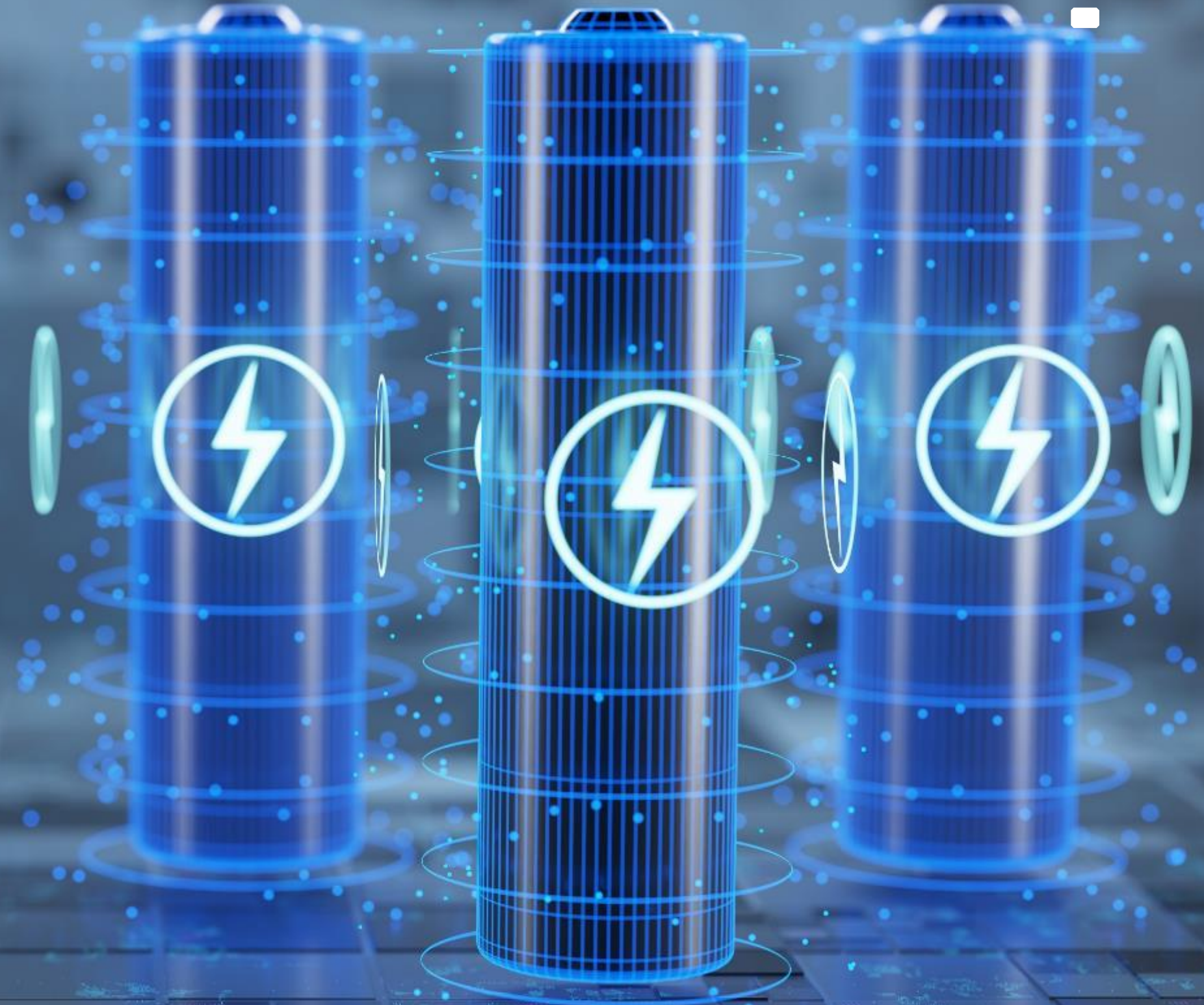




Fastmarkets



Battery raw materials global outlook





Introduction



Paul Lusty
Head of Battery Raw Materials
Fastmarkets

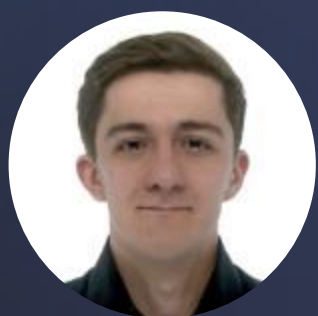
Agenda and speakers

1. **Battery demand** – Connor Watts
2. **Lithium market** – Will Adams
3. **Nickel market** – Olivier Masson
4. **Cobalt market** – Rob Searle
5. **Graphite & anode market** – Amy Bennett
6. **Manganese market** – Rob Searle
7. **Cell costs & forecasts** – Muthu Krishna
8. **Recycling & black mass** – Luke Sweeney
9. **Q&A**





Demand outlook



Connor Watts

Analyst, Battery Raw Materials
Fastmarkets

Key factors



1. Demand Outlook

European battery demand dragged down by France & Germany, 2025 to be supported by new emission regulations



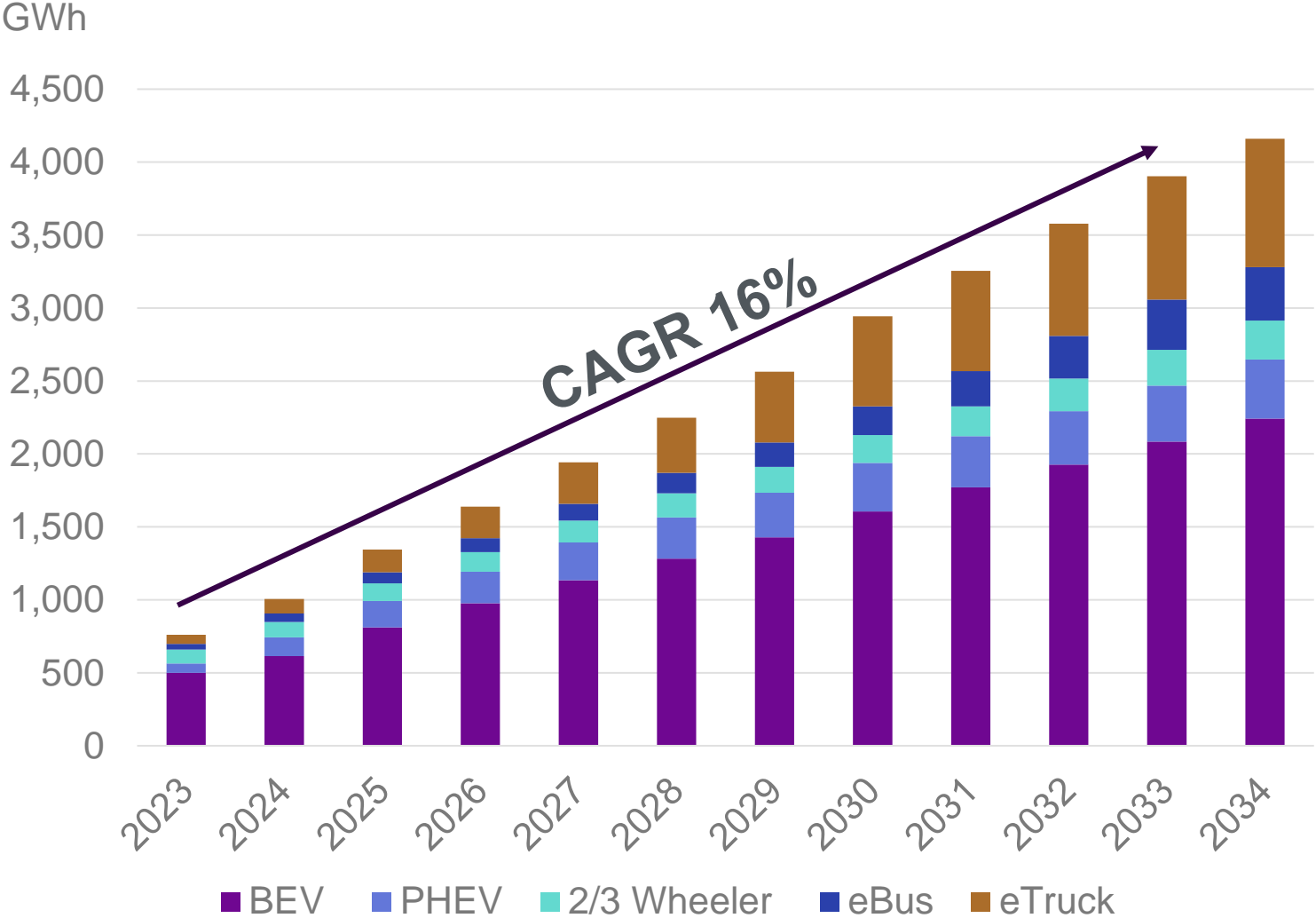
2. Key Trends

Intentions shift towards LFP in Europe while mid-nickel makes a comeback, EREVs significantly increase
Chinese PHEV pack sizes, US to follow suit

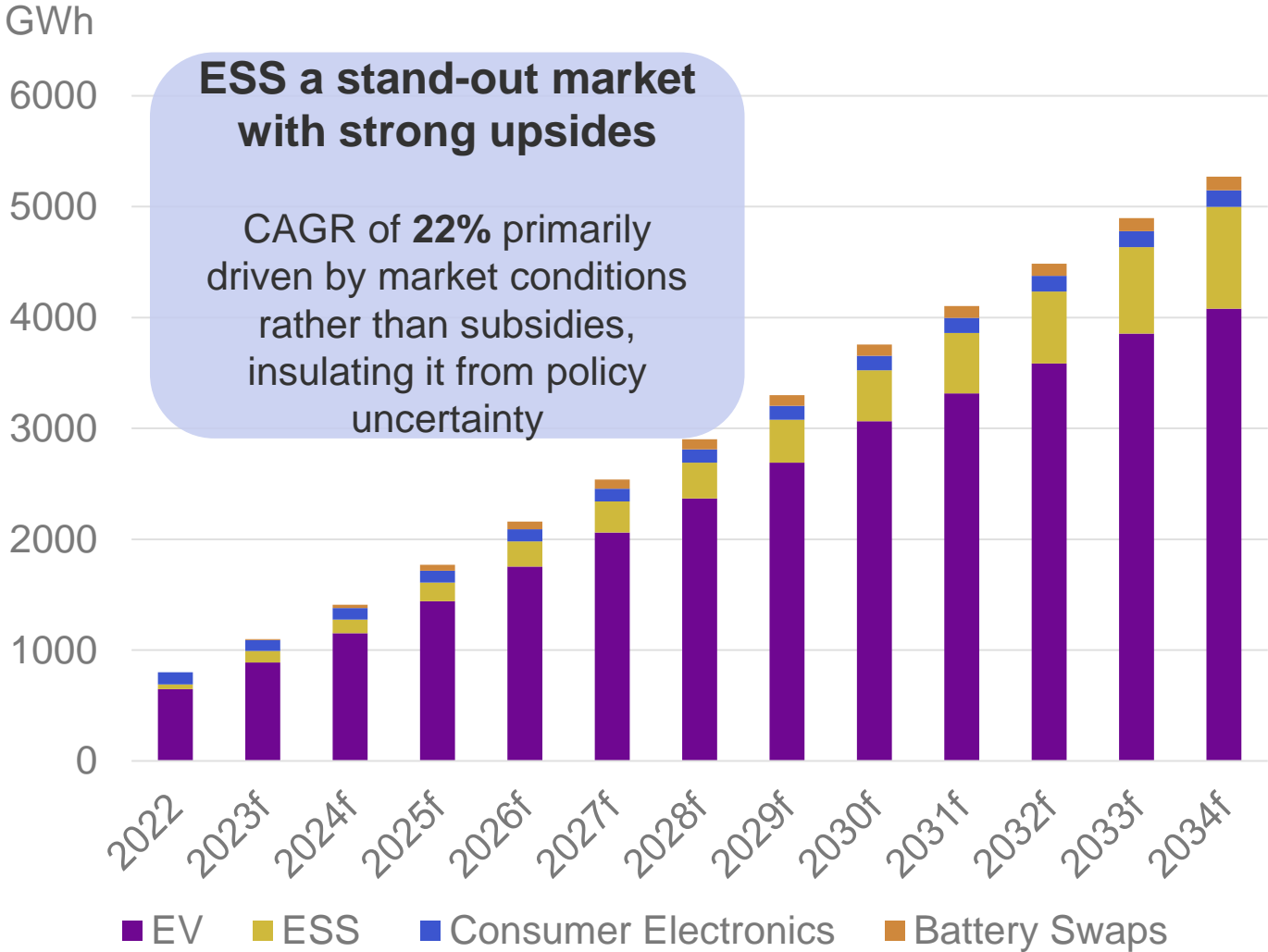
Growth for battery demand hasn't been as strong as the market hoped this year...



xEV battery demand forecast, by vehicle type (2023-2034)



Demand by sector (2022-2034)

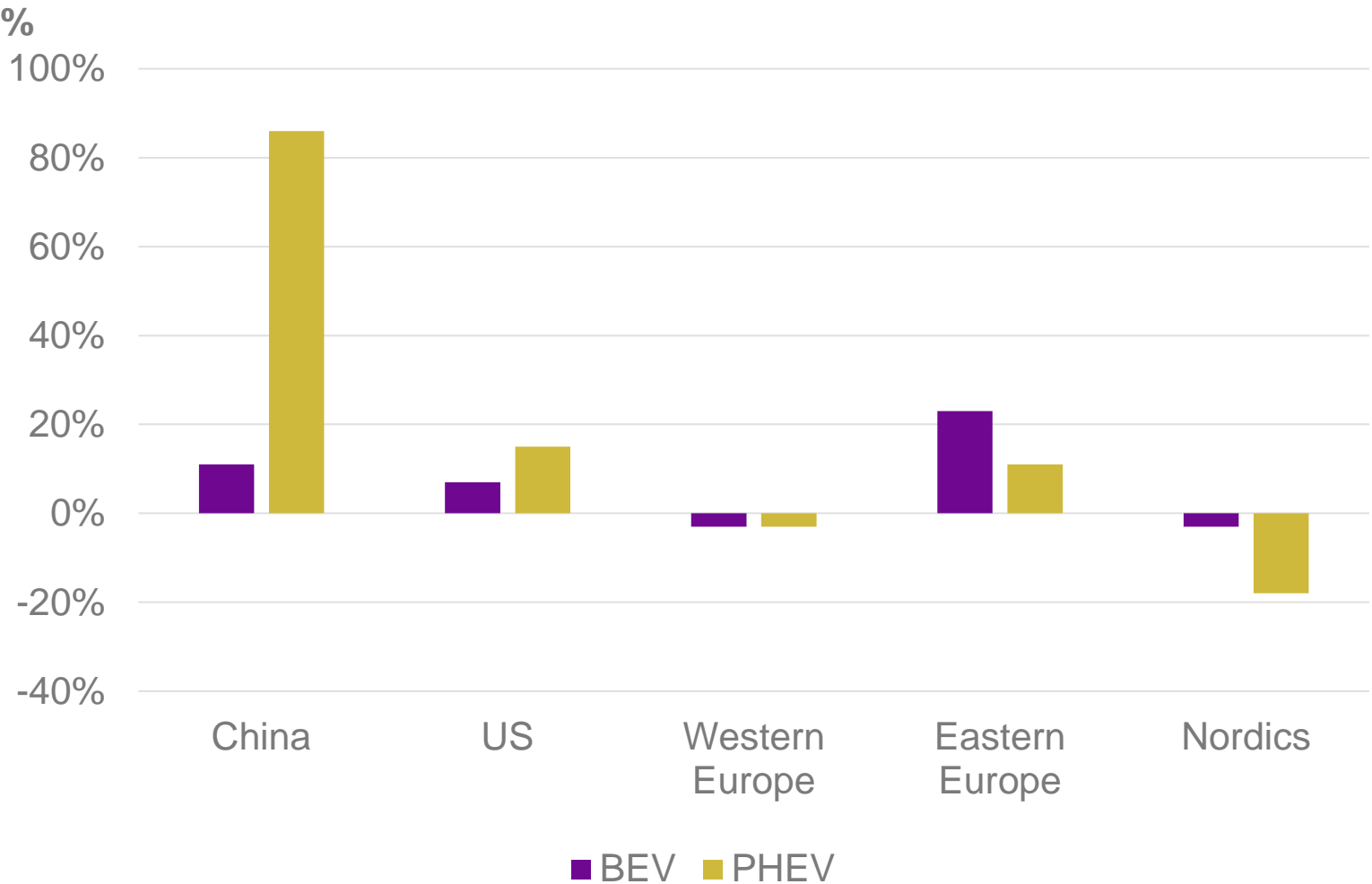


Source: Fastmarkets Long Term Forecasts



...but it is still occurring in lower material intensity areas, through PHEVs and EREVs in China

Q1-Q3 YoY regional market growth by powertrain










- EREVs in China represented **10%** of the domestic NEV market in September, about **130,000** of the 1.3 million strong market
- The average battery pack size of PHEVs in China has increased due to the growing popularity of EREVs – Increased from <20kWh to **>23kWh** per vehicle

Source: Fastmarkets Long Term Forecasts



Policy and regulation remains a major challenge, compounded by Chinese import tariff confusion

	Germany	United Kingdom	China	USA
EVS	 <p>Subsidies intended to be dropped at the end of 2024 prematurely ended December 2023, PHEVs lost subsidies at beginning of 2023</p>	 <p>Plugin car grant ended in mid-2022 after decade of use, EV tax remains at 5% relative to petrol and diesel's 37% until 2028</p>	 <p>Vehicle trade-in subsidy scheme seeing significant uptake, province-level subsidies compound with national incentives</p>	 <p>EPA emissions regulations likely to be repealed, IRA FEOC terms liable to change under new administration</p>
ESS	 <p>German Federal Ministry has identified 18 areas it considered appropriate to take measures in to promote storage deployment</p>	 <p>Government committed to introduce policy framework by 2024 to enable investment in LDES</p>	 <p>Government mandates co-location of storage assets alongside solar deployments, gives floor to ESS demand in the country</p>	

Source: Fastmarkets Long Term Forecasts



Lithium market



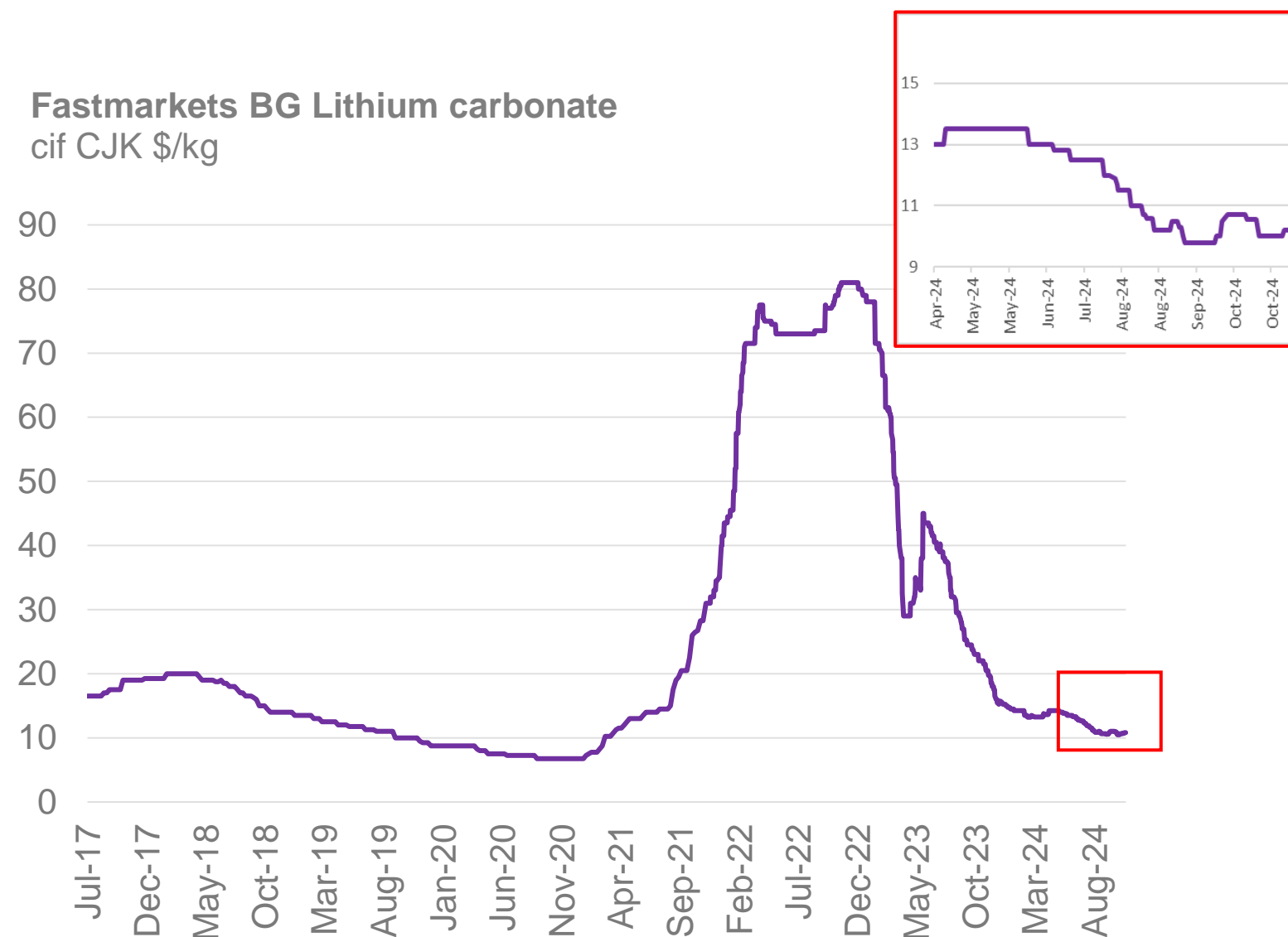
William Adams
BRM & Base Metals Analytics
Fastmarkets



Lithium prices appearing to form a base

- 2024 has been a relatively quiet year – prices have held within a **\$5/kg** range, compared with ranges of:
 - \$64/kg in 2023
 - \$40/kg in 2022
 - \$30/kg in 2021
- Flatter prices suggests a floor is in place, but prices are still 50% above the 2020 low
 - **\$10.50/kg** (2024 low) v **\$6.75/kg** (2020 low)
- The longer prices remain at this level, the more likely it is there will be further production cuts

Fastmarkets BG Lithium carbonate
cif CJK \$/kg



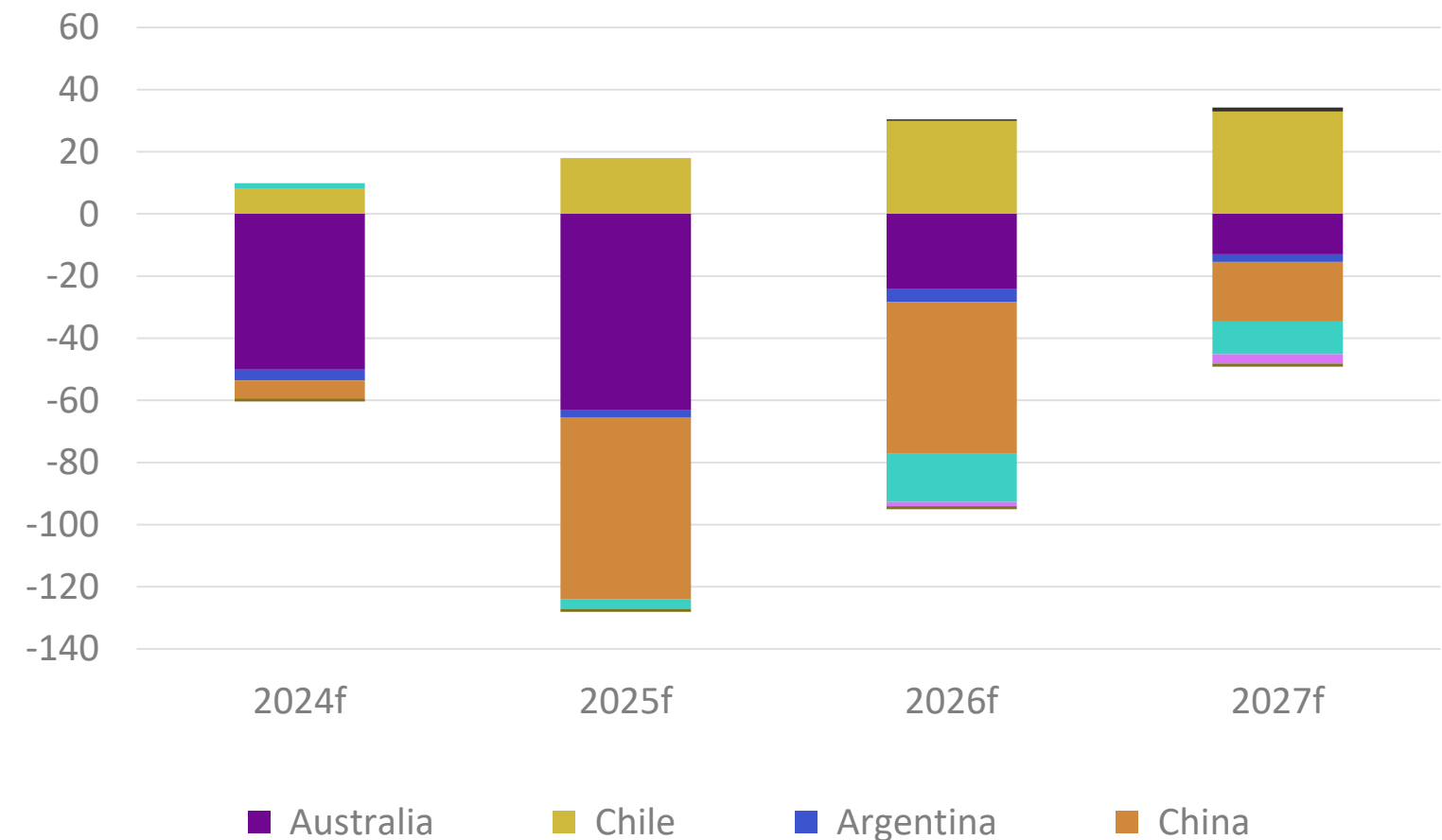
Source: Fastmarkets Dashboard



Lithium market is trying to rebalance

- **Chinese and non-Chinese production cuts underway:**
 - Lepidolite mines in China
 - Pilbara Minerals: Ngungaju
 - MinRes: Bald Hill
 - Arcadium: Mt Cattlin (not until end of H1'25)
 - Liontown: Kathleen Valley
- **Cuts to refinery production**
- **Cuts to CAPEX**
- Delaying, suspending or cancelling projects
(Risk - the West losing market share to China)
- **But some production continuing to ramp up**

Mine supply changes Q3'24 vs Q4'24 forecast
000'tonnes LCE

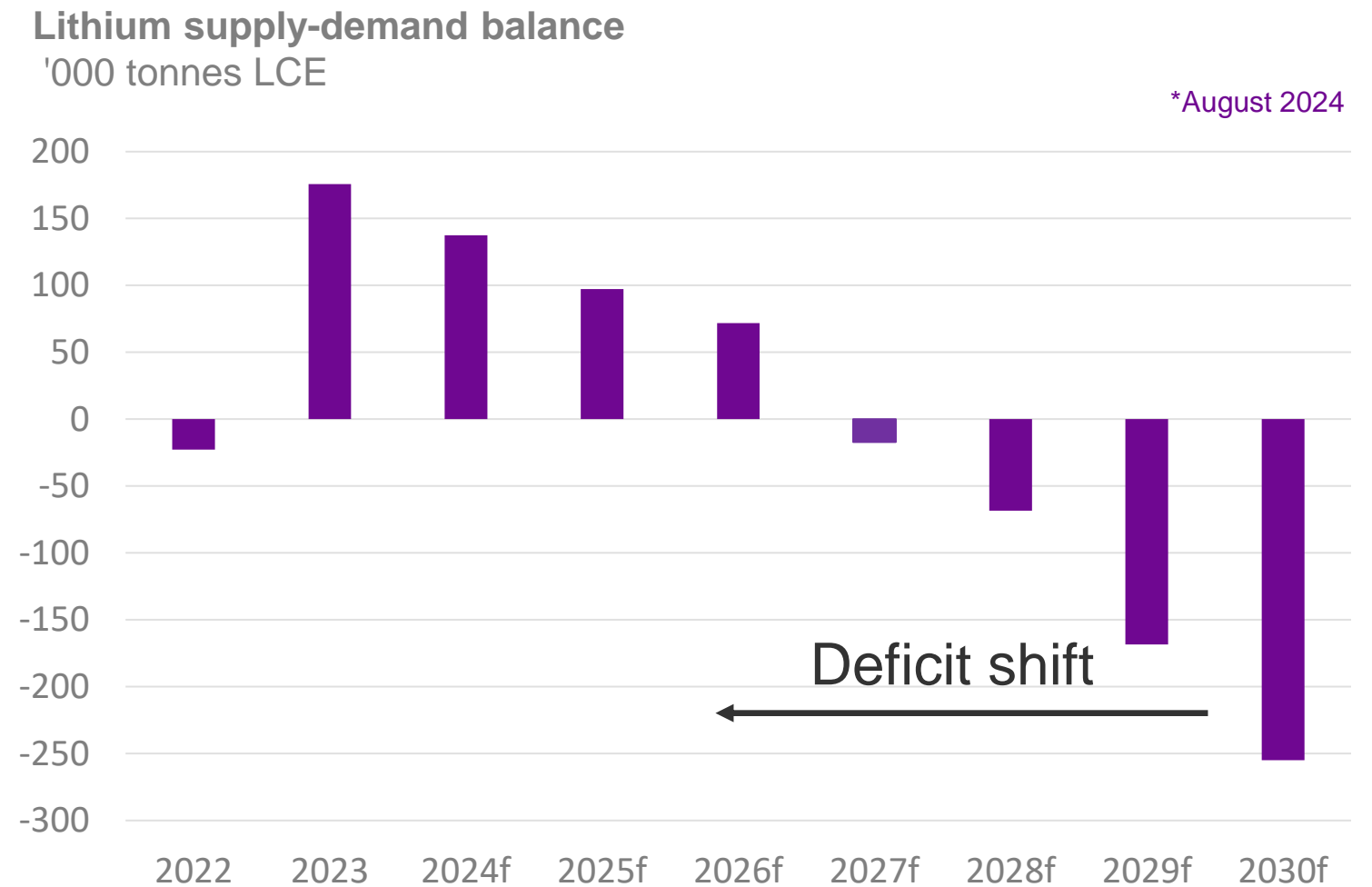


Source: Fastmarkets Long Term Forecasts



Lithium – bringing forward the deficit

- Demand – 2024 saw temporary weakness, the outlook remains bright
 - Germany in 2024, similar to China in 2019
- Robust EV demand, strong ESS outlook and the producer response means **it's time to talk about the market moving back into a supply deficit**
 - Stepping in and out of deficit for a while
- As a deficit gets closer, watch out for restocking and its impact on prices



Source: Fastmarkets Long Term Forecasts



Nickel market



Olivier Masson
Principal Analyst, Battery Raw Materials
Fastmarkets

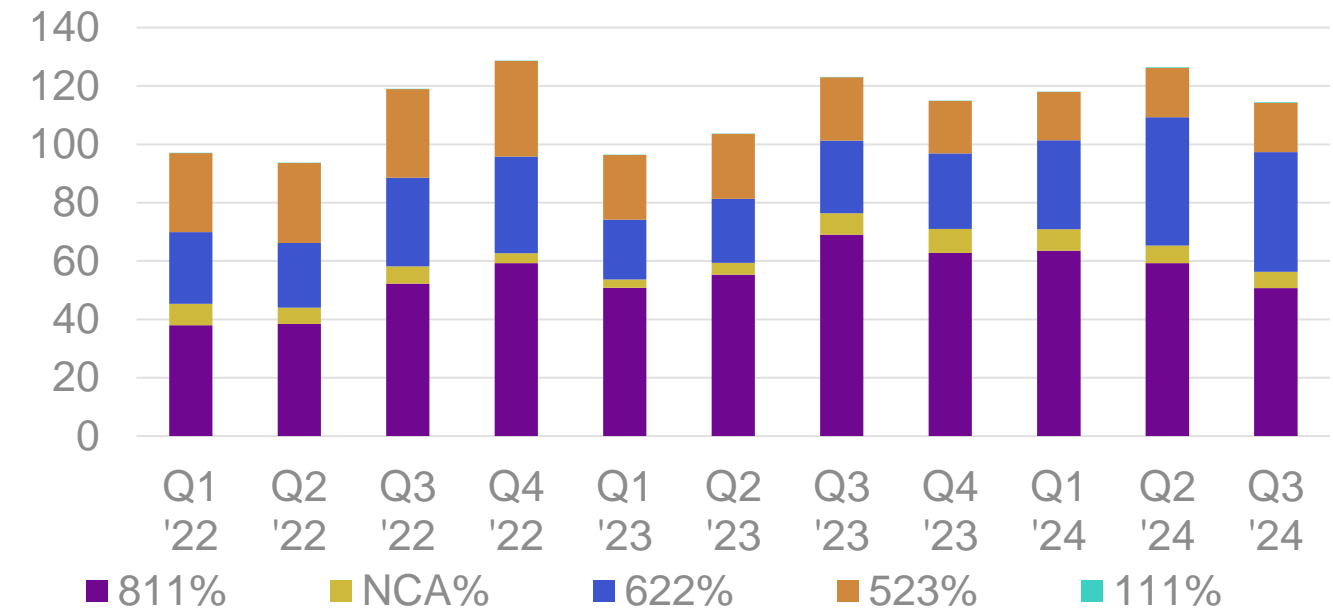
Despite recent sluggishness, batteries to lead demand growth



- Barely any growth in nickel in Chinese pCAM between 2022 and 2024
- Demand growth to come mostly from the battery sector, driven by the adoption of electric vehicles (+625kt contained nickel)
- Growth from stainless +275kt Ni over 2023-2028, but sector will be over 2x batteries size by 2028.

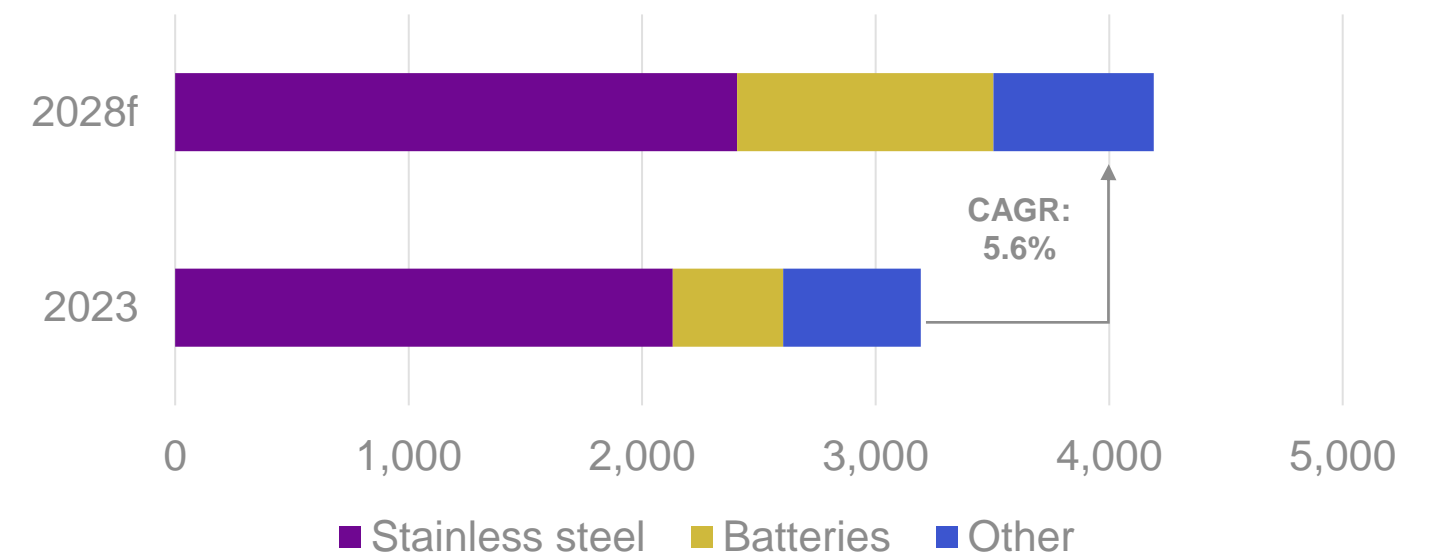
Nickel in Chinese pCAM

'000 tonnes of nickel, including from scrap sources



Primary nickel demand

'000 tonnes nickel

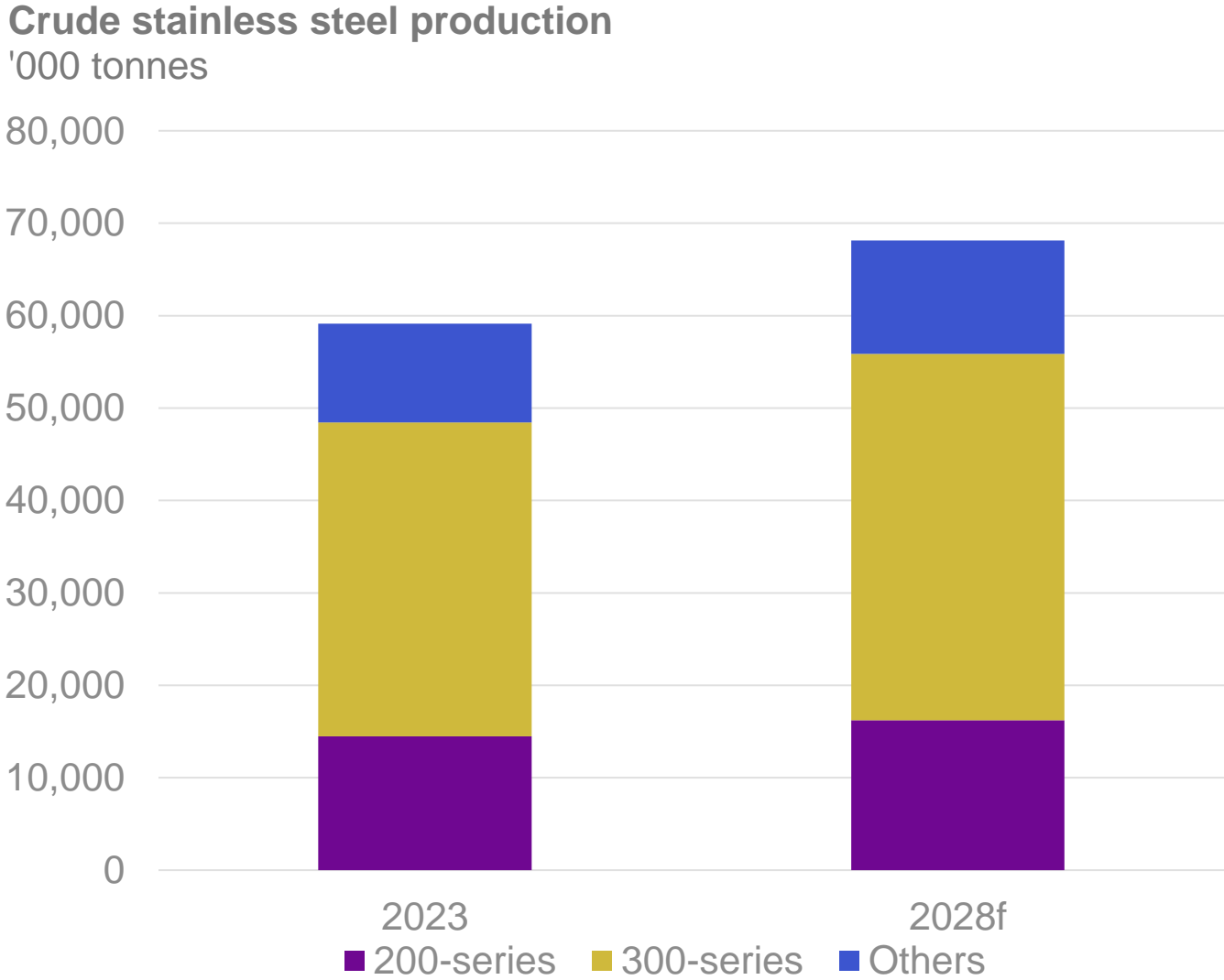


Source: Fastmarkets Long Term Forecasts, Xinze



Crude stainless production to rise by 2.9% p.a to 2028, led by 300-series

- World crude stainless steel production will rise by **2.9%** p.a. between 2023 and 2028
- This will be driven mostly by high-nickel 300-series (**3.1%** CAGR)
- China – where scrap usage is low will drive this production growth



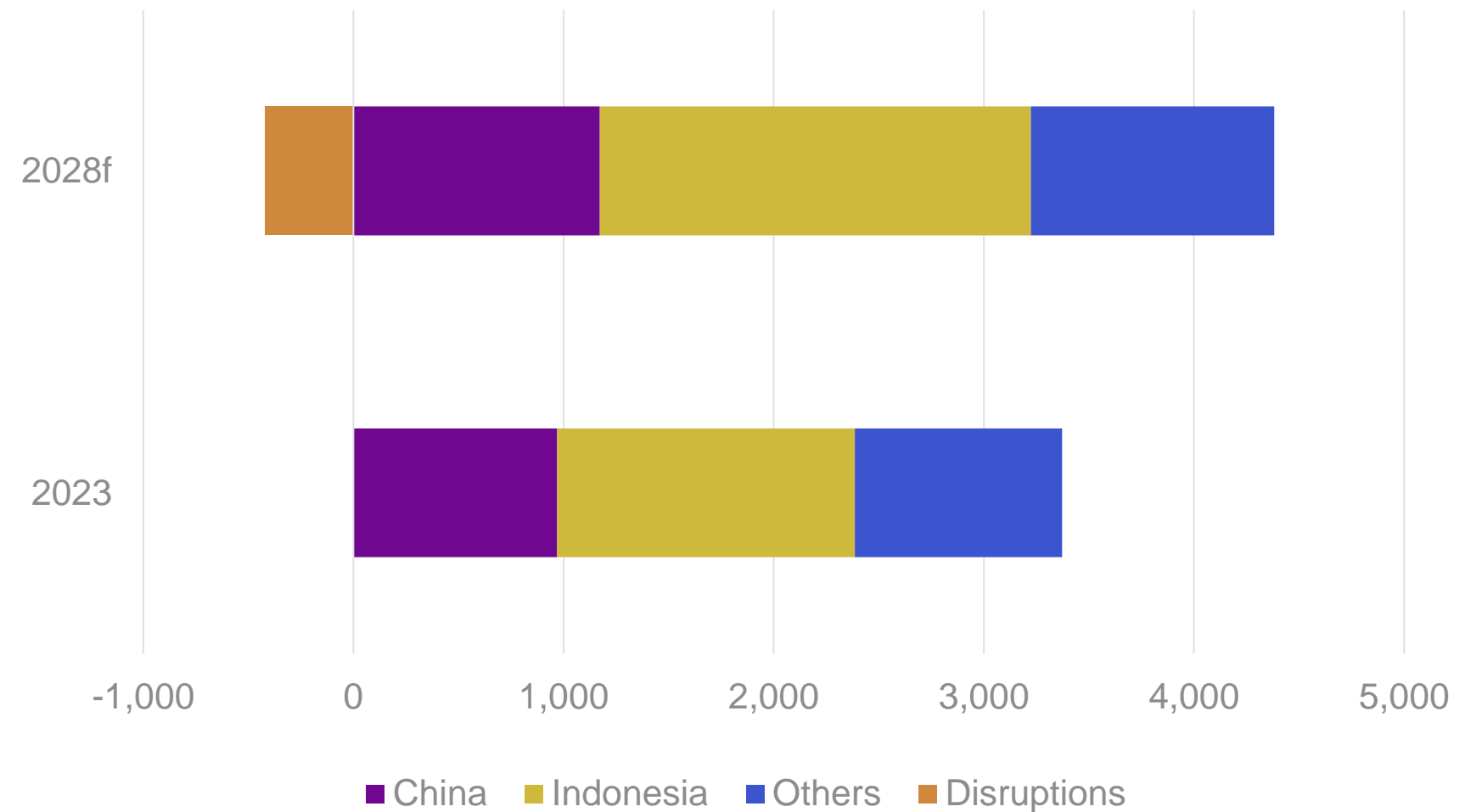
Source: Fastmarkets Long Term Forecasts

Indonesia driving supply growth



- Weak prices in 2023 lead to supply cuts; Indonesia slow to approve mining quotas. **No supply growth in 2024**
- Indonesia to lead supply in subsequent years, with Chinese supply also rising (thanks to Indonesian intermediate feed)

Primary nickel production
'000 tonnes nickel



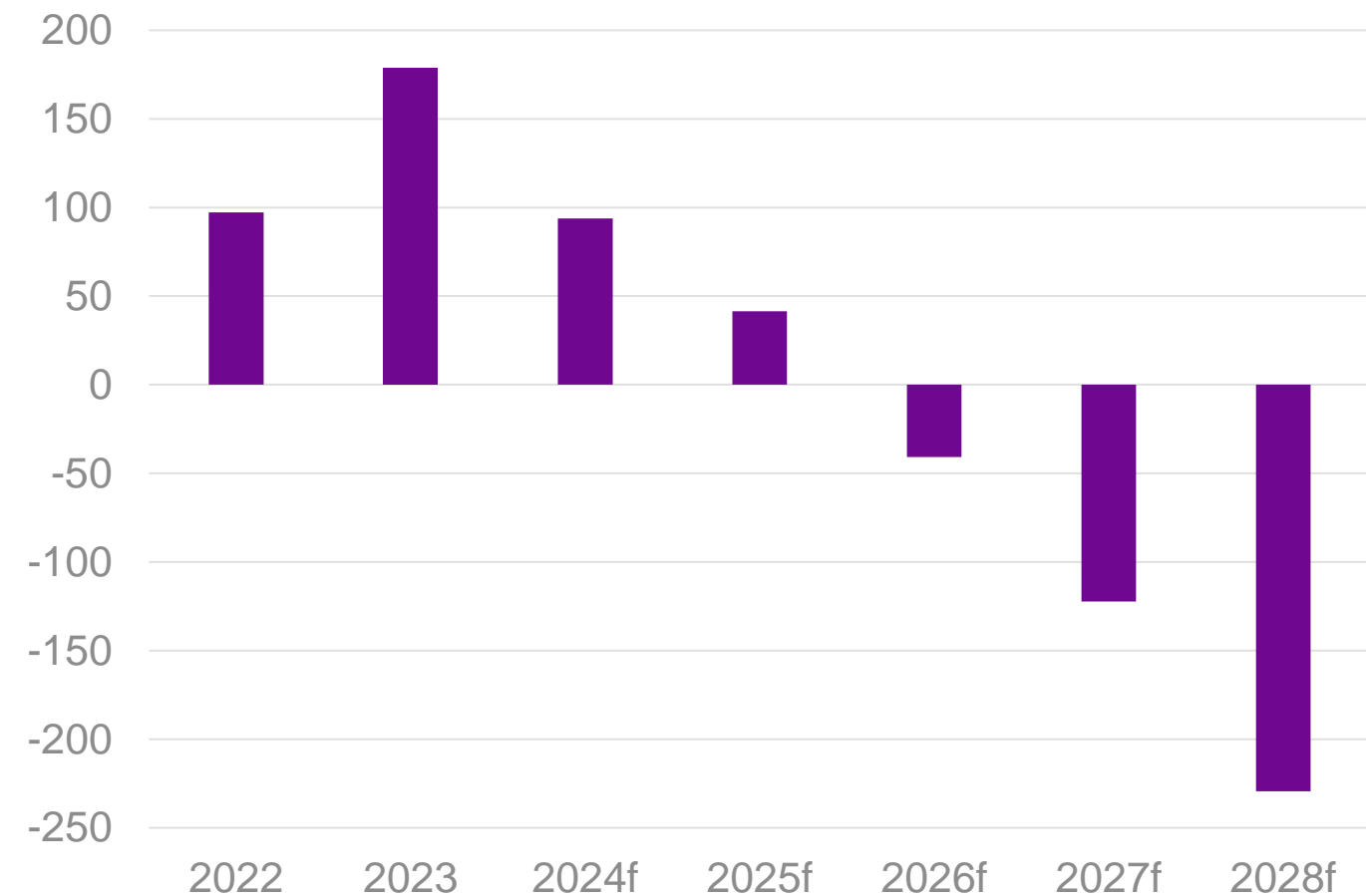
Source: Fastmarkets Long Term Forecasts

Market gradually rebalancing



- Production cuts have lowered the primary supply growth profile
- Market to be remain oversupplied in 2024, but the forecast surplus of **94 kt** Ni is nearly half 2023's surplus
- Small **surplus in 2025**, followed by small **deficit in 2026**
- Larger deficits in 2027-2028

Primary nickel market balance
'000 tonnes nickel



Source: Fastmarkets Long Term Forecasts



Cobalt market



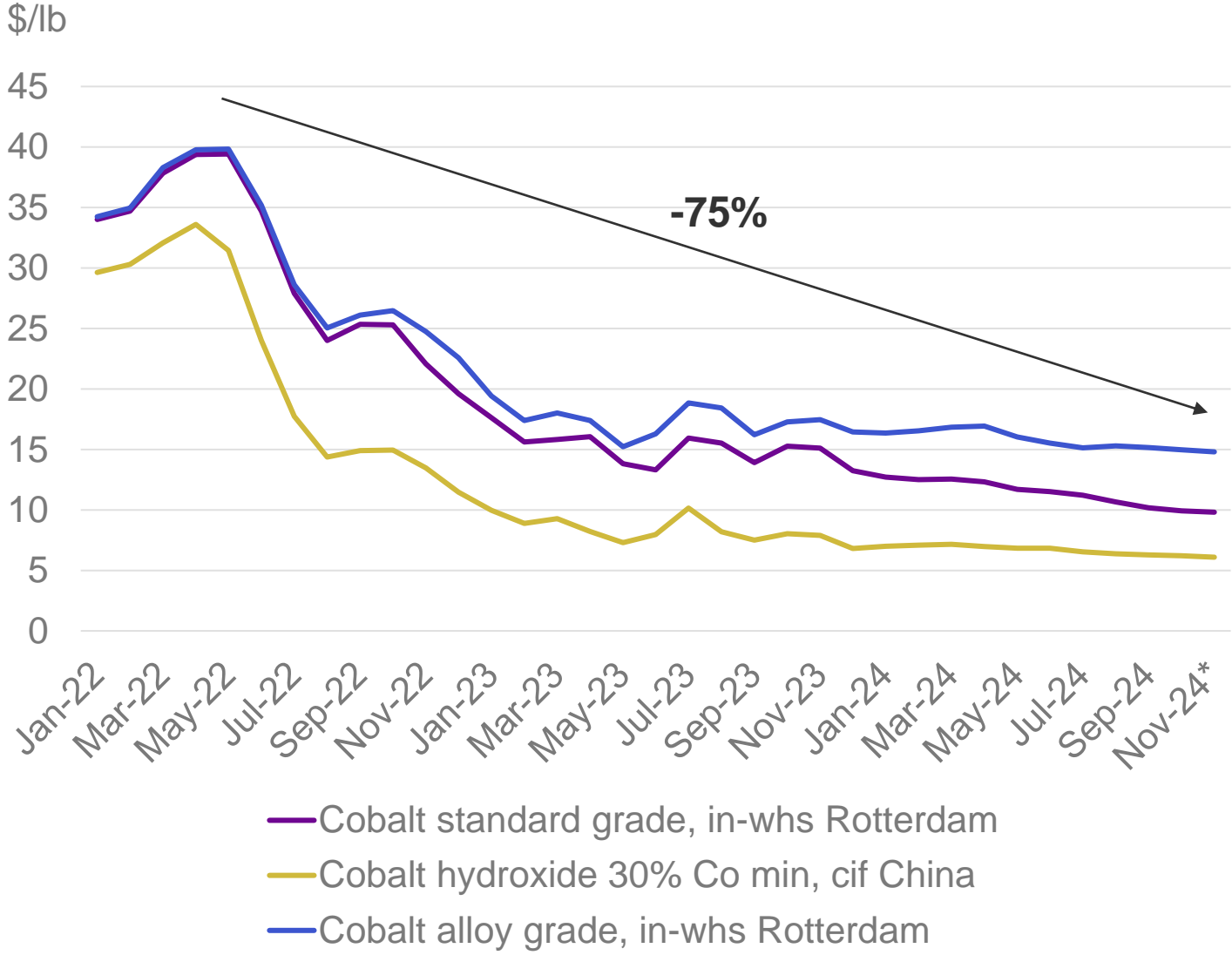
Rob Searle

Analyst, Battery Raw Materials
Fastmarkets

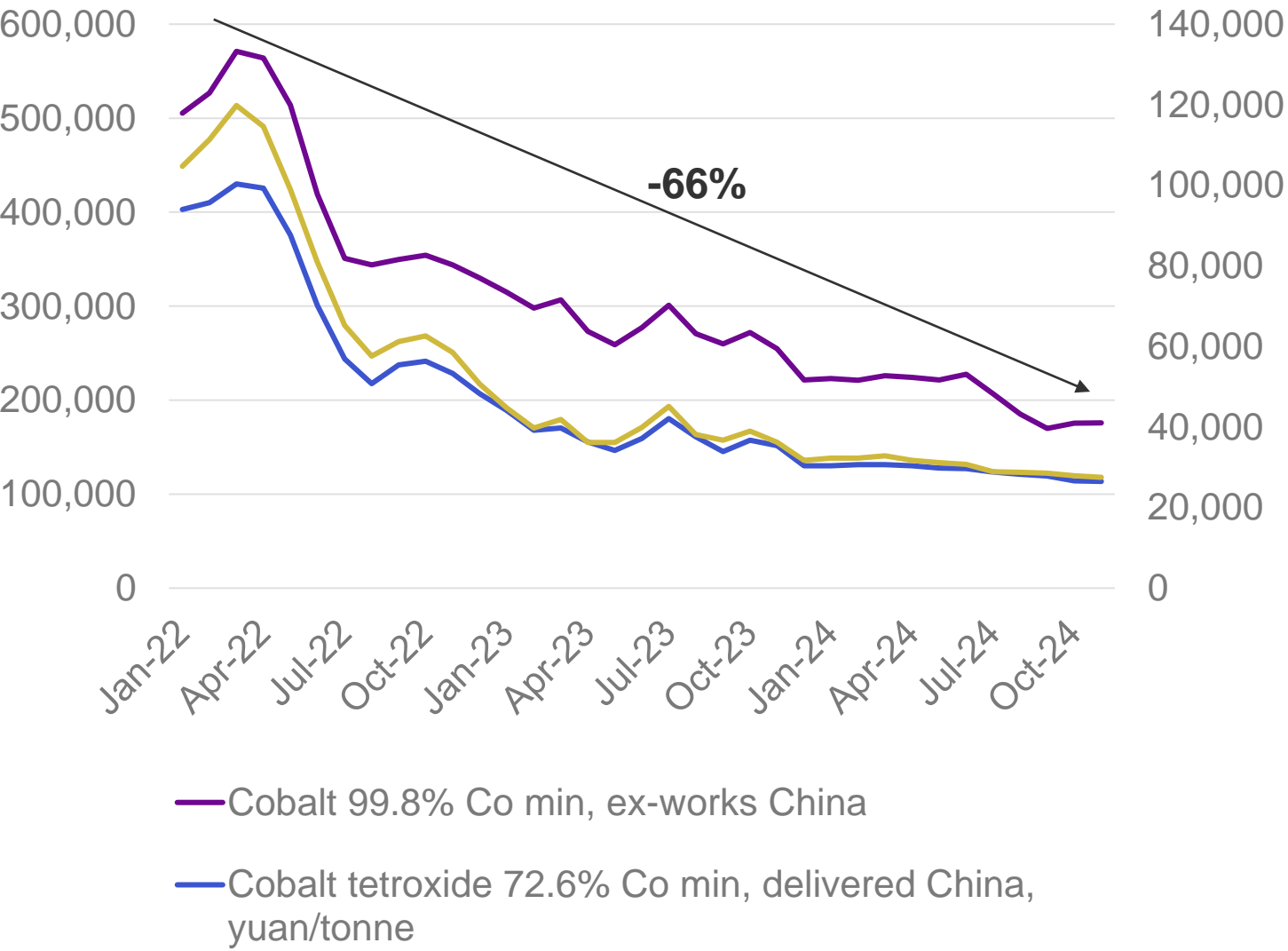


Continued pressure on cobalt prices in Q3 2024

Prices - SG cobalt metal, Co hydroxide & alloy-grade cobalt metal

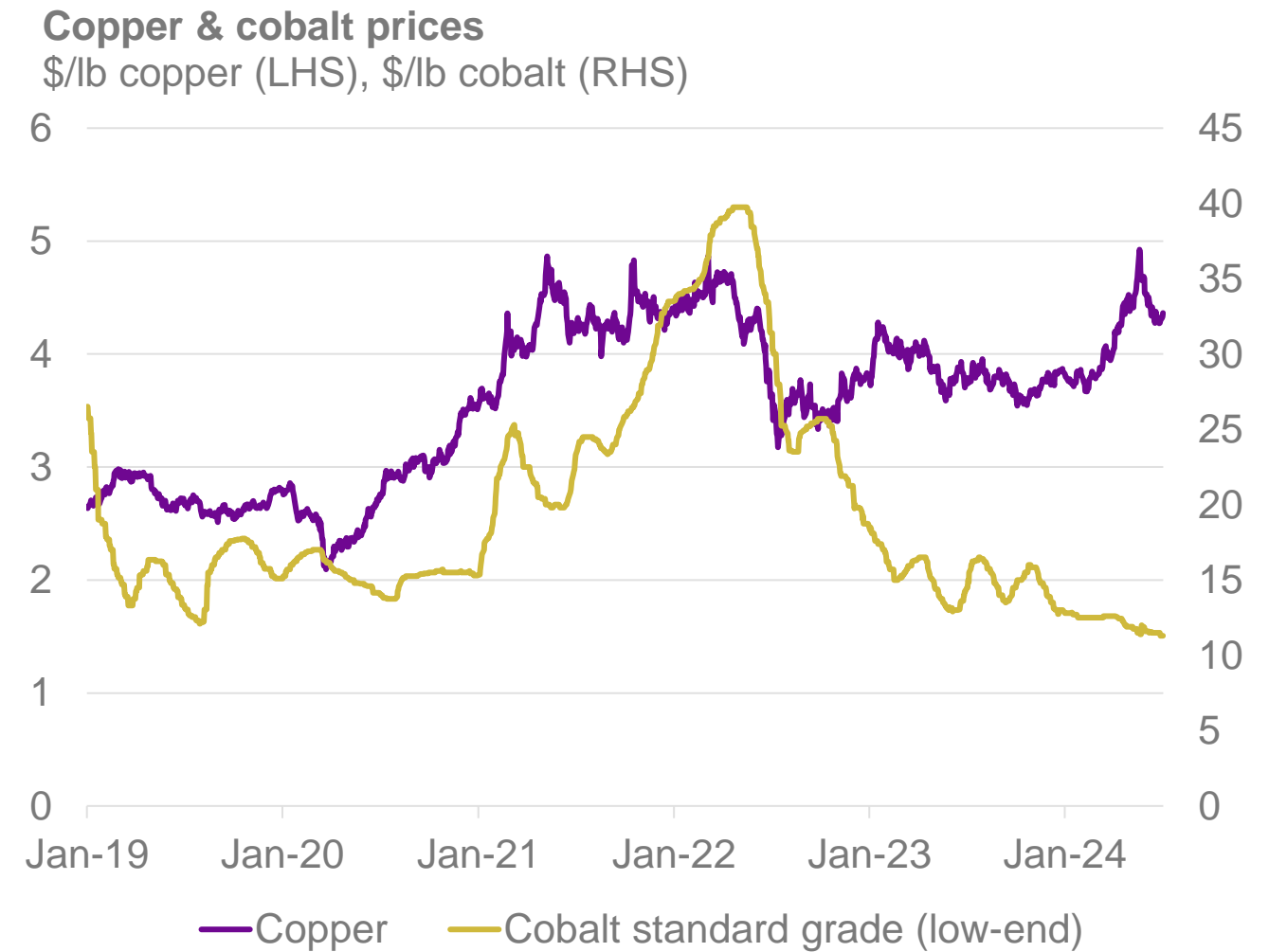
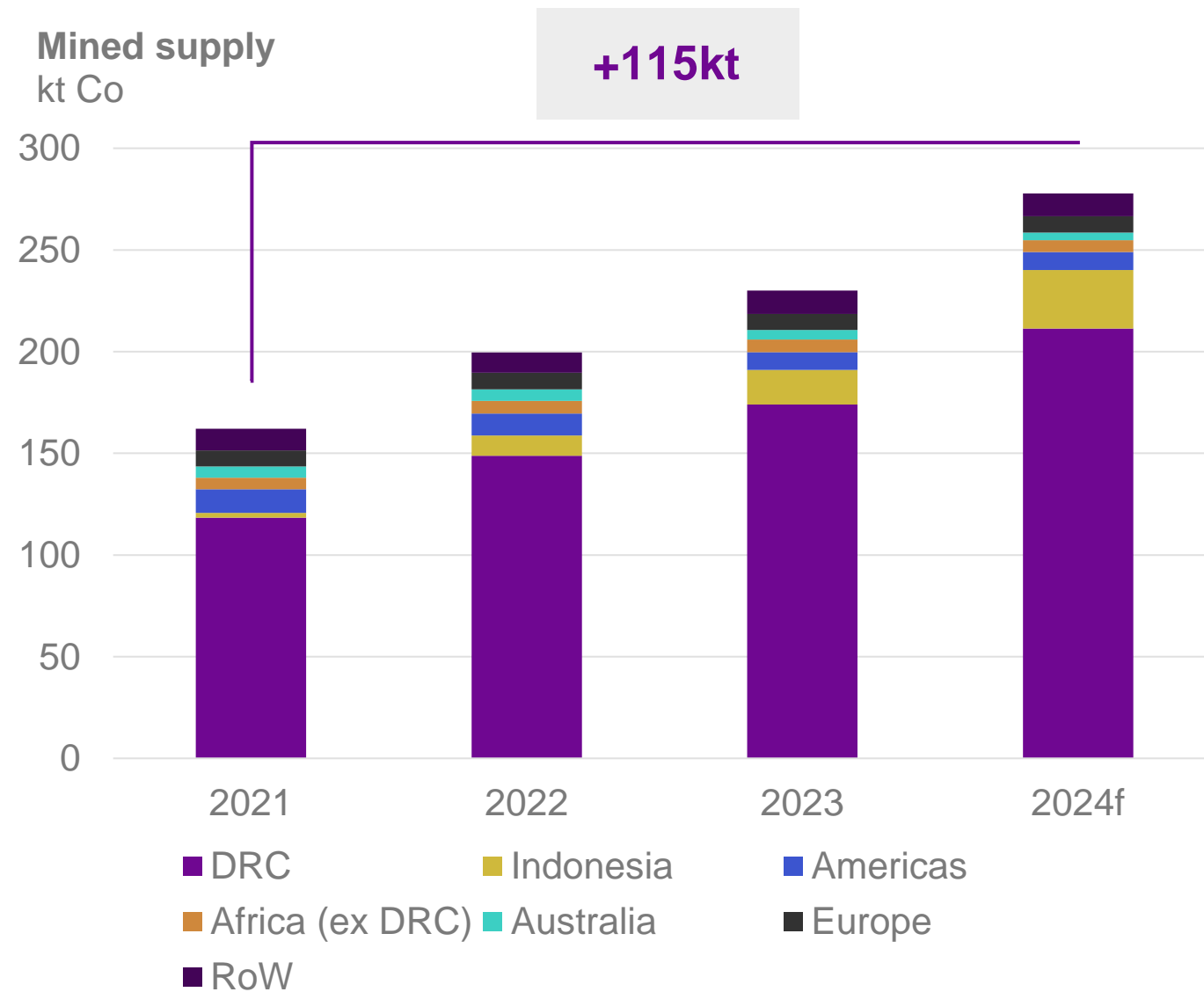


China refined cobalt prices
yuan/tonne metal & tetroxide (LHS), yuan/tonne sulfate (RHS)



Source: Fastmarkets Dashboard

Mined supply growth has outpaced demand



Copper prices in 2024 averaged **34% higher** compared to 2014 – 2023

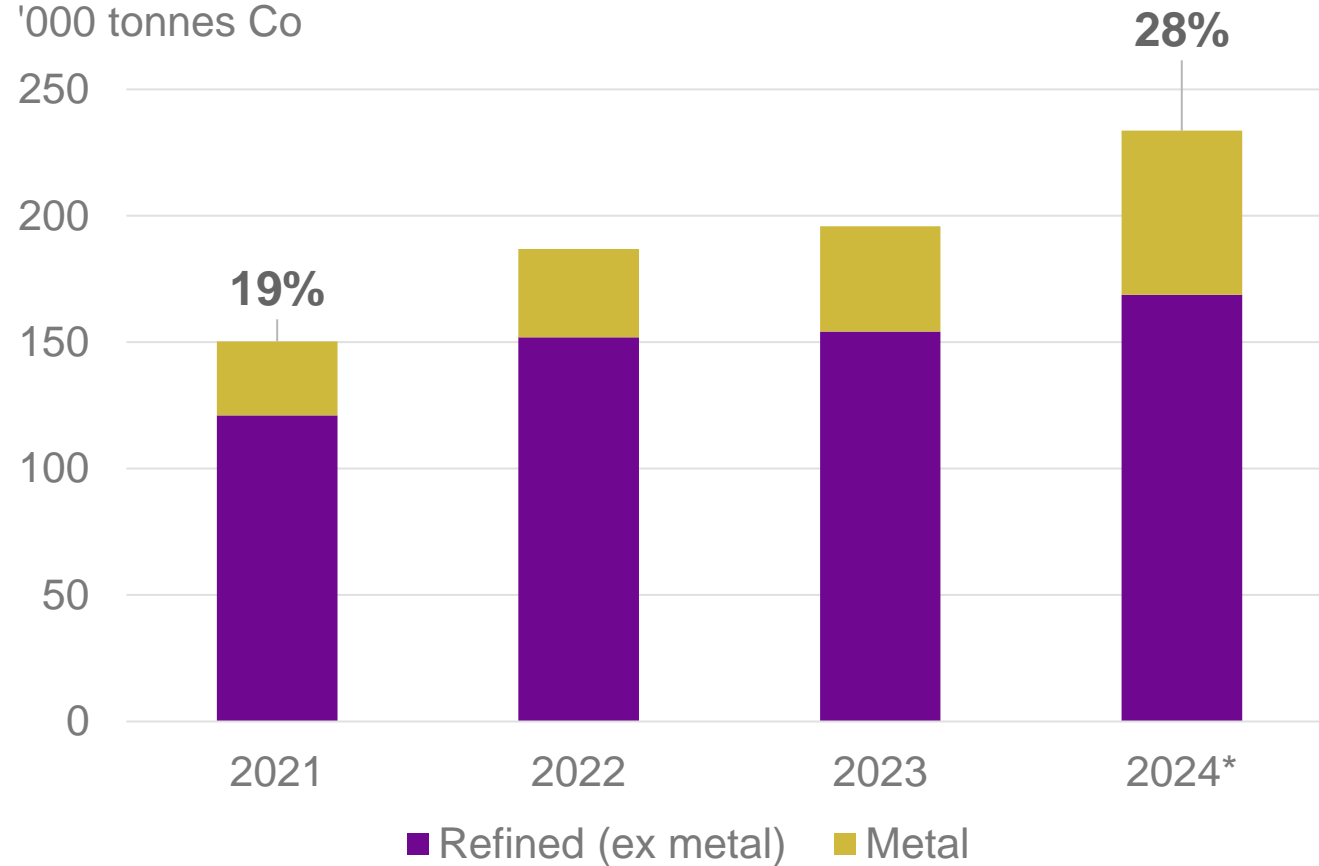
Source: Fastmarkets Long Term Forecasts

Refined metal supply has grown as chemical demand remains sluggish

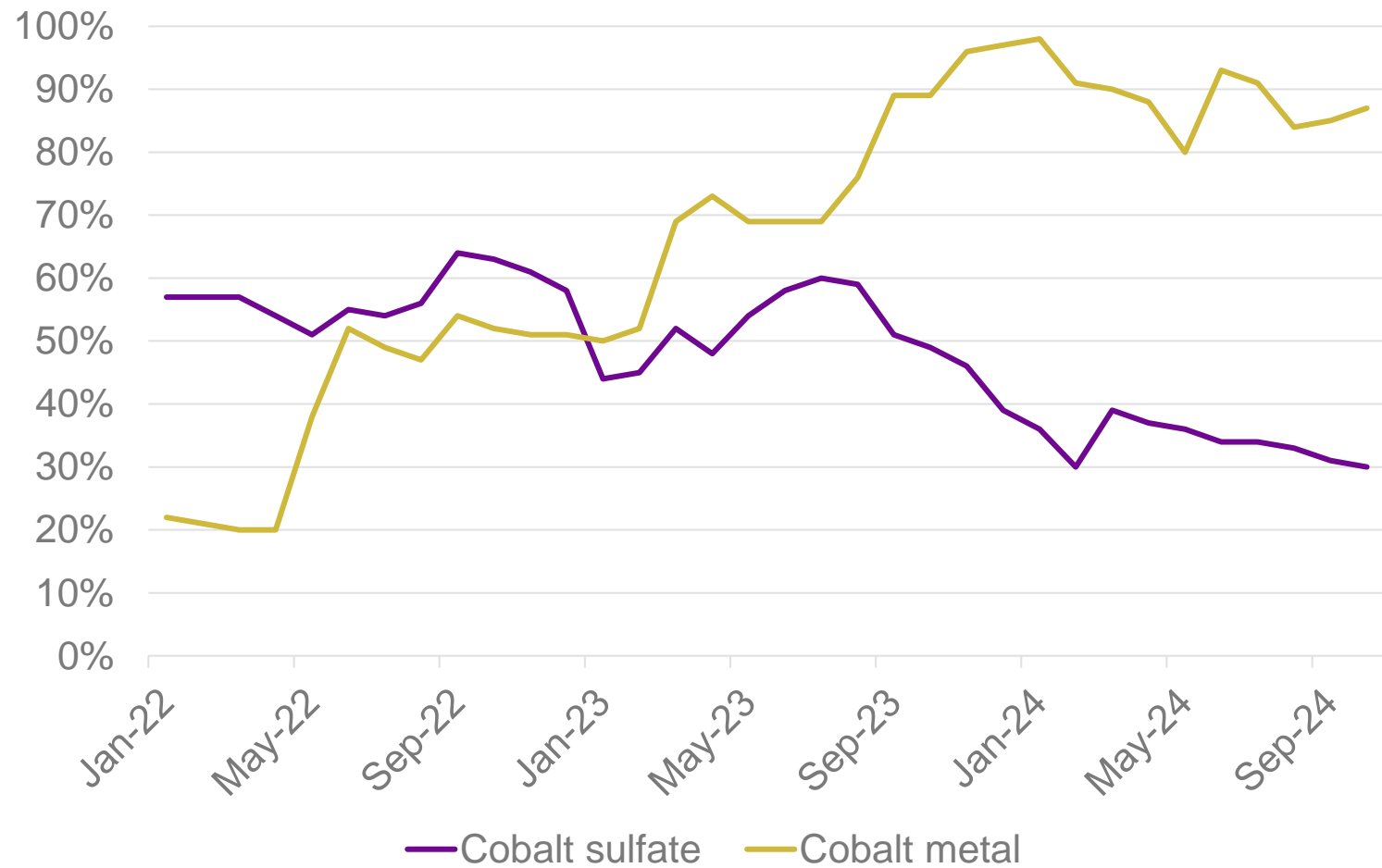


Refined cobalt production

'000 tonnes Co



China refined operating rates



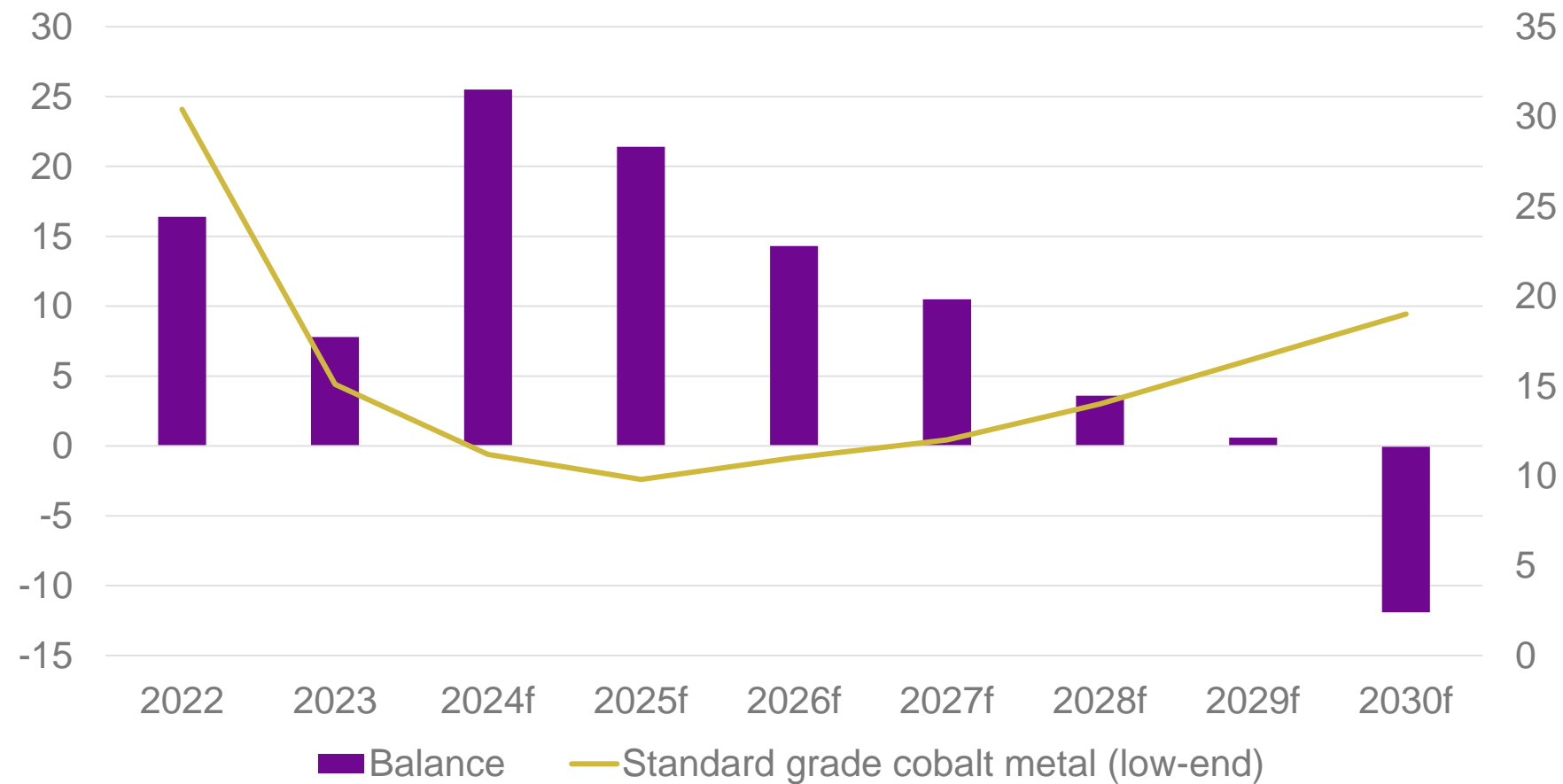
Refined cobalt metal supply has outstripped real downstream demand

Source: Fastmarkets Long Term Forecasts

Significant surplus to persist in 2025 with bearish prices to continue



Market balance & price forecast
'000 tonnes Co (LHS), \$/lb (RHS)



Surplus to persist to **2029** - market will be relatively tighter

Bullish prices in copper market to incentivise DRC production in 2025

Headwinds for Western EV demand & cobalt-thrifting in batteries

China and Indonesian-origin metal to continue to pressure prices



Source: Fastmarkets Long Term Forecasts



Graphite market



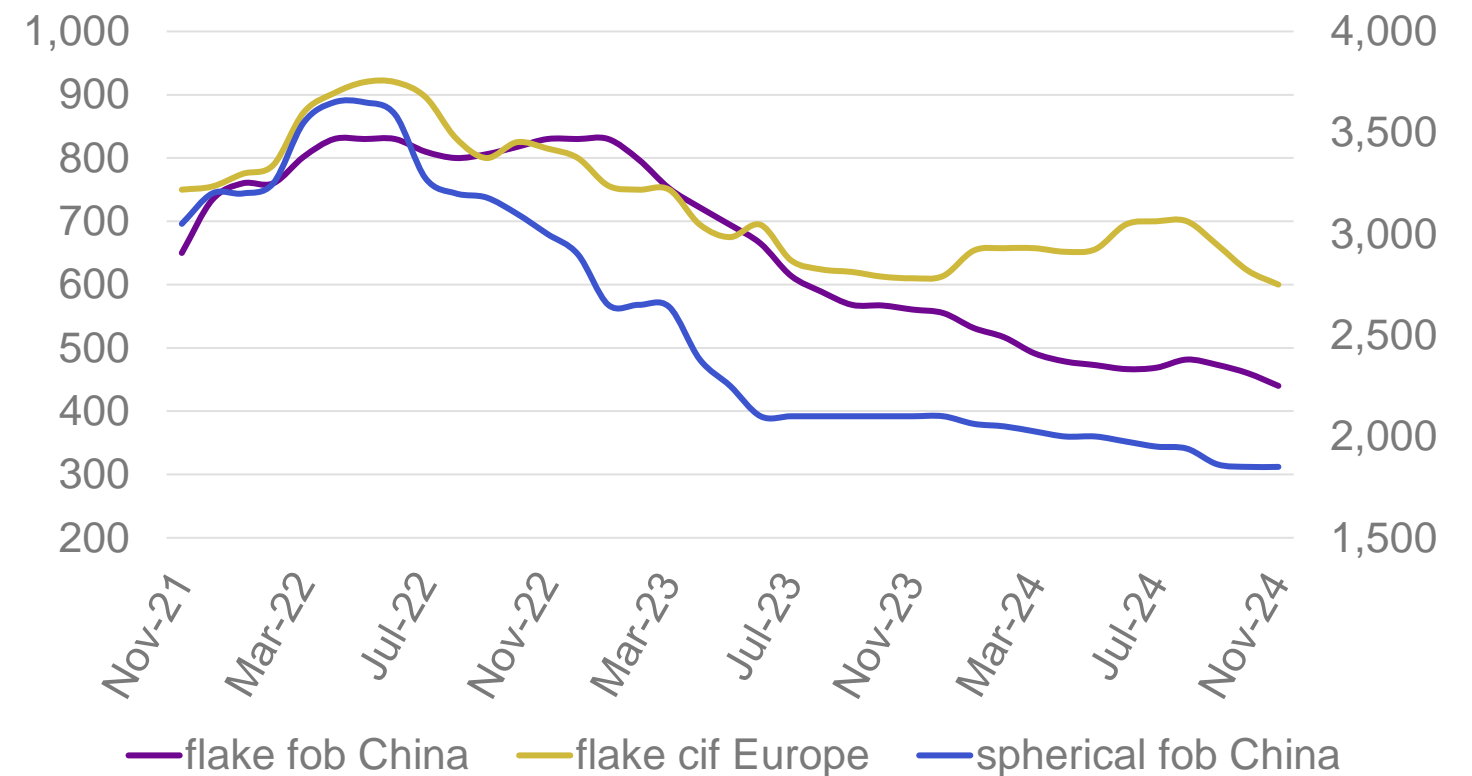
Amy Bennett
Principal Consultant
Fastmarkets

Chinese graphite prices at lowest level since 2020



- Chinese graphite prices in **decline** since mid-2022
- Natural graphite facing **intense competition** from the synthetic graphite sector
- Europe has enjoyed **price premiums** in 2024, reflecting geopolitical concerns and higher freight rates, indicator of ex-China market premiums
- Prices **below operating costs** for new and existing producers
- Current prices **unsustainable**, at or near pricing floor

Flake 94%C, -100 mesh & spherical 99.95%C prices
\$/tonne flake (LHS), \$/tonne spherical (RHS)






Source: Fastmarkets Long Term Forecasts






China controls price dynamics across anode supply chain

China natural graphite market share

-  ~ 80% of global natural graphite
-  ~ 99% of natural graphite pre-AAM (uSPG)
-  ~ 97% of natural graphite AAM (cSPG)

China synthetic graphite market share

-  ~ 57% of global synthetic graphite output
-  ~ 99% of synthetic graphite AAM output
-  ~ 99% of synthetic graphite AAM shipments

 **China graphite AAM market share**
~ 98% of global AAM production

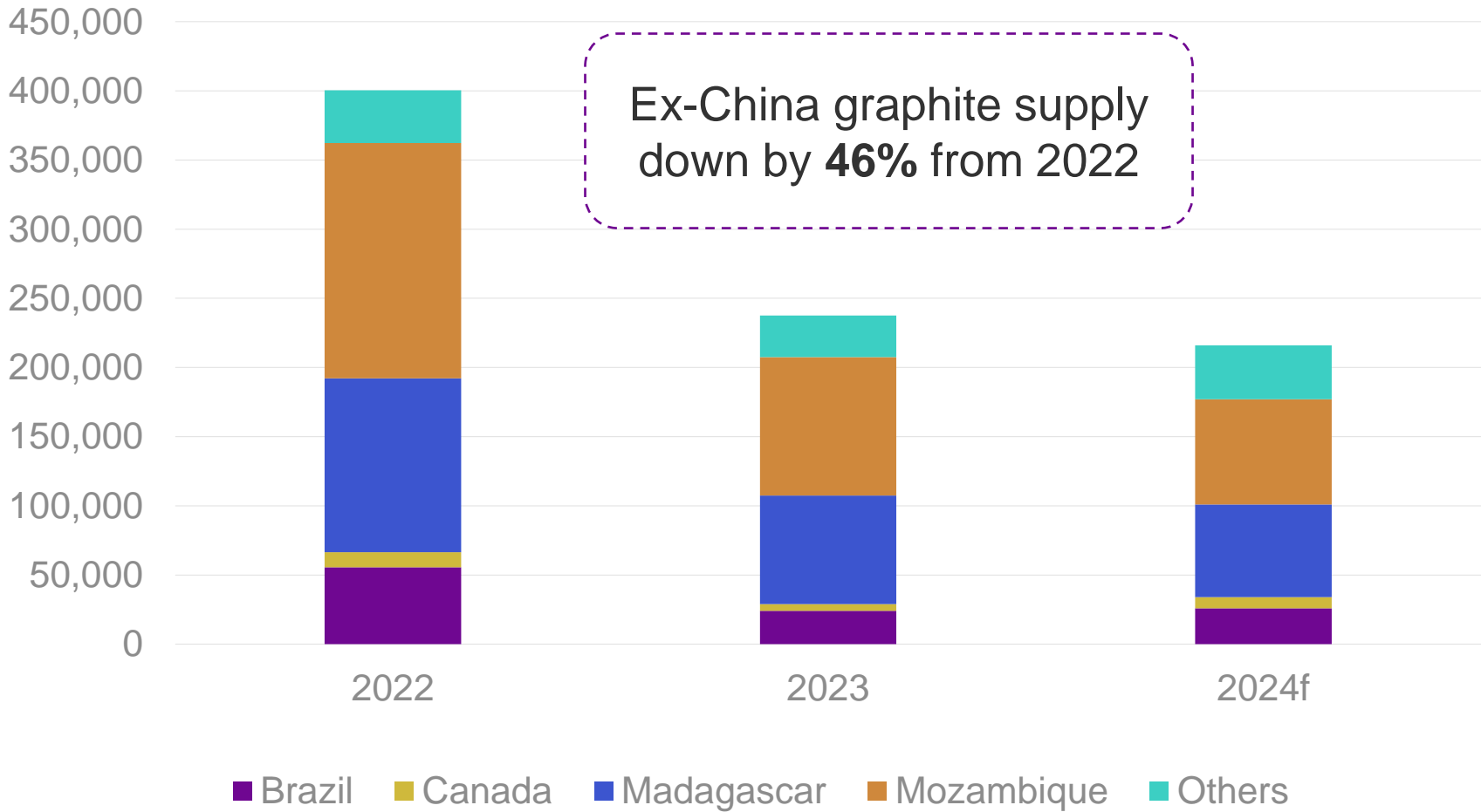
Source: Fastmarkets Long Term Forecasts



Graphite miners ex-China struggling under depressed prices

- Largest supply cuts coming from **Mozambique** and **Madagascar**
- New supply from **Tanzania** to add pressure to the market
- China has been the main market for fine flakes from Africa
- Demand from North America and Europe insufficient to replace the Chinese market

Ex-China graphite production 2022-2024f
tonnes



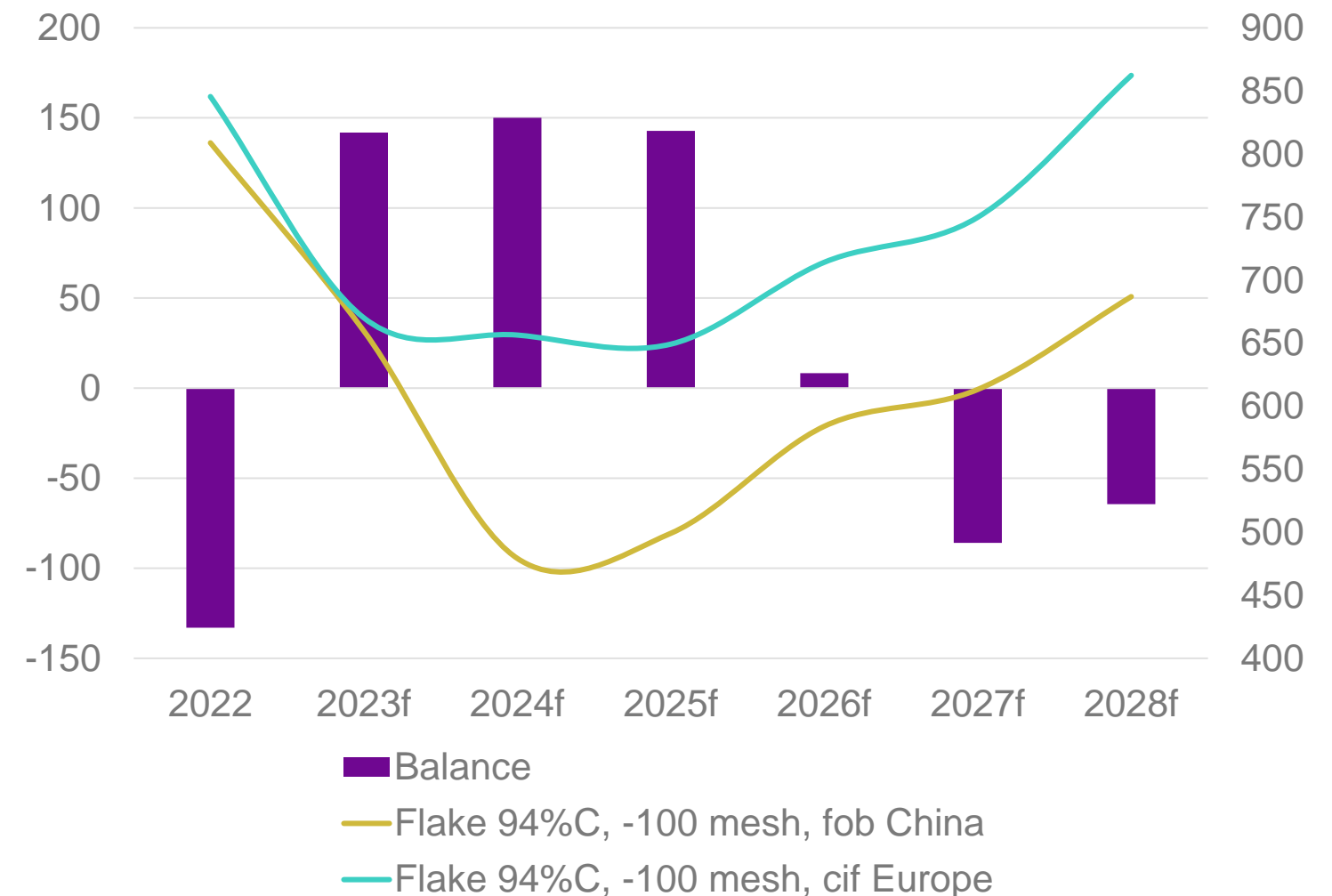
Source: Fastmarkets Long Term Forecasts



Market will struggle with surplus supply in 2025, but will become more balanced from 2026

- **Demand** outlook remains largely positive, with only a modest slowing in US demand with Trump administration
- Unsustainably low prices will prompt additional graphite **production cuts**, helping to rebalance the market
- EU/US will maintain **premium pricing** reflecting:
 - Geopolitical tensions
 - Protectionist measures
 - Higher prices required to support ESG-compliant, localized, diversified supply
- Prices will **bottom out in 2024**, but will not return to 2022 levels in the medium term

Total graphite battery balance vs price
'000 tonnes (LHS), \$/tonne (RHS)



Source: Fastmarkets Long Term Forecasts



Manganese market



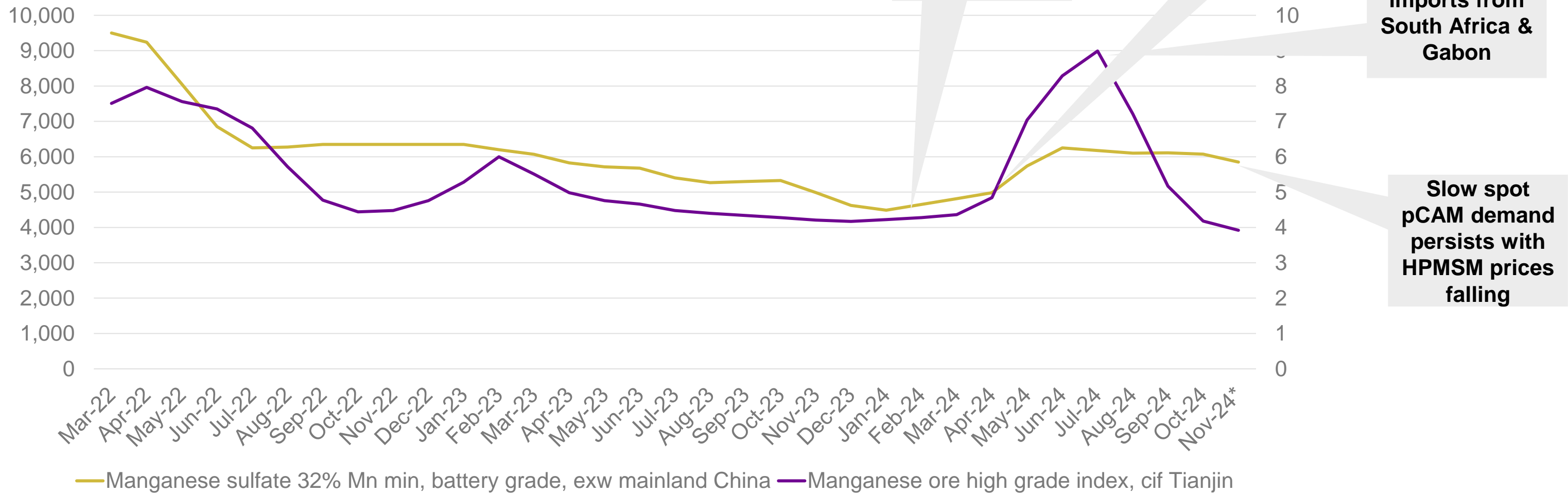
Rob Searle

Analyst, Battery Raw Materials
Fastmarkets

Slow decline in manganese sulfate prices seen in Q4 2024



Manganese prices - BG manganese sulfate & high-grade ore
yuan/tonne (LHS), \$/dmtu



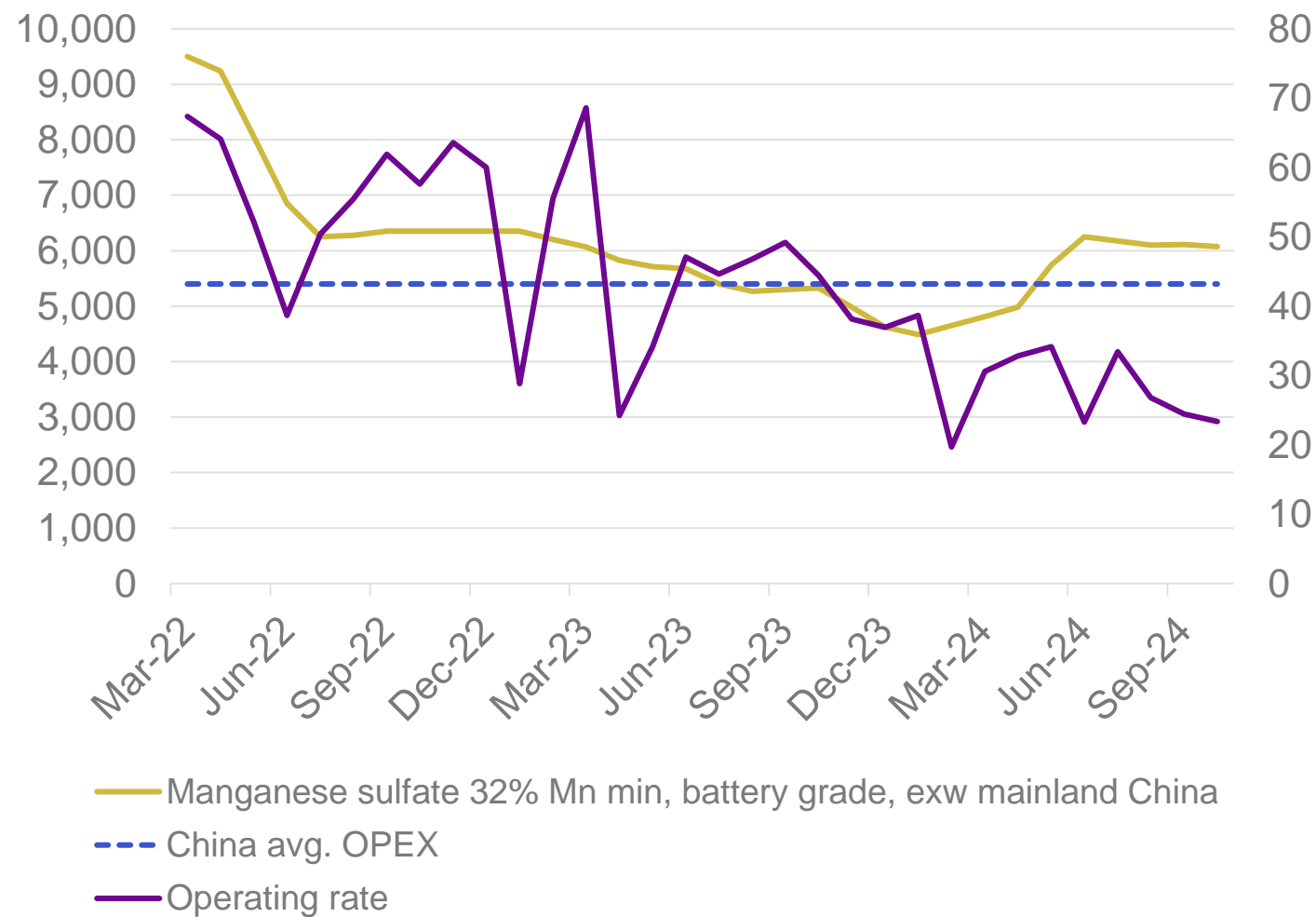
Source: Fastmarkets Dashboard

China's supply has room to grow



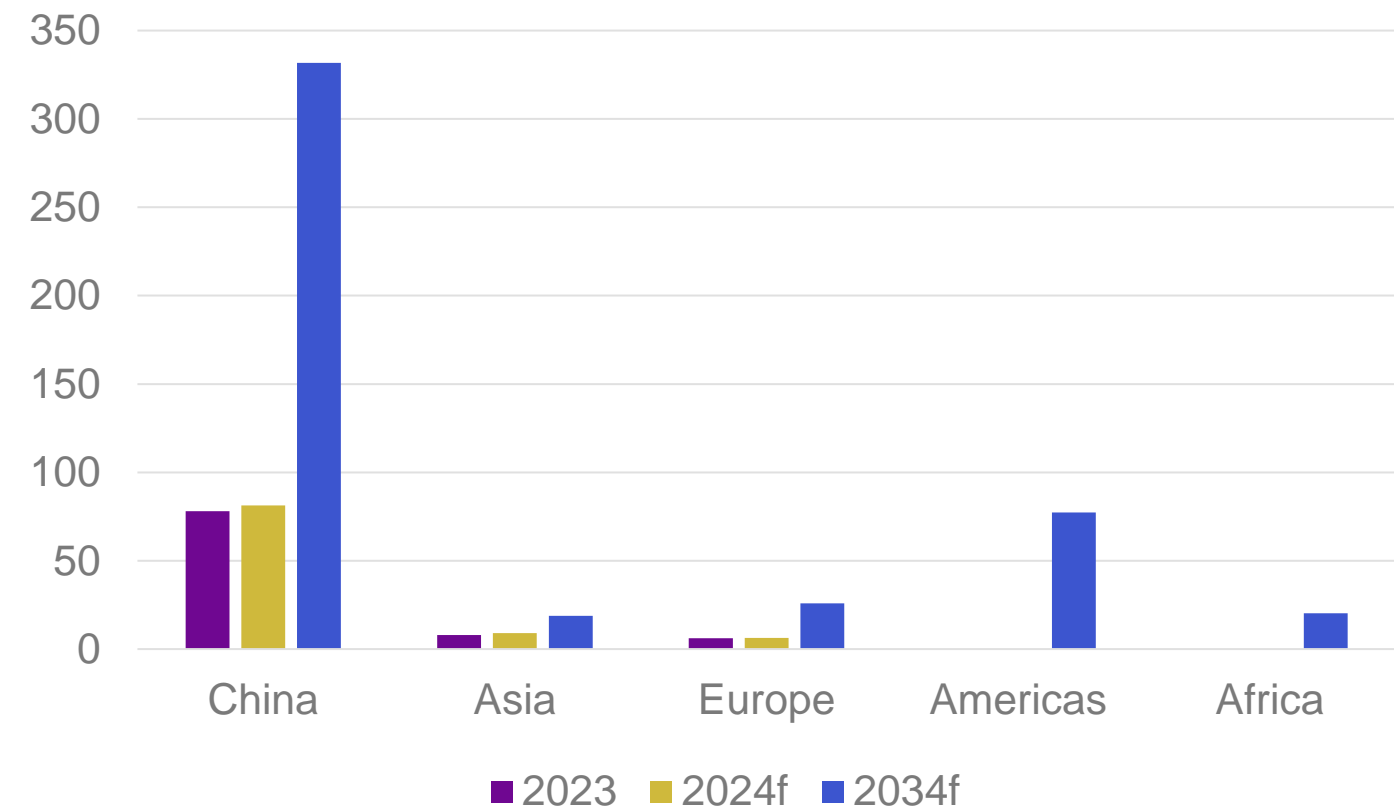
Manganese sulfate ex mainland China price & operating rate

yuan/tonne (LHS), % (RHS)



Regional HP-Mn supply forecast

'000 tonnes Mn



China's installed HP-Mn supply is forecast to **grow 4X** from 2023 – 2034

Source: Fastmarkets Dashboard & Long Term Forecasts

LMFP has the potential to revolutionize manganese demand

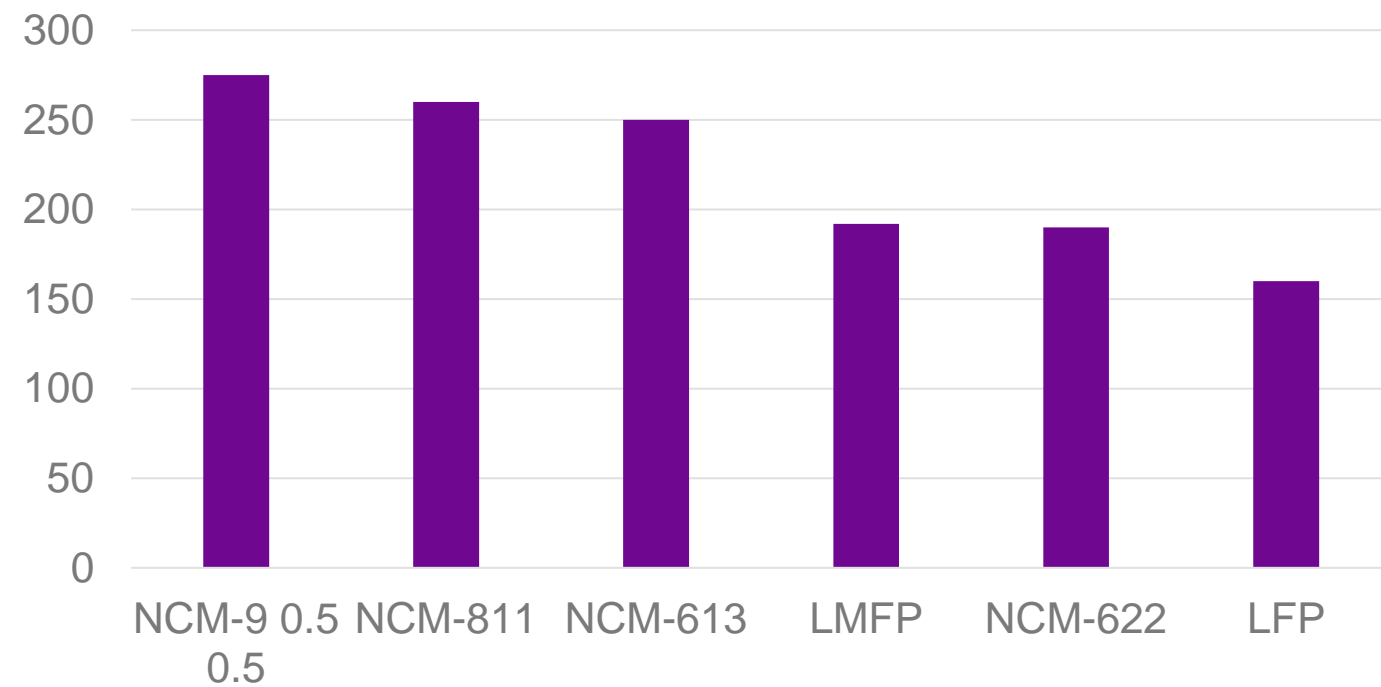


Bullish outlook on increased Mn-loadings

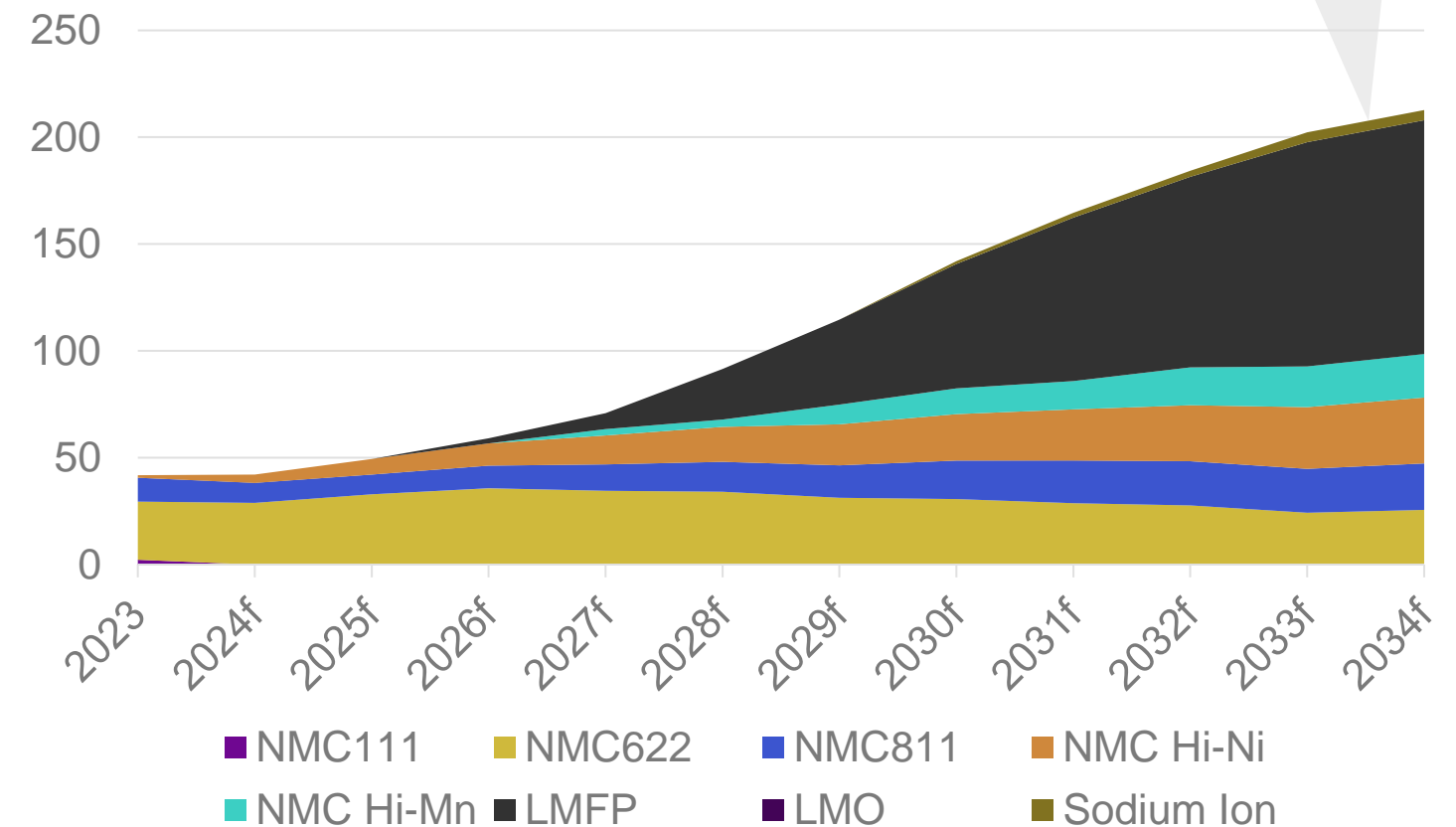
- Widespread commercial roll-out forecast in second half of the decade
- LMFP expected to take market share from NCM-622 & LFP globally

LMFP could represent 50% of total HP-Mn by 2034

Energy density
Wh/kg



BEV HP-Mn demand
'000 tonnes Mn



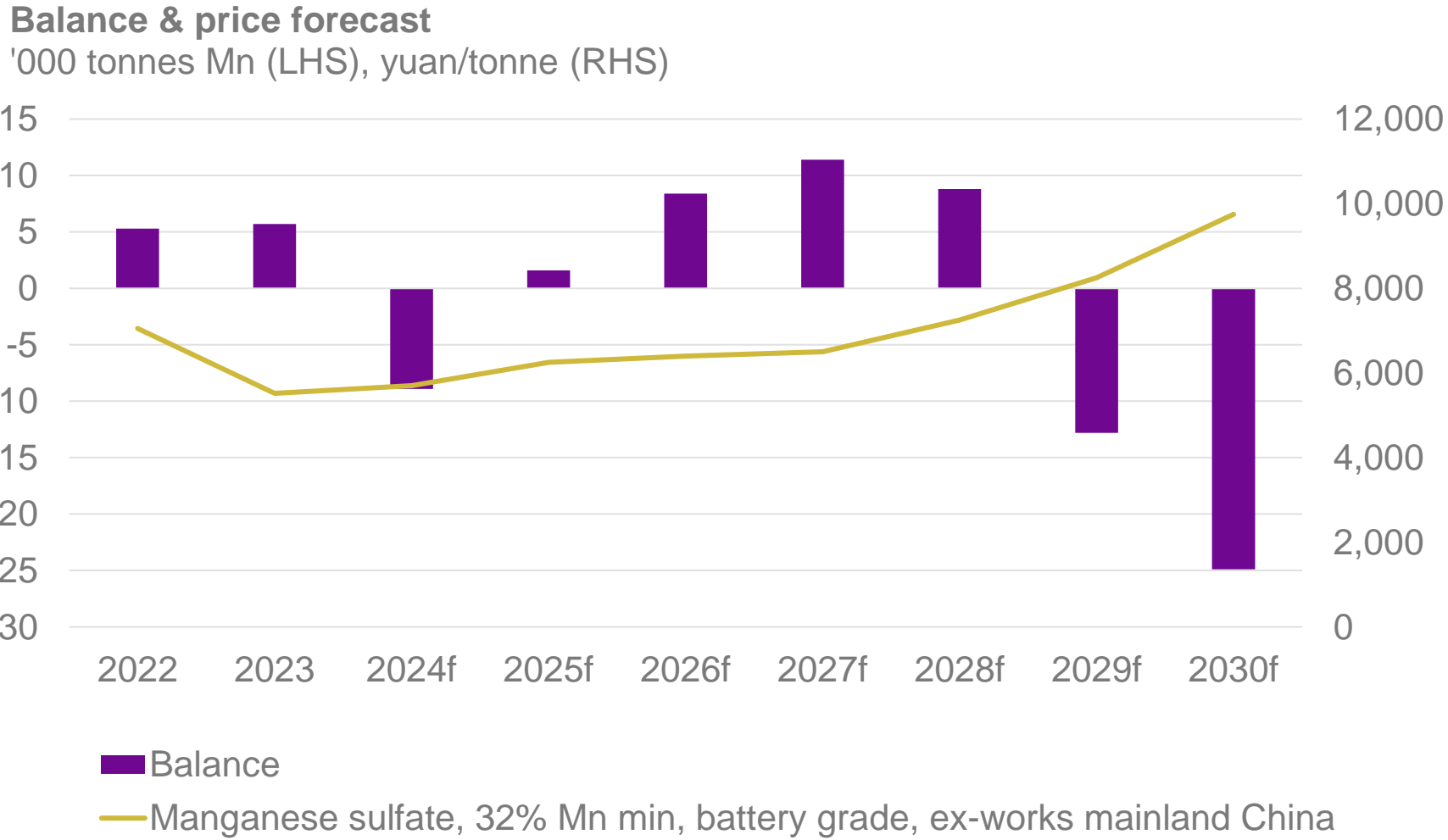
Source: Fastmarkets Long Term Forecasts



Ample installed capacity to limit significant short term price rises

Surplus expected in the short term

- **Slow pCAM buying** to persist through to year-end
- **Destocking** through 2024 – inventory rebuilding in 2025
- HP-Mn market forecast to be well supplied out to **2028**
- Need for new processing capacity in the 2030s



Limited short-term upside in prices on ample capacity in China

Source: Fastmarkets Long Term Forecasts



Cell costs and forecasts



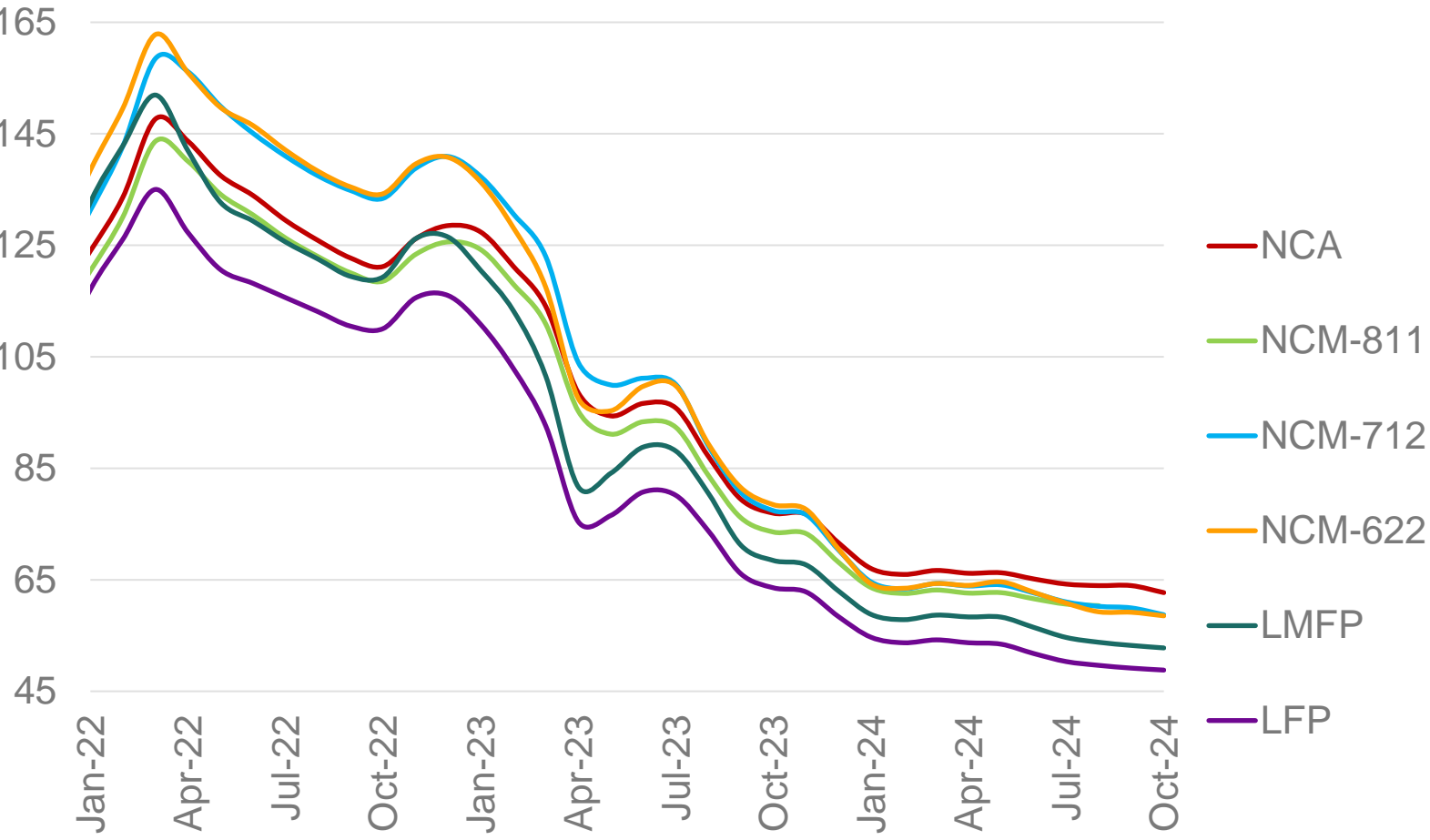
Muthu Krishna PhD CEng
Senior Analyst, Battery Cost Modelling
Fastmarkets



Jan 22 – Oct 24: cell costs have fallen 50-60%

- Both LCE* and LiOH* prices down **72%**
- LFP CAM price down **72%** and NCM-811 CAM price down **52%**
- LFP cell cost currently **~49 \$/kWh**, with NCM/NCA cells at **~59–63 \$/kWh** (excluding profit margins)

Cell cost averaged across all formats, China
Cell cost \$/kWh

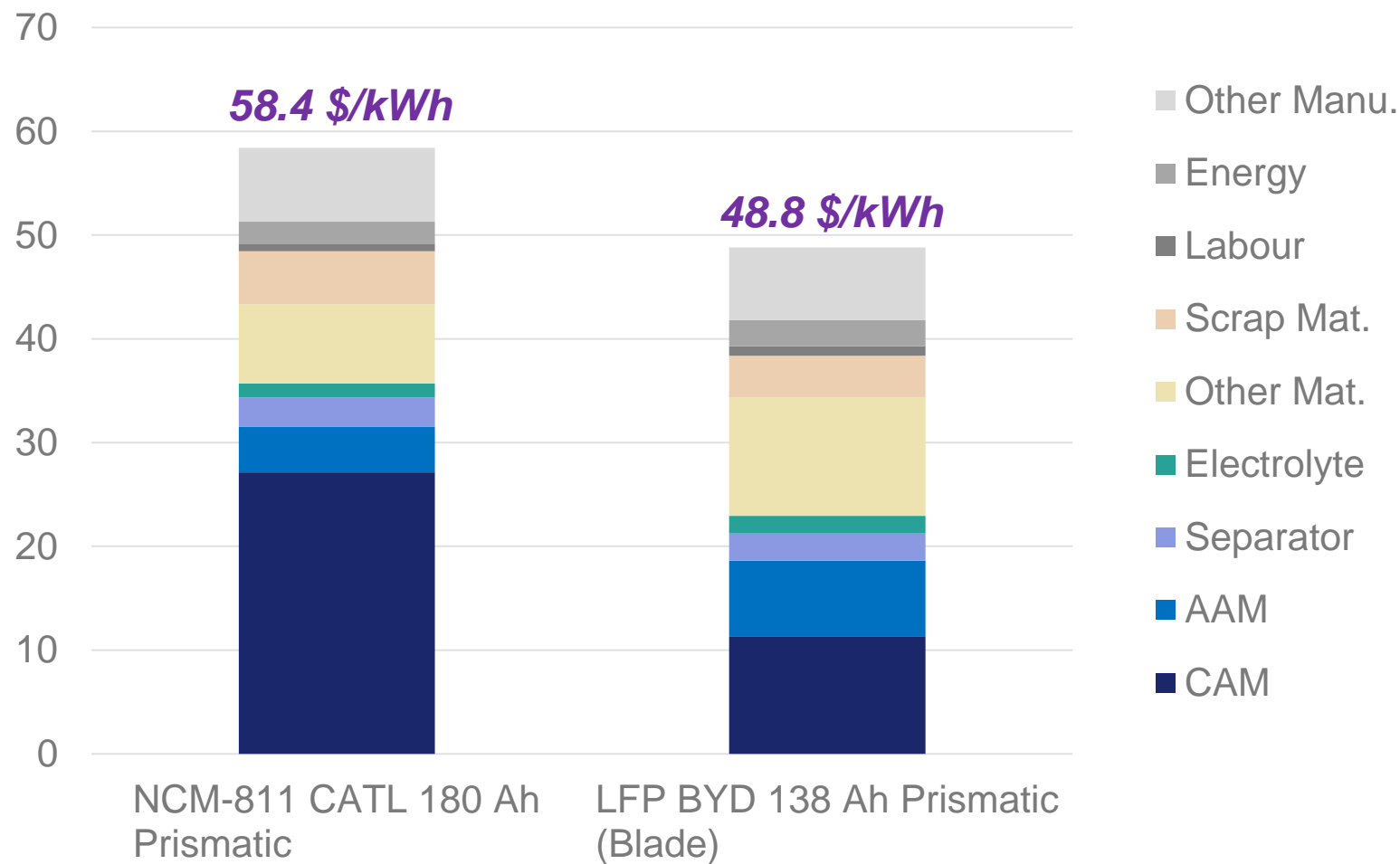


*Fastmarkets Lithium carbonate 99.5% Li₂CO₃ min, battery grade, spot prices cif China, Japan & Korea, \$/kg
*Fastmarkets Lithium hydroxide monohydrate LiOH.H₂O 56.5% LiOH min, battery grade, spot price cif China, Japan & Korea, \$/kg
Source: Fastmarkets Battery Cost Index, October 2024



China: LFP currently 16% cheaper than NCM-811

NCM-811 v LFP cell cost breakdown, Oct 2024, China
Cell cost \$/kWh



- CAM **46%** and **23%** of cell cost for NCM-811 and LFP, respectively
- AAM **8%** and **15%** of cell cost for NCM-811 and LFP, respectively
- Manufacturing (ex. scrap) **17%** and **21%** of cell cost for NCM-811 and LFP, respectively

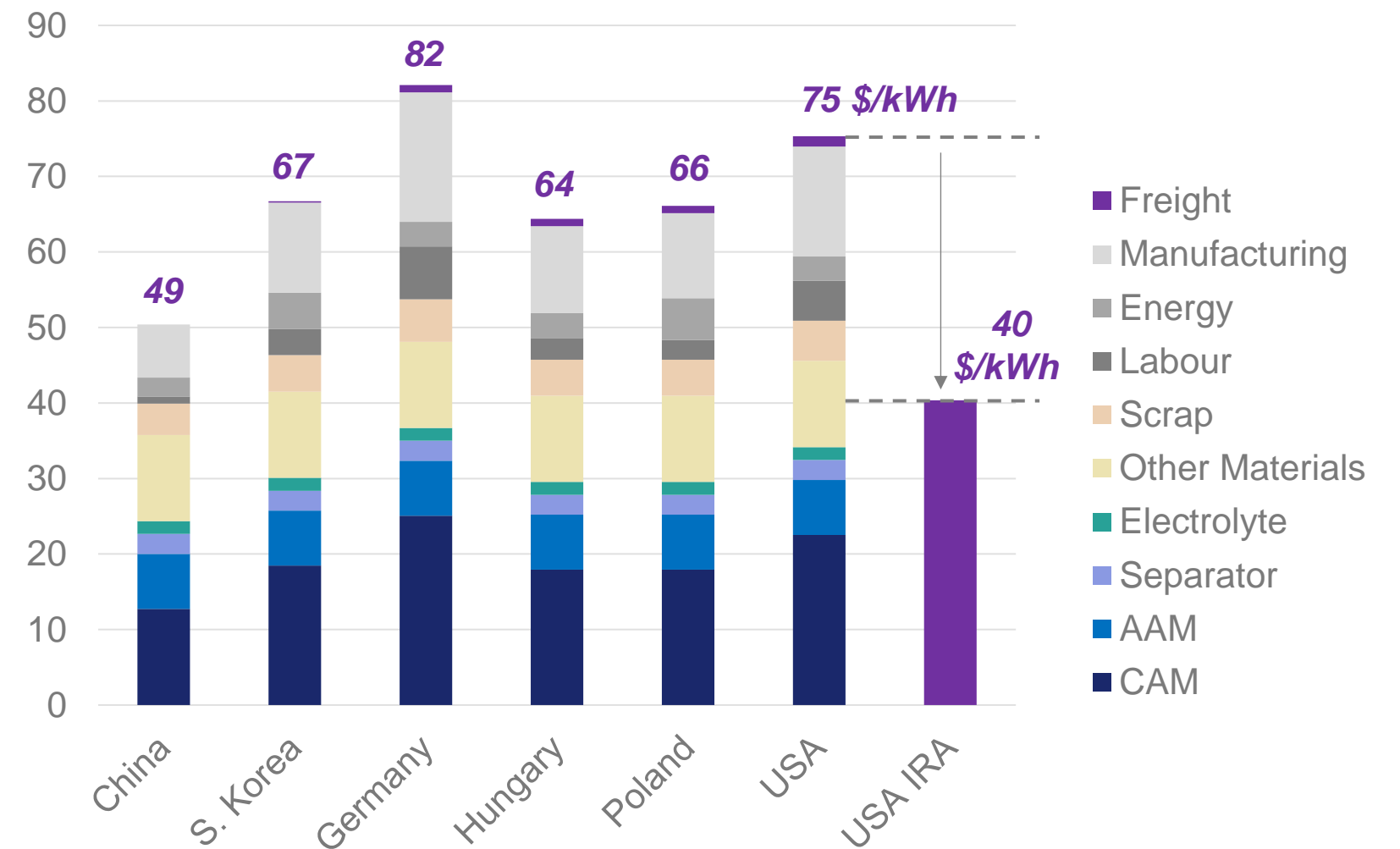
Source: Fastmarkets Battery Cost Index, October 2024



Variation in labour cost drives differences in cell cost

- Overall cell cost is **50%** greater in the US and **63%** greater in Germany
- Hungary, Poland have comparable cell costs to S. Korea
- IRA 45X tax credit would reduce US cell cost to **20%** lower than China

BYD Blade (LFP) 138 Ah Prismatic Cell 'Should-Cost', October 2024
Cell cost \$/kWh



CAM and cell produced locally. All raw materials shipped from China.

Source: Fastmarkets Battery Cost Index, October 2024

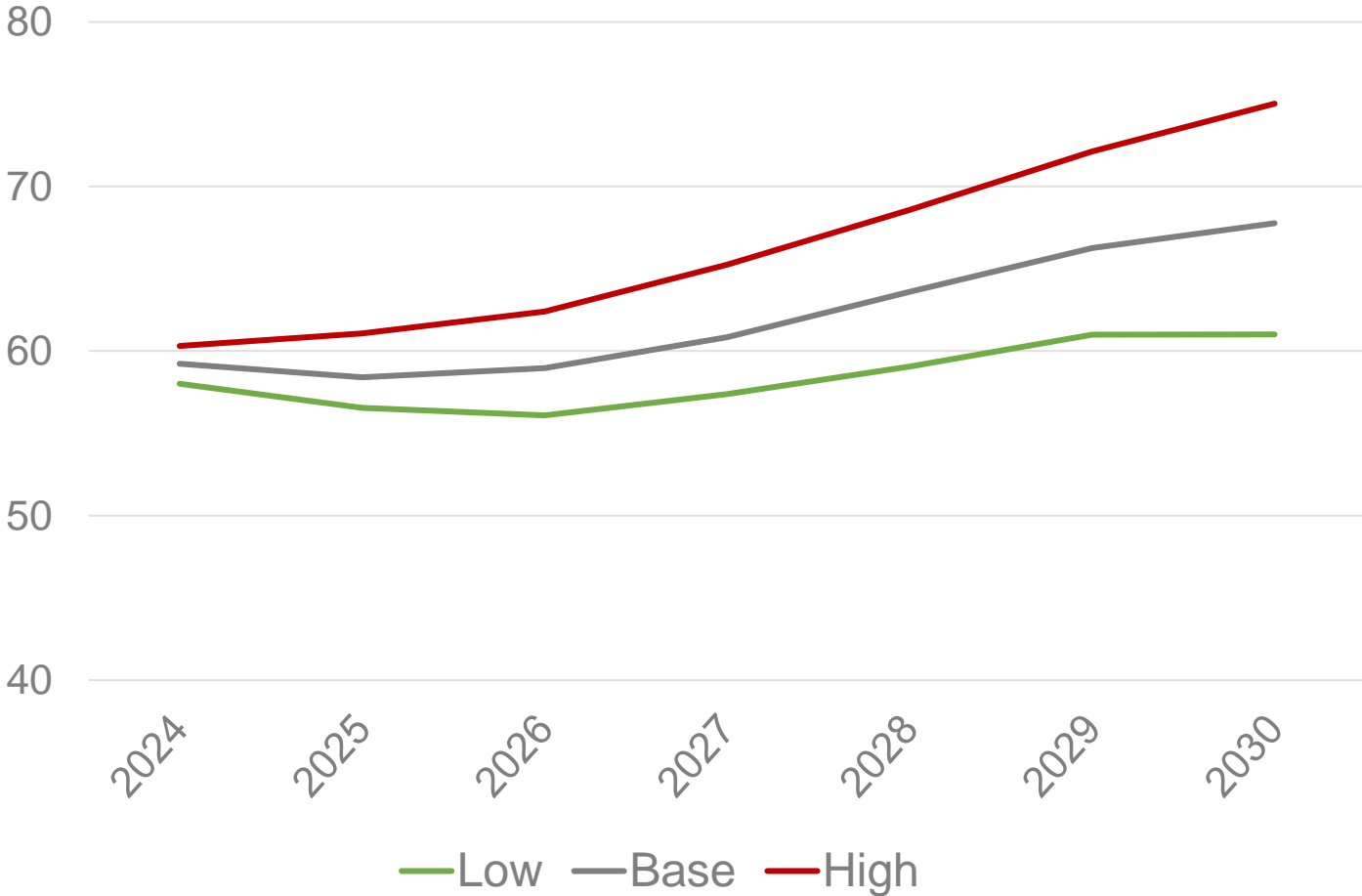


China: NCM-811 cell cost likely to rise towards 2030 due to BRM supply constraints

In the Base case between 2024-2030:

- Cell manufacturing cost to fall **~40%**
- CAM cost to rise **~59%**
- AAM cost to rise **~35%**
- Despite fall in production costs, rise in lithium, nickel, cobalt prices will place considerable strain on NCM cell costs, with 811 cost rising to **68 \$/kWh**

NCM-811 CATL 180 Ah Prismatic, China
Cell cost \$/kWh



Source: Fastmarkets Battery Cost Index, October 2024

Source: Fastmarkets Battery Cost Index, April 2024

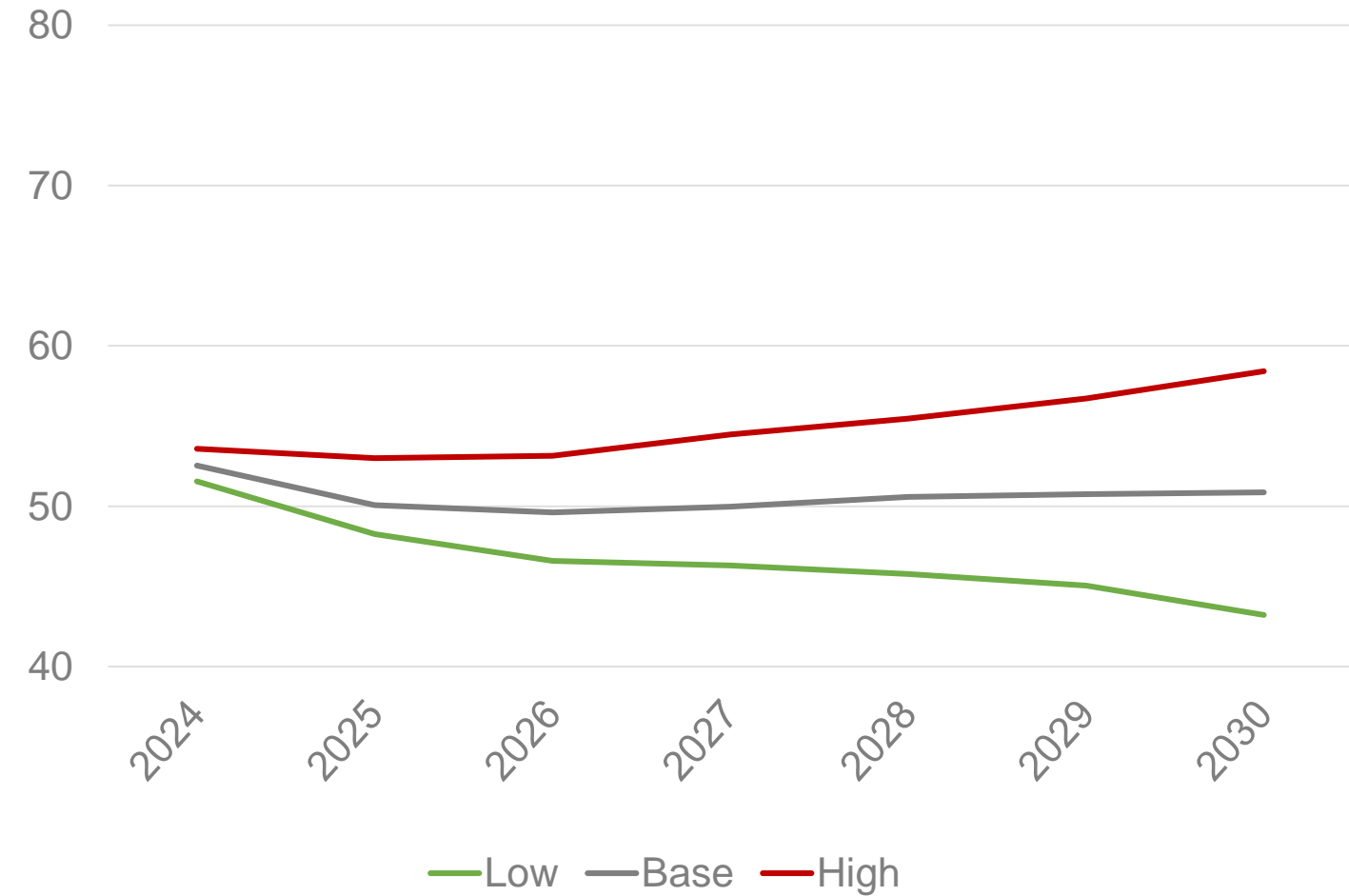


China: LFP cell cost likely to remain flat towards 2030

In the Base case between 2024-2030:

- Cell manufacturing cost to fall **~40%**
- CAM cost to rise **~48%**
- AAM cost to rise **~35%**
- Fall in manufacturing cost offsets material price rises, keeping LFP cell cost flat, close to **~50 \$/kWh**

LFP BYD 138 Ah Prismatic, China
Cell cost \$/kWh



Source: Fastmarkets Battery Cost Index, October 2024



Recycling & black mass

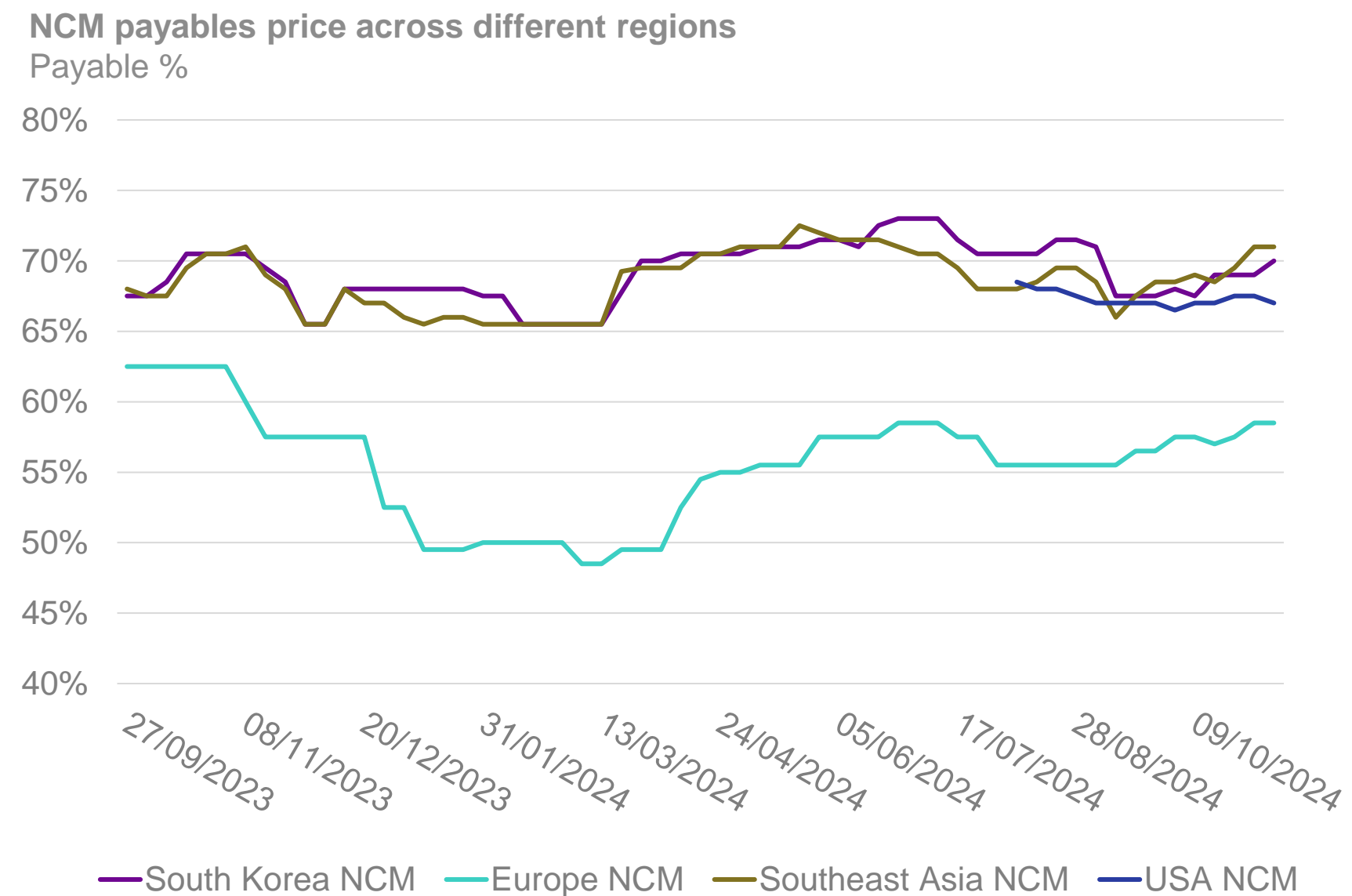


Luke Sweeney

Senior Analyst, Battery Recycling & Black mass
Fastmarkets



Two global markets for black mass exist: Europe and everyone else

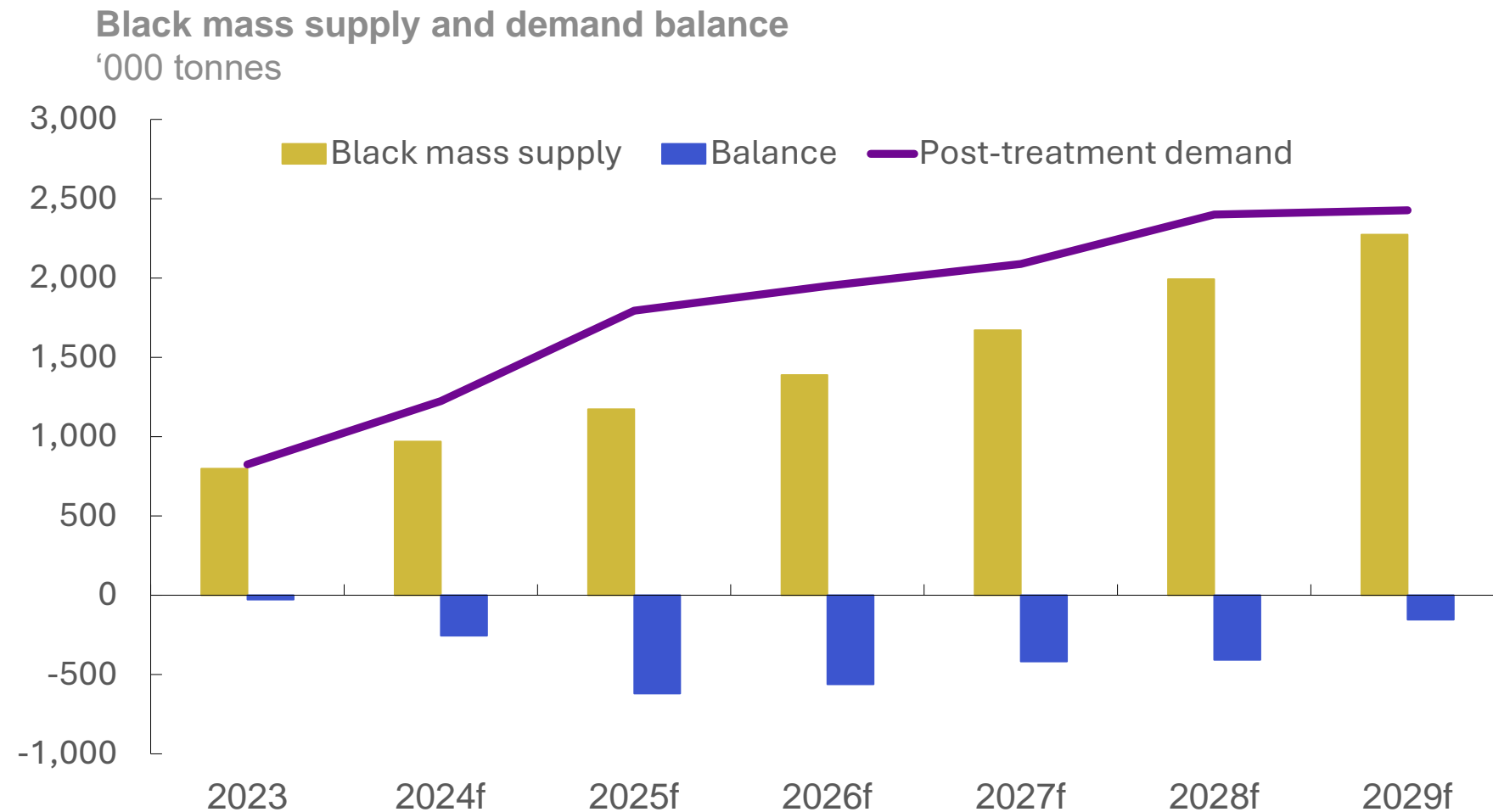


- **Large discounts in the European** market whilst Southeast Asia and South Korea offer best payables
- Lack of refining, strict export restrictions and large volumes of e-waste all contribute to an **oversupply of black mass in Europe**
- Despite historically paying the highest for black mass **South Korea** is struggling to maintain **high payables** amid weak metal prices

Source: Fastmarkets Long Term Forecasts



Supply and demand dynamics for black mass is set to change after 5 years

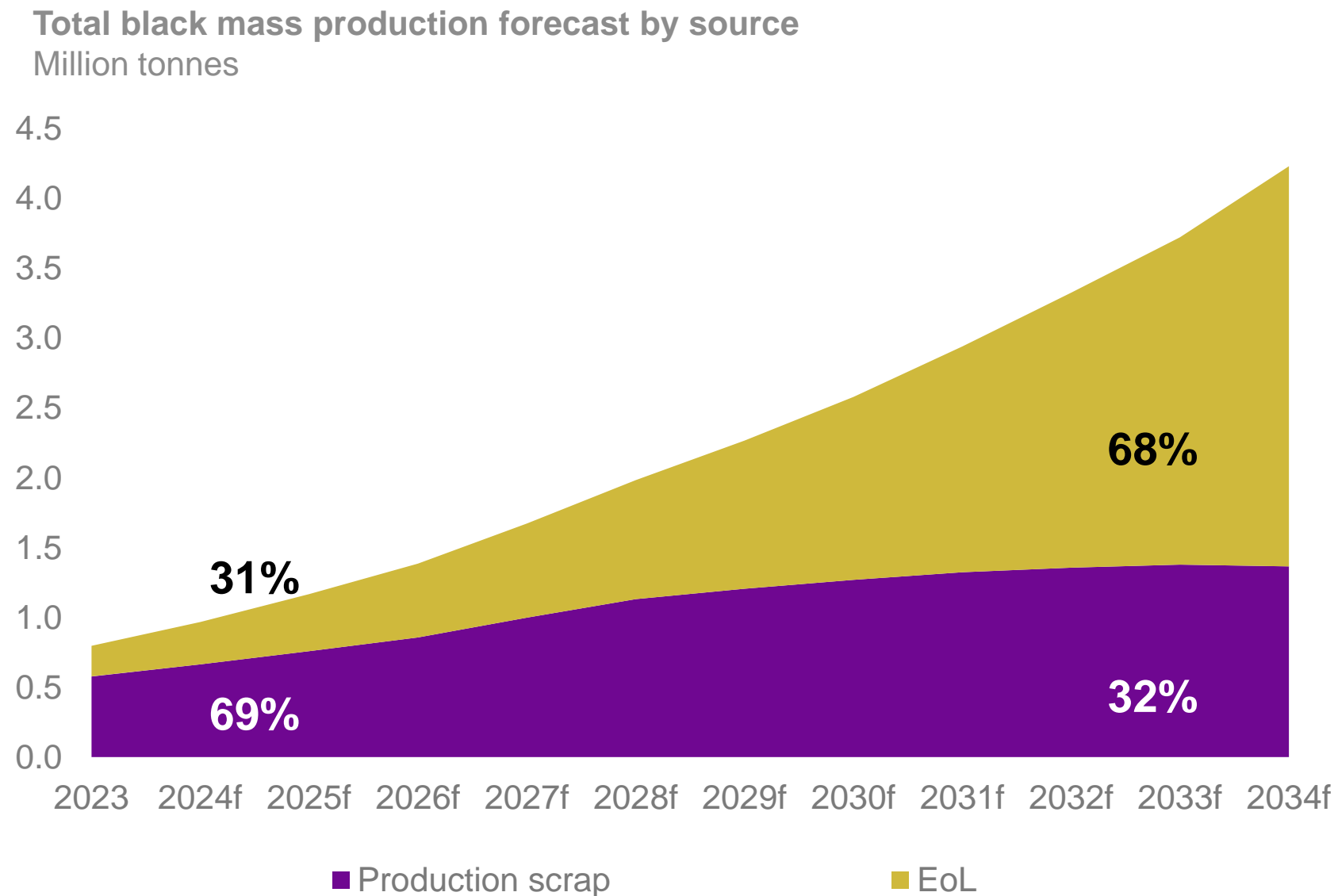


- There is a **deficit in black mass** supply and this will continue until **2030**
- The deficit in black mass supply has shifted payables in the favour of **black mass producers** as refiners need to maintain **minimum utilisation rates**
- As refining demand becomes met in 2030, we expect payables to be **pushed down by refiners** as black mass producers become increasingly competitive

Source: Fastmarkets Battery Cost Index, October 2024



Black mass feedstock is set to significantly change – from gigafactories to end-of-life batteries



- Until 2029 **production scrap** will be the primary source of feedstock
- Current **recycling business models** will need to **adapt** to accommodate changing supply
- We predict **14%** of metal supply in **2034** will be from **secondary sources**. This means there will still be a **significant demand** for **primary material** in the next 20 years

Source: Fastmarkets Battery Cost Index, October 2024

Conclusion

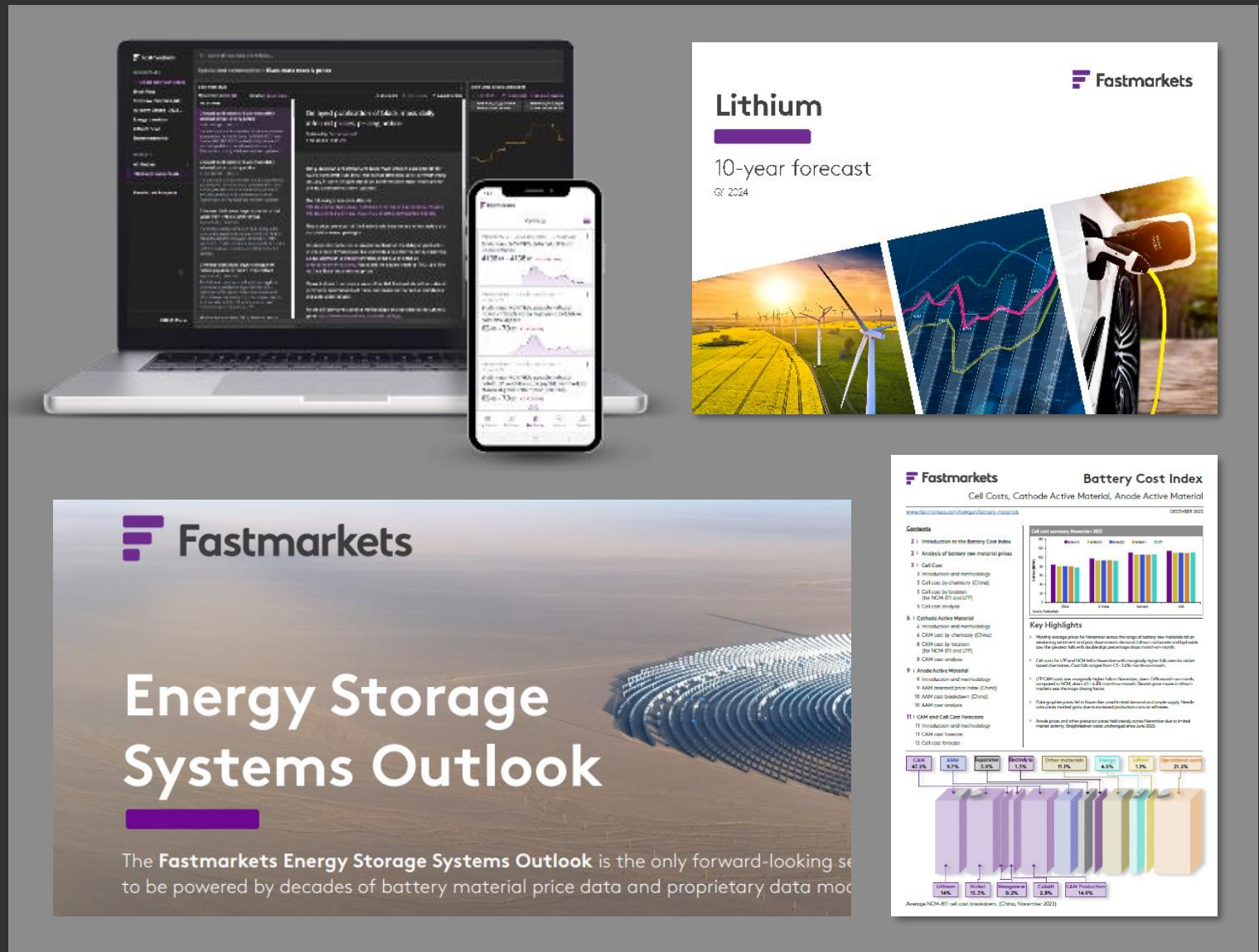


- **Demand** – remains robust and will continue to be driven by strong growth in PHEVs and ESS.
- **Lithium** – market is attempting to rebalance with the potential for a deficit earlier than previously forecast.
- **Nickel** – market is gradually rebalancing with a small surplus in 2025, followed by minor deficit in 2026.
- **Cobalt** – significant surpluses will persist in 2025 with bearish prices to continue.
- **Graphite** – market will struggle with surplus supply in 2025 but will become more balanced from 2026.
- **Manganese** – a balanced to well supplied market out to 2028 owing to excess capacity in China.
- **Cell costs** – historic lows in China, with LFP 16% cheaper than NCM, labour is the main regional cost driver.
- **Recycling** – market is divided, current undersupply of black mass means suppliers have a strong position, but this will switch in favour of refiners in the future.

Fastmarkets products



- Dashboard of prices, news & short-term forecasts**
 Battery raw materials prices, including the benchmark lithium and cobalt price & 13 black mass prices, plus our 2-year price forecasts for Li, Co, Ni, Mn, graphite & black mass with independent analysis
- Long-term forecasts & Battery Cost Index**
 Quarterly 10-year forecasts for Li, Co, Ni, Mn, Cu, graphite, recycling/black mass and ESS & monthly battery costs
- Consultancy**
 Bespoke consultancy projects



 Fastmarkets

Battery Raw Materials Shanghai

 February 25-26, 2025  Shanghai, China



SCAN ME

Use **BRMGO20** discount code
for **20%** off the ticket rate*

* Discount is only applicable
by January 31, 2025

 Fastmarkets

Asian Battery Raw Materials & Recycling Conference

 April 07-09, 2025  Seoul, South Korea



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* Discount is only applicable
by January 31, 2025

Q&A



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– battery raw materials

– battery & raw material demand

– lithium market

– nickel market

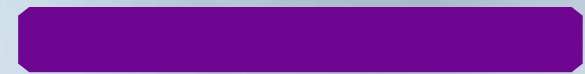
– cobalt & manganese market

– graphite & anode market

– cell costs & manufacturing

– battery recycling & black mass

Thank you



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