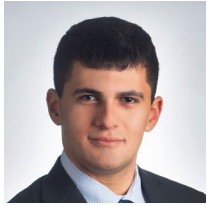




Copper Market Outlook

American Copper Council
Spring 2024 Meeting - Scottsdale

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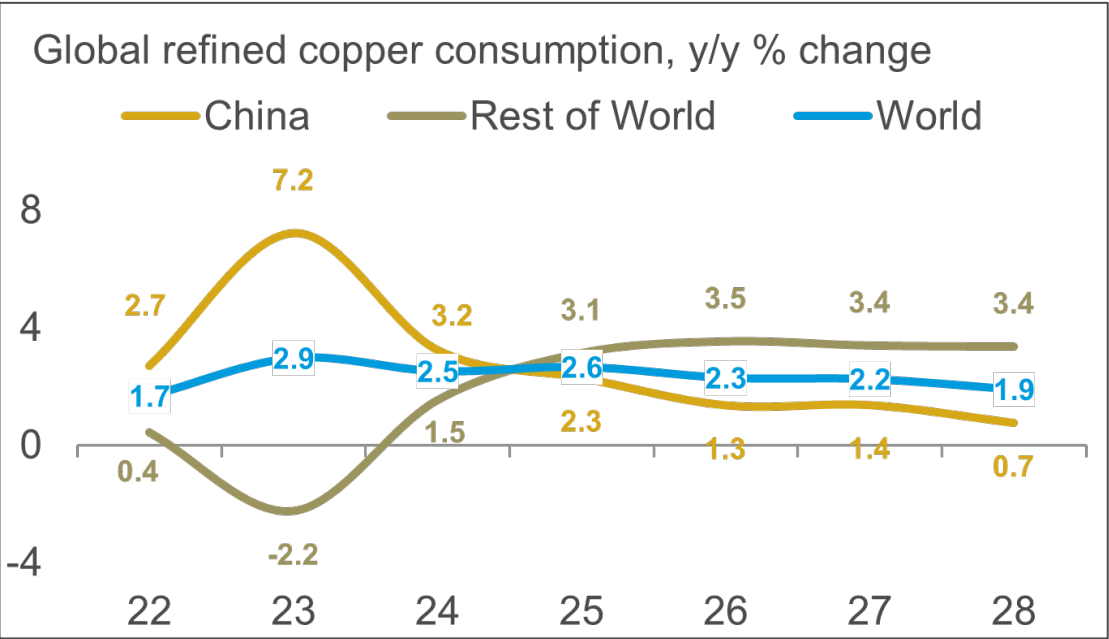
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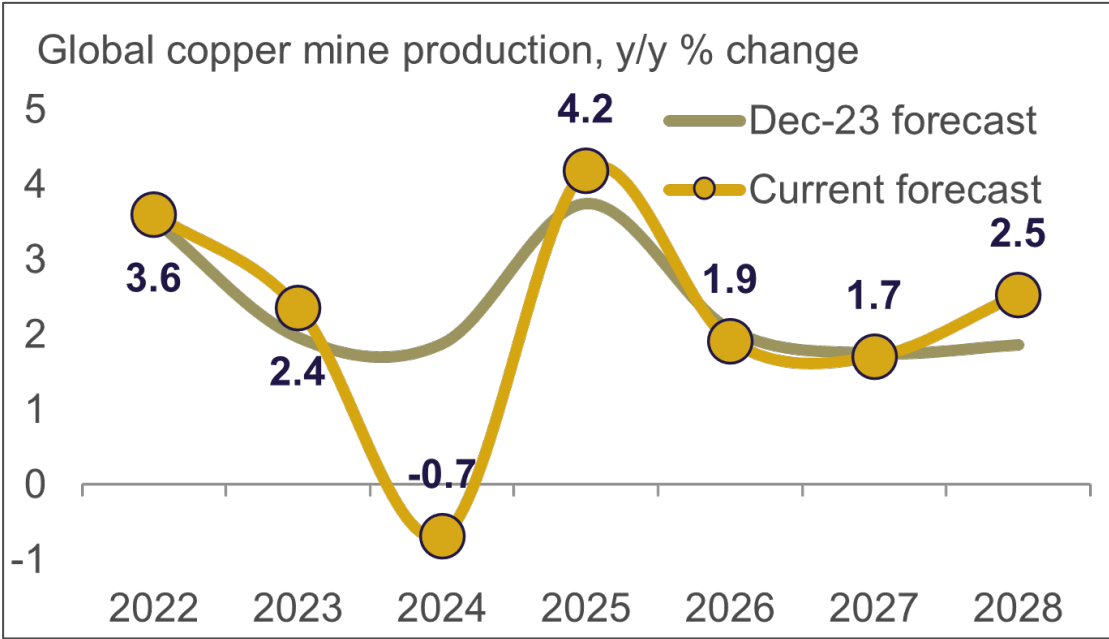


Looking beyond short-term demand challenges and low(er) mine supply growth

Small consumption gains in 2023

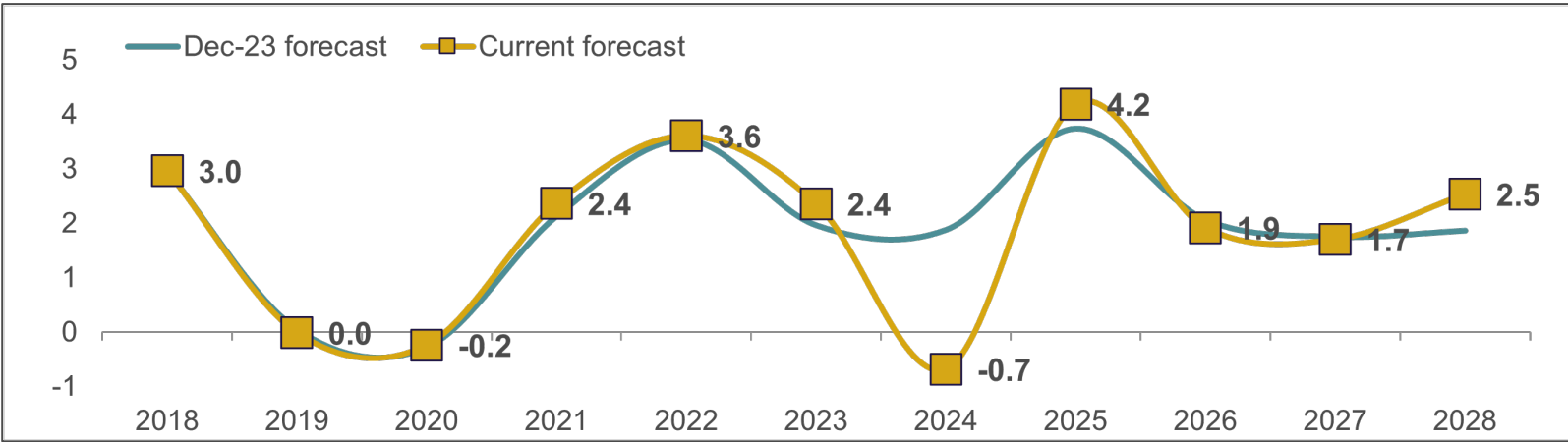


Cobre Panama slices 2024 supply

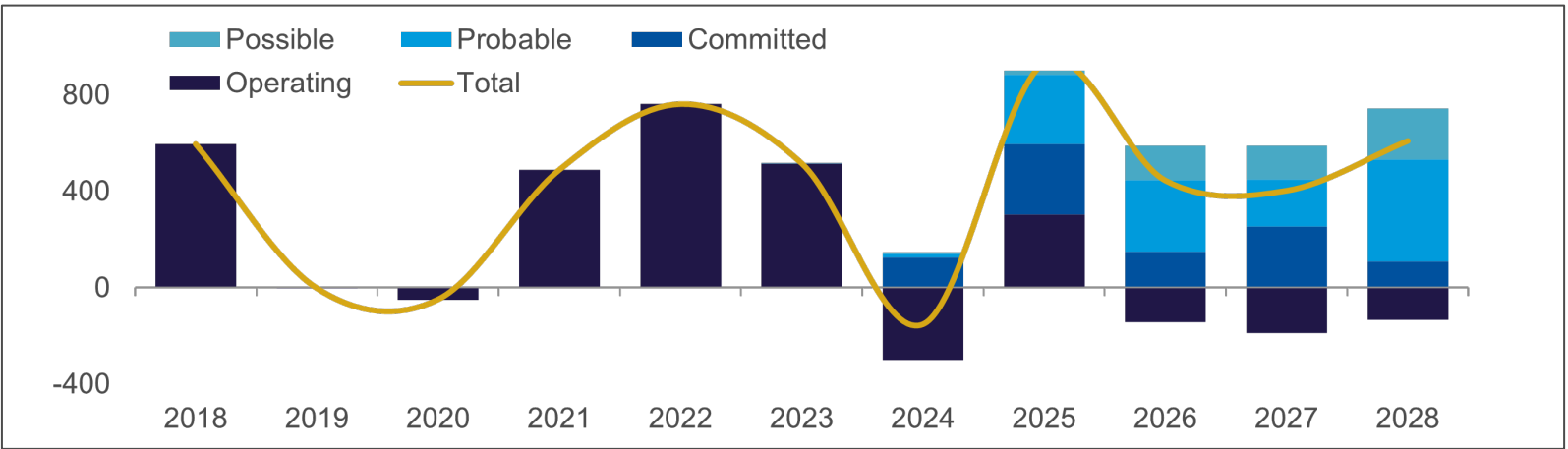


2024 mine supply growth now shaping as the lowest in four years

Copper mine production growth y/y, %

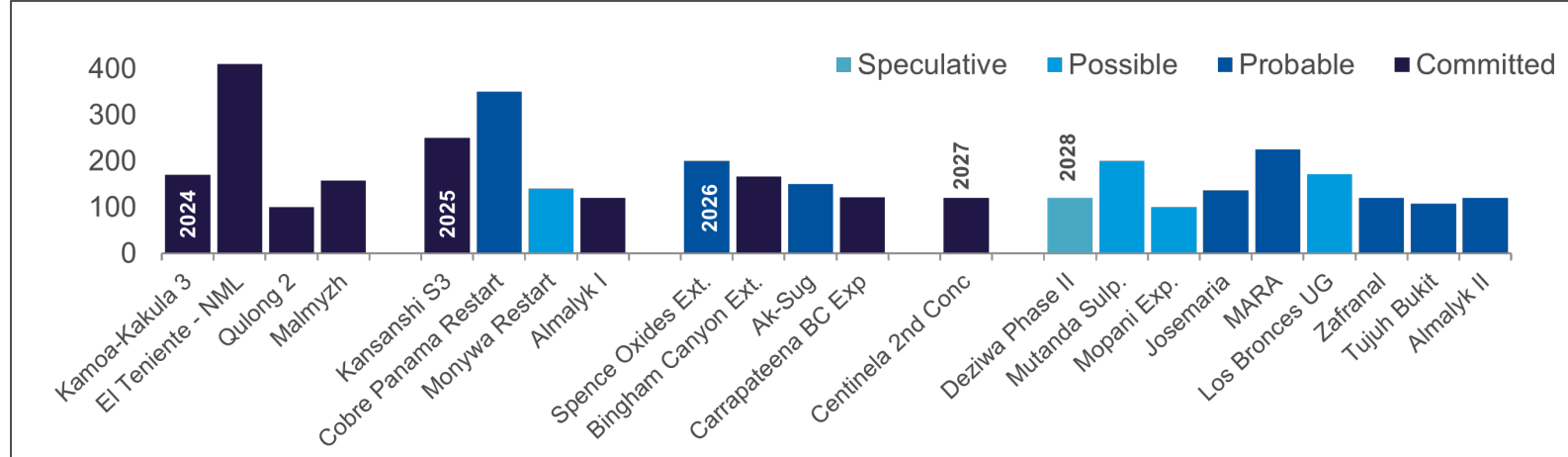


Mine production growth, '000 t

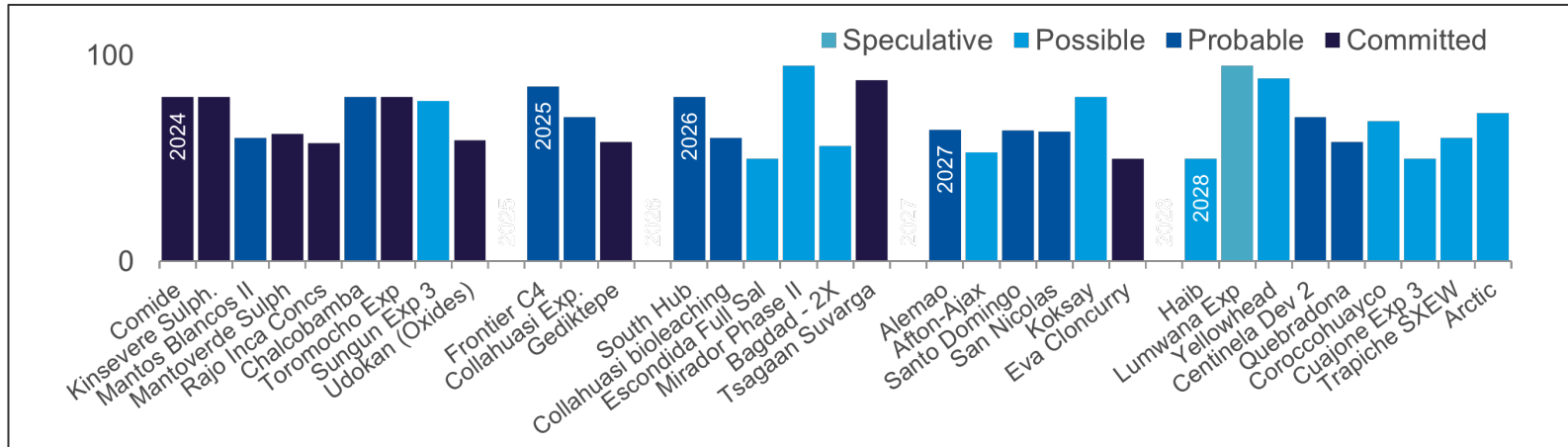


Pipeline progress offers hope for the medium term

Tier 1 copper mine projects (>=100,000 t/y); '000 t/y

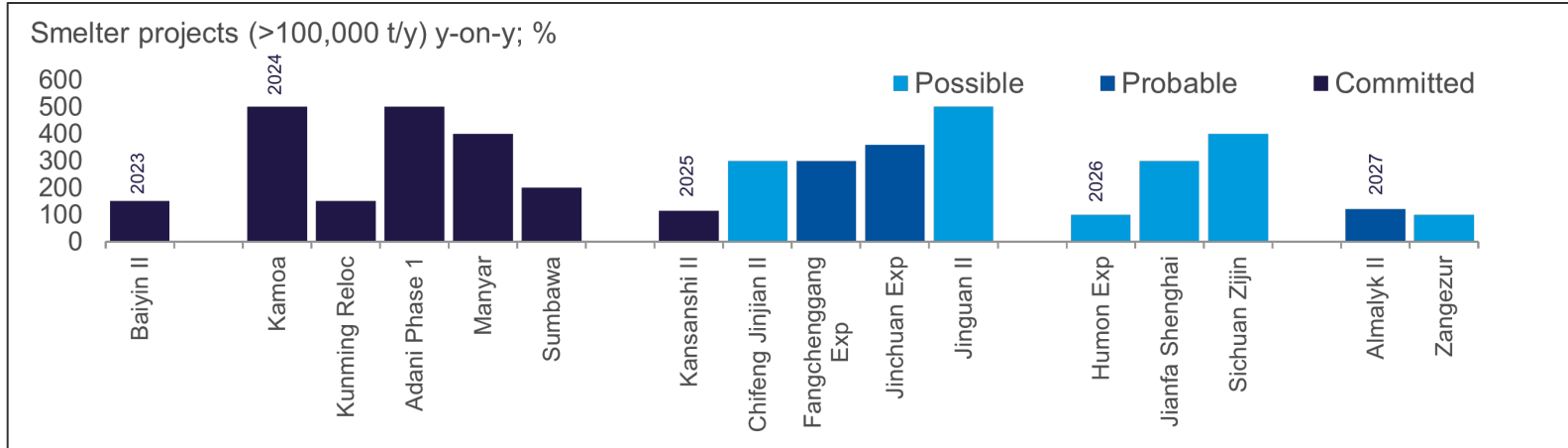


Tier 2 copper mine projects (>=50,000 t/y); '000 t/y

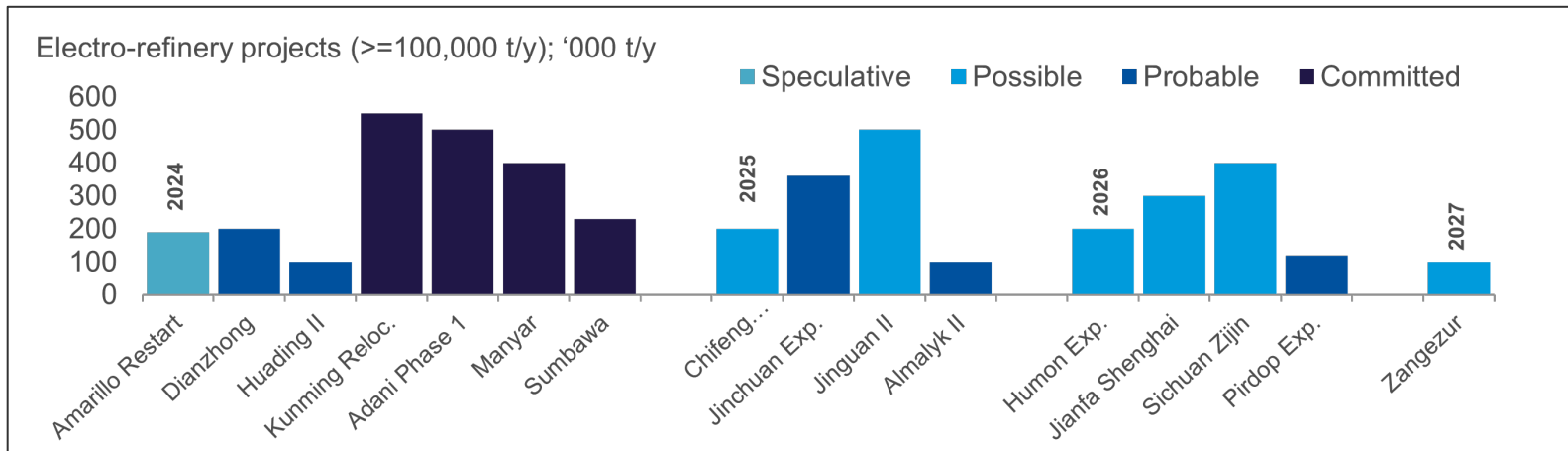


Strong pipeline of committed smelter and refinery projects in 2024

Four ex-China committed smelter projects will start up from Q3 2024

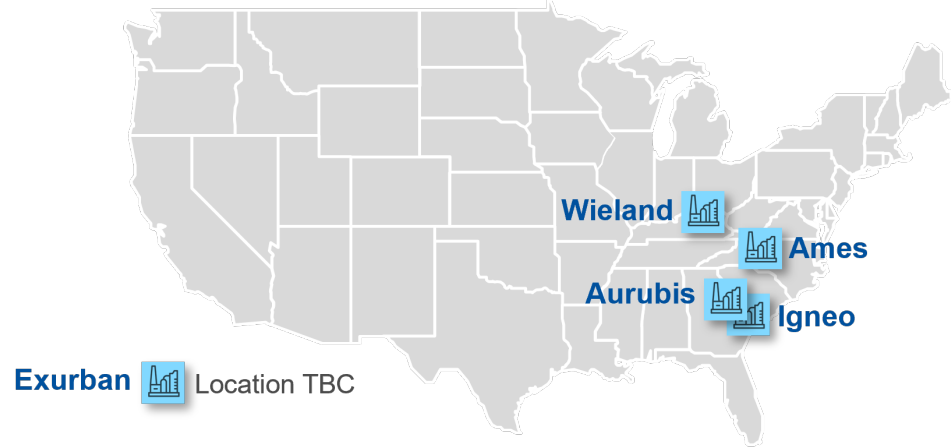


Refinery project pipeline is packed in 2024



Secondary smelting capacity has returned to the US and will continue to grow

Latest scrap expansions in the US



Like similar investments in other domestic metal industries, some US scrap investments have been delayed

In the last couple of years, secondary smelting capacity returned to US soil following a two-decade hiatus. However, the pipeline of projects is drying up, while some are stalling. Regardless, confirmed near-term capacity additions will limit the export of scrap, which soared in the absence of domestic smelting capacity.

Ames (Shelby, NC), operating - 50,000 t/y output capacity of anode with feedstock of an equal amount of birch cliff (#2).

Wieland (Shelbyville, KY) H1 2024 (delayed) - The facility will have scrap treatment capacity of 100,000 t/y of higher-grade scrap, producing feedstock for Wieland’s mills.

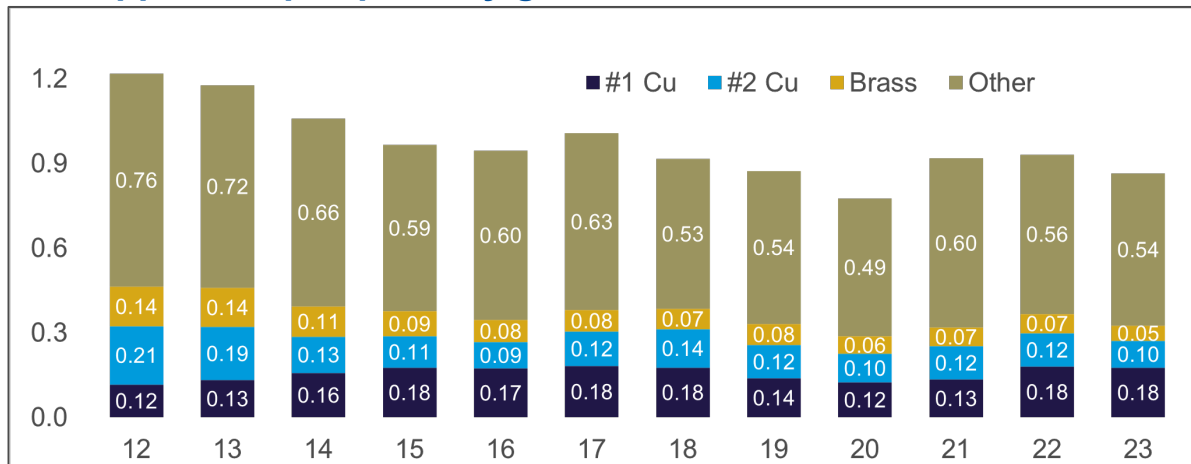
Aurubis (Richmond, GA) Phase 1, H1 2024 - It will initially process 90,000 t/y of complex scrap materials including printed circuit boards, producing 35,000 t/y of blister. There are plans to double capacity by 2026.

Igneo (Savannah, GA) H1 2025 (delayed) - facility will process 80,000 t/y of e-scrap, adding to the company’s existing 30,000 t/y capacity in France.

Reco project – The Cohen-sponsored recycling facility was slated to begin producing 80,000 t of cathode in 2024, but there has been no reported progress.

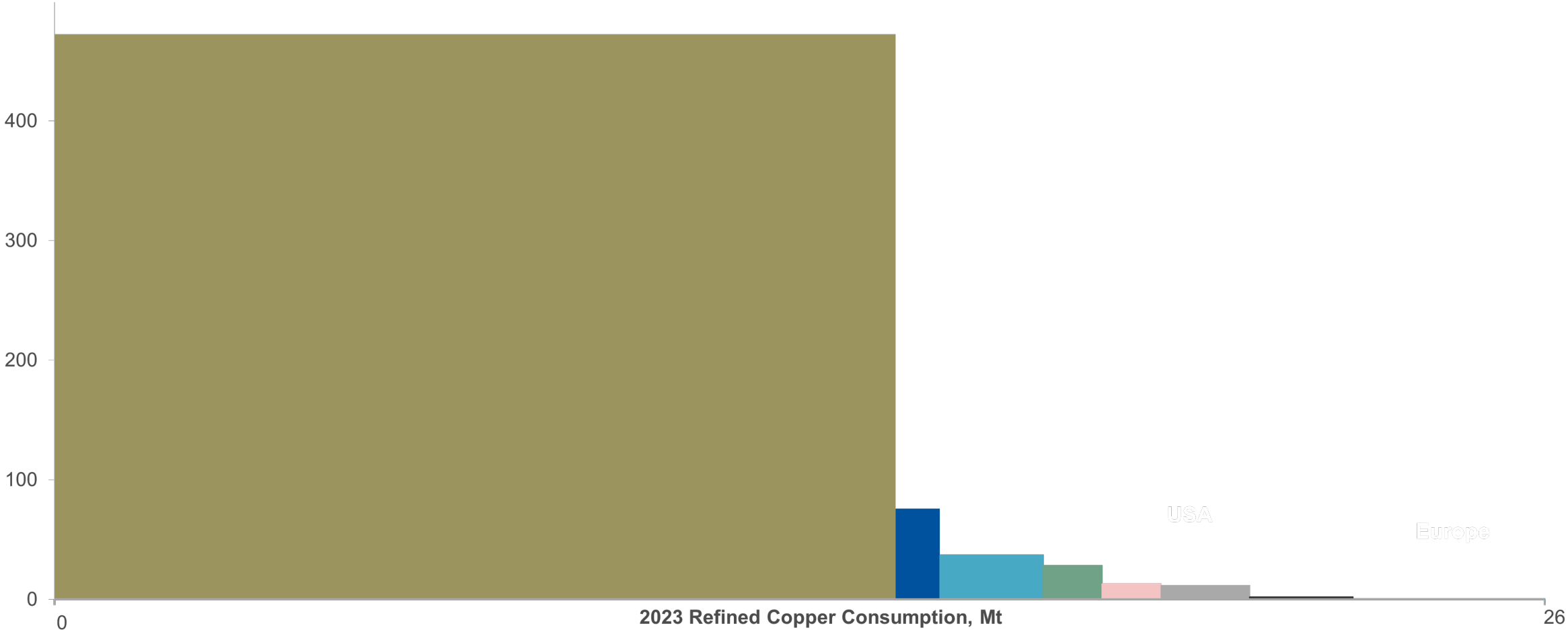
Exurban - Rejected from building e-scrap smelter in Fort Wayne which was set to commence in Q1 2025. Looking for a new location.

US copper scrap exports by grade, Mt



China and India accounted for >100% of the growth in 2023 metal demand, and China will still account for around two-thirds of global demand growth in 2024

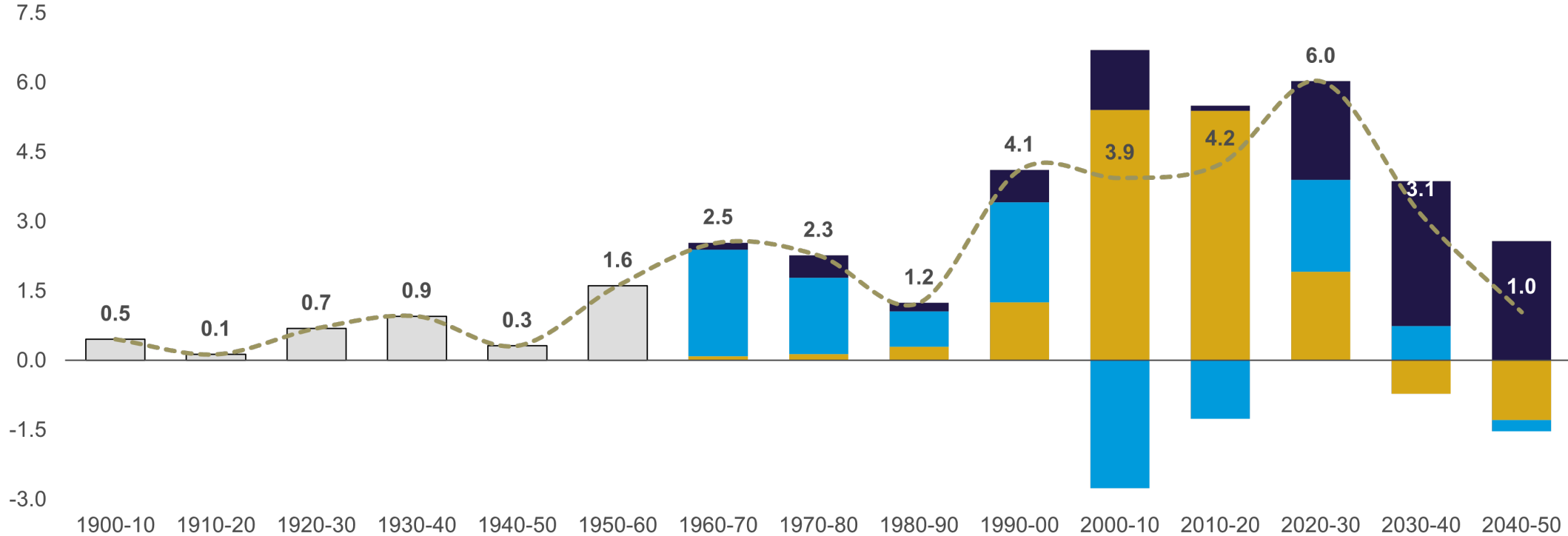
2024 Refined Copper Consumption Growth, '000 t



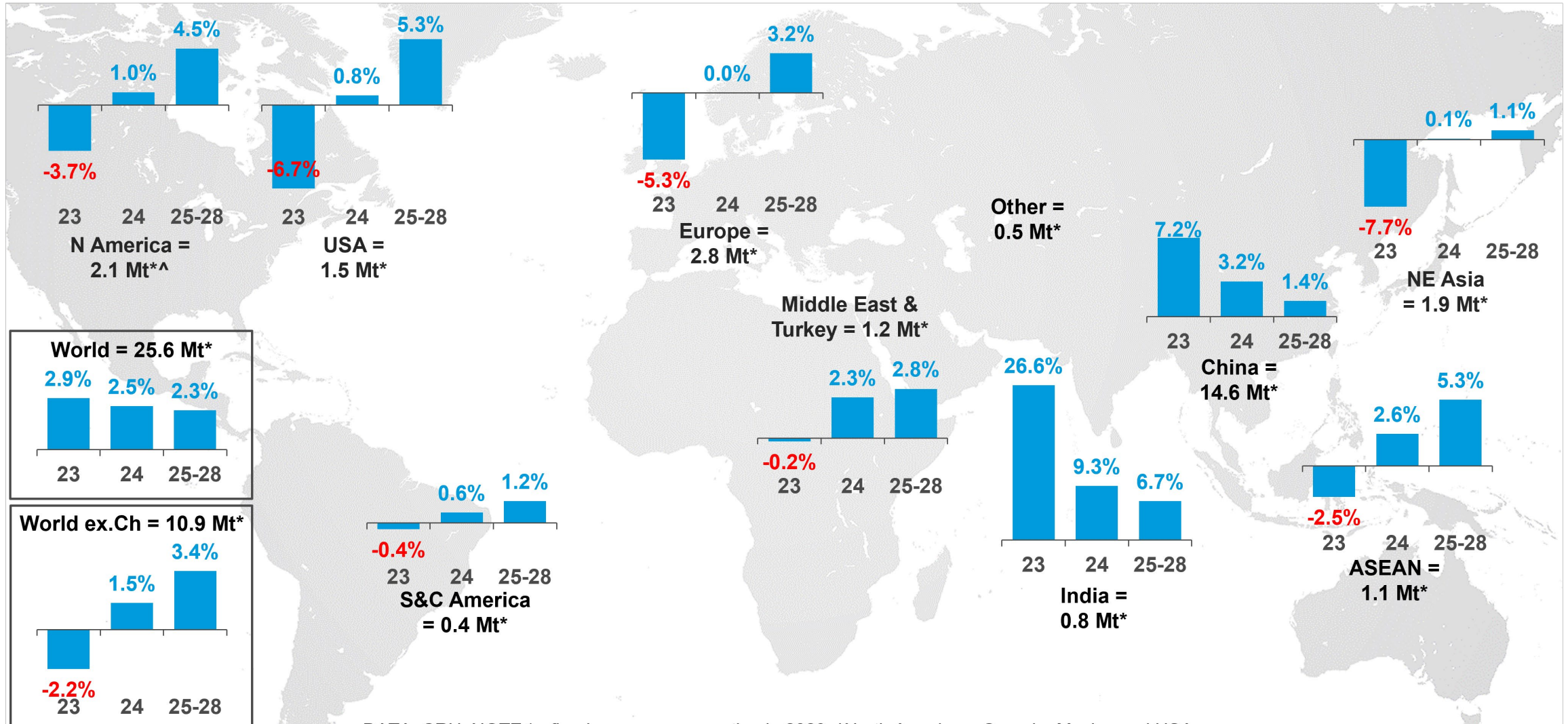
But moving forward, two decades of purely China-driven growth in copper demand will end

World growth in refined copper consumption by decade, Mt

China (Yellow) Developed World (Blue) Developing World (Dark Blue) World (Dashed Green)



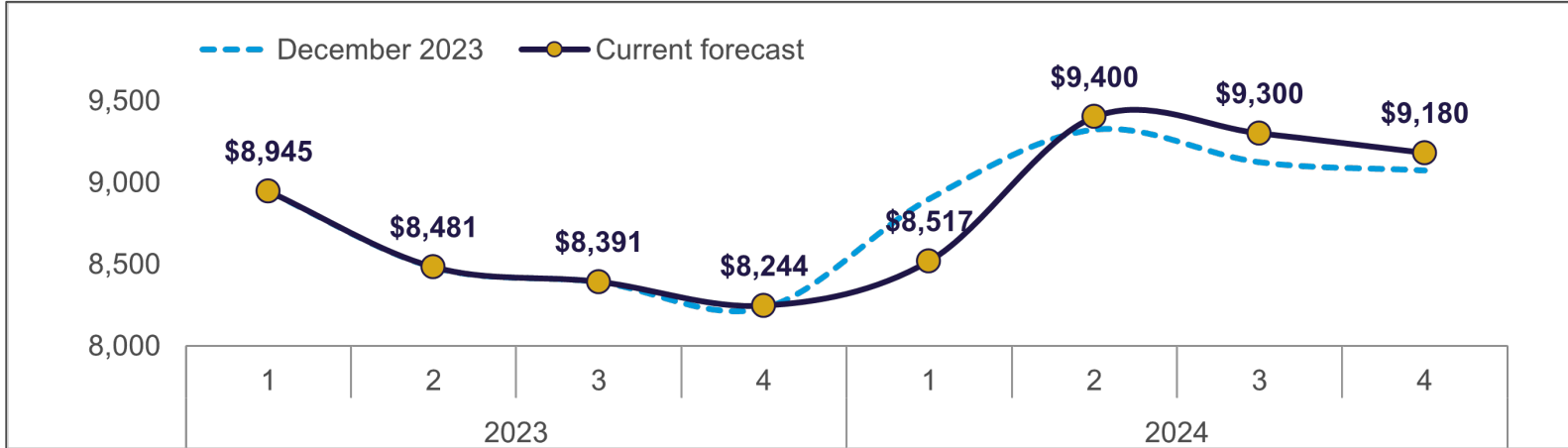
2024: Limited recovery in developed world; emerging Asia to drive growth



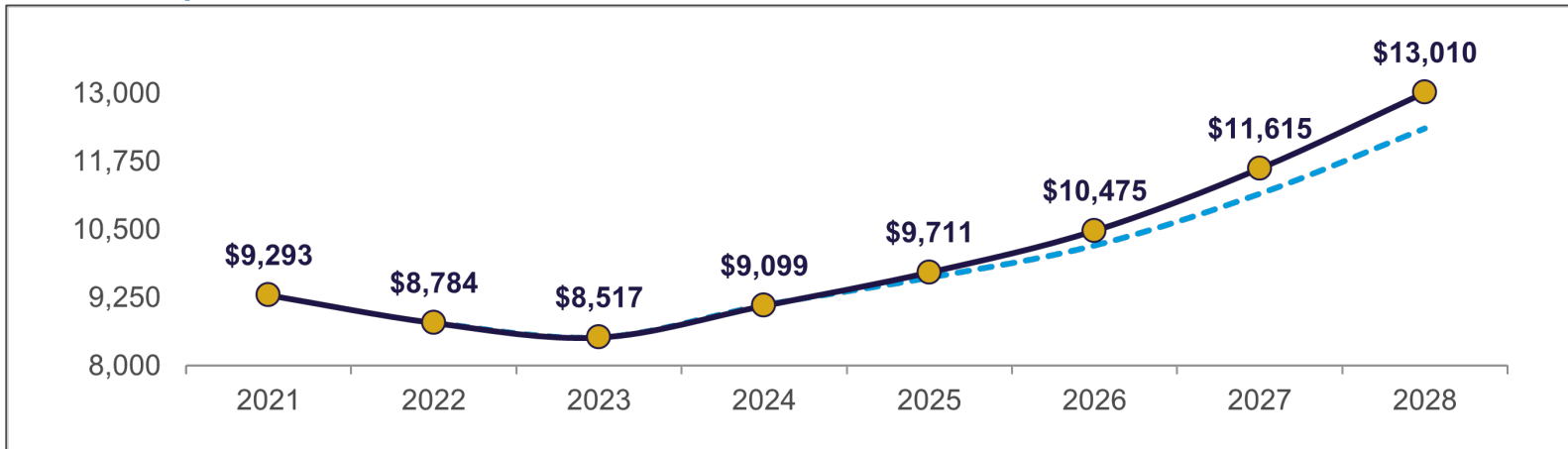
DATA: CRU. NOTE:*refined copper consumption in 2023; ^North America = Canada, Mexico and USA

Copper prices to advance over 2024

LME 3M price, \$/t



LME 3M price, \$/t



DATA: LME, CRU

Waiting for the real push higher

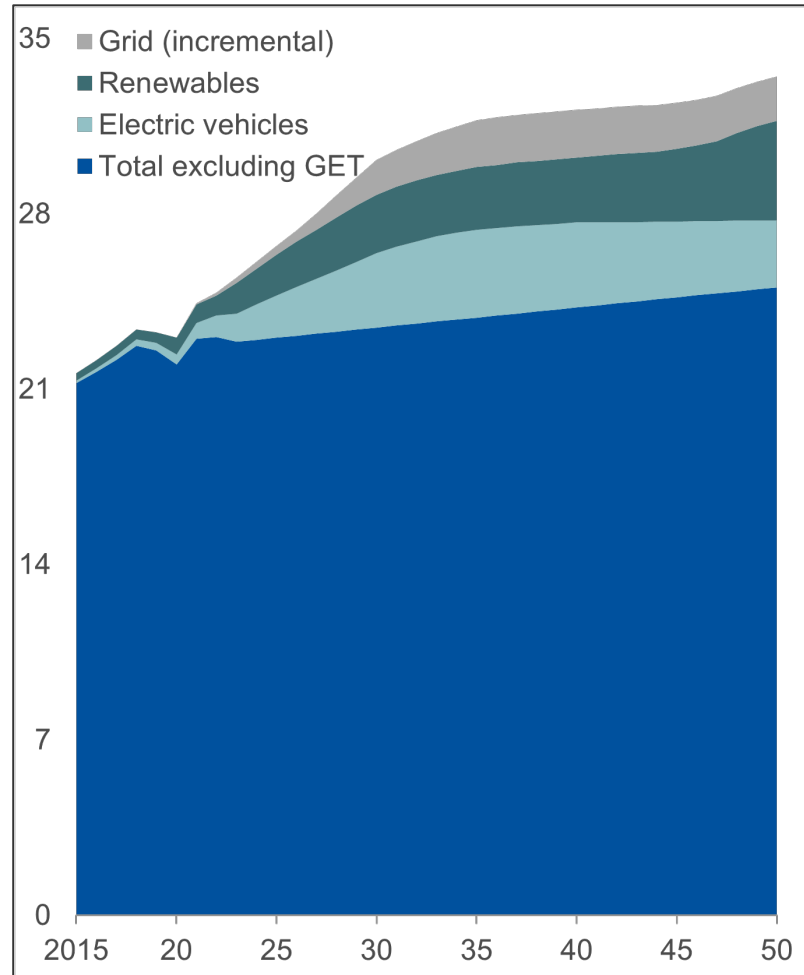
If the macroeconomic narrative (cyclical recovery and interest rates) is sufficiently constructive, we expect the copper price to rally in the coming months, as the market wakes up to the realities of the S/D balance through the seasonally strongest demand quarter of the year (Q2). LME 3M should consolidate above \$9,000 /t during the balance of 2024.

The specific factors (+ positive for price, - negative for price) driving our copper price forecast in the balance of 2024 are:

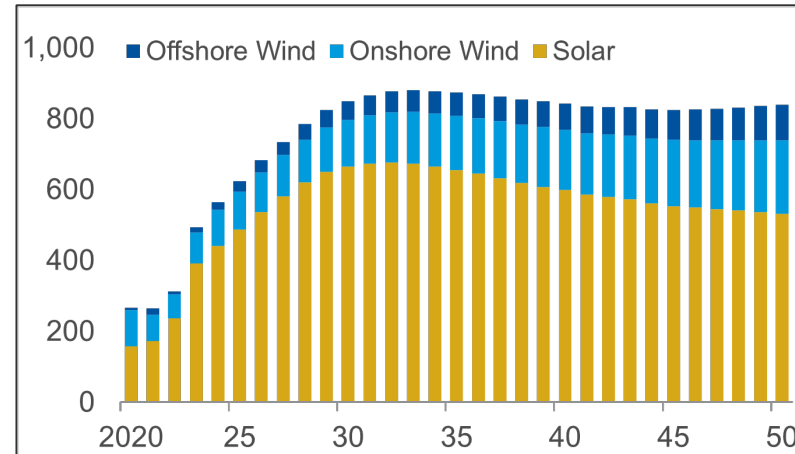
- Macro and micro:
 - A near-record cash-3M contango suggests there is no shortage of physical metal. However, while exchange stocks are building for seasonal reasons, they remain low in absolute terms. The cushion previously provided by Chinese bonded inventories has almost disappeared. +
 - Manufacturing PMIs and anecdotal evidence from copper semi-fabricators and end users is not totally convincing but on balance moving in the right direction. The logistics challenges in the Panama Canal and the Red Sea/Suez are negatives for copper demand, but for now are affecting supply more. +

“Green Energy transition” related applications accounted for over 10% of copper use in 2023

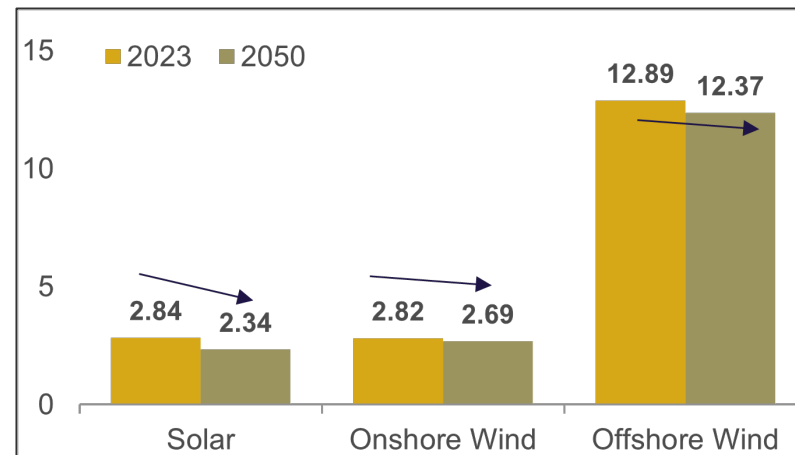
Global refined copper consumption, Mt



Annual capacity installations, GW



Copper intensity, '000 t/GW



Solar leading the way

We have made some upward adjustments to solar generating capacity installation forecasts, to reflect the stronger near-term outlook in China.

China accounted for half of renewables generating capacity installations globally in 2023, with Europe leading the world e-China contribution.

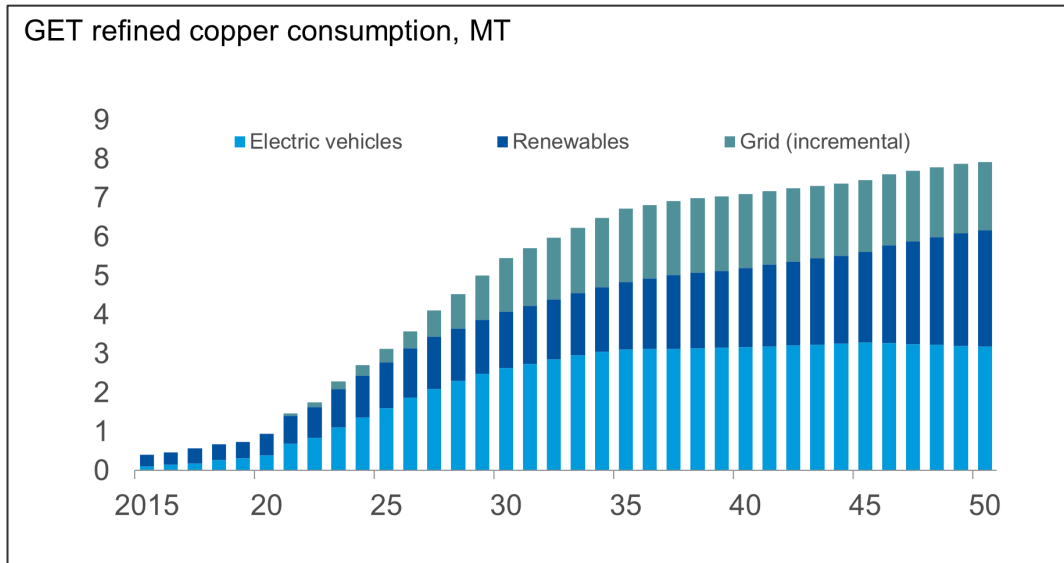
Annual renewables capacity installations have increased by 85% since 2020, reaching almost 500 GW in 2023. Despite some recent negative new sflow in Europe and US, the renewables sector is on an upward trajectory with annual installations expected to reach 850 GW by 2030.

Renewables-related copper use is forecast to increase from 1.5 Mt this year to 2.9 Mt/y by the end of the decade. That assumes substitution to aluminum and thrifiting does not accelerate beyond the base case.

Green energy transition (GET) copper use is expected to increase from 10% of refined metal demand in 2023 to 22% in 2030.

Electrification uses expected to account for around 20% of refined copper use by the 2030s

GET underpins Cu demand growth

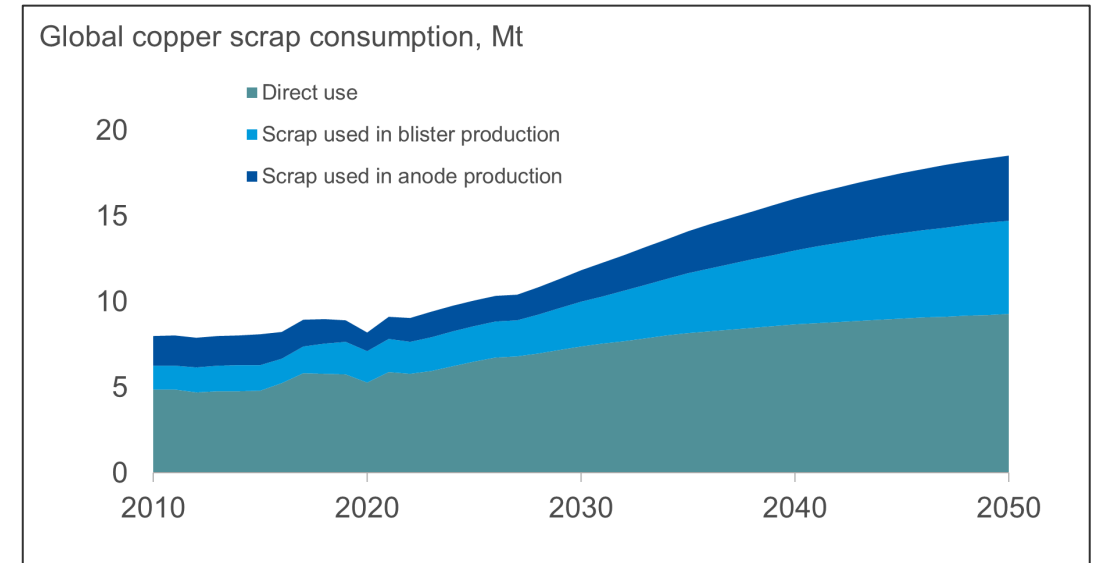


The Green Energy Transition (GET) will have a large impact on copper demand intensities. Without it, per-capita intensity would remain stagnant at ~3.0 kg until 2035, but now intensity is forecast to increase to ~3.5 kg.

Copper consumption volumes associated to the GET are significant – 6.23 Mt by 2033 in the base case, compared to a low-case of 4.11 Mt and a high-case of 10.94 Mt representing ~30% of refined copper consumption.

The high-demand scenario would lead to demand destruction, as the mining industry likely does not have the capacity to bring the additional capacity needed.

Scrap increasing its market share



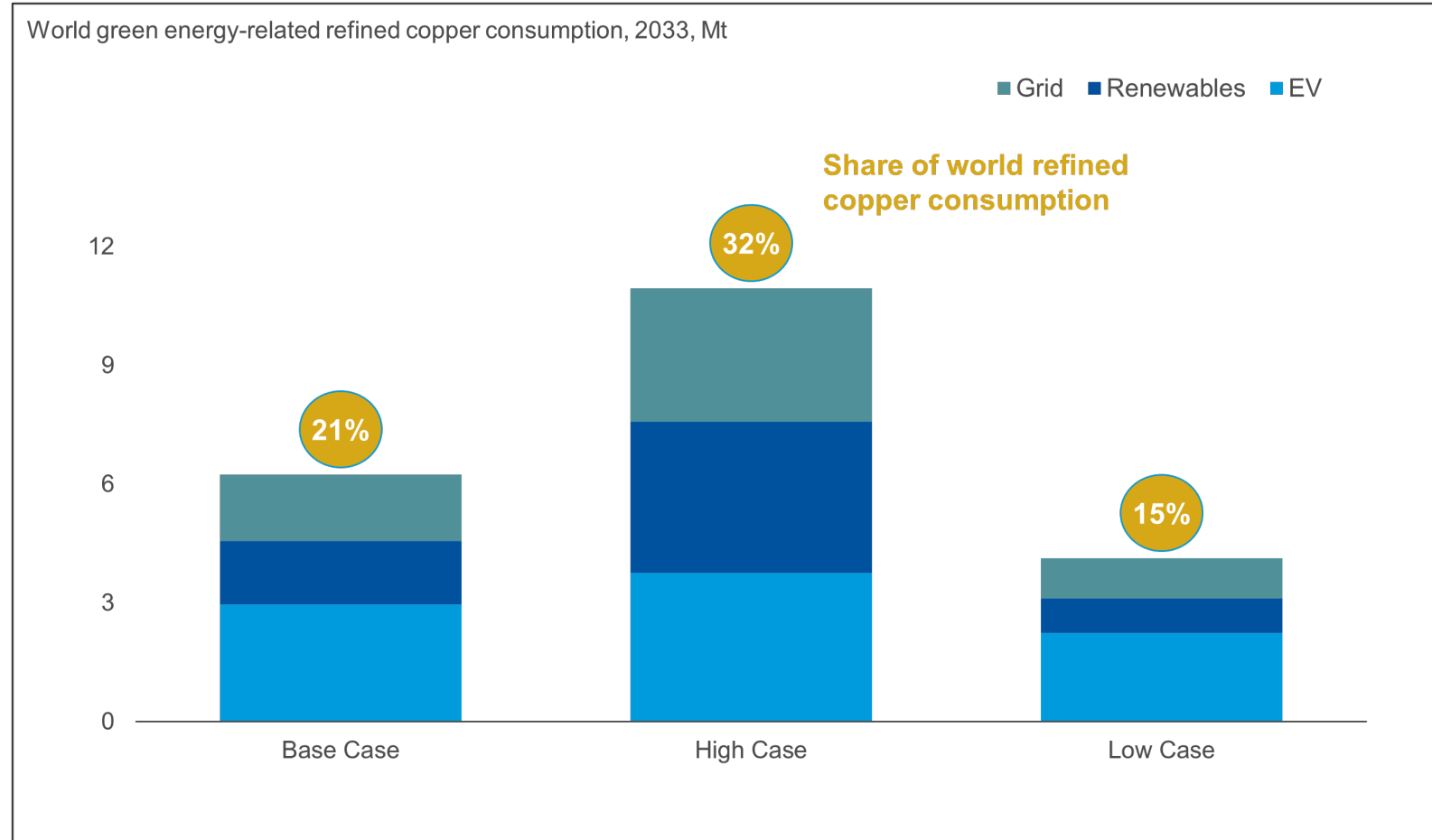
The combination of increased rates of recycling and China's exploitation of its growing scrap pool, mean that secondary units will account for a growing share.

To meet quality requirements (particularly for metal going into GET applications), secondary units, beyond those going into the brass mill sector, will generally need to be processed through the secondary smelting/refining route.

Alternatively, major investments need to be made in scrap sortation and alloy segregation by the scrap collection/processing value chain, much like we now see in aluminum, to make this EOL material amenable for direct-melt use.

Long term price forecast sensitivity centered around different global energy transition scenarios

GET could account for one-third of refined copper consumption in the high case



High Case

Renewables: higher generating capacity installations, closer to Net Zero by 2050 requirements. More limited substitution.

EVs: Zero Tailpipe Emissions production scenario; base case copper intensities.

Grid: more rapid growth in renewables and EVs spurs additional grid investment to cope with increased loading and intermittency.

Scrap: technical / environmental challenges limit growth in use in semi-fabricated products and / or smelting-refining.

Low Case

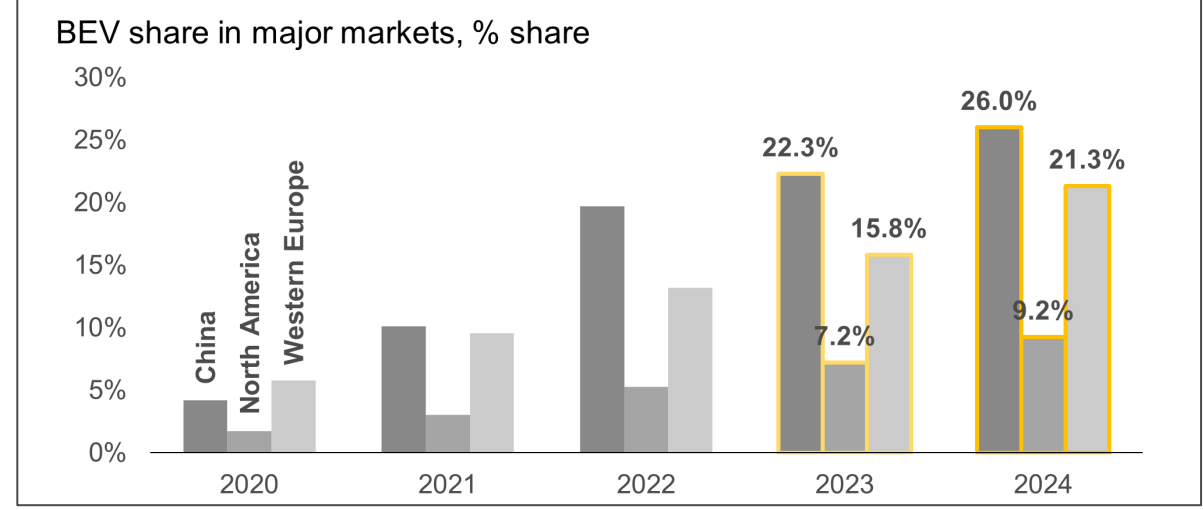
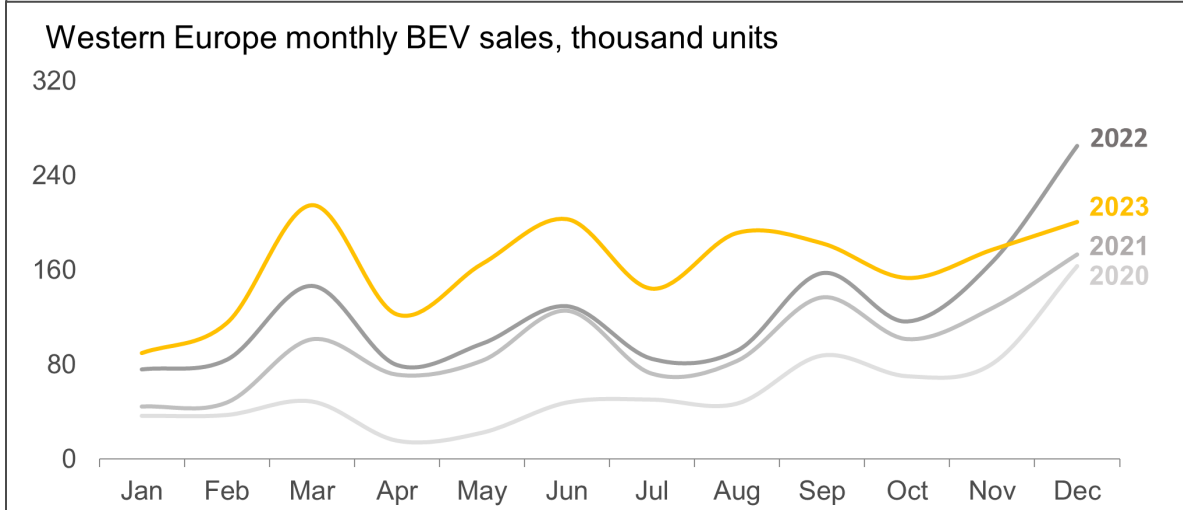
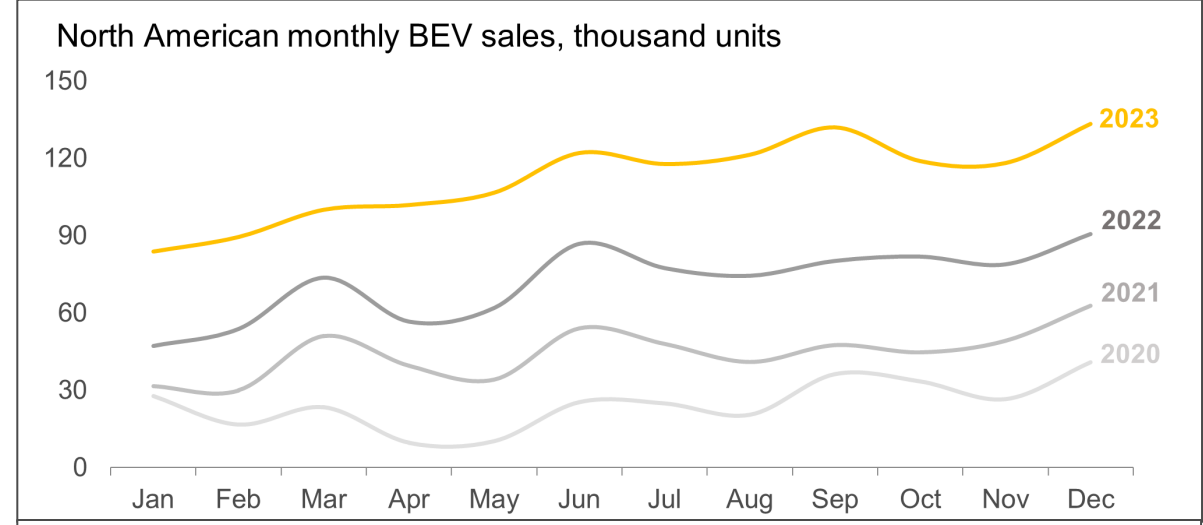
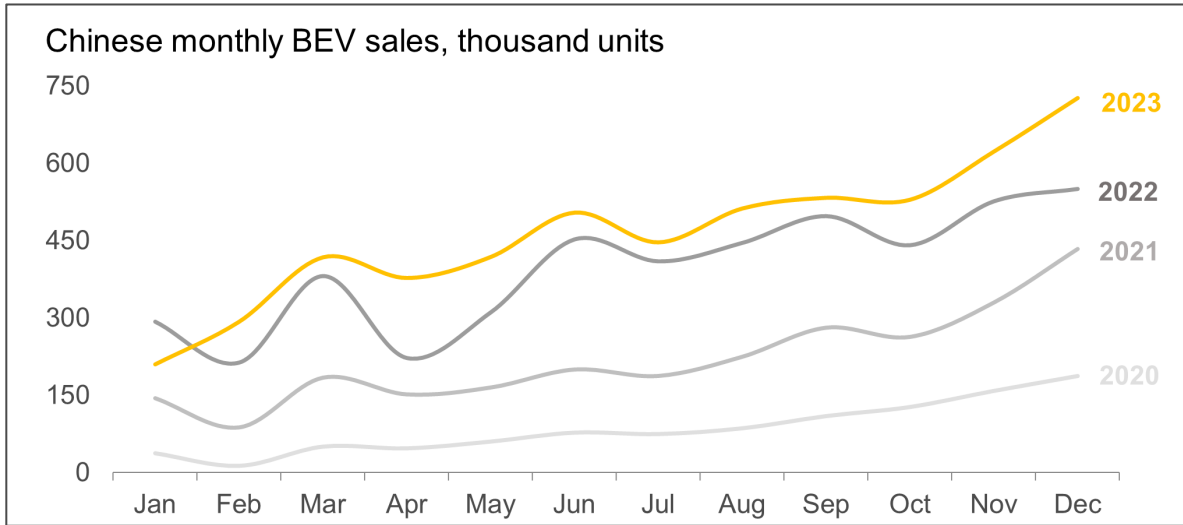
Renewables: annual generating capacity installations stay near 2022-23 levels. Higher rates of substitution away from copper.

EVs: base case production; higher share of Next Generation low copper intensity BEVs.

Grid: lack of growth in renewables negates need for grid upgrades in developed world.

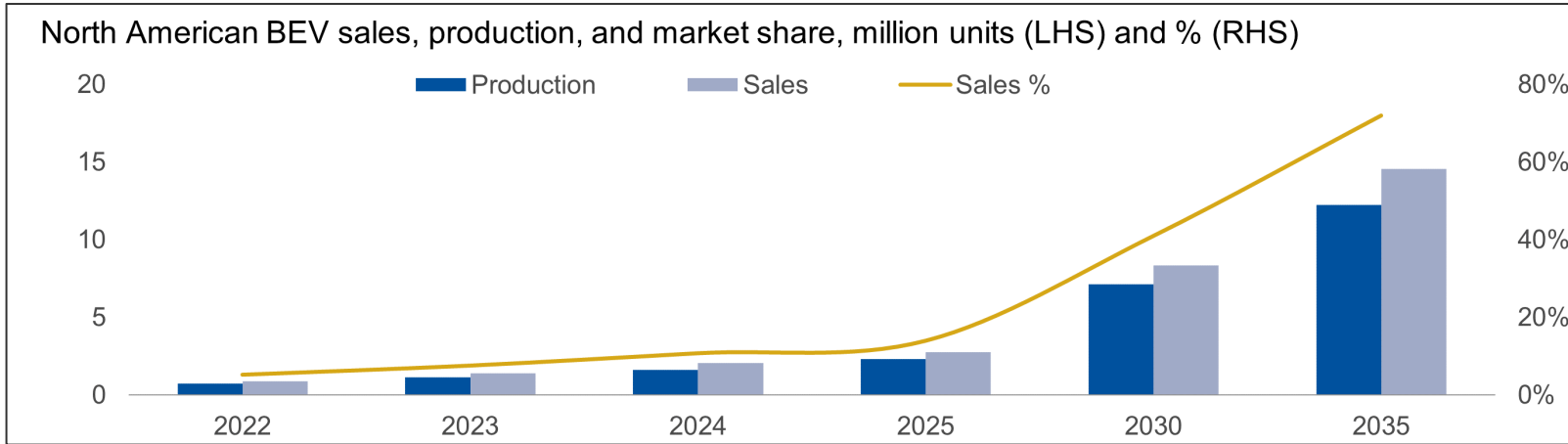
Scrap: scrap-based wirerod and secondary smelting sectors develop more quickly than expected, especially in China.

BEV sales continue to grow despite economic headwinds



Policy spurs investment in North America but long-term risks remain

BEV sales will accelerate in the late 2020s

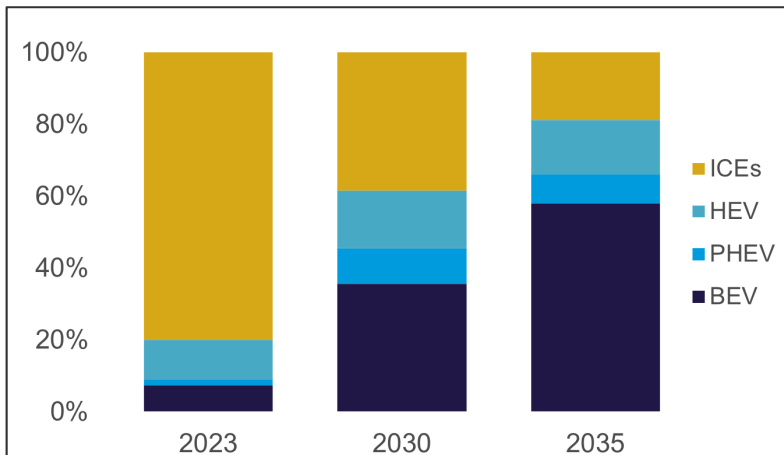


IRA is turbocharging BEV adoption in the short term

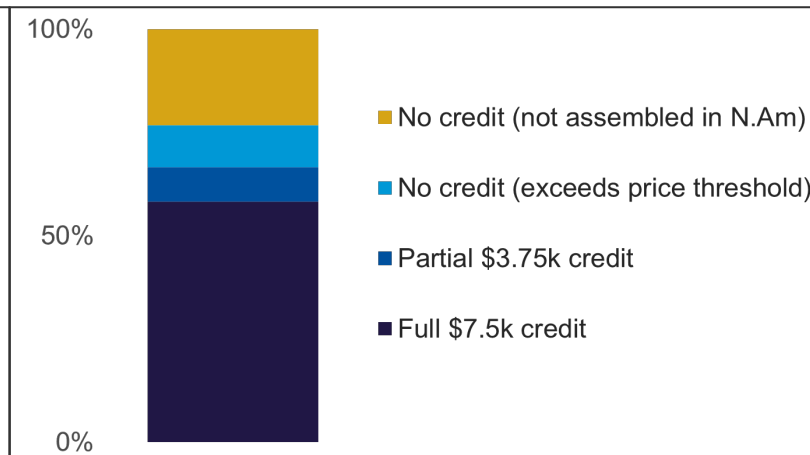
While not a boom, and very much underpinned by Tesla, the US BEV market continues to make solid progress and, in terms of y/y growth rates, is outperforming both Europe and China.

Underlying consumer sentiment is strong, but regular price cuts by Tesla are causing some hesitancy regarding residual selling values; in turn holding back more profound growth in the short term.

BEV's share to outrun ICE from 2030



IRA credit for 66% of BEVs sold in 2023

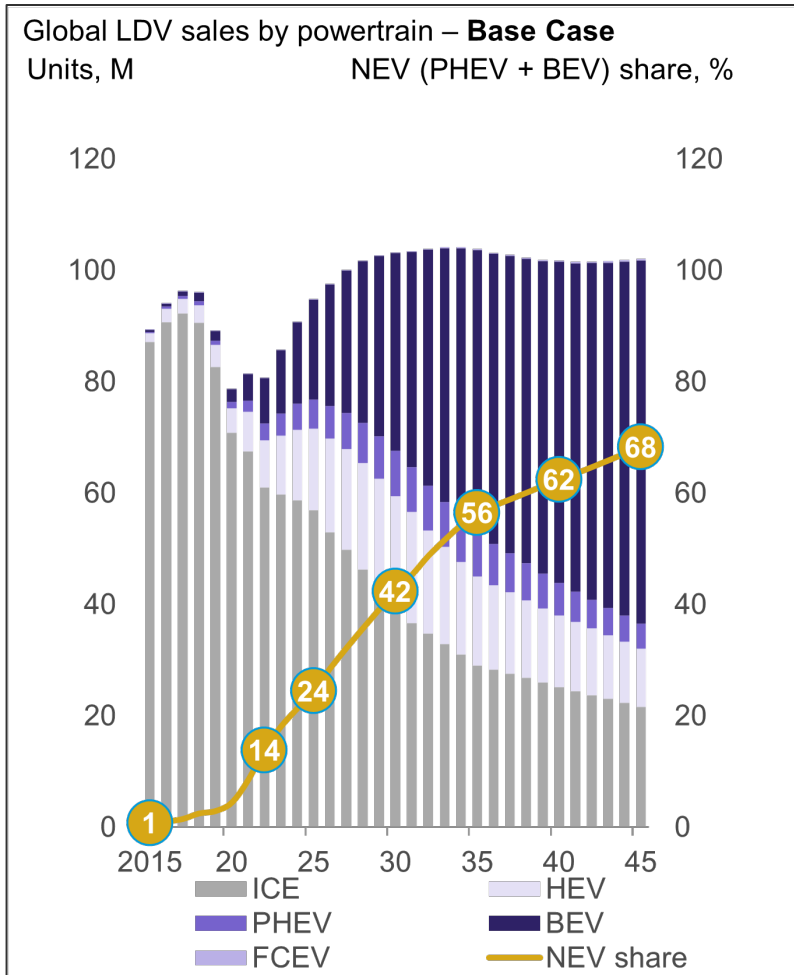


The IRA tax credit system is full of complexities but is still having a positive impact on demand. However, as the criteria becomes progressively more stringent, many vehicles will lose eligibility. An additional risk is the 'Foreign Entity of Concern' designation which, under our current working assumption, will apply to Chinese companies operating in any jurisdiction.

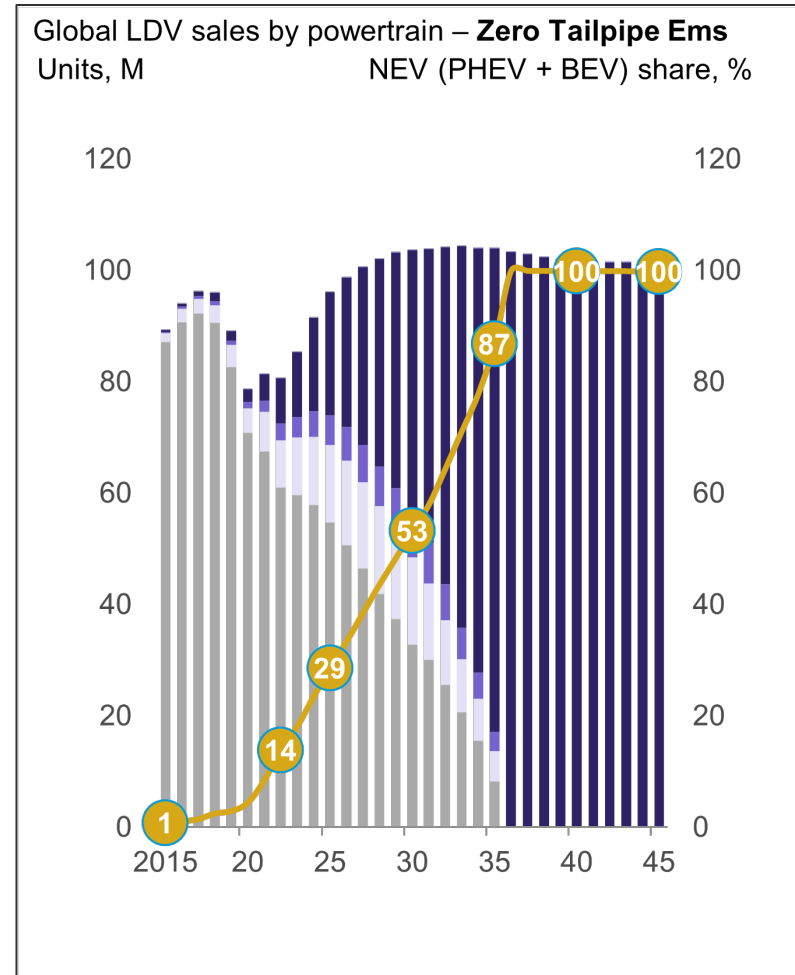
BEV sales will surge in the latter half of the decade, coinciding with new domestic supply projects coming online, which will enable greater selection of vehicles.

There are a lot of uncertainties surrounding the electric vehicle story

NEV market share heading towards 50%



More rapid fleet electrification is possible



How quick for BEV adoption?

NEV sales increased by 60% in 2022 and are set to rise by almost 40% this year, taking their share of the LDV market from 14% to 18%.

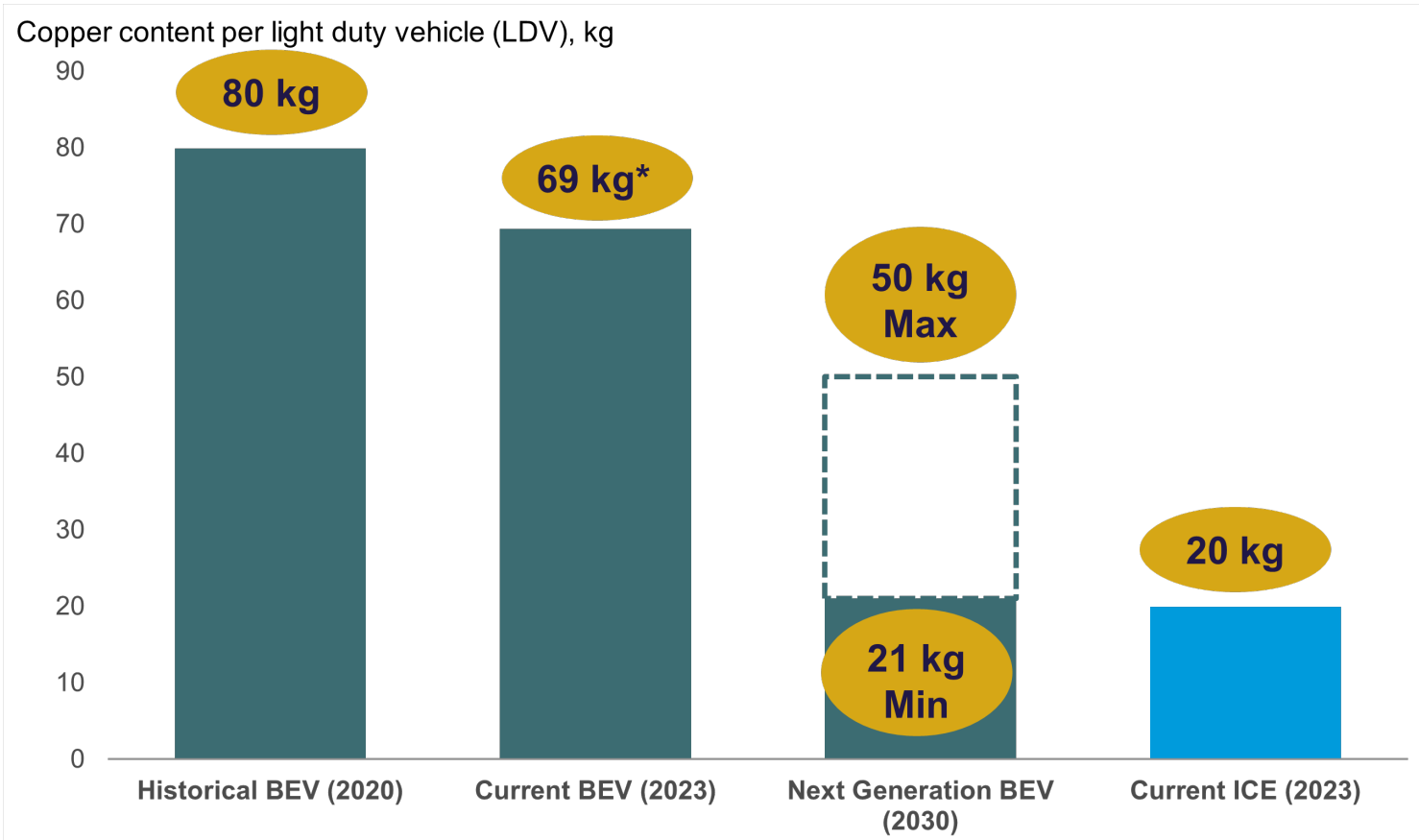
In the base case, NEV penetration rates, led by China which already accounts for 60% of the global sales, are expected to reach 42% in 2030 and approach 70% in the 2040.

A more optimistic zero tailpipe emissions scenario, sees 100% penetration rates for NEVs by the mid-2030s.

Do not forget fleet size

Recent supply chain problems; growth in ride hailing, car sharing and, to a lesser extent as yet, autonomous vehicles; and a reassessment of achievable levels of car ownership have seen fleet size projections lowered over the last few years. In 2018, global LDV sales were expected to eventually approach 145 M; today that figure is just over 100 M, having been revised down by ~4% over the last year.

Copper use in EVs could fall to the same level as ICEs



Examples of changes that are reducing copper usage in BEVs

The historical 80kg of copper in BEVs no longer applies. Next generation vehicles could see copper use drop towards levels traditionally seen in ICE vehicles.

Space efficient battery pack designs - 'Cell-to-Pack' [bus bars]

'Rightsizing' – making smaller battery packs [foil and bus bars]

'Rightsizing' of electric **motors** [winding wire]

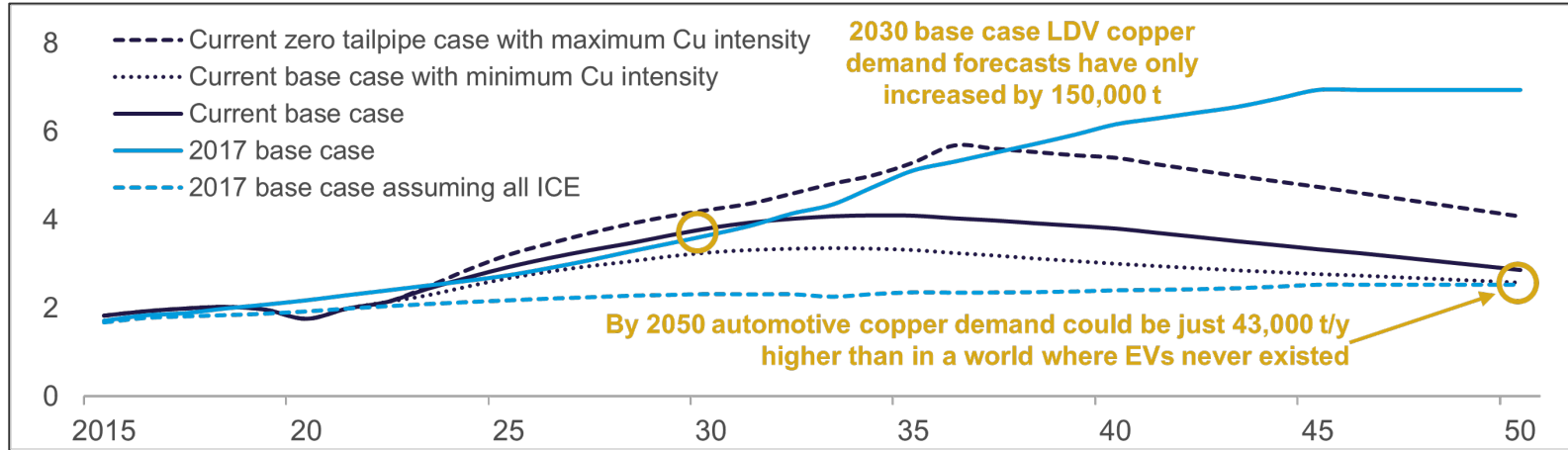
Higher voltage electricals 400V to 800V primary battery [bus bars and cabling], 12V to 48V secondary battery [ancillary cabling]

Thinner copper foils in battery cells historical 15 microns to now best in class 5 microns

Substitution to aluminum (charger cabling and insulated cable for charging infrastructure)

The copper EV story: Using history to separate fact from fiction

Global copper consumption in LDVs, MT



What if EVs had never happened?

We compared the current light duty vehicle (LDV) copper demand forecast with one made in 2017, when the EV story was in its infancy. There are three major differences between the two forecasts

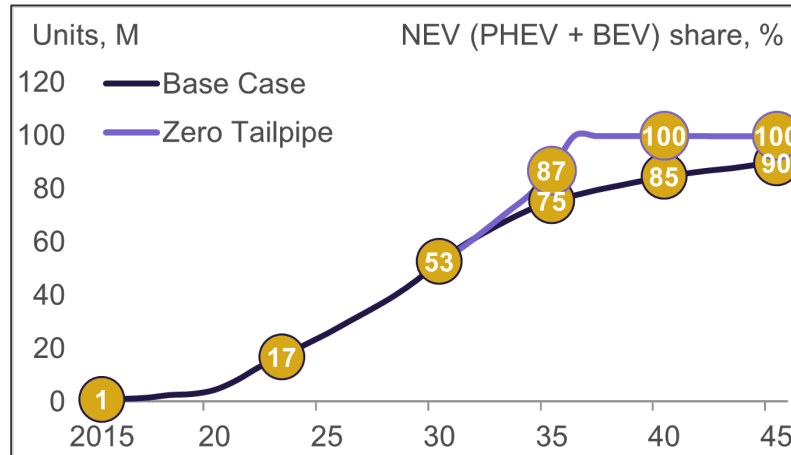
- Steady state LDV sales forecasts have been reduced from ~125 M vehicles p.a. to ~100 M.
- NEV share forecasts have risen from 16% (2030) and 55% (2050) to 53% and 90%.
- BEV copper intensity assumptions have been reduced from a constant 80 kg to ~60 kg now and ~30 kg in 2050.

There are two takeaways from the analysis:

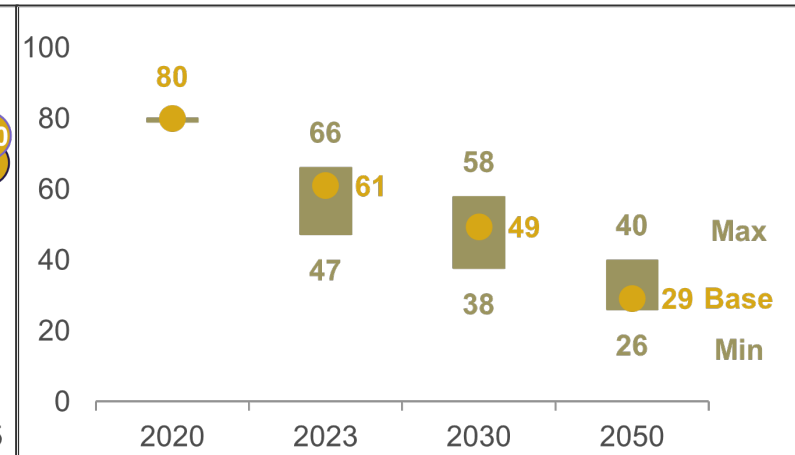
- Despite more rapid adoption of EVs than was expected, copper demand forecasts through to 2030 are relatively unchanged
- By 2050, LDV copper demand will only be 330,000 t/y or 13% higher than historical forecasts, even assuming ICE vehicles were 100% of sales. The numbers drop to 43,000 t/y and 2%, if copper content in BEVs eventually falls to the minimum case of 26 kg per vehicle

This suggests the EV-related copper consumption story is exaggerated, notwithstanding demand coming from the build out of associated energy infrastructure (chargers, renewables, grid).

Global PHEV + BEV sales



Copper content per BEV, kg





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