Cobalt Processing

Bipartisan Policy Center

INVESTMENT CHALLENGES FOR U.S. PROJECTS

Cobalt, essential for high-energy-density batteries, is procured from minerals like cobaltite. Post-extraction, the ore undergoes refining—first through comminution and concentration, then via pyrometallurgy to create cobalt matte, and finally through hydrometallurgical processes including acid leaching and electrowinning to achieve high purity levels. In battery production, cobalt is crucial for maintaining cathode structure integrity, enhancing energy retention, and ensuring thermal stability, which are vital for electric vehicle performance. As the electric mobility market expands, recycling cobalt becomes imperative, providing a sustainable alternative to direct mining, reducing environmental impact, and addressing ethical sourcing concerns.

Applications requiring cobalt.

China's Influence	Mining (%)	1.2%
	Processing (%)	72.0%
	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 cobalt processing.

Feedstock Scarcity	Major	Feedstock availability for cobalt is challenged by the DRC's dominance in production, political instability, human rights issues, geopolitical risks, and competition from China.
Competition for Labor	Major	Labor difficulties are due primarily to niche skill shortages, better prospects in other industries, and geographic mismatches.
Need for Technical Expertise	Mild	Scaling requires advancing extraction and purification for varied ores, creating greener and safer methods, while improving recoveries.
Immature Market	Major	Pricing volatility due to sourcing from unstable regions like the Congo and few domestic supply chain counterparties add risk to domestic projects.
Lack of Price Competitiveness	Major	Price competitiveness is constrained by stringent environmental regulations and high labor costs compared to China, where most cobalt processing occurs.
Lack of Investor Interest	Mild	Investor caution stems from high startup costs, stringent environmental laws, cheaper foreign competition, and volatile prices in part due to demand uncertainty.

Overview of cobalt processing.

Upstream Material	Common Mid-Stream Technologies	Mid-Stream Product Outputs
Cobalt-containing ores	▪Physical Beneficiation [crushing, grinding, screening, flotation, magnetic separation, gravity separation] ▪From Sulfide Ore: ○Hydrometallurgy and Pyrometallurgy [froth flotation, smelting, leaching, SX, electrowinning] ▪From Laterite Ore: ○Hydrometallurgy [high-pressure acid leaching, SX, electrowinning] ▪Electrometallurgy: Electrorefining	High purity cobalt metals, salts, and alloys

ADAM JOHNSON AND JOHN JACOBS. 2024. "THE MISSING MIDSTREAM IDENTIFYING INVESTMENT CHALLENGES FOR AMERICAN CRITICAL MINERAL PROCESSING PROJECTS." BIPARTISAN POLICY CENTER.

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