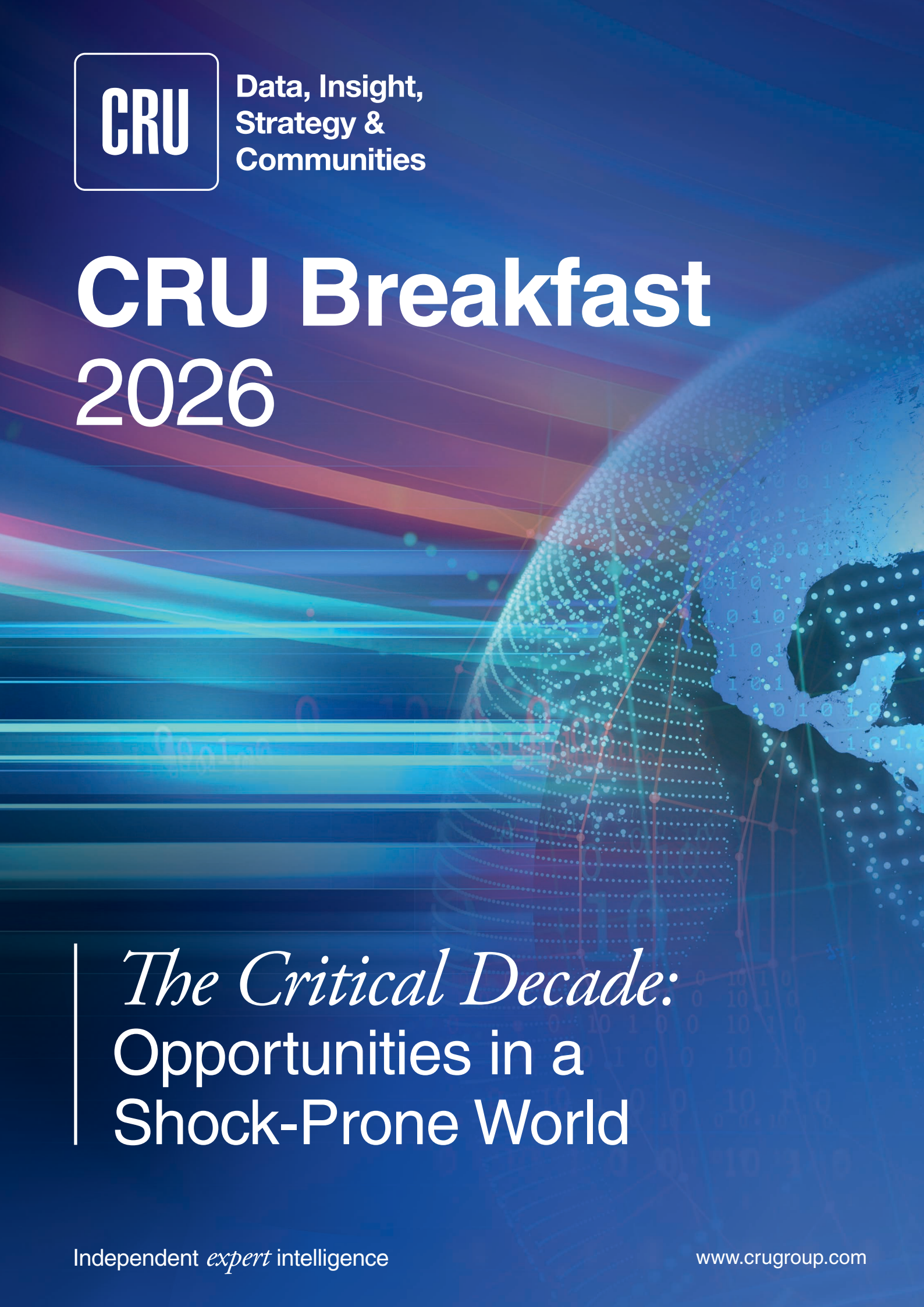
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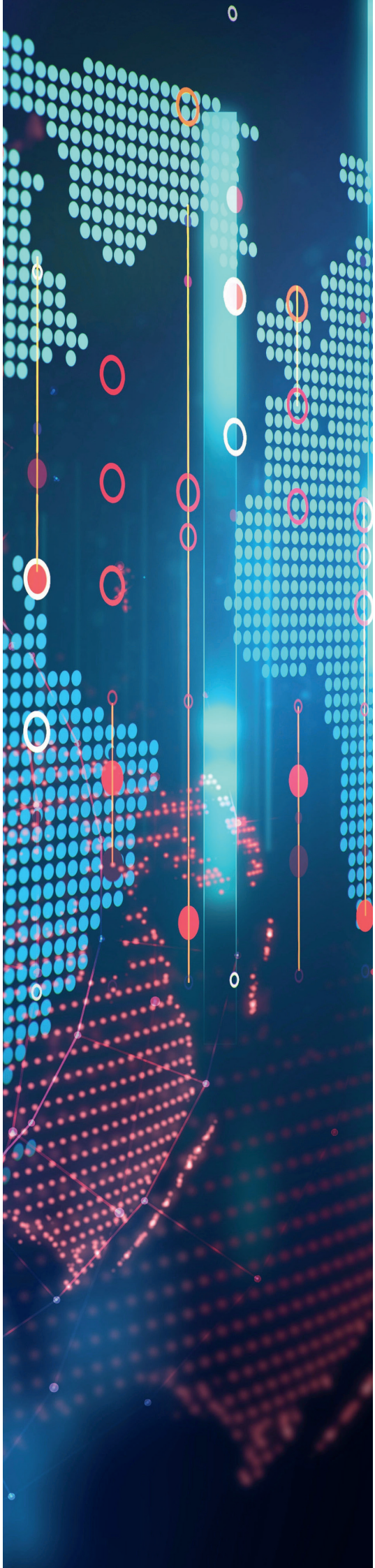
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EDITORIAL

Welcome!

Welcome to the CRU Breakfast Companion. As we once again bring together industry leaders, investors and strategic thinkers, we hope this supplement adds context and insight to your conference experience. This year's theme "The Critical Decade: Opportunities in a Shock-Prone World" reflects a simple reality – turbulence in commodity markets is no longer the exception, it is the operating environment. Every shock creates risks, but also opportunities for those who are well-informed.

2026 put that to the test. The most far-reaching shock was the Middle East conflict and the Strait of Hormuz closure. Together, they constrained Gulf aluminium supply and spread through sulphur and sulphuric acid markets into nickel, cobalt, copper and zinc. Governments are playing a growing role in determining marginal supply – from Indonesian ore quotas and DRC export allocations to US trade policy. The latter pulled large volumes of cathode into the US in anticipation of tariffs on refined copper. Today, where metal is located matters as much as how much of it exists.

Some shifts came with early warning. Our zinc analysis signalled China's progression to self-sufficiency a year ago. Our cobalt outlook expected both the early-year squeeze (following the DRC's quota implementation) and the easing that came later. For copper, we identified the supply concerns and US stockbuilding behind the price spike, even if its scale and persistence went further than expected. Other shifts took markets beyond our base case – lithium and aluminium went into deficit, nickel moved towards balance and refined zinc tipped into a surplus concentrated in China. Each outlook in this Companion sets out what we expected, what changed and why.

Looking ahead, the decade's shape is coming into focus, though new shocks will continue to test it. We expect nickel and cobalt to stay broadly balanced in the near term, while other markets loosen – aluminium towards a substantial surplus in 2027; lead as high stocks and growing recycled supply weigh on the market; and lithium later in the decade as investment arrives. Where disruptions ease, production costs will do more to anchor prices, while government decisions on quotas and tariffs remain a key swing factor. Beneath these shifts, the structural pull of demand remains intact. Electrification, energy storage, grid expansion and data centre build-out are meeting supply chains that run on very different clocks, and copper's later-decade balance rests on projects not yet fully sanctioned.

As you read, consider where these risks and opportunities meet your own business – your exposures, your supply chains, your hedging and procurement choices. CRU Breakfast is your chance to explore these questions with our experts and fellow industry leaders. Remember, the conversation doesn't end when the event does. Our team is here to help you discover how our insights apply to your markets and how to turn uncertainty into advantage. ■



By **Chris Asgill,**
VP, Market Analysis & Forecasts,
London, UK, **CRU**

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EVENT

Agenda

8:45

Metals in Transition and Regional Premiums



Alex Tuckett,
Head of Economics

9:10

How CRU Regional Premiums Helps You Understand Shocks and Trends



Chris Lawson,
VP Market Intelligence and Prices



Tom Rutland,
Head of Non-ferrous Metals

9:35

Managing Risk in Practice



Matthew Perlman,
Senior Innovation Manager

10:00

Networking Opportunity

10:30

CRU's Global Outlooks pt.1 - Forging the Future

Charlie Durant,
Research Manager, Analysis & Forecasts



Frank Nikolic,
Research Principal, LME & Precious Metals



Sam Adham,
Head of Battery Materials



Jennifer Tong,
Principal Consultant



Zaid Aljanabi,
Head of Aluminium Products



10:55

CRU's Global Outlooks pt.2 - Fault Lines in Supply



Kaitlin Gebbie,
Senior Consultant



Wan Ling,
Research Principal, Aluminium



Erik Heimlich,
Head of Copper & Zinc Markets



Nikhil Shah,
Principal, Nickel Market Service



Martin Jackson,
Head of Battery Materials Markets

11:20

Creating Value in Uncertain Times

Ben Carstein,
Asset Data Product Manager



11:45

Networking Opportunity

FEATURE

Impact of War and Geopolitical Tensions on Mining Costs



By **William Tankard,**
Research Principal, Assets,
London, UK, CRU

Geopolitical tension and trade friction are creating ripples and challenging the ability and cost of producing raw materials our global economy needs. These complexities make the landscape of 'supply-side' dynamics highly nuanced with specific geographies and technology exposed to pronounced change. As a result, instances of margin compression and expansion across industries now lack some of the predictability that existed before the de facto closure of the Straits of Hormuz.

In the following insights, expert members of CRU's Assets team evaluate some of these themes, exploring competitiveness challenges within Latin America's two copper majors. Follow the QR code to read about the travails of Indonesia's burgeoning HPAL nickel industry facing shortages of first sulphuric acid and now potentially of process water, and of bifurcated fortunes across the lithium industry.

These times of uncertainty call for trusted expertise as well as scenario analysis to help navigate and model outcomes as the landscape evolves. For further information on how CRU can help, please speak to us or contact your account manager.



INDUSTRY INSIGHT

Chile and Peru's competitive positioning amid rising geopolitical tensions

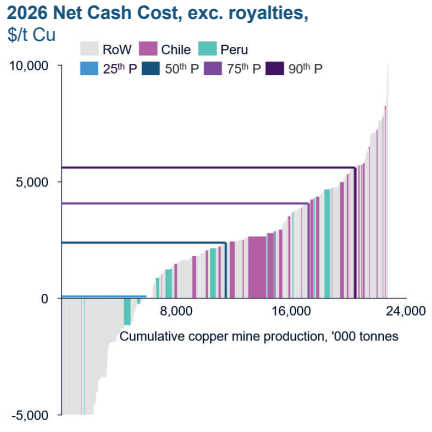
Chile and Peru appear as high-cost countries on the Net Cash Cost curve for 2026, but Cash Costs, ex-royalties, ex-works frame a different story. Labour and fuel productivity still give the region an edge, though unit prices and rising acid costs put future competitiveness in question.

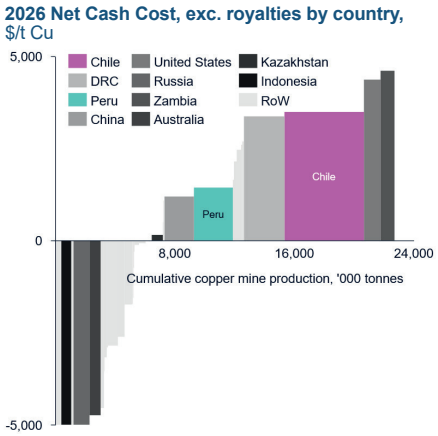
Structural changes in the global economy are reaching the copper industry on several fronts simultaneously – the precious metals rally, macro-driven copper price momentum, and rising costs across key drivers as geopolitical tensions intensify are all contributing to a paradigm shift. That prompts rethinking how competitiveness is assessed – and where capital is best deployed – with future demand set to outstrip committed production. For more detail on the forecast, see **CRU's Copper Long Term Market Outlook**.

A principal indicator of asset competitiveness is CRU's Net Cash Cost, excluding royalties. This measure groups direct operating costs at the mine site (Cash Cost, ex-royalties, ex-works), realisation costs (freight, TC/RCs and marketing) and by-product credits. Therefore, it accounts for the asset as a whole – from production through to freight at port – and reflects all revenue streams rather than just copper alone, making it, at first glance, a well-rounded metric for competitiveness analysis.

The Net Cash Cost metric is highly relevant for mining companies, investors and future stakeholders seeking to understand an asset/company/country relative position on the curve, and specifically whether it sits below the 25th, 50th, 75th or 90th percentile – where a higher percentile denotes a less competitive cost position. However, as noted above, recent structural change has complicated that picture – most pertinently, the rally in precious metals (see our latest **Precious Metals Market Outlook**).

Chilean and Peruvian assets under Net Cash Costs pressure, sitting in the upper percentiles



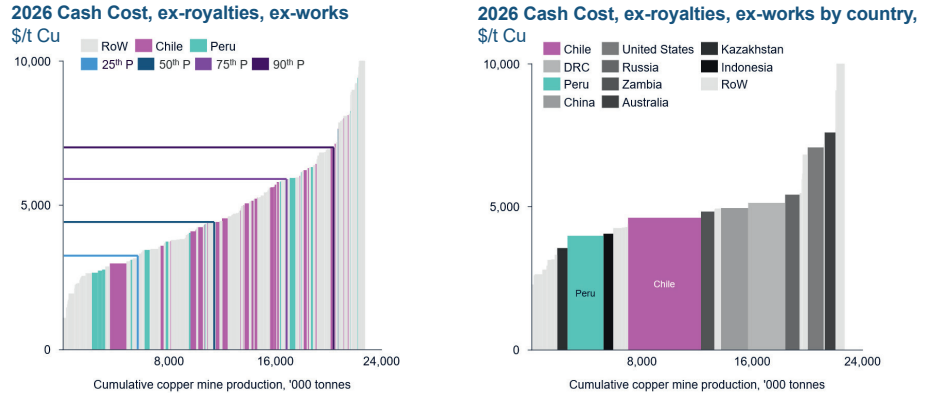


DATA: CRU Copper Mine Asset Services, CRU Macro 2026 Q2

"Labour and fuel productivity still give the region an edge, though that advantage is narrowing."

On 2026 Net Cash Costs, Chile and Peru – Latin America's leading producers – have not benefited to the same extent as jurisdictions with more polymetallic geologies such as Indonesia, Russia and Australia, which now all post negative average Net Cash Costs – with both Chile and Peru approximately book-ending the 3rd quartile based on the latest results from CRU's Copper Mine **Asset Platform**. That is a clear sign the two countries are struggling to maintain their competitiveness, with their assets unable to capture the momentum in by-product credits, raising questions regarding their long-term industry position.

Chilean and Peruvian assets are more competitive on Cash Costs, placing lower on the curve



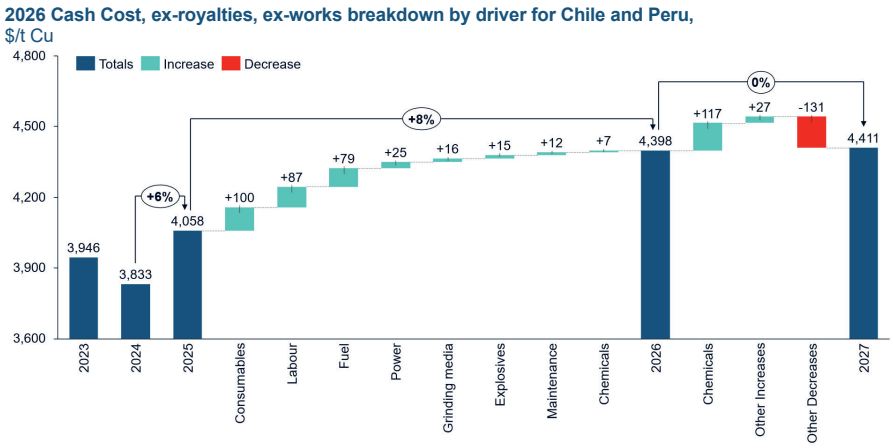
DATA: CRU Copper Mine Asset Services, CRU Macro 2026 Q2

> Rising labour and fuel costs are driving a second consecutive year of higher cash costs in 2026."

If we isolate the components of Net Cash Cost and focus only on Cash Costs – a foundational metric in CRU's methodology – a different cost curve emerges for 2026. Chilean and Peruvian assets are far more evenly distributed across this curve, appearing in each of the percentile bands above. At the country level, both now sit below the 50th percentile, a materially more competitive position.

This divergence points to a broader conclusion – the competitiveness of a company or an asset cannot be read from a single metric. It requires all cost components to be examined stage by stage. This Insight, therefore, examines the critical Cash Cost drivers in Chile and Peru against the global average, and the fundamentals behind the variations.

Chilean and Peruvian Cash Costs rise for a second year in 2026, driven by Fuel and Labour



DATA: CRU Copper Mine Asset Services, CRU Macro 2026 Q2

Average Cash Costs in Chile and Peru have fluctuated sharply in recent years, as a succession of geopolitical conflicts fed through to key cost drivers. Sulphur and sulphuric acid (Chemicals) unit prices rose steeply over 2025, and explosives markets came under pressure too, producing an

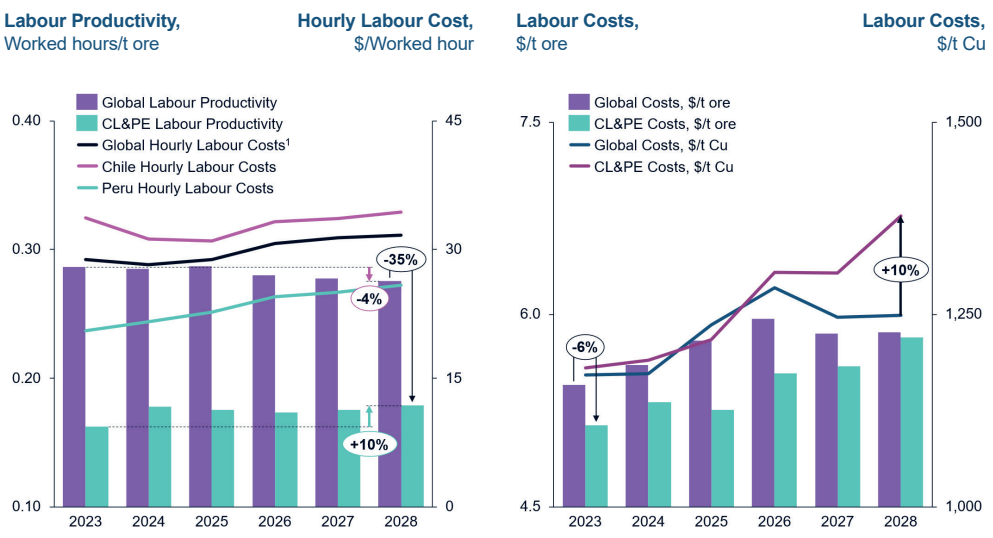
unsurprising 6% increase in Cash Costs between 2024 and 2025.

The intensification of US-Iran tensions in 2026 has since been felt in both oil prices, via the risk to traffic through the Strait of Hormuz, and sulphur prices – hitting the fuel and chemicals drivers simultaneously. Sulphuric acid faces added pressure from China's restrictions on exports, and our forecast points to a further 8% rise in 2026.

For Chile and Peru specifically, as the waterfall chart above illustrates, excluding consumables – an item that aggregates several drivers but carries little explanatory value in isolation – the 2026 increase is led by labour and fuel. Looking further out, our 2026 Q2 macroeconomic outlook, which assumes the effects of the Middle East conflict unwind by 2027, points to broad-based cost deflation across most inputs, offset in both countries by significant increases in sulphuric acid, where prices are expected to reflect the shock with a one-year lag.

On that basis, we examine these three drivers – labour, fuel and sulphuric acid – in turn. For each, we analyse consumption/productivity, unit prices and cost trends, distinguishing between costs per ton of ore and per ton of copper, and benchmarking both countries against the global average.

Chile and Peru lead on labour productivity, but labour costs erode the advantage



DATA: CRU Copper Mine Asset Services, CRU Macro 2026 Q2. Note: Global Hourly Labour Costs include a weighted average of Chile, DRC, Peru, China, the U.S.A., Canada, Europe and Australia.

Labour

On productivity – measured as worked hours per ton of ore – Chile and Peru both sit below the global average. The global trend has been, and is expected to remain, relatively stable, with variations of less than 5%. By contrast, both South American countries are on an upward trend, pointing to an erosion of competitiveness – though with a 35% gap to the global average, they retain considerable headroom.

That productivity edge does not carry over to unit prices. Hourly labour costs in both countries diverge from the global average, with Peru the more acute case: up 20%, against 10% globally, between 2023 and 2028. Chile's profile is steadier but starts from a higher base. Both are forecast to see marked increases in 2026, driven by minimum wage policy, a trend echoed elsewhere in Latin America, as well as by union negotiations.

That raises the question of how long regional prices can remain competitive, particularly against the

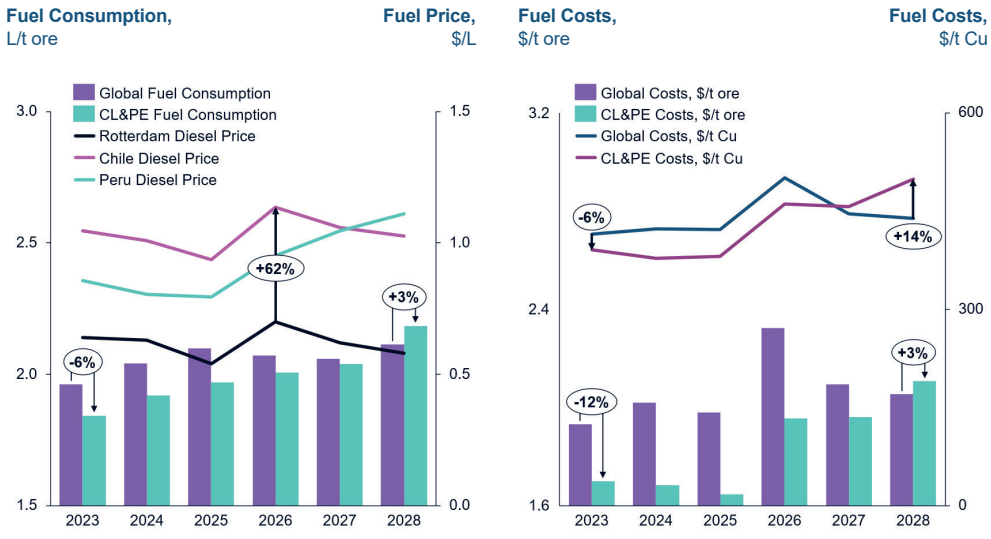
DRC and China, at $1 and $14 per worked hour, respectively, in 2026.

Translating this into overall costs, the picture depends on the denominator. On a per-ton-of-ore basis, Chile and Peru started the period 6% below the global average, a gap that narrows to 1% by 2028. Movement in both underlying metrics is dragging costs towards the global average, with competitiveness largely eroded by 2028.

On a per-ton-of-copper basis, accounting for Chile and Peru's relatively low average head grades, the outlook is worse. Both countries hold costs below the global average until 2025.

But from 2026, the increases in worked hours and hourly costs begin to bite. Compounded by stagnating levels of copper production in both countries reversing the advantage in 2025, opening a 10% gap to the global average by 2028.

Rising fuel consumption rates will push Chile & Peru above global average fuel costs



DATA: CRU Copper Mine Asset Services, CRU Macro 2026 Q2

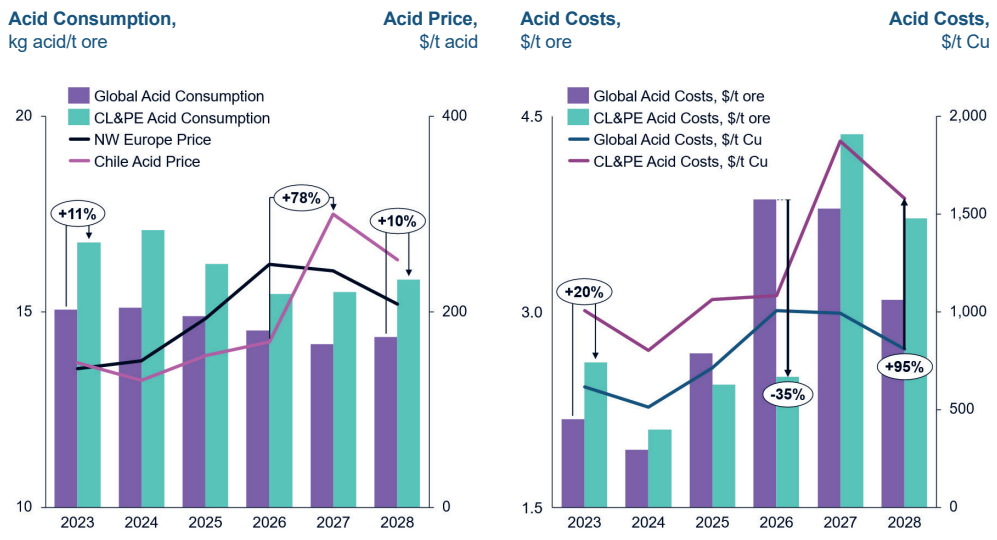
Fuel

On consumption, the position is more competitive for the South American powerhouses, with the gap to the global average narrower than for labour productivity. That advantage is likely to be short-lived, as the increase in Chile and Peru is steep enough to close the gap entirely and push unit consumption above the global average by 2028.

On unit prices, expressed per litre, the picture is more challenging, with increases of 20% in both countries in 2026. Local policy measures to ease the impact on miners have been under discussion, but the Middle East shock has already fed through. Plus, even if the conflict eases, prices in Chile and Peru are expected to hold above $1 /litre – ahead of 2025 figures – to 2028 at least.

On costs, the upward trend is clear on a per-ton-of-ore basis, with both countries moving above the global average. Global indicators fall significantly by that point but forecast prices in Peru do not follow them down – Chile does, though from a higher base – and the crossover in consumption compounds the effect. The same pattern holds for a per-ton-of-copper basis, where flat production in both countries against global growth widens the gap considerably: 3% per ton of ore, against 14% per ton of copper.

Early-year contracts delay the Middle East effect on acid prices, pushing up 2027 costs



DATA: CRU Copper Mine Asset Services, CRU Macro 2026 Q2. Note: Acid Costs in $/t Cu only consider SXEW operations.

Sulphuric acid

On consumption, this is the least competitive of the three drivers against the global benchmark, with Chile and Peru sitting some 10% above the average – a gap that holds broadly constant over the period. However, measured against other key SXEW markets, the two countries retain a clear advantage – unit consumption runs at 16 kg acid/t ore, against 40 kg acid/t ore in Africa. Because LATAM countries process considerably more ore, total regional consumption is nonetheless higher, at 8,400 kt in Chile and Peru against 5,100 kt across Africa.

On unit prices, the Middle East conflict has lifted key acid markets sharply, with NW Europe up nearly 30% in 2026. The increase in Chile has been comparatively modest to date, holding close to the pre-conflict forecast. With 40% of consumption imported, an immediate pass-through might have been expected as Chilean spot prices reached $500 /t. However, roughly 80% of requirements sit under fixed contracts negotiated at the start of the year, concentrating the shock in marginal volumes. The adjustment will land in earnest by 2027, when the Middle East shock and China's export restrictions combine to drive prices up 78%. For a more detailed assessment, read CRU's **Sulphuric Acid Market Outlook**.

On costs, less competitive unit prices and higher consumption will leave the region uncompetitive on a per-ton-of-ore basis, with a gap of close to 20% in 2028. Faster growth in global prices than in Chilean and Peruvian prices between 2025 and 2026 allows for some respite before Chile's sharp price growth in 2027 restores the earlier trend. On a per-ton-of-copper basis, costs in Chile and Peru remain above the global average throughout. The gap narrows in 2026 but widens materially thereafter, reaching 95% by 2028 – a level that calls the competitiveness of regional SXEW operations into question.

Major operations are already set to close their SXEW lines between 2030 and 2032, Chuquicamata and Centinela among them, and lower grades and recoveries from ageing deposits compound the cost pressure. Taken together with permitting constraints, this raises a broader question over the future of the processing route in the region – one that rests on emerging technologies, sulphide leaching foremost among them.

Drawing on the analysis of these three drivers, Chile and Peru retain an edge on consumption and productivity in 2026. However, that edge is narrowing as geological constraints take hold, and the

> Sulphuric acid costs are set to rise sharply in 2027 as contracts reset and market pressures take hold."

unit price disadvantage is harder to address, with both countries sitting above other key markets. Facing the future cost challenge will require operations to adopt new technologies or process optimisation to offset current consumption trends.

Chile and Peru may be competitive today, but retaining that position is far from assured – particularly at a point when more metal is needed, and committed production in both countries is expected to remain flat over the forecast period. That raises the question of whether the region can meet the challenge and remain attractive enough to attract new capital. Cash Costs will be a key metric by which opportunities are judged, with underlying consumption and unit price dynamics that support a competitive analysis at a more granular assessment underpinned by CRU's Copper Mine Asset Platform services.

AUTHORS



By **Nicolas Rojas,**
Analyst, Copper Mining Assets,
Santiago, Chile, CRU



By **William Tankard,**
Research Principal, Assets,
London, UK, CRU

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VALUE CREATION

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Every mining investment begins with a view of the future. Once capital has been committed, investors, lenders and operators need to understand whether the investment delivered the expected value, what can influence the result, and what lessons should inform the next decision.

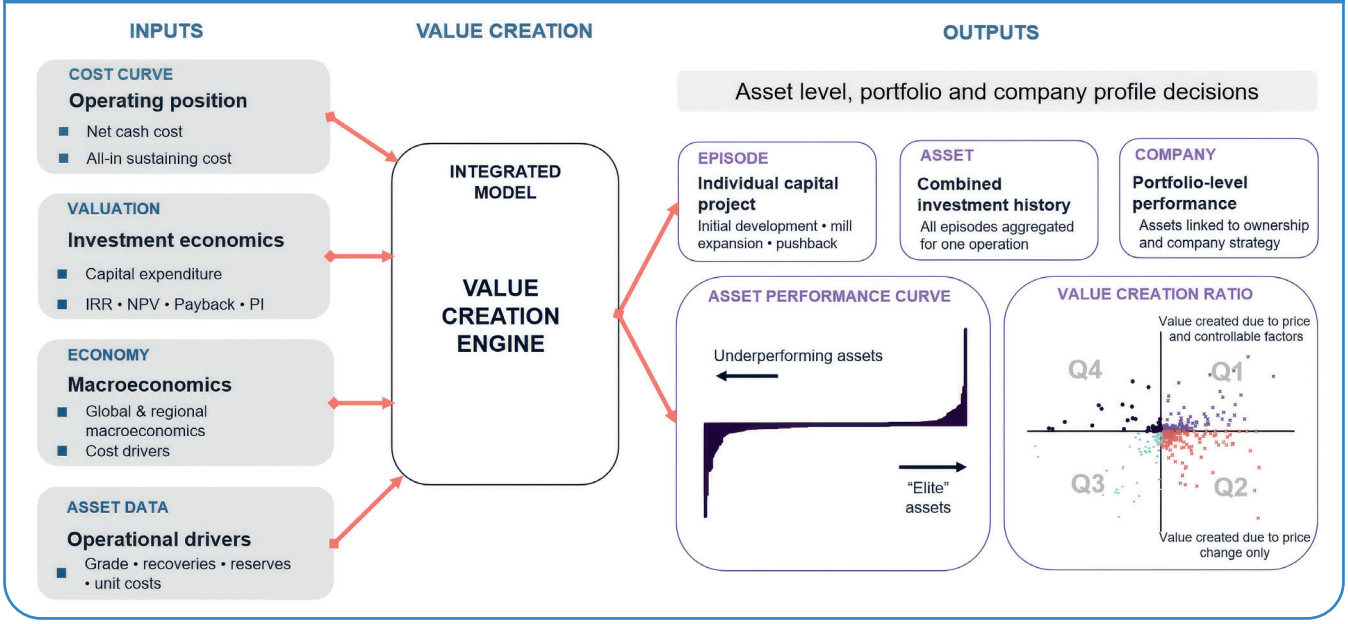
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FEATURE

Copper Concentrate - a new commercial paradigm



By **Chris Lawson,**
VP, Market Intelligence & Price,
London, UK, CRU

The upstream copper industry has changed dramatically in a short period. Smelting economics have shifted, with revenues increasingly dependent on by-product sales; competition for concentrate supply has intensified; and the industry is moving rapidly away from its legacy 12-month benchmark pricing model.

CRU is tracking this evolution, providing the data, analysis and insight clients need to navigate a fast-changing market. This year, we expanded our coverage with weekly copper concentrate treatment charge (TC) assessments.

The timing has proved significant. Treatment charges have continued their remarkable decline into deeply negative territory -meaning smelters are effectively paying miners to process their concentrates. At the same time, the spread between Miner/Trader and Trader/Smelter treatment charges has widened to exceptional levels.

These developments reflect an increasingly competitive market amid shortfalls of concentrate. Pricing structures are changing quickly. While spot material is becoming modestly more available, the more consequential shift is towards indexation. We estimate that almost 40% of concentrate trade could be priced against an index in 2027, with purchases referencing CRU and other industry price reporting agencies' treatment charge assessments.

INDUSTRY INSIGHT

The CRU Advantage: Using Copper cost tools to optimise commercial outcomes

Market intelligence is paramount for achieving optimal commercial outcomes in copper concentrate buying, selling and trading. This applies to understanding global and regional supply-demand dynamics, production costs for sellers, processing costs for buyers (to convert concentrate into finished products), and the understanding of the transaction value levers.

CRU empowers informed decision-making through our industry-leading copper cost analysis tools. The CRU Copper Minesite Cost Analysis Tool and CRU Copper Smelter and Refinery Cost Analysis Tool provide a granular breakdown of cost and revenue drivers in a typical copper concentrate transaction. Understanding this cost structure will allow you to negotiate with greater intelligence, ultimately securing more favourable commercial terms.

This insight leverages real-world data obtained from CRU's cost analysis tools. To ensure confidentiality, we have anonymised the names of the specific assets involved. For consistency, all calculations are presented in US dollars.

Significant Value Is Being Negotiated When Selling Copper Concentrates

The figure below details the copper concentrate quality employed for this analysis. This is a clean concentrate that contains gold and silver. To calculate the value chain transaction, a production cost of $3,500 per tonne of copper (Cu) has been assigned.

Sample Copper Concentrate Quality

Element	Units	Value
Volume	wmt	40,000
Moisture	%	8
Copper	%	32
Gold	g/t	15
Silver	g/t	150

DATA: CRU

Traditionally, sellers initiate a request for quotation (RFQ) process to engage the market. This involves inviting targeted buyers, such as smelters and traders, to submit bids. Ideally, sellers possess prior knowledge of potential buyers with the interest, capacity and capability to process their concentrate.

> "Understanding the cost structure allows you to negotiate with greater intelligence and secure more favourable commercial terms."

CRU's database of smelters and refineries serves as a valuable tool in this regard, enabling sellers to make informed decisions when selecting participants for the RFQ process.

The seller receives purchase terms from each interested buyer. The analysis presented in this Insight uses a single offer term to simplify the calculation. The concentrate purchase terms for this concentrate are shown below. This set of terms was provided to CRU by a market participant for use in this Insight and represents actual offer terms in the market for a clean concentrate at the time such an offer was made. Actual market terms will change from time to time depending on market specificities:

Dynamics: Market conditions for copper concentrate significantly influence the offered terms, with the **CRU Copper Concentrate Service** providing insights into market dynamics.

Buyer Specifics: Different buyers may have unique terms based on their business needs.

Contract vs. Spot: Terms for long-term contracts may differ from those for spot purchases.

Concentrate purchase terms are typical for a clean concentrate at the time of tender

Term	Payable	Minimum Deductible
Copper	96.5% of the final agreed content	1 unit at LME Grade A for grades below 29.85%
Silver	90%	30 g
Gold	96%	1 g
Treatment Charge	$80 / dmt	
Refining Charge for Copper	$c 8 / lb payable	
Refining Charge for Gold	$4.00 / oz t payable	
Refining Charge for Silver	$0.35 / oz t payable	

DATA: CRU

The commodity prices used to calculate the metal values within the concentrate. These prices are:

- Copper: $9,000 per tonne (t)
- Gold: $2,000 per troy ounce (oz t)
- Silver: $25 per troy ounce (oz t)

For reference, the contained metal value in the concentrate, based on these prices and the contained metal value determined using the offer terms, are presented below.

Calculation results in a seemingly good return – but this can be optimised

Element	Quality	Contained	Contained Value $M	Payable given min. deductible %	Returned Value $M	Charges $M	Net Payable Value $M
Volume	40,000wmt	36,800dmt				2.94	-2.94
Copper	32%	11,776 t	105.98	96.5%	105.98	2.00	100.27
Gold	15 g/t	17,747 oz t	35.49	93.3%	35.49	0.07	33.06
Silver	150 g/t	177,472 oz t	4.44	80%	4.44	0.05	3.50
Totals			**145.92**		**138.95**	**5.06**	**133.89**

DATA: CRU

The calculation above yields a critical metric for evaluating competing offers – the percentage of net payable contained metal value. In this example, this metric indicates that 91.8% [(133.89 / 145.92) x 100] of the net payable amount to the concentrate seller reflects the value of the contained metal.

This metric plays a vital role in streamlining the buyer selection process following an RFQ. It facilitates the identification of a shortlist of potential buyers based on the offers received. Subsequent negotiations can then be pursued with these shortlisted buyers to secure the most favourable terms that maximise the seller's share of the overall value. Moreover, the settlement process for selling concentrate includes the weighing, sampling and moisture determination (WSMD) either at the discharge or loading port.

Commercial outcomes can be further optimised by understanding the smelter and refinery

In this example, CRU's copper smelter and refinery database is used to randomly select a smelter and refinery that is suitable for processing this concentrate. The database hosts all smelter and refinery copper assets; and the accessible market for this concentrate (given its clean quality) is significantly larger.

In this example, an integrated smelter and refinery complex is selected. Furthermore, smelters and refineries generate additional revenues through the sale of products created from the concentrate, such as sulfuric acid. Additionally, some smelters generate excess electricity which is sold back to the grid. In this example, the smelter has significant sulphuric acid credits which is captured in the credit line. The selected smelters and refineries, together with key operating costs and parameters, are shown below.

Selected Smelter and Refinery Costs

Element	Units	Value	Assumed Nature of Element
Labour Cost	c/lb	5.26	Fixed
Electricity Cost	c/lb	3.47	Variable
Fuel Cost	c/lb	3.47	Variable
Maintenance Cost	c/lb	2.98	Fixed
Consumables Cost	c/lb	7.75	Variable
G&A Cost	c/lb	5.24	Fixed
Operating cost	c/lb	29.38	
Credits	c/lb	21.89	Variable
Net Operating Cost	c/lb	7.42	

Key Operating Parameters

Parameter	Units	Example 2: Integrated Integrated Smelter	Integrated Refinery
Feed	kt	1100	340
Cu Production	kt	290	289
Cu Recovery	%	97.4%	
Gold Recovery	%	98.5%	
Silver Recovery	%	98%	

DATA: CRU

Smelters and refineries have hidden revenue drivers

Smelters and refineries generate additional revenues from the copper concentrate that are not part of the payable terms. In order to completely tabulate the value of the concentrate to the buyer, a new term is introduced, the Accessible Value Pie.

> The Accessible Value represents the complete value of the concentrate and the revenue levers available to the buyer."

This represents the complete value of the concentrate given the buyer's various levers to extract revenue, and therefore forms what is fundamentally available for distribution to each party involved. The particulars of the smelter and refinery will determine how big the Accessible Value Pie can become. Furthermore, how much of this is available to the seller and buyer of the concentrate may be different due to factors influencing their respective negotiation positions. A detailed explanation of the Accessible Value Pie calculation is provided below.

Understanding the Actionable Value Pie

Calculation Element	Value $M	Explanation
Contained Metal Value in Concentrate	145.92	This is the contained value of the concentrate for the payable metals.
Less Cost to Produce Concentrate	41.22	All-in mine and concentrator cost ($3,500/t Cu)
Less Cost to Smelt and Refine Concentrate	3.87	The volume of concentrate being offered is incremental to the smelter and refinery, only variable costs are considered.
Less Process Losses (Unrecoverable Metal)	3.38	This is lost by the smelter and refinery and is not recoverable without slag reprocessing. In this example, no slag reprocessing takes place.
Add Cu Cathode Premia	2.0	The copper cathode premium represents a revenue stream retained by the seller of the copper cathode, typically a smelter or refinery that also acts as the buyer of copper concentrate. This premium reflects the added value created by the smelting and refining process, which transforms raw concentrate into a usable finished product – recovered copper metal. For illustrative purposes, this example assumes a cathode premium of $8 per pound.
Add Sulfuric Acid Margin	5.53	Sulfuric acid is produced from the sulphur in the copper concentrate and there is typically a positive margin associated with the activity.
Add Minor Metals Margin	0	The distinction between minor and deleterious elements in concentrates impacts their commercial viability. Smelters may not compensate for minor elements, but they can be recovered and sold separately. Conversely, deleterious elements often incur processing charges due to their negative impact on the smelting process. In both scenarios, the smelter realizes a margin. This is explored in more detail below
Add Deleterious Metals Margin	0	
Maximum Value Pie	**104.98**	
Seller Accessible Value Pie	**97.45**	In this example, seller does not access Cu Cathode Premia or other credits
Seller Accessible Value Pie	**97.45**	In this example, the buyer has access to the Maximally Available Value Pie

DATA: CRU

Under the agreement, the concentrate buyer retains a portion of the payable metal. The seller incurs a separate processing charge for the material. Additionally, the buyer receives the full cathode premium, and any other credits associated with the concentrate such as sulfuric acid or minor metals. These combined elements represent the buyer's share of the 'Accessible Value Pie,' with the remaining portion going to the seller. A tabular representation of this breakdown is shown below.

The calculations highlight a greater access to additional value for the buyer

Calculation Element	Value $M	Explanation
Pay Metals Retained by Buyer	3.59	Smelter/Refinery Recovery less Payables
Add Treatment and Refining Charges	5.06	The volume of concentrate being offered is incremental to the smelter and refinery, only variable costs are considered
Add Cu Cathode Premium	2.0	Copper cathode premium is retained by the seller of the copper cathode, which in this case is the buyer of the concentrate. It is a direct result of making concentrate available to the buyer but is typically not made available to the concentrate seller. A cathode premium of $c 8/lb is used for this example.
Add Other Credits	5.53	
Value to the Buyer	**16.18**	**Sum of the above items**
Value to the Seller	**88.8**	**Maximum Value Pie less Share to the Buyer**

DATA: CRU

The analysis can yield additional statistics about the transaction, particularly margins for each party. The margin is calculated as follows: (Total Revenue less Operating Cost) / Total Revenue. This is tabulated below.

A buyer of concentrate has higher margins than the seller

Calculation Element	Transaction Margin	Share of Maximum Accessible Value Pie	% Return on Contained Metal Value
Seller of Concentrate	69%	85%	92%
Buyer of Concentrate	75%	15%	8%

The above calculation is the starting point of the negotiation. Further optimisation of the negotiated outcome is possible when bringing certain components of the buyer-only accessible value pie into the payable term sheet; and making this part of the accessible value pie for the seller. In the case discussed here, including a share of the copper cathode premium (as well as the margins generated on sulphuric acid sales) would result in an improvement in the margins. This sophisticated fine-tuning of the negotiation is possible through an understanding of the smelter and refinery processing and available value levers.

Smelters and refiners have levers to maximise the value of the concentrate which adds to their margins

Copper smelters process minor and deleterious elements present in the concentrate feed through various techniques and technologies.

These elements, such as arsenic (As), antimony (Sb), bismuth (Bi), lead (Pb), and zinc (Zn), can be found in the concentrate feed due to the natural presence in the ore or because of the smelting process itself. The main methods used to remove these elements include:

1. Feed preparation: Copper smelters use feed preparation techniques, such as blending and mixing, to ensure the feed materials are compatible with the smelting process. This helps to minimise the presence of minor elements in the feed and improve the overall efficiency of the process.

> Bringing buyer-only value levers into the payable terms can improve the seller's share of the transaction value."

The mineralogical composition of the concentrate can affect the ease of separating the impurities. For example, arsenic is more easily removed from the copper circuit due to its high volatility, while antimony is not readily removed due to its lower partial pressure.

2. Smelting processes: The primary smelting processes for copper, such as flash smelting and the ISASMELT process, are designed to remove impurities efficiently. These processes rely on high levels of volatilisation and strong bath agitation to promote the partitioning of impurities into the gas phase, which can then be removed through off-gas handling systems. The most efficient copper smelting processes for removing minor and deleterious elements are those that employ high oxygen partial pressures and calcium ferrite slags. These techniques are more effective than converting furnaces in removing arsenic (As) and antimony (Sb) from the copper concentrate feed.

3. Slag chemistry and properties: The presence of minor elements in the slag can influence the slag chemistry and properties, such as surface tension and liquidus temperature. By understanding the behaviour of minor elements in copper smelting processes, it is possible to optimise the smelting process and maintain the desired final grade of the copper cathode.

4. Electrolysis: In the final stage of copper production, electrolysis is used to produce copper cathodes from copper anodes. The presence of minor elements in the anodes can lead to the formation of floating slimes in the electrolysis tanks, which can cause short circuits and the inclusion of minor elements in the cathode. To avoid these problems, the copper industry has established accepted levels of minor elements in copper cathodes, such as 65 ppm for a Grade A cathode.

5. Waste treatment: Copper smelters also employ waste treatment technologies, such as gas cleaning and slag treatment, to remove impurities from the off-gas and slag. These technologies help to reduce the environmental impact of the smelting process and improve the overall sustainability of copper production. Copper smelters can make money from removing minor and deleterious elements from the copper concentrate feed through several mechanisms:

- **Penalties and credits:**
Smelters can impose penalties on the miner/supplier if the concentrate contains high levels of certain impurities like arsenic, bismuth, lead, or tungsten. Penalties help offset the additional costs of removing these elements.

  Conversely, smelters can provide credits to the miner/supplier if the concentrate contains valuable minor elements, like gold or silver, above a certain threshold. This allows the smelter to recover and sell these valuable by-products.

- **Improved copper recovery and product quality:**
By effectively removing minor and deleterious elements, smelters can improve the overall copper recovery rate and produce higher-quality copper products, such as copper cathodes, that command higher market prices.

- **Recycling and reuse of waste streams:**
Smelters can generate revenue by recycling and reusing the waste streams containing minor elements, such as off-gas solids and slag. These materials can be further processed to extract and recover valuable metals.

- **Regulatory compliance and environmental benefits:**
Effective removal of impurities helps smelters meet environmental regulations and reduce the environmental impact of their operations. This can lead to cost savings and potentially generate revenue through carbon credits or other green incentives.

- **Technological advancements and process optimisation:**
Investments in advanced technologies and process optimisation techniques to improve impurity removal can provide a competitive advantage for smelters, allowing them to have higher treatment or attract more concentrate supply.

CRU's offers various must-have "tools of the trade" that enable better commercial outcomes. The cost analysis outlined in this Insight would be conducted in parallel for each potential partner during the bid negotiation stages. By understanding each party's cost structure, and the accessible value available to both sides while approaching the negotiation with a deep understanding of the transaction dynamics, both buyers and sellers can explore and test options to optimise their margins.

Additionally, CRU covers emissions for all the smelters and refineries in our cost database. Carbon footprint has become an important variable to consider as part of the negotiation process, given the increasingly strict carbon requirements towards Net Zero.

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Abdulnasser Bin Kalban

CEO, Emirates Global Aluminium

*by **Thomas Willatt**, Projects Director, Communities, CRU.*

CRU looks at this as a "critical decade" for commodities. How do you distinguish between structural trends in aluminium – such as decarbonisation and recycling – and the short term shocks from geopolitics, power markets or smelter outages, and where do you see the biggest opportunities in a shock prone world?

We see a clear distinction between long-term structural shifts and short-term market disruptions. Decarbonisation, recycling and the growing demand for responsibly produced aluminium are fundamental changes that will continue to shape our industry for decades.

At the same time, geopolitical developments, energy-market volatility and operational disruptions are accelerating the need to build a more resilient industry. They reinforce the importance of diversifying supply chains and logistics routes, strengthening local capabilities, increasing recycling, and using technology to make existing operations more efficient and adaptable.

In a more shock-prone world, we see significant opportunity in building resilience while continuing to invest for the future. For EGA, this means developing a more diversified global footprint, expanding recycling capacity closer to customers and scrap supplies, advancing low-carbon primary aluminium production, and continuing to improve the efficiency and flexibility of our operations through technology.

From EGA's position as an integrated alumina to metal producer supplying more than 50 countries, what are the key forces now driving regional aluminium premiums, and how do you expect those differentials to evolve across major hubs through the decade ahead?

Regional aluminium premiums are increasingly shaped by a combination of physical supply and demand, energy costs, trade policy, logistics constraints and geopolitical disruption. We expect these factors to continue creating differences between major markets, while customers increasingly place value on security of supply and proximity, in addition to quality and carbon footprint of the metal they purchase.



Image: EGA

For EGA, our integrated value chain and global customer base provide important resilience in this environment. We supply customers in more than 50 countries, and we are continuing to diversify our logistics and supply chains while expanding our recycling footprint closer to customers in key markets, including the US and Europe.

Our strategy is not built around predicting short-term regional premiums nor their differentials. We focus on long-term business, building up partnership and conduct the bulk of our business on medium to long term contracts. We believe long-term success comes from geographic production and product diversification.

New demand currents around AI infrastructure, data centres, electrification, energy storage and grid expansion are reshaping aluminium consumption. Which of these themes do you see as most decisive for EGA's growth, and how are they influencing your product mix and customer base?

Electrification and the expansion of power infrastructure are among the most important long-term demand drivers for aluminium. AI and data centres are adding another significant source of electricity and grid investment. What matters for EGA is that these trends are not only increasing demand for aluminium – they are changing the type of aluminium customers want, with growing focus on lower-carbon products, recycled content and security of supply.

That is directly reflected in our growth strategy. We are expanding our global recycling business across the UAE, US and Europe, bringing production closer to customers and sources of scrap. Our acquisition of EGA Eco Green in Italy is the latest example, complementing our recycling operations in Germany and the US and our new recycling plant at Al Taweelah.

This positions EGA to capture growth in sectors where aluminium's combination of light weight, conductivity, recyclability and lower-carbon potential will be increasingly important.

On the supply side, where do you see the most important "fault lines" in aluminium,

> We believe long-term success comes from geographic production and product diversification."

> The question I would like investors to ask is: where can you create the most value from the next tonne of aluminium?"

and how is EGA responding across its operations in the UAE and its growing global recycling business in the UAE, Europe and the US?

The fault lines are logistics and geopolitical uncertainty. Recent events have reinforced the importance of building greater resilience and optionality across the value chain.

EGA is responding by diversifying our sources of raw material supply and improving the efficiency and flexibility of our UAE operations. We will continue working with authorities and partners to expand port options and strengthen inland transportation. We also have a strong foundation of raw material security, with close to half of our alumina requirements supplied by our Al Taweelah alumina refinery. We focus on continuously improving at all our assets through creep, including our alumina refinery.

At the same time, we are expanding our recycling footprint across the UAE, Europe and the US, which gives us a broader set of options to manage disruptions, serve customers closer to their markets and grow with a lower-carbon product mix.

In an environment of frequent shocks and more selective capital, how do you define "creating value in uncertain times" for EGA – whether through technology, portfolio positioning or partnerships – and where do you see the most compelling risk reward in aluminium over the coming decade?

For EGA, creating value in uncertain times means being disciplined about where we deploy capital, investing where we have a clear competitive advantage, and strengthening the resilience and competitiveness of our business for the long term. It also means using periods of disruption as an opportunity to emerge stronger.

Technology is an important part of that. At Al Taweelah, for example, as we restore production following the disruption earlier this year, we are using the opportunity to accelerate the pilot of our E40 technology upgrade, which is designed to increase production and improve energy efficiency from our existing assets. At the same time, we are positioning our portfolio for structural growth through lower-carbon aluminium and recycling, while using partnerships where they give us access to capabilities, markets or growth opportunities.

Over the coming decade, we believe the most compelling risk-reward is in meeting growing aluminium demand while producing the metal more efficiently and with a lower carbon footprint. Electrification, renewable energy, infrastructure and packaging provide strong long-term demand fundamentals. Our strategy is to capture that growth through technology, recycling, lower-carbon products and selective expansion, while maintaining the financial discipline and resilience required in a more volatile world.



Image: EGA

As the metals world converges on London, what conversations do you think the industry really needs to be having at this moment, and what one question would you most like attendees to ask EGA in terms of financing the future of in this critical decade?

The conversation the industry needs to have is not whether aluminium demand will grow, but where the next generation of competitive supply will come from and how it will be financed. New capacity is increasingly shaped by access to competitive power, carbon intensity, capital costs, trade dynamics and security of raw materials, making the investment case more complex even as long-term demand remains strong.

For EGA, the question I would like investors to ask is: where can you create the most value from the next tonne of aluminium? Sometimes that will be new primary capacity; in other cases, it will come from recycling, technology upgrades that unlock more production and help decarbonise existing assets, or partnerships that provide competitive access to energy, markets and resources.

That is how we think about financing growth – not growth for its own sake, but disciplined investment in the tonnes that can remain competitive through the cycle and deliver sustainable returns. ■

If you would like to learn more about EGA, follow this link:

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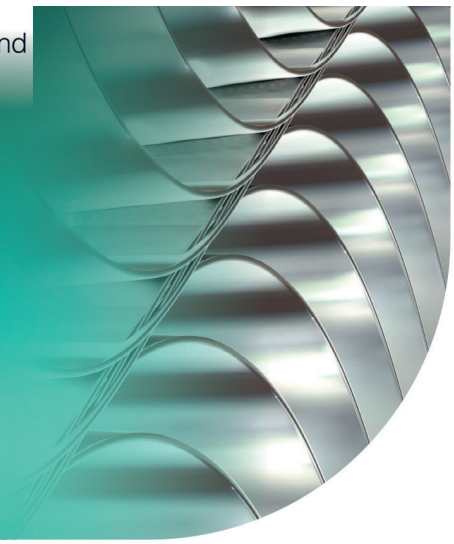
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COMMODITY OUTLOOK

Aluminium



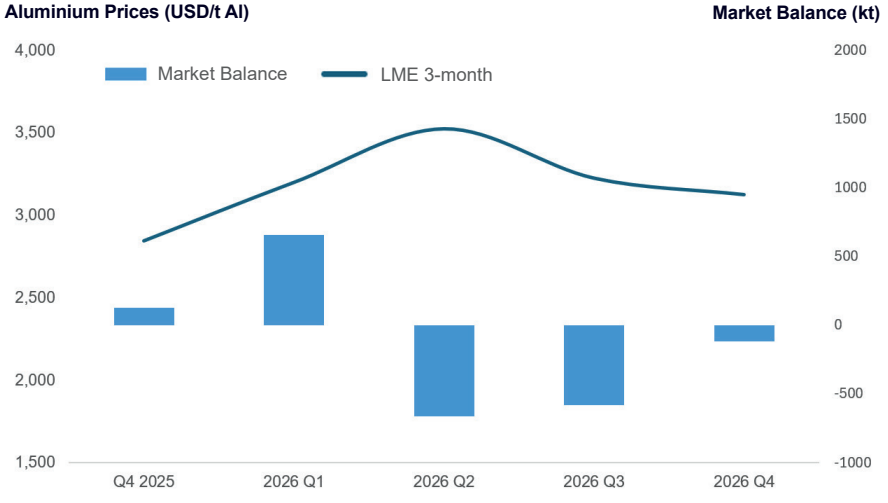
By **Wan Ling,**
Research Principal, Aluminium, Analysis & Forecasts,
Beijing, China, CRU

Aluminium remained tighter than expected through September 2026. Supply delays, low inventories and resilient Chinese demand supported prices, even as consumption outside China disappointed. Our latest interim update shows the near-term outlook is expected to strengthen, but the five-year view is unlikely to be overturned. Recovering production and new capacity are expected to move the market into surplus, eventually putting pressure on prices and higher-cost smelters.

What we expected and what changed in 2026

At the end of 2025, the outlook hinged on whether disruption at Mozal would offset new Indonesian production. We anticipated a surplus 2026 market, albeit relatively small in the World ex. China, while still expecting Indonesian growth to improve supply availability over time.

Supply delays kept aluminium tighter than expected in 2026



DATA: CRU Aluminium Market Outlook, September 2026

During 2026, supply outside China faced a broader set of disruptions. Middle Eastern production was affected, and some Indonesian capacity took longer to ramp up than expected. Although recovery began at certain operations, delays continued to constrain supply, pushing the market into deficit rather than the surplus envisaged by end-2025.

Demand has been mixed. Chinese buying improved during the third quarter, helping to draw down domestic inventories, while consumption outside China remained weaker than expected. Low visible stocks, tight nearby availability and strength in copper also helped support aluminium prices.

Our expectations for the years ahead

The central expectation is for a substantial surplus in 2027 as curtailed output recovers and new capacity contributes more fully. China's smelting capacity ceiling will continue to limit growth domestically.

Nevertheless, its influence on global supply will expand through investment in capacity elsewhere, particularly in Asia. The speed of these ramp-ups and the reliability of Middle Eastern restarts will be decisive for the 2027 balance.

Demand outside China should improve as lower prices and easing inflation support downstream activity, although high energy costs, interest rates and weak industrial markets remain as obstacles. In China, transport, energy storage and electrical applications should provide support, while construction remains a drag.

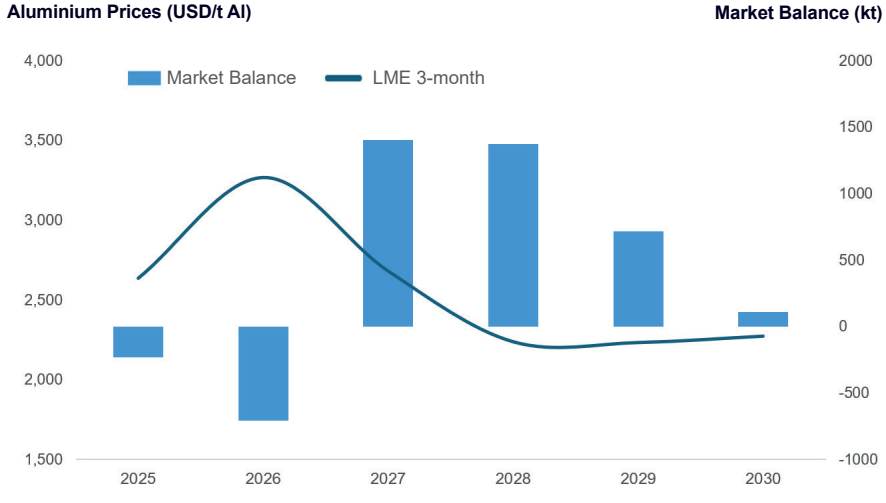
Beyond 2027, the five-year outlook expects surplus conditions to persist for a period, allowing inventories to rebuild and prices to ease. Lower prices would put pressure on higher-cost smelters, prompting curtailments that will gradually narrow the surplus later in the decade.

Trade and carbon policy will continue to affect where aluminium is produced and sold. Regional sourcing, access to lower-carbon metal and scrap availability may influence premiums even as the broader market loosens.

The principal upside risks to prices are further supply disruption, slower project ramp-ups and stronger-than-expected demand. The principal downside risks are a faster supply recovery and a weaker consumption rebound. Lower aluminium prices could also create opportunities for substitution against more expensive materials, while energy storage and electrification remain sources of demand growth.

> Supply recovery and new capacity are expected to shift the market towards surplus, with later high-cost curtailments helping restore balance."

Supply growth points to lower prices before higher-cost output adjusts



DATA: CRU Aluminium Market Outlook, September 2026

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COMMODITY OUTLOOK

Copper



By **Erik Heimlich,**
Head of Copper & Zinc Markets, Analysis & Forecasts,
Santiago, Chile, CRU

Copper has moved well beyond the price levels anticipated at the start of 2026. The near-term market is being shaped by US cathode stockbuilding, tighter availability outside the United States, supply-chain constraints and heightened disruption risk.

However, slower demand growth, substantial US inventories and the prospect of future project supply should increasingly reassert themselves as the market moves beyond the current period of tariff-related tightness.

What we expected and what changed in 2026

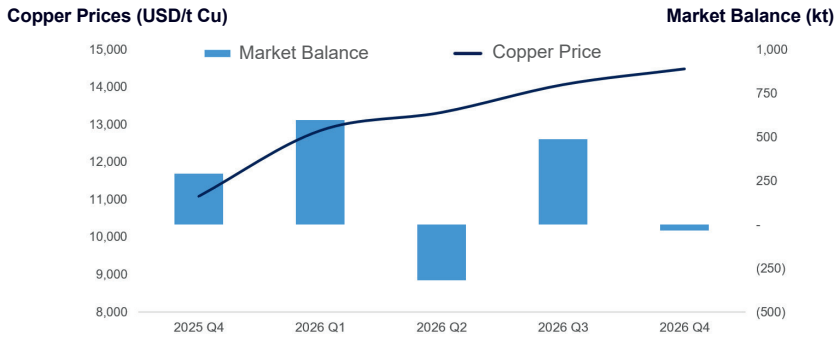
The expectation was for constrained mine growth, resilient refined demand and a temporary price spike driven by supply concerns and US cathode stockbuilding. That broad direction proved correct, but the scale and persistence of the price move exceeded earlier expectations.

The market has been characterised by materially higher prices, strong US import demand and a significant build in US cathode holdings. While the global refined market has retained a headline surplus, the location of inventory has become critical – metal held in the United States has reduced accessible availability elsewhere.

Demand has been softer than anticipated. Chinese construction, solar and cooling-related demand weakened, reducing global consumption growth. However, this slowdown is viewed as cyclical rather than a reversal of the longer-term electrification trend. Grid investment, export-oriented manufacturing, machinery and electric vehicles continue to provide support.

Mine output has remained relatively stable rather than collapsing, but refined output faces more immediate pressure from low smelter margins, acid shortages and operational disruption risk. Market tightness is therefore concentrated in particular regions and supply chains, rather than being reflected uniformly in visible inventory indicators.

Copper prices stayed high despite weaker demand growth



DATA: CRU Copper Market Outlook, September 2026

Our expectations for the years ahead

Demand growth is expected to recover from its subdued 2026 rate in 2027 before settling at a strong medium-term pace. Electricity networks, energy storage, transport electrification and data-centre construction should remain the principal sources of support.

China's property sector will remain a structural drag, but grid investment and export-oriented manufacturing will provide an important offset. India and other developing markets are expected to play a growing role in incremental demand, reducing – but not removing – China's influence on the global outlook.

Supply will improve after 2026 as production from large mining operations affected by serious disruptions recovers, while committed expansions are commissioned and ramp up and new projects begin to contribute. However, towards the later part of the decade, the refined copper balance will remain highly dependent on projects that are not yet fully sanctioned.

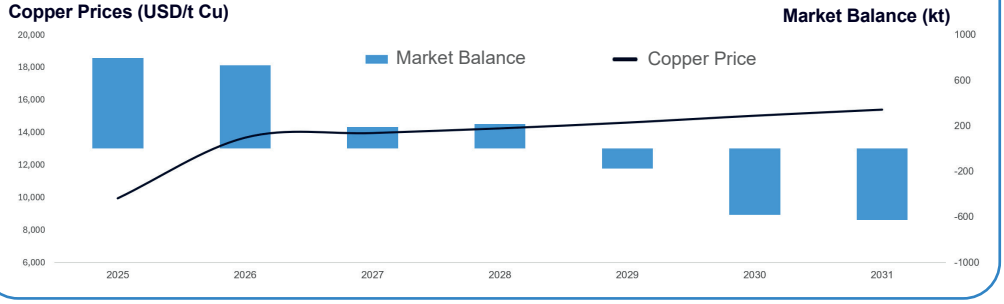
US tariff policy will determine the outlook for US copper cathode imports, and thus it will remain a major determinant of price direction. If tariffs are not imposed on copper cathode but the threat of future tariffs remains credible, the risk of an abrupt release of the United States' accumulated stocks remains limited. Any change in policy could alter global cathode flows, inventory distribution and regional and global prices quickly.

Over time, the price outlook will become more closely tied to physical balances and the marginal cost of developing new supply. This should support an elevated price environment, but not necessarily a continuously accelerating one. Higher prices will also increase incentives for substitution, thrifting and secondary supply growth.

The principal upside risk is a tightening market driven by delayed mine development, persistent refined-supply constraints and stronger electrification or data centre demand. The main downside risks are a tariff-driven reversal in import flows leading to the release of US inventories, weaker Chinese demand, faster scrap availability and greater substitution towards aluminium.

> Electrification supports demand, but the longer-term balance depends on mine-project delivery, US inventory flows and substitution."

Pace of supply delivery will determine the longer-term balance and price



DATA: CRU Copper Market Outlook, September 2026



COMMODITY OUTLOOK

Nickel



By **Nikhil Shah,**
Principal, Nickel Market Service, Analysis & Forecasts,
London, UK, CRU

Nickel moved materially closer to balance in 2026. Stronger demand from stainless steel and batteries coincided with constrained Indonesian supply growth, pressure on HPAL operations and disruption elsewhere.

The outlook now depends less on the scale of announced capacity and more on whether Indonesian policy continues to limit ore availability and prevents a return to persistent oversupply.

What we expected and what changed in 2026

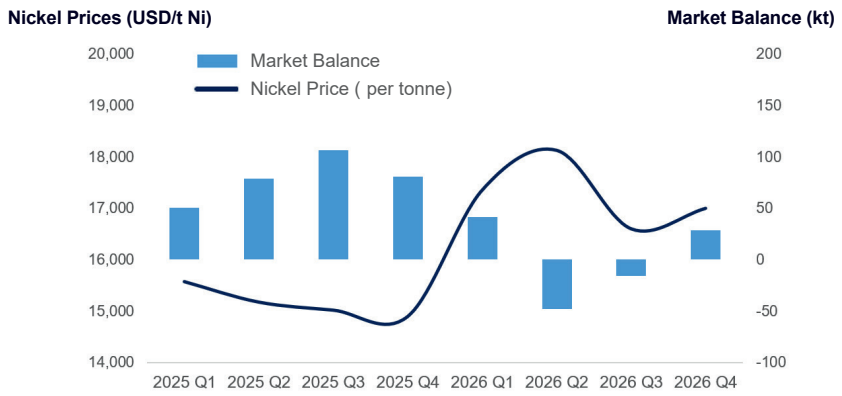
The expectation was for another year of structural oversupply. Expanding Indonesian capacity for nickel pig iron and mixed hydroxide precipitate together with weaker expected battery demand, was anticipated to maintain pressure on prices. Stainless steel was expected to carry most of the demand burden.

This outlook changed materially during 2026. Demand strengthened more than anticipated, with battery consumption recovering alongside stainless steel growth. In particular, firmer demand for high-nickel battery chemistries and improved European battery electric vehicle (BEV) sales helped narrow the gap with stainless steel as a source of incremental nickel demand.

At the same time, Indonesian supply growth slowed sharply. Lower ore quotas, high ore and sulphur costs, weather-related operating constraints and other production challenges restricted output. HPAL operations remained particularly exposed to costly sulphur, feedstock constraints and weaker cobalt by-product economics.

The market is therefore no longer defined primarily by excess supply. It has moved closer to balance, with tighter conditions particularly evident in Class 2 units. However, inventories, uncertainty around future Indonesian quota decisions and the potential for supply recovery continue to limit confidence in a sustained shortage.

2026 shifted from surplus management to market rebalancing



DATA: CRU Nickel Market Outlook, September 2026

Our expectations for the years ahead

Indonesia will remain the decisive variable. The outlook assumes the government continues to manage ore availability and avoids a return to unrestricted production growth. If this discipline is sustained, the market should remain broadly balanced rather than revert to the large surpluses anticipated at the end of 2025.

Stainless steel should remain the principal source of medium-term demand growth, particularly in China, Indonesia and India. Battery demand is also expected to increase, although its path remains more uncertain as LFP continues to gain share, and Chinese domestic demand for ternary batteries remains under pressure.

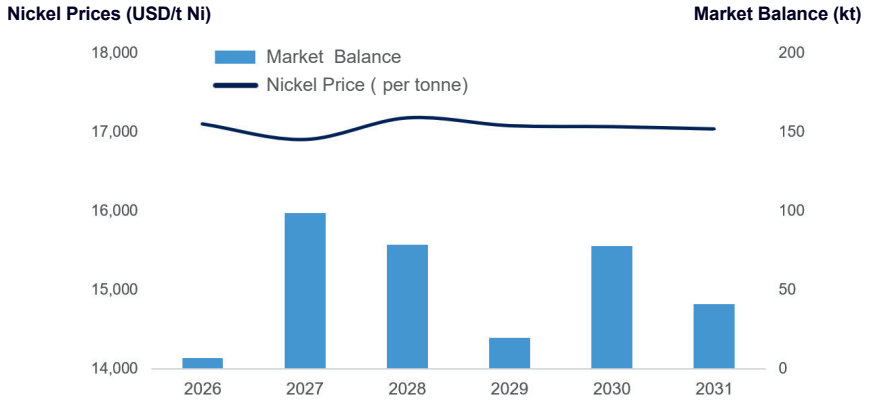
Supply risk remains concentrated in Indonesia. HPAL output faces continued exposure to high operating costs, sulphur availability, ore constraints and policy change. A material increase in ore quotas, or a faster-than-expected recovery in HPAL output, would loosen the market and restore downside risk.

Nickel prices are expected to remain volatile in the near term, reflecting sensitivity to Indonesian policy, energy costs, global growth and currency conditions. Over time, controlled supply growth and a higher cost base should provide more support than in the earlier oversupply scenario.

The principal opportunity is a sustained period of Indonesian supply discipline, reinforced by continued stainless steel growth and investment in higher-value battery materials. The main risks are renewed supply liberalisation, weaker global demand, faster substitution towards nickel-free battery chemistries and continued operational disruption across the Indonesian value chain.

> “Indonesian supply policy will remain decisive, as stainless and battery demand support the market while chemistry shifts temper growth.”

Indonesia ore policy determines market balance and prices



DATA: CRU Nickel Market Outlook, September 2026



COMMODITY OUTLOOK

Zinc



By **Olga Hepting,**
Principal, Zinc Market Service, Analysis & Forecasts,
London, UK, CRU

The zinc market in 2026 has softened materially as Chinese demand weakened, moving the refined market from an anticipated deficit into surplus. However, the surplus is concentrated in China, while the rest of the world has been in deficit so far this year. As China becomes the marginal supplier to the rest of the world, LME prices will likely need to rise periodically to open the export arbitrage. The key question for the years ahead is whether China can maintain its refined output growth as a net exporter of refined material.

What we expected and what changed in 2026

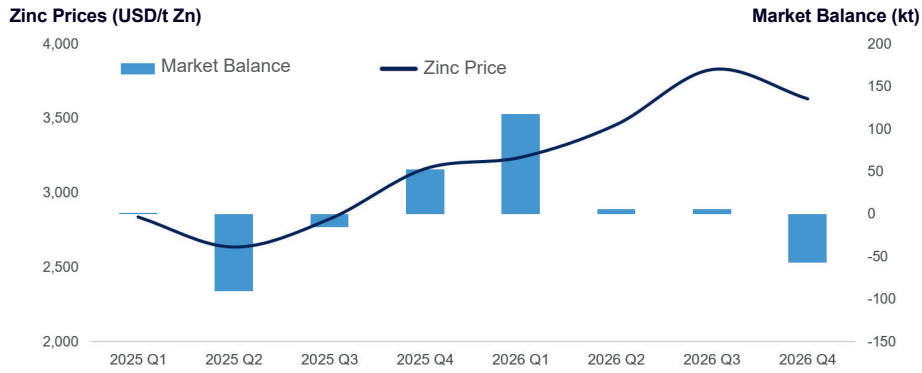
We expected a second year of refined-market tightness, with constrained mine growth, low inventories and a modest demand recovery supporting prices. Instead, demand weakened, particularly in China, as domestically focused industries – property, infrastructure and automotive – lost momentum in 2025 Q4 and remained subdued thereafter. This shifted the global refined balance towards surplus, despite a tight concentrate market limiting refined output.

Mine supply also underperformed. In December 2025 we expected 2026 mine supply to grow by less than 1% y/y. After several downside revisions and disruptions, mainly outside China, it is now estimated to decline by 1.4%. Concentrate availability therefore remained tight, and treatment charges overshot expected record lows, given significant increases in precious metals and especially sulphuric acid prices.

About a year ago we started to signal Chinese self-sufficiency in refined metal and forecast at least one export arbitrage window in 2026, which has now happened. However, we expected China to still import refined zinc in 2026 and reach full annual self-sufficiency in 2027. Given the demand slowdown, China is expected to be a net exporter already this year.

As expected, Chinese smelters maintained strong output growth from new capacity added in late 2025, intensifying competition for concentrate. Also predictably, smelters outside of China continued to curtail production, amid weaker economics, energy cost increases and operating disruption. Consequently, metal accumulated in China while LME availability remained low, creating a regional imbalance and altering the long-standing structural relationship between LME and SHFE prices.

2026: Refined surplus globally, but physical tightness outside China



DATA: CRU Zinc Market Outlook, September 2026

Our expectations for the years ahead

The refined market is expected to remain finely balanced after 2026 before more visible surpluses emerge later in the forecast. Demand should recover only gradually, with China's consumption constrained by a structural shift away from property- and infrastructure-led growth. As the new five-year plan focuses on high tech and consumer goods – sectors with low zinc intensity – we expect very little Chinese demand growth. Demand outside China will remain uneven. India and Southeast Asia should provide the main growth, while Europe and North America remain exposed to weak construction and automotive activity, energy costs and macroeconomic uncertainty.

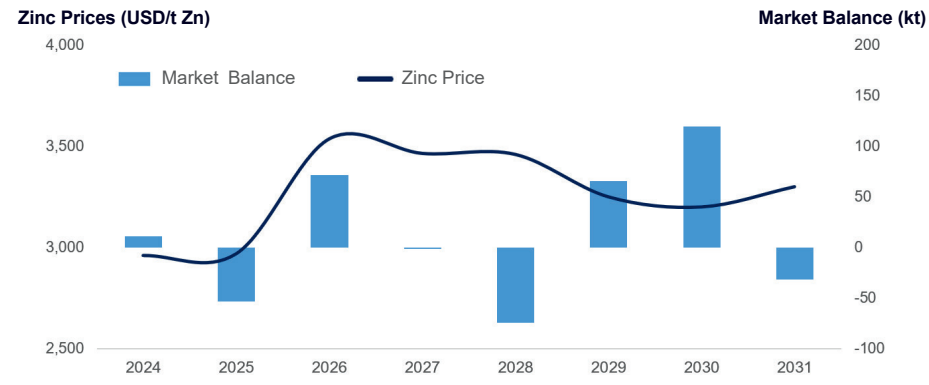
The main downside risk is a deeper deterioration in industrial demand, particularly if geopolitical disruption, energy inflation or financial instability intensify. The principal upside risk is further mine disruption or ex. China smelter curtailment, which would deepen physical tightness ex. China and increase dependence on Chinese exports.

Mine supply is expected to recover from current lows, peaking around 2029–2030, as projects responding to high prices start up. However, long-term growth will remain limited by resource constraints in China and weak demand prospects limiting miners' interest in zinc. This is likely to preserve the status quo, whereby miners avoid oversupply through disciplined investment while demand declines, keeping prices and margins high. Concentrate should therefore remain constrained, even as refined metal becomes more available, with only some surpluses by the end of the five-year forecast. We expect double-digit TCs to persist for several years, possibly reaching triple digits again around 2030 at the earliest.

China will become increasingly important to global zinc pricing and trade. As domestic refined output exceeds requirements, China will need significant LME price volatility to continue importing concentrate and exporting refined metal. On average, this means higher LME prices, keeping SHFE prices elevated through the arbitrage. Zinc price formation will increasingly reflect the cost and practicality of moving Chinese metal to where it is needed, rather than global balance alone.

> China's growing refined-metal availability will reshape trade, while concentrate constraints and export frictions could keep regional markets uneven."

Chinese exports will keep LME prices elevated



DATA: CRU Zinc Market Outlook, September 2026



COMMODITY OUTLOOK

Lead



By **James Griffiths,**
Lead, Lead Market Service, Analysis & Forecasts,
London, UK, CRU

Lead's market has moved from anticipated near-term tightness towards a more clearly oversupplied outlook. Demand continues to grow modestly, led by India and wider Asia, but this is insufficient to offset weakening traditional applications, growing recycled supply and a large visible inventory overhang. The central question for the years ahead is whether physical demand can absorb accumulated stocks quickly enough to support a more sustained price recovery.

What we expected and what changed in 2026

The expectation was for a broadly balanced-to-tight market. Constrained primary supply, low treatment charges and persistent refined-metal deficits were expected to provide modest price support. Replacement batteries were expected to underpin demand, while slower electrification was seen as moderating – rather than reversing – the longer-term erosion of lead consumption.

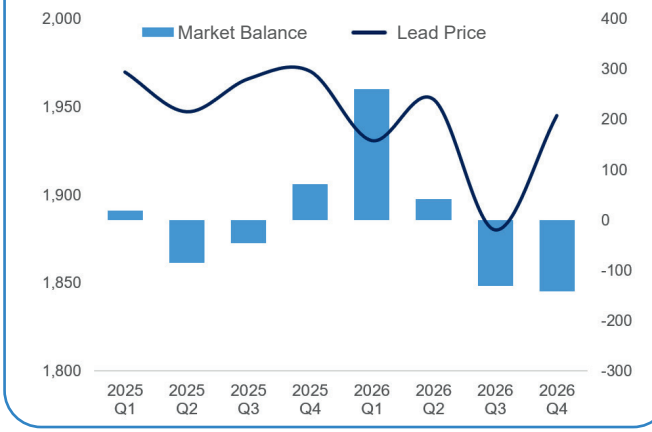
That view weakened as 2026 progressed. The market experienced episodes of regional tightness, supported by Chinese buying and supply constraints in parts of Asia. However, these conditions did not lead to sustained physical destocking or a lasting global squeeze.

Instead, significant volumes accumulated in exchange warehouses, particularly in Asia. These stocks have capped outright prices despite periodic tightness in prompt regional availability, reinforcing the distinction between local physical conditions and the wider market balance.

Demand has also developed more softly than anticipated. Replacement batteries remain the largest source of consumption, but vehicle fleets in North America and Europe are expanding slowly and improving battery durability reduces replacement frequency. China's traditional demand pillars – including passenger vehicles, battery exports and e-bikes – are also maturing as alternative battery technologies gain share.

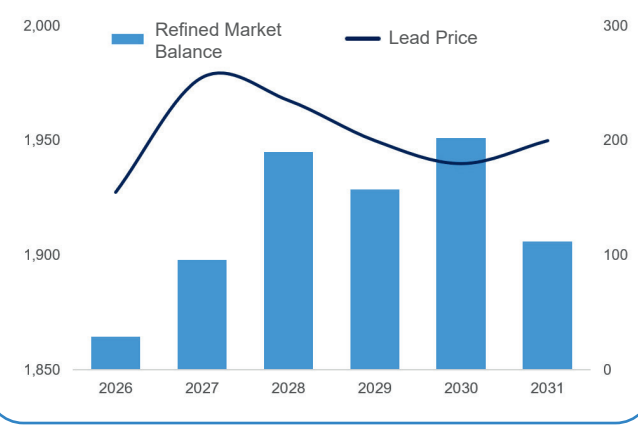
The result is a looser market than expected earlier in the year. Supply expectations have risen modestly while demand has been revised down, shifting the outlook towards surplus and limiting the potential for a durable price recovery.

Lead shifted towards surplus as inventories rose and demand softened



DATA: CRU Lead Market Outlook, September 2026

High inventories and recycling growth limit lead's price upside



DATA: CRU Lead Market Outlook, September 2026

Our expectations for the years ahead

Lead demand will continue to grow slowly, with the centre of gravity moving further towards India and wider Asia. Low-cost backup power, two- and three-wheelers, industrial applications, and growing regional battery manufacturing should provide support. However, this is unlikely to fully offset stagnation in mature economies and China's diminishing contribution to global demand growth.

Replacement batteries will remain the industry's core demand base, particularly in North America and Europe. However, this demand will be limited by longer battery lives, slow vehicle-parc growth and changing vehicle technologies. More lead-intensive battery designs provide some support but are unlikely to restore strong growth.

Battery energy storage and data-centre-related power requirements create opportunities in selected segments. Lead is most likely to remain concentrated in backup power, telecoms, uninterruptible-power systems, substations and other applications where cost, safety and temperature tolerance are valued. Mainstream utility-scale storage is expected to remain dominated by lithium-ion technologies.

Refined supply is expected to grow steadily but become increasingly recycling-dependent. Primary production remains constrained by concentrate availability and weak treatment charges, while recycled material accounts for a rising share of supply. Asia will be central to this recycling expansion, though Chinese scrap availability remains constrained by the growing share of exported batteries that reach end-of-life outside the country.

The concentrate market may remain tight even as refined lead becomes more available. Primary smelters depend on concentrate not only for lead production but also for by-product revenues, making treatment charges and by-product prices important determinants of operating rates.

Overall, the central outlook is for progressively looser market conditions. High visible inventories – particularly in Asia – are expected to restrain price upside, while softer mature-market consumption and stronger recycled supply increase the likelihood of sustained surpluses. A more durable recovery would require clear and sustained destocking, alongside a stronger physical call on available metal.

The key opportunity is stronger-than-expected demand in India and Southeast Asia, supported by delayed electrification, resilient replacement demand or improved industrial activity. The main risks are further weakness in Chinese lead-acid battery demand, faster technology substitution, continued inventory accumulation, stronger recycling growth and a prolonged macroeconomic slowdown.

> Recycling-led supply growth and high inventories are expected to limit price upside, with Asian demand providing a partial offset."



COMMODITY OUTLOOK

Lithium



By **Cameron Hughes,**
Analyst, Lithium Market Service, Analysis & Forecasts,
London, UK, CRU

The lithium market has moved into a significant deficit in 2026, as surging Chinese cathode active material (CAM) output, led by LFP for energy storage, has coincided with ongoing supply disruptions.

Higher prices are stimulating a supply response, especially from recycling, but not quick enough to close the gap. Investment in pipeline capacity is also accelerating, increasing the risk of market surpluses later in the decade.

What we expected and what changed in 2026

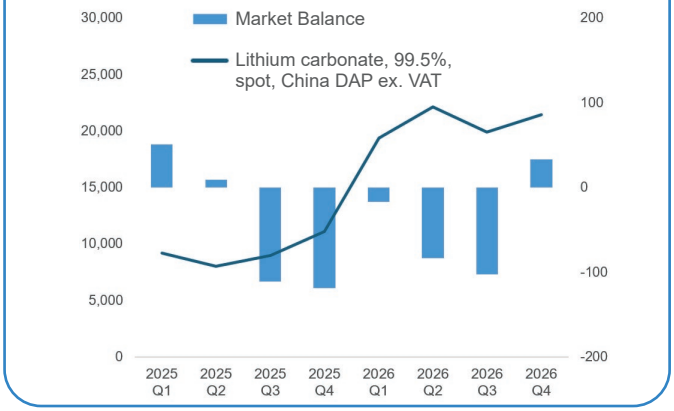
Entering 2026, the expectation was that strong battery-material production would support lithium demand, but rapid supply growth across the major producing regions would return the market to surplus. Lower prices were expected to prompt further mine curtailments, with a more balanced market emerging only after these cuts took effect.

By September, demand growth had proved considerably stronger than anticipated. Chinese LFP cathode production and battery energy-storage orders remained robust, increasing raw-material demand and drawing down inventories. However, this strength also coincided with continued inventory accumulation further downstream in cathode and cell supply chains.

Supply has responded to higher prices through increased recycling, higher operating rates at existing mines and further project investment. While these additions have mostly offset the disruption to Chinese lepidolite output and African concentrate flows, supply has not kept up with surging CAM output. As a result, the market moved into deficit rather than the surplus expected at the start of the year.

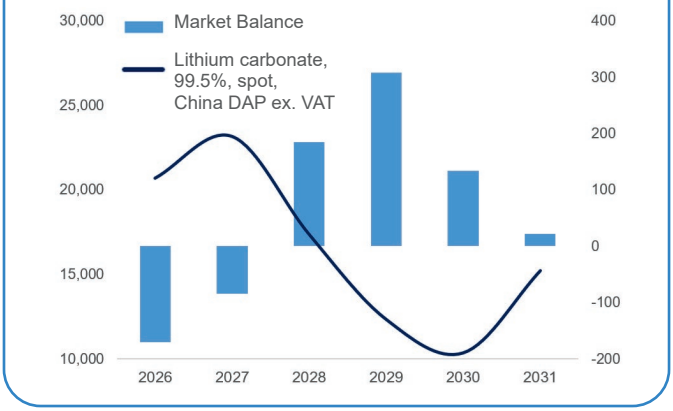
The distinction between current conditions and the full-year outcome remains important. Raw-material markets were tight, import demand was strong and producer margins improved during the year, but some rebalancing was still expected as selected projects ramp up, inventories are released and demand front-loading moderates.

Strong LFP demand and supply disruption pushed lithium into deficit



DATA: CRU Lithium Market Outlook, September 2026

Lithium tightness may give way to surplus later in the decade



DATA: CRU Lithium Market Outlook, September 2026

Our expectations for the years ahead

Lithium is expected to remain tight through 2027, as supply continues to grow but remains behind demand. Raw-material inventories are expected to decline further before the market moves back towards surplus as new capacity ramps up later in the decade.

Near-term tightness is likely to be most visible in spodumene concentrate. Disruption, high cathode-material output and low inventory levels should continue to support lithium prices and producer margins while the market remains in deficit.

Higher prices are encouraging a stronger supply response. Existing producers are increasing output, recycling is expanding and investment is continuing across mining and conversion. Much of this additional supply is expected to arrive later, increasing the risk that tightness gives way to renewed oversupply when demand growth moderates.

Battery energy storage is expected to remain the principal source of demand growth. Grid-balancing requirements, renewable integration, technology improvement and policy support continue to favour storage deployment, with LFP expected to remain the dominant chemistry. However, substantial cathode and cell inventories mean that future destocking could restrain first-use lithium demand.

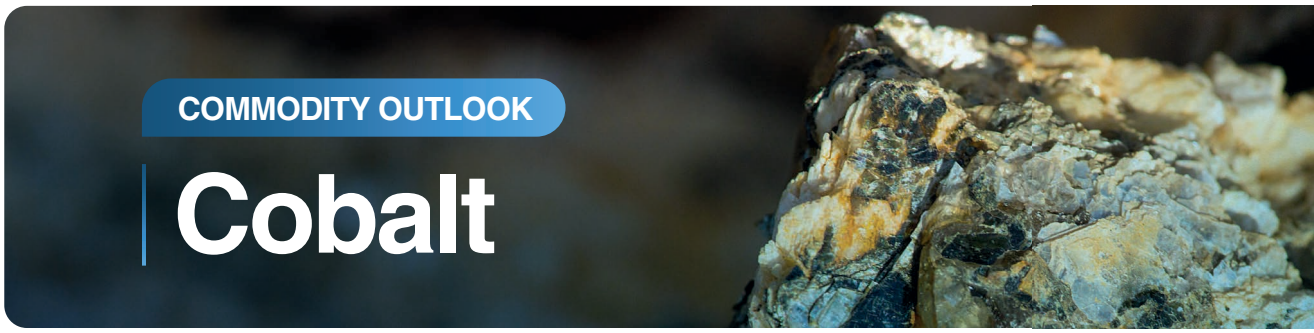
Electric-vehicle demand should remain supportive, led by China and continued LFP share gains. European growth is expected to continue, while North American demand remains more exposed to policy uncertainty and competition from other powertrains. Outside China, LFP supply chains are developing, but progress is constrained by cost, technology-transfer and trade barriers.

Policy and technology will remain influential. Chinese controls on LFP technology may reinforce China's central role in cathode supply, while resource nationalism and export restrictions could disrupt concentrate availability. Sodium-ion batteries are expected to gain share in selected storage and smaller-vehicle applications, moderating lithium-demand growth without displacing LFP's leading role in storage over the medium term.

Prices are expected to remain supported while inventories are depleted, before weakening later in the decade as mine, conversion and recycling supply expands, LFP inventories are drawn down and sodium-ion adoption increases. A lower-price environment would raise closure and project-delay risks for higher-cost or uncommitted supply.

The principal upside opportunities are stronger battery-storage demand, delayed new supply and further policy-led disruption. The main downside risks are earlier downstream destocking, weaker storage economics, greater trade barriers, end-market policy rollbacks and continued integrated-producer output despite weaker prices.

> New supply, recycling and inventory adjustments are expected to ease tightness, while storage demand remains an important source of growth."



COMMODITY OUTLOOK

Cobalt



By **Thomas Matthews,**
Lead, Cobalt Market Service, Analysis & Forecasts,
London, UK, CRU

The cobalt market in 2026 proved less acute than anticipated in late 2025. Early supply disruption and export controls tightened availability, but subsequent hydroxide arrivals, alternative feedstocks, weaker procurement and inventory drawdown eased near-term pressure. The key question for the years ahead is whether managed supply from the Democratic Republic of the Congo (DRC) and Indonesia can maintain balance as battery technologies continue to reduce cobalt intensity.

What we expected and what changed in 2026

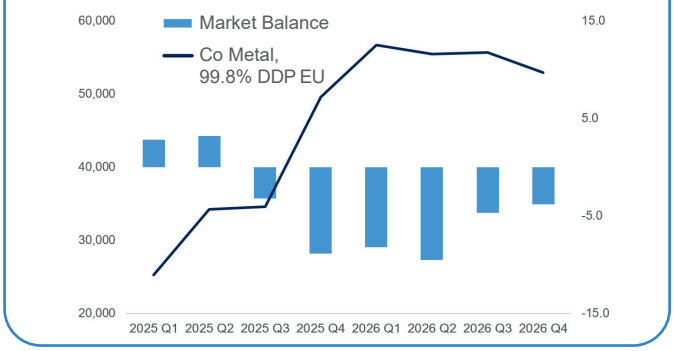
We expected a highly volatile first half of 2026 as the DRC transitioned from an export ban to a quota system. Delays in the new export process were expected to tighten intermediate availability, draw down Chinese inventories and extend the refined market deficit. These expectations were realised early in the year. Tight intermediate supply, limited arrivals and frontloaded purchasing supported a significant price rally.

However, a sustained price response did not materialise despite continued market tightness. Downstream consumers had prepared more effectively than expected, procuring material earlier and then relying on inventories during the period of greatest disruption. This reduced spot market demand and limited the impact of tight supply on prices.

Demand also weakened relative to expectations. Slower portable electronics consumption, elevated lithium cobalt oxide inventories and frontloaded procurement offset growth in ternary pCAM production. The combination of softer demand and improving feedstock availability shifted the market from an anticipated supply-driven spike towards a more inventory-managed and finely balanced environment.

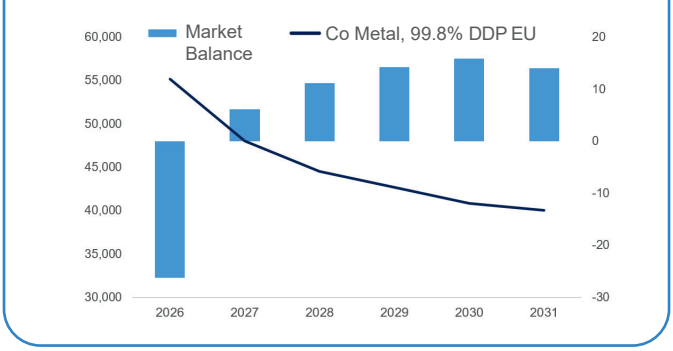
As expected, prices (particularly in China) have come under pressure later in the year as DRC shipments began to reach the market and ease feedstock pressure. Widespread forfeitures of unused export quotas will nevertheless limit available material later this year. Consequently, while supply conditions have improved from the early-year squeeze, they remain dependent on DRC quota management.

2026 shifted from an anticipated supply-driven spike to a softer market



DATA: CRU Cobalt Market Outlook, September 2026

DRC exports and Indonesian output will determine cobalt's balance



DATA: CRU Cobalt Market Outlook, September 2026

Our expectations for the years ahead

The market is expected to remain broadly balanced through 2027. The outlook will depend primarily on export management by the DRC, the pace of Indonesian intermediate production and secondary supply.

The DRC will remain the central supply variable. Mine output continues to exceed the material made available to international markets, building substantial inventories within the country. Continued quota discipline could keep internationally available cobalt tight. Conversely, an easing of restrictions or release of accumulated inventory would place material pressure on prices.

Indonesian MHP remains the principal potential source of additional non-DRC supply. However, near-term growth is constrained by weak intermediate economics, high sulphur costs, ore availability and environmental considerations. Higher utilisation of installed capacity could contribute more later in the decade if these constraints ease.

Refined supply should recover gradually as intermediate availability and conversion margins normalise. However, the recovery is likely to be measured, however, given weak refining economics and the potential for more Indonesian intermediate material to be processed domestically rather than exported to Chinese refiners.

Battery demand should recover following a weak 2026, supported by electric vehicle growth outside China and continued demand for selected ternary applications. However, cobalt demand will grow more slowly than the wider battery market as manufacturers move towards no- and low-cobalt chemistries and continue to reduce cobalt use per kilowatt-hour. Demand from portable electronics faces a more challenging outlook, owing to elevated inventories, slower device sales and substitution of LCO.

China will remain central to cobalt processing and first-use demand, despite efforts to develop more geographically diverse battery supply chains. Chinese ternary output continues to benefit from exports, while domestic electric vehicle demand increasingly favours LFP. Trade controls, technology restrictions and the cost of establishing alternative supply chains may slow diversification.

Prices are expected to stabilise following the 2026 decline, supported by managed exports and a relatively tight refined market. Further out, prices could ease gradually as intermediate supply, recycling and refining recover. The decisive variables remain supply discipline in DRC, Indonesian utilisation rates and the availability of secondary material.

Key upside risks include even more stringent supply discipline, stronger EV or electronics demand, strategic stockbuilding, lower recycling output or further disruption to reagent supply. Downside risks include an easing of DRC export controls, faster battery thrifting, continued destocking and weaker global economic activity.

> Supply growth and declining battery cobalt intensity are expected to move the market toward surplus, subject to export policy and Indonesian output."



COMMODITY OUTLOOK

Gold



By **Kirill Kirilenko,**
Lead, Precious Metals Market Service, Analysis & Forecasts,
London, UK, CRU

Gold entered 2026 with a strong structural outlook, supported by investment demand, central-bank purchases, geopolitical uncertainty and concerns over fiscal and currency stability. By mid-year, these structural drivers remained intact, but near-term conditions had become more challenging as firmer yields, a stronger US dollar and tighter liquidity outweighed safe-haven support. The key question for the years ahead is whether renewed monetary easing and persistent systemic risks can reassert themselves as the dominant price drivers.

What we expected and what changed in 2026

The expectation was that gold would remain well supported by investor demand, central-bank buying, lower real-yield expectations and continued geopolitical uncertainty. The 2025 outlook also highlighted gold's growing role as protection against fiscal stress and declining confidence in traditional safe-haven assets.

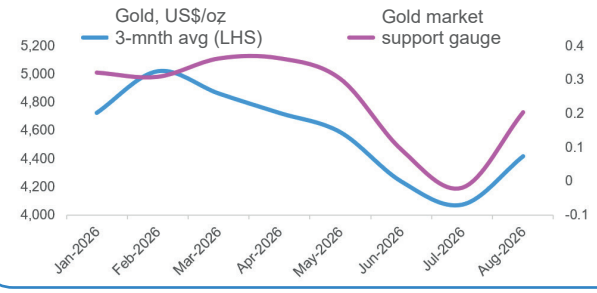
By mid-2026, the longer-term investment case remained intact, but price performance had become more sensitive to interest-rate expectations, bond yields and liquidity conditions. Gold came under pressure during H1 as the US dollar and equities strengthened, illustrating that safe-haven demand can be temporarily outweighed by a higher-yield and stronger-dollar environment.

Central banks remained a consistent structural source of demand. However, official-sector buying increasingly provided a floor for prices rather than a catalyst for a renewed rally. Purchases are expected to remain supportive, albeit more moderate than during recent peaks.

Physical demand weakened more sharply as high prices reduced affordability. Jewellery consumers responded through lighter products, delayed purchasing and substitution, while industrial demand remained comparatively small. Electronics provided some support from advanced hardware and AI-related investment, but not enough to offset weaker jewellery demand.

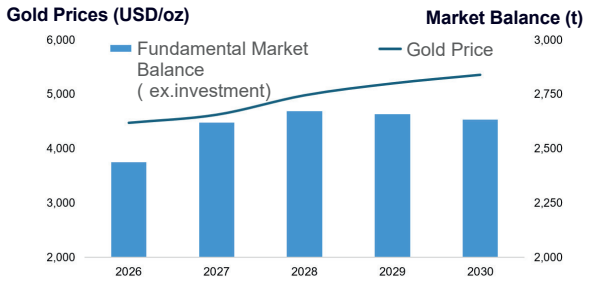
Mine supply responded more positively to elevated prices than previously expected – through reserve upgrades, revised mine plans, restarts and ramp-ups. However, sustained growth remains constrained by depletion, mature-mine closures and a thin pipeline of large new projects. Our **Gold Asset Service** also shows All-In Sustaining Cost increases accelerating as royalty burdens and fuel inflation start to bite. Recycling has been less responsive than prices alone might imply, as readily-available scrap was already brought to the market during earlier rallies.

Gold price and CRU Gold Market Support Gauge, 2026



DATA: CRU Precious Metals Market Outlook

Investment and central-bank demand support gold's medium-term outlook



DATA: CRU Precious Metals Market Outlook, July 2026

Introducing the CRU Gold Gauge

The CRU Gold Gauge is a monthly indicator designed to assess how supportive the broader financial and macroeconomic environment is for gold. It combines key drivers of financial demand, including real yields, the US dollar, investor flows, central-bank demand, monetary conditions and geopolitical risk.

A lower Gauge reading indicates a less stable and generally more supportive environment for gold demand, while a higher reading points to more stable conditions and less support for gold as a financial hedge. The Gauge is intended as a regime indicator rather than a short-term price forecasting model. In mid-2026, it weakened sharply as the macroeconomic and monetary environment became less favourable, before recovering in August. This broadly coincided with the correction and subsequent recovery in gold prices.

Our expectations for the years ahead

Gold is expected to remain in a structurally-higher trading range, despite continued short-term volatility. Fiscal pressures, reserve diversification, geopolitical fragmentation and concerns over currency debasement should continue to underpin the medium-term investment case. Investment demand will remain the principal balancing mechanism in the gold market. Prices are likely to be shaped more by monetary-policy expectations, risk appetite, financial stability and investor positioning than by conventional supply-and-demand conditions.

Central banks are expected to remain net buyers, maintaining gold's role as a politically neutral reserve asset. Purchases may be steadier and less pronounced than at recent peaks, but should remain an important long-term source of support. Jewellery demand is likely to remain under pressure while prices stay elevated. Affordability constraints will encourage lower gold content, lighter products and delayed purchases. Electronics should provide a limited offset, supported by investment in advanced electronics, chip packaging and AI-related hardware.

> Central-bank and investment demand are expected to underpin gold, with monetary policy, the US dollar and financial uncertainty shaping its price direction."

Mine production is expected to increase in the near term as producers respond to stronger prices, but growth should fade later in the decade. Depletion, declining grades, mature-mine closures and limited large-scale project development will make sustained supply growth increasingly difficult. Miner's margins should nevertheless remain near record levels while prices continue to outweigh costs. Recycling should rise only gradually, as the readily-recoverable pool of jewellery and high-grade scrap becomes less elastic.

The macro outlook is likely to create a two-stage environment. In the near term, sticky inflation, elevated yields and delayed monetary easing may constrain gold demand. Over time, less restrictive policy, weaker growth or renewed financial stress could provide stronger support. Geopolitical uncertainty remains constructive in principle, although acute stress can also trigger short-term liquidity-driven selling.

The key opportunity is renewed demand for monetary and fiscal hedges, driven by financial instability, reserve diversification, geopolitical escalation or earlier-than-expected rate cuts. The main risks are a stronger US dollar, higher-for-longer interest rates, improving confidence in US institutions, easing geopolitical tensions and softer central-bank demand.

FEATURE

AI Tech: the next physical demand cycle



By **Frank Nikolic,**
Research Principal, LME & Precious Metals,
Toronto, Canada, CRU

Artificial intelligence is rapidly becoming a materials story. The immediate buildout of data centres is increasing demand for the power, cooling, connectivity and structural infrastructure that underpin digital AI—creating new requirements across copper, aluminium, steel and associated equipment supply chains. Over the longer term, embodied AI, including humanoid robots, could introduce a further source of demand for battery materials, advanced alloys and magnet rare earths.

The opportunity is substantial, but it is not a simple volume story. Technology choices—from higher-voltage power distribution and optical networking to copper-to-aluminium substitution and magnet thrift—will reshape material intensity, demand timing and exposure across the value chain. Meanwhile, constraints in power availability, grid connection, equipment delivery and critical-mineral supply will determine how quickly this investment cycle can advance.

CRU helps clients translate these fast-moving technology developments into robust commodity-market insight. By linking technology adoption scenarios with detailed forecasts for demand, prices, assets, costs and supply chains, we identify both the near-term metals implications of AI infrastructure and the longer-dated risks and opportunities created by AI Technologies. Across data centres and humanoid robots, CRU provides the integrated, independent perspective needed to navigate a new and increasingly consequential driver of metals demand.



INDUSTRY INSIGHT

AI-Tech that will redefine commodity demand

AI-Tech that will redefine commodity demand

The discussion on artificial intelligence is focused on software or apps and the use-case, but its implications for commodity markets is physical. Behind every advance in digital AI sits a growing base of physical infrastructure – data centres, power networks, backup systems, cooling equipment, and communications capacity. As investment in these systems scales, so too does demand for the metals and materials that enable them. This is the first AI-Tech channel.

A second channel is beginning to emerge alongside this digital buildout. If AI becomes increasingly embodied in robotics and autonomous machines, the technology's footprint will extend beyond compute infrastructure into batteries, motors, magnets, sensors, and structural materials.

AI-Tech is starting to reshape how we do work while holding the promise of profound (positive) change on society. However, that promise is only possible with the metals and materials needed to build out the physical infrastructure for AI-Tech – and this requirement for physical infrastructure for both digital and embodied AI is creating a new mega driver for commodity demand.

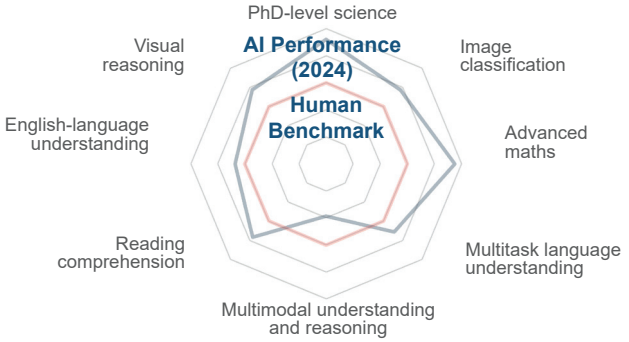
This first insight in CRU's AI-Tech series sets out the two main routes through which the trend could redefine commodity demand – digital AI infrastructure and embodied AI. Subsequent insights will examine the underlying component mix and material intensities in more detail, with separate coverage of conductive materials, battery metals, structural materials, and rare earths.

Investment is accelerating in digital AI infrastructure

Artificial intelligence is not a new idea, but its commercial deployment has accelerated materially in recent years. Improvements in model capability, broader access and falling costs have expanded the range of tasks AI can perform across research, coding, administration, and decision-support workflows. For commodity markets, the crucial point is not the novelty of the technology itself, but the fact that AI is moving from experimentation toward large-scale deployment and that needs metals and materials.

The graphic below illustrates the underlying reason for this acceleration – AI capability has improved rapidly across a widening range of commercially relevant tasks and is now superior to humans. This

AI outperforms humans across most metrics while costs have fallen sharply



Cost per 1M tokens:

2022 Q4: ~USD 20
2024 Q4: ~USD 0.22

>98% cost reduction

DATA: Adapted from Stanford HAI, AI Index Report 2025 (performance: Figure 1.3.22; cost: Figure 2.1.33)

> For commodity markets, the crucial point is not the novelty of the technology itself, but the fact that AI is moving from experimentation toward large-scale deployment and that needs metals and materials."

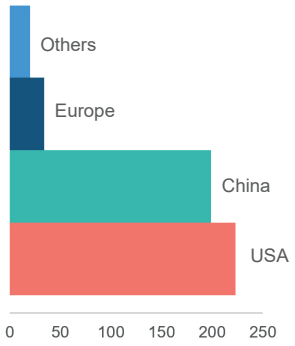
means that the technology is becoming more useful, more accessible, and cheaper to deploy, forcing governments and hyperscalers continue to invest heavily to secure strategic advantage. The business models will continue to evolve, but the direction of travel is increasingly clear – AI is moving into mainstream commercial use, and that shift is beginning to drive real infrastructure demand.

> Large-scale AI model development is centred on competition between the US and China, but the buildout of physical infrastructure is global."

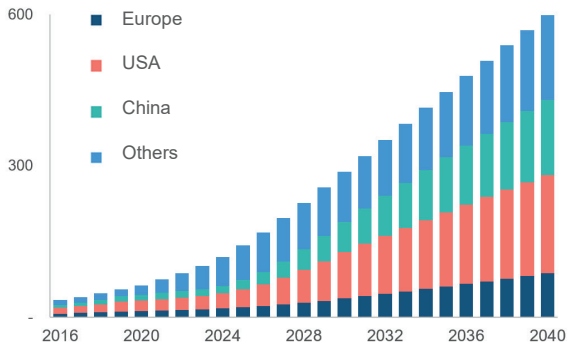
Large-scale AI model development is centred on competition between the US and China, but the buildout of physical infrastructure is global. This global push is driven partly by national security concerns – as AI becomes a key engine of economic growth, relying on external powers to host critical AI capacity is increasingly seen as an unacceptable risk. This shows that AI is evolving into a strategic industrial race, not just a software contest.

The AI model development is a race between China and US, infrastructure buildout is global

Cumulative number of large-scale AI systems by country (2019 to 2025)



Data centres cumulative annual installations (additions + replacements), GW



DATA: CRU, Our World in Data, based on Epoch AI (2026)

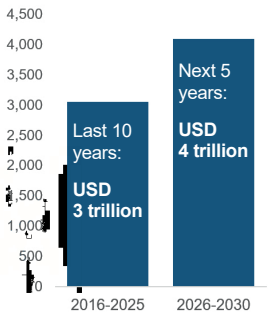
Digital AI depends on an expanding stack of compute infrastructure: semiconductors, servers, racks, networking equipment, cooling systems, backup power, and the buildings that house them. As training and workloads increase, so too does the need for new data-centre capacity and for the electricity infrastructure required to operate it reliably. This is therefore also a buildout of electricity-intensive physical assets.

As governments and hyperscalers increase the pace of investment to secure the advantages AI offers, the acceleration is driving the buildout of electricity-intensive, metal-intensive physical assets.

Digital AI requires a broad physical infrastructure stack and significant capital deployment



Global Investment in data centre infrastructure (excl. power)



DATA: CRU, IEA

Keeping pace now depends on access to key metals and minerals to build the infrastructure needed. For commodities, this makes digital AI the first major channel through which AI-Tech affects demand. Data centres require conductive metals in wire and cable applications, optical fibre and communications systems for data transmission, battery systems for backup and resilience, and extensive power infrastructure ranging from transformers and switchgear to distribution equipment. As AI adoption broadens, demand growth will increasingly depend not only on software capability, but on how quickly this physical infrastructure can be built.

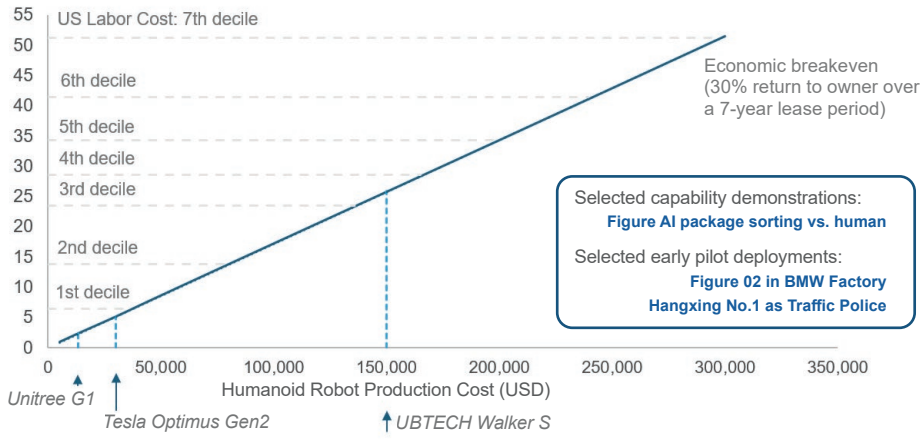
Embodied AI bridges the gap between digital platforms and physical machinery

If digital AI is the brain of the next economy, embodied AI is the beginning of its body. It extends AI from digital workflows into machines that can sense, decide and act in the physical world, widening the addressable market from information work to real-world labour. For commodity markets, the significance lies not in the novelty of the machines themselves, but in the possibility that AI becomes embedded in a growing installed base of physical equipment.

What has changed in recent years is not only AI capability, but the economics of applying it through machines. Improvements in perception, navigation, reasoning and task execution are beginning to coincide with better robotics hardware and falling system costs, making a wider range of applications commercially viable. Early deployment remains selective, but activity in areas such as factory support, logistics, sorting and inspection suggests embodied AI is moving beyond laboratory demonstration towards pilot use in structured industrial and commercial environments.

As unit economics improve, early deployments are moving from demonstration to pilot use

The business case for humanoid robot workforce comparing US labour costs and robot lease costs (USD/hour)



DATA: CRU, ILO

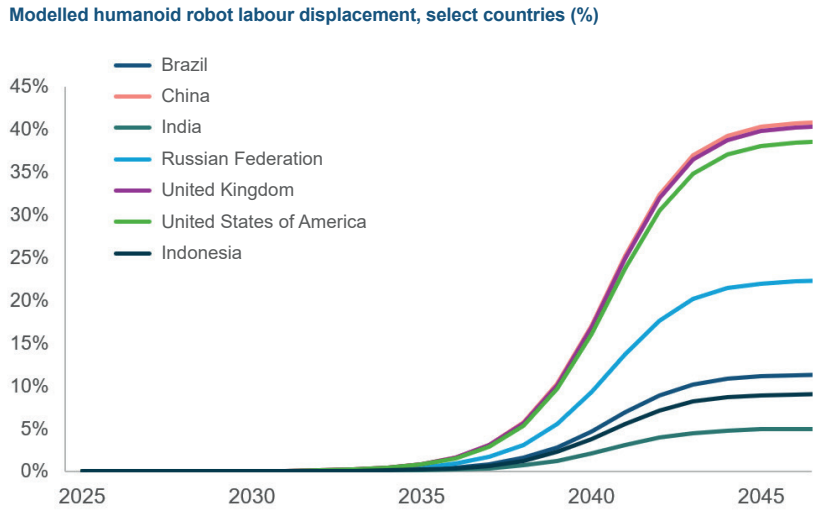
Adoption is unlikely to occur evenly across the economy or across countries. While early deployment is most plausible in occupations with a high share of repetitive, structured and physically automatable tasks, realised adoption will also depend on country-specific conditions that shape the practical ceiling for deployment. Our modelling points to a staggered adoption path rather than a uniform global rollout. As commercially viable use cases broaden, adoption rises unevenly across countries and applications. As the economics improve, embodied AI has the potential to move from niche deployment towards broader commercial use.

For materials demand, this creates a second pathway that is distinct from digital AI infrastructure. Where data centres drive demand through compute, networking, cooling and power systems, embodied AI adds demand through batteries, electric motors, actuators, sensors, power electronics,

“As commercially viable use cases broaden, adoption rises unevenly across countries and applications. As the economics improve, embodied AI has the potential to move from niche deployment towards broader commercial use.”

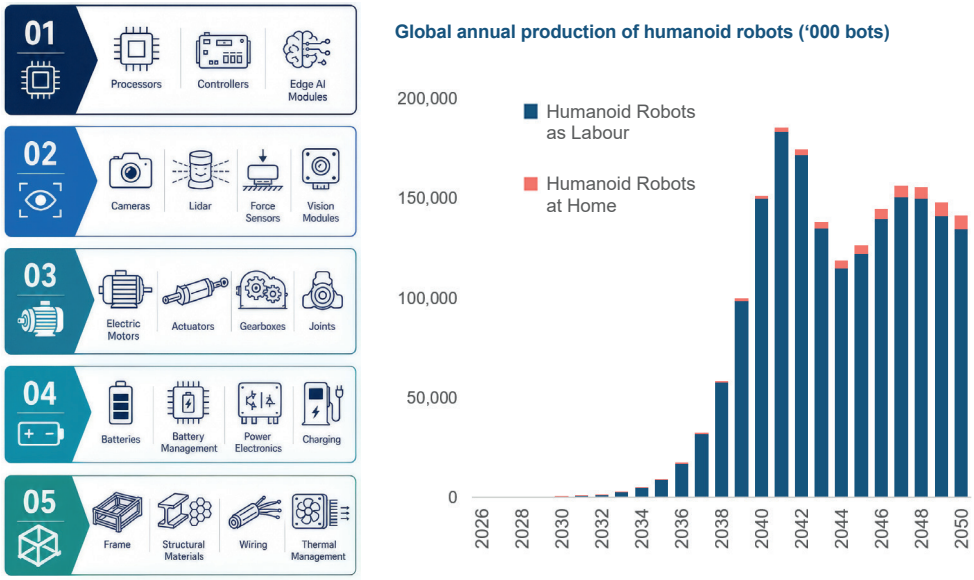
wiring, processors and structural materials. As annual production scales across labour-replacement and other applications, embodied AI could create meaningful new demand for battery materials, conductive materials, engineered alloys and magnetic materials, particularly where performance, weight, durability and energy density are critical.

As unit economics improve, early deployments are moving from demonstration to pilot use



DATA: CRU, ILO

Digital AI requires a broad physical infrastructure stack and significant capital deployment



DATA: CRU

The timing and scale of this second wave remain more uncertain than for digital AI, but the direction is increasingly important. If digital AI reshapes how information is processed, embodied AI could reshape how physical work is performed. For commodity markets, that means the AI story does not end at data centres – it may also extend into the machines that operate across warehouses, factories, infrastructure and, eventually, a far wider range of real-world environments.

What this means for commodity demand

Taken together, digital AI and embodied AI suggest that this technology cycle will be defined not only by software capability, but by the physical systems built to support and deploy it. For commodity markets, that shifts the focus from AI as an abstract productivity story to AI-Tech as a new source of demand for infrastructure, equipment and materials.

This first insight has set out the two main pathways through which that demand could emerge. The next insights in CRU's series will examine the underlying component mix and material intensities in more detail, with separate coverage of conductive materials, battery materials, structural materials and magnetic and rare earth materials.

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CRU expands long-term data centre metallics forecasting

The data centre and AI industries have exhibited significant growth and commercial interest over the past couple of years. CRU's Wire & Cable team has been tracking and modelling this sector and has recently expanded its long-term forecasting to cover metallic wire and cable and non-cable demand. This insight provides a brief breakdown of CRU's expanded coverage and data offerings on the data centre sector, which now includes long-term forecasting for non-cable products used inside data centre facilities and campuses, such as busbars and busway systems, electrical distribution components, and cooling systems.

Explore CRU's full analysis of how AI-led data centre expansion, evolving power and cooling systems, and technology-driven efficiency gains are reshaping long-term demand for copper and aluminium.

Click here to read the full insight.

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Humanoid robots can widen the projected REE supply deficit

Humanoid robots could become a significant new source of magnet rare earth demand, adding to pressure from electric vehicles and wind turbines. The technology is still emerging, but its potential to deepen an already projected supply deficit makes it a topic for OEMs to watch. The insight explores the scale of that opportunity—and options for strengthening supply resilience.

Could humanoid robots deepen the coming rare earth supply deficit? Read our full analysis of the demand outlook, supply risks and the actions OEMs can take to strengthen resilience.

Click here to read the full insight.

FEATURE

When Critical Becomes Strategic



By **Mark Jeavons,**
Head of Sustainability,
London, UK, CRU

Critical raw materials have shifted from the margins of industrial policy to the epicentre of economic and national security. Their importance extends far beyond official risk registers: they form the indispensable backbone of modern defence, artificial intelligence, digitalisation and the global energy transition. Crucially, as demand accelerates, the concentration of mining, processing and refining in a small number of locations has created systemic vulnerabilities across major economies.

China's commanding position across many critical-mineral value chains has made this exposure an urgent strategic policy priority. In response, governments are deploying an increasingly assertive toolkit: accelerating permitting, providing public finance, supporting exploration, building strategic stockpiles, securing offtake agreements and forging new international partnerships. However, the goal is rarely complete decoupling, which remains economically unfeasible. The core focus is instead on securing genuine resilience through diversified supply chains and reduced exposure to geopolitical risk.

Yet not every material can be de-risked in the same way, and there is no one-size-fits-all policy. An effective strategy depends on the scale and structure of each market, the criticality of its supply chain, the capital intensity of developing alternatives and, crucially, the cost of government intervention needed to change market outcomes. Small, highly vulnerable markets for rare earths may respond rapidly to targeted, high-impact support at a manageable cost. By contrast, diversifying large-scale midstream processing capacity, including copper and lithium refining, requires far greater and more sustained public support, backed by commercially durable private investment. Governments must therefore weigh the strategic value of greater security against the financial cost and potential market distortions of achieving it.

For governments and companies, the question is no longer whether critical raw materials matter, but where intervention is most necessary, which measures can mobilise investment, whether their costs are proportionate to the risks, and how quickly viable alternative supply chains can be built. CRU brings together commodity-market fundamentals, asset-level intelligence, policy analysis and long-term forecasts to help clients evaluate these choices and navigate an increasingly strategic landscape.

Our three-part Insight series explores how critical-mineral strategies are evolving—from the formation of international alliances and the design of national policy to the practical costs and market implications of government intervention.



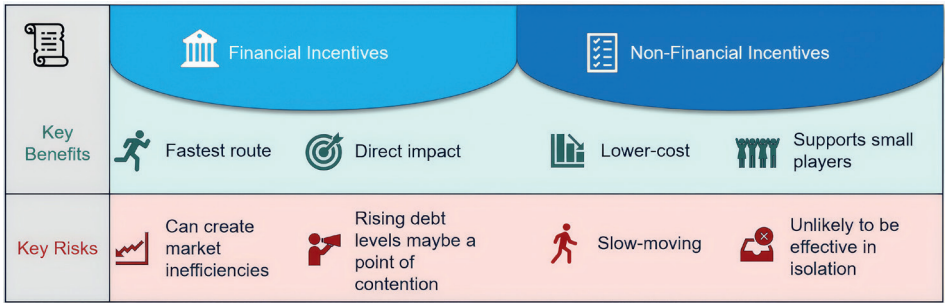
Critical mineral strategies: Evaluating Progress and the road ahead

In this insight, we will discuss the appropriate set of policy measures required to support governments in their efforts. This clearly depends on the country/jurisdiction and the mineral in question. We conclude by assessing how realistic it is for governments to achieve their stated objectives.

In **Part 1** and **Part 2** of this series, we provided an overview on the recent critical mineral strategies globally. Critical minerals policy measures can broadly be divided into financial and non-financial incentives. For strategies to be successful, governments need to pursue the right mix of these policy measures.

This policy mix will vary across critical minerals, depending on the level of government intervention required and the scale of the associated risk. Supply chain risk refers to the probability of events that could disrupt the availability, cost, quality or delivery of goods and services.

Figure 1: Risk-benefit profile for different policy measures



DATA: CRU

The appropriate mix of policy support depends on the specific commodity market

As more commodities are designated as critical, determining the appropriate balance of policy measures is becoming increasingly complex:

- **Distinct market characteristics:** The appropriate combination of financial and non-financial incentives must reflect the specific characteristics and challenges of each market.

- **Risk of resource misallocation:** Not all designated critical minerals require immediate substantial government support. Treating them equally or applying measures universally could obscure the markets facing the greatest risks and lead to misallocation of public resources. We discussed the need to narrow the critical minerals investment focus in a previous **insight**.

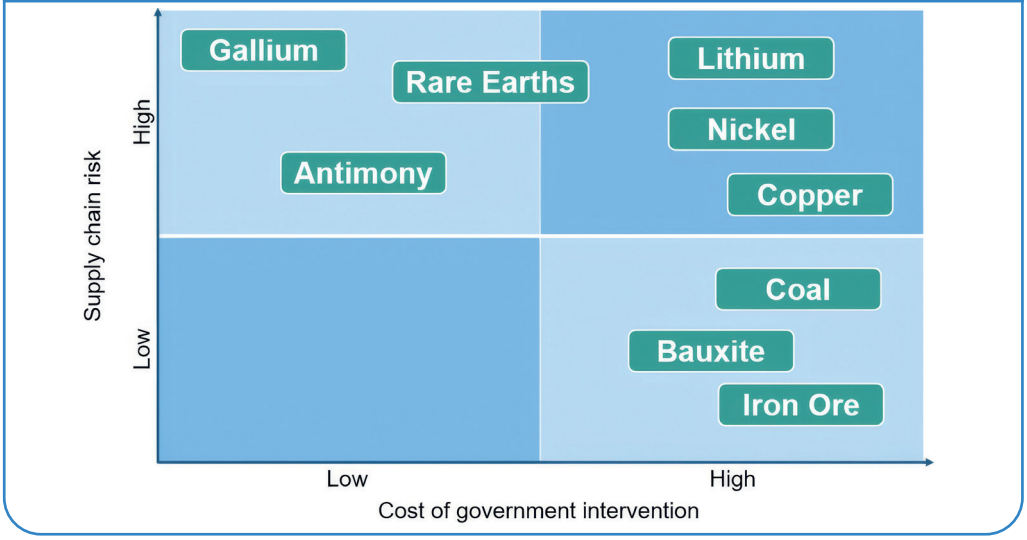
> Treating all critical minerals equally could obscure the markets facing the greatest risks and misallocate public resources."

To identify the most appropriate intervention, CRU has developed a critical minerals risk matrix. The matrix groups commodities into four quadrants based on two dimensions specific to each industry – the cost of government intervention and the level of supply chain risk.

In this instance, the cost of government intervention refers to the financial cost for the government to participate as a producer or an investor to mitigate supply chain risks. It excludes non-financial impacts such as environmental and social costs. The scale of supply chain risk depends on several factors, including concentration and the criticality of end uses.

For instance, disruption of supply in metals used in defence, energy transition and AI will have severe economic and geostrategic implications. Based on these two dimensions, metals can be positioned across the matrix's four quadrants, helping determine the most appropriate policy mix for each commodity.

Figure 2: Critical metals risk matrix (non-exhaustive list of metals)



DATA: CRU

> In high-risk, high-cost markets, financial support alone is unlikely to be enough to attract the investment needed."

Low supply chain risk and low intervention cost: These markets do not require government intervention and are unlikely to feature in critical minerals lists.

Low supply chain risk and high intervention cost: Given the limited supply chain risk, these markets do not require government intervention. For example, iron ore is widely available, and its demand is not expected to grow significantly over the long term because infrastructure investment in China – the world's largest consumer of iron ore – is slowing down. However, because the iron ore sector is large, significant government resources would be needed to intervene in the market.

High supply chain risk and low intervention cost: These markets are likely to require greater emphasis on clearly focussed financial incentives. Despite the requirement for new supply, private investors may remain wary of entering such markets. In particular, markets characterised by low volumes and low barriers to entry may be pushed into oversupply by a few capacity additions, thereby affecting long-term profitability. Governments may therefore need to identify industry champions and directly support selected producers.

An example of a market in this category is gallium. CRU estimates that if gallium were recovered as a by-product from all alumina refineries, annual production could exceed 20,000 t Ga, compared to a total market size of just under 1,000 t Ga contained.

High supply chain risk and high intervention cost: These markets will generally require a combination of strong financial incentives and substantial non-financial support. Although financial assis-

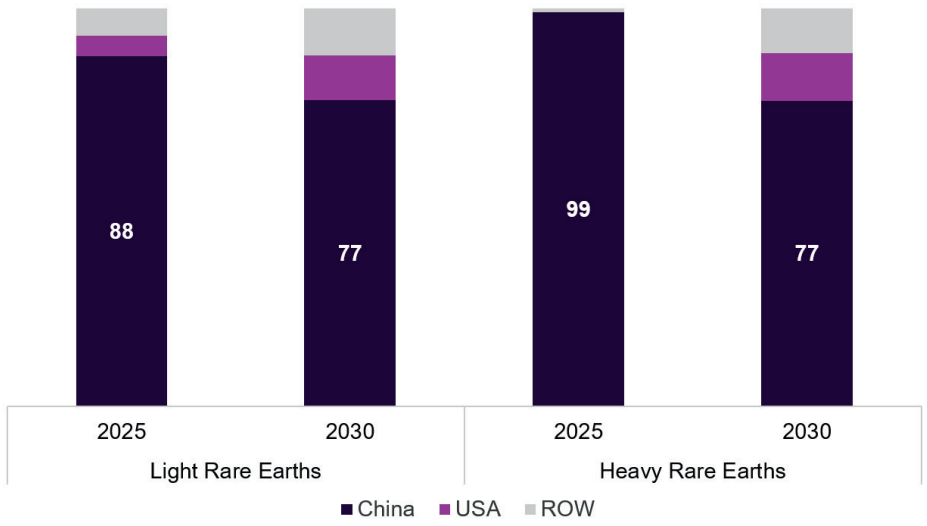
tance will be needed to encourage production and support sustained production, it is unlikely to be sufficient on its own. Given the large size of such markets, governments are unlikely to fund a large share of the required investment directly. Strong non-financial measures are therefore needed to encourage private-sector participation. This will also allow much needed 'hidden' champions in these markets to emerge.

Policy interventions are working in the rare earths market

Rare earths are characterised by a relatively low cost of government intervention and high supply chain risk. Investments in the sector have increased significantly over the past year, following **China's trade restrictions on rare earths**. Due to the nature of geopolitics at play, these investments have mostly been driven by the US government through a combination of loans and equity partnerships.

For example, the US government has taken an equity stake in MP Materials, a US-based rare earths producer, while also providing generous loans to other domestic producers in the rare earths value chain. In another recent example, the US Department of War, formerly the Department of Defense, announced a $620 M loan to Vulcan Elements to support NdFeB (Neodymium Iron Boron) permanent magnet production. As a result of such investments, global supply of rare earths outside China is forecast to grow at an accelerated pace by 2030. This will lead to a declining market share for Chinese supply over time (see Figure 3).

Figure 3: Separated rare earth supply by region (%)



DATA: CRU REE Special Report 2026

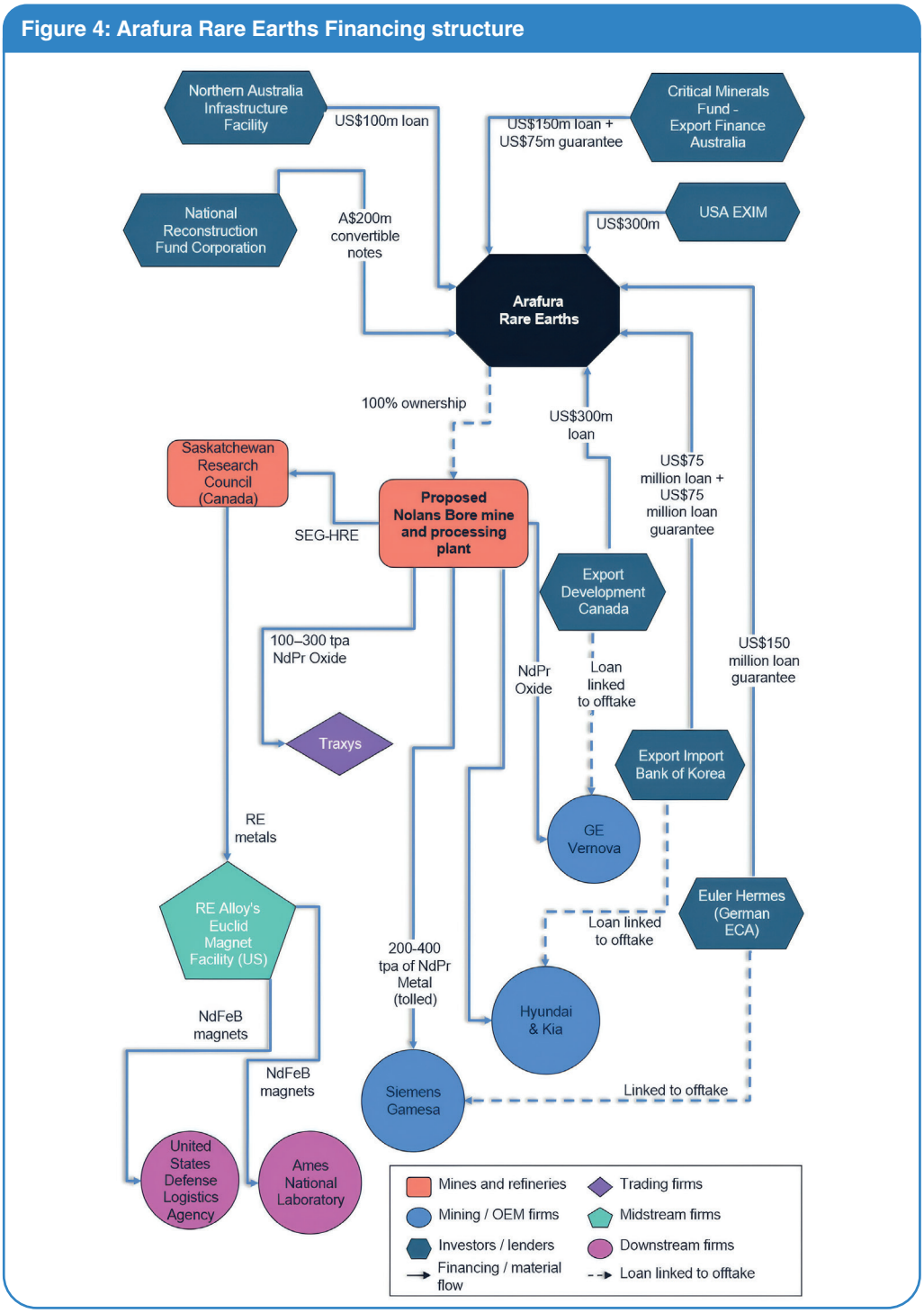
> Rare earth investment shows how financial incentives can work alongside permitting reforms and multilateral agreements."

This momentum has been driven largely by strong financial incentives, such as equity partnerships, price floors and favourable debt financing. These are complemented by several non-financial measures, including multilateral agreements and accelerated permitting.

One of the most notable policy measures in the rare earths sector is the use of price floors by the US government to support **MP Materials** and **USA Rare Earth**, two key US-based producers. Historically, investors have been sceptical of investing in the rare earth market because of the risk that oversupply from China could depress prices sharply, creating significant investment uncertainty.

Given the rare earth industry's positioning in the matrix shown in Figure 2, the current combination of financial and non-financial incentives by advanced economies represents an impactful mix. Figure 4 below shows how Arafura, an Australian mining company, has secured project financing for a rare earths project, which is expected to start production towards the end of the decade.

Figure 4: Arafura Rare Earths Financing structure



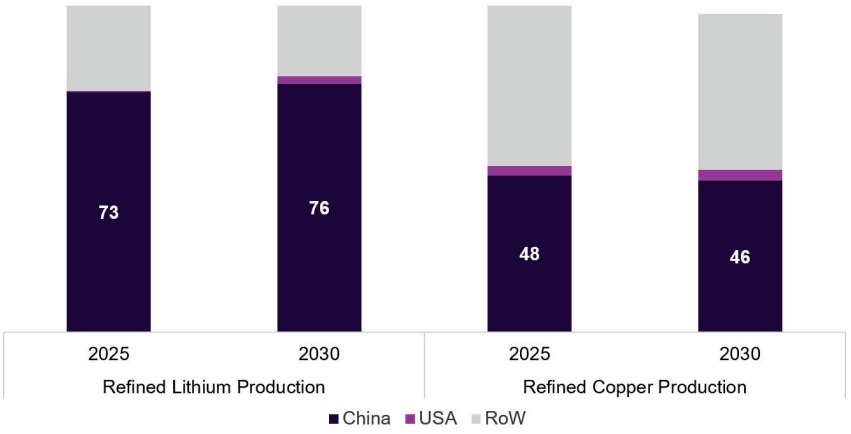
DATA: Adapted from Figure 5 in Mapping nascent rare earth global production networks in a time of geopolitical contestation by Neil M. Coe, Lian Sinclair, and Eli Hayes, 2026, licensed under Creative Commons Attribution 4.0 International. Changes made by CRU.

Resolving supply concentration in high-cost midstream commodity markets is more complex

High-cost industries are too large to support only with direct financial intervention. For example, China is forecast to remain the dominant supplier of copper and lithium refining in 2030, both of which are essential to the energy transition and increased electrification. Although policymakers and industry participants can draw inspirations from the rare earths sector, the incentive mix will need to

be different. Well-chosen non-financial measures will need to be blended with financial measures in larger markets for diversification to be a success.

Figure 5: Refined lithium and copper production by region (%)



DATA: CRU Lithium and Copper Market Outlooks

Midstream capacity is particularly challenging, and copper refining provides a useful example. Treatment and refining charges (TC/RCs) are currently close to record lows, revenue from by-products such as gold and sulphuric acid is highly volatile, and profitability remains under pressure in the developed world, due to higher operating costs (partly linked to the need to meet stricter environmental standards).

Addressing this challenge will likely require a combination of non-financial incentives, such as bilateral agreements with lower-cost emerging economies, and financial incentives, including equity partnerships, backed by advanced economies with more financial resources and strong motivation to diversify supply.

Completely decoupling the supply chains is unlikely, particularly given the inter-connected nature of global production and processing networks. Assessing the probability of success therefore requires understanding the relative effectiveness of different types of incentives.

- **Financial incentives:** These typically have an immediate impact on the supply chains because they provide direct capital, accelerating investment across the supply chain.

- **Non-financial incentives:** Their impact may take longer to materialise because they generally rely on attracting and mobilising private-sector capital, which is generally slow to move.

Figure 6 illustrates the potential for success of these policy measures.

- **High supply chain risk and low intervention cost:** As mentioned earlier, these markets need to see a greater degree of direct financial support across the value chain. As a result, supply chain risks are likely to be reduced substantially over the long term. However, because new plants require time to build, configure and qualify for strategic end-uses, meaningful progress in the short to medium term is possible but less certain.

- **High supply chain risk and high intervention cost:** Given the larger scale of these markets, medium-term success is unlikely. Supply chain risks can be reduced over the long term, but this depends on mobilising sufficient capital. Sustained private sector participation (incentivised by non-financial incentives) is essential.

A policy framework based on recommended matrix does not mean certain success. Other condi-

> Completely decoupling supply chains is unlikely; success depends on mobilising private capital and sustaining alternative supply."

tions must also be in place, such as sustained private sector interest in developing alternative supply chains and establishment of a durable premium for supply produced outside China.

Figure 6: Relative success of recommended policy mix

Market type	Medium term (1-5 years)	Long term (>5 years)
High supply chain risk low intervention cost	Maybe	Likely
High supply chain risk high intervention cost	Unlikely	Maybe

DATA: CRU, NOTE: Low supply chain risk commodities are not included in the table, since decoupling is not required for such metals.

As supply chain risks increase, developing effective policies is becoming a growing priority for governments worldwide. In a rapidly evolving policy environment, companies must also identify and assess the incentives most relevant to their operations and investment decisions. CRU provides ready-made intelligence and tailored research to help governments and organisations navigate critical minerals markets.

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RELATED CONTENT

National critical mineral strategies reflect different perceptions of challenge and opportunity

Governments are moving beyond broad critical-mineral strategies to practical measures aimed at reducing reliance on China and strengthening supply-chain resilience. Common approaches include faster permitting, financial support, exploration funding, strategic project designation, stockpiling and international agreements. However, priorities differ: the USA is using more direct market intervention, the EU is coordinating procurement and investment, resource-rich countries such as Canada and Australia are supporting domestic development, while Japan and South Korea focus more on securing overseas supply.

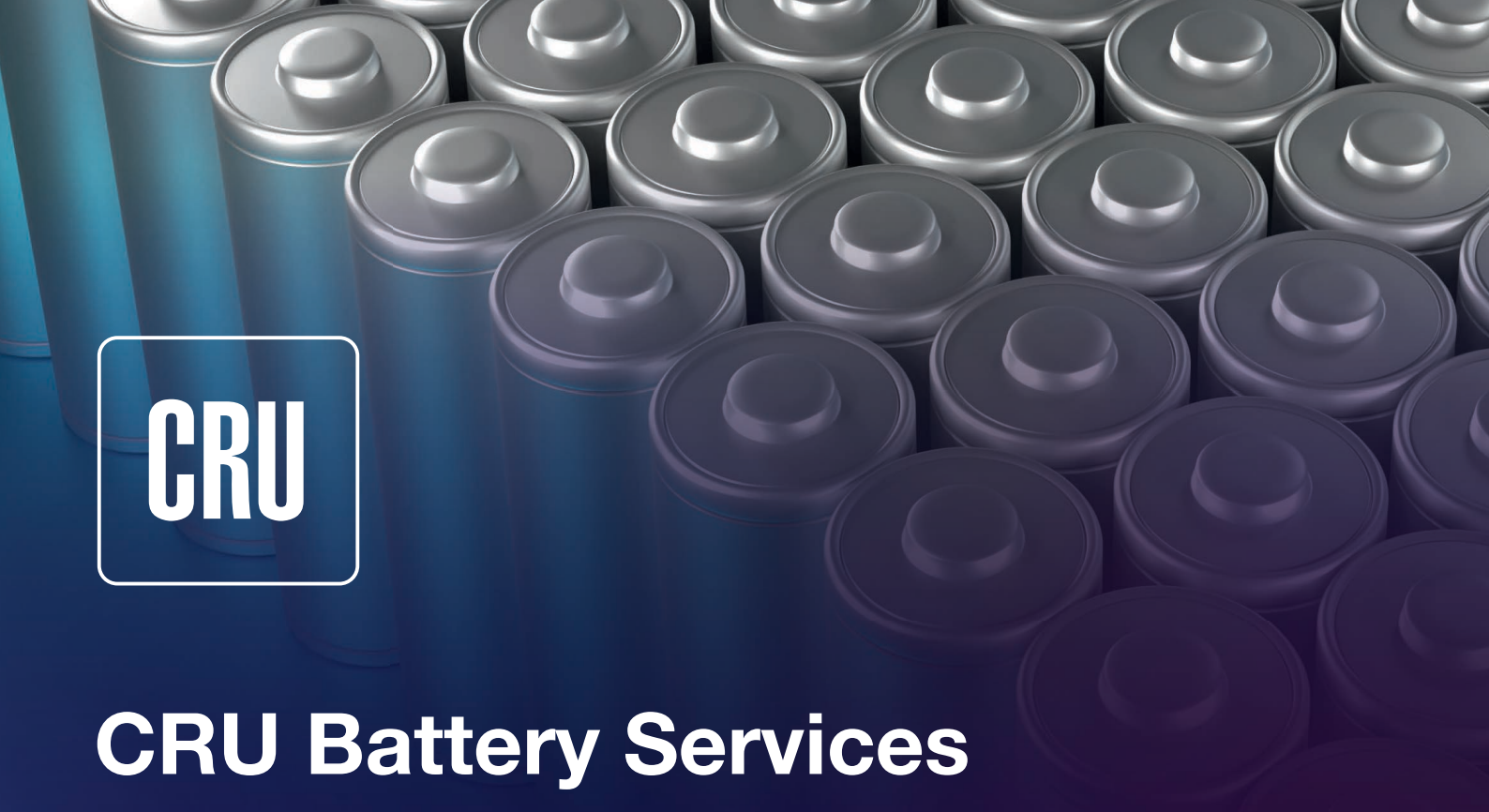
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FEATURE

Protectionism is bottlenecking globalisation in the battery supply chain



By **Sam Adham,**
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The battery industry is booming with strong energy storage momentum and recovering EV demand driving an ongoing surge in battery and material production. Yet Western and Chinese restrictions on IP and investments are keeping the production of critical and advanced materials firmly localised within China, the incumbent and dominant industrial base.

Supply chain risk concerns and other strategic motives have prompted Chinese-origin producers to expand overseas and new Western companies to enter the market, particularly to capitalise on a bottleneck for critical materials such as LFP cathode and synthetic graphite anode. The necessity for onshoring has emboldened them even when facing higher production costs overseas.

However, these projects face an intensifying dilemma, squeezed between Western regulations mandating technology and ownership transfers and China's countermeasures tightening outbound technology, equipment, and investments. This has already started to stall localisation efforts in many projects.

For battery raw materials markets, this means that if the 'midstream' precursor and cathode production does not globalise, neither will the consumption of metals and chemical salts. Chinese companies remain the largest buyers and importers of lithium, nickel, cobalt, manganese, and graphite materials.



INDUSTRY INSIGHT

The geopolitical squeeze on the global battery value chain

Chinese producers in the global battery value chain with overseas projects face an intensifying dilemma, squeezed between Western regulations mandating technology and ownership transfers, and China's countermeasures restricting outbound intellectual property (IP) and investment. This regulatory friction is already stalling localisation efforts for critical components like cathode and anode active materials. Meanwhile, Korean companies are actively deploying new growth strategies to capitalise on this rising protectionism.

This Insight aims to:

- Recap the crucial regional policies during the first half of the year, directly addressing our clients' most frequent questions.
- Assess how these instrumental regulations will exert a lingering impact on battery supply chain globalisation, particularly for critical components like electrode active materials.
- Analyse how Chinese and Korean manufacturers are strategically responding.

> "Chinese producers face an intensifying dilemma between Western requirements and China's restrictions on outbound intellectual property and investment."

US upholds Prohibited Foreign Entity standards

On 12 February, the US Treasury and IRS released **interim guidance** regarding sourcing rules to qualify for key tax credits. The rules focus on the Prohibited Foreign Entity (PFE) and Material Assistance Cost Ratio (MACR) frameworks, the definitions for which can be found in our **previous Insight**.

Battery manufacturers and energy storage project owners must satisfy increasingly stringent thresholds on how much supply they source from PFEs.

The recent interim guidance offers them an optional shortcut – the Cost Percentage Safe Harbor – which allows producers of "listed components" to use a pre-assigned ratio, enabling them to bypass granular, unit-by-unit material tracing.

Although this seems to provide some relief for the administrative and accounting burden, the caveat is that companies with mixed PFE and non-PFE supply chains are heavily penalised in this method. As it relies on fixed percentages, the presence of any PFE in the upstream supply chain taints the entire assigned value of a component. Most companies are therefore better off self-tracking costs than using shortcuts, as demonstrated by the example below taken from **CRU's Battery Value Chain Service**.

US Foreign Entity Rules appear to offer some relief, but remain stringent in reality

Example: MACR calculation when a BESS project owner or battery module producer uses a PFE p/CAM to process non-PFE raw materials

	Self-tracking	Self-tracking using Certification Safe Harbor	Cost Percentage Safe Harbor (Feb notice)
48E BESS project owner	Total BESS system cost – PFE pCAM cost / Total BESS system cost	Total BESS system cost – PFE pCAM value-add cost / Total BESS system cost	Total BESS system % – PFE cell % / Total system % = (100% – 52%)/100% = 48% **< 2026 threshold: 55%**
45X Battery module producer	Total battery module cost – PFE pCAM cost / Total battery module cost	Total battery module cost – PFE pCAM value-add cost / Total battery module cost	Total module % – PFE cell % / Total system % = (65.6% – 52%)/65.6% = 20.7% **< 2026 threshold: 60%**

DATA: CRU Battery Value Chain Service, US IRS. NOTE: Pre-assigned ratio refers to IRS Notice 25-08

Meeting the MACR threshold will become significantly more challenging once the exemptions for existing binding contracts expire (1 January 2027 for battery producers, and 1 January 2030 for BESS project owners). While it is difficult to predict definitively if the thresholds will hold, we are increasingly seeing global manufactures actively adapting to the rules. For example, the Chinese p/CAM companies are restructuring their equity ownership to meet non-PFE standards, indicating the regulator would uphold the rules instead of relaxing the restrictions.

> The EU's proposed rules could make investment in local production more difficult for Chinese companies."

EU's rising protectionism could upend onshoring

In Europe, one of the most consequential legislative proposals in 2026 is the Industrial Accelerator Act (IAA). It aims to accelerate EU battery supply chain localisation and ensure coherent implementation across member states by introducing domestic sourcing and Foreign Direct Investment (FDI) requirements.

The IAA signals a significant pivot in EU policy – from an inclusive, collaborative stance that welcomed onshoring and tolerated imports, to a protective, EU-first approach that uses targeted measures to force foreign investors to localise production.

This draft regulation explicitly targets investments from nations holding over 40% of global manufacturing capacity in relevant sectors, effectively singling out China. The new FDI mandate also imposes a conditional framework, as summarised below:

EU Industrial Accelerator Act aims to tighten foreign investment rules

If investment from a country holds > 40% global manufacturing capacity and investment amount >€100mln, FID must meet at least 4 of 6 criteria to gain approval:

- ✓ (**Mandatory) local workforce requirement**: ≥50% EU workforce with adequate training.
- ❑ **Ownership cap**: Foreign investment (FI) holds ≤ 49% control or share capital.
- ❑ **JV**: Investment structured as a JV with FI holding ≤ 49%.
- ❑ **IP transfer**: Investor licenses IP to the EU target.
- ❑ **R&D**: Investor spends ≥1% of the target's gross annual revenue on R&D within the EU.
- ❑ **EU sourcing**: FI publishes strategy aiming to source ≥30% of inputs within the EU.

What defines control and triggers scrutiny:

- If FI's collective holdings to reach or **exceed 30%** of the share capital, voting rights, or asset ownership.
- Applies to both existing and new projects.

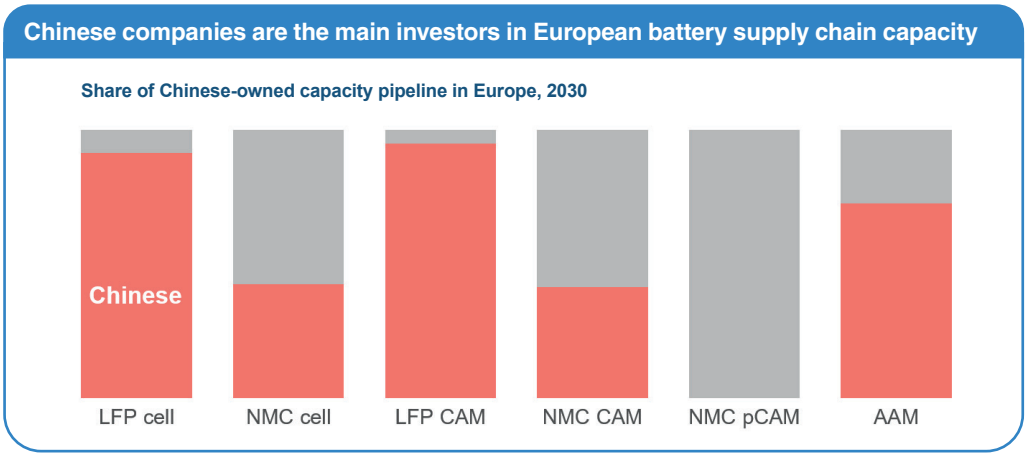
DATA: CRU Battery Value Chain Service, European Commission

While foreign investors seem to have the flexibility to choose three of the five non-mandatory criteria for approval, the reality is far more restrictive. As the research and development (R&D) commitment is the only easily achievable metric, manufacturers are effectively forced into one of two difficult options to meet the remaining criteria – dilute ownership or initiate a technology transfer. Crucially, these new FDI rules apply not only to greenfield investments but also affect the existing operations requiring capital injections for project expansion.

According to data from **CRU's Battery Value Chain Service**, EU construction pipelines are over-

whelmingly dominated by Chinese capital, particularly for LFP cells and electrode materials, where the region faces a structural deficit. However, the IAA has effectively placed these Chinese investors in a dilemma. Relinquishing project control or transferring IP are both major hurdles, especially given the increasing scrutiny on technology exports by Chinese regulators.

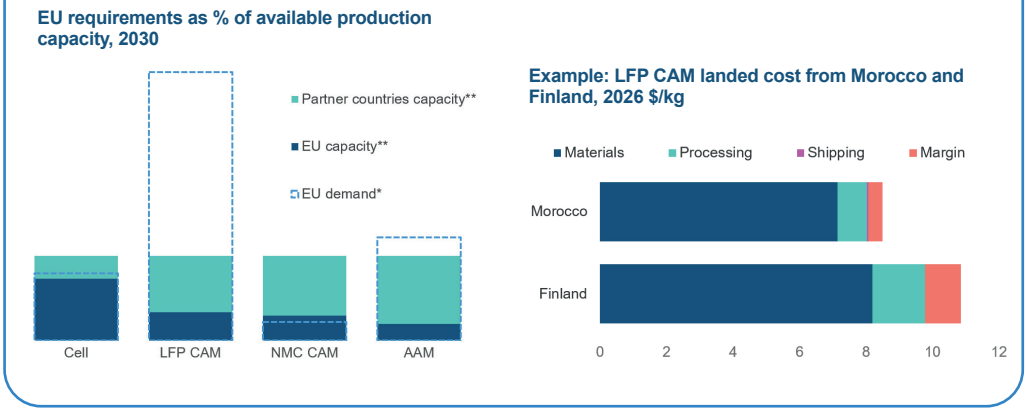
Chinese companies are the main investors in European battery supply chain capacity



DATA: CRU Battery Value Chain Service

In the short term, some investors might front-load their CAPEX ahead of schedule. However, in the long term, it is reasonable to consider that new projects may be better directed toward lower-cost, more investor-friendly EU trade partners such as Morocco, rather than being localised within the EU. As demonstrated in **CRU's Battery Cost Model**, the cost profile supports this case.

The EU cannot meet LFP CAM needs domestically and cost remains top priority



*DATA: CRU Battery Value Chain Service, CRU Battery Technology & Cost Service. NOTE: *Based on end-use demand. **Based on risk-adjusted capacity.*

Chinese counter-measures limit projects going overseas

Amid rising geopolitical tension, China is strategically leveraging its industry dominance by tightening battery supply chain regulations. In March and April, China subsequently introduced Provisions on Supply Chain Security and the Counter-Extraterritoriality Regulation. These decrees establish a coordinated legal mechanism to penalise multinational entities that comply with regional protectionist or de-risking policies.

Crucially, the legislation restricts unauthorised data collection, creating severe legal risks for routine supplier audits and information-sharing required by Western regulators for supply chain tracing and ESG compliance. These laws serve as direct countermeasures, authorising the Chinese govern-

ment to investigate and impose retaliatory actions against any organisation whose compliance with foreign mandates discriminates against or harms Chinese industrial supply chains.

Meanwhile, the ongoing technology export restrictions apply to both physical exports and intangible IP transfers. While the government temporarily lifted export licensing requirements for selected battery products until November 2026, this waiver applies strictly to the physical products. Cross-border IP transfers, overseas plant relocations, and the relinquishment of project ownership controls are still facing intensifying state scrutiny.

China's technology export restrictions target both physical exports and IP transfers

Restrictions suspended until Nov 2026:

- **Finished product**
  - Li-ion batteries with energy density higher than 300 Wh/kg
  - Ternary precursor (NMC and NCA)
  - Li-rich Mn-based cathode materials
  - High compaction-density* LFP cathode materials
  - Graphite anode materials, including artificial graphite and mixture of natural and artificial graphite
- **Technology & equipment**
  - High energy-density battery cell technology and equipment
  - CAM manufacturing equipment
  - Graphite anode technology and equipment

Restrictions that remain in place:

- **Technology**
  - High compaction-density* L(M)FP cathode and raw material production technology
  - DLE from raw brine
  - Lithium refining technology

Implications for overseas operations:

- Limited licenses for 100%-owned Chinese firms to produce overseas
- Chinese gov. can intervene in attempts to dilute ownership of operations for US PFE compliance

DATA: CRU Battery Value Chain Service, China Ministry of Customs, China Commerce

How manufacturers are responding

Chinese midstream companies restructure equity to meet non-PFE standard

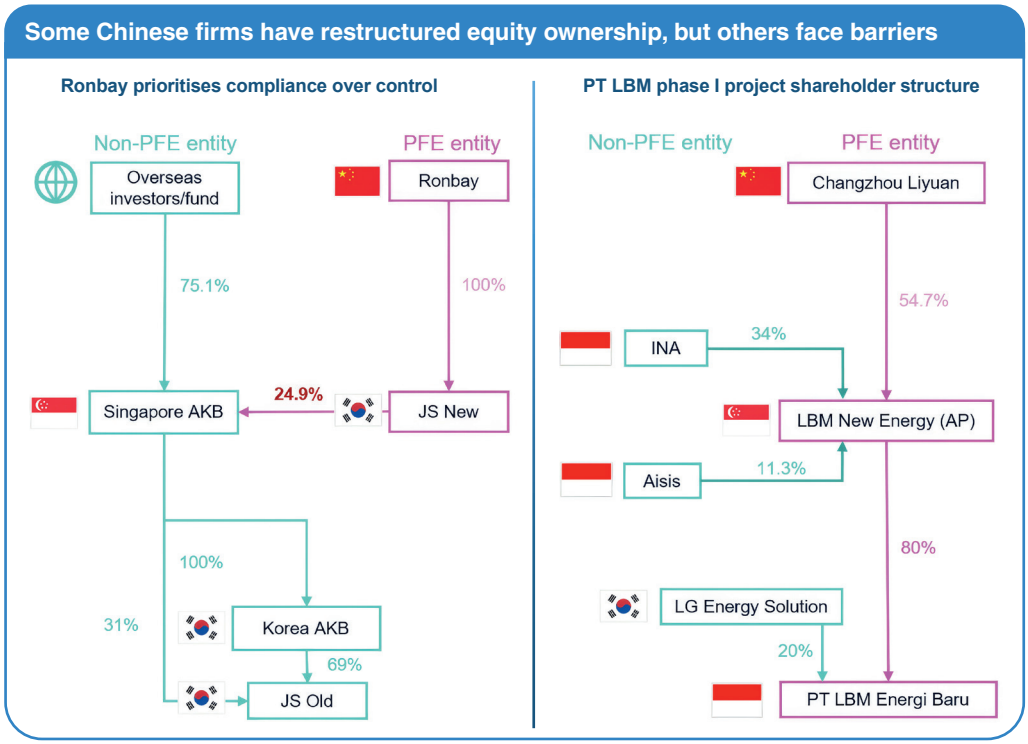
To comply with PFE thresholds and supply US customers, Chinese firms are restructuring equity ownership of their overseas operations, although success varies by the type of product.

Since ternary CAM is not on China's export restriction list, equity dilution was relatively straightforward for leading ternary producers, such as Ronbay. In its public announcement, the company stated it would reduce its effective ownership in the overseas project to just below the 25% PFE threshold, with the transaction being conducted through its Singapore-based holding entity, Singapore AKB. This restructuring was also driven by a financial lesson – Ronbay's Q2 earnings revealed a substantial revenue hit, after downstream US clients suffered retroactive production tax credit losses due to its subsidiary's prior PFE status.

LFP producers are facing a more precarious situation. Changzhou Liyuan (Lopal) indirectly holds a 43.8% stake in Indonesia's PT LBM, which is well above the PFE threshold. Lopal secured approval to produce LFP abroad, long before China imposed export controls, cementing its position as the operator of the only active LFP project outside China. Currently, the company is shielded from immediate scrutiny by US's exemption rules for supply agreements, signed prior to June 2025. However, this safe harbor only insulates sales until 1 January 2027.

Replicating Ronbay's strategy remains challenging because LFP sits on China's active technology export restriction list, making operational control relinquishment subject to government approval. PT LBM's Phase 3 project announcement explicitly stated the facility will only produce second and third-generation LFP cathodes, likely because exporting more advanced technologies would struggle to secure regulatory approval.

Some Chinese firms have restructured equity ownership, but others face barriers



DATA: CRU Battery Value Chain Service, China Ministry of Customs, China Commerce

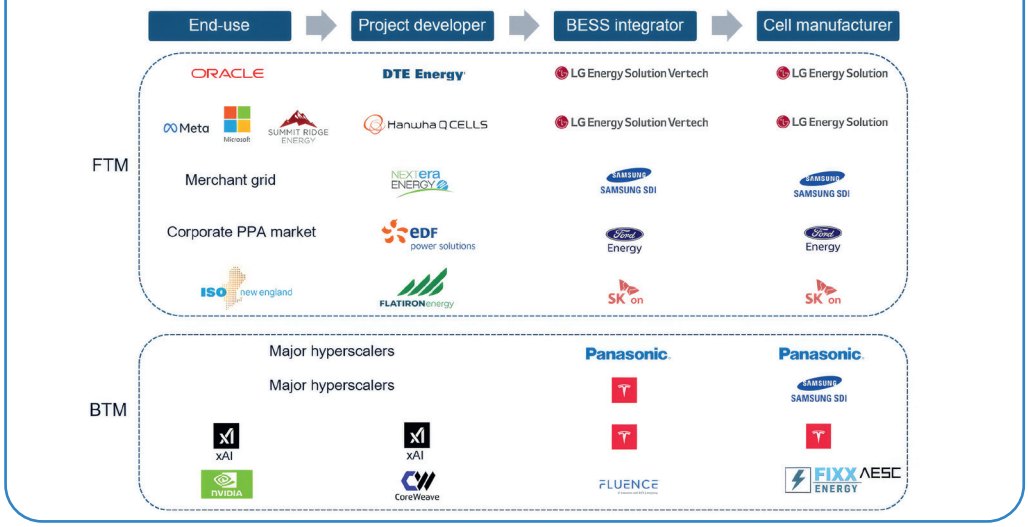
Korean companies accelerate battery plant retooling and pivot to energy storage

Korean companies are seeking to capitalise gains from the geopolitical squeeze. Following the scrapping of US EV tax credits, Korean cell manufacturers are urgently pivoting their strategies towards LFP BESS as the new high-growth market.

Previously focused on NMC chemistries, they had limited exposure to LFP batteries where China held a dominant position with cost advantages. However, the multiple layers of tariffs imposed on Chinese imports and the new PFE rules have shifted the economics. Localising LFP cell production in the US is now more cost-effective, thereby positioning Korean-owned US plants at the low end of the cost curve.

> Korean manufacturers are pivoting towards energy storage as protectionism reshapes the economics of battery production."

US battery producers are accelerating partnerships with end-users and project developers



DATA: CRU Battery Value Chain Service. NOTE: FTM = Front-of-the-meter, BTM = Behind-the-Meter, PPA = Power Purchase Agreement

Leading cell producers – and even some automakers – are retrofitting and reallocating existing and planned capacities towards LFP energy storage cell production. To improve profitability, they are shifting their focus toward grid storage and data centres.

To guarantee capacity amid widespread electrical infrastructure bottlenecks, these producers are forging strategic partnerships across the entire value chain. Recent market developments indicate that cell manufacturers are increasingly locking in direct supply agreements with major project developers, regional grids, and leading hyperscalers.

Cell manufacturers are also vertically integrating into full-scale BESS integrators. By shifting from selling bare cells to delivering turnkey, software-enabled systems, producers can capture higher margins and provide robust performance warranties instrumental to secure AIDC partnerships.

> International cooperation remains possible, but through compliant and increasingly limited channels."

When will the status quo be broken?

Korean and Western manufacturers in the value chain are starting to exploit geopolitical tensions by establishing new alternatives to Chinese batteries, but they remain largely reliant on Chinese producers interwoven in their supply chains.

Chinese companies are the experienced incumbent producers holding the know-how, the equipment and industrial capacity to produce critical battery products such as LFP cathodes, ternary precursors and graphite anodes. They are being held back from expanding overseas or sharing their knowledge with foreign partners.

As long as geopolitical tensions remain, production of these key battery materials will remain firmly localised within China, and companies outside of the country will take far longer to industrialise. However, current Western and Chinese trade barriers and restrictions are not a blanket ban that apply uniformly. International cooperation is still possible through compliant – albeit limited – channels, and it is reasonable to expect that Chinese companies will keep investing in overseas projects given the several long-term imperatives to do so.

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