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WHEN AUTONOMOUS TRUCKS BECOME
THE DEFAULT, NOT THE PILOT

AI Comes to the Plant

How Vale's Itabira Model Turned Beneficiation Into a 25% Productivity Story

The Reliability Business:

Can Mining Services Deliver Measurable Uptime?

Securing the Autonomous Mine

Connected mining demands cybersecurity for operational resilience.



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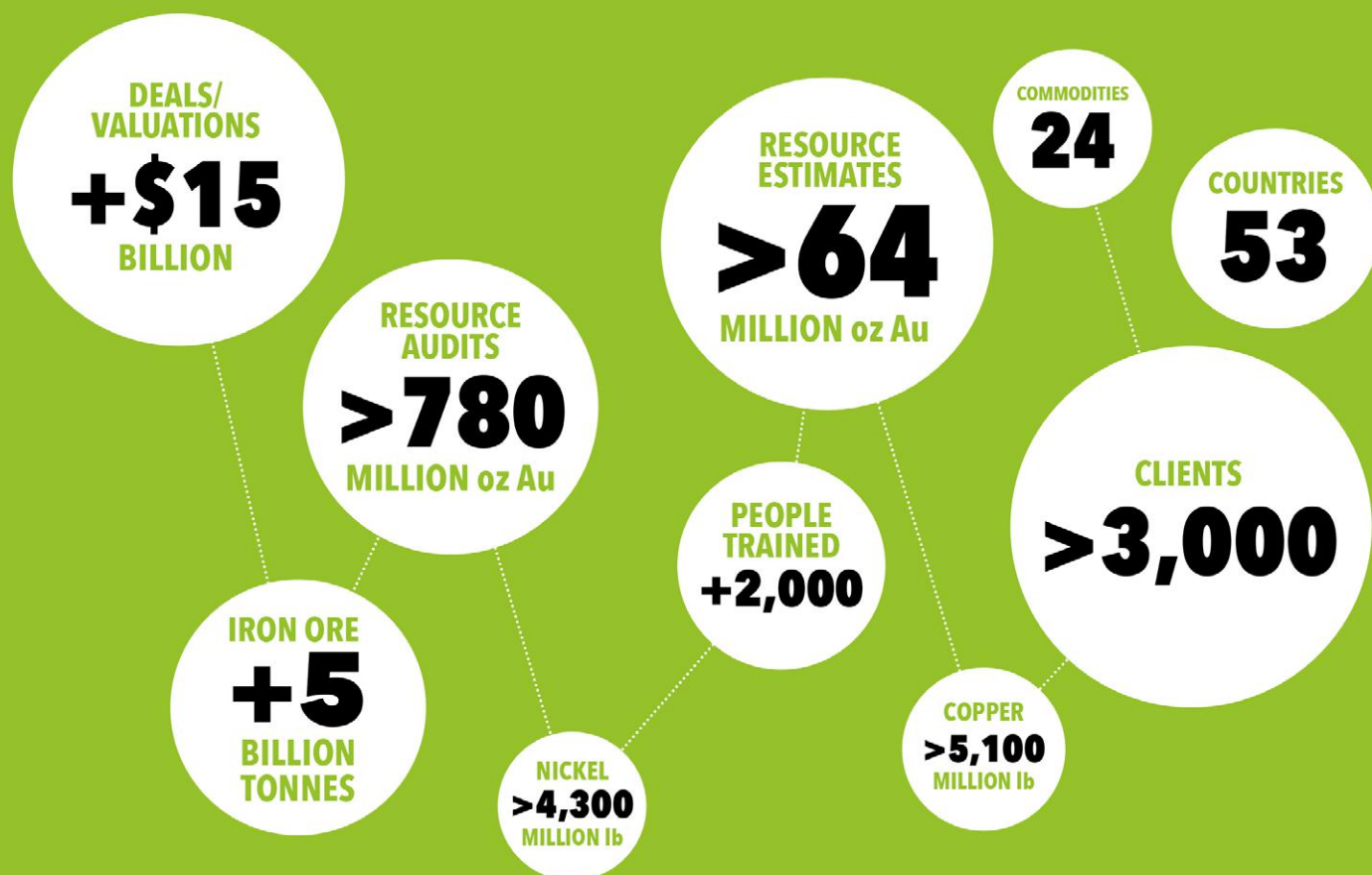
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SkillingS **MINING** Review

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Mining's Next Technology Shift

The October issue of *Skills Mining Review* examines how advances in load, haul and processing equipment are reshaping mining operations. From autonomous haulage fleets moving beyond pilot projects to AI-enabled beneficiation, the focus is on the technologies changing how mines move material, process ore and manage costs.

Our cover stories explore two critical shifts across the mining value chain. Autonomous haulage is approaching a new industrial scale, raising questions about fleet economics, electrification, charging infrastructure and the investment decisions facing mine operators. Meanwhile, AI-driven processing highlights how digital systems can improve plant performance, optimise operations and extract greater value from existing assets.

We also examine the growing cost pressure caused by declining iron ore grades. As producers process more material to recover the same amount of iron, energy-intensive grinding, water use and tailings management are becoming increasingly important to project economics. New approaches – from high-pressure grinding rolls and vertical roller mills to early waste rejection – offer potential pathways to more efficient processing.

Together, these stories explore a mining industry where productivity depends not only on the scale of equipment or the size of the resource, but on how intelligently technology is deployed. From the haul road to the concentrator, the challenge is to move more efficiently, process smarter and protect operating margins in an increasingly demanding environment.



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Hemerdon Redesign Uses Ore Sorting to Cut Processing Load



Tungsten West is deploying six X-ray transmission (XRT) sorters at its Hemerdon tungsten mine in Devon, England, as it prepares to

ramp up production. Full-scale output is targeted for the first quarter of 2027. The sorters will handle rock measuring 10-80 mm, separating

mineralised material from lower-grade rock. The system is designed to send about 30% of this feed to the concentrator for tungsten and tin recovery. The remaining material is intended for sale as construction aggregate.

By removing much of the material before further processing, the redesigned plant aims to reduce the load on the downstream circuit. This could lower energy use and operating costs.

The benefits, however, will depend on actual plant performance, including recovery rates, throughput and the quality of the resulting products.



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NEWS BRIEFS

SANDVIK TO SUPPLY 27-UNIT FLEET FOR KAZAKHSTAN MINE

Sandvik has received an order to supply a 27-unit underground mining fleet to Orken LLP, Qarmet's iron ore division, in Kazakhstan. The equipment will support the transition from manual development to mechanised mining at the Atasu operation at Western Karazhal. The order highlights the continuing role of mechanisation in underground mine development.



RIO TINTO AND SHOUGANG COMMISSION CARBON-CAPTURE TRIAL

Rio Tinto and China's Shougang Group have commissioned an industrial-scale trial facility designed to capture carbon dioxide from blast-furnace gas. The project will test carbon-capture technology in an operating steelmaking environment. Its results could help establish how emissions-reduction technologies perform when applied to the blast-furnace process.

FORTESCUE PRODUCES FIRST HOT METAL AT GREEN METAL PROJECT

Fortescue's Christmas Creek Green Metal Project in Western Australia has produced its first hot metal using Metso's direct-reduction smelting furnace technology. The milestone advances the project's effort to develop an alternative ironmaking route. The next challenge is demonstrating the technology's performance as the project moves beyond its initial production milestone.

BARRICK SELECTS AVATHON FOR AI-BASED OPERATING MODEL

Barrick's North American business has selected Avathon's Autonomy Platform as a strategic technology partner. The collaboration is intended to support an AI-based operating model across its North American operations. The announcement reflects growing interest in applying artificial intelligence to operational decision-making, though the announcement does not quantify expected productivity gains or cost savings.

VIZSLA COPPER STAKES MILLER PROJECT IN BRITISH COLUMBIA

Vizsla Copper has staked the Miller copper-gold project in central British Columbia. The acquisition adds ground to the company's exploration portfolio in the province. Staking establishes a new exploration position, but further geological work and exploration results will be needed to determine the project's mineral potential.



SANDVIK EARNS CYBERSECURITY CERTIFICATION FOR EQUIPMENT DEVELOPMENT

Sandvik has achieved IEC 62443-4-1 Maturity Level 3 certification for its secure product development lifecycle. The certification relates to cybersecurity processes used in developing industrial automation and control products. As mining equipment becomes more connected and automated, secure development practices are increasingly relevant to protecting operational technology and mine systems.

HEXAGON LAUNCHES FLEET-WIDE COLLISION-AVOIDANCE INSIGHTS TOOL

Hexagon has launched CAS Insights, a web-based analytics application that consolidates data generated by its Collision Avoidance System-equipped fleets. The tool is designed to give operators a fleet-wide view of safety performance and help turn collision-avoidance data into operational insights. Its practical value will depend on how effectively mine operators use the information to manage risks.

KOMATSU

KOMATSU EQUIPMENT SELECTED FOR CRAWFORD NICKEL PROJECT

SMS Equipment and Komatsu have been selected to support Canada Nickel's Crawford Nickel Project in northern Ontario. The announcement brings equipment supply and technology into the project's development planning. The selection is a procurement milestone; it does not, by itself, establish the project's construction schedule or confirm when mining operations will begin.

OBITUARY

STEPHEN SCOTT, FORMER CEO, ENTRÉE RESOURCES

Stephen Scott, who led Entrée Resources as president and chief executive for more than a decade, died on September 8, 2026. His career spanned more than 30 years in mining, including senior roles at Rio Tinto and Turquoise Hill Resources. He retired from Entrée in July 2026.

Jevons Automates Explosive Loading at Mine Highwalls



Jevons Robotics has launched a battery-electric robot designed to automate the loading of packaged explosives for pre-split blasting at surface mines.

Pre-split blasting fires a line of explosives before the main blast to create a controlled fracture along the planned mine wall. The technique

helps limit overbreak and protect the final rock face. Loading explosives in this area can expose workers to highwall hazards.

The ARTEV1000 system autonomously locates and aligns with blast holes before deploying and retaining the explosives. The task is managed remotely, reducing the need for work-

ers to handle explosives at the highwall. Jevons says Newmont's Boddington mine in Western Australia will host the system's first global deployment. Its performance will depend on reliable operation and its ability to reduce worker exposure. The scale of any safety or productivity gains remains to be established in the field.

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TROILUS RECEIVES US\$850 MILLION DEBT COMMITMENT

Troilus Mining received a credit-approved debt commitment letter from KfW IPEX-Bank and Société Générale on September 28. The proposed US\$850 million facility forms part of an anticipated US\$1.1 billion debt package for the Troilus gold-copper project in Quebec. A proposed US\$250 million contribution from Export Development Canada remains subject to final approval.

EDM REPORTS LOWER POTENTIAL CAPITAL COST FOR SCOTIA ORE SORTING

EDM Resources reported that X-ray fluorescence ore-sorting tests for its Scotia lead-zinc project indicated a potential capital cost of US\$1.5 million, compared with US\$3.5 million estimated for an earlier dense-media-separation test programme. The company described this as a 57% reduction. The tests used different feed samples and conditions, so the figures are not a direct like-for-like comparison.



MAXUS REFINES ANTIMONY TARGETS AT BRITISH COLUMBIA PROJECT

Maxus Mining has refined its exploration targets at the Alturas West Antimony Project in British Columbia following interpretation of preliminary airborne electromagnetic survey data. Modelling identified conductive responses along more than 900 metres of the Alps-Alturas shear corridor. The company said interpretation would be refined using final processed survey data and drilling observations.

GALLEON GOLD BEGINS UNDERGROUND DEVELOPMENT AT WEST CACHE

Galleon Gold has begun underground development at its West Cache Gold Project near Timmins, Ontario. Ramp development is advancing toward Zone 9, supporting an 86,500-tonne bulk-sample programme for future mine development.

COEUR ALLOCATES US\$18 MILLION TO RAINY RIVER EXPLORATION

Coeur Mining has allocated US\$18 million for exploration at its Rainy River gold-silver mine in northwestern Ontario, as part of its US\$158 million 2026 exploration budget. The programme includes underground and surface drilling to identify additional mineralisation, with the potential to support resource growth and extend the mine's life.

TEAM TS² WINS AI4SAFEMINES COMPETITION WITH SMART DOME

Team TS² won the inaugural AI4SafeMines Student Competition with Smart Dome, an AI concept for detecting potential failures and contamination risks at potash storage domes. The concept is not yet evidence of a deployed system or proven safety improvements.

METSO SIGNS €40 MILLION-PLUS ANALYZER SERVICES AGREEMENT

Metso signed a five-year analyzer Life Cycle Services agreement worth more than €40 million with a major copper producer in South America. Announced on September 22, the contract is Metso's largest analyzer services agreement to date. Its scope includes analyzer-related services and support, with orders to be recognised in stages as contractual milestones are reached. Metso

VOLVO AUTONOMOUS SOLUTIONS REPORTS THREE MILLION TONNES HAULED

Volvo Autonomous Solutions reported on September 24 that its autonomous transport systems had moved more than three million tonnes of material across mining and quarrying sites in Europe, including Brønnøy Kalk in Norway and Boliden's Garpenberg mine in Sweden.



HARMONY REPORTS FATAL SEISMIC INCIDENT AT MPONENG

Harmony Gold reported a fatal incident at its Mponeng mine in South Africa following a seismic event on September 14. The company announced the death on September 15 and suspended work in the affected area pending an investigation. Authorities were notified, and support was provided to those affected.



OROSUR REPORTS GOLD MINERALISATION AT EL CEDRO

Orosur Mining reported an initial gold intersection from drilling at the El Cedro prospect within its Anzá project in Colombia. The first hole intersected 61.35 metres grading 0.93 grams per tonne of gold from surface, according to the company. The result is an early exploration indication; further assays and geological work are needed to assess the significance of the mineralisation. Sibanye-Stillwater

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Caterpillar Expands **Autonomous Hauling** *to Two Luck Stone Quarries*

WORDS BY PENNY LANEFORD // DATA BY SKILLINGS RESEARCH

Caterpillar and Luck Stone plan to extend autonomous hauling to two more Virginia quarries, building on an operation at Bull Run that has moved more than 3.5 million tons of material since November 2024, according to the companies.

The planned deployments at Luck Stone's Boscobel and Bealeton operations will use fleets of Cat 775 trucks. The rollout marks the first deployment of Caterpillar's autonomous haulage system on the Cat 775 model. Caterpillar and its local dealer, Carter Machinery, will support the expansion. The programme will also include technologies for loaders and

other site equipment. The programme builds on the use of autonomous Cat 777 trucks at Bull Run. Extending the technology to the Cat 775 brings another truck model into Caterpillar's quarry autonomy programme. The operating environment differs from that of large mines: quarry sites may run smaller fleets and do not necessarily haul material around the clock. These conditions affect how autonomous systems must be integrated into site operations.

Caterpillar and Luck Stone report that the Bull Run operation has improved safety and production consistency, while creating opportu-

nities for employees to develop technology-related skills. However, the companies have not disclosed detailed figures for productivity gains, operating costs or the scale of any safety improvements.

The new deployments will provide a further test of autonomous hauling across quarry operations. The key measures will be system reliability, production performance and the cost of deploying and maintaining the technology. Until those results are reported, the commercial benefits of extending autonomy to the Cat 775 and additional sites remain unquantified.

Mali Renews 14 Gold and Lithium Exploration Permits

Mali has renewed 14 gold and lithium exploration permits held by eight companies since August 21, following a suspension of permit renewals that lasted from December 2022 to March 2025.

The renewals cover 12 gold permits and two lithium permits. At its August 21 meeting, the Council of Ministers approved renewals for several gold exploration areas, along with second renewals for two lithium permits and one gold permit. The approved extensions allow companies to continue exploration work for an



additional three years, subject to licence terms.

The decisions restore continuity for existing projects, but do not represent a full reopening of new

exploration licensing. Nor do renewed permits confirm that drilling has resumed. Actual field activity will show whether companies can advance their projects under the extended licences.

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Tanbreez Reports 99% Dissolution as Refinery Economics Take Shape



Critical Metals Corp. reported more than 99% dissolution of eudialyte concentrate from its Tanbreez rare earth project in Greenland on September 16. The company says its proposed processing route is designed to produce 19 rare earth and critical-metal products. The result addresses a processing challenge, but does not establish commercial recovery or prove the economics of a full-scale refinery.

Eudialyte can be difficult to process because silica may form a gel during chemical treatment, complicating downstream separation. Critical Metals says its proposed multistage, mixed-acid process is designed to manage this issue.

However, dissolution measures how much material enters solution; it does not show how much of each target element can be recovered, separated to specification or produced consistently as a saleable product.



The proposed Romanian refinery is designed to process up to 100,000 tonnes of concentrate annually. Company modelling projects annual revenue of US\$1.8 billion to US\$2.2 billion.

The model includes value from silica, a by-product the company expects to recover. Estimated capital expenditure is US\$1.85 billion, with a stated accuracy range of plus or minus 25%. These figures are projections based on modelling and assumed market prices, not operating results.

The commercial case will depend on more than dissolution. Element-by-element recovery, product purity, reagent consumption, energy demand, waste handling and operating costs will shape the refinery's performance. The company's proposed flowsheet must demonstrate that these processes can work together reliably at scale.

Until integrated performance and costs are established, the 99% figure remains a reported technical milestone—not proof of a commercially viable rare earth refinery.



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The copper segment of ElvalHalcor S.A. is composed of six subsidiaries and seven associates/joint ventures, based in Greece, Belgium, Bulgaria, Romania and Turkey, while it operates a total of five production plants in Greece, Bulgaria and Turkey.

The copper segment of ElvalHalcor S.A. develops and distributes a wide range of products, including copper and copper-alloy rolled and extruded products with Halcor being the sole producer of copper tubes in Greece. High quality in production

is achieved through strict controls applied throughout the production process. With a consistent quality focus, the company implements an ISO 9001:2015 Certified Quality Management System and leverages high technologies and expert staff.

As a result of the Group's strategic investments in research & development, Halcor is recognized as one of the leading copper producers globally, setting new standards in copper processing. The company maintains a consistent focus on quality and

environmental protection and a strong commitment to the principles of sustainable development. In this context, all production facilities in the Group's plants leverage advanced technologies to bring in the market innovative products that are energy efficient and environmentally friendly.

For more information, please visit our website www.halcor.com

THE METRICS

Behind the Claim

WORDS BY SONNY JIMERSON // DATA BY SKILLINGS RESEARCH



WesTrac reported a 32% reduction in machine downtime at a mining customer's operation in Western Australia. The result, announced on September 14, 2026, was attributed to its Digger and Drill Services, which embeds specialist technicians at mine sites and supports equipment maintenance across its lifecycle.

The customer recorded more than 760 fewer hours of downtime, according to WesTrac. The company equates that reduction to an estimated 3.6 million tonnes of additional ore moved. Its team worked with the mine operator on asset lifecycle strategies, work-event sequencing and on-site technical support.

The figures suggest a substantial operational gain, but the announcement does not provide the measurement period, fleet size or baseline

used to calculate the 32% reduction. It also does not specify whether the downtime figure includes planned maintenance, unplanned failures or both. Without these details, the result cannot be directly compared with performance at other mines.

The 3.6-million-tonne figure also requires careful interpretation. WesTrac presents it as additional ore moved, but does not publish the calculation used to convert recovered

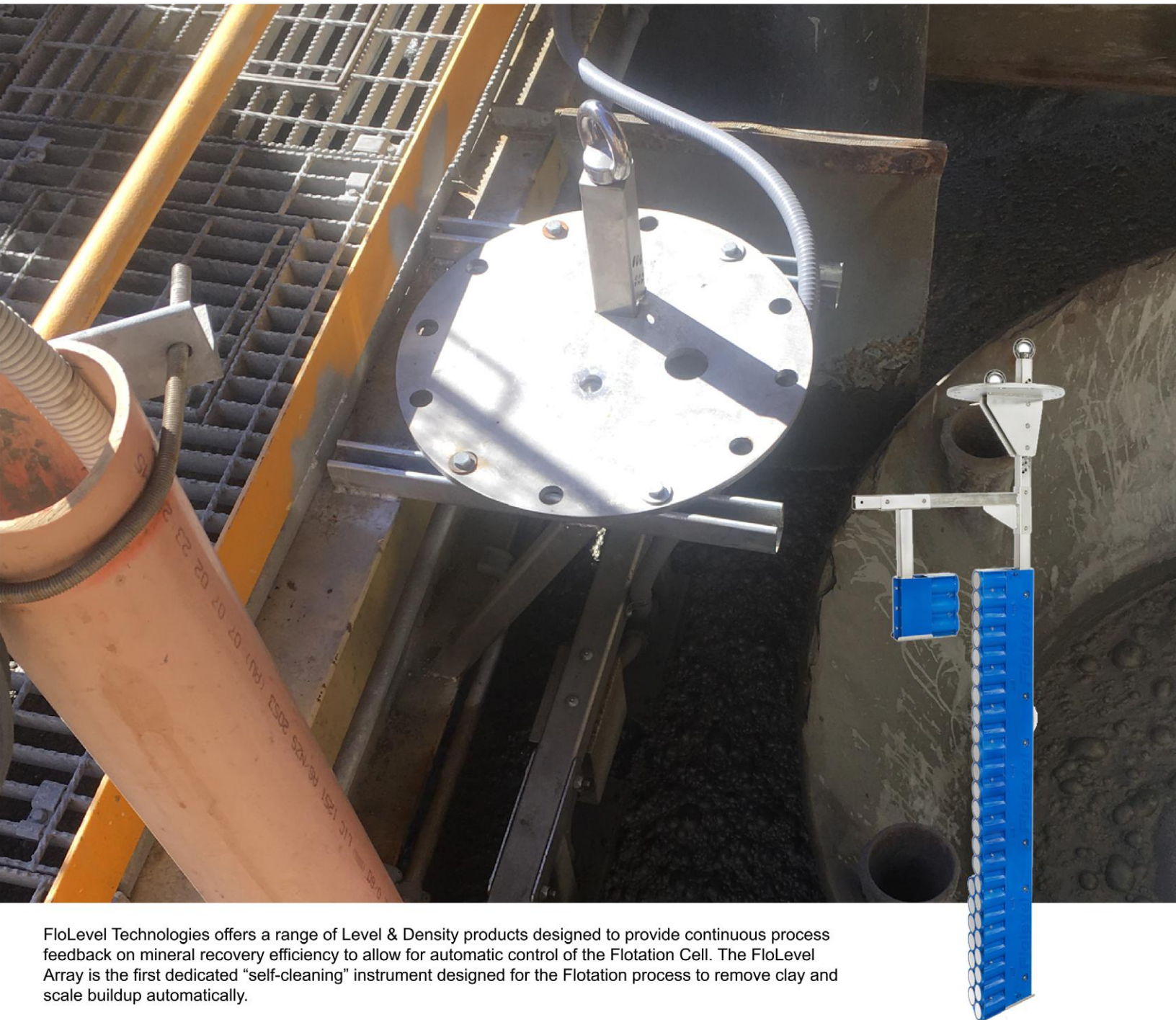
operating hours into tonnage. It should therefore be treated as a company-reported estimate, rather than independently verified incremental production.

Launched in 2024, Digger and Drill Services had supported nearly a dozen diggers and more than 18 drills across nine Western Australian mine sites by September 2026, WesTrac said. This establishes the service's reach, but not whether the reported reduction is typical across its customers.

For mine operators, assessing such claims requires consistent downtime definitions, comparable reporting periods, equipment availability data and maintenance costs. Until those measures are disclosed, WesTrac's 32% figure remains a customer-specific result—not a transferable industry benchmark.



A Level & Density Measurement Revolution for **Flotation Cells** is here!



FloLevel Technologies offers a range of Level & Density products designed to provide continuous process feedback on mineral recovery efficiency to allow for automatic control of the Flotation Cell. The FloLevel Array is the first dedicated "self-cleaning" instrument designed for the Flotation process to remove clay and scale buildup automatically.

Process feedback from the FloLevel Array allows the DCS to control aeration flow rate, adjustment of dart valve, optimisation of solids concentration, and adjustment of frother flow rate for the flotation circuit.

AI COMES TO THE PLANT

*How Vale's Itabira Model Turned
Beneficiation Into a*

25%

Productivity Story

WORDS BY CHARLES PITTS // DATA BY SKILLINGS RESEARCH

“A successful
installation is one step.
Reproducing the results is
another.”

The next battleground in mining automation is not the haul road. It is the processing plant. For years, mining companies have invested in autonomous trucks, automated drilling and remote operations. Yet the benefits of automation can be limited when processing plants struggle to respond quickly to changing ore characteristics. At this critical stage, variations in grade, hardness and mineralogy can affect throughput, recovery and product quality.

Vale's Conceição II plant in Itabira, Minas Gerais, offers a case study in addressing that challenge through artificial intelligence and integrated process control.

Inaugurated in June 2026, the modernised facility is Vale's first high-tech "Model Plant". With an annual capacity of 11.2 million tonnes, it uses more than 400 monitored process variables, approximately 7,300 automated instruments and more than 100 monitoring cameras.

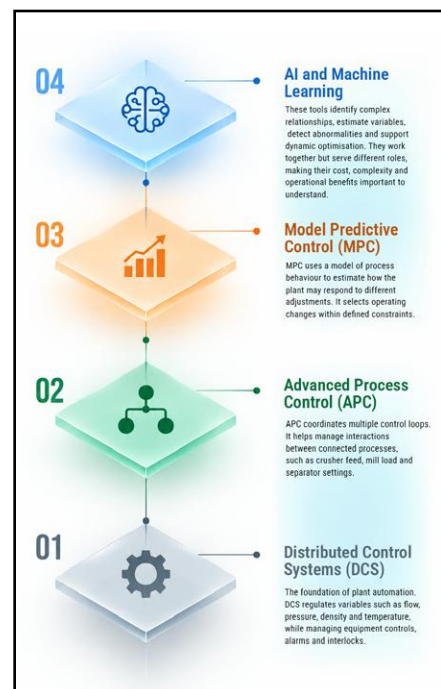
Vale reports a 25% increase in productivity since implementation began in 2024. The company also reports a 40% increase in direct-reduction pellet feed output and a 26% reduction in iron losses to tailings.

These figures highlight the potential of automation to improve more than production volumes. By coordinating process measurements and operating adjustments, a plant can seek to increase output while improving recovery and maintaining product specifications.

From Monitoring to Optimisation

The value of an AI-enabled plant lies not simply in collecting data, but in using it to influence operating decisions.

At Conceição II, Vale's reported system combines online ore-grade analysis, real-time monitoring, AI-supported interpretation and automatic adjustment of operating parameters. The system measures



changing conditions, compares performance with operating targets and adjusts connected equipment. It then monitors the results and continues optimising.

This closed-loop approach can help the plant respond while material is still moving through the circuit, rather than relying entirely on laboratory results that may arrive after conditions have changed.

The technology builds on conventional control systems, which remain essential for regulating equipment and maintaining safe operating limits. Advanced process control and AI-supported tools add the ability to coordinate multiple variables and respond to more complex operating conditions.

The Value of Better Iron Recovery

The reported 40% increase in direct-reduction pellet feed output gives the project a product-quality dimension. Suitable feedstock is important for direct-reduction ironmaking, a route used in steel production that can support lower-carbon processes, depending on the energy source and reductant.



THE NUMBERS BEHIND VALE'S AI PLANT

Vale's Conceição II Model Plant in Itabira combines industrial-scale production with integrated automation and AI-supported process control.

The company reports a 25% increase in productivity, a 40% increase in direct-reduction pellet feed output and a 26% reduction in iron losses to tailings.

The plant has an annual capacity of 11.2 million tonnes. Its operating systems monitor more than 400 process variables, automate approximately 7,300 instruments and use more than 100 monitoring cameras.

The figures highlight three distinct performance measures: productivity, product output and resource recovery. They are Vale-reported results and should not be interpreted as independently verified outcomes or as a guarantee of similar gains at other operations.

Higher output alone does not guarantee higher revenue. Product specifications, customer contracts, operating costs and market conditions determine the commercial value. However, improving the consistency and recovery of saleable material can strengthen an operation's ability to serve specific markets.

Vale and ABB formalised a strategic alliance in August 2026 to expand automation, AI and digitalisation across Vale's iron ore operations. Conceição II is intended to serve as a reference for other facilities, with implementation at the Brucutu processing plant underway and operations expected to begin in early 2027.

Replicating the results will require reliable data, integration with existing control systems, workforce training and clear safeguards. Each plant has different equipment, ore characteristics and operating constraints. Conceição II does not establish that every mine can achieve the same gains. It demonstrates the potential of integrating real-time measurement, automation and process optimisation at industrial scale.

Mining automation has transformed how material is extracted and transported. Vale's Itabira model puts the spotlight on the next challenge: extracting greater value from the material already being mined.



CAN THE ITABIRA MODEL BE REPLICATED?

Vale's Conceição II plant is intended to serve as a reference for wider deployment of automation and digitalisation across its iron ore operations.

In August 2026, Vale and ABB formalised a strategic alliance covering automation, AI, digitalisation and integrated IT/OT solutions. The supplied material identifies the Brucutu processing plant as being in the implementation phase, with operations expected to begin in early 2027.

Scaling the model will require more than installing similar software. Processing plants differ in equipment, instrumentation, ore characteristics, control systems and operating procedures.

Reliable data is essential. Sensor drift, missing measurements and inconsistent records can undermine model performance. Operators also need training, clear oversight procedures and a tested fallback when automated systems are unavailable.

The reported gains at Conceição II therefore provide a reference point—not a guaranteed outcome for every facility. The next test is whether the approach can deliver measurable benefits across plants with different operating conditions.



WHY REAL-TIME DATA MATTERS

In mineral processing, timing can determine whether a problem is corrected or allowed to affect more production.

Traditional workflows may depend on laboratory assays to confirm changes in ore grade. By the time results become available, material may already have moved further through the processing circuit.

Online analysis can provide information sooner. Combined with automated measurement and process control, it can help a plant respond while material is still being processed.

At Conceição II, Vale describes an operating model that combines online ore-grade analysis, real-time monitoring and automatic adjustment of operating parameters. The objective is to move beyond identifying deviations after they occur. Earlier information can create an opportunity to adjust the process and manage the effects on recovery, throughput and product quality.

The benefit depends on measurement reliability and whether the plant can make an effective adjustment.

Crawford Nickel: *What the Equipment Selection Reveals About the Project*



Canada Nickel's selection of Komatsu and SMS Equipment for its Crawford Nickel Project reveals how the proposed Ontario mine plans to move material at scale. Announced in September 2026, the selection covers more than 300 machines, with an estimated current value of C\$1.5 billion. Purchases are expected over the project's planned 40-year life.

The selection is a step towards defining Crawford's operating system. It is not yet a completed equipment order. Canada Nickel expects to finalise agreements with both suppliers in the first quarter of 2027.

Designed for Large-Scale Haulage

Located approximately 40 kilometres north of Timmins, Crawford is planned as a large open-pit operation. Its fleet must coordinate loading, hauling and dumping while moving ore and waste efficiently.

The project's 2023 feasibility study considered 290-tonne haul trucks,

700-tonne electric excavators and electric rope shovels with 60-cubic-metre buckets. These are feasibility-study examples, not confirmed specifications for the final Komatsu fleet.

The final configuration must match haul distances, road gradients, loading rates and production requirements. Equipment availability and maintenance will also shape operating performance.

Automation and Electrification

The proposed technology package includes Komatsu's DISPATCH fleet management system and FrontRunner autonomous haulage. These systems can support truck coordination and autonomous operations, but results will depend on mine design, communications, maintenance and operating procedures.

Trolley-assist haulage is another option. Overhead power lines can supply electricity to compatible

trucks on equipped road sections, reducing diesel use along those routes. The extent of deployment at Crawford has not been specified. Battery-powered equipment is also a potential future option, rather than a confirmed final fleet choice.

The Capital Commitment

The C\$1.5 billion estimate represents planned purchases spread across the project life, not an immediate order. Canada Nickel is also pursuing fleet financing with Taykwa Tagamou Nation.

The next milestones are the final equipment list, financing terms, delivery schedule and support agreements. These will clarify how the selected fleet moves from supplier selection to an operating mine.

Crawford's challenge is not simply acquiring large machines. It is integrating equipment, infrastructure and maintenance into a reliable production system.

Funding the Next Mine

What Public Investment Can and Cannot Deliver

Generation Mining's Marathon copper-palladium project in northwestern Ontario shows how public investment can help finance a mine. It also shows why a financing milestone is not the same as a producing operation.

WORDS BY MO SHINE // DATA BY SKILLINGS RESEARCH

On September 14, 2026, the company announced a construction financing package of approximately C1.3 billion. The package included C340 million in final funding. A C200 million public share offering and C40 million private placement closed on September 21, raising C240 million in gross proceeds. A separate C100 million convertible-note financing was allocated equally between Canada Growth Fund and the Canada Infrastructure Bank. That note financing remained subject to required approvals.

Public support also extends to the processing facility. On September 18, Generation Mining announced a non-binding term sheet with the Ontario government for a loan of up to C\$11 million through the Critical Minerals Processing Fund. The proposed loan depends on eligible project spending, employment requirements and final documentation. It is not yet equivalent to funding received.

The processing facility and related eligible infrastructure account for

about C410 million. These costs sit within the project's C992 million feasibility-study capital estimate. That estimate should not be directly compared with the C1.3 billion financing package. The package includes a C185 million cost-overrun facility, alongside surety bonds and letters of credit. The feasibility estimate also includes C\$119 million in contingency. These figures serve different purposes.

Generation Mining said it expected to make a final investment decision after completing the financing process, with early works construction planned for the fourth quarter of 2026. Financing arrangements alone do not complete construction, commissioning or operational ramp-up.

Public investment can help unlock private capital and support critical-mineral infrastructure. It cannot remove construction risk, guarantee schedules or ensure projected returns.

Marathon's next milestone is turning its financing plan into a built mine capable of sustained commercial production.



EQUIPMENT

Metso's Copper Analyser Deal Measuring the Value of Process Data

Metso has secured a five-year analyser services agreement worth more than €40 million with a major copper producer in South America. Announced on September 22, 2026, it is the company's largest analyser Life Cycle Services (LCS) contract to date.

The agreement covers new on-stream analysers and sampling systems, equipment modernisation, spare parts, digital support, engineering, and operation and maintenance services. The systems measure elemental content and particle size in process streams. Their data can help operators assess process conditions and inform adjustments.

The potential value lies in using reliable measurements to support operating decisions. Metso's LCS model is built around mutually agreed performance targets, but the



company has not disclosed customer-specific targets or improvements achieved under this contract.

The first part of the order was booked in Metso's Minerals segment in the third quarter of 2026. Further bookings are scheduled as contractual milestones are reached. Whether the agreement delivers measurable plant-performance gains will depend on results achieved at the operation.



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The Economics of Separation and Refining



The economics of rare earths increasingly depend on what happens after extraction. Mining projects must convert ore into saleable material, while separation facilities must produce products that meet customer specifications. Offtake agreements can connect producers with buyers, and technology partnerships can help advance processing projects. But neither guarantees that a proposed facility will reach production or operate profitably.

Developments involving Serra Verde in Brazil, Lindian Resources in Kazakhstan and Rainbow Rare Earths in South Africa illustrate how companies are approaching market access, processing technology and downstream capacity.

Offtake Agreements: Different Routes to Market

Serra Verde's 15-year offtake agreement covers 100% of its Phase I production of neodymium, praseodymium, dysprosium and terbium, supplied as mixed rare earth carbonate. The arrangement includes guaranteed price floors for these four

magnetic rare earths. By establishing minimum prices, the agreement provides a degree of revenue protection against market downturns. It does not, however, remove production, processing or delivery risks. The commercial outcome still depends on the operation's ability to produce and supply material under the contract's terms.

Lindian Resources has taken a different approach. Its binding offtake agreement with Carester covers 70% of the mixed heavy rare earth compound produced at Lindian's SARECO facility in Stepnogorsk, Kazakhstan, subject to an annual cap of 8,750 dry metric tonnes. The initial term is 10 years, with two possible five-year extensions.

This agreement concerns a mixed product, not separated rare earth oxides from the proposed Stepnogorsk separation plant. The contract provides a market for specified material, but it should not be treated as proof that the planned separation facility is financed, built or commercially viable. The agreement's

pricing and payability terms will also influence the revenue Lindian ultimately receives.

Rainbow Rare Earths' September 2026 memorandum of understanding with Neo Performance Materials combines technical support with proposed offtake rights. Neo is expected to provide design input for the final solvent-extraction circuit at Rainbow's Phalaborwa project in South Africa. The proposed offtake covers 40% of planned neodymium-praseodymium oxide production and 65% of the mixed SEG+ product.

Unlike Lindian's binding purchase agreement, Rainbow's MoU is a preliminary arrangement while the parties work towards definitive agreements. It signals a potential route to market and a technical relationship, but does not yet carry the same contractual status as a completed binding offtake deal.

Separation Capacity: From Plans to Saleable Products

Lindian's proposed Stepnogorsk facility is designed to produce up to 8,000 tonnes of rare earth oxides annually through solvent extraction. A definitive feasibility study was targeted for completion in the fourth quarter of 2026. The facility remains a proposed development, and its planned capacity should not be counted as current supply.

At Phalaborwa, Rainbow plans to recover rare earths from phosphogypsum, a residue generated by fertilizer production. Using an existing industrial residue as feedstock offers a different route to rare earth production from developing a conventional

mine. However, the material must still be processed, separated and converted into products that meet customer specifications.

Capacity figures across these projects are not directly interchangeable. Tonnes of feed material, mixed rare earth compounds and separated oxides represent different stages of the production chain. Actual saleable output depends on feed composition, recovery rates, product specifications and plant performance.

The Economics Beyond the Mine

Separation and refining add technical and commercial requirements to rare earth projects. Capital investment, energy and reagent consumption, recovery rates, product purity and the ability to sell individual product streams all affect operating



economics. The value of an offtake agreement also depends on its pricing formula, volume commitments, product specifications and provisions for delays or non-delivery.

The three examples represent different commercial arrangements and development stages. Serra Verde has a long-term agreement with price floors for mixed rare earth carbonate. Lindian has a binding offtake for a

specified mixed product alongside a separate proposed oxide-separation facility. Rainbow is pursuing technical development and prospective offtake through an MoU.

These arrangements can help connect projects to markets, but they do not make their economics equivalent. The decisive test is whether each operation can produce the required material consistently, meet contractual specifications and deliver it at a sustainable cost.

For the rare earth industry, announced capacity is only the starting point. Commercial supply depends on turning processing plans into reliable production—and converting that production into sales under contracts that work for both producer and buyer.



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Estonia's Rare Earth Magnet Milestone

Building a Resilient European Supply Chain

Europe's effort to diversify rare earth magnet production has taken a significant step in Estonia. On September 14, 2026, Neo Performance Materials announced commercial production at its permanent magnet facility in Narva, alongside its first commercial shipments of sintered rare earth magnets to a Tier 1 electric vehicle traction motor customer. The milestone moves the plant from qualification into commercial deliveries. It does not, however, mean Europe has secured a fully integrated supply chain.

WORDS BY SALINI KRISHNAN // DATA BY SKILLINGS RESEARCH

Neo reports multiple magnet programmes with three Tier 1 motor manufacturers. The company expects two to three additional programmes to enter commercial production before the end of 2026. These are targets, not confirmed production outcomes.

Narva's initial phase has a nameplate capacity of approximately 2,000 metric tonnes a year. Neo is developing plans for a Phase 1B expansion that would raise capacity to around 5,000 tonnes annually. These figures describe designed and planned capacity, not actual output. The first shipments show that the facility has passed an important customer qualification threshold.

The next test is whether it can increase production reliably while meeting demanding quality, delivery and cost requirements.

Connecting the Supply Chain

Estonia's role also extends to rare earth processing. In April 2026, Neo commissioned a small-scale heavy rare earth solvent-extraction line at its Silmet facility in Sillamäe.

The line produced terbium and dysprosium process solutions from mixed rare earth carbonate feedstock. These solutions are intermediate products for further



processing, not finished metals or magnet-ready alloys. Neo said it was working to achieve stable product purity before moving towards routine production.

Together, the facilities connect separation and magnet manufacturing within Estonia. But a small-scale processing line does not yet guarantee the volumes of heavy rare earths required for large-scale magnet production.

A resilient supply chain must link raw materials, separation, metal and alloy production, magnet manufacturing and component assembly. A bottleneck at any stage can constrain the entire system.

The Wider Capacity Gap

The International Energy Agency's 2026 outlook highlights the scale of the

challenge. Under its stated assumptions, existing and announced capacity outside China would meet less than 20% of projected rare earth magnet demand outside China in 2035. The IEA identifies magnet manufacturing as a key bottleneck in diversifying supply.

Narva's commercial shipments are therefore an important industrial milestone, but not proof of supply-chain resilience. Europe must still secure dependable feedstock, expand processing and manufacturing capacity, and deliver competitive products at scale.

Estonia has moved from plant development to commercial deliveries. Turning that progress into a reliable European supply chain will depend on whether every stage can grow together.

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ORE Sorting at *Scale*

What It Takes to Change a Processing Flowsheet

WORDS BY PENNY LANEFORD // DATA BY SKILLINGS RESEARCH

Ore sorting can reduce the volume of material entering a processing plant. But at mine scale, the technology must do more than reject waste. It must separate valuable material reliably, fit the flowsheet and improve the economics of the operation.

The principle is to remove low-value rock before it reaches energy-intensive processing stages. Depending on the deposit, sensor-based systems can identify differences in properties such as X-ray response, composition or colour. X-ray transmission (XRT), X-ray fluorescence (XRF) and optical sensors each have different applications. The right choice depends on the ore, particle size and whether the sensor can distinguish valuable material from waste at the required throughput. Potential benefits include lower grinding loads, reduced energy demand and more capacity for valuable material. However, these gains depend on how much waste can be rejected without losing too much metal.

The Ore Sets the Limits

Sorting performance begins with the feed. Mineralisation must be sufficiently distinguishable for the sensor to make useful decisions. Particle size, surface condition, fines, overlapping rocks and variations in mineralogy can all affect separation.

Testwork must use representative samples from across the orebody. A promising result from selected material may not hold across different grades, lithologies or mining domains. Engineers need to establish



grade-recovery relationships and determine whether the chosen technology can reproduce test results under industrial conditions.

A 2022 copper-porphyry study illustrates the challenge. Ideal laboratory XRF results indicated that about 40% of the feed mass could be rejected while maintaining copper recovery above 80%. Yet the study found no sorting potential using the industrial-scale sensor assessed. These findings apply to the study's specific ore and test configuration; they do not establish that industrial sorting is ineffective across other deposits.

Integration Changes the Flowsheet

Where sorting is installed determines its impact. Positioned after crushing and before grinding, it can reject waste before that material consumes milling capacity. Sorting a stream within an existing circuit may

offer a retrofit option, but can introduce additional handling and operational constraints.

For new projects, sorting can influence crusher, conveyor, mill and tailings design. Existing mines must also consider space, shutdown windows, equipment capacity and reject disposal. The sorter's rated throughput is only one factor: the complete circuit must accommodate screening, feed presentation, separation and material routing.

Recovery Determines the Economics

A high rejection rate is not necessarily a good result. If valuable minerals leave with the rejected material, lost revenue may outweigh processing savings.

Engineers must evaluate mass rejection, valuable-material recovery and the grade of the accepted stream

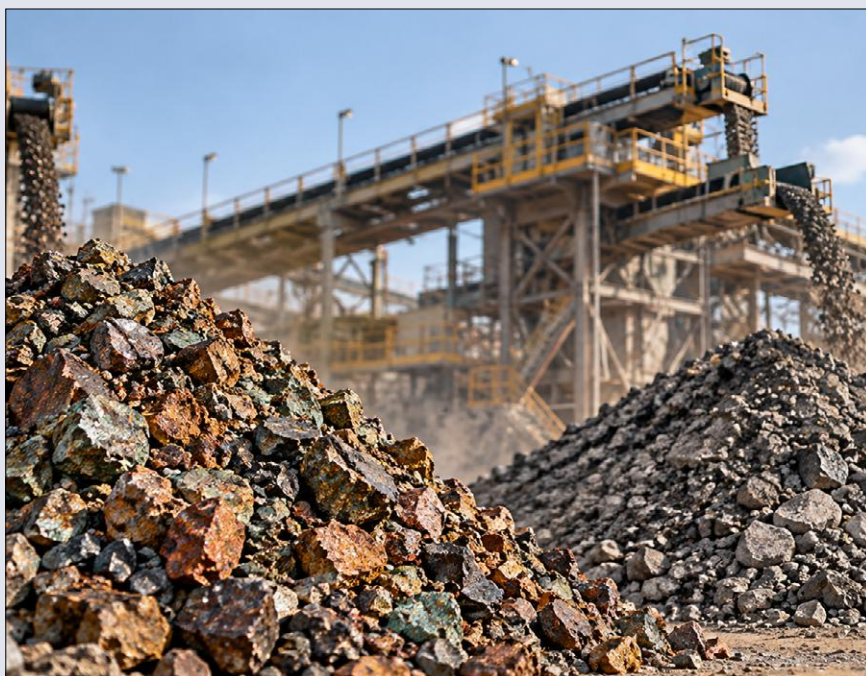
Evaluation Area	Evidence Required	Why It Matters
Feed characteristics	Representative samples across ore types, grades and particle sizes	Establishes whether the ore is sortable
Sensor performance	Results from the intended industrial sensor under realistic conditions	Tests whether separation can be achieved at scale
Mass rejection	Rejected mass at different sorting settings	Quantifies the reduction in plant feed
Valuable-material recovery	Assays of accepted and rejected streams	Measures the value lost during sorting
Plant integration	Throughput, screening, conveying and reject-handling design	Identifies bottlenecks and infrastructure needs
Operating performance	Availability, maintenance and response to variable feed	Tests reliability under mine conditions
Economic case	Capital and operating costs, savings, recovery losses and sensitivity analysis	Determines whether sorting improves project economics

together. Assays of both products are essential to establish a reliable mass balance.

The business case must include equipment, installation, operating costs, maintenance and reject handling. These costs should be compared with potential savings in energy and downstream processing, alongside any throughput benefits.

A published economic evaluation using data from Laos' Phu Kham copper-gold operation examines how sorting outcomes depend on factors such as cut-off grade, recovery and throughput. It provides a framework for assessing potential value, not evidence that a proposed sorting system was installed or achieved those benefits commercially.

Ore sorting earns its place when the whole operation benefits. The decisive measure is not how much waste is rejected, but how much value the mine retains after accounting for costs, recovery losses and the realities of operating at scale.



The Two Numbers That Define Sorting Performance

Ore sorting performance cannot be judged by waste rejection alone. Two measures must be considered together: mass rejection and valuable-material recovery.

Mass rejection is the proportion of feed diverted from the processing plant. A higher figure can mean less material needs to be crushed, ground or treated, potentially reducing costs or freeing plant capacity.

Recovery measures how much valuable material remains in the accepted stream. If too much metal is discarded with the rejects, savings from processing less rock may be offset by lost revenue.

Consider a hypothetical 100-tonne feed. A sorter rejects 30 tonnes, leaving 70 tonnes for

processing. The mass rejection is 30%. But this figure does not reveal how much valuable material was lost.

That requires assays of both the accepted and rejected streams. Engineers must establish the grade and quantity of valuable material in each, then calculate recovery across the sorting stage. Testing different settings reveals how rejection, recovery and product grade change together.

The optimum setting is not necessarily the one that rejects the most waste. It is the point where processing savings and capacity benefits outweigh lost value and sorting costs.

The test: measure both the material removed and the value that leaves with it.

Cariboo Gold: What a Final Investment Decision Means for the Road to Production

Osisko Gold Group has approved full-scale construction of its 100%-owned Cariboo Gold Project in central British Columbia, moving the development from pre-construction into its main build phase. The company is targeting first gold in the first quarter of 2029, followed by commercial production in the second half of the year. These remain scheduled milestones, not completed outcomes.



Osisko estimates the project's remaining capital requirement at C\$990 million from August 1, 2026. This is the go-forward obligation, not the project's total capital cost. The estimate includes a contingency and accounts for expected equipment financing, pre-production costs and revenue.

The company's funding plans include a US\$30 million strategic equity investment from a Trafigura affiliate. Trafigura has also agreed to purchase Cariboo's gold concentrate and doré during the first four years of production, subject to contractual terms.

Osisko has priced a US\$600 million senior

secured notes offering due in 2031. The proceeds are intended to refinance its existing Appian project financing facility and support Cariboo's development. The offering remains subject to closing conditions. A separate gold prepayment facility of up to US\$120 million has been proposed; it should not be treated as secured funding.

From Construction to Production

As of July 31, 2026, the project was reported to be 22% complete. Detailed engineering was approximately 40% complete, while procurement and commitments for long-lead items stood at about 44%. These figures provide a snapshot of progress at that date, rather than the

current status of every workstream.

The revised schedule allows approximately 30 months from August 2026 to first gold. Engineering, underground development, infrastructure construction and commissioning remain ahead.

The construction decision establishes a framework for completing the project, but it does not

remove the execution risks. The remaining capital must be deployed, construction milestones achieved and the plant commissioned before production can begin.

For Cariboo, the next test is delivery against the revised schedule. First gold in 2029 remains a company target; progress on construction and financing will determine whether that target is met.



AUTONOMY / ELECTRIFICATION

Load and Haul's ROBOT TIPPING POINT

WHEN AUTONOMOUS TRUCKS BECOME
THE DEFAULT, NOT THE PILOT

WORDS BY MO SHINE // DATA BY SKILLINGS RESEARCH

How autonomous haulage and electrification are changing fleet economics, equipment procurement and mine planning—and why power infrastructure and operating readiness will shape the next phase.

Mining has spent two decades asking whether haul trucks can drive themselves. The question now is how quickly mines can build their operations around autonomous haulage.

As of July 2026, 5,684 autonomous or autonomous-ready haul trucks were operating at surface mines worldwide, according to GlobalData. China accounted for 3,843, or about 68%. Komatsu commissioned its 1,000th FrontRunner autonomous ultra-class truck in April, while Caterpillar is targeting more than 2,000 Command for Hauling trucks by 2030.

Autonomous haulage has moved beyond pilot projects. Its next phase will depend on fleet economics, power availability and mine redesign.

The convergence of autonomy and electrification adds another layer. In suitable, high-utilisation environments, indicative models suggest lower energy and maintenance costs, but results depend on mine conditions and infrastructure. The technology is advancing. The operating model must catch up.

Autonomy and Electrification Converge

Autonomous systems can improve cycle-time consistency, reduce delays linked to shifts and operator availability, and provide continuous haul-cycle data. They can also reduce

exposure to certain vehicle-related hazards, subject to site-specific controls.

Battery-electric powertrains can reduce diesel use and, in suitable conditions, energy and maintenance costs. Combined with autonomous fleet management, they can connect vehicle movement, energy use, charging and production scheduling.

The value is therefore not simply removing the driver or replacing the powertrain. It is managing the truck as part of the wider mine system.

A Global Fleet, With China at the Centre

GlobalData's figures include both fully autonomous and autonomous-ready equipment, while vendor figures may refer to trucks commissioned, deployed or equipped with autonomous systems. They should therefore not be treated as a fully audited global census. Even so, deployments show that autonomous haulage is now operating at significant scale.

Chinese manufacturers are a major part of this expansion. Tonly reports more than 2,500 autonomous mining trucks, while LGMG has a growing presence in wide-body and new-energy mining vehicles.

For buyers, the expanding market means comparing OEM systems, independent autonomy

providers, retrofits, battery-electric trucks and trolley-assisted equipment—along with software ownership, data access, cybersecurity and long-term support.

Komatsu's Milestone—and the Battery-Electric Distinction

Komatsu's 1,000th FrontRunner truck, a 930E-5AT deployed at Nevada Gold Mines, has a rated payload of approximately 290 tonnes.

However, the 930E is an electric-drive truck, not a battery-electric truck. It uses traction motors but is not powered by onboard batteries. Ultra-class haulage continues to rely on diesel-electric architectures and, in some applications, trolley assist.

Full battery-electric operation requires new energy architecture, charging strategies and production planning. Payload, route length, gradient and charging time all affect the equation.

Why Mid-Size Trucks Are Moving Into Focus

Battery-electric autonomous deployments are gaining ground in mid-size and wide-body classes, where routes and charging can be easier to manage.

EACON reported more than 1,500 battery-electric mining trucks using its autonomous solution by September 2026, up from about 800 in March. Its wider autonomous fleet exceeded 3,500 trucks.

Deployments include coal and high-altitude copper operations, showing that battery-electric autonomy is moving beyond controlled demonstrations.

The Economics Depend on the Mine

An indicative 10-year model for a high-utilisation surface mine suggests battery-electric autonomy could reduce energy costs by about 55% and maintenance costs by around 25%. Under favourable conditions, estimated total-cost-of-ownership savings are approximately US\$2.5million-US\$3.2 million per truck, with potential payback in less than 3.5 years.

These are scenario-based estimates, not guarantees. Results depend on payload, haul distance, energy prices, labour, battery replacement, gradients, charging infrastructure and utilisation.

The business case should therefore consider cost per tonne, availability, energy use, productive hours and total fleet-support costs, not purchase price alone.

The Grid Becomes Part of the Mine Plan

Electric fleets can require major investment in substations, transformers, grid connections, chargers and energy-management systems.

Charging must also fit the production schedule. Peak demand, charging queues, battery state,

China's Autonomous Truckmakers Reshape the Market

China's mining-equipment manufacturers have become a major force in autonomous haulage, expanding the choices available to mine operators evaluating new fleets.

Market tracking cited in the supplied cover-story material places Tonly and LGMG among the leading companies by autonomous truck population. Tonly reports more than 2,500 autonomous mining trucks operating in active mines. LGMG's autonomous fleet total is less openly disclosed, but the company has a significant presence in wide-body dump trucks and new-energy mining vehicles.

Their growth is supported by a domestic industrial ecosystem that brings together truck manufacturing, battery suppliers, autonomous-driving integrators and large mining operations. Factory-integrated technology and high-volume deployment can help shorten the path from equipment production to operational use.

For international buyers, the expanding supplier base creates more options—but also a broader set of questions. Software ownership, data access, cybersecurity, spare-parts availability, service support, regulatory acceptance and long-term warranties all require scrutiny.

The procurement decision is no longer only about the truck. It is also about the technology and support ecosystem behind it.



AUTONOMOUS HAULAGE: TECHNOLOGY COMPARISON TABLE

Factor	Conventional Diesel	Diesel-Electric / Trolley Assist	Battery-Electric Autonomous
Energy source	Diesel fuel	Diesel fuel; trolley systems use electricity on equipped haul routes	Onboard battery charged through charging infrastructure
Automation	Typically operator-driven; automation can be added	Can be integrated with autonomous haulage systems	Autonomous operation can be integrated with battery-electric propulsion
Infrastructure	Fuel storage, refuelling and maintenance facilities	Diesel infrastructure plus trolley lines and supporting electrical systems where used	Charging stations, electrical connections, grid capacity and charging management
Energy considerations	Exposed to diesel consumption and fuel-price changes	Potential to reduce diesel use on trolley-equipped sections; benefits depend on route and system design	Electricity costs, battery capacity, charging time and energy-management requirements
Operational considerations	Established operating model, with driver availability and shift arrangements	Route suitability and trolley infrastructure can influence deployment	Charging schedules, fleet dispatch, battery performance and charging queues must be coordinated
Potential advantage	Uses established mine infrastructure and operating practices	Can reduce diesel consumption on suitable haul routes	Potential to combine autonomous operation with reduced diesel use and lower operating costs
Investment question	What are the fuel, maintenance and labour costs over the truck's operating life?	Do route conditions and expected diesel savings justify trolley infrastructure?	Can expected productivity and operating-cost benefits justify the truck, battery, charging and electrical infrastructure investment?

power interruptions and blasting schedules can affect fleet availability. Autonomous fleet-management systems can coordinate charging with dispatch and production, but software cannot overcome physical grid limitations.

Electrical infrastructure must therefore be planned alongside equipment procurement and mine design.

The Final Barrier Is Organizational

Autonomous haulage also requires changes to workforce arrangements, maintenance, dispatch, emergency response, cybersecurity and regulatory compliance.

New skills will be needed in remote supervision, autonomy maintenance, battery and high-voltage systems, and data analysis.

Procurement teams must also assess software integration, data access and long-term support. Before ordering the next fleet, operators need a clear business case, suitable power infrastructure and defined technology requirements.

The Next Fleet Decision

By July 2026, the global autonomous or autonomous-ready surface-mine truck count had reached 5,684. Komatsu had commissioned its 1,000th FrontRunner, Caterpillar was targeting more than 2,000 Command for Hauling trucks by 2030, and EACON had reported more than 1,500 battery-electric autonomous trucks.

Adoption will vary by mine and payload class. Ultra-class fleets face major energy and infrastructure challenges, while mid-size trucks may offer more manageable routes to battery-electric adoption. Diesel-electric and trolley-assisted systems will remain part of the mix.

The question is no longer simply whether autonomous trucks can haul material. It is whether mines can capture their potential benefits while managing the required cost, infrastructure and organisational changes.

The robot may be ready for the job. The next decision belongs to the mine.

Can Industry Reduce Its Dependence on Chinese Supply?

Aerospace manufacturers are exploring alternatives to rare-earth-based thermal barrier coatings used in jet engines. The goal is to reduce reliance on concentrated Chinese supply chains without compromising the performance of materials exposed to extreme heat.

The National Research Council of Canada and industry partners are evaluating ceramic materials, including zirconia-based formulations, as potential alternatives.

Oerlikon Metco has also developed rare-earth-free coating products and is working on additional formulations using zirconia with magnesium or calcium oxides. These efforts point to possible alternatives, but they do not yet establish that existing coatings can be replaced across aerospace applications.

The Chemistry Behind Substitution

Zirconia is not automatically rare-earth-free. Conventional yttria-stabilised zirconia (YSZ), widely used in thermal barrier coatings, contains yttrium. Replacing it therefore requires more than changing the base material: the stabilising chemistry must also change.

That distinction matters because coating performance depends on the properties of the complete formulation. Yttria helps give zirconia the stability required for demanding applications. Alternative additives may reduce reliance on rare earths, but they must also provide the thermal protection and durability required in service.

A promising laboratory result is only an early step. Any replacement must demonstrate reliable performance under operating conditions and meet the requirements for its intended aerospace application.



A Targeted Route to Supply Diversification

The potential impact is specific. If alternative coatings qualify and gain adoption, they could reduce demand for selected rare-earth inputs. However, the available evidence does not quantify that reduction or show that these materials can replace rare earths across aerospace systems.

For mining and materials producers, substitution is another factor

shaping future demand. Its effect will depend on the materials displaced, the applications that adopt alternatives and the scale of commercial use.

The critical milestone is qualification, not discovery. Until alternatives demonstrate performance and achieve wider adoption, they remain a potential means of reducing supply exposure—not a substitute for diversified rare-earth production and processing.



THE RELIABILITY BUSINESS

Can Mining Services Deliver Measurable Uptime?

WORDS BY CHARLES PITTS // DATA BY SKILLINGS RESEARCH

Mining equipment manufacturers increasingly compete on more than machine performance. Maintenance agreements, component support and equipment-monitoring services promise to keep fleets operating for longer. For mine operators, the value is clear: fewer unexpected failures, more productive hours and greater control over maintenance costs.

But reliability is not established by a headline percentage. Operators need to know what improved, how the result was measured and whether the gains can be sustained.

Measuring What Matters

Equipment availability is not the same as production. A machine can be mechanically ready but remain idle while waiting for a truck, operator or downstream process.

Likewise, shorter loading cycles do not automatically mean less maintenance downtime. A credible assessment separates mechanical availability, unplanned downtime, failure frequency, repair duration and production rate. It also establishes a baseline and defines which machines and operating hours are included. Without consistent definitions, results from different sites cannot be compared reliably.

What the Quellaveco Case Shows

A Caterpillar programme at Anglo American's Quellaveco copper mine in Peru illustrates how technology and operational practices can work together. In its published case study, Caterpillar reported that boom-jack events on rope shovels fell by more than 80% per month. The programme combined its Operator Assist technology with operator training and site-level engagement.



Caterpillar also reported a 36% decrease in shovel loading-cycle time, a 15% decrease in truck idle time around the shovel, a 5% increase in shovel fill factor and a 7% increase in production rate. These are supplier-reported results from one operation, not independently audited findings or guaranteed outcomes for other mines.

The metrics describe different effects. The reduction in boom-jack events is not an 80% reduction in total equipment downtime. Nor do shorter loading cycles, by themselves, establish an equivalent increase in mine-wide production. The case demonstrates the potential of a combined improvement programme, but does not quantify its financial return.

A Service Commitment Actually Guarantees

Caterpillar's mining Customer Value Agreements offer configurable support covering planned maintenance, components, powertrain services and equipment-health management. The company describes these agreements as a way to support fleet uptime and provide cost controls; the precise coverage depends on the selected agreement.

Caterpillar also advertises a Services Commitment for eligible Customer Value Agreements that includes next-day parts availability and two-business-day repairs for qualifying common repairs. If the commitment is missed, the stated remedy is payment in Cat Credits or a dealer voucher. The published

terms specify that coverage depends on eligibility, dealer participation and applicable conditions; major repairs may require separate terms. This is a defined service commitment, not a blanket guarantee of mining-equipment uptime.

That distinction matters. A parts-availability promise is not the same as a machine-availability guarantee. A repair-time commitment applies only within its stated scope, and the remedy may not compensate a mine for the full value of lost production.

Turning Reliability into Value

Mine operators should examine the contract's covered equipment, response times, exclusions, performance measures and remedies. They should also ask whether claimed improvements were measured across the full

fleet, against a credible baseline and over a representative period.

The commercial test is whether recovered operating time can be used productively—and whether the value of that time exceeds the cost of the service, parts and labour. Supplier case studies can identify potential benefits, while contract terms establish specific obligations. Neither alone proves the financial return for every operation.

Uptime becomes a business outcome when it is defined, measured against a credible baseline and sustained in operation. Mining services can help deliver that outcome, but the evidence must show not only that equipment stopped less often, but that the improvement created measurable value for the mine.





LOWER GRADES / HIGHER PROCESSING COSTS

The **IRON** **ORE** *Squeeze*

As grades fall, the battle for profitability moves inside the processing plant.

Declining ore grades are forcing iron ore producers to process more material for every tonne of saleable iron. With energy-intensive grinding, water use and tailings adding to the cost burden, the industry is rethinking how ore is crushed, ground and upgraded. From HPGR and vertical roller mills to early waste rejection, the next cost advantage may be won not at the mine face, but inside the concentrator.

WORDS BY SONNY JIMERSON // DATA BY SKILLINGS RESEARCH

The next iron ore cost crisis may not begin at the mine face. It may begin inside the concentrator. As head grades decline, producers must process more ore to recover the same amount of iron. This increases the load on crushing, grinding, separation and tailings systems – driving up equipment, electricity, water and operating costs. The challenge becomes greater when lower-grade ore is also harder or requires finer grinding to liberate iron-bearing minerals. Comminution is central to this cost burden. The supplied source estimates that energy can approach 40% of total processing costs at some operations, while grinding can account for 50-70% of plant power demand.

The industry is therefore focusing on the entire processing flowsheet. HPGR, vertical roller mills (VRM), stirred mills, advanced classification and early waste rejection offer different ways to reduce energy and water consumption. Their effectiveness depends on ore mineralogy, liberation requirements and operating conditions.

The Grade Problem Begins with the Resource

Grade decline is a resource-management challenge, not simply a market-cycle issue. As operations mature, producers may need to process more marginal material to sustain output. At the same time, steelmakers supplying pelletizing and direct-reduced iron (DRI) plants are placing greater emphasis on product grade and impurity levels.

This creates a difficult equation: higher-quality iron products may command greater value, while the ore available to producers becomes more expensive to upgrade.

Magnetite can produce high-grade concentrates suited to pellet and DRI applications, but typically requires grinding and magnetic separation to liberate iron from gangue. Fine grinding and additional separation stages can increase energy use and plant complexity.

Hematite may sometimes require simpler processing, but low-grade or finely interlocked

hematite can also demand intensive beneficiation. The processing route must therefore be matched to the ore characteristics.

More Tonnes Through the Same Plant

The effect of declining grade can be illustrated simply. An operation targeting 300 million tonnes of contained iron would require about 1.0 billion tonnes of feed at a 30% iron head grade, before recovery losses. At

ties and product specifications, but shows how a five-percentage-point grade decline increases material-handling requirements. If the ore also becomes harder or requires finer liberation, energy demand can rise beyond the increase in tonnage alone.

A Different Approach to Comminution

No single machine is a universal solution. The circuit must be designed around the ore and re-

classification in a dry circuit. They may be useful where water is constrained, but performance depends on feed characteristics, product fineness, wear and circuit design.

Stirred mills are suited to fine and ultrafine grinding, including concentrate regrinding and silica reduction. They can be more energy efficient than conventional ball milling at fine sizes, but generally operate wet and require grinding media.

The key decision is therefore not which technology is universally better, but which combination delivers the required concentrate grade and recovery at the lowest lifecycle cost.

Reject Waste Before Grinding

Another opportunity is to remove waste before fine grinding. Where ore sorting, coarse magnetic separation or similar methods can reliably separate waste from valuable material, less mass enters the most energy-intensive stages. This can reduce grinding demand, tailings volumes and downstream equipment load.

Early rejection requires reliable ore characterisation and process control, with geology, mine planning and processing teams working from a shared understanding of mineralogy and ore texture.



25% grade, the requirement rises to 1.2 billion tonnes – a 20% increase.

That additional material must be crushed, conveyed, ground, classified and separated, while also increasing concentrate and tailings handling. The example excludes recovery, dilution, moisture, impuri-

qu coast product size. HPGR uses interparticle compression and can reduce downstream grinding energy in suitable applications. It can also support dry or hybrid processing, although later stages may still require water.

VRMs combine grinding with potential drying and

The same systems approach applies to water and tailings. Dry or hybrid processing may reduce water demand and support filtered tailings, but filtration, dust control, handling and dry-stack construction introduce their own costs.

Measure the Value That Leaves the Plant

Declining grades make it increasingly important to measure performance against saleable concentrate, not simply tonnes of feed.

Project economics must account for head grade, ore competency, liberation size, electricity prices, product premiums and future plant modifications. A higher-grade product may command a premium, but that

value must be assessed against grinding, separation, dewatering, pelletizing and transport costs. Operators should also consider whether the plant can accommodate different technologies as ore conditions change. Space, power capacity and material-handling flexibility can influence future upgrade costs.

The central question is no longer simply how much ore a plant can process, but how efficiently it can convert changing ore into a consistent, saleable product.

Grade decline increases the amount of material that must be handled. Harder ore and finer liberation can make each tonne more energy intensive. Together, these

pressures place the concentrator at the centre of iron ore cost competitiveness. The response will vary by deposit, but the principle is consistent: reject waste earlier, match grinding technology to the ore, and evaluate the circuit by the quality and quantity of concentrate it produces.

As ore grades fall, the cost curve will increasingly be shaped inside the processing plant.

Source basis: Supplied cover-story draft. Figures and technology-performance ranges are retained as presented and should be independently verified before publication.

The Grinding Technology Decision: One Circuit, Different Jobs



HPGR, vertical roller mills and stirred mills are not interchangeable. Their value depends on where they fit in the processing circuit.

The push to reduce iron ore processing costs has brought renewed attention to the equipment used to break ore down to the size required for separation. But comparing grinding technologies using a single energy-efficiency figure can be misleading.

High-pressure grinding rolls (HPGR) use compression between counter-rotating rolls. In suitable circuits, they can reduce comminution energy and lower the burden on downstream

grinding. They are particularly relevant to coarse and intermediate size reduction, including some hard-ore and magnetite applications.

Vertical roller mills (VRMs) grind material between rollers and a rotating table. Depending on configuration, they can combine grinding, drying and classification. Their dry-processing potential may be useful where water availability is a constraint, though feed variability, wear and product-size requirements remain important design considerations.

Stirred mills serve a different role. They are

used for fine and ultrafine grinding, including concentrate regrinding and applications where additional liberation or silica reduction is needed. They can offer energy advantages at fine sizes, but generally operate with slurry and grinding media.

The technologies should therefore be assessed as parts of a system. A circuit may use one technology for coarse breakage and another for final grinding, depending on the ore and the target concentrate.

The key comparison is not simply the energy consumed by each machine. It is the energy, water, media and capital required to produce a tonne of saleable concentrate at the required grade and recovery.

AT A GLANCE

These are general applications, not a universal equipment ranking. Actual performance depends on ore characteristics and circuit design.

Source basis: supplied cover-story draft. The source includes indicative energy-saving ranges for these technologies; those ranges should be checked against original technical studies and comparable operating conditions before publication.

What Does Public Funding Unlock?



Public funding has helped Generation Mining assemble the financing structure for its Marathon Copper-Palladium Project in northwestern Ontario. On September 14, 2026, the company announced C\$340 million in financing components, including commitments from the Canada Growth Fund (CGF) and Canada Infrastructure Bank (CIB). The wider construction financing package is valued at approximately C\$1.3 billion.

How the Funding Fits Together

The C\$340 million comprises a C\$200 million bought-deal share offering, a C\$40 million private placement by CGF and C\$100 million in subordinated convertible notes. CGF's commitments include approximately C\$90 million in common shares across the equity financing and C\$50 million in convertible notes. CIB committed the remaining C\$50 million in notes. The bought deal and

private placement closed on September 21. The convertible-note financing remains subject to required shareholder and regulatory approvals.

The wider package also includes previously announced debt, an undrawn metal-streaming facility and estimated equipment leasing. It incorporates a C\$185 million cost-overrun facility and C\$119 million in project capital-cost contingency. These are distinct financing and risk-management components—not C\$1.3 billion of unrestricted cash immediately available for construction.

Financing Is Not Production

Generation Mining said its board was expected to make a final investment decision after completion of the remaining financing steps. The company has targeted early works construction in the fourth quarter of 2026. The financing announcement

therefore marks a development milestone, not a final investment decision or evidence that construction is underway.

Ontario has separately signed a non-binding term sheet for a loan of up to C\$11 million through its Critical Minerals Processing Fund. The proposed support is tied to eligible project expenditures and maintaining a minimum employment level. Final documentation and conditions remain outstanding; the loan is separate from the C\$1.3 billion package.

Public capital has helped structure Marathon's proposed financing and support participation by other funders. Whether that financing translates into a producing mine will depend on completing the remaining requirements, reaching a final investment decision and delivering the project.



Underground Copper Expansion

The Equipment, Development and Production Challenge

Expanding an underground copper mine is a coordinated engineering challenge. New production areas require access development, ground support, specialised equipment and infrastructure capable of moving ore to the processing plant. At every stage, delays or capacity constraints can limit the benefits of investment elsewhere in the system.

WORDS BY SALINI KRISHNAN // DATA BY SKILLINGS RESEARCH



BHP's Carrapateena operation in South Australia illustrates this complexity. The company is advancing a block-cave expansion designed to extend the mine's life beyond its existing sublevel cave and increase throughput to as much as 12 million tonnes per annum (Mtpa). Completion of the decline to the base of the block cave marked a significant development milestone. However, underground infrastructure development and preparation for production remain distinct stages, with block-cave ramp-up scheduled for FY2030.

Development Before Production

Block caving involves undercutting an orebody so that rock fractures and collapses under gravity. The broken ore is collected through drawpoints and transferred into the mine's haulage and conveying network. Before production can ramp up, the required extraction areas and supporting infrastructure must be prepared.

This sequence demands coordinated drilling, blasting, ground support and installation of underground services. Ventilation, power and communications must support workers and machinery as development advances. The availability and productivity of development equip-



ment influence how quickly access and production areas can be completed.

The challenge is not simply to deploy more machines. Equipment must be suited to the work sequence and underground conditions. Faster excavation has limited value if haulage, conveying or processing cannot accommodate the resulting flow of ore.

From Mine to Processing Plant

Carrapateena's existing sublevel-cave operation provides the baseline for the expansion. BHP has been investing in process-

ing capacity to lift throughput from this operation to approximately 7 Mtpa. The planned increase to as much as 12 Mtpa relates to the subsequent block-cave expansion. These figures describe different stages of the mine's development, not competing targets for the same operating phase.

A separate potential expansion is also under study. In September 2026, BHP awarded Worley study and engineering, procurement and construction management services for a potential expansion of Carrapateena's underground operations and processing infrastructure.

The scope includes underground mining, materials handling and concentrating facilities. This potential project remains subject to a final investment decision and is distinct from the existing block-cave development.

Reliability Is Part of the Production Challenge

The importance of materials handling was highlighted by an underground conveyor-belt failure at Carrapateena in July 2026. BHP said replacement work was expected to affect mine production for up to eight weeks. The incident illustrates how a failure in a critical compo-

nent can constrain output, even when other parts of an operation remain available. It does not, by itself, establish a persistent reliability problem.

Carrapateena's expansion will depend on aligning underground development, equipment availability, ore transport and processing capacity. The objective is not merely to reach a higher mining rate, but to sustain material flow through the entire operation. In underground copper mining, additional capacity becomes productive only when every connected stage is ready to support it.



SECURING THE AUTONOMOUS MINE

WORDS BY MO SHINE // DATA BY SKILLINGS RESEARCH



As mining equipment becomes more connected, cybersecurity is emerging as a core requirement for operational resilience.

Autonomous mining depends on more than intelligent machines. It relies on secure communications, trusted data and software that can be maintained throughout the equipment lifecycle. Sandvik's latest cybersecurity certification highlights the role of secure engineering—but protecting an autonomous mine requires coordinated action across equipment, networks and operations.

An autonomous haul truck is not an isolated machine. It operates within a digital ecosystem of onboard sensors, control systems, fleet-management software, communications networks and mine-site infrastructure.

These connections allow equipment to exchange data and coordinate operations. They also create potential points of exposure. A cybersecurity incident affecting connected systems could compromise data integrity or system availability, with consequences for production and business continuity.

The Global Mining Guidelines Group (GMG) identifies cybersecurity as a consideration throughout autonomous-system selection, implementation and operation. Its guidance addresses access management, secure communications, software updates and the need to manage security across connected systems.

The challenge is not simply to secure an individual truck. It is to protect the interfaces between machines, networks, software and people.

Security Built Into the Product

Sandvik's September 2026 certification milestone illustrates how manufacturers are addressing cybersecurity during product development.

The company achieved IEC 62443-4-1 Maturity Level 3 (ML3) certification for its Mining Secure Development Lifecycle, advancing from Level 2, achieved in 2025. The assessment was supported by evidence from Sandvik Intelligent Control Architecture (SICA), the common control-system platform used across Sandvik's i-series mining equipment.

IEC 62443-4-1 addresses secure product-development processes.

Sandvik says the ML3 certification validates that cybersecurity practices are systematically applied in day-to-day product development. The standard covers lifecycle requirements including security definition, design, implementation, verification, defect management and patch management.

The scope is important. The certification covers Sandvik Mining's Secure Development Lifecycle, practised through SICA. It should not be interpreted as certification of every Sandvik machine, autonomous haulage system or mine-site network.

The achievement follows Sandvik Mining's ISO/IEC 27001 certification in May 2026 for its information-security management system supporting global application delivery. The two certifications address complementary areas: secure product development and information-security management.

The Mine Site Is the Other Half

Securely developed equipment must still operate within a well-managed site environment. Network separation, controlled access, secure remote connections and disciplined software updates can help reduce exposure and limit the impact of an incident.

Responsibility is shared. OEMs develop and maintain products; integrators connect systems; mine operators manage site networks, access rights, updates and incident response. Remote support and third-party connections deserve particular attention because they cross organisational boundaries.

AI introduces further considerations. The integrity of input data, software and model updates can matter to AI-enabled functions. These are potential security concerns, not evidence that a particular mining AI system has been compromised.



WHAT SANDVIK'S ML3 CERTIFICATION COVERS - AND WHAT IT DOESN'T

Sandvik's IEC 62443-4-1 Maturity Level 3 certification concerns its secure product-development lifecycle. The company advanced from Level 2, achieved in 2025, to ML3 in September 2026. The assessment was supported by evidence from Sandvik Intelligent Control Architecture (SICA). The standard addresses how cybersecurity is incorporated into the processes used to develop and maintain industrial automation and control-system products. Sandvik says the certification validates the systematic application of security practices throughout day-to-day product development. The scope, however, is not every machine or mine-site deployment. The certification applies to Sandvik Mining's Secure Development Lifecycle, practised through SICA. It does not establish that every Sandvik product has been individually certified, nor does it guarantee immunity from cyber incidents.

For mine operators, the milestone provides information about a supplier's engineering processes. It remains one part of a broader assessment that must also consider site infrastructure, system configuration, access controls and ongoing maintenance.

The distinction: Secure product development strengthens the foundation. It does not, on its own, secure the entire mine.

THE CYBERSECURITY QUESTIONS EVERY MINE SHOULD ASK

Cybersecurity planning for autonomous equipment should begin before installation and continue throughout its operating life. Guidance from the Global Mining Guidelines Group highlights security considerations across system selection, implementation and operation.

01



Access control

Are user identities verified and permissions limited to each role's requirements?

02



Network & remote access

Are operational systems segmented appropriately, and is OEM/contractor access controlled?

03



Software updates

Who approves, tests and deploys patches and upgrades?

04



Vulnerability & recovery

How are security issues reported, assessed and resolved, and are procedures in place to restore systems after an incident?

05



Supplier & site governance

Are security responsibilities clear across OEMs, integrators and mine operators, and included in procurement, commissioning and operational reviews?

Cybersecurity, AI performance and functional safety require separate assessments.

Resilience by Design

For mining companies, cybersecurity belongs in procurement, commissioning and lifecycle planning—not as

an afterthought once equipment is operating.

Questions about vulnerability reporting, update management, access rights and recovery procedures should be addressed with suppliers before deployment and reviewed as systems evolve. Autonomous mining

promises new ways to move material and manage operations.

Realising those benefits depends on keeping the digital systems behind the machines dependable. In the connected mine, cybersecurity is not separate from operational resilience. It is one of its foundations.

2025 GLOBAL CRUDE STEEL PRODUCTION TOTALS

Total world crude steel production was 1,849.4 Mt in 2025.

Rank	Country	2024	2023	%2024/2023
1	China	960.8	1005.1	-4.4
2	India	164.9	149.4	10.4
3	United States	82.0	79.5	3.1
4	Japan	80.7	84.0	-4.0
5	Russia (e)	67.8	71.0	-4.5
6	South Korea	61.9	63.6	-2.8
7	Türkiye	38.1	36.9	3.3
8	Germany	34.1	37.3	-8.6
9	Brazil	33.3	33.9	-1.6
10	Iran (e)	31.8	31.4	1.4
11	Viet Nam	24.7	22.0	12.2
12	Italy	20.7	20.0	3.6
13	Indonesia (e)	19.0	18.6	1.9
14	Taiwan, China (e)	17.1	19.2	-10.8
15	Mexico (e)	13.5	14.3	-5.9

Rank	Country	2024	2023	%2024/2023
16	Spain (e)	12.0	11.9	0.7
17	Canada (e)	11.5	12.3	-7.2
18	Saudi Arabia	10.8	9.6	12.3
19	Egypt	10.6	10.7	-0.8
20	France (e)	9.8	10.8	-8.7
21	Malaysia (e)	9.0	9.0	-0.2
22	Austria	7.6	7.1	5.9
23	Ukraine	7.4	7.6	-2.2
24	Poland (e)	7.2	7.1	0.8
25	Belgium (e)	7.2	7.1	0.5
26	Netherlands	6.5	6.4	1.4
27	Algeria (e)	5.3	4.5	17.9
28	Australia	5.2	4.7	12.1
29	Thailand (e)	5.0	4.9	2.6
30	Bangladesh (e)	4.5	4.5	0.0

Rank	Country	2024	2023	%2024/2023
31	South Africa	4.5	4.7	-4.7
32	Kazakhstan	4.3	4.2	2.2
33	Argentina	4.0	3.9	4.2
34	Sweden	4.0	4.0	-0.7
35	United Arab Emirates	3.8	3.7	3.3
36	Finland	3.7	3.7	2.1
37	Slovakia (e)	3.7	3.9	-5.6
38	Pakistan (e)	3.6	4.1	-12.2
39	Iraq (e)	3.0	3.0	0.3
40	Oman (e)	3.0	3.0	0.0
Others		41.8	44.1	-5.3
World		1849.4	1886.8	-2.0

e – annual figure estimated using partial data or non-worldsteel resources. * The world total production figure in this table includes estimates of other countries that only report annually.

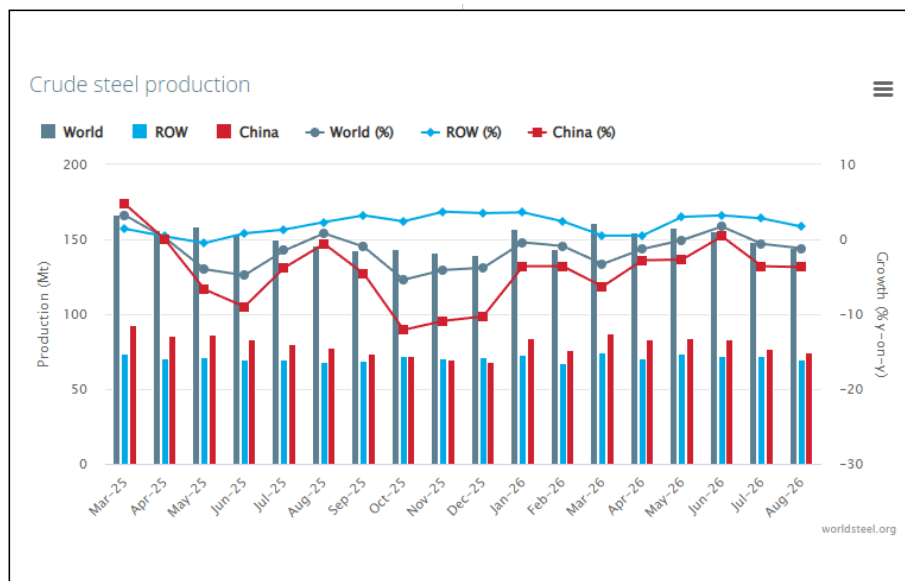
Source – World Steel Association. 2025 Steel Statistical Yearbook published

AUGUST 2026 CRUDE STEEL PRODUCTION

World crude steel production for the 70 countries reporting to the World Steel Association (world-steel) was 144.2 million tonnes (Mt) in August 2026, a 1.2% decrease compared to August 2025.

Africa produced 2.1 Mt in August 2026, up 8.8% on August 2025. Asia and Oceania produced 106.7 Mt, down 1.4%. The EU (27) produced 8.9 Mt, down 1.0%. Europe, Other produced 3.8 Mt, up 1.2%. The Middle East produced 3.7 Mt, down 4.6%. North America produced 9.4 Mt, up 3.9%. Russia & other CIS + Ukraine produced 6.3 Mt, down 5.6%. South America produced 3.4 Mt, down 4.9%.

The 70 countries included in this table accounted for approximately 98% of total world crude steel production in 2025. Africa, Asia and Oceania, European Union (27), Europe, other, Middle East, North America, Russia & other CIS + Ukraine, South America.



TOP 10 STEEL-PRODUCING COUNTRIES

China produced 74.6 Mt in August 2026, down 3.7% on August 2025. India produced 14.8 Mt, up 4.6%. The United States is estimated to have produced 7.3 Mt, up 3.0%. Japan produced 6.7 Mt, up 0.4%. Russia is

estimated to have produced 5.5 Mt, down 0.3%. South Korea produced 5.4 Mt, up 2.6%. Türkiye produced 3.4 Mt, down 0.4%. Germany produced 2.6 Mt, up 1.7%. Brazil produced 2.7 Mt, down 6.2%. Viet Nam produced 2.7 Mt, up 36.4%.

TABLE 1. CRUDE STEEL PRODUCTION BY REGION

	JUN 2026 (MT)	% CHANGE JUN 26/25	JAN-JUN 2026(MT)	% CHANGE JAN-JUN 26/25
Africa	2.1	8.8	16.7	9.4
Asia and Oceania	106.7	-1.4	906.4	-0.9
EU (27)	8.9	-1.0	84.5	-0.3
Europe, Other	3.8	1.2	29.5	4.8
Middle East	3.7	-4.6	33.3	-7.8
North America	9.4	3.9	75.3	5.2
Russia & other CIS + Ukraine	6.3	-5.6	52.0	-5.7
South America	3.4	-4.9	27.5	-0.7
Total 70 countries	144.2	-1.2	1,225.2	-0.7

TABLE 2. TOP 10 STEEL-PRODUCING COUNTRIES

	JUN 2026 (MT)	% CHANGE JUN 26/25	JAN-JUN 2026 (MT)	% CHANGE JAN-JUN 26/25
China	74.6	-3.7	651.9	-3.1
India	14.8	4.6	115.9	6.0
United States (e)	7.3	3.0	57.5	5.5
Japan	6.7	0.4	54.0	-0.2
Russia (e)	5.5	-0.3	43.8	-5.1
South Korea	5.4	2.6	42.8	2.8
Türkiye	3.4	-0.4	26.6	6.8
Germany	2.6	1.7	23.9	6.3
Brazil	2.7	-6.2	21.8	-1.8
Viet Nam	2.7	36.4	20.6	29.1

The 70 countries included in this table accounted for approximately 98% of total world crude steel production in 2025. Africa: Algeria, Egypt, Libya, Morocco, South Africa, Tunisia, Asia and Oceania: Australia, China, India, Japan, Mongolia, New Zealand, Pakistan, South Korea, Taiwan (China), Thailand, Viet Nam, European Union (27): Austria, Belgium, Bulgaria, Czechia, Finland, France, Germany, Greece, Italy, Luxembourg, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Europe, Other: Macedonia, Norway, Serbia, Türkiye, United Kingdom, Middle East: Bahrain, Iran, Iraq, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, Yemen North America: Canada, Cuba, El Salvador, Guatemala, Mexico, United States, Russia & other CIS + Ukraine: Belarus, Kazakhstan, Russia, Ukraine, South America: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela



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