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CRU Breakfast 2025

Financing the Future: Impact and Opportunity in the Metals Industry

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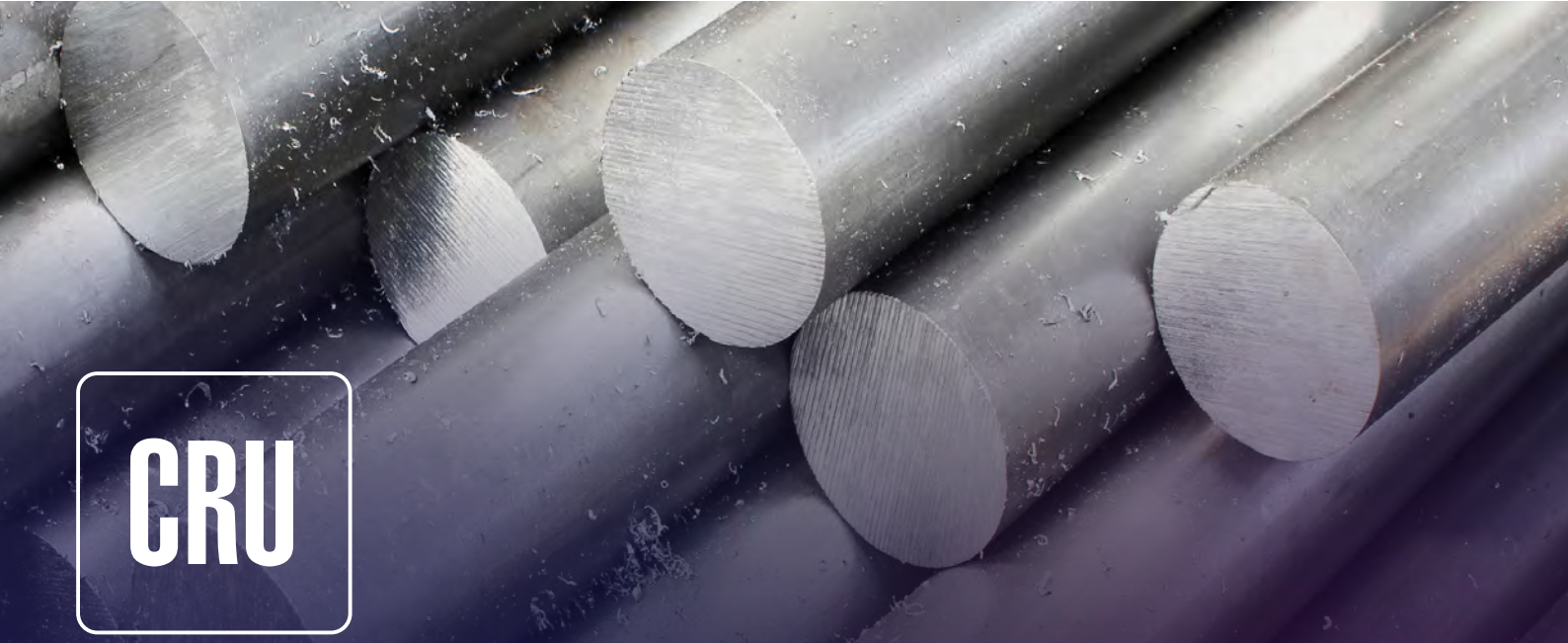

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EDITORIAL

Welcome!

***Mark Jeavons**, Head of Sustainability, Economics & Sustainability, CRU*

Welcome to the CRU Breakfast Supplement. As we gather industry leaders, investors, and strategic thinkers for this year's event, this supplement provides context and insights to enhance your conference experience. This year's CRU Breakfast theme "Financing the Future – Impact and opportunity in the metals industry" puts the funding challenge at centre stage: what will it take to unlock new supply and who will bear the risk?

The metals industry is entering a new era defined by a fundamental shift in investment drivers. We're moving beyond the age of Chinese construction-led growth that defined the last two decades. Instead, new forces, including technological innovation, geopolitical tensions and the urgent need to address climate change, are reshaping the metals industry. This transition presents both massive investment requirements and significant risks. The pace of technological development, from the rise of electric vehicles and solar power to robotics and AI, is rapidly altering supply chains and creating new demands for materials. Yet, these long-horizon investments must now be weighed against policy and technology risks, making it difficult for some investors to justify the returns. This dynamic is creating a "supply-chain trilemma" where the goals of resilience, sustainability and affordability are in constant tension, requiring a new strategic mindset for investment.

As you explore the insights within this supplement, I invite you to consider how these transformative trends will impact your investment strategies and business positioning in the months ahead. CRU Breakfast offers a unique opportunity to engage directly with our speakers, network with fellow industry leaders and connect with our CRU experts to dive deeper into the strategic implications for your specific market challenges.

The conversations we begin at CRU Breakfast are designed to continue well beyond the event itself. Should you have questions or wish to explore how these insights can inform your investment strategies and business decisions, please don't hesitate to reach out to our team. We are here to support you in navigating this rapidly evolving landscape.

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Agenda

08:40 to 09:50

Financing the Future: Impact and Opportunity in the Metals Industry ***(Adelphi Suite)***
Including welcome message, keynote presentation & fireside chat

09:50 to 10:20

Networking opportunity ***(Palm Court)***
Ask an Analyst ***(Knowledge Hub)***

10:20 to 11:00

CRU outlooks for LME commodities ***(Adelphi Suite)***

11:00 to 11:50

Industry panel discussion and audience Q&A ***(Adelphi Suite)***

11:50 to 12:00

Closing remarks and key takeaways ***(Adelphi Suite)***

12:00 to 13:00

Ask an Analyst ***(Knowledge Hub)***
Networking opportunity ***(Palm Court)***

13:00 Close

INSIGHT

Fourth generation LFP battery technology will upheave the industry

Lithium iron phosphate (LFP) battery technology has gained importance for affordability in electric vehicles (EV) and as the dominant chemistry in energy storage systems, given its superior cost and longevity. It is now in its 4th generation and constitutes a technological breakthrough and a fundamentally different material standard.

Its emergence has far-reaching implications that could upheave global battery investments, supply chain structures, market competition and geopolitics. Our main takeaways are:

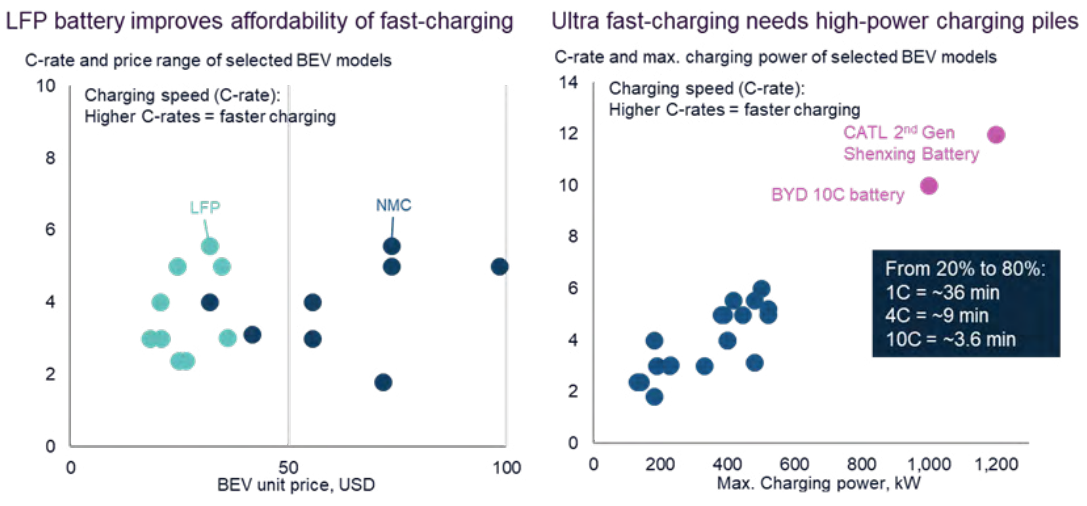
- 4th generation LFP is enabling super-fast charging in EVs in China and narrowing the performance gap versus other chemistries.
- Only a handful of manufacturers are capable of producing or procuring this material, turning the LFP cathode, battery and EV sector into 'haves and have-nots' and driving consolidation.
- China's export restriction policy on high-end LFP technology is ensuring it will remain in the hands of Chinese companies, while non-Chinese firms generally take longer to achieve and scale up similar cost and technical advancements for LFP.
- The different nature of the cathode production route means that it is shifting raw material feedstock demand from conventional chemicals to alternative ones, especially for lithium and phosphates.

LFP battery technology keeps improving

The performance characteristics of LFP continue to improve in the hands of Chinese innovators. At a cathode material level, it is now in its 4th generation and characterised by super-high compaction density, among other properties – essentially a much more granular and dense powder material. Pilot lines are already being built for 5th generation.

While the conventional wisdom was that LFP would not improve noticeably on the electrochemical level, high compaction density – along with other methods – is enabling **improved energy density and fast-charging capabilities in batteries** by addressing the trade-off between electrode thickness and performance. The upshot is that these super-fast-charging batteries are in EVs on the road in China today, with headline figures such as five minutes of charging giving 250 miles of range.

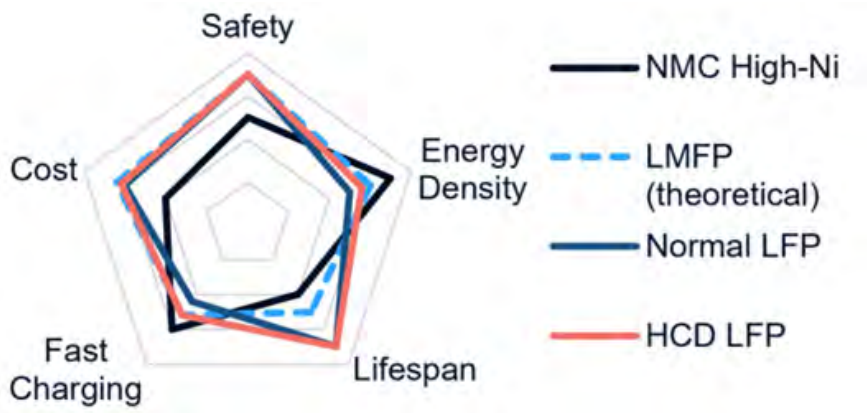
High compaction density is enabling super-fast-charging capability in Chinese EVs



DATA: CRU Battery Value Chain Service, company announcements, EVCIPA. NOTE: Fast charging is also enabled by other methods such as higher system voltage architectures, advanced thermal management, silicon carbide inverters, and advanced graphite anode materials

"Only a handful of manufacturers are capable of producing or procuring this material, turning the LFP cathode, battery and EV sector into 'haves and have-nots' and driving consolidation."

Performance gap narrows between LFP and other chemistries

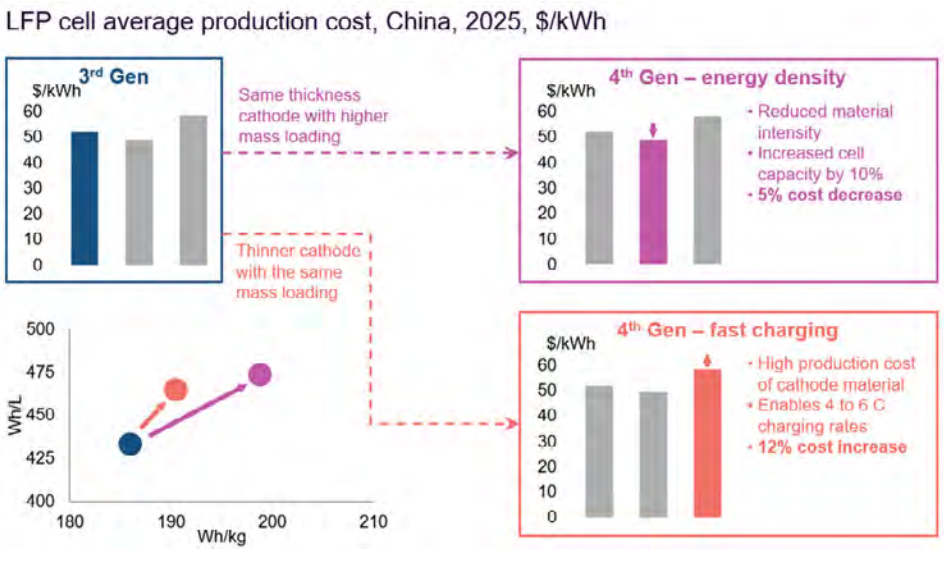


DATA: Battery Technology & Cost Service. NOTE: NMC = Lithium Nickel Manganese Cobalt, LMFP = Lithium Manganese Iron Phosphate, HCD = High compaction density.

Although other technical challenges remain against practical implementation of charging rates beyond 4C, **4th generation LFP nevertheless is narrowing the performance gap** – though not closing it entirely – with NMC and LMFP. The former now has a minority market share in China, and the latter has yet to see mass adoption.

Though fast-charging EVs are the current target application, there is the possibility of 4th generation LFP making its way into battery energy storage systems, which are approaching physical space and weight limits of their standardised containers and transportation infrastructure. Therefore, energy density is becoming increasingly important, which 4th generation LFP can also enable.

The production cost of 4th generation LFP cells depends on the purpose



DATA: CRU Battery Technology & Cost Service

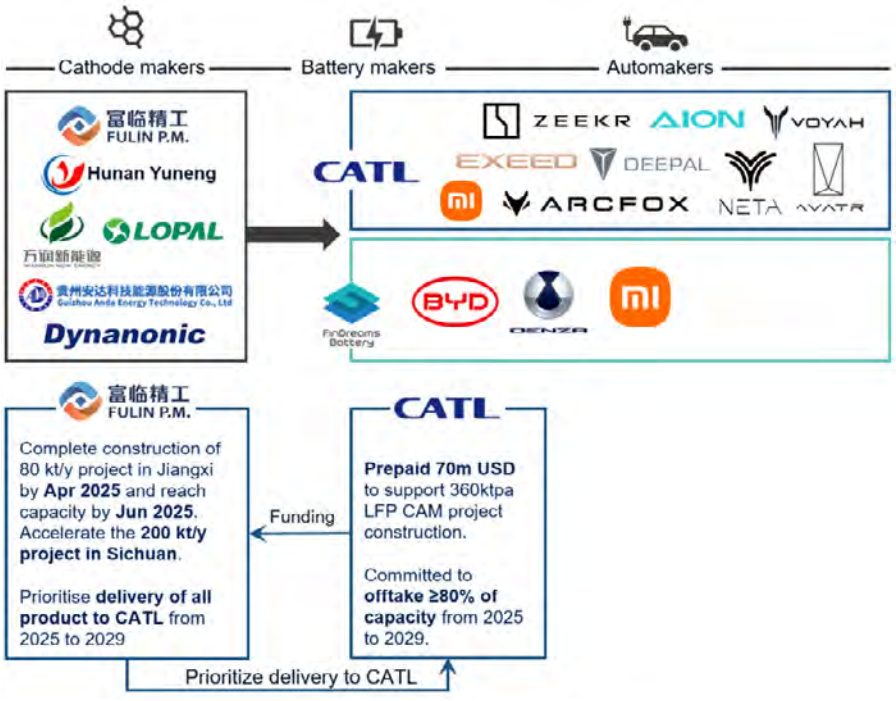
Consolidating the overcrowded LFP cathode industry

The trend of upgrading LFP products will **accelerate the phase-out of outdated capacity and drive consolidation** in China's LFP cathode material industry, which has been marked by severe overcapacity and competition. Within 4th generation methods, production time, OPEX and CAPEX are all increased as it requires upgraded equipment and significantly different processes to ensure precise particle control, fewer impurities and uniform carbon coating.

Currently, only a handful of producers have 4th and 5th generation capability, setting the stage for a market of haves and have-nots. As such, **battery manufacturers have been willing to pay a premium for high-end materials** and help struggling LFP producers to profitability during the ramp up phase.

CATL – the largest battery maker in the world and in normal circumstances has strong bargaining power – has committed to taking almost all capacity from Fulin Precision, a cathode producer that is in a league of its own in terms of high compaction density. It has also provided a pre-payment to support construction of new capacity.

Industry leaders are adopting 4th generation LFP and aggressively securing partnerships



DATA: CRU Battery Value Chain Service

"In other words, lithium producers may find demand shifting from what is their main product towards an intermediate chemical or even a waste byproduct."

A new opportunity for lithium producers

The production of 4th generation material involves fundamentally different process flows, and therefore different lithium, iron and phosphate inputs compared to the norm in China, along with more stringent purity requirements.

The solid phase iron oxalate route currently yields the highest-grade material. The precursor, lithium dihydrogen phosphate, can be made through lithium carbonate but it is cheaper and less complex to use lithium sulphate or chloride.

Supply chains are already forming around this procurement route. Ganfeng currently supplies lithium carbonate to supplies Fulin – who then supplies CATL – but it is constructing a joint venture plant that instead uses lithium sulphate. As 4th and 5th generation materials take over the LFP market, this implies a shift in the preferred feedstock away from lithium carbonate. Sulphate is an existing byproduct of potassium extraction from brines and an intermediate in the spodumene conversion process, and aqueous chloride is an intermediate step in carbonate production from brine.

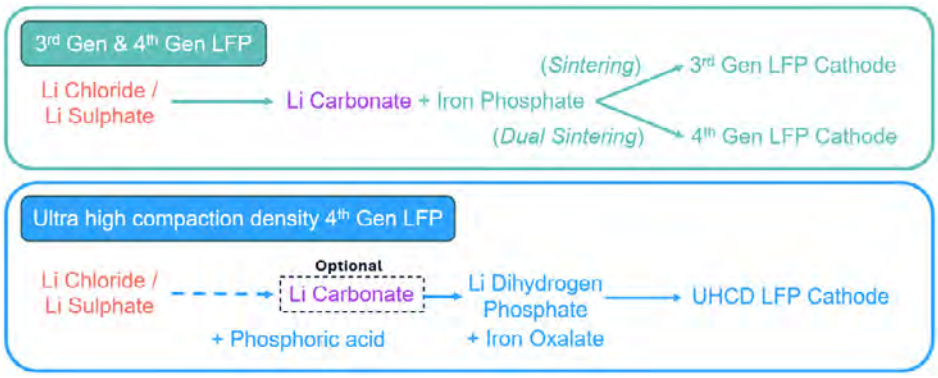
It will not be an immediate transition, as the dual sintering route – which still uses lithium carbonate – will remain for some time, as will 3rd generation material to serve the energy storage sector which has less stringent requirements. It nevertheless signals an opportunity for the supply side. In other words, lithium producers may find demand shifting from what is their main product towards an intermediate chemical or even a waste byproduct.

Primary sources of lithium sulphate are rare – only SQM has capacity to refine ~45 kt/y LCE as a byproduct of its potassium sulphate operation in Chile. However, its production quota, expiring in 2030, will not allow any further expansion unless other output is sacrificed.

Sinomine and Zhejiang Huayou have indicated they will invest in sulphate plants in Zimbabwe, in line with a government measure to ban concentrate exports from 2027. US sedimentary projects have proposed that sulphate could be a saleable product, but carbonate tends to be the common ambition.

All concentrate convertors in China are already producing aqueous lithium sulphate as an intermediate in the refining process. Adapting this would not only simplify chemical production from concentrate, but also drastically lower the need for caustic soda and soda ash, the largest contributors to refining costs. This would lower conversion costs by around 20% when compared to carbonate, though it is heavily dependent on the price of reagents.

Lithium sulphate is the preferred feedstock for the highest grade LFP production route

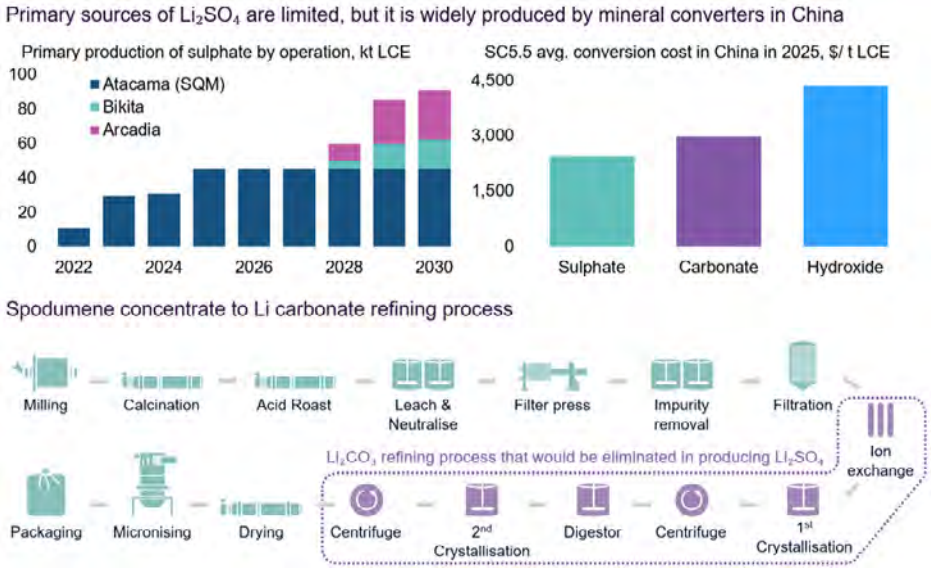


*DATA: CRU Lithium Service. NOTE: *There are several variations on the standard process flows that use alternative chemical inputs.*

Similarly, brine producers would find significant cost advantages in delivering granular chloride, simplifying their production process and reducing their reliance on reagents as an input. South American projects are already making this pivot in their development strategies, but there may be resistance from governments to allow the export of a lower value product.

As advanced LFP proliferates, we expect primary producers and refiners to adapt their processes to make sulphate and chloride refining more commonplace. This presents an opportunity to simplify the value chain, integrate further, and reduce feedstock costs in cathode manufacturing.

A new chemical competitor emerges to challenge Li carbonate's dominance



DATA: CRU Lithium and Lithium Asset Service

China is forced to protect against technology leakage

While the transition to advanced LFP is a given in China, policy and geopolitics – from both the western and Chinese sides – are getting in the way of adoption in the rest of the world. Tariffs and tax credit rules in the US have hindered domestic automakers from importing LFP batteries and even partnering with Chinese suppliers for domestic production, leaving a narrow range of options for procurement.

More importantly, **4th generation material is particularly targeted by China's new export restriction policy on high-end LFP technology.** Specifically, the policy restricts companies from sharing the know-how and equipment for 4th generation LFP cathode material with foreign companies.
Initially, our assumption was that this would not hinder overseas investments as most pipeline projects are fully owned by Chinese companies. However, contacts tell us that they are finding it difficult to obtain the export license.
Similar moves have been made by China in other high-tech industries, partially as a geopolitical response, and partially as a strategic move to maintain Chinese dominance in key stages of supply chains.

Physical exports of the cathode material are not restricted, but there are only a handful of producers with 4th generation capability and most of their supply is already spoken for. Thus, western customers would find it difficult to source material directly from China for now, and instead can only import batteries from the likes of CATL.

Sharing know-how on 3rd generation material is also not officially restricted. Ex. China companies, such as Korean firms that are commercializing their LFP products, are therefore stuck with 'last year's' technology. Indeed, Ford – who is building a LFP battery gigafactory in the US under license from CATL – will be making "CATL's best LFP batteries outside China".

The policy will therefore:

- Ensure that **high-end LFP production and technology will remain in the hands of Chinese companies**, while non-Chinese firms generally take longer to achieve and scale up similar cost and technical advancements for LFP

- Help Chinese EV manufacturers to out-compete their western peers in vehicle range and charging time

- Pose a potential constraint – albeit likely a temporary one – on global LFP adoption and therefore broader affordable EV adoption

For more information on battery technology, costs, supply chains and markets, please get in touch regarding CRU's Battery Value Chain Services.

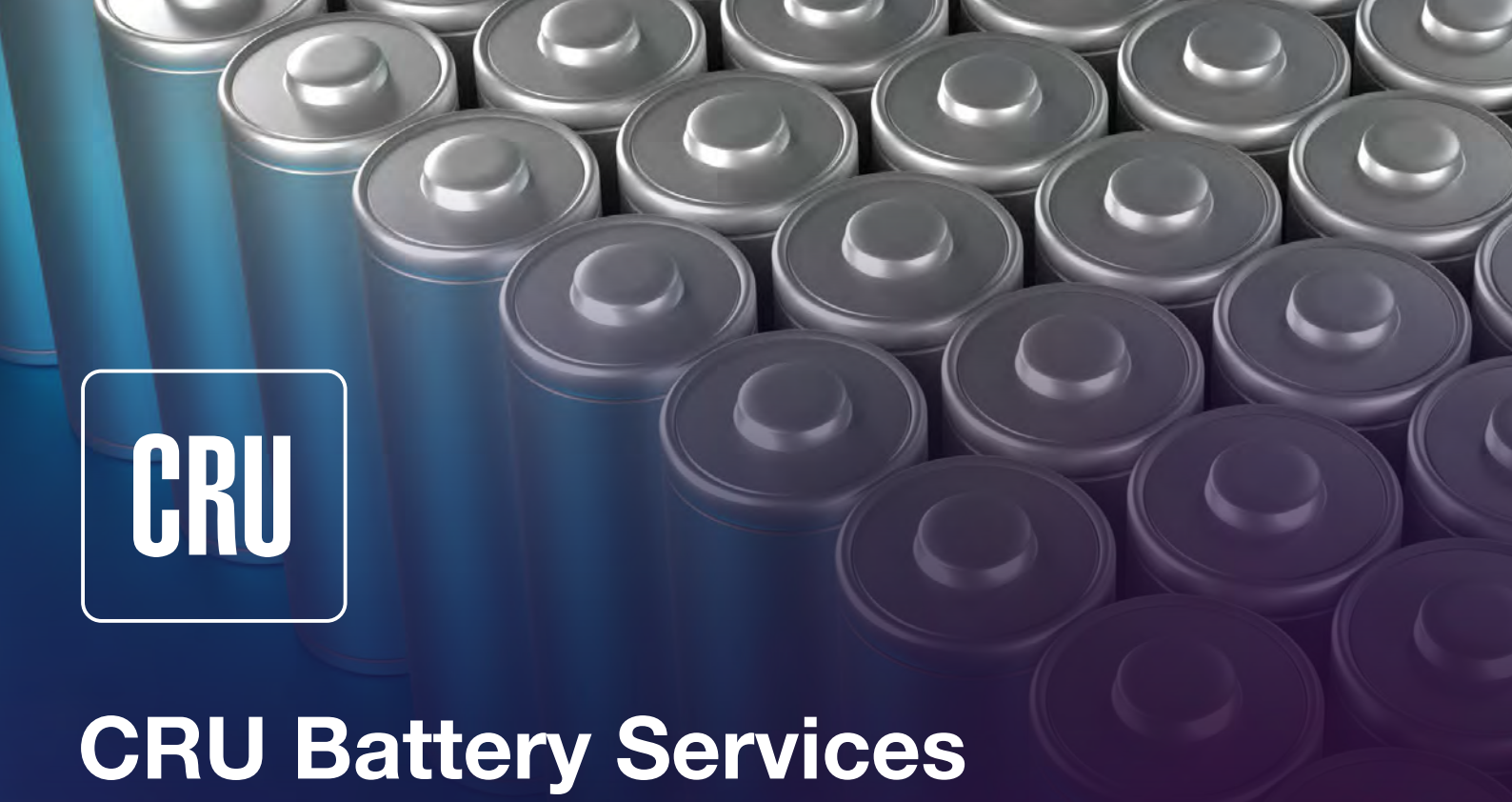
Technology	Conditions
LFP	■ Powder compaction density under 300 MPa ≥ 2.58 g/cc ■ Reversible capacity at 0.1 ≥ 160 mAh/g ■ Initial Coulombic efficiency ≥ 97%
Input materials	■ Tap density > 2.1 g/cc ■ Magnetic impurities < 10ppb Iron phosphate (FePO4) Iron oxalate (FeC2O4) Lithium dihydrogen phosphate (LiH_2PO_4) Lithium phosphate (Li_3PO_4)

DATA: CRU Battery Value Chain Service, China MOFCOM. NOTE: LMFP and lithium processing technologies are also specified by the policy.

*By **Sam Adham**, Head of Battery Materials // London,UK, CRU*

*By **Xiaowei Mei**, Senior Battery Demand Analyst // Singapore, CRU*

*By **Martin Jackson**, Head of Battery Raw Materials // London,UK, CRU*



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Session 1 **Speakers**

BIOGRAPHY

Charlie Durant

Research Manager,
Economics & Sustainability

Charlie joined CRU in 2010. He is a Research Manager within CRU's Sustainability Division, providing thought leadership, insight and data on emissions, the energy transition, and the circular economy.

Charlie was previously Head of Demand and Markets Research in CRU's Base and Battery Metals team. In this role he managed a global team of analysts, delivering world-class research on all aspects of base, battery, precious and technology metal markets.

Earlier in his career he was editor of the Copper Market Outlook, as well as Head of CRU's Aluminium Downstream and Demand Team. Charlie also was part of a team that established CRU's Thermal Coal market research.

He gained a Master's in International Business at the University of Nottingham, where he also obtained his undergraduate degree.

BIOGRAPHY

Hang-Wei (Henry) Hao

Principal Economist,
Economics & Sustainability

Henry is a Principal Economist at CRU. He is based in CRU's Singapore office and is responsible for the macroeconomic coverage of Asia.

Henry joined CRU in 2021 from academia in the US, where he has over 15 years of experience in economics teaching and research. Henry has published his research through several journal articles and working papers on topics including the Great Trade Collapse and China's Belt and Road Initiative.Henry taught undergraduate and graduate courses focused on energy economics, international trade and development economics.

Henry holds a PhD and an MSc in Economics from the University of California, Davis and a BSc in Public Finance from National Chengchi University, Taiwan. He is also a Chartered Financial Analyst and a part-time lecturer of economics at Nanyang Technological University, Singapore.

BIOGRAPHY

Veronika Truslove

Senior Economist, Economics & Sustainability

Veronika joined CRU's Economics Team in September 2021 as an American Economist. She focuses on the economic analysis and forecasting for the North America region. Veronika holds a PhD in Economics and Finance and has lectured at Birkbeck, University of London, since 2016, teaching modules such as applied statistics and econometrics, mathematics for finance, and international finance. She has presented her research at academic conferences and at internal and external seminars.

BIOGRAPHY

Kaitlin Gebbie

Senior Consultant, Consulting

Kaitlin is an experienced project manager and commodities consultant with a strong knowledge base in sustainability and expertise in recycled material, circular economy, and ESG risk assessment. Kaitlin has been with CRU since 2021 and is based in the London office.

Kaitlin has led numerous studies to support a global client base answering critical questions around portfolio diversification, decarbonization strategy, market entry strategy, financial due diligence and negotiation across a range of commodities. Most recently, Kaitlin has been at the forefront of CRU's assessments to navigate CBAM, helping clients to understand impacts to business rooted in financial, scenario and emissions analysis through strategic advice.

Kaitlin is a guest lecturer at UCL's Institute for Sustainable Resources on Master's modules including ESG Risk Management in Natural Mining Projects and Business & Sustainability. Kaitlin joined CRU after university and holds an MSc (Distinction) in Sustainable Resources: Economics, Policies & Transitions and a BSc in French & Business Management with study abroad completed in Paris, and CFA certification in ESG Investing.

INSIGHT

Part 1: Financing the Future of Metals

Commodity markets have entered a new era. The decades-long period of Chinese construction-led growth has ended. Investments are increasingly driven by geopolitics, electrification and technological developments. China is looking outward, which is changing metal supply chains and the industries they support. Many other governments are looking to localise production and reduce reliance on China, compounding this change.

The pace of technological development is rapid, creating winners and losers. We only need to look at the state of flux in automotive markets and energy systems to see how rapidly change is happening. Yet, the material-intensive technologies of tomorrow will not look exactly like those of today. Material efficiency (thrifting), technological shifts and substitution are all key risks.

Getting the balance right between risks and returns is difficult. Some investors will conclude other sectors offer higher returns on a risk-adjusted basis. However, commodity value chains are strategically vital – they are the building blocks of much of the economy and enable technological change. Owning or controlling them brings geopolitical power and supply chain security. Metal market investments will be increasingly viewed through this lens.

China's dominance in the global metals supply chain is a result of a multi-decade strategic plan and pressing macroeconomic necessities, which drove massive investments both domestically and internationally. If western governments want to catch up, then long-term policy stability is needed, but often this does not survive successive governments. Metal market investments require long-horizon planning– for producers, consumers and investors, navigating this landscape increasingly requires balancing long-term vision with new policy and technology risks.

The new forces rewriting commodity demand

Governments are reprioritising economic security over efficiency, fundamentally altering investment flows and supply chains, and creating new ones. This shift extends far beyond the energy transition. While electric vehicles and renewables remain important, technological change now includes robotics, automation, data centres and AI infrastructure, each with distinct material requirements that need to be captured in forecasts.

Geopolitical tensions are redrawing the map of who invests what and where. For example, defence spending is increasing across major economies, and supply chain security is in focus. Climate change will also increasingly alter the nature of economies and investments; spending on both mitigation and adaptation will need to scale massively. Consequently, industrial production as a share of global GDP is set to rise for the first time in decades.

Technology shapes commodity markets

Technological innovation is fundamentally reshaping commodity markets and the sectors that depend on them. The automotive industry, for instance, is very different from only a decade ago. Similarly, energy systems are also evolving. The solar sector now consumes the same amount of aluminium as Germany, South Korea and Brazil combined. Emerging technologies, such as drones and robotics, will grow rapidly, also changing how and where commodities are utilised (subscribers can access some of CRU's thinking here).

Yet, commodity industries are not simplistic. It is not simply the case that demand for all metals will increase uniformly. Also, given supply dynamics that follow rapid commodity demand growth, higher demand does not automatically lead to elevated prices over a prolonged period.

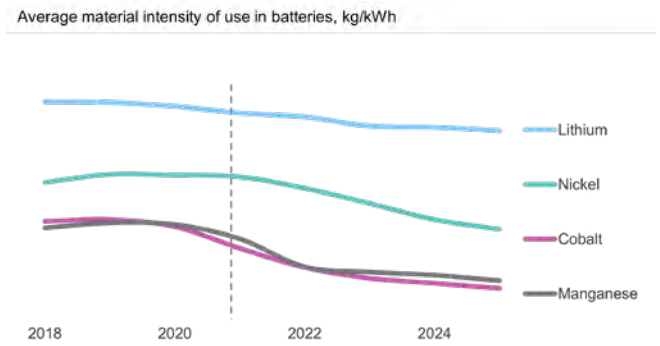
Technologies shift and innovations drive material thrifting and substitution. Metal markets have seen many historical examples, such as when optical cables replaced copper in data-telecom markets or how LED lighting hit the aluminium bright sheet market.

Material loadings change. Cobalt content in NMC batteries has been progressively reduced, while silver loadings in solar cells have declined significantly. Even mature, established markets remain dynamic: in automotive body-in-white applications, advances in high-strength steels have curtailed aluminium's growth trajectory.

Material specifications are of increasing importance. Commodity markets are becoming more heterogeneous – differing grades, emission intensities or countries of origin will all matter more in the future than they have in the past. This makes signing long-term contracts and investment decisions even more challenging.

Many of these forces are interwoven with geopolitical and corporate-level pressures. To mitigate these risks, we are factoring in far more policy and technological thinking into forecasts. This helps us roadmap what technological solutions will be needed where. Analysis of this type could have saved industry huge amounts when thinking on the promise versus the reality of green hydrogen, or in batteries, where the rise of LFP has hit nickel demand projections. However, this is difficult and requires detailed cost forecasting – even then, it often requires scenario analysis and constant review to understand the uncertainties.

The strategic approach to investment targets ROI at the system, not asset, level



DATA: CRU, Battery Value Chain Service

China's pivot – from construction to technology

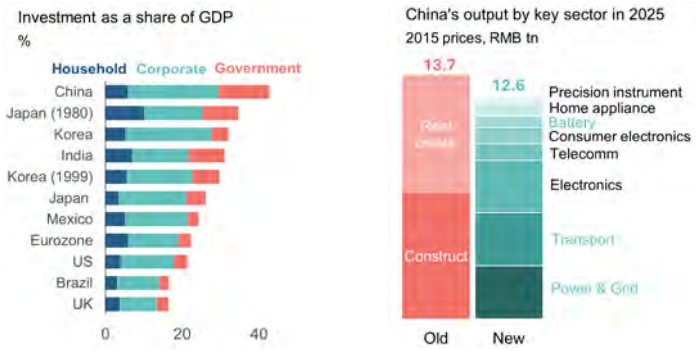
China sits at the epicentre of the commodity market transformation. Foreign investors are pulling back from China amid geopolitical tensions and sluggish domestic demand. Chinese firms, facing a more challenging home market, have been motivated to look abroad for growth, with a focus on investments across Southeast Asia, Latin America and Africa. This is not just about seeking growth – it's a strategic play to secure resources, build influence and diversify supply chains. The outward flow of Chinese capital is creating new opportunities for investors in emerging markets while changing the risk profile of some global assets.

This capital exodus is partly driven by continued trade surpluses and a deliberate pivot away from US Treasury bonds. But it also reflects a more complex response to evolving geopolitical pressures and domestic economic realities.

China's willingness to invest has also been a function of macroeconomic as well as sectoral imperatives. China invests a far higher proportion of GDP than any other major country, or even than other rapidly emerging economies did at an equivalent point in their development. While the Chinese government has repeatedly advocated for a consumption-led model to rebalance the economy, this pivot remains challenging.

With ambitious growth targets set each year, policymakers often fall back on the old playbook – use large-scale public investment to stimulate the economy. Consequently, investment capital that once flowed into traditional infrastructure and real estate is now strategically redirected toward securing the foundational materials and advanced capacity needed for new growth sectors.

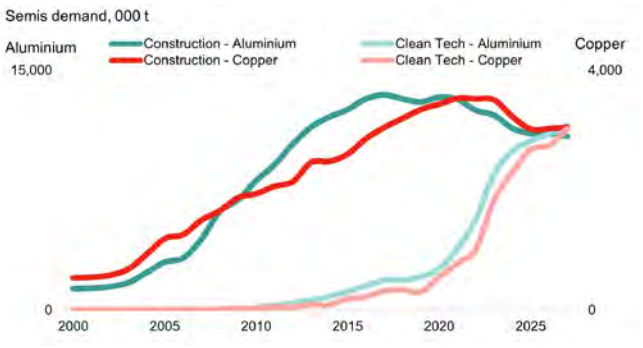
China maintains high investment, steering funds to advanced manufacturing



DATA: CRU, Oxford Economics

Commodity demand from the Chinese construction sector, which was the engine of many metal markets, has plateaued and begun to decline. In China, copper and aluminium demand from clean technologies (renewables, electric vehicles, and grid investments needed to support them) has, or soon will, surpass demand from the construction sector. The Chinese government has embraced what it calls "New Productive Forces" for these high-tech, sustainable and advanced manufacturing sectors, which often require a more diverse basket of commodities to support them.

Clean technologies almost as large as construction for copper and aluminium in China



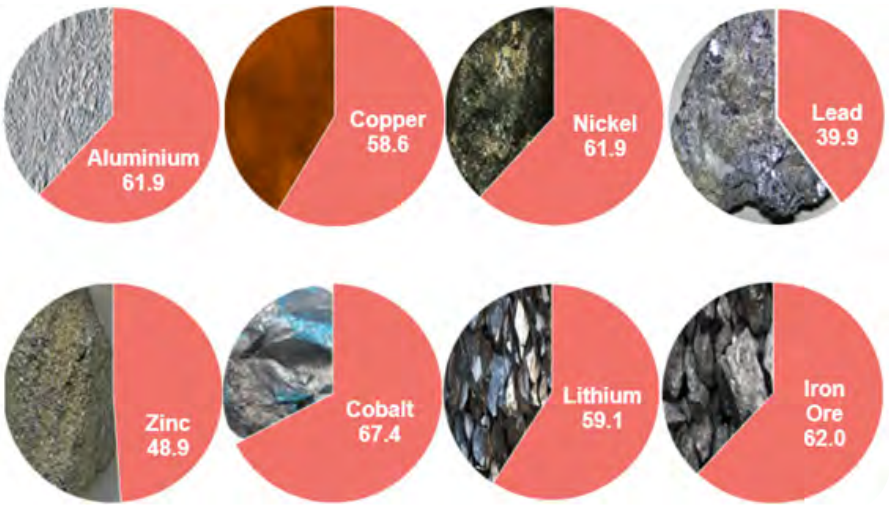
DATA: CRU, Copper Market Outlook, Aluminium Market Outlook. NOTE: Clean Tech includes renewable energy (solar and wind), full battery electric vehicles (BEVs), and assumptions of grid upgrades needed to support clean technologies

Similar forces will drive investment elsewhere in the world. Globally, we need to spend vastly more on electric power generation, grids, and adaptation. This means electricity conductors, mainly copper and aluminium, more energy storage, particularly lithium, and structural materials, such as steel, will be utilised differently.

Chinese companies are filling the gap

For the past two and a half decades, China has solidified a commanding position across global metal supply chains, influencing both supply and demand dynamics. This strategic leverage is continually reinforced by targeted overseas investment. For example, copper production in the DRC is growing quickly, driven by high-grade shallow ore bodies and the influx of risk-tolerant Chinese investment. Similarly, expansions by Chinese companies in Indonesia are driving capacity growth in the aluminium industry. The nickel market shows how significantly Chinese-funded capital and technological expertise can reshape production.

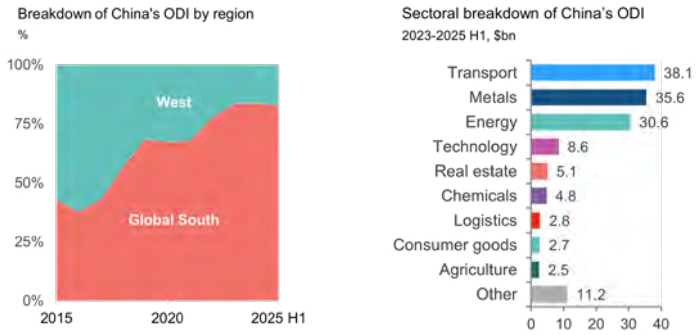
China's share of global consumption across metals in 2025, %



DATA: CRU

Since 2018, the allocation of Chinese overseas investment has undergone a pronounced geographical shift, soaring into the Global South and decisively surpassing flows into Western economies. This strategic redeployment serves a dual purpose – it secures access to vital mineral-rich regions while simultaneously expanding China's political and economic footprint in areas with lower geopolitical friction. Reflecting a targeted effort to secure the building blocks of the modern economy, China's top overseas investment sectors remain transport, metals and energy.

China shifts investment to Global South, prioritising metals, energy and transport



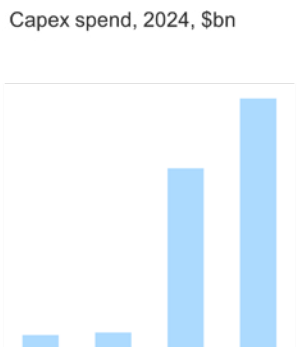
DATA: CRU, AEI

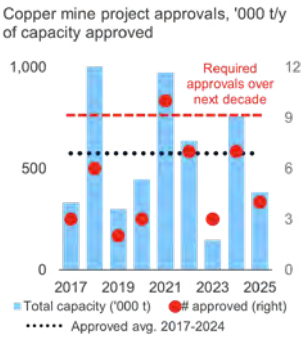
The investment required in metals can be funded by the global financial system – but needs to be attractive

Global capital spending by miners is modest when compared to technology companies, for example. Even the amounts needed to fill incoming supply gaps, on a global scale, are not vast. Yet many miners still struggle to attract the needed capital, despite the geopolitical significance of commodity value chains.

In some metals, such as copper, there is an investment gap, despite the metal's importance and increasing Chinese investment. Since 2017, an average of 574,000 t/y of capacity has reached a final investment decision, well below the 750,000 t/y needed over the next decade. Projects are generally of lower quality and more expensive than seen in the past. If we look at the copper project pipeline, only six projects have copper content of over 1% and a mine life of over ten years. Also, the overall weighted-average copper capital intensity of projects is 20% higher than in 2024. In short, project risk is growing.

Mining capex. modest at the global level but gaps filled by risk-tolerant organisations





DATA: CRU, AEI

Capital allocation within project portfolios presents another challenge, as companies lack the resources to develop multiple projects simultaneously within the required timeframes. Securing investment is increasingly difficult, particularly as many western investors are redirecting capital towards sectors offering superior risk-adjusted returns, leaving commodity projects competing for a shrinking pool of available funding.

Strategic planning needs more evaluation of policy and technology risks

Metal markets are in a new era, where new sources of demand growth are emerging. Technological innovation is driving much of this change, but this also brings new risks to contend with.

Globally, supply gaps are being filled by those with higher risk appetite, often supported by coherent and long-term industrial strategies. This brings certain geopolitical advantages. If western governments want to catch up, then long-term policy stability is needed. Many Chinese organisations do not look at projects in terms of internal rate of returns (IRRs), thinking more of importance across whole commodity value chains. This creates a tension with the west as it weighs reducing its reliance on China.

For producers, consumers and investors, navigating this landscape requires balancing long-term vision with near-term returns, and this needs analysis and scenario foresight on policy and technology risk – areas where CRU is dedicating more time and resources.

*By **Charlie Durant**, Research Manage, Economics & Sustainability // London, CRU*

*By **Hang-Wei Hao**, Principal Economist Economics & Sustainability // Singapore, CRU*

INSIGHT

Part 2: Financing the Future of Metals

In this Insight we explore the growing global interest in 'strategic' approaches to investing in metals value chains. There are deep-seated reasons for China's success in this field, and achieving more resilient supply chains faces many barriers. However, this approach is likely to gain further traction, not just in developed economies but in non-aligned countries in the Middle East, Southeast Asia and Latin America.

Resilient supply chains won't come cheap

China has played a dominant role in investing in metals supply chains since the turn of the century. However, this dominance has sparked growing concern among other countries. The US, viewing China as its primary geopolitical rival, has been most vocal in these concerns. But increasingly, many other advanced and emerging economies have come to view China's control of metal value chains – and adjacent sectors such as solar and batteries – as a strategic vulnerability. This shift in perspective has been reinforced by supply disruptions during the Covid pandemic and recovery, which highlighted that supply chain resilience matters as much as cost efficiency.

Globally, there has been a shift towards 'economic nationalism' – a desire to increase domestic manufacturing or processing capacity and have more ownership and influence of upstream parts of the value chain. However, achieving this is easier said than done. China's ability to invest heavily and dominate the sectors it chooses to is no accident. It enjoys a number of advantages over western countries, set out in the table below.

Investment in, or by, the west faces many barriers relative to China

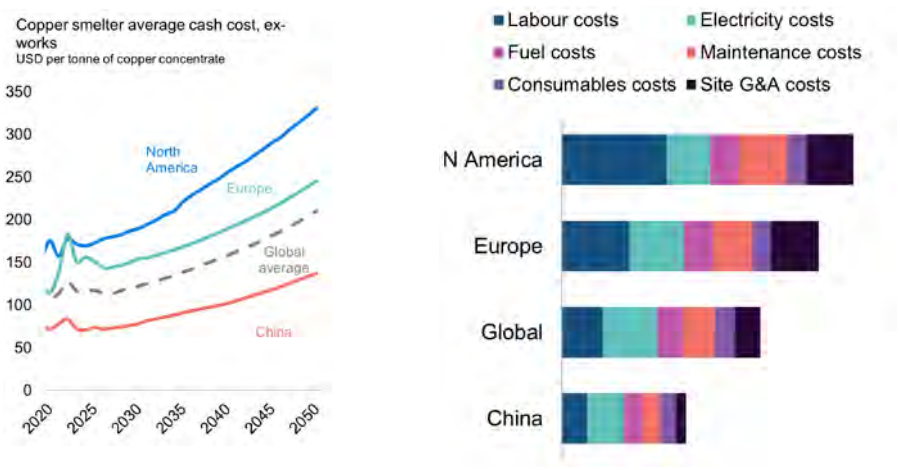
Factor	China	The west
Permitting timelines	~1-2 years	~5-10 years
Cost of capital	State directed, low	Market based, high
ESG burdens	Minimal	Considerable
Industrial strategy	Centralised	Fragmented
Public attitude to mining/ heavy industry	Positive (strategic asset)	Negative (NIMBY)
Policy consistency	High (long-term planning)	Low (frequent policy shifts with the electoral cycle)

DATA: CRU

The advantages in the table above apply to greenfield and brownfield investment in metal production facilities themselves – for example smelters. But it also applies to much of the ancillary infrastructure – ports, roads, railways and power lines – which are needed for heavy industry. What's more, at least some of the factors – cost of capital and investor pressure – also apply to investment in international upstream assets. The location of mining investment is to some extent constrained by where mineral resources are. However, the ownership structure has become increasingly Chinese over the last 20 years.

These advantages mean that diversifying supply away from China will bring higher costs. CRU cost data illustrates the scale of this challenge. As an example, the charts below show estimated costs for copper smelters. The size of the cost advantage China enjoys helps explain why it has accounted for most of the additional capacity built in the last 20 years.

Building capacity in the west instead of China will increase costs

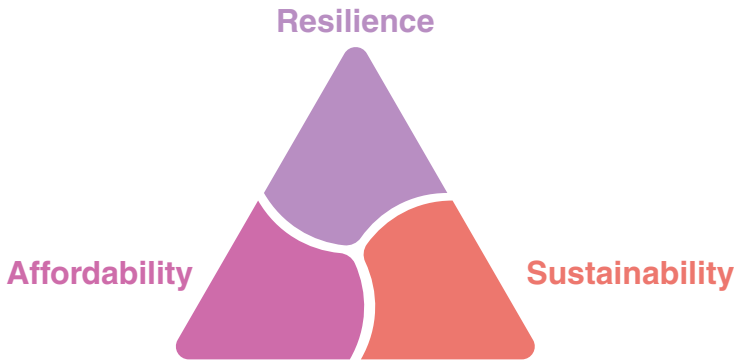


DATA: CRU

The difficult trade-offs: Who will pay?

Supply chains ultimately face a trade-off. In an ideal world, supply-chains would deliver resilience and environmental sustainability at a low cost. However, in reality, there is usually a trade-off – we can't achieve all three objectives. Getting more of one usually means compromising on one of the others. This trade-off is illustrated in the diagram below.

The supply-chain trilemma: we can't have everything



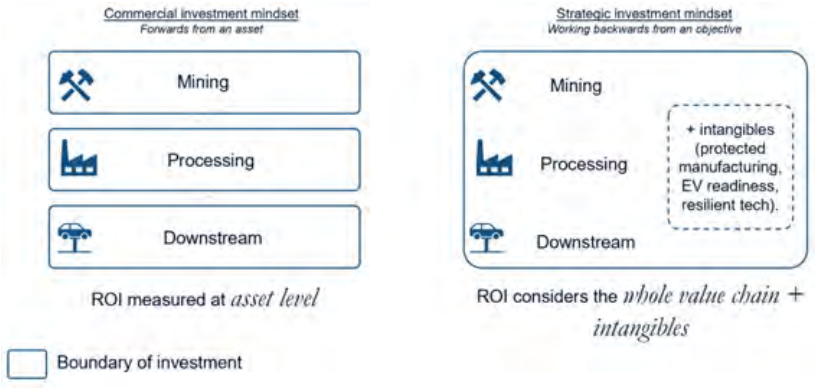
DATA: CRU

From a commercial mindset to a strategic one

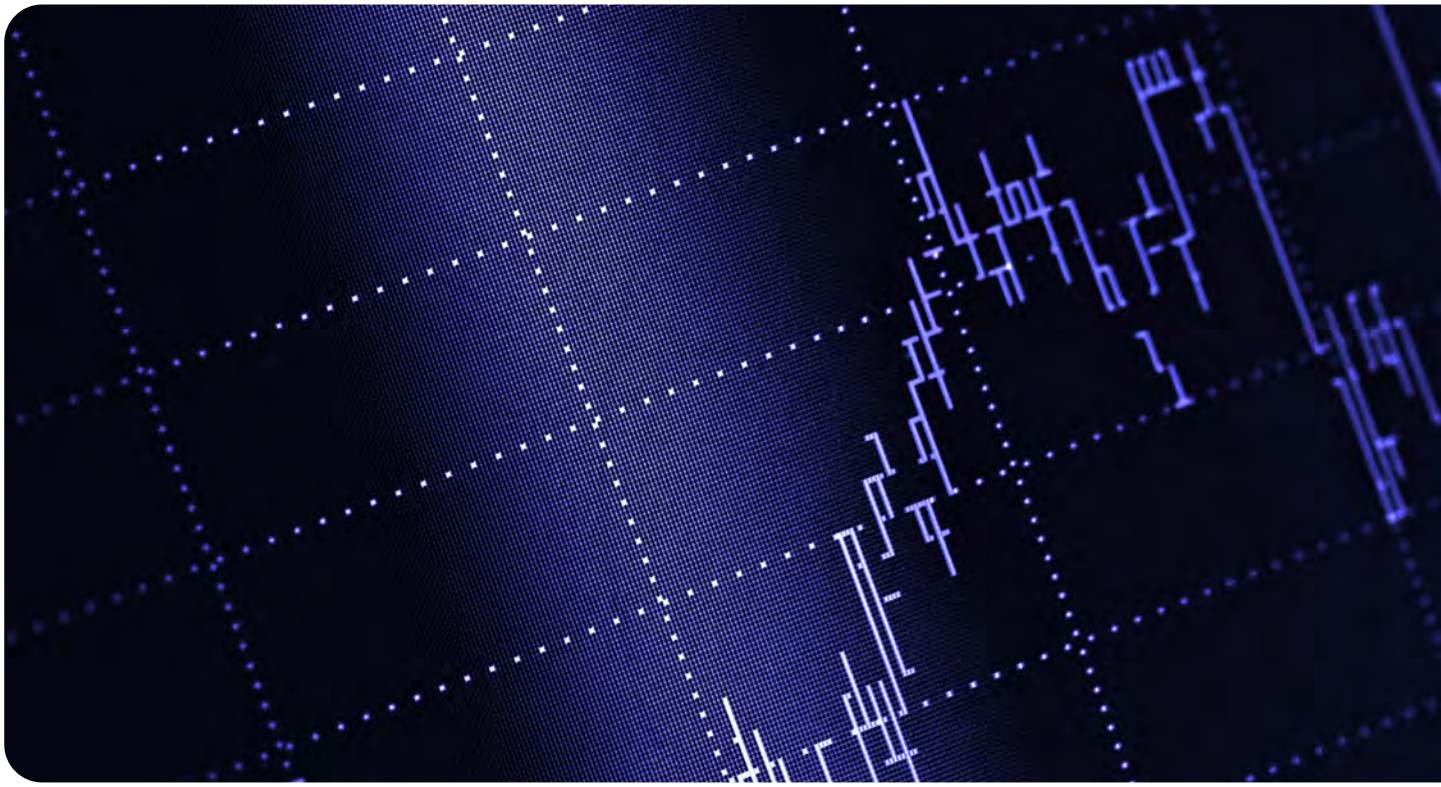
In response to the trilemma outlined above, metals investment is shifting from a 'commercial' to a 'strategic' mindset. In a strictly commercial approach to investment, what matters is the NPV and risk of each project individually. Projects which are not expected to generate a high enough IRR, or which have cashflows that look too risky, are not undertaken. Crucially, investment in multiple parts of the value chain is only considered if the assets are attractive individually. But this mindset risks missing out on value at the system level – it ignores spillovers and the advantages of integrated and resilient supply chains.

The strategic approach to investing – as practiced heavily by China – creates value differently. Capital is directed to deliver on national supply-chain goals. It uses sovereign tools to de-risk investment and reframes the calculation of ROI to the whole chain (see diagram below). That's how restarts and expansions to projects that once looked "un-investable" can access finance – because they create value for the system even if a single asset's metrics are marginal.

The strategic approach to investment targets ROI at the system, not asset, level



DATA: CRU



Strategic investment momentum is building, but execution remains the challenge

The strategic mindset is playing out strongest right now in the Middle East and Indonesia. Their structures differ, but the underlying logic is similar. They are export-oriented, they integrate vertically, and they cultivate industrial clusters by co-locating complementary businesses. They can access relatively cheaper capital, energy and labour while sitting more neutrally within the geopolitical landscape. Crucially, the hurdles that slow western investment – like lengthy permitting and higher capital costs – are absent or less serious.

In the Middle East, diversification strategies are turning mineral endowment into productive hubs by co-locating extraction with processing. An example is Ras Al Khair in Saudi Arabia, a Ma'aden anchored complex spanning phosphate, aluminium, rolling capacity and a Gulf export terminal. Clustering these operations has created value by aligning assets with Saudi's national strategy, improving economics via shared infrastructure and streamlining permitting at the zone level rather than asset by asset.

Indonesia has pursued a more extraction-led path, catalysed by the 2014 ban on unprocessed ore exports and a clear aim to capture value domestically. Foreign investment – predominantly Chinese – has flowed into clusters such as Morowali and Weda Bay. Sponsors including Lygend, Xinfa and Tsingshan have scaled across nickel and, increasingly, aluminium, lowering unit costs and tightening supply chains through co-location. The result is a system that internalises processing, logistics and power.

These strategic bets are not without risk. While technology is driving net positive demand for materials overall, it's also reshaping which specific materials will dominate future markets in unpredictable ways. The nickel market is a good example of this volatility – the unexpected surge in LFP battery adoption has significantly altered nickel's expected growth trajectory.

Each region faces its own challenges, but policy everywhere benefits from joined-up thinking and durability

It is easy to speak of strategic investment – it is much harder to finance and permit it when low-cost power, cheap capital and large-scale resources do not naturally coincide. That is the reality in many western jurisdictions, and also in parts of South America and Africa where higher borrowing costs and perceived risk elevate hurdle rates. But replication of the strategic investment mindset elsewhere in the world is still possible. The tool that travels best across contexts and complements strategic investment is a coherent regulatory framework that lowers uncertainty, compresses timelines and aligns incentives across the value chain to ultimately make these national strategies happen.

Poorly designed rules do the opposite. As an example, mandating local content may lift primary output, yet could erode downstream competitiveness and raise delivered costs. Requiring low-carbon material without providing verification standards or transitional cost support can penalise domestic producers while rewarding imports with opaque footprints. These are examples of shifting value within the chain, not creating it – one segment benefits while the system loses resilience and scale.

One example of this is CBAM. In principle, taken together with the ETS, it levels the carbon playing field by placing a fair cost on embedded emissions, whether produced within the EU or imported. If executed cleanly, it can reward lower-carbon producers and channel capital to abatement – clear value creation under a strategic mindset. In practice, complexity, uncertain timelines and unsettled verification raise reporting burdens, slow investment and invite workarounds. If downstream markets are ignored, higher prices and carbon leakage follow – or in other terms, value destruction via demand erosion and misallocated capital. Without a coherent, joined-up framework, the outcome is not genuine decarbonisation but instead leads to price rises, carbon leakage and further de-industrialisation.

*By **Alex Tuckett**,*
Head of Economics //
London,UK, CRU

Next, the Inflation Reduction Act (IRA). Tax incentives that offset capex can bring assets to life, but without a credible pathway for opex, they risk becoming stranded. It's easiest to think about this with a practical example. The IRA jumpstarted the US battery value chain by pairing construction incentives with production credits and demand-side support, but the current rollback of some elements threatens continued profitability.

*By **Veronika Truslove**,*
Senior Economist //
London,UK, CRU

The broader point here is policy durability: where project returns hinge on schemes such as the IRA – or on the durability of ETS trajectories and CBAM phase-in schedules – investors require a reasonable expectation of continuity across political cycles. In practice, the most effective frameworks blend targeted capacity build-out with proportionate protections during ramp-up (for example, time-bound ETS free allocation that declines as CBAM phases in), and they're underpinned by stable rules that de-risk private capital.

*By **Kaitlin Gebbie**,*
Senior Consultant //
London,UK, CRU

Overall, 'strategic investment' and 'resilient supply-chains' are ideas which are here to stay, for better or worse. Whether the strategies are successful or not will come down to implementation, and designing policies that are joined up, coherent and durable.

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Session 1 **Fireside Chat**

BIOGRAPHY

Luis Lucero

Argentine Minister of Mines

Buenos Aires, Argentina

Prior to his current role, Mr. Lucero practiced law in the fields of natural resources (with focus in the mining industry), corporate matters, complex litigation and arbitration and project-finance in major law firms in Argentina representing large international corporations. He also acted as Foreign Law Consultant for Pillsbury, Madison & Sutro (currently Pillsbury Winthrop Shaw Pittman) in San Francisco, California between October 1993 and May 1994.

He was awarded his Law Degree by Universidad de Buenos Aires in 1983. In the following years, along with his law practice he attended a graduate short course on Business Law at Universidad Argentina de la Empresa, as well as other courses and seminars including the Program of Instruction for Lawyers at Harvard Law School (1993); the Fundamentals of Management Program, at Columbia Business School (2000); Global Issues in Corporate Mining Strategy and Government Policy at the University of Dundee (2001) and Business Management Program at Judge Business School, University of Cambridge (2014). In 2023 he was awarded a Master of Arts degree, with merits, by University College London, UK.

BIOGRAPHY

Willis Thomas

Head of CRU+, Consulting

London, UK

For more information on the Rare Earth Elements Special Report please visit:

Willis Thomas joined CRU in February 2017 with more than five years of experience in metals sales, production and procurement activities. Before leading CRU+, Willis spent six years in Consulting, covering mainly critical minerals (including silicon, manganese, vanadium, tin, rare earths, germanium, gallium, high-purity quartz, tin, zinc, aluminium), as well as across fertilizer markets for nitrogen, phosphorus, potash and sulphur.

As Head of CRU+, Willis is responsible for the team delivering CRU Bespoke Services and CRU Special Reports. Bespoke Services provides custom data and reports, which fall outside of CRU's Insights or Strategy offerings, while Special Reports are multi-client, singular market reports on niche markets across metals, mining and fertilizers.

Willis' team have recently released a Special Report for Rare Earth Elements. The U.S. Department of Defense funding for MP Materials (a U.S.-based rare earth producer), Apple's US$500 million investment in the same company, and China's trade restrictions on heavy rare earths and related alloys, have brought renewed attention to the future of this strategically important market.

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INSIGHT

Commodity market outlooks

Policy drives 2025 price turbulence and sets the scene for a mixed 2026

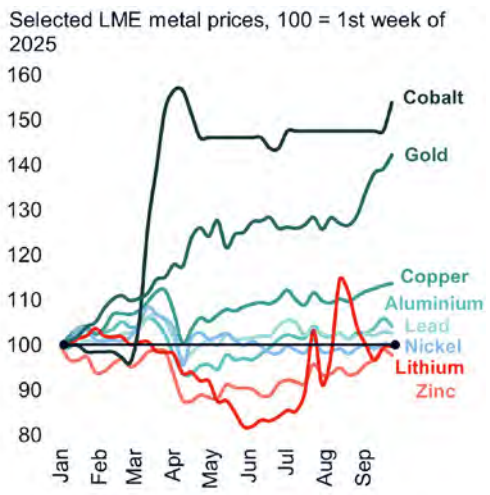
Heading into LME Week, LME base metals, battery metals and gold (LME Basket) are broadly flat year-to-date (YTD). Escalating trade tensions and the drag from their uncertainty weighed on LME Basket prices in 2025 H1, which have since been rising as a softer dollar – against which LME metals are priced – support prices.

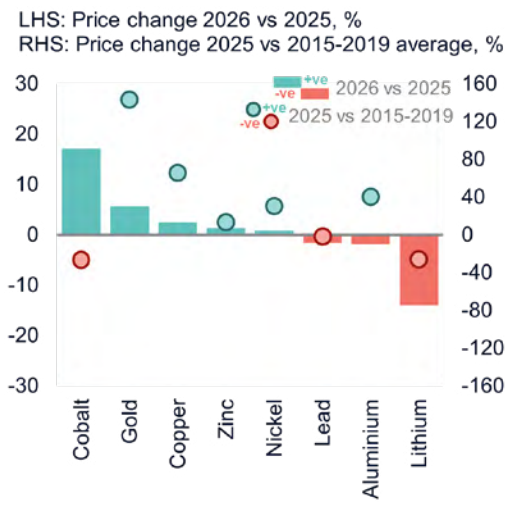
Gold, cobalt and copper are the exceptions. Investors leaned into gold's safe-haven role driving prices to record highs throughout the year. The cobalt price has shown the largest increases so far this year, as DRC export restrictions rocked the market. However, these increases have not been enough to bring it back to historic levels. Copper, while impacted by tariffs earlier this year, has increased by double digits YTD. Prices have been supported by expectations of longer-term supply deficits, and major mine disruptions in the lead up to LME Week.

We expect average annual prices for the LME Basket to increase 3.0% year-on-year in 2025 followed by a further 1.3% increase in 2026.

How this year's key policy events play out into next year, as well as Chinese demand dynamics, will all be pertinent during this week's discussions.

Cobalt and gold the strongest price performers in 2025 and 2026





DATA: CRU. Note: Prices shown as weekly averages with historic prices and forecasts correct as of 26th September

Ross Strachan

Head of Aluminium Raw Materials

London, UK

Aluminium

Indonesia supply growth could prevent rally

LME aluminium prices are slightly above the level recorded at the start of this year, but the largest move was the dramatic decline in prices following the imposition of the reciprocal tariffs by the US. Subsequently, prices gradually recovered as it became increasingly clear that these tariffs would not be as large as feared. Overall, with Chinese supply constrained by the primary capacity cap, the market is in a small deficit, and when coupled with the US dollar weakness, this has underpinned aluminium despite lacklustre demand.

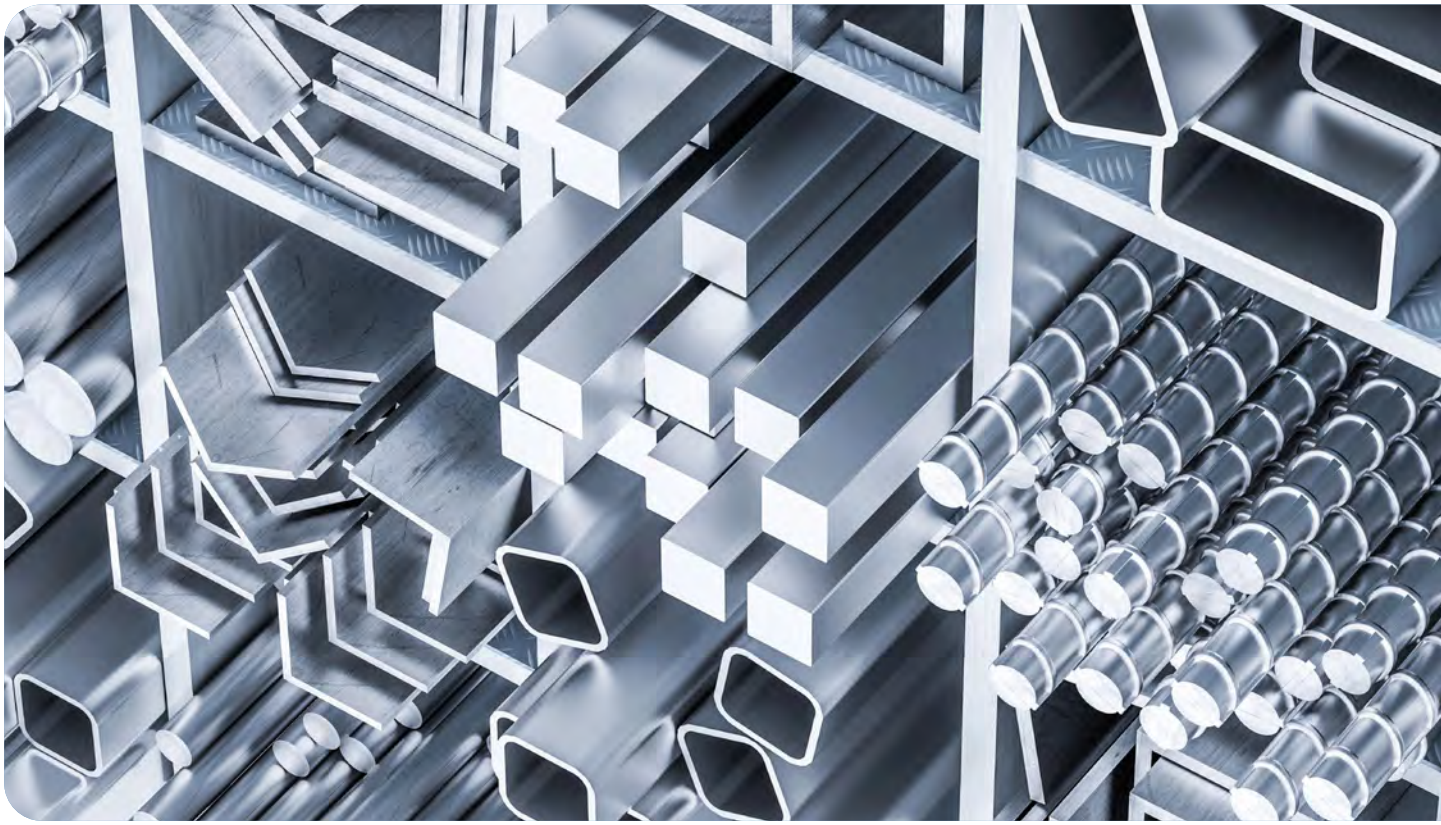
Looking ahead to 2026, we expect demand to expand at an accelerated pace after a prolonged period of below-trend growth across most of the world as supply chains adjust to the new trade deals. However, it appears increasingly clear that Indonesian output is set to climb substantially and that most of these projects are progressing faster with Chinese backing.

At LME Week, key discussions will be focussed on Indonesian supply, consumption trends and CBAM:

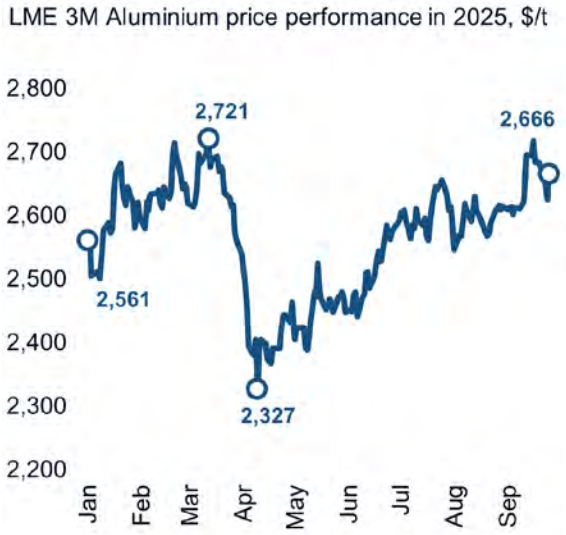
- **Indonesian supply:** The pace and capacity of Indonesian smelter projects will be a major source of discussion. The attractive margins at present, with low alumina prices and high aluminium prices, are encouraging Chinese investment beyond China's borders. In turn, this will fuel discussions around the knock-on consequences for aluminium prices and for previously expected restarts, especially in Europe.

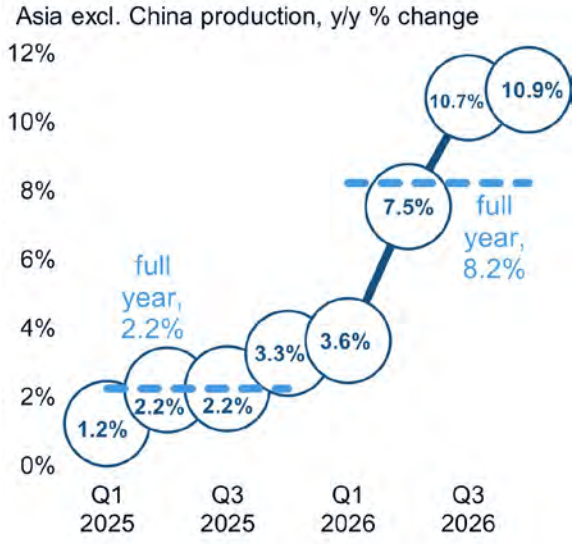
- **Consumption trends:** Chinese demand was stronger than expected at the start of this year, before a marked slowdown over the summer. Conversations are likely to centre on whether the recent improvement can be maintained. Meanwhile, elsewhere in the world demand growth has slowed, hindered by tariffs. The speed and recovery from this policy change will be critical to whether there is a major surplus next.

- **CBAM:** It is now only three months until companies will become liable for the emission costs related to the European Union's Carbon Border Adjustment Mechanism (CBAM). There remains significant dispute about the likely impact that this will have on European industry and trade flows.



Indonesia supported by India and Vietnam to cause supply surge





DATA: CRU, LME

Craig Lang

Principal, Copper Concentrate Service

Singapore

Copper

Copper – Near-term realities versus future expectations

The LME 3M copper price began 2025 just below $9,000 /t and has subsequently reached $10,000 /t. While macroeconomic factors have been important in driving price formation this year, the announcement of a US Section 232 investigation into copper in late February and the subsequent surge in cathode imports created some artificial tightness in the market. The Chinese cathode market has grown by more than 5% in 2025, supported by energy infrastructure demand and despite the ongoing contraction of the residential property sector. Meanwhile, the copper supply narrative has been led this year by the effects of heavily negative spot TC/RCs on the smelting industry and production problems at some Tier 1 mines.

The recent disruption at the Grasberg mine in Indonesia appears sufficient to push what was a refined copper market heading for surplus in 2026 closer to balanced. Consequently, an average price of $10,000 /t is now a distinct possibility next year even if it is not yet the base case.

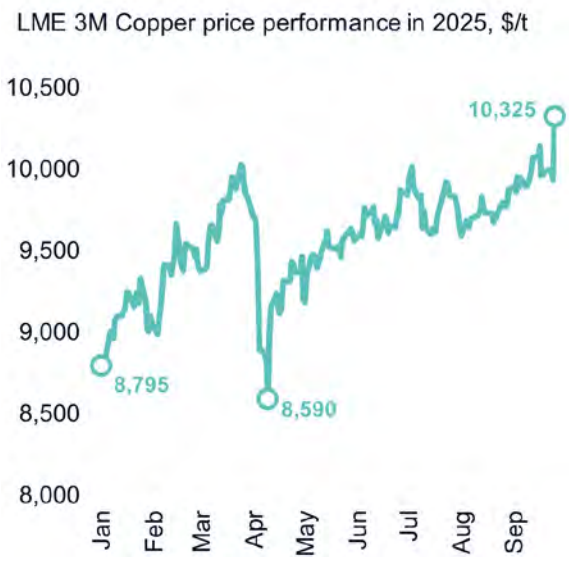
At LME Week, key discussions will be focussed on market balance dynamics, consumption trends and TC/RCs:

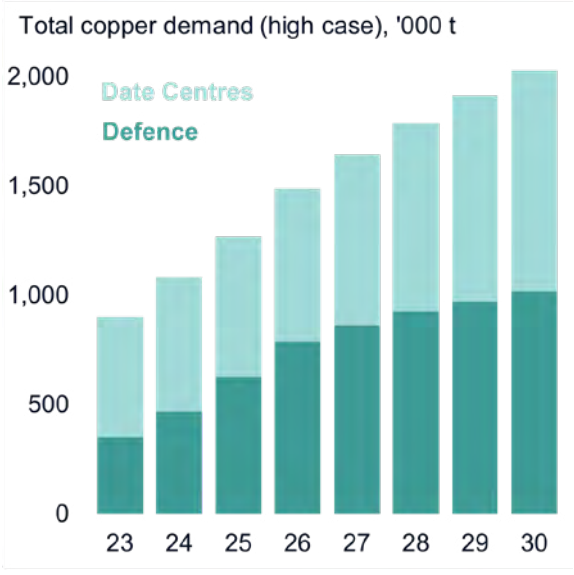
- **Market balance dynamics:** Will forecasts of sufficient near-term supply or end-of-decade production shortages hold sway over the copper price in 2026? The copper market is torn between expectations of near-term alignment between supply and demand and predictions of multi-million tonne per year shortfalls in supply by 2030.

- **Consumption trends:** Will refined copper consumption growth remain above trend? If world refined copper consumption achieves a fourth consecutive year of 3% or more growth in 2026, it will be the first time this has happened since the late 1950s.

- **TC/RCs:** Where next for the copper concentrates market? Spot TC/RCs have been heavily negative all year, suggesting a further decline in the annual benchmark in 2026. Yet, there is still an extensive pipeline of projects, leaving the concentrates market facing steep deficits in the years ahead unless there is further rationalisation and consolidation of the smelting industry. This challenges the sanctity of the benchmark system.

Adequate supply or deficits ahead?





DATA: CRU, LME

Nikhil Shah

Principal, Nickel Market Service

London, UK

Nickel

Will Indonesia manage the surplus?

The nickel market in 2025 has been characterised by a widening surplus, driven by weaker stainless and battery demand together with firm supply growth from Indonesia and China. 2025 marks the fourth consecutive annual surplus, which has capped price upside and left the nickel price rangebound around between $14,500–15,500/t for much of this year, with episodic moves tied to macro news and policy signals.

The 2026 surplus is projected to narrow from 2025 levels due to a combination of moderating supply growth and a demand recovery from both the stainless and battery sector. Against this background, we see limited upside for prices in 2026.

At LME Week, key discussions will be focussed on policy, battery demand and cost drivers:

- **Policy:** Indonesian government policy adds upside risk to the nickel market as the government is set to reportedly implement its plan to shorten the nickel ore mining quota period (RKAB) from three years to one year in early September. This policy shift is aimed at regulating nickel ore supply. Any significant reductions in Indonesian supply will be supportive to the nickel price.

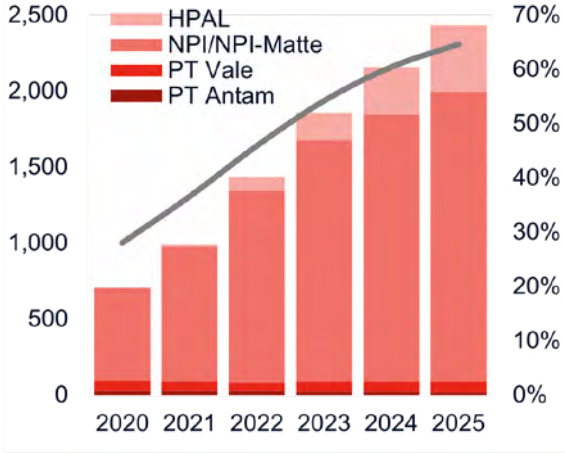
- **Battery demand:** Nickel demand from the battery sector has fallen short of expectations with the market facing a third straight year of no growth. We forecast battery sector nickel demand to recover from 2026 onwards, though downside risks persist from extended destocking and the faster uptake of LFP chemistries outside China.

- **Cost drivers:** HPAL producers are facing increasing costs from higher sulphur prices since the beginning of the year . Sulphur, which is used to make sulphuric acid (the main reagent for HPAL's), has more than doubled in 2025. Meanwhile, premiums on limonite ore have also increased cost pressure for Indonesian HPAL producers. While threats to Indonesian dominance are not expected in the short term, ore supply will remain key to the country's continued progress over the long-term.

Indonesia dominance in nickel supply continues to rise

LME 3M Nickel price performance in 2025, $/t

LHS: Indonesian nickel supply, '000 t of nickel eq
RHS: Share of global supply, %



DATA: CRU, LME

Olga Hepting

Principal Analyst, Zinc Markets

London, UK

Zinc

SHFE/LME price decouples as China drives refined supply

Both supply and demand surprised on the upside in 2025. Demand benefited from a better-than-expected trade war outcome. Similarly, unexpected ramp-up at several mines grew supply. This additional concentrate found its way into China and boosted TCs as well as refined output.

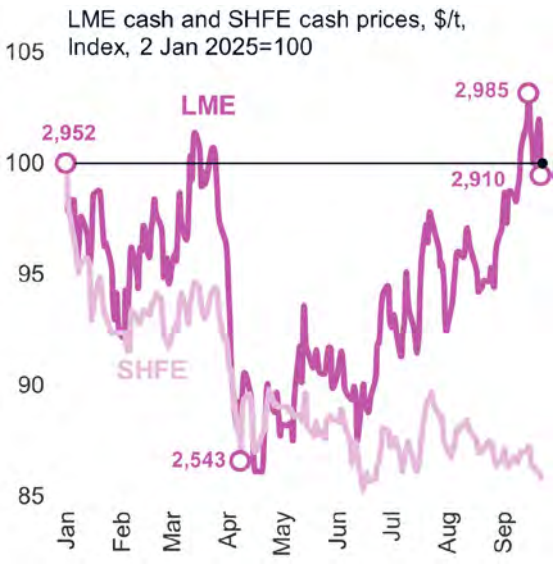
In 2026, we expect LME zinc prices to remain relatively flat at around 2,800 /t. We are forecasting small surplus in the refined market and an increase in refined stocks based on the continued ramp-up of mine supply and refined production, driven by China, while demand is likely to show only small growth at under 1%.

At LME Week, key discussions will be focussed on refined zinc trade flows and low LME stocks:

- **Refined zinc trade flows:** Fast-rising Chinese smelter output, high TCs and refined surplus in China have caused a decoupling of prices in 2025. At some point, it will result in China exporting excess refined material, pressuring LME prices. Further growth in the Chinese smelting sector will affect global trade flows going forward.

- **Low LME stocks:** Despite weak demand, LME stocks have been declining through 2025. What can explain these low stock levels if demand remains weak?

SHFE/LME arbitrage opens after excessive Chinese production



DATA: CRU, LME. Note: Price labels show absolute LME zinc cash prices through the year

Olga Hepting

Principal Analyst, Zinc Markets

London, UK

Lead

From overlooked to critical

After recovering from the 'Liberation Day' tariff announcement on 2 April, the LME 3-month lead price has risen above and fallen below the $2,000 /t mark. Since summer, despite the number of lots rising CRU now identifies the net position back in negative territory.

Prices will gain support in the coming weeks as European and US markets enter the autumn battery rebuild season. Despite ongoing headwinds for the US and global economies, CRU notes a comparatively more stable business environment. We forecast that lead will average $2,007 /t in 2025.

2026 will mark the fifth and final year of decline from the price highs of 2021. The global lead market is expected to move into a modest shortfall, with the excl. China market moving to closer to balance next year in comparison to this, with exchange stocks still expected to overhang the market. CRU forecasts an average annual 3-month LME price of $1,975 /t.

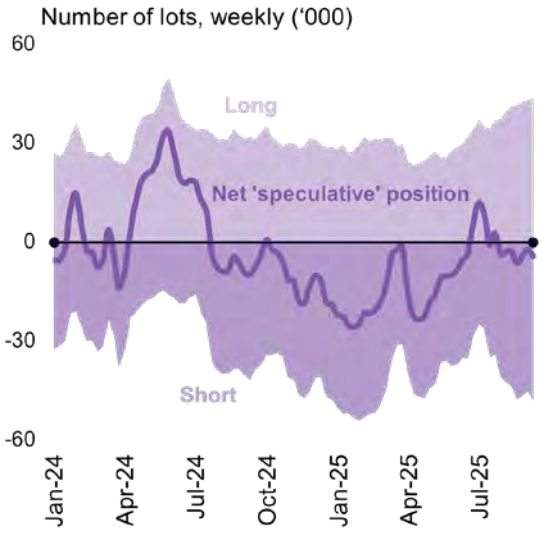
At LME week key discussions will be focused on the status of lead as a critical raw material, primary refined supply concerns as well as the commercial shifts in Europe.

- **Lead – the critical raw material:** In late August, the US released an updated list of critical minerals. This draft now includes lead. If it remains on this finalised list, it will leave the tariff argument behind.

- **Smelter cutbacks possible:** With treatment charges at all-time lows, pressure is mounting on primary smelting operations not just in China but globally. With contractual reference terms expected to decline again in 2026, margins will be under mounting pressure.

- **Commercial changes in Europe:** While Ecobat's divestment from the European market does not raise questions on the market balance picture itself, it does on the operational dynamics of the industry.

Lead price trades sideways through the summer amid greater investor activity



DATA: CRU, LME

Xiaowei Mei

Senior Battery Demand Analyst

Singapore

Lithium

Structural surplus persists amid policy-driven volatility

2025 has been another turbulent year for the lithium industry. The market has remained in a structural surplus, facilitating low prices throughout the year, with a brief respite in Q3. The lithium carbonate price is anticipated to fall back below $8,000 /t (DAP China, ex. VAT) in 2026, given a growing market surplus. While end-market demand continues to see strong y/y growth despite rising trade barriers and softening supportive legislation, supply remains out of step with demand.

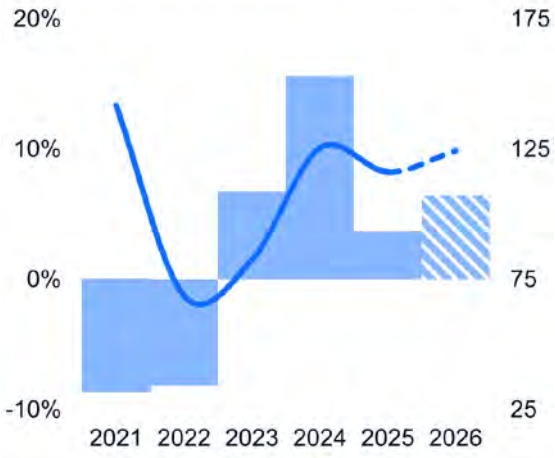
At LME Week, key discussions will be focussed on:

- **Chinese supply reforms:** A significant tightening of China's Mineral Resources Law has increased government scrutiny of lithium producers. Supply disruptions have followed with two operations currently offline and seven more lepidolite mines at risk.
- **Shifting feedstock requirements:** Mid-stream developments are facilitating structural changes to the lithium market; 4th (and 5th) generation high compaction density LFP technology has the potential to shift the preferred feedstock away from lithium carbonate.
- **Anti-involution in the mid-stream:** China's anti-involution campaign is yet to target the battery value chain midstream. If cathode producers are targeted next, lithium demand and prices will be negatively impacted in the short-term.

Chinese supply reforms drive short-term disruption

CRU Lithium carbonate, 99.5%, spot price performance in 2025, $/t

LHS: Market balance as a share of demand, %
RHS: Global inventories, days of consumption



DATA: CRU,

Xiaowei Mei

Senior Battery Demand Analyst

Singapore

Cobalt

DRC export ban upends market dynamics

After a year when supply soared and demand disappointed, early 2025 saw cobalt metal prices at real-terms record lows. Everything changed on February 21, when the Democratic Republic of the Congo (DRC) imposed an unexpected four-month export ban. Prices jumped over 50% within a month, before the ban was extended first in June, then in September. While shipments, albeit much lower volumes, are slated to resume after October 15, 3-4 month transit times mean that hydroxide will not arrive in China until the new year. Following the announcement, EU metal prices jumped 10% within a week – the question now is how far they climb by end-2025.

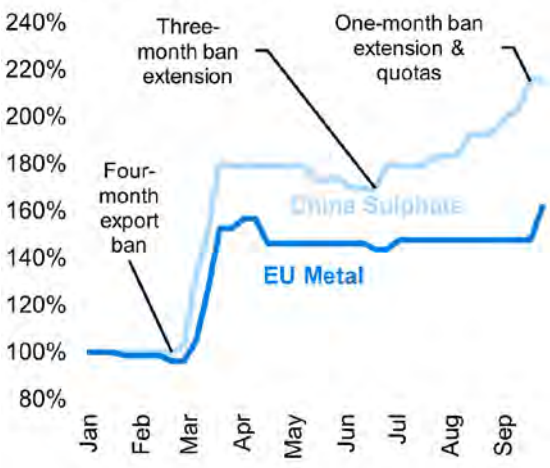
At LME Week, key discussions will be focussed on:

- **Stocks, prices and balances:** Given that quotas will effectively halve DRC supply, the outlook is bullish out to 2027, but the rally's depth hinges on supply response and stocks. Can Indonesian MHP growth, secondary supply, metal dissolution and stocks bridge the gap, or are we headed back to the highs last seen in 2022?

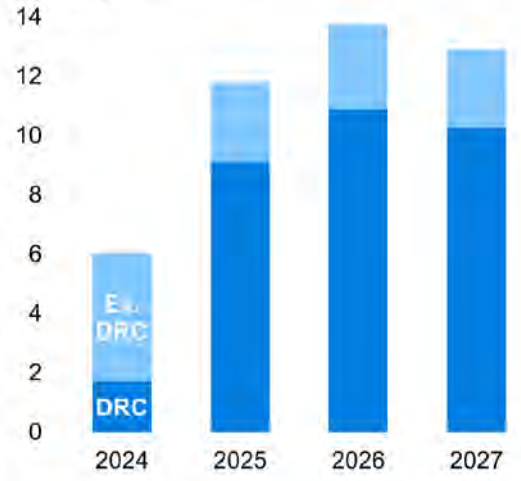
- **DRC policy:** Are we witnessing a structural shift in the DRC? Will quotas trigger deep mine cuts and catalyse domestic processing? Could allocations be revised higher, who gets what, and will the government purchase the seven months of stocks amassed during the ban?

Prices keep climbing amid dwindling excl. DRC stocks

CRU cobalt indexed price performance in 2025, 100 = 1st week of 2025



Cumulative Co intermediate stocks, months of consumption



DATA: CRU, LME

Kirill Kirilenko

Senior Analyst,
Base Metals

London, UK

Gold

By-product economics at play in copper mining

By September, gold was up 43% year-to-date, nearing $3,800 /oz. What began as a tariff-driven spike in Q1 has evolved into a structural re-rating, with central banks and institutions anchoring gold as a strategic reserve asset. Momentum is expected to carry into 2026 as macro, monetary and geopolitical risks persist. Against this backdrop, gold prices are expected to remain elevated, trading in a broad range between $3,500 and $3,900 / oz with a push above $4,000 /oz plausible if macro and geopolitical stresses intensify

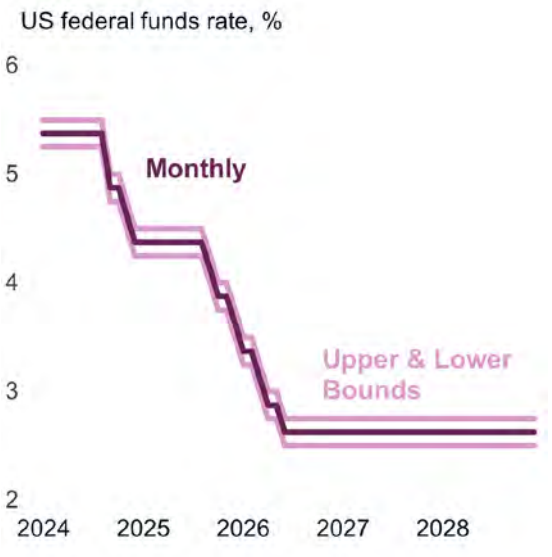
At LME Week, key discussions will be focussed on:

- **The by-product effect:** Gold's record-breaking rally in 2025 has delivered extraordinary margins for gold miners, but its quieter impact is being felt in copper. Many porphyry copper mines produce gold as a by-product, and at today's prices these credits are reshaping cost curves, investment choices and project feasibility.

- **The copper cost curve may be sending false signals:** Gold often contributes ~20% of revenue, lowering reported copper costs and widening the gap between gross and net cost curves. Gold-rich assets are leaping down the curve while underlying challenges such as grade decline, higher energy costs or complex metallurgy remain concealed.

- **Higher by-product credits are driving wider change:** Miners are boosting gold output, cross-commodity M&A is accelerating and long-stalled copper-gold projects are back in play. Copper strategies can no longer be separated from gold dynamics. For investors, polymetallic assets must be valued as integrated entities, not copper plays with incidental credits. For producers, mine plans, feasibility studies, and financing assumptions hinge increasingly on multi-metal trade-offs. Those who continue to treat copper and gold in isolation risk misreading the next chapter of mining.

Gold's rally shows no signs of fading



DATA: CRU, LME

Session 2 **Industry Panel**

BIOGRAPHY

Jennifer Willis-Jones

Regional Director Sales, Central and Southern Europe, Sales & Customer Services

Jennifer joined CRU's Fertilizer Week team in 2013. She became Fertilizer Week Senior Markets Editor in 2014 and Fertilizer Week Head of Nitrogen in 2019. Moving into the commodities space, Jennifer is now working as CRU's Regional Sales Director for Central and Southern Europe. She is fluent in Spanish and Portuguese.

BIOGRAPHY

Simon Morris

Head of Base & Battery Metals

Simon has 21 years' experience in the natural resources sector spanning all parts of the value chain. Before joining CRU, he held positions at Rio Tinto and Shell in senior strategy, investment analysis and corporate relations roles. He has been leading large teams for over a decade, including a base metals division for a B2B market intelligence company. Most recently, Simon was Chief of Staff and headed the strategy and corporate affairs departments at a commodity trader.

Simon has a Masters in International Strategy & Diplomacy from the London School of Economics and Bachelors in Commerce from Edinburgh University.

BIOGRAPHY

James Fryer

Inigo/MIRA

James Fryer joined Inigo in June 2023 to establish a specialist mining property book supporting mining companies globally. He has specialised in mining insurance for the last 15 years working at companies including CNA Hardy (Lloyd's Syndicate) and IMIU. With a background in chemical engineering, James commenced his insurance career in 2001 as a risk engineer and then loss adjuster before moving into underwriting. James is also the chairman of the Mining Insurance and Risk Association (MIRA).

MIRA is a global, non-profit, organisation established more than 10 years ago by professionals with extensive experience of mining risk and claims. It is a collaborative forum enabling ongoing improvements in the underwriting, risk management, and claims processes, along with the exchange of views, experiences, and dissemination of knowledge. Members are drawn from across the insurance and mining sectors. The organisation runs a number of specialist subject groups, periodic webinars, and a biennial global conference.

BIOGRAPHY

Tim Hawk

Societe Generale

Tim Hawk is a London-based Managing Director in the Batteries, Mining, & Industries team of Societe Generale, one of Europe's leading financial services groups.

Prior to moving to Societe Generale in 2018, Tim spent 12 years at Investec, where his role spanned debt financing, commodity structuring, and principal investments for projects and corporates in the metals and mining sector.

In line with Societe Generale's leadership in financing the transition to a low carbon economy, Tim advises on and structures transactions in his sector that are increasingly critical to a de-carbonised world. These include projects in the battery value chain, from production of the critical minerals required to the development of gigafactories downstream. Tim also advises on transactions in hard to abate mining and metals industries, most notably leading the advisory team in Stegra, a ground-breaking project to produce carbon free steel using hydrogen rather than coal.

Tim is also a participating member in the Faraday Battery Challenge Advisory Group, and holds a Diploma in Law from BPP Law School in London, and a Bachelor (Honours) in Politics, Philosophy and Economics from Durham University.

INTERVIEW

Larry Lorden

Chief Information Officer

London, UK

Building on Bedrock: How CRU's Data Foundations Turn AI from Hype to Advantage

LME Week remains the non-ferrous industry's sharpest mirror – it reflects what investors demand, what producers can deliver and where traders and buyers see margin and risk – often months before the rest of the world.

*by **Lavan Mahadeva,** Research Director CRU*

Q: Why should the industry care about AI, and how much of the noise around it is hype vs reality?

A: Firstly, I'd just like to say that it's great to be at LME week. Even though my world is largely focused on data, so bits and bytes, it is totally dependent on the physical world and the metals that make up the infrastructure the industry runs on.

It's also worth giving the quick primer on Large Language Models (LLMs) – everyone is probably familiar with LLMs from chatbots, but it's useful to remember that all they are essentially doing is recursively looping through a string of text, predicting the next word or part of a word. The sometimes-amazing results are an emergent property from the sheer scale of data being processed, which runs to hundreds of billions of parameters in the models, which in turn need massive amounts of hardware.

To give some idea of the scale of compute used, if you were to perform a billion calculations per second, it would have taken 100 million years just to train GPT3.5. The training for that started around 18 months ago and GPT3.5 is already 3 generations old, the latest models are far, far larger and require increasingly sophisticated GPUs. This translates back to the physical world as these new AI servers have about 5x the power density of traditional servers, with lots of extra copper needed for cooling. Our analysts are finding that $60 M of every $1 bn of modern data centre (DC) spend is on copper alone.

Q: Okay, but how much of the talk about AI is hype and how much is reality?

The hype comes from the fact that gen AI has come from nowhere 3 years ago to having hundreds of millions of users today and enables some tasks which previously would have taken hours or days to be accomplished in seconds. It's also driving huge deals adding trillions of dollars of additional market cap to the major players in this space.

AI is also different from most industries where there is a natural cap on the market, for example, we know the demand model for the number of cars in a country has a natural limit

based on factors like the number of people, GDP, the road system, etc. With AI, there isn't this natural cap. As the models get more capable, the number of use cases increases, and demand goes up.

We've already seen an increase in compute due to the new thinking models, and there is a potential scenario if some form of Artificial General Intelligence (AGI) is established that sees AI itself driving the demand for more AI. This could cause exponential growth that sees metals demand driven by DCs overtake more established use cases. Even without AGI, Open AI just released Pulse, a model that will work overnight or over a weekend on a task, which is a large increase in the compute required from any of the previous models.

Full disclaimer, that's my own edge case as a technologist, I'm definitely not qualified as an industry analyst.

On the flip side, the reality is that while AI can be amazing for some use cases. it's incredibly frustrating or disappointing for other, often seemingly simple, use cases. This is down to GenAI being fundamentally non-deterministic, so you can't always predict the results, plus the content and data the AI is trained on and has available to it is of mixed quality. In this regard, at least, AI is no different than other areas of computing where garbage in = garbage out.

Q: If data is key, what have you been doing to ensure CRU's data is of good quality?

A: It's actually been the main company initiative over the past few years. Since 2022, we've migrated close to two million data series out of spreadsheets and into modern platforms, with versioning, lineage and multiple quality gates. These series cover assessed prices, core market data and asset data, and by the end of next month, 100% of our prices and assets data will be out of Excel and AI-ready.

It has definitely been some very hard yards, but totally foundational to our customers and our analyst teams, as well as making the data available via API, and ultimately AI. This type of work is as much business transformation as it is a technology programme, requiring deep cooperation between analysis, product and technology. Being privately held helps – this kind of quality investment doesn't yield short-term ROI, but it's the only way to build for the long term and make AI reliable in our space.

Q: So what are the AI use cases you see as useful for the industry?

A: The main use case is no different than it was before AI: improving the speed and quality of information gathering and decision making. It's just that we now have a way to understand and comment on limitless amounts of information

Q: For a producer or trader, can you give examples of market shifts where "good data" directly drives decisions – and thus is a precursor to useful AI?

A: Absolutely. Take zinc. Our zinc team has used our data to warn that overcapacity in Chinese smelting has kept treatment charges (TCs) depressed. That pressure has been severe enough to threaten the viability of non-integrated smelters outside China – these conditions pushed Toho Zinc to announce closure of its 137 kt/y Annaka smelter in December 2024.

If you have high-quality TC data (spot histories, contract benchmarks, forward views, plus costs and balance forecasts) you can rigorously model break-evens, negotiate terms, and time curtailments. AI won't "decide" for you, but on top of this data, it can assemble strategic scenarios and sensitivity analyses in minutes instead of days, giving senior staff time to reach the best decision.

Q: Any other examples?

A: Sure, consider the US move to a 50% tariff on semi-finished copper imports, obviously something which is closely monitored and analysed by our copper market experts. That shifts relative value for US domestic wire and cable but challenges domestic capacity. Producers with accurate premium data, capacity utilization and trade flows can re-route cathode, prioritize domestic offtake and justify indexed premiums in contracts. Again, AI can help surface the right data at the right moment – but only because the data is trusted and modelled properly. This is where we are very different to a pure data provider: our own experts are the main consumers of our data.

Alumina is another. It has been a volatile price. When refinery curtailments tighten spot supply, prices move quickly. With well-organised data on benchmark prices and price baskets, combined with expert intelligence on refinery availability, and port stocks, aluminium smelters can decide whether to draw inventories or adjust production, and alumina producers can weigh how much to sell at spot. AI-assisted alerts and summaries make teams more responsive, but the quality of the underlying signal is everything.

Q: A common executive worry is that AI will "dumb down" analysts or converge opinions to the crowd. How do you avoid that?

A: It's a real concern that we've heard about in other companies, but it isn't in CRU's DNA, which is about the real-world knowledge and judgement of our experts. To preserve this, we have an AI policy that stipulates that we don't ever use AI to form opinion – we always leave this to our analysts. We use it to critique, challenge and sharpen the communication of our independent ideas that come from our proprietary content, data and models which public LLMs don't have. In summary, CRU's differentiated data and analyst judgment lead – AI pressure-tests and accelerates.

Q: Where specifically is CRU using AI now – and what's coming?

A: On the operational side, we've had summarisation and translation for web articles on CRU Online for a while and these have a good and growing level of engagement.

Internally, we've deployed a chatbot and agent-creation tool and are linking this to our content and data – this is the next generation of capabilities that will be available, but we want to thoroughly test and refine to ensure relevance and accuracy before our customers start using it. We're obviously using it to improve internal workflows or quality, but there's always a focus on the items that impact our customers, which is mainly about good data.

Q: What are the biggest lessons learned from that journey?

A: Three stand out:

- AI works best when it has access to content and data. Our first internal chatbot trial in late 2024 had access to our web content, which it did a good job of answering questions on, but it often failed to answer analytical questions as it didn't have the underlying data. We paused that work and are re-architecting it so that the next version will access both content and data.

- Don't underestimate scaling complexities. Our new Asset Platform has about 10x the data of our prior cost and emissions products – the process and tools we used to build those prior versions simply didn't scale to the new level of data complexity in the new product and we kept missing internal deadlines. We took a step back and over a couple of months built internal tooling and designed a new delivery process, which between them accelerated product delivery 2–3x.

- Shift problems left. We were finding issues with data too late in the process, which was impacting release dates, so shifting left is finding the earliest time in a process where you can find issues and put controls or monitors in. The general rule of software development, which equally holds for data transformation, is that it's around 10x more expensive to fix issues at each stage of the process. Finding an issue in user testing is 10x more costly than if it was found in internal testing and 100x more than if it was caught during data mapping. We've found that adding checks in at each layer of the process has reduced data errors by at least an order of magnitude.

Q: Where does CRU's differentiation show up for customers adopting AI?

A: We've done the 'dull but worthy' work to make our data AI-ready and reliable at scale. That allows us to deliver:

- Clean, governed data as a service via APIs and excel plug-ins, as well as the traditional excel downloads – full disclosure here is that downloads contain ancillary data, which doesn't go through the same process.

• Proprietary, analyst-led models that public LLMs don't have, so you avoid convergence with the consensus.

• Tools and patterns to integrate our data into your workflows, with audit trails and controls. AI is only as good as the data and models beneath it. Our strategy and execution have been about building that foundation.

Q: How should executives message AI to their boards to avoid overpromising?

A: Good question, FOMO is definitely causing pressure to deliver quickly and you need to be using the technology constantly to see what works and what doesn't. Setting out your company's AI stance and finding some simple use cases which add value help take the pressure off, but it's also important to progress on the things that give long-term advantages:

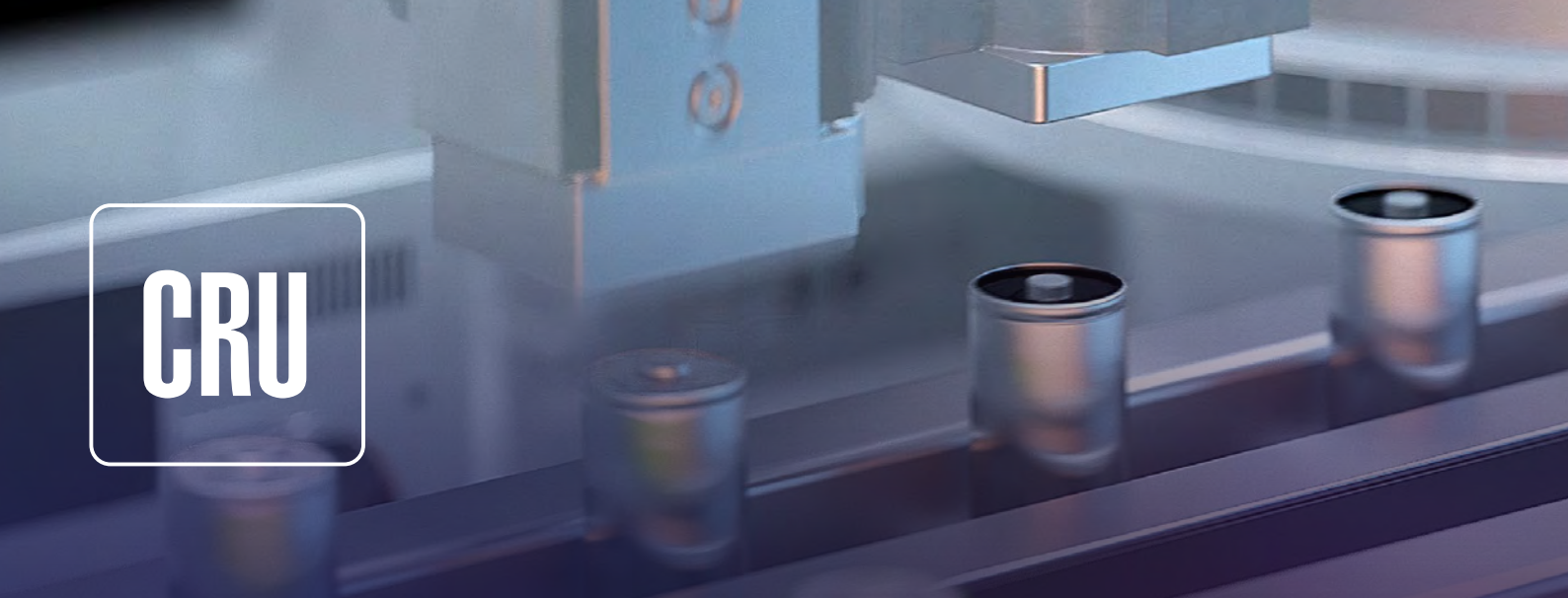
• Protect your differentiation: There was a saying in technology a short while ago that data is the new oil. GenAI makes it effectively free to process publicly available data, but what it can't replicate, and is running out of, is new sources of high-quality data. Public data is like oil at $1/barrel, whereas high-quality proprietary data is the new gold. Investments in data models, governance and quality control add value to everything that uses the data and is the prerequisite to any AI productivity claim.

• AI is a force multiplier, not an author. State clearly that AI critiques and accelerates your experts – it doesn't replace them. That avoids the "wisdom of crowds" trap and protects independent thought.

• Stage-gated delivery. Commit to two or three use cases with measurable outcomes in the first 6–9 months: negotiation cycle time, forecast iteration speed, research throughput, error rate in recurring reports.

Q: Did you use AI to write this?

A: Ha-ha. No, but I did use AI to find some of the examples from our research.



CRU

Asset-level analysis enables intelligent investments in lithium

CRU's *Lithium Asset Service* provides unparalleled insights into cost dynamics within the lithium sector, to optimise strategies, make informed decisions, and navigate market complexities with confidence.

- Access detailed asset performance databases and gain a comprehensive view of lithium production.
- Optimise procurement decisions by understanding the cost dynamics and product quality of lithium assets. Negotiate competitive terms and navigate market volatility effectively.
- Benchmark operations against industry peers. Identify areas for cost optimization and maintain a competitive edge in the market.
- Make informed financing decisions by assessing the economic viability of potential investments. Clarify cost structures and revenue potential, allowing for confident investment strategies.
- Elevate your trading strategy, reduce risks, spot profitable and high-quality assets, and explore new trading opportunities.

Request a demo

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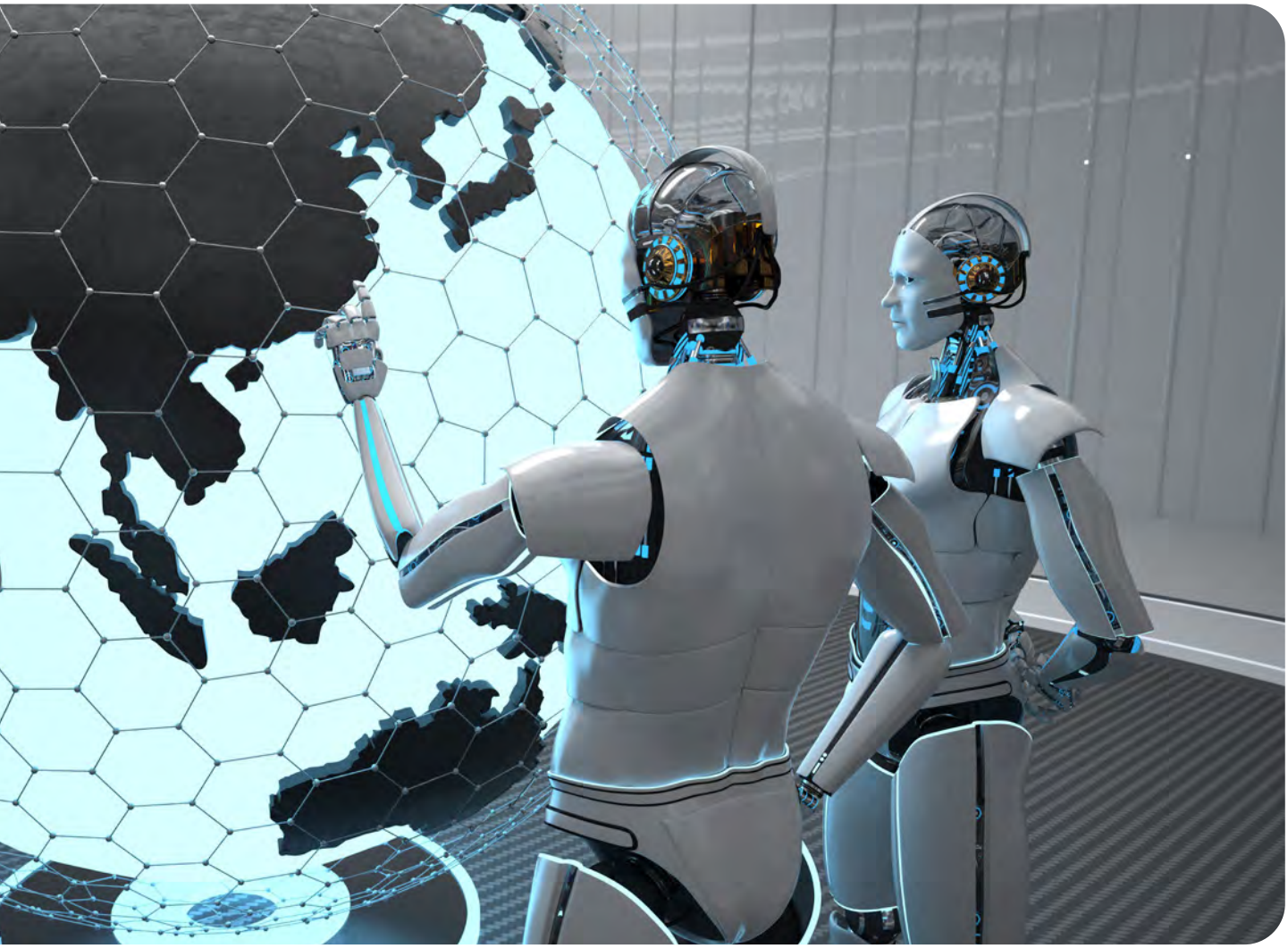


INSIGHT

The next commodity battleground: Humanoid robots

The coming of the humanoid robots has long been prophesized in various sci-fi media. Now, the convergence of advanced AI, precision manufacturing and rising labour costs and shortages is creating conditions to incubate the next largest commodity demand driver for critical metals. Our analysis indicates that up to 100 million humanoid robots could be manufactured globally by 2040 and rapidly increasing to 400 million units by 2050, consuming metals at unprecedented rates and fundamentally reshaping competition for critical resources.

Defining the humanoid robot difference: Robots designed to interact with the environment as a human would

Humanoid robots represent a fundamental departure from existing automation technologies. Unlike industrial robots, which are fixed-position, single-purpose machines and existing service robots, which are task-designed, humanoid robots are designed to operate in human environments without modification. According to the International Federation of Robotics, these machines possess "human-like aesthetic appearance capable of performing tasks in an environment designed for humans without the need to adapt it."

Industrial and service robots vs. humanoid robots – the design intent is evident

DATA: KUKA Roboter GmbH, Bachmann. Factory Automation Robotics Palletizing Bread (2005). Public Domain. Wikimedia Commons, Guzugi, Roomba3g.jpg, public domain. Wikimedia Commons, Tesla, Tesla-optimus-bot-gen-2 (cropped).jpg, CC BY 3.0, Wikimedia Commons, DARPA. Atlas during testing (2013). Public Domain. Wikimedia Commons, Unitree. Unitree Robotics, Unitree H1 (2023). Public Domain. CC BY-SA 4.0 Wikimedia Commons.

This distinction matters significantly for commodity markets. While industrial robots are typically large, stationary units deployed in limited numbers, humanoid robots are designed for mass deployment across diverse applications. Current units typically weigh 50–90 kilograms, with lighter weight models starting to appear, and contain substantial metal content optimised for mobility and precision.

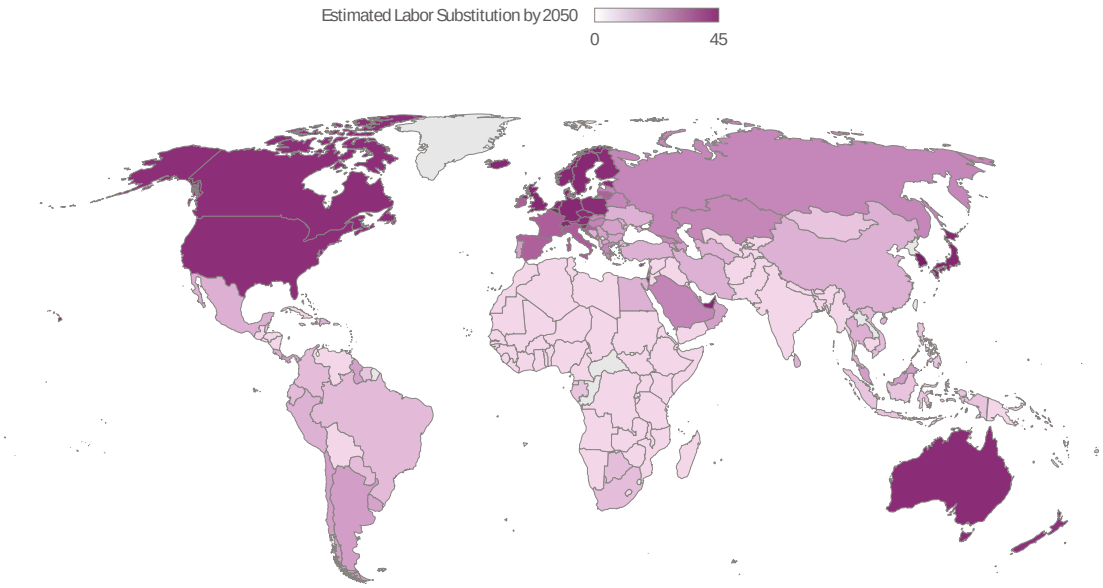
Humanoid robot deployment projections point to massive manufacturing scales

Our deployment projections are built on the analysis of global employment patterns. We evaluated over 830 US occupations using government labor statistics, applying five criteria to assess substitutability: physical repetition, cognitive simplicity, low emotional/social skill requirements, environmental structure and low safety/criticality of errors.

This analysis indicates that 39% of US occupations are potentially substitutable by humanoid robots. Extending this methodology globally using UN labor data reveals remarkably consistent patterns – 40.6% substitutability with a tight distribution of ±2.2% across 195 countries. The tight global distribution of job substitutability (40.6% ± 2.2%) demonstrates the universal nature of how human societies organise work, lending confidence to our global projections.

However, maximum substitutability differs from realistic adoption timing. We applied Human Development Index factors to account for the readiness of each society to adopt a humanoid workforce, including labor costs, education levels and infrastructure capability.

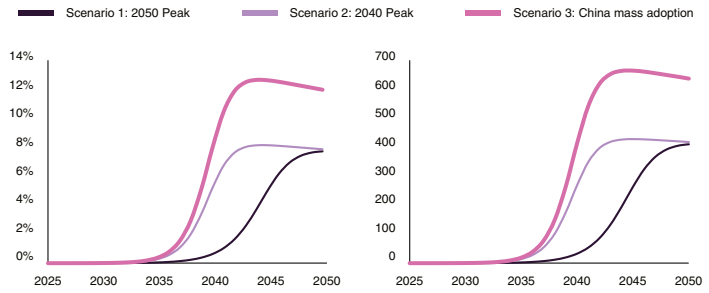
The developed world will lead the charge in labour substitutability



DATA: CRU

Our methodology produces deployment scenarios spanning realistic ranges while maintaining analytical rigor. We model three scenarios driven by combinations of technology cost curves and societal acceptance, with peak adoption occurring in 2040s to 2050s. Specifically, we modelled a conservative scenario with adoption peaking in 2050, a moderate scenario with adoption peaking in 2040 and an aggressive scenario where China adoption matches that of the US, removing HDI factors that limit China adoption rate. Moreover, the ramp-up of production is likely to occur in late 2030s and the pace of growth will pressure supply chains to keep up with demand.

Our scenarios suggest by 2040 up to 550M humanoid robots could be deployed



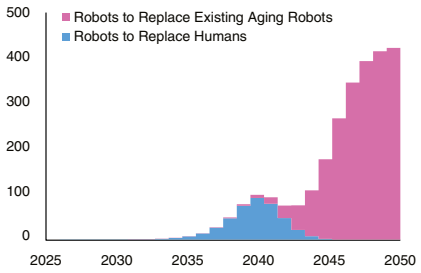
DATA: CRU; NOTE: Left-chart represents % of working-age population replaced by humanoid robots, right-chart shows number of individuals

Note that the reason for the peak and slow decline is the UN population estimates: human population is anticipated to decline over the next several decades. These scenarios show the humanoid robot deployed 'fleet'. The annual manufacture of humanoid robots consists of building units towards the indicated fleet as well as the production of robots to replace the aging deployed fleet.

We are assuming an average of seven years (five to ten-year) life expectancy for humanoid robots. The annual production of humanoid robots in 2040 for our moderate scenario amounts to 100 M units, which quickly ramps up to 400 M units by 2050.

The specific timing matters less than understanding the scale of eventual deployment and its commodity implications.

Moderate scenario suggests humanoid robot annual production of 100M by '40, 400M by '50



Scenario	2040	2050
2050s Peak	15M	200M
2040s Peak	100M	430M
2040s Peak + China Adoption	160M	660M

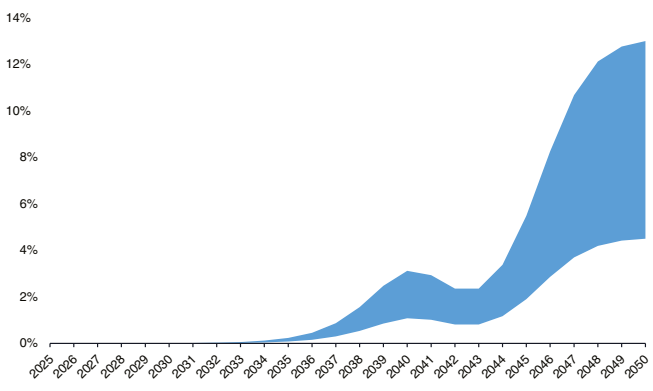
DATA: CRU: NOTE: Left-chart shows annual production of humanoid robots in millions of units, right-table shows annual production across stated scenarios

Massive quantities of critical metals will be needed to enable the humanoid robot revolution

Component analysis reveals the material intensity per robot: aluminum comprises 17–25 kg (structural framework), copper accounts for 4–8 kg (actuators and wiring), battery metals total 4–8 kg (lithium, nickel, cobalt), and rare earth elements contribute 1–2 kg (motor magnets). Steel, plastics and other components round up the rest of the weight. When multiplied across hundreds of millions of units, these individual requirements translate into massive aggregate demand.

For perspective, our moderate scenario's peak annual production of 400 million robots in 2050 would require approximately 10 million tonnes of aluminum, 2.4 million tonnes of copper, and 1.6 million tonnes of battery metals – representing significant percentages of current (and anticipated) global production concentrated within a compressed deployment timeline.

Our scenarios suggest by 2040 up to 550M humanoid robots could be deployed



DATA: CRU Copper Long Term Outlook NOTE: Showing moderate scenario copper demand for humanoid robots as a percentage of total copper demand with two intensity considerations: low (4 kg per unit) and high (8 kg per unit)

Our analysis assumes current material compositions with modest efficiency improvements over time. While robots may become lighter through technological advancement, they remain constrained by the need to operate in human-built environments, limiting opportunities for radical material substitution.

Strategic implications are profound

The humanoid robot revolution extends beyond demand forecasting to fundamental questions about global competitive positioning and supply chain control. Three strategic implications emerge from our analysis.

First, supply chain security becomes critical as robot deployment scales. Our Battery Value Chain Service has documented Chinese dominance in EV supply chains, where, for example, China controls >70% of battery metals processing and battery cell production – in particular LFP-based ones. Humanoid robot deployment at scale creates similar strategic dependencies on Chinese-controlled supply chains for critical components. This dependency extends beyond rare earths to battery materials processing and precision manufacturing capabilities.

Second, there is the manufacturing control question. Our scenarios illustrate the stakes: China's domestic robot deployment could reach 50 million units by 2040 (moderate) or 200 million units (upside). However, if China also captures global robot manufacturing – as it did with EVs – the commodity implications multiply exponentially. The question of whether China becomes the 'robot factory of the world' has profound implications for global supply chains.

Third, geopolitical competition accelerates as technology leadership translates directly into resource security and competitive advantage. The United States missed early positioning in electric vehicle battery supply chains – a strategic oversight with lasting consequences. The humanoid robot revolution presents similar strategic choices with potentially greater implications given the broader economic applications.

Deep dives: The analysis continues

These implications raise critical questions that shape commodity demand forecasting. Our analysis of the humanoid robot revolution extends far beyond this initial assessment. The strategic implications require deeper examination across regional strategies, commodity-specific impacts and competitive dynamics.

Our upcoming analysis will focus on the competition between China and the US as we examine investment strategies, adoption policies and manufacturing capacity developments. The stage is being set for the next technological and manufacturing frontline with no global power able to afford falling behind. This is because humanoid robots will have profound implications for the economies that are leading this change: to give some perspective our moderate scenario anticipates estimates a $2 trillion market size by 2040 and $8 trillion market size by 2050 (assuming $20,000 cost per unit).

The technological and manufacturing frontline will resonate across the commodity space. Our upcoming analysis will also focus on commodity-specific insights will that detail supply response capabilities and market dynamics across lithium, copper, nickel, cobalt, rare earths, aluminum, steel, and battery supply chains.

The humanoid robot revolution is no longer the stuff of science fiction. We are nearing the point of technological knowhow to start deploying them in massive numbers. Understanding the dynamics behind humanoid robots now determines competitive positioning as markets evolve. The question is not whether humanoid robots will reshape commodity markets – they absolutely will – but how quickly transformation occurs and where supply chain control ultimately resides.

For organizations across the commodity value chain, from miners to manufacturers to investors, and across the policy makers and global powers, the strategic imperative is clear – the next commodity battleground is taking shape, and early positioning advantages compound over time.

*By **Frank Nikolic**,*
Vice President, Base & Battery Metals // Toronto, CRU

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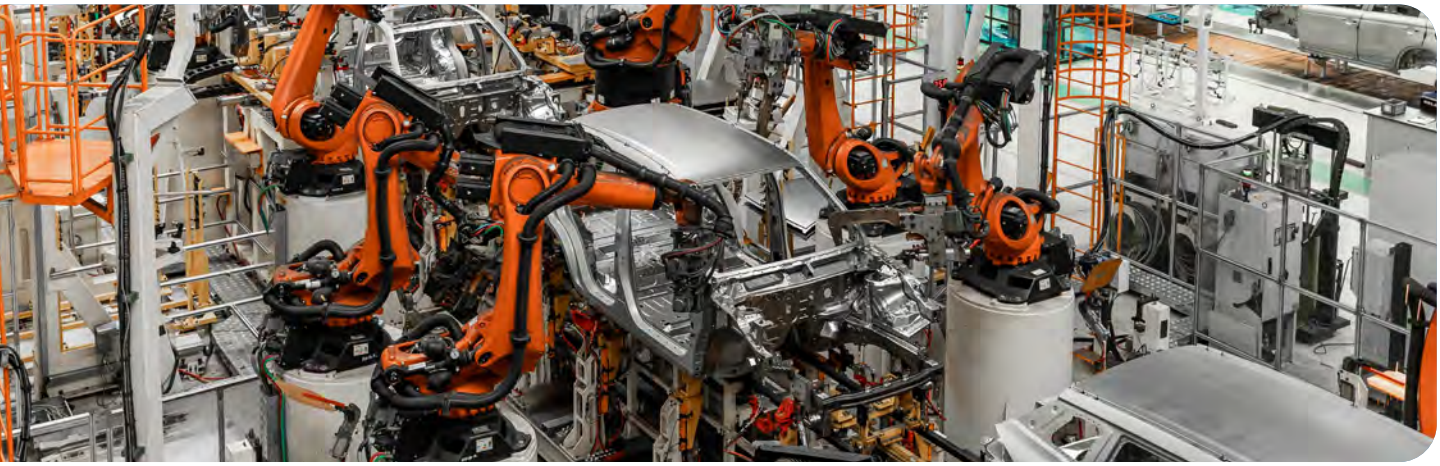

INSIGHT

Aluminum Market Update: Quantifying Oswego's interruption for the auto industry

While most outlets have reported that Novelis' Oswego mill is offline, the real question is: how much this affects the supply of automotive flat rolled products? Our analysis quantifies the potential tonnage impact on body-in-white and closures across different restart scenarios.

The facility is the largest producer of automotive alloys in North America and a key supplier to a who's who list of automakers. According to CRU production estimates, more than 90% of the site's projected 2025 flat-rolled product output was dedicated to automotive body sheet and structural sheet, with only a small fraction flowing into the beverage can market.

Anticipated 2025 capacity utilization placed Oswego above its automotive sheet peers, excluding Logan Aluminum mill and Constellium's Muscle Shoals facility, which is heavily supported by a booming can sheet sector.

That elevated utilization highlights Oswego's importance to automakers. While industry peers such as Arconic and Commonwealth Rolled Products have underused capacity that could, in theory, be redirected to automotive sheet, the same cannot be said for Novelis' Kingston, Ontario plant, where tariffs and product focus limit flexibility.

But will a prolonged shutdown of Oswego impact the aluminum market?

Semi-fabricated shortfall

In terms of the semi-fabricated automotive aluminum market, the impact is clear.

First and foremost, it's worth noting for further calculations a 2022 Alumobility paper noted that about 60% of aluminum sheet consumed in automotive press shops ends up in vehicles, while the remaining 40% returns as scrap.

If the site remains closed for the rest of the year, the effective loss of Oswego's production in the fourth quarter equates to around a little more than 50,000 metric tons (t) of usable automotive sheet, net of scrap generation.

Any shortfall in supply will be felt most acutely in the truck and large SUV classes, which dominate North American production and carry outsized aluminum content per unit.

Together, large internal combustion engine (ICE) and battery electric vehicles (BEV), classified as D-F by size under the Environmental Protection Agency's framework, account for nearly nine of every 10 tons of body-in-white (BIW) and closures sheet.

CRU's segmentation shows the mill would have supplied more than 50% of the half a million tons of BIW and closure sheet required for production intended to be sold in North America – nearly enough to cover the combined needs of midsize and full-sized ICE vehicles, which together account for well over two-thirds of aluminum demand in this segment.

Capacity headroom

On paper, the North American rolling mill industry has the spare capacity to absorb Oswego's loss.

Collectively, peer mills with automotive sheet output already underway (excluding Aluminum Dynamics' Columbus mill) have more than 1 million metric tons in excess nameplate capacity, over three times the otherwise anticipated output of automotive sheet from Oswego's mill for the year.

Two underutilized facilities based on CRU production estimates for 2025: Commonwealth Rolled Products in Kentucky and Arconic's Knoxville plant, each have spare capacity equivalent to more than three-quarters of Oswego's lost tonnage.

On a proportional basis, distributing Oswego's theoretical lost fourth-quarter volume of 85,000t of automotive flat rolled products across the seven North American mills with spare capacity would yield allocations ranging from just a few hundred tons to a smaller player like Golden Aluminum to nearly 20,000t to Commonwealth Rolled Products.

Other major mills such as Arconic's Knoxville and Davenport sites, Logan Aluminum, Constellium Muscle Shoals, and Novelis' Kingston plant in Canada would each take between 6,000t-19,000t.

After accounting for the 40% scrap generation rate mentioned earlier, those quarterly allocations translate into roughly 1.2 million vehicles' worth of BIW/closures aluminum content spread across the market.

Broken down by segment, that's the sheet needed for just under 700,000 full-size ICE trucks and SUV's, just under 400,000 smaller ICE cars and crossovers, just under 100,000 large BEV platforms, and a little more than 10,000 smaller BEVs combined.

Import backfill

Making up loss tonnage by importing semi-fabricated aluminum comes at a substantial cost under the Section 232 duty rate of 50%.

In fact, it might make sense to import a fully assembled car rather than its major component feedstock at elevated prices, though supply chains do not pivot so easily.

Nevertheless, automotive aluminum alloys hold a very narrow niche in the flat-rolled import market.

Excluding steep Canadian imports of plate, sheet, and strip, which could attributed to cross-border processing or transshipments, a large portion of U.S. imports have historically come from the Middle East.

Oman, Bahrain, and Saudi Arabia, in particular, have become more prominent suppliers, while South Korea has increasingly emerged as a source as well. In South Korea's case, the growing prevalence is largely as a result of Novelis' expanding operations in the country, where its two rolling mills account for somewhere between half and two-thirds of the country's rolling capacity, with the balance spread across five other mills. Much of that exported material, however, is presumably beverage can sheet and part of a larger captive supply chain.

Other notable suppliers include Turkey, which operates roughly a dozen rolling mills, and Greece which largely runs a single plant. There is also a Azerbaijani mill, though it does

not have substantial capacity and the U.S. is mostly a primary outlet.

When it comes to 6XXX series automotive alloys, 6011/6016/6022, those grades are not widely available globally and tend to be source primarily from European producers.

This makes sense for two reasons. First, the European automotive market was historically second only to North America in vehicles sales until the recent surge in Chinese demand. Second, China's role as a supplier to the U.S. has been constrained both by tariffs and duties in various forms and by longstanding U.S. trade restrictions, which have shifted raw material procurement elsewhere.

Finally, U.S.-based rolling mills in particular often rely on affiliated overseas plants across the Atlantic to supplement volume. The automotive aluminum market is highly specialized, where margins run higher than common alloy sheet, where producers aim to balance narrow margins with economies of scale.

As a result, Germany, Belgium, France, Austria, Italy, and Switzerland remain key suppliers of 6XXX automotive sheet to the U.S. Constellium has historically produced this material at its German and French operations; Hydro at its German site; Novelis at its Swiss mill, AMAG Austria Metall in Austria; and several Italian mills, including Lamial.

There is more flexibility with 5XXX-series alloys, especially since 5052 is widely used across nearly every aluminum-consuming sector. That is where suppliers such as Saudi Arabia's Ma'aden Rolling Company and Bahrain's GARMCO have re-emerged, while more automotive-specific 5XXX series products are still offered by European produces, like ProfilGlass and Laminazione Sottile in Italy, as well ElvalHalcor in Greece.

Conclusion

The Oswego downtime underscores the fragility of North America's automotive sheet supply chain.

On the surface, idle domestic capacity more than matches the lost volume, yet the practical hurdles of alloy qualification, customer approvals, and commercial realignment mean the gap cannot be erased overnight.

Imports offer another outlet but face tariff headwinds and limited specialization of automotive grades.

For automakers, particularly those heavily invested in aluminum-intensive truck and SUV platforms, the disruption highlights a structural vulnerability: North American production of BIW and closures sheet remains highly concentrated, and when a single plant falters, the ripple effects are felt across the industry.

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