

INVESTMENT CHALLENGES FOR U.S. PROJECTS

Copper is a key mineral in many cutting-edge technologies from grid infrastructure to advanced electronics. Its production commences with the extraction of its ores, which are subsequently crushed and ground. After a concentration phase, primarily through froth flotation, the copper minerals are isolated. This concentrated copper is then smelted and refined to eliminate impurities, employing oxidation in converters and electrolytic refining in a sulfuric acid and copper sulfate solution. The final product, which is nearly 99.99% pure copper, plays a pivotal role in the energy transition. Copper is extensively utilized in renewable energy systems such as wind turbines, solar panels, and energy storage units, as well as in electric vehicles and their charging infrastructure — all of which are foundational to a sustainable energy future. Furthermore, recycling used copper components aids not only in meeting the rising demand in these sectors but also in promoting a circular economy.

Applications requiring copper.

China's Influence	Mining (%)	8.6%
	Processing (%)	42.3%
	Export Rules	
Electric Vehicles (incl. batteries)		✓
Aerospace		✓
Defense Technologies		✓
Mobile Electronics (incl. batteries)		✓
Satellites/Space (incl. batteries)		✓
Robotics (incl. batteries)		✓
Wind Turbines		✓
Solar Panels		✓
Nuclear Power		✓
Energy Storage		✓
Grid Infrastructure		✓
LED Lighting		✓

Risks to establishing domestic copper processing.

Feedstock Scarcity	Minor	Feedstock challenges are due to long permitting timelines.
Competition for Labor	Major	Labor challenges arise from specialized skill deficits, more attractive opportunities in competing sectors, and location discrepancies.
Need for Technical Expertise	Minor	Scaling copper processing in the U.S. requires efficient energy use and strict environmental adherence.
Immature Market	Minor	Copper is a relatively more mature market than other critical minerals but still suffers from Chinese competition and processing concentration.
Lack of Price Competitiveness	Major	Price competitiveness is hindered by logistics and local energy cost trade-offs, and expensive raw material sourcing, compared to Chile and Peru.
Lack of Investor Interest	Mild	Investor hesitation is influenced by the significant capital, environmental compliance, lower-cost international competition, and market volatility.

Overview of copper processing.

Upstream Material	Common Mid-Stream Technologies	Mid-Stream Product Outputs
Copper-containing ores	<ul style="list-style-type: none"> ▪Physical Beneficiation [crushing, grinding, flotation, leaching, gravity separation, magnetic separation] ▪From Sulfide Ore: <ul style="list-style-type: none"> ◦Pyrometallurgy of sulfide ores [roasting, smelting, converter refining, electrolytic refining] ▪From Oxide Ore: <ul style="list-style-type: none"> ◦Hydrometallurgy [leaching, solvent extraction ("SX"), electrowinning] 	High purity copper anode or cathode material