MAY 2025

UN trade & development | UNCTAD

Global trade update

Policy Insights

Focus on critical minerals: Copper in the new green and digital economy

KEY TAKEAWAYS

- **Copper is a strategic commodity** in the energy transition and the digital economy, yet supply constraints and long project lead times reveal structural shortfalls.
- **Restrictive trade measures and tariff barriers** are stifling value addition in producing countries, trapping them in the role of primary exporters.
- **Recycling will be vital.** With primary output falling short and 80 new mines needed by 2030, copper scrap is fast becoming a strategic material.
- **For developing economies, mining and exporting ore is no longer enough.** To capture real value, they must refine, manufacture and sell—not just dig and ship.

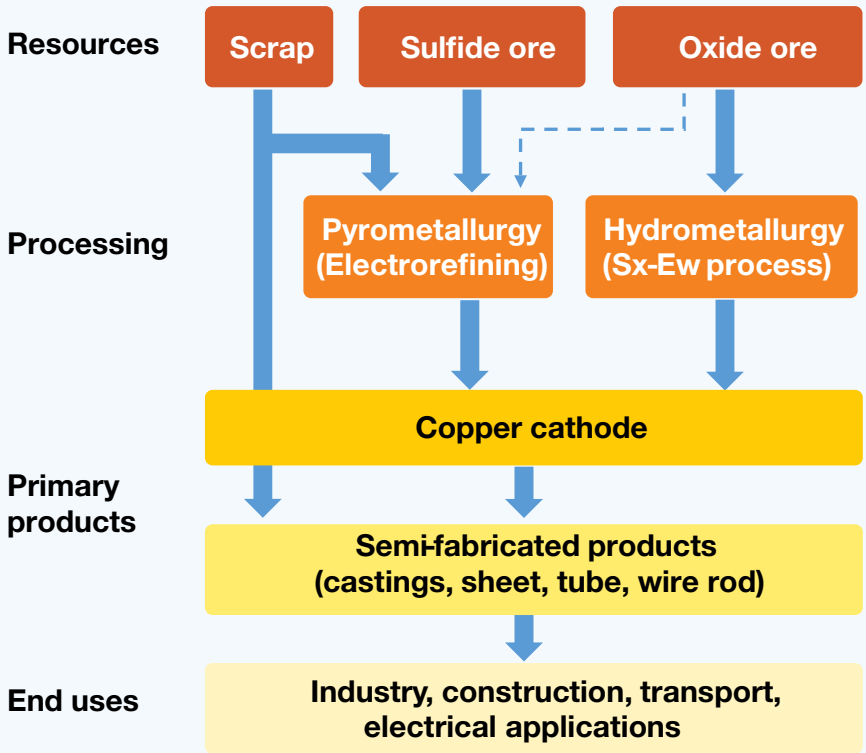
Copper is central to the global transitions toward renewable energy and a digitally connected economy. Its unparalleled conductivity and versatility make it crucial for key industries such as construction, electronics, renewable energy, transportation, and defense. As demand rises—projected to increase by over 40 per cent by 2040—the global copper market faces mounting pressure from supply limitations, geopolitical uncertainties, increasing trade tensions and declining ore grades.

To meet this demand, coordinated policy action is essential. This includes accelerating mine development, expanding refining and manufacturing capacities, scaling up recycling efforts, and, most importantly, supporting producer countries to transform their raw materials. By promoting domestic processing, integration into regional and global value chains, and industrial transformation, these nations can capture greater value and enhance their role in the global supply chain.

Understanding the structure of the global copper supply chain

The global copper supply chain consists of several stages, beginning with ore extraction, moving to processing and production of refined copper (Figure 1). The extraction stage involves the initial beneficiation of copper ores and unrefined copper. Processing includes the smelting of copper ores and unrefined copper into copper mattes, blisters, and anodes. At the refining stage, anodes are transformed into refined copper, which is then used to manufacture industrial products. Copper's exceptional properties—outstanding electrical and thermal conductivity, malleability, and corrosion resistance—make it a vital material for various industries.[1]

Figure 1
Copper supply chain

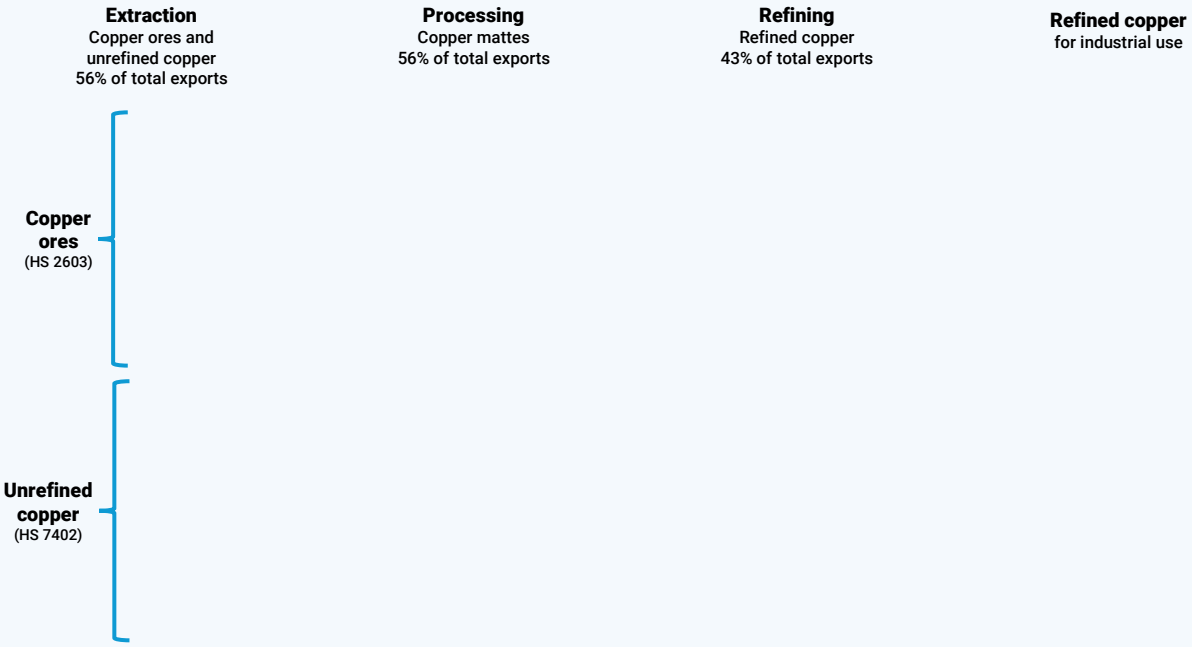


Source: International Energy Agency (2021). *The Role of Critical Minerals in Clean Energy Transitions*. Paris: IEA.

[1] Copper is widely used in electrical wiring and electronic products, motors, batteries and harnesses for electric vehicles, facilitating the transmission of electrical power between components as well as in machinery and equipment, consumer and general products, and construction materials.

A notable feature of this supply chain is China's role as a major processing hub (Figure 2). [2] In the upstream segment of the supply chain, **Chile and Peru together account for nearly half of global copper ore and concentrate exports** (26 per cent and 21 per cent, respectively). Zambia and the Democratic Republic of the Congo are key exporters of unrefined copper, with China being the destination for most of these exports (60 per cent). Further downstream, China also stands as the largest importer of refined copper, followed by the United States, India, and Brazil.

Figure 2
China stands out as a processing hub for copper
Trade flows and major exporters and importers, 2023



Source: Authors' calculations based on data from UN Comtrade.

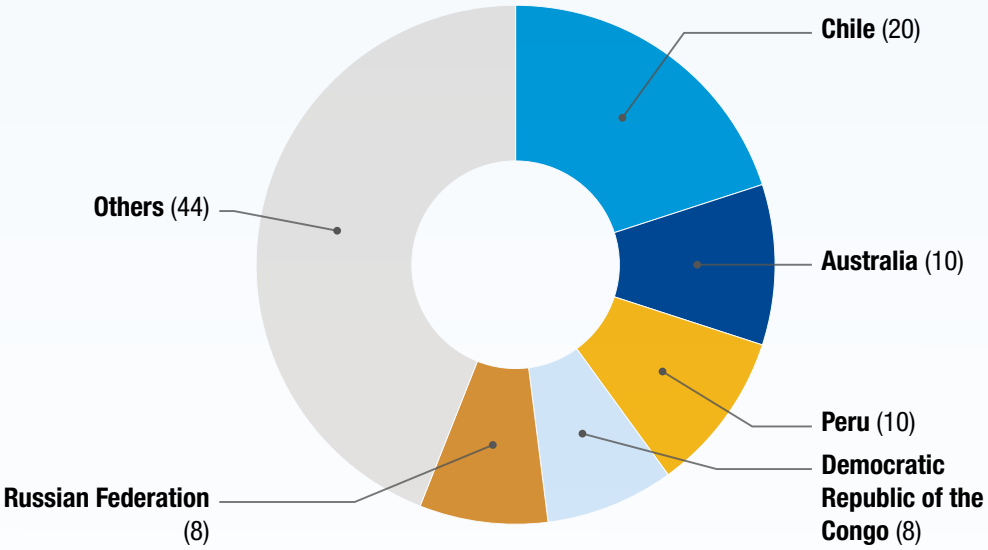
Note: The figure shows trade between countries in terms of exports and imports, without local production. The trade data are as reported in the following 4-digit HS Codes: 2603, 7402, 7401 and 7403. The first node represents the share of exports of the main exporting countries of raw material.

[2] The figure shows major bilateral copper trade flows in 2023. The widths of these flows represent the share of the bilateral trade in total exports in each processing stage. Each line connects the exporting country with the importing country. Only the top three exports and importers are presented.

The world's copper reserves

Five countries hold over 50 per cent of the world's total reserves (Figure 3). Chile possesses the largest copper reserves, with about 20 per cent. Australia and Peru each account for 10 per cent, while the Democratic Republic of the Congo and the Russian Federation each hold 8 per cent. The remaining 44 per cent is spread across other nations. The Democratic Republic of the Congo has largely untapped reserves of high-grade copper, offering significant growth potential.

Figure 3
Over 50 per cent of reserves are concentrated in five countries
Countries with major reserves of copper, percentage, 2024



Source: UNCTAD based on data from U.S. Geological Survey.

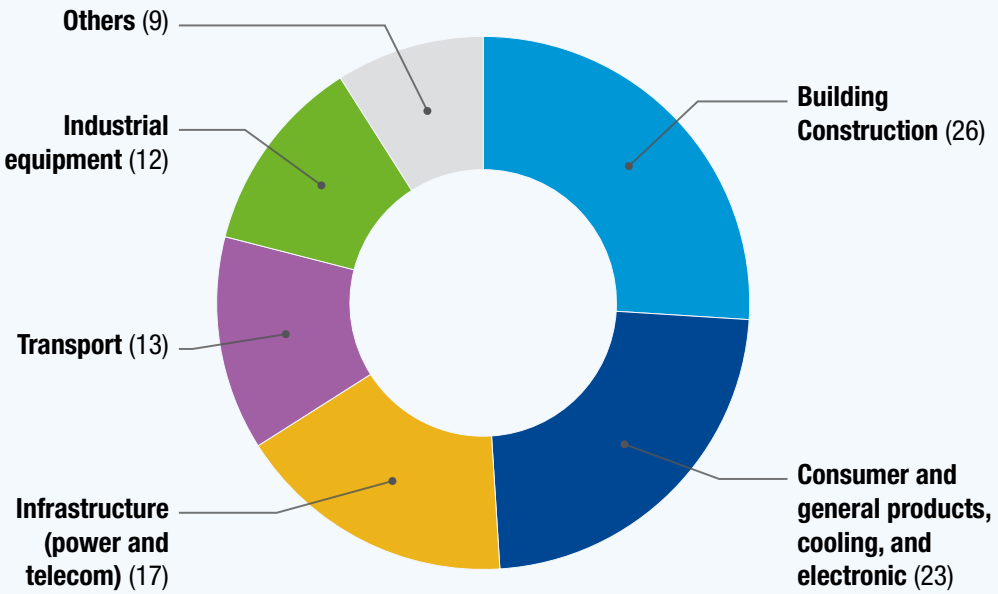
The demand for copper

Global demand for copper is expected to grow by over 40 per cent between 2023 and 2040, driven largely by the transition to clean energy and the rapid expansion of digital economies. Some projections suggest that the demand for copper in clean energy technologies alone could triple by 2040. Meeting this need would require more than 10 million tons of additional copper—almost half the total global supply in 2023.[3]

This growing demand highlights the urgent need for major investments in new copper mining projects, especially as existing ore grades decline, and supply becomes more constrained. To stay on track for net-zero emissions by 2030, the world may need to develop approximately 80 new copper mines, requiring up to $250 billion in investments.[4,5]

In 2023, nearly half of global copper consumption was driven by building construction and consumer electronics (Figure 4). The remaining demand came from infrastructure, transport, industrial equipment, and other sectors.

Figure 4
Building construction and electronics drive copper demand
Shares of major demand sectors, percentage, 2023



Source: UNCTAD based on International Copper Study Group (ICSG) (2024). *The World Copper Factbook 2024*. Lisbon: ICSG. Available at: https://icsg.org/copper-factbook/

[3] International Energy Agency (IEA), Global Critical Minerals Outlook 2024, Paris: IEA, 2024.
[4] https://unctad.org/news/critical-minerals-boom-global-energy-shift-brings-opportunities-and-risks-developing-countries
[5] https://www.spglobal.com/commodity-insights/en/news-research/latest-news/metals/032123-meeting-energy-transition-demand-may-need-copper-mines-capex-of-250-bil-to-2030-bhp

Copper production: mined and refined

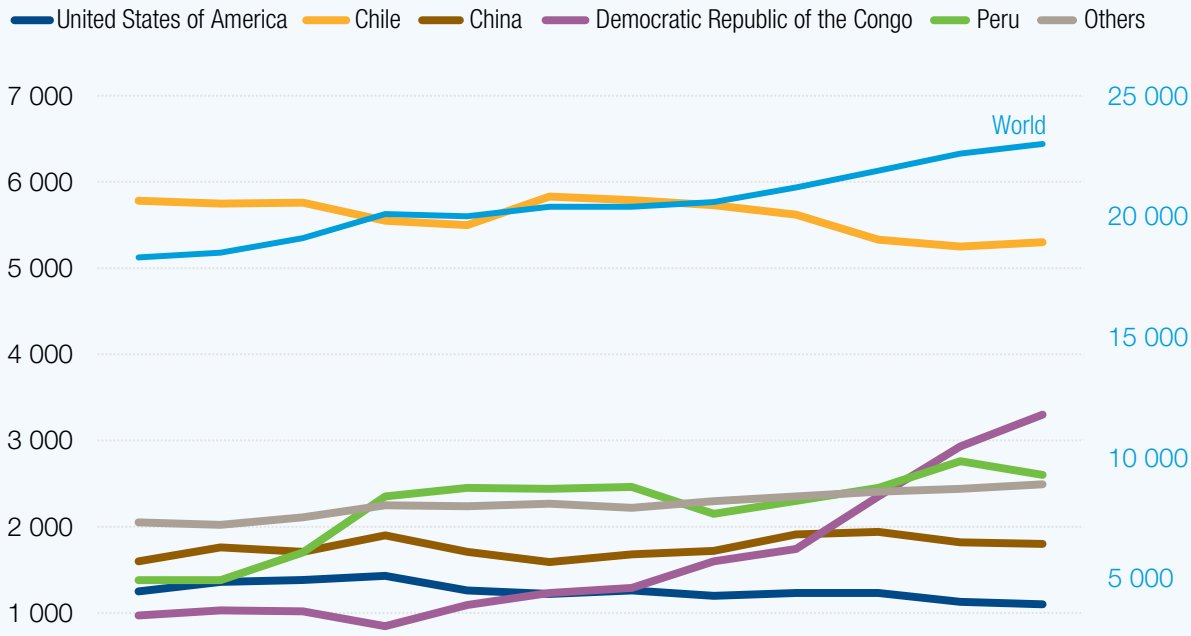
Global copper production can be categorized as mined and refined. Mine production refers to extraction of copper ores from the earth, marking the upstream sector. Refinery production, on the other hand, involves the processing of mined ore into pure, usable copper.

Mine production

Developing countries play a central role in the global copper industry, particularly in mining. In 2024, Chile led global copper mine production with approximately 23 per cent of the total, producing 5.3 million metric tons. The Democratic Republic of the Congo and Peru followed, contributing 14 per cent (3.3 million metric tons) and 11 per cent (2.6 million metric tons), respectively. (Figure 5) Together, the three countries accounted for nearly half of the world's copper output.

The Democratic Republic of the Congo is rapidly strengthening its position as a leading copper producer, thanks to the high quality of its reserves—some mines have copper grades exceeding 3 per cent, well above the global average of 0.6–0.8 per cent.[6] Between 2016 and 2024, the country nearly tripled its mine production, showing its ability to respond to rising global demand. In contrast, Chile's copper production declined by 5 per cent during the same period.

Figure 5
Mine production has surged in the Democratic Republic of the Congo
Copper mine production by major producers, thousand metric tons, 2013-2024



Source: UNCTAD based on data from U.S. Geological Survey.
Note: Right axis refers to world mining production.

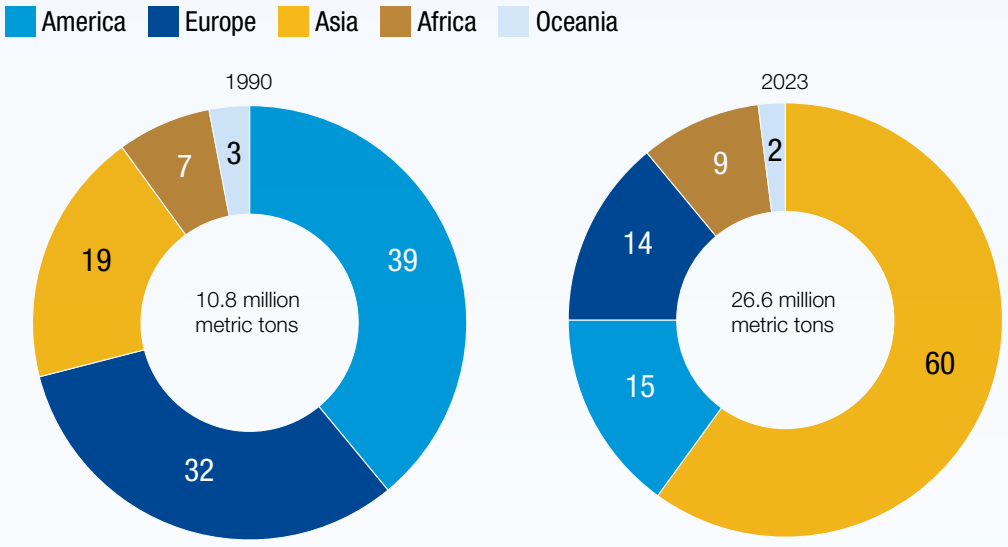
[6] https://www.trade.gov/country-commercial-guides/democratic-republic-congo-mining-and-minerals

Refinery production

Global copper refinery production grew significantly from 10.8 million metric tons in 1990 to 26.5 million metric tons in 2023. This includes 4.5 million metric tons from secondary refining, which uses recycled copper (scrap). Much of this expansion has been driven by China, which has become the world's leading copper refiner, accounting for 45 per cent of global output. China's rapid growth has been the main force behind Asia's rise as the dominant region in copper refining. With an annual output exceeding 12 million metric tons, China now holds the largest copper refining capacity worldwide. (Figure 6)

Significant regional shifts have accompanied this global expansion. Africa's share of global copper refining rose modestly from 7 per cent to 9 per cent, led by increased capacity in the Democratic Republic of the Congo and Zambia. Meanwhile, the Americas experienced a steep decline, with their share falling from 39 per cent in 1990 to just 15 per cent in 2023. Europe also saw a marked decrease, from 32 per cent to 14 per cent, while Oceania's share edged down from 3 per cent to 2 per cent

Figure 6
Refinery production in Asia tripled in 30 years, led by China
Global copper refinery production, 1990 and 2023



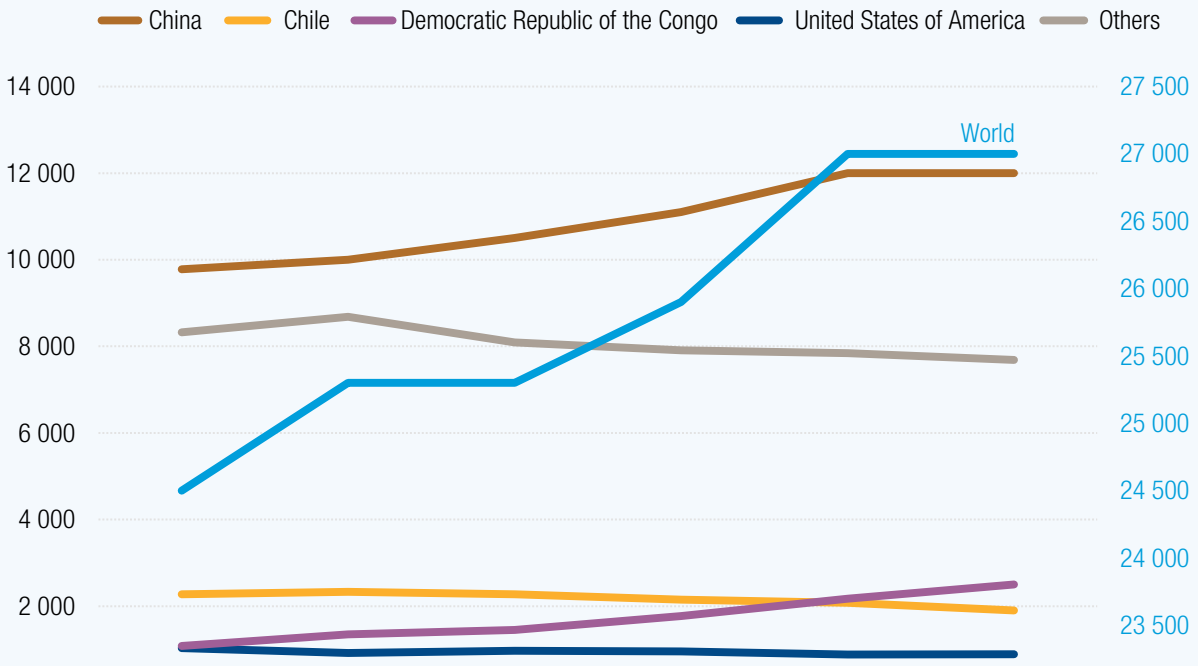
Source: International Copper Study Group.

China has by far the largest copper refining capacity in the world, producing over 12 million metric tons annually (Figure 7).

Figure 7

Global refinery production increased by over 10 per cent in the last five years

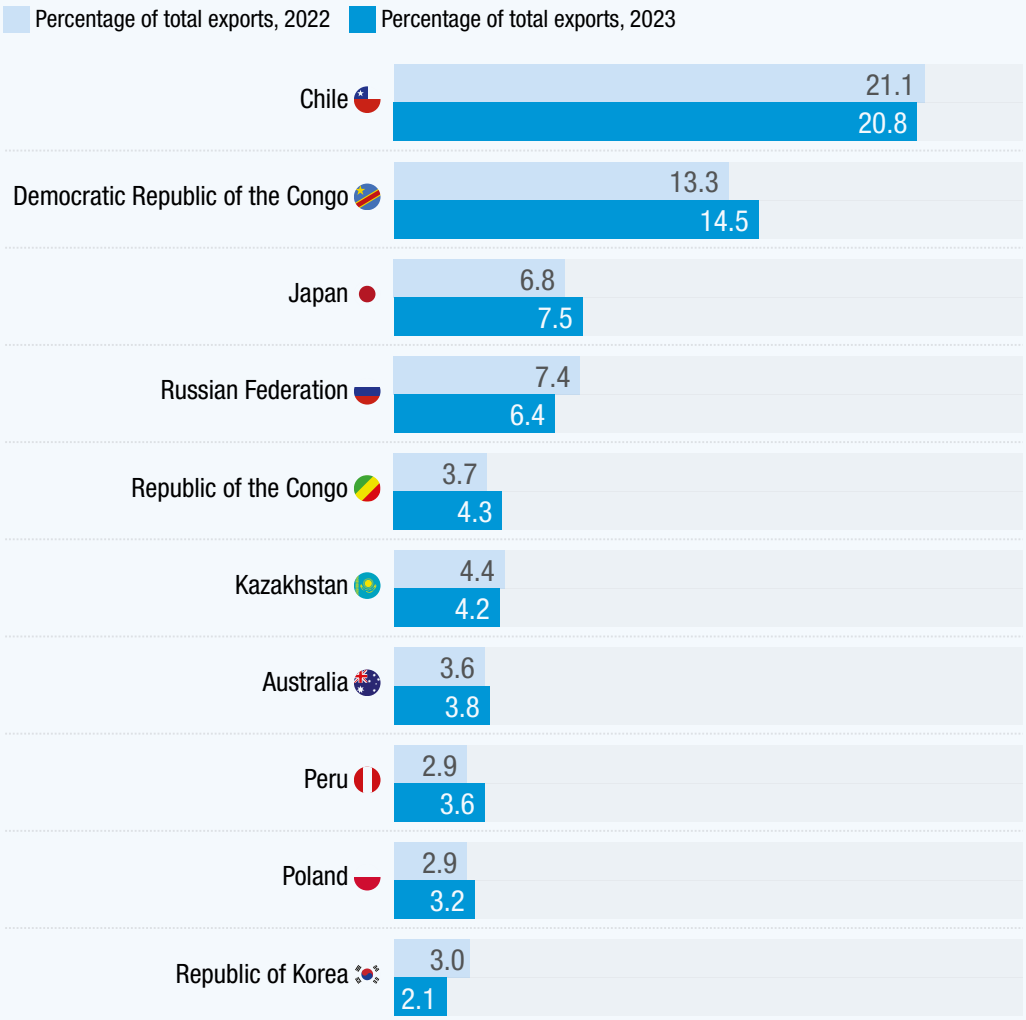
Global copper refinery production trends, thousand metric tons, 2019-2024



Source: UNCTAD based on data from U.S. Geological Survey.
Note: Right axis refers to world refinery production.

Countries with a significant share of their total exports coming from refined copper and copper alloys (Figure 8).

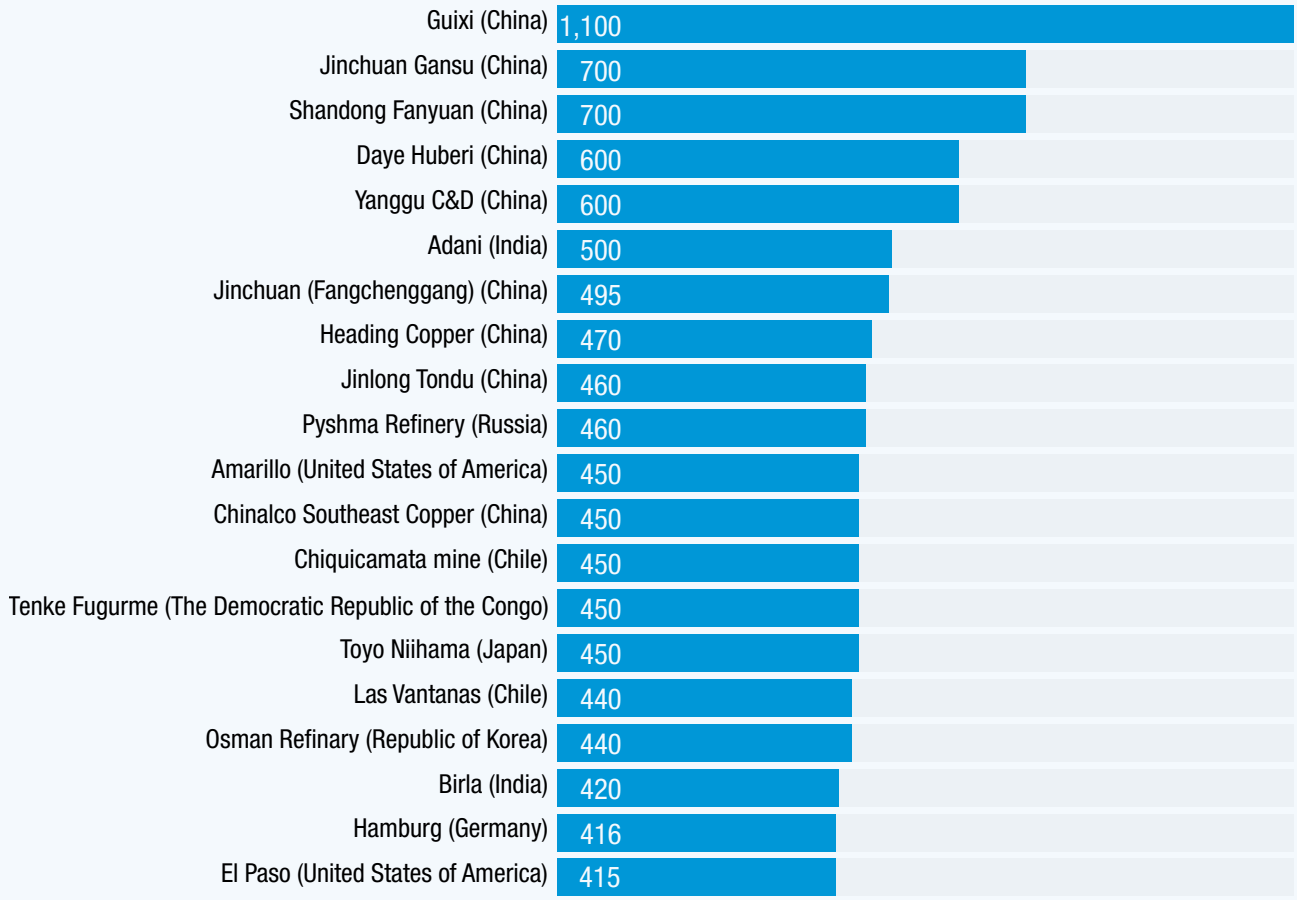
Figure 8
Chile leads as the main exporter of refined copper and copper alloys
Share of country's refined copper and copper alloys export in global exports of refined copper and copper alloys, percentage, 2022 and 2023



Source: UNCTAD based on data from UN Comtrade.
Note: 4-digit level HS Code, 7403.

Major refineries are listed in Figure 9. The Guixi refinery in China leads with a capacity that exceeds 1 million metric tons per year, which adds to 8 Chinese refineries that overall produce more than 5.57 million metric tons per year.

Figure 9
Most leading copper refineries are located in China
Major refineries in the world, capacity in thousand metrics tons, 2024



Source: International Copper Study Group.

Fluctuating global copper stockpiles

Geopolitical tensions and logistical challenges can significantly disrupt copper supply chains, often reflected in fluctuating stockpile levels. In early June 2024, for instance, copper stockpiles registered with the Shanghai Futures Exchange (ShFE) surged to a 51-month high of 339,964 metric tons.[7] Typically, rising stockpiles suggest that supply is outpacing demand, while declining levels may indicate shortages or stronger demand. However, the accumulation observed in June 2024 defied seasonal patterns, as inflows to the ShFE

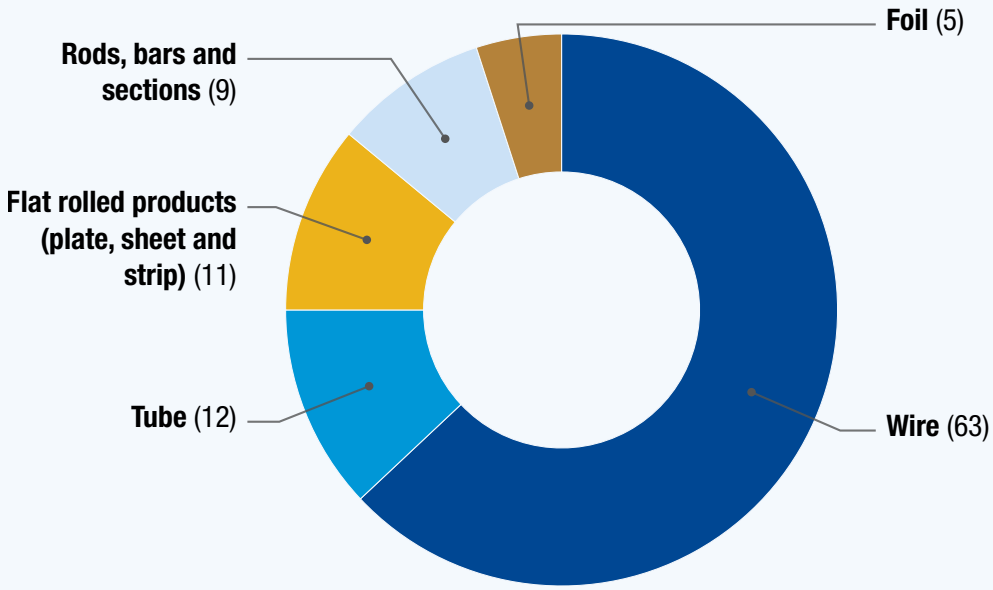
[7] https://www.reuters.com/markets/commodities/chinas-vast-copper-overhang-will-clear-one-way-or-another-russell-2024-06-13/

continued during a period when copper is usually being shipped out. This atypical buildup was driven by a combination of factors, including headwinds in key copper-consuming sectors such as housing construction and manufacturing.[8]

Value addition in copper

Value addition does not automatically translate into higher profits, as it does not account for factors such as production costs. However, it often reflects greater economic value. Enhancing value through domestic processing can also strengthen key macroeconomic indicators, such as the trade balance. Moreover, value addition supports industrial development, job creation, and technological progress in resource-producing countries. By investing in downstream processing and manufacturing capabilities, these countries can boost their global competitiveness and reduce reliance on raw material exports. In the case of copper, value addition is largely concentrated in the production of copper wire, which accounts for 63 per cent of total first use. (Figure 10).

Figure 10
Copper wire represents the main first-use
Share of first-use (semis production) of copper, percentage, 2023



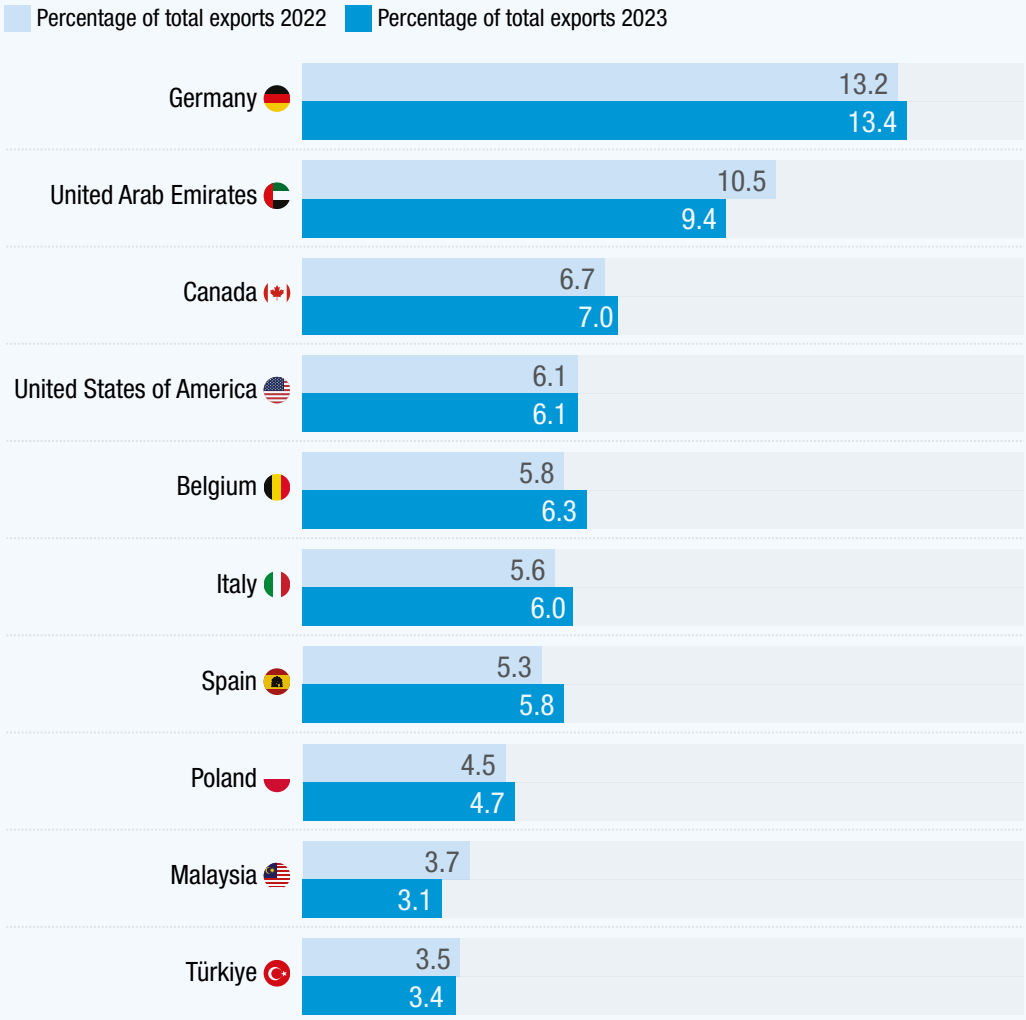
Source: International Copper Study Group.

[8] https://redcloudfs.com/what-factors-affect-copper-supply-and-demand/

Understanding trade in value-added copper products

China, Germany, Japan and the United States are the main exporters in value-added copper. Major export markets include developing markets like India and Southeast Asia, as well as the European Union. Four of the top five exporters of copper wire are developed countries. (Figure 11)

Figure 11
Germany leads as the main copper wire exporter
Share of country's copper wire export in global exports of copper wire, percentage, 2022 and 2023



Source: UNCTAD based on data from UN Comtrade.
Note: 4-digit level HS Code, 7408.

The value of recycled copper: waste and scraps

The projected shortfall in copper supply to meet growing global demand underscores the need for sustainable alternatives with lower environmental impact. One promising solution is copper recycling, which preserves the metal's physical and chemical properties without degradation. Recycling also requires significantly less energy than mining and refining newly extracted copper, leading to lower greenhouse gas emissions.

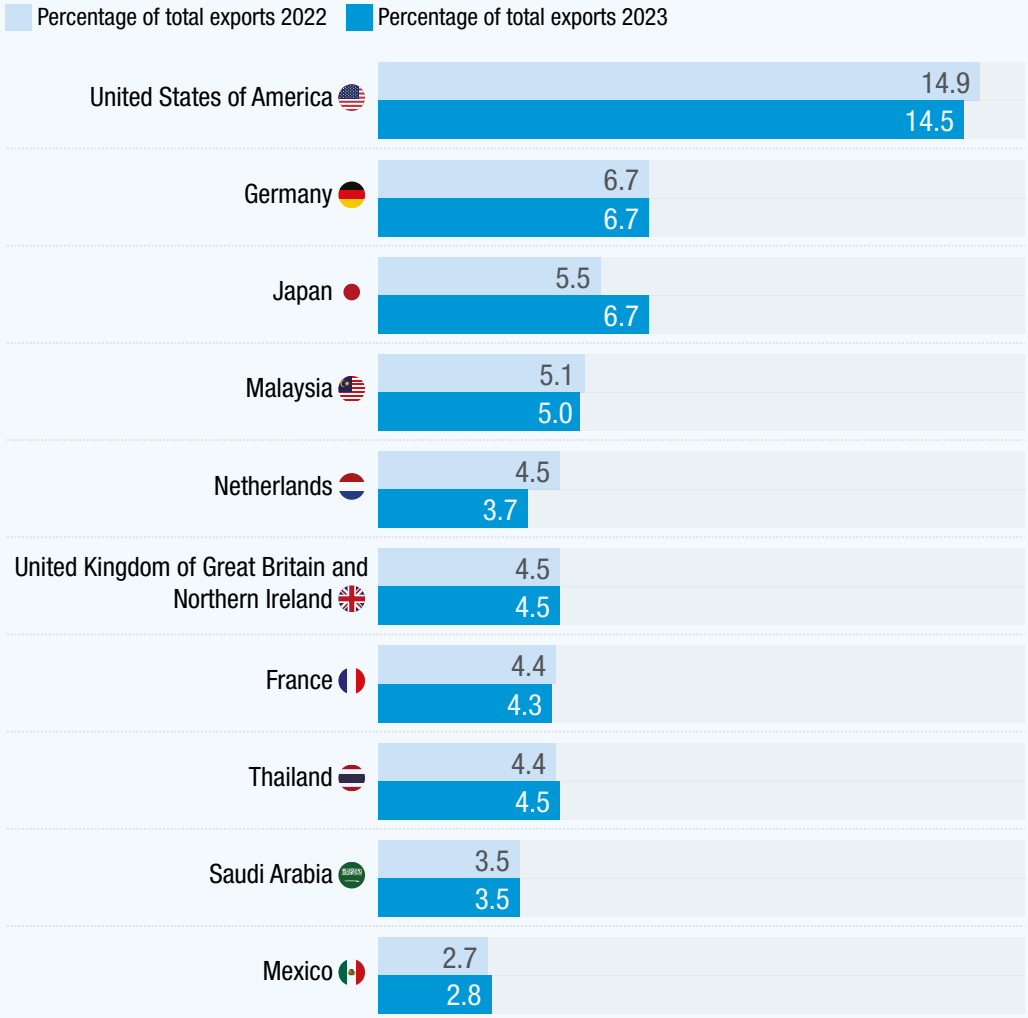
As industries increasingly prioritize sustainability and circular economy principles, recycled copper is playing a vital role in meeting demand. Countries can also derive economic benefits by exporting copper scrap to nations with advanced recycling infrastructure.

According to the International Copper Study Group, nearly one-third of global copper use in 2023 came from recycled sources. Developed countries are the primary exporters of copper waste and scrap for recycling. (Figure 12) In 2023, the United States alone accounted for 14.5 per cent of these exports, followed by Germany (6.7 per cent), Japan (6.7 per cent), Malaysia (5 per cent), and the Netherlands (3.7 per cent)

Figure 12

The United States leads copper waste and scraps exports

Share of country's copper waste and scraps export in global exports of copper waste and scraps, percentage, 2022 and 2023



Source: UNCTAD based on data from UN Comtrade.

Note: 4-digit level HS Code, 7404.

Copper supply chains and trade: global trends

Over the past two decades, the global copper supply chain has undergone a profound geopolitical realignment, marked by China's rapid ascent from a major importer to the leading player across multiple stages of the value chain. By 2023, China accounted for 60 per cent of global imports of copper ores and concentrates, reflecting its role as the world's primary refining hub. Simultaneously, traditional exporters such as Botswana, Brazil, Chile and Peru have seen their shares decline, while new players, including the Democratic Republic of the Congo and Germany, have emerged as key exporters of refined copper and copper mattes, respectively. Germany, notably, transitioned from being the top importer of copper mattes in 2003 to their leading exporter by 2023. These shifts underscore a broader trend of consolidation of refining capacity in Asia and parts of Europe.

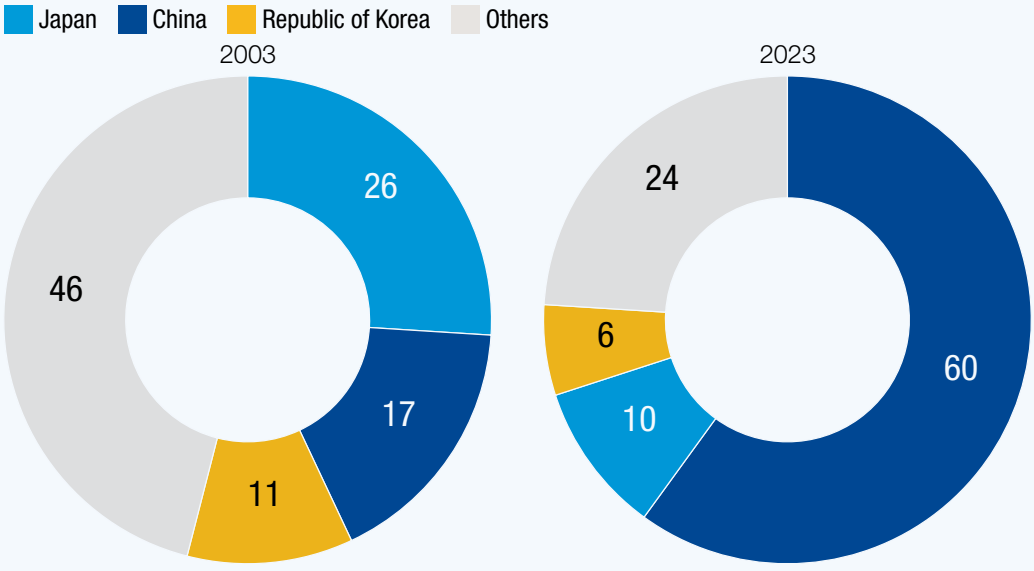
The significant shift in trade patterns in copper markets

Over the past two decades, global copper trade patterns have undergone a significant transformation, particularly in the imports of copper ore and unrefined copper. In 2003, Japan led the world as the top importer, accounting for 26 per cent of global imports, while China held a comparatively smaller share at 17 per cent. (Figure 13) However, by 2023, this dynamic had shifted dramatically, with China emerging as the dominant importer, commanding 60 per cent of the global market. In contrast, Japan's share dwindled to just 10 per cent. This shift reflects China's leading role in the global copper supply chain and highlights broader changes in the geography of industrial demand.

Figure 13

China overtook Japan as main global importer, accounting now for 60 per cent of global copper ore and unrefined copper imports

Main importers of copper ore and unrefined copper, percentage, 2003 and 2023

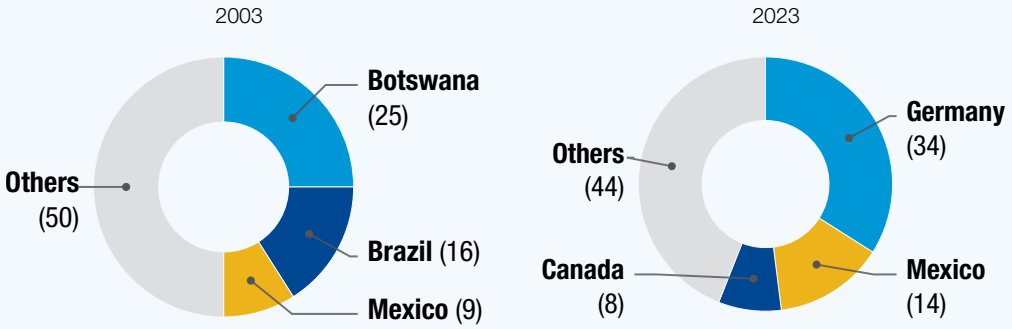


Source: UNCTAD based on data from UN Comtrade.

Likewise, the landscape of copper matte exports also changed considerably. In 2003, Botswana (25 per cent), Brazil (16 per cent), and Mexico (9 per cent) were the leading exporters, collectively accounting for nearly half of global exports. By 2023, however, Germany had taken the lead with 34 per cent of exports, followed by Mexico (14 per cent) and Canada (8 per cent), while Botswana and Brazil had dropped out of the top ten altogether. (Figure 14)

These shifts in both import and export patterns highlight the evolving global geography of copper production, trade, and consumption, driven by economic growth, industrial policy, and shifting supply chain strategies.

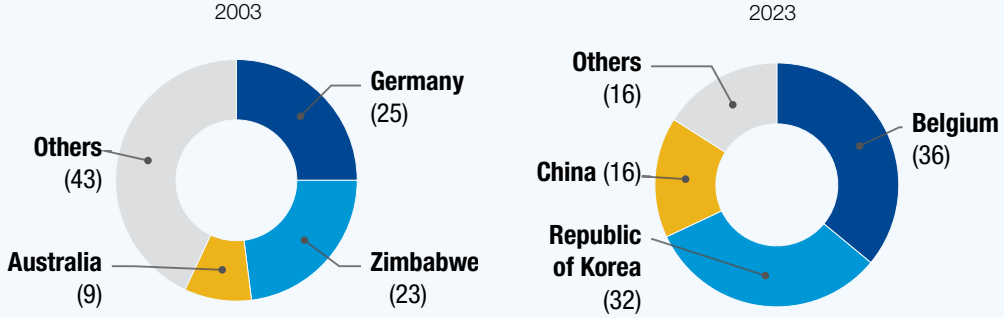
Figure 14
Germany leads copper mattes exports
Main exporters of copper mattes, percentage, 2003 and 2023



Source: UNCTAD based on data from UN Comtrade.

In 2023, Germany was the leading importer of copper mattes (25 per cent of total imports). (Figure 15) By 2023, it was no longer an importer, but a leading exporter. The top importers of copper mattes in 2023 included Belgium (36 per cent), the Republic of Korea (32 per cent) and China (16 per cent).

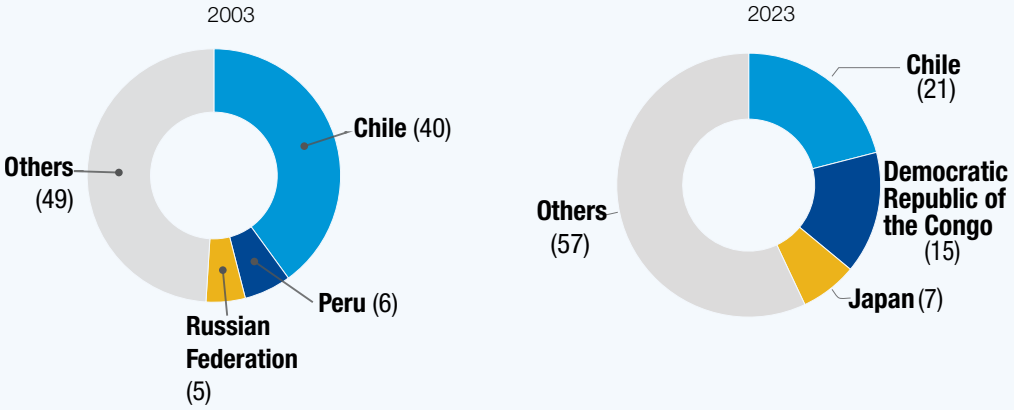
Figure 15
Germany transitions from leading importer to exporter of copper mattes
Main importers of copper mattes, percentage, 2003 and 2023



Source: UNCTAD based on data from UN Comtrade.

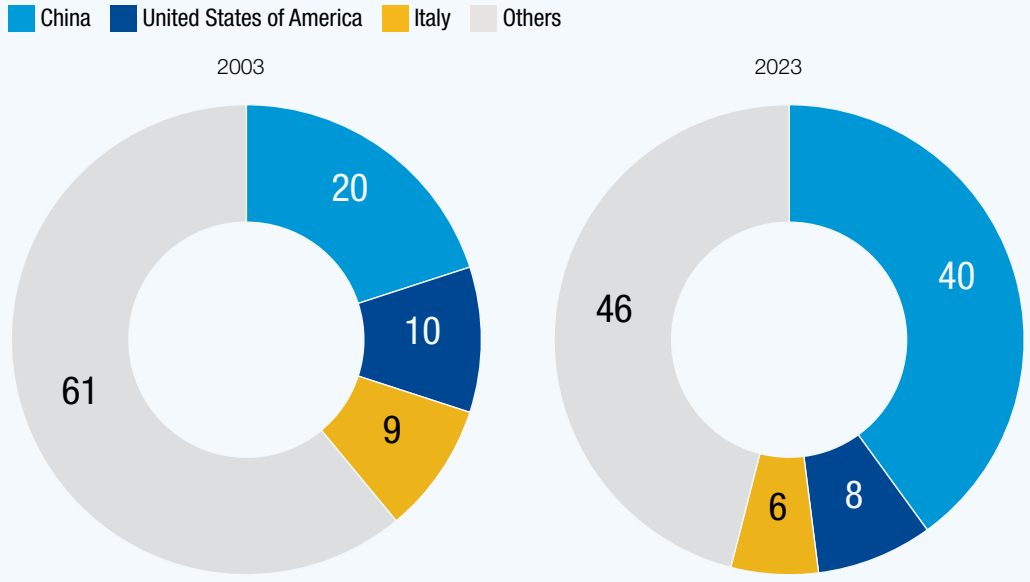
Chile remained the primary exporter of refined copper in the last two decades, though its share decreased from 40 to 21 per cent. (Figure 16) The Democratic Republic of the Congo emerged as a significant exporter of refined copper, accounting for 15 per cent in 2023. The top importers remained largely unchanged, although China's share doubled. (Figure 17) The United States and Italy remain the second and third largest importers.

Figure 16
New players dominate the refined copper market
Main exporters of refined copper, percentage, 2003 and 2023



Source: UNCTAD based on data from UN Comtrade.

Figure 17
Although a leading producer, China relies on refined copper imports
Main importers of refined copper, 2003 and 2023



Source: UNCTAD based on data from UN Comtrade.

The shifting landscape of the global copper market: opportunities and challenges for developing economies

As global demand for copper intensifies—driven by the energy transition, digitalization, and the expansion of green technologies—developing economies with abundant copper reserves, such as Chile, Peru, and the Democratic Republic of the Congo, are scaling up investments in mining infrastructure. These efforts include launching new projects, modernizing existing facilities, and expanding domestic processing capabilities to produce refined copper and semi-finished goods. By fostering industrial growth and reducing dependency on raw material exports, these countries aim to capture greater value from their natural resources.

However, realizing these ambitions involves overcoming a range of structural challenges. Copper-dependent economies remain vulnerable to external shocks, including commodity price volatility, trade restrictions, and shifts in global demand. Moreover, disparities in economic complexity highlight uneven readiness for industrial upgrading. For example, while Indonesia exhibits relatively advanced industrial capabilities, with a high economic complexity score, countries like Zambia and the Democratic Republic of the Congo lag significantly behind. Bridging this gap will require a combination of targeted public policy, investment in infrastructure and workforce skills, and stronger regional economic integration.

Tariffs

The 2023 Most Favoured Nation (MFN) tariff landscape for copper products underscores the complexity of international trade in the sector. While refined copper and unwrought alloys typically face low import tariffs—often below 2 per cent in major markets such as the United States and China—tariffs increase sharply for semi-finished and value-added copper products. For instance, tariffs on copper wire, sheets, tubes, and pipes can reach up to 8 per cent in the Republic of Korea and 7.5 per cent in India. (Table 1) These elevated rates reflect strategic efforts by importing nations to protect and promote domestic downstream industries, thereby discouraging processing in resource-rich exporting countries. This pattern of tariff escalation reinforces global value chain asymmetries, entrenching the role of developing economies as suppliers of raw materials while limiting their participation in higher-value manufacturing.

Table 1
Simple average Most Favoured Nation tariff rates[a] by main copper importers in 2023
(percentage)

Refined copper and copper alloys, unwrought		Copper wire		Copper plates, sheets and strip, of a thickness ex		Copper tube and pipes		Copper tube or pipe fittings	
Country	**Tariff**	**Country**	**Tariff**	**Country**	**Tariff**	**Country**	**Tariff**	**Country**	**Tariff**
Switzerland	0.02	South Africa	0.80	Thailand	1.50	Thailand	1.50	United States of America	3.00
United States of America	1.00	United States of America	2.50	United States of America	2.40	United Kingdom	4.00	Australia	5.00
Japan	1.30	Austria	4.80	Japan	3.00	Czechia	4.80	Austria	5.20
China	1.80	Italy	4.80	Czechia	4.80	France	4.80	Belgium	5.20
Morocco	2.50	Poland	4.80	France	4.80	Italy	4.80	France	5.20
Republic of Korea	3.60	India	5.00	Germany	4.80	Poland	4.80	Germany	5.20
India	5.00	Oman	5.00	Italy	4.80	Türkiye	4.80	Czechia	5.20
United Arab Emirates	5.00	Qatar	5.00	India	5.00	Indonesia	5.00	Netherlands	5.20
Brazil	6.00	China	6.00	China	6.30	India	7.50	Poland	5.20
Saudi Arabia	9.00	Saudi Arabia	9.00	Republic of Korea	6.50	Republic of Korea	8.00	China	5.50
Average	3.50	Average	4.80	Average	4.40	Average	5.00	Average	5.00

[a] MFN treatment requires Members to accord the most favourable tariff and regulatory treatment given to the product of any one Member at the time of import or export of "like products" to all other Members.

Source: UNCTAD, TRAINS.

Note: The tariff information is based on the following 4-digit HS codes: 7403, 7408, 7409, 7411 and 7412.

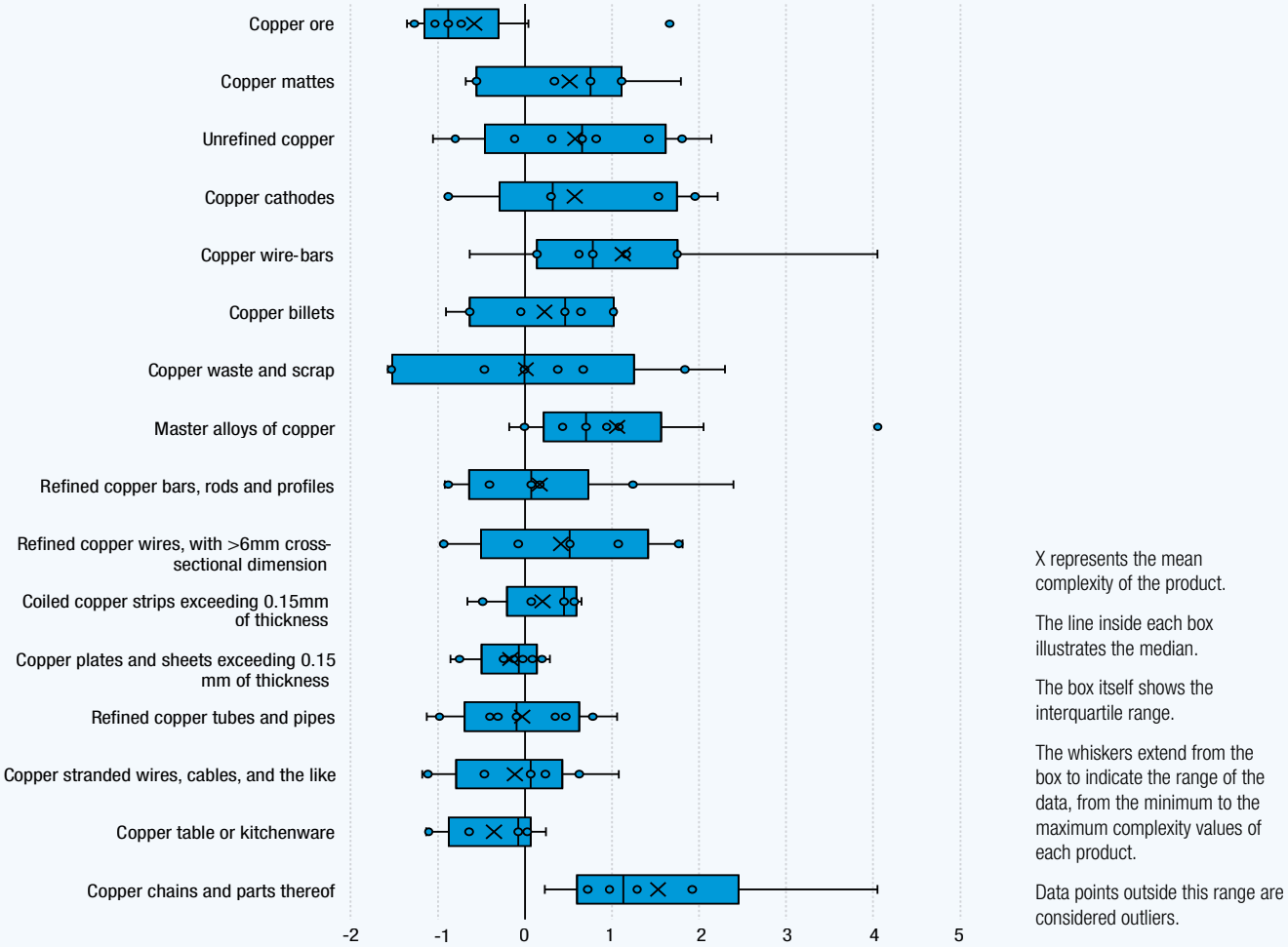
Local value addition and industrial upgrading: the potential for domestic copper-based manufacturing

At the same time, opportunities for copper-based manufacturing—particularly in sectors such as electric vehicles (EVs)—are expanding. EV components, such as wiring and battery foils, are highly copper-intensive, and developing countries could position themselves as competitive suppliers if they invest in relevant manufacturing infrastructure. Initial stages of beneficiation, such as the production of copper mattes or refined copper, can create industrial spillovers that enhance a country's broader productive capacity. (Figure 18) Data from the Product Complexity Index (PCI) reveals a sharp increase in complexity between copper ore and downstream products, underscoring the potential benefits of moving up the value chain.

Figure 18

Initial beneficiation can positively spill over to related sectors

Product complexity of copper ore and copper-based products, 2023



Source: UNCTAD based on calculations from UN Comtrade.
Note: The calculation of product complexity for products is based on HS codes 260300, 740110, 740200, 740311, 740312, 740313 , 740400, 740500, 740710, 740811, 740911, 740919, 741110, 741300, 741810 and 741910. A product complexity value of zero indicates the average product complexity in the world and one represents the standard deviation.

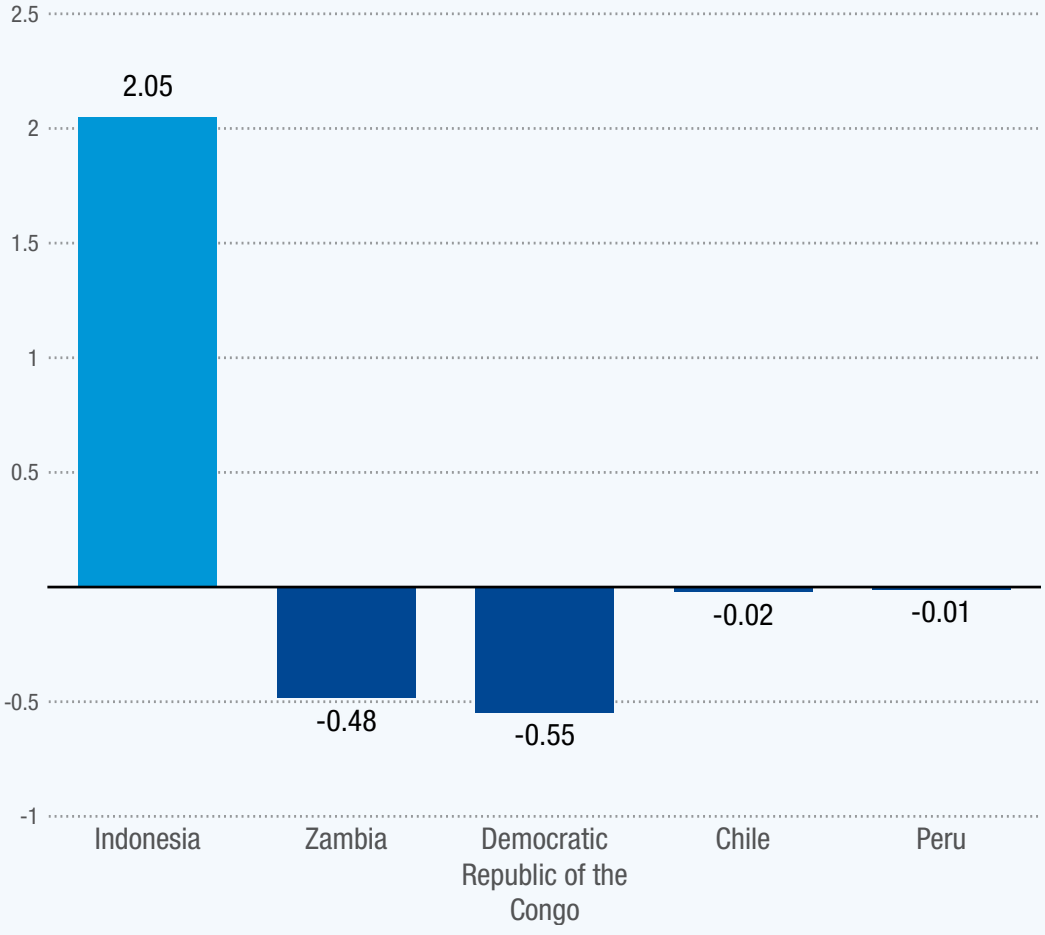
Nonetheless, most copper-exporting countries remain below the global average in economic complexity. Indonesia, with a PCI score of 2.05, stands out as an exception, while Zambia (-0.48) and the Democratic Republic of the Congo (-0.55) are significantly below average. (Figure 19)

Economic complexity is a critical proxy for technological capability and industrial sophistication, highlighting the importance of diversification into higher-complexity products as a strategy for long-term development. These products require advanced knowledge and skills, which are crucial for further economic development.

Figure 19

Major copper-exporting countries rank below average economic complexity

Economic complexity of major copper-exporting countries, 2023



Source: UNCTAD based on calculations from UN Comtrade.

Note: The measure of economic complexity in these graphs is calculated considering 0 as the average of the world distribution and 1 is a standard deviation of the distribution. Therefore, negative values indicate that a country has a complexity value below the global average.

Policy options and strategic responses

The global copper industry faces a looming supply deficit, driven by rising demand from electrification, artificial intelligence, and clean energy technologies. This is compounded by declining ore grades, geopolitical risks, and long project development timelines—typically ranging from 15 to 25 years. To address these challenges, exploration and project development must be accelerated through streamlined permitting, financial incentives, and investment in advanced extraction technologies. Enhanced collaboration between major producers and junior mining firms can also help expedite project timelines and stabilize supply.

Diversification of supply sources will be crucial. Strategic trade partnerships between producing and consuming countries can help mitigate tariff-related barriers, while fostering regional value chains will bolster industry resilience. Encouraging domestic utilization of copper—particularly through local refining, smelting, and manufacturing—will reduce reliance on exports and promote industrial self-sufficiency.

To compete effectively in a rapidly evolving global market, copper-exporting countries must transition from raw material providers to value-added producers. Key policy measures include tax incentives for downstream processing, development of industrial parks, support for high-value copper product manufacturing, and negotiation of improved market access. Mechanisms such as the European Union's Everything But Arms (EBA) or the Generalized System of Preferences (GSP) offer important pathways for expanding trade under preferential terms

Moreover, mining alone will not meet future copper demand. Circular economy strategies, such as scaling up recycling and secondary copper production, will be essential in closing the gap between supply and demand.

In conclusion, **the global copper industry is entering a pivotal phase—one that calls not only for increased production, but also for smarter, more inclusive, and technologically driven growth strategies. Reducing trade barriers, building industrial capabilities, and embracing innovation will be central to ensuring that copper-rich developing countries benefit more equitably from the green and digital transitions.**

Through this publication,
UNCTAD provides valuable insights
into current and emerging trade policy
issues and their impact
on economic development in a fast
changing global trade context.

unctad.org

This document has not been formally edited - UNCTAD/DITC/INF/2025/3

Division on International Trade and Commodities