Vehicle Electrification & the Outlook for Copper

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Contents

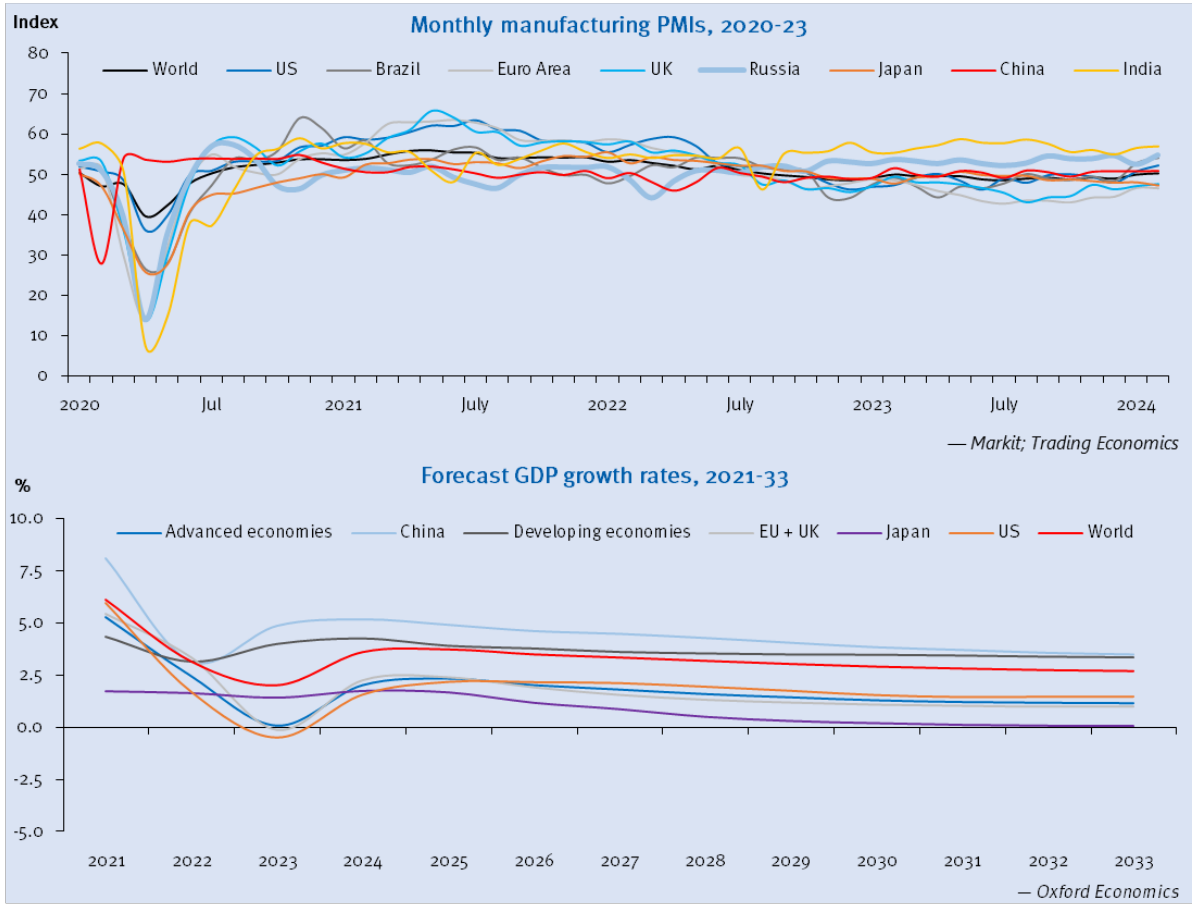
Introduction

Macro-economic outlook – Manufacturing PMIs and GDP growth

Global manufacturing PMI fell sharply with the onset of Covid-19, recovering strongly towards the end of 2020 and in the first half of 2021, before indices dropped towards the end 2021 and into 2022. The average for 2023 of below 50 indicates recessionary conditions

- The global manufacturing PMI dropped to a low of 39.6 in April 2020 as Covid-19 took hold, before recovering relatively quickly, and posting a full-year average of 52.8.
- Growth outside China helped push the global PMI even higher in the first half of 2021, to a peak of 56 in May. The Chinese economy then cooled, with China's full-year figure at 50.6 and less than 50 in August and November. The full-year global average jumped by 12pc to 54.7 in 2021.
- In 2022, the global monthly manufacturing PMI averaged 51.1, falling throughout the year from 53.6 in February to post 48.6 in December, as a result of the significant negative effect of the conflict in Ukraine, particularly in Europe.
- Global PMIs picked up briefly at the start of 2023, but inflationary pressures and high interest rates and a disappointing recovery from lockdown in China, all combined to keep PMIs in most countries below 50. The global PMI averaged 49.2 for the full year.
- The global PMI has started 2024 at around the 50 level, with the US, Brazil, Russia and India showing the most positive numbers, and China at 50.9 in February.

Annual average index	2019	2020	2021	2022	2023
Global manufacturing PMI	50.0	48.7	54.7	51.1	49.3



Macro-economic outlook – Manufacturing PMIs

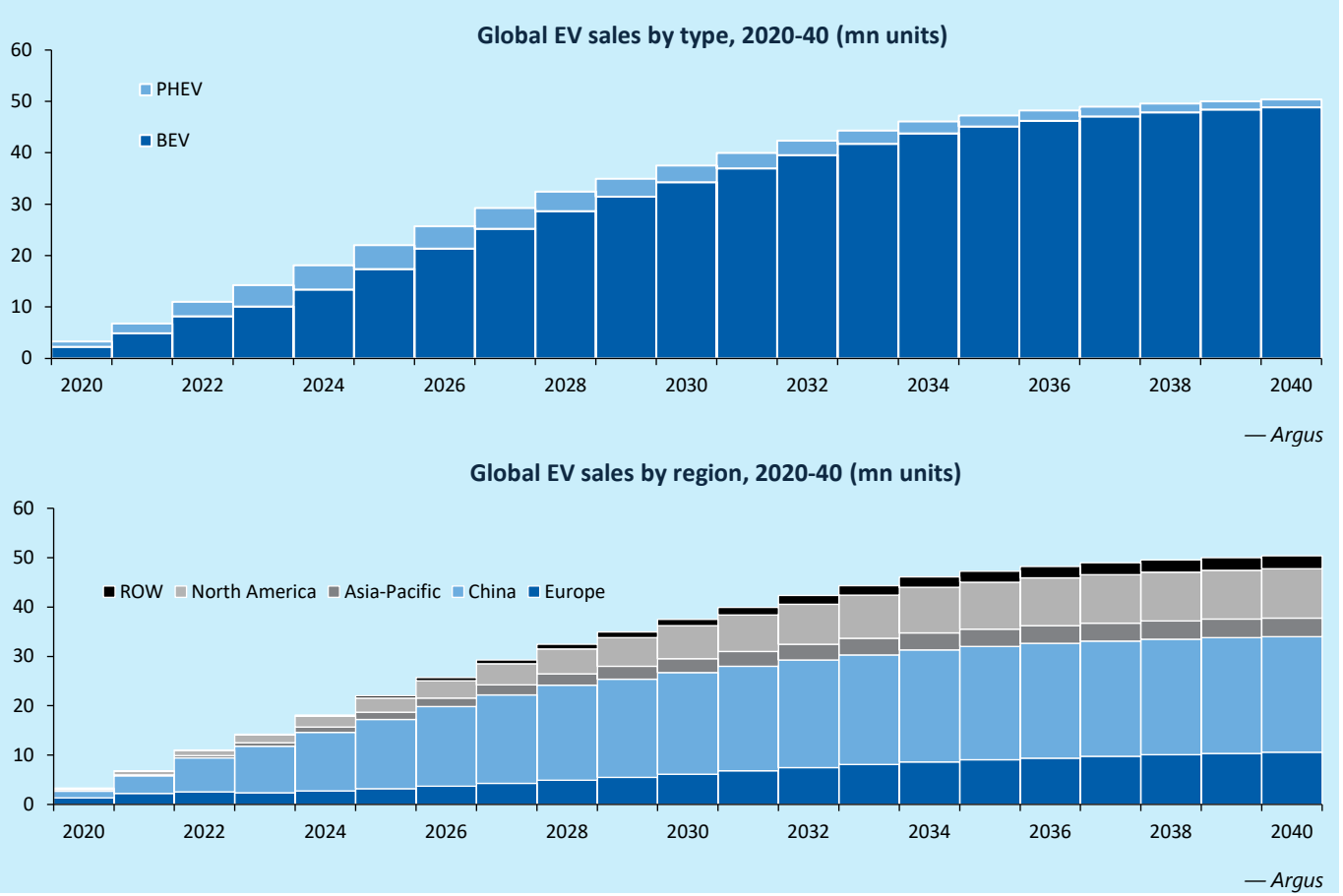
	World	US	Brazil	Euro Area	UK	Russia	Japan	China	India
Jan-22	53.2	55.5	47.8	58.7	57.3	51.8	55.4	49.1	54.0
Feb-22	53.6	57.3	49.6	58.2	58.0	48.6	52.7	50.4	54.9
Mar-22	52.9	58.8	52.3	56.5	55.3	44.1	54.2	48.1	54.0
Apr-22	52.2	59.2	51.8	55.5	55.8	48.2	53.5	46.0	54.7
May-22	51.3	57.0	54.2	54.6	54.6	50.8	53.3	48.1	54.6
Jun-22	52.2	52.7	54.1	52.1	52.8	50.9	52.7	51.7	53.9
Jul-22	51.1	52.1	54.0	49.8	52.1	50.3	52.1	50.4	56.4
Aug-22	50.3	51.5	51.9	49.6	47.4	51.7	52.1	49.5	46.2
Sep-22	49.8	52.0	51.1	48.4	48.4	52.0	50.8	48.1	55.1
Oct-22	49.4	50.4	50.8	46.4	46.2	50.7	50.7	49.2	55.3
Nov-22	48.8	47.8	44.3	47.0	46.5	53.2	49.0	49.5	55.7
Dec-22	48.6	46.2	44.2	47.8	45.5	53.0	48.9	48.9	57.8
Jan-23	49.1	46.9	47.5	48.8	47.0	52.6	48.9	49.2	55.4
Feb-23	50.0	47.3	49.2	48.5	49.3	53.6	47.7	51.6	55.3
Mar-23	49.6	49.2	47.0	47.3	47.9	53.2	49.2	50.0	56.4
Apr-23	49.6	50.1	44.3	45.8	47.9	52.6	49.5	49.5	57.2
May-23	49.6	48.4	47.0	44.8	47.4	53.5	50.6	50.9	58.7
Jun-23	48.8	46.2	46.6	43.3	46.5	52.6	49.8	50.5	57.8
Jul-23	48.6	49.0	47.8	42.7	45.3	52.1	49.6	49.2	57.7
Aug-23	49.0	47.9	50.1	43.5	43.0	52.7	49.6	51.0	58.6
Sep-23	49.2	49.8	49.0	43.4	44.2	54.5	48.5	50.6	57.5
Oct-23	48.8	50.0	48.6	43.0	44.5	53.8	48.7	49.5	55.5
Nov-23	49.3	49.4	49.5	44.2	47.3	53.8	48.3	50.7	56.0
Dec-23	49.0	47.9	48.4	44.4	46.2	54.6	47.9	50.8	54.9
Jan-24	50.0	50.7	52.8	46.6	47.0	52.4	48.0	50.8	56.5
Feb-24	50.3	52.2	54.1	46.5	47.5	54.7	47.2	50.9	56.9

EVs

Global EV sales to 2040

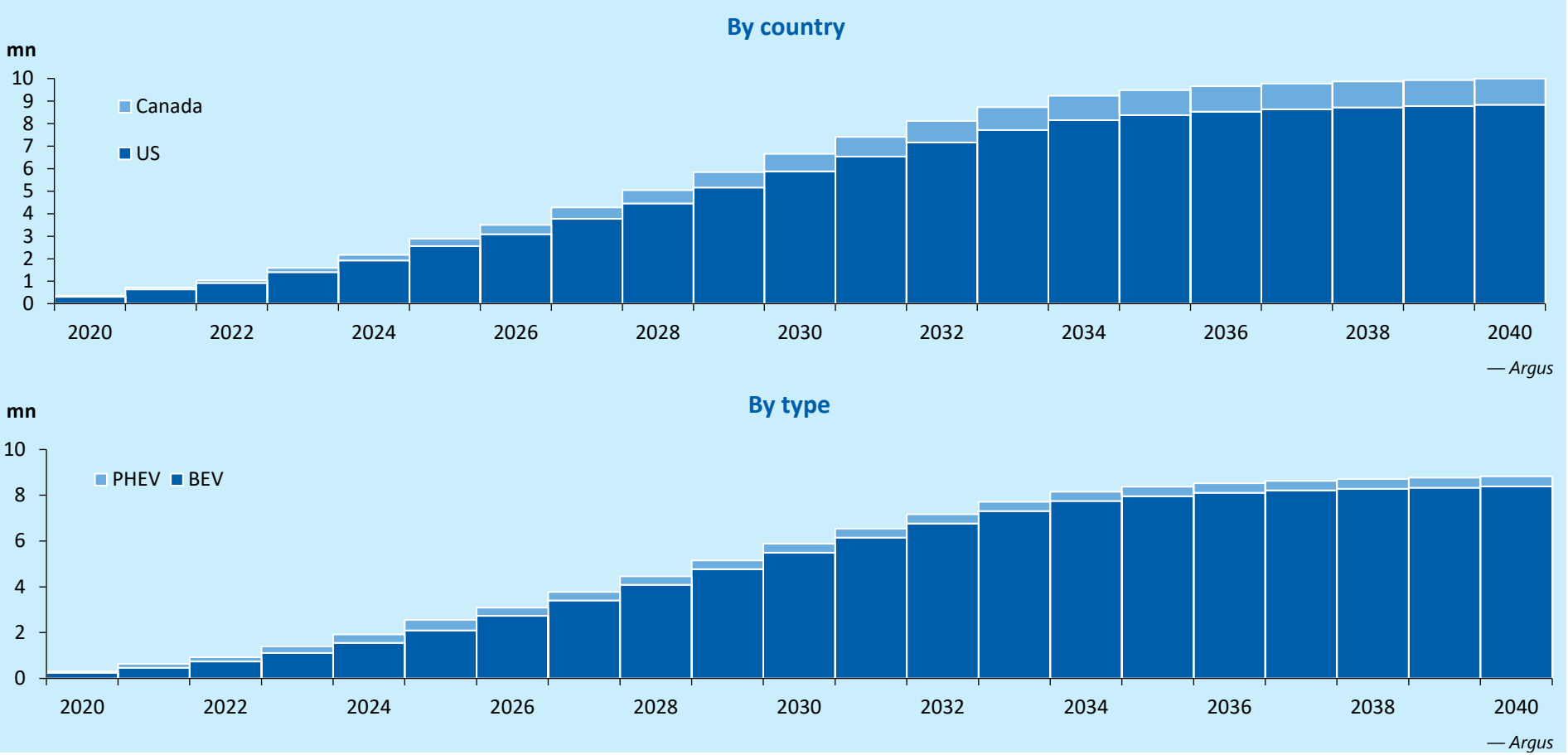
Argus forecasts global EV sales to reach 50mn units by 2040, with battery EVs (BEVs) accounting for a 96pc market share

- We have revised our overall forecast of global EV sales downwards, primarily on a softening macroeconomic outlook in China. And the European market is still facing some economic headwinds. But we expect to see strong growth in the US and Asia-Pacific (ex-China).
- Global EV sales are forecast to rise to 44mn units in 2033, an average growth rate of 12pc in the 10 years from 2023. We expect growth to be stronger in the first five years of the forecast period at 18pc, dropping to 6.5pc between 2028 and 2033.
- China should continue to dominate global EV sales, although we anticipate its share of global sales will decline from 63pc in 2023 to 50pc in 2033. Sales in Europe are forecast to grow steadily at 13 pc/yr over the next 10 years, taking that region's share of global sales to 18pc in 2033.



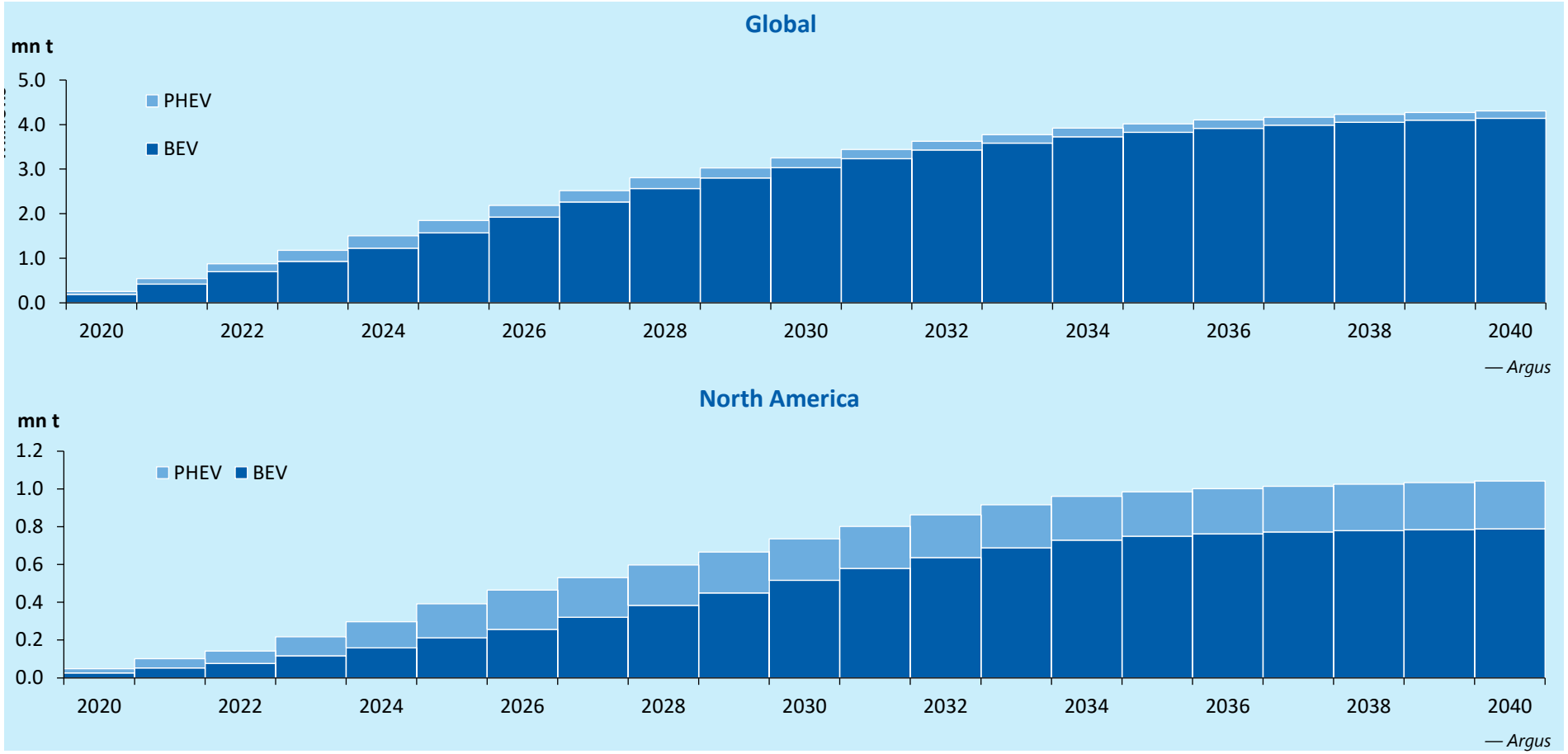
North American EV sales to 2040

North America EV sales are forecast to increase strongly to nearly 9mn units in 2033 (7.7mn in the US and 1.0mn in Canada) at a CAGR of 18.5pc. Growth then flattens out at just over 2 pc/yr (to 10mn units)



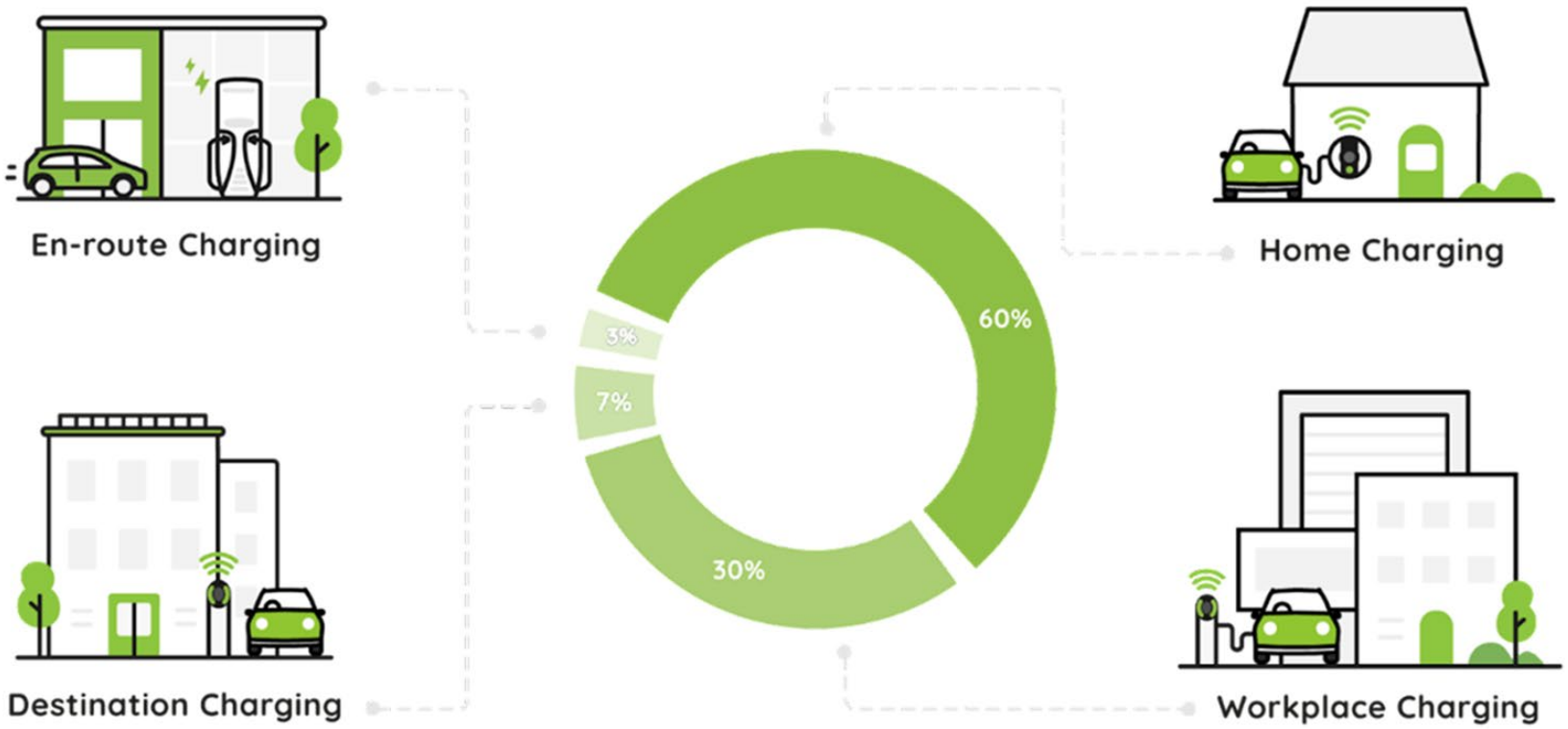
Copper consumption in EVs

Global copper consumption increases from 1.2mn in 2023 to 3.8mn t in 2033 and then to 4.3mn t by 2040. Demand in North America grows from 220,000t to 915,000t and then just over 1mn t over the same period



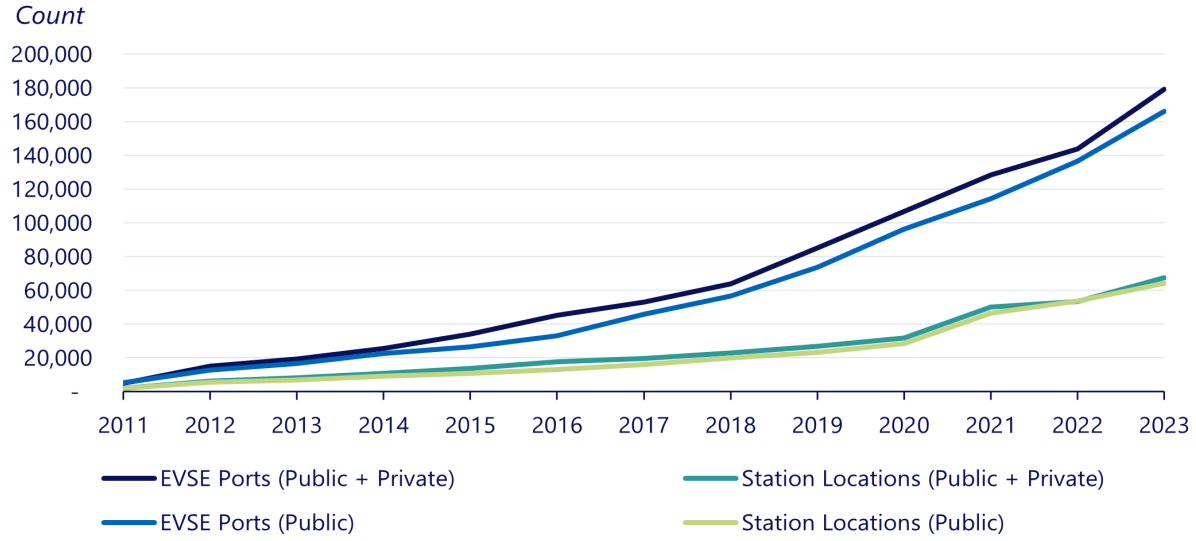
Charging Infrastructure

EV charging infrastructure

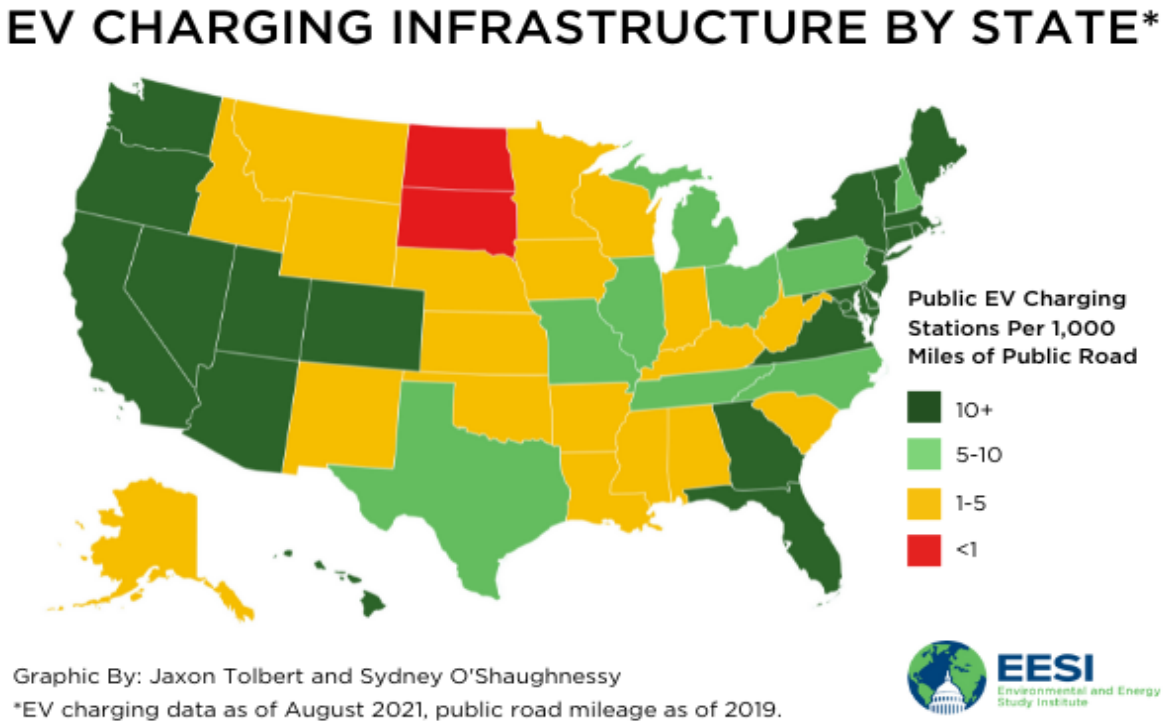


EV charging infrastructure

Figure 1. U.S. Electrical Vehicle Charging Infrastructure, 2011-2023



Source: Alternative Fuels Data Center
Note: Between 2011 and 2013, the electric vehicle charging station counts are an estimate of the number of geographic locations (i.e., station locations) based on the number of EVSE ports because station counts were not captured in these years.
As of December 2023



EV charging infrastructure

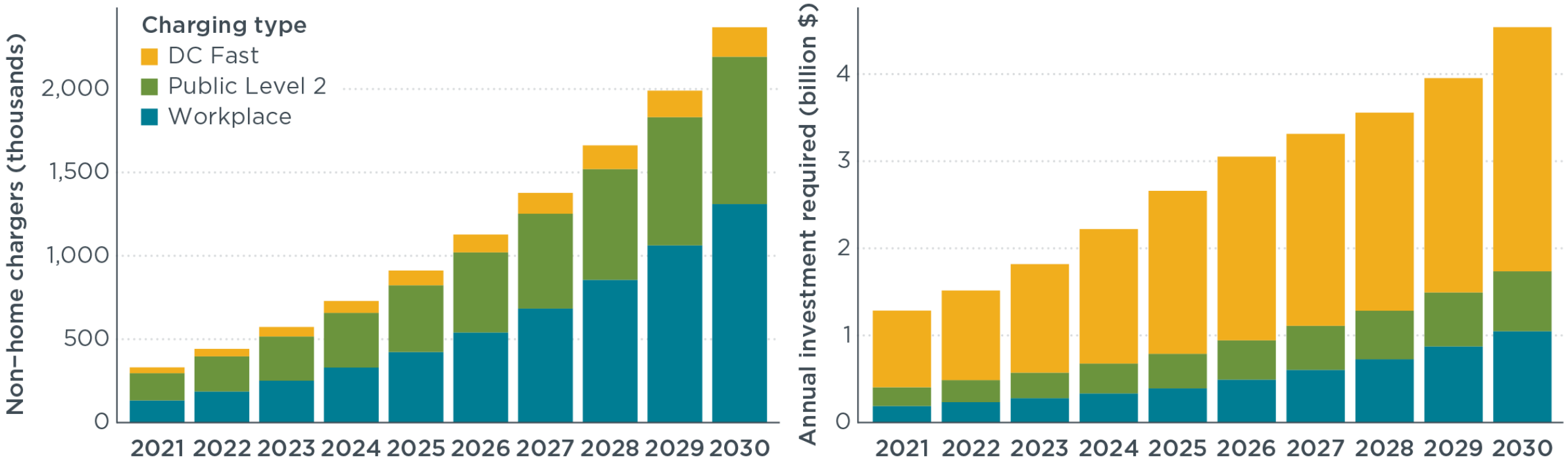
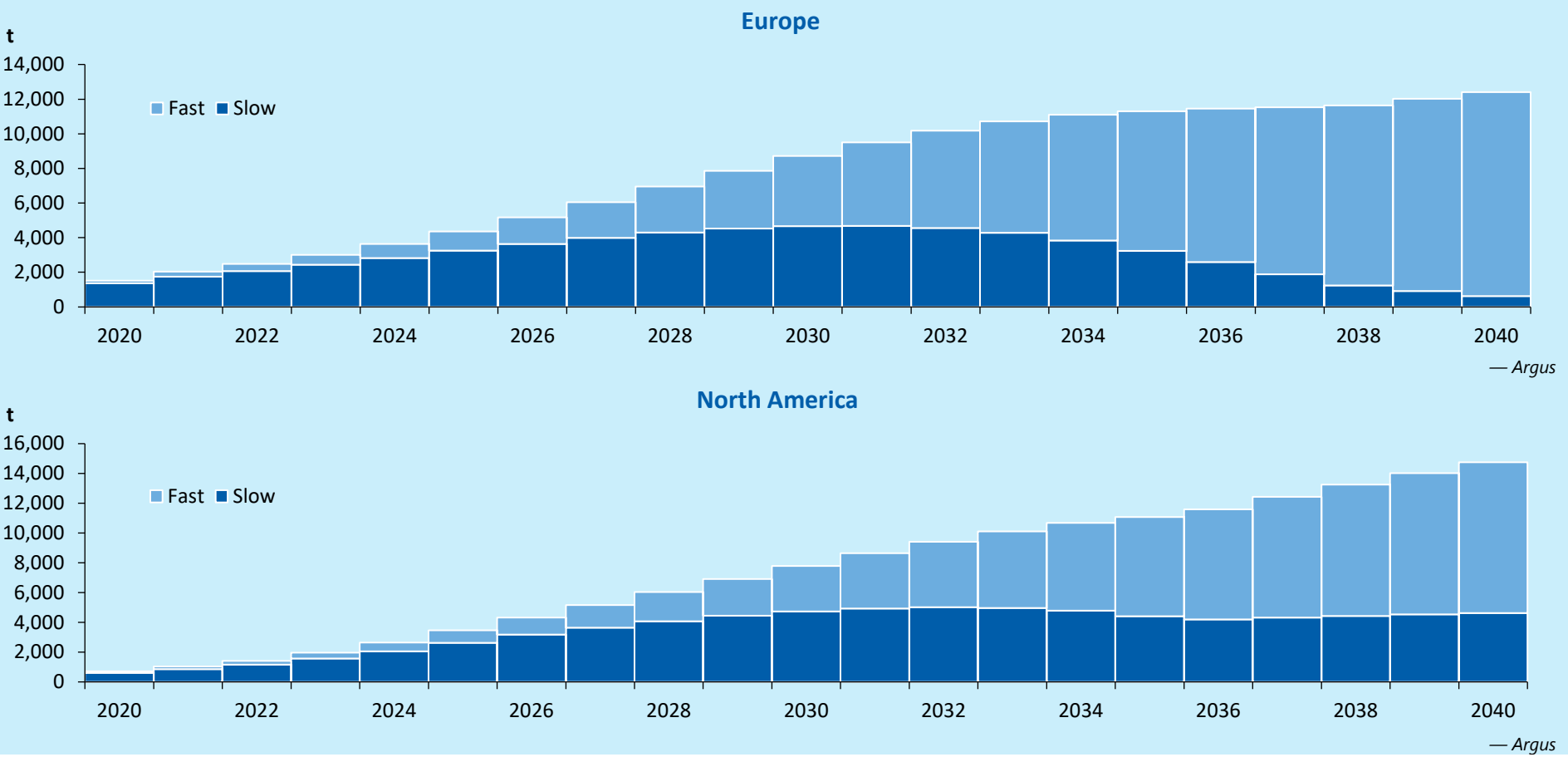


Figure ES-1. Charging infrastructure (left) and the associated investment (right) needed to support U.S. electric vehicle market through 2030.

Copper consumption in charging infrastructure

North American copper demand in charging infrastructure increases from 2kt in 2023 to 10kt in 0233 and then to 15kt in 2040

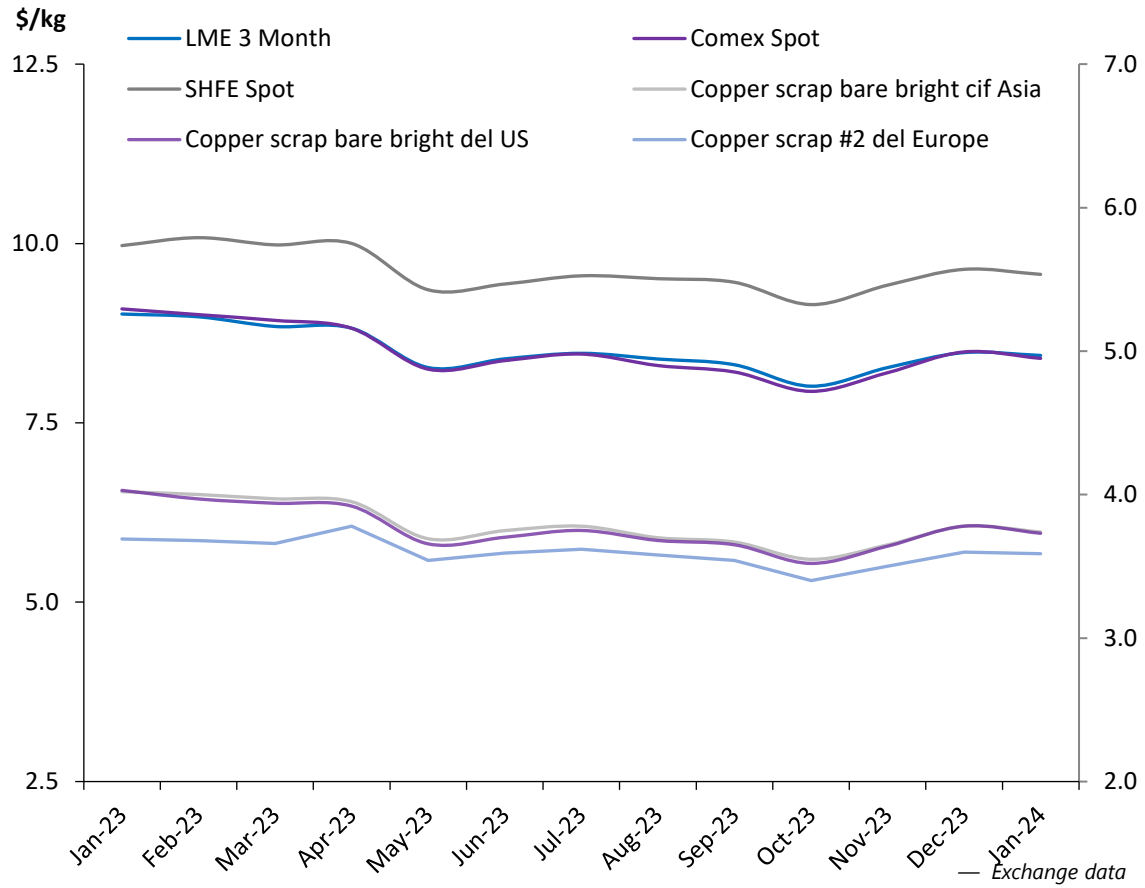


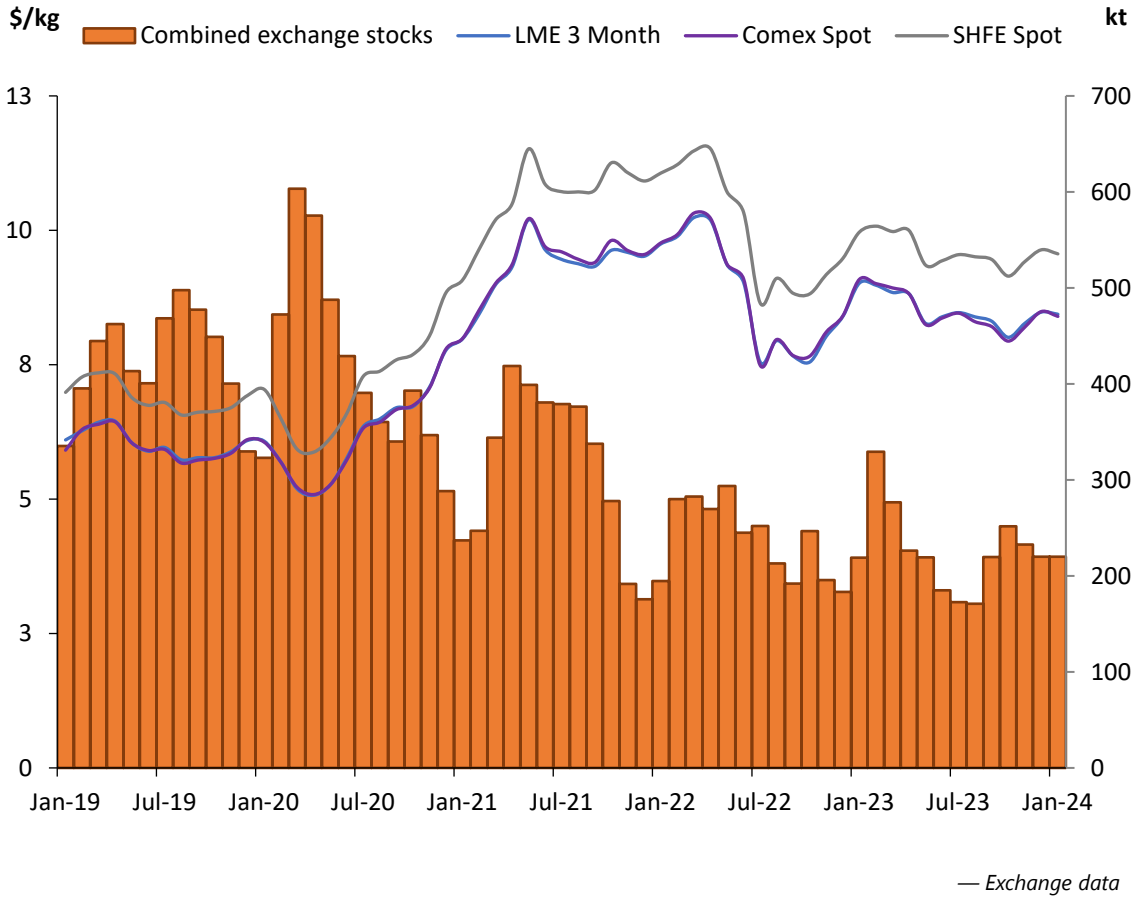
Copper Outlook

Copper Outlook

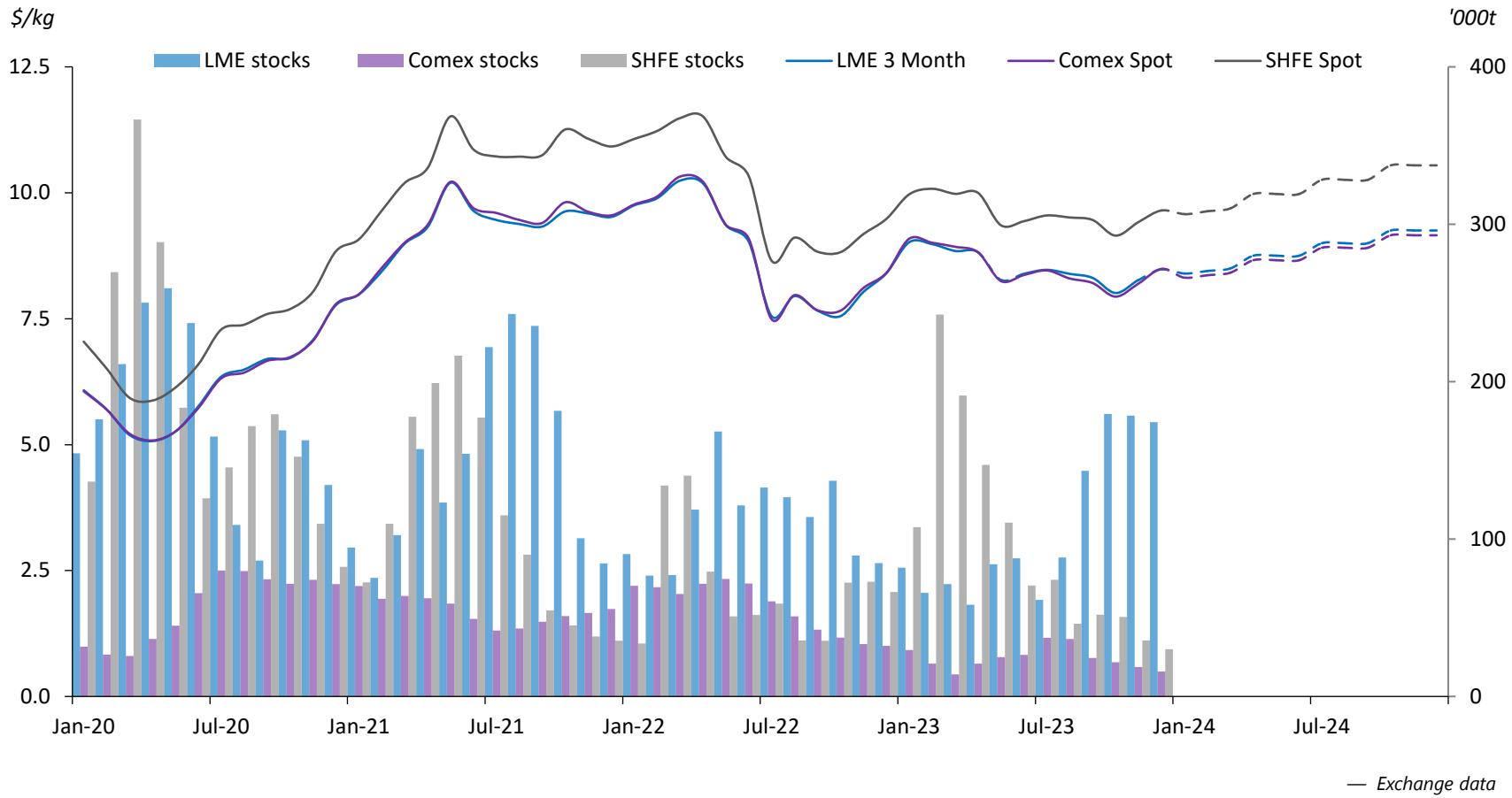
- Copper demand is forecast to double over the next decade, from 25 million metric tons today to about 50 million metric tons by 2035 (5-6pc CAGR).
- Copper use in vehicles:
  - ICE vehicle ≈ 23kg
  - HEV ≈ 40kg
  - PHEV ≈ 60kg
  - EV ≈ 83kg
- Copper is a highly efficient conduit and is used in renewable energy systems to generate power from solar, hydro, thermal and wind energy across the world. Copper helps reduce CO2 emissions and lowers the amount energy needed to produce electricity. In many renewable energy systems, there is 12 times more copper than in traditional systems.

Recent copper prices





Copper price forecast



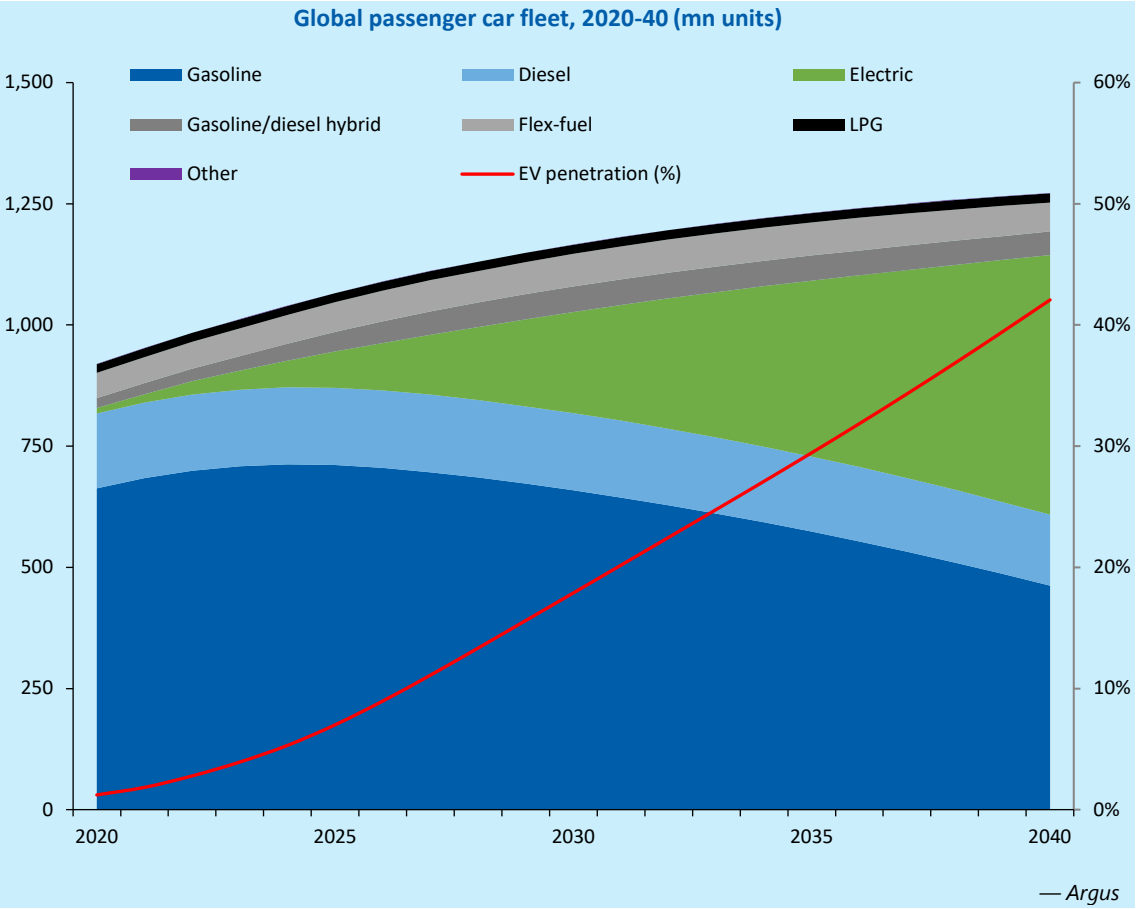
— *Exchange data*

Annual averages ($/kg)	
	LME 3-month
2020	6.20
2021	9.30
2022	8.80
2023	8.50
2024f	8.85

Conclusions

Conclusions

- We have reduced our EV forecasts given the current situation, but EVs will continue to grow strongly (& EV penetration grows from 1pc in 2020 to 18pc in 2030 and over 40pc by 2040)
- Charging infrastructure appears to be a lagging indicator (not a brake on EV growth)
- Copper demand could double to close to 50mn t in the next decade
- A significant copper supply deficit could develop without significant investment in new copper supply and an increase in supply of copper scrap
- The incentive price for copper to achieve the necessary investment is at least $10,000/t (compared to current prices of $8,000-8,5000/t)



Q&A

The Copper Outlook Service

Comprehensive price coverage & 12-month price projections for exchange prices and key global scrap assessments

Comprehensive trade data and full year forecast

Supply and demand analysis, & crucial developments

Project tracker

Excel datafile

White papers, webinars & other content

Long-term analytics (in development)

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Argus Copper Monthly Outlook

Outlook

The month ahead
Monthly average exchange copper prices increased by between 3pc and 4pc in November, as LME three-month prices rose from $8.13/kg to $8.42/kg over the month. Prices dropped back in early December, but had recovered to $8.52/kg on 18 December, so the outlook for the month ahead is for higher monthly averages.

The next 3-6 months
In the medium term, a forecast of copper concentrate demand outstripping supply in 2024 is likely to underpin copper prices at year-end 2023 levels or above.

12 months forward
In the longer term, market fundamentals and cost curve pressure will come more into play, and the copper market will need long-term prices at around $9.00/kg or above to stimulate investment in new copper supply.

Exchange copper prices
LME three-month official copper prices trended upwards in November, ending the month 3.5pc higher at $8.42/kg. The monthly average was up 3.0pc at $8.27/kg in November, and was a further 1.9pc higher at $8.43/kg in the month to 18 December. The Comex and SHFE spot copper prices averaged $3.72/lb ($8.20/kg) and $9.41/kg in November, up 3.2pc and 2.9pc respectively.

OUTLOOK: Strengthening

Exchange copper prices, 2020-24

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Thank you