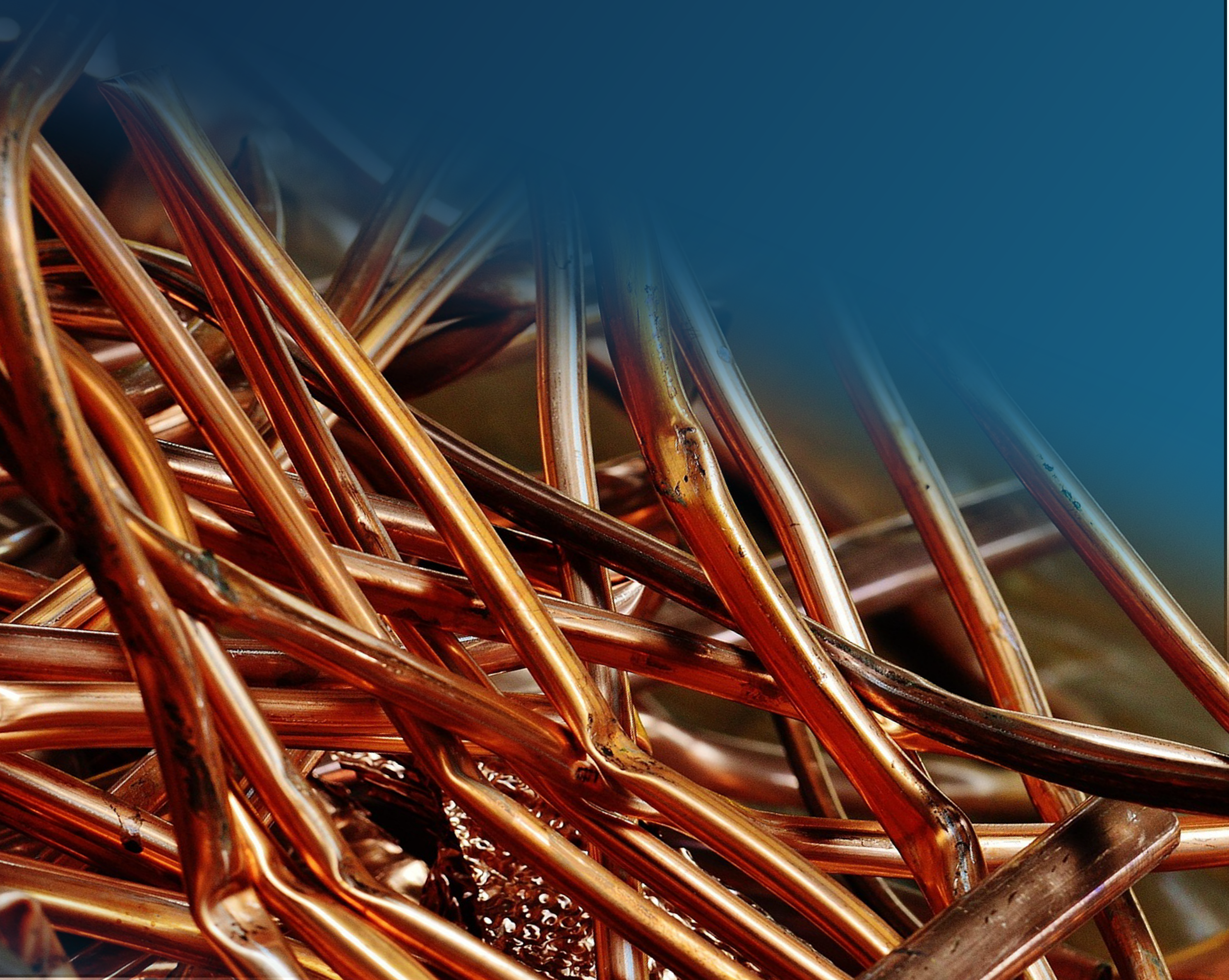
TRUTH

Is Copper the Next Big Shortage?

Structural Deficit Drivers and the Case for a Sustained Up-Cycle.



GLOBAL OUTLOOK

The global copper market faces a medium-term supply deficit that is likely to sustain and reinforce upward price trends in the current cycle.

Expected market deficit.

More than a decade ago, major miners such as BHP warned that the copper market could face a deficit of up to 10 Mt. That projection was not a transient scare, but a preview of what we see today: supply growth has struggled to expand while demand stabilises, extending the market's structural tightness.

Market equilibrium adjustment mechanism.

When projected supply cannot meet future demand, the market must react by raising prices so that this increase makes previously marginal reserves profitable and allows companies to bring new supply to the market. However, some greenfield projects require long lead times and significant capital investment for their development. The result is that supply replenishment is slow and costly, prolonging the period of high prices before equilibrium is restored.

Replenishment data (2014–2023).

Between 2014 and 2023, roughly 205 Mt of copper were mined and a further 30 Mt were lost during processing. By contrast, discoveries over the same period totalled only 181 Mt. Even after including unreported resources, the total would barely reach 244 Mt, just enough to match cumulative consumption according to MinEx Consulting. This indicates that reserves are being replenished only at the rate they are being consumed, leaving no safety margin for the expected growth in future demand.

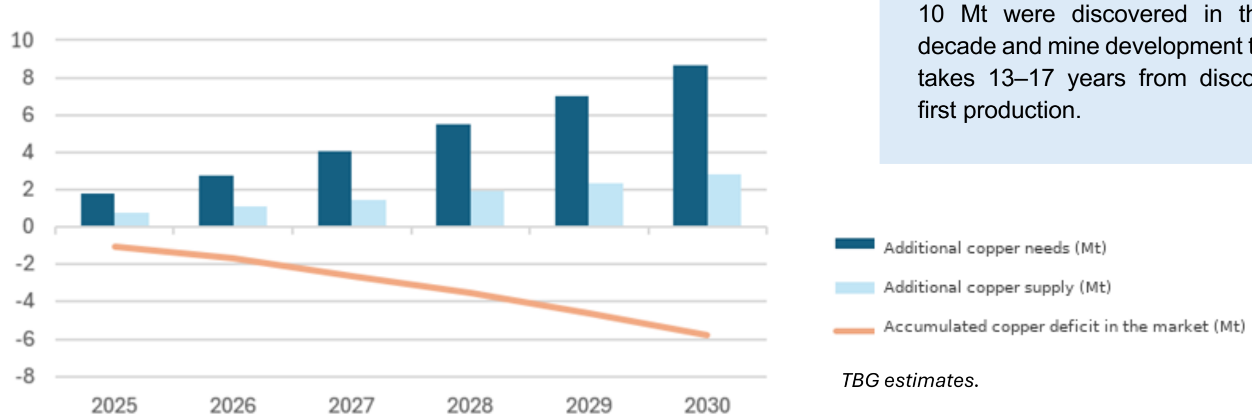
Trend.

Beyond the replacement shortfall, recent discoveries are increasingly scarce, lower-grade, and smaller in scale. This deterioration in quality and quantity constrains supply growth, raises industry unit costs, and widens the market's structural gap. The result is a persistently tight supply/demand balance.

Price impact.

Current market dynamics indicate that copper will continue to face tight supply in the coming years. This imbalance will make the price mechanism the primary regulator, driving structurally higher price levels over the medium term.

Figure 1. Global copper market accumulated supply, demand and deficit, Mt.



TBG estimates.

HIGHLIGHTS

Economic and demographic growth is the primary demand driver.

By itself, demographic and economic growth through 2030 will require more than one million tons of additional copper per year, excluding the energy transition.

Energy system shift: from fossil-based to metals-intensive.

Each megawatt of installed renewable capacity uses up to twice as much copper as a fossil-based plant.

AI's physical footprint: data centres are copper-hungry.

Between 2025 and 2030, data centres will add more copper to the system than most traditional industries.

Recycling, the secondary source, will help, but not close the gap.

Growth in scrap recycling will ease supply pressures but remain insufficient to balance the market.

Declining ore grades and deposit quality.

Average grades have fallen ~1.8% per year; the best deposits have largely been mined. What remains is lower-grade, deeper, more remote, costlier, and harder to extract.

New supply remains slow.

New copper deposits must be brought operative or existing operations expanded. Only seven deposits above 10 Mt were discovered in the past decade and mine development typically takes 13–17 years from discovery to first production.

DEMAND DRIVERS

Copper demand is propelled by five fundamental catalysts. The first (and most decisive) is demographic and economic growth. Additional medium-term drivers include India, the energy transition, the expansion of data centres and the adoption of electric vehicles.

Let us delve into the drivers shaping this market and quantify the copper required to meet these five needs over the medium term, through 2030.

Economic and demographic growth.

Per-capita copper consumption typically follows an S-curve: low in the early stages of development, accelerating as incomes rise, and stabilizing at higher levels. This pattern makes population growth and rising per-capita income structural demand catalysts.

In 2024, per-capita copper consumption was 3.3 kg per person, relative to a world population of 8.15 billion and refined copper consumption of 26.9 Mt. Projections by organizations such as the United Nations and the World Bureau of Metal Statistics indicate 0.96% annual population growth and 2.5% annual growth in GDP per capita through 2030. On these drivers alone, per-capita consumption could reach 3.7–4.3 kg, implying >22% growth in global demand over five years.

These estimates, which assume a continuation of current trends, imply an annual growth of around one million tons of copper through 2030. This calculation does not include additional demand factors such as the energy transition or the rollout of new technologies, which act as additive forces further reinforcing structural pressure on the copper market.

India.

The second major potential driver leading copper demand is India, which recently became the world's most populous country, surpassing China, the current leader in global copper consumption with nearly 50% of the global consumption. Since copper consumption is closely linked to the level of economic development (S-curve acceleration in adoption), China's trajectory serves as a useful benchmark for projecting India's potential future. In 2007, China had a per capita GDP of USD 2,600 and consumed 5 Mt of copper. By 2022, India reached a similar level of income (USD 2,400), but its copper consumption was less than 1 Mt, demonstrating a significant gap.

This consumption gap, potentially exceeding 4 Mts per year, is not a result of projections, but rather reflects what India should theoretically be consuming today, given its population and level of development. The need to modernise a deficient electrical infrastructure and boost its industrial competitiveness reinforces the idea that India will significantly increase its copper demand in the coming years.

For a visual summary, see Figure 2, in the appendix.

However, this study adopts a conservative stance: it is not assumed that India will completely close the gap with China, as its economic structure (more oriented toward the services and telecommunications sectors) is not as copper-intensive as the industrial base that drove China's growth. Even so, the current gap is difficult to justify solely due to structural differences.

India not only represents an emerging economy with great potential, but also a significant growth driver for global copper demand in the short, medium, and long term.

“This consumption gap, potentially exceeding 4 Mt per year, is not a result of projections, but rather reflects what India should theoretically be consuming today”

Energy transition.

Some supranational entities such as the European Union, the IMF, the World Bank, and the International Energy Agency (which has outlined the shift from a fuel-based to a mineral-based energy system) have recently expressed concern about whether there are enough metal to meet the requirements of the Net Zero Emissions goal by 2050. Meeting this milestone will require greater electrification for the energy transition, boosting the use of electric vehicles, renewable electricity, and the need for expanded electrical infrastructure that will be much more copper- and zinc-intensive than fossil fuel or nuclear plants. In fact, installing a new renewable energy plant requires twice as much copper as installing nuclear, coal, or gas plants: around 2,800 kg per installed MW. And the vast majority of new global generation capacity is already renewable. By 2024, the world added 580 GW of renewable energy (93% of total new capacity), of which 78% was solar. The International Renewable Energy Agency (IRENA) forecasts that global renewable capacity will double from 4,400 GW installed to 9,900 GW by 2030. S&P agrees with this undeniable trend, but forecasts compound growth of between 9% and 10%. For a visual summary, see Figure 3 in the appendix.

Last year, 580 GW of renewable energy was added. If we estimate a 9,5% compound average growth rate through 2030 (25% CAGR over the past 5 years), renewable energy should reach 7,000 GW installed. Both onshore wind and solar require 2,800kg of copper for each installed megawatt, and represent 90% of new installed capacities. Offshore wind requires around 8,000kg, representing 3% of installed capacity (for a visual summary, see Figure 4, in the appendix). With those numbers the need for additional copper in the coming years due to the energy transition factor between now and 2030 is around 0.15 Mt and more than 1 Mt per year.

Data centres.

Data centres have become critical infrastructure for the global economy with a strong concentration in the US and Europe, and accelerated growth in Asia. This deployment implies a growing demand for copper, used in three key areas: power supply, cooling, and internal equipment.

The estimate of copper usage per installed megawatt (MW) varies depending on the source. Some projections point to intensities of up to 65,000 kg/MW, but this study adopts a conservative approach based on a real case: the Microsoft Azure data centre in Chicago, built in 2022 and with a certain degree of scale and efficiency. This centre, with 80 MW capacity, required approximately 2,177 tons of copper, implying an intensity of 27 tons of copper per MW. Given the scale and relevance of the project, this one is considered a representative reference for medium- and large-scale projects.

According to Cushman & Wakefield and Goldman Sachs, global installed data centre capacity will grow from 55 GW in 2025 to approximately 122 GW in 2030, implying a compound average growth rate of 14%. Applying the aforementioned conservative intensity, it is estimated that this industry could demand between 200,000 and 400,000 tons of copper annually until 2030, accumulating up to 1.5 Mt in five years (~6% of current annual consumption).

Although some market estimates seem exaggerated (driven by high copper intensity), this segment represents a significant structural tailwind for copper demand, closely linked to the growth of artificial intelligence and global digitalization.

Electric vehicles.

Since 2023, the pace of EV adoption has moderated in some Western markets, without implying a structural reversal. Both battery-electric vehicles and hybrids continue to consolidate as key technologies in the transport transition, likely coexisting with internal combustion engines over the next decade. Ongoing technological progress, falling battery costs, intensifying competition and rising environmental awareness should continue to support this trend.

According to the IEA's Global EV Outlook 2025, battery electric vehicle (BEV) sales could reach 45 million by 2030 (39% market share), while plug-in hybrid vehicles (PHEVs) would add another 10 million (8%). Significant growth is also projected in heavy-duty transport: electric truck sales up to 1.9 million units and 800,000 electric buses annually, with a market share close to 60%.

The electrification of transport is estimated to generate an additional combined demand between 300,000 and 900,000 tons per year until 2030 (between 1% and 3% of current global consumption), resulting in a structural growth driver for the metal.

"The electrification of transport is estimated to generate an additional combined demand between 300,000 and 900,000 tons per year until 2030"

COPPER DEMAND INCREASE

The Indian factor will be excluded from the quantitative analysis due to the possibility that, given its service-oriented economy, its potential demand for copper could be structurally lower than industrialized economies. However, we believe that the consumption gap compared to economies at a similar level of development is anomalously low and should be corrected, at least in part, assuming a significant tailwind for the sector. Thus, the total additional copper needs between now and 2030 derived from each of the factors, excluding India, are as follows:

Table 1. Additional copper requirements for four of the five quantified factors, Mt.

	2025	2026	2027	2028	2029	2030
Copper requirements for economic and vegetative growth	0.94	1.91	2.91	3.95	5.02	6.13
Copper needs due to energy transition	0.15	0.32	0.50	0.70	0.92	1.16
Copper needs for data centres	–	0.22	0.26	0.29	0.34	0.39
Copper requirements per electric vehicle	–	0.32	0.42	0.55	0.72	0.95
Total extra copper requirements	**1.09**	**2.77**	**4.08**	**5.49**	**7.00**	**8.63**

TBG estimates.

We should also mention that, due to these factors, we face an increase in copper demand of around 6% in 2025.

Although we believe the projected growth rates are realistic and conservative, it is important to consider that higher prices also send signals to demand, stimulating efficiency in the use of copper. For example, is it feasible for the automotive industry to standardize a 48V vehicle architecture within the next five years? It could be. We leave it up to the reader to decide whether a possible correction through this or other similar means would constitute the third derivative of the thesis (very specific aspects derived from the causality and feedback of the thesis itself: long-term structural high copper prices).

High prices also encourage the development of substitutes, which could partially or even completely mitigate the projected imbalance: the greatest threat is graphene technology, which we will discuss in the conclusions.

But can copper supply keep pace? Let's analyse it.

SUPPLY DRIVERS

As anticipated in the introduction, analysing the price of a raw material like copper requires a balanced assessment of the medium-term supply and demand fundamentals. The objective is to determine whether the market will have sufficient metal available to meet its future needs. Depending on the outcome of this balance, the price will tend to adjust either to the marginal cost of the least efficient producer (in surplus contexts) or to the incentive price necessary to stimulate new investment and expand production capacity (in structural deficit scenarios). This distinction is not trivial: it allows us to anticipate whether we are dealing with an industry with structural tailwinds and growth prospects, or a sector with little expected traction.

Supply analysis remains fundamental in a market where supply shocks can trigger sharp short-term price movements and sustained long-term movements. In commodities sector, supply responds to the investment cycle (CAPEX), where prices act as signals: high prices incentivise new projects (including substitute products), but these can take years to materialise, introducing a cyclical and self-regulating dynamic.

The main question is whether there will be sufficient supply to meet future demand. To this end, four main factors are identified that influence the evolution of supply: the progressive decline in ore grades, the opening of new mines, operational disruptions, and recycling capacity.

Ore grades.

One of the key factors in mining economics is ore grade, which measures the concentration of metal contained in the extracted rock. The higher the grade, the lower the extraction cost per unit of metal produced since less material needs to be moved and processed to achieve the same output.

Historically, ore grades have shown a downward trend. This follows a logical pattern: deposits with the highest metal concentration are exploited first, and as they are depleted, lower-grade deposits are required. A century ago, open-pit mines operated with ore grades close to 5%, and underground mines even higher. Today, open-pit projects typically operate with ore grades between 0.5% and 1%, while underground mines, although operating at higher grades, face higher unit costs due to their lower efficiency and limited scale. For a visual summary, see Figure 5 in the appendix. This deterioration in ore grades has had a direct impact on global production. According to a study by Richard Mills, over the last five years, the world's top 20 mining companies have collectively produced 20% less than expected, primarily due to falling ore grades. Despite production guidance, operational reality often deviates. In this context, it's worth remembering that costs tend to structurally rise, even when producers project otherwise.

This is a factor that removes supply from the market. We'll quantify this in the final section.

Secondary source; scrap.

Fortunately, copper can be recycled indefinitely without any loss of properties, which partly eases pressure on primary supply: today, around 18% of global supply (about 5 Mt per year) comes from scrap. We identify tensions linked to the U.S. market: the United States generates around 1.5 Mt of recycled copper annually and exports approximately half of it. In the near term, the threat of tariff measures in the U.S. has disrupted trade flows and contributed to concentrating a significant share of inventories in COMEX warehouses. This reallocation of stocks may reduce relative availability in other markets, increase volatility and widen regional differentials, while also providing support to prices outside the U.S., including on the LME. See Figure 6 in the appendix.

Beyond this cyclical noise, our analysis focuses on the medium and long term, once Trump is no longer in the White House: the recycling rate should continue to increase. The specialised literature places its compound annual growth between 4% and 8%; we adopt the IEA's 7% estimate as a reference to incorporate it into the model.

Under this assumption, recycling would add between 0.3 Mt and 2.3 Mt per year from now through 2030.

Operational disruptions.

Every year, global copper supply is affected by operational disruptions. These can be due to strikes, accidents, natural disasters, or (increasingly frequently) environmental factors such as prolonged droughts or heavy rains that disrupt operations in different regions of the world.

In December 2023, for example, the Panamanian government ordered the closure and expropriation of the Cobre Panamá mine, operated by First Quantum, one of the largest copper mines in the world. This decision removed approximately 600,000 tons of copper from the market annually. In the summer of 2024, Lundin Gold and BHP faced strikes at two of their major copper operations, and more recently, Ivanhoe Mines revised its production guidance for 2025 downwards by approximately 150,000 tons due to seismic activity and flooding at its facilities. Adding to this are the disruptions to operations in Zambia following the failure of a tailings dam at a Sino-Metals Leach operation, the impact of which on production volume has yet to be quantified, and, most recently, the accident at Grasberg (Freeport-McMoRan), which is expected to impact production by nearly 300,000 tons in 2026.

This is a factor that removes around 5% of supply from the market. See Figure 7 in the appendix. Therefore, the effects of this type of disruption on the global market balance are relevant, but we believe it is a factor worth monitoring in the short term, as it has a greater impact with low inventories. We do not believe the rate of disruption will increase sharply for any reason, so we will not incorporate it into the medium- and long-term analysis.

New Mines coming.

Of the three key factors shaping copper supply (recycling, ore grade and supply disruptions), only the first shows a likely growth trajectory in the near term. The other two, by contrast, structurally constrain the volume of copper available to the market. The sustained decline in ore grades is particularly concerning and, in theory, could be offset by bringing new mines onstream. However, this is precisely where the mining industry faces one of its most binding constraints and challenges.

The reality is that copper discoveries have become increasingly scarce. At the beginning of the century, the industry was finding between 15 and 20 new deposits per year, with an average size of 60 Mt per discovery. Over the past decade, that figure has fallen sharply to just 3–4 discoveries per year, with a much more modest average of 30 Mt, according to MinEx Consulting. Only seven deposits containing more than 10 Mt have been identified over the last ten years. Clear evidence of the depletion of easily accessible resources and of the rising technical, geological and geopolitical complexity associated with recent finds. Moreover, global exploration effort has weakened after several years of subdued copper and broader commodity prices, reducing exploration budgets (especially among juniors) and limiting the pipeline of new projects. For a visual summary, see Figure 8 in the appendix.

On top of this, bringing a new project into production has become a marathon. Developing a mine can take 13–17 years from discovery to first production, and it is exceptional for a project to come online in less than five. This reflects rising technical complexity, high capital intensity, the need for large-scale financing, and lengthy environmental and permitting processes alongside social pressures and local opposition. Taken together, these factors create an operating environment that is increasingly unconducive to rapidly expanding copper supply through new developments.

INCREASE IN COPPER SUPPLY

Having laid out all of these points, we now analyse the expected copper supply over the coming years.

First, we need to adjust the 23 Mt of copper mined in 2024 for the expected decline in ore grades. According to AME Group, average grades have fallen at a 1.8% CAGR since 2005. Individual mine performance varies, but we believe this is broadly consistent with the global backdrop.

Second, we need to add the new mines expected to come online in the next few years. To do so, we extrapolate the annual copper additions observed over the past decade. From 2013 to 2022, mined copper increased from 18.3 to 21.5 Mt. On average, this implies an increase of 350 kt per year (i.e., approximately 1.8%). Extending this trend would be optimistic, as current start-ups largely reflect projects initiated 20 years ago during the 2000s supercycle. As discussed, since 2010 new project exploration has slowed by around 80%, so we believe that, at best, net new primary supply will be broadly flat through 2030 for these reasons.

Finally, we add secondary (recycled) copper supply and update the growth rate of this market to 7%. Under these assumptions, the resulting total expected copper production is as follows

Table 2. Global copper supply decreases and increases according to previous detailed drivers, Mt.

	2025	2026	2027	2028	2029	2030
Deterioration in ore grades −1,8%/year	−0.39	−0.38	−0.37	−0.37	−0.36	−0.36
New copper supply added	0.40	0.40	0.40	0.50	0.50	0.50
Total copper mined	22.80	22.80	22.80	22.90	22.90	22.90
Secondary source (scrap) 7% CAGR.	4.86	5.20	5.56	5.95	6.37	6.82
Total copper produced.	27.66	28.00	28.36	28.85	29.27	29.72
Additional copper supply	**0.76**	**1.10**	**1.46**	**1.95**	**2.37**	**2.82**

TBG estimates.

Globaldata's outlook places copper supply at 29.3 Mt, very close to our estimates.

Currently, we expect copper output to increase by 2.8 Mt annually by 2030, not because more copper will be mined, but because of the positive projections and development of the secondary source. However, this could change. We'll discuss this in the conclusions.

CONCLUSION

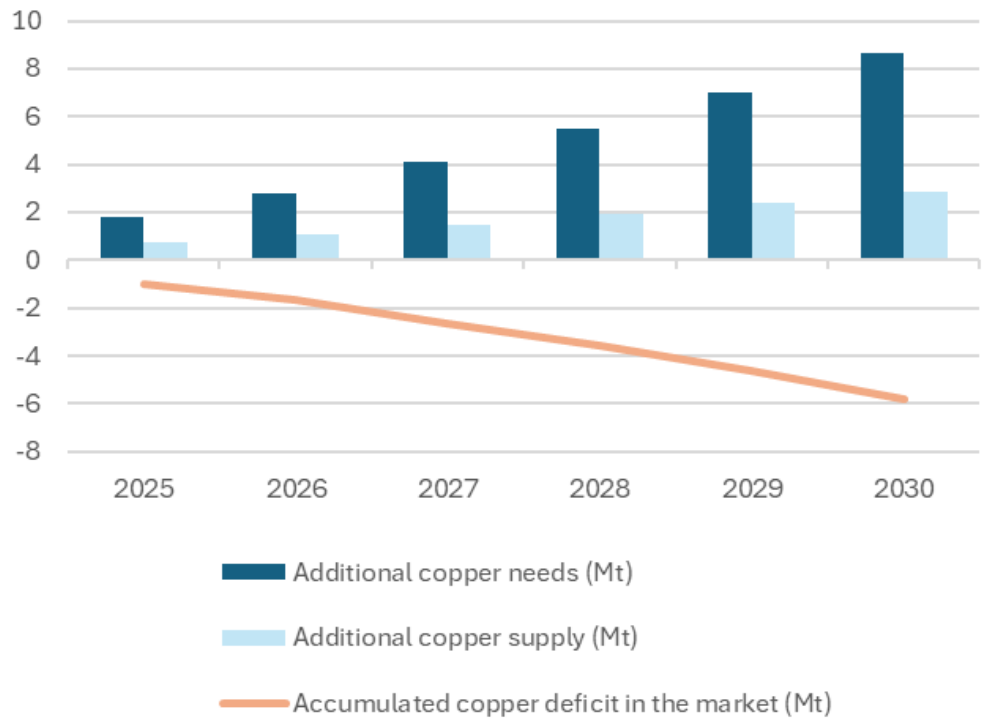
If we match the projections between supply and demand, the imbalance in the market is as follows.

Table 3. Global copper market accumulated supply, demand and deficit

	2025	2026	2027	2028	2029	2030
Total extra copper requirements.	1.79	2.77	4.08	5.49	7.00	8.63
Additional copper supply.	0.76	1.10	1.46	1.95	2.37	2.82
Accumulated copper deficit in the market.	**1.03**	**1.67**	**2.62**	**3.54**	**4.63**	**5.81**

TBG estimates.

Figure 1. Global copper market accumulated supply, demand and deficit, Mt.



TBG estimates.

Different sources agree that the copper market will face a significant deficit by 2030 if old or new mines are not developed. McKinsey estimates a shortage of 6.5 Mt, while Wood Mackenzie raises that figure to 8.5 Mt. The International Energy Agency (IEA) projects that up to 30% of the necessary supply could be missing. These gaps reflect growing structural demand driven by the energy transition and emerging technologies, compared to a limited supply due to the slow expansion of new projects.

What about the price?

A decade ago, some players such as BHP were already projecting a 10 Mt deficit in the copper market. What has happened since then?

The world is not running out of copper. When supply is scarce, the market must adjust. That adjustment comes through the necessary increase in prices to incentivise production and new supply: it reclassifies previously marginal, uneconomic resources into economically viable reserves through brownfield projects, and it stimulates investment in greenfield exploration; projects which, as discussed earlier, are more complex and costly to build and operate, and whose resources therefore generally need to be extracted at higher cost. With the right incentive, projects move forward and output increases, restoring the balance between supply and demand. However, this process is slow and costly, and it creates tension along the way, particularly as tighter regulation makes market adjustment more difficult.

At the same time, today's replacement rate shows how fragile that balance can become. Between 2014 and 2023, around 205 Mt of copper were mined and a further 30 Mt were lost during processing, while discoveries added only 181 Mt of new copper. Even after including unreported resources, the total would barely reach 244 Mt, just enough to offset consumption.

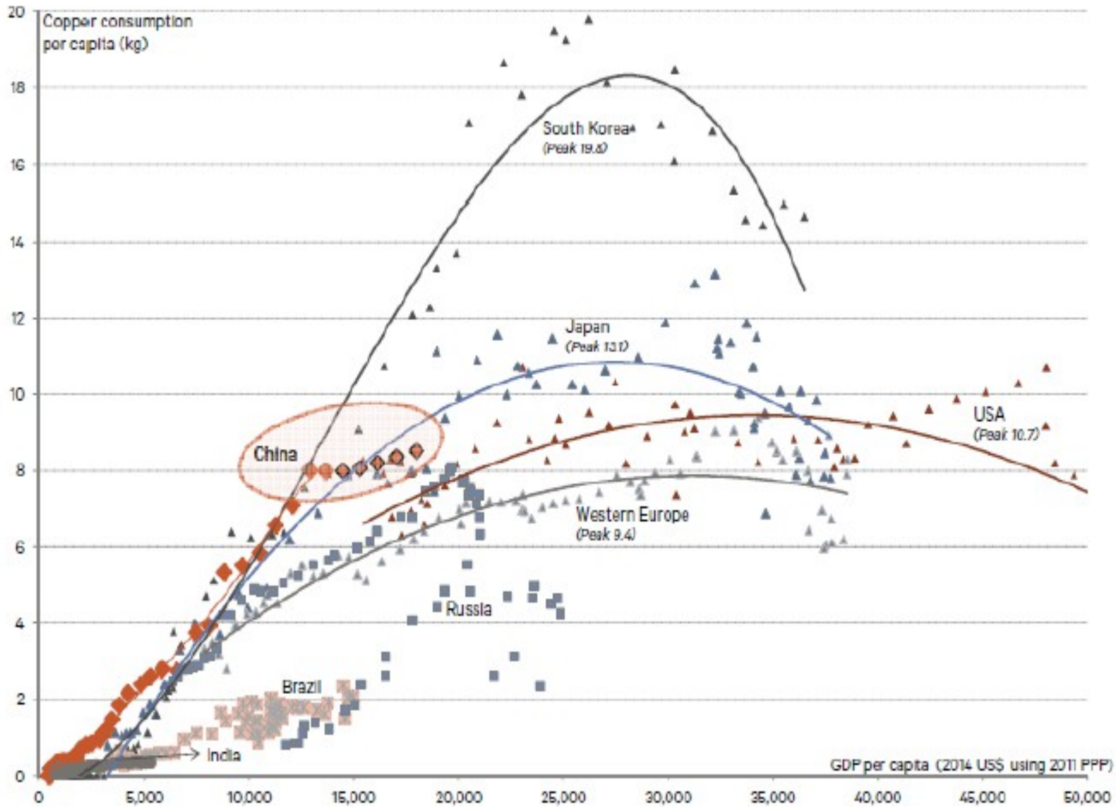
The conclusion is clear: reserves are being depleted faster than they are being replaced, and new discoveries are becoming less frequent and smaller. This structural gap keeps supply tight and puts upward pressure on prices. With few (if any) known substitutes capable of materially challenging copper's end uses over the medium term, rebalancing the market requires incentivising new capacity, and the most effective mechanism is price itself: higher and sustained levels that make currently marginal projects viable, unlock investment, and expand production. As a result, we believe it is reasonable to expect copper to trade structurally in higher ranges over the long term, providing strong tailwinds for the sector.

These price increases also carry a risk for the broader ecosystem, in the form of substitutes that could challenge copper's dominant position in electrical and thermal conductivity. There are better conductors (gold and silver) but at a much higher cost, making them economically unviable. Elevated copper prices, including current levels, may accelerate substitution in certain applications (where regulations allow), primarily toward aluminium, but substitution is not linear. Aluminium, with 40% lower conductivity than copper, requires larger cross-sectional area to deliver equivalent performance, and its use is constrained by technical and safety requirements. In applications where current density, reliability and performance in confined spaces are critical, copper remains difficult to replace.

The biggest potential threat to copper could be graphene. However, while graphene offers superior technical properties, large-scale production at competitive costs remains technologically nascent, limiting its medium-term economic viability as a mass substitute for copper.

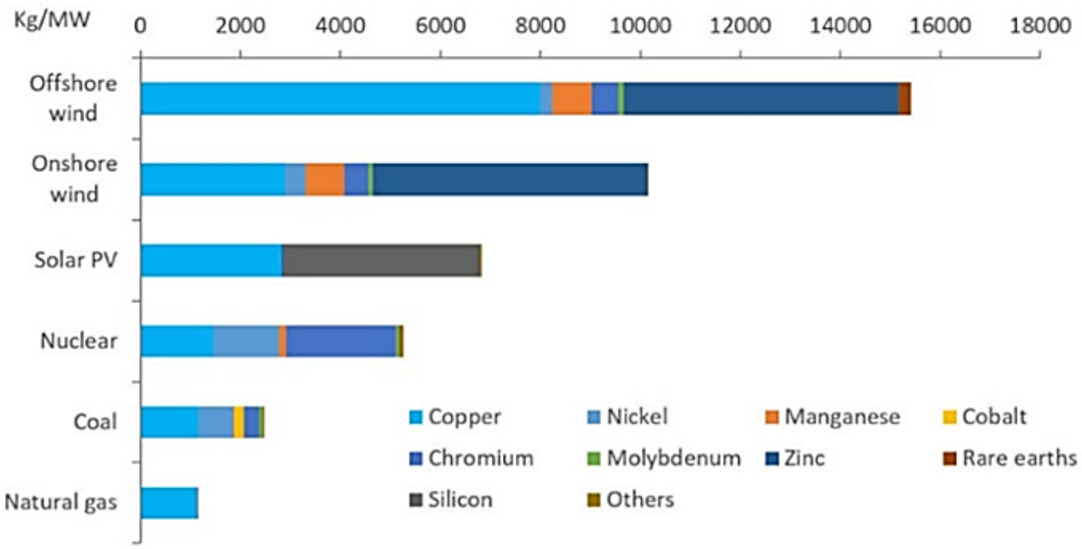
APENDIX

Figure 2. Per capita copper consumption (kg) and per capita income (USD) across different economies.



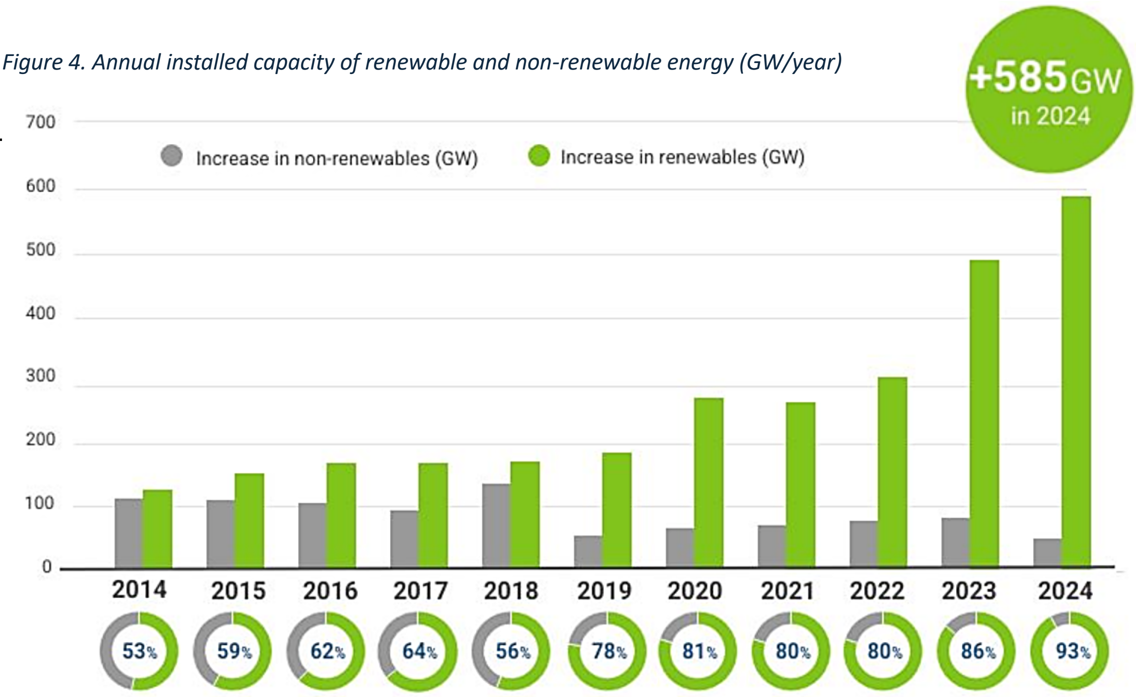
AME; Bloomberg; Berenberg estimates.

Figure 3. Copper intensity across different power generation technologies.



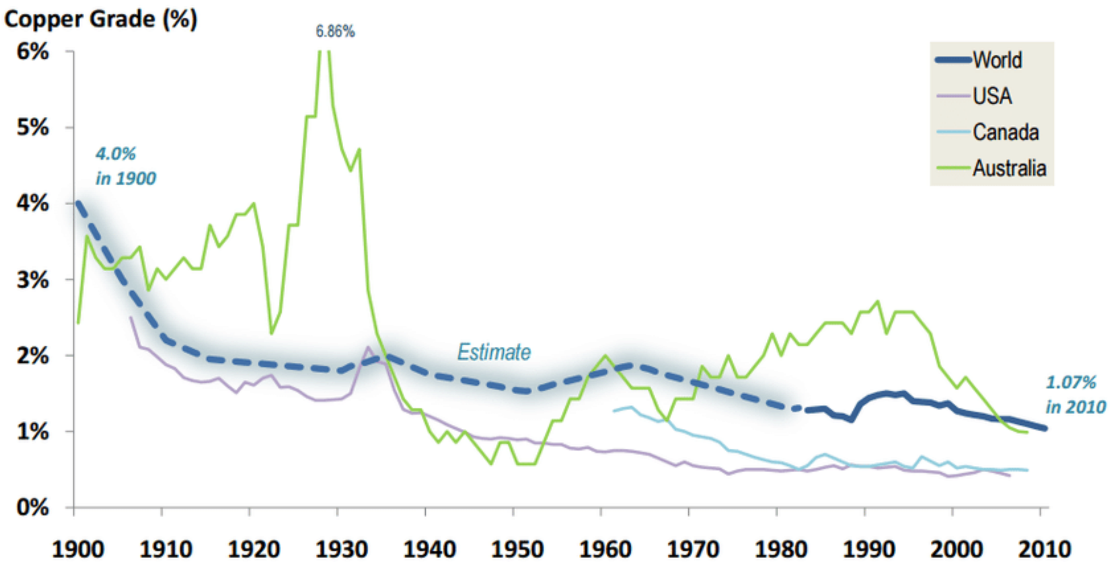
BofAGlobal Research, US Energy Information Administration; 2024. IEA (2021), IEA.

Figure 4. Annual installed capacity of renewable and non-renewable energy (GW/year)



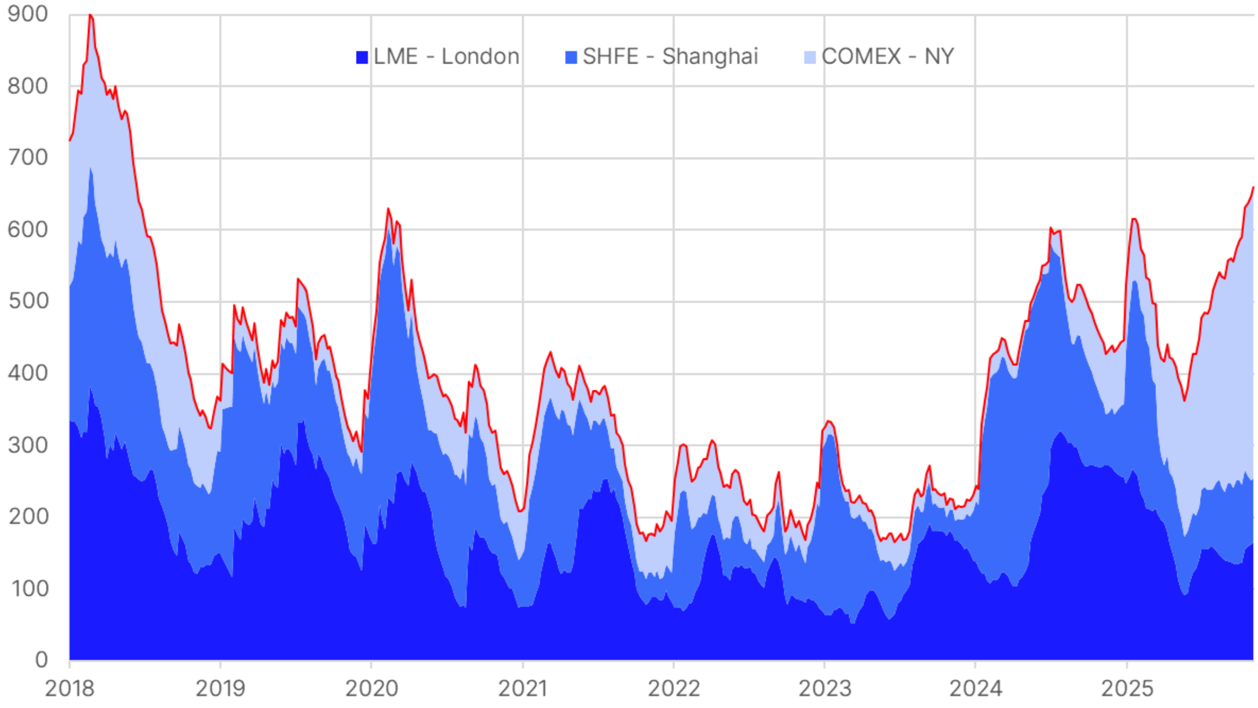
International Renewable Energy Agency.

Figure 5. Estimated global copper ore grade and ore grades in the main producing countries (1900–2010).



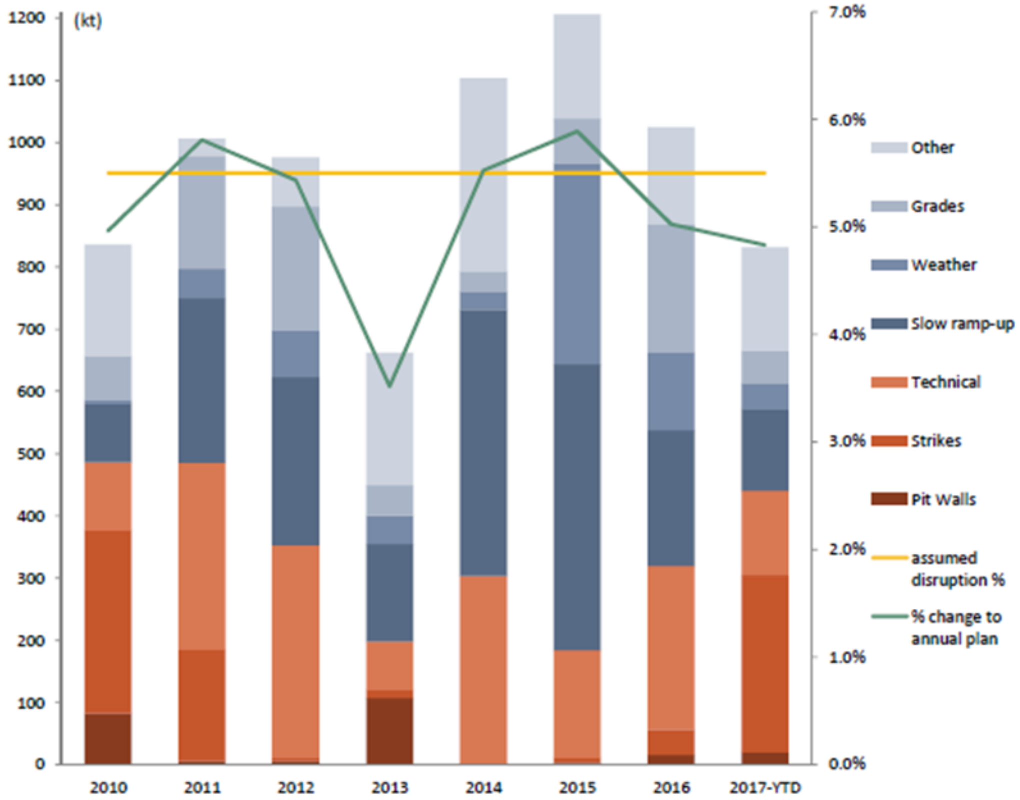
USGS, Seeley G. Mudd (2009), Brook Hunt, UBS.

Figure 6. Inventory trends in warehouses monitored by the LME, SHFE and COMEX (2018–2025, kt; x1,000 t)



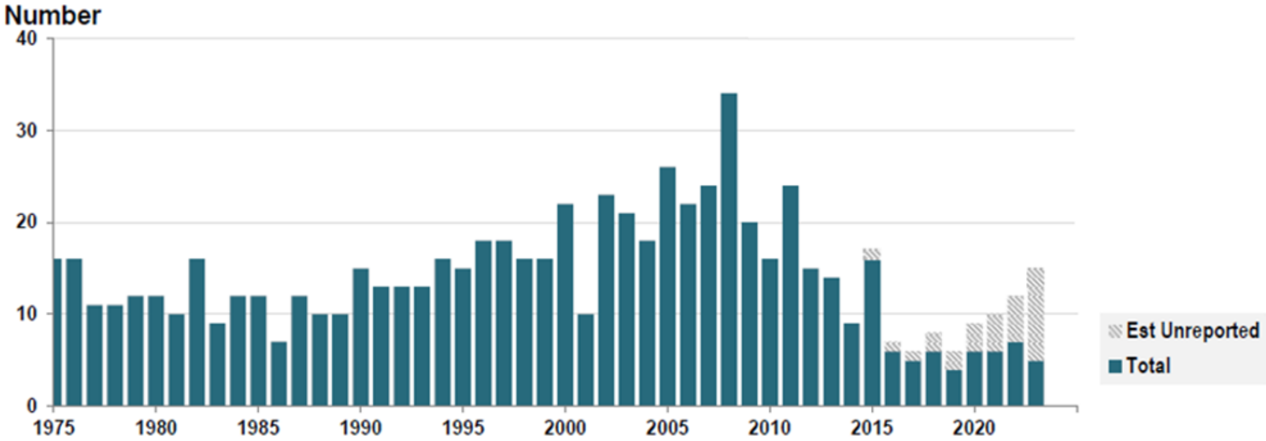
Bloomberg, Saxo.

Figure 7. Disruptions in annual copper production.



Wood Mckenzie, Berenberg estimates.

Figure 8. Number of copper deposits discovered globally (1975–2023).



MinEx Consulting.

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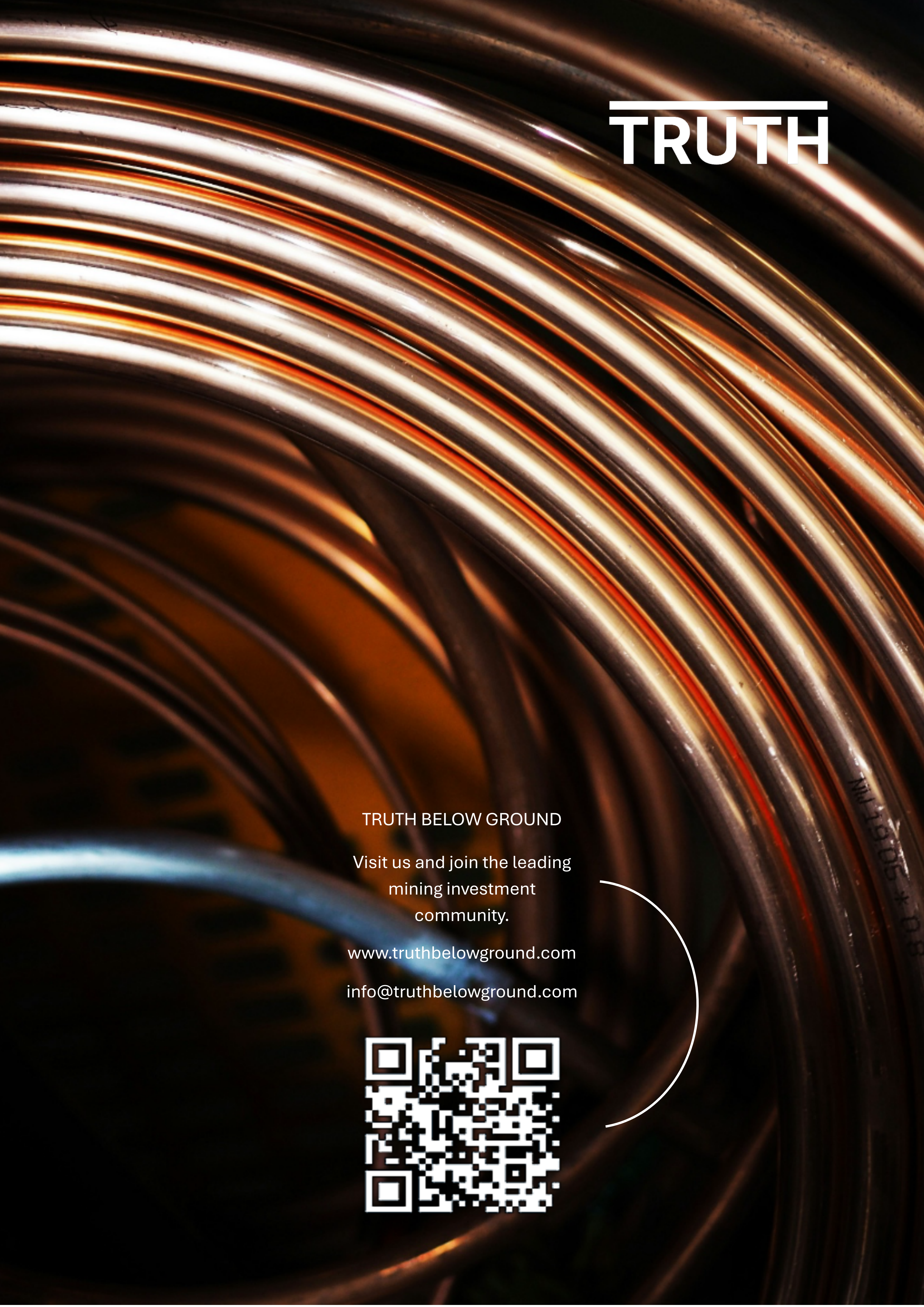

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