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Tracking the trends 2025

Leading through transformational change in mining and metals



Contents

Introduction 3

Trend 1 Leading in a new era of mining and metals:

Creating resilient organizations through future-ready leadership **4**

Trend 2 Shaping critical mineral supply chains:

Leveraging business ecosystems **11**

Trend 3 Driving growth and resilience:

The power of active portfolio management **18**

Trend 4 Enhancing mineral exploration with AI:

Utilizing precompetitive geoscience data **25**

Trend 5 Transforming the digital core:

Using next-generation ERP to unlock future advantages **32**

Trend 6 Smart operations in mining and metals:

The data driven advantage **39**

Trend 7 The impact of GenAI on the mining and metals workforce:

Developing effective reskilling strategies **46**

Trend 8 Scaling progress toward net-zero:

Collaborating to address climate change **54**

Trend 9 Making ESG strategies more value-led:

Driving purpose and progress **61**

Trend 10 Generating a natural competitive advantage:

The value of embedding nature into mining and metals **68**

Global contacts 77

Authors & Acknowledgments 78

Introduction

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

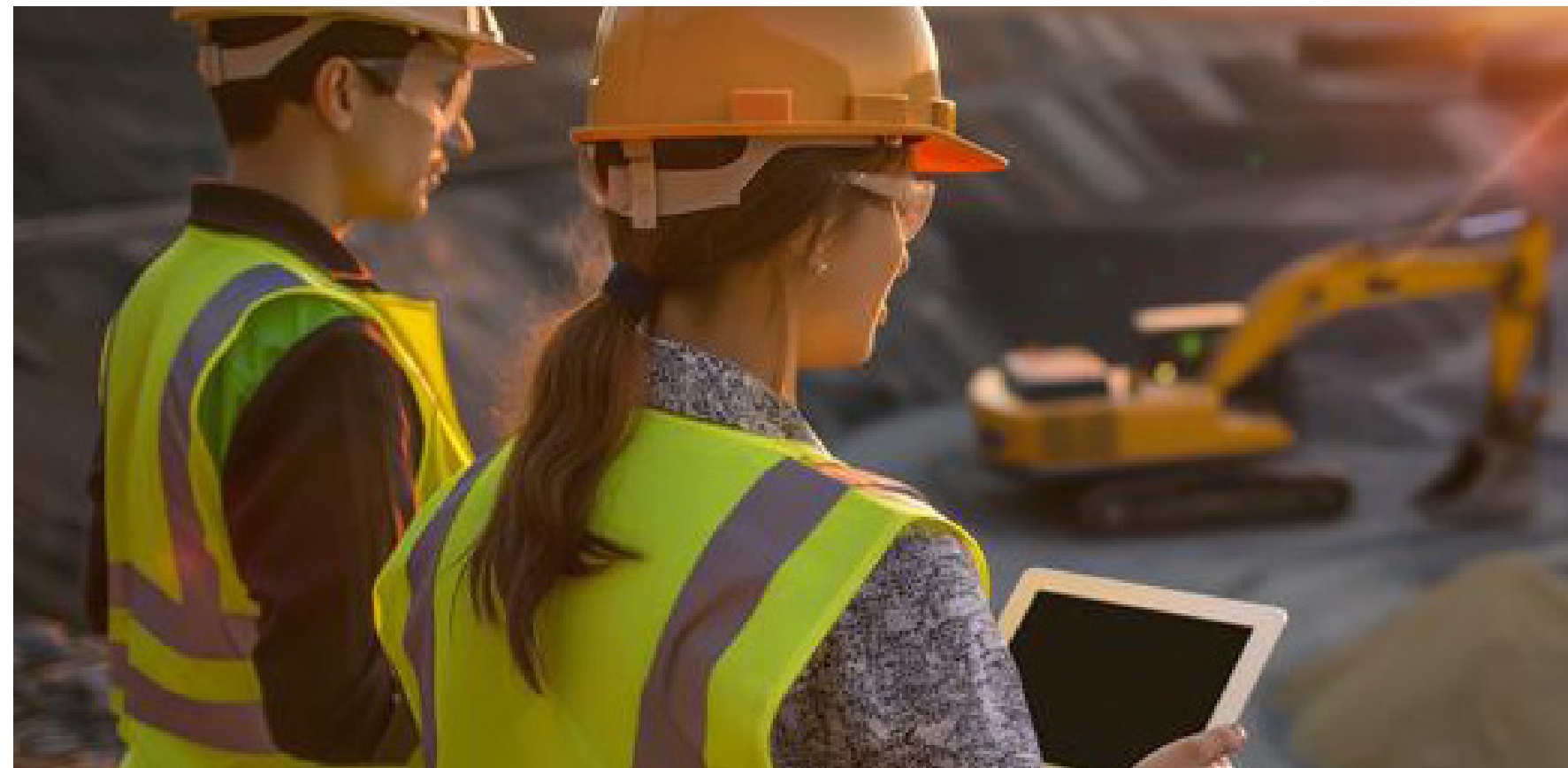
Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments



Looking ahead to 2025, it's clear that some important opportunities lie before mining and metals companies. Uncertainty in the global geopolitical sphere is intensifying, and supply chains are being rapidly reworked to accommodate tensions and emerging relationships. Organizations that have committed to net-zero by 2050 (or sooner) are racing to scale deployments of renewables and low-carbon technologies as interim targets approach. In addition to this is the ongoing question of how best to optimize operations by managing the areas of talent, technology, and sustainability effectively.

A new era of leadership could be key to companies' ability to capitalize on emerging opportunities—both predictable and less predictable—and cultivating resilience. For instance, to assume market commanding positions in this complex, rapidly evolving landscape may require low-cost, efficient, and smart operations. It may also require a streamlined business core enabled through next-generation enterprise resource planning systems, for nature to be properly valued and embedded into organizations, and a portfolio that's designed to be active and agile. It also necessitates an engaged, future-skilled workforce.

To achieve this, the industry will likely require leaders who have the cultural competency to spearhead a diverse, purpose-driven labor force and work alongside communities and traditional landowners to bring lasting environmental and social value to bear. It may require technological curiosity and the ability to help empower teams to experiment with innovative technologies, like Generative AI (GenAI), and solve problems collectively, as well as the vision to transform traditional mining and metals systems and processes. Most importantly, tomorrow's mining leaders balance productivity and profitability imperatives with care and compassion for people's well-being.

This is why the 17th edition of *Tracking the trends* is centered on the need for a new leadership approach. A team of professionals across Deloitte's network share their insights along with ideas and tools that companies can start applying to their own businesses to help reaffirm their organization's positions as the employers, innovators, and suppliers of the future.

Trend 1

Leading in a new era of mining and metals: Creating resilient organizations through future-ready leadership

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Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

The complexities and levels of uncertainty that many mining organizations face are challenging. From fast-moving geopolitical matters and climate-related instabilities to the advent of game-changing technologies such as GenAI; calls for greater diversity, equity, and inclusion (DEI); and disrupted supply chains, to name a few.

Where companies may have once been structured for relative stability and led accordingly, today, organization’s profitability, sustainability, and relevance to society could be governed by their ability to adapt.

For example, Gen Z, which will soon make up a significant portion of the global mining and metals workforce, is highly purpose-driven; Deloitte Global’s 2024 Gen Z and Millennial Survey found that 50% of Gen Zs and 43% of millennials have rejected an assignment based on their personal ethics or beliefs, and nearly as many have turned down an employer.¹ Gen Z’s collective spending power is also expected to grow to US\$12 trillion by 2030, making this generation the dominant future consumers of products that contain minerals and metals.²

Companies looking to attract the next generation of future-skilled talent, secure Gen Z’s purchasing power, and thrive through other economic, social and environmental step changes may evolve, and this could demand a new style of leadership.

What makes an effective mining and metals leader?

Global economic and geopolitical dynamics are changing as explored in [trend 2](#), and the role that mining and metals organizations play in the world economy is evolving. As the context in which these companies operate may become more uncertain, the question arises as to what kinds of leaders the industry should be developing for this new golden age of minerals?

Ian Sanders, Global Mining & Metals sector leader, Deloitte Global, explained:

“Operating in today’s more complex environment requires the ability to lead through transformative change. While context is important and each company may face very different challenges, there are some key leadership traits that will likely be significant in the years ahead.”

These are as follows:

1. Cultural competence

Mining and metals companies operate in a wide and diverse set of geographies. This requires leaders who have sensitivity, awareness, and confidence in leading a culturally diverse workforce in a way that is inclusive and respectful of the perspectives of different groups.

There has been a significant shift in the past few years of companies putting greater emphasis on hiring and developing local leadership versus the more traditional expat model. For example, in 2023, 97% of Barrick Gold’s employees and 77% its site senior management were host country nationals.³ In many cases, as companies develop local talent, expats might play a strong coaching and development role, and cultural competence may be key in these situations.

Over the past decade, there has also been an increase in the inclusion (driven partly, in some geographies, by government regulations) of Indigenous and First Nations participation and leadership in mining projects.⁴ Today, many companies and governments are actively embracing the rich social and environmental perspectives that traditional owners can bring to mining and metals projects.

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

For example, in January 2023, the Yaqit ʔa·knuq̓li'it (YQT), a community in southeastern British Columbia, signed an agreement with NWP Coal Canada that gave the community a veto over the proposed US\$300 million Crown Mountain project. Under the deal, the YQT are recognized as a regulator and reviewer of the project.⁵ Realizing the value of Indigenous knowledge highlights the need for even greater cultural competency from mining leadership.

2. Productivity and mental health management

The importance of mental health in the mining workforce and creating an environment of physiological safety has been featured heavily in industry conversations over the past two to three years.⁶ But the mining and metals industry is also one where the productivity focus is key.

As important resources become depleted, significant new mineral deposits become harder to find, and the presence of future-skilled talent may dwindle, leaders must work to help ensure that productivity and profitability do not come at the cost of workforce health and safety.

For example, Anglo American has established a Global Mental Wellness Framework as part of its health and well-being strategy. Under the framework, the company makes immediate mental health support available to its people when needed. It has also trained more than 500 employee mental health first aiders (MHFAs) to ensure coverage across its global operations, and offers counseling through employee assistance programs, while using apps and other platforms to provide additional options for relaxation and mindfulness that aid mental wellness.⁷

“Our Global Mental Wellness Framework aims to help our people feel supported and safe to bring their whole selves to work and prosper in both the workplace and community,” the company stated in its 2023 sustainability report.⁸

Trend 1: Leading in a new era of mining and metals

3. Technological curiosity

For mining leaders, it could be important to understand how new technologies like GenAI could affect their organization’s future ability to compete, and how best to support their workforce through the change. Realizing the full value of smart operations (as explored in [trend 6](#)) and AI-enabled technologies, including advanced analytics, may require leaders who are technologically curious, who can embrace the power of these technologies, and find ways to scale them across their organizations.

Companies are already recognizing this and making moves to appoint skilled leaders. For example, in December 2023, McEwen Mining appointed Google’s former Chief Evangelist Nicolas Darveau-Garneau to its board.⁹

Andrew Swart, partner, Energy, Resources & Industrials leader, Deloitte Canada, commented:

“This shift isn’t about reinventing leadership but enhancing it. Fostering a culture of innovation requires the ability to cut through the noise and create space for true leadership that brings courage, clarity, and speed to problem-solving with the workforce. In this way, leaders can connect with their people, engage with technology teams, and collaborate with peers.”

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

4. Empowerment and collaboration

Leaders can be found throughout mining and metals organizations, not just in managerial positions. Shifting from a command-and-control-type leadership structure to employee empowerment is important to future organizational effectiveness. This is particularly important in the context of attracting and retaining Gen Z.¹⁰

Gen Zs and millennials have long held a reputation for valuing purpose-driven work, and Deloitte Global's 2024 Gen Z and Millennial Survey supports this: 9 in 10 respondents in both groups said that having a sense of purpose in their work was very or somewhat important to their overall job satisfaction and well-being. The results also showed that both groups are also keen to drive this shift personally—37% of millennial leaders said they had made good progress implementing the changes they envisioned before taking on a leadership position, while a further 18% said they had completely implemented the changes they envisioned.¹¹

These numbers underscore the belief that effective mining organizations of the future may rely on workers who are both empowered and actively collaborating across the organization.

For leaders who are constantly under time and productivity pressures, it can be tempting to provide people with answers and solve problems themselves. However, there are different types of problems. Unless leaders become skilled at stepping back to empower others to probe a situation and find and test solutions, they will likely remain in a constant state of reaction. It's important to understand that different people can offer different—sometimes better—ideas and solutions to different problems.

5. Transformative leadership

Across the industry, we see mining companies driving transformative programs and change. These may take the form of establishing a new target operating model or driving a cost transformation. For instance, Anglo American announced in December 2023 that it planned to unlock value through a US\$1 billion operational, cost, and capital discipline program.¹²

While most companies have well-established change programs that focus on communication of the change, there is an increasing need to develop leaders who are comfortable with transformative change, and are able to embrace that change, and can act as leaders and stewards.

This may require leaders with the ability to bring teams together to collectively own and drive transformation and/or change, be it cultural-, performance-, or engagement-based. This can also require leaders who are comfortable navigating uncertainty both internally and externally in the organization.

Andrew Swart, partner, Energy, Resources & Industrials leader, Deloitte Canada said:

“As leaders progress, they may naturally face more adaptive transformative challenges. Having leaders who are focused on the business’s North Star and able to rally their teams through the inevitable ups and downs of the transformation programs will be key.”

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Purpose-driven mining creates positive social legacies

Having a strategic view of social impact means aligning a company's purpose with long-term societal benefits, helping to ensure that its operations create meaningful, lasting contributions beyond immediate economic gains. For mining companies, this can require embedding purpose into their cores by addressing critical needs in the communities where they operate. For example, Brazilian niobium producer, CBMM, offers full-time employees food vouchers, meal vouchers, health and dental plans, a co-participation medication purchase plan, and educational assistance for children of employees (ages 1 to 25 years). The company also maintains a kindergarten program in the town of Araxá where approximately 400 children of its employees attend free of charge.¹³

Approaches such as these can not only help transform individual lives, but also uplift communities, demonstrating that purpose-driven mining can pave the way for a more sustainable and inclusive future.

Effective leaders create resilient organizations

Developing effective leaders to operate in a more uncertain and disruptive world is not simple or easy, but it is valuable. By taking steps toward a more adaptive leadership style, embracing collaborative problem-solving, empowering the workforce to experiment and take ownership of solutions, and learning to balance strategic priorities with immediate ones, mining and metals leaders could expand their effectiveness across the five key areas discussed.

In doing so, they can also increase their organization's ability to solve future challenges, no matter the context and no matter how quickly that context changes.



Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments



From ideas to action

Leading the mining and metals organizations of tomorrow

- **Upskill/reskill leaders:** A balance of mining and leadership-specific skills is important to effectively transform mining organizations, operations, and processes. Providing time and opportunities for existing leaders to learn, grow, and engage with important stakeholders will help to retain mission-critical knowledge and skills while cultivating awareness and capacity in new areas.
- **Review leadership search criteria:** It may be necessary to review and update the organization’s search criteria when recruiting for new leaders to reflect the qualities discussed. By making search criteria skills-based rather than task-based, there could be an opportunity to expand the search radius to adjacent or even contrasting industries. Remember that fresh perspectives can be valuable in tackling challenges both old and new.
- **Develop meaningful relationships with Indigenous leaders and communities:** It’s never too late for leaders to build or increase their own cultural competency or that of their organization. Prioritizing regular and meaningful engagement with Indigenous leaders could benefit the organization in multiple ways, including helping to strengthen the company’s workplace culture and tackle any underlying DEI-related matters that exist.
- **Practice leading collectively:** Coming together as a broad team of leaders to solve and, where appropriate, scale answers to presenting complex challenges could result in better solutions and, ultimately, more resilient organizations. It’s the role of mining and metals leaders to help ensure that their teams are fully supported during this process, in a way that enables them to thrive and grow at the edge of their capabilities.

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

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Trend 2

Shaping critical mineral supply chains: Leveraging business ecosystems

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Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

As the energy transition gathers pace, countries and industries are racing to lock in supplies of minerals and metals that are essential to the production of clean energy technologies and infrastructure. In doing so, an unprecedented amount of capital is changing hands; it’s estimated that for the world to reach net-zero, approximately US\$9 trillion must be invested every year until 2050, this includes investment into critical minerals extraction and processing.¹

Current limited diversification of global critical mineral supplies and increasing demands for value chain transparency, particularly with respect to environmental, social, and governance (ESG) concerns, are helping to drive change in the trade and investment landscape. For mining and metals leaders, balancing company growth opportunities with supply chain risks while also helping governments to address the triangulation of economic growth, security, and infrastructure needs is proving complex.

To make the best possible decisions in response to rapid geopolitical and economic changes may require leaders who can empower their teams to explore the different headwinds, tailwinds, and potential pathways forward for the company. For example, through studying potential future global scenarios and their implications for value chains, considering new ways to leverage incentives and alliances, and establishing new trade arrangements, leaders can gain clarity and plan in a way that helps enable their organizations to move fast and thrive through unpredictability.

Volatility reshapes global trade

While regional concerns surrounding economics, security, and technology can be the primary drivers of trade and investment choices for critical minerals, at a global level, these changes are being influenced by more fundamental geopolitical, economic, and demographic shifts.

2024 was a year of significant political upheaval; 64 countries, plus the European Union (EU)—around 49% of the global population—planned to vote in new governments.² Globally, trade growth doubled, with China and East Asia as prolific drivers.³ However, growing political tensions saw bilateral trade between key economies in the East and West cool. For instance, trade between the US and China, which reached a record high in 2022, grew 30% less in 2023 than their trade with the rest of the world.⁴

Since the start of the Russia-Ukraine war, trade within blocs of politically aligned economies, roughly split into “East” and “West,” also increased by 4%.⁵

Looking ahead, countries like the United States and China, could soon make up a smaller share of global gross domestic product (GDP) as their aging workforces retire. The United Nations predicts that soon the best balanced workforces will mostly be in South and Southeast Asia, Africa, and the Middle East.⁶



Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

To help navigate the risks and opportunities these changes pose for metal supplies and prioritize investments, many countries have developed their own critical minerals lists. Industrial jurisdictions, such as Japan and the European Union (EU), have similar albeit slightly different lists to countries like the United States.⁷ Meanwhile, mineral extracting countries, like Australia and Canada, have approaches that are oriented toward the demand side—providing minerals the world needs for the energy transition, as opposed to simply resolving supply chain and security concerns.⁸

Currently, the supply of many raw critical minerals and their refined chemical or product form are dominated by a small number of countries. For example, cobalt is a key component in nickel-cobalt-manganese batteries for electric vehicles. In 2022, 65% of the world’s cobalt was mined in the Democratic Republic of the Congo (DRC). The mined product is then transported primarily to China where 73% of the world’s processing capacity exists. In recent years, China has shored up supplies of raw material inputs into its processing facilities by integrating up the value chain—it now owns or co-owns more than 75% of the operating cobalt mines in the DRC.⁹

While China has invested ahead of the curve to become the world’s dominant battery manufacturer (for the first four months of 2024, more than 65% of the world’s batteries were made in China), narrow supply chains like this can pose a risk to other countries’ industries and economies.¹⁰

Maximizing value creation through relationships

As new trade architectures emerge, companies up and down mining value chains are forming alliances to flex their collective muscle and leverage incentives.

John Diasselliss, principal, Mining leader, Deloitte & Touche LLP, said:

“The mining sector continues to see increasing shifts in focus from traditional products, like iron ore, to newer ones, such as critical minerals. Various countries are each offering a range of industry incentives to help their country counter critical mineral supply chain security implications and make the metal ecosystem less vulnerable to risk and disruption. The US, China, India, and the EU - among others - are prime examples of countries enacting their own critical minerals strategies. Intergovernmental relationships have also been formed, such as the Minerals Security Partnership (MSP), which includes the EU and 14 member countries (including Australia, Canada, the UK, Germany, and Japan, to name a few), to build out and diversify global supply chains.”¹¹

The benefits of intersections between governments, corporates, and industry can be significant. Access to incentives can reduce the cost of doing business; for example, lowering the cost of capital needed to establish new mining and processing capacity. Companies might also gain access to markets based on alliances and security, rather than just commercial returns. On the other hand, if geopolitical concerns are not addressed, it could be easy to get locked out of certain markets—this equation is about more than just cost.

Lean into ecosystem efficiencies

Given this backdrop, it’s important to understand the dynamics of business ecosystems. Companies operate within these to deliver value to markets; yet, for many, these ecosystems have evolved organically without significant planning. Until relatively recently, few leaders have taken the time to systematically assess the different types of ecosystems in which their organizations participate and the advantages they can offer.¹²

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

However, given the urgency of the energy transition and the criticality of minerals and metals to its delivery, a more intentional or purpose-driven approach to ecosystem participation (or creation) could help accelerate important developments and uncover opportunities for enhanced efficiencies at the value chain level through industrial symbiosis.

An example is the Global Battery Alliance, which was launched in 2017 in collaboration with the World Bank and 28 organizations to unlock the energy transition through robust and transparent battery supply chains. Membership of the alliance has grown fourfold since its establishment of more than 120 members who, together, span the global battery value chain. It includes diverse players, from car brands, such as Audi, mining companies, such as Eurasian Resources Group (ERG) and Glencore, and battery component and vehicle manufacturers, such as Umicore and Tesla, to IT solution providers and leading nongovernmental and international organizations like the German Ministry for Economic Affairs, Climate Action, and Natural Resources Canada.¹³

More recently, mining and metals companies are starting to take a leading role in ecosystem creation. One example comes from Anglo American and Finnish state-owned holding company, Finnish Minerals Group (FMG). FMG owns Terrafame, a subsidiary that produces nickel and cobalt sulphates; the Sokli phosphate and rare earths deposit; and a 20% interest in the Keliber lithium project as well as greenfield downstream investments. The two signed a memorandum of understanding in February 2024 to explore opportunities to further support Finland's battery strategy.¹⁴

There's also growing potential to deploy and manage dynamic ecosystems where the focus is on helping participants learn faster and accelerate their performance improvement. Multiple examples exist within mining and metals to lift the industry's collective operational performance—for example, the Earth Moving Equipment Safety Roundtable¹⁵ and the Global Mining Guidelines Group¹⁶—but dynamic ecosystems remain a relatively untapped opportunity

in critical mineral supply chains. However, leaders could, for example, harness them to better forecast and mitigate supply and demand shortfalls, or to plan for and manage the physical impacts of climate change more effectively.

Leading the circular economy

Critical minerals are indispensable to a low-carbon economy. However, to meet future demand, companies must scale up production, explore alternative supply methods and look at ways to keep metals in circulation for longer.¹⁷ For example, through its Waste to Value program, Vale has set an ambition to establish a global iron-based metals operation with a minimal waste footprint by 2035, advancing circularity across the entire value chain.¹⁸

Stacey Toder Feldman, partner, Mining & Metals leader, Deloitte UK commented:

“A circular economy will likely help to reduce global reliance on ever-increasing demands for larger quantities of critical minerals, improving the resilience and sustainability of organizations both upstream and downstream in the supply chain. Mining and metals companies have a unique understanding of metallurgy and the properties required for these materials to remain useful. There's a significant opportunity for leaders to harness this expertise along with technologies, such as digital twins and the use of AI, to enable their organizations to participate in and drive the circular economy through the creation of new, more sustainable, business models and material flows.”

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Building flexibility into planning

In addition to leaning into ecosystems to help maximize value realization and identify leadership opportunities that enable businesses to get ahead, dynamic planning and strategizing could prove key to building resilient and agile supply chains.

For example, it’s important for mining leaders to consider how different market scenarios might play out. Specifically, how regulators (or customers or financiers) might impose sustainability compliance requirements. Owners might assess how these could affect demand-supply dynamics for different products over time, or the potential impacts of a broader trade war.

Mining and metals leaders could also use scenarios to understand the implications and prepare for different eventualities. For example, the US Defense Production Act can support value chain investment into foreign mineral projects—Canadian companies Fortune Minerals and Lomiko Metals, were awarded grants of US\$6.4 million and US\$8.3 million, respectively, in May 2024 to help build cobalt and graphite supply chains that are essential for US defense and civilian markets.¹⁹ However, to tap into this opportunity may require alignment of businesses to US offtakers, and financiers should meet certain thresholds.

Flexible planning capabilities could also help realize the value of minerals and metals in new applications. This was the case for Brazilian metals producer CBMM. Initially focused on supplying niobium products for the steel and construction industries, the company has recently entered a new market, partnering with Toshiba and Volkswagen Truck & Bus to produce a prototype lithium-ion with niobium battery-powered electric bus with ultra-fast charging capabilities. This redefinition of industrial transportation, through the development of electric trucks capable of revolutionizing mining operations worldwide, features an ultra-fast recharge of only 10 minutes. It enables niobium lithium-ion batteries to deliver not only energy efficiency but also safety.²⁰

Patricia Muricy, partner, Energy, Resources & Industrials leader, Deloitte Brazil, said:

“The world is changing, and so, too, is the role of mining and metals supply chains. In times of uncertainty and volatility, exploring different scenarios and building multiple eventualities into medium- and long-term plans is one of the best ways that boards and executives can strategically think through the nature of their businesses. Without this capability, companies can run the risk of losing their competitive edge or missing out on important opportunities.”

Leading for the greater good

There’s a chance for critical minerals developers to take advantage of the changing landscape by aligning projects to support the diversification of value chains through extraction, refining, and production as the climate transition gathers pace.

In broadening their strategic focus to benefit not only their own organization, but also players up and down their supply chains, mining and metals leaders have an opportunity to galvanize their companies’ leadership positions, help meet critical minerals targets, and restore the health of the planet.

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

From ideas to action

Build supply chain resilience and maximize value creation

- **Engage regularly with stakeholders across the value chain:** Identifying potential threats and opportunities as early as possible will allow the business to model different scenarios and plan across different time horizons. Consider sharing these insights with your supply chains to build collective resilience.
- **Stay ahead by monitoring, reviewing and performing due diligence:** After the right policies and procedures have been identified and implemented, ongoing monitoring, reviews and due diligence are pivotal to identifying new or emerging risks, assessing the effectiveness of existing risk mitigation measures, and making necessary adjustments to risk management strategies.
- **Look for leadership opportunities:** Where business ecosystems do not exist to support growth realization, consider their formation. Experience has shown that fortune favors early movers.

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

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Trend 3

Driving growth and resilience: The power of active portfolio management

Authors

Nicki Ivory, partner, Mining & Metals leader, Deloitte Australia

David Harrison, partner, Strategy, Risk & Transactions, Deloitte UK



Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

As the energy transition gathers pace and technological development continues to disrupt mining and metals businesses, leaders are increasingly scrutinizing their portfolios and capital allocation strategies in a bid to rebalance interests, identify new growth opportunities, and assume a leading role through the energy transition.

The need to navigate geopolitical matters is causing dislocation of marketplaces, supply chains, and trade partners. For instance, the past 15 years have seen a fivefold increase in export controls on critical minerals globally as geopolitical competition builds.¹

Growing investor activism is encouraging miners to address underperforming assets and divest non-core businesses, and the net-zero agenda continues to fuel mergers and acquisitions (M&A) as well as divestments to transition organizations to environmentally sustainable portfolios. Anglo American is a prime example; in May 2024, the company announced its intention to divest its metallurgical coal business to focus instead on copper and iron ore, in a move it said was critical for delivering products aimed at the energy transition.²

While the bulk of deal activity is being driven by major miners (the global mining market in Q3 2024 witnessed total deals worth US\$23 billion; a growth of 42% compared to Q3 2023),³ private equity firms are increasingly seeing entry opportunities to operate mining and metals assets. Private equity deal activity increased by 463% between Q2 2023 and Q2 2024 with the largest disclosed deal (US\$1.9 billion) being the acquisition of U.S. Silica by Apollo Funds.⁴

Private capital is also playing a significant part in Australian coal divestments, with large private Chinese, Indonesian, and Russian companies acquiring the thermal and coking coal assets that are being recycled out of major producers' portfolios. For instance, Indonesian company, Golden Energy and Resources, and partner M Resources have acquired the coal business of Australia's South32 for as much as US\$1.65 billion.⁵

Trend 3: Driving growth and resilience

Nicki Ivory, partner, Mining & Metals leader, Deloitte Australia, said:

“There’s a lot of activity in support of portfolio realignment today and there’s a lot of capital being recycled. How companies choose to reinvest that and in which jurisdictions depend largely on their corporate philosophies. However, the energy transition presents a growth opportunity. Tomorrow’s leaders may be determined by today’s investment choices, and companies should prepare for that by building resilience and agility.”

Active portfolios help enable agile companies

Dynamic marketplaces and trade lanes, rebalancing of energy markets in response to global conflicts, the rising cost of capital, recalibration of the Chinese growth story and more are profoundly altering economies and industries. The ability to survive and thrive in these conditions will likely be determined by how well companies develop their resilience and reinvent themselves to drive market leadership and long-term shareholder value.

An active outlook on portfolio reviews, where assets are regularly assessed for their fit, cost, and contribution to the company’s overall strategy, could prove central to these capabilities. Through this approach, assets that are likely to deliver a competitive advantage are retained, while those that are deemed non-core to future growth or generate marginal returns on capital are positioned for rebalancing. Deloitte Asia Pacific recently surveyed 250 executives from the region and found that 59% of corporates are now assessing their portfolio performance at least twice a year, up from 46% in 2022.⁶

To be agile and able to respond rapidly to external forces, companies could even adopt a continuous mindset, dedicating resources and board-level bandwidth to help ensure that assets are continually aligned with the business’s overall strategic direction.

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

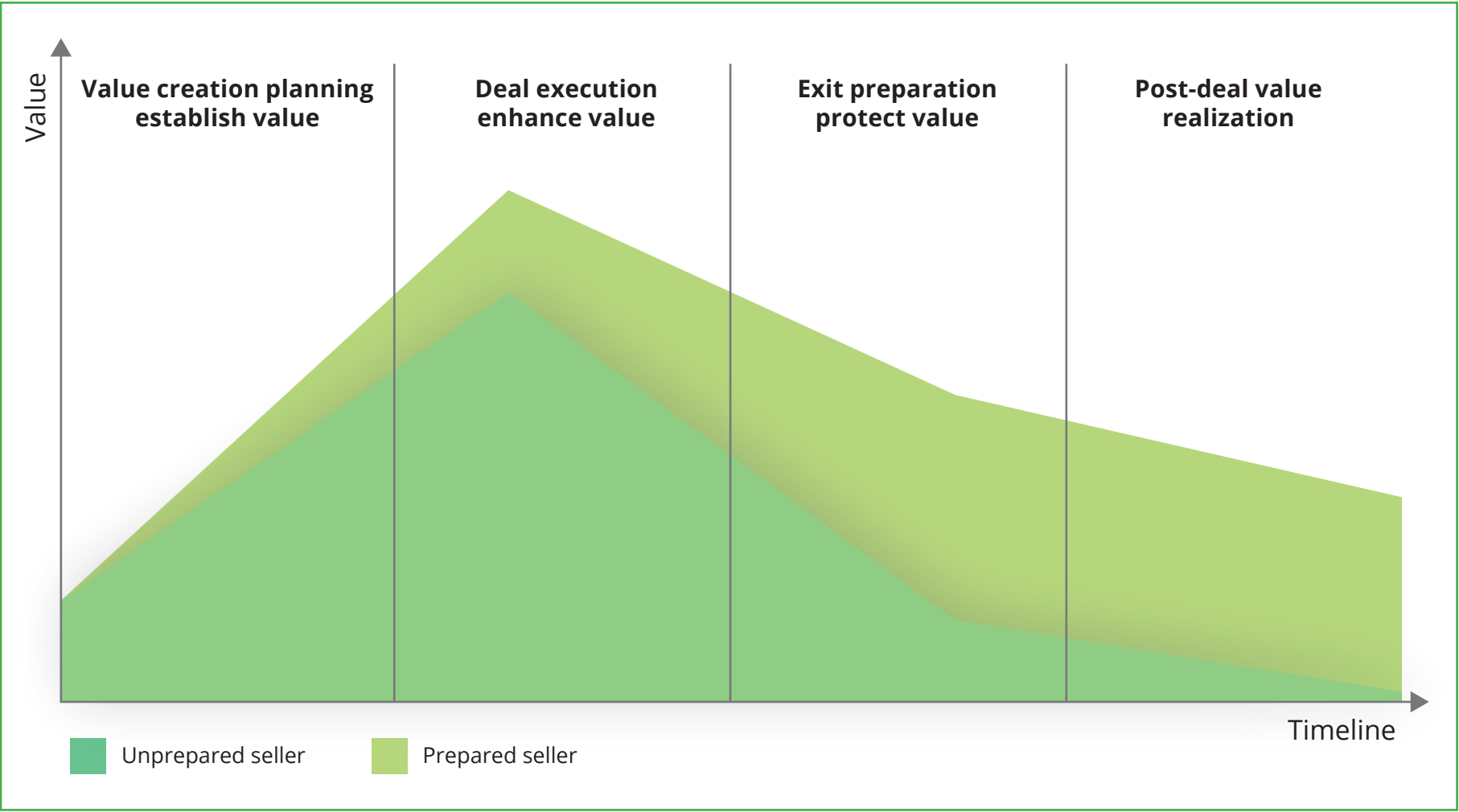
Authors & Acknowledgments

Ultimately, the aim of active portfolio management is to better position companies to achieve their strategic objectives and withstand the impact of market developments and factors beyond their control. However, moving toward this approach is an ongoing process and a significant change from the current paradigm in mining and metals, requiring structured thinking and senior-level buy-in and commitment.

Preparing to preserve value

A shift toward active portfolio management underscores the importance of preserving and maximizing the value of assets that are divested through thorough planning and preparation. Value can be eroded at any and every stage of the portfolio rebalancing process (figure 1) and, once gone, it can be very hard to rebuild.

Figure 1: How a prepared seller is better positioned to establish value prior to a deal and protect against value loss through divestiture



Source: Deloitte Asia Pacific⁹

BHP rebalances portfolio through divestments

In April 2024, BHP Mitsubishi Alliance (BMA), a metallurgical coal joint venture in Queensland, Australia, between BHP Group Limited and Mitsubishi Development Pty Ltd, divested two of its operating mines, Blackwater and Daunia, for US\$4.3 billion.⁷ The decision stemmed from BMA’s desire to optimize its portfolio composition as part of a proactive strategy angled toward higher-quality metallurgical coal.

The transaction was one of the most operationally complex that BHP has completed with the asset sale structure, change in rail and port arrangements, and a preference to complete the transaction without a transition services agreement, presenting significant challenges. Because the two operating mines were part of a highly integrated portfolio of assets, the separation at divestment also required the disentangling of data and personnel.

However, BHP successfully navigated these challenges and executed the divestment with minimal disruptions to operations and within the envisaged timeline. The transaction enabled it to reallocate resources toward its core growth areas, including future-facing commodities like copper, and environmental responsibility, in a move that reflected stakeholders’ environmental, social, and governance (ESG) concerns.⁸

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Creating and preserving value throughout a divestiture can require strategic acumen, meticulous planning, and strong execution. The objective is to not only present the business in its best light, thus increasing its value, but also help ensure that its intrinsic worth is maintained throughout the process. Developing a compelling value story could prove central to this and could be achieved through the following actions:

- **Create a strong narrative:** Describe a value proposition that resonates with potential buyers or investors. This could feature a detailed explanation of the divested entity's growth expectations, highlight synergistic opportunities for buyers, and demonstrate its stand-alone viability.
- **Undertake bidder analysis:** Prepare a detailed bidder list and analysis, which could help target the right potential buyers (e.g., corporate versus private equity), stimulate competitive bids, and align the sales approach to their preferences.
- **Define a strategy:** A clear exit strategy tailored to the right buyer group(s) identifies divestment options and how to take the entity to market, as well as a valuation impact analysis that highlights how divestiture pathways align with the company's overarching objectives and prevailing market dynamics.
- **Detail separation financials and operational data:** Robust financial and operational data builds credibility in a divestiture, providing transparency on the health and potential of the business and the integrity of the deal.
- **Align on ESG:** Incorporating ESG considerations into a divestiture strategy and value story can help to align business ethics, mitigate risks, and enhance the overall value proposition for sustainability-conscious buyers. Research by Deloitte Asia Pacific has found that sellers with a clear ESG story are six times more likely to receive higher-than-expected deal value.¹⁰

- **Reconfigure the entity and remaining business:** Analyze the complexities of divesting the entity and their financial and non-financial impact. Design day one operating models for both the divested entity and the remaining business that set both up for success with the divested entity operating productively and safely, and the remaining business restructured to address dyssynergy impacts.

Structures for strategic purposes

Private capital is playing a growing role as a buyer or strategic partner in divesting or restructuring mining and metals assets that are deemed to be non-core, underperforming, or under-resourced. To engage these partners effectively, companies could consider initiating dialogues earlier and being open to alternative strategies and structures when rebalancing their portfolios.

Traditionally, divestiture used to mean the sale of a company or division. However, a more sophisticated and fast-growing approach considers a range of options, including joint ventures (JVs), partnerships, and alliances. Alternatives to traditional M&A made up 43% of pursued deals in 2023, compared to only 26% in 2022.¹¹

A company's strategic objectives can be used to drive the approach and structure selected. For example, if a company wants or needs to unlock capital for use elsewhere in the business, an outright sale of a non-core asset might be the best option. But, if it's looking to inject capital, leverage new relationships, or reinvigorate management, a JV might be a better option.

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

David Harrison, partner, Strategy, Risk & Transactions, Deloitte UK said:

“Depending on the reasons for divestiture and the time frame, private capital can be an option for portfolio rebalancing, offering various potential advantages over corporate buyers. For example, private capital can often do things that corporate entities cannot. They can be more creative and work within a wider range of potential structures, including JVs, partnerships, and can, in some circumstances, offer mechanisms such as callback options to enable the seller to retain a say in the asset post-transaction. These can offer the seller a broader range of options to achieve their goals.”

Financial investors may also have experiences, through current or past portfolio companies, that bring strategic knowledge and advantageous networks to the table. For example, in April 2023, Osisko Metals and Appian Natural Resources Fund III LP formed the JV, Pine Point Mining Limited. The company said it would leverage Appian’s extensive mine development experience and an investment of C\$75 million (US\$54.5 million) to bring the project to “shovel-ready” status.¹²

They may also be able to draw upon synergies across their global portfolio of investees, such as customers or suppliers, which can be beneficial to the asset in question. Additionally, selling to private capital means the company is not selling to a peer or competitor, adding strategic benefit to the divestment.

Automotive manufacturers are starting to play a wider part in supporting battery metal projects to first production using risk-sharing investment structures that provide the original equipment manufacturer (OEM) with security over the project’s offtake (e.g., nickel, lithium, cobalt) in exchange for funding the project through development and ramp-up. Funding options include basic equity, traditional debt, and pre-payments for the eventual production.

Trend 3: Driving growth and resilience

For example, in February 2023, car maker Stellantis acquired a 14.2% stake in McEwen Copper, a subsidiary of Canada’s McEwen Mining, which owns the Los Azules project in Argentina. The US\$155 million investment makes Stellantis the second-largest shareholder in McEwen Copper along with Rio Tinto.¹³

A dynamic future may require an active approach

These are just a few potential considerations for mining and metals leaders that are looking to grow and add value to their businesses through future-focused portfolio management. The way in which ESG can affect deal value and the implications of evolving tax regimes in specific jurisdictions are some other important factors to be weighed.

To thrive in an increasingly dynamic future can require companies to take a more active and agile stance on portfolio management. This should help them to build resilience and secure transformative growth options, making them more effective and sustainable in the long term.



Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

A close-up photograph of two hands shaking in a firm grip, symbolizing agreement or partnership. The hands are positioned in the upper right portion of the page, with the background being a soft, out-of-focus light color.

From ideas to action

Shifting to an active portfolio management approach

- **Harness scenario planning:** Develop multiple plausible future scenarios based on the intersection of critical uncertainties identified in industry, value chain, geopolitical, and global mega-trend analysis. Overlay this with key forces that could influence the portfolio, including technological advances, market shifts, regulatory changes, and economic conditions. Use advances in artificial intelligence (AI) to actively monitor shifts in the scenarios and key forces.
- **Refresh enterprise strategy and competitive positioning:** Evolve the enterprise strategy as new information becomes available or as specific scenarios or risks begin to materialize, making choices on where to play and how to win, and identifying the capabilities that may be required to create a distinctive competitive advantage for stakeholders.
- **Leverage optionality and risk adjustment:** Create a range of strategic options ranging from no-regret moves that are beneficial in most scenarios to more speculative big bets that could pay off in specific scenarios.
- **Prudent capital allocation:** Help ensure investment decisions are underpinned by robust analysis on the financial and operational levers that can maximize returns for the portfolio.

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Endnotes

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Trend 4

Enhancing mineral exploration
with AI: Utilizing precompetitive
geoscience data

Authors

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Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Mineral exploration is a critical component of company growth and supply chain security. A steady pipeline of projects helps support the long-term output of the mining and metals industry and contributes to economic prosperity in both established and emerging economies. In turn, this bolsters exports and the ability to manufacture goods, such as batteries and solar panels, which are essential to the energy transition.¹

Mining companies are aware of their foundational role in global supply chains, and investment in exploration is currently strong, reflecting a healthy market, high demand for metals, and the impacts of geopolitical sensitivities.² At the end of 2023, investment in non-ferrous mineral exploration stood at a near record high of US\$12.8 billion.³ However, the rate of discovery for economic deposits has halved over the past decade, and the average cost of discovery is now four times higher than 20 years ago, at around US\$220 million.⁴

Previously, most economically viable mineral deposits were detected in the near-surface environment. But today, teams are searching under post-mineralization cover in more remote regions, as well as more difficult jurisdictions, which can make the exploration process more complex and more costly.⁵

When treated as part of a systematic approach to mineral exploration, precompetitive geoscience data on properties and deposits can be leveraged by geologists to better inform their exploration programs. This, in turn, can generate cost and time savings, the extent of which is dependent upon the volume and value of the data and where the exploration team is in their program. It can also speed the identification of potential drill targets and help companies better understand mineralization systems that could lead to subsequent discoveries.

By empowering teams to experiment with emerging tools and datasets and helping to foster a culture that supports learning and growth through failure as well as success, leaders can support their companies to become exploration leaders. This will, in turn, help bolster project pipelines and meet society's need for minerals and metals.



Trend 4: Enhancing mineral exploration with AI

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

The value of precompetitive geoscience data

Precompetitive geoscience data describes geological, geophysical, geochemical, and other types of data that are created and curated through federal, state, and territory government geological surveys and is made freely available as a public good. This data and its analysis by skilled geoscientists can be used to generate hypotheses on areas that could offer the greatest resource potential, acting as a stimulus for exploration activity across geographies and commodities, including precious, base and non-ferrous metals, and critical metals like lithium and cobalt.⁶

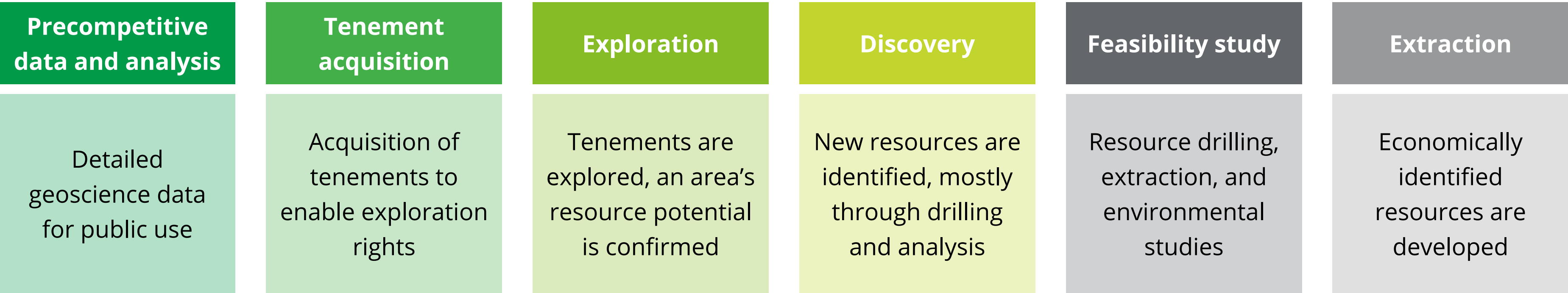
As data analysis technologies become more sophisticated and the cost of application falls, more companies are turning to precompetitive geoscience data to enhance their own data repositories and exploration activities. Today the primary users are publicly listed companies, for whom precompetitive data can directly help reduce the risk and cost associated with exploration and enhance their chances of successful discoveries. Some potential benefits across the value chain are outlined in figure 1.⁷

While most economic value from precompetitive geoscience data generation and analysis is realized through profits on the sale of extracted resources, the indirect benefits, such as expenditure on goods and services that support the value chain, wages paid to workers, and profits on the sale of tenement and exploration rights, can also be significant.⁸

For example, Geoscience Australia estimates that precompetitive geoscience data and analysis provides the foundation for economic activity in downstream industries of resource exploration and extraction worth more than 1,000 times the initial economic activity for data production.⁹ Between 2021 and 2022, precompetitive geoscience data and its analysis directly and indirectly supported 3.5% of Australia’s GDP (or US\$50.3 billion).

This value-generation potential can be seen in the Fraser Range in Western Australia, which was unexplored prior to the release of precompetitive soil geochemical data by the Geological Survey of Western Australia in 1998. Exploration using this data uncovered nickel, copper, and cobalt deposits that led to the development of the Nova mine in 2015. Annual revenues

Figure 1: Precompetitive geoscience data and analysis value chain



Source: Deloitte Access Economics

Trend 4: Enhancing mineral exploration with AI

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

from the operation have totaled US\$331.2 million per year since production commenced. It employs more than 450 people, and the region has subsequently seen hundreds of millions of dollars in development growth in tenement coverage and exploration from other companies.¹⁰

Speeding discovery to development

While discovery performance has decreased in recent years, exploration costs, time to discovery, and time from discovery to production have also all increased. For example, S&P Global has found that developing a new critical minerals mine in the United States takes an average of 29 years from discovery to production, longer than any other country except Zambia (34 years).¹¹

It takes significant time to gather enough information about the size, grade, and character of mineralization to enable informed investments that eventually catalyze the development of a resource into a mine.¹² And, with potential global metal shortages looming, speed is of the essence.

Charles Hooper, director, Strategy, Risk & Transactions, Deloitte Canada, said:

“The use of precompetitive data can increase the attractiveness of a country as a destination for mineral exploration and mining investment. By making critical data available to companies, to help their leaders develop, refine and test their exploration hypotheses, governments are assisting in shortening the exploration process. In line with this, a number of countries, including Australia and Canada, are working to increase the amount of data to which explorers have access and help fund analysis.”

Trend 4: Enhancing mineral exploration with AI

The extent to which governments are doing this depends largely upon the maturity of the mining industry within their jurisdictions as well as their mining and metals policies. In Canada, for example, where mining makes up a significant portion of the gross domestic product (GDP) — mining, quarrying, and oil and gas extraction contributed 7.9% or US\$109 billion to Canada’s GDP in 2021¹³— the Critical Minerals Geoscience and Data (CMGD) Initiative was set up in 2024 by the federal government to unlock the sustainable development of critical mineral resources by providing knowledge and data to support decision-making. This is achieved through funding initiatives that help advance availability of data and insights on the location, quality, and economic feasibility of critical minerals resources. One of the four workstreams is investigating the ability of advanced analytics to support responsible critical minerals exploration, production, and marketing decision-making.¹⁴

Additionally, transparency concerns can arise when mining companies carry out mapping instead of governments, as well as the risk of environmental damage.

Louis Kruger, partner, Energy, Resources & Industrials leader, Deloitte Africa, explained:

“Competitive bidding, which has already been introduced in the Democratic Republic of Congo (DRC), Guinea, Sierra Leone, Nigeria, and Zambia, could increase transparency, and governments could establish no-go environmental zones prior to mapping exercises to limit environmental damage. For example, Kenya suspended the issuance of mining licenses to conduct large-scale mapping of the country’s mineral deposits between 2019 and 2023.”¹⁵

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Data quality and organization matters

Much depends, not just on the availability of data, but also its quality and organization. In many jurisdictions, precompetitive geoscience data exists, but it’s stored in multiple disparate systems and in different formats. Some are digitized, some are paper-based, and the accuracy can vary depending upon the age and level of rigor with which the datasets were recorded.

Companies are opting to collaborate with geoscience specialists to help enhance their chances of success in discovering new deposits. For example, in August 2024, US Critical Materials Corp signed an agreement with US-based tech developer VerAI Discoveries to deploy its mineral targeting platform to explore covered terrain at the Sheep Creek area of interest in Idaho, US.

VerAI’s methodology combines AI/ML technology with geoscience knowledge to generate an objective, reproducible targeting platform for use in mineral exploration. This utilizes tailor-made datasets for undercover location of economic greenfield and brownfield mineral deposits. VerAI generates high-probability target portfolios that are at drill-ready stage, then collaborates with explorers to develop them. Value is generated through monetizing equity and royalty from successful assets. The company claims its approach can increase the probability of success in discovering economic deposits by two orders of magnitude and reduce targeting costs by more than 90%.¹⁷

US Critical Minerals stated that the addition of VerAI’s AI/ML technology will augment their current exploration methodologies. The US Defense Advanced Research Projects Agency (DARPA) is also looking at AI-assisted mining to expedite the search for critical minerals needed for US industry, consumer use, and the US military.¹⁸

Leading the race to find critical minerals and metals

In the past few years, the improvement of AI and machine learning (ML) technologies has skyrocketed, helping to create stronger, faster, and more

accurate algorithms. When applied selectively to good, quality, well-organized data, and in combination with precompetitive geoscience data, AI and ML can increase efficiencies in almost every part of the mineral exploration value chain, as they have done in other industries like oil and gas.¹⁹

The value-generation possibilities for both corporations and host economies could be huge, and the use of precompetitive geoscience data could become a differentiating factor for mining and metals companies in the race to uncover future-critical metals. Leaders who recognize this and support their teams to help extract new value using emerging technologies will likely see the greatest successes.

Supporting mineral systems exploration

Mineral systems exploration is an approach that has been widely applied in industries such as oil and gas and is fast gaining momentum in the mining and metals industry to identify new, potentially major mineralization districts. This method has helped to uncover world-class deposits, including Olympic Dam, Yeelirrie, Cannington, and Gruyere.

To maximize the targeting potential, geologists require access to large quantities of precompetitive data, including public access satellite imagery; geo-referenced academic interpretive maps; high-quality regional electromagnetic, radiometric, and gravity data, and more.¹⁶ The increasing availability of such data and growing analysis capabilities could support the wider application of mineral systems exploration in the future.

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments



From ideas to action

How to get the most from precompetitive data and analysis

- **Consider data quality and comprehensiveness:** The resultant output of AI/ML tools can be dependent upon the quality and accuracy of data inputs. To generate useful insights requires comprehensive datasets covering geochemistry, geophysics, mineral occurrences and more that have been captured correctly, have the required attributes, and have been validated. This is especially important in emerging jurisdictions where paper-based information is often transferred into digital systems manually.
- **Use standardized data formats and metadata:** Data alone doesn't speed up the exploration process—but it's availability and usability are important. Standardized formats (e.g., GeoJSON, Shapefiles) are required for consistency, and detailed metadata can provide context and improved data usability. User-friendly databases and portals can also aid easy data retrieval, supported by policies to help encourage utilization.
- **Apply advanced analytical tools and technologies:** To support the use of AI as part of data analysis, visualization tools may be needed to help interpret and present complex datasets. This is particularly pertinent when skilled multidisciplinary teams are working collaboratively on data interpretation and analysis.
- **Leverage ecosystems and relationships:** Establishing relationships with government agencies, academia, and industry will enable sharing of leading practices, leveraging of collective experience, and collaboration to help achieve joint value. Ecosystems can also support sustained investment into exploration and technological development to drive long-term success and foster the development of policies to promote data-sharing and transparency.
- **Continuous data updating and maintenance:** To help ensure data stays relevant, regular updates, including the addition of new findings and corrections, are important.
- **Legal and ethical compliance:** Adherence to ethical considerations and local and international laws relating to data, AI, and mineral exploration is vital throughout.

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Endnotes

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Trend 5

Transforming the digital core: Using next-generation ERP to unlock future advantages

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Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Enterprise resource planning (ERP) systems are an important part of mining and metals businesses around the globe. These software and tools support full value chain management, continuous production, and organizational improvements through the digital integration of organizations’ core functions and processes. But there’s a new generation of ERP software coming to the fore and, for most mining and metals companies, its adoption may require a complete replacement of their current ERP platform within the next five years.

Implementing a next-generation ERP system, whether to drive competitive advantage through a significant change of capabilities, or because an incumbent software provider will soon cease maintenance of an older ERP system, is no small task. However, if implementations are strategically timed, there’s a chance for organizations to transform their digital core, reduce their technical debt (bespoke customizations) and make themselves more streamlined, flexible, and responsive.

As the industry reinvents itself to meet the demands of the energy transition, and as companies reshuffle their business models and asset portfolios to get ahead, a steady wave of acquisitions, mergers, and demergers presents a golden opportunity to drive a competitive advantage through large-scale synergies and efficiencies enabled by ERP transformations.

ERP moves with digital and sustainable mining practices

Traditionally in mining and metals, ERP packages have supported collaboration and information-sharing between back-office functions. However, as information technology (IT) and operational technology (OT) have converged in recent years, and as the capabilities of these systems have grown, the reach of ERP systems has extended further into mines, boosting productivity and cost-effectiveness through AI-based insights and cloud-enabled services.

There are various reasons why many mining and metals companies are currently considering new ERP implementations. First, there is the impending withdrawal of support for various legacy ERP systems, such as SAP’s Business Suite of core applications, including ERP Central Component 6.0 (ECC6). In February 2020, the company announced that it will cease maintenance of SAP Business Suite 7 in 2027, with optional extended maintenance until the end of 2030. After that, clients who have not transitioned to its newer S/4HANA suite will require customer-specific maintenance.¹

Frank van Niekerk, SAP leader, Deloitte Asia Pacific, explained:

“It’s important to understand that moving from a platform like ECC6 to S/4HANA should not be just a software upgrade; it’s the opportunity to unlock the value of a completely different system and ways of working. S/4HANA has been redesigned for the HANA database to enable the use of embedded analytics, cloud platform integration and extensibility in the cloud, keeping the core clean.”²

Secondly, the advent of cloud computing has been a major catalyst for industrial digital transformation over the past decade and has become a significant driver of new ERP implementations in mining and beyond; the global cloud ERP market is expected to grow 13.6% annually and reach US\$40.5 billion by 2025.³

Historically, many organizations used on-premises ERP applications and were reluctant to entrust core business functions to the cloud. However, that’s changing, and businesses are now adopting cloud ERP to take advantage of simpler deployments, lower costs, elasticity (the ability to use only the necessary resources at a given time), new functionality, fewer internal IT resources, and the ability to easily add users and functions to quickly accommodate business growth.⁴ Cloud-based applications also support remote working and operations, which are increasingly important to the mining workforce.

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Frank van Niekerk, partner, SAP leader, Deloitte Asia Pacific, said:

“With straightforward brownfield ERP implementations, where a system from one vendor is simply superseded by the next generation, companies can miss out on the transformational possibilities on offer. For instance, reducing complexity and getting rid of customizations in a business’s core systems and functions plays an important role in enabling it to reap the long-term benefits of cloud computing. It also allows a reduction in the amount of ‘technical debt’ that long-life organizations and operations often carry, making their systems costly to run and maintain.”

An ongoing focus on driving sustainable mining practices is also important. The global introduction of mandatory reporting against sustainable mining standards could create significant pressure on the industry if there is a lack of forward-thinking in this regard.

For instance, the setup and usage of SAP ERP systems is vital in creating a Green Ledger, which can be used for reporting purposes, such as carbon accounting.⁵ This could enable mining practices to be adjusted to lower the operation’s environmental and carbon footprint and allow up-front planning for rehabilitation upon closure.

Marius van Jaarsveld, partner, Technology & Transformation, Deloitte Canada, added:

“Given the ongoing focus on cost and profitability, large-scale ERP implementations should be optimized. The days of multi-year ERP implementations are becoming absolute, and the effective usage of Generative AI and optimization of the technical landscape should be at the forefront. For instance, in the junior and mid-tier miner space, building of reusable cloud-based industry solutions—for example, for permit and project management—could be extremely beneficial.”

Transactions could be a trigger for core reinvention

The third and arguably most compelling reason for new ERP implementations are business transactions, including mergers and acquisitions (M&A) or demergers, which can be harnessed to trigger a complete reinvention of a business’s digital core.

For example, in the case of a merger where two businesses with different processes, operating models, and systems are integrated, it can be hard to realize business synergies by simply moving one organization on to the other’s existing ERP platform, particularly if both are using older, bespoke, or complex systems.

Trend 5: Transforming the digital core



Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Marius van Jaarsveld, partner, Technology & Transformation, Deloitte Canada, explained:

“Transactions provide an opportunity to build a brand-new core to enable a new operating model for the combined business and to eliminate system customizations as far as possible. Allowing large, complex businesses to run in the same way sets up organizations to unlock synergies, such as shared corporate services and centralized back-office functions. It can also unleash the true benefits of cloud computing, because most parts of the business can operate from one version of the truth.”

In some cases, demergers could also trigger an ERP-enabled transformation. For instance, if an organization sells an asset to a competitor that already has a streamlined core in place, then the ERP system that asset comes with may be of little significance. However, if the asset is to be listed as a stand-alone organization, perhaps through an initial public offering, then to fulfill compliance and regulatory requirements, it must have proper systems of record in place.

Rather than attempting to replicate the parent company's organizational complexities, a more efficient course of action would be a greenfield ERP implementation for the new entity. The result would likely be a leaner, lower cost, more efficient, self-sufficient organization, which could make it more attractive to potential investors or buyers.

Some of the benefits of core transformation

Examples are emerging, particularly in the oil and gas industry, of companies that are maximizing the value of next-generation ERP implementations by timing them with key business events, like mergers or demergers.

Catalyzing collaboration through cloud

Data management is a rapidly growing challenge for mining and metals providers, but by integrating company data into a centralized space, next-generation cloud ERP systems allow teams from across the enterprise and its supply chain to work from a single source of the truth.⁶ This is key in breaking down the siloed ways of working upon which mining operations have historically been based, and in realizing large-scale efficiencies, for instance, in scaling low-carbon technology deployments across a global portfolio of assets as detailed in [trend 8](#).

The current wave of M&A activity that the mining and metals industry is experiencing (according to S&P Global, 2023 saw 47 deals for a total value of US\$26.36 billion⁷) presents a chance for these businesses to follow suit, and M&A activity is expected to remain strong in the coming years. For forward-thinking miners, this activity presents an opportunity to maximize returns, and there are examples from across the resource sector that companies can draw upon for inspiration.

For example, Brazilian fuel distribution company, Atem Distribuidora de Petróleo, opted to implement a cloud-based ERP system when it acquired an oil refinery in 2022. Under the terms, it had nine months to complete the merger, despite the challenge posed by the refinery's multiple legacy systems and heavily customized operating environment.⁸

Atem selected SAP S/4HANA along with SAP's RISE offering and was able to complete the migration on time and on budget, while reducing ongoing

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

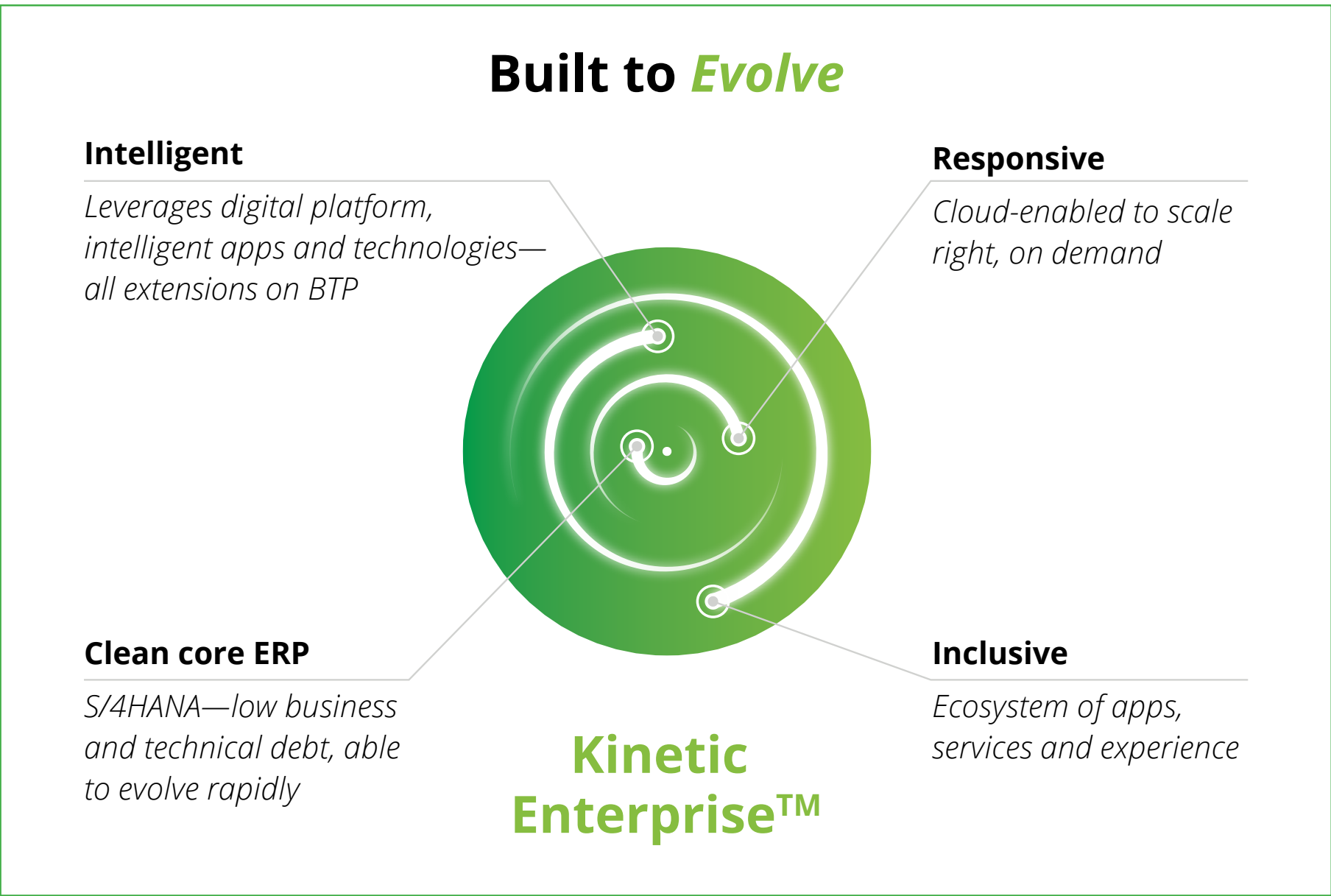
Authors & Acknowledgments

IT maintenance requirements. It also saw a 20% increase in sales process efficiency in the refinery business and an 80% reduction in its data center energy consumption.⁹

Making enterprises more kinetic

To support ERP-enabled transformations and digital core transformation, Deloitte Development LLC has created a concept called the Kinetic Enterprise. Through this, business systems are designed (or redesigned) with the intent of evolution over time, rather than static state. This allows the organization and its business model to swiftly adapt to challenges and opportunities as they arise.¹⁰ A Kinetic Enterprise has four pillars: it's intelligent, responsive, inclusive, and has a clean ERP core, as shown in figure 1.

Figure 1: The four pillars of a Kinetic Enterprise



Source: Deloitte Development LLC

Trend 5: Transforming the digital core

Often, companies get caught up in the how part of ERP implementations, rather than focusing on the why, which is to create value for the business, for example, through optimized capital expenditure and reduced procurement spend. By placing enhanced focus on why, the Kinetic Enterprise model helps companies to close the growing gap between transformation efforts and business value.

Prioritizing transformation to unlock future growth

Timing is important in maximizing the value of greenfield ERP implementations. By using today's transactions as a springboard to create a streamlined digital core, and building reusable assets in the cloud, mining and metals companies could increase their return on investment, leverage large-scale organizational synergies, and configure their businesses to support a competitive advantage. However, to achieve this requires leaders who are technologically curious and can balance today's priorities with a vision for future growth.





Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

From ideas to action

Digital core transformations can be achieved through ERP implementations

- **Assess technical feasibility and decide on the transformation approach:** Analyze the company's current ERP platform, develop a concept business case for the new platform and decide whether a greenfield, selective transformation (i.e., in areas such as finance or supply chain), or brownfield approach would be most appropriate for the organization and business case in question.
- **Create a transformation heat map for the project:** Including the software transformation itself and surrounding steps. Consider breaking down the roadmap into manageable phases and scoping out implementation partners.
- **Migrate to the public or private cloud:** Consider taking advantage of the chosen software vendor's wider proposition (e.g., SAP Grow or RISE, which focus on broader value creation opportunities).
- **Transform through paced innovation:** Pursue an enterprise landscape that is built to change, instead of being built to last. This starts with a streamlined digital core that has minimal technical debt, provides intelligent and innovative capabilities, is cloud enabled and therefore responsive, and is inclusive in that it utilizes an ecosystem of applications.

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Endnotes

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Trend 6

Smart operations in mining and metals: The data driven advantage

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Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

To meet future metal demand, the mining industry will likely be required to build new projects at an unprecedented scale and pace. For example, research by Benchmark Mineral Intelligence has found that more than 300 new mines might be required by 2035 to meet demand for electric vehicles and energy storage technologies.¹

At the same time, leaders are likely working hard to address immediate pressures created by the depletion of deposits, rising operating costs, and skills shortages, alongside calls for long-term positive sustainability impacts. This balancing act is seeing many operators double down on their optimization efforts at existing operations in a bid to produce more while using and wasting less, and alleviating stress on the workforce.

Increasingly, companies are looking to smart operations as a solution to manage complex priorities and demands. Injecting advanced technologies such as artificial intelligence (AI), digital twins, and predictive analytics into mines offers the potential to make them more cost-effective and resilient while helping to generate measurable gains in efficiency, safety, and sustainability performance, which could prove important in leading the future race for investment and talent.

Steve Dyson, partner, Strategy, Risk & Transactions, Deloitte Australia, said:

“With the number of new mining and metals projects that must be delivered, there’s a need for operational support, especially through the configuration and build process. Smart operations could provide an answer to these challenges and help mining and metals companies stand out from the pack when it comes to decisions surrounding investment, permitting, transactions and more.”

What are “smart operations”?

The traditional definition of a smart operation is one that uses digital capabilities to drive higher performance outcomes versus a baseline. This is achieved by breaking down the divide between the operational technologies (OT) that run the physical mining and mineral processing operations and the information technology (IT) systems that run the rest of the business.²

Combining technology, data, and human knowledge helps businesses to work smarter. This may result in optimized processes, increased productivity, and data-driven decisions across most stages of the value chain and through the asset life cycle—from engineering and design to production and operations, processing, and maintenance.

For years, mining and metals companies have been working to digitally transform their operations, adopt equipment and devices powered by the Industrial Internet of Things (IIoT), harness cloud computing, and integrate AI and analytics into their systems, with a view to operating more efficiently and driving a competitive advantage.³

From smart operations to smart enterprises

Today’s definition of a smart operation is much broader, referring to an organization that applies these capabilities at an enterprise scale.⁴ This important change may require a combination of digital, process, and talent-based transformation across the company and its value chain.

The rewards can be significant. By blending digital and human intelligence at increasing levels of scale, scope, and complexity, businesses can optimize processes, boost productivity, and make more informed decisions across the value chain. There’s also a chance to optimize across the asset life cycle, from design and production through to operations, processing, maintenance, and finally rehabilitation.

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

For example, a large industrials company recently worked with Deloitte Consulting LLP to help maximize the value of its manufacturing investments. Stakeholders across the global organization aligned to build a roadmap and transformation strategy to drive value over three years. The Plant of the Future program focused on eight areas and 25 improvement targets in different areas of the business.⁵

To improve workplace safety, manufacturing facilities adopted an AI model that uses video footage to spot safety risks. The collision avoidance solution can provide an extra layer of awareness to mobile equipment operators and pedestrians, alerting them to the surroundings and helping prevent incidents in real time. Meanwhile, to improve cycle times, one of the organization’s mills implemented software to predict vibration—an indication of potential impending failures. This allows workers to run the plant more aggressively during smooth operating conditions.⁶

A new model for mining and metals

The resulting operations are agile and can tailor their inputs (resources, energy, staff, etc.) and outputs (quality and quantity of products) to market conditions and customer requirements. When applied across the enterprise, this approach allows for increased usage of data-driven insights, cloud-enabled benefits, and the centralization of functions, such as sales and finance. While this type of customer-driven business structure has been commonplace in industries like manufacturing and fast food for 25 to 30 years, to the mining and metals industry, it’s still relatively new.

Steve Dyson, partner, Strategy, Risk & Transactions, Deloitte Australia, explained:

“The quality and reliability of the data that mining and metals operations now generate from sensor-equipped machines and processes mean that it can potentially be used to drive the business model and strategy of the organization. Mining and metals operations have lots of variable inputs and outputs, which makes it more complex for them to achieve the same level of responsiveness seen in other industries. However, the technologies are available now to understand the impact of different inputs on outputs (and vice versa), and for systems to automatically configure the processes.”

Organizations that can achieve this level of connectivity have the opportunity to generate value from leveraging true global experience and knowledge remotely when they need assistance. For example, GE Vernova provides this model to clients with steam power plant assets across the globe. The team monitors client’s turbine operations 24/7 and is available to provide real-time optimization and support services when needed.⁷

The insights that smart operations offer also make it possible to apply simultaneous stochastic optimization across complex operations, which is a significant departure from traditional static mine planning processes. Through a strategic mine planning framework that incorporates components of a mining complex into a single mathematical representation, this approach can enable operators to capitalize on the synergies between components while considering uncertainty.⁸

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Digital twins: Try before you decide

While brownfield operations can be reconfigured into smart operations, the cost and logistics may make this option uneconomic for some. However, for greenfield projects, there can be a strong business case to be made for optimizing the running of an asset from day one and instilling smart operations’ thinking from the get-go.

To do this requires the use of digital twins—virtual replicas of physical assets or processes. These are created using data that’s initially simulated and eventually collected from sensors and other devices that monitor a physical asset or process. The information is subsequently used to create an AI model that simulates or predicts the real-time behavior of that asset or process.⁹

There are four types of digital twins: analytics, asset, process, and system. Each offers a different perspective and opportunity to optimize mining operations, reduce costs, and enhance productivity. For instance, digital twins can uncover value losses and unrealized potential within the mining value chain, helping to identify new product streams and collaborative opportunities.¹⁰

Some mines are already being designed in this way. For example, Anglo American’s Quellaveco copper mine in Peru uses digital twin technology to improve efficiency and safety in its mineral processing plant. The digital twins are controlled from Quellaveco’s Integrated Operations Center. There are twins of the grinding system, flotation, tailings management, water control, electrical system, among others. These provide recommendations to help avoid failures in the real equipment or processes, optimizing costs and time through simulations of the different processes using AI. Additionally, they help to increase safety by reducing error rates.¹¹

Elevating enterprise data management

Mines often focus on trying to improve yield at the mine or processing plant level and miss easier yield improvements that could be gleaned by using the right input materials for the right market need.

End-to-end optimization of the value chain requires a strong connection between mining operations, processing plant, and end clients. This requires coordination between geologists, mining engineers, process engineers, and technical marketing supported by stronger data management systems and practices.

Eamonn Treacy, partner, Technology & Transformation, Deloitte Canada, explained:

“This also requires transformational leadership. Until mining companies have a senior person—that is, a chief data officer—and a team in charge of enterprise data, there may not be a single source of the truth or analytics that can serve across business functions. It’s important that those individuals understand the opportunities and limitations of current technology, as well as the true needs, differentiators, levers, and opportunities to value, not just from an industry perspective but also for the organization and its portfolio of assets.”

Design mines to solve challenges

For reasons of cost and scale, most mining projects are designed based on a similar blueprint and delivered using a standard engineering procurement construction (EPC), or engineering procurement construction management (EPCM) approach.

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

However, by leaning on digital design approaches and technologies, such as building information modeling (BIM), there's an opportunity to solve challenges, such as decarbonization, through new and innovative designs. This has already been done in other industries.

A good example is Powerhouse Brattørkaia, an office building located in Trondheim, Norway, designed by the Powerhouse Alliance and completed in 2019. Powerhouse Brattørkaia is energy-positive across the entire building life cycle, including embodied energy in construction materials and end-of-life deconstruction. It produces more electricity than it consumes daily, supplying renewable energy to itself, neighboring buildings, and vehicles via a local microgrid.

Mining operations are more complex than a single building. However, the technology to design intricate, even living cities, is already available. For instance, in April 2024, infrastructure engineering software company, Bentley Systems, unveiled an unlimited scope digital twin of the city of London, United Kingdom. The geospatial model can be operated from a tablet. It combines Bentley's iTwin software, photo-realistic 3D map tiles from Google Earth and Epic Games' Unreal Engine.¹²

The model can be linked to many different channels, including BIM models, IoT, and point cloud scanning. Because it's hyperconnected, information is not handed over to the Bentley digital twin but instead streamed, so that data remains with those that own it. The developers hope that as new projects are delivered, new layers will be added to create an evolving model of the city.¹³

In the future, models like this could prove key to creating smart, multi-user delivery models in mining and in optimizing the expansion of important, long-life brownfield projects.

Enabling smart operating models

As more operations across the mining and metals value chain become "smart" and/or autonomous, this could also enable companies to outsource the management of certain assets or functions to trusted partners and third-party suppliers based on data-led insights.

Herman Lombard, partner, Technology & Transformation, Deloitte Canada, explained:

"Historically, the mining industry has been distrustful of data and has relied heavily on humans to make decisions. However, today, the problems that mines need to solve are so complex and with so many variables that it's hard for humans to make good decisions, let alone optimal ones, in a reasonable time frame. The systems and data are now becoming robust enough to solve a lot of that complexity much faster and better than humans. It's time to start trusting the data driven insights and that will likely unlock new, more cost- and resource-effective business models."

The next generation of mines can be smart

The efficiencies that integrated, connected, digitally enabled enterprises can generate far outweigh the initial investment required, particularly for the next generation of greenfield mines. The flexibility and agility that these technologies instill could allow leaders to better balance priorities surrounding productivity and sustainability with workforce health, safety, and culture at existing operations and across the value chain too. This sets companies up to lead by capitalizing on new opportunities as and when they arise.



Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

From ideas to action

Creating smart mining and metals enterprises

- **Set a clear smart operations strategy and vision:** Smart operations transformations are typically multi-year journeys that can drive significant change across the business. As with any major organizational transformation, setting a clear and crisp strategy and vision up front is essential to provide a clear North Star for all and to help ensure that senior leadership is aligned and stays the course.
- **Challenge traditional design approaches:** The tools and techniques required to design mining and metals operations to help tackle the challenges of today, and even tomorrow, already exist. Where industry-specific solutions are not yet available, consider partnering or collaborating with leaders from adjacent sectors to find answers.
- **Consider more integrated ways of working:** Integrated operations thinking and approaches are essential to get the most out of operations and help ensure that personnel are equipped to make the best decision for the business across its value chain, rather than the best decisions for a specific step in the

value chain. Smart operations may require significant shifts to new ways of working to maximize the benefit of data-driven insights.

- **Be deliberate with IT/OT convergence:** Mining companies could evaluate current ways of working between IT and OT functions and determine which operating model best suits their culture and maturity. Integrated governance is vital to manage both the convergence process and resulting operating model effectively.
- **Get on top of data management:** At the heart of smart operations and enterprises is a centrally governed data management strategy and enabling system. This not only allows all teams, vendors, and partners to operate on a single source of truth but also allows acceleration if the foundation is built consistently and systematically over time. Consider the robustness of your organization's current data management approach and whether it could potentially support the organization's smart operations strategy and vision.

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

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Trend 7

The impact of GenAI on the mining and metals workforce: Developing effective reskilling strategies

Authors

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Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

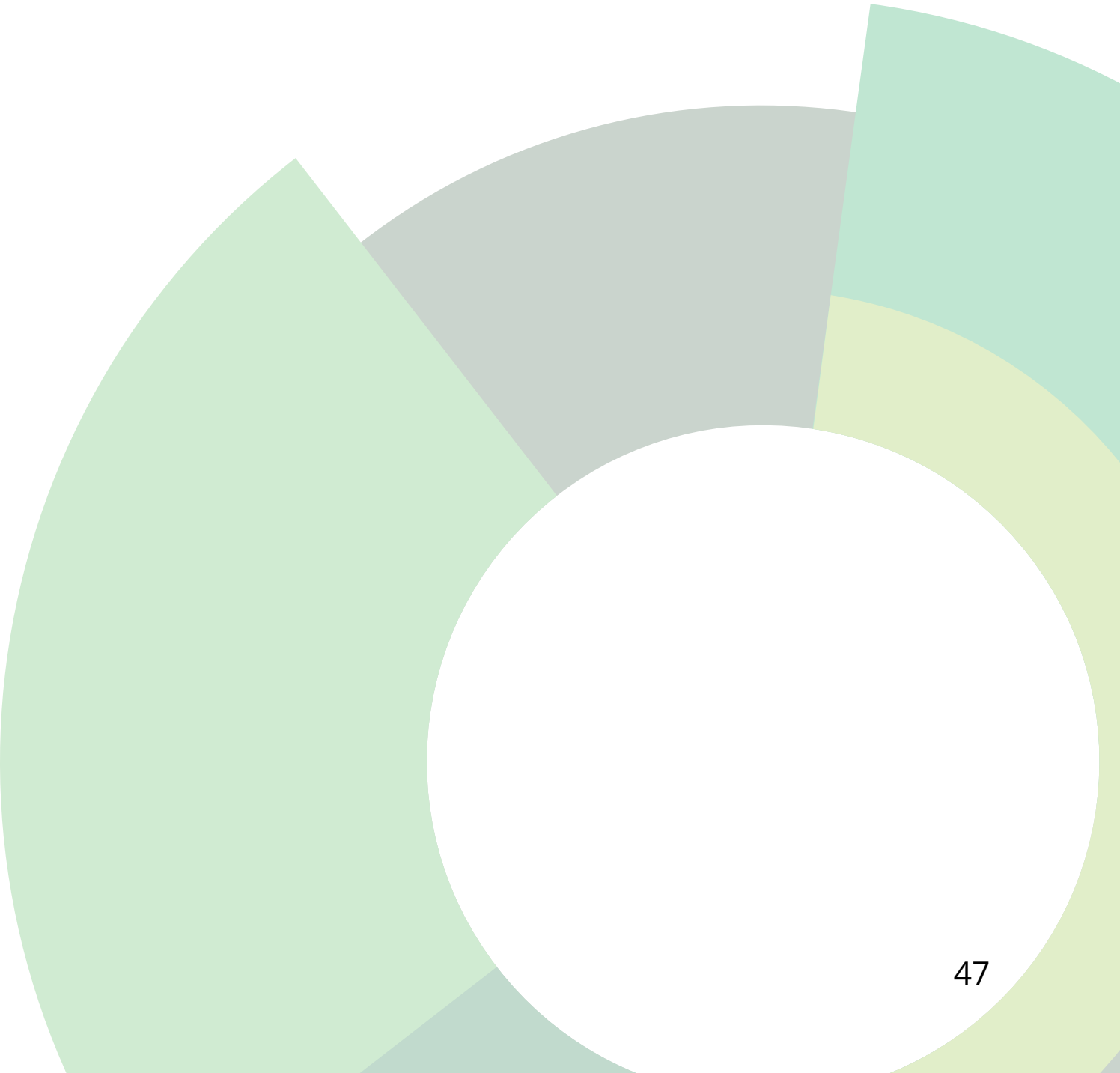
In mining and metals, like many other industries, leaders are encouraging their teams to experiment with a range of different AI use cases, including in predictive and prescriptive maintenance (see [trend 6](#)) and mineral exploration (see [trend 4](#)). But the question remains as to whether these tools will be able to drive a productivity increase for organizations in a world where operations are increasingly talent constrained.

For business leaders, the challenge isn't if or when to adopt these technologies—their deployment is inevitable—instead, the focus should be on how. Strategizing the deployment of AI to help ensure that it's used effectively to achieve the organization's productivity, financial, and sustainability goals could prove an important priority over the next 12 to 24 months.¹

The way in which mining and metals leaders act now to reskill and upskill their workforces to harness these technologies might afford companies a significant future advantage by lowering costs, boosting employee safety and well-being, reinvigorating recruitment, retaining staff who are hungry for professional development, and using data-driven insights to unlock exciting new ways of working. For example, the Deloitte Global 2024 Gen Z and Millennial Survey found that the overwhelming majority of Gen Zs and millennials who frequently use Generative AI (GenAI) believe it will free up their time, improve the way they work, and improve their work/life balance.²

Sonia Solova, senior manager, GenAI leader for Energy, Resources & Industrials, Deloitte Canada, said:

“The future of work isn’t about replacing humans with machines. It’s about harnessing the symbiotic potential of AI tools, freeing workers to spend time on higher-value tasks that are innately more human. Reskilling the current mining and metals workforce and preparing potential future talent for this development is high on the agenda for leaders. To do this successfully, they need to understand how roles could evolve and the skills that could be required to complete critical work.”



Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Enabling and enhancing work using AI

Mining and metals organizations continue to face difficulties in recruiting and retaining workers who have the skills and capabilities necessary for today's operations and are available when and where they're needed.³ Meeting net-zero targets is expected to require around 0.7 million new workers in the critical minerals extraction industry by 2030 (an 88% increase from 2022 levels),⁴ but many of these roles could go unfilled unless action is taken to change perceptions of the industry, attract and retain talent, and improve output per worker.

Resourcing challenges, combined with the changing world of work, labor market dynamics, shifts in employee values, skills gaps created through retirements, and cost optimization pressures are also affecting organizational productivity, engagement, and growth. For example, Freeport-McMoRan and Pilbara Minerals, among others, have cited labor challenges as a limiting factor in their productivity and growth over the past two to three years.⁵

When used strategically, AI can augment routine tasks and free up people's time to engage in higher-level, creative, empathetic, and strategic activities, helping to address some of these fundamental talent-related challenges. It can also provide opportunities to introduce cost efficiencies, improve employee engagement by designing better work, and unlock greater productivity.⁶

For example, AI can be used to automate repetitive tasks such as data entry and simple data analysis for reporting against responsible mining standards, allowing people to focus more of their time on tasks like problem-solving.

The transformative potential of GenAI

By utilizing the capabilities of GenAI tools, tasks can also be augmented and enhanced to speed up safe working and positive outcomes. For example, mine maintenance teams can already use GenAI-enabled virtual field assistants as reference tools. This provides quick access to parts catalogs, manuals, and other technical information, as well as to aid troubleshooting and avoid safety pitfalls.⁷

Looking ahead, GenAI could be used to help solve complex problems in several different ways. For example, models could be used to automate layout generation and optimize novel designs for capital projects; design and optimize flowsheets to solve complex mineral processing challenges; and identify, classify, and predict ore properties without testing on known processing assays.⁸

Extensive use of GenAI in other industries is already proving its value, and similar gains could soon be realized in mining and metals. For instance, software engineers at Australian bank Westpac used GenAI to augment their software development tasks, realizing a 46% overall productivity benefit. Senior engineers said that time saved was directed to more value-add tasks, while junior engineers said the tools helped them from a training and learning perspective.⁹

Research has found that 79% of business leaders expect GenAI to transform their organizations within the next three years.¹⁰ By rearchitecting work and recognizing which tasks can be automated, augmented, and created, and which ones will remain unchanged, companies can devise strategies to successfully navigate the challenges and opportunities posed by AI.¹¹

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

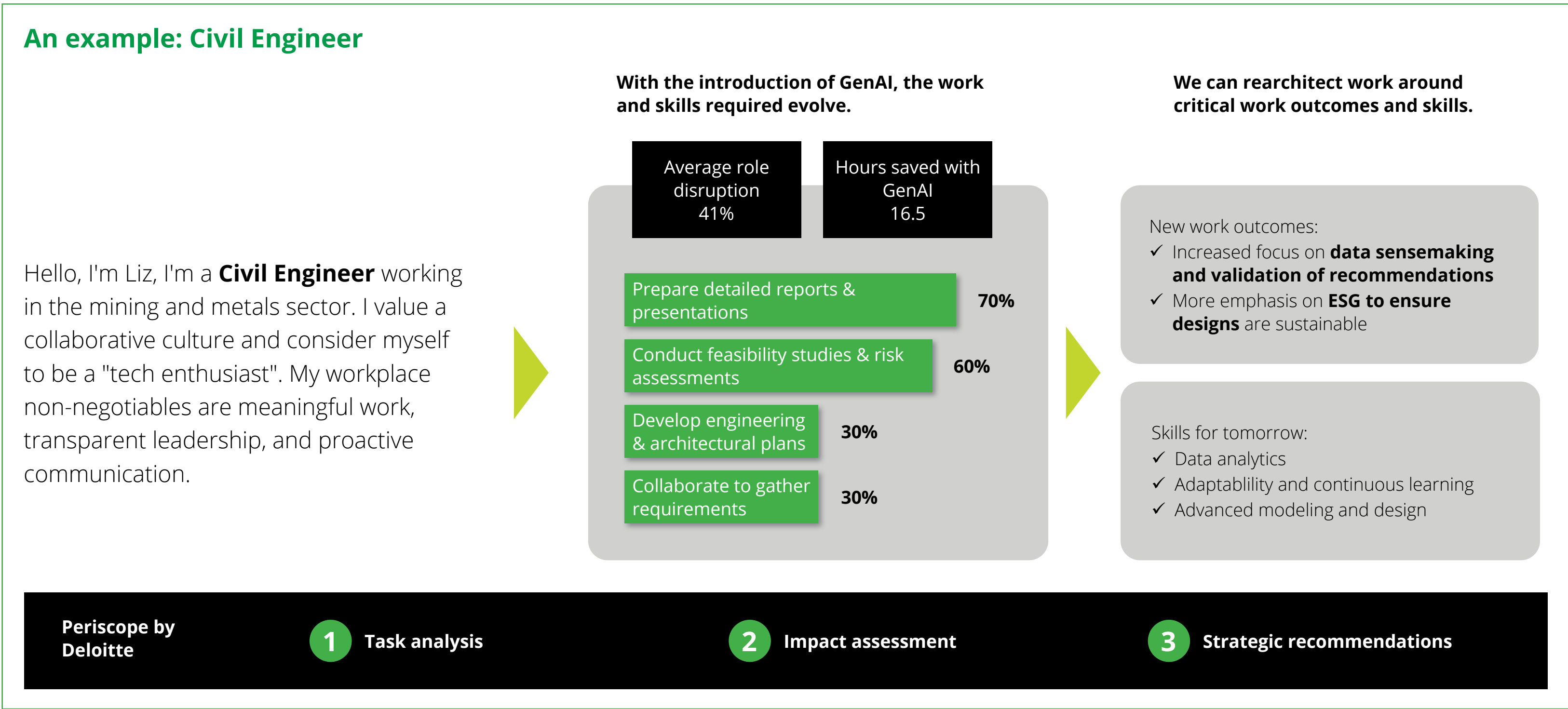
Authors & Acknowledgments

The evolution of key business roles

One way to approach transformational AI technologies like GenAI and navigate their impacts on the workforce is to explore potential disruption at the task level for key roles. AI-based tools already exist to help with this. For example, in figure 1, Deloitte Canada has modeled the level of change in different tasks that a typical civil engineer working in the oil and gas industry might experience with the introduction of GenAI.

In the center of the image are four tasks that are important to the civil engineer's work and a prediction of the percentage disruption to each task when GenAI is introduced. For example, preparing detailed reports and presentations would be disrupted by 70%. Based on the percentage change in these four key tasks, an average percentage disruption to the civil engineer role has been determined: 41%. That number indicates that the role would fundamentally change with the introduction of GenAI.

Figure 1: Example of how the civil engineer role could be disrupted by GenAI and how work can be rearchitected around work outcomes and skills



Source: Deloitte Canada

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Modeling change in mining and metals

Joanne Doyle, senior manager, Technology & Transformation, Deloitte Canada, explained:

“The team at Deloitte Canada has identified four roles that are essential to the future of work in mining and metals operations: maintenance technicians, engineers, geologists, and drillers. Companies could run scenarios to determine how these roles could change with the introduction of AI technologies and use those insights to prioritize and optimize their upskilling efforts.”

For example, it’s likely that in the future, mine maintenance technicians will use AI technologies more extensively than today to diagnose mechanical challenges and analyze data quicker and more effectively. This shift would mean that teams could gain additional capacity. AI can also support optimal planning and scheduling of maintenance activities and improve precision accuracy, to avoid unnecessary work and boost safety by reducing workers’ exposure to heavy equipment.

Given these advantages, it would be reasonable to expect that if AI technologies were made accessible to an entire maintenance team in their day-to-day work, the result would be a department that’s more efficient, potentially creating benefits for the entire supply chain through reduced downtime of mission-critical assets. To facilitate these changes, tomorrow’s maintenance technicians would likely need to be more competent in data handling, analysis, and interpretation; be familiar with advanced robotics and automation; and have critical thinking and problem-solving skills.

An insight into future skills requirements

Recognizing that traditional skilling approaches might not suffice in this new AI-enabled world, Deloitte Canada has developed Periscope, a tool that can empower organizations to take informed, proactive steps toward integrating AI into their workforce. The platform scans job titles and associated tasks across an organization to rapidly identify the potential impact that technologies like GenAI may have on different roles, business areas, and the overall organizational structure.

Periscope rapidly assesses the impact on the human workforce, enabling companies to shift from analysis (which can involve months of manual work), to crafting upskilling strategies and programs in days. The analysis provides insights into task automation potential rolled up into individual job and function impacts and provides a heatmap of the parts of the organization that will be affected by AI.

Beyond upskilling, these insights can help leaders to prioritize where they want to invest in tools, such as GenAI, based on their business strategy and decide where best to start experimenting and scaling the technology.¹²

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Upskilling and reskilling to help enable value

Based on the insights extracted from data analysis, a targeted upskilling program could then be created for existing employees at an asset or business level to help ensure the company is ready to meet future challenges and opportunities over a range of time horizons. Where recruitment is necessary to fill vacant roles, mining and metals companies could use this list of skills to search for candidates in adjacent asset-intensive industries (oil and gas, civil infrastructure, aggregates, etc.) within their regional business ecosystem.

Additionally, information on desirable future skills could be shared with local and regional educational partners, such as universities, colleges, and schools. This could help inform the evolution of degree programs, redefine apprenticeships, and develop micro-credentials that fit the industry's long-term skills requirements.

Unlocking value with AI technologies

As we look to 2050, transformative AI technologies could enable mining and metals companies to unlock significant value through productivity gains and workflow efficiencies and help younger generations to get excited about working in an industry that's critical to society's future.

However, the adoption of GenAI can bring about fundamental changes in critical mining roles and trades. The way in which leaders use their organization's data to prepare the workforce for this change and prioritize upskilling and reskilling efforts could give companies a head start over competitors.



Trend 7: The impact of GenAI on the mining and metals workforce

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments



From ideas to action

Using AI to help solve critical reskilling challenges

- **Define workforce requirements:** Conduct assessments to identify the critical skills and roles required to achieve business strategies in prioritized business units. Use this information to map company requirements against forecasted labor market supply.
- **Design reskilling programs:** Using data from the labor market assessment, as well as skills analytics, workforce planning, and AI analysis, design the reskilling programs that help meet the needs of the business.
- **Refine and scale:** After pilot testing the process with one area of the business, apply lessons learned to scale reskilling efforts further into the organization.
- **Conduct strategic workforce planning:** Prepare data for AI analysis and run a strategic workforce planning process to determine build, buy, borrow, and automation plans to close workforce gaps.

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Endnotes

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Trend 8

Scaling progress toward net-zero:
Collaborating to address climate
change

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Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

With ambitious net-zero targets in place for 2050 and plans for operations to transition to clean energy sources in finalization, the decarbonization focus for many mining and metal providers is shifting from preparation to execution. However, for many companies, this is proving more complex than initially thought. Despite the time spent scoping out new processes, optimizing systems through modeling, and testing emerging technologies, such as hydrogen fuel cells or battery energy storage systems, the practicalities surrounding concerns such as energy and supply chain security and technological maturity are now coming to bear.

For example, high commodity prices and supply chain bottlenecks have led to an increase in solar panel prices in recent years and delays in deliveries. Furthermore, 80% of the world’s manufacturing capacity for solar panel components is located in one country—China.¹ Such significant reliance on one geography to produce required elements for solar power, combined with concerns around trade tariffs and adequate controls on relevant compliance protocols across China’s operations in this area, puts increasing pressure on the sector to diversify.

John O’Brien, managing director, Sustainability & Climate lead for Mining & Metals, Deloitte & Touche LLP, said:

“To mitigate or manage the impacts of these challenges, it’s vital that company leaders and policymakers work together to assess the risks and implement solutions to scale the necessary solutions. By taking a systems approach and exploring innovation business models, mining and metals companies could both accelerate their transition and help the economies within which they operate to meet their climate targets.”

Trend 8: Scaling progress toward net-zero

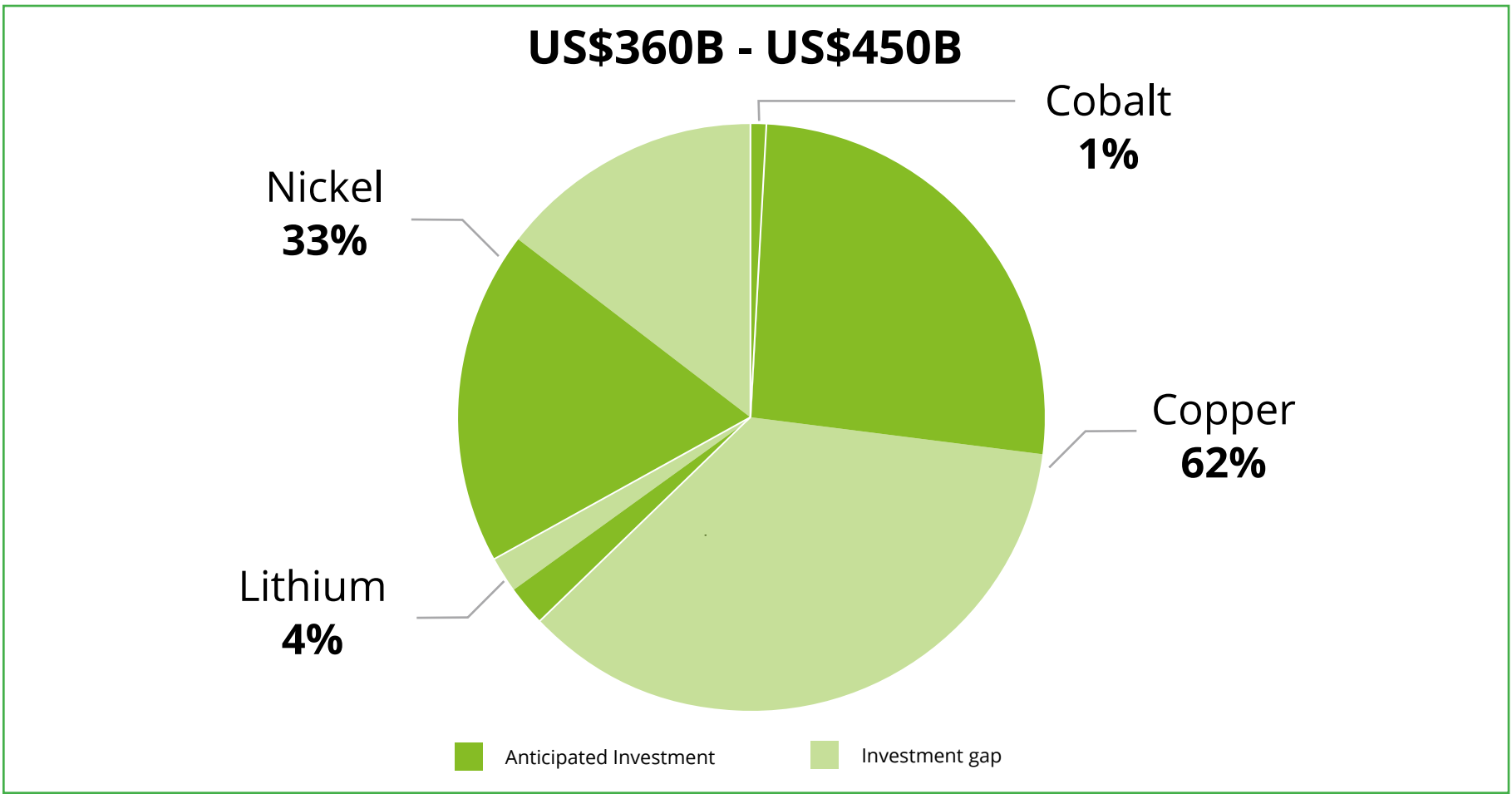
Achieving net-zero by 2050 will likely be a considerable challenge. It could require moving as much as four times faster than in past transformations, such as the Industrial Revolution. This necessitates local, regional, and global coordination across companies, industries, and economies to sequence the introduction of new policies and technologies. Different regions will proceed at different paces depending upon challenges, such as workforce readiness, supply chain resilience, cost advantages, water availability, and energy accessibility.²

The pace of unlocking net-zero in mining and metals could be determined by four key factors:³

1. Access to finance

Although investments for critical minerals mining and processing are increasing, the International Energy Agency (IEA) states that to meet a net-zero emissions scenario requires an additional US\$360 billion to US\$450 billion by 2030 to bridge potential supply-demand gaps (figure 1).⁴

Figure 1: Required investment to meet minerals demand in the net-zero scenario, 2022–2030



Source: IEA

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

For each organization, the nature of the investment challenge depends upon its size and the way in which it’s structured. For example, for large publicly listed miners and metal producers that have plenty of liquidity, gaining shareholder approvals for capital deployment into decarbonization initiatives will be a key consideration. Whereas for mid-tier and junior miners that are looking to financial institutions and private investors to support execution, there may be additional obstacles to overcome, and much will ride on the balance of risk and return.

Where funding is required, leaders could consider engaging downstream consumers, like automotive manufacturers and defense companies, for direct investments in mining, refining, and precursor materials. Many miners are seeking long-term fixed-price contracts to help anchor demand and mitigate raw material price volatility; for example, in May 2023, Sociedad Química y Minera de Chile SA (SQM) and Ford Motor Company announced a long-term strategic agreement for the supply of battery-grade lithium carbonate and lithium hydroxide for production of Ford’s electric vehicles.⁵

Tax incentives, early-mover grants, and critical mineral agreements can also help to minimize risks for capital-intensive projects. For instance, to strengthen critical metal supply chains and accelerate net-zero goals, the US Inflation Reduction Act (IRA) provides financial incentives to mining companies through tax credits and loan guaranties. Amendments under the IRA have expanded the scope of the Title 17 Clean Energy Financing Program to include projects that reinvest in legacy energy infrastructure. While the Title 17 program eligibility can be challenging, and a number of companies are competing for selection, a loan guarantee thereunder can cover up to 80% of a project’s eligible costs, thereby helping to finance mine development.⁶

2. Technological maturity and applicability

Decarbonizing mining and metals operations and end consumption hinge on the availability and commercialization of a wide range of technologies affecting each stage of the value chain.⁷ For mine operators, decarbonization efforts thus far have centered heavily on the electrification of mine haulage—diesel-powered vehicles account for approximately 30% to 80% of direct emissions onsite,⁸ making them “low-hanging fruit.”

However, the deployment of battery-powered vehicles and autonomous systems is still relatively small compared to the industry’s installed base of diesel vehicles. To further improve technological suitability and performance and lower the cost of adoption, leaders could consider collaborative ventures. For example, in May 2024, iron-ore producers, BHP and Rio Tinto, announced a collaboration to test two CAT 793 haul trucks and two Komatsu 930 haul trucks at mine sites in Western Australia’s Pilbara region.⁹

Declining ore quality has contributed to a 28% productivity drop in global mining operations over the past decade.¹⁰ To address this while lowering emissions, leaders could encourage and empower their teams to look at more widespread use of advanced technologies, including automation, artificial intelligence (AI), and data analytics. This could improve process efficiencies, as detailed in [trend 6](#). For example, the adoption of digital twins can help develop virtual models of physical assets, systems, and processes that can be used to simulate different operational scenarios and optimize decisions that improve mining productivity and lower their carbon footprint.¹¹ Nokia Bell Labs and Vale are currently trialing a digital representation of Vale’s autonomous iron-ore mine in Carajás, Brazil. Initial estimates at the mine predict an increase in productivity of up to 25% through process optimization.¹²

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Carbon capture, utilization, and storage (CCUS) technologies could also prove important to addressing emissions in hard-to-abate sectors like mining and metals. CCUS involves capturing carbon dioxide (CO₂) emissions from sources such as the atmosphere, power plants, and industrial processes—utilizing the captured CO₂ for beneficial purposes and/or storing the remainder underground in geological formations. It could provide an important interim option given the low-technology readiness level and high cost of low-carbon options in critical industrial processes, such as steelmaking, as well as long capital planning cycles involved. In fact, the IEA states that CCUS will likely account for a proportion of heavy industry emissions reduction, even after alternative energy sources have been developed.¹³

3. Forging new business models

Justine Winston-Smith, partner, Strategy, Risk & Transactions, Deloitte Australia, said:

“To help meet demand for sustainable products, many mineral and mining companies are looking to modify their business models to create future optionality and resilience. Scaling up decarbonization remains challenging and developing an effective ecosystem will likely be key to unlocking progress.”

Mitigating this challenge could require multi-user infrastructure models that allow users to pool their expertise and resources for developing the necessary capabilities that can expedite the supply in a cost-effective manner. Partnership models such as joint ventures and minority investments could integrate the value chain to mitigate supply and pricing risks.

Another option is the mining-as-a-service model as offered by Canada-based Inspire Resources. Inspire is a proponent of small, modular projects that enable companies to harness new business models which unlock shared value through

community ownership or leadership. The company provides facilitation and advisory services for executives and boards, stochastic modelling of mining and metals value chains to allow projects to be evaluated under uncertainty and simulation and co-design with technology innovators.¹⁴ Shifting to operator roles with communities controlling resources helps enable more flexible, scalable operations and closer community engagement.¹⁵

4. Securing talent

To meet net-zero targets, the critical metals extraction industry is estimated to require around 700,000 new workers by 2030, representing an 88% increase from 2022 levels. Similarly, around 3.5 million job openings are expected to be present in the metals and machinery industry across the European Union between 2022 and 2035.¹⁶

Shifting public perceptions of miners from resource extractors to sustainability catalysts through regular engagement with youth via school programs and community initiatives could help attract new talent into the mining and metals industry and mitigate future job vacancies.

Creating a global talent marketplace could support the mobility of the workforce across the sector, which would require industry collaboration, standardization of skills and certifications, and adoption of automation and remote work. Establishing such global talent pools can make it easier for companies to recruit specialized skills, knowledge, and experience.¹⁷

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

A tri-phased strategy to scale solutions

The increasing demand for critical minerals and long development timelines highlight the need for swift scaling of both production and decarbonization measures.¹⁸ Leaders could consider a tri-phased strategy—focused on the asset, system, and cross-system levels—across the following areas to help further net-zero in the metals and mining industry:

- **Build a foundation for net-zero:** Improving the efficiency of existing production processes, optimizing resource usage, and bringing on new capacity at lower emission levels can help build a low-carbon foundation.
- **Build efficiency and resilience across value chains:** Resilient supply chains can help ensure supply reliability and fair pricing. Additionally, value chain partnerships can spur innovation, drive scope 3 decarbonization, minimize disruption risk, decrease critical mineral consumption, ease resource stress, and boost equitable access.
- **Take an ecosystem approach to expansion and the environment:** Many growing mining operations overlap with Indigenous lands, necessitating active community collaboration for acceptance and permitting. Greater recycling of metals and minerals is also key to reducing their carbon footprint, conserving natural resources, and enhancing supply chain resilience.¹⁹

Work together for maximum impact

The urgency of these actions shouldn't be understated. A 2023 report from UN Climate Change stated that global greenhouse gas emissions need to be cut by 43% by 2030, compared to 2019 levels, to limit temperature rise to 1.5°C by the end of this century and avoid the worst impacts of climate change. It also found that national climate action plans remain insufficient to achieve this.²⁰

The mining and metals industry accounts for approximately 15% of annual global emissions,²¹ and the commodities it produces are essential to a large

portion of the likely technology mix in solutions deployed. As such, these companies are in a unique position to help lead the scaling of net-zero efforts. If mining and metals leaders take steps now to help organizations, industries, and policymakers band together to sequence policies based on their costs and feasibility for implementation, prioritize low-emissions projects based on resource availability and potential co-benefits, and identify and manage trade-offs in the short and long term, then their collective impact on global climate targets will likely be swifter and more meaningful.

Boost recycling to decarbonize key metals

Electric cars now account for 95% of the growth in electric vehicle (EV) battery demand, which reached 750 GWh in 2023—a 40% increase compared to the previous year. In this rapidly expanding market, US\$500 billion in investments were announced in 2023 to boost battery manufacturing capacity.²²

However, batteries don't last forever. It's vital that mining and metals companies work with recyclers and initiate partnerships to help reduce the impact of this imminent waste surge. For instance, CirCular, Atlantic Copper's flagship circular economy project in Huelva, Spain, has the capacity to process 60,000 tons per year of non-ferrous metal shreds from obsolete waste electrical and electronic equipment (WEEE) once its operational in 2025. Through this project, the Huelva company will recover materials such as copper, gold, silver, platinum, tin, and palladium and feed them back into Atlantic Copper's metal processing supply chain.²³

Boosting recycling levels through initiatives such as urban mining will be important to reduce potential supply gaps and help decarbonize supply chains as recycled metals often have a lower carbon footprint than virgin metals. For example, the recycling of copper produces 43% fewer emissions than traditional mining.²⁴



Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

From ideas to action

Strategies to help scale net-zero

- **Tri-phase scaling efforts:** A tri-phasing approach recognizes the importance of incremental and sequential progress, whereby the process of decarbonization starts at the asset level (for example, a machine, process, or facility), followed by scaling up at the system level (such as a set of machines and processes or multiple facilities), and culminates in the integration of diverse systems or sectors into a cohesive low-carbon ecosystem (for example, across processes, technologies, supply chain, vendors, and sectors).
- **Facilitate acceleration:** Leverage enablers such as technology, talent, finance, and innovative business models to help expedite the transition's pace by offering important support and momentum.
- **Serve as transition architects:** Drive action among policymakers, companies, and consumers who may play pivotal roles in shaping the trajectory of the transition, ultimately determining its outcomes. For example, involvement in organizations such as Critical Metals Association (UK), that bring together mining and metals companies with public affairs, communications, marketing, research, and governments; allows companies to have a say in policymaking; and helps to coalesce broad-scale actions.²⁵

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Endnotes

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Trend 9

Making ESG strategies more value-led:
Driving purpose and progress

Authors

Andrew Swart, partner, Energy, Resources & Industrials leader, Deloitte Canada

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Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

The environmental, social, and governance (ESG) movement, which came to bear following the Paris Agreement in 2015,¹ recognized that the private sector has a prominent role to play in keeping global warming below 2°C above pre-industrial levels. Investor’s appetite for sustainability-linked funds peaked in 2021, shortly before the Russia-Ukraine war²—an event that created tensions between affordability, energy security, and decarbonization into sharp relief for many economies.

Fast-forward four years and poor ESG fund performance has seen some investors turn their backs on ESG-focused stocks. By mid-2024, US\$40 billion had been withdrawn from ESG equity funds.³

A few years ago, ESG was a key focus of capital market days and annual general meetings for companies in many industries; today, investor pressure has become more focused. For mining and metals leaders that have invested significant effort and resources into helping ensure their companies gained good ESG ratings and establishing dedicated reporting functions and mechanisms, many are left pondering the future of ESG. However, public and regulatory expectations have not lulled, and this shift in gears from investors should not deter leading organizations from fulfilling their purpose.

Andrew Swart, partner, Energy, Resources & Industrials leader, Deloitte Canada, said:

“Many mining and metals executives feel that ESG metrics haven’t necessarily led to better performance or higher stock market valuations. Investors have also become disillusioned with the term, and for many, the gas pedal has come off of ESG. While disclosure pressures will remain, tomorrow’s leaders will likely be the companies that refocus on what brings value to the organization and their stakeholders, so that they continue to drive meaningful social and environmental progress.”

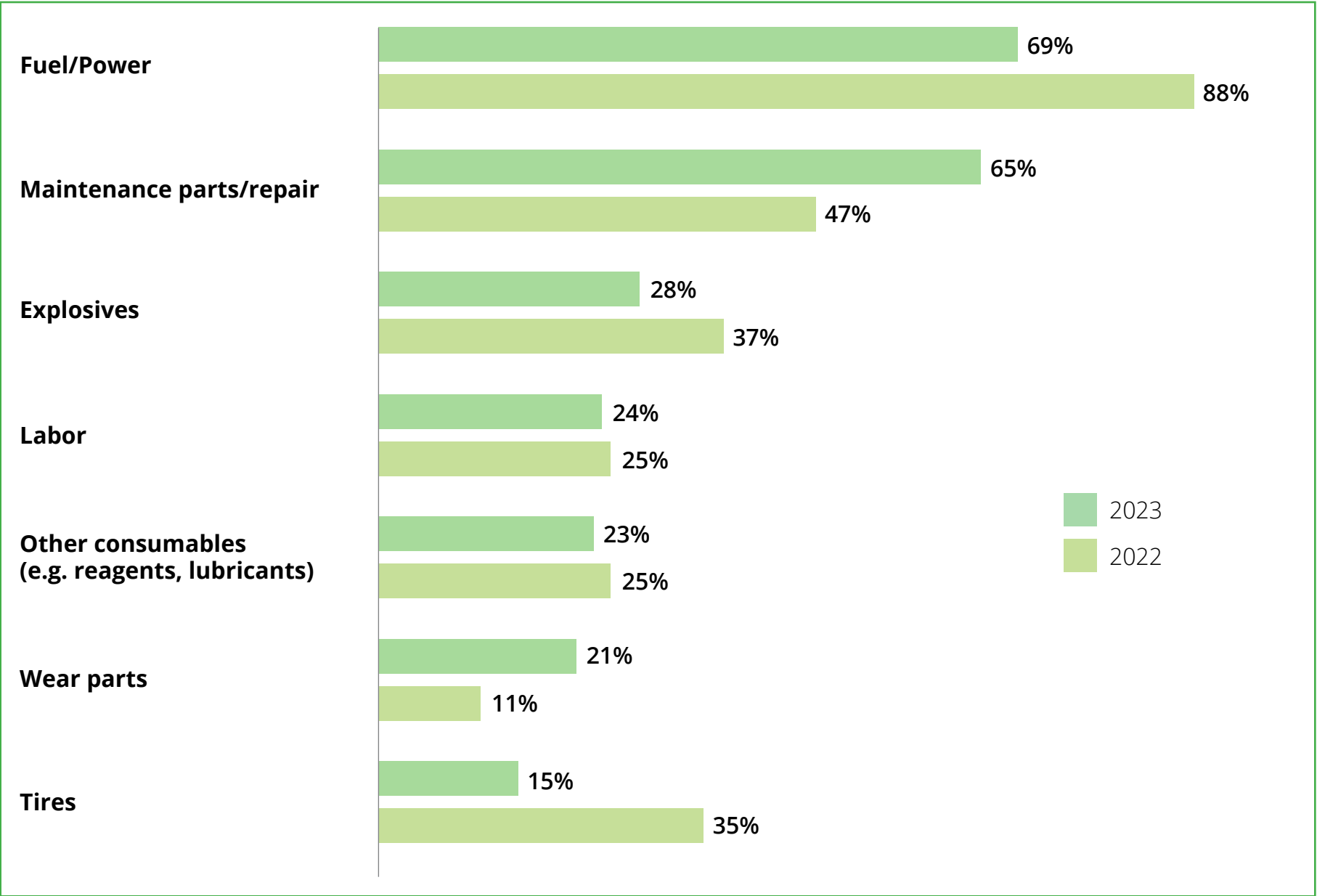
Trend 9: Making ESG strategies more value-led

Focusing on the fundamentals

The mining and metals industry has long understood that good sustainability practices are important to its ability to operate, and despite the current uncertainty of the ESG movement, the fundamentals have not changed.

Aside from the moral and reputational imperatives in permitting and running a mine, there’s also a strong financial driver for responsible practices. For example, fuel and power make up around 10% to 40% of mine operating costs⁴ and, according to a survey by GlobalData, these have seen some of the biggest price increases since 2022⁵ (figure 1).

Figure 1: Areas where miners experienced the greatest cost increases from 2022 to 2023 (sample of 75 mines)



Source: GlobalData⁶

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Looking ahead, energy will likely remain a significant driver of business costs and, decarbonization commitments aside, volatile oil and gas prices⁷ mean that, in many cases, it may make sense for companies to pursue renewable or sustainable energy technologies that can offer lower premiums over the long term.

In terms of broader social concerns, the mining industry is fast becoming talent starved in key jurisdictions. For example, Canada’s mining industry is expected to see a shortage of 80,000 to 120,000 workers by 2030, and unless action is taken (see [trend 7](#) for more thoughts on this), the Australian mining industry could see a 30% deficit in the workforce needed to uphold new projects by 2027.⁸

Leaders may recognize that attracting the next generation of workers can be linked to the future viability of their businesses, and greater focus may be needed to drive diversity, equity, and inclusion (DEI) and redefine company purpose.

The mining and metals sector, like others, is also being increasingly affected by the physical and transitional effects of climate change. For instance, in 2021, Norilsk Nickel was forced to suspend operations at its Oktyabrsky and Taimyrsky mines in Siberia due to flooding caused by thawing permafrost. Global production of nickel, copper, and palladium (which are critical to the energy transition) as well as platinum dropped by 7% due to the temporary shutdown.⁹

Putting ESG into perspective

As a risk management framework and value-creation tool, ESG may be more relevant than ever. ESG can represent core parts of mining and metals businesses, and its continued use in the market will help to keep organizations focused on areas that are central to their social license to operate. Leaders ultimately need to balance this against their commitments to shareholder value.

Celia Hayes, partner, Strategy, Risk & Transactions, Deloitte Australia, said:

“ESG, as an acronym, may have lost its way somewhat. However, if we reframe ESG and look at these domains as drivers of financial risks and opportunities—as the Taskforce for Climate-related Financial Disclosures (TCFD)¹⁰ did with climate risks—then it makes sense that miners continue to focus on them. Directors and executives would be neglecting their fiduciary duties if they did not stay on top of ESG risks and look for chances to create new value.”

A more focused approach to ESG—one in which actions and initiatives are based on value-generation potential, rather than metrics and ratings—could help to lower organizations’ risk exposure. It may also make it easier to integrate ESG matters into business strategy and purpose, which could, in turn, increase the likelihood of delivering corporate sustainability commitments.

Each company is affected by a unique mix of ESG-related challenges, and materiality assessments can help identify topics that are of particular importance to the organization in a corporate or operational context. This information can be used to prioritize resource and capital allocation into programs and initiatives that will generate the greatest value for the organization.¹¹

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Traditional financial materiality considers how ESG and sustainability challenges affect company financial performance, while impact performance takes into account broader company impacts on society and the environment. The combination of both types is referred to as double materiality¹²—an approach that is increasingly considered to be best practice.

In jurisdictions like the European Union, a double materiality lens has explicitly been adopted in mandatory ESG disclosure requirements on topics like greenhouse gas (GHG) emissions, human rights, and diversity¹³, and some miners are already applying this across their portfolios. For instance, in 2023, Teck Resources reevaluated its material topics using a double materiality framework to strengthen its management approach to documents, controls, and procedures (figure 2).¹⁴

Figure 2: A double materiality framework



Source: Teck Resources

Making ESG more purposeful

For mining and metals companies, the benefits of strengthening the basics and being more purposeful with their ESG efforts are many and varied. For instance, in looking to renewable or sustainable energy options to power their operations, companies could lower their energy footprint, save money, and impact the climate in a positive way.

By reexamining their environmental stewardship, there’s a chance to create new relationships with communities, invest to leave a legacy that stretches beyond extraction, and gain a social license. And by focusing more deeply on DEI, there’s a chance to increase the talent pool to which miners have access, create more resilient organizations, and strengthen team capabilities in areas like innovation.

Andrew Swart, partner, Energy, Resources & Industrials leader, Deloitte Canada, said:

“The difference between future ESG leaders and average performers could lie in the ‘why’ companies do these things. By giving ESG initiatives a purpose beyond ratings—that is, value creation—and tying them to core company values and strategy, they can become a more integral part of doing business and generate more meaningful outcomes.”

Case study

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Client challenge

With the sustainability landscape becoming increasingly complex, a growing gold miner based in Western Australia was taking steps to better understand its sustainability performance with reference to both internal practices and investor expectations.

Solution

The board engaged Deloitte Australia to help them consider both internal and external views of sustainability integration, performance, and disclosure for the company. This project was achieved through two stages:

1. **ESG integration assessment:** This internal-facing current-state assessment involved desktop research, internal document reviews, and interviews with key internal stakeholders across the company. The Deloitte Sustainability Integration Model was utilized to map levels of sustainability maturity across key domains including governance, risk, strategy, process, capability, and implementation.
2. **Critical review of disclosures:** The review provided an analysis of the company's public-facing sustainability identity and perception of maturity and identified areas for attention and focus to meet external expectations and requirements. The approach included a review of the company's FY2024 sustainability report and a map of its disclosures against selected industry peers.

Outcomes

The board developed an understanding of opportunities to better integrate sustainability into the business, as well as current risk areas and gaps. It was also able to form a view on how the business's sustainability efforts may be perceived externally. The findings and recommendations provided focus areas and helped to steer progress on the company's sustainability journey, highlighting areas to help uplift its sustainability maturity, enhance external perceptions of the organization's sustainability prowess, and help ensure that future disclosure expectations and requirements could be met.

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments



From ideas to action

How greater purpose can be put into ESG

- **Reestablish investor expectations:** Investor expectations can change over time, and it may be worth conducting regular reviews. Understanding a company's investor base and how it needs to shift can inform focused reporting and disclosure efforts, both today and in the future.
- **Quantify ESG-related financial risks and opportunities:** Use globally recognized frameworks, recommendations, and guidelines, such as those from the Global Reporting Initiative,¹⁵ the IFRS Foundation's Sustainable Accounting Standards Board,¹⁶ and the Taskforce on Nature-related Financial Disclosures,¹⁷ to help understand ESG concerns and prioritize initiatives based on business returns.
- **Double down on materiality:** Using a double materiality approach, which considers a company's impacts to people and the planet, as well as their financial impacts to the company, may provide a more holistic assessment of ESG risks and can better inform potential value-creation opportunities.
- **Communicate the wider impacts:** When preparing ESG-related communications—that is, sustainability reports, case studies, and press releases—consider the language used and how it could better link ESG initiatives to financial risks and opportunities. For example: “Reestablishing this species has added XX value to the local ecosystem and XX value to the company's bottom line.” This will help explain the value to the organization beyond being simply the right thing to do.

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Endnotes

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Trend 10

Generating a natural competitive advantage: The value of embedding nature into mining and metals

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Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

2024 heralded a turning point in the way that mining and metals businesses consider their relationship with nature. As stewards of significant tranches of land globally, the industry and its key players understand their impacts on nature, and some companies have been working to measure, manage, and mitigate the associated risks for 20 years or more.

However, the launch of a strong position statement on nature from the International Council on Mining and Metals (ICMM)¹ as well as release of mining-specific guidance from the Taskforce on Nature-related Financial Disclosures (TNFD) in June 2024,² signaled an increasing connection between miners and the natural environment—the commitment from ICMM members means that one-third of the global mining and metals industry now supports radical action to support a nature-positive future by 2030.³

2024 also saw governments working to adopt the targets set out in the Kunming-Montreal Global Biodiversity Framework⁴ and develop policies that support their delivery. And standards agencies, such as the Global Reporting Initiative⁵ and International Sustainability Standards Board,⁶ also moved to solidify companies’ commitments toward the preservation and promotion of nature.

For mining and metals leaders, particularly those who’s companies are early on in their journeys to becoming nature stewards, aligning with these requirements in the specified time frames will likely be challenging. However, for early movers, this spotlight presents a rare opportunity to lead on the global stage. By making nature a more integral part of their organizational processes, systems, and structures, there’s a chance for companies to realize significant new value, attract different financing options, redefine public perceptions of mining, and inspire businesses in other sectors to accelerate their own performance.

A beyond biodiversity look at nature also shifts the dialogue away from species and presence/absence assessments toward ecosystems and landscapes considerations, with a heavier emphasis on understanding dependency—all critical considerations in creating a deeper, more meaningful connection with host communities.

The financial imperative

The ICMM defines “nature” as “all life on Earth (i.e., biodiversity), together with the geology, water, climate and all other inanimate components that comprise our planet.” It adds that nature can also be understood through a construct of four physical realms—land, ocean, freshwater, and atmosphere, each of which interacts with people and society.⁷

The phrase “nature positive,” which is widely used by the ICMM and others, refers to halting and reversing biodiversity loss through measurable gains in the health, abundance, diversity, and resilience of species, ecosystems, and natural processes.⁸ Pressure on mining and metals companies from governments, investors, and society to become nature positive—not just because “it’s the right thing to do” but also because of the financial implications—is mounting. However, respecting, protecting, and restoring nature can and should be seen as more than a hoop through which businesses must jump to satisfy stakeholders.

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

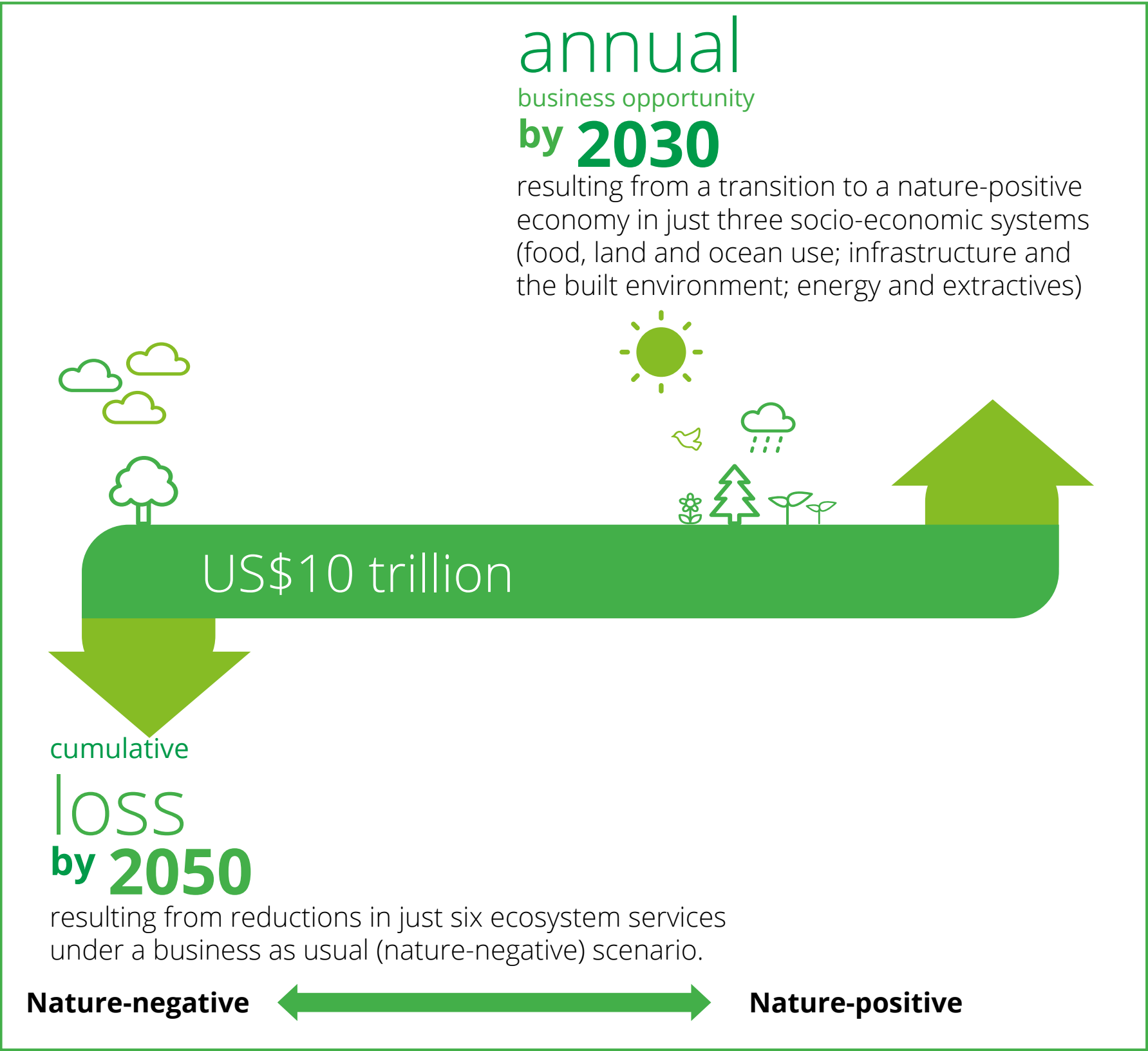
Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

As organizations that supply the raw materials needed by virtually every other sector globally, there’s a huge financial imperative and opportunity for the mining and metals industry to lead the transition to a nature-positive or regenerative economy.⁹ For example, the World Economic Forum (WEF) estimates that the transition to nature-positive practices in just three sectors (including extractives) could present an annual business opportunity of US\$10 trillion by 2030 (figure 1).¹⁰

Figure 1: The opportunity of nature-positive industry



Source: Deloitte Asia Pacific

And, when integrated holistically into mining and metals businesses, nature offers immense possibilities for value creation through new revenue streams, lower costs, and helping businesses to secure a social license to operate. Conversely, the cost risk at stake for businesses that under-respond could be significant, resulting in delayed or lost approvals and increasingly limited financing options. Ultimately an extractive industry shifting toward nature-positive practices requires business transformation, so timing will be key in terms of both capturing value and minimizing cost.

Opportunities for early movers

Businesses are making progress toward nature-positive practices by exploring concepts such as natural capital accounting (NCA), as BHP is doing at its Beenup mineral sands closure site in Western Australia—the first attempt at NCA within the mining sector.¹¹ NCA is an environmental accounting framework that provides a systematic way of measuring and reporting on natural capital assets (stocks) and ecosystem services (flows).

This framework can help develop a more comprehensive understanding of the interactions between the environment and economy, foster greater sustainable development, grow more responsible resource management, and drive improvements in existing disclosure and sustainability reporting practices. By quantifying the value obtained from natural resources and the services provided by its ecosystems, the adoption of NCA can help society recognize the significant contributions that nature makes to human well-being and economic development. This can lead to improved decision-making and ultimately the potential for net positive environmental impact.¹²

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Others are taking steps to integrate nature-based solutions into business designs, as Rio Tinto is doing at eight sites globally as part of its decarbonization strategy. These projects will put around 500,000 hectares of land (equivalent to half the footprint of Qatar) under conservation, restoration, or sustainable land management. The first round of projects is expected to generate up to one million tons of carbon offsets annually by 2030.¹³

However, at some companies, these types of projects are mainly driven by a single champion or team rather than being consolidated at the enterprise level. The changing expectations to which the industry is exposed require systemic integration to be truly sustainable, and few businesses have achieved this yet.

Celia Hayes, partner, Strategy, Risk & Transactions, Deloitte Australia, said:

“Few companies, perhaps with the exception of agricultural businesses, understand the direct relationship between nature and industry better than mining and metals companies. These organizations have been researching and creating scientific outputs around nature, as well as monitoring natural systems for a long time, and so most are well placed to respond to shifting expectations surrounding global standards. However, not all of them have taken the next step and integrated the value of nature into their businesses holistically.”

Leadership and funding go hand in hand

Leadership and funding are important to this shift. Companies are required, to an extent, to restructure how they do business, and without sufficient funding and strong leadership who demonstrate the qualities outlined in [trend 1](#), teams will struggle to build meaningful programs, integrate nature into their operating models and deliver lasting, high-quality outcomes.

Hayes said:

“Ask most mining leaders what their climate targets are and how the business will achieve them, and they will be able to explain in detail, but ask them the same question about nature, and most will struggle to answer beyond the company’s goals or ambitions.”

To make a significant impact and ensure initiatives are maintained through business cycles, leadership should champion nature, ideally by identifying a sponsor within the C-suite to lead strategy development and delivery, supported by good governance. This requires directors to be intimately aware of the business’s risks and dependencies upon nature, and the role the organization plays within the natural systems in which it operates. It will also require bold decision-making, and this may necessitate upskilling or ongoing education—a topic that’s discussed in more detail in [trend 7](#).

One example of such decisive action is Rio Tinto’s show of support for Australia’s Environment Minister Tanya Plibersek’s stalled push for a national environmental regulator in October 2024. The proposed regulator would set clear standards for habitat and wildlife protection and account for the carbon emissions of new projects, and Rio Tinto broke ranks with its peers to back Plibersek.¹⁴

Once responsibilities are established, capital and resources can be allocated to ensure that every function and role within the company understands its importance in delivering nature-positive outcomes and can take effective steps toward them.

There’s a careful balance to be struck here; business leaders who wait until they are comfortable with their understanding of nature and natural systems may find they act too late. Systems thinking is a critical aspect of the needed shift, and leaders will have to take responsibility early and (likely) take a few risks to shape their understanding.

Case study

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Client challenge

A globally diversified miner identified potential nature-related risks at one of its closure projects, as natural assets and systems form a critical part of the landscape and are central in meeting the organization's constructive obligations in mine closure and handover to its predominantly Indigenous local community.

Solution

The firm engaged Deloitte Australia to help it develop a cohesive understanding and support the decision-making process regarding natural assets, as well as enable value accretion for all stakeholders. This was achieved through:

- Identifying and characterizing natural assets at and around the mine lease through qualitative research and geospatial mapping.
- Developing a list of potential natural project opportunities that could be deployed according to the natural assets identified and other place-based factors.
- Co-defining a prioritization method for shortlisting opportunities, incorporating social and economic criteria.
- Analyzing and ranking project opportunities using the prioritization framework.
- Delivering a natural asset database, geospatial output, and path forward for uplifting natural capital at the operation through the closure process.

Outcomes

The business now has a comprehensive understanding of both the natural assets in the region and the data gaps that need to be addressed to continue developing that knowledge. The company has also created a functional prioritization framework that can be used to assess any nature-related project opportunity going forward. This methodology can be applied across all assets at any stage in the life-of-mine to increase its understanding of natural assets and subsequent natural capital.

Ultimately, a better understanding of natural capital and its impacts on projects will allow the company to maximize natural asset value through closure, and lead the way in exploring, operating, and closing other assets.

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Humanizing mining and metals businesses

A more holistic understanding and reflection of the value of nature within businesses could provide a vital way for mining and metals companies to connect with communities, speak to future talent, and even work with mining opposers to find mutually agreeable solutions. We all need nature to thrive, and this intersection of interests in a resource that is precious to everybody could provide common ground for discussions, dialogue, and collaborative efforts to restore and protect the natural world.

The importance and expansion of data

This is not just about managing company compliance or mitigating liability. To effect transformational change on this scale requires an enterprise-level view of nature-related data and for it to be presented in a format that’s easily understood and applied by different teams throughout the organization.

John O’Brien, managing director, Sustainability & Climate lead for Mining & Metals, Deloitte & Touche LLP, said:

“Without this information, it would be very difficult to understand how an individual operation is placed with regard to its interactions with the natural environment, let alone the consequent financial impacts and how it contributes to a company’s broader nature-related goals.”

For example, environmental impact assessments have been the primary means of establishing a baseline regarding a project’s potential impacts on and interactions with nature. Today, best practices suggest that this information is regularly revisited and updated with data gathered from the latest monitoring technologies over the life-of-mine to improve its relevance and usefulness.

Additionally, these assessments are often constrained to the operational footprint and will need to expand to consider a systemwide view of an operation’s influence on the region. Overlaying environmental data with that gathered from spatial mapping systems, will help companies develop a better understanding of how the complete system—inclusive of the built environment, the natural world, and its actors—moves and evolves over time.

Investing early in the technologies and systems needed to collect high-quality, reliable environmental data, and to centralize and manage it in a way that supports transparent, un-siloed analysis and application, is essential to synthesizing valuable insights. In turn, these can enable decisions that bring businesses closer to nature and drive productivity and resourcefulness.

For example, Vale, in partnership with the Chico Mendes Institute of Biodiversity Conservation, is working to protect and conserve 800,000 hectares of natural environments in the state of Pará, Brazil. Through the protection of nature, the partners strive to contribute to the progress of bioeconomy, science, and culture, highlighting the value of traditional knowledge and promoting social development. The company stated: “Around 60% of Vale’s iron ore production originates in this region. Despite the volume, the company’s operations cover approx. 2% of this area, proving that it is possible to match commercial production with environmental protection.”¹⁵

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

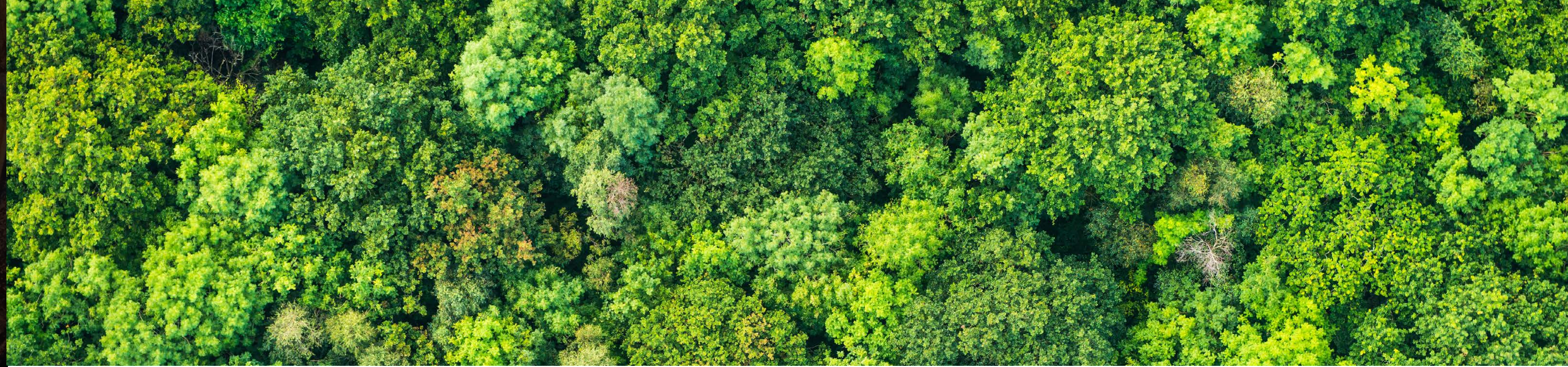
Engage Indigenous leaders

Indigenous leaders and communities can serve as a voice for the environment and important partners in the conservation, restoration, and sustainable use of nature. Their knowledge, cultures, and practices help advance development and sustainable management of the environment, yet they're often disproportionately affected by nature degradation and loss. Initiatives addressing loss of nature require the meaningful, equitable, and inclusive participation in decision-making of the people likely to be affected.¹⁶

A natural advantage

Mining and metals leaders who are proactive and take the time now to gain an understanding of how their organization interacts with nature—and redesign their systems, structures, and processes to make nature-positive practices an integral part of doing business—could be able to drive a significant competitive advantage going forward. Meanwhile businesses that are reactive will be subject to legislation forcing them in this direction.





Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

From ideas to action

Steps to make nature an integral part of mining and metals businesses

- **Choose a nature leader:** Identifying a leader, preferably within the C-suite, who can ensure consistency in outcomes through business cycles is vital to the sustainability of nature-positive transformation.
- **Give nature a seat at the table:** According to the WEF, “giving nature a seat at the table” means integrating environmental considerations directly into decision-making processes. For example, this can be achieved through incorporating nature-based solutions into projects to ensure sustainable and resilient outcomes and integrating nature into corporate strategies and policies by setting measurable environmental goals, conducting regular impact assessments, and ensuring transparency in environmental reporting.¹⁷
- **Connect with data:** Determine whether the organization’s current data management systems and practices are centralized and support the open, traceable application of environmental data and its integration with data of other types. Considering nature-related data in the same way as financial data, including implementing similar governance structures and controls is key. Without this, it will be hard to integrate and scale nature-related insights.
- **Ensure board competency:** Upskill board members with the latest knowledge and understanding of nature governance to provide valuable insights into emerging practices, risk management, and regulatory compliance while promoting transparency and stakeholder engagement.¹⁸

Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

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Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

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Authors & Acknowledgments

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Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Authors & Acknowledgments

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Introduction

Trend 1: Leading in a new era of mining and metals

Trend 2: Shaping critical mineral supply chains

Trend 3: Driving growth and resilience

Trend 4: Enhancing mineral exploration with AI

Trend 5: Transforming the digital core

Trend 6: Smart operations in mining and metals

Trend 7: The impact of GenAI on the mining and metals workforce

Trend 8: Scaling progress toward net zero

Trend 9: Making ESG strategies more value-led

Trend 10: Generating a natural competitive advantage

Global contacts

Authors & Acknowledgments

Authors & Acknowledgments

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