

Critical mineral scarcity is not a reserves question

GEM separates volume pressure, chain fragility and reliable tonnes

GEM analyzed six mineral chains - copper, lithium, nickel, cobalt, battery-grade graphite and magnet rare earths - using the IEA 2035 supply outlook and a GEM screening framework for processing, concentration, trade exposure and conversion risk. The result is not one scarcity league table. It is a map of two different problems: whether enough primary tonnes are likely to exist, and whether those tonnes can reach users in the required product form.

The numbers show why the distinction matters. Expected 2035 mined or raw supply covers only 68% of lithium primary requirements, 74% for cobalt and 75% for copper. Yet graphite and magnet rare earths appear close to or above aggregate requirements while remaining heavily exposed to dominant processing hubs and weak diversified supply routes.



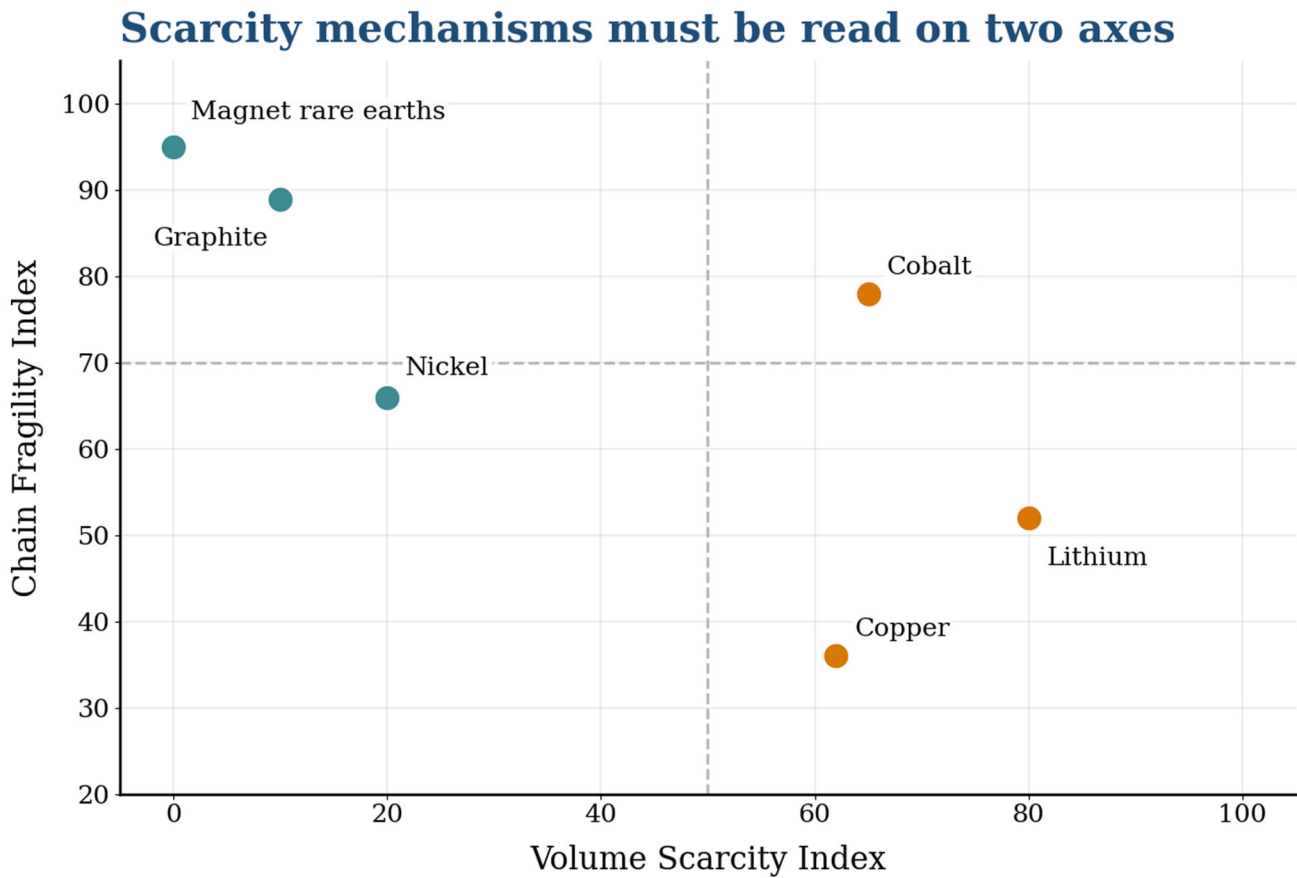
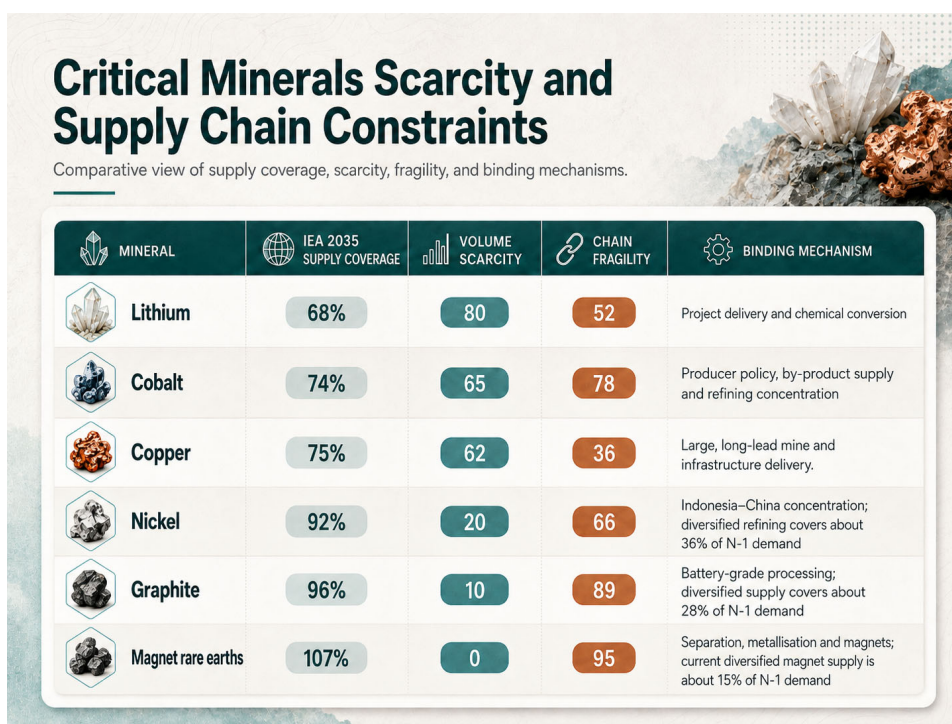


Figure 1. Scarcity mechanisms must be read on two axes. GEM Volume Scarcity is derived from IEA 2035 supply coverage; Chain Fragility is a GEM screening score, not a disruption probability. Source: GEM calculations from the IEA Global Critical Minerals Outlook 2026.

A single ranking hides the mechanism

The same headline word - scarcity - describes very different investment and policy problems. Copper, lithium and cobalt require more dependable project delivery. Graphite and magnet rare earths require qualified processing, technology, equipment and customers outside the dominant hub. Nickel shows how aggregate availability and concentration can move in opposite directions: supply can be ample while diversified refining remains weak.



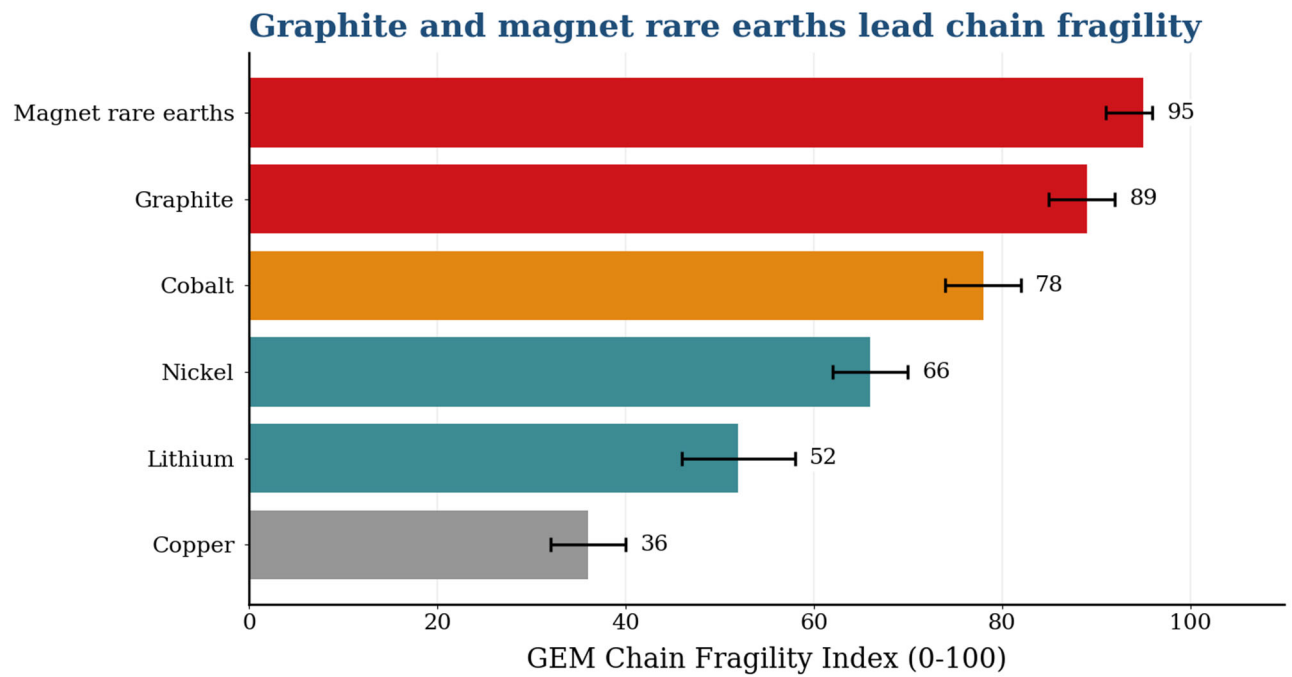


Figure 2. Chain fragility is highest in battery-grade graphite and magnet rare earths. Values are GEM screening scores on a 0-100 scale; black whiskers show model-sensitivity ranges and the numeric labels show the central scores. The ranges are not forecast confidence intervals.

Nameplate tonnes are not reliable tonnes

Commodity balances often count announced nameplate capacity as if it were immediately saleable output. GEM instead recommends a project-level reliability chain. Each gate is time-bounded and supported by evidence: permits and finance, commissioning, stable ramp-up, recovery and product quality, customer qualification and operating continuity.

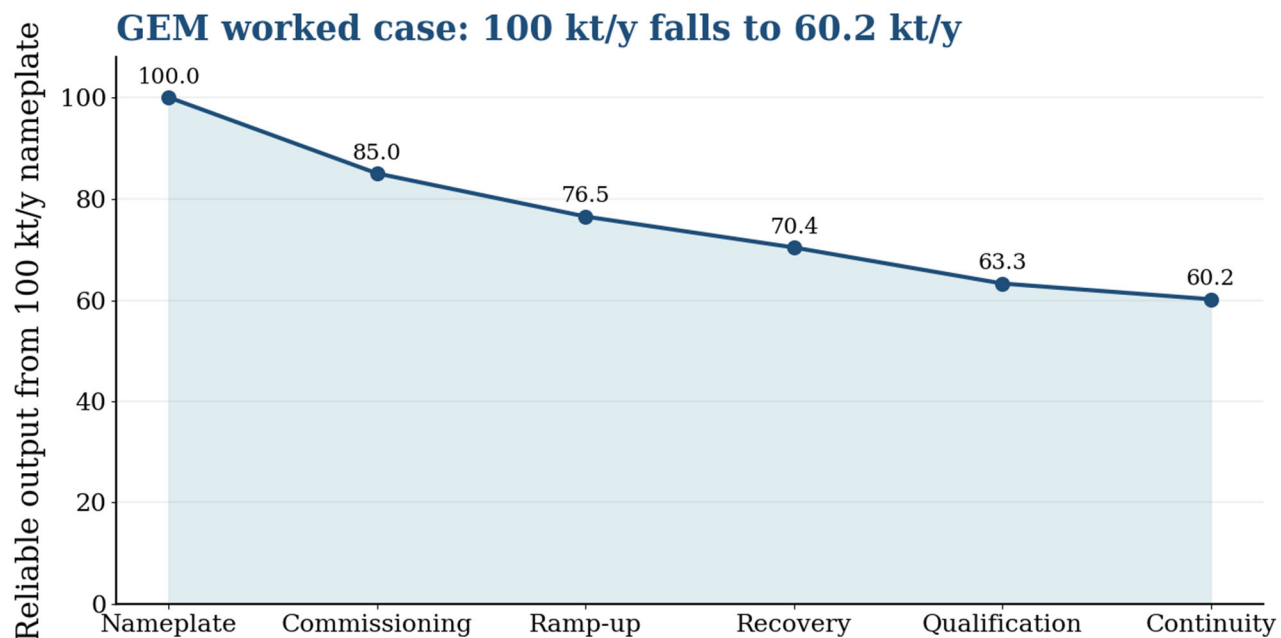


Figure 3. GEM worked case: a 100 kt/y nameplate project falls to 60.2 kt/y after sequential delivery and continuity gates. The factors are transparent case assumptions, not market averages or forecasts.

From Nameplate to Continuity

Gated view of GEM case output and the key management questions at each stage.

 GATE	 GEM CASE OUTPUT (kt/y)	 QUESTION FOR MANAGEMENT
① Nameplate ↓	100.0	What is the saleable product capacity?
② Commissioning ↓	85.0	Will the project start by the target year?
③ Stable ramp-up ↓	76.5	Can throughput and recoveries stabilise?
④ Recovery and quality ↓	70.4	Will output meet specification consistently?
⑤ Qualification ↓	63.3	Will customers accept and pay the modelled price?
⑥ Continuity	60.2	Can power, water, reagents, logistics and maintenance sustain output?

This arithmetic changes how projects are presented. A junior with a smaller resource but a validated process route, qualified product and credible infrastructure can be strategically stronger than a larger resource with no conversion pathway. For lenders and offtakers, the relevant output is not the reserve or nameplate figure alone, but the expected qualified tonnes available in the target market and year.

What this means for decision makers

Stakeholder	Decision implication	Evidence to require
Producers	Use Volume Scarcity and Chain Fragility separately in portfolio reviews; probability-weight project delivery and continuity.	Permits, committed finance, construction status, process performance, qualification and infrastructure redundancy.
Juniors	Prove the product route before marketing scarcity. A resource without processing, power, reagents, logistics and customers is not yet strategic supply.	Pilot results, impurity control, recovery, customer tests, offtake and a route to scale.
Offtakers and lenders	Contract at the specification-qualified product stage and stress supplier replacement time, not only supplier share.	Qualification lead time, inventories, alternative routes, counterparty diversity and continuity plans.
Governments	Match the policy tool to the binding constraint: infrastructure and permitting for volume gaps; processing, offtake and capability support for fragile chains.	A demonstrated market failure, additional supply, private co-investment and measurable performance.
Mining suppliers	The highest-value opportunities sit in conversion and reliability: laboratories, modular plants, critical equipment, water, power, reagents and digital monitoring.	Reduced ramp-up time, higher recovery, lower downtime and transferable capability.

The public message

Reserves are not supply. A tonne becomes strategic only when it can be financed, permitted, mined, processed, qualified and delivered through a resilient chain. That is why copper can face the clearest global volume deficit while graphite and magnet rare earths remain the most fragile supply chains.