Critical Minerals & Rare Earth Elements
Part 1 - An Overview

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Critical Minerals, Elements, or Materials

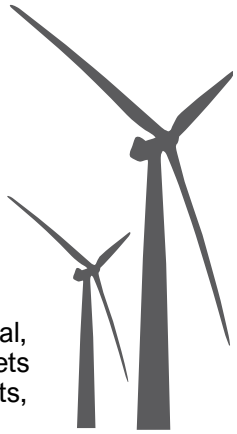
as defined by the U.S. Energy Act of 2020

- Are essential to the economic or national security of the United States;
- The supply chain of which is vulnerable to disruptions including restrictions associated with foreign political risk, abrupt demand growth, military conflict, violent unrest, anti-competitive or protectionist behaviors, and other risks throughout the supply chain;
- Serve an essential function in the manufacturing of a product (including energy technology-, defense-, currency-, agriculture-, consumer electronics-, and healthcare-related applications), the absence of which would have significant consequences for the economic or national security of the United States

Critical minerals, by definition, do not include: fuel minerals (including uranium), water, ice, snow, common varieties of sand, gravel, stone, pumice, cinders, and clay

What makes these minerals, elements & materials critical?

1. The U.S. is highly reliant on imports for a large and growing number of mineral commodities whose production is concentrated in a few countries. This high degree of import reliance exposes the U.S. to potential foreign supply disruptions, which may make U.S. manufacturing industries vulnerable.
2. The transitions from fossil fuels to clean energy technologies and the transition to digital technologies has created a growing demand for critical minerals and rare earth elements. This demand will put pressure on extraction, production, and refining but developing a supply of domestic critical minerals and rare earth elements can create new jobs and stimulate economic growth.
3. Critical minerals and rare earth elements are vital components of technology, defense, medical, and manufacturing industries. Many clean energy technologies including batteries and magnets in wind turbines and electric vehicle motors require large sources of critical minerals, elements, and materials.



Rare Earth Elements - a subset of critical minerals and materials

Rare Earth Elements (REEs) are a group of 17 metallic elements, including the 15 lanthanide series elements (the lanthanide series are the elements on the periodic table that are separated into two rows beneath the main table). Despite their name, REEs are quite abundant in Earth's crust but rarely form in economically-concentrated deposits and, when found, they are hard to separate from other elements.

The unique properties of REEs (magnetism, phosphorescence, and conductive properties) make them critical in our national security, energy independence, clean energy future, and economic growth.

Many advanced technologies have components made from REEs, including magnets, batteries, phosphors, and catalysts. These technologies are used in many sectors of the U.S. economy including health care, transportation, power generation, petroleum refining, and consumer electronics. Military applications of REEs include night-vision goggles, laser range finders, amplifiers in fiber optic data transmissions, precision-guided weaponry, and "white noise" production in stealth technology.

Before 1965 there was little demand for REEs but the invention of color TV made REEs necessary - europium (Eu) was the essential material needed to produce color images!

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U.S. Energy Act of 2020

The U.S. Energy Act of 2020 addresses several energy-related issues, including critical minerals. It defines critical minerals and aims to promote energy security, reduce greenhouse gas emissions, and improve the efficiency of federal energy consumption. The Act seeks to create a more resilient and sustainable energy infrastructure for the U.S. by lessening our country's dependence on imports of critical minerals, materials, and elements.

What did the Act do?

- Defined critical minerals and mandated the U.S. Geological Survey to conduct resource assessments and track production, consumption, and recycling patterns.
- Tasked the U.S. Secretary of the Interior (acting through the Director of the U.S. Geological Survey) with reviewing and revising the methodology used to evaluate mineral criticality and the Critical Minerals List (CML) no less than every 3 years. The most recent CML was released (as a draft document) in August 2025
- Authorized the Department of Energy to develop programs for processing, recycling, and alternative materials to secure domestic supply chains.
- U.S. Geological Survey is tasked with performing quantitative assessments of critical, non-fuel minerals which is based on risk modeling.

Why is this important?

In its February 2025 report titled "Critical Mineral Resources: The U.S. Geological Survey (USGS) Role in Research and Analysis", the U.S. Congress notes that critical minerals are *essential* for certain products and services and are subject to supply chain risks.

The report further states that "according to a review in the USGS Mineral Commodity Summaries 2024, the United States was 100% net import reliant for 12 of the 50 critical minerals on the 2022 CML and more than 50% net import reliant for an additional 29."

In addition to supply chain risks, this reliance on imports raises concerns about the ability of U.S. manufacturers to process and produce products that rely on critical minerals. REEs are essential in the manufacture of touchscreen electronics and magnet-based motors of wind turbines and electric vehicles. Other critical minerals and REEs are essential components of medical devices, consumer electronics, aviation equipment, power grids, and more.

Demand for critical minerals and REEs is expected to increase in the next decade and this legislation provides the requirement for the U.S. Geological Survey to research and assess the supply of critical minerals and REEs within the United States.

DID YOU KNOW?

"Graphite" comes from the Greek word "graphein" which means "to write"

Lithium is so soft that it can be cut with a knife

Cobalt is a vital component of vitamin B12, which is essential for human health

Graphite

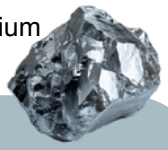
Spodumene (lithium source)

Cobalt

Current List of Critical Minerals (2025 - Draft)

The U.S. Geological Survey developed a list of 50 critical minerals in 2022 and aims to prioritize these minerals in its resource assessments. Below is the most up-to-date list (draft) from August 2025 of critical minerals, elements, and materials as defined by the U.S. Geological Survey, including a few, but not all, of their uses. The list, while considered to be 'final', is dynamic and will be updated to represent current data on supply, demand, concentration of production, and current policy priorities. This list will be the focus of research for the U.S. Geological Survey and State Geologic Surveys quantifying critical mineral potential within the U.S.

- Aluminum: LED lighting, lightweight airplanes
- Antimony: lead-acid batteries, flame retardants
- Barite: hydrocarbon production
- Beryllium: aerospace and defense industries
- Bismuth: medical and atomic research
- Cerium: catalytic converters, metallurgy
- Cesium: research and development
- Chromium: stainless steel and other alloys
- Cobalt: rechargeable batteries, superalloys
- Copper: wiring, cables, HVAC systems, plumbing
- Dysprosium: permanent magnets, lasers


Beryllium

- Erbium: fiber optics, optical amplifiers
- Europium: phosphor, nuclear control rods
- Fluorspar: used in manufacture of cement, steel, gasoline
- Gadolinium: medical imaging, permanent magnets
- Gallium: integrated circuits, LED lighting
- Germanium: fiber optics, night vision applications
- Graphite: lubricants, batteries, fuel cells
- Hafnium: nuclear control rods, high-temp ceramics
- Holmium: permanent magnets, lasers, nuclear control rods
- Indium: liquid crystal display screens


Magnesium

- Iridium: anode coating, chemical catalyst
- Lanthanum: catalysts, ceramics, batteries, metallurgy
- Lead: batteries for energy storage, radiation shielding, alloys, ammunition
- Lithium: rechargeable batteries, medications
- Lutetium: medical imaging, electronics, cancer therapies
- Magnesium: alloy, metal reducer
- Manganese: steelmaking, batteries, MRI equipment
- Neodymium: permanent magnets, rubber catalysts, medical and industrial lasers
- Nickel: Stainless steel, superalloys, rechargeable batteries
- Niobium: steel, superalloys
- Palladium: catalytic converters
- Platinum: catalytic converters, pace makers, chemotherapy


Platinum


Scandium

- Potash: agricultural fertilizer, de-icing, food additive, glass
- Praseodymium: permanent magnets, batteries, aerospace alloys
- Rhenium: high-temp superalloys & thermocouples, chemical catalyst
- Rhodium: catalytic converters, catalyst
- Rubidium: research and development in electronics
- Ruthenium: catalysts, electrical contacts, chip resistors
- Samarium: permanent magnets, absorbers in nuclear reactors, cancer treatments
- Scandium: alloys, ceramics, fuel cells
- Silicon: circuits, microprocessors, solar cells, glass, diodes, displays
- Silver: photovoltaic cells, circuit boards, wires, medical devices

- Tantalum: electronic components, capacitors, surgical tools
- Terbium: permanent magnets, fiber optics, lasers
- Thulium: metal alloys, lasers
- Tin: protective coatings, steel alloys
- Titanium: white pigment, metal alloys
- Tungsten: wear-resistant metals
- Vanadium: alloying agent for iron and steel
- Ytterbium: catalysts, scintillometers, lasers, metallurgy
- Yttrium: ceramics, catalysts, lasers, phosphors, MRI machines
- Zinc: galvanizer, alloy agent, die casting, paints, human immune system
- Zirconium: cladding material for nuclear rods, surgical equipment, steel alloy


Tungsten