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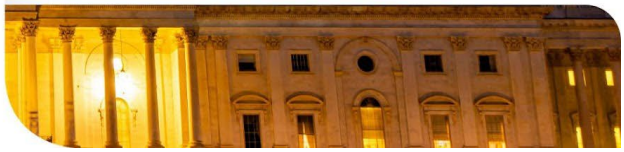


Fact Sheet

Critical Mineral Deep Dive: Cobalt

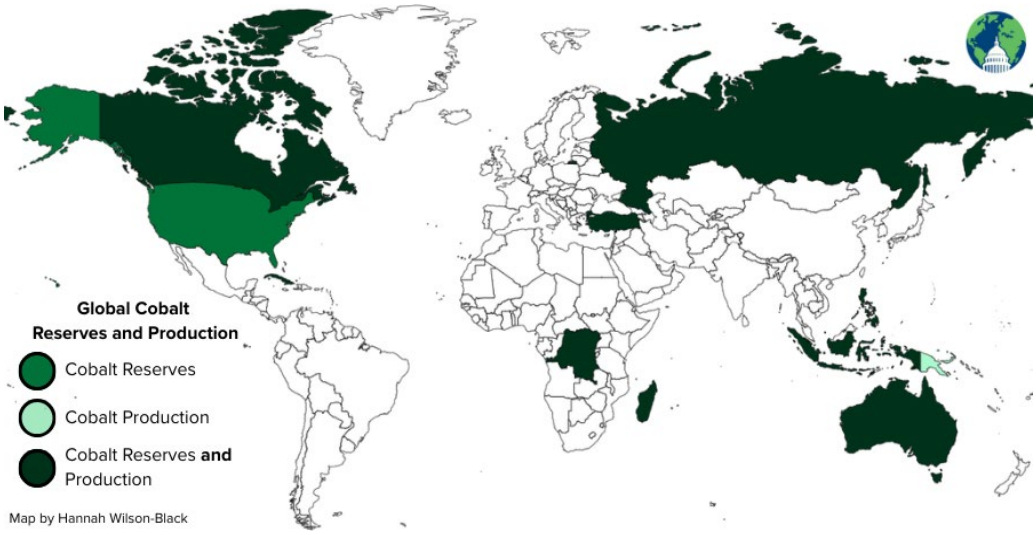
Cobalt is a U.S. Geological Survey-designated critical mineral. It is widely used in lithium-ion batteries for electric vehicles and electronics, and in superalloys for aerospace and industrial applications. The U.S. Department of Energy (DOE) classifies cobalt as having medium to high importance to the clean energy transition through 2035.

Clean Energy Applications

Cobalt's durability, high melting point, and magnetic properties make it a critical component of rechargeable batteries. Cobalt is largely used in the cathode of lithium-ion batteries, offering high stability, energy retention, and energy density. Lithium-ion batteries power most of today's electric vehicles and electronics. According to the DOE, about 71% of cobalt demand in 2025 was from electric vehicle batteries and energy storage systems, with that share expected to reach 93% by 2035. Cobalt demand for clean energy technologies is expected to increase by 80% between 2025 and 2030.

Availability and Supply Chain

The Democratic Republic of the Congo (DRC) holds 52.8% of the world's known cobalt reserves, followed by Australia (15%), Indonesia (5.6%), Cuba (4.4%), the Philippines (2.3%), and Russia (2.2%). The DRC is also responsible for about 76% of global cobalt production, followed by Indonesia (9.8%) and Russia (3%).



The United States has a 76% import reliance for cobalt, primarily from Norway, Finland, Japan, and Canada. About one million tons of identified cobalt resources are found in fourteen states, with the most in Minnesota. Domestic cobalt production is limited. Eagle Mine in Michigan produces cobalt-bearing nickel concentrate, which is exported to Canada for processing, and an Ohio facility began producing nickel-cobalt products from scrap. The only domestic cobalt-specific mine, located in Idaho, closed in 2024 before becoming operational due to low cobalt prices. China dominates processing operations, refining 50 to 70% of global cobalt supplies, mostly from the DRC and Indonesia. Finland and Indonesia are also major cobalt refiners, and together with China are responsible for about 89% of global refining.

Extraction ↓	Cobalt is typically a coproduct of copper mining (74%) or byproduct of nickel mining (25%). Only 1% of cobalt is produced from cobalt-specific mining. In each of these cases, cobalt is extracted via open-pit mining, underground mining, or a combination of both. These are usually large-scale, mechanized operations, though artisanal and small-scale mining comprises 15% to 30% of cobalt production in the DRC, the top producer in the world.
Processing ↓	Cobalt is refined into a form suitable for manufacturing by crushing and grinding cobalt-bearing ore. The cobalt is concentrated using froth flotation to separate minerals from waste. The concentration then undergoes smelting processes to create cobalt matte, followed by hydrometallurgical processes like acid leaching and electrowinning to produce high-purity cobalt suitable for industrial use.
Manufacturing ↓	Globally, 43% of cobalt is used in electric vehicle batteries, followed by batteries for portable devices (30%). Cobalt is also used in superalloys (8%) and hard metals (4%).
Recycling ♻	Recycling can reduce the need for new mines by 40% and reduce greenhouse gas emissions by 80%. Cobalt is primarily extracted by smelting and leaching the mineral from end-of-life lithium-ion batteries. In 2024, scrap accounted for one quarter of U.S. cobalt consumption.

Externalities of Cobalt Development

Cobalt mining, particularly in the DRC, is linked to human rights violations, including child trafficking, child labor, sexual assault, forced evictions, and forced labor. Small-scale mining typically uses "low-tech," labor-intensive methods and faces limited oversight and regulations, leading to deadly hazards like pit wall collapses. Cobalt is also toxic to touch and inhale, posing health risks such as hard metal lung disease, cardiomyopathy, thyroid dysfunction, and neurologic dysfunction. Cobalt can also cause birth defects in newborns within mining zones. As of 2023, no "clean" supply chain existed for cobalt from the DRC.

From 2001 to 2020, cobalt mining led to the deforestation of 32,100 acres of the Congo Basin forest, the second largest tropical rainforest in the world and a critical carbon sink. Cobalt mining also contaminates soil, air, and water supplies, corrupting food chains and threatening ecosystem health. The electricity generation required for mining and processing accounts for the bulk of greenhouse gas emissions within the cobalt supply chain. Transitioning to renewable energy sources for these steps can help reduce associated emissions.

Scientists and companies are exploring substitutes for cobalt that have fewer harmful impacts. Some electric vehicle battery manufacturers use iron-phosphate as a substitute for cobalt in their battery chemistry, but this has half the energy density of the batteries that use cobalt. MIT researchers have found a promising alternative to cobalt—layers of an organic small molecule known as TAQ, which has comparable conductivity and storage capacity to cobalt-bearing lithium-ion batteries.

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This fact sheet is available at **www.eesi.org/papers**.

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