



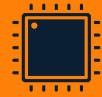
Critical Materials & Critical Minerals in California

Building the Supply Chain for Tomorrow

An overview of California's critical material and mineral ecosystem, supply chain opportunities, and new aligned federal and state investments.



Overview



Critical Material

By federal definition, a **critical material** is one that is subject to supply risks, such as a single source of production or geopolitical unrest; has limited substitutability; and has an end use that is important to U.S. economic or national security interests.



Critical Mineral

By federal definition, a critical mineral is one that the Secretary of the Interior has identified as a non-fuel mineral or mineral material essential to economic and national security (2) that has a supply chain vulnerable to disruption, (3) that serves an essential function in the manufacturing of a product, and (4) whose absence would have significant consequences for our economy or national security.

In 2018, the Secretary of the Interior designated an initial 35 minerals and mineral groups as critical. The list was updated to 50 in 2022 by splitting “rare earth elements” and “platinum group elements” into individual entries rather than groups, adding nickel and zinc, and removing helium, potash, rhenium and strontium.



Supply Chain

The 2022 USGS report, Mineral Commodity Summaries 2022, found that the United States is **import-reliant** (imports greater than 50% of annual consumption) on **29** of the **35** critical minerals originally designated. Of those, the U.S. does not domestically produce **14** of them and relies completely on imports to meet its demand.

Examples of Critical Materials Used in Technologies.

Those **highlighted** are currently produced, or have recently been produced, in California.

ZEVs



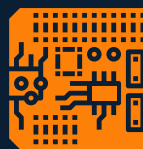
Lithium
Neodymium
Cobalt
Graphite
Manganese
Nickel
Boron

Aircraft & Spacecraft



Neodymium
Tungsten
Yttrium
Beryllium
Niobium
Cerium
Praseodymium

Semiconductors & Electronics



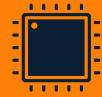
Lanthanum
Cerium
Boron
Germanium
Neodymium
Chromium
Tungsten

Solar Panels & Wind Turbines



Praseodymium
Germanium
Boron
Dysprosium
Terbium
Indium
Arsenic

California Ecosystem



The Golden State

Of the initial **35** critical minerals initially listed in 2018 by the U.S. Geological Survey, the CA Geological Survey **noted that California had resource potential for 34 out of 35 of them.** Demand for critical minerals in California is driven primarily by its ambitious climate goals, such as **100% clean energy by 2045** and **100% zero-emission vehicle sales by 2035.**



Rare Earth Elements

California is the sole producer of rare earths in the Western Hemisphere and second only to China. Together they account for over **75%** of global production. Rare earths are used in magnets for ZEV motors, wind turbine generators, lasers, and satellite communications.



Boron

California is the sole producer of boron in the U.S. and second only to Turkey. Together they account for over **75%** of global production. Boron is used in magnets for ZEV motors, glass for solar PV, military armor, and wind turbine blades.



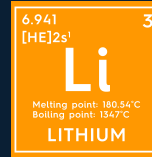
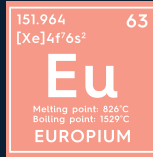
Lithium

California is home to numerous lithium resources found in clays, mine tailings, subsurface brines, and geothermal brines. This includes the most sought-after lithium-bearing clay Hectorite - named after Hector, San Bernardino. It also includes brines located in a geothermal field below the Salton Sea in Imperial Valley. **Estimates for that resource alone project capacity to meet up to 40% of current global lithium demand.** Lithium is used in ZEV batteries, energy storage, and aircraft ceramics.



Active projects as of
December, 2022

Ecosystem Applications



Rare Earths**

Boron

Lithium



Transportation

- + Magnets for ZEV motors
- + Batteries
- + Linear motors in high speed rail
- + Bicycle dynamos

- + Magnets for ZEV motors
- + ZEV panels and glasses
- + Ceramic capacitors in ZEVs

- + Batteries for ZEVs
- + Aircraft ceramics
- + Metal-to-metal lubrication applications



Energy

- + Wind turbine generators
- + Hydrogen electrolysis
- + Fluorescent lighting

- + Wind turbine blades
- + Solar PV glass
- + Rods in nuclear reactors
- + Fusion energy

- + Energy storage systems
- + Ceramics/glazes for wind blades
- + Nuclear fusion reactors



Aerospace & Defense

- + Radar + sonar
- + Satellites
- + Lasers
- + Night vision
- + Semiconductors

- + Semiconductors
- + Boron nitride and carbide armor
- + Aerospace ceramics
- + Satellite materials

- + Oxidizing agents for rockets and space capsules
- + Lithium-6 for tritium production



Other Applications

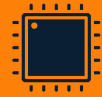
- + Cell phone screens
- + X-Ray + MRI Machines
- + Motion picture and film studio lighting

- + Borosilicate Glass for Fiber Optic Networks
- + Micronutrients and fertilizers

- + Ceramics/glasses in biotech
- + Battery operated medical devices

****Rare Earths include 17 elements on the periodic table Ce, Dy, Er, Eu, Gd, Ho, La, Lu, Nd, Pm, Pr, Sc, Sm, Tb, Tm, Y, and Yb**

Broader Context



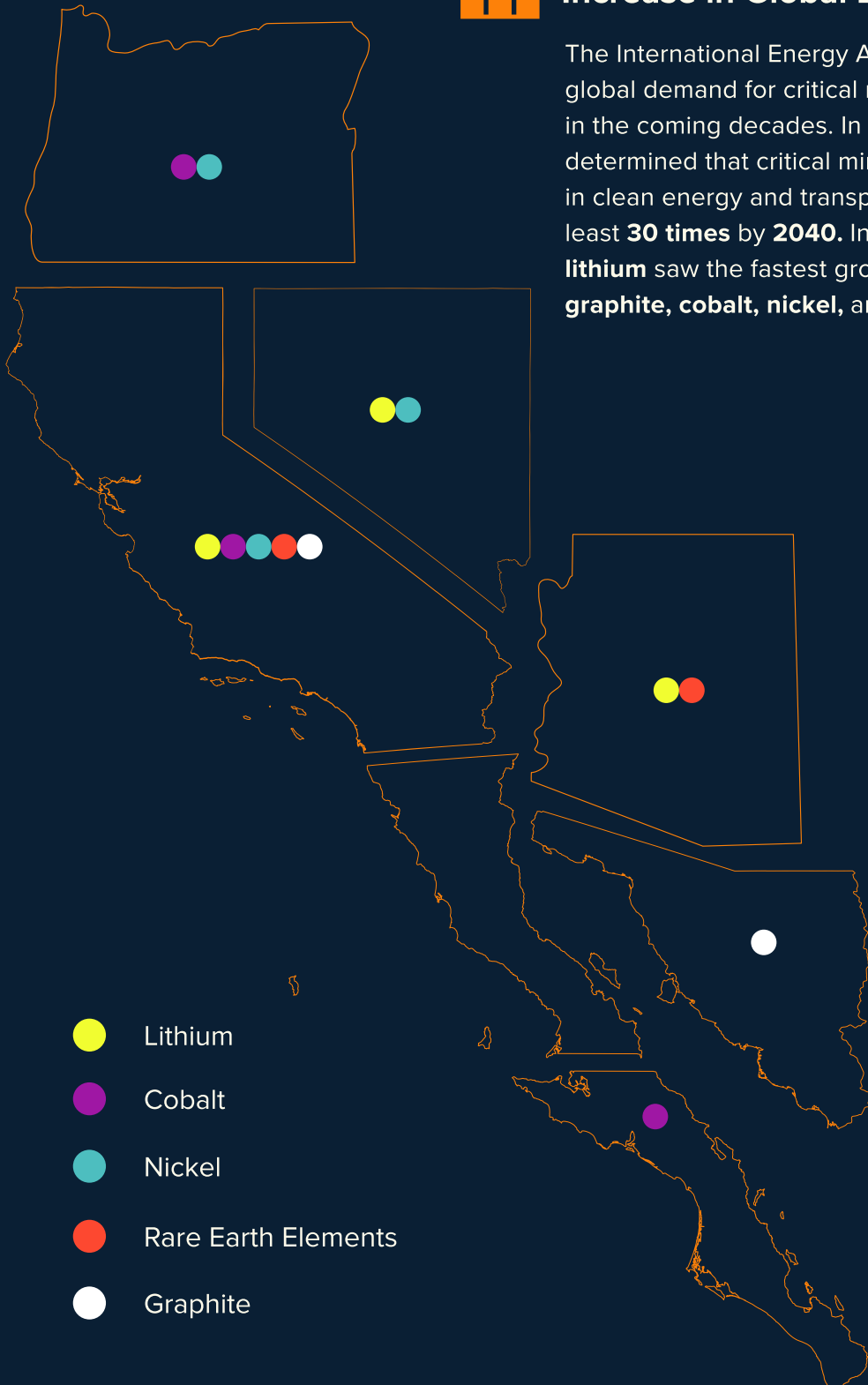
Increase in Global Demand

The International Energy Agency (IEA) in 2021 estimated global demand for critical minerals to increase by **400 - 600%** in the coming decades. In their climate-driven scenarios, they determined that critical mineral demand for use specifically in clean energy and transportation technologies will grow at least **30 times** by **2040**. In their modelling of that demand, **lithium** saw the fastest growth at over **40 times** - followed by **graphite, cobalt, nickel, and rare earths**.

Demand in the U.S. is driven by ambitious climate goals, national defense, and domestic supply chains. All have led to an **unprecedented amount of federal investment and new federal opportunities**.

Collective demand for critical minerals will not only lend to interest in production, but also **research and development, recycling, and geological surveying**.

The left depicts known resources of the five critical minerals listed above within the context of California and adjacent states utilizing data from Major Mineral Deposits of the World, a tool created by the U.S. Geological Survey to share regional locations and general geological settings of known deposits of major non-fuel mineral commodities.



- Lithium
- Cobalt
- Nickel
- Rare Earth Elements
- Graphite

Support and Incentive



Federal: Inflation Reduction Act

Business

+ **\$40B** in loan authority to DOE to guarantee loans for projects including **critical minerals** processing, manufacturing, and recycling.

+ **\$10B** to the Secretary of Treasury for new authority to provide Advanced Energy Project Tax Credits to projects that re-equip, expand, or establish facilities for the processing, refining, or recycling of **critical materials**. Credit = **6%** of qualifying investment. Up to **30%** if it meets wage and apprenticeship requirements

+ **\$500M** to the President for “Enhanced Use” of the Defense Production Act (DPA). **Critical mineral** production, processing, and manufacturing were made eligible for the DPA on March 31, 2022

+ New permanent Advanced Manufacturing Production Tax Credit for **critical minerals** equal to **10%** of project costs incurred by the taxpayer

+ **\$2B** for Domestic Manufacturing Conversion Grants to vehicle/component manufacturers and suppliers to encourage clean vehicle production

+ **\$3B** for the DOE Advanced Technology Vehicle Manufacturing Loan Program for loans to manufacture clean vehicles and their components in the United States

Consumer

+ Revision of existing US tax credit of **\$7,500** for purchases of new electric vehicles to require minimum of **40% minerals** that are extracted or processed in the United States or a U.S. free-trade agreement partner or recycled in North America

+ New Residential Clean Energy Credit to provide **30%** tax credit to lower the installation cost of residential clean energy including solar, wind, geothermal, and ESS

+ Commercial Clean Vehicles Credit to defray up to **30%** of the cost of replacing commercial vehicles with electric vehicles

+ New Energy Efficient Home Credit provides **\$1000 - \$5000** in tax credits for each new energy-efficient home or multifamily unit

Federal: CHIPS & Science Act

R&D

+ **\$11.2B** to DOE for research, development, and demonstration aligned with 10 technology areas including sustainable transportation, advanced manufacturing, industrial emissions reduction technology, **advanced materials**, and renewable research, development, and demonstration

+ **\$250M** to DOE for research and development of fusion **materials**

+ **\$250M** to DOE for research and development of multivalent ion **materials** in electric energy storage system

Support and Incentive



Federal: CHIPS & Science Act (cont)

R&D

+ **\$2.75B** to the DOE for the Science Laboratory Infrastructure Program.

+ **\$1B** in total to DOE to establish up to **four** “Microelectronics Science Research Centers” each being funded at up to **\$25M** annually

+ **\$11B** to DOC to implement semiconductor R&D and workforce programs, including the National Science and Technology Council and various initiatives at the National Institute of Standards and Technology (NIST)

+ **\$2B** for the CHIPS for America Defense Fund to establish a national network of microelectronics research and development

Business Development

+ **\$39B** to DOC for direct incentives for semiconductors. Includes manufacturing of **materials** used to manufacture semiconductors or semiconductor manufacturing equipment

+ Creates a new Advanced Manufacturing Investment Credit providing a **25%** investment tax credit for investments in semiconductor manufacturing including **materials** as well as specialized tooling equipment required in the semiconductor manufacturing process

Federal: Bipartisan Infrastructure Law

Business Development + R&D

+ **\$3B** in grants through the DOE for **battery materials** processing

+ **\$3B** in grants through the DOE for battery manufacturing and recycling

+ **\$125M** through the DOE for battery and **critical mineral** reuse and recycling

+ **\$200M** through DOE to expand an existing program for research, development, and demonstration of EV battery recycling and second-life applications for vehicle batteries

+ **\$23.6M** in competitive grants through USGS for documentation and preservation of maps, samples, and data including preservation of samples to track geochemical signatures from **critical mineral** ore bodies

+ **\$320M** in direct federal spending to the USGS to accelerate its mapping mission, including interpretation of both critical mineral resources still in the ground and **critical mineral** resources that may be reprocessed from mine wastes

Support and Incentive



Federal: Bipartisan Infrastructure Law (cont)

Business Development + R&D

+ **\$75M** through DOE for a U.S. Critical Material Supply Chain Research Facility that will (A) Further enable research, development, demonstration, and commercialization activities throughout the supply chain for **critical materials**; and (B) Provide an integrated, rapidly reconfigurable research platform

+ **\$600M** in grants through the DOE for **critical material** supply chain and research

+ **\$10M** through DOE to provide a prize to project(s) for recycling of lithium ion batteries

+ **\$20M** through DOE for Solar Recycling Research and Development cooperative agreements and grants for uses including recovery of **critical materials** from solar energy systems

+ **\$20M** through DOE for new solar manufacturing projects that support domestic supply chains of **critical materials** and increase efficiency and cost effectiveness of **critical minerals**

+ **\$140M** through DOE for a **rare earth** element refinery to separate and refine rare earth oxides

+ **\$127M** through DOE to assess technologies for extraction and recovery of **rare earths** from coal-based resources

+ **\$40M** through DOE for Wind Energy Tech Recycling Research and Development cooperative agreements and grants for uses including recycling of **critical materials** from wind technology components

Federal: Additional

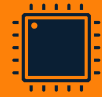
+ **\$2M** via a FY22 Congressionally Directed Spending Request to the University of California, Riverside for **critical mineral** analytic training

+ **\$825M** to the DOE under H.R. 2471 for advances carbon reduction and mitigation in sectors and applications that are difficult to decarbonize while assisting in facilitating the transition toward a net-zero carbon economy and rebuilding a U.S. **critical minerals** supply chain

+ **\$388.3M** to the Secretary of Defense under H.R. 2471 for the Defense Production Act available until expended. **Critical mineral** production, processing, and manufacturing were made eligible for the DPA on March 31, 2022

+ **\$600M** to the DOD under The Emergency Supplemental Funding for Ukraine for the Defense Production Act with a focus on expanding domestic capacity and investing in domestic production of **strategic** and **critical materials**

Support and Incentive



State: California Budget 2022-2023

+ ~**\$8B** energy reliability and clean energy investments, including **\$1.2B** for residential energy storage, **\$250M** for transmission financing, and **\$1.2B** for building and industrial decarbonization

+ **\$6.1B** for ZEVs of which over half at **\$3.3B** is to incentivize heavier duty ZEVs and associated infrastructure including trucks buses, and OHVs

+ **\$15B** over four years for transportation infrastructure investments, including multiple in supply chain such as **\$1.2B** for port and freight infrastructure

+ **\$83M** to establish the CSU Bakersfield Energy Innovation Center

+ **\$500M** for the Climate Innovation Program through the California Energy Commission to provide financial incentives to drive CA's climate goals. Eligible projects include those in **lithium** processing, manufacturing, and recovery

+ **\$345M** over three years for advanced manufacturing sales tax exclusions that drive good jobs and clean investments including **\$45M** reserved to projects that manufacture, refine, extract, process, or recover **lithium**.

+ **\$120M** for California Competes Grants for qualified businesses that invest and create jobs in CA

+ **\$900M** in tax credits through California Competes through 2027-2028 for qualified businesses that invest and create jobs in CA

+ **\$20M** to expand Innovation Hubs in CA

State: California Budget 2021-2022

+ **\$4B** for ZEVs including \$250M for direct manufacturing grants

+ **\$6B** in investment to to expand broadband infrastructure including both middle mile and last mile

+ **\$600M** for the Community Economic Resilience Fund (CERF) program for regional collaboratives to plan and implement region- and industry-specific economic recovery and transition strategies

+ ~**\$1B** for the State Small Business Credit Initiative that will strengthen state programs that support financing of small businesses and entrepreneurs

+ **\$245M** for workforce development including \$100M for High Road Training Partnerships in new sectors such as manufacturing

+ **\$15M** for UC Riverside Center of Environmental Research and Technology facilities.

+ **\$270M** for the circular economy including **\$100M** in expansion funds to the Recycling Market Development Zone Program at CalRecycle

+ **\$120M** for California Competes Grants for qualified businesses that invest and create jobs in CA

+ ~**\$300M** in tax credits through California Competes for qualified businesses that invest and create jobs in CA