

# Critical minerals supply chains – key briefing

Key trends in sector circularity  
and financing

2025



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Q+A with Christian Spano, Vale Base Metals

# The \$tn potential from circularity in critical minerals

Christian Spano from Vale Base Metals spoke with Innovation Forum’s Ian Welsh about some of the exiting potential for realising the value of metals and minerals within new circular systems – but significant re-think is required

**Ian Welsh:** Why don’t you start by giving us some brief context to the work of Vale Base Metals and your role?

**Christian Spano:** Vale Base Metals is a base metals mining company with operations in Brazil, Canada and Indonesia. We have clients globally. The work that we do in circularity started long ago. As traditional mining companies, we focus on the value that we could recover from what traditionally has been framed as waste, our tailings, our slags, our waste rock.

Then we have evolved to thinking about ways of engaging existing customers and future customers to incentivise them to work with us and recover the products that we produce, the copper, the nickel, the cobalt and the platinum group metals (PGMs).

Our work looks at what we call circular endowments, which had previously has been understood as waste in our operations. We call that process circularity, but we also look at what we call product circularity, which is creating the incentives to recover and re-offer what we produce forever.

**IW:** Thinking about opportunities from developing new circular business models for the metals and minerals essential for the energy transition, what do you see as the difference between circularity and recycling?

**CS:** That’s an excellent question. When we all go to conferences or read reports or articles in newspapers, often you’ll have “circularity” in the title, when in fact it’s all about recycling.

Once you produce waste, you have basically two choices.



Circular Economy estimated in 2018 that we had trapped \$150tn of resources in the global economy



PHOTO BY RAFAEL GARCIN ON UNSPLASH

One is to manage the waste, and we will have a liability forever that we need to manage. Or we recycle the waste, which is that we need to recover as much as we can from waste streams.

Recycling is super needed. It’s something that we must support, it’s something that we must increase, and it’s something that we will need increasingly in the near term. The reason for that is that we have created an economy that produces a lot of waste.

Circular Economy estimated in 2018 that we had trapped \$150 trillion of resources in the global economy. Recycling is something that we have, something that we know is an industry that exists, and so we usually tend to go straight into recycling as our waste solution.

But what actually is the circular economy? It is mostly based on design. How do we design infrastructure and products in such a way that the last strategy that we want to put in place is recycling? How do we reuse? How do we refurbish? How do we avoid use of materials? What are the different elements and strategies that we can put in place so that when we design products and infrastructure, we can make the most of the resources that we have available?

What we see an opportunity in the circular space is in applying new commercial models, new commercial offerings, that are circular solutions. As we grow the circular solutions, we need to think about the business models that we can offer in parallel of our traditional mining model so that we can tap into a number of opportunities. Mining will stay; mining will grow. What we need to ask is what is the most sustainable way of mining. Circularity will greatly support this.

## Potential at scale

**IW:** The mining sector produces, as you’ve mentioned, a lot of what is traditionally regarded as waste. Can you give us a sense of the scale of this waste that the sector produces?

**CS:** The mining industry has become increasingly efficient in terms of how much ore we move to get the refined minerals and metals that we need. We don’t want to create waste; we don’t want to move a lot of ore because that is the cost that we need to bear for every gramme, kilo or tonne of material that we ultimately produce.

Across our operations in Canada we have a total of 130m tonnes of tailings in place. If you go to our nickel operations in Brazil, we

generate 2m tonnes of material known as furnace slag every year.

This is good news if you think about that as a potential resource that can influence a new circular business model for mining companies. Instead of looking at that as a liability forever, you could think of that of resources beyond the nickel, copper, and so on that we produce. There is sulphur, silica, iron that we could recover from that.

It could be bad news if this becomes a liability for life – if we have to monitor the tailings and waste. Or if you just give away the furnace slag for raw construction material of very low value.

It depends on the lens you apply. That tailings and furnace slag could be good news or bad news. In our case, it's great news. They are new circular resources that we're going to be developing and offering.

**IW:** Can you give us a sense of the potential of that then?

**CS:** If you sell furnace slag into traditional basic construction materials markets in Brazil, you'll get \$2 per tonne. And if you think about the logistics of moving that furnace slag around, it's uneconomic to move it very far.

If you look at alternative uses that we're tapping into there is some significant potential value. Among the options are carbon removal credits and providing inputs into fertilisers. The cost of carbon today in the regulated markets is \$100 per tonne, give or take, depending on where you take the value. In the voluntary market, it could go as high as \$450 per tonne.

In the fertiliser value chain, it depends at which point you offer it. And we're working with partners to develop this. But wherever you sell, it's much higher than \$2 per tonne.

One thing that we're learning from our partners is that what we see as waste or very low-value material for many of these industries is actually decent-value material elsewhere. But new business models are required for this to work. If we keep selling it, and if we kept selling it to the same industries that we have been approaching over the past, it's not attractive. If we do our homework and we learn from our partners, there is a very interesting future.

### Mindset shift

**IW:** What have been the barriers to utilising these resources in this way in the past?

**CS:** I think psychological more than anything. We are an industry that has done well in the past, focused on very specific materials. If you look at the copper industry, the nickel industry, gold, steel, iron ore, we were after very specific materials. There was enough value to justify moving a substantial amount of ore.

We would focus on the efficiency of recovering those primary materials, and we would do really well. The industry would focus on "if we move a tonne of ore, how many kilos of copper, for example, will we get out of it?" Now we need to shift to think about what's left as a resource or as waste.

Psychologically, you need to shift the way you think about your business. Once you do that, then you go into some technical challenges and some commercial challenges. The people that will engage in the

new frontiers of that circular business may not be the same customers that you have been engaging with. Those customers that you need to engage with may struggle to engage with a mining company because they have never spoken to one.

Technologically or technically, there are some very interesting challenges. For example, in our Canadian tailings, we have something called pyrrhotite, an iron sulphide compound. However, separating the iron and sulphur in a stable way is difficult. But if we want to really take advantage of all the value in our tailings, we need to find a way to deal with pyrrhotite.

**IW:** What are some of the things that leaders can do to facilitate the mindset shift required to adopt circular business models in organisations? How do you get around those psychological barriers?

**CS:** We need to have leaders in our industry that start to frame our role in society and in the economy in a different way. Different leaders will talk about our industry in different ways.

Let's take EV batteries. To develop properly circular business models for those require battery producers to be able to recover their batteries. If batteries are still sold in a linear fashion or electric vehicles are still sold in a linear fashion, it's very hard for us to then offer circular solutions from a resource point of view because our customers are

not recovering their products.

We are working with partners to develop circular solutions that allow us to enter that space. It's a challenge. We need politicians and



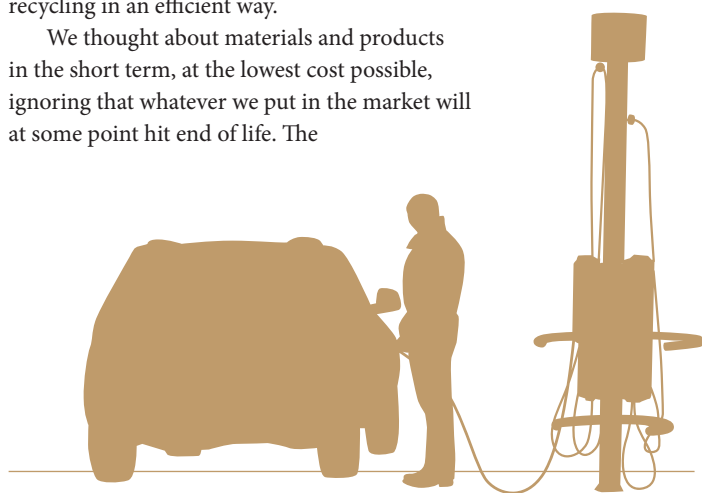
Psychologically, you need to shift the way you think about your business. Once you do that, then you go into some technical challenges and some commercial challenges

policymakers to incentivise and to reduce the barriers for our potential customers to be able to offer electric vehicles as a service, batteries as a service, and many other products and infrastructure as a service without facing the reality that, if you sell them in the traditional linear model it might be more profitable initially.

**IW:** As we move towards thinking about ever-greater use of critical minerals, how many products are designed for real circularity currently?

**CS:** Very few. History has been against circularity. From mid-20th century onwards the global economy focused on efficiencies. We were chasing ways of bringing prosperity in a global economy that was coming out of war. The question we were trying to answer was what the most efficient way was to produce infrastructure or to put in place infrastructure and products. In chasing that question, we made everything linear. We didn't think about second use. We didn't think about reuse, refurbishing. We didn't think about recycling in an efficient way.

We thought about materials and products in the short term, at the lowest cost possible, ignoring that whatever we put in the market will at some point hit end of life. The



If batteries are still sold in a linear fashion or electric vehicles are still sold in a linear fashion, it's very hard for us to then offer circular solutions

bigger our economies became and the bigger our populations became, the more this has become a cost to our business models, and more generally a cost to our economy.

We tend to think about minerals and metals as finite resources, but we can use and recover them forever. Putting copper in something or putting nickel in something that is designed to become waste is an illusion. That copper and that nickel will remain with us forever. Two-thirds of the 700m tonnes that we have put in the market in copper is still around today in used material infrastructure. One third is in waste.

The value of that one-third is in the \$bns, if not \$tns. We need to engage politicians, businesses, and all stakeholders so that we can design-in for easy recovery at any point in time.

### The price can be right

**IW:** What then are the steps that the sector needs to make to start realising that potential value as the world demands ever more critical minerals and metals?

**CS:** We need to frame the price better. I think we did something in the past with renewable energy, batteries and electric vehicles that morally was right in the sense that as society, we came together and we said we want a future that is zero carbon, nature-positive, based on trust and

in just transition. Regardless of the economics, we will work together to make this work and to make it economically attractive. We pushed a transition for renewables, for electric cars and for batteries, and for the rest.

I think we need to learn from those transitions. One thing that I think we could have done better is to frame the size of the price. If we think about those 700m tonnes of copper and we take a very, very conservative long-term price of \$6,500 per tonne (today's is \$10,000 per tonne), that stock of copper is around \$4.5tn worth of value.

Now, if you take our 130m tonnes of tailings and you take the nickel, the copper, all the different materials of sulphur, the water, and everything that you have in there, it's around \$14bn worth of value. We're not chasing pennies here. You take the whole mining industry combined today, it's around \$2-3tn.

Mining will be still needed in the short, medium, and long-term, but there is a delta here that, working together with customers, we can untap and provide a model that is going to be aligned with climate goals, nature-positive goals, and a just transition.

**IW:** How do you see the market developing for all of this, then?

**CS:** The exciting thing is to be able to frame new value in a way that is not through a lens of waste or through a linear lens. At Vale we are developing a new business line that complements our existing mining business. We see complementarities, and we see that by offering low-carbon, sustainably produced primary mining alongside circular solutions, it's a fantastic offering for the future.

Recycling is definitely part of the short-term solution. We need to support it. It needs to be bigger, better, more efficient. We need to look at our tailings 100%, but we need to develop a circular solutions market going forward. If we can turn this into a market, bringing alongside competitors and partners, we will move forward faster, and we will be more credible in influencing policymakers, the financial sector and markets.

**IW:** To sum up, then, what are the keys to delivering circular mineral value chains?

**CS:** We used to talk about corner solutions where you either get it right or get it very wrong, zero or one solutions. This might be an example of that. Going back to your first question about the difference between recycling and circularity – we need to think about why that is important. Why would a mining company care about becoming circular? It would be counterintuitive in the past.

Why should we be thinking about circular markets? Why do we need to think about materials in use, not only at the end of life or at the beginning of life? What's the value in there, the \$tns of materials in the stock? Why do we need to chase politicians and policymakers to allow new markets to evolve?

Thinking about these and similar questions will help us to evolve and think about resource value in new ways.

*Christian Spano is director for circularity at Vale Base Metals. This Q+A is adapted from a [live webinar](#) conversation.*

Interview with ING's Tim van Pelt

# Plugging the funding gaps for critical mineral projects

Are investors shifting towards holistic, risk-adjusted investments that consider environmental and social impacts? What's the significance of transparency, traceability and standard-setting in mineral supply chains? Talking with Ian Welsh, ING's Tim van Pelt outlines some challenges and possibilities

There are significant challenges for financing of critical minerals. Responsible sourcing increasingly requires values-based decision-making.

Traditional financing models rely on predictable cash flows and established markets – and they can prove inadequate for critical minerals due to geopolitical sensitivity, technical complexity and high ESG risks. As Tim van Pelt says: “Critical minerals are anything but predictable.”

There remain funding gaps in midstream processing and refining in Europe, outside of China, and early-stage exploration in underdeveloped jurisdictions. The challenge for many in the sector is balancing the long-term sustainability goals that many countries are committed to with short-term financial incentives.

## Calculated risks

Van Pelt emphasises this need for early-stage risk-taking and better alignment between long-term sustainability goals and short-term financial incentives. And this is an improving picture, he argues. “There was a period when there was a narrow focus on financial returns only. I think that has shifted to a more holistic risk-adjusted view.”

He highlights that investors are now demanding more due diligence and third-party verification to ensure responsible sourcing of materials and predicts that projects that cannot demonstrate responsible practices will see less interest from the financial markets.

“Values-based decision-making ... builds the trust with clients and stakeholders that we are looking for.”



Investors are now demanding more due diligence and third-party verification to ensure responsible sourcing



PHOTO BY DANE DEANER ON UNSPLASH

## 'Tough questions early'

Van Pelt advises to “ask tough questions early and often” to ensure projects align with the right values, even if it means walking away from potentially profitable deals.

The tough questions have inevitable focus on potential environmental impacts, including mitigating secondary effects of primary processes, and working with local stakeholders.

Financing critical mineral and energy transition projects is inevitably different from traditional sectors due to evolving technology, changing regulation and long payback periods. Energy transition projects also require more technical expertise, flexibility in structuring, and a longer-term view. But they can offer significant financial and impactful upsides.

## Transparency and traceability

How does Van Pelt characterise the growing clamour for transparency and traceability in mineral supply chains? It's about end-to-end knowledge. “It's important investors and lenders not only know what they are financing, but also how it's being sourced,” he says.

Van Pelt emphasises the role of technologies such as blockchain and digital twins to enable traceability. The ability to represent materials as meeting certain standards and not being sourced from specific places is crucial for financing, he says.

Equally important is assessing the credibility of sustainability claims when making financing decisions. Van Pelt looks for “substance over slogans”, focusing on third-party verification, science-based targets and clear roadmaps.

Governance and accountability are crucial to prevent greenwashing and ensure credibility. “Greenwashing is a real risk, and credibility is becoming a currency in its own right,” he says.

**EV lessons learned**

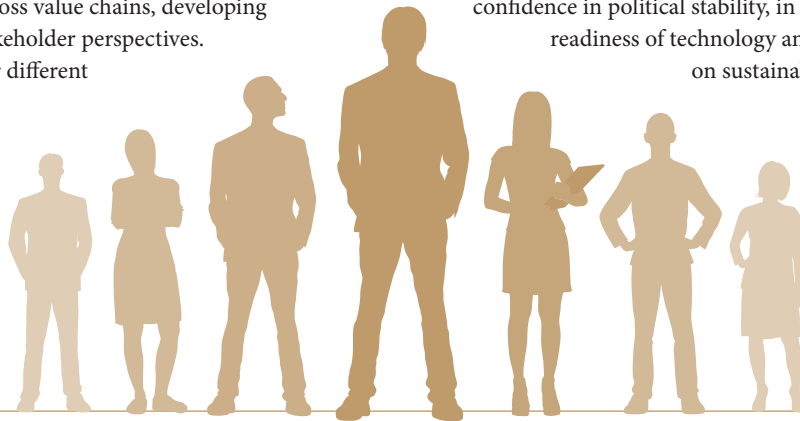
The dramatic growth in the number of electric vehicles, and their batteries, has a few lessons that can be applied elsewhere, Van Pelt says, illustrating the need to take an entire value chain approach.

“You need to think about all of an ecosystem.” In the case of batteries, for example, “...you can’t just finance a battery plant, you need to think about upstream minerals sourcing, downstream recyclers and everything else”. In other words, financing the energy transition will mean financing entire systems.

**Mobilising capital**

Van Pelt argues that for effective financing in the critical minerals sector, and for the energy transition, banks should position themselves to work with the right players across value chains, developing understanding of contrasting stakeholder perspectives.

A bank should bring together different perspectives to craft financing and mobilise capital for energy transition projects. “We work with most of the players in most of the value chains, so we understand the perspective of a miner, and we understand the



perspective of an automotive player [for example],” Van Pelt says.

He argues that discussion should underscore the importance of collaboration and understanding the broader ecosystem to finance the energy transition effectively.

**Follow the science**

ING has the stated aim of “steering the most carbon-intensive parts of the bank’s portfolio towards reaching net zero by 2050”. ING combines a portfolio-level approach called Terra for the carbon-intensive sectors in which it is active in with data-driven client engagement that strives to support companies in accelerating their own net-zero transitions. “Terra is a science-based target mechanism. We prefer quantitative targets over more fungible metrics,” says Van Pelt.

He also highlights the need for confidence. “Investors need confidence in political stability, in regulatory frameworks, in the readiness of technology and the integrity of any claims on sustainability.”

If the risk is taken from these elements, then “the capital will flow, but it will take collaboration first to make that happen”.

*Tim van Pelt is global lead for battery supply chains at ING.*

A bank should bring together different perspectives to craft financing and mobilise capital for energy transition projects

**Critical Minerals Innovation Forum**

**5th-6th November**

Tim van Pelt will be among the industry experts meeting in London in November. So, what are his hopes for the two days of discussion and debate?

“The forum will be interesting because it will bring together many players from different sectors. I am excited about the cross-sector dialogue, with miners talking to automakers, financiers talking to policymakers.

“Hopefully everyone gets a bit uncomfortable, in the best possible way. And while I hope we all will walk away with a sense of urgency, I hope also of possibility. The transition is hard, but it is happening now. Finance has a critical role to play in making it fair, fast and future-proof.”

**The to-do distilled read**

- » Collaborate with various stakeholders (miners, automakers, policymakers) to have cross-sector dialogues and find ways to de-risk investment for critical minerals projects.
- » Emphasise the urgency and possibility of the energy transition, and highlight the critical role that finance can play in making it happen in a fair, fast, and future-proof manner.

# Critical minerals supply – sector snapshot

By **Catie Ball**

There are a number of core challenges facing sustainable critical mineral supply – including geopolitical uncertainty, a skills gap, financing and impact risks. Here we outline some of the key factors, the risks and some potential next steps

## Geopolitical uncertainty

### Challenges

Critical minerals supply chains face mounting geopolitical uncertainty and challenges as much of the world’s mining and processing sites are located in geographically challenging, vulnerable or unstable regions. Political volatility, restrictive trade policies, and shifting diplomatic priorities all contribute to the uncertainty of the supply chain’s stability. Tariffs and export controls are actively shaping trade flows, forcing companies to reassess where and how they source materials.

The geographic concentration also creates single-point dependencies, so a single event of political tension, conflict, or policy change has the capacity to send shockwaves across the global market.

### Risks

The dependency on limited suppliers introduces both operational and reputational risks within the supply chain. **Operational** failures can halt production, delay projects, drive up costs, and ultimately disrupt the global landscape of industries reliant on critical minerals, including the clean energy transition and national security.

Reputationally, sourcing from regions with volatile governments and poor environmental oversight increases the risks of human rights violations, environmental degradation, and labour exploitation. Without enforceable international environmental standards, producers in some regions may operate under lax regulations, creating an uneven playing field for responsible companies.

Transparency across the supply chain remains a persistent challenge, as limited visibility into upstream operations makes it harder to verify ethical and sustainable practices. This is compounded by increasing regulatory scrutiny from downstream stakeholders, resulting in possible lost contracts, legal consequences and public backlash.

### What’s next

To mitigate these vulnerabilities, buyers and producers should prioritise geographic diversification, including sourcing from multiple countries to avoid over-reliance on any single region and developing strategic processing **hubs** in politically stable areas to reduce exposure to geopolitical upheavals.

Simultaneously, companies are embedding traceability and transparency requirements into procurement from the earliest stages, setting clear expectations for human rights and environmental standards at the onset of a contract with a supplier.



PHOTO BY ARYA KRISDYANTARA ON UNSPLASH

Investment in advanced tracking systems, independent audits, and multi-stakeholder initiatives can help ensure compliance and build trust with customers and regulators. Over the long-term, building resilience will require balancing short-term supply security



Transparency across the supply chain remains a persistent challenge

with sustainable practice, ensuring diversification efforts don’t shift problems from one high-risk location to another.

Buyers who invest in responsible sourcing, transparent operations, and regionally balanced supply networks early will weather disruptions more effectively. They will also gain a competitive edge in a market where ethical, sustainable, and politically secure supply chains are becoming a decisive factor in commercial success.

**Skills gap**

**Challenges**

As global demand for critical minerals accelerates, the mining and refining industries are contending with a shortage of personnel in the very regions where these resources are found. And not only are there currently shortages of talent in the field, but mining-related university enrolments have also declined, signalling a potential longer-term staffing crisis.

If mining projects cannot be staffed locally, there is a risk that economic progress will bypass the very communities where it takes place, leaving local residents unable to share in the benefits of development.

Mining must also contend with its public image to attract talent, often carrying a reputation of hazardous and environmentally damaging work that is less popular in younger workers.

**Risks**

The talent gap carries tangible and operational risks. A **McKinsey survey** found that 71% of mining leaders say talent shortages are holding back production and strategy, while an **EY report** found that the current mining skills gap raises costs and elevates safety risks. Insufficient training and experience can increase the likelihood of workplace accidents, while a lack of ESG expertise can lead to weak or inaccurate impact assessments.

The option exists to fly in international teams to remote sites to account for the staffing shortages, but this carries the risk of escalating local tensions, especially if communities perceive that economic benefits are being exported rather than shared.

**What's next**

Addressing the skills gap will require a combination of local investment, educational innovation, and international collaboration; in some cases, governments are already responding.

In **Australia**, a new vocational mining degree, developed by the Australian Minerals and Energy Skills Alliance, blends classroom learning with on-site training to deliver industry-ready graduates; **India** plans to establish a centre of excellence for mining and logistics to train workers for the critical minerals sector.

Regional mineral **hubs** which combine processing capacity with shared training facilities could further

accelerate workforce development by pooling expertise and resources. Similarly, **Canada**, the NORCAT's Underground Centre provides real-world training in safety and emerging technologies, enabling suppliers and operators to acquire practical skills under one roof and offering scalable training in proximity to mining activity.

However, localised education is still imperative to ensure local and indigenous peoples are part of the mining industry reform and must also be a priority in the next stages of educational partnerships.

These initiatives share a common theme: the emphasis on technical and operational safety must be scaled, and international collaboration in a necessity to achieve this goal.

**Financing**

**Challenges**

Securing funding for expanding critical minerals supply has become increasingly fraught, as traditional financiers grow wary of the inherent risks. Conventional banks and investment funds often are wary of lending to mining ventures with high capital requirements, volatile commodity prices, and exposure to geopolitical instability. This very wariness was illustrated in 2024 in the UK by **Lloyds Bank** when a refinancing bid was rejected due to nickel price volatility, undermining the UK's national critical minerals strategy.

Additionally, mining projects are typically a long-term investment and often don't fit the short-term return profiles financiers expect, making them less appealing to conventional debt or equity investors.

**Risks**

These financing gaps present immediate structural threats.

Without reliable funding, long-term or smaller-scale projects deemed unimportant may never launch.

There's a real danger that developers, under financial pressure, might cut corners that compromise safety measures, environmental safeguards, or community engagement in pursuit of cutting costs. The lack of stable financing opportunities is a very significant threat to project viability, broader sustainability initiatives and the wellbeing of workers in the industry.



The current mining skills gap raises costs and elevates safety risks

### What's next

To overcome the risks that accompany traditional financing avenues, **blended finance models** are being introduced to offer a path forward. In these models, public or philanthropic funds are deployed to de-risk private-sector investment by providing grants or credit enhancements to private financiers. This blended model serves as a bridge between risk-averse investors and critically needed infrastructure.

The industry is also beginning to integrate ESG performance into their financing arrangements which aligns financial incentives with environmental and social impact, thereby outlining ESG as an incentive rather than a liability. Polymetal's \$80m agreement with bank ING, for example, demonstrates how a bank can embrace more sustainable financing routes. The metal miner converted its \$80m bilateral credit facility into a sustainability performance-linked loan where interest rates fluctuated based on the company's ESG score: improved performance lowers the rate and deterioration raises it. This structure demonstrates how traditional loans can be de-risked by tying financing to ESG outcomes.

Similarly, where traditional models favour short-term returns, mining companies must seek short-term incentives such as early revenue streams (pre-sale agreements, tolling arrangements, etc), public sector guarantees (loan guarantees, tax incentives, etc), revenue participation, and visibility reporting to offer financiers so that the long-term returns and benefits may be realised.

*See p6 for more on critical minerals financing from ING's Tim van Pelt.*

### Impact risks – social and environmental

#### Challenges

Due to historic and current social and environmental impacts, and opaque supply chain practices, mining projects continue to face intense scrutiny. Major concerns including water use, biodiversity loss, ecosystem disruption and human rights violations are all ongoing concerns of which workers, local communities, stakeholders, and the public remain aware and wary.

Additionally, transporting minerals from remote mines to refineries and consumers compounds infrastructure challenges that amplify their environmental footprint.

Of particular importance is Free, Prior and Informed Consent (FPIC) – the requirement to obtain explicit consent, and confirmation of understanding the true impact, from indigenous and local communities before proceeding with mining and building on their lands. Failure to secure FPIC can result in social conflict, legal challenges and reputational damage.

Full transparency and outlined risks, impact, and expectations are imperative to ensure environmental standards are met and local communities are protected.

#### Risks

Without proper engagement and traceability, mining projects face many social and environmental risks.

Human rights abuses can easily occur, especially if local communities are excluded from decision-making or are displaced

from their land. Land use conflicts may also escalate when cultural or ancestral sites are threatened.

Environmental degradation is also a major risk with any mining project, as it can erode ecosystems, poison land and water use, and pollute air, all while increasing public distrust.

Public discontent, both from locals and international communities, can reduce support for mining projects and material recycling initiatives, and projects that ignore these considerations risk delays, fines, or outright shutdowns.

### What's next

The sector has started to move toward strategies that prioritise both ethical compliance and tangible community benefits. Community benefit agreements (CBAs) are increasingly used to ensure that local populations gain from mining operations through employment guarantees, infrastructure development, and revenue-sharing mechanisms.

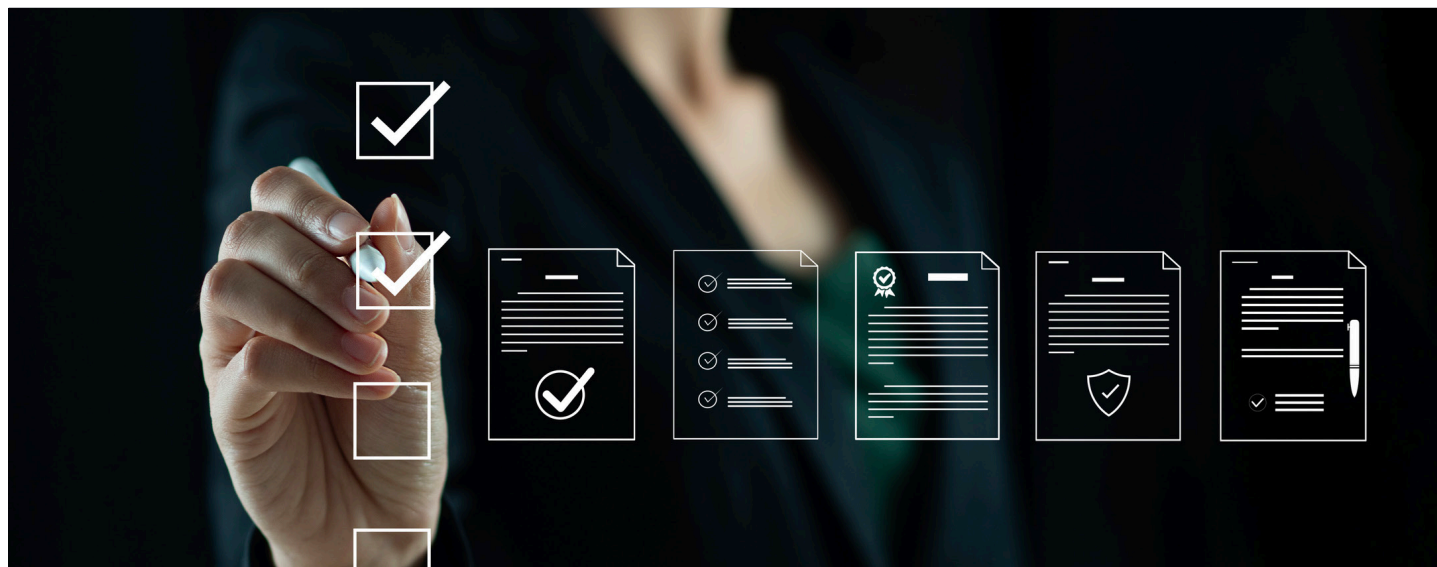
Third-party verifications programmes also play an important role in independent assurance than human rights and environmental standards are met, and local communities protected.

Collectively, FPIC, CBAs and traceability programmes are helping projects operate more sustainably while fostering trust with local



Land use conflicts may also escalate when cultural or ancestral sites are threatened

communities. However, further investment in local education and continuing to pressure the industry to uphold the highest human rights standards is an imperative part of the industry's transition to setting responsible practices as the standard.



STANDARDS AND CERTIFICATIONS

## Reassuring and rigorous

As mining operations face increasing scrutiny over social, environmental and governance impacts, standards and certifications have become critical tools for companies, investors, and communities seeking assurance that minerals are sourced responsibly. These frameworks help mitigate risks, improve transparency, and ensure that mining benefits local communities while protecting ecosystems.

The International Council on Mining and Metals' (ICMM) Mining Principles outline 39 performance expectations covering ethical business practices, environmental stewardship and human rights. ICMM members publicly report their progress, ensuring accountability and transparency. To further strengthen responsible practices, ICMM collaborates on initiatives such as the Consolidated Mining Standard Initiative (CMSI), which aims to harmonise leading global standards from ICMM, the Copper Mark, the Mining Association of Canada (MAC), and the World Gold Council into a single unified framework.

The Initiative for Responsible Mining Assurance (IRMA) is widely recognised as a robust standard for environmental, social and governance performance at the mine level, with independent third-party verification. Its rigour has earned recognition from major companies seeking credible certification for supplier operations. Complementing this, the Responsible Minerals Initiative (RMI) evaluates smelters and refiners for conflict-free and responsible sourcing, while the OECD Due Diligence Guidance provides downstream purchasers with a framework to assess risks in mineral supply chains. For artisanal and small-scale mining, the CRAFT Code helps local miners meet market requirements for responsible sourcing. (CRAFT = Code of Risk-mitigation for Artisanal and small-scale miners engaging in Formal Trade.)

Additional environmental and social management standards include:

- ISO 14001 for environmental management (global benchmark for operational sustainability)
- ISO 45001 for occupational health and safety (global benchmark for operational sustainability)

- UN Guiding Principles on Business and Human Rights (transparency and responsible reporting)
- Global Reporting Initiative Mining and Metals Standard (transparency and responsible reporting)
- Equator Principles (investment criteria for responsible and ESG-based practices)

Similarly, certifications give stakeholders tangible assurance that standards are being met. Some of the highly regarded certifications include:

- Fair-mined and Fairtrade Gold (ensures artisanal gold is mined ethically, with fair labour and environmental safeguards)
- London Bullion Market Association (LBMA) Responsible Gold Guidance (audit supply chains to confirm conflict-free sourcing)
- Responsible Minerals Assurance Process (RMAP) (audit supply chains to confirm conflict-free sourcing)

Broader certifications such as TSM (Towards Sustainable Mining), Copper Mark, and Aluminium Stewardship Initiative are multi-metal assurance across environmental, social, and governance criteria, aligning operations with international best practices.

Together, these standards and certifications form a framework for accountability, risk management, and sustainability in mining that give stakeholders assurance, local communities protection, and hold mining companies accountable for their practices. They allow companies to demonstrate compliance with internationally recognised benchmarks, help investors make informed decisions, and ensure that communities and ecosystems benefit from responsible mineral development.