WORLD COPPER SUPPLY

INDUSTRY ANALYSIS AND FORECAST

DECEMBER 2023

INTRODUCTION: COPPER

- Copper, a symbolic metal with a rich history, is becoming a key player in the modern era of electric vehicles (EVs), where clean energy and sustainability play a crucial role. EVs, aimed at reducing carbon emissions and efficiently utilizing energy, are creating a new demand for copper, especially in the electrical systems of transportation.
- As newer EV's transition towards all-electric (BEVs) type vehicles, the amount of copper required for each increases significantly. This will certainly put a strain on the long-term supply of copper as more and more BEVs are produced.
- Over the past decade, the leaders in copper mine production have remained unchanged with Chile accounting for 25% of global production, Peru at 10%, and China at 9%. However, in recent years, the Democratic Republic of the Congo has been actively increasing its contribution to global supply reaching approximately 10%.
- Copper prices have returned to 2011 levels of about USD $8,500/tonne with the increased demand for cooper in the EV market. Incorrys expects prices to continue to rise as supply lags demand.
- There is currently almost 900 million tonnes of proven copper reserves worldwide. Chile accounts for about 20% of the total reserves followed by Australia at 11% and Peru at 9%. The global reserves life for copper is 30 years.

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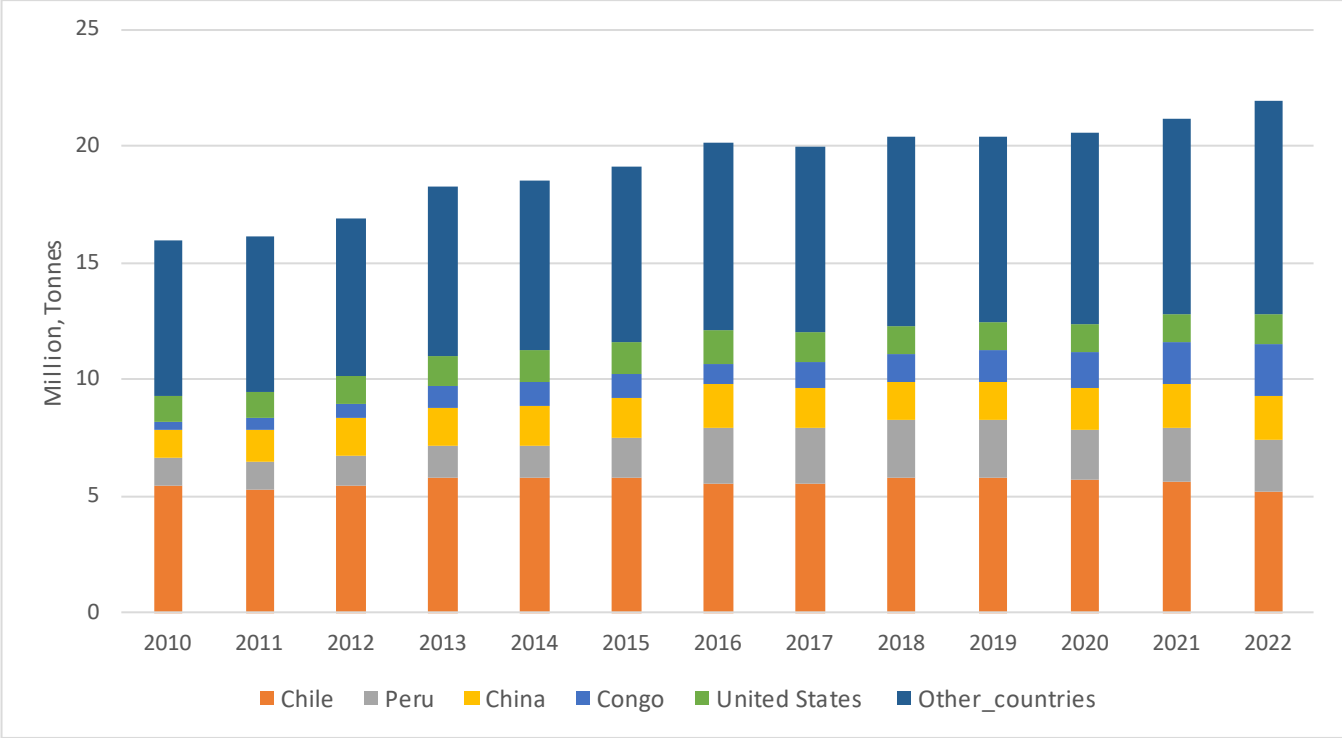
GLOBAL COPPER MINE PRODUCTION



Global copper production increased over 25% between 2010 and 2019 from 16 million tonnes to just over 20 million tonnes. Production remained relatively flat in 20 million tonnes range from 2016 through 2021 before increasing to almost 22 million tonnes in 2022, up 4% from the previous year

Note: Mine production has 30% of copper (copper concentrate)
Source: US. Geological Survey

Although Chile has seen copper mine production decline since 2010 from about 5.4 million tonnes to 5.2 million tonnes, they remain the global leader accounting for 25% of the world's total in 2022; down from a 34% market share in 2010.

All other regions have seen copper production increase since 2010 led by the Congo which is up from 350,000 tonnes to 2.2 million tonnes, Peru from 1.2 million tonnes to 2.2 million tonnes, and China from 1.2 million tonnes to 1.9 million tonnes.

The US has seen only marginal growth increasing from 1.1 million tonnes to 1.3 million tonnes. For comparison, Canada produced about 500,000 tonnes in 2022.

Fluctuations in production levels are influenced by market demand and resource availability.

The growth in copper production reflects the rising demand for the metal, especially for the expanding electric vehicle (EV) market. There has been a surge in production over the past couple of years, up 7%, as countries prioritize net-zero carbon goals.

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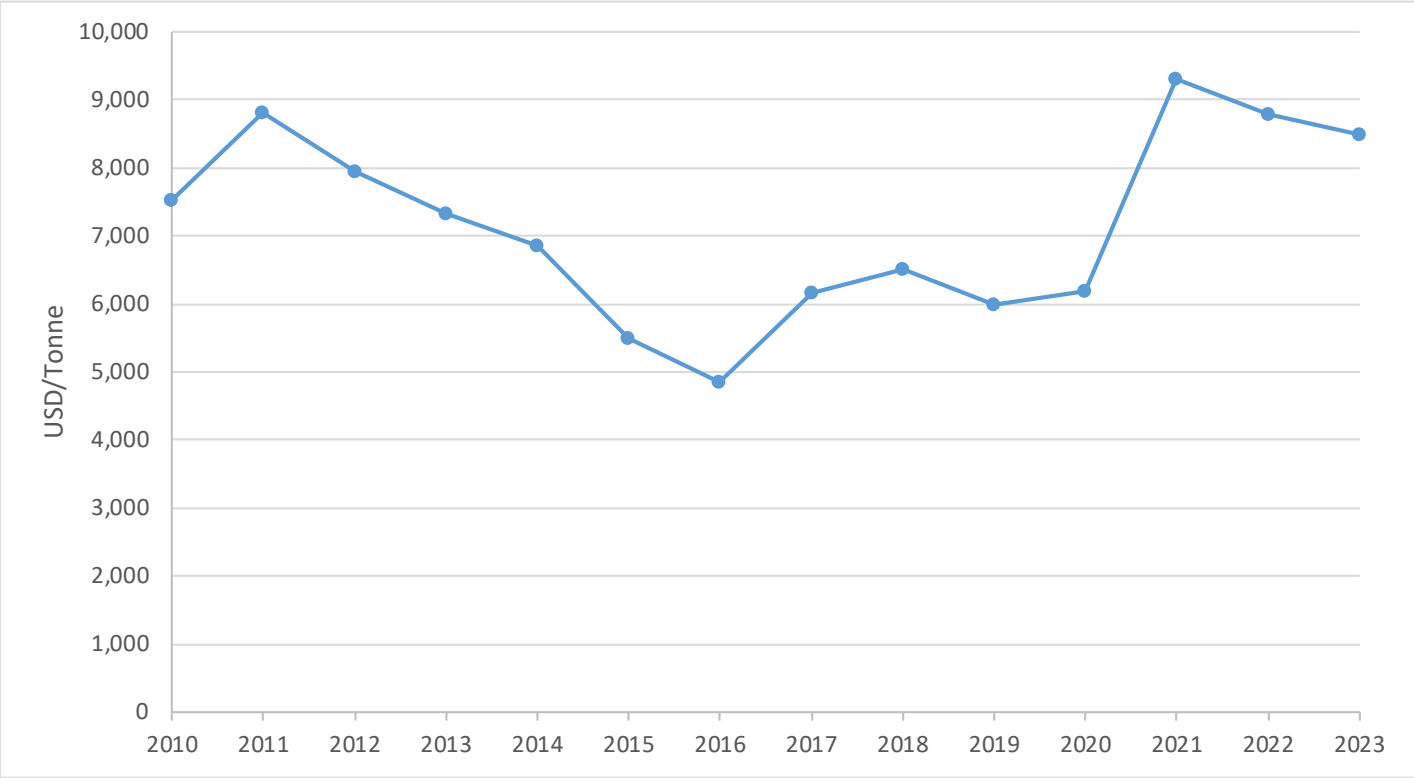
COPPER PRICE



Annual copper prices have exhibited varying trends between 2010 to 2023.

Prices generally trended downward from 2011 through 2016 going from over USD $8,000/tonne to just under USD $5,000/tonne. Copper hit a low of just USD $4860 in early 2016.

Copper prices have since been generally trending upwards peaking at over USD $9,000/tonne in 2021 before retreating over the past 2 years to about USD $8,500 in 2023.

These fluctuations in copper prices were influenced by a variety of factors, including global supply and demand dynamics, economic conditions, and geopolitical factors.

Like most raw materials, copper prices are expected to increase going forward as demand for the material outpaces available supply.

Source: Westmetall

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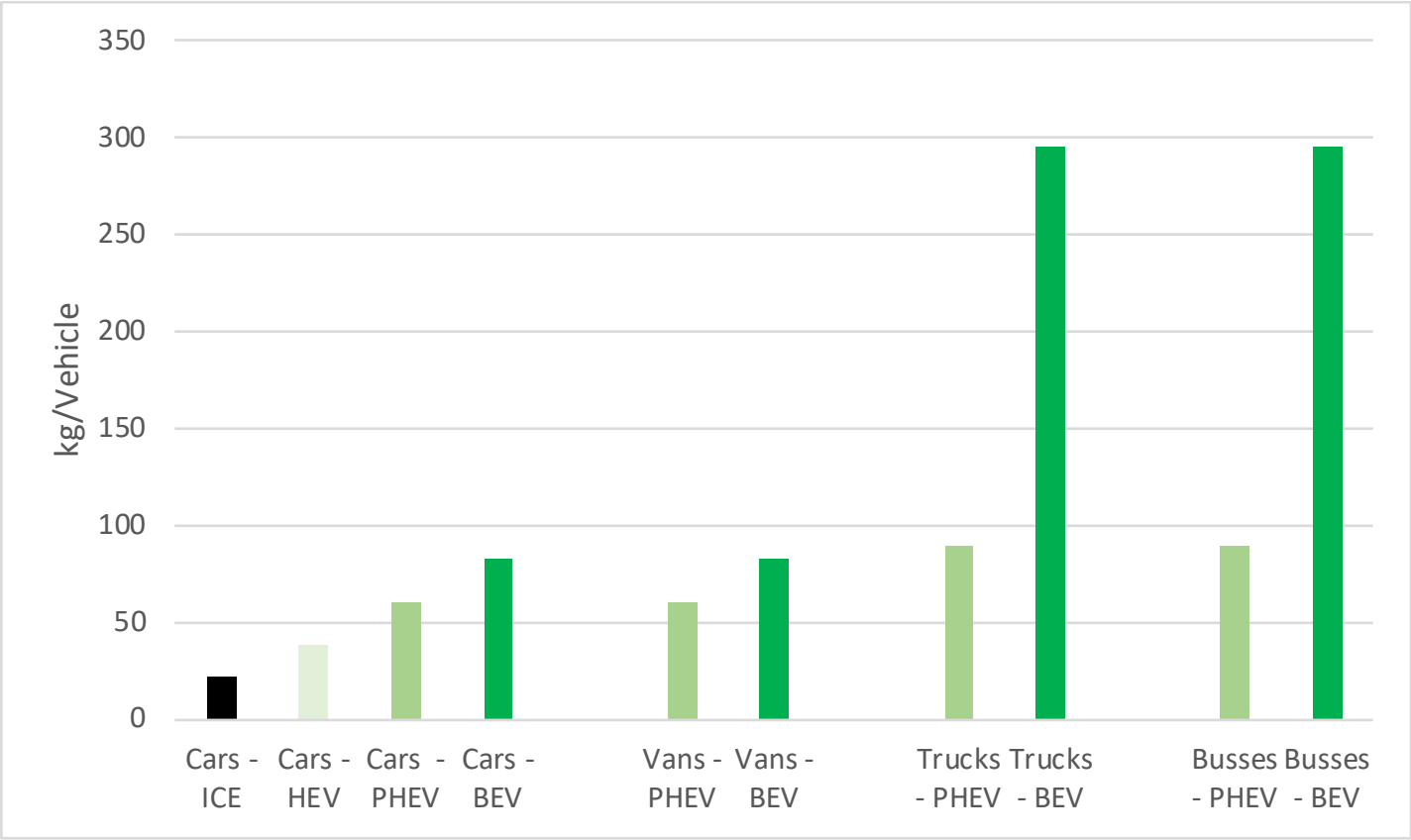
COPPER REQUIREMENTS PER VEHICLE TYPE



Conventional cars with internal combustion engines (ICEs) use the least amount of copper compared to all electric vehicle (EV) types at under 25 kg/vehicle.

Every type of EV significantly amplifies the demand for copper compared to conventional vehicles with internal combustion engines. The copper requirements (kg/vehicle) for each EV category are:

- Conventional internal combustion engine: 23 kg.
- Hybrid electric vehicle (HEV): 40 kg.
- Plug-in hybrid electric vehicle (PHEV): 60 kg.
- Battery electric vehicle (BEV): 83 kg.
- Hybrid electric bus (Ebus HEV): 89 kg.
- Battery-powered electric bus (Ebus BEV): 224–369 kg (depending on battery size).

As newer EV's transition towards all-electric (BEVs) type vehicles, the amount of copper required for each increases significantly. This will certainly put a strain on the long-term supply of copper as more and more BEVs are produced.

Sources: Incorrys, Copper Development Association Inc., and International Copper Association

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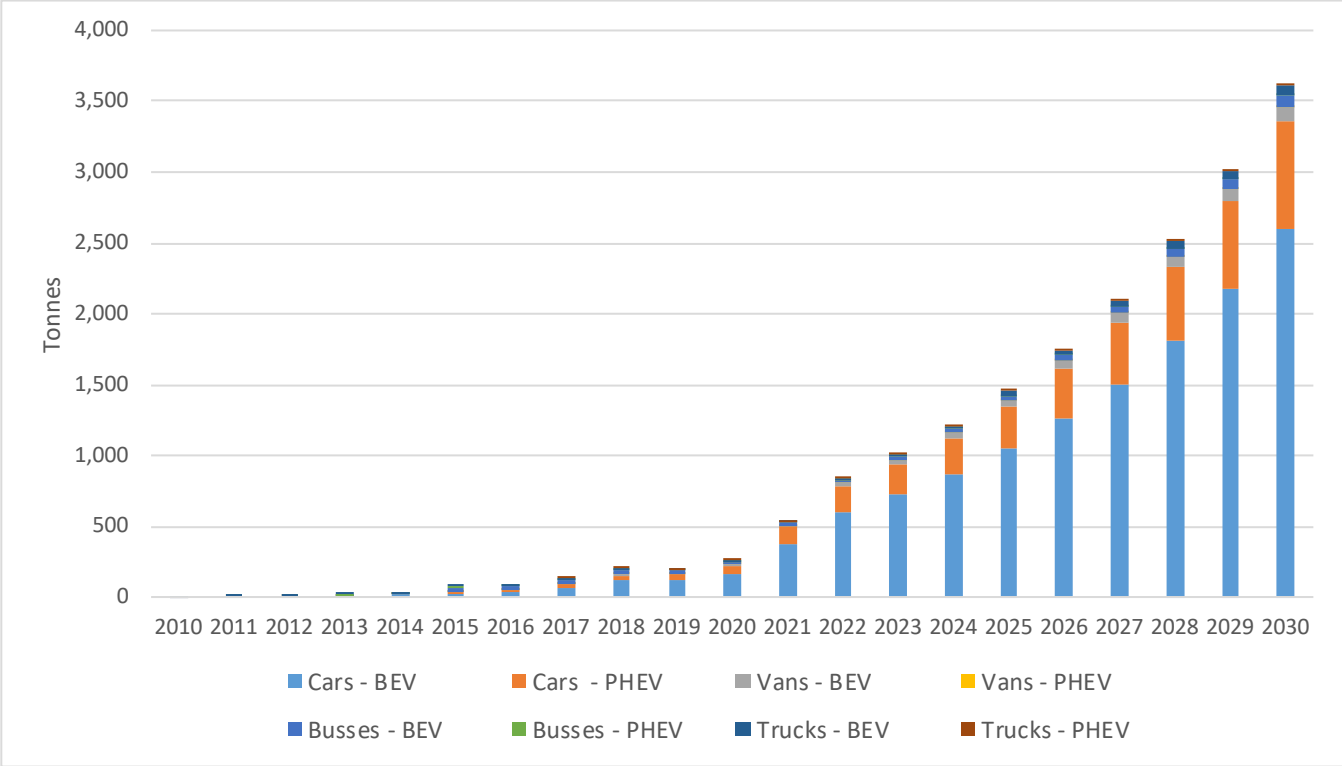
COPPER FOR BEV BATTERIES 2010-2030



Copper used in BEV cars has grown from 1 thousand tonnes in 2010 to 1 million tonnes in 2023. Demand is expected to accelerate through to 2030 increasing to about 3.6 million tonnes.

BEV cars account for almost three quarters of the copper demand from 2023-2030 while BEV and PHEV cars combined represent over 90% of the total.

The number of BEVs cars is also expected to show steady growth reaching 45 million units in 2030. This growth reflects the rising popularity of electric cars and the transition towards cleaner transportation options.

The projected demand of 3.6 million tonnes of copper in 2030 is enough to meet the needs of the global electric vehicle market, even when considering additional factors such as improvements in battery technology, the efficiency of copper utilization, and material recycling.

Sources: International Energy Agency and EV-volumes

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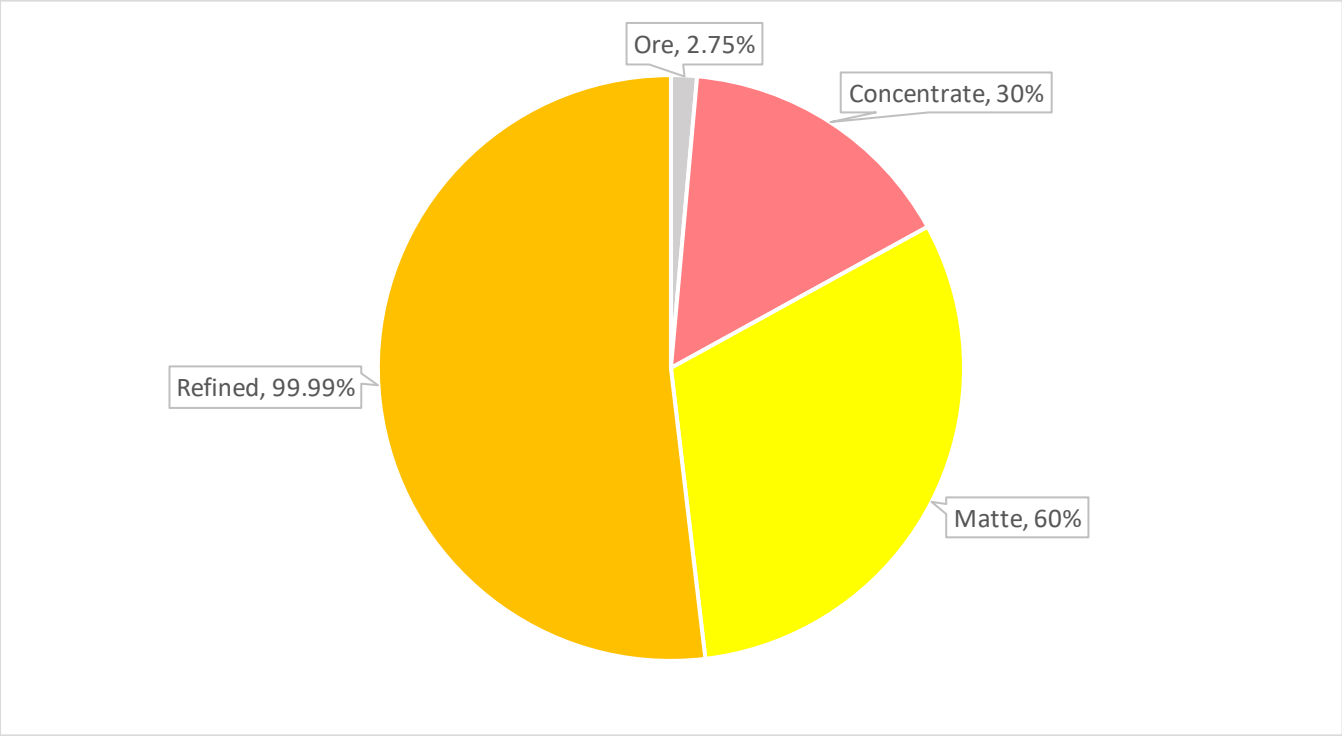
COPPER CONTENT BY TREATMENT PHASE



Ore mining = 2.75% copper → Concentrate = 30% copper → Matte = 60% copper → Refined copper = 99.9%

Source: International Copper Study Group

Geologists search for indicators of mineral deposits, paving the way for mining under favorable geological, economic, environmental, and legal conditions.

The amount of copper content increases in each phase of refinement.

Primary copper production involves extracting copper-bearing ores through surface, underground, or leaching methods, with open-pit mining being the most common.

After extraction, ores are crushed, ground, and concentrated, resulting in copper concentrates containing approximately 30% copper.

The subsequent smelting processes yields a "matte" with 50-70% copper.

It is further refined to blister copper and, ultimately, to refined copper cathodes through electro-refining or hydrometallurgical routes.

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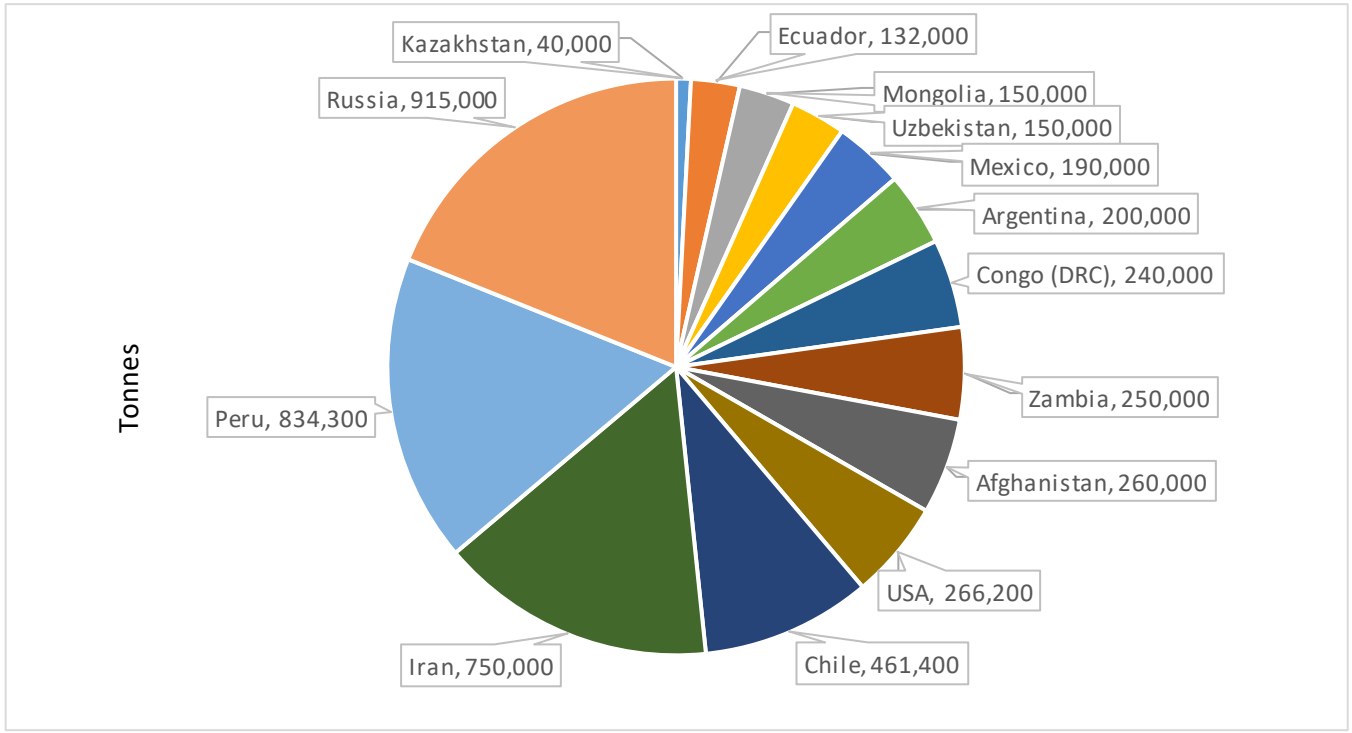
COPPER PRODUCTION FORECAST BY COUNTRY TOTAL 2023-2029



Russia is the top producer of copper worldwide with forecasted production of almost 1,000,000 tonnes between 2023 and 2029.

Peru is next largest with forecasted production of 835,000 tonnes, closely followed by Iran at 750,000 tonnes. Chile and the US round out the top 5 copper producers with over 450,000 and 250,000 each, respectively.

The stability of copper-producing nations plays a pivotal role in ensuring a consistent global copper supply, given its vital applications in diverse industries.

Regions like Peru, Chile and the US, with proven records of political stability, continue to be reliable sources for copper production.

Conversely, many regions face political unrest hindering a dependable supply of copper. These regions include Russia, Iran, Afghanistan, Congo, Ecuador, Mexico, and of course, Russia following their invasion of the Ukraine.

So, while some regions offer stable platforms for sustained copper production, many others face obstacles that could impede their ability to help meet global demands.

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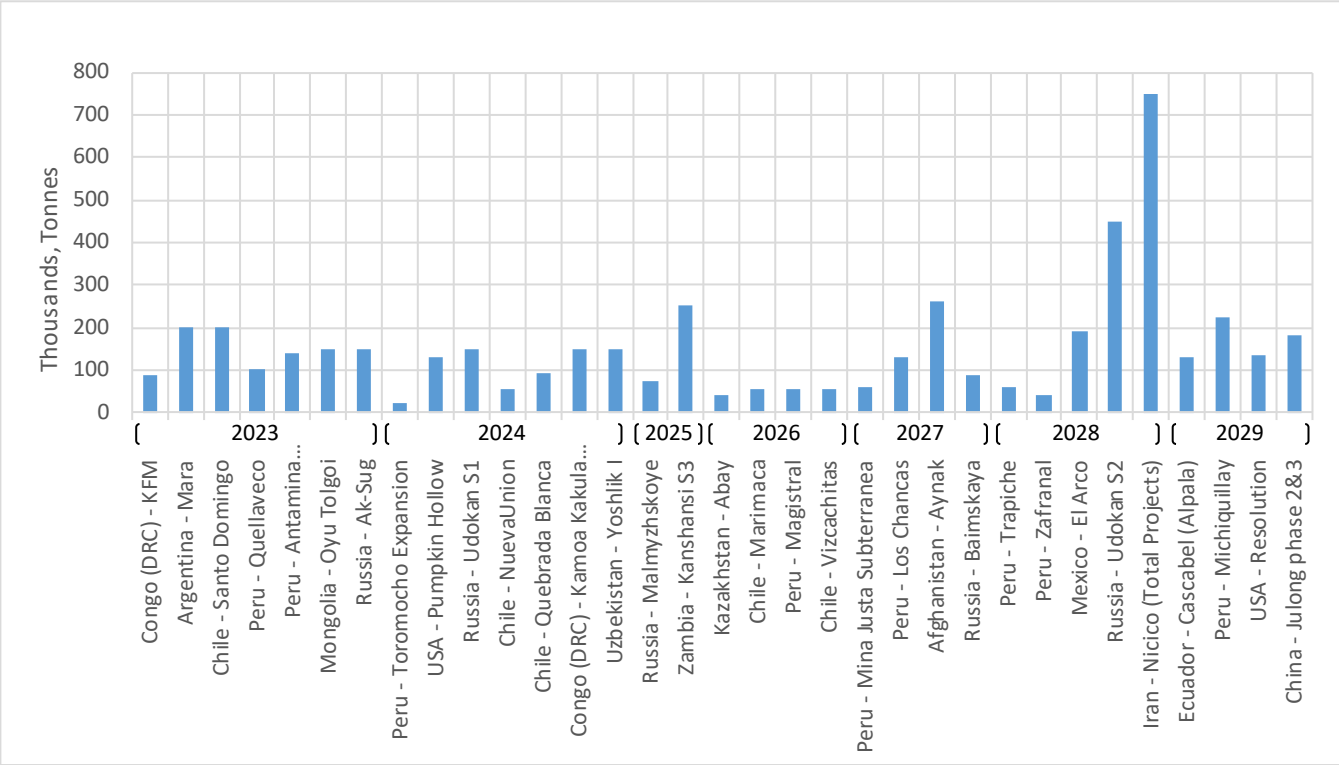
Note: Based on information obtained from open data sources

FUTURE COPPER PRODUCTION – KNOWN PROJECTS

2023-2029



There are currently over 30 copper projects worldwide where projected start dates and average annual copper production are known. Many others are in various stages of development as demand drives leading producers to invest in new projects.

The largest projects include:
Iran - Nicico (Total Projects) – 750,000 tonnes (2028)
Russia – Udokan S2 – 450,000 tonnes (2028)
Afghanistan – Aynak – 260,000 tonnes (2027)
Zambia – Kanshansi S3 – 250,000 tonnes (2025)
Peru – Michiquillay – 225,000 tonnes (2029)
Argentina – Mara – 200,000 tonnes (2023)
Chile – Santo Domingo – 200,000 tonnes (2023)

The ongoing growth of the electric vehicle industry will be a key factor for the copper market.

Note: Based on information obtained from open data sources

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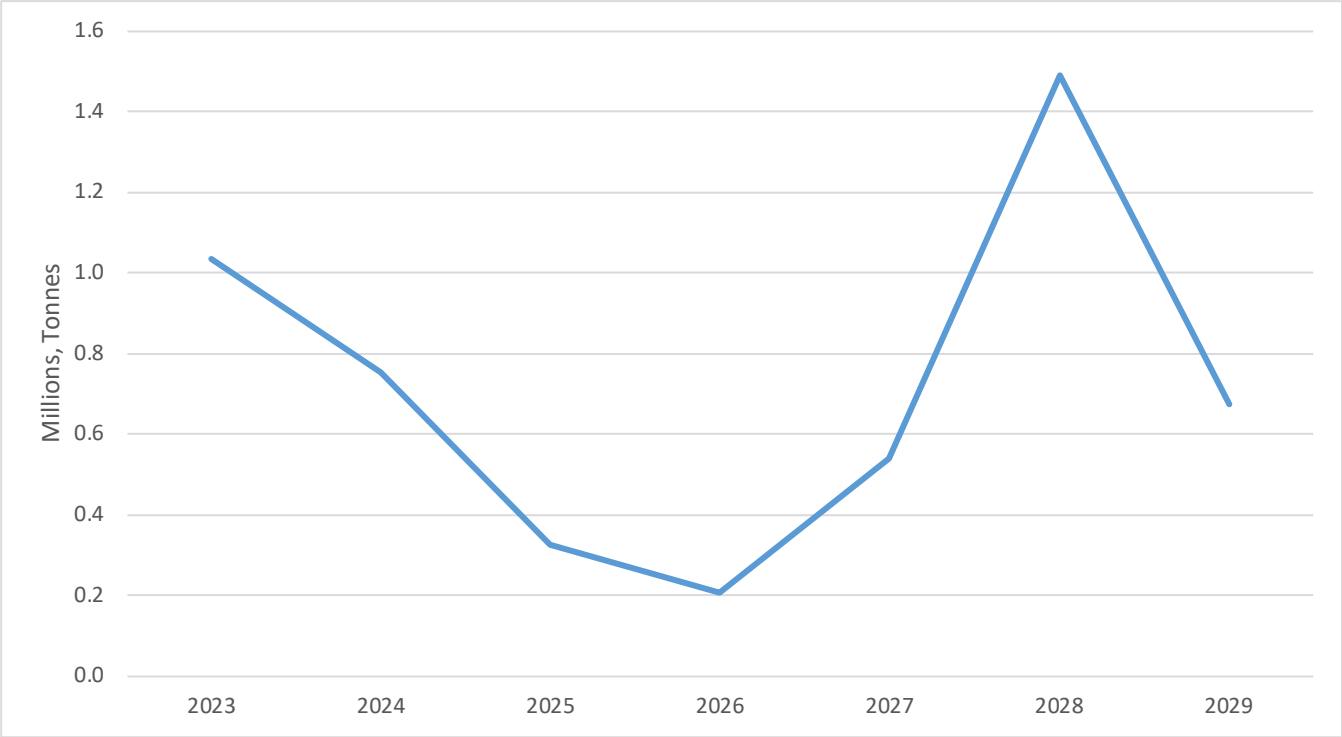
FUTURE COPPER PRODUCTION FROM KNOWN PROJECTS 2023-2029



Total copper production from over 30 know projects totals over 5 million tonnes between 2023 and 2029.

Total production declines year-over-year from 2023 through 2026 from over 1 million tonnes to only about 200,000 tonnes.

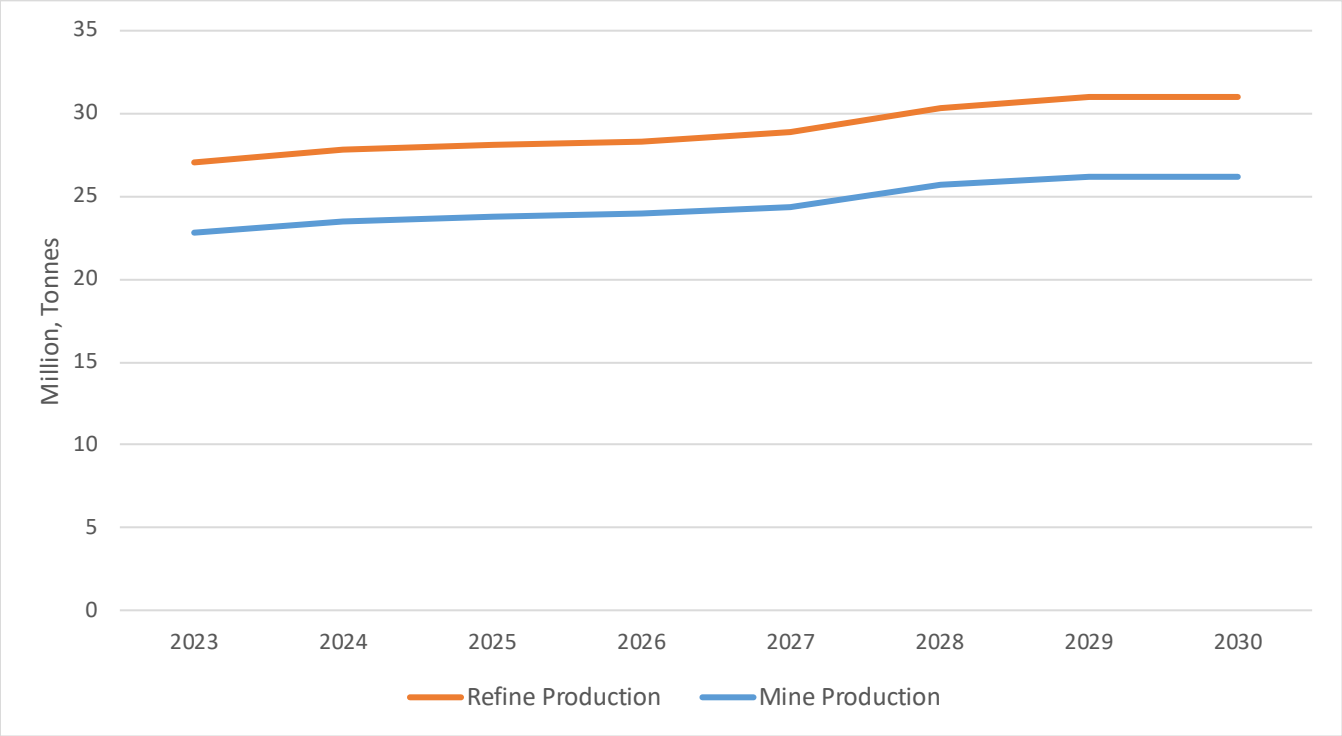
Production increases rapidly over the next two years peaking at almost 1.5 million tonnes in 2028 before retreating to just over 600,000 tonnes in 2029.

The key regions with known projects include:

- Argentina – Mara – 200 000 tonnes – 2023
- Chile – Santo Domingo – 200 000 tonnes – 2023
- Iran – Nicico (Total Projects) – 750 000 tonnes – 2028
- Russia – Udokan S2 – 450 000 tonnes– 2028
- Mexico – El Arco – 190 000 tonnes – 2028

Note: Based on information obtained from open data sources

GLOBAL COPPER PRODUCTION FORECAST 2022-2030



The copper production forecast is based on future projects and grows from about 26 million tonnes in 2022 to over 30 million tonnes in 2030. The difference between copper mine production and refined production is due to recycling which accounts for 18%, or 4.8 million tonnes, of refine copper.

This strong growth is the direct result of increasing demand from the EV market with the ongoing growth being a key factor for the copper market. It is importance the market uses a diversified approach to copper mining to meet the growing demand and ensure market stability. Further, the increase in copper content in batteries indicates ongoing advancements in energy storage technologies.

In summary, copper remains a strategic metal in the transition to clean energy and sustainable mobility. Companies and investors, understanding the significance of this element, can better adapt to market dynamics and demand, contributing to the creation of a more sustainable future.

Sources: US. Geological Survey, International Copper Study Group

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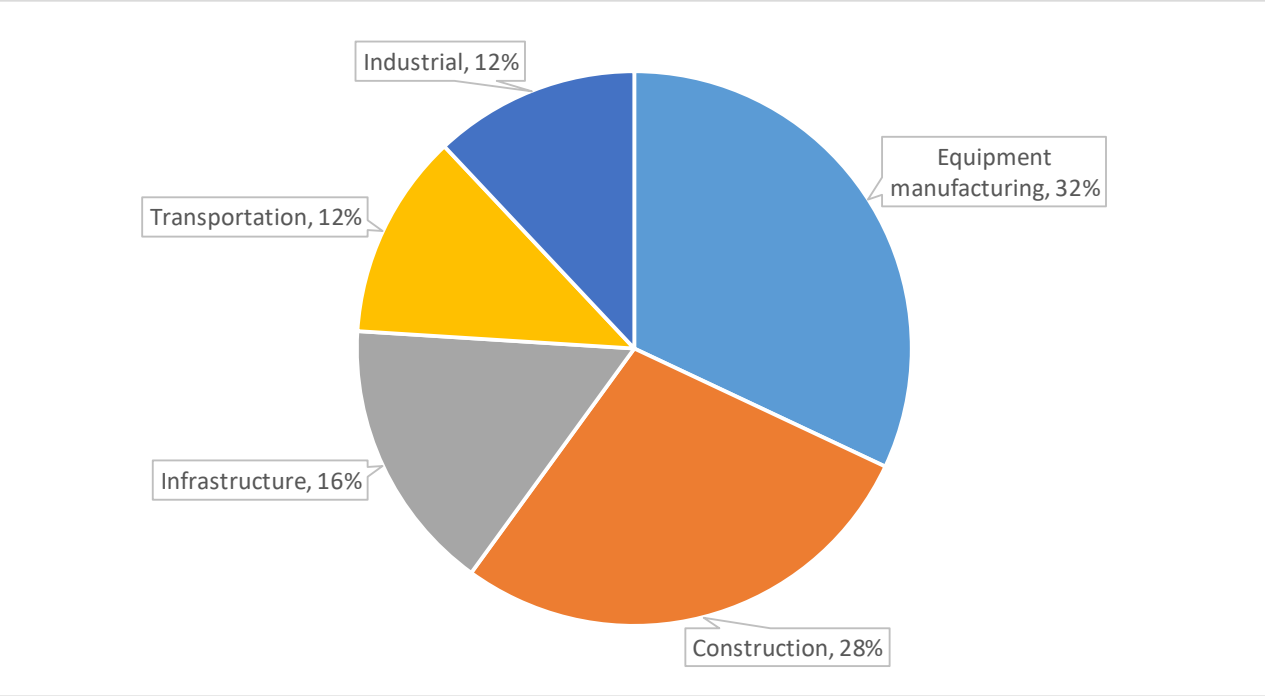
REFINED COPPER USAGE BY SECTOR



Equipment Manufacturing (32%): Copper is used extensively in the production of various equipment and machinery, including electrical and electronic devices, due to its excellent conductivity and durability. It is commonly found in wiring, connectors, and other components.

Construction (28%): Copper is utilized in electrical wiring, plumbing systems, roofing materials, and structural elements. Its corrosion resistance and conductivity make it a valuable material for ensuring the efficiency and longevity of building systems.

Source: Government of Canada

Infrastructure (16%): Copper is crucial in infrastructure projects, especially in electrical systems, telecommunications, and power generation. It is used in the wiring and components of power grids, telecommunications networks, and other critical infrastructure elements.

Transportation (12%): The transportation sector relies on copper for various applications, including wiring in vehicles, electrical components, and infrastructure for electric vehicles (EVs). The growth of the electric vehicle market further increases the demand for copper.

Industrial (12%): In the industrial sector, copper is used in a wide range of applications, such as motors, generators, and other machinery. Its conductivity and resistance to corrosion make it valuable in ensuring the efficiency and reliability of industrial processes.

Overall, the distribution reflects the versatile nature of copper, with applications ranging from electrical and electronic devices to construction materials and infrastructure components across multiple industries.

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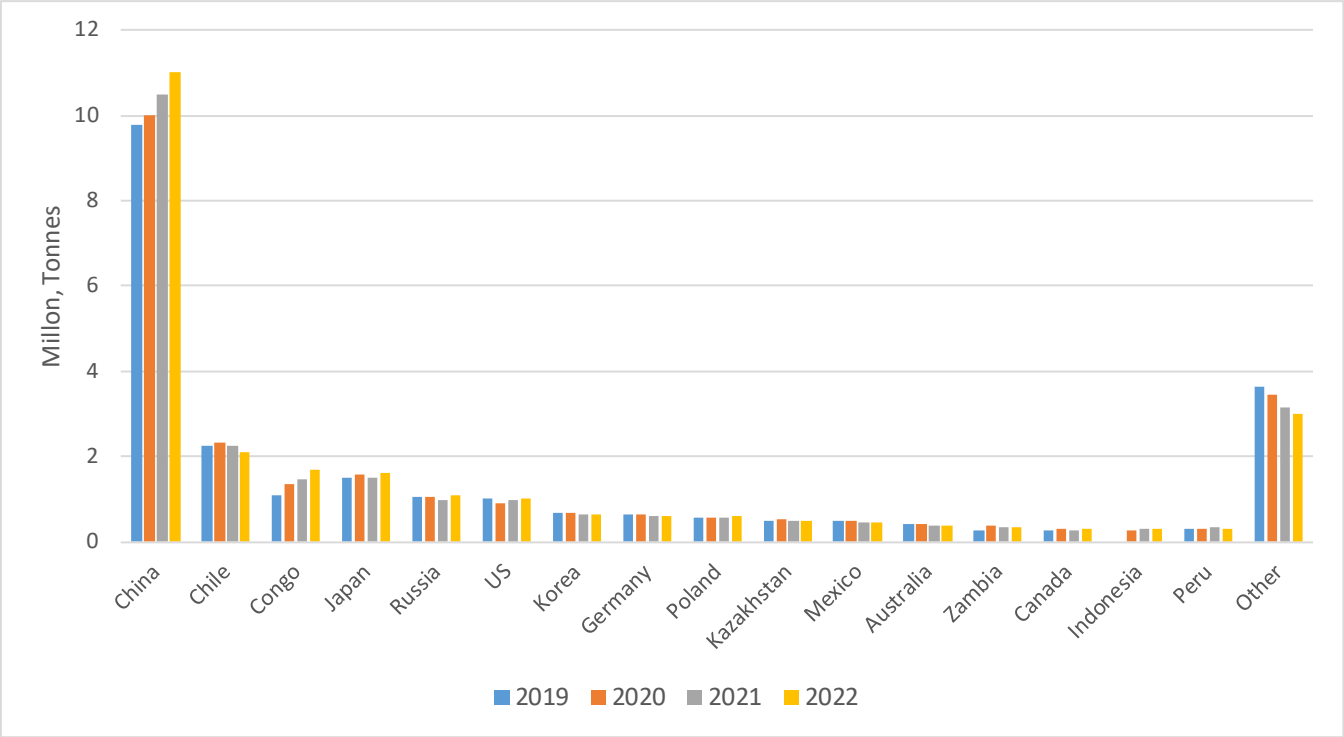
GLOBAL REFINED COPPER PRODUCTION



World refined production of copper, by region, increased 6% from 24.5 million tonnes in 2019 to 26 million tonnes in 2022. Total growth from regions with increasing production, like China, Congo, Zambia, and Canada were partially offset by declines in many other regions.

China is the world leader in refined copper production growing from under 10 million tonnes in 2019 to about 11 million tonnes in 2022. This represents about 42% of total production in 2022.

Chile ranks 2nd with a 2022 market share of 8% although they have seen production decline slightly from about 2.3 million tonnes to 2.1 million tonnes.

Congo is the 3rd largest producer with a 2022 market share of about 7% with production increasing almost 60% from 1.1 million tonnes in 2019 to 1.7 million tonnes in 2022.

Source: US. Geological Survey

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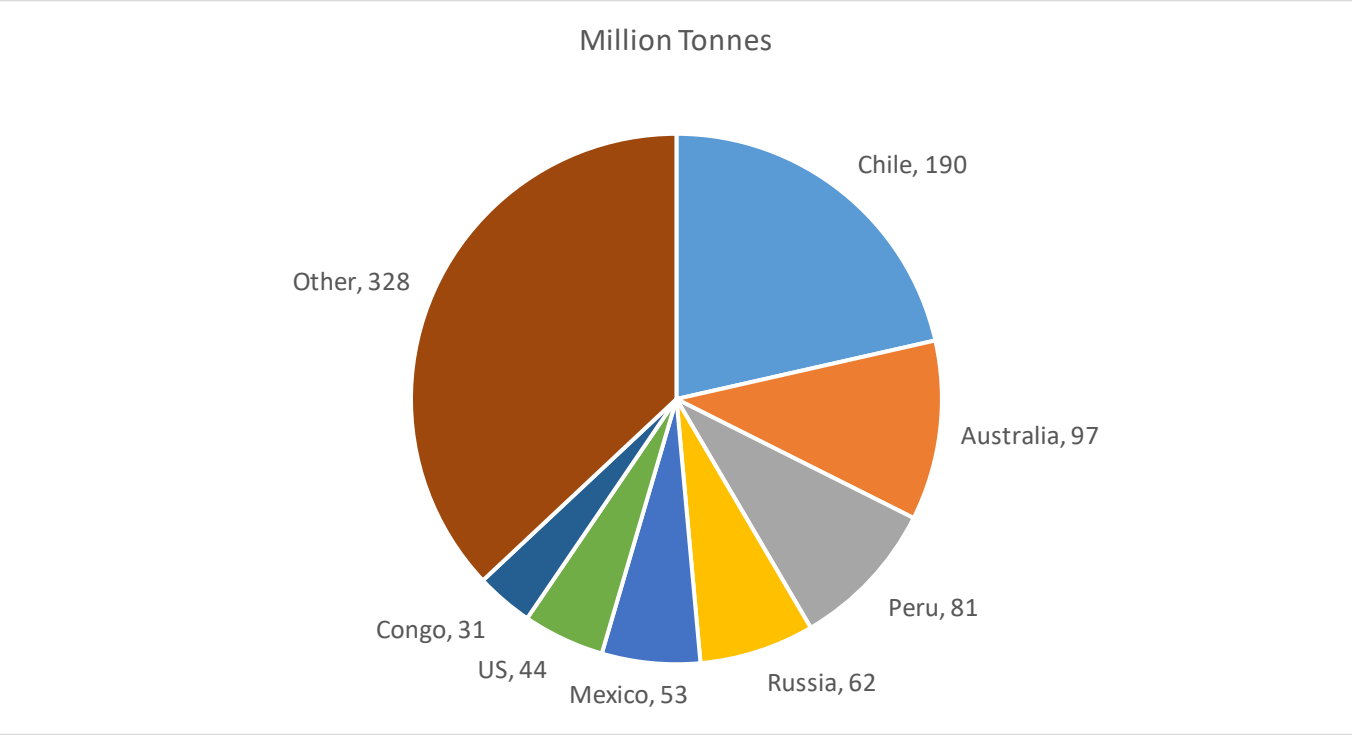
GLOBAL PROVEN COPPER RESERVES



Total global resources of copper are estimated to be about 2.1 billion tonnes. Of this total resource, less than half are proven reserves (890 million tonnes).

Chile accounts for over 20% of global proven reserves (190 million tonnes) followed by Australia at about 11% (97 million tonnes) and Peru at 9% (81 million tonnes).

Most global copper reserves are from stable, or relatively stable, regions and therefore shouldn't result in supply disruptions or shortages caused by political instability unlike other raw materials utilized in the production of EV batteries.

Although Incorrys estimates the global reserves life for copper is over 30 years, more copper resources must be developed to satisfy the demand for EV batteries.

Incorrys expects the price of copper to remain high until at least 2030. This will increase the price of batteries on a per kWh basis. Technological improvements will be required to lower battery prices and, as such, many battery technology applications for large trucks and large stationary energy storage could prove to be uneconomic.

Source: US. Geological Survey
Note: Reserves are a subset of resources that have been evaluated and deemed commercially viable for production.

FINAL THOUGHTS

- Refined copper is a very versatile metal that is used in various applications in several different demand sectors; equipment manufacturing, construction, infrastructure, transportation, and industrial.
- There are significant resources of copper worldwide. The global reserves life for copper is 30 years.
- Demand for electric vehicles represents only 12 percent of total copper demand. Incorrys believes that there will be sufficient copper supply to 2030 to satisfy copper demand for electrical vehicles worldwide.
- There is a significant uncertainty in *longer-term* demand for the burgeoning electric vehicle market but also all the other various applications the copper is used for.
- Further, there is an uncertainty in supply of copper given the politically instability in a number of producing regions.

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WHY INCORRYS INFORMATION SYSTEM

COMPREHENSIVE DATA

Incorrys constantly collects huge amounts of data from multiple sources world-wide

ADVANCED ANALYTICS

Incorrys performs data analysis to ensure quality and consistency among different industries and jurisdictions

ACCURATE FORECASTS

Incorrys employs proprietary forecasting methodologies to ensure accurate forecasts of trends in different industries.

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