Critical Minerals

Minerals essential for clean energy transition (2025 addition)

- Lithium, Cobalt & Nickel (batteries)
- Copper & Aluminium (grids & EVs)
- Rare Earths (wind turbines, EVs)
- LATAM Mining & Critical Minerals Supply

Lithium, Cobalt & Nickel (batteries)

Source Metadata

Field	Value
source	iea
source_version	ETCS 2025
source_id	IEA-MIN-001
iea_category	critical_minerals
technology	Lithium, Cobalt & Nickel (batteries)
technology_readiness	commercial
mitigation	Y
adaptation	N
last_checked	2026-05-26

IEA Technology Definition

The IEA's Global Critical Minerals Outlook classifies lithium, cobalt, and nickel as essential battery minerals driving the energy transition. Lithium is the core element in all major lithium-ion battery chemistries (LFP, NMC, NCA). Cobalt and nickel enable higher energy density in NMC and NCA cathodes used in EVs and grid storage. The IEA tracks demand, supply, prices, and geopolitical concentration for each mineral.

Technology Readiness & Deployment

Mining and refining of all three minerals are commercially established industries. Lithium demand rose by nearly 30% in 2024 alone, significantly exceeding the 10% annual growth rate seen in the 2010s. In the IEA Stated Policies Scenario, lithium demand grows fivefold from today to 2040. Nickel demand is projected to double, while cobalt demand grows 50-60% by 2040. The shift toward LFP chemistry reduces cobalt and nickel intensity per battery but total demand still grows with fleet electrification.

Key Metrics & Benchmarks

Global lithium production exceeded 180,000 tonnes (lithium carbonate equivalent) in 2024. Australia, Chile, and China dominate lithium supply. The Democratic Republic of Congo supplies over 70% of cobalt. Indonesia has become the world's largest nickel producer. Near-term lithium markets appear well-supplied, but the IEA projects markets will move into deficit by the 2030s as EV adoption accelerates beyond current mine project pipelines.

LATAM Relevance

Latin America supplies 35% of the world's lithium, led by Chile (26%) and Argentina (6%), and holds more than half of global lithium reserves in the Lithium Triangle (Chile, Argentina, Bolivia). The region's lithium is primarily extracted from brine deposits in salt flats. Regional efforts to move up the battery value chain include Chile's national lithium strategy and Argentina's investment incentives for lithium processing. Brazil has emerging hard-rock lithium deposits.

Critical Minerals Link

This is the core critical minerals page for battery supply chains. Lithium, cobalt, and nickel demand are directly driven by EV and storage battery deployment. Recycling and second-life applications are emerging but currently recover less than 5% of lithium and 10-15% of cobalt from end-of-life batteries. Diversifying supply and developing recycling infrastructure are IEA priorities for supply chain resilience.

Cleantech Taxonomy Crosswalk

Maps to Cleantech Taxonomy sectors: IN (Industry) — mining, refining, battery manufacturing; TR (Transport) — EV battery demand; ES (Energy Systems) — grid storage battery demand; XS (Cross-Sectoral) — supply chain governance, ESG standards in mining.

Copper & Aluminium (grids & EVs)

Source Metadata

Field	Value
source	iea
source_version	ETCS 2025
source_id	IEA-MIN-002
iea_category	critical_minerals
technology	Copper & Aluminium (grids & EVs)
technology_readiness	commercial
mitigation	Y
adaptation	N
last_checked	2026-05-26

IEA Technology Definition

The IEA's Global Critical Minerals Outlook identifies copper and aluminium as foundational metals for electrification and grid expansion. Copper is essential for electrical conductors, motors, transformers, EV wiring, and renewable energy systems. Aluminium is used in transmission lines, solar panel frames, EV lightweight structures, and heat exchangers. The IEA tracks copper as the mineral with the largest established market among energy transition metals.

Technology Readiness & Deployment

Copper and aluminium mining and smelting are mature commercial industries. Copper demand from clean energy technologies is projected to grow by 30% by 2040 under current policies. The IEA's Global Critical Minerals Outlook 2025 warns of a potential 30% copper supply shortfall by 2035 due to declining ore grades, rising capital costs, limited new discoveries, and long development timelines. Aluminium supply is more diversified but energy-intensive smelting creates decarbonization challenges.

Key Metrics & Benchmarks

Global copper mine production reached approximately 22 million tonnes in 2024. An EV uses 2-4 times more copper than an internal combustion vehicle. A single offshore wind turbine requires 8-30 tonnes of copper. Electricity grids are the largest demand sector for copper. Aluminium production exceeds 70 million tonnes annually, with China producing over 55%. Recycled aluminium requires 95% less energy than primary production.

LATAM Relevance

Latin America accounts for 40% of global copper production, led by Chile (27%) and Peru (10%). The region's copper mines are critical to global electrification and grid expansion. Declining ore grades in Chilean mines and water scarcity in the Atacama are pressing challenges. Brazil is a significant bauxite producer (aluminium ore) and hosts aluminium smelters powered by hydroelectricity. Mexico and Colombia also contribute to regional copper and aluminium supply chains.

Critical Minerals Link

This is the core page for copper and aluminium in the energy transition. Copper faces the most acute supply-demand tension among transition minerals. Substitution options are limited for electrical applications. Aluminium can partially substitute for copper in some conductor applications but with efficiency penalties. Recycling rates for both metals are relatively high (copper ~30%, aluminium ~35% of supply from secondary sources) but insufficient to close projected gaps.

Cleantech Taxonomy Crosswalk

Maps to Cleantech Taxonomy sectors: IN (Industry) — mining, smelting, refining; ES (Energy Systems) — grid copper demand, transformer manufacturing; TR (Transport) — EV copper and aluminium demand; XS (Cross-Sectoral) — recycling, circular economy, water-energy-mining nexus.

Rare Earths (wind turbines, EVs)

Source Metadata

Field	Value
source	iea
source_version	ETCS 2025
source_id	IEA-MIN-003
iea_category	critical_minerals
technology	Rare Earths (wind turbines, EVs)
technology_readiness	commercial
mitigation	Y
adaptation	N
last_checked	2026-05-26

IEA Technology Definition

The IEA classifies rare earth elements (REEs) as critical minerals essential for permanent magnet technologies used in wind turbines, EV motors, and industrial applications. Key REEs for clean energy include neodymium, praseodymium, dysprosium, and terbium, which are used to manufacture high-performance NdFeB (neodymium-iron-boron) permanent magnets. The IEA's dedicated Rare Earth Elements 2025 report tracks supply, demand, and concentration risks.

Technology Readiness & Deployment

Rare earth mining and processing is a mature industry, though highly concentrated geographically. Demand for rare earth elements is growing 50-60% through 2040 under the IEA Stated Policies Scenario. Direct-drive wind turbines (using permanent magnets) and EV traction motors are the primary demand drivers. Efforts to develop rare earth recycling and alternative magnet technologies are at R&D to early commercial stage. China dominates the entire REE value chain from mining through magnet manufacturing.

Key Metrics & Benchmarks

China produces approximately 60% of rare earth mine output and over 85% of refined rare earth products. A single offshore wind turbine can require up to 600 kg of rare earth magnets. Each EV motor uses approximately 1-2 kg of rare earth elements. Global REE mine production reached approximately 350,000 tonnes in 2024. Recycling currently recovers less than 1% of rare earths from end-of-life products, though several pilot plants are scaling.

LATAM Relevance

Brazil holds approximately one-fifth of global rare earth reserves, making it a strategically important potential supplier for diversification away from Chinese dominance. However, Brazil currently produces only small to moderate volumes of rare earths. The Serra Verde project in Goias and CBMM's niobium-REE operations represent emerging production capacity. Colombia and other LATAM nations have identified but not yet developed rare earth deposits.

Critical Minerals Link

This is the core page for rare earth supply chains. The extreme geographic concentration of REE processing in China creates significant supply chain vulnerability for wind and EV industries globally. The IEA emphasizes the need for supply diversification, recycling technology development, and research into REE-free motor and generator designs. Trade restrictions on REEs have historically caused price spikes and supply disruptions.

Cleantech Taxonomy Crosswalk

Maps to Cleantech Taxonomy sectors: IN (Industry) — REE mining, refining, magnet manufacturing; ES (Energy Systems) — wind turbine permanent magnets; TR (Transport) — EV motor magnets; XS (Cross-Sectoral) — supply chain security, trade policy, recycling.

LATAM Mining & Critical Minerals Supply

Source Metadata

Field	Value
source	iea
source_version	ETCS 2025
source_id	IEA-MIN-004
iea_category	critical_minerals
technology	LATAM Mining & Critical Minerals Supply
technology_readiness	commercial
mitigation	Y
adaptation	N
last_checked	2026-05-26

IEA Technology Definition

The IEA's Global Critical Minerals Outlook and Latin America commentary identify the region as a globally significant supplier of energy transition minerals. This page synthesizes the IEA's assessment of Latin America's role across copper, lithium, nickel, rare earths, graphite, and manganese supply chains. The IEA projects Latin American mining and refining value to reach USD 154 billion amid regulatory reforms to attract foreign capital.

Technology Readiness & Deployment

Latin American mining is a mature commercial industry with world-class operations in copper (Chile, Peru), lithium (Chile, Argentina), iron ore (Brazil), and bauxite (Brazil). The region is at early stages of developing midstream processing and downstream manufacturing capacity for battery materials and components. Regulatory modernization is underway in Chile (lithium nationalization framework), Argentina (RIGI investment incentives), and Brazil (critical minerals strategy) to capture more value from the energy transition.

Key Metrics & Benchmarks

Latin America accounts for 40% of global copper production, 35% of lithium production, and holds more than half of global lithium reserves. The region supplies significant shares of nickel (Brazil, Cuba), tin (Bolivia, Brazil, Peru), and molybdenum (Chile, Peru). Brazil alone holds around one-fifth of global reserves in graphite, nickel, manganese, and rare earth elements, but as of today produces only small to moderate amounts of these materials.

LATAM Relevance

This page is the central LATAM reference for critical minerals in the Cleantech Taxonomy. The IEA highlights that Latin America's mineral wealth positions it as a pivotal region for global clean energy supply chains, but moving up the value chain requires investment in processing infrastructure, skills development, ESG governance, and enabling policies. Water scarcity in Chilean and Peruvian mining regions, indigenous community rights, and environmental regulation are key constraints on expansion.

Critical Minerals Link

Comprehensive LATAM mineral supply: Chile (copper 27%, lithium 26% of global), Peru (copper 10%, zinc, silver), Argentina (lithium 6%), Brazil (iron ore, bauxite, rare earths, graphite, nickel, manganese), Bolivia (tin, lithium), Mexico (copper, silver, fluorspar), Colombia (coal, nickel, emeralds). The IEA recommends diversifying refining and processing away from China, creating opportunities for LATAM midstream investment.

Cleantech Taxonomy Crosswalk

Maps to Cleantech Taxonomy sectors: IN (Industry) — mining, mineral processing, smelting; XS (Cross-Sectoral) — ESG governance, water-energy-mining nexus, community engagement, trade policy, circular economy; ES (Energy Systems) — mineral demand from renewable deployment.