सत्यमेव जयते

खान मंत्रालय

MINISTRY OF MINES

भारत सरकार

GOVERNMENT OF INDIA

Vision Document on Copper Sector

2025



Disclaimer

This document has been developed with the objective of providing a strategic framework for the long-term growth of the sector and is intended to serve as an indicative reference for stakeholders across the entire value chain, including upstream, downstream and recycling. This document does not constitute and shouldn't be construed to be an opinion or report or policy covering any legal or regulatory advice or procedures to detect fraud or illegal acts. The information provided in this document is being disclosed on an 'as is where is' basis. The Ministry of Mines, Government of India makes no representation whatsoever, express, implicit or otherwise, regarding the accuracy, adequacy, correctness, reliability and/or completeness of the same as the document mainly relies upon the data provided by consultant, Copper industry players and other stakeholders.

To the fullest extent permitted by applicable law, the Ministry of Mines hereby expressly disclaim any and all liability or responsibility to any party whatsoever in respect of this report, and any related communications, including any conclusions or opinions expressed herein. Neither the Ministry of Mines nor any of its affiliates shall be held liable for any losses, damages, or claims arising from or in connection with the use of this report by any recipient.

The sole purpose of this document is to support collaborative efforts towards the sustainable development of the Copper sector in India. All recommendations and data presented are for informational purposes only and subject to further validation and stakeholder inputs. Nothing contained herein shall constitute grounds for any action by recipients of this document before any writ court or other judicial or quasi-judicial forum.



जी. किशन रेड्डी
జి. కిషన్ రెడ్డి
G. Kishan Reddy

सत्यमेव जयते

कोयला एवं खान मंत्री
भारत सरकार
नई दिल्ली
MINISTER OF COAL AND MINES
GOVERNMENT OF INDIA
NEW DELHI



MESSAGE

It gives me immense pleasure to present the vision document on Copper for India, a forward-thinking blueprint aimed at unlocking the full potential of India's copper sector and aligned with Prime Minister Narendra Modi's vision of Viksit Bharat 2047. Copper is a strategic enabler of India's economic transformation, playing a pivotal role in renewable energy, EVs, infrastructure, and digitalization. As India advances towards Atmanirbhar Bharat, securing a reliable and sustainable copper supply is critical to achieving our industrial and energy ambitions.

Despite rising domestic demand, over 95% of India's copper concentrate requirement is met by imports, creating supply vulnerabilities. The vision document outlines a roadmap to expand domestic mining, enhance refining capacity, and strengthen recycling, reducing dependence on imports and ensuring long-term resource security.

A robust copper industry will boost GDP, create high-value jobs, and support India's net-zero goals, positioning the nation as a global leader in the green economy. With decisive action, we can turn copper into a pillar of India's industrial might, powering the journey towards Viksit Bharat by 2047.

(G. Kishan Reddy)

Office : Room No. 353, 'A' Wing, 3rd Floor, Shastri Bhawan, New Delhi-110001, **Tel.** : 23387277, 23383109, 23386402
Residence: 6, Ashoka Road, New Delhi- 110001, Tel: 21411415, 21411403

सतीश चन्द्र दुबे
Satish Chandra Dubey

सत्यमेव जयते

राज्य मंत्री
कोयला एवं खान
भारत सरकार
**MINISTER OF STATE FOR
COAL & MINES
GOVERNMENT OF INDIA**



संदेश

जैसे-जैसे भारत दुनिया की तीसरी सबसे बड़ी अर्थव्यवस्था बनने की ओर अग्रसर हो रहा है, वैसे-वैसे तांबे जैसे खनिजों की स्थिर और सतत आपूर्ति सुनिश्चित करना सर्वोपरि हो गया है। तांबा, जिसे अक्सर "अर्थव्यवस्था की धातु" कहा जाता है औद्योगिक विकास, विद्युतीकरण और उन्नत प्रौद्योगिकियों का एक आवश्यक घटक है।

तथापि, तांबे के लिए भारत की बढ़ती मांग के बावजूद, आयातित तांबा अयस्क पर देश की भारी निर्भरता चिंता का विषय है। इस चुनौती को पहचानते हुए, यह विज़न दस्तावेज़ घरेलू खनन को बढ़ाने, मौजूदा भंडारों को चालू करने और शोधन क्षमता का विस्तार करने के लिए एक विस्तृत रोडमैप की रूपरेखा प्रस्तुत करता है।

खान मंत्रालय एक ऐसा सक्षम वातावरण सृजित करने के लिए प्रतिबद्ध है, जो निवेश को आकर्षित करे, सतत खनन पद्धतियों को बढ़ावा दे और तांबा उद्योग के भीतर मूल्य संवर्धन को प्रोत्साहित करे। इन सामूहिक प्रयासों के माध्यम से, हमें विश्वास है कि भारत तांबे के उत्पादन और प्रसंस्करण में एक वैश्विक अग्रणी के रूप में उभरेगा और विकसित भारत @ 2047 की ओर हमारी यात्रा सुदृढ़ होगी।

(सतीश चंद्र दुबे)

Office : Room No. 504, 'C' Wing, Shastri Bhawan, Dr. Rajendra Prasad Road, New Delhi -110001
Phone : +91-11-23070522, 23070529, 23385203, E-mail : mos-mines@gov.in, mos-coal@gov.in
Delhi Residence : 12, North Avenue, New Delhi-110001, Ph. : 011-23092363, 23092415
Bihar Residence : Vill. Harsari, Post Narkatiyaganj, PS. Shikarpur, Dist. West Champaran, Bihar-845455

व्ही. एल. कान्ता राव, भा.प्र.से.
सचिव
V. L. KANTHA RAO, IAS
Secretary

सत्यमेव जयते

भारत सरकार
GOVERNMENT OF INDIA
खान मंत्रालय
MINISTRY OF MINES
Tel. : 2338 5173, 2338 2614 Fax : 23384682
secy-mines@nic.in, www.mines.gov.in

15th April, 2025



MESSAGE

India's vision for Viksit Bharat @ 2047 is anchored in self-reliance, technological leadership, and economic resilience. As the country accelerates its industrial and infrastructure growth, copper emerges as a critical enabler, powering renewable energy, electric mobility, and digitalization. With demand set to double by 2030, India has a tremendous opportunity to expand domestic exploration, enhance refining capacity, and strengthen supply chain resilience.

To unlock this potential, the government has undertaken bold and forward-looking reforms. Amendments to the MMDR Act and the introduction of composite licenses for copper blocks are paving the way for accelerated domestic exploration. Since 2015, 5 copper mineral blocks have been auctioned for grant of composite license (CL) by the state governments. There are 54 ongoing Copper exploration projects in different stages within the country. Additionally, India is advancing its global resource strategy, leveraging Indian mining companies expertise to assess foreign copper assets. These strategic initiatives create a thriving landscape for investment, unlocking opportunities for the PSU and private sector to play a pivotal role in mineral exploration, sustainable mining and downstream value addition.

The Ministry of Mines is committed to fostering a transparent, agile, and investment-friendly ecosystem, positioning India as a leader in resource efficiency, industrial competitiveness, and mineral security. With ambitious policies, proactive global engagement, and a strong commitment to self-sufficiency, India is poised to reshape its mineral landscape, drive industrial growth, and establish itself as a global powerhouse in the new resource economy.

(V. L. Kantha Rao)

कमरा नं. 320, 'ए' विंग, शास्त्री भवन, डॉ. राजेन्द्र प्रसाद रोड, नई दिल्ली–110001
Room No. 320 'A' Wing, Shastri Bhawan, Dr. Rajendra Prasad Road, New Delhi-110 001

विवेक कुमार बाजपेयी, आई आर एस एम ई
संयुक्त सचिव
VIVEK KUMAR BAJPAI, IRSME
Joint Secretary

सत्यमेव जयते

भारत सरकार
GOVERNMENT OF INDIA
खान मंत्रालय
MINISTRY OF MINES

Dated: 15.04.2025



MESSAGE

It is with great pride that the Ministry of Mines presents the Vision for India's Copper Sector, which is crucial for the country's economic growth.

As we embark on the journey of reimagining India's future, this Vision Document serves as a testament to our unwavering dedication and shared ambition. Recognizing the critical role of Copper in driving industrial growth, clean energy transitions, and advanced manufacturing, India is aggressively pursuing a two-pronged approach—accelerating domestic exploration while securing strategic assets overseas, to reduce dependency and build resilience.

Simultaneously, India is also strengthening its refining and processing capabilities to emerge as a global hub for value-added Copper production. This includes investments in state-of-the-art smelting infrastructure, policy support for the development of integrated processing zones, and the adoption of cutting-edge technologies to enhance efficiency. The transition to a circular economy, with a robust focus on metal recycling and urban mining, will further strengthen India's position as a self-reliant and sustainable player in the global supply chain.

The Vision is clear – an eco-system that is resilient, competitive, and future-ready, fuelling the nation's ambitions for a developed, self-reliant India by 2047.

(Vivek Kumar Bajpai)

325–ए, शास्त्री भवन, नई दिल्ली–110 001, दूरभाष : +91-11-23384741, ई-मेल : vivek.bajpai@gov.in
325-A, Shastri Bhawan, New Delhi-110 001, Tel.: +91-11-23384741, E-mail : vivek.bajpai@gov.in

Table of Contents

Executive Summary 15

Copper: A Strategic Metal for Global Development 18

1. Copper as a critical mineral 25

1.1. Copper is a critical mineral – global perspective 29

1.2. Copper as a critical mineral - Indian perspective 31

2. Copper and the world 34

2.1. Megatrends shaping the global copper outlook 34

2.2. Emerging sectors driving the growth trajectory 36

2.3. Prevailing and Evolving Technologies Transforming Copper Value Chain 40

2.4. Focus on reducing carbon footprint across the copper value chain 42

2.5. Resource & reserve across major economies and global trends on resource discovery 44

2.6. Copper supply scenario in major economies 51

2.6.1. Global copper mine production 51

2.6.2. Global refined copper production 54

2.7. Reflection on leading copper producers 57

2.8. Trends in secondary copper production & refining 62

2.9. Copper trade flow 66

2.9.1. Copper ore and concentrate trade flow 66

2.9.2. Copper blister and anode trade flow 68

2.9.3. Refined copper trade flow 70

2.10. The challenges impacting the global copper market 75

2.11. Key Takeaways for Indian copper sector 77

3. Copper and India 80

3.1. Domestic sector-wise usage of copper 85

3.2. Resource and reserve across regions in India 88

3.3. Copper Supply Scenario 91
3.4. Major copper producers and their expansion Plans 102
3.5. Trade flows 105
3.5.1. Import and export overview 105
3.6. Secondary copper and processing in India 107
3.7. Key trends and drivers important for growth of Secondary Copper sector 108
3.8. Safeguarding against future high prices by building functional reserves 110
3.9. Key highlights of the Indian copper sector 112
4. Benchmarking with Other Countries: China and Japan 114
5. Expected growth of domestic copper sector 119
5.1. Expected growth of copper usage in short-term (2030) and Amrit Kaal (2047) 119
5.2. Major copper consuming sectors outlook 120
5.3. Potential supply scenario in 2030 and Amrit Kaal 128
6. Stakeholder Consultation 135
7. Navigating The Way Forward In The Sector 139
7.1. Emphasizing on exploration activities 139
7.2. Enhancing supply chain resiliency 141
7.3. Imagining India as a Processing Hub with downstream integration (smelting & refining and fabrication) 144
7.4. Streamlining & promoting responsible recycling 147
8. Suggested constitution of taskforces to drive the growth of domestic copper industry 151
9. Conclusion 156

List of Graphs

Graph 1 Different stages of growth (S-curve) 27

Graph 2 Metal consumption and economic parameters correlation 28

Graph 3 World refined copper usage (in MT) 36

Graph 4 Refined copper usage region-wise 37

Graph 5 Semis Production 37

Graph 6 Sector-wise copper usage 38

Graph 7 Copper Exploration Budget and Number of Companies Investing 47

Graph 8 Copper Exploration Budget by Regions (US$ Bn) 47

Graph 9 Mine production (MT) in terms of metal content 51

Graph 10 Country-wise share of copper mine production 52

Graph 11 Refined copper production (MT) 54

Graph 12 Refined copper production country-wise share 55

Graph 13 Company-wise Copper Production (MT) 58

Graph 14 Major copper refineries by capacity (MT) 59

Graph 15 Share of secondary copper in refined copper production 63

Graph 16 Global Exporters of Copper Ore & Conc. 67

Graph 17 Global Importers of Copper ore & conc. 67

Graph 18 Global Copper blister and anode exporters 69

Graph 19 Global Importers of Unrefined Copper (Copper blister and anode) 69

Graph 20 Global Refined copper Exporters 70

Graph 21 Global Refined Copper Importers 71

Graph 22 Domestic refined copper usage (MT) 85

Graph 23 Domestic sector-wise copper usage 86

Graph 24 Domestic product-wise copper demand..... 87

Graph 25 Grade-wise distribution of Indian Copper Resources 89

Graph 26 Indian Copper ore production / Hindustan Copper Production (MT) 93

Graph 27 Domestic MIC production (MT) from HCL 94

Graph 28 Copper Concentrate import and export (MT)..... 94

Graph 29 TC/RC price trend in copper..... 99

Graph 30 Indian Copper Cathode Snapshot (MT) 99

Graph 31 India's Import and Export of Copper (all forms) (INR Cr)..... 106

Graph 32 India's Cu Import Category wise share in FY23..... 106

Graph 33 Copper scrap trade..... 107

Graph 34 LME price over the years 110

Graph 35 Copper in use (MT), 2020..... 111

Graph 36 Historical and projected domestic apparent copper demand (in MT) 119

Graph 37 Domestic copper ore production (MT) projected snapshot 130

Graph 38 Copper concentrate scenario in FY47(P) (KT) 132

Graph 39 Domestic refined copper capacity projections FY47(P) (KT) 133

List of Tables

Table 1 Key sectors and its end-use that will drive the domestic demand of major minerals 25

Table 2 Global Comparison of Per Capita Metal Consumption 28

Table 3 Global Economies perspective on copper and critical minerals 29

Table 4 Technologies across value chain 40

Table 5 Copper reserves 45

Table 6 Major discoveries of copper (1990-2021) 48

Table 7 Mines undergoing expansion 53

Table 8 Copper Smelter/Refinery undergoing expansion 56

Table 9 Direct cost breakdown of mines owned by First Quantum in $/tonne 59

Table 10 Summary of select underground mines 61

Table 11 Countries and their Policies on Recycling 63

Table 12 Initiatives by major copper economies 65

Table 13 Taxation & Duties on Mining over Major Copper Producing Countries 74

Table 14 Challenges faced by players in copper value chain 75

Table 15 Operational status of HCL Mines 92

Table 16 Auctioned copper mines 93

Table 17 Domestic refined copper production (KT) 96

Table 18 Technology being used by Indian players 97

Table 19 Comparison of pyrometallurgy process 98

Table 20 Major copper players expansion plans 104

Table 21 Copper recycling benefits, challenges and solutions in copper recycling 107

Table 22 Key trends and drivers of secondary copper sector 108

Table 23 Comparative analysis of Refined Copper production 114

Table 24 Taxation and Financial Incentives 115

Table 25 Scrap and Recycling Policies..... 115

Table 26 Investment and Acquisition Strategies 116

Table 27 Domestic mine-wise production FY30 (P)..... 129

Table 28 Projection of domestic refined copper production FY30 (P) 129

Table 29 Potential ore production of auctioned blocks in FY47..... 131

Table 30 Potential ore production from upcoming blocks in FY47 131

Table 31 Suggested constitution of taskforces..... 151

List of Figures

Figure 1 Geological reserve and functional reserve across major copper economies 18

Figure 2 Emissions in Copper industry 43

Figure 3 Copper geological presence 46

Figure 4 Major Copper producers & their geographies 58

Figure 5 Trade Flow - Copper concentrate 66

Figure 6 Trade Flow - Copper blister & anode 68

Figure 7 Trade Flows - Refined Copper 70

Figure 8 Indian Copper Resources Snapshot 89

Figure 9 State-wise preliminary explored blocks 90

Figure 10 Copper supply snapshot 91

Figure 11 Indian Copper Concentrate Imports 95

Figure 12 Presence of Indian copper producers 103

Figure 13 Future copper supply scenario 128



EXECUTIVE SUMMARY

Executive summary

The Copper Vision Document outlines a strategic roadmap for India's copper industry to support national growth, sustainability, and energy independence by 2047. Recognizing copper's pivotal role as a critical mineral, the document emphasizes copper's importance across vital sectors—such as renewable energy, electric vehicles, electronics, and infrastructure—which are essential for achieving India's ambitious economic and sustainable development targets.

Copper has been recognized as a critical mineral in India's resource strategy, playing a key role in advancing national goals for green energy and electric vehicle (EV) transition. The demand for copper is projected to surge as India accelerates its transition to clean energy technologies, transportation electrification, and digital infrastructure.

By 2050, global refined copper demand is expected to reach 53 million tonnes (MT) due to rapid urbanization, infrastructure expansion, and industrialization. In addition to traditional sectors, increased demand is anticipated from renewable energy, EVs, charging infrastructure, and AI. Despite this growing demand, supply is expected to tighten due to factors such as the recent closure of the Cobre Panama mine and Indonesia's ban on copper concentrate exports. Additional challenges include declining ore grades, environmental oversight, resource nationalism, and escalated operational costs.

On a positive note, copper miners are taking steps to reduce emissions and make mining more environmentally friendly. Approximately 73% of carbon emissions in the copper industry occur during mining and beneficiation, with the remainder from smelting, refining, and transport. The largest emission source is the carbonized electricity used to process ore into copper. Miners are increasingly adopting renewable energy and energy-efficient technologies to minimize pollution, enhancing the industry's environmental sustainability.

The Kamoa-Kakula mine in the DRC has recently completed its Phase 3 expansion, achieving a copper production capacity of 650,000 tpa from concentrate and a smelter capacity of 0.5 MTPA. Phase 4 expansion is underway, aiming for an annual ore throughput of 20 million tonnes. New smelter capacities are also emerging in Indonesia, India, the DRC, the USA, and China. However,

the increase in smelter and refining capacities has led to a copper concentrate deficit, driving down TC/RC prices. In November 2023, a benchmark agreement between Chilean miner Antofagasta and Chinese smelter Jinchuan set the treatment charge (TC) at USD 80/t—9% lower than the previous year and the first drop in TCs in three years. Given the recent concentrate supply tightening and expanding smelter capacity in China, spot TCs have plunged to negative level.

India, the third-largest importer of copper scrap, imported 0.310 MT in CY23, while China imported 1.98 million tonnes. With an increasing focus by major scrap-exporting nations on domestic recycling, the global scrap supply chain is expected to face disruptions. Scrap trade dynamics are evolving as key scrap-producing economies consider restricting scrap exports to encourage domestic recycling.

In FY24, India's refined copper usage stood at 0.844 MT, while total copper apparent usage was 1.718 MT, with the remainder sourced from direct scrap melting and net imports of semi-finished products. Over 90% of copper concentrate requirements were met through imports. Additionally, anode net imports of copper anodes stood at 0.205 MT in FY24. Since the closure of the Sterlite Copper Tuticorin plant, India has been a net importer of copper cathodes, with a net import of 0.335 MT in FY24. Consequently, India's copper (HS code 74) trade deficit has grown from USD 0.76 billion in FY17 to USD 6 billion in FY23, with the copper concentrate trade deficit (HS code 2603) reaching USD 3.4 billion. The three-month average LME copper price in October 2024 was USD 9,724/t, and it is expected to rise further in the long run due to increased demand and supply constraints, impacting the nation's forex reserves.

To address these challenges, the Indian government has introduced several initiatives, including the Exploration License (EL), Reverse Charge Mechanism (RCM) on scrap, Quality Control Order (QCO), and Extended Producer Responsibility (EPR). However, further action is required to stimulate domestic demand. For example, China has approximately 116.1 million tonnes of copper in use, which can be recycled within about 20 years to hedge against supply disruptions. In contrast, India has only 15.2 million tonnes, making scrap copper relatively scarce. Policies to

standardize copper content in end-use products and public awareness campaigns on copper's benefits could promote higher energy efficiency and living standards.

India's copper demand is projected to reach 3–3.3 million tonnes by 2030 and 8.9–9.8 million tonnes by 2047, reflecting a 2–2.2x increase by 2030 and a 5.9–6.5x increase by 2047. Demand is expected to grow at an elasticity of 1.1–1.3 relative to GDP growth until 2030 and 0.6 – 0.7 until 2047, spurred by the government's ambitious renewable energy targets (500 GW by 2030, with 50% of power from non-fossil sources) and EV goals (30% EV penetration by 2030), as well as India's potential role as a global manufacturing hub under the China+1 strategy. These projections should be reviewed and adjusted every 2–3 years as technologies will evolve and copper content in the finished product might vary due to technology change. For instance, copper content in EVs has dropped from 99.32 kgs in 2015 and is expected to be 61.7 kgs in 2030 marking a 38 kgs per car reduction from 2015 to 2030.

Such substantial demand increases necessitate a strategic approach to secure supply. By 2047, India must expand its refining capacities by an additional 1 MT by 2030 and another 3.5 MT by 2047. Alongside overseas mine acquisitions, downstream integration near these assets should be prioritized. Furthermore, India must improve its scrap refining capabilities, currently negligible, aiming to refine 15–20% of available scrap in the long term.

Given the strategic role of scrap in achieving net-zero goals, major economies are contemplating scrap export bans. India should consider imposing similar restrictions on copper scrap while enhancing domestic scrap collection. Copper in buildings and infrastructure becomes available for recycling after 30–50 years, whereas consumer goods and vehicles provide scrap within 15–20 years. Government initiatives should thus focus on increasing copper demand in consumer goods to leverage this shorter recycling cycle.

To ensure a stable supply of primary raw materials, India should prioritize expanding domestic mining capacity and acquiring or investing in foreign assets in copper-rich regions such as Australia, South America, and Africa. Increased imports from Africa may be feasible following the recent removal of copper concentrate import duties.

Copper: A Strategic Metal for Global Development

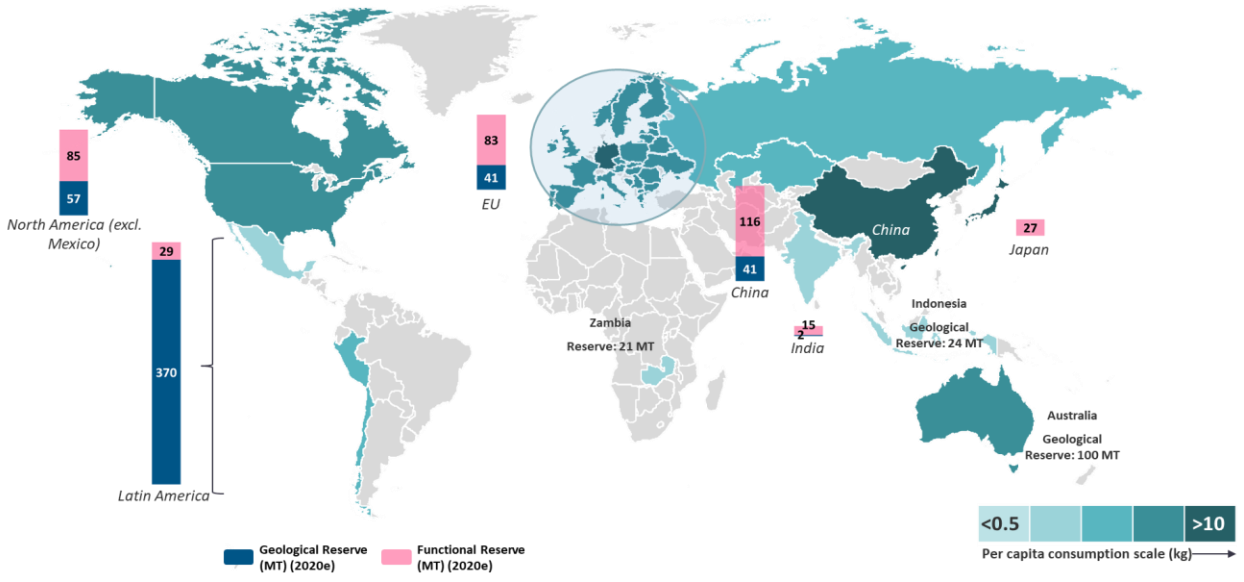
The Unique Role of Copper in Society

Copper, a highly versatile and essential metal, has been at the core of human development for over 10,000 years. Renowned for its superior properties such as high electrical and thermal conductivity, corrosion resistance, and antimicrobial traits, copper is indispensable in energy systems, construction, electronics, and healthcare. Its role extends to sustainability through extensive recycling, making it a cornerstone of the circular economy.

Global reserves and per capita consumption across major economies

Germany leads in per capita refined copper consumption at 13.6 kg, followed by South Korea at ~11 kg, compared to a global average of 3.2 kg, whereas India's copper consumption stands at 0.5–0.6 kg, highlighting the growth potential. Major copper economies such as China, Japan EU countries, having limited geological reserves, are focusing on increasing their functional reserve for future use.

Figure 1 Geological reserve and functional reserve across major copper economies



Source: Secondary Research

Copper's Economic and Environmental Impact

- **Economic Contributions:**
    - Copper mining and processing are creating jobs and infrastructure.
    - Trade and investment in copper are stimulating economic growth in both developed and emerging economies.
- **Sustainability through Recycling:**
    - **Recycling Rates:** Copper is boasting one of the highest recycling rates among metals, preserving its properties.
    - **Energy Savings:** Recycling copper is consuming significantly less energy compared to primary production, reducing environmental footprints.

Meeting Future Demand: Innovation and Efficiency

While global demand for copper is rising, technological advancements, resource discovery, and recycling ensure its availability. Challenges like declining ore grades and environmental concerns necessitate continuous innovation in mining technologies, policies promoting efficient resource utilization and investment in sustainable practices to support long-term copper supply.



Vision

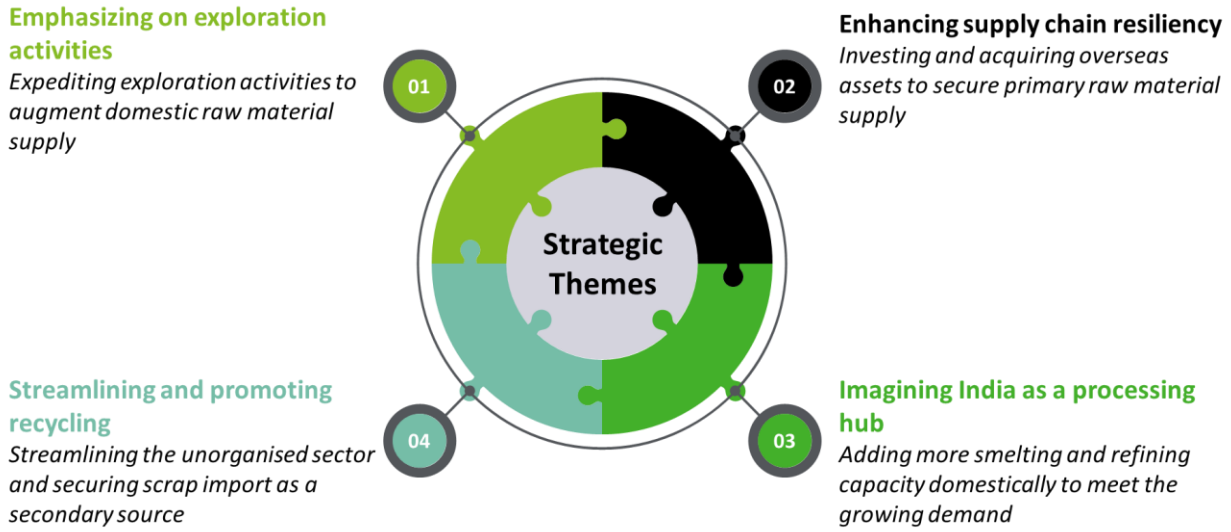
Excel in the availability of copper and associated copper industry essential for overall socioeconomic and environmental growth vision of India"

Mission

Ensure a secure and sustainable supply of copper while fostering a thriving copper industry that drives economic growth, creates job opportunities and contributes to cleaner and Atmanirbhar Bharat"

Strategic Initiatives for Advancing India's Copper Sector

To meet these objectives and support the anticipated growth in copper demand, India must adopt strategic initiatives to address current challenges and drive the copper sector's sustainable development.



1. Navigating the way forward: *Emphasizing on exploration activities*

About 18% of geological resources are categorized as reserves, indicating that exploration efforts need to be expedited to improve the domestic raw material supply.

Short term (until 2030) strategic focus areas		Efforts	Potential ROI
Promotion of domestic exploration activities	▪ Introduction of **NMET funding** for brownfield exploration ▪ **Integrating IMIC (following the JORC template) alongside UNFC** to enhance the credibility and attract investment ▪ Adoption of digital technologies such as **AI/ML-based prospecting engines, geological mapping using hyperspectral data and ML models**, etc.	◑	●
Partnership with copper-rich countries	▪ Conducting feasibility study in **foreign copper assets for further prospecting** (using the learning from KABIL, IndoAsia Copper Ltd.)	●	●
Long term (until 2047) strategic focus areas			
Focus on deep sea exploration	▪ Under the Samudrayaan mission, **expedite deep sea exploration** in the Central Indian Ocean Basin for the mining of polymetallic nodules	●	◑

2. Navigating the way forward: *Enhancing supply chain resiliency*

India's copper concentrate import is expected to reach 91%–97% by 2047, necessitating diversification of supply and foreign asset acquisition for seamless raw material supply.

Short term (until 2030) strategic focus areas		Efforts	Potential ROI
Domestic upstream capacity augmentation	▪ **Fastrack the re-opening of closed mines** through revenue sharing MDO model ▪ Facilitate **duty-free import for high-capacity mining and beneficiation equipment**	●	●
Facilitating supply security and overseas investment	▪ **Offtake agreements** by introducing **dedicated copper chapter in FTAs** with countries such as Chile and Peru for securing a fixed quantity of copper concentrate ▪ Facilitate **G2G partnerships** to enable Indian PSUs, private companies, and JVs to invest strategically in mining assets in copper-rich countries ▪ Provide **sovereign guarantee by Govt.** to companies in protecting overseas assets, with option to impose levies for protection	●	●
Long-term (until 2047) strategic focus areas			
FDIs in copper sector	▪ Encourage foreign copper companies to set up smelters and refineries in India, with PSUs investing in their overseas mining projects in return	●	◑

● High ◑ Medium ○ Low

3. Navigating the way forward: Imagining India as a processing hub with downstream facilities

To meet the domestic refined copper demand, India needs to establish robust midstream and downstream facilities with responsible waste management mechanism.

Short-term (until 2030) strategic focus areas		Efforts	Potential ROI
Building competitive and efficient domestic copper units	▪ **Provide financial support** (capital investment subsidy, customs duty exemption on imported plant and machineries, operating subsidy) for building **4-5 MTPA of new smelting & refining capacity** in long-run ▪ Provide **subsidies** (incentivisation for capacity expansion) and **promote new age application industries** for import replacement to encourage domestic mid to downstream industry for capacity expansion ▪ Formulate **strategy for re-operationalisation** of closed smelting and refining facilities ▪ Supporting **MSME development in copper clusters** with the help of primary copper players	●	●
Ensuring the viability of domestic copper units	▪ Adjust **duty structures** [review existing FTAs (ASEAN, the UAE, Japan) and avoid importing of refined copper products (cathodes, rods, wires) and other downstream products (tubes, copper foils, etc.) in new FTAs being negotiated] to make the domestic industry more resilient to low TC/RC cycles	◑	◑
By-product strategy for sustainable practices	▪ Promote sustainability through the **utilisation of smelter by-products** (use of slag in building and construction, producing DRI from slag, etc.) ▪ Provide substantial **subsidies or grants towards R&D** for advanced metallurgical processes to **reduce environmental impact**	●	●
Driving innovation in the copper midstream industry	▪ Allocate **dedicated funds for R&D activities** in processing technologies under various national innovation foundations ▪ Foster **international collaborations** for technology transfer, joint research and pilot plant development ▪ **Training and capacity building:** Establish centres of excellence and launch national specialised programmes across the copper value chain	◑	●

4. Navigating the way forward: Streamlining and promoting responsible recycling

The secondary copper sector will play a significant role in meeting the growing demand; hence, the focus will be on organizing the scrap sector through proper classification of scrap, securing scrap supply, formalizing billing mechanism and promoting sustainable scrap usage.

● High ◑ Medium ○ Low

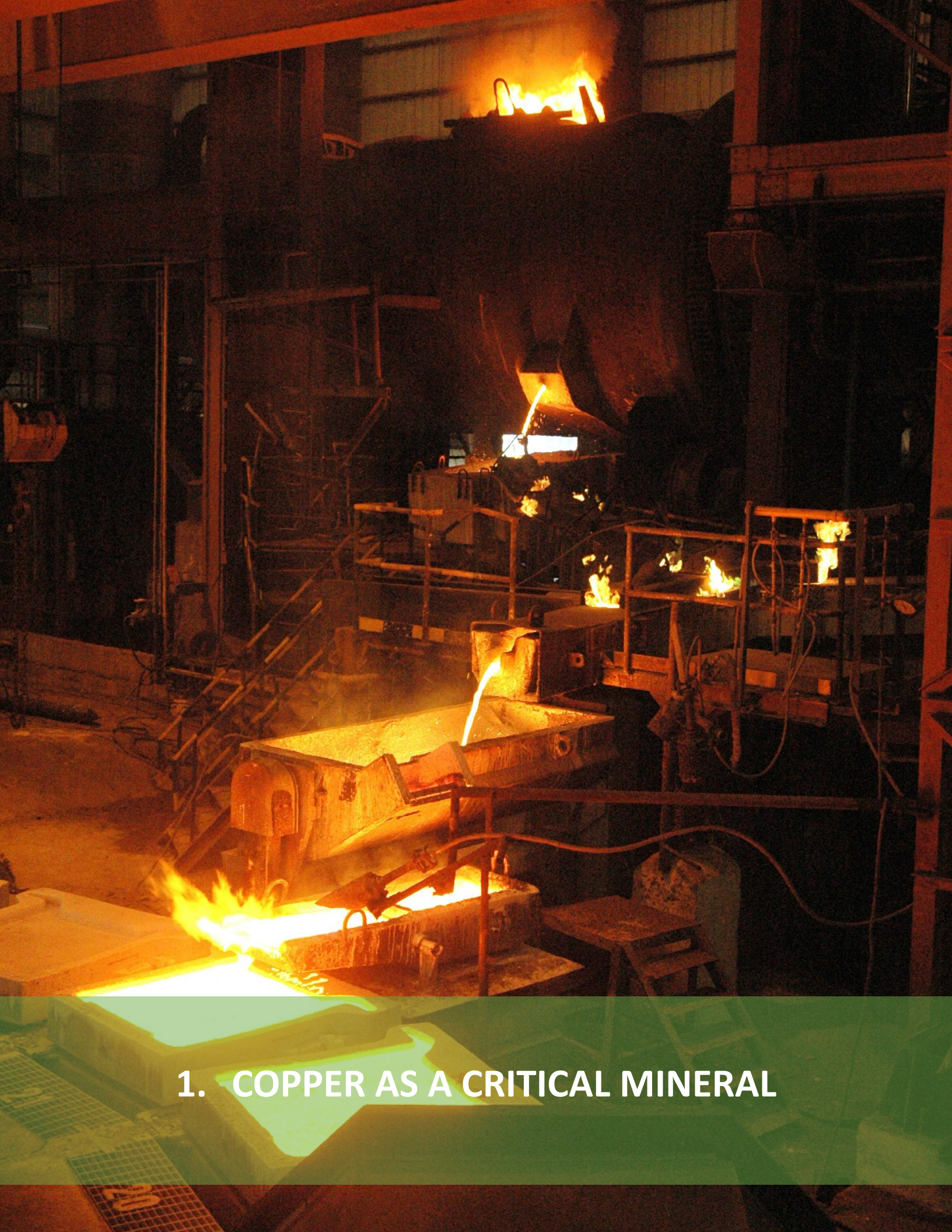
Short term (until 2030) strategic focus areas			Efforts	Potential ROI
	Enhancing sustainability through responsible recycling	▪ Provide financial support towards building of **responsible scrap processing facilities,** including efficient segregation mechanisms	●	●
		▪ Boost secondary refining by enforcing **stringent regulations to ensure the refining of scrap** with a **dedicated governing body** for monitoring		
		▪ Introduce **Green Fence Policy, classify imported & domestic scrap** and introduce **HSN codes for scrap items** to track copper content in end-products		
	Reviewing of scrap trade policies	▪ Introduce **policy for export ban on high-grade copper scrap** and **special trade agreements** with developed countries to secure scrap supply	◑	●
Long term (until 2047) strategic focus areas				
	Focus on initiatives towards reducing carbon footprint	▪ Introduce **certification for "Green Copper" products** and incentivisation to encourage adoption of greener practices	●	◑
		▪ Provide **grants and funding for R&D in "Green Copper"** towards environmental sustainability and decarbonisation		

Immediate high-impact initiatives:

To address critical needs with substantial effects, immediate and strategically important high-impact initiatives need to be adopted.

- *Expedite **re-opening** of closed mines and formulate strategy for **re-operationalisation** of domestic closed smelting and refining facilities*
- *Facilitate **G2G partnerships** to enable Indian PSUs, private companies, and JVs to invest strategically in mining assets in copper-rich countries to secure seamless raw material supply*
- ***Secure fixed quantity of copper concentrate** through offtake agreements – introduce dedicated copper chapter in FTAs with countries such as Chile, Peru*
- ***Adjust duty structures** – review existing FTAs (ASEAN, the UAE, Japan) and avoid importing of refined copper products (cathodes, rods, wires) and other downstream products (tubes, copper foils, etc.) in new FTAs being negotiated*
- *Provide Government support towards efficient **scrap segregation mechanisms***
- *Supporting **MSME development in copper clusters** with the help of primary copper players*
- *Provide **financial support for R&D activities** in processing technologies and advanced metallurgical processes to reduce environmental impact*

● High ◑ Medium ○ Low



1. COPPER AS A CRITICAL MINERAL

1. Copper as a critical mineral

Viksit Bharat@2047: The Amrit Kaal Journey

To achieve these ambitious goals, the Government of India (GoI) is allocating significant budgets, introducing progressive policies, and making targeted investments across key sectors such as energy, infrastructure, and defence. In each of these sectors, the government is setting clear and ambitious targets for the mid-term (2030) and long-term (2047), providing a strategic roadmap to guide the nation towards realising its Viksit Bharat@2047 vision.

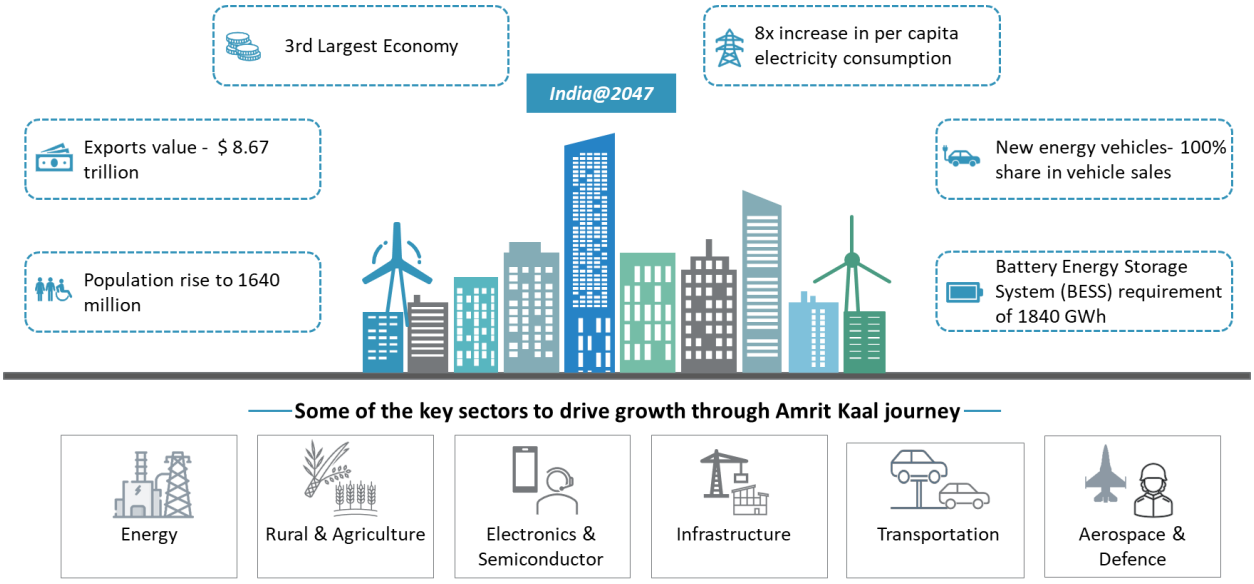


Table 1 Key sectors and its end-use that will drive the domestic demand of major minerals

Key Sectors	Government's Push	Future Outlook
Energy	*Budget allocation for solar power grid stands at INR 8,500 crore in FY25, a 70% increase from the previous year*	• *90% clean grid by 2047 under the energy independence pathway*

Key Sectors	Government's Push	Future Outlook
Infrastructure	*The Indian government has allotted ~INR 11 lakh crore for infrastructure development in the 2024-25 budget*	• *51% of India's population is likely to be living in urban centres.* • *Infra investment of INR 845-880 lakh crore is expected between 2023 & 2047.* • *500 MT crude steel capacity & 245 kg per capita consumption by 2047*
Consumer durables	*Ministry of Electronics and Information Technology (MeitY) received INR 21,936 crore in budget FY25, 52% jump from last budget*	• *3x increase in semiconductor market by 2032* • *9x increase in electronics manufacturing market by 2030*
Transportation	*PM E-drive (INR 10,900 crores from FY24 – FY26), PLI, and Vehicle Scrapping Policy*	• *Various analyst reports project EV penetration to be 87% by 2047* • *>85% of the value chain expected to be manufactured in India by 2047*
Health	*Budget allocation for health is INR 90,958 crores in FY25 budget, 164% increase from 2013-14*	• *Indian industry expected to grow to USD 450 Bn by 2047, from current USD 30 Bn*

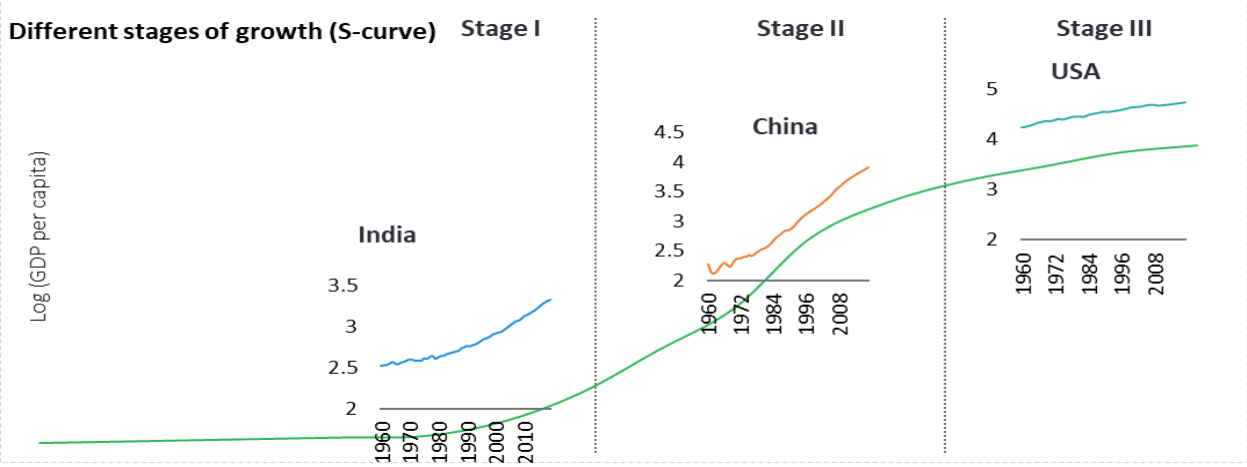
Key Sectors	Government's Push	Future Outlook
Defence	*Budget estimates for FY25 stands at INR 621,940.85 crores*	• *Self-reliance in defence sector* • *INR 3 lakh crore annual defence production & INR 50,000 crore exports expected by 2028-29*

Source: IBEF, PIB, Ministry of Finance, Invest India

Metal usage driven by economic growth:

India is currently in the early stages of the S-curve of wealth creation, while China is progressing toward becoming a mature economy, and the United States is already displaying the characteristics of a fully matured economy. This presents a significant growth opportunity for India.

Graph 1 Different stages of growth (S-curve)



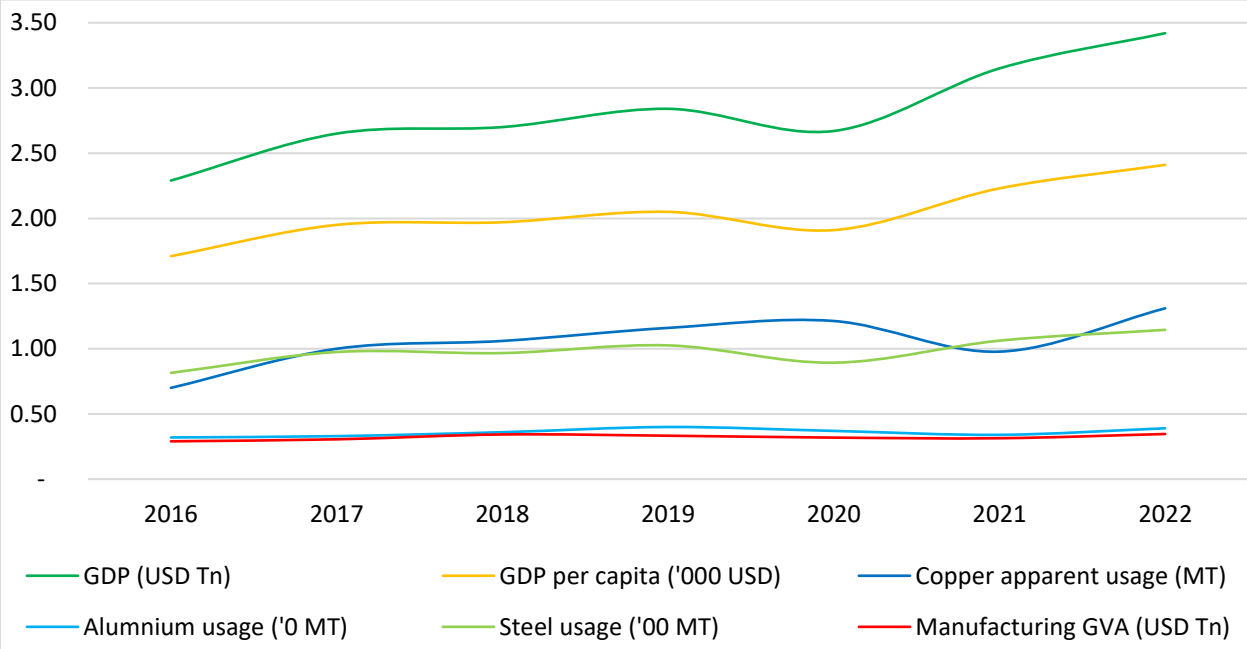
Source: ICA

Table 2 Global Comparison of Per Capita Metal Consumption

Per Capita Consumption (Kg)	USA	China	India	Global
Refined Copper	5.9	10.7	**0.5**	**3.2**
Aluminium	14.9	28.0	**2.5**	**11.0**
Steel	280.0	645.8	**86.7**	**221.8**

Historically, the consumption of key metals in India has grown in parallel with GDP and per capita income. As an emerging economy, India's metal usage is projected to grow substantially in tandem with its economic growth as increased consumption spurs demand for goods and services, driving growth in sectors such as manufacturing and transportation, which in turn elevates the demand for metals.

Graph 2 Metal consumption and economic parameters correlation



Source: ICA, Secondary Research

This correlation between metal usage and manufacturing output is not unique to India. A similar trend was observed globally, for instance, in the early 1990s (1994), China's per capita copper

consumption was approximately 1 kg. Over the next two decades, as the Chinese economy underwent rapid industrialization, this figure surged to around 9 kg. Currently, India's per capita refined copper consumption stands at roughly 0.5 kg, and it is expected to follow a similar trajectory of steep growth in the following years.

1.1. Copper is a critical mineral – global perspective

The global push for net-zero emissions by 2050 has intensified the focus on clean energy technologies, driving an unprecedented demand for minerals such as lithium, cobalt, nickel, copper, and graphite. These minerals are essential for technologies like electric vehicles, renewable energy systems, and advanced grid infrastructure. However, the supply of these critical minerals is concentrated in a few countries, making economies worldwide vulnerable to potential supply chain disruptions.

In response, major economies have classified certain minerals as critical and are implementing strategies to safeguard their supply chains. Major economies have recognized copper's indispensable role in clean energy technologies by including it in their critical mineral lists.

Table 3 Global Economies perspective on copper and critical minerals

 ***USA*** **Cu intensity:** **57 tonne/USD bn**	• USGS included **50 minerals** as critical minerals. • The Department of Energy (DOE) added copper to its list of critical materials due to increasing demands for cleaner energy. • Tax credits for green energy production, and electricity storage. • USD 3.1 Bn investment to support domestic production of advanced batteries and EV battery-recycling capabilities.

	• Expansion of domestic manufacturing and net zero by 2050.
 ***Japan*** **Cu intensity:** **194 tonne/USD bn**	• Ministry of Economy, Trade and Industry (METI) names **35 minerals** as critical including copper. • Copper demand is going to increase towards achieving ~90% clean electricity share by 2035. • Reduce GHG emissions by 46% by 2030, and to achieve net-zero emissions by 2050.
 ***Australia*** **Cu intensity:** 0 **tonne/USD bn**	• Federal govt. created a 'strategic materials' list including copper, separate to its critical mineral list of **24 minerals.** • Building strategic material hubs to meet the demand for clean technology and mitigate supply chain risk. • 82% renewable energy in electricity grid by 2030.
 ***China*** **Cu intensity:** **875 tonne/USD bn**	• Formulate the list of critical minerals according to their industrial requirements & supply risks. • Classified **25 minerals** as critical minerals, copper included in the list due to its importance for clean technologies. • 1,200 GW from Solar & Wind by 2024 as per IEA. • Carbon neutrality by 2060, urbanization agenda, recovery in global electronics sector, rapid expansion of EV market. • Slower future economic growth may impact copper demand.
 ***EU***	• **34 critical minerals** have been designated. The economic and strategic importance of copper and the high risk associated with its supply led to its inclusion under the Critical Raw Materials Act.

Cu intensity: **Poland: 369 tonne/USD bn** **Spain: 262 tonne/USD bn** **Germany: 220 tonne/USD bn**	• Green energy investment plans under RePowerEU initiative. • Focus on energy security – ~45% of energy from renewable sources. • New-energy vehicle sales and related infrastructure – 1 Mn charging stations by 2025.
 ***Chile*** **Cu intensity:** **214 tonne/USD bn**	• Mining industry contributing **~14% of country's GDP** where copper makes up a large part of the total volume of national export. • Copper is going to play a crucial role to achieve the ambitious target of becoming carbon neutral by 2050.

Note: Intensity of refined copper usage per GDP refers to the amount of copper used by the semis industry divided by GDP

Source: Copper Factbook, Secondary Research

1.2. Copper as a critical mineral - Indian perspective

In line with global net-zero initiatives, India has committed to reducing its emissions intensity by 45% by 2030 (from 2005 levels) and aims to achieve Net Zero by 2070. To achieve these ambitions, a 7-member committee was formed by the Ministry of Mines in 2022 and recommended a list of critical minerals, which the government officially released in July 2023, identifying 30 minerals as critical for India's future growth in technologies such as green energy, electric vehicles (EVs), defence, etc.

The MMDR Amendment Act, 2023 has empowered the central government to exclusively auction Mining Leases and Composite Licenses for 24 critical and strategic minerals. Additionally, the Act introduced an Exploration License for 29 critical and deep-seated minerals, aiming to facilitate resource identification, encourage private sector participation, and incentivize exploration within

India. While copper is not included in the critical and strategic minerals list, it is part of the critical and deep-seated minerals list.

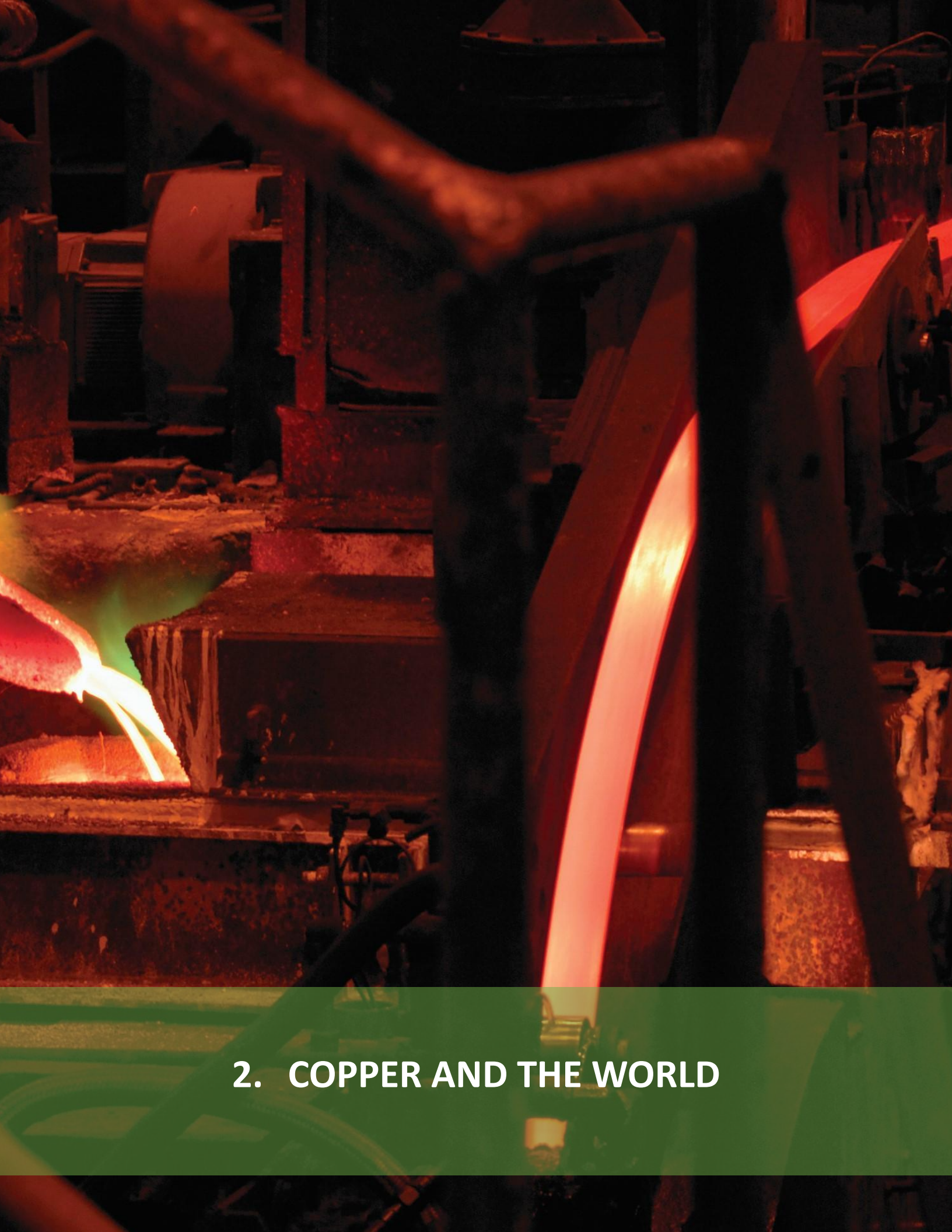
Moreover, the Government of India has taken significant steps to ensure supply chain security for critical minerals through initiatives such as the Mineral Security Partnership (MSP), the establishment of KABIL, and the National Critical Mineral Mission.

To achieve the target of Net Zero by 2070, copper is going to play a key role in India…

- Supporting economic growth
- Securing raw material supply
- Growing demand from traditional & emerging sectors
- Driving research, innovation and exploration
- Promoting climate action and environmental protection

Source: Secondary Research, Ministry of Mines Reports





2. COPPER AND THE WORLD

2. Copper and the world

2.1. Megatrends shaping the global copper outlook

Rapid urbanization and increased investments in renewable energy infrastructure are projected to significantly boost refined copper demand, rising from the current ~26 MT to a record-high of ~53 MT by 2050[1]. Rapid technological advancements and pressing environmental concerns, several megatrends are poised to shape the global landscape.

- **Global climate action and sustainability**
    - 2023 saw a remarkable 50% increase in renewable energy capacity compared to the previous year[2]. This surge underscores the global commitment to scaling up renewable energy sources. However, to meet the global climate targets[3], renewable energy capacity must reach at least 11 terawatts (TW) by 2030[4].
    - Electric car sales are expected to reach ~17 million in 2024, accounting for more than one in five cars sold worldwide. By 2030, almost 1 in 3 cars on the roads in China is expected to be electric, and almost 1 in 5 in both the United States and European Union based on today's energy, climate, and industrial policy settings[5].

- **Urbanization and infrastructure investment**
    - Currently, 56% of the world's population – 4.4 billion inhabitants live in cities. This trend is expected to continue, with the urban population more than doubling its current size by 2050, at which point nearly 7 of 10 people will live in cities[6].
    - Projects such as China's Belt and Road Initiative (BRI) and the G7's Build Back Better World (B3W) are expected to drive significant infrastructure growth at a global level.

[1] S&P Global
[2] World Economic Forum
[3] Limit warming to 1.5°C
[4] IRENA- International Renewable Energy Agency
[5] IEA – Global EV outlook 2024
[6] World Bank Group

- **Resource nationalism**
    - Resource nationalism is becoming increasingly prominent as countries focus on strengthening their supply chain resiliency and promoting local value addition such as processing, refining, etc. By focusing on these areas, countries aim to achieve greater economic stability, reduce dependence on foreign resources, and ensure the sustainable development of their natural resources.

- **Industry 4.0 and smart technologies**
    - The advent of Industry 4.0 and smart technologies is driving significant advancements in process efficiency across various industries. Key technologies such as autonomous vehicles, drones, robotic systems, virtual reality (VR), and augmented reality (AR) are at the forefront of this transformation, enabling unprecedented levels of automation, precision, and operational effectiveness.

- **Foreign asset acquisition**
    - China has strategically secured its copper supply chain by acquiring stakes in around 30 foreign-owned copper mines. These overseas assets allow China to import copper concentrates, ensuring a stable and reliable supply for its growing domestic needs.
    - Other countries might adopt similar strategies to secure their own raw material supplies.

- **Circularity**
    - The circular economy is rapidly gaining traction as global economies increasingly adopt sustainable practices. This shift is driven by the growing recognition of the need to reduce waste, conserve resources, and promote environmental sustainability. The circular economy is expected to become a US$ 2-3 billion market in the coming years, reflecting the significant investment and interest in sustainable practices.

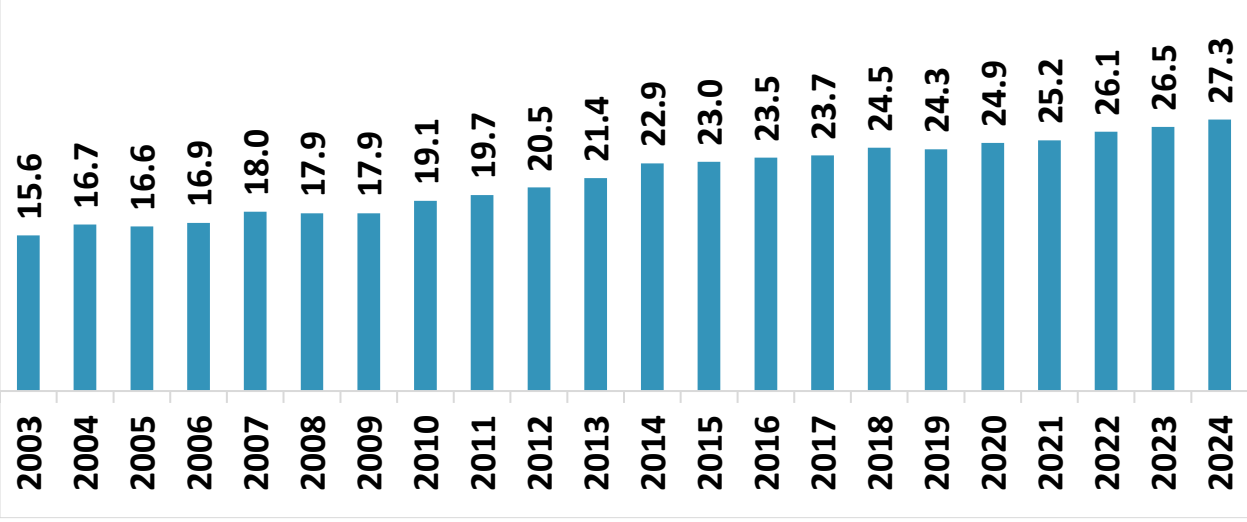
- **Green copper**
    - The demand for copper, produced with a significantly lower carbon footprint, is expected to be on rise. This shift is driven by stringent Environmental, Social, and Governance (ESG) norms that are increasingly shaping market preferences for copper which is responsibly produced.

Global refined copper consumption per capita is expected to grow steadily from **present 3.2 kg to ~5 kg till middle of the next decade** due to Net-Zero targets; after 2035, copper consumption per capita is expected to flatten up to ~5.6 kg till 2050 as fleet electronification is expected to get saturated.

2.2. Emerging sectors driving the growth trajectory

Global copper demand has grown at a CAGR of ~2.7% over past two decades, increasing from ~15.6 MT in 2003 to ~27.3 MT in 2024. This growth is driven largely by the transmission and distribution sector, which has relied on copper for decades. However, the global copper market is entering a new age with transition technologies, which is expected to see double-digit growth rates.

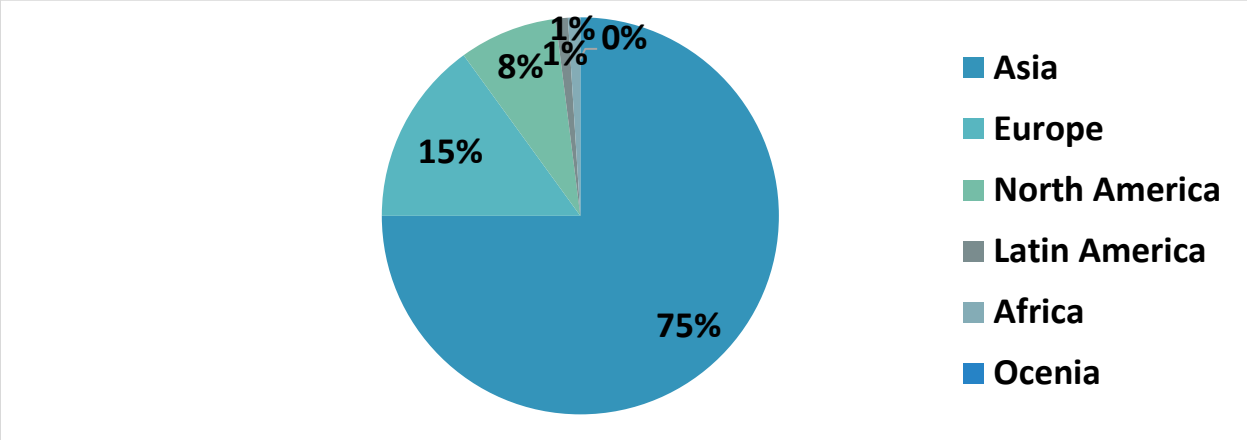
Graph 3 World refined copper usage (in MT)



Source: World Copper Factbook 2023, ICSG press release

Asia stands out as the top consumer, accounting for 74% of world copper usage, followed by Europe, America, and Africa with 15%, 10%, and 1% respectively. Within Asia, China accounts for 50-55% of global copper demand. China drove growth in refined copper usage, in the past decade, usage in developed economies such as the US, and EU has plateaued or declined, while growth has been observed in countries such as India, Malaysia, the United Arab Emirates, and Vietnam.

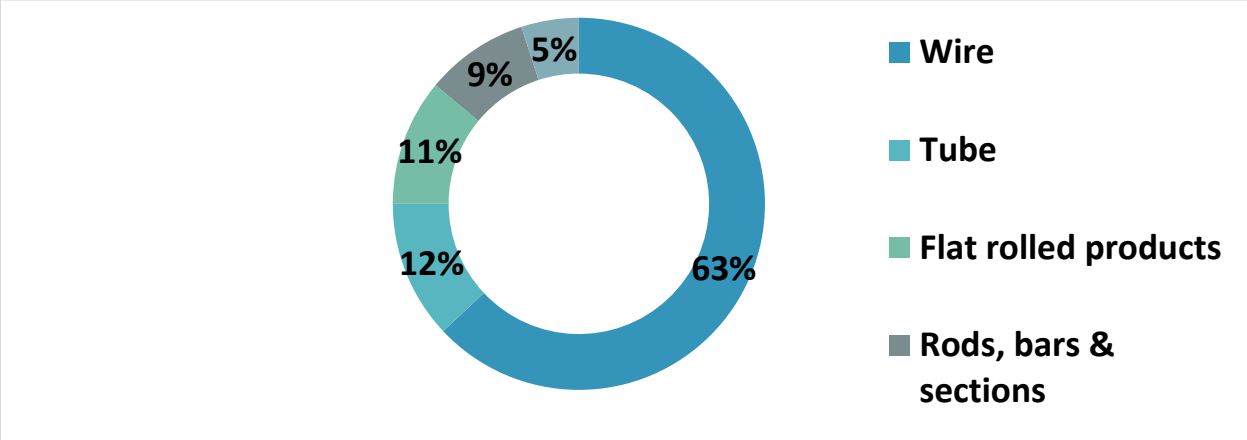
Graph 4 Refined copper usage region-wise



Source: World Copper Factbook 2023

Direct melting contributes ~18% of copper semi-finished products, in 2022 copper usage stood at 32 MT, of which 26.1 MT came from refined copper and 5.9 MT came from direct melting of scrap. Asia accounted for 83% of semi-finished copper output.

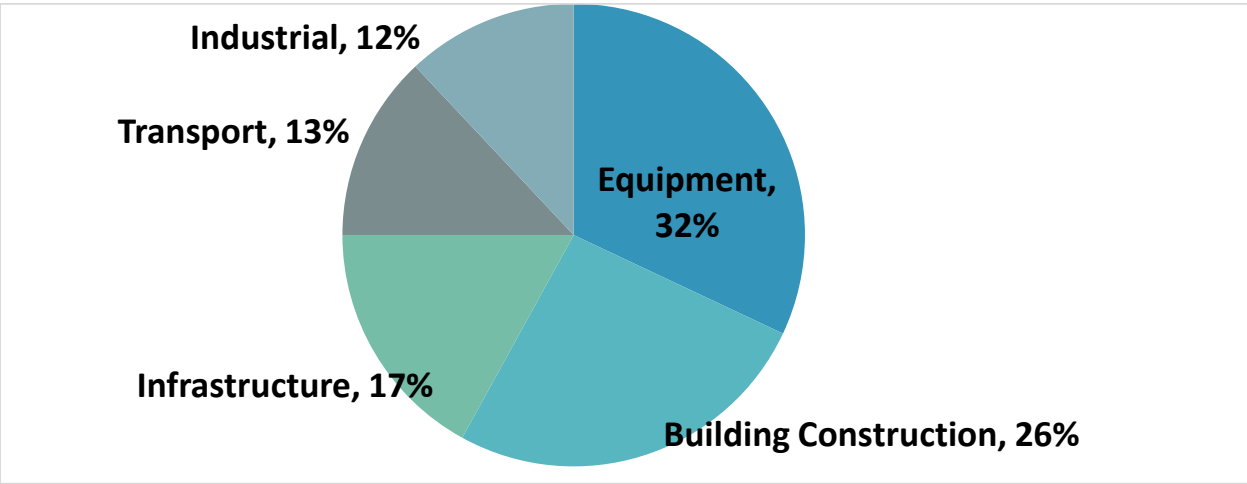
Graph 5 Semis Production



Source: World Copper Factbook 2023

Copper finds essential use across key traditional sectors like electronics and semiconductors, Infrastructure, energy, and transportation, as highlighted below. While these sectors remain vital for copper consumption, the rise of renewable energy, particularly in solar and wind power generation, along with the electrification of transportation through electric vehicles (EVs) and charging infrastructure, drives further demand growth.

Graph 6 Sector-wise copper usage



Source: World Copper Factbook 2023

In electronics, copper plays a vital role in enabling high-speed data transmission in global information and communication technologies (ICT). It is widely used in ICT components like subscriber lines, networks, and devices such as mobile phones and computers.

Moving to construction, copper and its alloy brass are preferred materials for plumbing fixtures and architectural elements due to their aesthetic appeal and durability. Copper's fire-resistant properties make it a superior choice for applications where safety is paramount, such as in preventing bacterial proliferation in tubing installations.

In infrastructure, copper's reliability as a conductor sets the standard for efficient power transmission. It is extensively utilized in power cables across various voltage requirements, thanks to its strength, ductility, and resistance to corrosion. This ensures stable and dependable power supply, contributing significantly to infrastructure stability.

Transportation benefits from copper's properties as well, especially in enhancing efficiency. Copper-nickel alloys are used to reduce drag and improve fuel efficiency in marine vessels. Moreover, its conductivity, durability, and recyclability are crucial for various automotive components like motors, wiring systems, and brakes, thereby playing a key role in transportation systems performance.

In industrial settings, copper and its alloys are prized for their durability, machinability, and precise casting. These properties make them ideal for critical components such as gears and bearings, ensuring reliable operation and precision in industrial machinery and equipment. Overall, copper's versatility and performance characteristics make it indispensable across a wide range of sectors, driving innovation and progress in various industries.

In line with the traditional sector, there are new emerging sectors that are going to drive the copper demand in coming years.

- **Renewable Energy Drive**
  - Solar technology to boost demand to ~1.6MT by 2030 at CAGR of 15%.
  - Wind energy to drive copper demand ~1.3MTPA by 2030.
  - Green energy sector to contribute ~5 MT by 2030.

- **EV and Charging Infrastructure**
  - EV sales are expected to reach 31.5 million units by 2030.
  - Supportive regulations in major economies for EVs, and investment in large EV charging infrastructure.
  - Higher copper content than ICE, essential for batteries and charging infrastructure.
  - Additionally, aviation and rail sectors are increasingly relying on copper-intensive components for improved performance and sustainability in modern transportation systems.

- **Rise of AI and growing demand for T&D infra**
    - Transmission & distribution infrastructure will rise from ~5 MT in 2020 to ~10 MT by 2040.
    - Underground and subsea lines, electrification of the transportation sector.
    - Global rise of AI to intensify copper demand from current <1% to 6-7% by 2050 for data centres.

2.3. Prevailing and Evolving Technologies Transforming Copper Value Chain

In the pursuit of sustaining and enhancing copper production, leading copper economies and producers have embraced a myriad of technological innovations to revolutionize the process across the copper value chain. Leveraging advancements in exploration methodologies, data analytics, and remote sensing technologies, these entities are reshaping the landscape of mineral exploration.

Table 4 Technologies across value chain

Value Chain	Technology	Developed by
Mining	Pulsed-power technology enabling the rapid and efficient fragmentation of ores through high-intensity bursts of energy	• I-ROX Technology: BHP and I-ROX have forged a collaboration agreement aimed at expediting the advancement of I-ROX's technology and business
Extraction	Bioleaching of sulphide ores having environmental benefits and lower capital of investment	• Nuton System developed by Rio Tinto and partnered with McEwen Mining and Arizona Sonoran to use the technology for green mine development

Value Chain	Technology	Developed by
Extraction	Leaching of low-grade primary sulphide ores using catalyst-based system	• Developed by Jetti resources, the technology being used at 22 active project sites
Extraction	Enabling recoveries of over 70% in half the time of traditional leaching methods	• SandLixTM technology developed by Anglo American can deliver metal at roughly half the embodied water and energy intensity than conventional concentrator circuits
Beneficiation	Sulphide floatation circuits for coarse metal particle recovery from slurry	• Grind-circuit roughing, such as the CiDRA P29 system • Coarse particle scavenging: Eriez's HydroFloat system
Process Optimization in Beneficiation	Improving copper recovery using artificial intelligence	• Collaboration between BHP and Microsoft to use new digital technology to optimise concentrator performance at BHP's Escondida operation in Chile
Tailings utilization	Utilization of Copper Tailings as Clay for Cement Clinker Calcination.	• Research Paper was published on by Key Lab of Clean Energy Utilization, Zhejiang University, College of Communication Engineering China Jiliang University
Supply Chain	Hyperledger Fabric based platform for cross border copper concentrate trial shipment processed on blockchain technology	• Developed by MineHub Technologies which is being adopted by BHP and China Minmetals. • BHP has a subscription to MineHub platform, which will help it gain improved visibility into its supply chains to proactively mitigate disruptions.

Source: Mining journals, Secondary research

In addition to the above initiatives, companies like BHP operate global accelerator programs like Xplor which targets innovative early-stage mineral exploration companies to find critical resources which are necessary to drive the energy transition. As a part of this initiative, in 2023 BHP announced its first cohort of seven companies, infusing them with cash to carry out R&D and providing them access to internal and external experts.

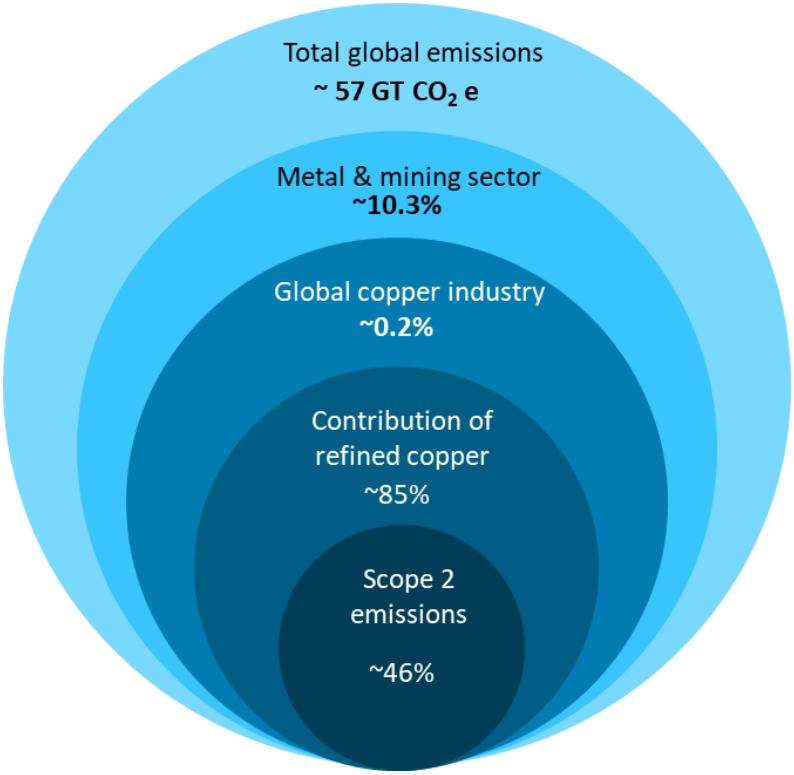
Companies like Mining Process Solutions are developing novel leaching technologies based on glycine, which will be helpful to utilize low-grade copper ores where traditional leaching is prohibited due to environmental or social sensitivities[7]. Global players like Anglo American and Mitsubishi Materials are collaborating to leverage advanced technology driven traceability solutions to enhance transparency across the copper value chain[8].

2.4. Focus on reducing carbon footprint across the copper value chain

The global copper industry contributes only 0.2% of total carbon emissions. Within the industry, 85% of emissions come from refined copper production, while the remaining 15% arises from secondary production, semi-finished products, finished goods manufacturing and others. Approximately 73% of emissions occur from mining and beneficiation, with the remainder stemming from smelting, refining, transportation, and other processes. The use of carbon-intensive energy sources primarily drives these emissions. Global efforts to produce low-carbon copper are focused on reducing Scope 2 emissions, either through the generation or purchase of renewable energy.

[7] Engineering and Mining Journal December 2022
[8] https://www.mining-technology.com/news/anglo-mitsubishi-responsible-copper/?cf-view

Figure 2 Emissions in Copper industry



Some initiatives by global copper players and technology providers to reduce carbon emissions include.

Decarbonized electricity: Transition from conventional to renewable energy generation / PPAs at copper mines and production sites

- Antofagasta's Zaldivar copper mine (Chile): Operates with **100% renewable energy**, saves 3.50 LT of CO2 annually.
- KGHM's **solar plant** in Poland is connected to its Legnica smelter which generates 3 GWh of electricity annually.
- Grupo México´s **wind farm** in Mexico provides 600 GWh per year of green electricity to the company´s nearby mining and metallurgical operations.

Energy efficiency: Improvements in milling efficiency and smelting technologies, installation of in-pit crushing and conveying systems.

- Freeport-McMoRan has reduced energy consumption by 20% with innovative **high-pressure grinding rolls.**
- **Flash Smelting Pierce Smith** Converting process is evaluated to produce lowest of direct & indirect CO2 emissions.

2.5. Resource & reserve across major economies and global trends on resource discovery

Geological nature of copper deposits across the world

There are three main categories of copper deposits they are porphyry-type deposits, strata-bound deposits, and massive sulfide deposits. Porphyry-type deposits are the most common and they account for 45% of the world's copper production.

- **Porphyry deposits**
    - Porphyry copper deposits are low grade but are important sources of copper because they can be worked at a large scale for low costs.
    - These deposits are associated with deposits of igneous intrusive rocks with Cu sulfide minerals disseminated in them.
    - They typically contain between 0.4 and 1 % Cu in concert with smaller amounts of other metals, such as molybdenum, silver, and gold.

- **Massive sulfide deposits**
    - Deposits of compact massive copper, iron, zinc, and lead sulfide, and associated disseminated sulfide. These deposits have tabular or pond-like form and are interlayered with marine volcanic and sedimentary rocks.
    - These deposits typically are small with well-defined boundaries and commonly have a copper content from 1.0 to 5.0 percent.
    - Copper often is produced as a valuable by-product of the other minerals in these deposits.

- **Strata-bound deposits**
    - These deposits contain layers of sandstone or shale containing disseminated copper minerals and, commonly, valuable amounts of silver.
    - The second most important in terms of metal reserves, are less common & smaller than porphyry deposits.
    - The Zambian deposits commonly contain 2 to 4% copper in sulfide minerals, and the Zairian deposits 4 to 6 % copper in carbonate and silicate minerals.

Global Copper Reserves and Strategic Investment in Discovery

Global reserve increased from ~460 MT in 2020 to ~1 BT in terms of metal content. Current and future exploration opportunities, and technological advancements will lead to increases in geological reserves which is essential for long-term availability of copper. Chile is the country with the largest number of reserves with 19% of global copper reserves, followed by Peru and Australia with 12%, and 10% respectively.

Table 5 Copper reserves

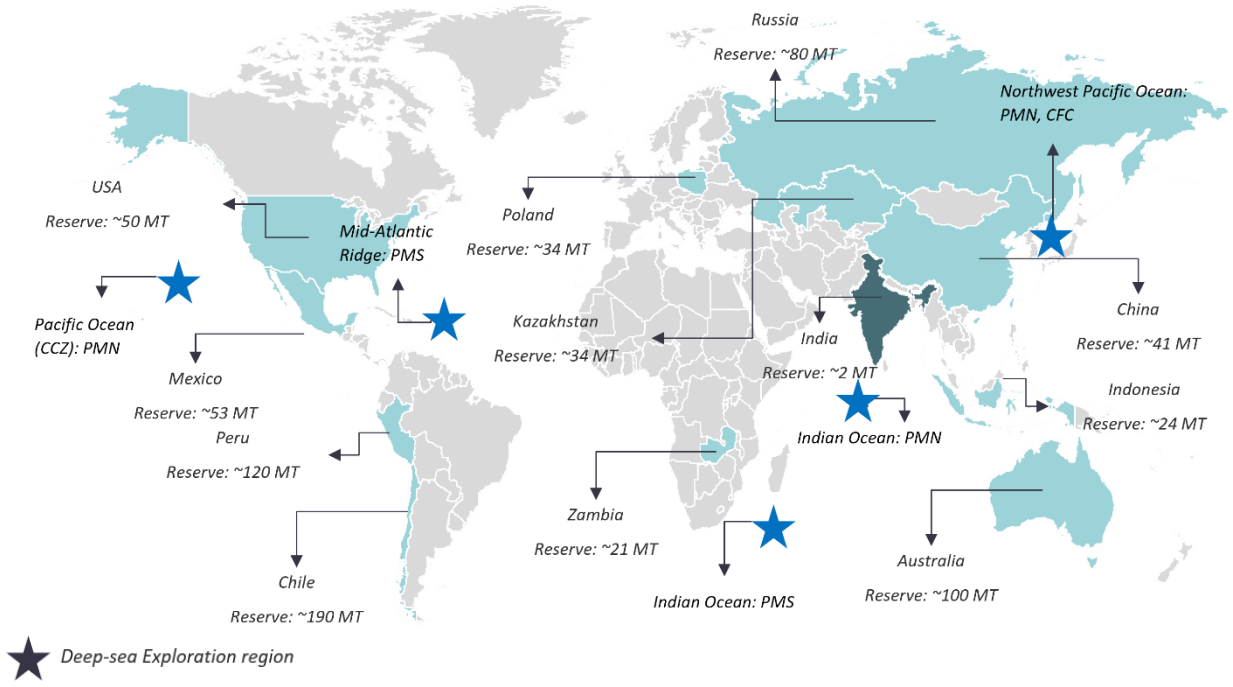
Country	Reserves (Cu Metal Content) (MT)[9]	% share
Chile	190	19
Peru	120	12
Australia	100	10
Russia	80	8
Mexico	53	5
USA	50	5
China	41	4
Poland	34	3

[9] The most recent U.S. Geological Survey assessment of global copper resources indicated that, as of 2015, identified resources contained 2.1 billion tons of copper and undiscovered resources contained an estimated 3.5 billion tons

Country	Reserves (Cu Metal Content) (MT)[9]	% share
Zambia	21	2
Kazakhstan	20	2
Others	291	29
Total	**1,000**	

Source: USGS

Figure 3 Copper geological presence

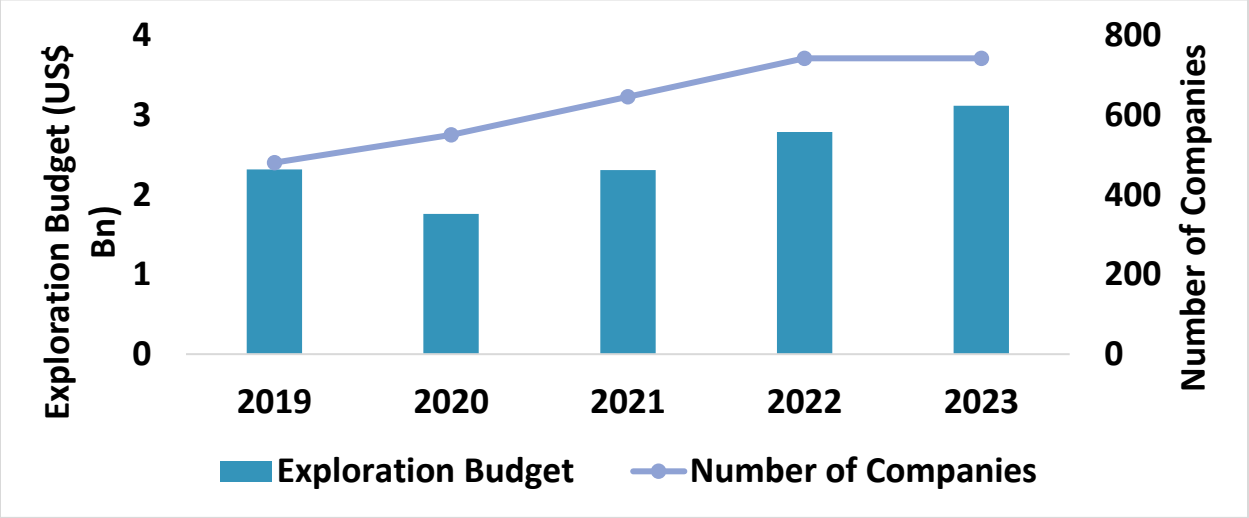


Note: PMN – Polymetallic nodules, PMS – Polymetallic sulphides, CFC - Cobalt-rich ferromanganese crusts

Source: USGS, S&P Global Report on Copper Exploration Budget Trends 2023, Deloitte Report-Tracking the trends, World Copper Factbook 2023

Given the demand for copper, there are significant investments that are being made in the exploration field of copper. In the fiscal year of 2023, the budget allocated for copper exploration soared to a decade-high figure of US$3.12 billion, notably eclipsing global non-ferrous exploration expenditure. The graph below shows the trend in exploration budget and the number of participating companies.

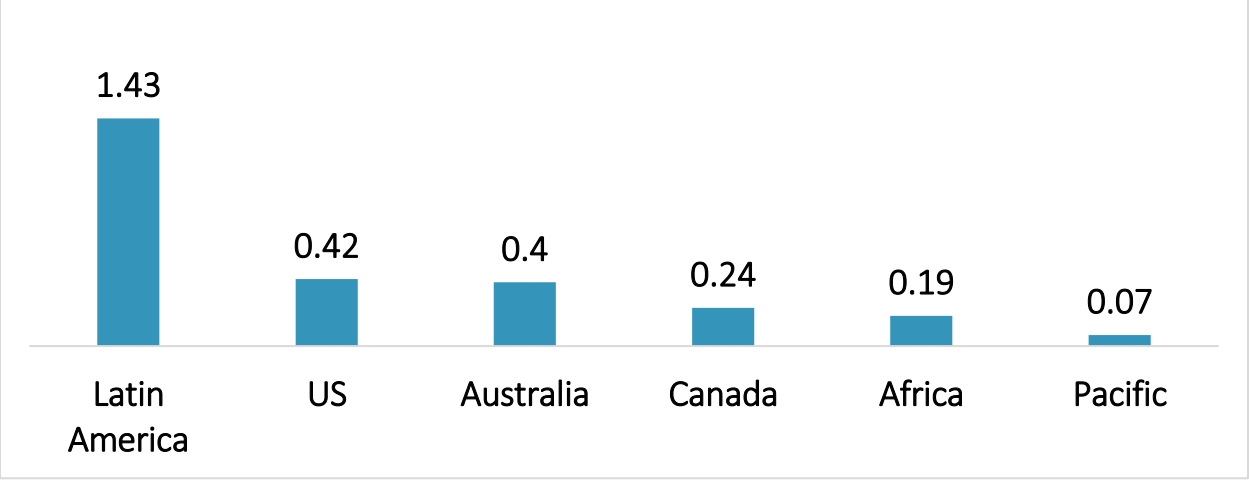
Graph 7 Copper Exploration Budget and Number of Companies Investing



Source: S&P Global Report on Copper Exploration Budget Trends 2023

In 2023, increased allocations for copper were observed across all regions, with Latin America leading the trend with a year-over-year rise of 19%, reaching a total of $1.43 billion.

Graph 8 Copper Exploration Budget by Regions (US$ Bn)



Source: S&P Global Report on Copper Exploration Budget Trends 2023

Although the total amount of copper discovered between 1990 and 2021 has notably increased, there continues to be a downward trend in both the frequency and scale of significant discoveries over the past decade. The recent surge in copper addition primarily stems from previously established discoveries dating back to the 1990s. Notably, only three additional discoveries have been identified in the past five years, contributing a mere 5.6 MT. This trend reflects a strategic shift among companies, directing more exploration resources toward established deposits and operational mines.

However, copper exploration increasingly leverages cutting-edge technologies. For example, KoBold Metals, a company focused on the discovery and development of new battery metal resources, uses AI and machine learning to identify potential copper deposits.

Table 6 Major discoveries of copper (1990-2021)

Year	Number of Discoveries	Copper in reserves resources and past discoveries (Mt)	Copper Exploration Budget ($M)	Implied delivery cost ($/t)
1990	8	70.2	528.9	7.5
1991	10	140.7	491.7	3.5
1992	8	44.4	486.5	10.9
1993	10	37.2	624.9	16.8
1994	13	73.5	563.1	7.7
1995	16	100.4	670	6.7
1996	11	62.5	729.9	11.7
1997	17	80.1	758.1	9.5
1998	12	32.3	625.4	19.4
1999	9	34.7	509.4	14.7

Year	Number of Discoveries	Copper in reserves resources and past discoveries (Mt)	Copper Exploration Budget ($M)	Implied delivery cost ($/t)
2000	9	10.7	451	42
2001	11	72.1	419.6	5.8
2002	8	17.4	315.9	18.2
2003	7	19.6	350.6	17.9
2004	7	16.6	584.1	35.2
2005	15	71.4	836.9	11.7
2006	7	26.5	1392.9	52.6
2007	15	75.3	2077.1	27.6
2008	10	78.5	2976.8	37.9
2009	5	19.9	1608.3	80.6
2010	1	1	2257.3	2300.8
2011	7	29.9	3657	122.4
2012	1	0.8	4700.6	5596
2013	4	31	3468.7	111.8
2014	3	22.4	2677.8	119.6
2015	0	0	2081.6	NA
2016	1	0.6	1576.9	2447.1
2017	2	3.9	1704.1	432.2
2018	0	0	2074.8	NA
2019	0	0	2321.2	NA

Year	Number of Discoveries	Copper in reserves resources and past discoveries (Mt)	Copper Exploration Budget ($M)	Implied delivery cost ($/t)
2020	1	1.7	1758.7	1046.8
2021	0	0	2313.6	NA
Total	**228**	**1,175.4**	**47,593.3**	

Source: S&P Global Report on Copper Discoveries – Declining Trend continues

Only 12 out of the 228 deposits examined corresponding to the above data were unearthed in the past decade, comprising merely 60.5 million tonnes, or 5.2%, of the total copper discovered since 1990. Another significant factor contributing to the dearth of major discoveries is a notable shift in exploration sector priorities. Since the 1990s, there has been a substantial reduction in the proportion of annual copper budgets allocated to grassroots exploration, with the 2021 allocation of 34.0% nearing the 2009 low of 32.2%. This contrasts sharply with the late 1990s and early 2000s, when grassroots budgets typically constituted between 50% and 60% of exploration expenditures.

New focus areas in copper exploration

With around 70% of the Earth's surface covered by oceans, the ocean floor holds promising mineral resources, including copper. As global copper demand rises, the discovery and exploration of new resources become crucial, with sea floor deposits offering potential additional supply. However, the challenge lies in exploiting these deposits while adhering to environmental standards and ensuring economic viability. In light of new developments in science and technology, as well as changing economic circumstances, commercial interest in deep-sea mining has grown in recent years due to the pressing need for new copper sources. The UN-backed International Seabed Authority (ISA) has issued 31 deep-sea exploration licenses. China holds 5

deep-sea exploration licenses, Russia holds 4, Japan has 2, and India has 2. Other countries with licenses include Korea, Germany, Jamaica, France, the UK, Poland, and others. Some important projects include:

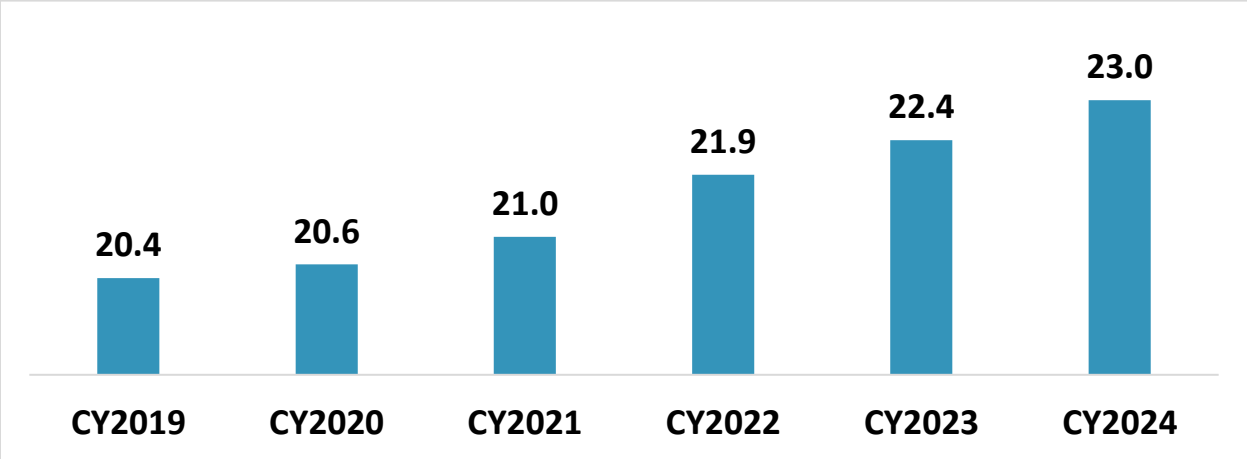
- Solwara 1 Project: Located in the Bismarck Sea, Papua New Guinea (PNG), this project is one of the pioneering efforts in deep-sea mining for copper.
- Polymetallic Nodules Project: Situated in the Clarion-Clipperton Zone (CCZ) of the Pacific Ocean, this project targets polymetallic nodules rich in copper and other valuable minerals.

2.6. Copper supply scenario in major economies

2.6.1. Global copper mine production

Copper mine production has experienced steady growth, achieving a compound annual growth rate (CAGR) of approximately 2.4% from 2019 to 2024. Mining capacity is projected to reach approximately 32 MT within the next five years.

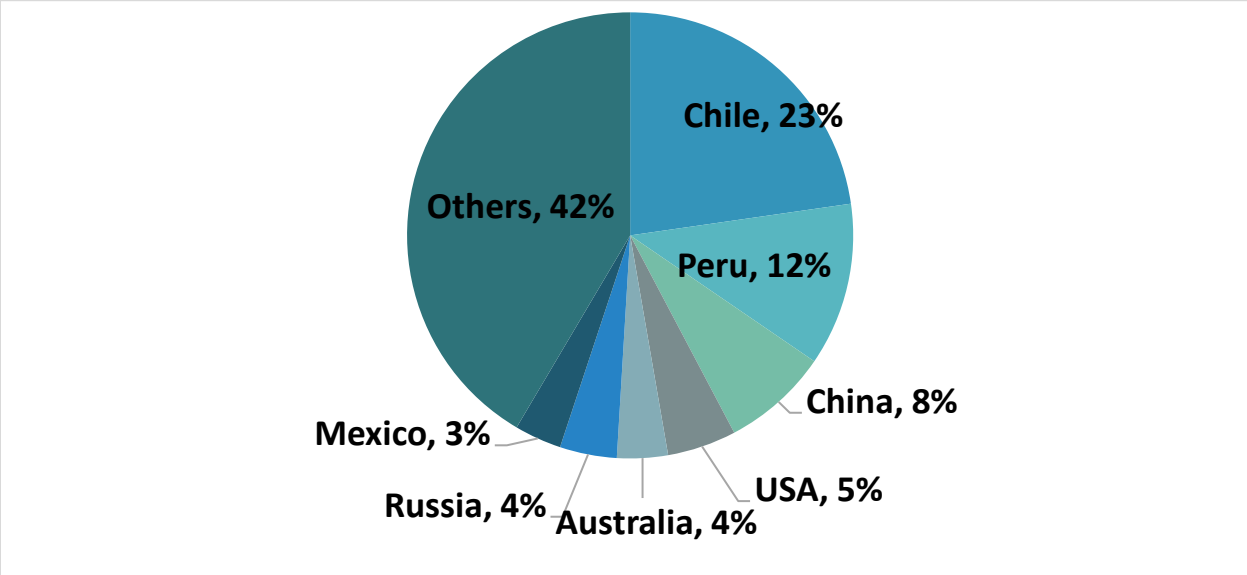
Graph 9 Mine production (MT) in terms of metal content



Source: World Copper Factbook 2023, ICSG press release, S&P Global: The Future of Copper, The Economist Intelligence Unit (EIU), Secondary Research

On a regional level, Chile remains the world's largest producer of mined copper, accounting for 23% of the global output. Peru and China follow, contributing 12% and 8% respectively. Overall, Latin America plays a pivotal role in copper mining, contributing approximately 39% of the total mine production.

Graph 10 Country-wise share of copper mine production



Source: World Copper Factbook 2023, S&P Global: The Future of Copper, The Economist Intelligence Unit (EIU)

The copper industry is currently experiencing a surge in expansion plans announced by major producers. This trend reflects the industry's response to the growing demand for copper and its commitment to ensuring market stability. However, in the short run closure of the Cobre Panama mine might have an impact on copper raw material supply. Declining ore grade, environmental oversight, resource nationalism, escalated operating cost and trade tensions continue to pose challenges in long term.

Mines expansion plan of leading copper producers

Several new copper mine projects are in the developmental pipeline, with expectations to contribute approximately 10 million tonnes (MT) of copper for processing by 2027. These projects are strategically positioned to address the escalating global demand for copper.

Table 7 Mines undergoing expansion

Name of the project	Owner	Location	Capacity addition (metal) MTPA	Approx. Capex (US$ Bn)	Tentative Year
Oyu Tulgoi	Rio Tinto	Mongolia	0.300	5.3	2027
Mara	Yamana & Glencore	Catamarca, Argentina	0.900	2.78	2026
Kalmakyr and Yoshlik-1	(AMMC)	Uzbekistan	0.250	15.0	2030
Vizcachitas	Los Andes Copper	Chile	0.183	2.44	2030

Source: Secondary Research, Company annual reports

Vedanta, actively seeking to strengthen its operations, is exploring investment options for expansion projects. One key initiative involves raising approximately US$ 1 Bn to revitalize Konkola Copper Mines, focusing on improving productivity and operational efficiency. Additionally, Vedanta plans to invest around US$ 300 Mn in the Konkola Deep Mining Project, demonstrating its commitment to growth and innovation despite challenging operational conditions.

Among the ongoing projects is Quebrada Blanca Phase 2, a $8.2 billion endeavor aimed at increasing production capacity by about 0.320 MTPA. Another significant development is the coupling of the Kamoa-Kakula Mine with the Tenke Fungurume Mine (TFM) in the Democratic Republic of Congo (DRC), expected to significantly boost copper output.

However, there are challenges on the horizon. The closure of the Cobre Panama mine may lead to a temporary impact on ore supply in the short term. Additionally, copper miners face long-term obstacles such as declining ore grades, stringent environmental regulations, resource

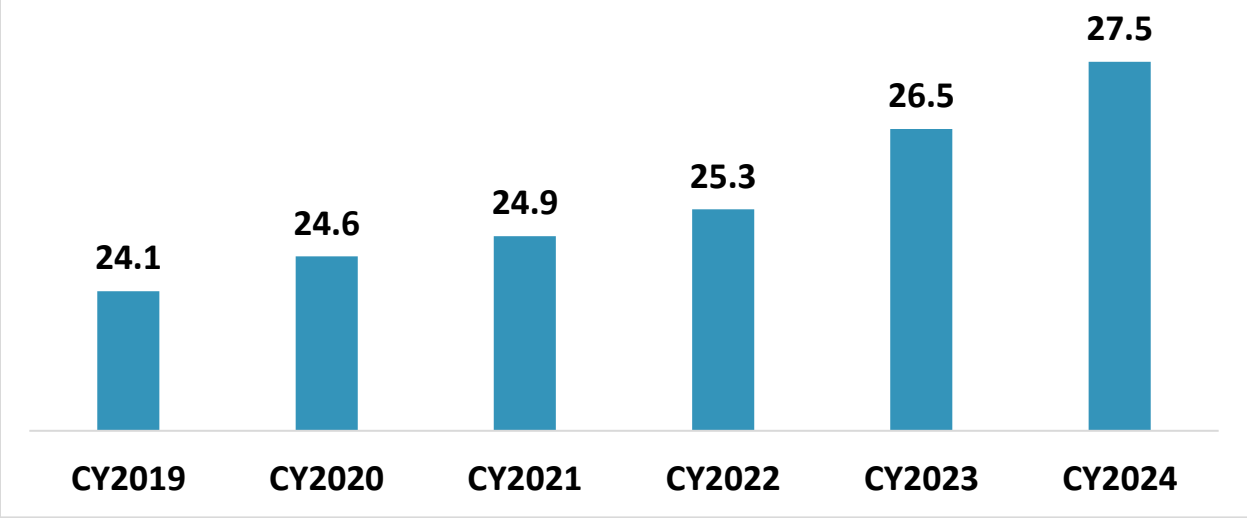
nationalism, rising operating costs, and trade tensions. Despite these challenges, the commitment to growth and innovation remains strong within the industry.

2.6.2. Global refined copper production

Refined copper production has experienced a CAGR of approximately ~2.7%, rising from 24.08 MT in 2019 to 27.5 MT in 2024. Secondary copper production contributed around 17% of the overall refined copper production, underscoring the importance of recycled copper in meeting global demand.

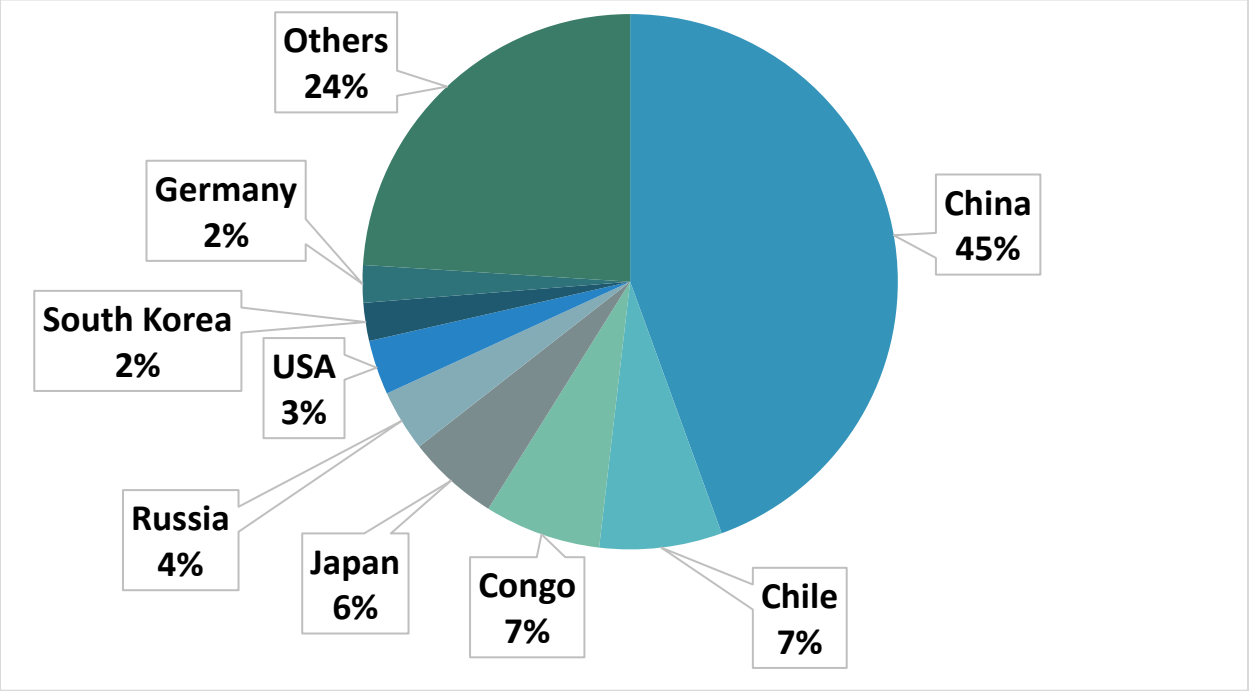
In 2023, China alone accounted for over 45% of the refined copper produced globally. While the United States dominated the copper markets in the first half of the 20th century, China has surpassed United States in annual copper mine production and ownership of global mining, smelting, and refining assets. Regionally, Asia contributed approximately 60% of global refined copper production.

Graph 11 Refined copper production (MT)



Source: ICSG press release

Graph 12 Refined copper production country-wise share



Source: ICSG Copper Factbook 2023

Smelter production in the copper industry currently stands at 22.88 million tonnes (MT). A significant shift has been observed in the geographical contribution to smelter production, with Asia now accounting for approximately 69% of the global total.

In terms of refining, the current capacity utilization factor is approximately 84%, with an anticipated capacity growth rate of 3.3% over the next five years. This growth is essential to meet the increasing demand for refined copper globally. Supporting this several notable smelter/refinery projects are scheduled to commence shortly in India, China, the Democratic Republic of Congo (DRC), the USA, and Indonesia.

Table 8 Copper Smelter/Refinery undergoing expansion

Name of the project	Owner	Location	Capacity addition (MTPA)	Approx. Capex (US$ Bn)	Tentative Year
Rifd Copper Smelting & Refinery Project	Rifd Project	Kingdom of Saudi Arabia	0.4	-	2025
China New Copper Smelting Capacity	Tongling Nonferrous, Xiamen C&D	China	3.4	-	2023-2026
Aurubis Expansion	Aurubis	Pirdop, Bulgaria	0.11	-	2025 (completion)
Kazakhstan new smelting capacity	KAZ Minerals, China NFC	Abai, Kazakhstan	0.3	1.5	2028
Kutch Copper Ltd	Adani Enterprises	Mundra, Gujarat, India	1	1.2	Phase 2 – 2029

Source: Secondary Research, Company annual reports

In addition to the capacity additions mentioned in the table, there's a significant agreement between US-based Freeport-McMoRan and the Indonesian government. This highlights collaborative efforts aimed at boosting smelter capacity in Indonesia. Furthermore, China is poised to experience a substantial increase in smelting capacity as its National Development and Reform Commission targets a rise in non-ferrous metal production.

However, the expansion in China is not without its challenges. Declining spot treatment charges (TC), stricter environmental standards, and restrictions on the imports of poor-quality scrap are likely to impact supply. Despite these challenges, China's commitment to expanding its smelting capacity remains strong.

The copper industry is poised for significant developments in both mining and smelting capacities, driven by robust projects and strategic agreements. However, long-term challenges such as environmental regulations and fluctuating market conditions will continue to shape the landscape.

Production from mine is expected to grow at a CAGR of 2.3% to reach ~42 MT by 2050 and refined copper production to expand at a CAGR of 2.6% to reach ~54 MT by 2050 to meet the growing copper demand across the world.

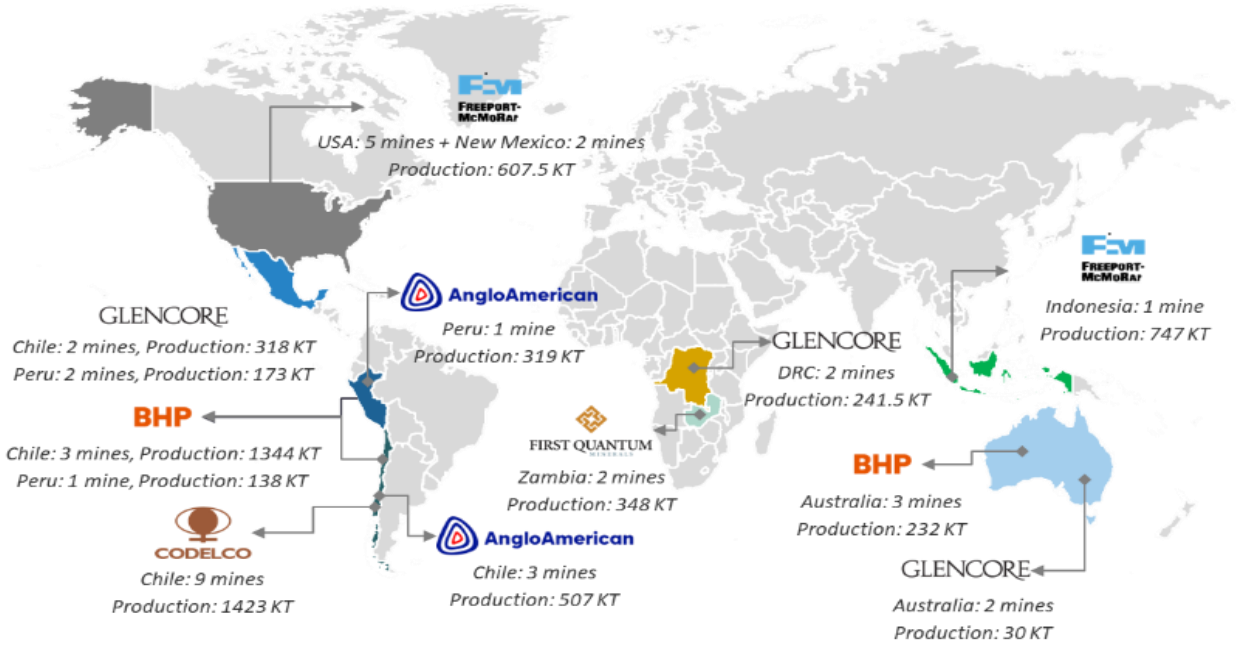
2.7. Reflection on leading copper producers

Leading Copper Producers Production Snapshot

Predominant copper mining firms are in Chile, Peru, the USA, Australia, and the DRC, with the top 5 producing companies collectively accounting for 32% of global copper output in 2023.



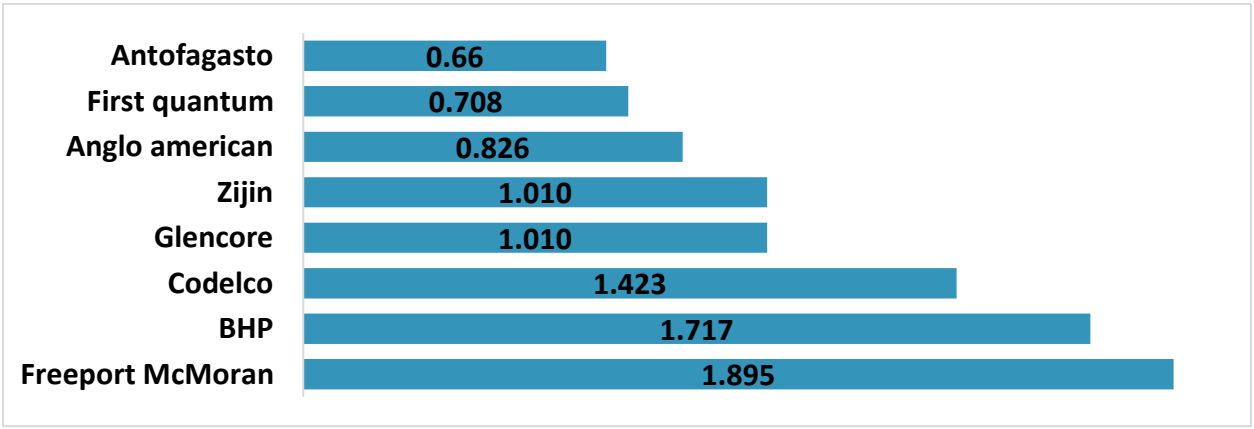
Figure 4 Major Copper producers & their geographies



Source: World Copper Factbook, Company Investor Presentations, Annual Report

Copper production output of various mining companies graph highlights the varying scales of copper production among leading mining companies, with Freeport McMoRan standing out as the top producer with ~1.9 MT of overall copper-related output.

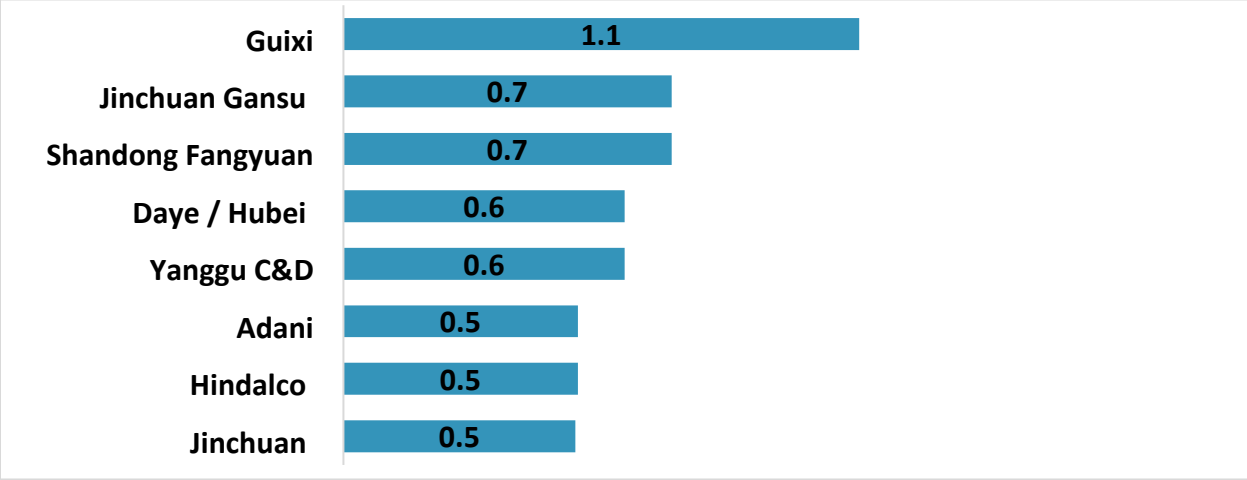
Graph 13 Company-wise Copper Production (MT)[10]



Source: World Copper Factbook, Company Investor Presentations, Annual Report

[10] Production includes overall copper related output (Conc., Anode, Cathode)

Graph 14 Major copper refineries by capacity (MT)



Source: World Copper Factbook, Company Investor Presentations, Annual Report

Among the world's top 8 largest copper refineries by capacity, seven are in China, clearly showcasing China's dominance in global copper refining capacity.

Production Cost Outlook of Leading Copper Producers

A significant portion of mining costs, approximately 50-60%, involves wages and raw materials & consumables. Processing costs account for another 30-50% of the total cost of producing a tonne or pound of copper. Major contributors to these processing costs include energy, sulphuric acid (used in the SX-EW process), and steel.

Table 9 Direct cost breakdown of mines owned by First Quantum in $/tonne

Parameter	Cobre Panama	Kansanhi	Sentinel
Country	Panama	Zambia	Zambia
Avg grade	0.45%	0.80%	0.50%
Mining	750	2,447	1,631

Parameter	Cobre Panama	Kansanhi	Sentinel
Processing	2,006	2,227	1,499
Site administration	198	573	441
TC/RC & freight	838	397	529
Smelter cost	-	375	265

Note: These numbers are indicative in nature

Source: Annual reports, Mining technology

Mining copper also involves extracting numerous valuable by-products such as gold, silver, selenium, tellurium, platinum group metals (PGMs), nickel, sulphuric acid (pyro-smelting), and molybdenum etc depending on ore composition. These by-products play a crucial role in reducing direct expenses, further highlighting the economic benefits of comprehensive resource extraction in the copper mining industry. For example, Freeport McMoran's PTX mine in Indonesia achieved a direct cost of USD 3,307/tonne, but with the inclusion of by-products like gold, the net cost is notably reduced to USD 220/tonne.

Summary of select underground mines globally

Open-pit copper mines are becoming increasingly scarce, prompting many mining companies to shift their operations underground. This transition to underground mining is driven by the need to access deeper ore bodies and improve resource extraction efficiency. The following table provides a comparative overview of several key underground copper mining projects worldwide.

Table 10 Summary of select underground mines

Parameter	Kamoa & Kakula	Oyu Tolgoi (Hugo North)	Cozamin Mine
Company	Ivanhoe Mines	Rio Tinto	Capstone Copper
Location	DRC	Mongolia	Mexico
Resource (MT)	1390	546	19.64
Avg. Grade (Cu %)	2.72	1.40	1.58
Production (MT)	0.390	0.1681	0.024
Minimum Vertical Thickness (mt)	3	5.5	5
Mining Method	Drift-and-fill	Block caving	Cut & Fill/ Longitudinal & traverse long hole
Products	Cu blister, conc.	Cu Conc.	Cu Conc.
Avg. Metallurgical Recovery (%)	85.5 - 87.5	93	96
Mining Costs ($/tonne)	38	7.03	37.11
Concentrator, Tailings Treatment, and G&A Costs ($/tonne)	15	3.21 (G&A only)	8.32
Smelter, Refining, and Transport Costs ($/tonne)	13.5	-	-

Source: Company annual reports, Technical reports, Secondary research

Kamoa & Kakula:

- Boasts large copper reserves, highlighting its potential for long-term copper supply.
- Known for high-grade copper ore, ensuring higher efficiency and profitability in extraction and processing.

Oyu Tolgoi (Hugo North):

- Technologically Advanced Operations contributing to cheap and efficient operations.
- Leveraging block caving mining method, the cheapest mode of extraction.

Cozamin Mine:

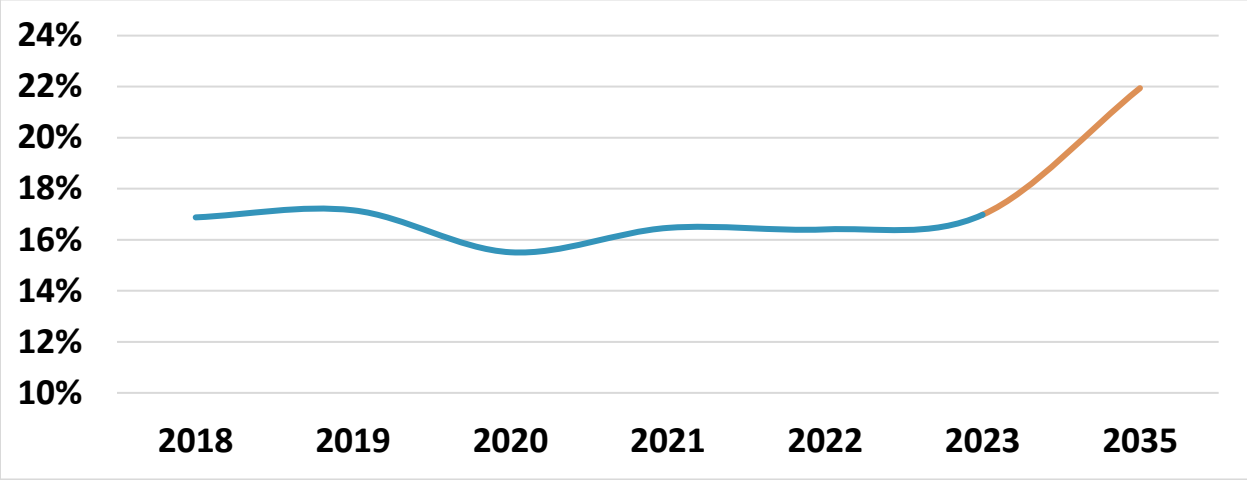
- Produces significant amounts of zinc and silver, enhancing its economic viability.
- Cost is slightly higher due to relatively lower production.

2.8. Trends in secondary copper production & refining

Secondary copper offers an efficient and sustainable alternative to primary copper sourced from mining. Secondary copper share in refined copper production (refining secondary) is expected to witness a significant increase from ~17% in 2022 to ~22% by 2035[11]. This growth is primarily driven by the global economy's focus on reducing dependency on primary raw materials and enhancing scrap utility. In China, approximately 25% of refined copper is sourced from refining scrap[12]. In India use of scrap in primary copper production is negligible, however, with introduction of QCO and upcoming scrap processing facilities is expected to drive secondary copper utilization up to ~5% in short term and ~10% in the long term.

[11] S&P Global
[12] ICA

Graph 15 Share of secondary copper in refined copper production



Source: Copper factbook, ICSG report, S&P global report, Statista

Government policies have a significant impact on recycling. These policies play a crucial role in shaping the recycling landscape, influencing import duties, and promoting sustainable practices within the industry. Effective regulations can encourage recycling efforts, streamline processes, and ensure the efficient use of resources. Below are the key policies from various countries:

Table 11 Countries and their Policies on Recycling

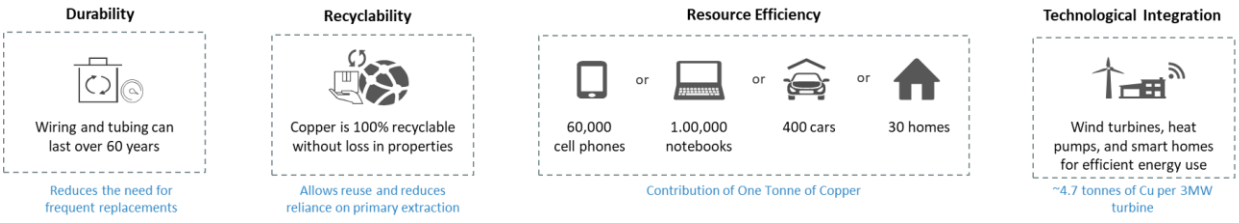
Country	Policies
China	• In 2021 China announced ban all solid wastes import later on allowed for high grade copper 92-99% Cu • China doesn't have an import duty on copper scrap but it taxes imports of copper rod at 4% • Copper smelting technologies are evolving. Smelters in China are hybrid, using 20–25% of their input feed as scrap.
USA	• Tax credits, deductions, or exemptions for expenses related to recycling infrastructure.

Country	Policies
	• Recycling Program Grants and the Sustainable Materials Management Grants. Import duty stands at 0%.
EU	• Circular Economy Action Plan (CEAP): Released in 2020, this plan aims to promote circular economy practices. • Import duty on copper scrap stands at 0% for most of the countries
India	• Reduced basic customs duty to zero in Union Budget 2025-26 • Govt unveiled the "National Scrap Recycling Policy" to formalize and streamline the scrap metal recycling sector.
Japan	• Created deposit and refund programs, tax exemptions. • Home Appliance Recycling Law facilitates the collection of scrap materials and their transfer to manufacturers

Source: Copper factbook, ICSG report, S&P global report, Statista

Copper's contribution to the circular economy & its promotion worldwide

Copper's unique properties, such as durability, versatility, and recyclability, make it a key material for the circular economy. ~8.5 MT of copper are reused annually across the globe.



Major copper economies and copper producing companies have taken several initiatives towards circular economy around copper.

Table 12 Initiatives by major copper economies

Country	Initiatives by government	Initiatives by copper producers
USA	• ***EPA's Sustainable Materials Management Program:*** Encourages the recycling and reuse of copper from electronic waste	• ***Freeport-McMoRan:*** Implements comprehensive recycling programs for copper recovery and reuse
EU	• ***Circular Economy Action Plan:*** Implements strict recycling targets and policies, including for copper	• ***Aurubis:*** Invests in technology to enhance copper recycling efficiency and reduce environmental impact
China	• ***National Circular Economy Development Strategy:*** Promotes the recycling and reuse of materials, including copper	• ***Jiangxi Copper Corporation:*** Extensive copper recycling to reduce environmental footprint
Japan	• ***Home Appliance Recycling Law:*** Mandates the recycling of copper from household appliances	• ***Dowa Holdings Co., Ltd.:*** Advanced recycling technologies for copper recovery from e-waste
Australia	• ***National Waste Policy:*** Focuses on waste reduction and increasing copper recycling rates	• ***Rio Tinto:*** Innovative recycling programs for copper from mining waste and end-of-life products
Chile	• ***Copper Mark Certification:*** Ensures responsible production and recycling of copper	• ***Codelco:*** Investing in technologies to improve copper recovery and recycling from waste

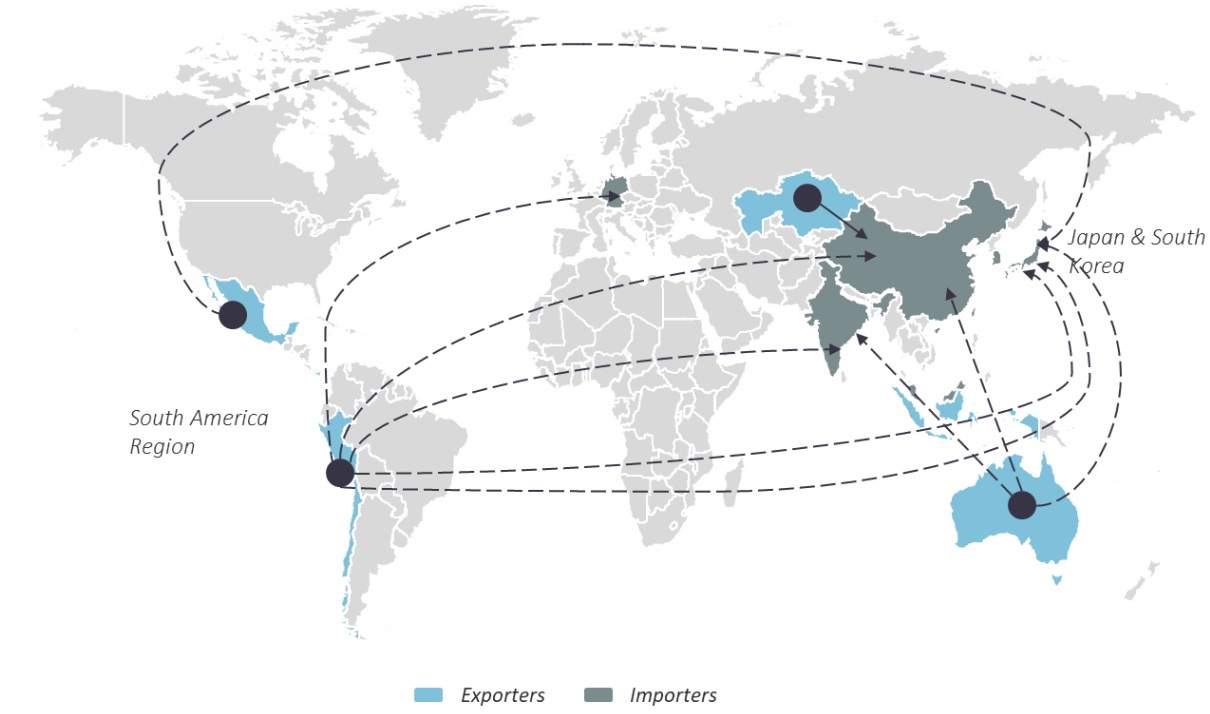
Source: Secondary research

2.9. Copper trade flow

2.9.1. Copper ore and concentrate trade flow

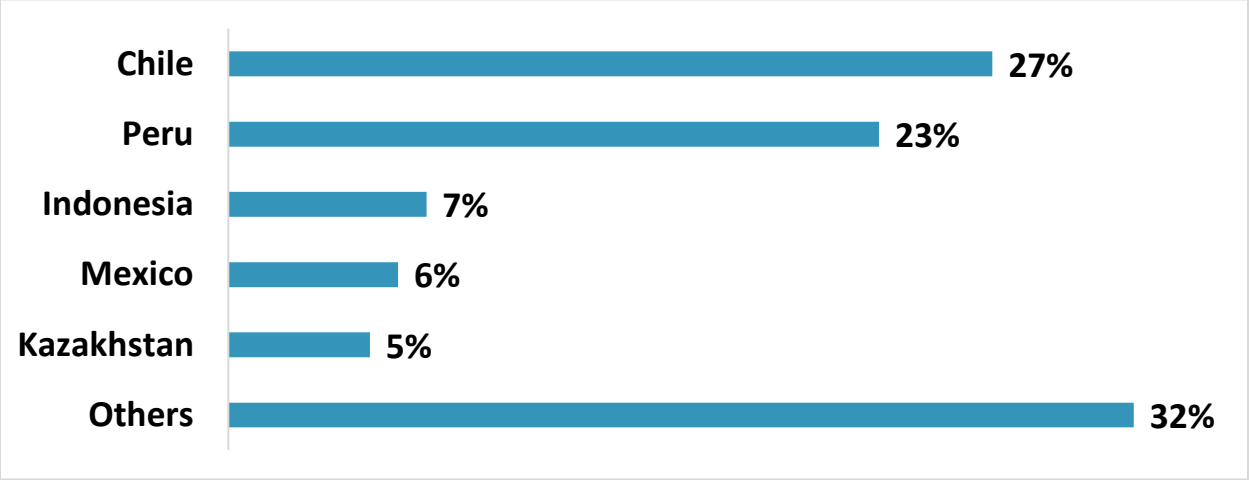
In 2023, the top exporters of copper ores and concentrates were Chile, Peru, and Indonesia. Chile and Peru together, were responsible for 50% of the world's copper ore and concentrate exports. Indonesia accounted for ~7% of copper concentrate exports, ban on copper concentrate exports in 2025 is expected to disrupt the global copper supply chain significantly.

Figure 5 Trade Flow - Copper concentrate

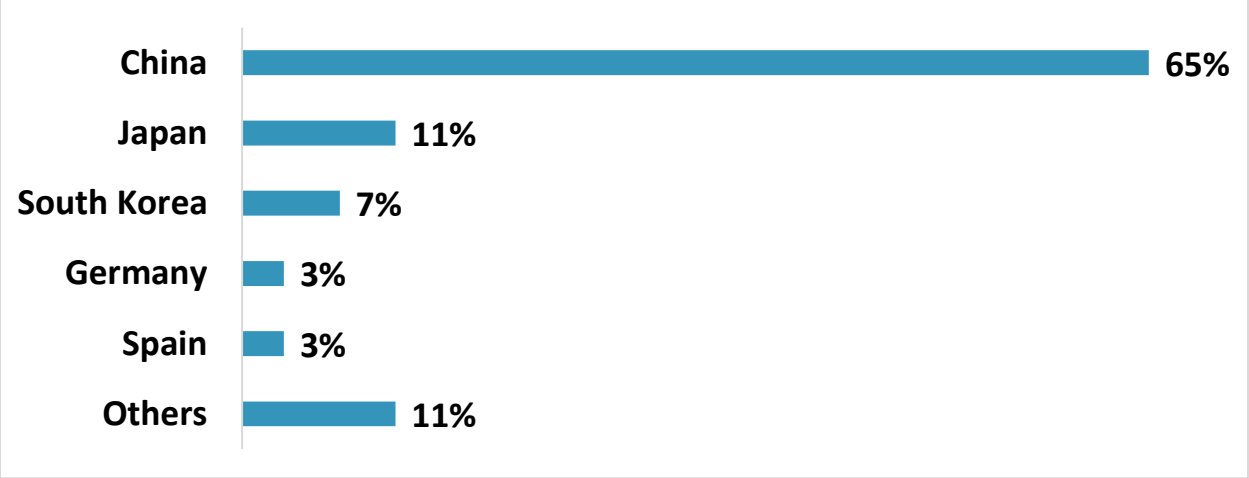


Note: Figure is intended to illustrate trade flows but no actual trade routes.

Graph 16 Global Exporters of Copper Ore & Conc.[13]



Graph 17 Global Importers of Copper ore & conc.



In 2023, China accounted for 45% of global refined copper production, while its copper mines only produced 1.7 million tons of copper, making the country largely import-dependent[14]. To secure its supply chain, China has made significant investments in countries such as Peru, Australia, the Democratic Republic of Congo, Zambia, and Papua New Guinea. India accounted for 2% of global copper concentrate imports in 2023. Japan, which is responsible for 5.5% of global refined copper production, lacks sufficient copper reserves and thus relies heavily on

[13] HS Code – 260300 – copper ore & concentrate
[14] USGS

importing the primary raw material. To facilitate this, countries like China and Japan, which have insufficient primary raw materials, have made significant investments in foreign copper assets and implemented a 0% import duty on copper ore and concentrates. In line with the global practices, India has also reduced import duty on copper concentrates to 0% in 2024.

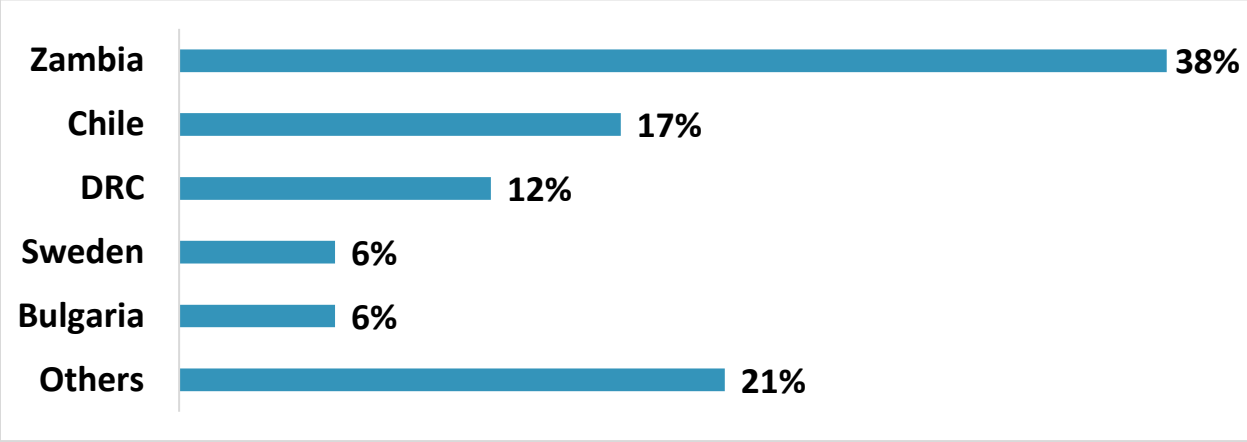
2.9.2. Copper blister and anode trade flow

Figure 6 Trade Flow - Copper blister & anode



Note: Figure is intended to illustrate trade flows but no actual trade routes.

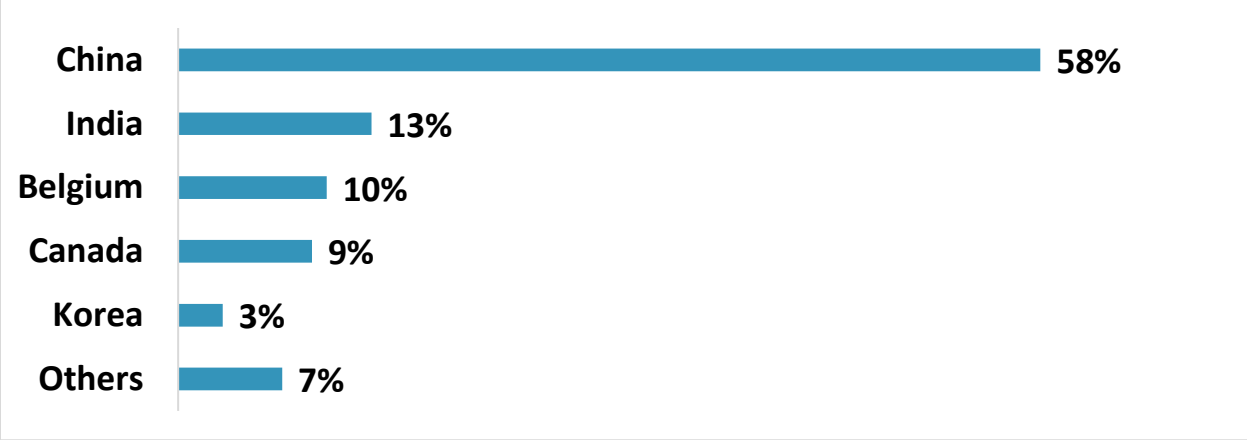
Graph 18 Global Copper blister and anode exporters[15]



In 2023, unrefined copper exports amounted to approximately 1.5 million tons, with Zambia emerging as the largest exporter of unrefined copper. Several factors contribute to Zambia's focus on exporting unrefined copper despite possessing significant refining capacity.

Firstly, refining copper is an energy-intensive process, and Zambia faces high energy costs. The infrastructure necessary to support large-scale refined copper production efficiently is also lacking in the country. These challenges make refining less economically viable for Zambia compared to exporting unrefined copper.

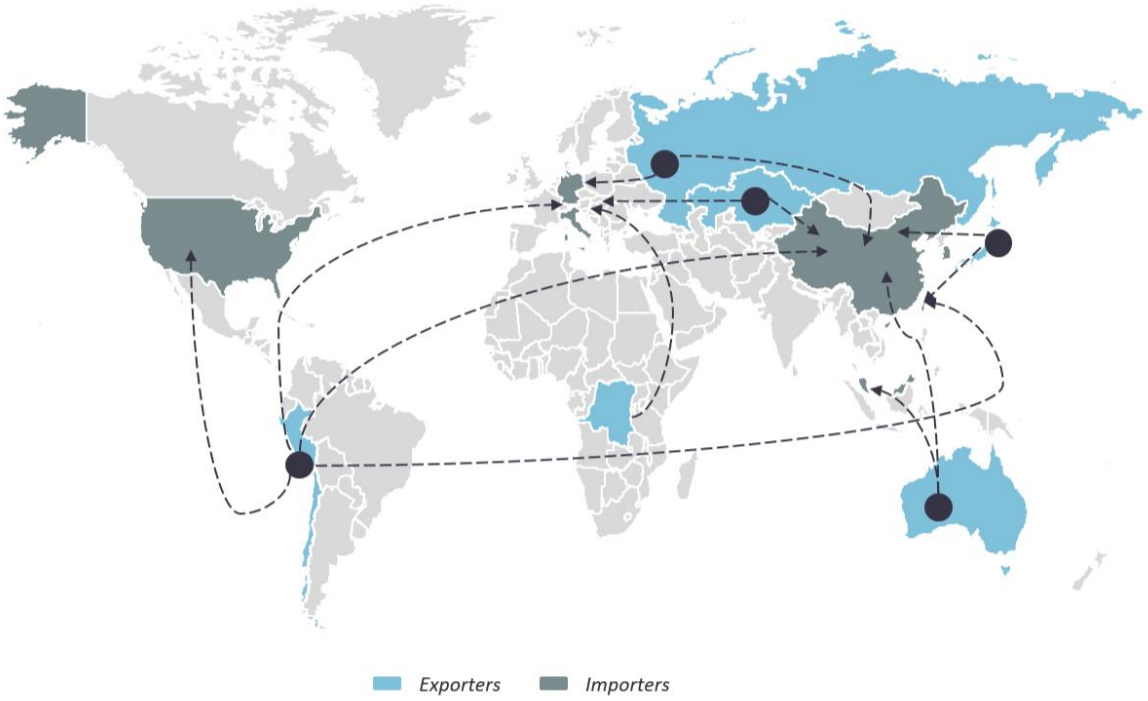
Graph 19 Global Importers of Unrefined Copper (Copper blister and anode)



[15] TradeMap (HS Code 740200) – Copper Blister & Anode

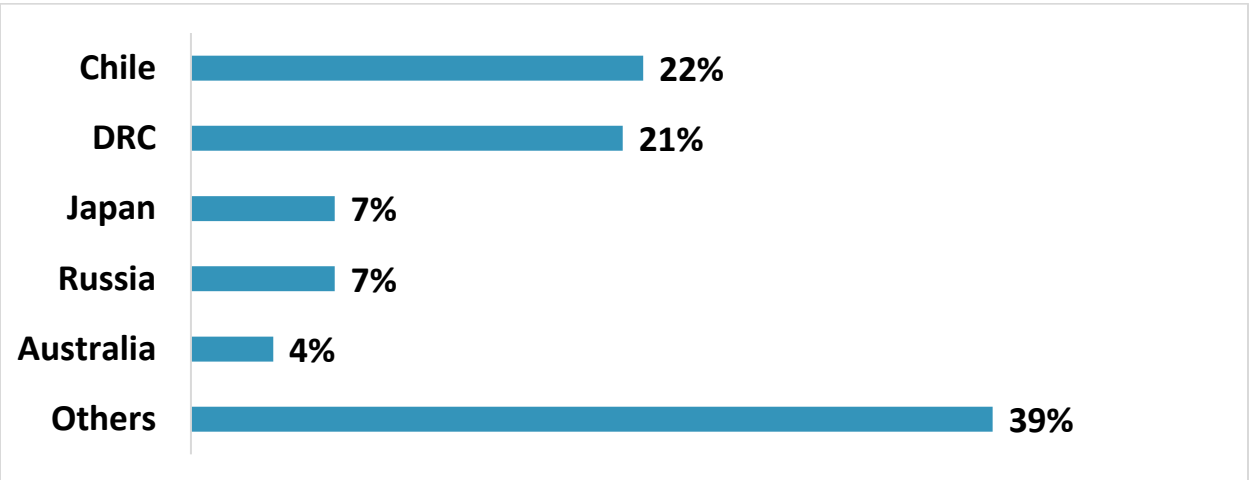
2.9.3. Refined copper trade flow

Figure 7 Trade Flows - Refined Copper



Note: Figure is intended to illustrate trade flows but no actual trade routes.

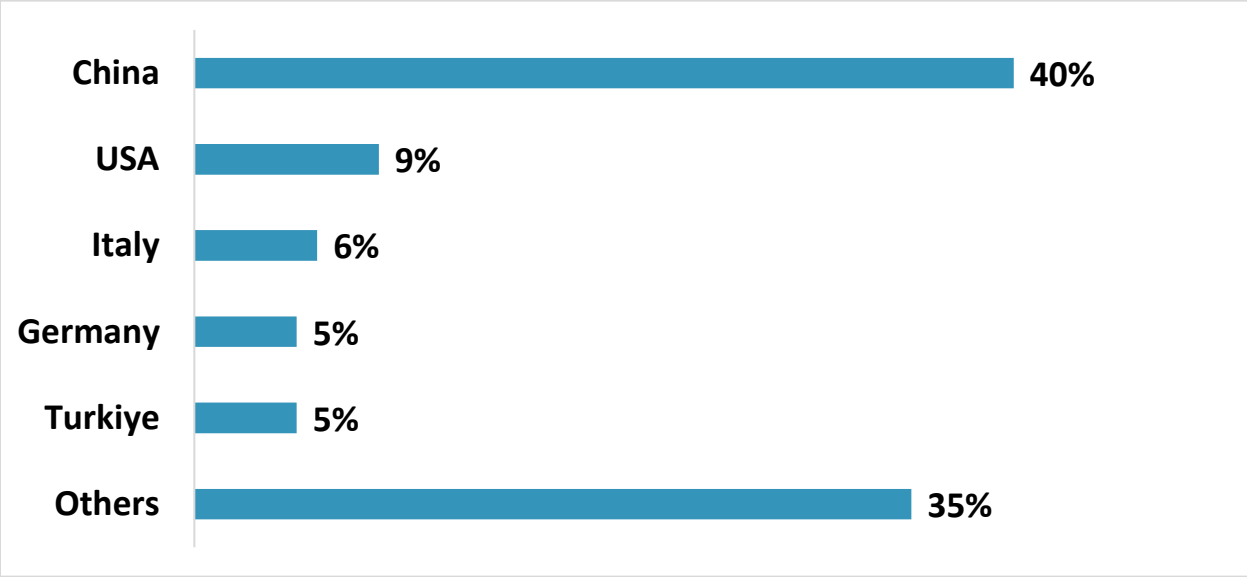
Graph 20 Global Refined copper Exporters[16]



[16] HS Code 740311 – Trade Map

The Democratic Republic of Congo's (DRC) in 2013 imposed an export ban on copper concentrate, aimed at boosting domestic processing. This move has positioned DRC as the second-largest exporter of refined copper only after Chile.

Graph 21 Global Refined Copper Importers[17]



China consumes approximately 55-57% of the world's refined copper.

Trade flow of copper scrap

The global dynamics of scrap trade are poised for significant changes as major scrap-producing economies consider restricting scrap exports to promote domestic recycling and responsible processing. This shift is expected to impact countries with existing scrap refining capacities and influence the global supply chain for scrap materials.

- **European Union**

Countries such as Germany, France, Italy, and the Netherlands collectively exported approximately 1 MT of copper scrap in 2023, making the EU one of the major exporters. The "European Green Deal" emphasizes reducing waste, promoting recycling, and retaining valuable

[17] TradeMap

raw materials within the EU. Ongoing discussions in EU are focusing on restricting the export of waste to non-OECD countries to boost domestic recycling efforts and enhance environmental sustainability. If a ban is imposed, it could lead to significant disruptions in the supply chain.

- **United States of America**

The United States is the largest copper scrap exporting nation, with 0.880 MT exported in 2023. There is growing awareness and concern regarding the environmental and health impacts associated with exporting scrap materials, particularly to countries with less stringent environmental regulations. Discussions are underway to ensure that exported scrap is processed responsibly and does not contribute to environmental degradation or health risks in receiving countries.

- **Japan**

Japan is the 2nd largest copper scrap exporting country, accounting for 0.375 MT in 2023. Renowned for its advanced recycling technology and waste management practices, Japan is investing heavily in cutting-edge recycling technologies and infrastructure to enhance its domestic recycling capacity.

India ranks as the 3rd largest importer of scrap, with imports amounting to 0.310 MT in calendar year 2023. India has reduced the Basic Customs Duty (BCD) on copper scrap to nil. Meanwhile, China imported 1.98 MT of copper scrap in the same year[18]. The heightened emphasis on domestic recycling by major scrap exporters is expected to disrupt the global scrap supply chain. In the short term, countries lacking the technological capacity for responsible scrap processing are likely to experience supply disruptions.

[18] TradeMap

Trade policy of leading copper-producing economies

The global copper industry is undergoing significant policy-driven changes that aim to enhance domestic processing capacities and control the flow of raw materials. Indonesia has imposed a complete export ban on copper concentrate. This policy is designed to compel miners to invest in smelting facilities within the country, thereby boosting local processing capabilities.

Similar measures have been also observed globally. For instance, since 2013, the Democratic Republic of Congo (DRC) has banned the export of copper and cobalt concentrate to encourage domestic processing. This move aligns with a broader trend where nations are seeking to add value within their borders.

Additionally, geopolitical tensions have led to restrictive measures on metal exports. Europe and the USA have imposed restrictions on the import of Russian metals, including aluminum, copper, and nickel, in response to broader political conflicts. These restrictions aim to limit Russia's economic leverage derived from its substantial metal exports.

China, a major player in the global copper market, has also tightened its regulations. In 2021, China's Ministry of Ecology and Environment (MEE) announced it would no longer approve solid waste imports and set stringent minimum copper content requirements for imports of copper scrap to be >92%. This policy is part of China's broader environmental strategy to reduce pollution and ensure higher-quality raw material imports. In addition to that, Free Trade Agreement (FTA) with the Association of Southeast Asian Nations (ASEAN) and the Comprehensive Economic Partnership Agreement (CEPA) with Japan, Korea, and UAE, where copper semis can come to India at zero or near-zero duties, is creating significant competitive challenges for domestic producers.

These shifts indicate a global movement towards greater self-sufficiency in metal processing and stricter control over raw material exports. The impact of these policies will be felt across the supply chain, influencing global copper production, processing, and trade dynamics.

Table 13 Taxation & Duties on Mining over Major Copper Producing Countries

	Chile	Western Australia	Peru	China	DRC
Corporate income tax & VAT	25% & 19%	30% & 10%	29.5% & 18%	25% & 16%	30% & 16%
Royalty base	Operating margin	Ad valorem	Net profit before tax	Revenue	Net revenue
Royalty	8% - 26% depending on operating margin	5%, 7.5% (beneficiated ore, raw ore)	1% - 12% (depending on operating margin)	6%	3.5%
Any other tax	Ad valorem tax: 1% over annual copper sales	-	Special mining tax 2% - 8.4% on the operating margin of profits obtained quarterly	-	50% Super profit tax – if commodity prices rise by 25% from reference price
India import duties & trade agreement with India	**Cu Cathode:** 2.5% at 50,000 TPA and above this at MFN rates (5%) & PTA	**Cu Cathode:** MFN rate & ECTA	**Cu Cathode:** 5%	**Cu Cathode:** 5%	**Cu Cathode:** 5%

Ongoing policies related to resource nationalism are expected to increase uncertainties around copper trade flows. As a result, major economies anticipating future demand are reassessing their trade policies & investing in securing overseas assets.

India needs to intensify its efforts to address uncertainties in the supply of raw materials by adopting strategies similar to those employed by China. To secure its resource needs, China has proactively invested in foreign mining assets and established long-term offtake agreements, ensuring a stable and diversified supply chain. Currently, Chinese companies have ownership stakes in approximately 30 operational copper projects abroad, along with around 38 more in the exploration phase. In contrast, India has yet to match this level of strategic international engagement. To enhance its supply chain resiliency and reduce dependency on volatile global markets, India should prioritize foreign investments, build strategic partnerships, and negotiate offtake agreements in critical mineral sectors.

2.10. The challenges impacting the global copper market

Miners in the copper industry need to navigate challenges from exploration to logistics & supply chain. These challenges include the high lead time for an asset to transition from exploration to the mining phase, obtaining permits for mining, managing community and social conflicts, addressing resource nationalism, and handling technical and financial risks over the medium to long term.

Table 14 Challenges faced by players in copper value chain

Value Chain	Challenges	Remarks
Exploration	• High Lead time of primary copper mines	• ~16.8 years to develop a new copper mine from exploration to production. Open pit mines generally take longer when compared to underground mines to reach production due to longer exploration and regulatory approval.

Value Chain	Challenges	Remarks
		• Limited adoption of emerging exploration technologies to explore deep-seated minerals.
Extraction	• Mining techniques • Political instability • Social opposition	• Near surface copper deposits are becoming scarcer, leading copper mining is moving deeper underground. • Chile and Peru have experienced political instability in recent years. Zambia changed its tax regime and mining royalty 10 times in the last decade. • Chile faces social conflicts against lithium and copper mining. Peru has a history of roadblocks by indigenous people in mining projects. • Resource nationalism initiatives in some countries to impact trade flows.
Processing and Refining	• Technical Challenges • Declining Ore Grades • Environmental Concerns	• Ore grades at existing operations are expected to decline from an average of 0.61% in 2021 to 0.56% in 2030, will result in higher operational expenditure. • Tackling emissions is arguably the most important environmental issue faced by players in the copper value chain today. Required additional capex for adopting renewable energy source. • Lack of technology for utilization of sub-grade ore.

Value Chain	Challenges	Remarks
Logistics & Supply Chain	• Lack of Infrastructure Investments in major sourcing countries. • Climate Change	• There is no clear plan for the large investments needed in new roads, water treatment, and power grids in major copper ore-sourcing countries. • Unpaved roads in the mining corridor can slow cargo during monsoon. • Extreme weather events across the globe will continue to loom large and impact operations

2.11. Key Takeaways for Indian copper sector

As the global copper industry continues to evolve, it is crucial for the Indian copper sector to align with emerging trends and best practices to remain competitive and sustainable. The following key takeaways highlight the strategic areas that need focus to drive growth and efficiency in the Indian copper sector:

- **Focus on Exploration**
  - Strong emphasis on both greenfield (new mines), brownfield (existing mines) and deep-sea exploration to enhance the potential of converting resources into reserves.
- **Foreign Asset Acquisition**
  - Companies are pursuing foreign asset acquisitions through various strategic options such as Memorandums of Understanding (MoUs), Joint Ventures (JVs), Government-to-Government (G2G) agreements, and sole ownership. For example, China Copper holds sole ownership of the Toromocho Copper mine in central Peru, while China Minmetals has acquired a copper mine in Botswana through sole ownership.

- **Processing Hub Development**
    - There is a push for countries to position themselves as processing hubs for copper. This initiative is aimed at meeting growing domestic demand and enhancing export capabilities. Establishing processing hubs will also contribute to value addition and economic growth.
- **Technological Adoption**
    - By embracing the latest operational techniques, such as advanced mining and processing methods to boost copper recovery throughout the value chain, and by implementing digital technologies, the copper industry can significantly enhance process efficiency.
- **Promotion of Metal Recycling**
    - Promoting metal recycling is essential for improving resource efficiency and maximizing scrap utilization. Developing a circular economy not only reduces waste but also ensures a sustainable supply of copper through the reuse and recycling of materials. This approach supports environmental sustainability and resource conservation.

By focusing on these strategic areas, the Indian copper industry can enhance its resource base, improve operational efficiency, and meet the growing global demand sustainably.



3. COPPER AND INDIA

3. Copper and India

Viksit Bharat@2047 represents India's bold and ambitious journey towards becoming a developed nation by the centenary of its independence. As the nation approaches this historic milestone, it envisions itself as a $35 trillion economy with a per capita income of $20,000 to $21,000. India aims to be a global leader in innovation and technology, a model for human development, and a nation that fosters sustainable growth.

This vision marks a transformative era, where India emerges as a global leader in innovation, sustainability, and governance, setting new standards for excellence across industries such as transportation, telecommunications, renewable energy, and health care.



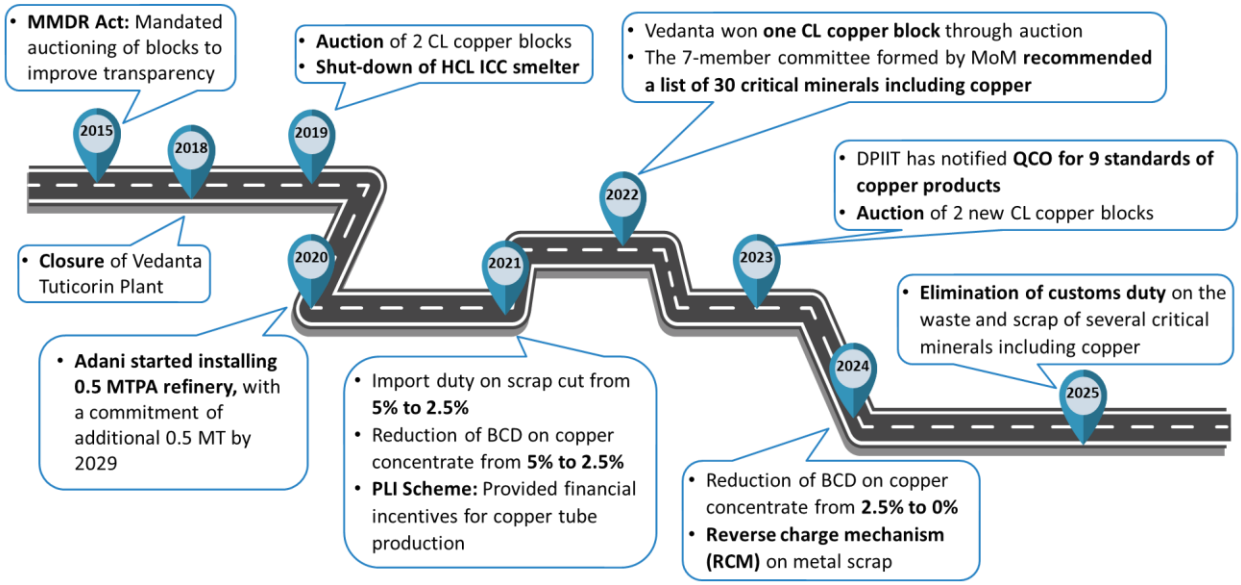
The rise in metal intensity in line with GDP growth is expected to drive domestic copper usage in India. In addition to traditional sectors driven by economic growth, emerging sectors such as EVs and renewables will further contribute to copper demand.

- **Decarbonization intent of the nation**
  - Reduce emission intensity of GDP by 33-35%
  - Share of non-fossil fuel-based electricity to be 40%
- **Rapid increase in fleet electrification**
  - EV30@2030: 30% of newly registered private cars, 40% of buses, 70% of commercial cars, and 80% of 2-wheelers and 3-wheelers will be electric by 2030.
  - PM – EV Drive – Total fund support of INR 10,900 Crs.

- **Rapid urbanization**
  - 700-900 mn sq meters of commercial and residential space every year till 2030 .
  - Pradhan Mantri Awas Yojana (PMAY).
  - Smart City Mission, Udaan to boost infrastructure.
- **Rising disposable incomes**
  - per capita income is likely to reach ~USD 4,000 by 2030 from ~USD 2,450.
- **Industrialization**
  - Policies (Make in India, Atmanirbhar Bharat, PLI Schemes, Ujala Yojana, UMPP, etc.) promoting investment for manufacturing in India towards becoming self-reliance and emergence as manufacturing hub.

Journey of Indian copper sector in the last decade

In recent years, Indian Govt. has taken several steps for the sustainable development of domestic copper sector.



2015

- The Mines and Minerals (Development and Regulation) Act (MMDR Act) introduced a significant reform by **mandating the auctioning of mineral blocks** as the primary method for granting mining leases. This move was aimed at enhancing transparency, fairness, and accountability in the allocation process. Through a competitive bidding process, the auction system ensures that mineral resources are allocated to entities offering the highest value to the government, thus maximizing public revenue. Additionally, it promotes a level playing field for private and public sector participants, encouraging more structured and long-term investments in the mining sector. The auction mechanism under the MMDR Act strengthens investor confidence and aligns resource governance with global best practices.

2018

- The **closure of Vedanta's Sterlite Copper plant** in Tuticorin (Thoothukudi), Tamil Nadu, in May 2018 was a significant event driven by environmental concerns. The Tamil Nadu Pollution Control Board ordered the shutdown, and despite Vedanta's efforts to reopen the plant, the Madras High Court and Supreme Court upheld the decision, citing public health and environmental protection. The closure impacted India's copper production, making the country a net importer.

2019

- In February 2019, the Government of Maharashtra initiated an **e-auction for two copper composite licenses (CLs)** in Chandrapur district. Vedanta Ltd emerged as the preferred bidder for both blocks—Thanewasna and Dubarpeth. These licenses, combining prospecting and mining rights, marked a significant step in India's strategy to bolster domestic copper production.
- The **closure of Hindustan Copper Limited's (HCL) Indian Copper Complex (ICC) smelter** in Ghatshila, Jharkhand, has had a major impact on India's copper production capacity. This plant played a crucial role in converting copper concentrate into refined copper, catering to both domestic and international markets. Its shutdown has

worsened the country's copper supply shortage, further compounded by the earlier closure of Vedanta's Sterlite plant in Tuticorin.

2020

- Adani Enterprises, through its subsidiary Kutch Copper Limited (KCL), is developing a **greenfield copper refinery in Mundra**, Gujarat, with a planned capacity of 1 MTPA in phases. The initial phase involving a 0.5 MTPA refinery, started the installation in 2020. The second phase aims to double the capacity by 2029, making it the world's largest single-location custom smelter. This project supports India's 'Atmanirbhar Bharat' initiative by reducing copper imports.

2021

- In the 2021–22 Union Budget, the Indian government **lowered the import duty on copper scrap from 5% to 2.5%.** This change was designed to encourage domestic copper recycling, improving resource efficiency and minimizing the environmental impact of primary copper production. By making recycled copper more cost-effective, the reduction incentivized local industries to invest in advanced recycling technologies, boosting competitiveness and profitability. Additionally, Indian government **reduced the Basic Customs Duty (BCD) on copper concentrate from 5% to 2.5%**. This move aimed at lowering the cost of copper production, benefiting industries reliant on imported concentrates.
- Launched in 2021, the **Production Linked Incentive (PLI) Scheme** for White Goods includes copper tubes as one of its eligible components. The scheme provides incentives ranging from 6% to 4% on incremental sales over a five-year period, aimed at fostering the growth of the white goods sector and reducing reliance on imports.

2022

- In 2022, **Vedanta Ltd won Ghanpur Mudholi (West) CL copper block in Maharashtra**, increased Vedanta's copper mining portfolio further.
- In November 2022, the Ministry of Mines formed a seven-member committee tasked with identifying minerals vital to India's economic growth and national security. The committee presented a **report recommending 30 minerals as critical, including**

copper, cobalt, lithium, nickel, graphite, and rare earth elements. The selection was based on factors like economic significance, supply risks, and strategic importance for sectors such as energy, defense, and technology. This initiative seeks to minimize import dependence and strengthen India's self-reliance in the supply chains of critical minerals.

2023

- In 2023, the Department for Promotion of Industry and Internal Trade (DPIIT) issued the **Copper Products (Quality Control) Order**, 2023, under the Bureau of Indian Standards (BIS) Act, 2016. This order requires nine specific copper products to meet Indian Standards (IS) and display the BIS Standard Mark. These products include copper wire rods, electrical rods and bars, copper strips, solid drawn copper tubes, and copper wires for general engineering use. The goal of this order is to improve the quality of domestically produced copper products, reduce the import of substandard goods.
- In 2023, India made significant strides in its efforts to secure critical minerals by **auctioning two CL copper blocks**. Shitalpani Copper Block in Madhya Pradesh won by The Commodity Hub and Minzhari Copper Block won by Hindalco.

2024

- In the 2024–25 Union Budget, the Indian government announced the **removal of the Basic Customs Duty (BCD) on copper concentrate, cutting it from 2.5% to 0%**. This change is intended to reduce copper production costs by making imported concentrates more cost-effective. Additionally, it aligns with the government's broader objectives of boosting domestic manufacturing and fostering self-reliance in critical mineral supply chains, ultimately enhancing India's competitiveness in the global copper market.
- In October 2024, the Indian government introduced a **Reverse Charge Mechanism (RCM)** for metal scrap transactions under GST. This move aims to improve tax compliance in the informal metal scrap sector, formalize the industry, and reduce tax evasion.

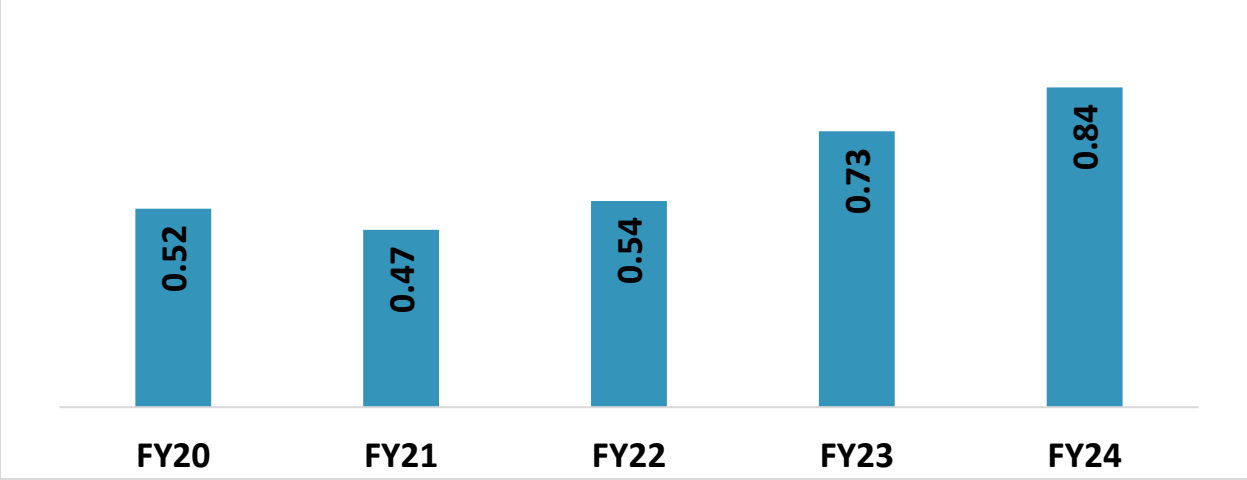
2025

- In the Union Budget of 2025, the Indian government announced the **removal of Basic Customs Duty (BCD) on waste and scrap from twelve critical minerals, including copper**. This decision is designed to support domestic manufacturing by ensuring a reliable and affordable supply of key materials such as copper, cobalt, lithium-ion battery waste, lead, and zinc. Furthermore, the government is working towards implementing the policies aimed at recovering critical minerals from mining by-products, further enhancing the resilience of the supply chain.

3.1. Domestic sector-wise usage of copper

With a CAGR of approximately 13.15%, there is a significant increase in domestic refined copper usage from 0.489 MT in 2019 to 0.84 MT in 2024. India's refined copper consumption surged more than 0.7 MT in 2023 and 2024, driven by extensive government infrastructure initiatives, a significant shift towards renewable energy, and growth in the automotive and electric vehicle sectors.

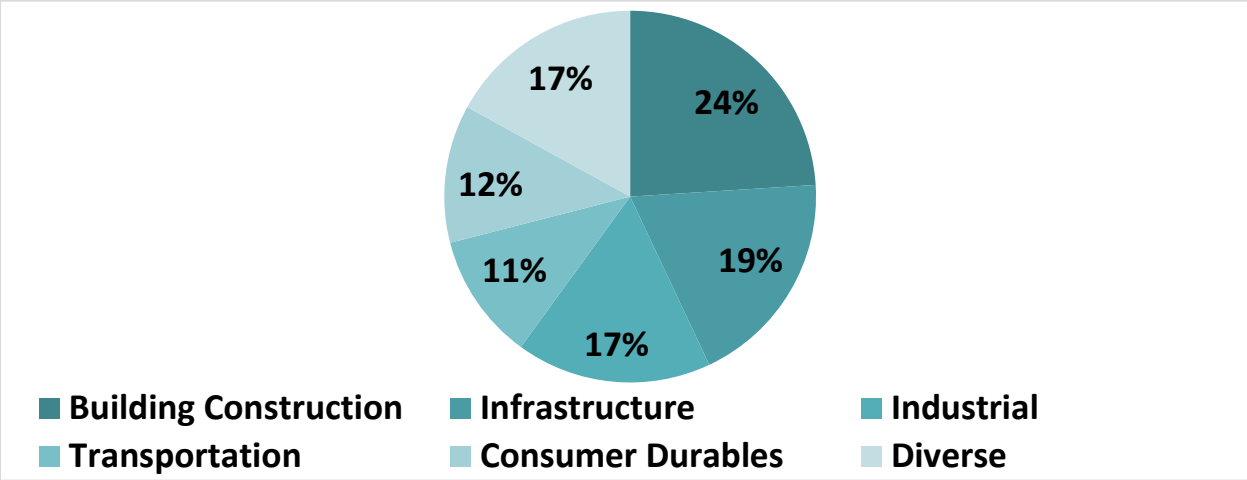
Graph 22 Domestic refined copper usage (MT)



The government's ambitious targets for renewable energy, including a 500 GW capacity by 2032, and major infrastructure projects under the National Infrastructure Pipeline, have boosted demand. The construction and real estate sectors, accounting for 43% of copper use, and the

automotive and consumer durables sectors, each contributing 11% and 12% respectively, have also grown substantially. Refined copper imports grew by 30% in FY2023 and 180% in H1 FY2024, highlighting robust domestic demand that outpaced local production.

Graph 23 Domestic sector-wise copper usage



Distribution of copper demand by product type, with copper rods accounting for a significant 65% of the total demand. Copper rods are essential in various sectors due to their excellent electrical conductivity, durability, and versatility. They are primarily used in the construction, electrical, and power distribution sectors.

- **Copper Rods (65% of demand):** Copper rods are extensively used in electrical applications such as power distribution and transmission lines, grounding systems, and in the manufacturing of electrical components like bus bars, switchgear, and transformers. Continuous cast copper rods are the primary feed material for the wire and cable industries. Copper rods' high electrical conductivity and thermal properties make them ideal for these applications, ensuring efficient energy transmission and reduced energy losses.

- **Tubes & Pipes (9% of demand):** Copper tubes and pipes are widely utilized in plumbing, heating, ventilation, and air conditioning (HVAC) systems. Their resistance to corrosion

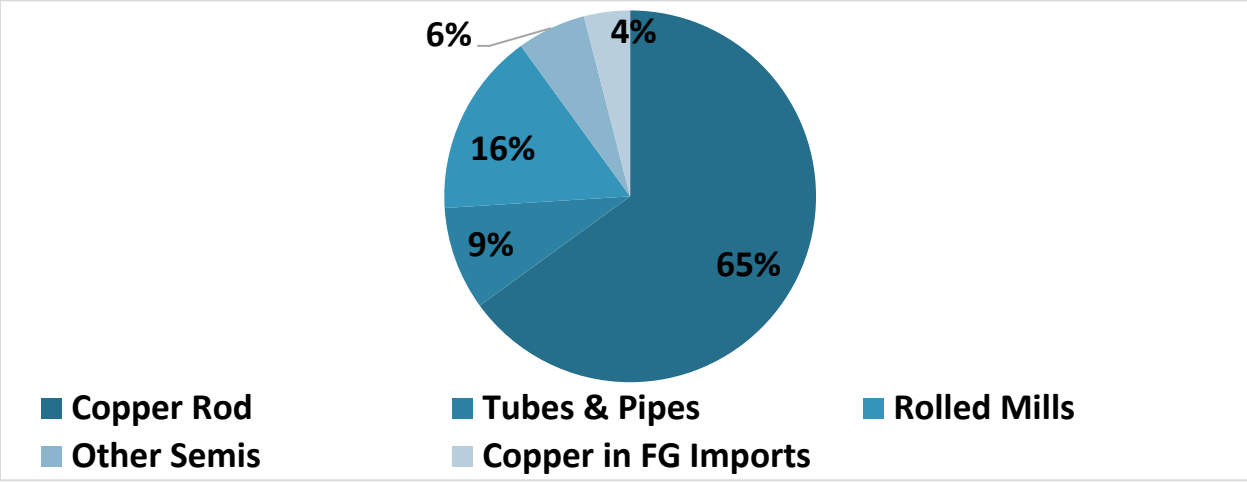
and high thermal conductivity make them suitable for refrigerant lines in air conditioning systems and for water distribution in both residential and commercial buildings.

- **Rolled Mills (16% of demand):** Copper sheets and strips produced by rolled mills are crucial in the electronics industry. They are used in the manufacturing of printed circuit boards (PCBs), connectors, and other electronic components due to their excellent conductivity and reliability. These materials are also employed in roofing, cladding, and other architectural applications for their durability and aesthetic appeal.

- **Copper in Finished Goods Imports (4% of demand):** This category includes copper components that are part of imported finished goods, such as electrical appliances, machinery, and automotive parts. The increase in demand for consumer electronics and electric vehicles has contributed to the growth in this segment.

- **Other Semi-Finished Products (6% of demand):** This segment comprises various semi-finished copper products, including rods, bars, and profiles, which are used in a range of industrial applications. These products are essential in the manufacturing of mechanical parts, fittings, and fasteners, providing strength and resistance to wear and corrosion.

Graph 24 Domestic product-wise copper demand



Domestic apparent copper usage grew by approximately 13% in FY24, reaching around 1.72 million tonnes (MT) compared to 1.52 MT in FY23. The demand for copper was primarily driven by urbanization and higher disposable income, particularly in sectors like building construction, consumer goods, and automobiles. Additionally, government initiatives and both public and private investments in infrastructure and industrial sectors further boosted copper consumption. The copper demand in the net-zero transition accounted for around 4% of total demand in FY24, approximately 0.064 MT, representing a 27% growth from FY23, with 56% of this demand coming from renewable energy and the rest from electric vehicles and charging infrastructure.

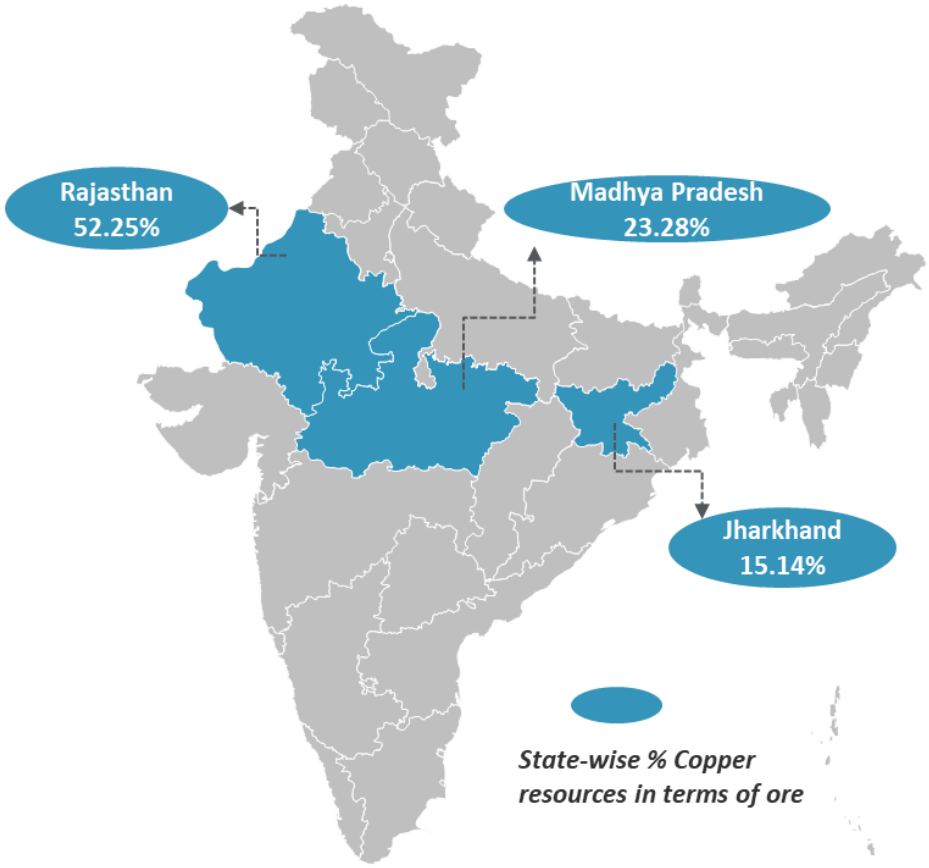
3.2. Resource and reserve across regions in India

India possesses approximately 1.66 BT of copper ore resources. Of these, 163.89 MT (9.87%) are classified as 'Reserves,' while the remaining 1.5 BT (90.13%) are categorized as 'Remaining Resources'. The total metal content from these copper resources amounts to 12.20 MT, with reserves constituting 2.16 MT[19].

The state of Rajasthan holds the largest resources of copper ore, amounting to 868 MT (52.25%). This is followed by Madhya Pradesh with 387 MT (23.28%) and Jharkhand with 251 MT (15.14%). Additionally, copper resources are found in Andhra Pradesh, Gujarat, Haryana, Karnataka, Maharashtra, Meghalaya, Nagaland, Odisha, Sikkim, Tamil Nadu, Telangana, Uttarakhand, and West Bengal. These states collectively account for the remaining 9.33% of the total copper resources in the country.

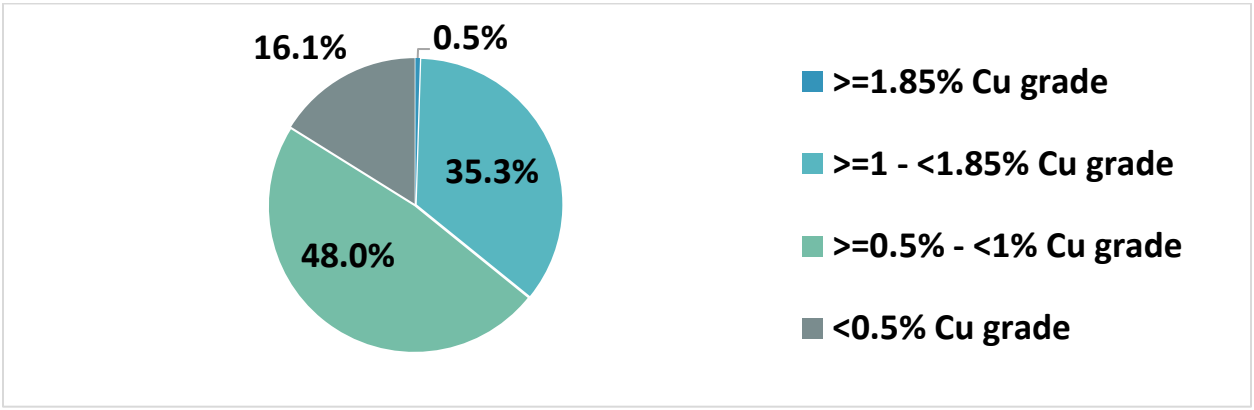
19 IBM

Figure 8 Indian Copper Resources Snapshot



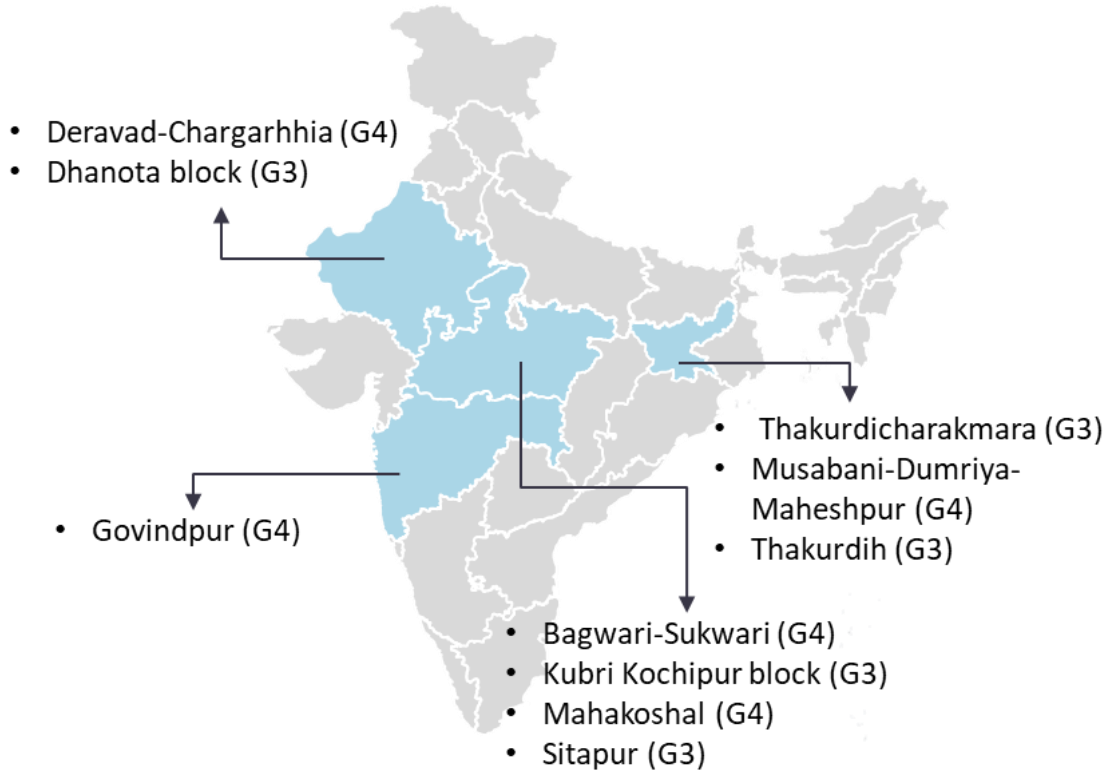
India's copper resources present a significant untapped potential, with 35.3% of these resources having more than 1% copper grade. This indicates a promising opportunity to boost domestic ore production in the future. To capitalize on this, India needs to further strengthen its domestic exploration efforts to increase its reserves.

Graph 25 Grade-wise distribution of Indian Copper Resources



In this context, in 2021, a provision was made in the MMDR Act for notification of accredited private exploration agencies under section 4(1) of the Act and such agencies were also made eligible for funding through NMET. Further, NMET was made an autonomous body in 2021. In 2023, a new mineral concession viz. exploration license was introduced in the MMDR Act. NMET has streamlined the process of sanctioning and releasing funds for the fast implementation of exploration projects. A scheme for partial reimbursement of exploration expenses for Composite Licenses (CL) holders has been formulated for the exploration of certain minerals.

Figure 9 State-wise preliminary explored blocks



Exploration license incentivizes the exploration of 29 critical and deep-seated minerals (includes Copper). This initiative is expected to attract foreign direct investment (FDI) and junior mining companies for exploration activities in India.

Hindustan Copper Limited (HCL), a government public sector undertaking (PSU), added ~66.59 MT of copper ore resources during FY23 and 56.88 MT in FY24, bringing the total copper ore

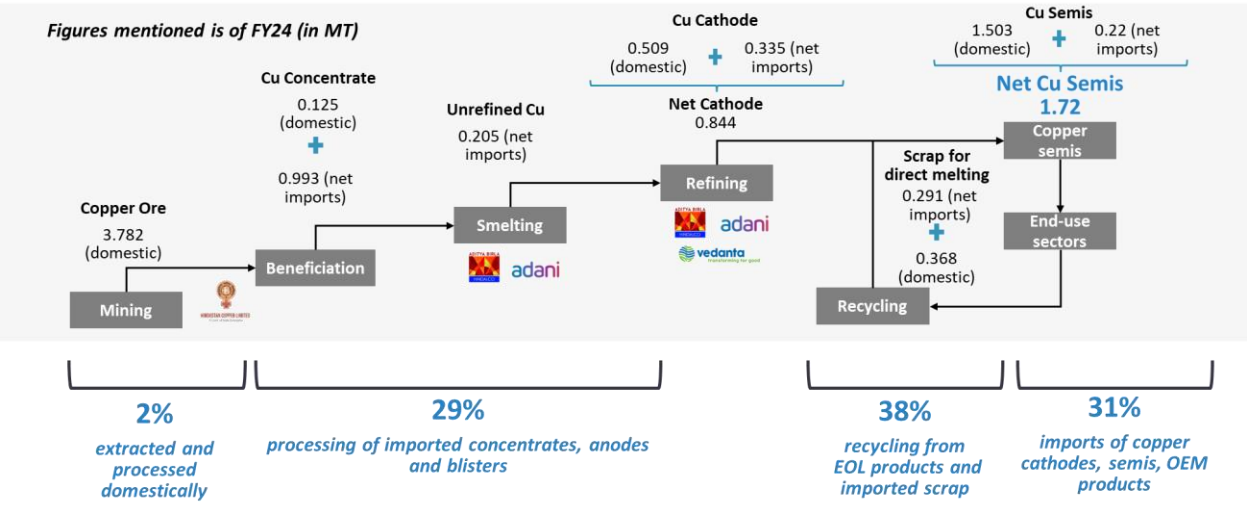
resources of the enterprise to ~755 MT at an average grade of 0.95%. HCL's budget for exploration has been increased nearly fivefold[20] compared to the expenditure over the past decade.

In addition to terrestrial deposits, India is also exploring deep-sea resources. The country holds two exploration licenses and plans to launch its Samudrayan mission by 2026. This mission aims to explore polymetallic nodules, which cover vast areas of the abyssal ocean floor and contain significant amounts of critical metals such as manganese, nickel, copper, and cobalt.

3.3. Copper Supply Scenario

India remains a net importer of copper products throughout the entire copper value chain; hence, to meet the growing demand of copper, India needs to embrace strategic initiatives across the value chain.

Figure 10 Copper supply snapshot



Mining and beneficiation

Hindustan Copper Limited (HCL) is the only copper miner in India, having a mining capacity of ~4 MT. India's mined copper production has remained static for the last few years. The transition from opencast to underground mining at Malanjkhand Copper Project in Madhya Pradesh, delays

20 Secondary Research

in extension and execution of mining leases in Jharkhand, and water shortages in Khetri, Rajasthan were the major reasons for stagnating production levels. However, HCL plans to ramp up ore production by 3x to 9.6 MTPA in short-term and ~12.2 MTPA in long-term. Proposed expansion in Malanjkhand Copper Project is expected to increase the production from 2.5 MTPA to 5 MTPA.

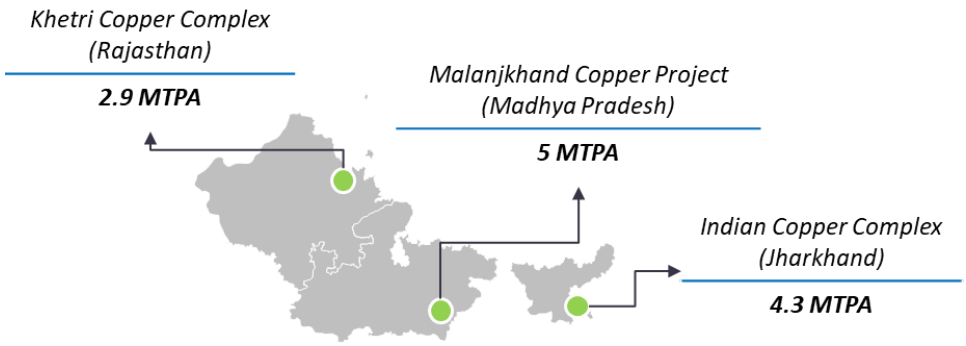
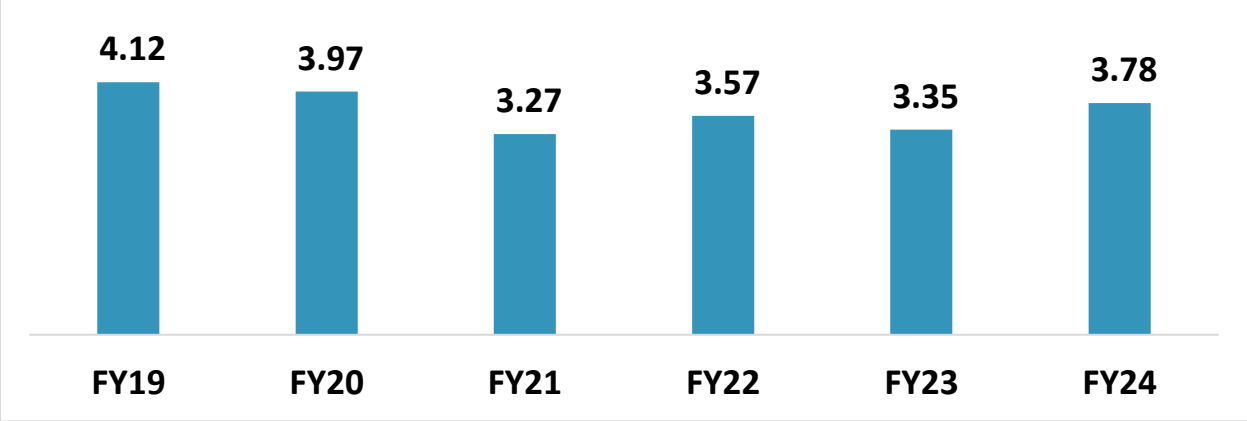


Table 15 Operational status of HCL Mines

State	HCL Mines	Production (MT) FY23	Production (MT) FY24	Remark
Rajasthan	KCC	1.00	1.23	Operational
Madhya Pradesh	MCP	2.31	2.55	Operational
Jharkhand	ICC	0.03	-	**Surda**: Received EC and operationalized in FY25 **Kendadih**: Lease execution is awaited due to statutory clearances **Rakha**: Lease execution is awaited due to statutory clearances, LOA issued to Mine Developer cum Operator (MDO)
Total Production		**3.34**	**3.78**	

The stagnation in copper ore production at Hindustan Copper Limited (HCL) can be attributed to regulatory delays & approvals and Operational Challenges.

Graph 26 Indian Copper ore production / Hindustan Copper Production (MT)



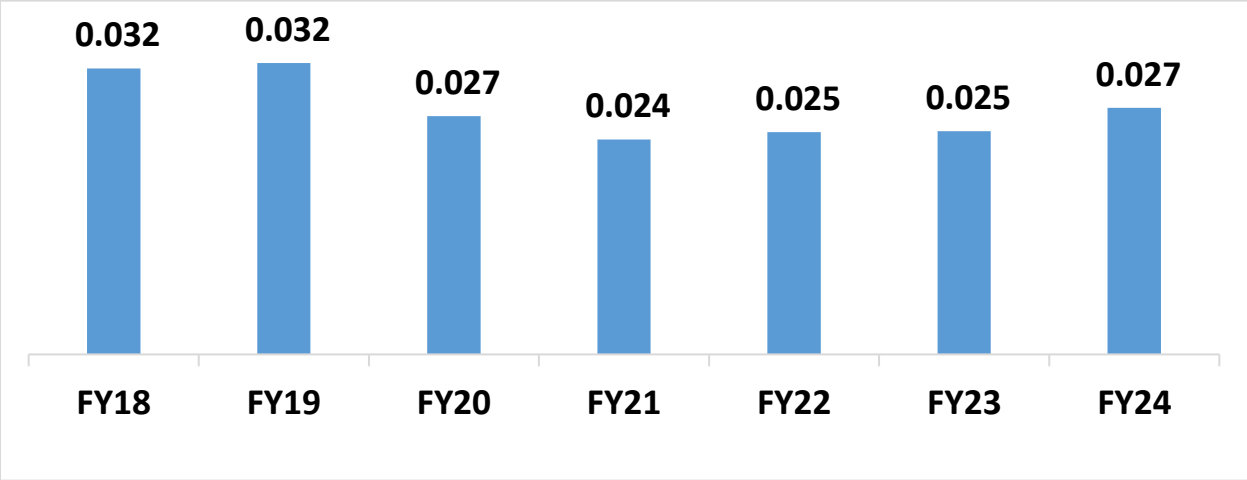
To augment the domestic supply of copper ore except HCL, the GoI has auctioned five copper CL blocks since 2015. The auctioned CL blocks have been envisaged to have potential combined geological resource of more than ~14 MT. Upon successful exploration activities, it has been expected that these blocks can start production in coming 10 years.

Table 16 Auctioned copper mines

State	Name of the block	Auction date	Preferred bidder	Present status of the block
Madhya Pradesh	Shitalpani Copper Block	9/9/2023	The Commodity Hub	SOP submitted, pending for forest clearances, LoI
Maharashtra	Thanewasana	5/8/2019	Vedanta	Exploration underway
Maharashtra	Dubarpeth	5/9/2019	Vedanta	**Block surrendered**
Maharashtra	GhanpurMudholi (West)	3/31/2022	Vedanta	Ongoing Exploration
Maharashtra	Minzhari Copper Block	11/21/2023	Hindalco	SOP preparation underway

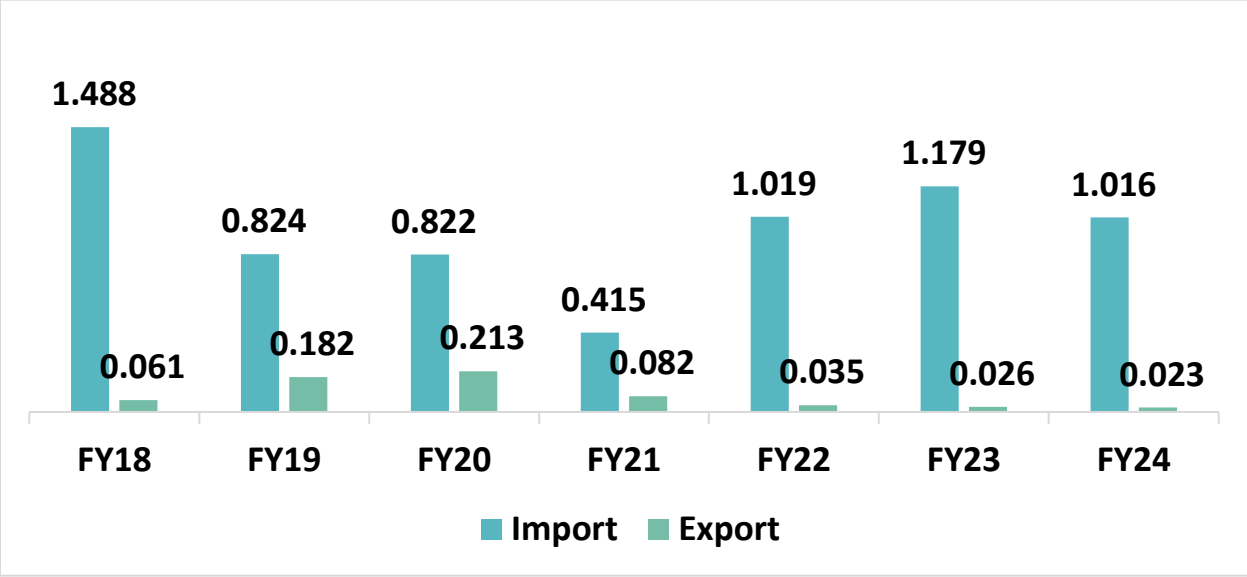
Due to domestic supply constraints, domestic copper smelters have been largely dependent on imports of copper concentrates. Copper concentrate imports in India have remained around 1 million tonnes over the past three years.

Graph 27 Domestic MIC production (MT) from HCL



Static mining production, as a result of various operational factors impacted domestic concentrate (MIC) production. Closure of Sterlite Copper in 2018 impacted copper conc. import by 44% in FY19 compared to FY18. In FY25, copper concentrate imports are expected to increase as Adani's Kutch Copper commenced operations of its 0.5 MT copper unit in Mundra in March 2024.

Graph 28 Copper Concentrate import and export (MT)



In CY2023, India imported ~1 MT of copper concentrate, with a significant portion of these imports coming from a handful of countries. Indonesia stands as the top exporter, accounting for about 27% of India's copper ore and concentrate imports, followed by Chile at 25% and Peru at 14%. Additionally, Panama contributes to 9% of these imports. Collectively, these four countries are responsible for around 75% of India's copper concentrate imports.

Figure 11 Indian Copper Concentrate Imports[21]



This concentration of supply leaves India in a precarious position, particularly because ~90% of the country's copper concentrate requirements were met through imports in FY24. Looking ahead, this dependency is projected to increase to about 95% by FY30. Such heavy reliance on a few key exporters exposes the Indian copper industry to significant risks, including supply chain disruptions due to policy changes or export bans in these nations.

To mitigate these vulnerabilities, it is crucial for India to adopt a multifaceted strategy. Apart from increasing downstream capacities, India must focus on enhancing its domestic mining

[21] TradeMap (HS Code – 260300)

capabilities. Additionally, investing in foreign assets and diversifying its supply chain are essential steps to ensure stability and reduce dependency on imports. By enhancing the nation's recycling capabilities, India can further safeguard its copper industry against potential disruptions and foster greater self-reliance in this critical sector.

Refined copper

In terms of refined copper, India became a net importer of refined copper following the closure of Vedanta's 0.400 MTPA Sterlite Copper Thoothukudi plant in May 2018. Domestic refined copper production increased from 0.453 MT in FY19 to 0.509 MT in FY24, growing at a CAGR of approximately ~2.4%. In FY24, domestic refined copper production stood at 0.509 MT, with India importing 0.363 MT and exporting 0.028 MT. Downstream-focused policies have increased demand, resulting in a surge of cathode imports.

Table 17 Domestic refined copper production (KT)

Company	Refined Cu Capacity (KT)	Annual Production (KT)						
		FY18	FY19	FY20	FY21	FY22	FY23	FY24
HCL	68.5	26	16	5	-	0.62	0.007	-
Hindalco	500	414	347	326	262	359	407	368
Vedanta	216 (Silvassa)	403	90	77	101	125	148	141
Total	**784.5**	**843**	**453**	**408**	**364**	**485**	**555**	**509**

With the commissioning of the new 500 KT smelter and refinery in Mundra, domestic cathode production is expected to rise. In FY23, 71% of imported refined copper was from Japan, attributed to the FTA between India and Japan.

Smelting & refining technology is predominantly from Finland and Japan, being leveraged globally. Adani for their Mundra facility, utilizing Nerin technology from China, capable of handling scrap for secondary refining route.

Table 18 Technology being used by Indian players

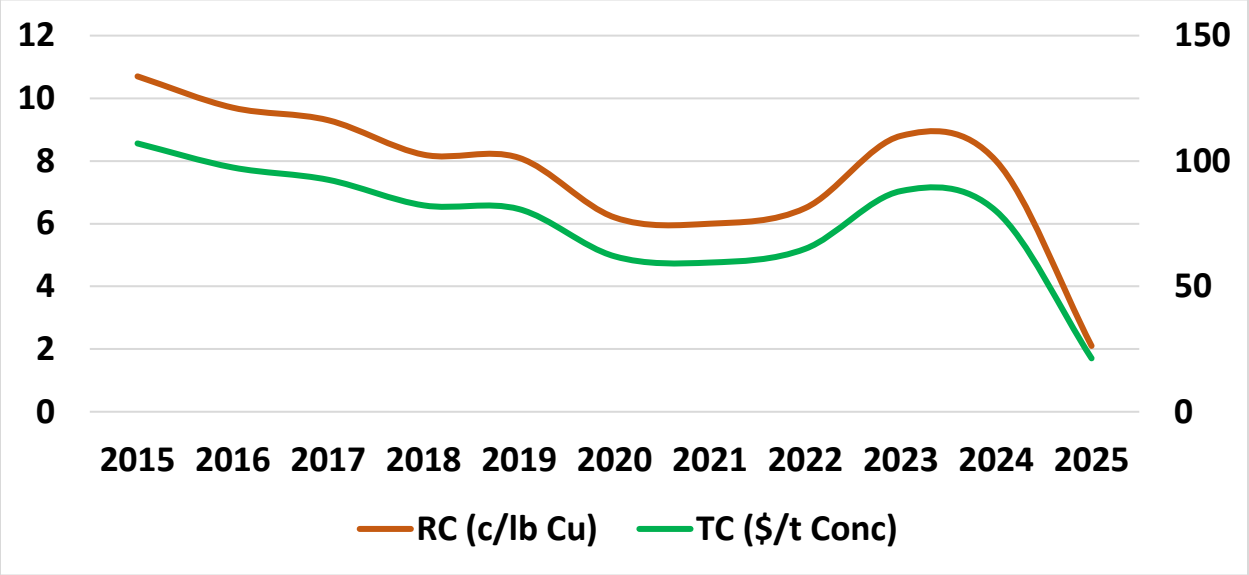
Location	Name of Plant	Name of Company	Name of Technology	Country of Origin	Availability of Indian Equivalent
Smelter	Tuticorin	Vedanta Limited	ISA, MIM	Australia	No
	Dahej	Hindalco Industries	Mitsubishi & Flash Smelting Outotec	Japan & Finland	No
	Mundra	Adani Group	Nerin (modified flash)	China	No
	Ghatsila	HCL	Flash Smelting Outotec	Finland	No
Refinery	Tuticorin	Vedanta Limited	ISA, MIM	Australia	No
	Dahej	Hindalco Industries	ISA, MIM	Australia	No
	Mundra	Adani Group	Nerin	China	No

Table 19 Comparison of pyrometallurgy process

	Nerin (China)	Mitsubishi (Japan)
Process type	Pyrometallurgy modified Flash Smelting	Primarily Pyrometallurgy Continuous Smelting
Operational efficiency	Cost-effectiveness and high throughput, making their facilities suitable for handling diverse feedstocks, including lower-grade of concentrate	Operational consistency, with a high level of automation and integration, contributing higher operational stability copper losses in slag is lower, leading to recovery rates exceeding 95%
Utilization of scrap for secondary refining	Capable of handling scrap upto 20%, promoting sustainability and high-quantity secondary copper feedstock	Can handle upto 5% scrap for secondary refining in smelting facility
Environmental considerations	Adopted more efficient technologies for improved gas recovery rates and reduced emissions	Advanced off-gas cleaning systems and a robust commitment to minimizing ecological impact, having lower energy consumption and emissions

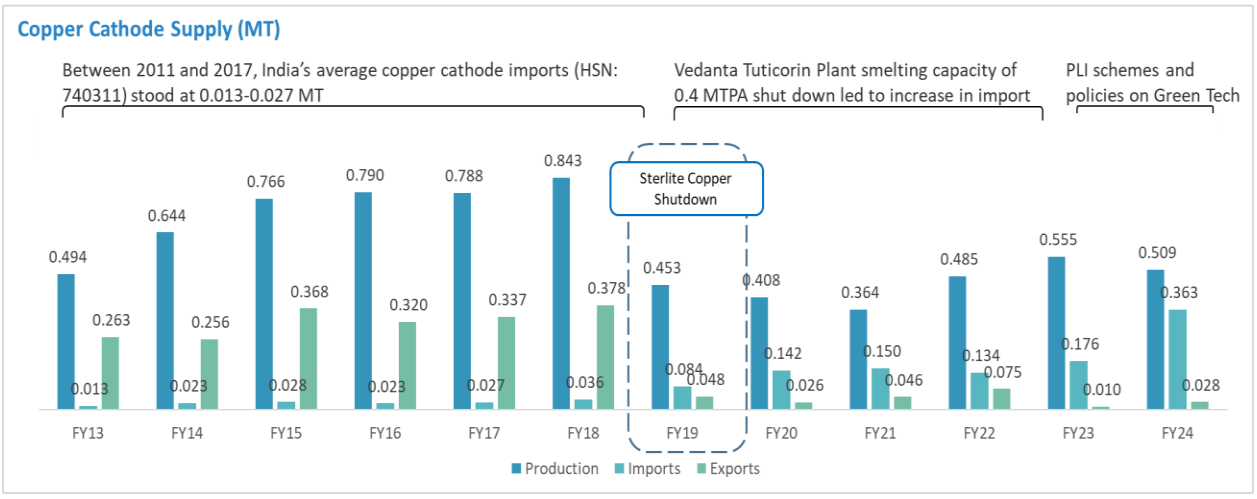
Declining TC/RC, impacting the domestic primary producers. TC fell from US$80/tonne conc. in 2024 to US$21.3/tonne conc. in 2025, reflecting a ~73% drop in a year due to supply-tight scenario and over expansion of smelter & refineries. TC is expected to slide further to $8/tonne by late 2025 or 2026, driven by concentrate deficit and relentless smelter competition.

Graph 29 TC/RC price trend in copper



From the high of 27.4 c/lb in 2015, the combined TC/RC has softened to 5.4 c/lb in 2025, mainly due to strong smelter growth in China. During 2025, the drastic drop in TC/RC is on account of multiple developments including non-availability of Indonesian concentrate, new smelter additions in Indonesia, India and China and closure of Cobre Panama mine. TC/RC to be subdued for next two years after which the tightness in concentrate market is expected to reduce with augmented mining output and addition of new mines.

Graph 30 Indian Copper Cathode Snapshot (MT)



Initiatives taken to secure supply chain resiliency

Establishment of National Mineral Exploration Trust (NMET) (MMDR Act, 2015): The primary purpose of NMET is to systematically explore and identify new mineral resources across the country. By providing funding and support for exploration activities, NMET aims to uncover new mineral deposits, ensuring a steady and reliable supply of essential minerals to meet industrial demands and strengthen the supply chain.

MMDR Act, 2021: The amendment to the Mines and Minerals (Development and Regulation) Act, 2021 aims to accelerate the pace and participation of the private sector in mineral exploration and extraction. A provision was made in the MMDR Act for notification of accredited private exploration agencies under section 4(1) of the Act and such agencies were also made eligible for funding through NMET. Further, NMET was made an autonomous body in 2021. By easing regulatory requirements and providing incentives, the amendment seeks to attract more private investment, thereby boosting exploration activities and increasing mineral production. This increased involvement from the private sector is expected to enhance the efficiency and resilience of the supply chain.

Issuance of Composite Licenses: In 2023, the Ministry of Mines issued composite licenses for significant copper blocks, including the Shitalpani Copper Block in Madhya Pradesh and the Minzhar Copper Block in Maharashtra. Additionally, the Ministry announced the auctioning of the Dudhiasol East Nickel and Copper Block in Odisha. By encouraging investment and expediting resource development, these measures help ensure a more resilient supply chain.

National Mineral Policy 2019: Issued in February 2019, the National Mineral Policy includes provisions to promote the export of minerals in value-added forms. This policy aims to enhance the value chain by encouraging the processing and refining of minerals within the country before export. By adding more value domestically, the policy not only boosts export revenues but also stabilizes the supply chain by ensuring a steady supply of high-quality, value-added mineral products.

Introduction of Non-Ferrous Metal Import Monitoring System (NFMIMS): The Ministry of Mines has introduced the Non-Ferrous Metal Import Monitoring System (NFMIMS) specifically for copper. NFMIMS provides advanced and accurate import information, including the exact quantities of copper being imported. This system assists the copper industry in planning its pricing and production strategies by providing critical data on import trends. By enabling more informed decision-making, NFMIMS contributes to a more stable and resilient supply chain for copper.

Industry Delegation to Copper Countries: The Ministry of Mines plans to send industry delegation to countries rich in copper resources, to explore potential copper exploration and mining projects. This international collaboration aims to diversify and secure additional sources of copper, thereby reducing dependency on domestic resources alone. By establishing strong ties with copper-rich countries, India can enhance its supply chain resilience and ensure a steady supply of this critical metal. The India-Chile Mining Industry Round Table, held in April 2025, emphasized strengthening cooperation in copper exploration, production, and value-added processing. With Chile's global leadership in copper and India's growing demand, both nations aim to deepen collaboration for a resilient mineral supply chain.

Effective utilization of copper slag

Copper slag is a waste during pyrometallurgical production of copper from copper concentrates causing environmental pollution, hence various studies have been conducted for utilizing copper slag in construction industries towards sustainable management of by-products.

- **Copper slag as construction material**
    - India is the largest consumer (~60%) of river sand for construction use compared to global average (~30%).
    - BIS 383:2016 – Copper slag is an approved material to be used in concrete as fine aggregates, which can replace river sand up to 50% depending on the type of concrete.

- Ministry of Environment, Forest and Climate Change of India (MoEF&CC) has established guidelines for mandatory usage of by-product (fly-ash) in construction. Similar guideline may be established to promote copper slag usage nearby smelters region. Guidelines may be established mandating the inclusion of copper slag for all state government projects. This will help promote its widespread use in road construction and other infrastructure projects.

- **Copper slag in PSC manufacturing**
  - According to IS 455:1989, blast furnace slag can currently be used up to 70% in PSC production.
  - Standard was originally developed to promote the utilization of blast furnace slag in cement manufacturing.
  - Kutch Copper Limited (KCL) conducted a study with National Council for Cement and Building Materials (NCCBM) to replace blast furnace slag in Portland Slag Cement (PSC) with copper slag – using a combination of copper slag and blast furnace slag to produce cement can provide required strength.
  - BIS to amend IS 455:1989 to include copper slag as a permissible material in the production of slag cement which will facilitate the usage and enhance sustainability.

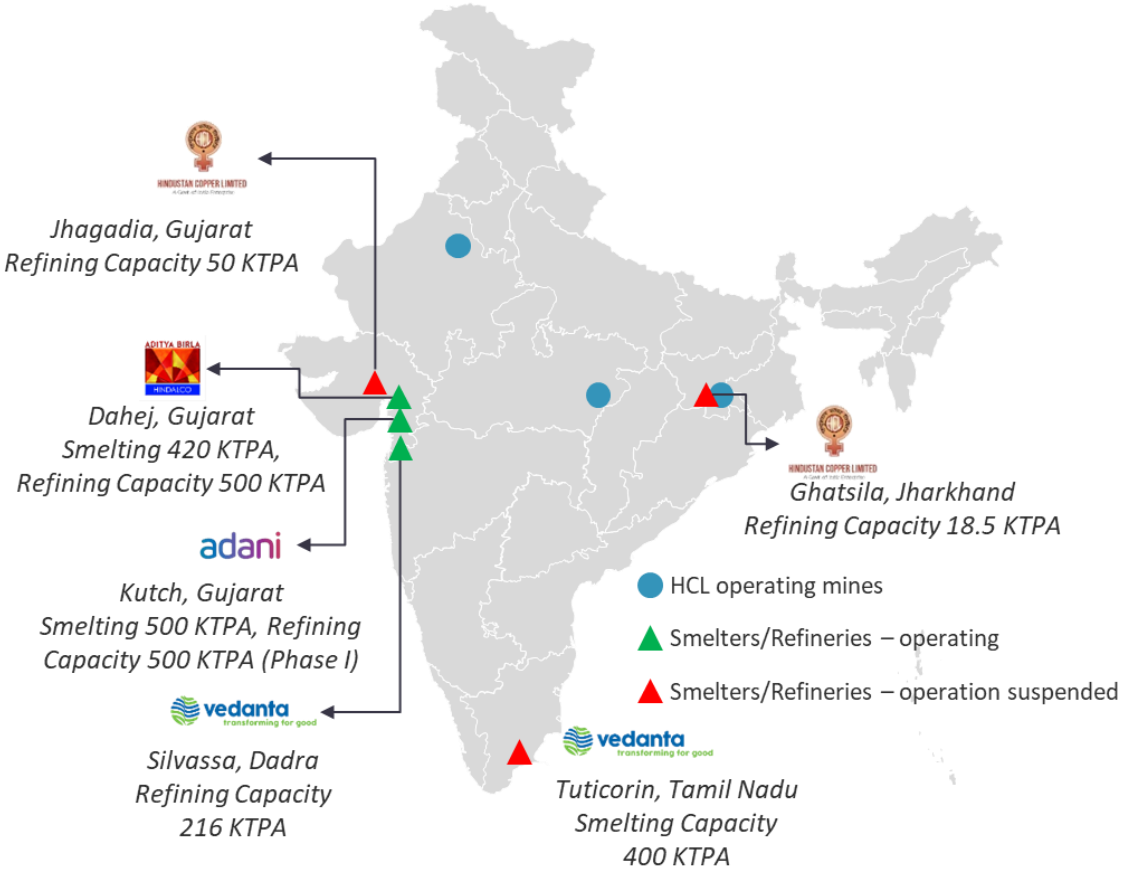
- Direct Reduced Iron (DRI) from copper slag – various studies have been conducted in China for recovering iron from copper slag by a coal-based direct reduction and magnetic separation process.

3.4. Major copper producers and their expansion Plans

India's major copper producers are embarking on strategic expansion plans to ensure a steady supply of refined copper for domestic consumption. This response is driven by the need to bridge the supply-demand gap and support the country's growing industrial and technological sectors.

The initiatives involve ramping up production capacities, establishing new facilities, and exploring international opportunities.

Figure 12 Presence of Indian copper producers



Two different production routes exist (pyrometallurgical and hydrometallurgical), depending on the characteristics of the raw material— sulfide or oxide ores. Production from secondary sources is fed by copper scrap. After initial treatment, which usually includes sorting and shredding, the copper scrap enters the pyrometallurgical production process at different stages. Copper refining is concentrated in 20 countries in the world and India is fortunate to have 1.285 MT of smelting and refining capacity, which will be 1.785 MT by 2029, with the coming up of Kutch Copper Ltd (Adani Group).

India's major copper producers are proactively expanding their production capacities and establishing new facilities to ensure a stable and sufficient supply of copper for domestic needs. These strategic initiatives are essential to meet the rising demand for industrial growth and technological advancements. Companies like HCL, Hindalco, Vedanta, and Adani are positioning themselves to strengthen the country's copper supply chain and support its economic development by enhancing production, setting up new plants, and exploring international opportunities. These efforts will be pivotal in maintaining the competitiveness and sustainability of India's copper industry in the global market.

Table 20 Major copper players expansion plans

Company	Remarks
HCL	• Ramp up overall ore production by ~3x to 9.6 MTPA by FY29 and 12.2 MTPA subsequently, further enhancement is subject to feasibility and availability of copper resources. • The proposed MCP expansion is expected to increase the output to 5 MTPA.
Hindalco	• Plan to invest Rs 2,000 crore to establish a copper and e-waste recycling facility. • Expansion of downstream business through the acquisition of copper rods facility.
Vedanta	• Set up of 0.125 MTPA CC Rod plant in Saudi Arabia. • In the process of operationalization of Konkola Copper mines in Zambia.
Adani	• $1.2 billion copper refinery project in Mundra, Gujarat having capacity of 0.5 MTPA in phase I. • Phase-II expansion to add 0.5 MTPA by 2029.
JSW	• JSW Group plans to set up a 500 KTPA copper smelter/refinery in Odisha with feedstock of copper concentrate from Peru, Chile, and domestic supply.

3.5. Trade flows

3.5.1. Import and export overview

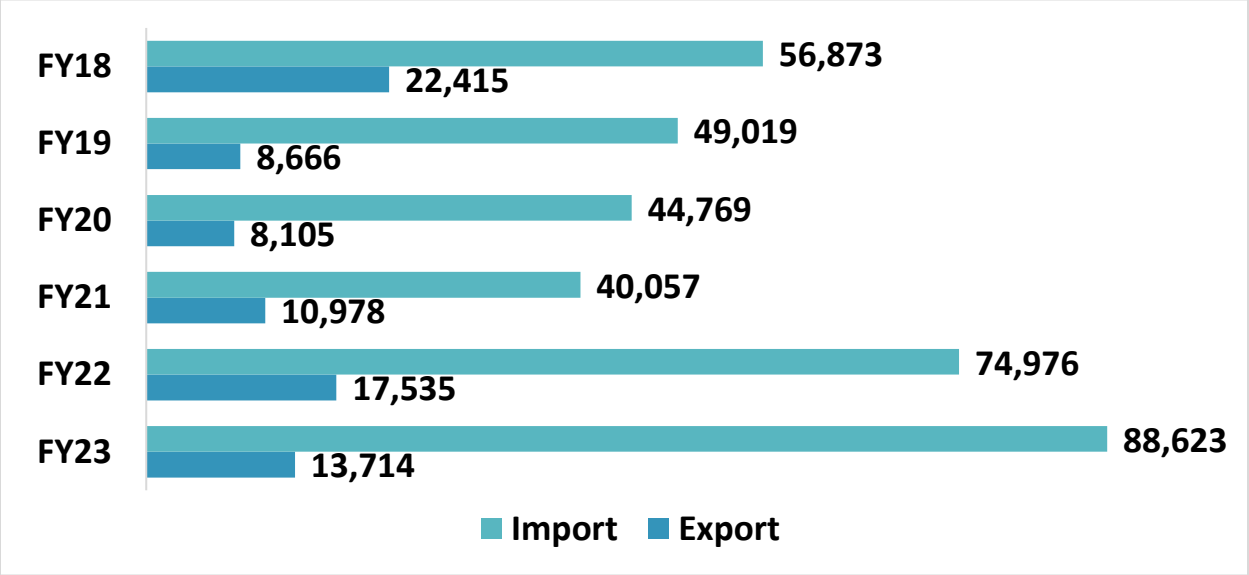
The Indian copper industry is marked by a persistent trade deficit, with imports vastly surpassing exports from FY18 to FY24. This period saw significant fluctuations in trade values, with imports rising notably from INR 40,057 crore in FY21 to INR 88,623 crore in FY23. The import composition in FY23 highlights a strong dependence on raw and semi-processed materials, such as copper concentrate (31%), anode copper for refining (18%), and refined copper and alloys (15%)[22]. This reliance underscores the necessity for India to expand its domestic production and refining capabilities to meet its industrial demand, primarily driven by the manufacturing and construction sectors. The observed export volatility suggests that improving the competitiveness and quality of Indian copper products could stabilize and boost exports. Additionally, fostering a robust recycling ecosystem could reduce import dependency and align with global sustainability trends. Enhancing local production, refining infrastructure, and recycling initiatives are crucial to addressing the strategic challenges in India's copper industry.

The Sterlite plant closure had a significant impact on copper concentrate imports, which dropped from 1.488 MT in FY18 to 0.824 MT in FY19. Consequently, the value of copper exports in all forms plummeted from ₹22,415 crore to ₹8,666 crore, a 159% decline influenced by the Sterlite copper's shutdown. Meanwhile, copper imports in all forms decreased from ₹56,873 crore to ₹49,019 crore, a 16% reduction, driven by the drop in concentrate imports.

The COVID-19 pandemic further disrupted copper demand, causing a contraction in FY20 and FY21. However, demand began to recover steadily from FY22 onwards. Despite this recovery, the Indian copper industry has been marked by a persistent trade deficit, with imports significantly outpacing exports from FY18 to FY23. Imports notably increased from INR 40,057 crore in FY21 to INR 88,623 crore in FY23.

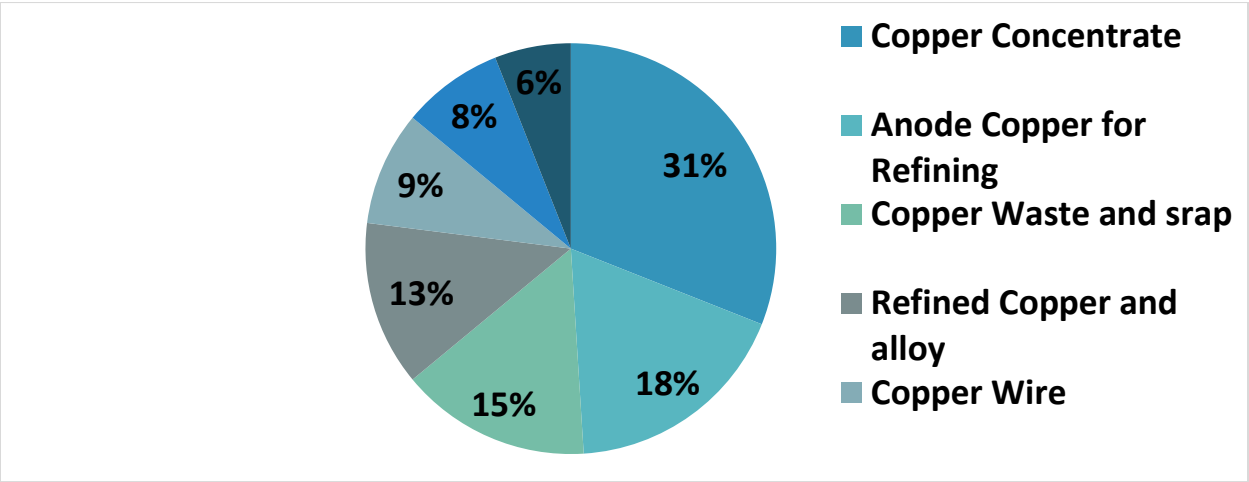
22 Ministry of Commerce

Graph 31 India's Import and Export of Copper (all forms) (INR Cr)



The import composition in FY23 revealed a strong dependence on raw and semi-processed materials, such as copper concentrate (31%), anode copper for refining (18%), and refined copper and alloys (15%). The commencement of Adani's 0.5 MT copper unit in Mundra is expected to reduce refined copper imports. This plant is projected to add an additional 0.5 MT by 2029, aligning capacities to decrease refined copper imports further. However, imports of primary raw materials will increase.

Graph 32 India's Cu Import Category wise share in FY23



3.6. Secondary copper and processing in India

In FY24, India imported 0.310 MT of copper scrap, marking an 10% CAGR compared to FY18. This growth can be attributed to the reduction in import duty on copper scrap from 5% to 2.5% in the Union Budget 2021-22. With initiatives such as the Vehicle Scrapping Policy, Extended Producer Responsibility (EPR), and Reverse Charge Mechanism (RCM), recycling in India is expected to increase further. However, refining low-grade scrap in India is currently limited, with direct melting predominantly used for secondary production. With the implementation of policies like the Quality Control Order (QCO), India is poised to expand its secondary refining capacity, reducing the share of direct melting in the coming years.

Graph 33 Copper scrap trade

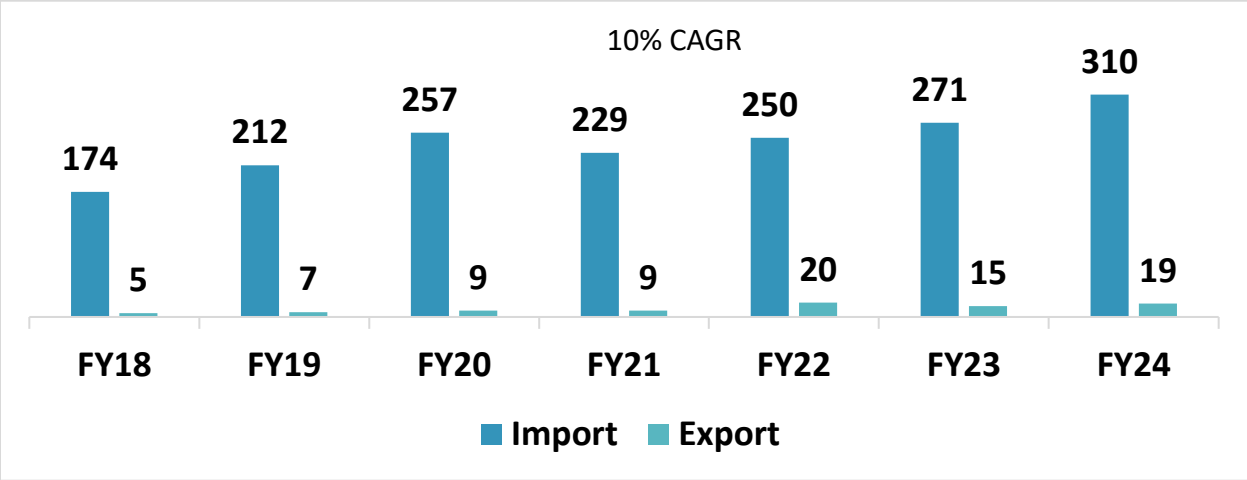


Table 21 Copper recycling benefits, challenges and solutions in copper recycling

Aspects	Remarks
Benefits of Copper Recycling	• Recycling consumes ***significantly lesser energy*** than primary extraction. • Decreases air and water pollution, ***lower greenhouse gas emissions.*** • Reduces landfill waste, ***promotes circular economy.***

Aspects	Remarks
Challenges in Secondary Copper Production	• Emissions and toxic elements handling. • ***EOL scrap*** is often heterogeneous and contaminated**.**
Solutions in Copper Recycling	• ***Efficient collection systems***, public awareness, ***advanced sorting technologies.*** • Stringent ***quality control***, ***refining technologies.*** • Government incentives, subsidies, public-private partnerships.

3.7. Key trends and drivers important for growth of Secondary Copper sector

The ramp-up of copper recycling facilities is primarily driven by constraints in primary metal supply, the need to reduce carbon emissions and enhance sustainability, and ensuring the security of metal supply.

Table 22 Key trends and drivers of secondary copper sector

Key Trends	Details	Examples
Rebalancing of secondary metal supply chains	• Current dynamics clash with climate goals and supply security. • Policies drive deglobalization of scrap trade, creating new domestic processing. • Onshoring scrap supply through stricter quality standards and import restrictions.	• China *processes 3.5 MT* of copper scrap annually, 60% imported. • North America *collects 1.5 MT*, 40% exported.

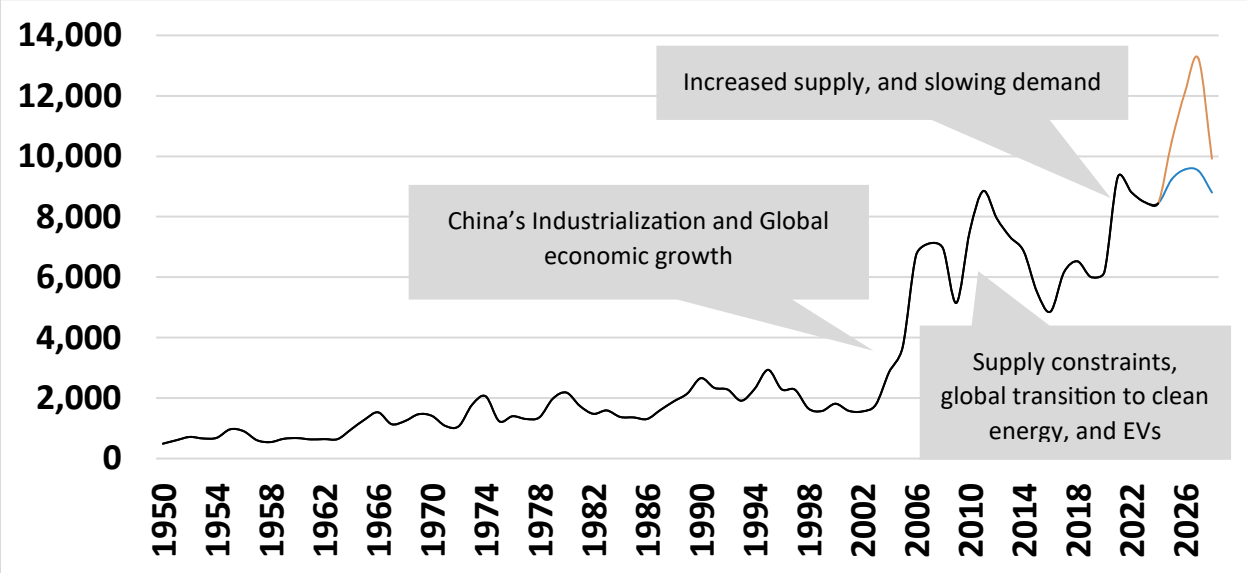
Key Trends	Details	Examples
Vertical integration and consolidation	• Ensure consistent supply, quality, and compliance through value chain ownership. • Heightened environmental, social, and governance oversight. • New business models and innovative recycling in nascent markets like EV lithium-ion batteries.	• Rio Tinto's acquisition of a 50% stake in Matalco for access to upstream scrap yards across North America.
Alleviating tight scrap supply	• Minimum recycled content laws boost demand for high-grade material. • Efficient collection, sorting, and processing will shape the industry.	• Aluminum packaging recycling rates vary from 45% in the US to 90% in Brazil. • Copper foil for EV batteries requires high-grade scrap.
Revolution in recycling technology	• Scrap is expected to be complex in near future (Solar Panels, EVs, E-Waste etc.). • Natural resources become scarcer and environmental concerns rise giving rise to Urban mining. • Enhanced material tracking in scrap ensures better monitoring, classification, and reuse of valuable metals.	• BASF and HGI partnership using geophysical techniques and LixTRA leach aid for improved copper recovery.
Disruption to pricing mechanisms	• Secondary material prices are set by reporting agencies. • Scrap metal prices are discounted from primary metal prices based on regional supply-demand.	• Carbon prices and border adjustment mechanisms help make the underutilized scrap pool more economical.

Key Trends	Details	Examples
	• Regulations, tariffs, and carbon policies will impact scrap pricing and historical relationships. • Consumer willingness to pay green premiums is vital for recyclers' profitability.	

3.8. Safeguarding against future high prices by building functional reserves

In 2024 LME price of copper fluctuates between $ 8,500 – 10,500 /t. Potential disruptions to supply, notably in South America due to depletion of mines, falling ore grades, lack of investment, and long project timescales are expected to drive the prices even higher in the long run. Analysts forecast global electrification will push copper demand to 36.6 MT by 2035, however, supply is anticipated to reach 30.1 MT creating a deficit of 6.5 MT[23].

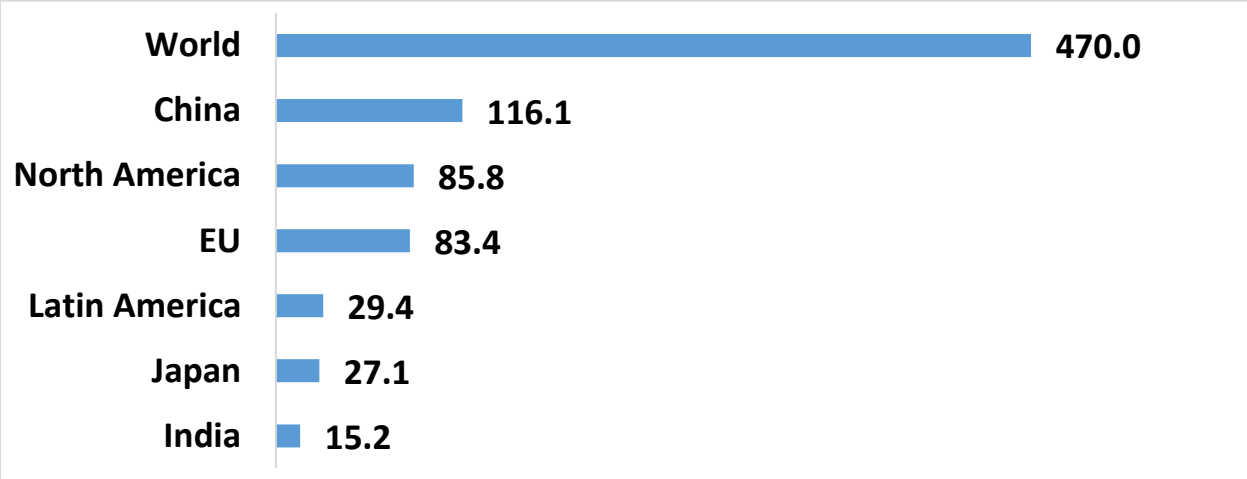
Graph 34 LME price over the years



[23] IISD – Copper Report

In FY23 India had a trade deficit worth $ ~3 billion[24] in copper concentrates with the expected increase in demand, price and insufficient domestic reserves concentrate import bill is expected to further increase. India needs to reduce reliance on concentrate imports to safeguard itself from supply chain disruptions and to preserve its forex reserves by increasing domestic scrap availability.

Graph 35 Copper in use (MT), 2020[25]



Copper which is 100% recyclable, and the metal used today can be used again & again, is going to help the nation reduce future imports of copper concentrates, which will be needed for our economic development.

China has ~116.1 MT of copper within the country, accounting for ~25% of global scrap in use. This copper can be recycled in about 20 years, which will be highly beneficial for hedging against potential supply chain disruptions. In contrast, India has only 15.2 MT, making even copper scrap scarce.

Government policies could be introduced to stimulate domestic demand for copper by standardizing the copper content in end-use products and mandating the use of such products in government projects to promote copper usage could increase India's copper use. Additionally,

[24] Ministry of Commerce
[25] ICA

increasing public awareness of the benefits of copper in everyday applications such as could help achieve a higher standard of living and greater energy efficiency.

3.9. Key highlights of the Indian copper sector

India has been largely dependent on imports of primary raw materials for refined copper production. To reduce this dependency, the Government of India (GoI) has increased its focus on exploration through the introduction of Exploration Licenses (EL) and deep-sea exploration initiatives.

To address the insufficient domestic resources, the GoI has formed KABIL, launched the Critical Mineral Mission, and joined the Mineral Security Partnership (MSP) to secure the nation's supply of critical minerals.

The domestic copper sector should work toward diversifying the raw material supply chain, decreasing reliance on imported refined copper, and organizing the secondary copper sector.

In addition to traditional sectors such as infrastructure and Transmission & Distribution (T&D) driven by urbanization and economic growth, India's copper demand will be further boosted by emerging sectors such as renewable energy and electric vehicles (EVs).

In FY25, India's reliance on imported refined copper is expected to decrease with the establishment of new refining unit. About 38% of India's copper demand is currently met through the direct melting of scrap, with only a negligible amount being refined. However, India plans to implement policies such as the Quality Control Order (QCO), which are expected to increase secondary refining in the country.



4. BENCHMARKING WITH OTHER COUNTRIES: CHINA AND JAPAN

4. Benchmarking with Other Countries: China and Japan

India's refined copper production peaked at 0.843 MT in FY18 but witnessed a significant decline following the closure of the Tuticorin plant. In contrast, countries like China and Japan have achieved remarkable growth and sustainability through strategic investments, policies, and innovations.

Production of refined copper:

Table 23 Comparative analysis of Refined Copper production

Metric	India	China	Japan
Production Trends	Stagnant MIC production, drop in refined copper (0.8 MT to 0.5 MT)	Rapid growth in refined copper (0.5 MT to 11 MT)	Stable demand, minimal imports (8 KT refined copper in 2022)
Key Challenges	Decline post-Sterlite closure	Environmental oversight, trade tensions	Aging domestic supply sources
Policy Support	Limited focus on copper demand	Renewable Energy Law (2005), Belt and Road Initiatives	Recycling Law (2001), Overseas acquisitions

Taxation and financial incentives:

Table 24 Taxation and Financial Incentives

Metric	India	China	Japan
Corporate Tax	~40% Domestic, ~55% Foreign (1990s)	15%-35% (1990s), 25% (2023)	~50% (1990s), 25-30% (2023)
Export/Import Taxes	BCD on Copper Conc.: 5% (1990), 0% (2024)	Tariff on Copper Conc.: 15% (2000)	Tariff on Copper Conc.: 0% (Early 2000s)
Investment in Renewables	INR 10,000 Cr Solar Grid (FY 25 Budget)	$184 Bn (2005)	$30-$38 Bn (2004-2005)
Special Incentives	Limited	Direct SOE funding	JETRO subsidies for exports

Scrap and recycling policies:

Table 25 Scrap and Recycling Policies

Metric	India	China	Japan
Focus on Copper Scrap	Import duty reduced on copper scrap from 5% to 2.5% (2021), further to 0% (2025)	Banned imports of lower-quality categories of scrap in 2018 and 2019. 1.5% tax on imported recycled copper	Home Appliance Recycling Law (2001) to support the recycling of copper from discarded appliances

Investment in acquisition strategies:

Table 26 Investment and Acquisition Strategies

Factor	India	China	Japan
Apex Government Body	None	NDRC seamless approvals	JBIC funding
Overseas Acquisitions	Limited to Lithium (Li) assets	Debt-trap diplomacy, BRI-funded projects	Joint Ventures (e.g., Mitsubishi in Escondida)
Investment	None	$16 Bn in 88 assets (since 2010)	Major internal funding, Japanese banks
Infrastructure Support	Minimal	Heavy investments in roads, beneficiation	Advanced logistics and community development

Case Studies of Major Acquisitions by China and Japan:

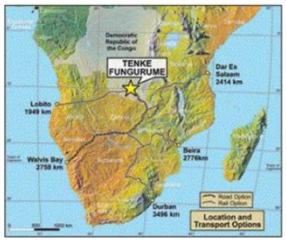
- **China:** Acquisition of Las Bambas (Peru) for $5.85 Bn (2014) and Tenke Fungurume (DRC) for $2.65 Bn (2016) through state-owned enterprises (SOEs), backed by loans from CDB and Axim Bank.

Peru



Mines acquisition	Acquisition of **Las Bambas** from Glencore at 5.85 Bn USD in 2014 through **Minmetal Corporation (MMG)** and hold 60% equity stake of the project
Financial support	Banks like CDB and Axim provided loans, with the entire amount potentially guaranteed by the government under BRI scheme
Infra. development	Heavily invested in infrastructure like roads, residences, investment in modifying beneficiation process and production improvement

Democratic Republic of Congo



Mine acquisition	**China Molybdenum Co.(CMOC)** acquired the **Tenke Fungrume project** in 2016 from FreePort-MacMoRan at 2.65 Bn USD and holds **56%** equity
Financial support	Chinese state-owned banks CDB, Axim, and ICBC provided loans under China's Belt and Road initiatives
Infra Development	Processing and beneficiation unit, roads, initiatives for sustainable development, and improved community relationships.

Note: DRC does not have an FTA with China

- **Japan:** Mitsubishi Corporation's acquisition of a 10% stake in the Escondida mine (Chile) and a 15% stake in Grasberg mine (Indonesia) through joint ventures, supported by Japanese government loans and internal funding.

Chile



Mines acquisition	Mitsubishi Corporation purchased a 10% stake in the largest copper mine in the world, Escondida, Chile. It acquired the equity stake through JV
Financial support	Internal funds along with debt financing by the Japanese government under the Overseas loan scheme
Infra. development	Not involved in any infra development

Indonesia



Mine acquisition	Mitsubishi and Sumitomo Corporation jointly hold a 15% stake through FreePort-McMoRan of the world's second-largest copper mine, Grasberg
Financial support	Investment is done in 1990 majorly through internal funds and loans from the Japanese banks
Infra Development	No direct involvement in any infrastructure development



5. EXPECTED GROWTH OF DOMESTIC COPPER SECTOR

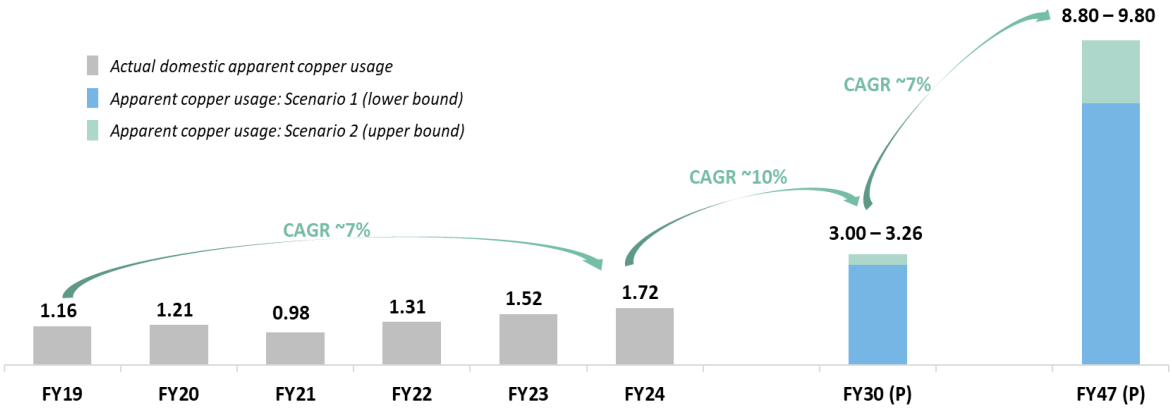
5. Expected growth of domestic copper sector

5.1. Expected growth of copper usage in short-term (2030) and Amrit Kaal (2047)

India's domestic apparent copper demand is projected to reach 8.8 - 9.8 million tonnes by FY47, with per capita apparent consumption anticipated to increase from ~1.2 kg in FY24 to 5.4 - 6 kg, reflecting a 4.5 - 5-fold growth over 23 years. Comparative historical trends indicate that China's per capita refined copper consumption rose from 1.04 kg in 1994 to 7.04 kg by 2011, representing a seven-fold increase over 17 years. By 2022, China's per capita copper consumption stood at 10.49 kg, with further growth expected due to the global transition towards electric vehicles (EVs) and renewable energy[26].

In the United States, per capita refined copper consumption was recorded at 8 kg in 1950, reaching a peak of 11 kg before stabilizing. Presently, U.S. consumption remains in the range of 5-7 kg per capita[27]. These historical patterns suggest that India's consumption will increase even after 2047.

Graph 36 Historical and projected domestic apparent copper demand (in MT)



Scenario 1: This has been derived by considering realistic GDP growth of the nation

Scenario 2: This has been derived by considering optimistic GDP growth of the nation

[26] ICA
[27] USGS

Drivers shaping the growth trajectory

- **Urbanization & higher disposable income**
    - India's urban population is expected to grow from 508 million (~35%) in 2023 to 675 million (~43%) in 2035.
    - Industrialization fueling sectoral copper demand (policy promoting investment in for manufacturing in India).
    - Metal intensity to rise with GDP growth (estimated to reach from ~USD 3.7 Tn to ~USD 30 Tn by 2047).
    - Rising disposal incomes with increase in per capita GDP (~USD 4,000 by 2030).

- **Clean energy transition**
    - Decarbonization efforts aiming to reduce GDP emission intensity by 33-35% from 2005 levels.
    - India aims for 500 GW of RE installed capacity by 2030 from the current 197 GW and 90% of its energy requirements from RE in 2047.
    - 30% of all vehicle sales to be electric by 2030 along with growing EV charging infrastructure.
    - Renewable, EV and associated infrastructure are expected to contribute ~16% in 2030 and ~25% in 2047.

5.2. Major copper consuming sectors outlook

- **Building construction sector**

The construction sector is expected to grow at a CAGR of ~17% in the short term (2030) and ~6% in the long term (2047). The government's push for infrastructure through initiatives such as the Pradhan Mantri Awas Yojana (PMAY) and the Smart City Mission is expected to drive growth.

Economic factors:

- Housing complex and commercial constructions (warehousing and storage facilities) demanding higher safety and a 'green' source of energy.
- Increased focus on infrastructure and growth in private investment.
- Availability of finance and repatriation of NRIs and HNIs enable the purchase/ construction of better-quality buildings (smart buildings).
- Continued public investment in infrastructure development and smart cities.
- Increased collaboration through the PPP model and rising private investments.

Policy/regulatory impact:

- Smart City Mission: sustainable and inclusive cities and application of smart solutions.
- PMAY: credit-linked subsidy scheme for affordable housing.
- Real Estate Investment Trust: to invest in commercial real estate.
- 100% FDI in construction development.
- Partnership for Energy Efficiency in Buildings (PEEB): promoting sustainable building design and construction.

Demographic factors:

- Growing population and a higher proportion of young, working people and nuclear families.
- Rapid urbanization in tier-2 cities, rising income, and easy credit leading to a real-estate push.
- Higher household income and a better standard of living.

Other factors:

- Energy efficient and environment friendly construction such as Leadership in Energy and Environmental Design (LEED) certified green buildings.
- Smaller and mid-sized developers impacted by reforms such as Real Estate (Regulation and Development) Act, GST, etc. increasing the share of larger developers.

- **Infrastructure sector**

Renewable power generation & storage capacities, distribution network & charging infrastructure and railway route electrification will witness rapid growth within the infrastructure sector. Infrastructure is expected to grow at a CAGR of ~12% in short-term (2030) and ~7% in long-term (2047).

Economic factors:

- Rise in economic activity and growth in international trade.
- India emerging as a manufacturing hub will drive demand for infrastructure through logistics and warehousing needs.
- Availability of infrastructure finance opportunities and growing PPP.
- Technology innovation and associated demand for efficient and environment-friendly infrastructure.

Policy/regulatory impact:

- Pradhan Mantri Sahaj Bijli Har Ghar Yojana, Deen Dayal Upadhyay Gram Jyoti Yojana, Vision '24x7 Power for All', National Mission on Advanced Ultra Supercritical Technology.
- Net Zero by 2070: National Wind-Solar Hybrid Policy, National Offshore Wind Energy Policy, National Solar Mission, Rooftop Solar Programme.
- Renewable Purchase Obligation: to promote renewable energy.
- Make in India, Atmanirbhar Bharat (PLI Schemes**).**

Demographic factors:

- Growing population and increasing proportion of young, working population.
- Rising urbanization and domestic migration.
- Growing per capita income and rising standard of living will lead to demand for high-quality infrastructure.
- Railway route electrification, metro rail and high-speed rail projects.
- Greater consumer awareness and demand for green infrastructure.

Other factors:

- Focus on clean energy (solar and wind) – grid connected solar roof top and wind-solar PV hybrid systems.
- Setting up of UMPP with super-critical technology.
- Construction of smart grids and improving energy storage facilities.
- Installation of charging infrastructure to enable faster adoption of EV.

- **Industrial sector**

Increasing demand for new plants and machineries due to growing industrialization will help the industrial sector to grow at a CAGR of ~7% in short-term (2030) and ~5% in long-term (2047).

Economic factors:

- Overall economic growth and growth of domestic manufacturing.
- Expanding private investment and export driven expansion of industries/manufacturing and plants and machinery.
- Focus on energy efficiency as well as incorporation on carbon tax policy.
- Increase in private final consumption and resulting demand for more and better goods (which may be serviced by domestic industries).

Policy/regulatory impact:

- National Manufacturing Policy: enabling policy framework and providing incentives for infrastructure development on PPP basis.
- National Capital Goods Policy: enabling ecosystem for capital goods growth and ensuring sustained incentive for domestic manufacturers.
- Make in India, Atmanirbhar Bharat (incl. PLI schemes), Start-up India, etc.
- Govt. policies and investment support to build manufacturing hubs.
- 100% FDI approved in the manufacturing and engineering sectors.

Demographic factors:

- Rising urbanization and resulting demand for products.
- Growing population and increasing proportion of young, working population.
- Growing income and rising standard of living reflected in demand for goods.
- Adoption of automation along with technologies such as IOT, Big data, AI/ML to promote "Smart Manufacturing".

Other factors:

- India is emerging as an R&D centre for various industries.
- Technological partnerships between companies to enhance capabilities and sustain market uncertainties.
- Growth in Merger & Acquisition activity in the industry.
- Transportation sector – EV market is expected to grow rapidly.

- **Transportation sector**

Focused policies aimed at reducing carbon emissions to drive growth of EV within transportation sector, expected to grow at a CAGR of ~18% in short-term (2030) and ~11% in long-term (2047).

Economic factors:

- Rising income and standard of living.
- Availability of credit and financial options.
- Strong export demand for auto components and small cars from India.
- Heavy investments in charging infra and manufacturing & value chain development.

Policy/regulatory impact:

- National Electric Mobility Mission Plan, PM E-drive for promoting EVs.
- Make in India, PLI scheme: promotion of local manufacturing.
- National Automotive Testing and R&D Infrastructure Project.

- National rail plan, Metro rail policy, schemes related to special purpose & high capacity wagons.
- Vehicle Scrappage Policy: Govt. funded programme to replace old vehicles.

Demographic factors:

- Growing population and increasing proportion of young, working population.
- Growth in tourism (domestic and foreign) and greater consumer awareness and demand for green transport.
- Rising urbanization in tier-2 cities to introduce metro linkages.
- More investment towards the development of EV infrastructure and railways rolling stock production.

Other factors:

- Deterrent for growth of ICE vehicles and stricter compliance for automakers w.r.t Carbon emission (BS-VI).
- Increased collaboration through PPP models and investments in setting up R&D operations & laboratories in India.
- Increased indigenization of global OEMs and the emergence of designing and manufacturing base in India.

- **Consumer durables sector**

The rise in organized retail with convenient and easier financing and credit options will drive the consumer durable sector and is expected to grow at a CAGR of ~6% in short-term (2030) and ~7% in long-term (2047).

Economic factors:

- Organized retail including the growth of digital economy/ e-commerce.
- Easy consumer credit.
- Growth in rentals of consumer durables particularly in urban areas.
- Growing market for luxury and affordable luxury brands and growth in exports.

- Demand for efficient and environment-friendly alternatives.

Policy/regulatory impact:

- Quality and energy efficiency standards such as BEE star rating, BIS testing and certification, Indian Cooling Action Plan (ICAP), etc.
- Atmanirbhar Bharat, Make in India, Production linked incentive (PLI) scheme, National Policy on Electronics, Scheme for Promotion of Manufacturing of Electric Components and Semi-Conductors: Govt. policies on promoting domestic manufacturing and providing financial incentives.
- Focus on Foreign Investment Policy, Foreign Trade Policy.

Demographic factors:

- Growth in home appliances and electronics items due to increase in urban, semi-urban and rural household.
- Growing working population and higher disposable income.
- Electrification & availability of reliable power and demographic shift.
- Generational preferences shape product design and marketing strategies.

Other factors:

- Higher energy efficient and eco-friendly large appliances.
- Technological advancements and interventions.
- Smart Mobile phones, PCs & Laptops as more focus due to online education and digitalization.
- Focus on Energy savings and decarbonization.

- **Diverse sector**

Increasing adoption of Solar Pumps and various other products like cartridges & gun heads, chemical, musical instruments, marine applications, brazing & welding products, etc. will drive the growth of diverse sector at a CAGR of 4% in the long-term.

Economic factors:

- Highly price sensitive market; subsidy and income opportunity put Solar Pumps at competitive advantage.
- Rising private consumption expenditure and share of agricultural product in this expenditure.
- Availability of credit and financial options.
- Growth of food processing industry and expand its exports.

Policy/regulatory impact:

- Subsidies upto 80 to 90 percent for buying solar panels, offered as cash back to purchasers.
- Pradhan Mantri Krishi Sinchayee Yojana (PMKSY).
- National Food Security Mission (NFSM).
- PM-KUSUM Scheme, Krishi Vikas Yojana.

Demographic factors:

- Large and growing population.
- Urbanization, growth of nuclear families, and increasing proportion of young, working population results in demand for semi-processed/processed food.
- Rising disposable income of rural and urban households.
- Changing lifestyle and increasing expenditure on healthy and nutritious foods.

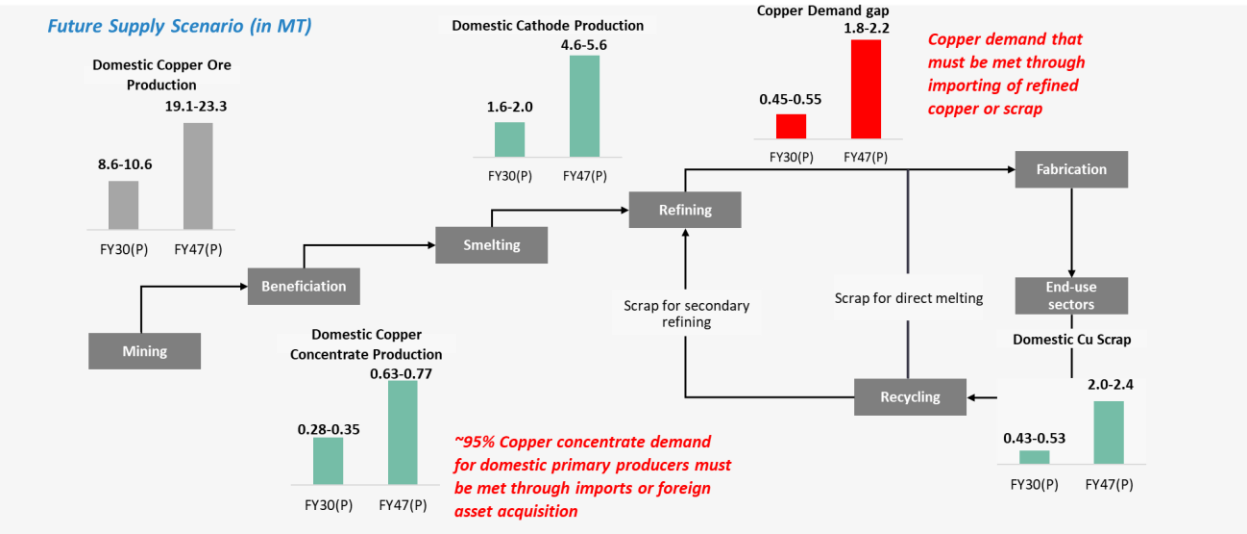
Other factors:

- Growth in India's agriculture sector and increased mechanization.
- Changing technology and innovation.
- R&D in the agriculture sector in general and irrigation in particular.

5.3. Potential supply scenario in 2030 and Amrit Kaal

India needs to add ~1 MT of refining capacity every five years to meet the projected demand of about 10 MT. In addition to enhancing mining production, investing in, or acquiring foreign copper assets and enhancing functional reserve will be crucial for supply chain resiliency.

Figure 13 Future copper supply scenario[28]



Short term (2030) scenario

About 95% of India's concentrate demand is projected to be met through imports. Enhancing domestic mining capacity by reopening closed mines, expanding existing ones, and bringing auctioned blocks into production will boost domestic production. Additionally, India should consider strengthening offtake agreements with copper-rich nations such as Chile, Peru, and Australia, ensuring a reliable and consistent supply. With the 0% import duty on concentrates, India has a strategic opportunity to diversify sourcing by exploring partnerships with African countries.

[28] **Assumptions**: improvement in process efficiency from ~80% to ~90%, MIC to conc. ratio 4, EOL is around 20 years, focus will be on minimizing imports of unrefined & refined copper and Semis/FGs in long run, whereas foreign assets can be acquired with downstream integration

Table 27 Domestic mine-wise production FY30 (P)

State	Mines	Potential Ore Production (KT)	Potential MIC Production (KT)	Potential Concentrate Production (KT)
Rajasthan, Madhya Pradesh, Jharkhand	KCC, MCP, ICC (HCL)	9,600	79.49	317.95
Maharashtra	Thanewasana (Vedanta)*	35	0.29	1.16
Total		**9,635**	**79.78**	**319.11**

Assumption: Ore Grade 0.9%, Recovery 92%, MIC:Conc. 1:4

**Thanewasana auctioned in 2019 is expected to be operationalized in 2030*

About 1.5 MT of additional refining capacity is expected to be added by FY30 compared to FY23 levels, mostly from Adani's 1,000 KT copper unit in Mundra. The increasing addition of new capacities in India is expected to produce 1.6 - 2 MT of refined copper in 2030.

Table 28 Projection of domestic refined copper production FY30 (P)

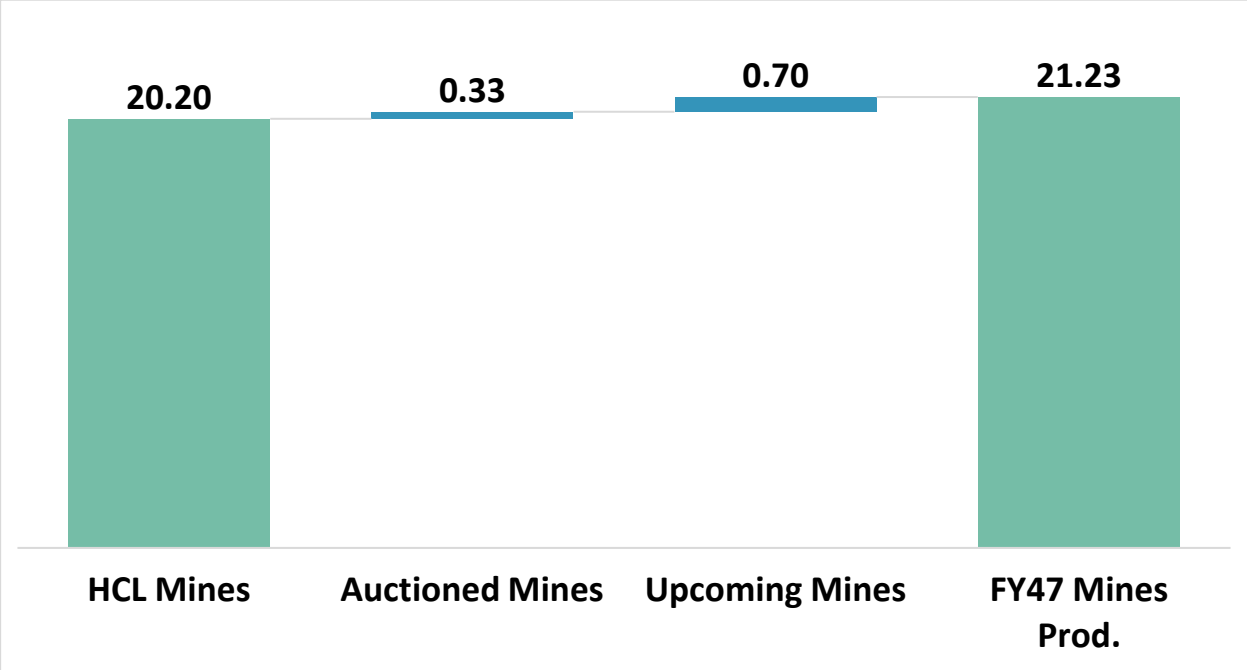
Sl. No.	Company	Capacity (KT)	Potential Domestic Production (KT) @ 80% utilization
1	Adani	1,000	800
2	Hindalco	500	400
3	Sterlite	216	173
4	Hindalco (secondary refinery)	50	40
5	Capacity addition	450	360
6	**Total**	**2,216**	**1,773**

Currently, almost all scrap undergoes direct melting to form Semis/FGs. Going forward, scrap utilization in secondary refining is expected to reach 5%, while 95% of scrap is estimated to be directly melted to form Semis/FGs. Domestic scrap availability is projected to be 430 - 530 KT[29], leaving India import dependent on copper cathodes and scrap for 0.45 – 0.55 MT of copper. Additionally, imposing restrictions on the export of high-grade copper scrap could help boost the secondary copper industry and prevents the loss of nation's strategic raw material.

Long-term (2047) Scenario

HCL has a goal to mine 20.2 MT of copper ore in the long term subjected to feasibility and availability of copper resources. Additionally, production of 1 MT of copper ore is expected to be from auctioned & upcoming mines in 2047, leaving India to rely on imports for more than 95% of its ore requirements.

Graph 37 Domestic copper ore production (MT) projected snapshot



[29] India consumed approximately 680 KT of copper in 2010, assuming that about 70% will reach EoL

Table 29 Potential ore production of auctioned blocks in FY47

State	Complex	Projected Ore Production (tonnes)
Madhya Pradesh	Shitalpani Copper Block	13,500
Maharashtra	Thanewasana	263,250
Maharashtra	GhanpurMudholi (West)	7,500
Maharashtra	Minzhari Copper Block	42,375
	Total	**326,625**

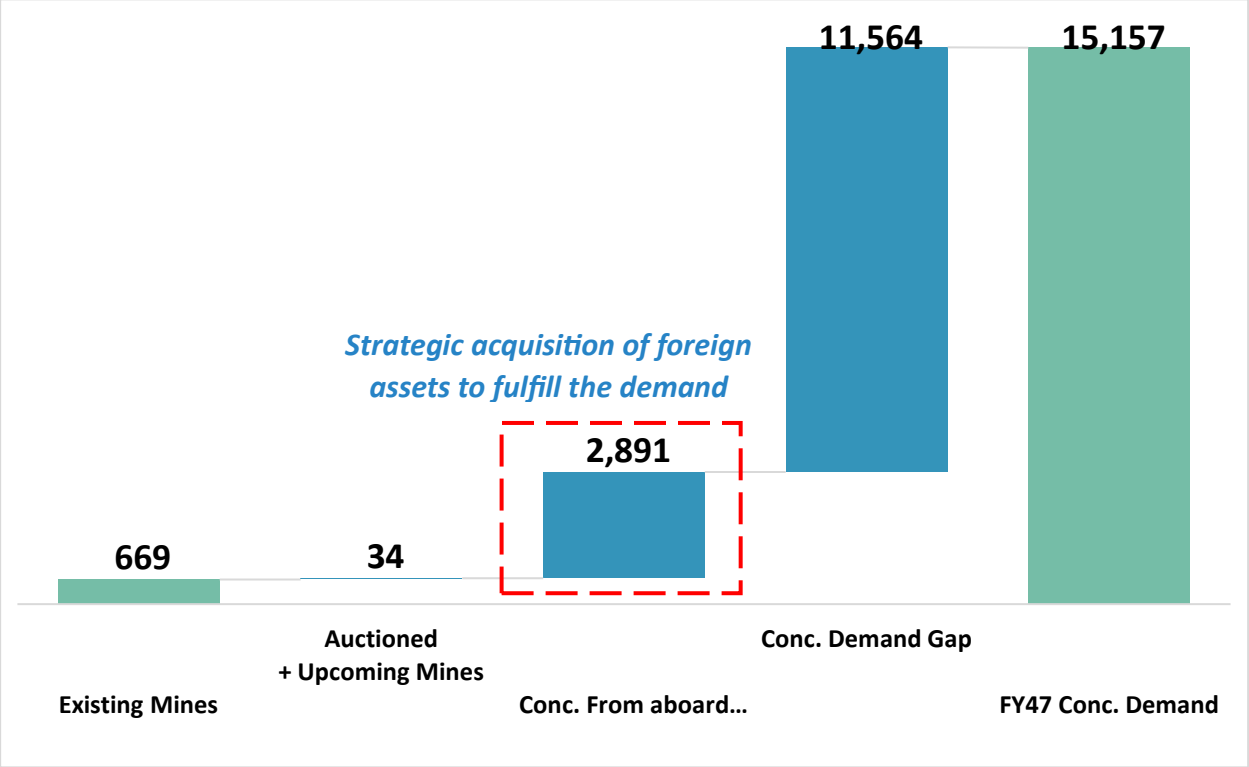
India's total copper concentrate demand stands at ~15 MT, while domestic production is projected to meet only 4.6% of the total requirement. This clearly indicates that auctioning small mines is not making a significant impact on the nation's mineral production leaving India with a substantial estimated concentrate demand gap of ~11.6 MT.

Table 30 Potential ore production from upcoming blocks in FY47

State	Block	Potential mineable Reserve (MT)	Projected Ore Production (tonnes)
Rajasthan	Deravad-Chargarhhia_Udaipur-G4_Cu-Au	0.5	22,500
Rajasthan	Dhanota_block_G3 block	2.15	96,750
Madhya Pradesh	Bagwari-Sukwari_G4 block	1	45,000
Jharkhand	Thakurdicharakmara	0.9	40,500
Jharkhand	Musabani-Dumriya-Maheshpur	2.25	101,250
Madhya Pradesh	Kubri Kochipur block	3	135,000
Maharashtra	Govindpur	0.3	13,500
Madhya Pradesh	Mahakoshal	0.3	13,500
Jharkhand	Thakurdih	3.25	146,250
Madhya Pradesh	Sitapur	1.8	81,000
Total		**15**	**695,250**

To bridge this gap, enhancing domestic mining, signing offtake agreements with international copper miners, investing in or acquiring copper mines and mining companies, and diversifying copper concentrate supply will be crucial.

Graph 38 Copper concentrate scenario in FY47(P) (KT)

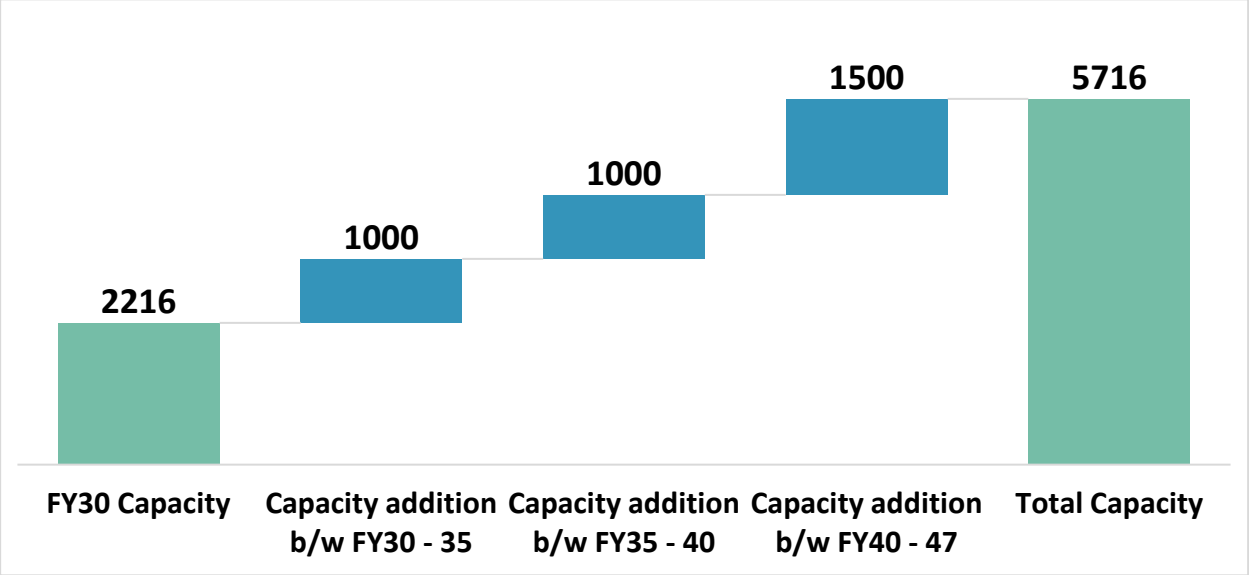


Indian copper units should establish offtake agreements for a certain period with miners in copper-rich regions such as Australia, Chile, and Peru to ensure consistent and reliable access to copper concentrate supplies, e.g., GWM, China signed a 5-year offtake agreement with Pilbara Minerals for Lithium.

In addition to offtake agreements, asset acquisition strategies should be established to secure supply. These should include bilateral investment funds in resource-rich countries, targeted bank loans or the acquisition of high-debt companies with promising assets, early investments in startups with high-potential mineral assets, and mandating clear critical asset acquisition targets for PSUs, backed by strong financial support.

To meet the projected demand of copper cathodes India needs to add approximately 1 MT of smelting and refining capacity every five years to meet the projected copper demand. Copper cathode supply is expected to reach 4.6 -5.6 MT.

Graph 39 Domestic refined copper capacity projections FY47(P) (KT)



In terms of scrap *80% of Scrap is estimated to be directly melted to form Semis/FGs. Domestic scrap supply is estimated to be ~2 – 2.4 MT.*[30] Mandating high energy-efficient appliances in India by increasing the minimum threshold of BEE standard can help secure scrap supply for the future.

The copper demand gap of 1.8–2.2 MT is expected to be met through imports of refined copper or scrap. To achieve this, India could leverage its investments by signing offtake agreements with companies where it has made investments through targeted bank loans.

Additionally, refined copper imports are expected to come from Japan, Russia, the DRC, Chile, and Zambia. Indonesia and Middle Eastern countries, such as the UAE and Saudi Arabia, are also anticipated to develop significant copper refining capacities, creating further opportunities for refined copper imports.

For scrap imports, Middle Eastern countries like the UAE and Saudi Arabia, along with developing nations in Africa and Latin America, could be viable sources. This is particularly relevant as developed countries such as the US, EU, Japan, and the UK are expected to export very limited scrap in the future due to their focus on domestic scrap utilization.

[30] 70% copper consumed in 2027 is estimated to reach EoL



6. STAKEHOLDER CONSULTATION

6. Stakeholder Consultation

Stakeholders in India's copper sector face economic, environmental, social, and regulatory challenges.

Miners

- **Complex and lengthy mineral auction process:** Delays and uncertainties in mineral auctions hinder timely exploration and development of mining projects, impacting industry growth and investment.
- **Limited high-grade copper reserves:** Scarcity of high-grade copper reserves poses challenges in maintaining production efficiency and meeting quality standards in mining operations.
- **Absence of contiguous mining legislation:** The absence of contiguous mining legislation to incentivize extraction of deep-seated minerals such as copper.
- **Limited Infrastructure in remote mining regions:** The lack of infrastructure in remote mining regions impedes operational efficiency and increases project costs, posing logistical challenges for transportation and resource extraction.
- **Stringent environmental regulations:** Copper miners are facing challenges due to strict ESG regulations, including high compliance costs, environmental sustainability pressures, and social responsibility demands.
- **Shortage of skilled workforce:** Lack of trained workforce hindering mining operations, adoption of digital solutions and safety

Smelters & Refineries

- **Navigating the regulatory landscape is challenging:** Adhering the regulatory landscape for capital projects is a lengthy process, requiring multiple permits such as EC, CTE, CTO and other licenses & clearances for power, water, land use, fire safety, etc.

- **Limited domestic availability of raw materials:** Domestic copper smelters rely on imports to meet industrial demand and sustain production, making them vulnerable to supply chain disruptions caused by export bans, political instability, and social unrest in copper rich nations.
- **Lack of incentive:** No capital or production-linked incentive for setting up smelters, refiners, and fabricators.
- **High GST on copper concentrates:** The 18% GST on copper concentrates places them in a tax bracket just below luxury goods, significantly impacting the cost structure and competitiveness of the copper smelting industry in India.
- **Intense competition from imported refined copper:** The increasing imports of refined copper into India at zero duty under FTAs intensify competition for local producers.
- **Lack of Availability of Processing Technology:** The lack of domestic mid-stream processing technology providers for smelters & refiners of copper in India remains an area of concern.

Secondary copper producers

- **Absence of Standardized Guidelines for using Copper Scrap:** Lack of BIS standards that can determine the technical varieties of copper scrap that can be used as a complementary raw material.
- **Infrastructure and Technology:** Insufficient infrastructure and outdated recycling technologies are impacting the efficiency of copper recycling operations.

End user

- **High copper prices:** Global price fluctuations and import dependence led to higher prices for finished products.
- **Limited availability of high-quality copper:** Users requiring specific grades might face shortages.

- **Quality & standards:** Ensuring the quality and adherence to international standards of copper products is crucial for end-users.

Local communities

- **Environmental concerns:** Adverse impact on water, air, and land quality from mining activities, also proper disposal, and management of waste, such as tailings, pose environmental challenges.
- **Livelihood displacement:** Resettlement and rehabilitation of communities affected by mining projects can be inadequate.
- **Limited benefits sharing:** Communities may not see tangible benefits from mining operations in their area.
- **Health & safety concerns:** Mining and processing activities pose potential health and safety risks for workers, addressing these concerns is crucial for maintaining a safe working environment.

Government

- **Balancing competing interests:** Striking a balance between promoting production, protecting the environment, ensuring compliance & safety regulations, and protecting community well-being.
- **Supply chain volatility:** About 90% copper primary raw materials are being imported and the number is expected to go up to 95% by 2030. Government needs to focus on securing supply chain and focus on price control mechanisms.
- **Attracting investments:** Creating a conducive environment to attract domestic and foreign investors in the sector while managing the financial challenges.
- **Developing a skilled workforce:** Addressing the skilled workforce shortage requires coordinated efforts from government and industry.



7. NAVIGATING THE WAY FORWARD IN THE SECTOR

7. Navigating The Way Forward In The Sector

India's copper sector faces multiple challenges that impede its self-sufficiency and growth. Despite an estimated 12.2 MT of copper resources, only 18% are classified as reserves, highlighting limited domestically available raw materials. Additionally, tightening copper supplies from key exporters like Indonesia and Panama have reduced India's sourcing options. Countries such as Chile and Peru have long-term commitments with global players like Japan and China.

Further compounding these issues, copper scrap utilization in Indian refineries remains low due to inadequate technological capabilities, leading to underperformance in recycling and secondary production. Direct melting of copper is predominant in India, resulting in quality standards that lag behind global benchmarks. These challenges underscore the urgent need for strategic interventions to support the copper sector's resilience and growth.

7.1. Emphasizing on exploration activities

India's copper reserves, totaling only 2 MT, are significantly lower than those of Chile (190 million tonnes) and Peru (120 million tonnes). This disparity underscores the urgent need to boost exploration efforts within the country. The entire country has been mapped on 1:50,000 scale through which GSI has been able to comprehensively identify all the possible non-bulk minerals including copper with surface manifestation. Based on geological mapping, known mineral belts and exploration data acquired, GSI had demarcated ~6.88 lakh sq.km. area which is potential for such mineralization and GSI has prioritized geochemical and geophysical mapping over this area. out of 6.88 lakh sq.km. area, ~40% is not fit for reconnaissance stage mineral exploration (G4 stage) due to presence of major water bodies, river channel, eco-sensitive zones, wildlife sanctuaries and dense reserve forest area and non-fertile areas. Therefore, actual OGP area available for reconnaissance stage mineral exploration is ~4.13 lakh sq.km. out of which ~2.13 lakh sq.km. area has already been covered through reconnaissance stage mineral exploration, which accounts for ~30% of the total OGP area. ~2.0 lakh sq.km. area is yet to be covered.

Short-Term (2030) Strategic Focus Areas

	Description	Efforts		Potential ROI	
		Cost to implement	Time Required to Implement	Financial Benefit	Social Impact
1. Promotion of domestic exploration activities	Propose **NMET funding for brownfield exploration** to augment geological copper resource	◑	●	●	●
	Encourage more private exploration agencies by making **preliminary prospecting data (G4) available on a public platform** *MinEX and MINEDEX portal of Australia, MEDD and Earthscape portal of Canada provide baseline & specific information regarding mineral findings*				
	Consider integrating **IMIC (following the JORC template) alongside UNFC** to enhance the credibility and attract investment				
	Adoption of digital technologies *AI/ML-based prospecting engine (Proprietary technology from KoBold Metals being used in Zambian copper belt)* *Geological mapping using hyperspectral data and ML models (conducted by ISRO in eastern part of the Chhatarpur district of MP), etc.*				
2. Establishment of partnership with copper-rich countries for investing in exploration	**Leverage KABIL** for conducting feasibility study for identifying appropriate copper block for further prospecting and conducting exploration activities in Chile, Peru, Australia, Mongolia and other countries *KABIL is working in Argentina for a lithium asset in CAMYEM*	●	●	●	●

● High ◑ Medium ○ Low

Long-Term (2047) Strategic Focus Areas

	Description	Efforts		Potential ROI	
		Cost to implement	Time Required to Implement	Financial Benefit	Social Impact
1. Focus on deep sea exploration for sustainable future	Under the Samudrayaan mission, **expedite deep sea exploration** in the Central Indian Ocean Basin (CIOB) for the mining of polymetallic nodules (PMN) *India's Matsya6000 having the capability of carrying out mining up to a depth of 6000 mt is still under development phase – China (Kaituo2) and Japan (Patania II) developed offshore mining vehicle*	●	●	●	○

7.2. Enhancing supply chain resiliency

To ensure a resilient copper supply chain, India must address its heavy reliance on imported copper concentrate, as of now over 90% of its needs are met through imports, with about 66% sourced from just three countries. As domestic processing capacity expands, this dependency is set to rise, making India vulnerable to supply chain disruptions, particularly with the growing global focus on resource nationalism. Thus, creating an urgency for foreign asset acquisition. For example, China which has insufficient domestic reserves has invested approximately US $ 16 billion since 2010 in acquiring overseas copper assets, particularly in Africa and other regions, underscoring the importance of securing resources abroad.

● High ◑ Medium ○ Low

Short-Term (2030) Strategic Focus Areas

	Description	Efforts		Potential ROI	
		Cost to implement	Time Required to Implement	Financial Benefit	Social Impact
1. Domestic upstream capacity augmentation	**Fastrack the re-opening of the closed mines** (Rakha, Kendadih, Chandmari) through revenue sharing MDO model	●	◑	●	●
	Facilitate **duty free import for high-capacity mining and beneficiation equipment** (LPDT, LHD, Semi-automatic Production Drill Rigs, Crusher components, etc.) towards augmenting production from underground mines by leveraging latest mining operational technologies				
	Pre-embedded in-principle statutory clearances for mining lease grant to reduce gestation period from auction to operationalization of mines				
2. Enhancing Supply Security and Overseas Investment	**Review offtake agreements** with other countries to reduce dependency on the existing major three importing countries (Chile, Indonesia, Peru) to navigate potential export ban on copper concentrate *Introduce **dedicated copper chapter in FTA** with countries like Chile, Peru for securing fixed quantity of copper concentrate*	●	●	●	●

● High ◑ Medium ○ Low

	Description	Efforts		Potential ROI	
		Cost to implement	Time Required to Implement	Financial Benefit	Social Impact
3. Enhancing Supply Security and Overseas Investment	Formulate **G2G facilitation** to encourage Indian PSUs and private companies to establish partnerships with copper-rich countries, promoting strategic investments in exploration and mining assets abroad *Facilitate **scheme for PPP model through a simplified approval procedure**, where Govt. owning the rights in foreign countries and operation by Indian privet sector* *Facilitate JVs between overseas mining companies and domestic PSU and private producers at G2G level*	●	●	●	●
	Provide **sovereign guarantee** to private & public companies in protecting overseas assets, whereas government could impose levies for protection				

Long-Term (2047) Strategic Focus Areas

	Description	Efforts		Potential ROI	
		Cost to implement	Time Required to Implement	Financial Benefit	Social Impact
1. FDIs in Copper sector	Promote **investment by foreign companies** such as Codelco, BHP to establish their smelters, refineries, other downstream industries in India, with government PSUs investing in their overseas projects in return	●	●	◑	◑

● High ◑ Medium ○ Low

Description		Efforts		Potential ROI	
		Cost to implement	Time Required to Implement		Cost to implement
2. Introduction of alternate financing mechanism	Facilitate **production-based financing** (companies can secure cash by selling rights to receive future production from their assets), **private equity financing** etc. to enable mine owners to secure funds for mine development and setting up mining and beneficiation facilities	◑	◑	◑	◑

7.3. Imagining India as a Processing Hub with downstream integration (smelting & refining and fabrication)

Since FY19, India has been a net importer of copper cathode, which intensified after operations at Vedanta's Thoothukudi smelter stopped in May 2018. The capital-intensive nature of the industry, requiring approximately ₹10,000 crore for a 0.5 MT facility, and stringent regulatory challenges further hinder capacity expansion.

● High ◑ Medium ○ Low

Short-Term (2030) Strategic Focus Areas

	Description	Efforts		Potential ROI	
		Cost to implement	Time Required to Implement	Financial Benefit	Social Impact
1. Ensuring support in building competitive domestic copper smelting and refining facility and generating employment	Offer financial support to build **4-5 MTPA of new smelting and refining capacity in long-run** ***Capital investment subsidy*** *to offset high capital costs* ***Customs duty exemption:*** *waive duties on imported plant & machineries* *Offer* ***operating subsidy or exemptions*** *(e.g., energy rebates on electricity duty)* ***GST reduction:*** *implement GST reduced rates from 18% to 12% for the initial years of operations*	●	◑	●	●
2. Ensuring the viability of domestic copper units against expected tight mining supplies and declining TC/RC	Adjust duty structures to enhance profitability across the value chain without reducing government revenue ***Review existing FTAs*** *(ASEAN, the UAE, Japan) and avoid importing of refined copper products (cathodes, rods, wires) and other downstream products (tubes, copper foils, etc.) in new FTAs being negotiated and* ***revise custom duty*** *on refined copper and semis/downstream products (7.5% and 10-12% respectively) to make the industry more resilient to low TC/RC cycles*	◑	◑	◑	◑

● High ◑ Medium ○ Low

	Description	Efforts		Potential ROI	
		Cost to implement	Time Required to Implement	Financial Benefit	Social Impact
3. Define by-product strategy for sustainable practices to effectively manage slag and emissions	Promoting sustainability through the utilization of copper smelter by-products, specifically copper slag ***Use of copper slag in building and construction*** *within a designated radius around smelters, akin to the fly ash guidelines* *In line with other major economies (Japan, China), amend cement manufacturing standards for acknowledging* ***copper slag as a raw material to produce Portland slag cement*** *Several studies on producing* ***DRI from copper slag*** *in China* Provide **substantial subsidies or grants** to companies that **invest in R&D for advanced metallurgical processes** with a priority to projects that focus on reducing environmental impact	●	○	◑	●
4. Driving Innovation in the Copper Midstream Industry	**Allocate dedicated funds for R&D activities** in processing technologies under various national innovation foundations, focusing on creating product development technologies that are adaptable to India's unique mineralogical challenges **International collaborations** to encourage partnerships with countries having advanced processing technologies with seamless technology transfer agreements, joint research projects and the establishment of pilot plants in India *Developed by Jetti resources, the technology of* ***leaching low-grade primary sulphide ores*** *using catalyst-based system being used at 22 active project sites*	◑	◑	●	●

Long-Term (2047) Strategic Focus Areas

Description		Efforts		Potential ROI	
		Cost to implement	Time Required to Implement	Financial Benefit	Social Impact
1. Driving Innovation in the Copper Midstream Industry	**Training and capacity building:** establish Centres of Excellence (COE) and launch national specialized programs across copper value chain aimed at developing highly skilled workforce	◑	◑	●	●

7.4. Streamlining & promoting responsible recycling

Recycling/remelting in India is dominated by unorganized sector. India lacks specific guidelines for copper scrap quality to improve dependency on scrap, unlike China's stringent policies. Heavily dependent on imports of copper concentrate due to weak domestic resource base, recycling is going to play a major role in meeting the demand.

Short-Term (2030) Strategic Focus Areas

Description		Efforts		Potential ROI	
		Cost to implement	Time Required to Implement	Financial Benefit	Social Impact
1. Enhancing Sustainability through Scrap Utilization	Provide financial support towards **building of scrap processing facilities** including efficient segregation mechanisms	●	◑	●	●

● High ◑ Medium ○ Low

	Description	Efforts		Potential ROI	
		Cost to implement	Time Required to Implement	Financial Benefit	Social Impact
	Boost secondary refining by enforcing **regulations to ensure refining of low-grade scrap** *Establish a dedicated governing body to monitor and ensure compliance with scrap utilization mandate, levy penalties to non-compliant primary refineries to ensure sustainability*				
1. Enhancing Sustainability through Scrap Utilization	Introduce **Green Fence Policy** to restrict dumping of low-grade scrap	●	◑	●	●
	Classify imported and domestic scrap and introduce **HSN codes for scrap items** to track the copper content in end-products ***Classify imported and domestic scrap in-line with global classification (ISRI)*** *to facilitate effective recycling and efficient material recovery*				
	Develop scrap recycling standards and mandate responsible recycling for seamless supply of imported scrap				
2. Reviewing of scrap trade policies	Introduce **policy for export ban of high-grade copper related scrap** to improve the availability of domestic copper scrap	◑	◑	●	●
	Special trade agreements with developed countries such USA, EU, and Japan to secure scrap supply				

● High ◑ Medium ○ Low

Long-Term (2047) Strategic Focus Areas

	Description	Efforts		Potential ROI	
		Cost to implement	Time Required to Implement	Financial Benefit	Social Impact
1. Focus on initiatives for reducing carbon footprint	Introduce **certification for low-carbon copper products** as well as incentivization to encourage adoption of advanced technologies, greener practices	◑	◑	◑	●
	Provide **grants and funding for R&D in low-carbon copper production methods**, including carbon capture and storage				

● High ◑ Medium ○ Low





8. SUGGESTED CONSTITUTION OF TASKFORCES TO DRIVE THE GROWTH OF DOMESTIC COPPER INDUSTRY

8. Suggested constitution of taskforces to drive the growth of domestic copper industry

Representatives from various organizations need to step forward and form a taskforce or action committee to support strategic objectives aimed at elevating the domestic copper sector.

Table 31 Suggested constitution of taskforces

Domestic Excellence (Upstream)	Foreign Assets & Trade Agreement	Domestic Excellence (Mid-Downstream)	Overall Scrap Management
Chair – MoM	Chair – MoEA	Chair – MoM	Chair – NITI Aayog
Representatives of MoM, MOEF&CC, NITI Aayog, IBM, NMET	*Representatives of MoM, NITI Aayog, DGFT,*	*Representatives of NITI Aayog, DPIIT*	*Representatives MoM, MoEA, ISO/BSI, BEE, DGFT*
Representatives of GSI, MECL, HCL, MEAI	*Representatives of GSI, MECL, KABIL, HCL and other PSUs*	*Representatives of HCL, IPCPA, ICA, ICDC, FIMI, EEPC India, IEEMA, IndoAsia Copper and other relevant agencies*	*Representatives of MRAI, HCL, IPCPA, ICA, ICDC, ASSOCHAM, academic institutions & research institutes and other relevant organization*
Representatives from integrated copper players, ICA	*Representatives of IPCPA, ICA, MRAI, ASSOCHAM and other relevant bodies*	*Representatives from DST, CSIR, pioneer academic institutions and research institutes*	*Representatives of recycling companies, end-use manufacturers*
Representatives from relevant International and Indian research organisations, educational institutes	*Support from MoC&I*		
Relevant SMEs and Industry experts			
Relevant Knowledge Partner for value addition and report compilation			

Objectives and mandates of Taskforce committees

A. Domestic Excellence (Upstream) Taskforce

Facilitating the acceleration of greenfield and brownfield exploration to enhance domestic copper concentrate production (5-7%) in alignment with growing copper demand.

Key activities	Stakeholders
▪ Facilitate fund allocation from NMET to expedite exploration programmes. ▪ Facilitate the adoption of the latest technologies/equipment for domestic miners through reduced import duties and additional support measures. ▪ Establish dedicated R&D centres to improve copper ore beneficiation techniques. ▪ Plan for new copper mining projects and facilitate the re-opening of viable closed mines. ▪ Chalk out detailed action plans to amend various rules and regulations at the central and state levels for faster operationalization of mines.	MoM, MOEF&CC, NITI Aayog, IBM, NMET, GSI, MECL, HCL, MEAI, integrated copper players, relevant research organisations, relevant SMEs

B. Foreign Assets & Trade Agreement Taskforce

Facilitate securing ~6 MT of concentrate supply by 2030 and 14.5 MT by 2047 and chalk out detailed activity plan for acquiring & protecting foreign copper assets.

Key activities	Stakeholders
▪ Promote investment of Indian companies to acquire or invest in overseas copper mining assets.	MoEA, MoM, NITI Aayog, DGFT, HCL, IPCPA, ICA, MRAI,

Key activities	Stakeholders
▪ Negotiate long-term trade agreements with copper-rich countries to ensure stable supply. ▪ Collaborate with countries in the Mineral Security Partnership (MSP) for access to copper resources. ▪ Secure equity stakes in copper mines abroad through partnerships with local governments. ▪ Collaborate with foreign research institutions for advanced copper processing technologies.	IndoAsia Copper, ASSOCHAM, relevant SMEs

C. Domestic Excellence (Mid-Downstream) Taskforce

Provide financial impetus for investment to add 1 MT smelting and refining capacity in every 5 years and promote indigenous processing technology and sustainability across value chain.

Key activities	Stakeholders
▪ Identify financial incentives to promote capacity addition across the value chain. ▪ Establish a robust monitoring framework to track performance and ensure compliance with quality and environmental standards. ▪ Monitor the performance of primary copper players and facilitate the adoption of latest technologies. ▪ Frame by-product strategy with monitoring governance mechanism. ▪ Constitute expert committee and chalk out a detailed plan for the operationalization of closed smelting and refining facilities.	MoM, NITI Aayog, CSIR, academic and research institutes, HCL, IPCPA, ICA, ICDC, MoEF&CC, CPCB, NERI, FIMI, EEPC India, IEEMA, IndoAsia Copper, relevant SMEs

▪ Leverage national innovation initiatives for dedicated R&D fund allocation and provide substantial subsidies or grants towards R&D activities. ▪ Frame a strategy for maintaining and increasing copper share in end-use products towards inducing demand for greater future supply.	

D. Overall Scrap Management Taskforce

Facilitate policy support for increasing domestic availability of scrap, classification of scrap for effective utilization and increasing secondary refinery up to 20% in the long run.

Key Activities	Stakeholders
▪ Develop a national framework for copper scrap grading based on purity levels, alloy composition and contamination thresholds. ▪ Provide policy and financial support for setting up systematic scrap collection and segregation infrastructure. ▪ Draft "Green Fence Policy" aimed to restrict the import of contaminated and low-quality recycled materials and establish scrap classification and standards. ▪ Promote importing of only high-grade scrap, till the development of right recycling facilities. ▪ Introduce export restrictions on high-grade copper scrap to retain valuable secondary raw materials within the domestic market. ▪ Support the adoption of cutting-edge separation and refining technologies to maximize recovery rates. ▪ Encourage industry-academia collaborations for research on improving scrap processing efficiency.	MoEA, RAI, HCL, IPCPA, ICA, ICDC, MRAI, IPCPA, ASSOCHAM, academic and research institutes, relevant SMEs



9. CONCLUSION

9. Conclusion

India's refined copper consumption is projected to grow by 5 - 6X in the long term (2047), underscoring the necessity for strategic planning and strategic initiatives to mitigate supply chain disruption and demand-supply gap.

Domestic Production and Import Dependency

Currently, HCL is the only domestic copper miner in India. However, with new copper blocks being auctioned, long-term domestic copper ore production is projected to reach about 21 MT, meeting only 4.6% of domestic concentrate demand. This limited domestic supply underscores India's heavy reliance on copper concentrate imports, making the nation vulnerable to external market fluctuations. Additionally, growing challenges such as resource nationalism, geopolitical tensions, declining ore grades, and a persistent lack of investment are likely to disrupt the global copper trade dynamic. These issues could leave India with few viable options to source copper, even from major exporters like Australia, Chile, Peru, and Zambia.

Strategic Actions

The next few decades hold great potential for substantial growth within the Indian copper sector. To lay a strong foundation for a brighter and more resilient future, the industry should focus on several key areas.

First, enhancing exploration activities will be crucial in expanding geological resources, allowing India to tap into its domestic potential more effectively. Additionally, adopting emerging technologies can boost mine productivity in existing operations. Alongside this, acquiring or investing in foreign assets is essential to secure a long-term copper supply, helping India mitigate its heavy reliance on imports of primary raw material. Strengthening relationships with copper-rich nations such as Australia, Chile, and Peru will also be critical to ensuring a steady copper concentrate supply.

Establishing downstream integrated processing hubs will address the growing domestic demand while creating new export opportunities for India. Beyond expanding domestic processing

capacities, India should also consider investing in or establishing smelters and refineries abroad. This approach would secure a steady supply chain, enabling it to better manage supply disruptions arising due to resource nationalism and export ban of copper raw materials.

Moreover, a streamlined domestic scrap market could encourage recycling, securing secondary copper supplies and promoting a circular economy within the sector. To sustain this progress, building a skilled workforce and developing R&D centers focused on innovation will be essential.

Finally, the drafting of regulatory policies and schemes that facilitate a seamless supply chain, stimulate demand, and promote sustainable development will play a vital role in the sector's evolution, ensuring long-term growth and stability.



Glossary

Abbreviations	Full forms
~	Approximately
AI	Artificial intelligence
ASEAN	Association of Southeast Asian Nations
ASSOCHAM	Associated Chambers of Commerce and Industry of India
BCD	Basic customs duty
BEE	Bureau of Energy Efficiency
BESS	Battery Energy Storage System
BIS	Bureau of Indian Standards
BRI	Belt and Road Initiative
BS	Bharat stage emissions standards
BSI	British Standards Institution
BT	Billion tonnes
CAGR	Compound Annual Growth Rate
CEPA	Comprehensive Economic Partnership Agreement
CL	Composite licence
CO2	Carbon di-oxide
CoE	Centres of Excellence
Conc	Concentrate
CSIR	Council of Scientific and Industrial Research
CTE	Consent to Establish
CTO	Consent to Operate
Cu	Copper
DGFT	Directorate General of Foreign Trade
DOE	Department of Energy
DPIIT	Department for Promotion of Industry and Internal Trade
DRC	Democratic Republic of Congo
DRI	Direct reduced iron
DST	Department of Science and Technology

EC	Environmental Clearance
ECTA	Australia-India Economic Cooperation and Trade Agreement
EEPC India	Engineering Export Promotion Council of India
EL	Exploration Licence
EoL	End-of-Life
EPR	Extended Producer Responsibility
ESG	Environmental, Social, and Governance
EU	European Union
EV	Electric Vehicle
FAME	Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India
FDI	Foreign direct investment
FG	Finished goods
FTA	Free Trade Agreement
FY	Financial Year
G2G	Government to Government
GDP	Gross Domestic Product
GNI	Gross National Income
GoI	Government of India
GSI	Geological Survey of India
GST	Goods and Services Tax
GVA	Gross value added
GW	Giga Watt
GWH	Giga Watt Hour
HCL	Hindustan Copper Limited
HNIs	High Net Worth Individuals
HSN	Harmonized System of Nomenclature
IBM	Indian Bureau of Mines
ICA	Internal Copper Association
ICA	International Copper Association
ICAP	Indian Cooling Action Plan
ICC	Indian Copper Complex

ICDC	Indian Copper Development Centre
ICE	Internal Combustion Engine
IEA	International Energy Agency
IEEMA	Indian Electrical and Electronics Manufacturers' Association
IMIC	Indian Mineral Industry Code
IPCPA	Indian Primary Copper Producers Association
ISO	International Organization for Standardization
ISRI	Institute of Scrap Recycling Industries
JBIC	Japan Bank for International Cooperation
JETRO	Japan External Trade Organization
JORC	Joint Ore Reserve Committee
JS	Joint Secretary
JV	Joint Venture
KABIL	Khanij Bidesh India Limited
KCC	Khetri Copper Complex
KT	Kilo Tonne
KTPA	Kilo Tonne Per Annum
LEED	Leadership in Energy and Environmental Design
Li	Lithium
LME	London Metal Exchange
M&A	Mergers and Acquisitions
MCP	Malanjkhand Copper Project
MEAI	Mining Engineers' Association of India
MECL	Mineral Exploration and Consultancy Limited
MEE	China's Ministry of Ecology and Environment
METI	Ministry of Economy, Trade and Industry
MFN	Most Favoured Nation
MIC	Metal in Concentrate
ML	Machine Learning
MMDR	Mines and Minerals Development and Regulation
MMDR Act	Mines and Minerals (Development and Regulation) Act

MoCI	Ministry of Commerce and Industry
MoEA	Ministry of External Affairs
MoEF&CC	Ministry of Environment, Forest and Climate Change
MoM	Ministry of Mines
MoR	Ministry of Railways
MoRTH	Ministry of Road Transport and Highways
MoU	Memorandum of Understanding
MP	Madhya Pradesh
MRAI	Material Recycling Association of India
MRR	Ministry of Ecology & Environment
MT	Million Tonne
MTPA	Million Tonne Per Annum
NCCBM	National Council for Cement and Building Materials
NDRC	National Development and Reform Commission
NFMIMS	Non-Ferrous Metal Import Monitoring System
NFSM	National Food Security Mission
NMET	National Mineral Exploration Trust
NRI	Non-resident Indians
OECD	Organization for Economic Cooperation and Development
OEM	Original equipment manufacturers
OGP	Obvious Geological Potential
PEEB	Partnership for Energy Efficiency in Buildings
PGE	Platinum Group Elements
PLI	Product Linked Incentive
PMAY	Pradhan Mantri Awas Yojana
PMKSY	Pradhan Mantri Krishi Sinchayee Yojana
PM-KUSUM	Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyaan
PPP	Public Private Partnership
PSC	Portland Slag cement
PSUs	Public Sector Units
PTA	Preferential Trade Agreement

PV	Photovoltaic
QCO	Quality Control Order
R&D	Research and Development
RC	Refining Charge
RCM	Reverse Charge Mechanism
RE	Renewable Energy
REEs	Rare Earth Elements
SMEs	Small and Medium Enterprises
SOE	State owned enterprises
SX-EW	Solvent Extraction & Electrowinning
T&D	Transmission & Distribution
TC	Treatment Charge
Tn	Trillion
ToC	Table of contents
TPA	Tonne Per Annum
UMPP	Ultra Mega Power Projects
UNFC	United Nations Framework Classification
US/USA	United States of America
USD	United States Dollar
VAT	Value added tax

Acknowledgement

The Ministry of Mines extends its deepest appreciation to all the stakeholders who contributed for the preparation of the **"Vision Document on Copper Sector"**. This comprehensive report would not have been possible without the invaluable support and collaboration of the Copper Industry.

The Ministry would like to express sincere appreciation to the primary and secondary Copper manufacturers, industry associations, academic institutions, research organizations, and key experts who provided critical data, insights, and guidance throughout the process. Your contributions, whether through data sharing, research findings, or constructive feedback, have enriched the quality and depth of this document. Your expertise and commitment have been instrumental in shaping this vision.

The Ministry also acknowledges the use of various sources in the preparation of this report, including industry reports, market analysis, academic research papers, and government publications. The collective knowledge from these sources has been pivotal in ensuring the accuracy and comprehensiveness of our vision for the future of Copper in India.

Further appreciation is extended to the team Hindustan Copper Limited (HCL) and the team of M/s Deloitte for their significant contributions in the preparation of Vision Document on Copper Sector for India.

Thank you all for your unwavering support and dedication to advancing the Copper industry. Together, we look forward to a sustainable and prosperous future.

Finally, the Ministry extends its sincere thanks to all others who contributed for the preparation of this report.

Link to access "Vision Document on Copper Sector":
https://mines.gov.in/webportal/content/vision-document



सत्यमेव जयते

खान मंत्रालय

MINISTRY OF MINES

भारत सरकार

GOVERNMENT OF INDIA

Follow us: | www.mines.gov.in