MINING & METALS / MID-YEAR OUTLOOK

The Mining Industry *2026 Outlook* by C3

The energy transition runs on metal, and the world is racing to mine more of it. Yet the same copper, lithium and iron the economy now depends on carry a carbon cost that is no longer invisible. From 2026 the EU, through CBAM, prices the emissions embedded in steel and aluminium, and every battery is graded on its footprint. The cleaner tonne earns a premium; the higher-carbon tonne is marked down or shut out. The difficulty is structural. Mines must cut their Scope 1 emissions for the downstream partners who inherit them as Scope 3, but enabling that is the challenge. This report maps that challenge and the solutions to it: where mining's carbon really sits, the levers that cut it fastest, and how the value of a cleaner tonne can reach the producers who deliver it.

CARBON3 GLOBAL PTE. LTD. / SINGAPORE JUNE 2026 / CARBON3.NET

THE ONE-PAGE THESIS

The mining industry's *carbon problem*.

Digging the ore is not the carbon problem. At the mine gate, non-coal mining is barely half a percent of global emissions. The carbon shows up later, when ore is smelted and refined into metal. By then the metals it feeds are close to a quarter of all industrial CO_2.

In 2026 that downstream carbon finally gets a price. The EU border levy (CBAM) puts a cost on high-carbon imports, and every EV battery carries a carbon grade. The dirty tonne now pays a penalty; the cleaner one avoids it and earns a premium. But the cut is made at the mine, while the buyer downstream captures the value. Carbon3 connects the two: it splits each verified mine-gate reduction into units shared across the buyers who carry the bill, each counted once.

0.54

% OF GLOBAL EMISSIONS

what non-coal mining actually emits at the gate. Mining of transition minerals is not a major carbon source.

ICMM / Wood Mackenzie GHG Dataset, 2026 (~1,700 facilities).

~11

% OF GLOBAL CO_2

Mining adds 3% and processing 8%, making the metals system the world’s 6th-largest carbon source.

ICMM / Wood Mackenzie, 2026; IEA ETP.

1 Jan 2026

CBAM GOES LIVE

the EU border carbon levy enters its definitive period; first certificates surrendered Sept 2027. Metal with embedded carbon now priced.

CBAM, Regulation (EU) 2023/956.

400–600

MT CO_2E / YR EXCESS

between mining's plans and a 1.5°C path by 2030. This is larger than today’s entire voluntary carbon market.

ICMM; IEA Net Zero Roadmap.

THREE ACTS, ONE THROUGH-LINE

What this report *covers*.

PART I

WHOSE CARBON IS IT, REALLY?

The *inheritance*.

Mostly in the metal, not the mine, and now carrying a price.

The paradox · Rio Tinto's books · The 2026 rules · Who pays · Three metals

P. 04–08

PART II

WHAT ACTUALLY CUTS THE CARBON?

The levers that *pay now*.

The cheap cuts pay for themselves. C3 moves them to the buyer.

Methane · Electric haul · Renewables · Nickel & steel · The C3 model · Two deals

P. 09–15

PART III

WHERE DOES THIS GO NEXT?

The frontier and the *reckoning*.

Scarcity rewards clean supply, and the report names its own risks.

Scarcity · Carbon removal · The 2050 path · Key risks

P. 16–20

PART I / THE INHERITANCE

I

Mining's own carbon is small. The carbon it *passes downstream* is not.

At the mine gate, mining is a rounding error in the global ledger. Follow the ore into metal and the picture inverts. In 2026 that downstream carbon gets a price tag, and someone has to carry it. This part follows the molecule, not the headline.

THE PARADOX

Where the *carbon comes from*.

The clean-energy build-out needs far more copper, lithium and nickel than the world mines today. More demand means more digging and more processing, so it is easy to assume mining is a major and fast-growing source of carbon, and to cast it as the villain of the transition. The numbers tell a more useful story, and that gap between perception and data is exactly where the value sits.

0.54%

OF GLOBAL EMISSIONS IS WHAT NON-COAL MINING ACTUALLY EMITS AT THE GATE

ICMM / Wood Mackenzie Global Mining & Metals GHG Dataset, 2026.

Now follow that ore into steel, aluminium and battery cathodes. The metals system it feeds is closer to **a quarter of all industrial CO_2**. That carbon is not created where the rock leaves the ground; it is created in what the rock becomes: the coke-fired blast furnaces that turn iron into steel, the power-hungry smelters that make aluminium and copper, and the high-heat processing behind battery cathodes. The abatement that matters is locked inside the product, not the pit.

> THE ONE IDEA IN THIS DECK
>
> The problem is not extraction; it is the metal. The cut therefore has to be made at the mine, but the carbon, and the economic value of removing it, lives downstream with the buyer who must report it.

For a producer, that asymmetry is the strategic prize rather than a footnote. A miner that abates carbon inside its own operations creates a saleable advantage for the steelmaker, the smelter and the cathode plant that buy its tonnes, because those firms carry the heavier reporting burden and the rising cost of carbon at the border. The producer pays for the reduction; the downstream buyer captures most of the benefit. Closing that distance, so the company that funds the abatement is paid for it by the partners who need it, is the commercial mechanism the rest of this deck builds out.

→ If most of mining's carbon sits downstream, then most of the value of cutting it does too. The next slide proves it with a single company's books.

WHERE THE CARBON ACTUALLY SITS

Upstream vs *downstream emissions.*

Take one of the world's largest miners and read its own carbon books. What it digs and powers is a fraction of what happens to its ore once it leaves the gate, which means the climate exposure that markets are starting to price is overwhelmingly an exposure the producer does not control by cutting diesel and grid power alone.

WHAT IT DIGS & POWERS · SCOPE 1+2

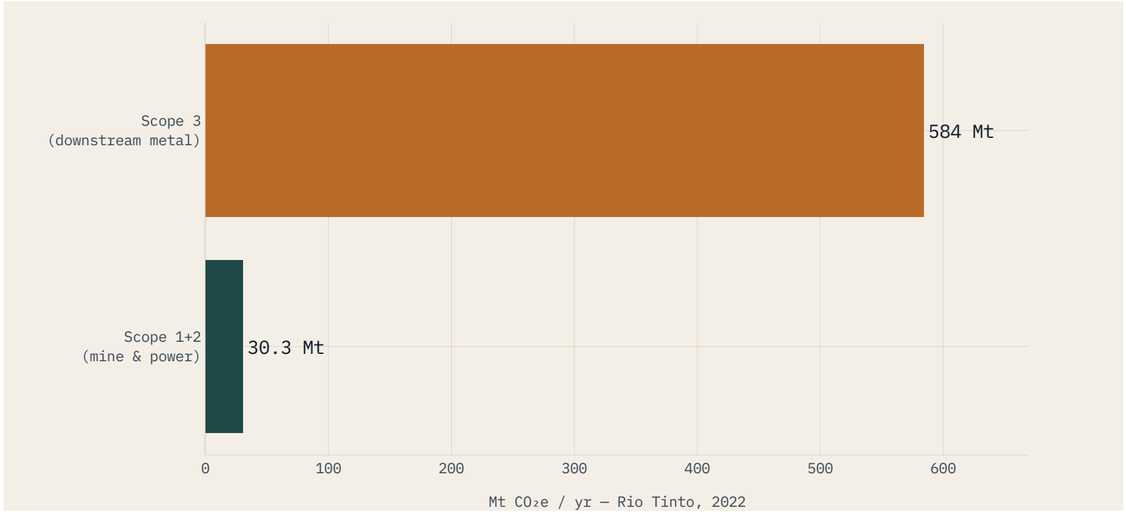
30.3 Mt CO_2e

WHAT ITS ORE BECOMES · SCOPE 3

584 Mt CO_2e

More than **94%** of it comes from downstream processing. Roughly **nineteen times** more carbon sits beyond the mine gate than inside it. Sector-wide, eight of every eleven tonnes come from turning ore into metal, not digging it up. The strategic consequence is that a miner can decarbonize its own operations completely and still own less than six percent of the footprint its customers will be asked to report, so the real decarbonization prize, and the cost of capturing it, lives in the value chain rather than at the pit.

RIO TINTO REPORTED EMISSIONS, 2022 (MT CO_2E PER YEAR)



A single major's disclosure makes the asymmetry stark. The mine-gate bar is real and worth cutting, and the producer carries its full cost. But the abatement that moves the climate, and the money, lives in the second bar, where the value at stake is roughly nineteen times larger. The implication for capital is direct: whoever can credibly account for reductions across that downstream bar, and route their benefit to the buyers who must report it, captures the margin a mine-only strategy can never reach. Source: IGF / IISD, citing Rio Tinto Climate Change Report 2022.

THE BILL COMES DUE · 2026

The new *carbon rules* for 2026.

For years the carbon embedded in metal was nobody's line item; it sat outside the financial statements, unpriced and unmeasured, while the physical product moved freely through the value chain. In 2026 three rules close that gap and turn embedded carbon into a declared, priced liability that travels with the metal all the way to the buyer. The consequence for a producer is that the carbon intensity of a tonne now sits alongside its grade and its purity as a commercial attribute that the customer can see, compare and pay a premium or a penalty for. Scope 3 is the carbon a company inherits from its suppliers; for a metals buyer, that is mostly the mine, which is why the pressure that lands on a brand or an automaker is transmitted, almost in full, back to the pit and the smelter.

CBAM · THE EU BORDER LEVY

From 1 Jan 2026

The definitive period begins, with the first certificates surrendered in Sept 2027, which means the cost is no longer hypothetical but a dated, budgetable cash outflow. Importers of steel and aluminium must declare the embedded carbon of the iron ore and alumina inside them, so the dirty tonne now costs more at the border and a lower-carbon supplier can quietly undercut a rival on landed price for the first time.

Regulation (EU) 2023/956.

EU BATTERY PASSPORT

Graded from 2026

Carbon-footprint declarations have been required on EV batteries since 18 Feb 2025; performance classes follow from 2026 and maximum thresholds from 2028, so the screw tightens on a fixed and published timetable. The carbon in every cell gets a grade, and a high-carbon nickel is screened out, which means a producer that misses the threshold loses access to the fastest-growing end market for its metal rather than simply selling it at a discount.

Regulation (EU) 2023/1542.

AUSTRALIA SAFEGUARD MECHANISM

−4.9% a year

Baselines fall almost five percent a year to FY30 across 215 covered facilities, most of them mines and metals plants, so the headroom a producer enjoys today is compounding away year on year. In the largest mining export nation, the mine gate is now under a hard, declining cap, which converts emissions from a reputational matter into a direct constraint on how much a facility can produce and how much capital it must set aside to stay compliant.

Safeguard Mechanism (Crediting) Amendment Act 2023; Clean Energy Regulator, 2025.

→ The liability is now declared and dated, and across these three regimes it points in the same direction: lower-carbon metal earns a premium while high-carbon metal absorbs a penalty. The question every metals buyer faces in 2026 is therefore simple: who pays to make that liability smaller, and who captures the advantage when it shrinks?

WHO PAYS, WHO CAPTURES

Cost upstream, *value downstream*.

Follow a single tonne of avoided carbon through the chain, and the central problem of mining decarbonization becomes visible. The cost of the reduction is incurred in one place, by one party. The benefit is captured in another, by someone else entirely. That separation between who pays and who gains is precisely the gap a market is needed to close, and it is the gap Carbon3 is built to bridge.

01 · AT THE MINE

The reduction is made here.

The producer electrifies a haul fleet, drains methane, or switches to clean power. Each of these is genuine abatement, and each carries a real cost the producer absorbs at the mine, well before any buyer sees the benefit or pays a premium for it.

COST: THE PRODUCER

02 · IN TRANSIT

The carbon travels in the metal.

The ore ships, and its embedded carbon, lower now because of the work done upstream, moves with it into the steel mill, the smelter and the cathode line. The abatement is locked into the physical product, but no one downstream has yet paid for it.

CARRIER: THE COMMODITY

03 · AT THE BORDER

The liability lands downstream.

It surfaces as the steelmaker's CBAM line and the cell maker's Battery Passport grade. This is where carbon is finally priced, which means the buyer, not the miner, holds the liability and has every reason to pay to lower it.

LIABILITY: THE BUYER

04 · THROUGH C3

The value flows back.

Buyers pay the producer for the carbon advantage they need at the border. C3 splits each verified, third-party-certified cut into units and shares them across multiple value-chain partners, retiring every unit once so the same tonne is never double-counted.

BRIDGE: CARBON3

The reduction is upstream. The value is downstream. *C3 is the bridge between them.*

MINING IS NOT ONE INDUSTRY

Mining's three *key metals*.

Treating "mining" as one number is the most expensive simplification a capital allocator can make, because it hides where the strategy actually lives. Each metal sits in a different value chain, answers to a different rule, and has a different cheapest cut, which means the right decarbonization play, and the return on it, looks nothing alike across the three. For a CEO setting capital priorities, and for an investor pricing transition risk, the differentiation is not a footnote: it is the whole of the value at stake.

Iron ore

FEEDS STEEL · THE BIGGEST LOAD

Mine-gate carbon is low, so the leverage is not at the gate at all. Iron ore feeds steel, the single largest downstream carbon load on earth, and the green-steel wave is pulling hard for premium ore the standard mine cannot supply. That mismatch is where the margin moves: the producer who can deliver qualifying ore captures a scarcity premium, while the one who cannot watches the best contracts route elsewhere.

~2.6 Gt
OUTPUT, 2024

11–18
KG CO_2E/T GATE

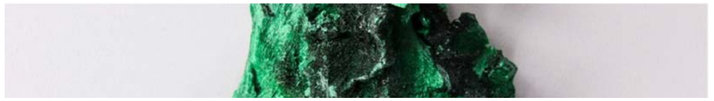
Battery metals

NI · LI · CO · DEMAND MULTIPLYING

Demand is set to multiply, and the same metal can carry wildly different carbon depending on its route and its power source. The implication is that the average is the wrong number to manage: it is the spread, not the mean, that decides which tonne clears the Battery Passport and earns its way into a premium supply chain, and which gets screened out and discounted. Carbon intensity, in other words, becomes a market-access question.

~5x
LI DEMAND BY 2040

>20x
NICKEL CARBON SPREAD



Copper

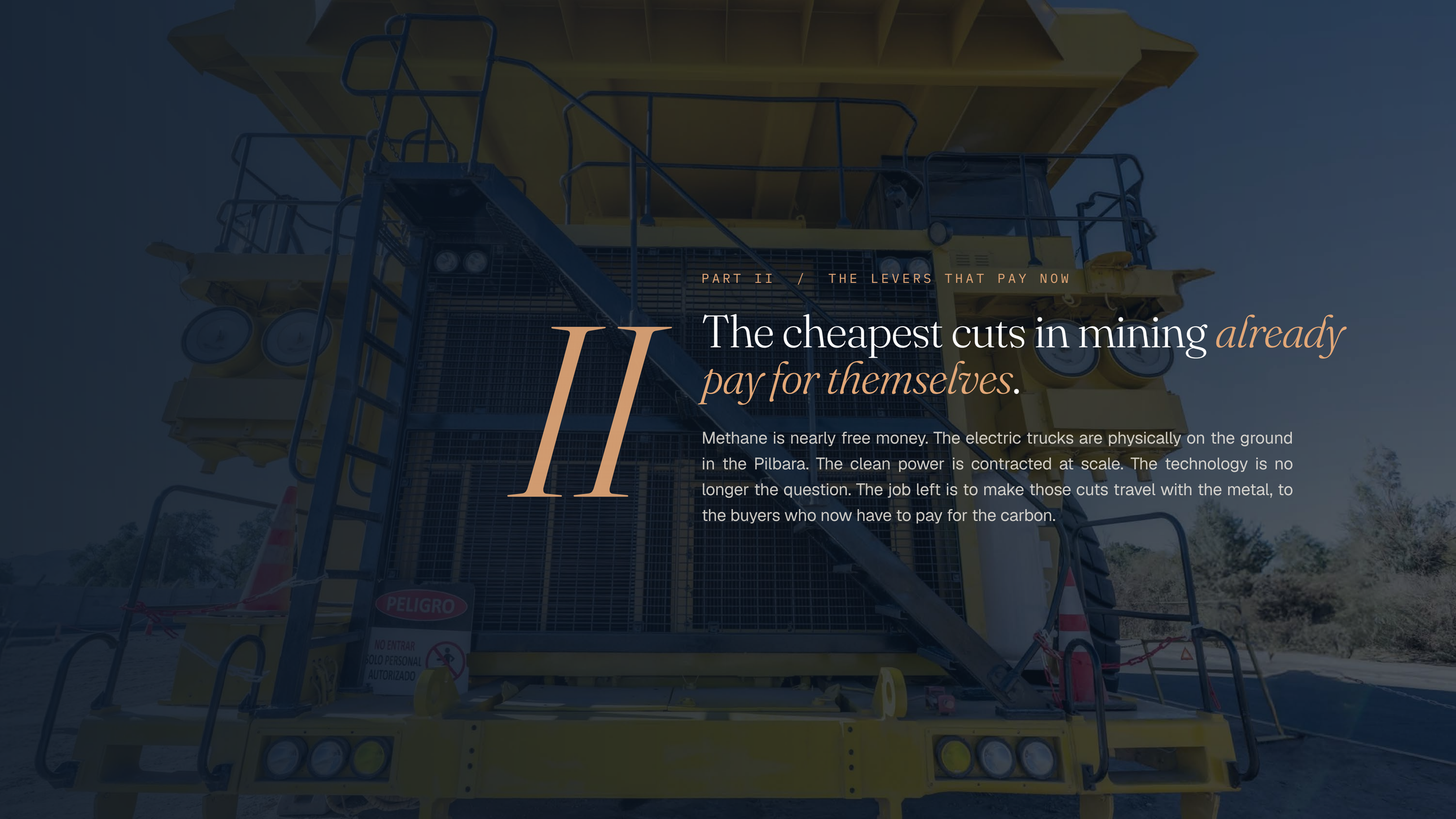
THE ELECTRIFICATION CHOKEPOINT

Nothing electrifies without copper, and it is running short as grades decline, which hands the low-carbon producer pricing power on a tightening market. At the gate, the carbon problem is almost entirely one thing, diesel in the haul trucks, so the abatement path is unusually concentrated and unusually bankable. Fix the diesel and a producer fixes copper's mine-gate footprint, with a clear line of sight on both the cost and the cut.

~30%
SUPPLY GAP BY 2035

96%
OF SCOPE 1 IS DIESEL

Sources: USGS Mineral Commodity Summaries 2025; IEA Global Critical Minerals Outlook 2025; Canadian Climate Institute 2025 (SKARN); Rio Tinto & Vale 2024 reports. Two more threads run through Part II: coal-mine methane (the cheapest tonne) and rare earths (the geopolitics).



PART II / THE LEVERS THAT PAY NOW

II

The cheapest cuts in mining *already pay for themselves*.

Methane is nearly free money. The electric trucks are physically on the ground in the Pilbara. The clean power is contracted at scale. The technology is no longer the question. The job left is to make those cuts travel with the metal, to the buyers who now have to pay for the carbon.

THE CHEAPEST TONNE · COAL-MINE METHANE

Methane: the *cheapest cut*.

Coal-mine methane is gas that leaks from coal seams, and ventilation air methane is the dilute stream fanned out of the shafts to keep miners safe. Both are easy to destroy with equipment that is already commercial, and because methane traps roughly 80 times more heat than CO_2 over 20 years, every tonne captured does outsized climate work for very little money. This is the arbitrage hiding in plain sight: the lowest-cost abatement in the entire sector, sitting almost entirely unfunded.

<11%

OF ONE YEAR'S COAL-MINING PROFIT WOULD CLEAN UP THE WORST OF MINING'S METHANE

Ember, Global Coal Mine Methane Review 2026.

54–63%

AVOIDABLE BY 2030 WITH EXISTING TECH

62%

OF DRAINAGE CAPTURE PAYS FOR ITSELF: NEGATIVE NET COST

USD 2.5bn

TO ABATE THE WORST STREAM (VAM), UNDER 11% OF 2025 COAL PROFIT

89%

LEFT UNREPORTED TO THE UNFCCC IN 2023

The economics are the headline a CEO should not miss. Between 54% and 63% of these emissions are avoidable by 2030 with technology that exists today, and 62% of drainage capture carries a negative net cost, meaning the captured gas can be sold or burned for power and pays for the equipment that catches it. Cleaning up the worst stream, ventilation air methane, costs roughly USD 2.5bn, under 11% of a single year of 2025 coal-mining profit. The catch is that 89% of this methane went unreported to the UNFCCC in 2023, so the lowest-cost, fastest, partly self-funding abatement in mining has stayed invisible precisely because no balance sheet has been forced to carry it.

→ Methane from coking coal alone adds at least 27% to steel's warming impact, yet it barely appears in steelmakers' books, which means the buyer paying a premium for low-carbon metal is already exposed to a number no one upstream has priced. The cheapest tonne is also the most under-financed, and that gap between real, cheap abatement and the capital willing to fund it is exactly what a market exists to close.

DIESEL-TO-ELECTRIC HAUL

Electric *haul trucks.*

In December 2025 the first battery-electric haul trucks rolled onto BHP's Jimblebar iron-ore mine in the Pilbara, in a joint program with Rio Tinto and Caterpillar, which means the largest producers are now operating the technology rather than studying it. The stakes are simple: diesel is 96% of the copper mine-gate problem and the dominant load in iron ore, so an electric fleet costs more to buy but earns it back on fuel year after year. The slide that used to read "pilot planned" now reads "trucks on site."

2 trucks

FIRST CAT 793 BATTERY-ELECTRIC HAULERS AT BHP JIMBLEBAR, PILBARA

Rio Tinto / BHP, Dec 2025.

USD 2.8bn

FORTESCUE–LIEBHERR ORDER: ~360 BATTERY-ELECTRIC TRUCKS, FROM 2026

Fortescue, 2024.

USD 300–400m

ESTIMATED ANNUAL FUEL SAVING FROM FORTESCUE'S ELECTRIC FLEET

Electrek, 2026 (analyst estimate).

40–84%

LIFECYCLE CUT FROM DROP-IN RENEWABLE DIESEL TODAY, NO NEW TRUCKS

Climate Institute 2025 (Xu et al. 2022).

The honest clock. Ultra-class battery trucks scale after 2030, not tomorrow, so renewable diesel is the drop-in bridge that cuts carbon today with no new equipment and no capital cycle. The investment case stands either way: electrification prints money on fuel before a single carbon credit is sold.

THE RENEWABLE SURGE · AND THE CATCH

Renewable power *at the mine.*

Mines are among the best renewable customers a developer can find, because their loads are large, steady and predictable, and they sit in exactly the sunny, remote country where solar and wind are cheapest to build. That combination is what makes a long-term power contract bankable, and it is why power contracts for 2026 operation jumped roughly fourfold while two majors effectively zeroed the emissions from the electricity they buy. The strategic point for an investor is that this lever pays now: clean megawatts displace diesel and grid carbon at, or below, the cost of the power they replace, which means the carbon comes out of the metal without coming out of margin. Scope 2 is the carbon in purchased electricity.

4,300 MW

RENEWABLE CONTRACTS FOR MINE OPERATION IN 2026, UP FROM ~1,000 MW FOR 2024

Wood Mackenzie, 2025.

~77%

OF RIO TINTO'S ELECTRICITY FROM RENEWABLES IN 2025; ~90% TARGETED BY 2030

Rio Tinto FY2025; Wood Mackenzie.

~0

MARKET-BASED SCOPE 2 AT ANTOFAGASTA AND VALE, NEAR-ELIMINATED

Wood Mackenzie, 2025.

~1 in 10

COPPER MINES OFF-GRID ON DIESEL: GRID ACCESS GATES THE TAIL

Climate Institute 2025 (SKARN).

Signing a contract is not a clean grid. The headline megawatts are the easy two-thirds; the hard part is the last third, because firming a round-the-clock base load for grinding and dewatering that never switch off requires storage, transmission and backup that a paper power-purchase agreement does not deliver, and the grid-connection queues that would supply it take years to clear. That is why the off-grid tail still runs on diesel: about one copper mine in ten has no grid to decarbonize against. The leaders have largely solved purchased power, so the remaining advantage, and the remaining cost, both sit in firming and transmission, which is where the next round of capital, and the next round of competitive separation between producers, will be decided.

CLEAN POWER FOR A HEAVY LOAD / MINING 2026

BATTERY METALS · THE SPREAD IS THE MARGIN

The carbon spread in *battery metals*.

Few commodities carry as wide a carbon range as nickel, where embedded emissions vary more than twenty-fold depending on the production route and the power behind it. Indonesian nickel made by **high-pressure acid leach (HPAL)** on captive coal carries roughly 45 tonnes of CO_2 per tonne of metal, while the sulfide route on clean power runs near 12. The strategic point for any cell maker is that this entire spread can sit inside the same battery, which means two chemically identical packs can differ by a factor of four in the carbon they report to a downstream buyer.

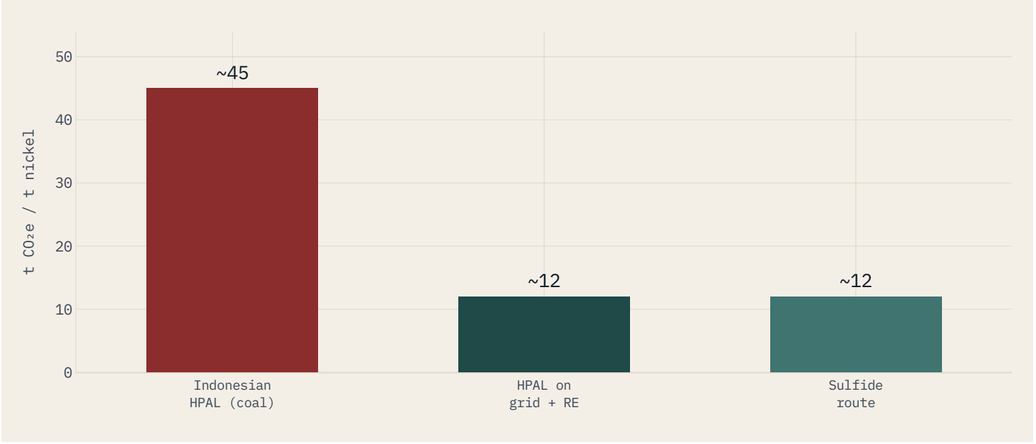
THE LEVER

Switching the smelter's captive coal to grid power and renewables is the single biggest cut available anywhere in battery-metal supply, and because the Battery Passport now rewards it, the producer that moves first converts an operating decision into a durable commercial edge.

THE CONSTRAINT

Low-carbon nickel is still under 2% of trade, and the spot market does not yet pay a premium for it, so on the price screen the clean tonne and the coal tonne fetch the same number. The value therefore has to travel by traceability and allocation rather than by the exchange, which is precisely where C3 fits as the layer that moves a verified, single-retirement reduction to the buyers who can report it.

NICKEL CARBON BY PRODUCTION ROUTE (T CO_2E / T NICKEL)



Across the full literature the range runs 5 to 105 kg CO_2e per kg of nickel, a span no other input in the battery comes close to matching. Under the EU Battery Passport and US §30D sourcing rules the high-carbon tonne is marked down or screened out altogether, so the spread stops being an academic figure and becomes the margin a producer can defend or lose. Sources: Climate Institute 2025 (Tijsseling 2023); BloombergNEF.

IRON ORE · THE GREEN-STEEL CHOKEPOINT

Ore quality and *green steel.*

Hydrogen-based steelmaking needs premium **direct-reduction-grade (DR-grade)** ore, the high-iron pellet the process can actually use, and only about 3% of the world's iron ore is good enough to qualify. The constraint matters because it reroutes where the value accrues: the Pilbara, the largest basin on earth, mostly cannot feed the hydrogen route without upgrading the ore first, which means the miners who can deliver DR-grade feedstock will command a structural premium long before the carbon math even enters the conversation.

THE LEVER · BENEFICIATION

Spend a little carbon upgrading the ore at the mine, and the steelmaker's hydrogen route saves two to three times as much downstream. This is the rare case where the cheapest place to cut a buyer's emissions sits upstream at the pit, which makes beneficiation an investment with returns that land outside the miner's own ledger and inside the customer relationship.

THE HONEST CONSTRAINT

That downstream saving belongs to the steelmaker's own route switch, so it is not extra credit volume the miner can sell twice. The integrity rule is firm: one tonne of avoided carbon, one claim. Beneficiation is therefore a commercial lever that wins offtake and pricing power, not a double-count, and the producers who treat it as the former will be the ones long-term steel buyers contract with first.

~3%

OF GLOBAL IRON-ORE OUTPUT THAT MEETS DR-GRADE FOR H_2-STEEL

Wood Mackenzie, 2024.

11–18 kg CO_2e/t

IRON-ORE MINE-GATE CARBON IS ALREADY LOW

Rio Tinto & Vale 2024 reports.

The strategic read for capital is that iron ore's decarbonization prize is not at the mine gate, where emissions of 11–18 kg CO_2e/t are already low, but in securing the scarce DR-grade tonnes the hydrogen transition will bid up. The producers positioned to supply that ~3% slice, and to beneficiate ore toward it, capture the premium and the long-dated offtake; the rest compete on a commodity whose buyers are quietly walking upmarket.

THE INTEGRITY MOAT

The *insetting* model.

The levers in Part II cut real carbon at the mine, but a reduction only becomes an asset once it can be verified, moved and counted without double-claiming. C3 is the layer that turns each verified cut into a tradable unit and routes it to the buyers who now have to pay for that carbon at the border. The discipline of the chain below is the product itself, and it is what makes the resulting claim hold up to an auditor.

STEP 01 · VERIFY

A third party confirms the cut.

An accredited verifier, whether ISCC, RSB, or an ISO 14064-3 body, measures the mine-site reduction against its baseline and signs off on the tonnage. C3 never performs that step, because the integrity of the whole chain depends on the measurement staying independent of the party that allocates it.

ISCC · RSB · ISO 14064-3

STEP 02 · ALLOCATE

C3 splits it across the buyers.

Once verified, the reduction is divided into units and shared across the multiple value-chain partners that draw on the mine, pro-rata to the metal each one takes. It is never assigned to a single buyer, which is what lets one physical cut settle fairly against many separate carbon balances.

MULTI-BUYER · PRO-RATA

STEP 03 · RETIRE

Each unit is retired once.

Every unit is then retired exactly once on the C3 ledger and written into that buyer's product-level declaration, so the same tonne can never be sold or claimed twice. One tonne, one claim, is the rule the whole market rests on.

RETIRE-ONCE · ON-LEDGER

WHAT AN INSET IS, AND IS NOT

Insets finance real cuts **inside** the supply chain that the buyer is already part of. They are **not** offsets, **not** EU ETS or CBAM certificates, and they do **not** make the metal carbon-neutral. What they do, and all they do, is lower the actual embedded carbon a buyer reports against the product it takes. That narrowness is not a limitation but the source of the integrity: it is precisely what makes the claim defensible when a regulator or an auditor tests it.

TWO WAYS THE MONEY MOVES

Two *deal structures*.

DEAL 1 · PILBARA IRON ORE → EUROPEAN STEEL

Electrify the haul, then sell the cut to the CBAM-exposed mill.

A Pilbara producer electrifies its haul fleet and contracts renewables, cutting **~1.6 Mt CO_2/yr**, and once a third party verifies that reduction C3 splits it into units allocated pro-rata across the pellet cargoes shipped to Stegra, POSCO and Tata. Every cargo carries its own unit, each unit is retired only once, and the saving is written straight into that buyer's CBAM declaration, which is where it converts into avoided border cost.

Integrity: these insets cut the physical carbon the CBAM declaration measures, so they are not CBAM certificates surrendered to the EU and they do not make the ore carbon-neutral. The economics work because bulk ore rides with the cargo rather than depending on a 12-year annuity, and the benefit begins crystallising from CBAM's first surrender in 2027.

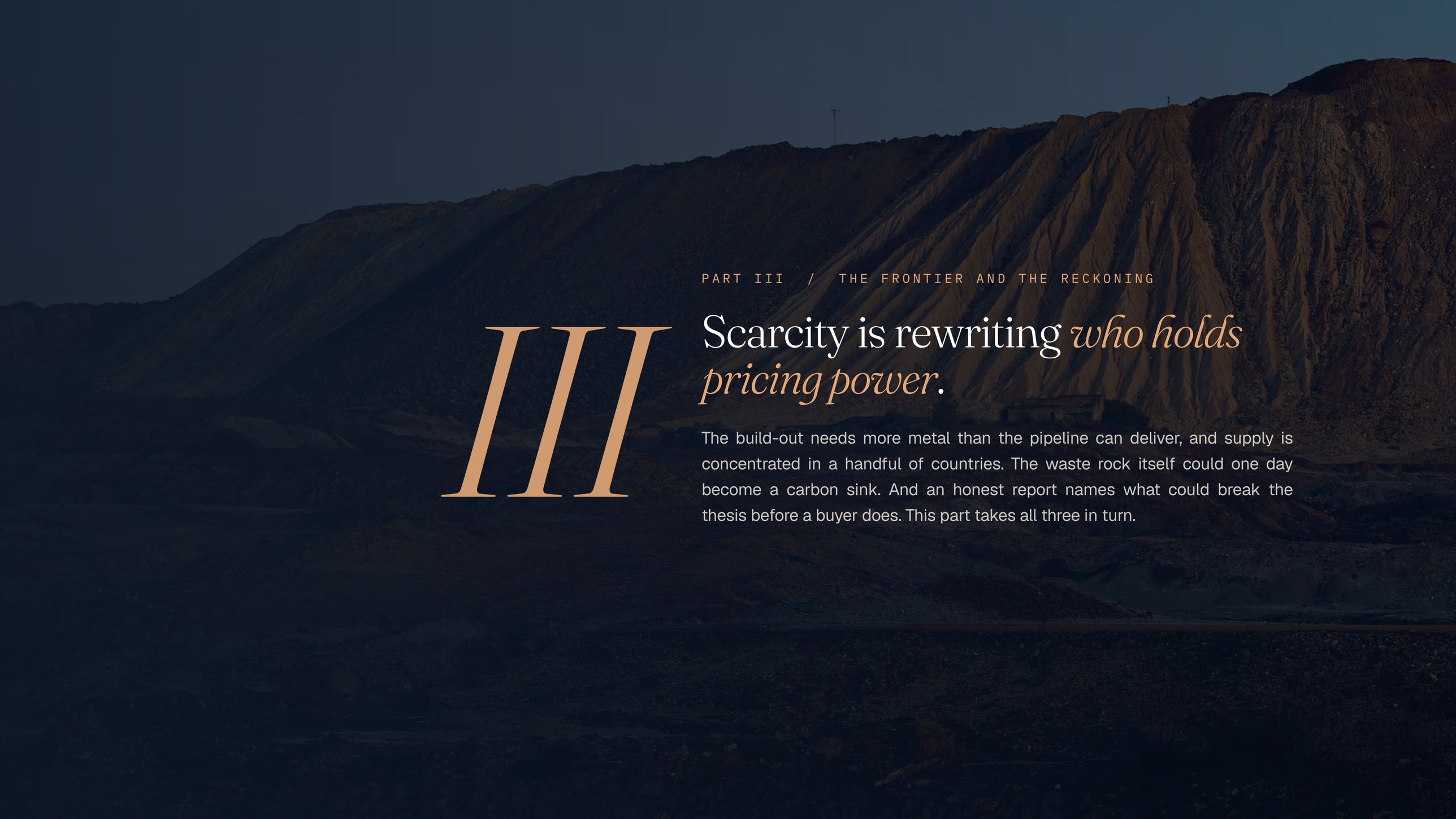
DEAL 2 · SULAWESI NICKEL → THE BATTERY PASSPORT

Swap the captive coal, and grade up every cell that uses it.

An HPAL nickel refinery contracts solar-plus-storage behind a long PPA, cutting **~2.4 Mt CO_2/yr** and taking intensity from ~45 toward ~22 t CO_2e/t Ni, and C3 splits the verified cut into units allocated pro-rata across the cathode volumes flowing to CATL, LG and Samsung SDI, each retired once at the SKU level. The lower embedded carbon then travels with the metal into every Battery Passport that records it.

Integrity: because battery offtakes genuinely run multi-year, a longer inset structure is credible here, and the cut reaches the refinery through allocation precisely because the spot market still does not price low-carbon nickel. The insets lower the reported embedded carbon of the cathodes, but they do not make the nickel carbon-neutral.

Both structures are illustrative and modelled, not executed C3 transactions or market quotes. Volumes are indicative; deal economics depend on the prevailing carbon price and the pace of free-allowance phase-out. Verification is by accredited third parties, not by Carbon3.



PART III / THE FRONTIER AND THE RECKONING

III

Scarcity is rewriting *who holds pricing power*.

The build-out needs more metal than the pipeline can deliver, and supply is concentrated in a handful of countries. The waste rock itself could one day become a carbon sink. And an honest report names what could break the thesis before a buyer does. This part takes all three in turn.

SCARCITY IS PRICING POWER

The case for *low-carbon metal.*

The energy build-out needs far more metal than the sanctioned project pipeline can deliver, and what supply exists is concentrated in a handful of countries and refiners. When a market is scarce, concentrated and carbon-priced at the same time, the three forces compound rather than offset, and the compliant low-carbon tonne becomes the one that clears at a premium because buyers facing a border carbon bill will pay to secure it. For a producer, that premium is not a soft sustainability story but tradable advantage that accrues to the lowest-carbon barrel of output and shows up directly in realized price and margin.

~30% / 40%

PROJECTED COPPER AND LITHIUM SUPPLY SHORTFALLS BY 2035

IEA Critical Minerals Outlook 2025.

86%

TOP-THREE REFINERS' SHARE OF SUPPLY; CHINA REFINES MOST AT ~70%

IEA Critical Minerals Outlook 2025.

25–40%

CUT IN NEW MINE DEVELOPMENT BY 2050 FROM RECYCLING: A HEDGE, NOT A FIX

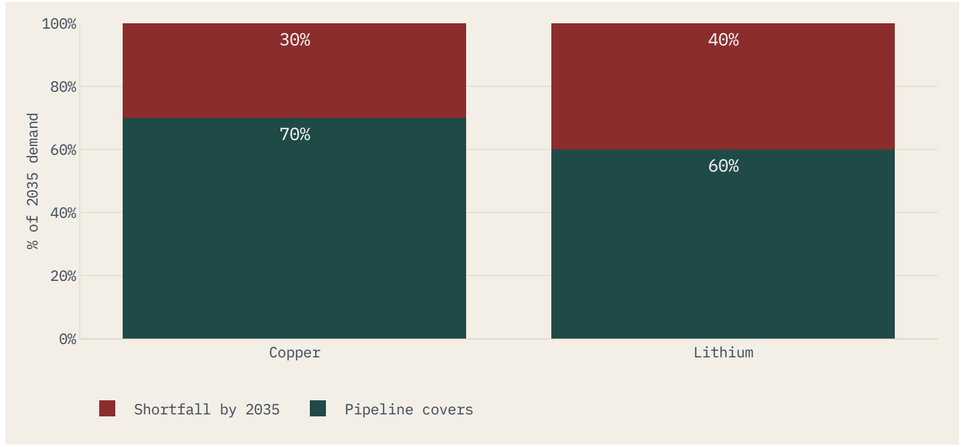
IEA, Recycling of Critical Minerals.

~50%

HIGHER CAPEX TO BUILD DIVERSIFIED SUPPLY VERSUS INCUMBENTS

IEA Critical Minerals Outlook 2025.

SHARE OF 2035 DEMAND MET BY THE SANCTIONED PROJECT PIPELINE



In a market that is structurally short and increasingly carbon-screened, the low-carbon tonne is the source of alpha, and the producer that can prove its embedded carbon is the one that captures the premium. C3 turns that proof into a bankable, allocatable position the buyer can report. Source: IEA Global Critical Minerals Outlook 2025.

THE FRONTIER · REMOVAL, NOT REDUCTION

The carbon-*removal* frontier.

Some mine waste is reactive alkaline rock. Left exposed, it slowly binds CO_2 from the air into stable carbonate, a process called enhanced weathering or mineralization. Mining already crushes and moves exactly this rock at gigatonne scale, which means the most expensive step in engineered carbon removal, the comminution and handling of feedstock, is already paid for and sitting in the closure plan. No other heavy industry starts from that position.

THE PROMISE

The same tailings that are a closure liability could lock carbon away for **centuries to millennia**. The first registry protocol for carbon removal in mining now exists, which gives the early movers a credited pathway rather than a science project. Because no other industry already operates the feedstock at this scale, the producers who prove it first stand to own a durable removal supply that buyers cannot easily source elsewhere.

THE HONEST RIGHT-SIZE

This is a frontier, and it should be underwritten as one. Pilots run **2026–28**, and real scale comes **after 2030**, so the value sits beyond most current capital-allocation horizons. Tonnes clear at USD 400–1,000 today against a sub-USD-200 target, and the gap between those numbers is the entire investment case: it closes only with scale and learning. It also touches dam safety, so engineering sign-off governs every deployment, and that constraint, not the chemistry, sets the pace.

THE WALL THAT MUST NOT MOVE

This is carbon **removal**, a durable but pre-commercial product, and it is a different instrument from the reduction insets that drive the economics of this deck. It is accounted and retired **separately** from C3's reduction insets, because conflating the two would let a frontier tonne flatter a balance sheet it has not yet earned. A removed tonne and a reduced tonne are never blended, and no frontier tonne is counted in the economics that pay out today. C3 watches this market, builds the reporting rails for the day it scales, and does not pretend it has arrived.

Sources: WSP, "Turn mine materials into credible, durable carbon removal," 2026; Isometric mineralization protocol; IEA, ICMM, Wood Mackenzie and McKinsey treat geochemical CDR as a longer-term frontier, not a 2026–30 lever.

TODAY → 2030 → 2050

The road to *2050*.

The distance between mining's current plans and a 1.5°C path amounts to **400–600 Mt of CO_2 a year by 2030**, an annual shortfall larger than today's entire voluntary carbon market. That gap is also the opportunity, because every tonne inside it is abatement that has to be financed somewhere, and C3 is built to convert it into independently verified reductions that flow through the supply chain to multiple value-chain buyers and are retired once.

METRIC	2025 TODAY	2030 (1.5°C PATH)	2050 ENDGAME
Mining Scope 1+2 Gt CO_2e/yr	1.4–2.0	0.9–1.2	<0.3
Coal-mine methane Mt CH_4/yr	~35 operating	<18	<10
Iron-ore mine-gate intensity kg CO_2/t ore	~14	6	<2
Class-1 nickel intensity t CO_2/t Ni	30–50 HPAL	<15	<5
Mine electricity from renewables	~25%	>75%	>98%
Haul fleet electric (by energy)	<3%	30–40%	>95%

Coal-mine methane shown on the Ember 2026 operating-mine boundary (~35 Mt CH_4, 2023); the IEA boundary including abandoned mines is higher (~70 Mt). Other rows: ICMM Pathways to Decarbonisation; IEA Net Zero Roadmap; mining.md §6. Trajectories are 1.5°C-aligned targets, not forecasts.

WHAT WOULD BREAK THIS THESIS

The *key risks*.

Every claim in this deck rests on a handful of conditions holding, and an investor underwriting the sector deserves to see them stated plainly rather than buried. Naming the things that could break the thesis is not a hedge or a weakness; it is the discipline that makes everything else in these pages worth trusting, because a market that cannot describe its own failure modes has not understood them.

01 · ADDITIONALITY

Electrification that would have happened anyway is not a saleable cut, and pretending otherwise is how a market loses its license to operate. The test is real abatement, measured net of business-as-usual, which means a weak or self-serving baseline is a fatal flaw rather than a rounding error. That is precisely why the baseline is set by a third party and never by the producer claiming the reduction or by Carbon3.

02 · POLICY REVERSAL

CBAM scope, or the US §30D and §45X credits, could be narrowed or diluted by the next political cycle. Soften the price signal and the premium buyers will pay for clean metal shrinks with it, compressing the very margin that funds abatement at the mine. In practice the thesis rides on the rules holding, so the prudent position is to back producers whose economics survive a partial rollback, not only a perfect one.

03 · CARBON-PRICE SOFTNESS

Inset economics depend on the carbon price holding, above all the level of the EU ETS and the pace at which free allowances are phased out. The mechanism is direct: a cheap tonne of carbon makes a cheap inset, because the buyer's incentive to pay for embedded reductions is only ever worth what avoiding the carbon is worth to them. A soft price does not break the abatement, but it does thin the revenue that pays for it.

04 · REMOVAL MRV

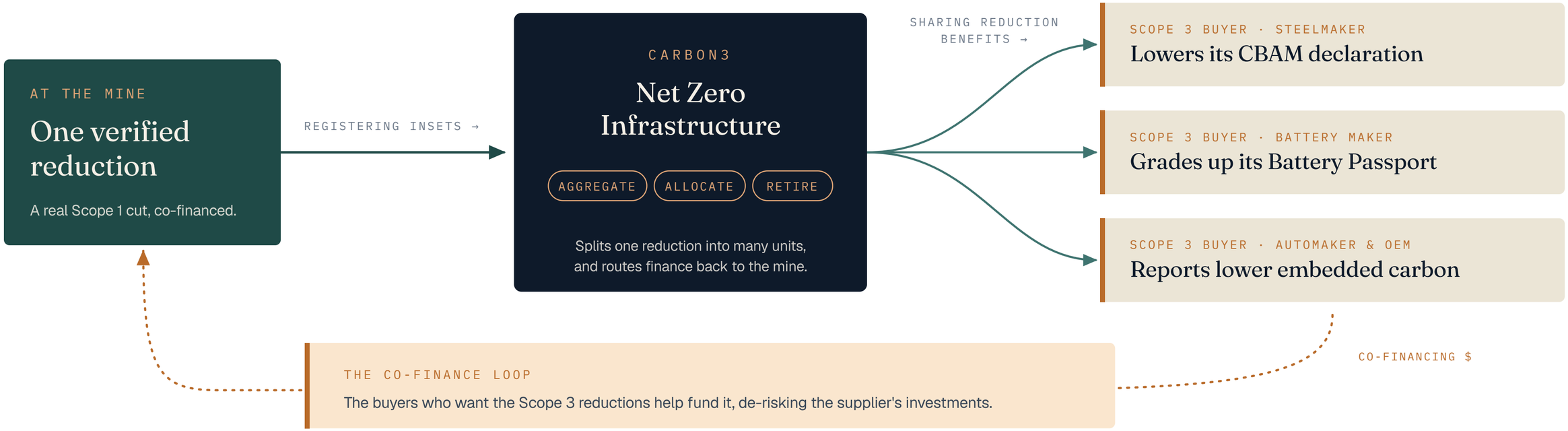
Carbon-removal durability and the measurement, reporting and verification behind it are still maturing, so frontier tonnes should not be banked early or sold against today. The implication for capital is a clean separation of products, which is exactly why this deck walls removal off from the reduction insets that pay now and never lets the two be counted as one.

→ **The discipline is the differentiator, because a market that polices additionality and retires each verified tonne exactly once is the only one buyers and regulators will ultimately stand behind, and it is where the durable value accrues.**

HOW CARBON3 WORKS

Carbon3, *end to end.*

The whole mechanism in one picture. A single cut at the mine is verified by a third party, split by Carbon3 into units, and shared across the value-chain buyers who carry the carbon bill. The value flows both ways: those buyers' forward purchases co-finance the cut and de-risk the producer's Scope 1 investment in the first place. Each unit is retired exactly once.



INSETS CUT REAL CARBON INSIDE THE CHAIN · NOT OFFSETS, NOT CBAM CERTIFICATES, NO CARBON-NEUTRAL CLAIM

THE POSITION

Mining will decarbonise *inside its own supply chain*. Carbon3 is the market infrastructure for it.

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"Verified by third parties. Allocated by C3. Retired once. The carbon advantage, made bankable."

— CARBON3, 2026 MINING OUTLOOK

STAY IN TOUCH

carbon3.net

linkedin.com/company/c3org

WHAT THIS BRIEF IS BUILT ON

Sources and *standards*.

Every number on a slide traces to a public 2024–2026 source, cited alongside it. Analyst estimates and modelled deal economics are marked as such on the slide. The right-hand column lists the verification and reporting standards referenced throughout.

REPORTS & DATA CITED

ICMM / Wood Mackenzie — Global Mining & Metals GHG Emissions Dataset, 2026 (~1,700 facilities).
ICMM.COM

IEA — Global Critical Minerals Outlook 2025; Recycling of Critical Minerals; Global Methane Tracker.
IEA.ORG

Ember — Global Coal Mine Methane Review 2026.
EMBER-ENERGY.ORG

IGF / IISD — Decarbonization of the Mining Sector, 2024.
IISD.ORG

Canadian Climate Institute — Mining decarbonization, 2025.
CLIMATEINSTITUTE.CA

WSP — Turn mine materials into credible, durable carbon removal, 2026.
WSP.COM

WEF / McKinsey — Securing Minerals for the Energy Transition, 2024; BloombergNEF Transition Metals Outlook 2025.
WEFORUM.ORG · ABOUT.BNEF.COM

STANDARDS, REGISTRIES & SUPPORTING DATA

Verification (third party) — ISCC; RSB; ISO 14064-2 / 14064-3; Copper Mark; IRMA Standard for Responsible Mining; Aluminium Stewardship Initiative; CIRAF (cobalt).

Allocation & reporting — GHG Protocol Corporate Value Chain (Scope 3); SBTi; CSRD ESRS E1; Global Battery Alliance Battery Passport; Isometric mineralization protocol (removal).

Regulators referenced — EU (Reg. (EU) 2023/956 CBAM; Reg. (EU) 2023/1542 Batteries; Reg. (EU) 2024/1252 CRMA; Reg. (EU) 2024/1787 Methane); Australia Safeguard Mechanism (Crediting) Amendment Act 2023; US IRA §45X & §30D; China ETS; India CCTS.

Operational data referenced — USGS Mineral Commodity Summaries 2025; Rio Tinto, BHP, Fortescue, Vale, Antofagasta disclosures; Caterpillar & Liebherr releases; Wood Mackenzie PPA tracker.

Market & cost data — IEA; BloombergNEF; SKARN Associates; peer-reviewed (Tijsseling et al. 2023; Xu et al. 2022).

Methodology · All quantitative claims trace to the primary public sources cited on each slide. Analyst estimates (e.g. Fortescue fuel savings) and modelled deal economics are flagged on-slide. Project and policy statuses are as of June 2026 from public reporting and were not independently re-verified at publication. The two deals are illustrative structures, not executed Carbon3 transactions. Carbon-intensity and reduction verification is performed by accredited third parties, not by Carbon3. Carbon removal (Part III frontier) is a distinct product, accounted and retired separately from reduction insets.