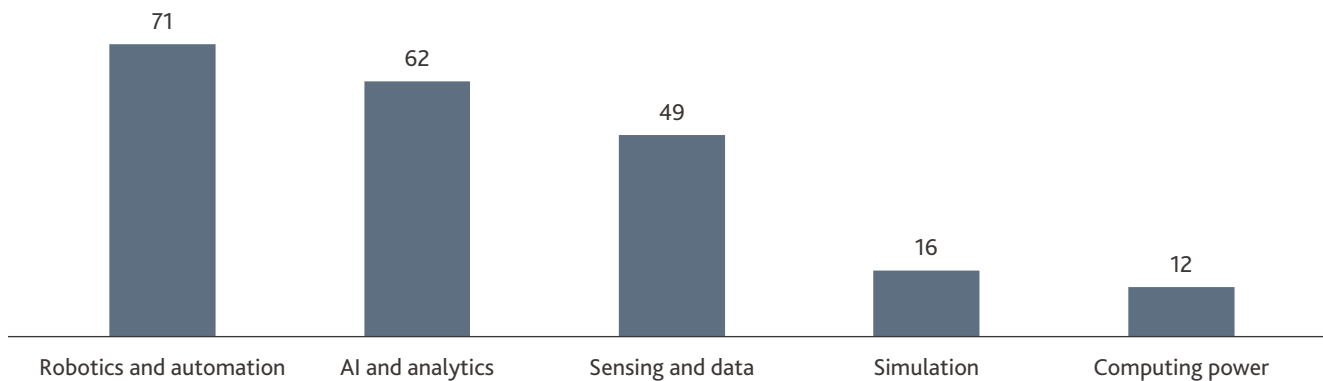


# Digital technologies in mining drive efficiency, through automation, AI and data analytics

## Most deployed technologies in mining in 2023<sup>2</sup>



## Technologies which will have the biggest impact on mining over the next 15 years<sup>3</sup> (%)



AI application in mining is already significant and will only grow, with predictive maintenance and automation being vital for driving productivity. For illustration, predictive maintenance powered by AI detects machinery issues before failure. By analysing data such as vibrations and overheating, Machine Learning predicts breakdowns, preventing unplanned downtime. As of 2024, the world's largest companies lose \$1.4tn annually from unplanned downtime, about 11% of revenues. Additionally, autonomous vehicles can function continuously with only stops for refuelling or maintenance, minimising human error and maximising efficiency. By July 2024, 2,080 autonomous haul trucks were in operation worldwide.

Source: Accenture — How investors view mining's new role as a champion of decarbonisation — [2022]; BCG — Racing Toward a Digital Future in Metals and Mining — [2021]; Mining Magazine Intelligence — Digitalisation Report 2023 — [2023]; Axora — Mining Technology Trends — [2023/2024]; State of Play — Unearthing Tomorrow: Trends shaping the future of mining — [2023]; MCA — Advantage Australia — [2021]; Media overview

Notes: (1) According to BCG's Digital Acceleration Index (DAI) analysis conducted in 2021, which measures the digital maturity of companies, industries, and countries by assessing digital readiness across 35 dimensions, using executive interviews and a four-point scale; (2) According to the Axora's survey of senior decision makers from metals and mining companies globally conducted in March-April 2023, n=160; (3) According to The State of Play survey conducted among miners, suppliers, government, investors, and researchers involved in the mining industry from 50 countries, n=720



### Key challenges related to harnessing digital technologies in mining

#### Implementation

Overcoming implementation barriers is a key challenge in the mining industry's digital transformation. Major obstacles include inadequate IT infrastructure for handling data (43%), a culture resistant to innovation (38%) and limited knowledge of new solutions (36%)<sup>2</sup>.

#### Governance

Effective governance is essential to bridging the gap between corporate innovation and mine site goals, which grew from 71% in 2022 to 85% in 2023<sup>2</sup>. Companies must clarify roles, foster a shared vision, promote a culture open to change, and adapt to regulatory and institutional challenges.

#### Reskilling

Over 77% of mining jobs will be impacted by technological advancements in the next five years, posing a significant challenge of workforce displacement that must be addressed, even as productivity may increase by up to 23%.

# Global mining companies actively leverage technology solutions to streamline operations

Over the past decade, the use of digital technologies by leading companies in the mining industry has become the new normal. They have been actively exploring the implementation of digital technologies across different stages of the value chain, including exploration, excavation, material handling, and logistics aimed at streamlining these operations, as well as making them safer and more sustainable. BHP, Rio Tinto, Glencore, Vale, Anglo American and other global mining industry players constantly develop the technical capabilities of used tools and technological solutions aimed at finding the new opportunities for increasing productivity and efficiency of operations at their sites around the world.

## Selected case studies on the technology solutions implemented by global mining companies

### BHP

#### Technology: Robotics and Automation

BHP deploys drones and associated ground control software to obtain mining surface data and measure stockpile volumes.

**Outcome:** Its automated vertical scanning tool can reduce time spent on tasks from a few hours to several days, depending on the complexity.

### Rio Tinto

#### Technology: AI and Analytics

The company uses AI as a part of its Mine Automation System to generate orebody models, organise equipment dispatch, and predict and control blasts.

**Outcome:** Overall increase in productivity due to small gains, for example, optimising the speed and reducing queuing of autonomous trucks.

### KoBold Metals

#### Technology: AI and Analytics

KoBold Metals is developing an AI agent to find the most desirable ore deposits in the least problematic locations.

**Outcome:** Elimination of the need for costly and invasive exploration missions, which often involve scouring the Earth many times to find reserves.

### Vale

#### Technology: Advanced connectivity

Nokia Bell Labs and Vale have joined efforts to create a holistic digital twin for mission-critical connected operations in the mine.

**Outcome:** The cognitive monitoring network service enables the enhancement of performance, reliability and safety of mining operations.

### Anglo American

#### Technology: Advanced connectivity

The company implemented digital twin technology at the Quellaveco mine in Peru to create virtual replicas of equipment and infrastructure.

**Outcome:** Reduction of safety risks, optimisation of the use of resources and improvement of the performance of production equipment.

### Glencore

#### Technology: Internet of Things

Glencore's joint venture Kamoto Copper Company<sup>1</sup> introduced proximity detection technology, which is aimed at supporting the exploration of copper and cobalt.

**Outcome:** Improvement of operator visibility between vehicles and people, as well as reduction in vehicle downtime.

# Global mining companies actively leverage technology solutions to streamline operations

## Selected suppliers of equipment and machinery for the mining industry

The leading manufacturers and suppliers of equipment, machinery, and respective technologies to the global mining companies are also actively developing comprehensive digital solutions to provide the clients with the most advanced solutions, facilitating operations management and efficiency.

### ABB

ABB offers a comprehensive suite of smart mining and digital applications for the mining sector, such as ABB Ability™ Operations Management System for mining, which allows to enhance operational excellence and increase productivity.

### Caterpillar

Caterpillar's MineStar technology solution allows mining companies and mine operators to track, monitor, automate, and manage all types of assets, from people to production machines, as well as light vehicles on site.

### Schneider electric

Schneider Electric provides its clients in the mining industry with solutions to accelerate digital transformation. For example, the company offers EcoStruxure, IoT-enabled, plug-and-play, open, interoperable architecture and platform.



Source: Companies websites; Media overview

Notes: (1) A joint venture between Glencore and Gecamines

# Zero harm mining is a long-term goal that can be advanced with the support of technologies

While considerably contributing to value creation, mining remains one of the most hazardous industries, accounting for around 8% of total occupational fatal accidents globally. The industry has made significant progress in reducing the injury rate, but the pace is slow with the higher number of non-massive events<sup>1</sup>. For example, the USA recorded 40 mining fatalities in 2023, the highest in a single year since 2014, with 65% of incidents related to machinery and powered haulage. This negative trend is exacerbated by the rise of illegal mining activities. For instance, in 2024, approximately 30 illegal miners were found dead in a decommissioned mine in South Africa. Psychosocial problems add to increased hazards in mining amid insufficient training and extended working hours, all within the context of growing extraction targets and opening new mines.

## Selected health & safety risks in the global mining by key categories

<b>Mechanical and structural</b> <ul style="list-style-type: none"> <li>▶ Equipment-related</li> <li>▶ Explosions</li> <li>▶ Electrocutation</li> <li>▶ Mine collapses.</li> </ul>	<b>Respiratory and chemicals</b> <ul style="list-style-type: none"> <li>▶ Dust</li> <li>▶ Fumes</li> <li>▶ Chemical hazards</li> <li>▶ Diesel exhaust.</li> </ul>	<b>Physical and sanitary</b> <ul style="list-style-type: none"> <li>▶ Heat stress</li> <li>▶ Noise level</li> <li>▶ Body vibrations</li> <li>▶ Poor hygiene.</li> </ul>	<b>Psychological and social</b> <ul style="list-style-type: none"> <li>▶ Security stress</li> <li>▶ Overtime working</li> <li>▶ Repetitive tasks</li> <li>▶ Social isolation.</li> </ul>
--	---	---	--

Technologies hold significant potential for improving mining safety, particularly by reducing person-vehicle interaction risks. However, 89% of respondents<sup>2,3</sup> from the industry reported a disconnect between corporate and mine site teams regarding innovation progress. This gap can hinder technology adoption, making close communication with on-site staff essential.

## Potential improvement in mining with technologies

<b>Underground operations</b> Drones for hazards identification Robots for laying explosion	<b>Material handling</b> IoT wearable tech for health monitoring Autonomous conveying system	<b>Training</b> VR simulation training platforms Apps for mental health check-ins	<b>Prediction</b> LiDAR-based imaging and mapping AI-based platform for risk assessment
---	--	---	---

■ Mechanical & Structural   
 ■ Respiratory & Chemicals  
■ Physical & Sanitary   
 ■ Psychological & Social



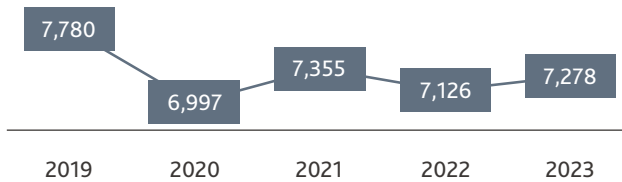
Source: ICMM website; ILO website; ICMM — Safety Performance Report — [2023]; I4 Mining — How the Mining Sector can Achieve Zero Harm with Industry 4.0 Technology — [2021]; Axora — Mining Technology Trends — [2023/2024]; Media overview

Notes: (1) Including machinery-related injuries or falling from heights; (2) Compared to 82% in 2022; (3) According to Axora's survey of senior decision-makers from metals and mining companies globally conducted from March 2023 to April 2023, n=160; (4) The report is based on data from 25 ICMM members

# Zero harm mining is a long-term goal that can be advanced with the support of technologies

## Is zero harm achievable?

Number of total recordable injuries for ICMM company members<sup>4</sup>



Periodic disruptions delay the mining industry's progress towards attaining a zero harm environment, making it a long-term goal. For example, ICMM members recorded over 7,200 injuries with 36 fatalities in 2023 (33 in 2022) despite a centralised approach to critical control management. A significant number of injuries resulted from mobile equipment-related accidents and structural collapses. Given the industry's growing dependence on technologies to accelerate productivity, the pace to zero harm is closely linked to ensuring safe interaction with vehicles and mobile equipment.

Source: ICMM website; ILO website; ICMM — Safety Performance Report — [2023]; I4 Mining — How the Mining Sector can Achieve Zero Harm with Industry 4.0 Technology — [2021]; Axora — Mining Technology Trends — [2023/2024]; Media overview

Notes: (1) Including machinery-related injuries or falling from heights; (2) Compared to 82% in 2022; (3) According to Axora's survey of senior decision-makers from metals and mining companies globally conducted from March 2023 to April 2023, n=160; (4) The report is based on data from 25 ICMM members

## Recent practices for ensuring employee health and safety in the global mining industry

 **BHP Chile**  
**Autonomous fleet**

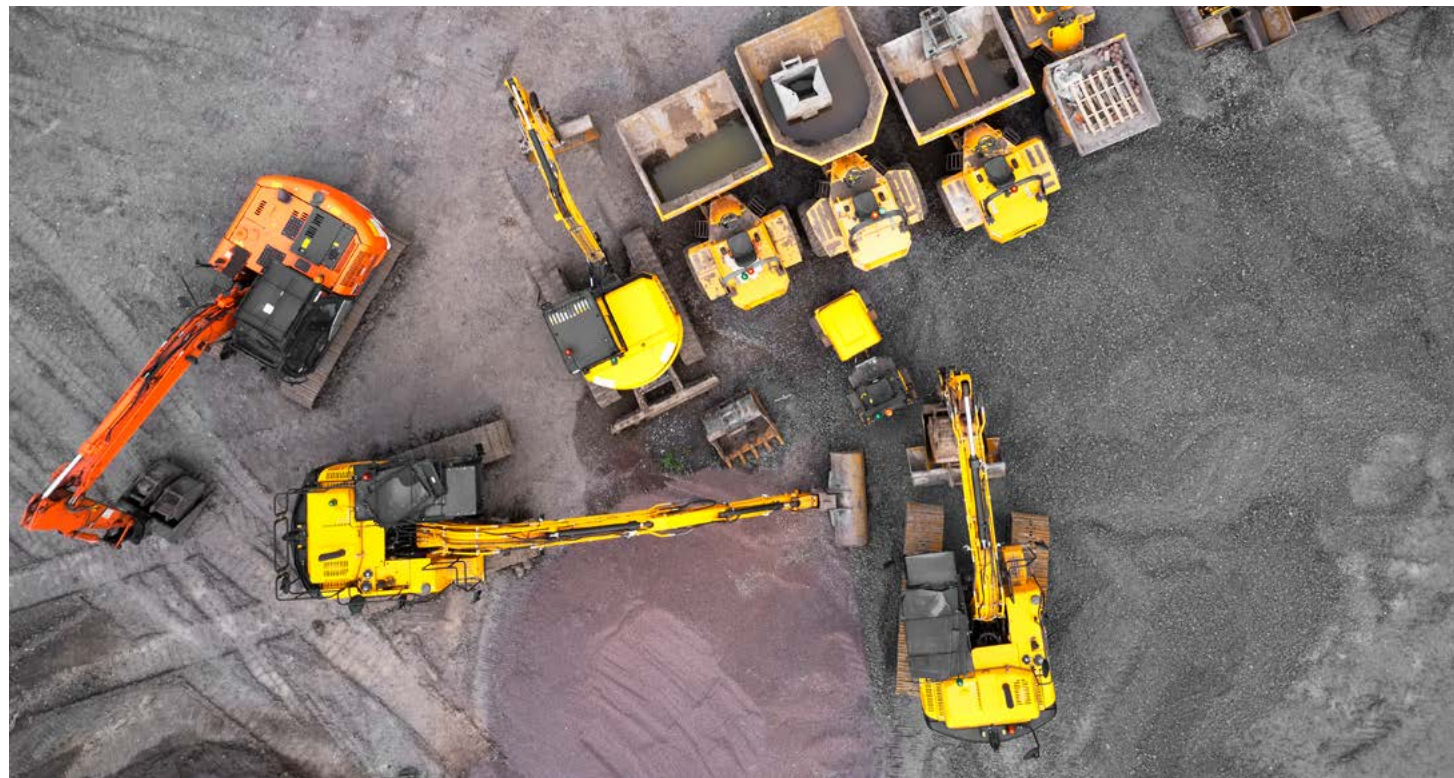
BHP in Chile achieved complete autonomy of the copper mining site by converting 33 vehicles and five drilling rigs. Therefore, the company has decreased its safety hazards by up to 90%.

 **Almonty Industries**  
**AI for mine safety**

Almonty Korea Tungsten Corp employs Mine Safety DX technology, a wearable AI-powered monitoring system. The solution can identify signs of fatigue and alert miners in hazardous areas.

 **US Department of Labour'**  
**App for healthcare access**

The US Department of Labour' has established the MSHA's Health Resource Locator Tool, which assists miners and their families in finding healthcare providers and associated resources.



# Meet the Natural Resources and Energy team

If you would like to discuss any of the content in this report or want to connect with any of our experts, please do get in touch.

## UK team



**Matt Crane**  
Audit Partner

UK Head of Natural Resources & Energy

+44 (0) 792 933 2677  
matt.crane@bdo.co.uk



**Fiona Davis**  
Advisory Partner

+44 (0) 784 149 4226  
fiona.davis@bdo.co.uk



**Jill MacRae**  
Audit Partner

+44 (0) 797 619 8665  
jill.macrae@bdo.co.uk



**Jeff Harris**  
Advisory Partner

Deal Advisory - Transaction Services

+44 (0) 778 814 4250  
jeff.harris@bdo.co.uk



**Pete Acloque**  
Audit Partner

+44 (0) 780 173 5862  
pete.acloque@bdo.co.uk



**Gareth Jones**  
Advisory Partner

Head of Strategic Resourcing Solutions

+44 (0) 779 089 7195  
gareth.jones@bdo.co.uk



**Katherine Brown**  
Tax Partner

+44 (0) 790 863 3016  
katherine.brown@bdo.co.uk

## Global team



**Sherif Andrawes**  
BDO Australia Partner, Deal Advisory

Global Natural Resources & Energy Leader

+61 412 902 444  
sherif.andrawes@bdo.com.au



**Servaas Kranhold**  
Audit Partner

Head of Natural Resources South Africa

+27 (8) 245 042 44  
skranhold@bdo.co.za



**Jacques Barradas**  
Audit Partner

BDO South Africa

+27 824 643 184  
jbarradas@bdo.co.za

# How BDO can help

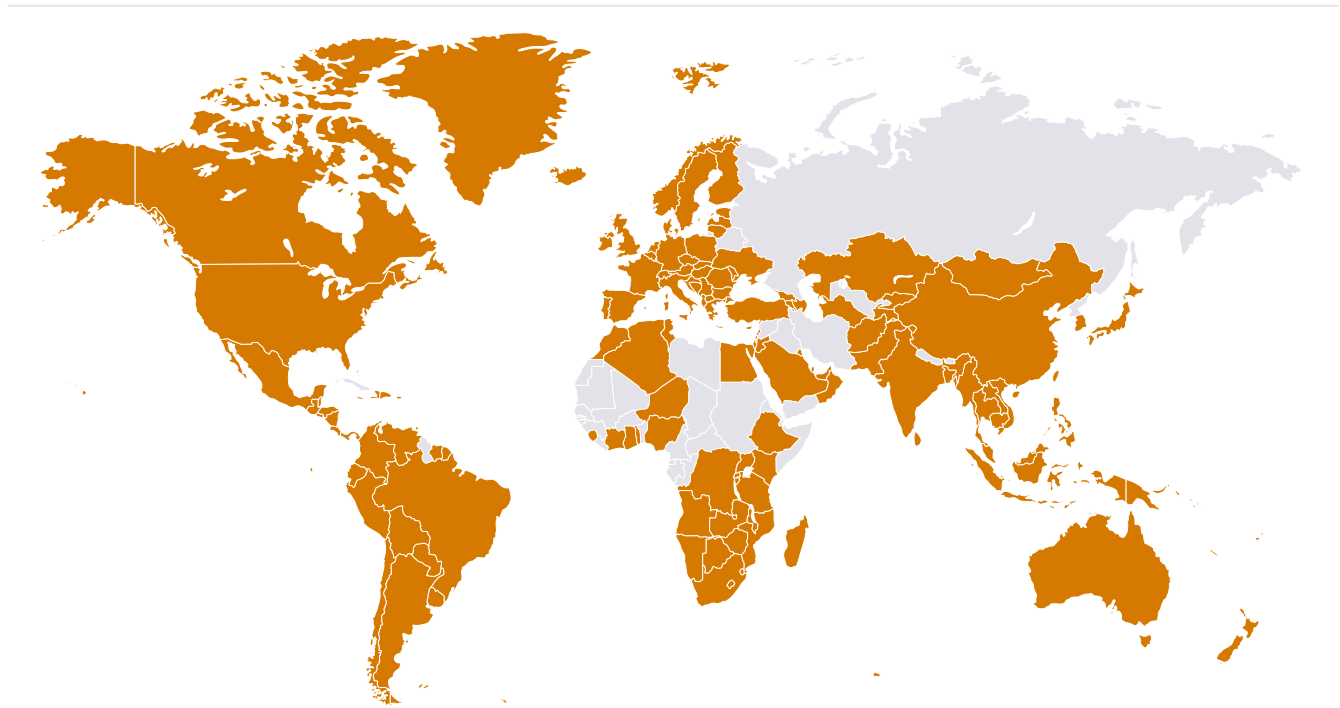
Our dedicated team of natural resources and energy specialists work across all parts of our business including audit, tax, corporate finance, forensics and advisory.

The services and facilities provided by the natural resources services sector are truly diverse and the companies operating within it have an international footprint. This diversity and international focus sit squarely within BDO's skill set.

BDO's international reach ensures we can provide professional services to sector companies in a way that mirrors their own corporate structures and operations.

### Key facts about the BDO International natural resources practice

- ▶ The natural resources sector is deeply international in nature. As a result, at BDO we treat our international natural resources team as a key priority sector for our global network
- ▶ 'Centres of Excellence' in the UK, North and South America, Australia, UAE, China and South Africa
- ▶ 100+ partners across the world who work exclusively within the natural resources sector.



**BDO INTERNATIONAL**

**US\$15 billion**  
2023/2024 REVENUE  
A YEAR ON YEAR INCREASE OF **7%**<sup>1</sup>

**166**  
COUNTRIES & TERRITORIES

**1,800 OFFICES**  
**119,000 STAFF**

1. At constant exchange rate  
All numbers updated as of 18 December 2024



# Glossary of terms

<b>\$/t.oz</b>	Dollars per troy ounce
<b>\$/k/mt</b>	Thousands of dollars per metric tonne
<b>AI</b>	Artificial Intelligence
<b>APS</b>	Announced Pledges Scenario
<b>BAU</b>	Business as Usual
<b>BEVs</b>	Battery electric vehicles
<b>CAGR</b>	Compound annual growth rate
<b>CSDDD</b>	Corporate Sustainability Due Diligence Directive
<b>CSRD</b>	Corporate Sustainability Reporting Directive
<b>DET</b>	Dynamic Energy Transfer
<b>EIA</b>	Environmental Impact Assessment
<b>EPA</b>	Environmental Protection Agency
<b>ESG</b>	Environmental, social and governance
<b>ESS</b>	Energy storage systems
<b>EVP</b>	Employee value propositions
<b>EVs</b>	Electric vehicles
<b>GDP</b>	Gross domestic product
<b>GHG</b>	Greenhouse gases
<b>Gtce</b>	Gigatonne of coal equivalent
<b>HIV</b>	Human immunodeficiency virus
<b>HSE</b>	Health, Safety, Environment
<b>ICMM</b>	International Council on Mining and Metals
<b>IEA</b>	International Energy Agency
<b>IoT</b>	Internet of things

<b>KfW</b>	Kreditanstalt für Wiederaufbau
<b>Kg/MW</b>	Kilogramme per megawatt
<b>LiDAR</b>	Light Detection and Ranging
<b>LMFP</b>	Lithium manganese iron phosphate
<b>MAS</b>	Mine Automation System
<b>MSHA</b>	Mine Safety and Health Administration
<b>MW</b>	Megawatt
<b>NZE</b>	Net Zero Emissions
<b>PV</b>	Photovoltaic
<b>RE</b>	Renewable energy
<b>STEPS</b>	Stated Policies Scenario
<b>VR</b>	Virtual Reality

## Elements

<b>Au</b>	Gold
<b>C</b>	Graphite
<b>Co</b>	Cobalt
<b>Cr</b>	Chromium
<b>Cu</b>	Copper
<b>Li</b>	Lithium
<b>Mn</b>	Manganese
<b>Ni</b>	Nickel
<b>REEs</b>	Rare Earth Elements
<b>Zn</b>	Zinc



FOR MORE INFORMATION:

**MATT CRANE**

**Audit Partner**

UK Head of Natural Resources & Energy

+44 (0) 792 933 2677  
matt.crane@bdo.co.uk

This publication has been carefully prepared, but it has been written in general terms and should be seen as containing broad statements only. This publication should not be used or relied upon to cover specific situations and you should not act, or refrain from acting, upon the information contained in this publication without obtaining specific professional advice. Please contact BDO LLP to discuss these matters in the context of your particular circumstances. BDO LLP, its partners, employees and agents do not accept or assume any responsibility or duty of care in respect of any use of or reliance on this publication, and will deny any liability for any loss arising from any action taken or not taken or decision made by anyone in reliance on this publication or any part of it. Any use of this publication or reliance on it for any purpose or in any context is therefore at your own risk, without any right of recourse against BDO LLP or any of its partners, employees or agents.

BDO LLP, a UK limited liability partnership registered in England and Wales under number OC305127, is a member of BDO International Limited, a UK company limited by guarantee, and forms part of the international BDO network of independent member firms. A list of members' names is open to inspection at our registered office, 55 Baker Street, London W1U 7EU. BDO LLP is authorised and regulated by the Financial Conduct Authority to conduct investment business.

BDO is the brand name of the BDO network and for each of the BDO member firms.

BDO Northern Ireland, a partnership formed in and under the laws of Northern Ireland, is licensed to operate within the international BDO network of independent member firms.

Copyright © January 2025 BDO LLP. All rights reserved. Published in the UK.

[www.bdo.co.uk](http://www.bdo.co.uk)

