3. Ev Boom Is Accelerating a Copper Crunch – S & T

The global shift toward electric vehicles (EVs) is leading to a growing challenge of copper crunch

Strategic Context

Copper is a foundational electrification metal because it is central to

1. EV batteries (busbars, interconnects, current collectors, pack wiring)
2. EV motors and inverters (windings, power electronics connectivity)
3. Vehicle wiring harnesses and onboard charging systems
4. Charging infrastructure (cables, transformers, switchgear)
5. Grid upgrades (transmission/distribution expansion, renewables integration)

The energy transition is therefore metal-constrained, not only technology- or policy-constrained. UNCTAD highlights copper as a strategic raw material for the clean energy transition and digital transformation, warning demand growth is outpacing supply readiness.

Copper Basics

Copper (Cu)- atomic number 29; reddish-orange; soft, malleable; excellent electrical and thermal conductivity.

Key alloys

1. Brass- copper–zinc
2. Bronze- copper–tin

Global copper reserves concentration - Chile leads with about 19% of world reserves; Peru and Australia are also major holders.

India's key copper ore belts

1. Khetri belt (Rajasthan)
2. Malanjkhand (Madhya Pradesh)
3. Singhbhum belt (Jharkhand)

EV Expansion and Copper Demand Linkage

EV sales acceleration - The IEA projects electric car sales in 2025 will exceed 20 million globally, underscoring the scale of electrification.

EVs are copper-intensive - EVs generally require more copper than ICE vehicles because electrification increases

1. High-voltage wiring
2. Power electronics
3. Motor windings
4. Thermal management electrical components
5. Charging interface hardware

System-wide copper demand rises even more when you include

1. Home/public chargers
2. Transformers, substations
3. Grid reinforcement for peak loads

"Copper Crunch" Risk is Emerging

Supply-side constraints

Ore grade decline - Existing mature mines increasingly yield lower grades, requiring more rock to be processed per tonne of copper.

Long project timelines - new copper mines typically face long lead times (often close to a decade when permitting, financing, construction, and ramp-up are included).

Environmental and social licensing - large mines face regulatory delays and community opposition, particularly in major copper regions.

Demand-side acceleration - Demand is being pushed simultaneously by

1. EVs
2. Renewable energy build-out
3. Grid expansion
4. Data centers and electrification of industry (an additional emerging driver)

Deficit Projections and Implications - Several current-affairs analyses highlight a projected shortfall that could reach

1. ~4.5 million tonnes by 2028
2. ~nearly 8 million tonnes by 2030
3. often framed as comparable to the output of the world's largest mines combined.

Impacts on EV transition - Higher copper prices can

a. Raise EV production costs
b. Slow mass adoption in price-sensitive markets
c. Delay charging network rollout
d. Increase grid upgrade costs and timelines

These effects can directly strain decarbonisation targets.

China Factor- Structural Advantage - China's advantage is frequently described as demand-side scale + supply-chain control, via-

1. Large share of EV production/consumption
2. Dominance across battery manufacturing supply chains (cells and upstream processing linkages)

Some current-affairs sources state China accounts for ~60% of global EV copper demand, which—if accurate—implies strong influence over-

1. Long-term offtake contracts
2. Refining and processing bottlenecks
3. Pricing leverage and strategic bargaining with copper-rich regions

India Angle- Constraints and Why It Matters

Not self-sufficient in copper - This creates vulnerabilities for EV manufacturing, renewables, and grid modernisation.

Exploration challenge - Copper being "deep-seated" generally increases

a. Exploration cost and uncertainty
b. Mine development complexity
c. Environmental footprint per unit output

Policy implication - India's energy transition and Make-in-India for EVs must integrate a critical minerals strategy, not treat minerals as an afterthought. The Ministry of Mines "Vision Document on Copper Sector" projects India's copper demand to rise sharply by 2030 and further by 2047, reinforcing the need for supply-chain planning.

Way Forward- Building a Resilient Copper Supply Chain

Domestic measures

Accelerate exploration

1. Incentivise deep exploration (risk-sharing, seismic and geophysical surveys, faster approvals)
2. Improve resource mapping and data transparency

Facilitate responsible mine development

1. Single-window clearances with strict ESG safeguards
2. Community benefit-sharing models to reduce conflict delays

Boost recycling (secondary copper)

1. Urban mining from e-waste, cables, transformers
2. Standards for scrap collection, segregation, and formal recycling capacity

External measures

Overseas asset acquisition and offtake

1. Secure long-term offtake agreements with copper-rich countries
2. Equity stakes through strategic PSUs/private consortia

Processing and refining strategy

1. Reduce dependence on single-country chokepoints in refining
2. Build resilient logistics and diversification of import sources

Strategic stockpiles - Buffer against price spikes and supply shocks for critical sectors

Industrial policy linkages

Material efficiency - R&D to reduce copper intensity per EV/charger where feasible without compromising safety

Grid planning alignment - Copper demand is also grid-driven; EV targets must be synchronised with-

1. Transmission capacity augmentation
2. Distribution transformer upgrades
3. Renewable integration plans

Source- https-//www.thehindu.com/opinion/op-ed/the-ev-boom-is-accelerating-a-copper-crunch/article70530376.ece