

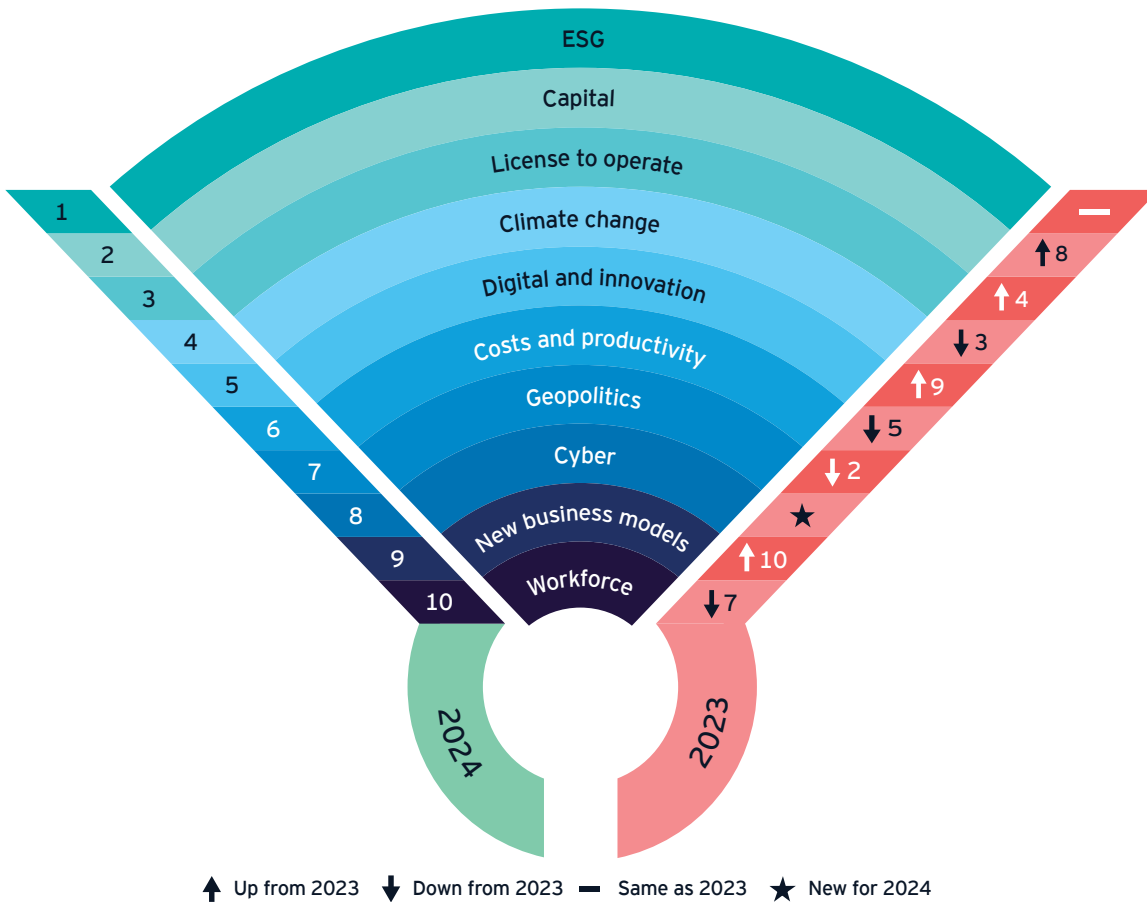
Top 10 business risks and opportunities for mining and metals in 2024



EY

Building a better
working world

Executive summary



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This year’s ranking highlights the complex operating environment miners will face in 2024. Risks will be numerous but history proves the resilience and the inventiveness of the sector to turn these into opportunities. We expect to see more innovation, collaboration and agility over the next 12 months as mining and metals companies embrace the upside of change.

Paul Mitchell, EY Global Mining & Metals Leader

At first glance, the 2024 ranking of the top business risks and opportunities in mining and metals doesn't differ too much from the last couple of years. Responses to these risks are now clearly embedded into the strategies of the best operators — particularly environmental, social and governance (ESG) and license to operate (LTO) — and will remain priorities for a number of years to come.

We see several key themes playing out:

■ Expectations of investors and stakeholders have been underestimated and continue to increase

According to our survey respondents, scrutiny from all stakeholder groups is increasing, particularly around ESG issues. **With these expectations anticipated to continue, miners will need to balance ESG priorities with other business goals, including productivity.** A number of miners

are now focused on **achieving net-positive impact, with significant benefits for those that get it right, including improved access to capital, a healthier talent pipeline and stronger LTO.**

■ The pace of change has accelerated

Capital has moved up in the ranking as the sector competes for investment and incentives to accelerate exploration and development of minerals and metals vital to the **energy transition.** We're seeing a shift from a short-term focus on returns **to a long-term view of value, encouraged by recognition that longer-term investment horizons are required to meet 2050 net-zero goals.**

Inflationary pressure has fast-tracked technology development, as miners focus on digital tools that can accelerate productivity. The pace of digital transformation is highlighting the importance of cybersecurity, which is new to the ranking this year. And supply constraints are a catalyst for consideration of circular economy principles, with miners more conscious of minimizing waste across the full value chain and lifecycle of metals.

■ Risks today are highly complex, interlinked and impact each other

Executives say that they have a better understanding of sustainability issues – but they cannot tackle all areas at once. **With ESG becoming more complex and interlinked, addressing them requires an approach that thinks beyond meeting regulation and controlling costs.** Leaders need

assurance **that investments will add genuine value rather than cause problems elsewhere or in the future.** In-depth scenario planning can help guide prioritization, identify potential trade-offs and help miners create real, long-term value.

■ Building trust and articulating value can evolve the sector's brand

When trust is an issue, transparency is key. Miners need to get better at articulating the financial and nonfinancial value they bring to communities and investors, beyond

merely meeting regulatory expectations. Creating and communicating a bigger bolder vision of legacy beyond life of mine can demonstrate a company's societal commitment.

1

Environmental, social and governance (ESG)



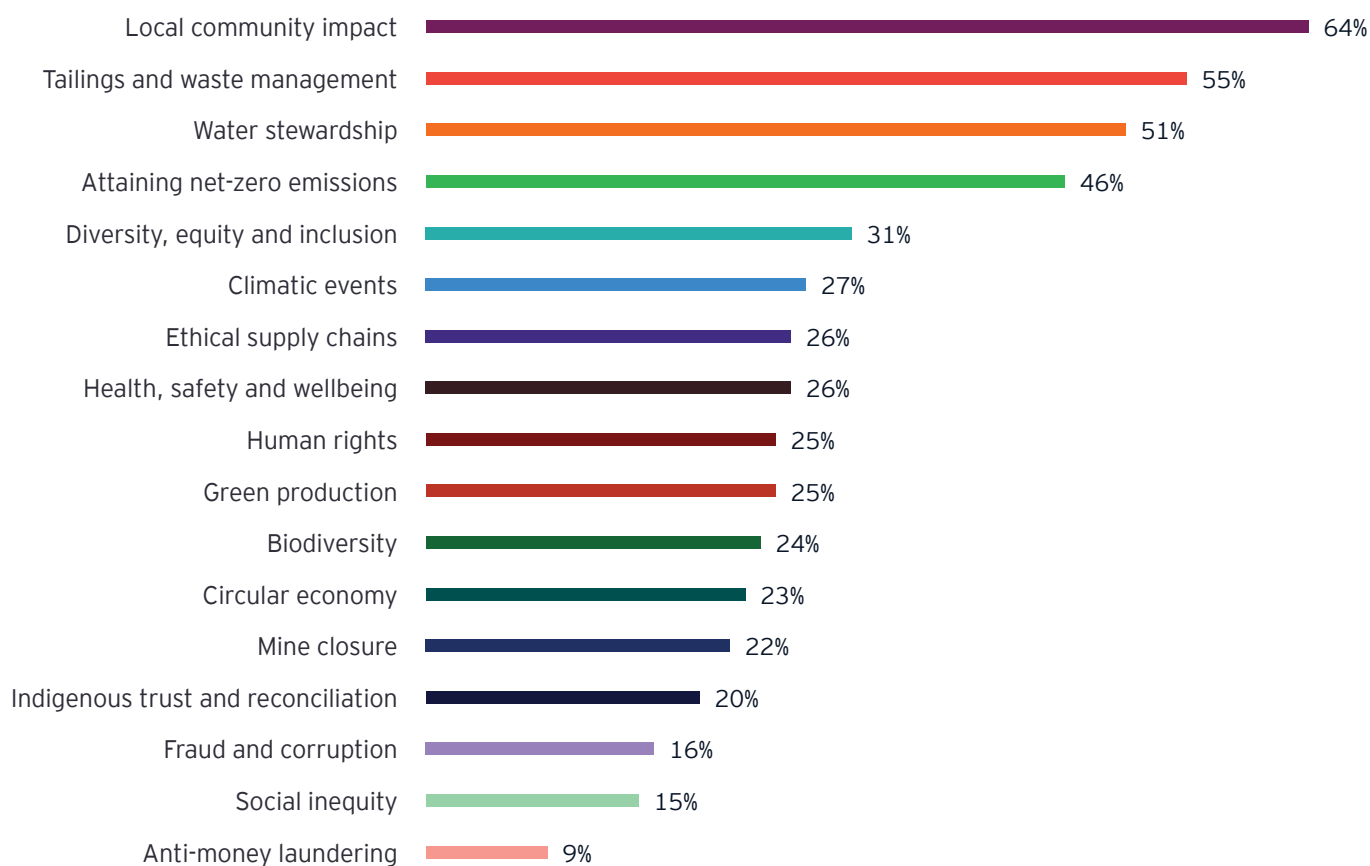
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It is clear that our industry has a unique role to play in supporting a nature-positive agenda.

Hayley Zipp, Director of Environment, ICMM¹

For the third year in a row, ESG is the biggest risk for miners, as well as their biggest opportunity to drive differentiation and improvements that will create long-term value for all stakeholders.

Which are the ESG factors facing the most scrutiny from investors in 2024?*



* Respondents could choose more than one option

Source: EY mining & metals Business risks and opportunities survey data 2024.

Miners are seeking innovative solutions to tailings and waste management

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Everyone is seeking alternatives to tailings dams, aiming for greater safety and control.

Senior mining executive

The past 10 years have seen more tailings dams built than in any previous decade. Today, safe storage of tailings is a key focus for stakeholders who are demanding miners do more to eliminate the failures that can devastate local communities and the environment, and cost billions to fix. With over 200 billion tonnes of existing tailings under management and an additional 40 billion to 50 billion tonnes expected in the next five years, this is a critical risk to manage. Fifty-five percent of survey respondents expected

tailings to receive investor attention, compared with less than 5% last year. In August 2023, International Council on Mining and Metals (ICMM) members released tailings disclosures to demonstrate ongoing commitment and provide transparency on the Global Industry Standard on Tailings Management (GITSM).²

But miners need more innovative solutions to monitor and manage tailings, and also to extract value from waste. The Mining Microbiome Analytics Platform project³ is an example of progress. This collaboration between UBC, Teck Resources, Rio Tinto and other partners identifies microbes that bind to minerals, to enable nonchemical-based extraction and remediation strategies. For example, microbes can bind to selenium to prevent toxic levels in mining waste from leaching into water. Remediating slag containing residual copper could be made profitable by introducing microbes that bind with the copper and enable extraction.

Investors and governments scrutinize water stewardship

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We face a challenge as legislation comes in to reduce water usage to see whether mines can remain sustainable. This is a large transitional risk.

Senior mining executive

Over half of our survey respondents said water stewardship was one of the top risks with significant increased scrutiny from investors. It's an issue top of mind for

many governments too. The Chilean National Mining Policy 2050 mandates that continental water makes up no more than 10% of total water used in all copper production. Other drought-affected regions are likely to adopt similar restrictions.

It's critical that hydrology is managed end-to-end given water impacts soil composition and, therefore, the ability to regenerate land. Many mining companies have set targets around their commitment to drive good water stewardship and improve disclosure to stakeholders. Rio Tinto was the first mining company to publish water usage through an interactive map on its website.⁴

Diversity, equity and inclusion (DE&I)

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We are slow to the dance of automation but, from a talent perspective, this needs to be dealt with carefully, as it could wipe out inclusion.

Senior mining executive

All companies we spoke to have DE&I targets and improvement initiatives – but few are making a meaningful difference. The participation of women remains low, though some progress has been made at the C-suite level, where female participation now sits at about 12%.⁵ A lack of diversity may hinder miners' ability to drive innovation and improve financial performance, both of which are positively impacted by having more women on boards.⁶

Industry associations are pushing for faster progress through tougher protocols, including Canada's Towards Sustainable Mining: Equitable, Diverse, and Inclusive Workplaces Protocol.⁷ Some of our respondents raised concerns about the use of demographic quotas to increase gender diversity, worried they could limit the capabilities and volume of candidate pools at a time when attracting talent is difficult enough. Others suggested that building KPIs around employment of local people into agreements and removing symbols of exclusion could help boost diversity. [How miners can accelerate gender diversity](#) talks about this in more detail.⁸

Some miners raised concerns about the potential negative impact of automation on DE&I, if not considered carefully. If automation reduces the need for administrators, truck drivers and operators more broadly, this could seriously diminish gender and Indigenous inclusion.



Health and wellbeing initiatives must expand in scope

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We are always adapting — psychological wellbeing is now part of our safety share.

Senior mining executive

Maintaining mental health and wellbeing is an increasing challenge in mining, particularly for fly-in fly-out (FIFO) workers, with more companies noting its impact on absenteeism, especially among First Nations communities. Some miners are responding by including psychological wellbeing in safety shares, offering more mental health support within employee assistance programs, reviewing rosters and investing in downtime activities that aim to reduce mental health struggles. Miners also acknowledge a

need to broaden the concept of wellbeing to consider other significant issues, including domestic violence. Suicide rates in mining also continue to increase, and are the highest across all sectors – 54 per 10,000 workers.⁹

Bullying and harassment claims are on the rise in mining workplaces, and the cost (in many forms) to employers is increasingly not tolerated. However, some miners are still approaching the issue from a legal perspective, rather than a cultural one. This is a missed opportunity. Companies that create a safe, inclusive workplace will gain a competitive advantage in recruiting and retaining staff.

Miners need to assess the impact of their systems, processes and work environment on workers' psychological health and safety. It is important to integrate the management of psychological health and safety into all aspects of the employee experience.

Increasing scrutiny on human rights

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Corporations have a responsibility to respect human rights — they must not only ensure compliance with national laws but also manage risks of human rights harms with a view to avoiding them.

John Ruggie, former UN Special Representative on Business and Human Rights, Harvard University¹⁰

Twenty-five percent of our survey respondents said that human rights is attracting investor scrutiny, up from only 4% last year. Miners are now more accountable for their actions, including ensuring safe working conditions and protecting

the rights of workers and Indigenous peoples. This means it is more important than ever for the mining sector to incorporate human rights into their business practices to manage risk and create opportunities. However, progress in this area has been slow. The Responsible Mining Index (RMI) 2022 report shows that overall performance around human rights in the sector has an average score of only 22%.¹¹ The report highlighted an inconsistent approach across human rights issues and the lack of attention given to the topic by the majority of miners assessed.

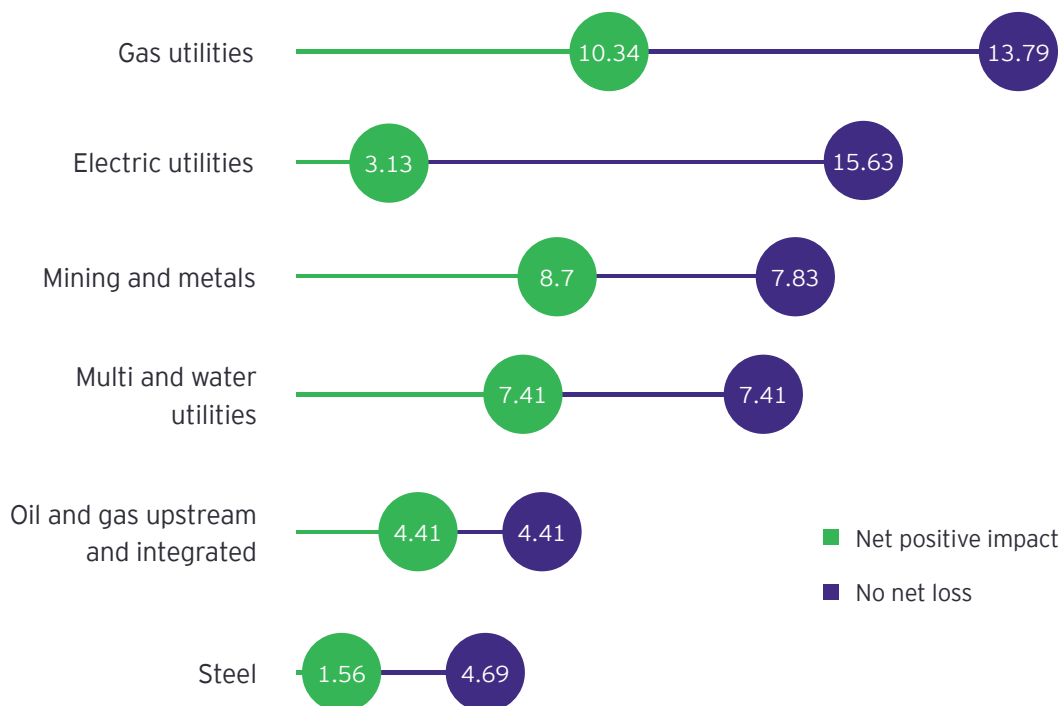
Failure to address human rights issues can lead to public opposition and legal consequences. Some mining companies are taking steps to integrate human rights into their operations by developing policies, addressing human rights in their annual reports, providing training and considering human rights in assessments. However, challenges remain in embedding human rights principles into day-to-day activities.

Progress toward net-positive biodiversity is encouraging

A quarter of respondents said the issue of biodiversity is attracting investor scrutiny, with this attention driving good progress toward positive biodiversity. Generative ecosystems are acknowledged as the ultimate goal, with miners taking a range of actions, including partnering with researchers, making greater use of data, and actively conserving and protecting ecosystems. For example, in Ghana, Gold Fields

has rehabilitated the ecosystem around its Damang Mine Tailings Storage Facility, developing an agroforestry system and self-sustaining wetland fishing area. But few companies are setting real targets in this area.¹² As of November 2022, only 8.7% of miners had targets in place to achieve a positive impact and just 7.8% had a target to prevent net loss.¹³

Percentage of companies making nature-related commitments by industry



Source: S&P global – biodiversity is still a blind spot for most companies around the world.

Mine closure is an opportunity to create a legacy of value

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Closure must create future value for our host communities; we mustn't leave ghost towns.

Senior mining executive

Mine closure is extremely complex, impacting a wide range of stakeholders with different, and increasingly high, expectations. A poor closure creates a negative legacy that is extremely difficult and costly to remediate. Many miners are

strengthening their focus on the issue, aiming to repurpose sites, establish secondary businesses and create long-term value for communities.

Partnerships and ecosystems can help miners ensure land reaps benefits long after mines have closed. For example, EY is currently developing a Leadership in Sustainable Mine Closure Program with Curtin University, Rio Tinto and the Bradshaw Research Institute for Minerals and Mining at the University of British Columbia. It demonstrates what good mine closure looks like and how to achieve it, and gives participants the skills and knowledge needed to inform closure-related decision-making across the entire mine value chain.

What gets measured gets done – the ESG data dilemma

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Environmental and social issues are the most challenging to measure, monitor and report, as there are no defined or widely agreed upon frameworks for measuring the impact, and the societal expectation for the desired or acceptable impact.

Senior mining executive

For most companies, one of the biggest challenges remains how to measure and monitor progress. Many ESG issues are now covered by regulation and frameworks but, while these can help drive action, they also create what respondents call an “alphabet soup” of regulations. As one miner said, “It is a challenge to keep ahead of myriad changes in the regulatory environment and the magnitude of issues that need to be managed, with an expectation to address these in the short term.”

Determining a baseline by which to measure positive achievements is a particular issue. This is critical to establish credibility, ensure integrity of these measurements and

integrate these considerations through the mine lifecycle. Ultimately, something like natural capital accounting will be needed to support companies in comprehensive assessments against global ESG sustainability standards. The Natural Capital Accounting for the Mining Sector: Beenup Site Pilot Case Study, based on a case study at BHP’s closed and rehabilitated Beenup mineral sands mine site in southern Western Australia, is the first attempt at trialing natural capital accounting within the mining industry.¹⁴

The corporate governance oversight of any net-positive program is critically important and requires board-level oversight of “how” the net-positive story is told to ensure it doesn’t have unintended consequences.

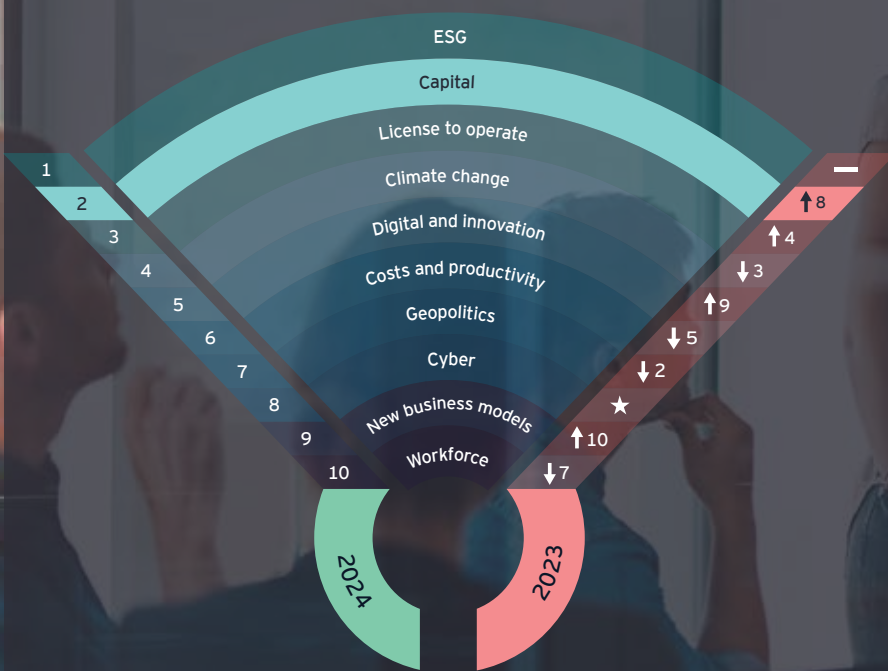
As the sector moves to mandatory reporting, companies are focusing on how to disclose and report in conjunction with financials. Many mid-tier miners told us resource constraints mean they will have to simplify processes.

One of the biggest issues for miners around ESG remains data integrity. As one respondent told us, “There are significant challenges in getting the platforms, people and processes we need to harness the data required to track and measure ESG goals.” Avoiding disclosure missteps requires a clear view of the high-quality data needed to inform decisions, with strong governance and controls in place to ensure appropriate sign-offs and processes.

Next steps:

- ▶ **Identify where you can achieve a net-positive impact** – from exploration to reclamation – taking care to ensure there is a defensible baseline.
- ▶ **Determine your strategies to use technology and data to improve ESG monitoring and measurement across the value chain** – particularly areas subject to greater investor scrutiny, including water stewardship and tailings management.
- ▶ **Consider how changes in the construction and operation** of mines can help improve safety and wellbeing for workers and communities.
- ▶ **Strengthen your focus on closure** to create long-term value for communities.
- ▶ **Assess the human rights impacts** of your organization, consult broadly and integrate considerations into environmental, social and health impact assessments.

2 Capital



“Growth capital to support the energy transition and business transformation is back on the agenda.”

Senior mining executive

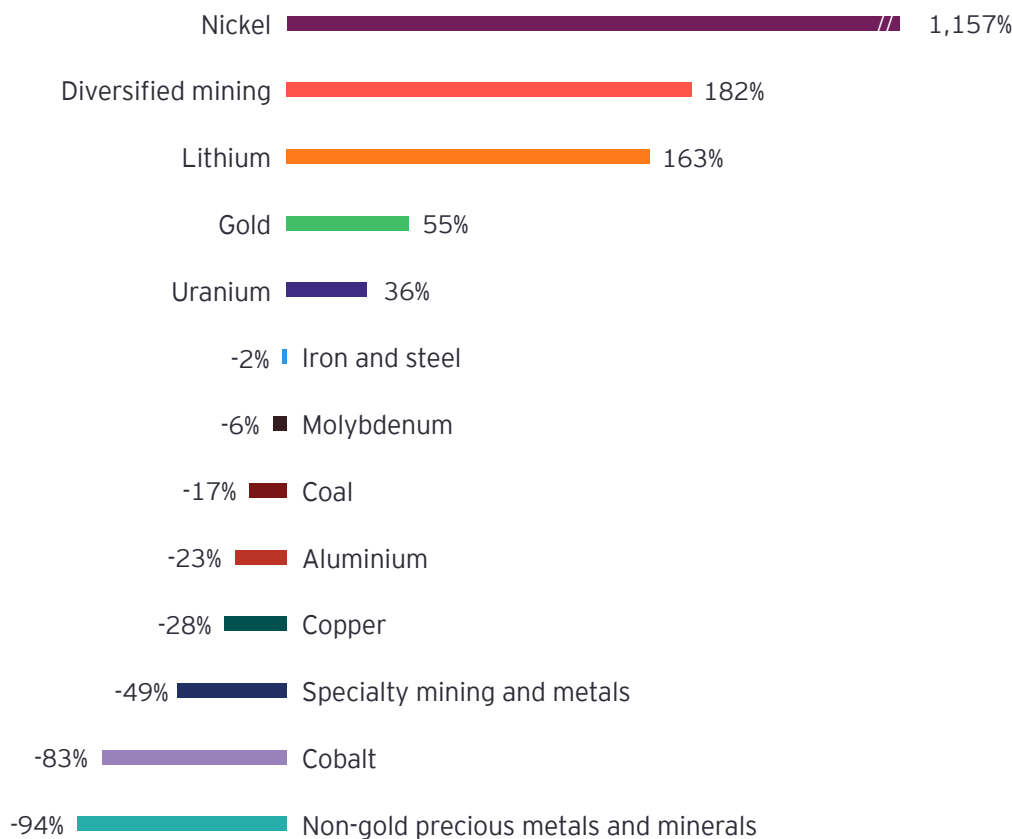
As the energy transition accelerates, future shortfalls in several key commodities (including copper, lithium and nickel) are becoming apparent. Investment in mining and metals is increasing to meet the need for more exploration and development, but the sector will need access to significantly more capital if we have any chance of meeting these shortfalls. This issue is attracting more attention, with capital markets recognizing the key role critical minerals will play in the energy transition. But capital raised through debt and equity in the first seven months of 2023 has remained steady (US\$196b compared with US\$192b in the same period of 2022), with this trend expected to continue into 2024.

Iron and steel, gold, and coal companies have attracted the most capital since 2022, but investment is increasing in nickel and lithium. In 2023, large nickel miners have raised

US\$2.76b through IPOs and follow-on equity issues. Junior lithium miners raised US\$560m through follow-on equity issues, mostly in Australia and Canada.

Capital raising by sector/commodity, Jan-Jul 2023

y-o-y % change



Source: EY analysis of refinitiv data.

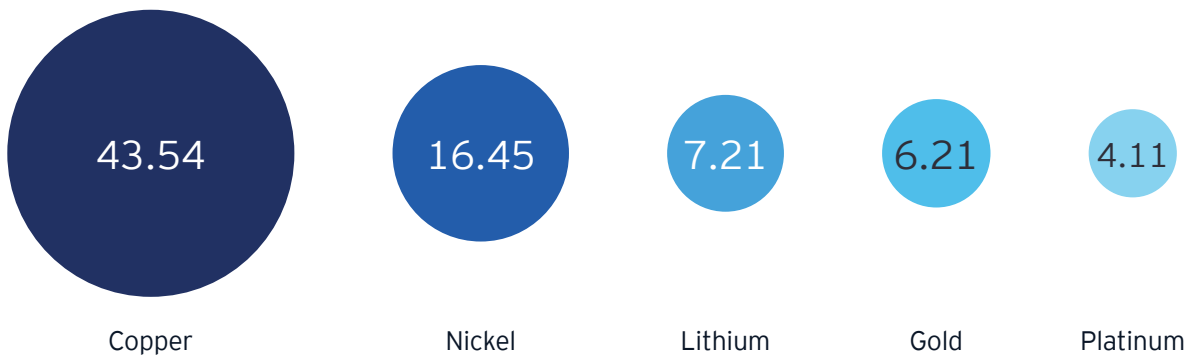
Significant capital being invested in developing new projects

The surge in early-stage development projects is expected to drive an unprecedented increase in the development of new operations. Analysis of S&P Global capital cost announcements of over US\$1b from 2020 to 2023 reveals the prospect of significant capital investment in greenfield

copper, gold, lithium and nickel project development over the next decade. Three-quarters of these projects are at the pre-feasibility or feasibility stage, with final investment decisions yet to be made.

Initial capital cost announcements for greenfield projects over US\$1b for top five commodities

January 2020-August 2023 (US\$b)



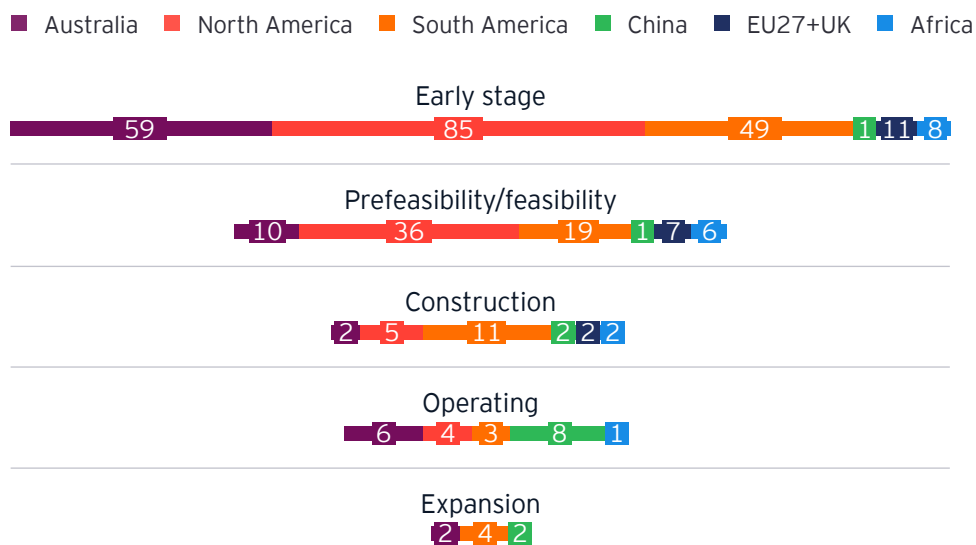
Source: EY analysis of S&P global capital IQ pro data.

As more lithium and nickel junior miners progress early stage projects through to the final investment decision, consolidation should increase. The recently announced

US\$10.6b merger of Livent and Allkem created the world's largest integrated lithium producer.

Lithium projects by country/region and development stage

No. of projects/mines



Source: EY analysis of S&P Capital IQ pro data.

Miners take action to meet future copper demand

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You can no longer develop brownfields if there is no green power supply.

Senior mining executive

The copper market outlook forecasts continued deficits from the late 2020s. This will push companies to consider several strategies:

- ▶ **Acquiring copper assets:** Some companies will consider stakes in high-margin, long-life copper mines. For example,

so far in 2023, we've seen BHP's acquisition of OZ Minerals and Glencore's acquisition of the remaining 56% of Argentina's MARA copper project.

- ▶ **Expanding brownfield copper projects:** Expanding supply through brownfield expansion is far quicker and less costly or risky than greenfield projects. But companies should be mindful of the need for older projects to meet newer ESG requirements, which may include electrification, green energy and low water usage, to win financing.

- ▶ **Spin-off of energy transition metals:** Some companies are spinning off energy transition metals into a separate entity to attract a broader investor base. For example, Vale is considering spinning off its base metals business.

Cross-sector investment aims to secure supply

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Strategy for capital for traditional builds will be very different — and will include joint ventures for offtake, etc.

Senior mining executive

With looming deficits of critical minerals, companies across sectors are integrating value chains in a bid to shore up supply. Automotive and battery manufacturers are

investing in mining companies: General Motors invested US\$650m of equity into Lithium Americas, and Tesla is constructing a lithium refinery in Texas and has offtake agreements with mining companies and Chinese lithium hydroxide producers.¹⁵

The impact of the US Inflation Reduction Act (IRA) is expected to attract more such deals, with an anticipated US\$63b+ investment into US battery factories - to produce almost 1TWh of cells by 2030 (about 15% of expected global capacity).¹⁶ A broad range of commodities, including battery minerals, have attracted some interest from private equity, as well as pension funds seeking ESG-friendly investments.

ESG bonds are supporting net-positive ambitions

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Ring-fenced green finance could be useful.

Senior mining executive

In the first seven months of 2023, mining and metals companies issued US\$1b of green bonds, down from nearly US\$4b in the same period of the prior year. Some

large miners, including Anglo American and Hydro, are issuing sustainability-linked bonds to demonstrate tangible targets.¹⁷ Other companies are refinancing credit facilities to strengthen ESG ambitions. Gold Fields, for example, has refinanced its US\$1.2b 2019 revolving credit facility, linking it to further gender diversity, water stewardship and decarbonization targets.¹⁸ This linkage of ESG bonds to specific projects (e.g., renewable energy, biodiversity and investing in local communities), rather than large overall targets, is a trend we expect to continue.

Exploration budgets rise, particularly in the US, Canada and Australia

The focus on minerals and metals for the energy transition has seen an increase in exploration, particularly in nickel and lithium. The US, Canada and Australia continue to be preferred destinations for exploration, as companies seek

new deposits in countries considered low risk. These three countries attracted more than half of all exploration capital invested in 2022.

Exploration budgets by destination 2018 vs. 2022 (US\$m)



Source: EY analysis of S&P global market intelligence data.

The challenge of balancing returns with responsibilities

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New mines need to be carbon-neutral from the outset.

Senior mining executive

Mining companies are keeping a firm focus on existing industrial markets. The biggest deals of the sector remain in copper, gold and steel. The deal value of completed copper deals in the first half of 2023 increased to US\$11.1b as BHP acquired OZ Minerals. Consolidation in the gold sector continues, with Pan American Silver acquiring Yamana Gold for US\$4.6b, and half of all annual exploration budgets are allocated to finding new gold deposits. In May, Newmont made a revised offer for Newcrest of US\$21b, including debt. The deal is expected to complete in the fourth quarter of 2023, pending shareholder and regulatory approval.¹⁹ And Cleveland-Cliffs has expressed interest in acquiring U.S. Steel.²⁰

But companies must balance growth and economic returns with the need to invest in decarbonization, sustainability and broader ESG issues. Linking ESG to financial value and reporting it as a value driver could significantly drive progress. One executive told us: “For it to make sense, it has to be linked to financial value, but this isn’t easy – it’s a work in progress for us.” Making the financial business case for ESG investment remains a struggle.

Major miners are also reassessing business models to better address capital risks and opportunities. Across the sector, companies continued capital discipline is reaping rewards for both shareholders and broader stakeholders. Average shareholder returns by the top 30 miners have increased by CAGR of 22% from 2019 to 2022. However, as miners adapt models and make more difficult investment decisions, they will need to make sure they bring investors along on the journey. With interest rates unlikely to decline soon, companies may need to work harder to balance sustainable alternatives with economic returns.

Next steps:

- ▶ **Conduct scenario planning** to build agility and ensure readiness for possible alternative futures.
- ▶ **Design the optimal portfolio to cater to future demand.** Building a portfolio fit for the future requires miners to consider a mix of strategies:
 - ▶ Building out reserves and replacing production
 - ▶ Investing in minerals and metals with strong demand prospects
 - ▶ Considering the impact of supply chain regionalization
- ▶ **Review your portfolio through a broader lens** of changing talent and societal expectations. Prepare to divest or reshape for a different environment.
- ▶ **Determine appropriate investment opportunities** in decarbonization, tools, technology and innovation.
- ▶ **Ensure balance sheet agility** when considering optimum levels of gearing and dividend policy.
- ▶ **Review funding and capital models**, including funding sources, the role of government and internal allocation, and how to make best use of tax breaks and incentives.
- ▶ **Conduct a full stakeholder risk analysis** to drive more informed investment decisions that incorporate financial, technical and ESG considerations.

3

License to operate (LTO)



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The reality is that industry has failed to earn the broad-based trust of society. Changing that is, first and foremost, the industry’s responsibility, but it is in everyone’s interest to see that happen, for never before has the world needed so much from an industry that is trusted so little.

Rohitash Dhawan, President and CEO, ICMM²¹

Expectations of companies are growing, with people demanding they do more for the communities in which they operate. According to the 2023 Edelman Trust Barometer, 50% of people think businesses aren't doing enough around societal issues, such as climate change, economic inequity or energy shortages.²²

Mining and metals companies face higher expectations than many other sectors. Miners typically operate on land that is licensed, not owned, and navigate a range of formal and informal conditions around how minerals are extracted.

Building trust is critical to managing expectations and to attaining and retaining LTO. In the past, we have focused LTO on Indigenous trust and reconciliation, but we believe its scope has expanded to encompass trust at a societal level.

Sector brand needs to evolve – building trust and articulating value is key

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Investors tend to be quite boxed in, so just ask about human rights and very basic DE&I terms. There is no discussion about what social sustainability really means.

Senior mining executive

The mining and metals sector ranked lowest in the 2021 GlobeScan report of attitudes toward all major sectors in 31 countries.²³ Some UK universities have banned mining companies from recruiting on campus, and the number of geology and mining engineering graduates continues to slide.²⁴

Much of the issue stems from poor historical performance, including the sector's impact on land, air, water and biodiversity, as well as a perceived inability to prepare communities to thrive after operations close. Awareness of mining's vital role in the energy transition remains limited, despite many miners working closely with countries to develop critical minerals strategies. ICMM CEO Rohitesh Dhawan describes the two "deficits" undermining the sector – a deficit of understanding and of trust: "Many in society do not understand what we do and why it matters, and this, combined with the legacy of accidents and disasters ... means that society ... does not trust our industry."

Companies also still face challenges achieving net-positive social impact, particularly in developing markets where expectations around the extent of a mine's social impact can be high. Managing these expectations requires careful program planning and ongoing stakeholder engagement.

Building trust through greater community engagement

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We need to work really closely with local communities for mutual success.

Senior mining executive

According to a report by the University of Queensland's Sustainable Minerals Institute, more than half of the 5,000+

critical minerals projects currently under development are on or near Indigenous lands.²⁵ Building trust with these communities is critical if the projects are to obtain approval, let alone meet required timescales – many executives we interviewed spoke of ongoing delays in obtaining project approvals.

Trust could be enhanced by doing more to meet increased expectations around greater stakeholder collaboration for mutual benefit. This requires transparency, listening to concerns and desires, and involving stakeholders in finding solutions.

In Australia, for example, South32 is working with the Illawarra Local Aboriginal Land Council and University of Wollongong to co-design an environmental management approach based on Aboriginal knowledge systems.²⁶ As the concept of “nature-positive mining” gains ground, Indigenous knowledge has a core role to play. As Hayley Zipp, Director of Environment at ICMM,²⁷ explains, “Indigenous peoples often have profound connections to

land and water, which can also be tied to their physical, spiritual, cultural and economic wellbeing. Their valuable traditional knowledge and experience in managing the environment in a sustainable manner makes them critical partners in the design and implementation of solutions for halting the loss of nature, and supporting the protection and regeneration of ecosystems.”

Creating a legacy with long-term value

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What other opportunities can we create for the community that reduce dependency on mining but still allow the community to thrive?

Senior mining executive

communities to thrive and improve energy security. As well as responsible mine closure (discussed in the “ESG” section), progressive miners focus on community health and challenge themselves to do more to create a positive long-term impact on communities. Addressing issues such as noise, dust, vibration and air quality should be minimum requirements, with miners also considering the long-term health impacts on communities and ensuring services are available to support people with health issues. In some regions, consultation with local governments can help manage stakeholder expectations.

Miners need to think about the legacy they want to leave behind – to create jobs, care for the environment, enable

Regulators and standard setters, including ICMM, OECD and The Copper Mark, have strengthened expectations around community engagement and development.



Take a long-term view of sustainability across different dimensions

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It's about value, not just costs. And this perspective is gaining space.

Senior mining executive

Executives say their understanding of sustainability-related matters has increased significantly over the years – but now they realize they cannot tackle all matters at once. The big question is what to prioritize to create real and lasting impact, a challenge made harder by the difficulty of monitoring and measuring social impact.

Actively engaging with communities to first understand, and then deliver, the value they need can also help prioritize actions. Anecdotally, there is a correlation between the level of maturity and depth of engagement with communities and benefits realized. Miners with open, close communication with community leaders appear to have more highly engaged employees and fewer strikes, perhaps because communities see the value of miners' contribution to local education, infrastructure and health care.

When trust is an issue, transparency is key. And in mining, expectations around transparency come not only from the community, but from the other stakeholders as well, especially investors and regulators. Never before have mining senior executives been so scrutinized and held accountable for incorporating all different aspects of the ESG agenda into their own. To date, miners demonstrated their responsibility through a vision statement and adherence to voluntary disclosure standards. Now, new standards, such as IFRS S1 and S2, impose an unprecedented level of responsibility on the executive agenda.²⁸ And the European Sustainability Reporting Standards impact global mining companies if they meet certain criteria, and these standards are based on double materiality (both impact and financial).

As leaders consider the implications of new responsibilities and expectations, they should consider that a survey by GlobeScan found that “sustainable business models and evidence of impact and action are the strongest drivers of recognized corporate leadership.”²⁹ Responsible, trustworthy governance is more important than ever if miners are to retain their LTO and succeed in the long term.



Next steps:

- ▶ **Align around a wider, stakeholder-driven agenda.** Moving away from a narrow focus on shareholders allows miners to consider how to create longer-term value for communities, including First Nations people, and the workforce.
- ▶ **Focus on articulating your purpose and use this to build the brand.** Strengthening brands through effectively measuring, articulating and reporting on the value delivered to stakeholders can help miners secure LTO and, ultimately, gain competitive advantage. Consider the legacy you want to leave that will provide the greatest value to stakeholders.
- ▶ **Develop a stakeholder engagement plan** that articulates the value proposition for each stakeholder group, designs appropriate engagement programs and ensures long-term value is delivered in line with expectations.

4

Climate change



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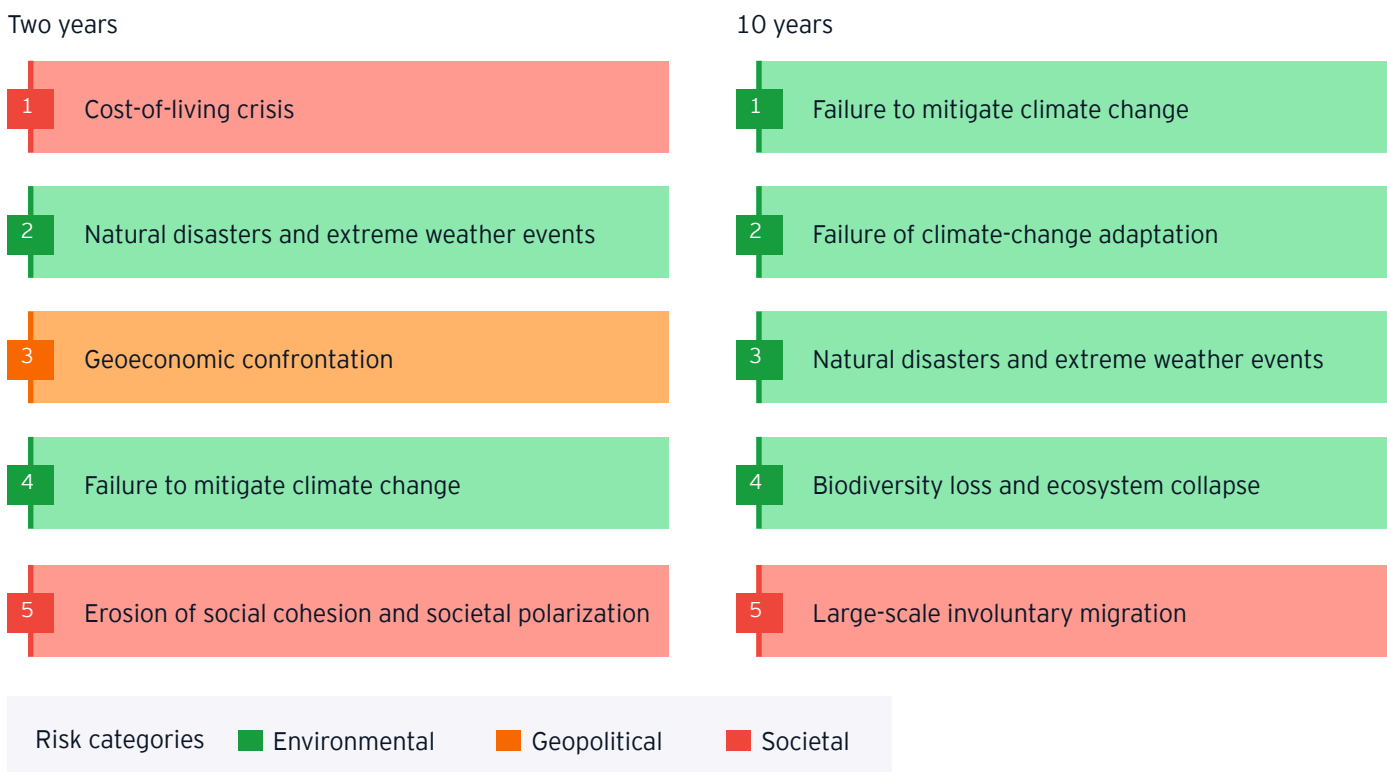
Climate change has caused widespread adverse impacts and related losses and damages to nature and people that are unequally distributed across systems, regions and sectors.

[IPCC climate change 2023 synthesis report³⁰](#)

Climate change and climatic events are the top global risks the world will face over the next decade, according to the World Economic Forum’s Global Risks Report 2023.³¹ Climate change is incredibly complex, with broad impacts. **Miners are expected to provide minerals for the energy transition, while also reducing greenhouse gas (GHG) emissions.** Scientists agree that if global warming exceeds 1.5° Celsius, this will trigger several tipping points for our climate systems that may lead to abrupt and irreversible impacts on ecosystems and societies. Without significant policy change and investment, climate change impacts could threaten availability of water and food in climate-vulnerable communities, many of which are key mining regions.

Global risks ranked by severity over the short and long term

“Please estimate the likely impact (severity) of the following risks over a ‘two-year and 10-year period’”



Source: World Economic Forum.

Climatic events on the rise

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 These events are getting closer and more frequent. It’s about how we prepare for these events.
 Senior mining executive

Climatic events continue to be a priority for mining companies as they increase in number and have a greater impact on day-to-day operations. Recent bushfires in Canada forced many miners to suspend operations and evacuate staff.³²

One affected miner told us they are considering better preparations for future events: “We are asking: ‘Do we allocate two-day stoppages per annum to cater for climate change?’ It might not be a bad idea going forward.”

The impact of climatic events on productivity and health and safety means miners must begin to plan and prepare now. The World Gold Council has identified a range of adaptation strategies in its Gold and climate change: **Adaptation and resilience report**,³³ with its Climate Change Lead **John Mulligan explaining**: “Without consistent, systematic and widespread planning, the increased complexity, frequency and severity of climate impacts will have a negative impact on the supply chain.”

Different options explored on the journey to net zero

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We're committed to climate change, but you need to be realistic about what it takes. I continue to stick to the targets set but, in hindsight, I probably regret that I set a target for 2025 and 2030.

Jakob Stausholm, Chief Executive Officer, Rio Tinto³⁴

CFOs are under pressure as they allocate funds to decarbonization projects that are costly, with long time frames and returns that are hard to quantify. As one mining executive said, "We've realized how expensive it is with a number of trade-offs – we can go the easy route and make supply chain changes, or we can redesign our operating model." Many mining companies admit they are struggling to meet interim net-zero targets (Scope 1 and 2) and are revisiting strategies, though none told us they were extending targets.

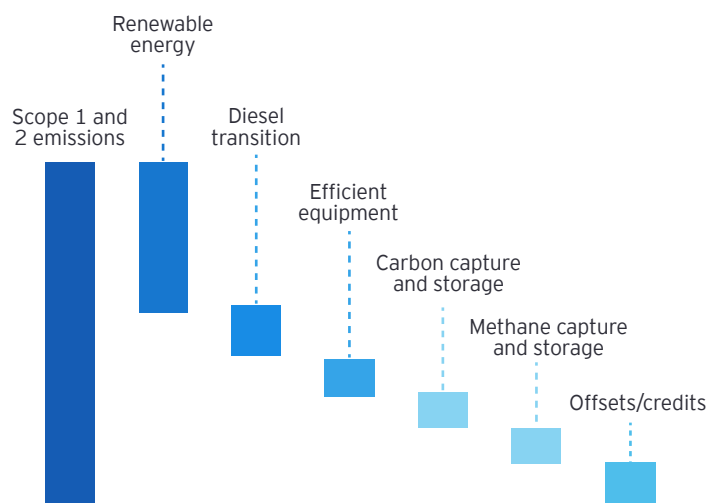
Government support in many regions is driving growth in renewable energy contracts and investment in solar or wind generation. For example, in 2022, Anglo American sourced 52% of its electricity from renewable sources, reducing Scope 1 and 2 emissions by 7% and 11% year-on-year to 8.3MtCO₂e and 5.0MtCO₂e, respectively.³⁵ The falling cost of renewables has seen an uptick in investment; however, finding the amount of land needed and negotiating land deals with traditional owners will take time. Many miners are sourcing green electricity to decarbonize Scope 2 but find it hard to get green energy at scale.

Vehicle electrification remains expensive, and miners have been considering other diesel transition options, including battery technologies, hydrogen and biofuels. For example,

Coal asset divestment continues

Many diversified miners have either divested their coal assets or set a date for phased closure (e.g., BHP's Mt Arthur coal mine). Those that haven't are beginning to face investor backlash. Thirty percent of Glencore's shareholders,³⁷ challenged the company's climate strategy due to its coal assets.³⁸ In January, Teck Resources announced a spin-off of its steelmaking coal business to create two independent companies, Teck Metals and Elk Valley Resources.³⁹ In June, Glencore offered to buy the metallurgical coal business of Teck Resources.⁴⁰

The path to Scope 1 and 2 abatement



Fortescue Metals Group announced it would invest US\$6.2b in capital by 2030 to eliminate fossil fuel risk and reduce operating costs.³⁶ The investment includes renewable energy generation and battery storage, as well as a green mining fleet and locomotives.

Carbon capture and storage is difficult and represents a significant proportion of GHG emissions. For underground mines, particularly coal mines, fugitive methane is an additional issue to deal with that will require innovation.

While ICMM members have collectively pledged to achieve net zero across Scope 1 and 2, few have set net-zero targets for their Scope 3 emissions. ICMM is currently collaborating with the Science Based Targets initiative (SBTi) to develop a Scope 3 emissions accounting framework for the sector, to enable its members to set detailed, transparent targets. Companies also continue to explore their options to improve performance on Scope 3 through sustainable supply chains, circular economy incentives and partnership opportunities.

The war in Russia-Ukraine slowed progress on phasing out fossil fuels. That said, Standard Chartered has recently pledged to stop providing financial services to mining and power generation companies deriving 100% of their revenue from thermal coal, and HSBC has declared exclusion of coal assets by 2030 in the EU and OECD, and globally by 2040.

Miners grapple with increasing demands for disclosure

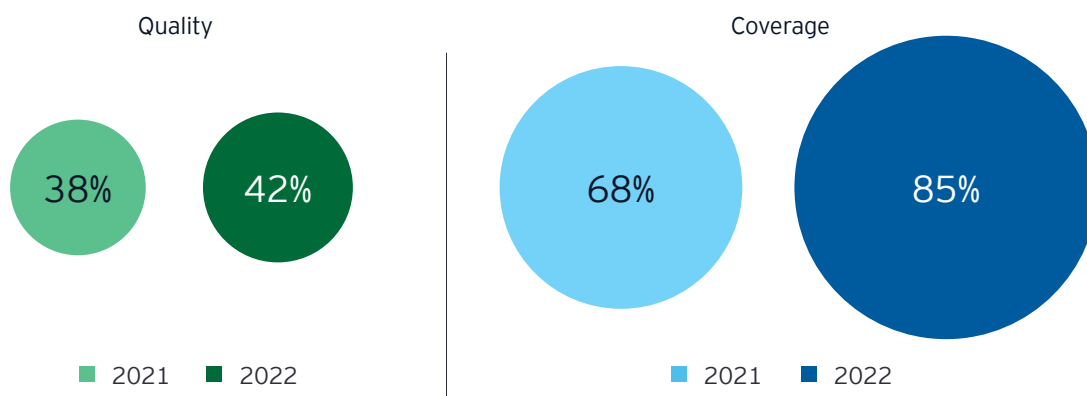
Concerns about potential greenwashing and emissions underreporting have led to mandatory proposed emissions disclosures in many countries. **In March 2022, the US Securities and Exchange Commission (SEC) announced plans to standardize climate-related ESG disclosures for investors. The SEC proposal mandates publicly listed companies to disclose Scope 1, Scope 2 and Scope 3 emissions.** Final rules will likely be adopted in some form under the current administration.⁴¹

In February 2023, the International Sustainability Standards Board (ISSB) also agreed to rules requiring companies to

report emissions from direct operations, energy purchases and value chains (Scope 3 emissions).

While the mining sector rates well for the high quantity of TCFD recommendations addressed, according to the EY Global Climate Risk Barometer 2022,⁴² the quality of disclosure reporting rates poorly. Still, we see year-on-year increases in disclosure coverage and improved quality, probably because climate risks and opportunities are increasingly integrated into organizational strategy, rather than treated as a separate initiative.

Miners' coverage of emissions reporting is improving, but quality is still lacking



Source: EY global climate risk barometer 2022.



Offsetting the cost of carbon

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There is a clear need to consider carbon offsets in conjunction with other ESG factors. If we are buying land, it needs to tick other boxes as well.

Senior mining executive

To avoid accusations of greenwashing, miners should ensure they source high-quality carbon credits and provide transparency around activities to actively reduce direct emissions. Land-based carbon credits via nature are being considered as a priority, as they also can provide a positive biodiversity benefit. For example, Rio Tinto is exploring the role that nature-based solutions and offsets can play in the decarbonization journey. The scale of the first round of projects is significant, with the potential to generate up to one million tonnes of offsets per year by 2030.⁴³

Partnering for innovation

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All nations must progressively pursue an economy-wide transition to net-zero emissions ... Actively positioning policies that encourage industry to produce the critical minerals needed for renewable energy, batteries, and electric vehicles and appliances.

Mike Henry, Chief Executive Officer, BHP⁴⁴

Many miners are focused on R&D to solve their decarbonization challenges. The bad news is that sometimes the right technology doesn't yet exist. The good news is that this is driving miners to form ecosystems and partnerships, including with startups, to develop innovation.

Anglo American's Pathways to Steel Decarbonization⁴⁵ challenges startups and small and medium-sized enterprises (SMEs) to create technologies that reduce carbon emissions in steel manufacturing. The company is partnering with the European Institute of Innovation & Technology, an EU institution that seeks to create platforms where advanced research and business can collaborate to support innovation.

ICMM's Innovation for Cleaner, Safer Vehicles initiative⁴⁶ sees it working alongside OEMs to promote operational and technological innovation that will enable mining operations to adopt GHG-free surface mining vehicles by 2040. Pilots will roll out over the next few years.⁴⁷

Nickel Creek Platinum, along with CarbMinLab, University of British Columbia, has demonstrated substantial carbon absorption from the Wellgreen tailings.⁴⁸ President and CEO Stuart Harshaw said, "Having a low-carbon nickel product will be beneficial to the downstream processors of our nickel, especially the EV market, where reducing the carbon footprint is a critical part of the green economy."

Next steps:

Building a flexible transition strategy with practical pathways requires miners to consider a range of actions:

- ▶ Scenario plan different pathways to net zero to create a flexible, agile decarbonization strategy. Determine which tools, technology and innovation to invest in, and whom to collaborate with to get there.
- ▶ Determine how high-value offsets and other financial instruments can be used to help achieve net zero while avoiding accusations of greenwashing.
- ▶ Consider projected future climatic events when designing, planning and provisioning mines.



5

Digital and innovation



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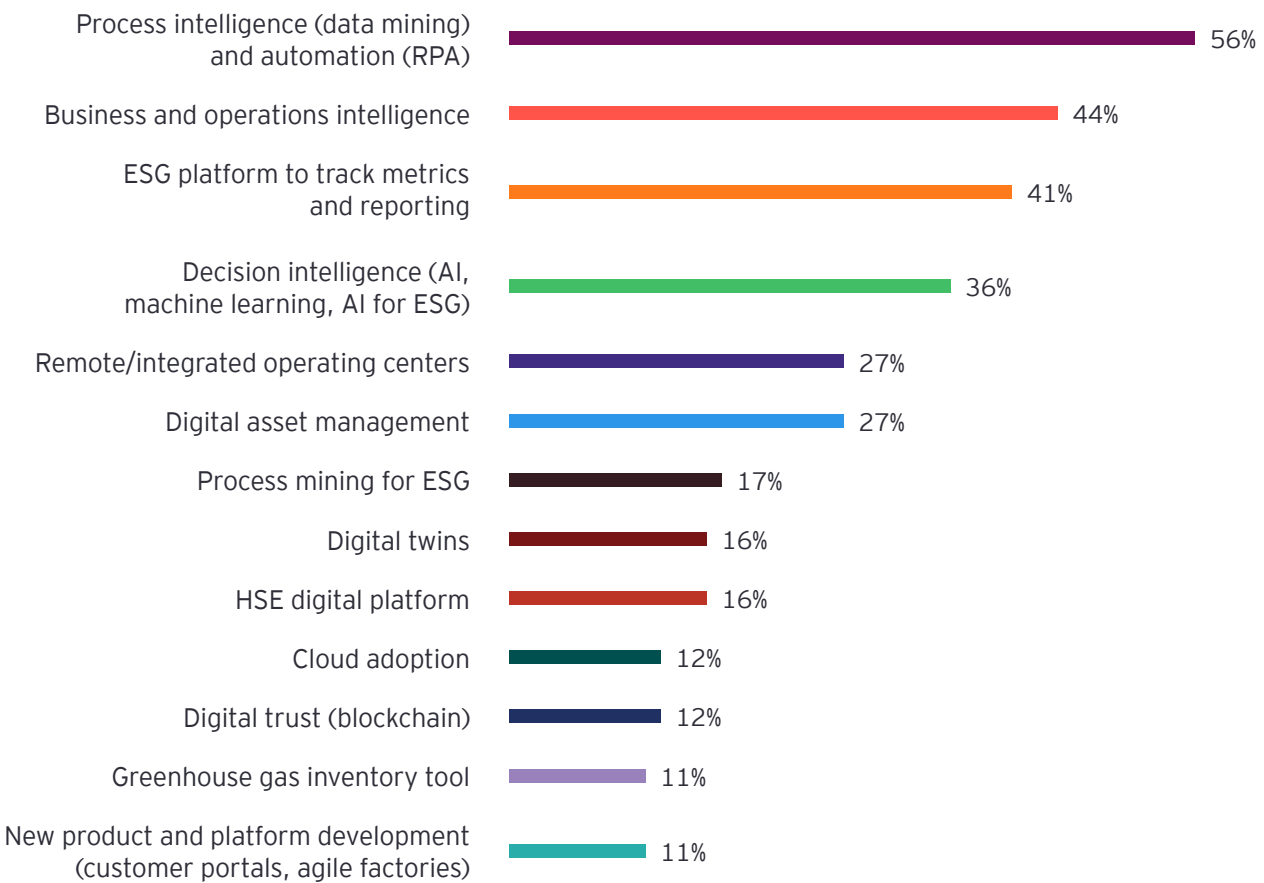
Transformation is happening around us, and we are trying to catch up with it.

Senior mining executive

Economic pressures are forcing mining companies to elevate the way they innovate with data and technology. Leaders anticipate a surge in investment in data and technology for the year ahead, driven by demand across the business for digital solutions to reduce costs and improve productivity and ESG outcomes. The complexity of digital investments requires miners to proceed with caution.

What are your digital priorities over the next one-two years?*

2024



* Respondents could choose more than one option.

Source: EY mining and metals business risks and opportunities survey data 2024.

Miners excited by potential of GenAI

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AI has the potential to transform the industry at a multitude of levels. However, there is a large hesitation to move forward, as people are concerned about how effective it might be and the impacts should it go wrong.

Joe Carr, Innovation Director for Mining, Axora⁴⁹

Generative AI (GenAI) is the most exciting new technology for our respondents this year, with leaders intrigued by its potential. Artificial intelligence (AI) could enhance how miners manage large data sets, but it will also expose underlying data quality issues and highlights the importance of getting the fundamentals of data management right.

Miners will need to carefully consider new AI technologies and how they apply to specific use cases. Language-specific GenAI can help streamline administrative tasks burdened

by inefficiencies. General approaches for these kinds of use cases are being proven in other sectors and can be tailored for mining-specific concerns that are similar in nature.

However, many applications currently fall outside the purview of the much-hyped language models, such as geostatistical applications, as well as supply chain simulation and optimization use cases. While the nonlanguage branches of GenAI, such as diffusion models, are being considered by research groups for their application in geosciences, they are not yet widely accessible.

Recent developments in AI present promising opportunities for the sector but bring with them additional complexity and operational management requirements. Identifying and executing on these opportunities requires the support of a robust AI strategy that underpins the essential components of a technology trial and aligns decision-makers with company objectives.

Modern AI platforms make it easy to build a demo, but the challenge is operationalizing and establishing the business value of these efforts.

Areas where GenAI can uplift capability in mining and metals

Contractor management

- ▶ Contract data extraction for Supplier management
- ▶ Accelerate RFP drafting and review
- ▶ Context-aware search for legal can uplift capability in mining and metals
- ▶ Multilanguage support and transparency
- ▶ Helping to standardize supply contract lifecycle by identifying policy exceptions

ESG

- ▶ Perform initial media scan to assess supplier labor practice
- ▶ Assistance on “greenwashing” screening
- ▶ Assist identification of stakeholder concerns and sentiment analysis from public consultation data

Safety

- ▶ Consolidate anonymous workplace safety incident reporting and suggestions
- ▶ Assist with creation and delivery of site-specific training materials
- ▶ Identify breaches of procedure from debrief transcripts and other logs

Asset management

- ▶ Automate the generation of context-aware safety and risk management strategies tailored to specific facility conditions
- ▶ Assist maintenance activities with summary and search of in-house technical documentation
- ▶ Accelerate capex project planning With human-machine chain-of-thought collaboration

Energy management

- ▶ Streamline greenfield projects by drafting submissions and planning scenarios
- ▶ Generate risk profiles for extreme weather events and natural disasters (resilience)

Compliance

- ▶ Assisted policy drafting and review to ensure compliance across regions and languages
- ▶ Automated compliance monitoring across sensitive business processes
- ▶ Monitoring regulatory and guideline updates to highlight existing practices that need review

Digital twins still underused

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Digital twin is the solution everyone wants but doesn't understand.

Senior mining executive

Digital twin technology is still underutilized despite its proven ability to add huge value, most likely due to lack of awareness of the capability and the upfront cost of on site sensor implementation. Through remote sensing capabilities, digital twins enable miners to collect more real-time data and gain a richer understanding of all sites under management. Miners have an opportunity to capitalize on this readily available technology. Rio Tinto's digital twin at the Gudai-Darri mine is creating virtual mine models that enable the company to test in-the-field decisions ahead of execution, improving both productivity and safety, as well as optimizing return on investment by identifying approaches to maximize production.⁵⁰

Providing an upside to ESG initiatives

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Bringing digital technologies to scale could reduce emissions by up to 20% by 2050 in the three highest carbon-emitting sectors: energy, materials and mobility.

World Economic Forum⁵¹

store and analyze large amounts of data from individual operational systems, enterprise systems and third-party sources, enabling miners to add value beyond compliance. It allows them to achieve and execute sustainability roadmaps, provide greater visibility across asset performance and operations, and demonstrate activities' exposure to potential adverse environmental and social impacts. The EY-Parthenon 2022 Digital Investment Index found that 26% of senior executives reported a positive impact from digital investments in addressing ESG challenges, and 23% said sustainability was the top operational goal for the company's digital investment over the next two years.⁵²

Digital solutions can help miners address increasing pressure to improve the availability and reliability of ESG data. Digital innovation can transform how miners gather,

Companies are making greater use of data analytics to accelerate their net-zero journey, tracking their carbon footprint and using smart sensors and blockchain to better track, monitor and manage Scope 3 emissions.



How do you manage data to extract maximum value?

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It's not just about collecting data, but how to manage data to extract maximum value.

Senior mining executive

Miners are usually data rich but struggle to capture insights from this data, despite huge investments in technology. Critical business data is locked in silos and difficult to access, and IT is disconnected from business teams. Technology projects move too slowly, with project-driven technologies almost obsolete by the time they go live.

If miners are to unlock more value from data, they must first identify what data is important, when it is needed and how to extract it from business processes. This requires a deeper understanding of the intersection between organizational data and business process landscapes, and the difference between data that is genuinely valuable versus transactional information. And data must be trusted: key decision-makers must have confidence in the source of data and its accuracy, completeness and reliability.

Organizations that are more mature in their digital journey have strong data governance across people, process, data and technology, and have invested in understanding data lineage. This is critical to creating a feedback symbiosis between decision-makers and those preparing the data. It also enables the embedding of a consumer-driven approach into their data-driven innovation culture.

Finding the right model to deliver digital transformation

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Would mining companies be more successful in digital transformation if you push data out to the operations?

Senior mining executive

Despite the growing focus on digital, many miners still lack an integrated approach to its implementation. This limits the value technology can bring to the business, and wastes money and time. As one CIO remarked, “The real challenge isn't the absence of technology but changing the organizational culture to be more integrated and focused on long-term goals rather than short-term results.”

Much of the challenge lies in developing the right model to deliver transformation. Within many mining companies, IT is siloed. Our conversations with mining executives revealed differing views on the function's rightful place and role. Should IT be in the business or centralized? Could it provide data as a service to operations, giving engineers access to valuable insights from operational data?

Finding the right talent remains a problem for mid-tier miners who are turning to service providers to help deliver digital transformation. And across the sector, miners are questioning whether they need a specialized digital team or transversal skills in engineers. We are seeing both approaches. Bigger companies tend to have a digital team and digital leaders, while mid-tiers tend to take the transversal skills approach – teaching people what they need to know to get the work done.

Tech-agnostic solutions enable future agility

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It's so easy to jump to the bright shiny toy, and in the absence of a strategy, it just becomes a distraction.

Senior mining executive

Miners continue to invest in technology stacks, but architecture is evolving at pace. Solutions that can be connected and added to, irrespective of their foundation architecture, give miners the ability to adapt for the future. Generic, “one-stop shop” solutions that promise the earth but have no clear scope or value profile waste time and money, and negatively impact the business's belief in data as an innovator.

We have begun to see a few players target tech-based investments and anticipate this trend to continue.

Greater collaboration and partnerships could speed up transformation

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What is the ecosystem we actually need to help us accelerate the building of capability?

Senior mining executive

Rather than adopting new off-the-shelf solutions, mining companies need to increase collaboration with partners, to influence what and how products are designed. As one CIO remarked, “No one understands our business better than us, so how can we use that knowledge to partner to develop the technology together?”

Change management is critical for effective technology adoption

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As CIOs, we need to fall in love with the problem, not the solution. We need to put ourselves in the operator’s shoes, to truly understand their real situation, and be able to transform various aspects of their routine.

Senior mining executive

with the impact on employees and other stakeholders, as well as processes, well understood and communicated. As one mining executive explained, “When we talk about the digital transformation journey, it’s not just about digital ... We need to transform individuals so they can use the technology, which should always be a means and never an end. That’s our challenge: How do we marry these concepts? How do we prepare our employees?”

Miners need to assemble the right teams with subject-matter experts across strategic change, data science and mining disciplines who can ask the right questions and make the right changes. Successful organizations deliver results and insights fast and have a clear plan for industrialization. They also use analytics sprints to iterate through business questions, starting simply and becoming more complex. This allows new innovations to be embedded at scale into daily business operations.

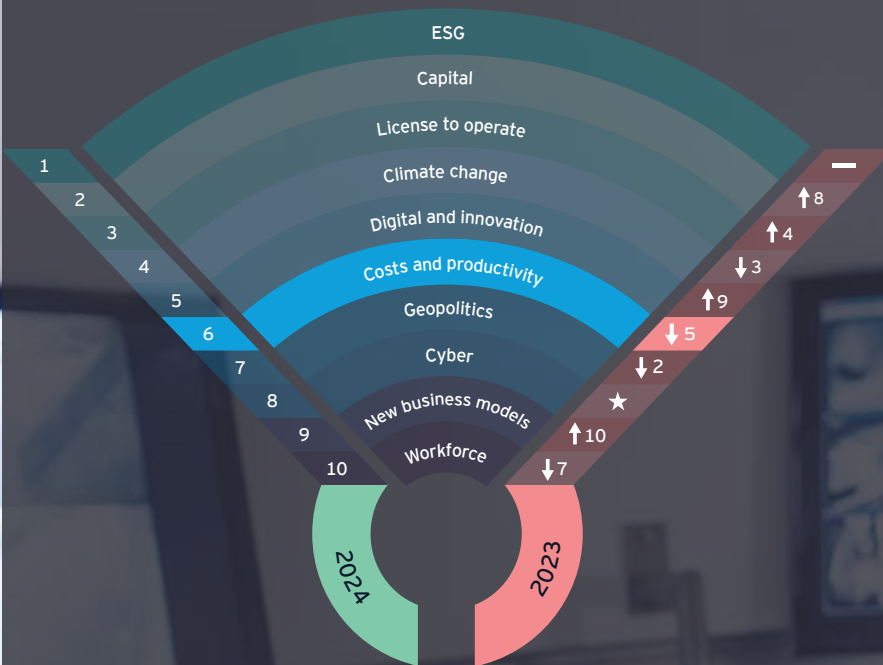
Technology adoption, and its success, differs between miners, with our research revealing that organizations that champion new technology at an operational level do best. People must be at the center of any digital transformation,

Next steps:

- ▶ **Put the right structure and processes in place** to enable true business transformation. Investing in change management to support technology adoption is key.
- ▶ **Extract more insights from data.** Better decisions start with data. Miners that make smarter use of data and technology to improve scenario planning can build the agility needed to respond to ongoing volatility.
- ▶ **Collaborate and partner.** Companies that haven’t already should act now to form collaborations and alliances with technology and data management companies to develop and implement new digital solutions.
- ▶ **Take a strategic approach to innovation.** The supply of innovative ideas is not the constraining factor for mining companies. Rather, the challenge is to ensure these innovations are focused on delivering the company’s strategy and driving a competitive advantage.

6

Costs and productivity



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Inflation has impacted costs across the board — it's stronger and higher than we all anticipated.

Senior mining executive



Inflationary pressures are now easing sharply around the world, and policy rates in the major advanced economies are probably at, or very close to, their peak. In other countries, such as Chile, rate cuts have begun.⁵³ Oxford Economics thinks policy rate cuts next year will be gradual.⁵⁴

Inflation is down, but higher costs are impacting margins

Despite inflation easing, mining companies noted that the positive impact on realized costs will take time to feed through.

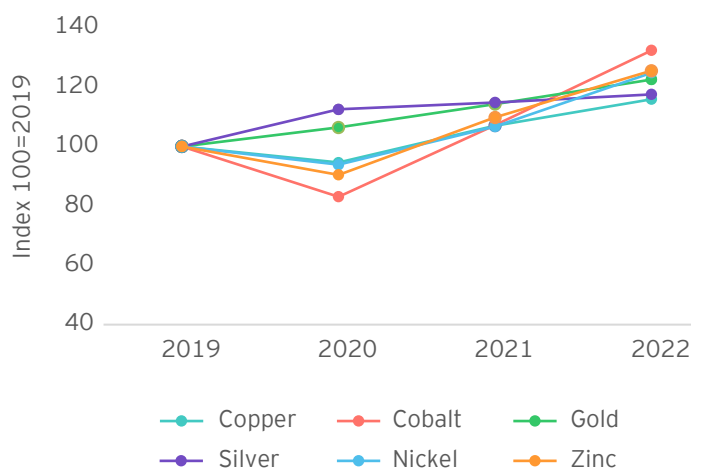
Energy and labor costs rose higher than official inflation numbers and are remaining higher. Increased energy costs, as a fallout of the war in Ukraine, are persisting. Labor costs have also risen due to a tight talent pipeline and a growing shortage of skilled staff in many mining regions, including Australia. As the talent shortage increases, we expect to see more wage inflation.

In Australia, mining companies are also raising concerns about the impact of the proposed industrial relations reforms on costs; for example, the reforms will require employers to pay labor hire workers the same rate as direct employees performing the same job.⁵⁵

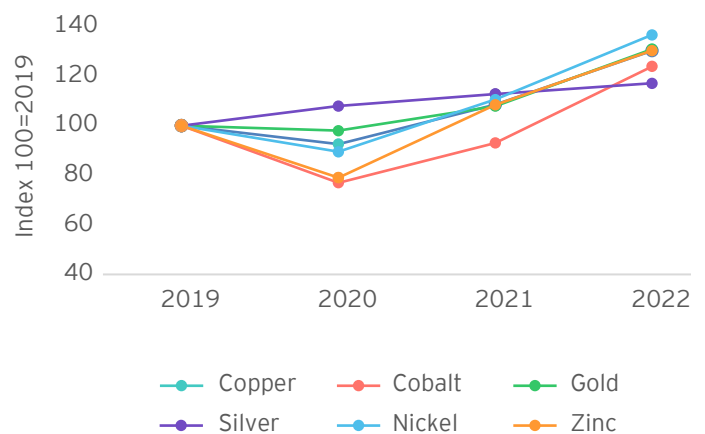
Other rising costs include:

- **Royalties:** Amid higher commodity prices, some jurisdictions have increased royalty rates to ensure sufficient returns. For example, Chile introduced a new Mining Royalty Law in August 2023 that subjects mining operators to an ad valorem component and a mining margin according to their level of sales and the type of minerals exploited. Coming into effect on 1 January 2024, the law has the potential to increase the total cash costs of copper and lithium producers.
- **Decarbonization:** Decarbonizing operations is costly. For example, Fortescue's decarbonization plan will require US\$6.2b of capital investment.⁵⁶

Labor costs – Index 100 = 2019



Energy costs – Index 100 = 2019

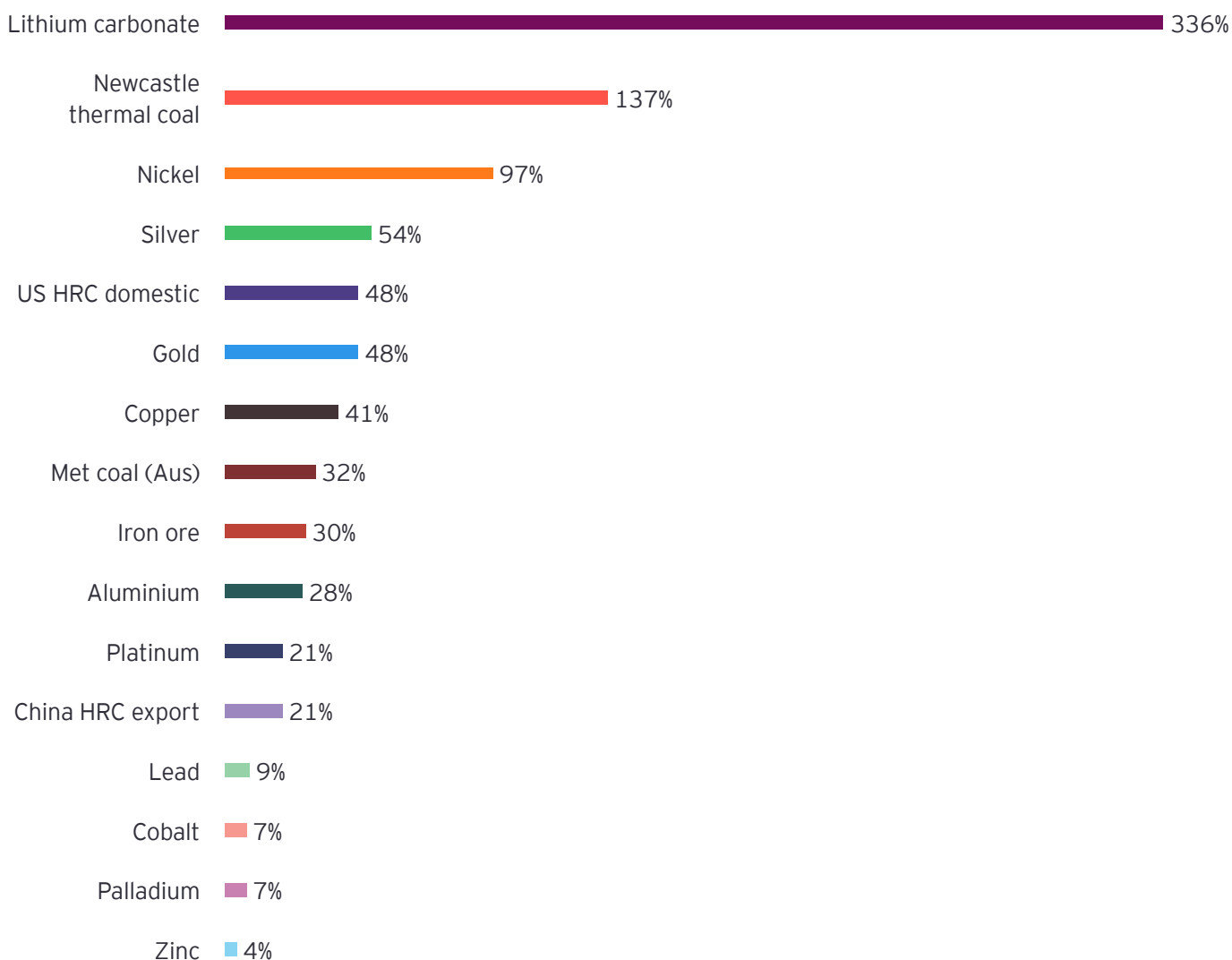


Source: EY analysis of S&P global capital IQ pro data.

Despite these increased costs, higher commodity prices have supported margins, but these are on the decline, according to analysis of EBITDA margins of major mining companies. Margins are now closer to 2019 figures, even as commodity prices stay high.

Commodity prices remain higher than in 2019

% change 1H 2023 vs. 1H 2019



Source: EY analysis of S&P capital IQ pro and refinitiv eikon data.

Capital projects face overruns

Capital productivity has long been a concern for the mining and metals sector, with recent volatility and uncertainty exacerbating the problem. As well as increased input costs, higher interest rates are pushing up the cost of capital.

A review of 132 development projects requiring over US\$1b of capital investment showed that nearly one in five faced cost overruns, with an average blowout of US\$500m.⁵⁷

Managing the ever-increasing cost of carbon

As of 2022, 46 national or regional and 36 subnational jurisdictions have set a price on carbon. Perhaps most notable of these is the EU's Carbon Border Adjustment Mechanism (CBAM), which targets carbon-intensive sectors, including mining, to address carbon leakage and reduce emissions.

Miners belonging to low-middle income countries may face greater exposure to CBAM-like taxes. For example, current EU carbon futures prices of US\$87 per tonne would add around US\$420m to the price of Mozambique's exports to the EU. If more countries adopt similar carbon taxes on imports, the impact will be felt in countries where energy is still largely provided by fossil fuels.

In the US, the federal government is yet to address carbon pricing, but a few states have introduced carbon pricing schemes. In Canada, inconsistent applicability of carbon

pricing is causing major discrepancies in impact. A study by the Mining Association of British Columbia indicates that, due to variances in carbon pricing structure, a mine in British Columbia will incur the highest functional carbon tax of any major mining jurisdiction in the world.⁵⁸

The price of Australian carbon credit units could double before 2035, according to modeling from the EY Net Zero Centre, increasing from around AU\$40/tonne today to around AU\$80/tonne.⁵⁹

And even with increased carbon pricing, current coverage of existing schemes sits at 12gt of CO2 emissions, which accounts for only 23% of global GHG and less than 50% of reductions required to reach the 1.5°C target. This indicates that miners can expect coverage for carbon pricing to increase.

Productivity challenges require a systemic approach

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The approach to improving productivity is still defined by point solutions. We need to get physical and financial data to accurately forecast what's happening in operations.

Senior mining executive

Our discussions reveal new challenges to productivity:

- ▶ The lack of experienced operators and managers is becoming acute, negatively impacting productivity. In

some cases, training does not adequately prepare workers for the job, hampering both productivity and safety. We are also observing an overreliance on point technology solutions to compensate for diminishing operational experience.

- ▶ ESG priorities are overshadowing the productivity agenda. Some interviewees commented that they believe the focus on productivity has diminished in the wake of ESG strategy development.

A broader problem is the sector's lack of a systemic end-to-end approach to productivity. This has been a challenge for over a decade, and it remains a weakness. Operations are managed for locally optimized solutions in the value chain, but this can diminish productivity across the entire value chain.

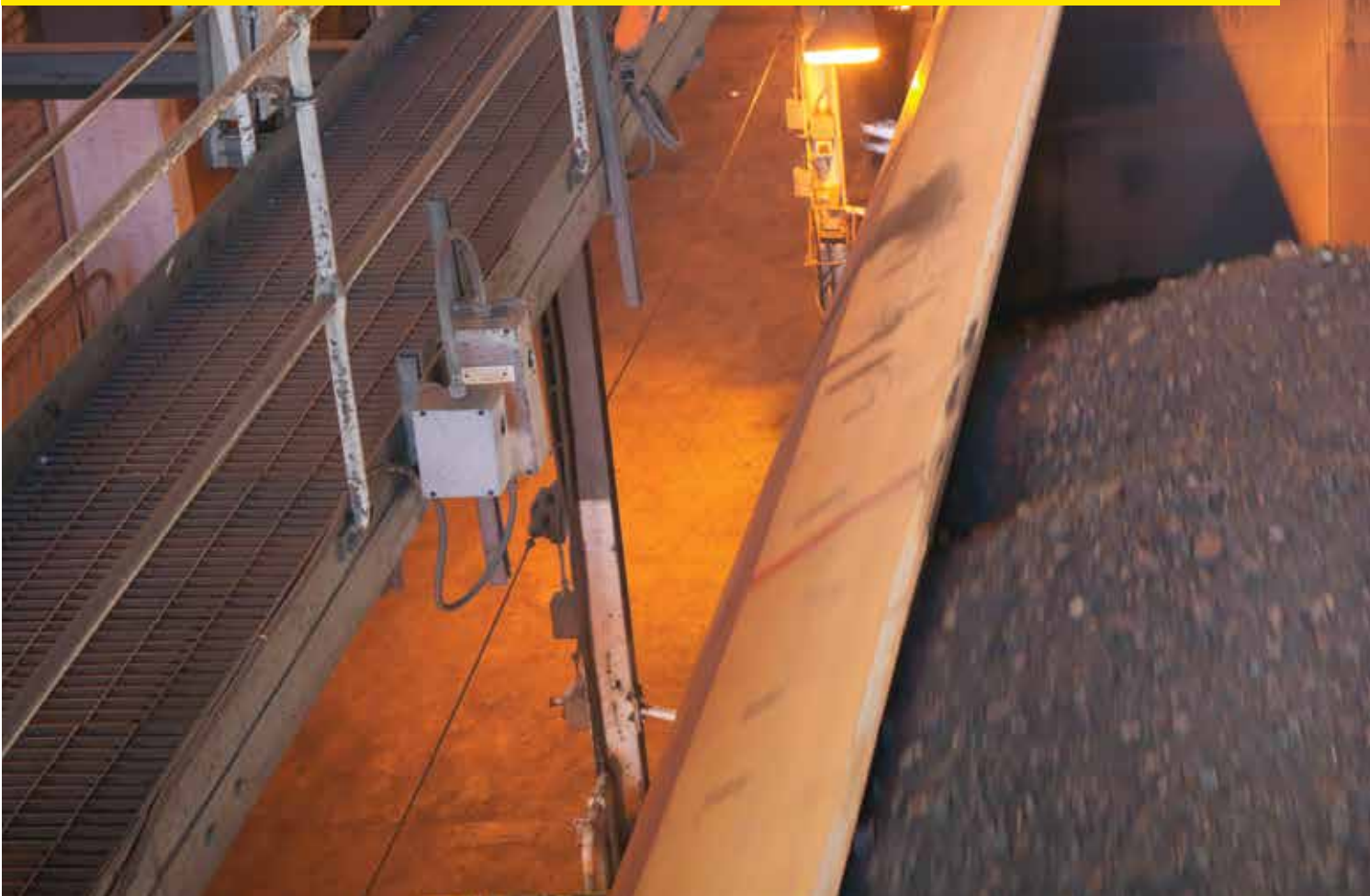
Next steps:

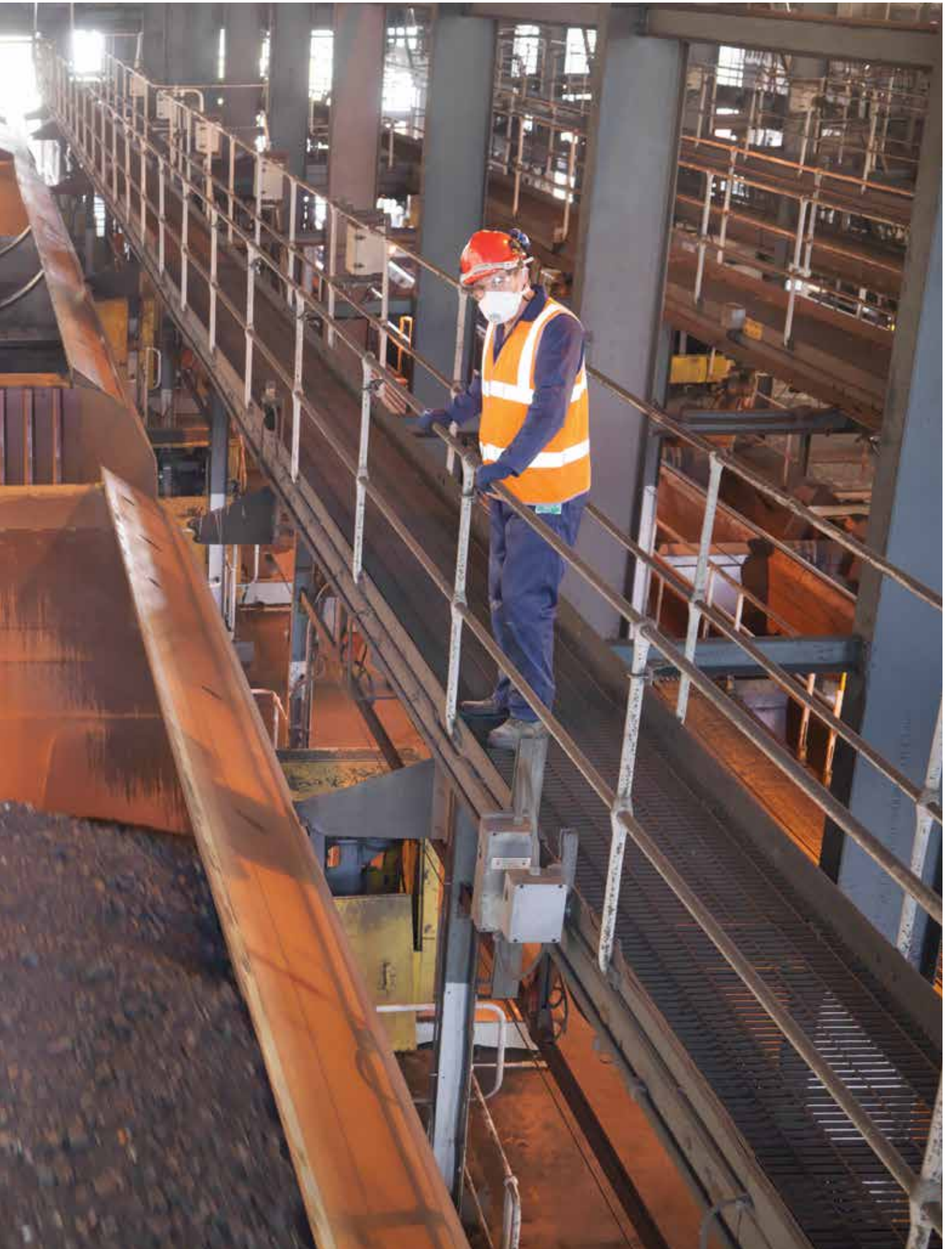
Improving productivity will depend upon a combination of data, information, knowledge and wisdom that is centered around people and powered by technology.

- ▶ **Build an integrated operating model.** Many miners still have a siloed operating model, with little integration between operations and maintenance and a lack of inventory optimization strategies and plans. Aligning a mining company's business model, how it creates and protects value, with its operating model is key to ensuring productivity improvement. Typically, value erodes from the resource base through to market. The role of each planning horizon is to ensure that erosion is both transparent and managed. Integrating all planning horizons, from life of asset to closure, enhances decision-making and operational stability, unlocking value across the value chain, and provides a foundation for operational excellence and discipline.
- ▶ **Transition from time-based to condition-based and, eventually, predictive maintenance.** This helps to improve the reliability and availability of physical assets, and to minimize risks and operating costs.

- ▶ **Focus on building a long-term sustainable cost base.** Ensure new measures add, rather than erode, value. Improving asset productivity can have a significant impact on cost reduction, given high maintenance spend, and an impact on productivity if asset performance is not optimized. Options to consider include:

- ▶ Switching to lower-cost renewable sources of energy
- ▶ Encouraging innovation and partnerships that will reduce costs in the longer term
- ▶ Reviewing capital tied up in high levels of pre-stripping, advance development and stockpiles
- ▶ Considering the use of contract mining versus sale or leaseback
- ▶ Reviewing supplier and service contracts
- ▶ Creating strategic joint ventures to optimize economies of scale
- ▶ Reducing back-office costs through automation or outsourcing





7

Geopolitics



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Resource-rich countries are likely to impose more control on the supply of minerals, while for importing countries, ensuring resilient supply chains of green minerals will be an increasingly important geostrategic imperative.

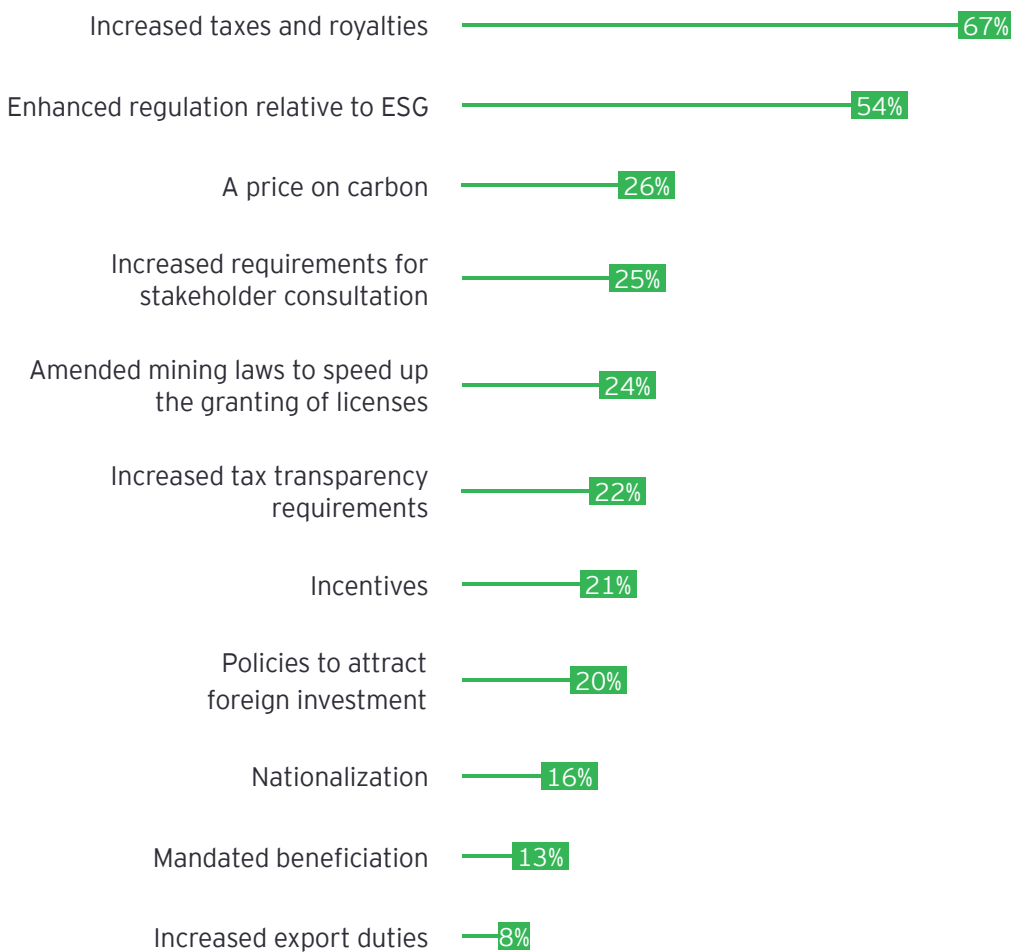
Courtney McCaffrey, EY Global Geostrategic Business Group Insights Leader

Geopolitics has moved to seventh place on the risks index, down from second last year. The change in ranking likely indicates the lack of new geopolitical risks on the agenda this year. However, ongoing issues — including tensions with China, the war in Ukraine and the introduction of new laws in key countries — mean mining and metals companies must remain vigilant to geopolitical risks and opportunities.

We now live in a multipolar world, according to the EY 2023 Geostrategic Outlook, driven in large part by US-China tensions and the rising assertiveness of middle powers.⁶⁰ Rising populism and nationalism have also contributed to a weakening of multilateral institutions as governments have exerted more control over their economies. These trends were accelerated by the COVID-19 pandemic and supercharged by the war in Ukraine.

Within this volatile environment, the race for minerals and metals required for the energy transition is accelerating, and so, too, are a range of government incentives and restrictions. The US IRA is a notable example, attracting investment into the US and allied countries, but also raising the specter of further global trade tensions due to its onshoring and friendshoring provisions. Mining companies will need to be agile – ready to manage the risk of government intervention in the sector, while also being open to capturing new investment opportunities.

What actions do you expect governments to take over the next 12 months?*



* Respondents could choose more than one option.

Source: EY mining and metals business risks and opportunities survey data 2024.

Navigating resource nationalism, political change and carbon taxes

With demand for critical minerals high, countries with these valuable resources are moving to optimize their economic returns. Expect to see an increase in government participation in mining, as well as more taxes, royalties and restrictions. In some countries, critical minerals may be nationalized.

This means that mining, extracting and exporting is going to become harder for miners. More countries are building their own processing facilities and expecting materials mined to be domestically processed.⁶¹ Indonesia has generated significant revenue by ensuring nickel is processed domestically, for example.⁶²

New or announced government actions since December 2020



The implementation of the EU CBAM is likely to push more countries to impose similar restrictions, to ensure equity for domestic producers and limit the import of embedded emissions. CBAM began its transitional period on 1 October 2023 and covers steel, iron ore, aluminium and some downstream products. Some companies are worried about how it will affect tax rates, while concerns have also been raised about the impact on developing countries' competitiveness. CBAM may still be challenged under the International Trade Law – India, for instance, has openly opposed it.⁶³

Ongoing regulatory and political changes reinforce the importance of mining companies maintaining vigilance and strong relationships with government. For example, the lead-up to Ecuador's national elections in August 2023 saw some calls to ban all mining in the Choco Andino region. Dundee Precious Metals took preventative action, signing an investment protection agreement with the Ecuadorian government to ensure regulatory and tax stability and ongoing access to tax incentives.⁶⁴

Mining companies face strong competition for green incentives

As governments double down on energy transition goals, many are introducing initiatives aimed at fast-tracking renewables while also reducing reliance on other countries, particularly strategic rivals and in critical sectors. The pursuit of self-sufficiency is creating a plethora of green incentives and subsidies, including the European Critical Raw Materials Act and the US IRA. These are influencing investment, with countries reshoring technology and energy, as well as the mining and processing of minerals and metals.⁶⁵ According to the American Clean Power Association, private companies have invested US\$271b in domestic utility-scale clean energy investments in the US since August 2022.⁶⁶

Mining companies are seeing some benefits and flow-on investments from these schemes, either through offtake agreements or even direct investment, but it seems downstream sectors will likely receive the bulk of stimulus for decarbonizing technology. Subsidies tend to stimulate

demand more than supply, but don't always eliminate the hurdles for miners, including around environmental permits and social licensing. Some fear this may result in widening the gap between supply and demand of critical minerals in the near to medium term.⁶⁷

There are also concerns that climate change-related regulations and subsidies in developed countries will exacerbate the global wealth divide, particularly for those countries without resource wealth. Resource-rich countries in Africa and elsewhere, on the other hand, have an opportunity to play the big powers off each other as countries scramble for influence in, and access to, mineral resources in emerging markets. In Africa, investment from China means governments have increased debts to the country. But China's dominance could be challenged, with both the EU and US eyeing Africa's role in the battery metal value chain, offering indirect support through incentives and grants.

Proactive strategies can mitigate geopolitical risk

In January 2023, the EY CEO Outlook Pulse Survey found all energy and resources CEOs have altered strategies in response to geopolitical challenges.⁶⁸ Forty-one percent have reconfigured supply chains, 39% are exiting businesses in

certain markets and 32% have halted a planned investment. More companies are also creating roles with the specific remit of managing geopolitical risk.

Next steps:

Mitigating geopolitical risk requires mining and metals companies to take a proactive, diversified approach. Now is the time to:

- ▶ **Integrate political risk into broader strategic planning.** Consider the impact of geopolitical trends when making strategic decisions, and ensure there is clear ownership of political risk within the organization.
- ▶ **Engage with stakeholders.** Companies should proactively seek opportunities for closer engagement with stakeholders, including governments, to demonstrate how mining creates long-term value for communities.

- ▶ **Collaborate with trade and industry groups.** Working together with these groups can help miners better advocate around future taxation schemes.
- ▶ **Influence taxes and policies** through articulating the impact of changes on mining and metals companies, and recommending improvements.
- ▶ **Investigate government incentives.** Mining and metals companies that make the most of government incentives or co-investment opportunities can fast-track innovation and decarbonization while reducing costs.

8

Cyber



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Mining companies are under attack. The sector wasn't a prime target before, but there's been a rise in mining companies suffering attacks.

Chief information security officer (CISO)



Cyber is back on the ranking for the first time since 2020 as mining and metals companies face increased attacks from cyber criminals.

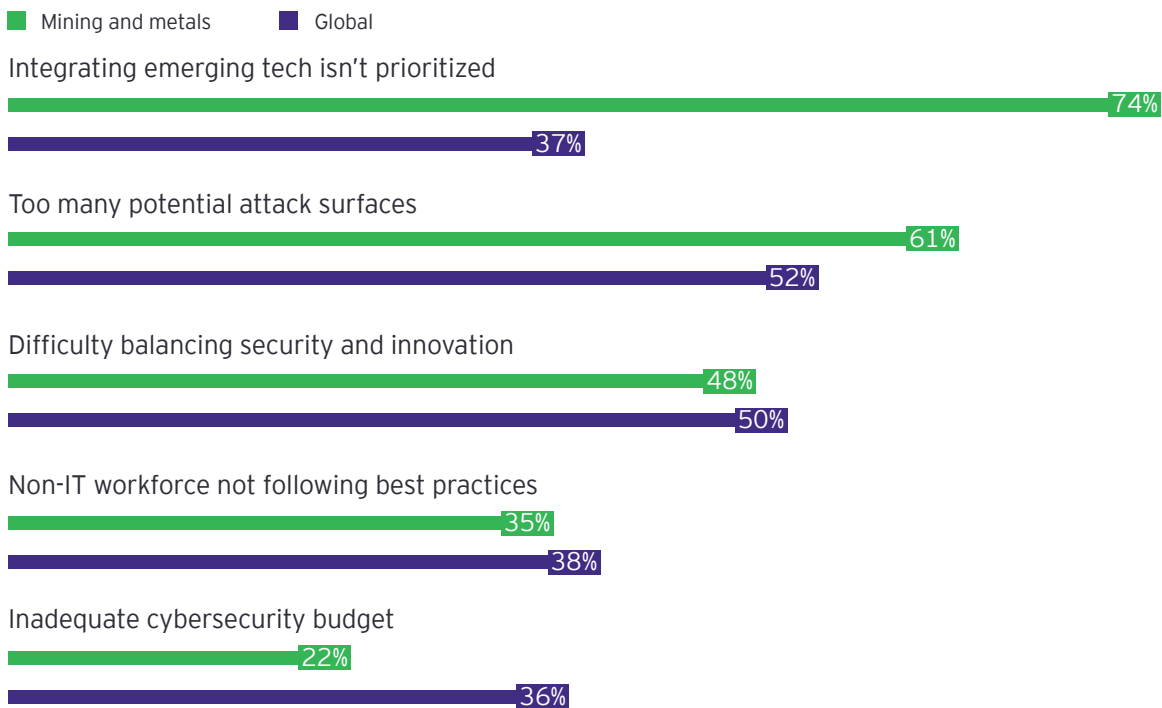
Growing IT and operational technology (OT) convergence, digital transformation and remote working, as well as the war in Ukraine, have seen cyber incidents skyrocket. The World Economic Forum has highlighted cybersecurity as both a short- and long-term risk that must be tackled now.⁶⁹

A more complex threat landscape spans IT and OT

“
OT isn’t as mature as IT — it becomes a weak point in the system.
CISO

Today, all mining organizations are digital by default, operating in a vast, connected digital landscape where every asset represents another node in the network and increases the attack surface. The EY 2023 Global Cybersecurity Leadership Insights Study⁷⁰ found 74% of mining and metals executives say integrating technology is a key challenge, compared with 37% for all sectors. Some of our clients are seeing a rapid increase in the number of attacks on operational systems, including attacks specifically designed to target these environments.

Top five internal challenges to cybersecurity approach



Source: EY 2023 Global cybersecurity leadership insights study.

Many CISOs we interviewed said they were responsible for the OT environment, but the experience on-site is somewhat different. They are often blocked by operations or OEM providers, who fear cyber tests and improvement initiatives will cause shutdowns and impact productivity.

The “human factor” is a major issue in cybersecurity, and a huge gap in mining and metals. The sector needs a step change in cyber culture and awareness to build cyber resilience and preparedness. Every company should accept that, when it comes to cyber attacks, it’s not a case of “if,” but “when.”

New focus on IP cyber risks

Our survey highlights a growing concern from miners around intellectual property cyber risks. This may be driven by a need to protect event-sensitive information (such as during M&A or negotiations for land rights) and

growing investment in R&D around ESG initiatives (such as decarbonization projects). It's a sign the sector is shifting its cyber focus from a narrow view of protecting "availability" to also securing "confidentiality."

Concern about cybersecurity-related risks to the organization

% very concerned

■ Mining and metals ■ Global

Technology infrastructure risks



Intellectual property protection risks



Financial risks



Reputation risks



Supply chain risks



Physical risks



Employee risks



Source: EY 2023 global cybersecurity leadership insights study.

Cyber threats require greater board attention

“

Cybersecurity threats are very much seen as a technology problem in the industry, where really it needs to be looked at as a business risk.

Rob Labbé, CISO, Mining and Metals Information Sharing and Analysis Center (MM-ISAC)⁷¹

Only 40% of boards in the [EY Global Board Risk Survey 2023](#) are confident they understand the biggest cyber risks facing the organization.⁷² Cyber reports to the board infrequently, with CISOs often seen as cyber tool operators rather than business risk managers. As miners expand into more businesses requiring a greater level of IP and insight (such as hydrogen power and green steel), financial risks of cyber attacks could increase significantly.

If boards are to make effective decisions around cyber risk, they need a cybersecurity reporting and risk framework, and a risk-focused mindset that enables them to ask better questions of management.

Mixed feelings about the impact of regulatory changes

New cyber-related regulation will elevate cyber to the board's agenda. For example, new rules proposed by the SEC will require public companies to disclose how boards oversee cyber risk.⁷³

We asked CISOs whether they thought extra regulation would help or hinder cybersecurity programs. Ninety percent of CISOs we interviewed felt it would help, but many

raised concerns around additional stress placed on already underresourced teams. This highlights the need for regulators to get the balance right and for business to increase investment in cyber capability. Our research suggests that cybersecurity funding has not kept up with the growing risk, with 22% of survey respondents saying budgets are lower than required to address cyber-related challenges.



New strategies to fill the cybersecurity skills gap

Upskilling the current cyber workforce is the biggest talent strategy to prepare for future threats, with 78% of survey respondents saying this is a significant or top priority. Many companies have built internal capabilities, but changing business demands see some opting to outsource critical

processes. The gap between demand for cybersecurity skills and workers is widening, with cyber OT professionals even harder to find. Mining and metals companies that co-source these skills can gain the capacity they need while upskilling their own cybersecurity teams.

To what extent in your organization prioritizing the following talent strategies to prepare for future cybersecurity threats?

% Top or significant priority

■ Mining and metals ■ Global

Standardizing and automating processes to reduce staffing needs



Diverse workforce retention and recruitment



Outsourcing more functions and capabilities to third-party specialists



Source: EY 2023 Global cybersecurity leadership insights study.

Next steps:

Building cyber resilience requires miners to consider key questions:

Have we aligned our cybersecurity strategy to enable business objectives?

- ▶ If yes, how is the organization structured to bring the diverse skill sets to advise and influence key stakeholder groups across IT and OT?
- ▶ If no, do we need to review the accountabilities framework and appoint a senior executive to champion the change?

How effective are our cyber controls to manage our top five enterprise-wide cyber risk scenarios?

- ▶ Are these cyber risk scenarios known and assessed periodically by the right teams?
- ▶ Has the approach incorporated "bottom up" analysis (e.g., identifying and assessing the multiple cyber

risk scenarios that are business unit specific (10 to 15 scenarios) and common group-level scenarios) and leveraged "risk bow-tie" principles (i.e., critical preventative and detective/recovery controls that are well defined with clear metrics to continually assess control effectiveness)?

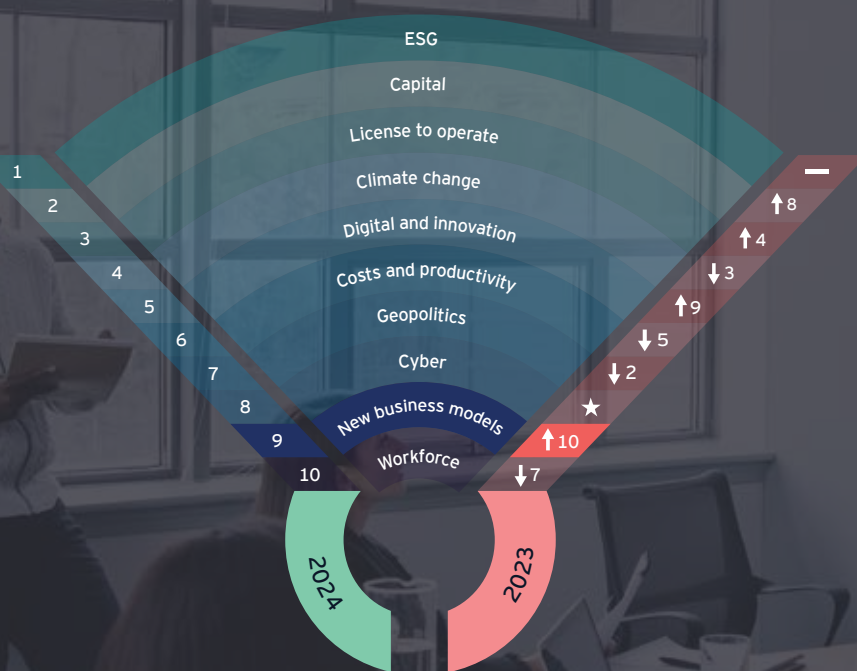
When did we last conduct cyber testing or a deep dive into OT cybersecurity?

- ▶ A dedicated industry framework, called the **MITRE ATT&CK® Matrix for ICS**, outlines the tactics and techniques used to gain unauthorized access and execute malicious commands in an OT network.
- ▶ If an exercise was recently performed, how effective were controls to prevent, detect and respond to unauthorized activities. More importantly, is there sufficient transparency and visibility to monitor the completion of short- and medium-term improvements?



9

New business models



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Our business model is being challenged - led by changes in digital, ESG and access to capital. We are reassessing our portfolio, considering vertical integration as well as how to invest in renewable energy.

Senior mining executive



Mining and metal companies are ramping up progress on new business models, both vertically and horizontally across the value chain, to maximize value.

Focus on improving mine to market flow

We see a greater focus on exploration, beneficiation and materials production, to help improve mine to market flow, generate incremental demand for commodities and allowing companies to leverage margins while reducing volatility. Advanced processing is attracting investment, as countries seek an alternative to China. For example, companies in

Indonesia have implemented high-pressure acid leach (HPAL) technology to process nickel ore, and, around the world, lithium miners are integrating mining into processing and battery manufacturing. Collaboration across the value chain is also increasing as OEMs seek to secure raw material supply, and mining companies secure capital to build new mines.

More innovation in green products

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Premiums are not yet available for all commodities.

Senior mining executive

Mining company executives told us they see green minerals and metals as the future of the business – but not all are seeing a premium. One said, “They might become available, and the objective to achieve net-positive impact will serve the need.” However, some producers are already receiving a premium for green metals, particularly copper and, as demand increases, it is expected that premiums may increase, especially if supply does not keep pace.⁷⁴

Demand for green products, and the associated transparency required, is expected to ramp up in line with a growing focus

on embedded emissions. Initiatives such as the EU's CBAM will increase scrutiny of how metals are produced and how much carbon is emitted in each process.

Some examples of green products include:

- ▶ **Green aluminium technology** to produce lower-carbon products. For example, Norsk Hydro's REDUXA technology produces aluminium products with less than 4kg CO₂/kg of aluminium, compared with the industry average of 16.7kg CO₂/kg of aluminium.⁷⁵
- ▶ **Green steel raw materials**, including higher-grade iron ores or direct reduced iron (DRI). For example, Vale is using concentration technology to raise ferrous content to around 67% at its Carajás complex⁷⁶ and is exploring how to produce carbon-neutral steel.⁷⁷
- ▶ **Green steel**, such as that produced by BHP and Hatch's trial of the electric steel furnace, can produce steel from DRI using renewable electricity and hydrogen.⁷⁸

Investment in adjacencies helps mitigate risk

Companies are also investing in adjacencies, particularly those that support or de-risk other investments, including infrastructure, energy and technology. Horizontal integration allows miners to increase scale and investment by decreasing risk in a nonfamiliar geography or commodity, driving a value model change to gain competitive advantage. It is also an option for

investing, rather than returning, a greater proportion of capital. For example, Anglo American partnered with EDF Renewables to form Envusa Energy, which will develop a renewable energy ecosystem in South Africa. The project is expected to generate 3GW to 5GW of clean energy by 2030, boosting the resilience of South Africa's electricity network.

Balancing new business models with core activities

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Reshaping business models is a challenge. While we internally see the need, shareholders are less willing to enter that conversation because of the impact to returns.

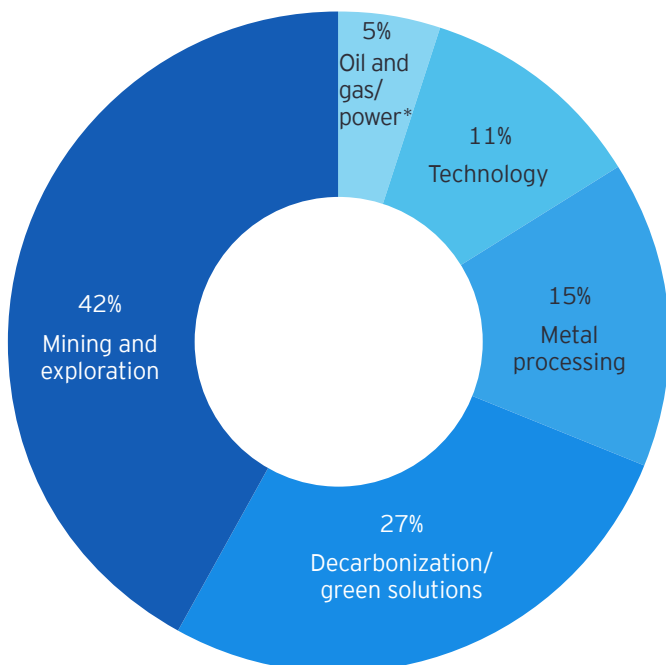
Senior mining executive

The question of where to invest for growth is not easy to answer. Scenario planning is vital to ensure agility. It helps underpin medium- and long-term business plans, prepare for alternative futures and forecast the impact of potential scenarios on demand.

Our survey reveals miners are considering a range of investment options. Digital is a growing focus, possibly because increasing costs and inflation have highlighted the role of technology in improving productivity. The rising impact of AI is also a factor.

The challenge for miners is addressing the need to invest in new business models while maintaining discipline and returns. EY analysis shows most companies are focusing investment in traditional or core activities such as exploration, mining and processing to ensure returns remain strong – and can fund investments in sustainability, technology and new business models.

EY analysis of investments of 12 major mining companies 2018-22

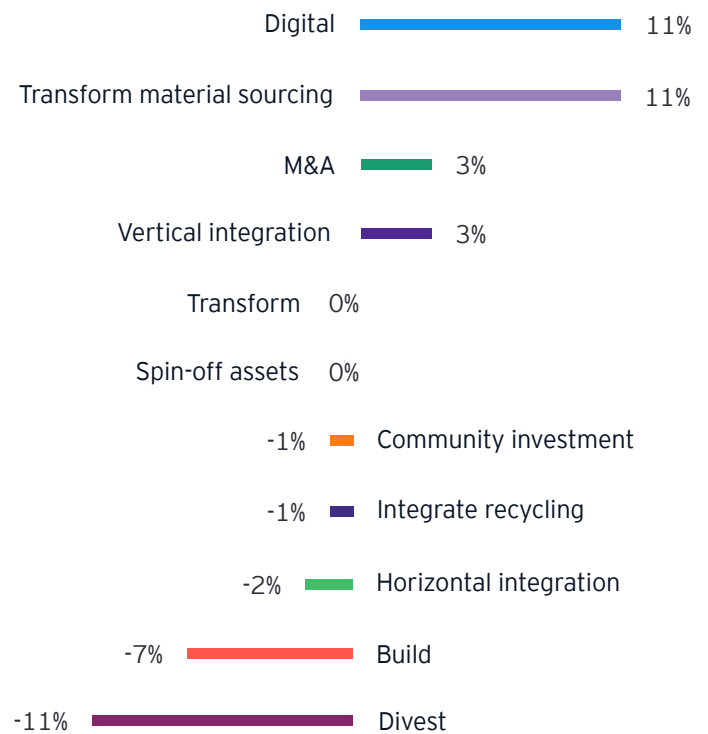


*power - does not include renewables

Source: EY strategy edge, march 2023.

Change in importance of options chosen by respondents

(% change 2024 vs. 2023)



Source: EY mining and metals business risks and opportunities survey data 2023 and 2024.

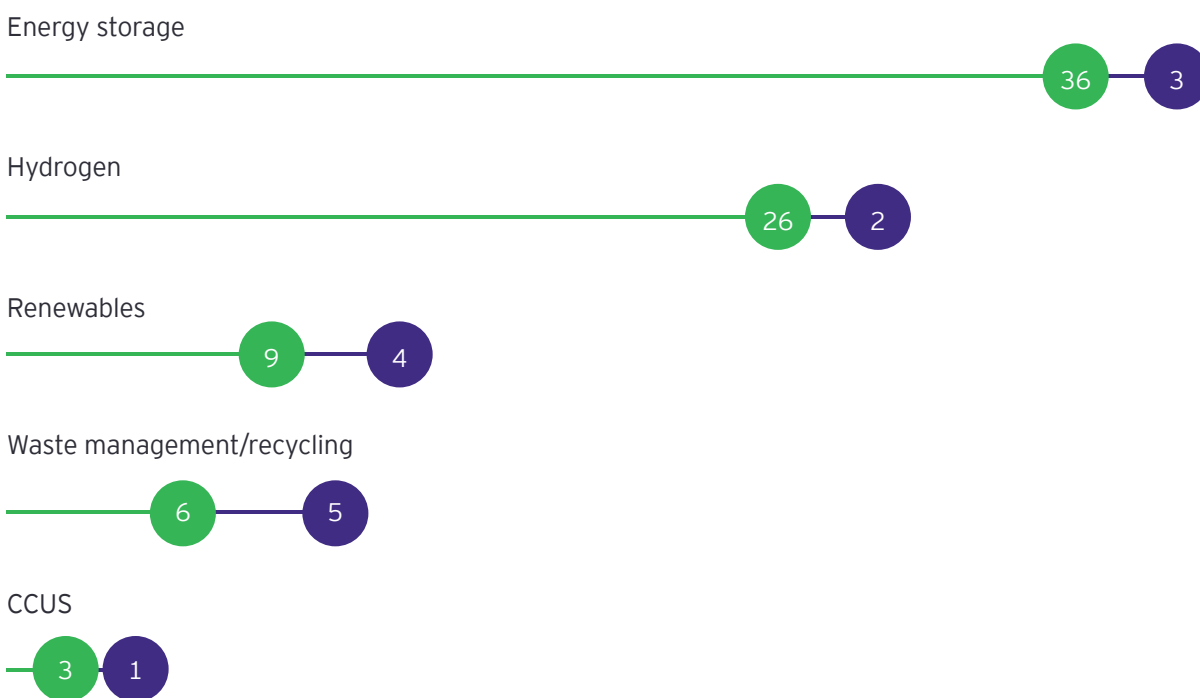
Sustainability is also a big driver of innovation. Beyond renewable energy, companies are investing in startups, including in energy storage, batteries and hydrogen. For

example, Fortescue is expecting a preliminary license to install a green hydrogen plant in Brazil and recently announced the acquisition of a hydrogen hub in Phoenix, Arizona.⁷⁹

Green investments largely in energy storage and hydrogen

No. of investments by top 12 mining and metals companies (2018-22)

■ Private placement ■ M&A



Source: EY analysis of company reports and public information.



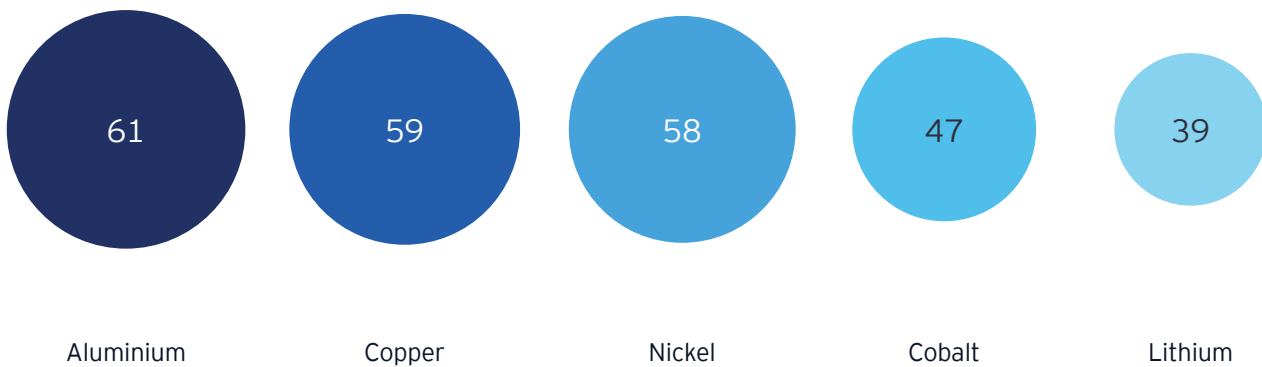
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Ignoring the circular economy as a source of supply would be foolish — but to be transformational, it needs to be a significant investment. However, this would change a company’s risk profile and may impact investors.

Senior mining executive

We are also seeing significant progress in the circular economy. Mining companies are considering how to use circular economy principles to better manage waste across the value chain, integrate recycling, and improve collaboration and transparency with manufacturers and customers. Capitalizing on a circular economy will require mining companies to make a holistic analysis of all material flows and consider lifecycle benefits and impacts.

Estimated % of cumulative 2050 demand that can be met through recycling



Source: IEA 2022 and world bank 2020




More miners are investing in recycling, which, while never able to fully overcome structural deficits in the market, will become a significant source of supply, particularly as battery recycling increases. For example, Glencore has been advancing battery recycling alongside base metals

such as copper, zinc, nickel and lead. We expect this trend to expand as mining companies and others in the value chain move into a true circular economy with closed material loops.

Implementing circular design into the mining and metals value chain

	Value chain	Action	Benefit
Transformation	Extraction	Remove inefficiencies, re-use resources (e.g., water) and design waste out of processes	Improved resource efficiency, and better waste management
	Processing	Reprocess wastes, tailings and scrap	Create by products and keep materials and products in use
	Logistics	Data analytics to optimize freight	Reduce costs Remove carbon emissions Sainsbury's is switching from using plastic to creating its signature coffee pods out of aluminium, which is infinitely recyclable
	Manufacturing	Collaborate with customers to develop new products that can be re-used in the future	Reduce costs Minimize waste Improved resource efficiency
	Consumer use	Data and technology to enable transparency of source of materials	Increased investment Greater accountability Reduction in illegal practices



Strategy Enabler

- ▶ Circular design for longer product life
- ▶ New business models and revenue streams
- ▶ Reverse cycles
- ▶ Eco-system
- ▶ Channel strategy

Next steps:

- ▶ **Conduct scenario planning** to build agility and ensure readiness for possible alternative futures.
- ▶ **Consider investment in adjacencies to help mitigate risk.**
- ▶ **Prepare to divest** or reshape for a different environment.
- ▶ **Use circular economy principles** to better manage waste across the value chain, integrate recycling, and improve collaboration and transparency with customers.

10

Workforce



Finding talent continues to be a major challenge for mining and metals companies. In an increasingly competitive labor market, the sector's poor brand and perceptions around LTO are deterring workers, especially younger ones, with some attracted to energy transition projects instead. At the same time, existing workforces are aging, and the potential of automation and technology to relieve talent pressures has not been realized, according to human resources officers (HROs) we surveyed. Most are now rapidly rethinking recruitment and retention strategies.

Recruitment strategies adapt to increased competition for scarce talent

“

We are reviewing our recruitment process to eliminate end-to-end structural barriers.

Senior HR executive

Recruitment for on-site roles is particularly challenging, given the lack of desire to work remotely and local community talent being exhausted. As miners struggle to fill specialist positions, including IT roles and mid-senior level engineers, they are rolling out initiatives including:

- ▶ Upskilling or filling roles with internal candidates, where possible
- ▶ Considering talent with transferable skills, rather than purely direct experience
- ▶ Recruiting global talent – however, logistics and immigration processes can be lengthy and expensive
- ▶ Recruiting younger talent, leveraging university and experiential programs, and participating in school career fairs (creative approaches will be required – a recent survey of young people by the Canadian Mining Industry Human Resources Council found 70% said they “definitely” or “probably would not” work in the mining sector)⁸⁰

Inspiring and developing talent to improve retention

“

We need to look at sustainability for tomorrow — we need to retain existing staff or face a major issue.

Senior HR executive

One HRO told us that the number one question posed by younger workers in interviews is: “How will my career develop?” Developing attractive career pathways can help inspire workers to see their future in mining, and improve retention rates. The issue is heightened for mid-tier

miners, which face annual labor turnover rates of 30% to 35%, according to Tom Reid of the Australian Resources & Energy Employer Association.⁸¹

Skills maps can help articulate growth opportunities within roles and support upskilling for role changes, rotations and certifications. Rotating early career engineers through disciplines can help avoid pigeonholing and may improve retention.

Miners may also need to re-evaluate their broader employee value proposition. Workers, particularly Gen Z, want to be in a company with values and a purpose that reflect their own. Many HROs are focused on creating a more attractive work culture, highlighting mining's role in the energy transition and support for local communities.

Upskilling and re-skilling are priorities

“

Upskilling is the No. 1 priority — it needs to be embedded into our DNA.

Senior HR executive

Sector leaders we spoke to agreed that upskilling and re-skilling must be core to every HR strategy. Miners need to define the skills and capabilities to succeed over the next 18 months and beyond, considering:

- ▶ A whole-of-organization approach
- ▶ The long-term view, compared with traditional quarter-to-quarter thinking
- ▶ Mobility across all functions and sites (to break down silos)
- ▶ Broader ESG capabilities – beyond the operational perspective
- ▶ Just-in-time training for operators and maintainers
- ▶ Re-skilling opportunities (one HRO said, “We’ve got [diesel] engineers, [but] we need those engineers to be electrical engineers. We’ve got the base skills, we just need to move them to the adjacency.”)

Overlooked onboarding should sound alarm bells

“

We need people to have access to the learning and development wherever they are, which is a massive cultural change.

Senior HR executive

Miners have achieved near zero harm on site, but near misses are increasing. Some mining unions are calling for increased reporting to identify trends and prevent serious injuries in the future.⁸²

Current onboarding processes often lack governance and rely too heavily on supervisors, many of whom are new to the sector themselves and lack experience. This elevates safety risks and has a negative impact on morale and productivity. In some cases, training does not adequately prepare workers for the job – skills needed on-site may be very different from those given in a two-day office-based training course. AI or virtual reality simulations could help fill training gaps, offer real-time opportunities to improve skills and, ultimately, improve safety on-site. There is a clear need to uplift basic digital and data skills for all in the workforce, to help everyone use new technologies in frontline roles. Organizations should invest in their systems, making them more “app-like” to create an easy user experience.



HR seeking greater data to drive decision-making

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What can I anticipate will happen via business intelligence?

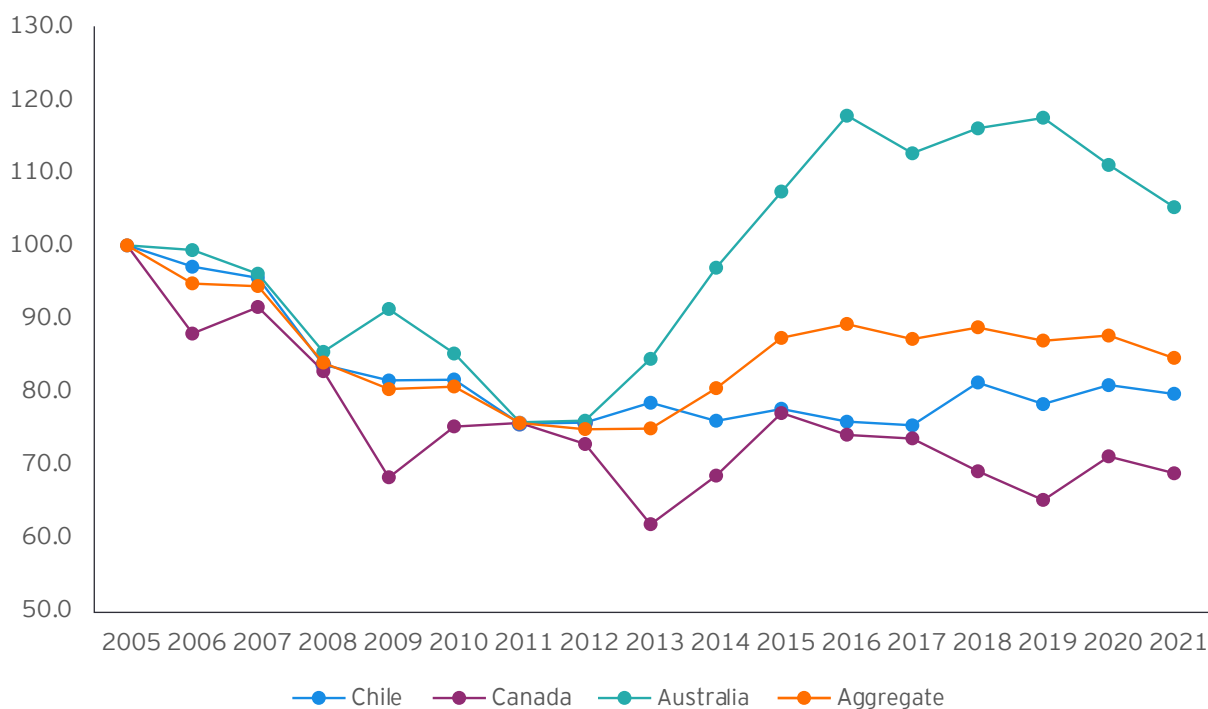
Senior HR executive

Data offers enormous value in helping track and understand employment trends and make more informed decisions. We see more HR leaders seeking robust data around retention, gender balance, absenteeism, on-site occupancy, and health and safety.

Data can also help deepen understanding around the complex levers driving productivity. In 2022, mining labor productivity fell 7% in the US⁸³ and 5% in Australia, with similar trends expected in other markets.

HR is making greater use of more robust data to track trends and make informed decisions, particularly around retention, gender balance, absenteeism, on-site occupancy, and health and safety.

Mining Labour Productivity 2005-2021



Source: EY analysis of country statistical websites

Many miners still face challenges in organizing data, extracting value from it and ensuring all privacy and security protocols are met. The right technology is critical, but we found successful adoption varies across the sector. Larger companies that use change management teams to help move to new technology fare better than smaller companies that attempt to figure out changes themselves.

Key to realizing the full potential of any new technology is a whole-of-organization approach – unless everyone understands and embraces the technology, it will not be used. One HRO commented, “Very little emphasis has been put on training the workforce to ensure readiness when implementing a change in technology – it has been assumed that we can adopt, and then we fail to launch.”

A new lens on leadership for successful transformation

With mining organizations facing an unprecedented level of change on multiple fronts (environmental, political, social, technological, etc.), leaders must shift their approach to transformation. In a recent report, EY and the University of Oxford's Saïd Business School identified six key drivers that increase the likelihood of transformation success to 73%.⁸⁴ These are as follows:

Inspire unite leadership on purpose and vision.	Lead shift to "we," not "me."	Care build a culture where opinions are embraced and encouraged.
Empower focus on clear roles and decision-making authority.	Build link your technology roadmap to skills development.	Collaborate build a culture of interdependent teams.

This approach, which engenders psychological safety for all workers, can create a more innovative culture and a more productive workforce.

Next steps:

- ▶ **Set the tone from the top**, considering whether HR needs a place on the board to effectively drive a people and culture strategy.
- ▶ **Make upskilling and re-skilling core to the HR strategy.**
- ▶ **Rethink your employee value proposition and recruitment practices** to attract a diverse workforce with future-ready skills.
- ▶ **Develop attractive career pathways** and skills maps to inspire workers to see their future in mining, and improve retention rates.
- ▶ **Ensure onboarding is fit for purpose**, improving its efficiency and speed, while maintaining a focus on safety and competence.

Outlook: mitigating risks and maximizing opportunities

Our ranking of risks and opportunities reveals that mining and metals companies face huge disruption and rapidly changing expectations that, together, may impact their ability to build sustainable value. Mitigating risks and making the most of opportunities requires companies to make significant changes to their business through a proactive, diversified approach that is integrated into strategy and broader planning. Miners that do so successfully will gain a competitive advantage.

About the survey

During June and July 2023, we surveyed or interviewed over 150 mining executives, including those in the C-suite, as well as leaders in human resources, sustainability and technology, across all major mining regions.

ESG is a complicated issue with many subtopics. Because of this complexity, we separate climate change and LTO from the broader topic of ESG to allow deeper focus on these issues.



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