S&P Global

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The Copper Conundrum: Why Meeting AI-Era Electrification Demands Is a Race Against Time

As digital transformation accelerates, the world is racing to electrify everything—yet the copper supply required for this revolution is under mounting pressure. For leaders in energy, technology, and manufacturing, the copper bottleneck is no longer a far-off risk; it's an urgent reality that could limit economic growth, the energy transition, and the AI boom.

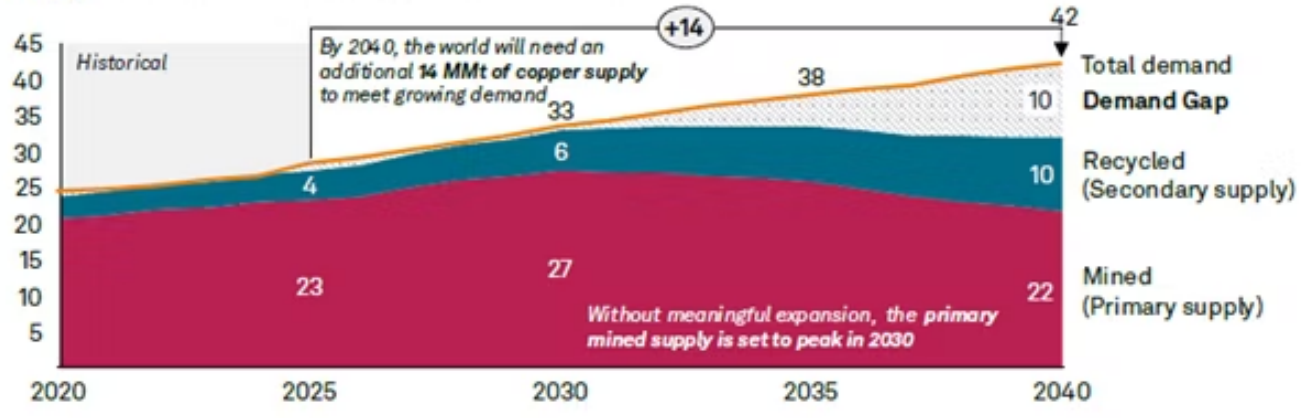
These challenges were at the heart of the S&P Global's report - **Copper in the Age of AI: Challenges of Electrification**. The report revealed how surging demand from AI, renewables, and electrification is colliding with supply-side constraints, threatening a shortfall that could reshape entire industries.

Discover the five key takeaways from the 116-page report—each packed with actionable data and strategic implications.

1. Copper Demand Is Surging, Outpacing Supply by Historic Margins

Global copper demand is projected to rise from 28.3 million metric tons in 2025 to 42.4 million metric tons by 2040—a 50% increase. This surge is driven by electrification, the energy transition, and the exponential growth of AI and datacenters. However, supply is not keeping pace. Mined copper output is expected to peak at 25.8 million metric tons in 2030 before declining to 22 million metric tons by 2040, while secondary (recycled) copper will only cover about 31% of total demand by 2040. The result? A potential annual supply gap of 10.1 million metric tons by 2040—even after accounting for all probable, possible, and speculative projects. S&P Global estimates that by 2040, an additional 14 million metric tons of copper supply will be needed to meet growing demand.

Figure ES- 1. Total copper market balance (2020–2040)
MMt Cu

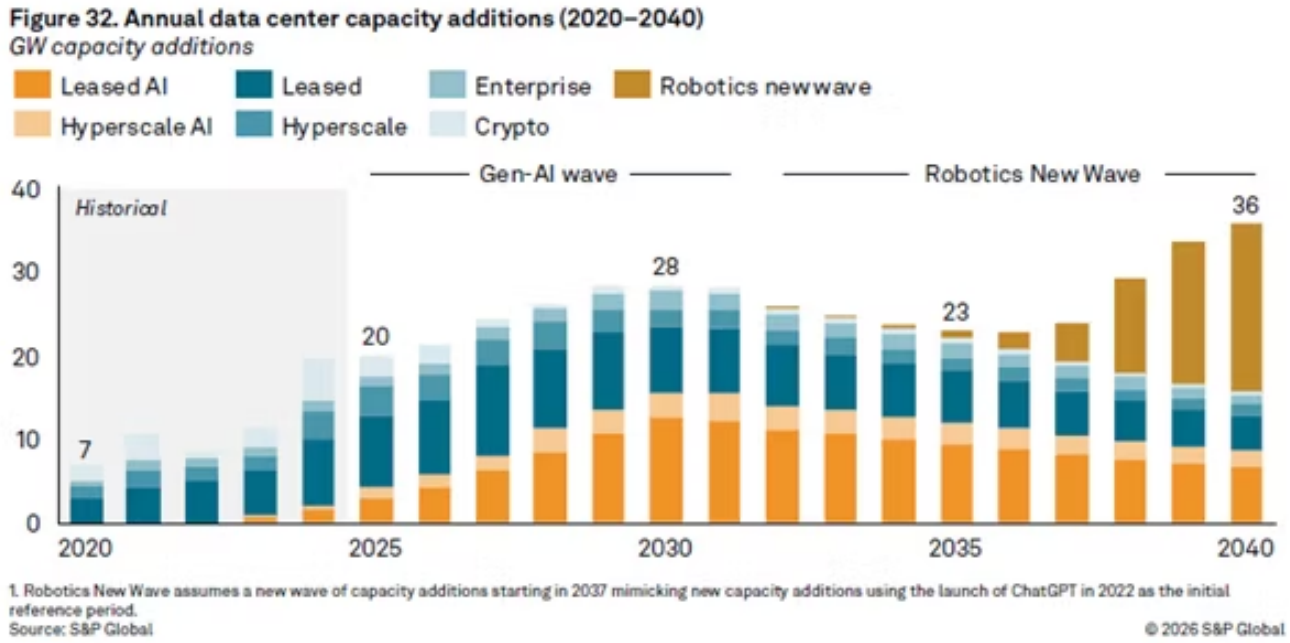


Note: Recycled supply represents end-of-life scrap. Mined supply includes operating production and risked production from committed, probable and possible projects.
Source: S&P Global

This looming shortfall is not just a theoretical risk; it's a structural challenge that, if unaddressed, could slow down electrification, disrupt manufacturing, and spike copper prices to record levels.

2. AI and Data Centers Are Becoming Major Copper Consumers

The AI revolution is transforming copper markets in unexpected ways. Datacenter electricity demand—driven by AI and cloud computing—will skyrocket from 100 gigawatts in 2022 to 550 gigawatts by 2040. In the US, datacenters are set to consume 14% of the nation's total electricity by 2030, up from just 5% in 2025. In Ireland, that figure could reach 23%, with the UK at 11% and the Netherlands at 8%. This growth is not just about more servers; it's about the copper-intensive infrastructure required for power delivery, cooling (especially with the shift to liquid cooling), and grid expansion.

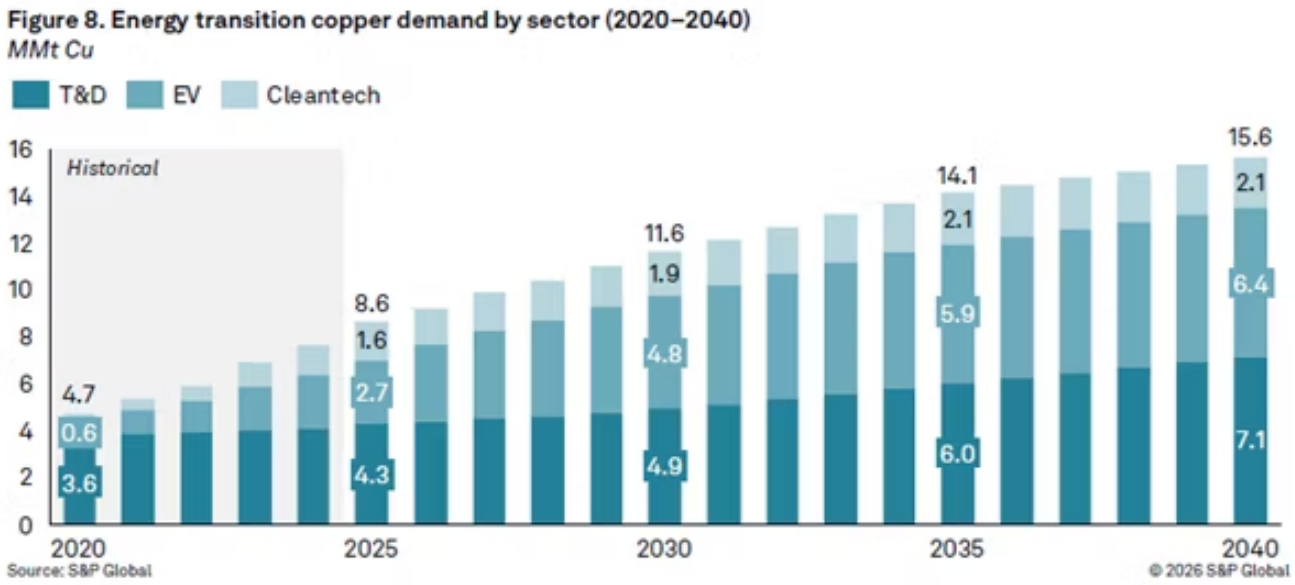


AI GPUs are significantly more power-hungry than previous generations, further increasing copper demand. The report notes, "copper plays a critical role in power distribution inside datacenters due to its density and fire safety properties," and the adoption of liquid cooling is making new datacenters even more copper-intensive

3. Energy Transition Remains the Largest Source of Copper Demand

The energy transition is the single most significant driver of copper demand growth. Electric vehicles (EVs) are a prime example, requiring an average of 83 kilograms of copper per vehicle—almost three times more than traditional internal combustion engine cars. Renewable energy installations are similarly copper-intensive. In 2025, over 90% of new global electric generating capacity will come from solar and wind, both of which require substantial copper for turbines, inverters, and grid connections

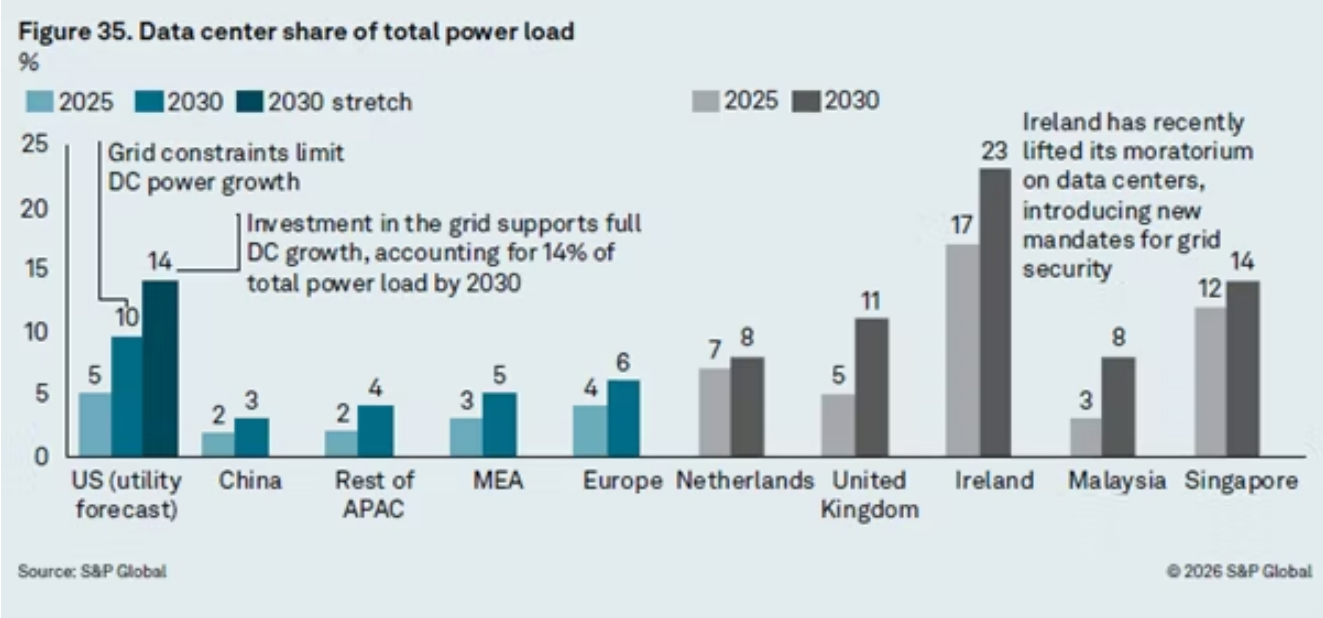
S&P Global forecasts that copper demand from the energy transition will rise from 8.5 million metric tons in 2025 to 15.6 million metric tons by 2040, with an annual growth rate of 4.1%. Grid infrastructure alone could require 2.5 times more copper in 2040 than today, as countries expand transmission and distribution networks to support electrification.



4. Power Constraints and Regional Bottlenecks Threaten DataCenter Expansion

Copper demand is not just a global story—it's highly regional. Grid constraints are already limiting the pace of datacenter expansion in the US, Europe, and parts of Asia. In the US, datacenters could account for 14% of total power consumption by 2030, but only if the grid can keep up. Ireland's datacenter power share could hit 23%, and Singapore's 14%, both facing severe land and power limitations. The report's sensitivity analysis shows that cumulative global datacenter capacity could range from 438 GW to 630 GW by 2040, depending on power availability and the adoption of new cooling technologies.

To address these constraints, operators are exploring on-site generation (such as backup diesel, natural gas, and renewables), co-location near power plants, and off-grid solutions. However, each of these alternatives brings new challenges—especially around the intermittency of renewables and the need for 24/7 reliability.

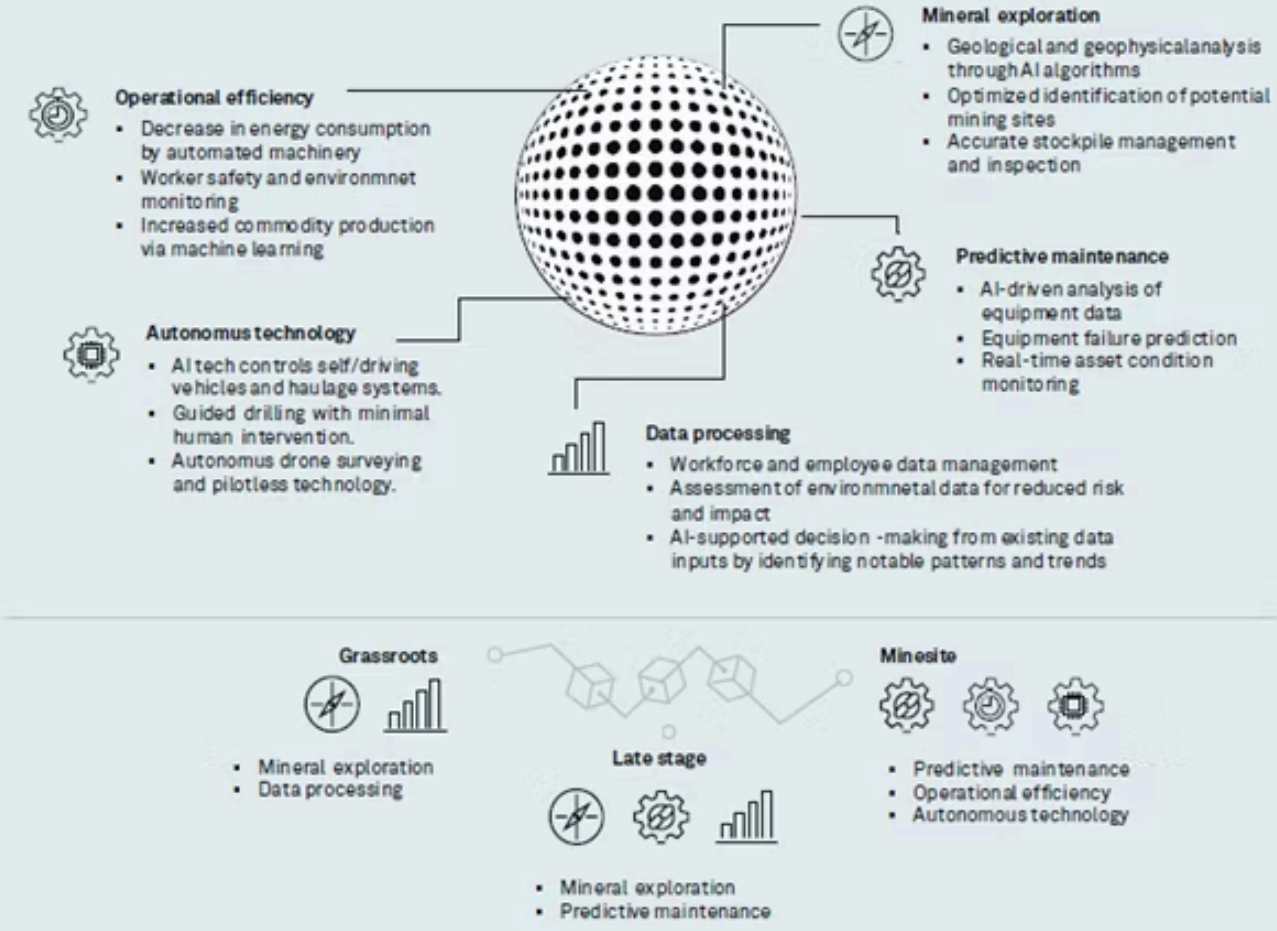


5. Above-Ground Risks and Policy Innovation Are Shaping the Future Copper Map

Unlocking new copper supply is not just a technical challenge—it's a geopolitical and regulatory marathon. The Cobre Panama case is a cautionary tale: after billions in investment, shifting government policies and local opposition led to a mine shutdown, stranding 300,000 tons of annual copper supply and impacting thousands of jobs. In Chile, water scarcity and new environmental regulations are forcing miners to invest in expensive desalination plants. Globally, more than 60% of new copper supply is concentrated in just four countries, increasing geopolitical risk.

In response, governments are moving fast. The US, EU, Canada, and Australia have all designated copper as a critical mineral, unlocking new funding, streamlined permitting, and incentives for domestic production. Sovereign wealth funds are investing directly in mining, and public-private partnerships are emerging to localize processing and secure supply chains. The mining industry is also deploying AI and automation to accelerate exploration and improve efficiency, but the report warns that "even the most optimistic scenarios require unprecedented policy coordination, investment, and technological innovation".

Figure 65. AI applications in mining



Note: **Non-Exhaustive**
Source: S&P Global: A peek at AI revolution in mining: promise meets peril (January 2025)

Conclusion

The copper supply challenge is not just about mining more metal—it's about rethinking supply chains, investment strategies, and technology adoption in an era of electrification and AI. S&P Global's insights reveal a world where scarcity, not abundance, will define the future of critical materials.

S&P Global Market Intelligence provides **essential data and insights** from mine to market, covering copper mining trends, supply–demand studies, price forecasts, and market analysis—all grounded in data-driven insights —to help you anticipate risks, seize opportunities, and secure your place in the electrified economy.

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