Rare Earths (wind turbines, EVs)

Source Metadata

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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.

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