Protecting Existing US and Allied Copper Smelting Capacity

By **Kevin Brunelli** and **Tom Moerenhout**

- Global copper smelting economics have deteriorated as smelter overcapacity and tight mine supply have pushed treatment and refining charges to historic lows, threatening the viability of US and allied smelters.
- As governments focus on building new critical minerals supply chains, the copper supply chain—essential for electrification, AI, and data centers—is at risk of increased geographic concentration in China, where smelters operate at less than half the cost of US and allied facilities and can recover smelter losses through vertical integration into copper products.
- Once a smelter closes, restarting or replacing it costs billions of dollars and takes years, highlighting the need for timely intervention.
- To prevent further concentration, US and allied governments can deploy defensive policy measures, including price floors for non-integrated, market-reliant smelters, targeted modernization grants, and production tax credits.

Refined copper, the product of smelting mined copper concentrate, is essential to the 21st-century economy, including for AI, data centers, electrical grids, and clean energy technologies. Copper is also one of the few critical minerals for which China does not dominate the full supply chain. As of 2024, China accounted for only about 8 percent of copper concentrate production, though it produced 48 percent of smelting output and exerts influence through investments in overseas projects.[1] However, the overexpansion of global smelting capacity, combined with structurally tight concentrate supply, have pushed treatment and refining charges (TC/RCs) to record lows. This has

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put copper smelters in the United States and allied economies—including the EU, Australia, Japan, Canada, and South Korea—at risk of closure, even as copper demand is estimated to increase by 50 percent from 2025 to 2040.[2]

Leading mining and commodity trader firms have already warned that existing smelters are not profitable[3] and require "government ownership or significant government support."[4] This pattern is visible across jurisdictions. For example, Glencore halted its smelter in the Philippines[5] and received government assistance to continue operations at its Mount Isa operation in Australia,[6] while its Horne smelter in Canada may also be at risk.[7] In Japan, Mitsubishi and JX Advanced Materials are reviewing operations or scaling back production.[8] Even the Chinese company, Sinomine, has paused smelting in Namibia.[9]

As the United States and allied economies are working to build new critical minerals supply chains, the immediate priority for copper is defensive—protecting existing midstream assets. Rather than building new smelters[10] or investing in overseas copper projects, as the US government is currently considering,[11] this means supporting domestic smelters that may otherwise soon shut down. Any lost capacity would likely be absorbed by Chinese smelters, reinforcing China's control over the supply chain. The following sections analyze the factors contributing to these trends and outline three potential policy solutions.

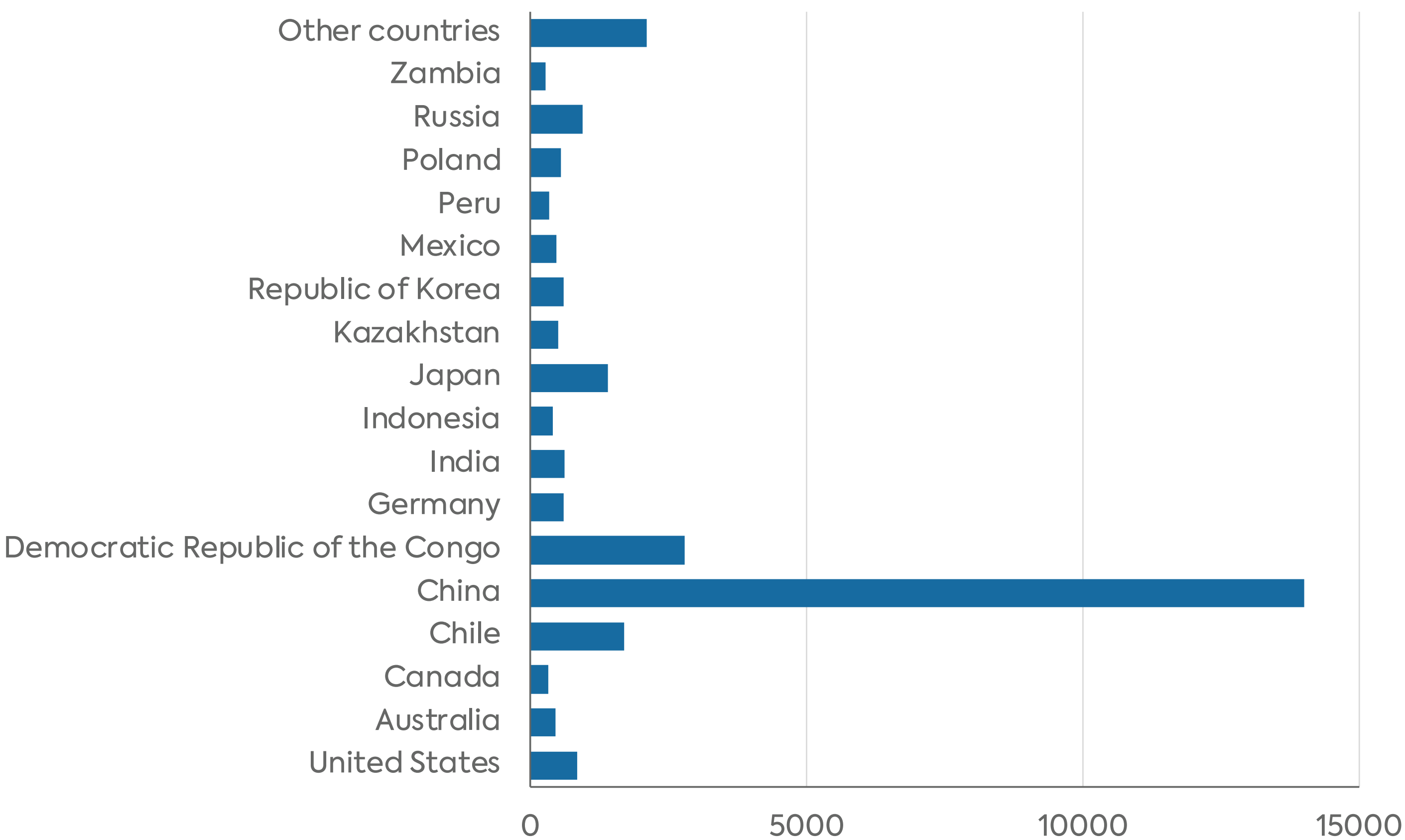
Background

Copper smelters convert copper concentrate, the material produced from mined ore, into blister copper, a semi-refined product containing roughly 99 percent pure copper. The semi-refined product is then refined into 99.999 percent copper cathodes and other copper products. Approximately 80 percent of global copper mines produce copper concentrate that needs to be smelted.[12]

Smelters are grouped into two main categories—integrated and custom. Integrated smelters are vertically integrated with a copper mine, whether co-located or part of the same company, though some purchase copper concentrate from smaller mines to increase utilization rates and improve economics. Custom smelters are standalone operations, sourcing copper concentrate from a variety of copper mines. Given these differences, the two types require distinct forms of government intervention to keep facilities open.

Figure 1 shows copper production by country. The United States has only two active copper smelters—Rio Tinto's Garfield Smelter in Utah and Freeport-McMoran's Miami Smelter in Arizona—both of which are over a century old and are integrated. China accounted for approximately 50 percent of copper smelter production in 2025 and has 12 of the 20 largest smelters by capacity.[13] China's smelter expansion was originally driven by the needs of its fast-growing economy, manufacturing base, and construction boom. Of its current capacity, 75 percent has come online since 2000,[14] even as domestic demand has slowed from double digit growth in the early 2000s to 4 percent annual growth in 2024.[15] Nearly 90 percent of copper smelters in China are custom, which means they compete on the market for concentrate.[16]

Figure 1: Global Refined Copper Production, 2025 (Thousand Metric Tons).



Source: USGS.

Note: Refinery production figures reflect total refined copper output, encompassing both primary production from smelted mine concentrate and secondary production from recycled scrap, and are therefore not limited to smelter production.

Copper Smelter Economics

China's growing dominance in this space is the product of copper smelter economics. Leading mining companies report that building a new copper smelter in the United States could cost up to $5 billion.[17] In China, new smelters can be built up to five times cheaper.[18] This cost advantage reflects lower labor and environmental compliance as well as construction efficiency and accumulated expertise. Additionally, access to cheap capital has allowed China to build smelters with advanced by-product recovery circuits that extract and monetize sulfuric acid, gold, silver, and other materials, the revenue from which further offsets costs and keeps plants profitable. Several big Chinese players, such as Jiangxi Copper, also manufacture copper products, allowing them to accept lower or negative margins at the smelter level and recover losses through vertical integration.[19]

This cost advantage for Chinese smelters extends to operating expenses, enhancing their competitive edge. Broadly, Chinese smelters operate at less than half the cost of facilities elsewhere in the world, benefitting from cheaper power, labor, maintenance, and raw material inputs.[20] The largest operating cost for smelters is electricity and fuel, as smelting and converting copper concentrate into anode metal require high-temperature furnaces and continuous power, making smelters highly sensitive to energy prices. Chinese smelters operate under significantly lower energy costs than their US and European counterparts, with European facilities facing the most severe energy challenges. Aurubis, Europe's largest copper producer, reports that energy costs at its facilities in Germany are roughly three times higher than those at its facilities in the United States.[21]

Beyond electricity and fuel, labor and maintenance costs are also substantial due to the complexity of smelting operations, environmental controls, and safety standards. Smelters spend heavily to manage waste and comply with environmental standards, including capturing harmful sulfur gases to protect neighboring communities and the land. China's modern smelters were built to meet some higher environmental standards like sulfur dioxide emissions.[22] Overall, however, they face lower environmental standards than their US and European counterparts, reducing their compliance costs and contributing to the overall operating cost differential.[23] Outside of China, the high expense of required environmental upgrades has reportedly been a major factor in Glencore's deliberations over whether to close its Canadian smelter.[24] Meanwhile, Grupo Mexico's smelter in Arizona, initially closed because of a labor dispute, faces additional challenges to reopening because of its long history of Environmental Protection Agency enforcement actions and designation as a Superfund alternative site—liabilities that contributed to financial issues.[25]

This severe differential in operating expenses poses an immediate challenge for smelters in the United States and allied countries, especially amid overexpanded smelter capacity and a tight copper market. Smelting capacity has continued to expand globally—especially in China, which experienced 11 percent growth in 2025 from the prior year[26]—while disruptions or underperformance at major mines, such as Kamoa-Kakula[27] and Freeport's Indonesian assets,[28] and the closure at Panama's Cobre Panamá mine due to ongoing political and legal proceedings,[29] have led to predictions of a copper deficit in 2026.[30]

National industrial policies promoting new smelter construction have exacerbated this discrepancy. China is the main driver of these policies, but other countries such as Indonesia, where domestic-processing requirements encourage investment in new smelters, are contributing as well.[31] Global smelting capacity is rising faster than concentrate supply, increasing competition for feedstock and resulting in record-low TC/RCs, a key source of revenue for smelters. US and allied smelters are likely to bear the brunt of these trends.

How Low TC/RCs Put US and Allied Smelters at Risk

Treatment charges are the fee that smelters charge miners to treat concentrate and produce a copper anode. Refining charges are the fee they charge miners to refine the anode into a high purity copper cathode. TC/RCs are estimated to account for a third of smelters' revenue.[32] In the current overcapacity environment, smelters vie for access to copper concentrate to process. Following basic supply and demand rules, when copper concentrate supply is in a deficit relative to smelter capacity, TCs fall as smelters compete to secure supply.

Historically, smelters and mining companies have agreed on TC/RCs through annual benchmark contracts negotiated by major players, which then served as a reference price for the wider market. This traditional benchmark system provided stability and predictability, with fees reflecting processing costs, concentrate quality, and prevailing supply-demand conditions to balance the interests of mines and smelters. In recent years, however, the bargaining power has shifted to miners. The China Smelters Purchase Team (CSPT), a consortium that coordinates procurement and negotiates benchmark TC/RCs, has strengthened China's collective bargaining position.[33] But smelters elsewhere now face a difficult choice between three bad options: accepting low TC/RCs; shutting down, which is costly; or operating at reduced capacity, which is uneconomical.

In 2025, smelters in China, Japan, and Europe accepted TC/RCs in the $20 range.[34] But charges on the spot market went negative at several points.[35] In December, Antofagasta, the Chilean copper miner, and a Chinese copper smelter agreed to $0 TC/RCs for 2026. This represents the lowest rate ever reached in annual negotiations (see Figure 2).[36] In March 2026, spot market TCs went to negative $90 per ton.[37] Industry experts expect TC/RCs to remain low due to mine disruptions and a lack of additional feedstock.[38]

Table 1: Annual benchmark treatment and refining charges (TC/RCs) agreed between major miners and leading Chinese smelters (2019–2026)

Year	TC ($/dmt)	RC (¢/lb)
2019[39]	$80.80	8.080¢
2020[40]	$62.00	6.200¢
2021[41]	$59.50	5.950¢
2022[42]	$65.00	6.500¢
2023[43]	$88.00	8.800¢
2024[44]	$80.00	8.000¢
2025[45]	$21.25	2.125¢
2026[46]	$0.00	0.000¢

China's own capacity restraint signals the severity of the problem. China's top smelters have cut production by over 10 percent in 2026 specifically in response to negative processing fees.[47] Moreover, the Chinese government has halted some new smelter build-out in response to negative treatment charges.[48] The fact that *even* China—whose smelters operate at half the cost of Western competitors—is reacting in this way shows that the TC/RC challenge is not a temporary but a structural problem requiring immediate government intervention. While some smelters have used revenues from by-products with historically high prices, such as gold and silver, as a lifeline,[49] this is not a sustainable solution. Relying on by-product revenues exposes profitability to broader commodity market cycles. Moreover, high by-product pricing may mask the severity of the structural collapse in TC/RC rates, and when by-product markets stabilize, smelters could suddenly find themselves facing a viability crisis.

In normal market conditions, challenging economics would force uneconomical smelters offline, with the lowest-cost producers remaining in operation. But in the current environment that would mean the smelter industry being concentrated in China—an untenable outcome for the United States and allies for both economic and national security reasons. Policy intervention can help chart a different path, but it would need to be carefully tailored.

Policy Options

Until now, the preferred policy intervention for critical minerals projects, especially by the Trump Administration, has been equity investments or loans, but these instruments are ill-suited for keeping existing smelters operational. The companies running these smelters are global businesses with already deep balance sheets. What they lack is not funding but an incentive to continue operating unprofitable or financially weak businesses. In the current environment, it could even make financial sense for integrated smelters to shut down facilities and sell the copper concentrate on the global market.

The United States and allied economies are currently placing particular attention on building out new greenfield midstream processing facilities for critical minerals across the periodic table. While it is logical to secure medium-term resilience and essential to build a policy ecosystem to support future smelter development, new facilities take years to permit and construct, and the economics of greenfield development remain unfavorable. Some proposals suggest retrofitting older smelters to capture additional commodities, but such modernization could cost the equivalent of building a new smelter.[50]

For policy interventions to be effective at preventing market concentration, they will instead need to focus on the operating expenses of existing facilities—and to do so in a tailored way that addresses the distinct mix of feedstock, cost, regulatory, and market constraints each copper smelter faces. This is undoubtedly a challenging task. Labor costs are relatively fixed, and maintenance costs are necessary for social operating licenses. Additionally, energy cost politics are fraught across Europe and the United States—especially in the US, where rising prices reflect grid investment, disaster recovery, volatile fuel markets, and growing electricity demand from data centers. Consumers are also facing affordability issues, making energy cost support politically unviable for now. Amid these constraints, the following three policy responses on the part of US and allied economies could be particularly effective:

1. **Provide funding to small-scale modernization projects tied to environmental compliance.** Rather than weakening environmental standards, governments can provide direct grants to upgrade legacy facilities. Glencore's Horne smelter in Canada is a prime target for this type of policy intervention, as modernization would allow the facility to meet current emissions and regulatory requirements while preserving project economics. Despite being in Canada, the Horne smelter is vital to US economic security.

2. **Introduce or expand production tax credits to reduce the all-in cost of production for domestic smelters.** In the United States, this would mean making copper eligible for, and

extending, the 45X Production Tax Credit. This federal statute, part of the Inflation Reduction Act (IRA) of 2022, defines which minerals are eligible for a 10 percent tax credit. Copper was not listed as a critical mineral when the IRA passed and therefore was not eligible.[51] Making copper eligible now would help smelters reduce their operating expenses.

3. **Implement a TC/RC price floor mechanism tied to market-purchased concentrate.** In the current low TC/RC environment, this measure could help restore TC/RCs as a revenue source rather than a structural expense, bridging the gap between market rates and those required for sustainable operations. The price floor would also benefit quasi-integrated smelters that rely on both their own feedstock and purchased concentrate to increase utilization rates.

   This policy would function as a contract-for-difference mechanism. The government and smelters would agree on a reference TC/RC based on operating breakeven levels or a historical sustainability benchmark. If market TC/RCs fall below this level, the government would compensate the smelter for the difference on open-market-purchased concentrate only. Concentrate transacted domestically would clear at globally competitive terms to ensure mines are not disadvantaged relative to export markets. This structure prevents concentrate from being exported solely due to temporary TC/RC pricing distortions while stabilizing smelter economics.

To see how these policies would play out in practice, consider a basic example of a non-Chinese copper mine that is weighing bids from competing smelters: a Chinese smelter offering a spot TC/RC of –$50 (essentially paying the mine for concentrate) and a US facility requiring a $50 TC/RC to cover labor, energy, maintenance, and environmental compliance costs. In this scenario, processing in the United States would be economically irrational. For the government to address this issue, it would need to intervene on both sides of the transaction.

- **The mine-side incentive:** ensuring that domestic mines receive terms competitive with foreign buyers to incentivize mining. Without this "stay-at-home" premium, mines are rationally incentivized to export concentrate.
- **The smelter-side credit:** ensuring that the TC/RC received by the smelter approaches its breakeven rate, so that processing concentrate once again functions as a revenue stream rather than a loss.

These three policy measures are not mutually exclusive and would function most effectively in tandem. Even integrated smelters suffer from a structurally low TC/RC environment. The low rates influence internal transfer pricing, which directly influences how shareholders assess smelter performance, and could be the deciding factor in whether companies keep an integrated smelter alive or close it and sell concentrate for more profit externally.

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