Critical Minerals in California

Building the Supply Chain for Tomorrow

A GO-Biz Innovation Primer on California's critical material and critical mineral ecosystem, supply chain opportunities, and aligned federal and state funding.

State of California
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CALIFORNIA
GOVERNOR'S OFFICE OF BUSINESS AND ECONOMIC DEVELOPMENT

CALIFORNIA JOBS FIRST

About

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Innovation Primers

Innovation Primers provide a concise overview of emerging sectors and technologies in California that are driving economic growth and sustainability. They are designed to provide brief, relevant insights, offering a foundation for understanding California's leadership in these sectors and its role in shaping the future economy.

About GO-Biz

The Governor's Office of Business and Economic Development (GO-Biz) serves as the State of California's leader for job growth, economic development, and business assistance efforts. Our teams are comprised of experts that span industries, geographies and business backgrounds.

About Jobs First

California Jobs First is a statewide economic development initiative designed to catalyze and guide the state's investments in key sectors by driving sustainable economic growth, empowering innovation, and increasing access to good-paying jobs over the next decade.

Additional Resources

Scan the QR code on the left to access an online PDF version of this document, which includes additional insights from the primer as well as links to resources, initiatives, data, and tools mentioned throughout.

For more information on other sectors in California, statewide economic development initiatives, and state business incentive programs, visit **business.ca.gov**.

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 (1) 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.

Supply Chain

> 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.
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> The 2022 USGS report, Mineral Commodity Summaries 2022, found that the U.S. 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 historically been produced, in California.

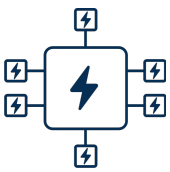
Zero-Emission Vehicles

Lithium
Neodymium
Cobalt
Graphite
Manganese
Nickel
Boron

Aircraft & Spacecraft

Neodymium
Tungsten
Yttrium
Beryllium
Niobium
Cerium
Praseodymium

Semiconductors & Electronics



Antimony
Lanthanum
Cerium
Germanium
Neodymium
Chromium
Tungsten

Solar Panels & Wind Turbines

Praseodymium
Germanium
Boron
Dysprosium
Terbium
Indium
Arsenic

California Ecosystem

The Golden State

Historically, California has consistently **ranked between 1st and 4th place nationally** for all non-fuel mineral production value since federal record keeping began, maintaining its consistent position as one of the top mineral producing states. For just the 35 critical minerals initially listed in 2018 by the U.S. Geological Survey, the California Geological Survey noted that **California has resource potential for 34 out of 35 of them**. In-state demand for critical minerals is driven by California's ambitious climate goals, including 100% clean energy by 2045, as well as California's leading role globally in numerous critical mineral dependent sectors, such as aerospace, semiconductors, telecommunications, and high tech.

Active projects as of April 2025

California is the nation's leading producer of critical minerals. It accounts for approximately **15% of global rare earth supply** and **over one-third of global boron supply**. Additionally, the state is home to numerous lithium projects, including one of the world's largest known reserves.

Currently, there are **over 30** active critical mineral projects in California. California projects have received **over $150 million** in state and federal investments since 2017.

Highlight: Rare Earths

Sole Domestic Source

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.

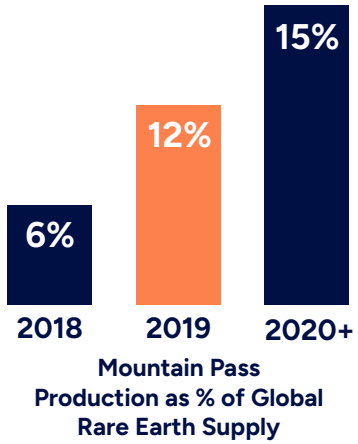
World-Class Resource

Although rare earth element resources are found in many places in California, Mountain Pass in San Bernardino County stands far above the rest. **The resource contains an estimated reserve of 18.4 million metric tons of rare earth oxides at an average grade of 8.24%, making it one of the world's largest and richest known deposits.** The ore body is particularly rich in cerium (49%), lanthanum (34%), and neodymium (12%), with smaller amounts of praseodymium, samarium, and other rare earths. Today, the site averages over 40,000 metric tons annually, accounting for approximately **15% of the global rare earth supply.**

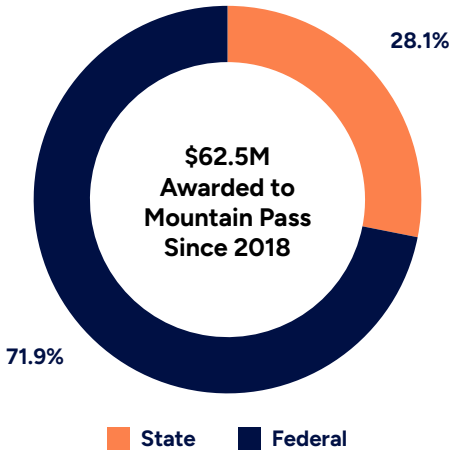
Innovation and Sustainability at Scale

Beyond resource potential, California has been host to an array of innovations and milestones in rare earth production, notably in sustainability. This includes the only rare earth operation in the world to deploy a dry stack tailings process as well as incorporate a closed-loop system where recycled water satisfies **95%** of demand.

Both state and federal funding have supported the direct development of rare earths. In February of 2022, California's Governor joined the President **to award MP Materials $35M** to build a facility to process heavy rare earths at Mountain Pass. This facility will be the first of its kind in the Americas and will mark a significant milestone for the United States in establishing a fully integrated domestic supply chain for rare earth elements.



Mountain Pass Production as % of Global Rare Earth Supply



Highlight: Lithium

Building the Supply Chain

California hosts a wealth of lithium resources, ranging from brine-based deposits in the geothermal fields of Imperial County, known as **Lithium Valley**, to lithium-bearing clays such as **Hectorite**, named after the community of Hector in San Bernardino County. Lithium is essential for electric vehicle batteries, energy storage systems, and aircraft ceramics.

In late 2023 and early 2024, California achieved several major milestones in lithium production. These included the **first commencement of commercial lithium production** at a complex near Barstow in San Bernardino County, the release of a U.S. Department of Energy-funded assessment estimating the total size of Lithium Valley's resource, and the initiation of construction on multiple commercial facilities by various companies.

Resource Diversity

There are **over a dozen** lithium projects in California, and the number continues to grow. However, not all lithium projects are the same. Currently, they fall into one of five categories:

Sedimentary Clays: Including the highly sought-after lithium-bearing clay Hectorite, with concentrated deposits near Hector in Southern California.
Geothermal Brines: Extracted from known geothermal fields in Southern California.
Mine Tailings: Recycling lithium from leftover assets of legacy mining operations.
Subsurface Brines: Over 20 subsurface dry lake sites with lithium, identified by USGS.
Boron Byproduct: Lithium found within boron-rich sedimentary deposits.

Lithium Valley: An Unparalleled Opportunity

Thousands of feet below the surface of northern Imperial County lies a vast lithium resource within a hot reservoir of mineral-rich liquid brine. This brine is already brought to the surface through geothermal power production. Now, multiple companies are advancing efforts to recover lithium from this geothermal resource using direct lithium extraction technologies.

In 2023, Lawrence Berkeley National Laboratory, alongside a group of researchers and universities, announced that with anticipated technologies, the total resources in Lithium Valley **could exceed 3,400 kilotons of lithium**. This amount could support the production of **over 375 million electric vehicle (EV) batteries**—more than the total number of vehicles currently on U.S. roads. The announcement underscores the enormity of this resource, not only as the largest in California, but as **one of the largest lithium reserves in the world.**

Highlight: Lithium

Scaling Lithium Valley: A Global Hub for Battery Production

The state is dedicated to building a world-class battery manufacturing ecosystem alongside lithium production and processing to drive economic opportunity. To date, **California has invested over $100 million** to support direct lithium production and refining within the state. This includes the nation's first lithium-specific incentive: a complete sales tax exclusion on all equipment associated with lithium refining or processing. Additionally, millions have been allocated to innovative research and development aimed at advancing new technologies for lithium recovery from brine-based resources.

California's commitment extends further with the creation of the **Lithium Valley Commission**, the first statewide body exclusively focused on lithium development, led by the California Energy Commission. The commission's work and the implementation of its recommendations are ongoing, as public and private partners collaborate to advance sustainable lithium production and encourage the in-state collocation of downstream battery supply chain assets.

How Much Lithium is in Lithium Valley?

	Metric Tons of Lithium Carbon Equivalent	# of Tesla Model S	# of Fiat 500e	# of Eblkes
Recoverable in Plants Today	115,000 MT of LCE	2.5 Million	5.1 Million	288 Million
Proven Reserves	4.1 Million MT of LCE	90 Million	183 MIllion	10 Billion
Accessible Reserves	13.7 Million MT of LCE	300 Million	613 Million	34 Billion

Assumptions:

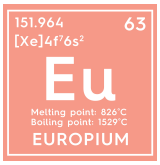
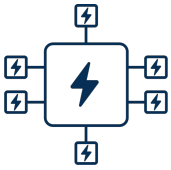
85 kWh Tesla battery

42 kWh Fiat 500 battery

0.75 kWh e-bike battery, with composition of .1kg Li/kWh

Based on "BatPaC 5.0" default material composition values

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 + Semiconductors + Micro-nutrients 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

Applications

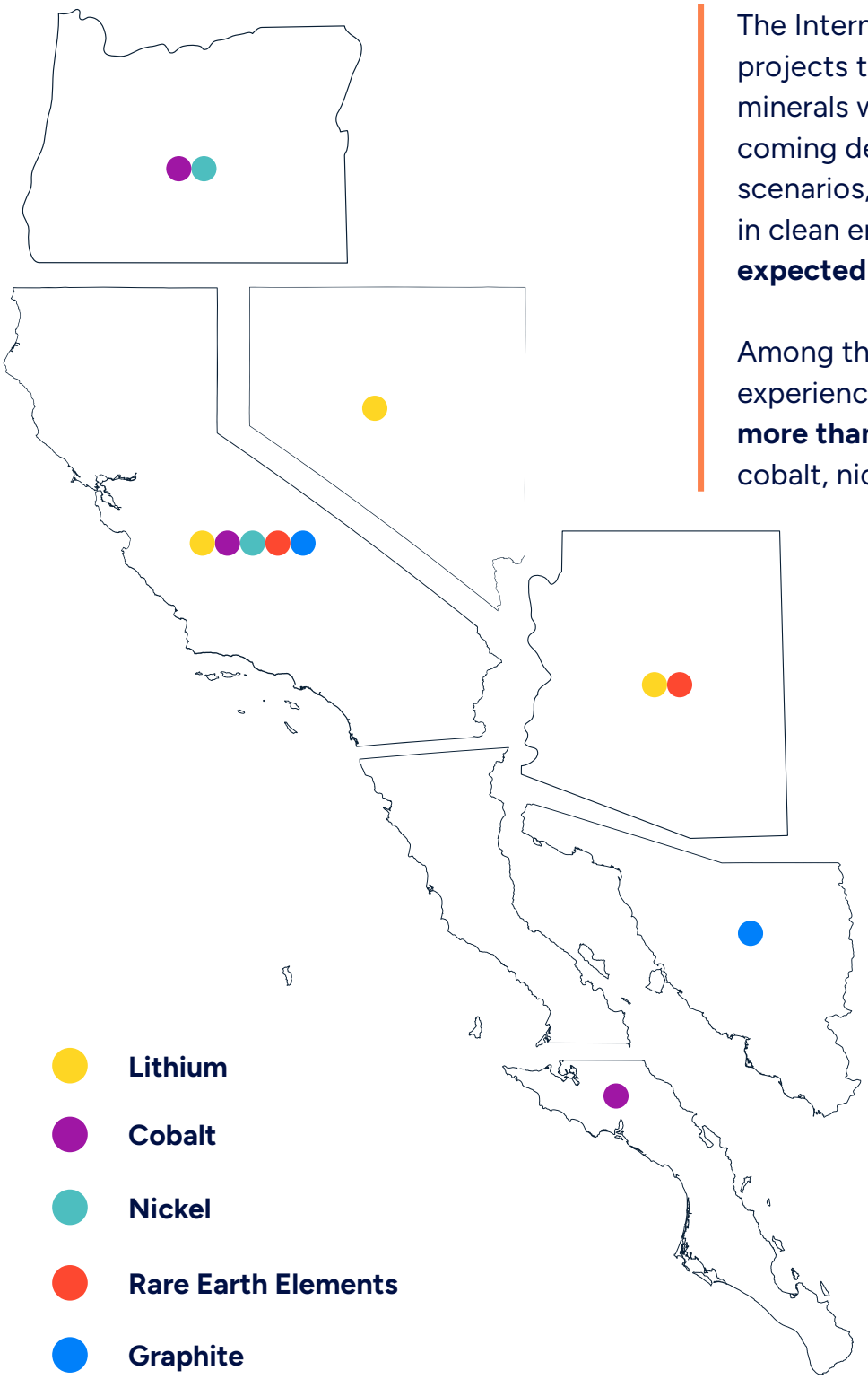
	Magnesium	Manganese	Zinc
Transportation	+ ZEV Batteries + Railway tracks + Metal-to-metal lubrication applications + Automobile coating	+ ZEV Batteries + Railway tracks + Metal-to-metal lubrication applications + Automobile coating	+ ZEV Batteries + Steel corrosion prevention + Metal-to-metal lubrication applications
Energy	+ Wind turbine infrastructure + Hydrogen production + Steel applications	+ Resistors + Wind turbine infrastructure + Coating for transmission lines + Steel applications	+ Solar PV cells + Wind turbine blades + Offshore wind - due to rust risk + Steel corrosion prevention
Aerospace & Defense	+ Gravity castings in aerospace industry + Military flares + Steel applications	+ Steel applications + Military armor/helmets + Alloys for aircraft	+ Molding and die-casting + Semiconductors + Steel corrosion prevention
Other Applications	+ Biotech ceramics + Battery operated medical devices + Fertilizer + Food/can production	+ Biotech ceramics + Battery operated medical devices + Fertilizer + Food/can production	+ Medical/health applications + Agriculture + Food production

Broader Context

Increase in Global Demand

The International Energy Agency (IEA) projects that global demand for critical minerals will increase by **400–600% i**n the coming decades. Under their climate-driven scenarios, demand for critical minerals used in clean energy and transportation is **expected to grow at least 30-fold by 2040.**

Among these, lithium is anticipated to experience the fastest growth, increasing **more than 40 times**, followed by graphite, cobalt, nickel, and rare earth elements.



Demand in the United States is driven by ambitious climate and energy goals, national defense priorities, and the need to strengthen domestic supply chains, resulting in unprecedented federal investments and new opportunities.

The growing demand for critical minerals will drive not only increased production but also advancements in research and development, recycling, and geological surveying.

The above shows known resources of the five critical minerals listed above in California and neighboring states, using data from 'Major Mineral Deposits of the World,' a tool developed by the U.S. Geological Survey to provide regional locations and geological contexts of major non-fuel mineral deposits.

Support and Incentive

Federal: Inflation Reduction Act (as passed)

Business Development

- **$40B** in loan authority to DOE to guarantee loans for **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
- **$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
- New permanent Advanced Manufacturing Production Tax Credit for **critical minerals** equal to **10%** of project costs incurred

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 U.S. or 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
- New Energy Efficient Home Credit provides **$1000** - **$5000** in tax credits for each new energy-efficient home or multifamily unit
- Commercial Clean Vehicles Credit to defray up to **30%** of the cost of replacing commercial vehicles with electric vehicles

Federal: CHIPS & Science Act (as passed)

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 energy
- **$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 for microelectronics research, including four "Microelectronics Science Research Centers," each being funded at up to $25M annually until 2027
- **$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, including 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: Infrastructure Investment + Jobs Act (as passed)

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 existing program for research, development, and demo of EV battery recycling and second-life for vehicle batteries
- **$23.6M** in competitive grants through USGS for documentation of maps, samples, and data, 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.
- **$75M** through DOE for a U.S. Critical Material Supply Chain Research Facility to further enable research, development, demonstration, and commercialization activities throughout the supply chain for **critical materials**
- **$600M** in grants through the DOE for **critical material** supply chain research

Support and Incentive

Federal: Infrastructure Investment + Jobs Act (cont)

Business Development + R&D

- **$10M** through DOE to provide a prize to project(s) for recycling of lithium ion batteries
- **$600M** in direct grants through the DOE for **critical material** supply chain and research
- **$10M** through DOE to provide a prize for 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

Business Development

- **$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 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 technologies

Federal: Additional Support (as passed)

Business Development + R&D

- **$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 in 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 mineral** 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 (as passed)

- **$8B** for energy reliability and clean energy investments, including:
  - **$1.2B** for residential energy storage
  - **$250M** for transmission financing
  - **$1.2B** for building and industrial decarbonization
- **$6.1B** for ZEVs (zero-emission vehicles), with over half at $3.6B to incentivize heavier-duty ZEVs and associated infrastructure, including trucks, buses, and off-highway vehicles (OHVs)
- **$15B** over four years for transportation infrastructure investments, including multiple supply chain initiatives such as $1.2B for port and freight infrastructure
- **$900M** in tax credits through California Competes (2027–2028) for businesses that invest and create jobs in California
- **$83M** to establish the CSU Bakersfield Energy Innovation Center
- **$500M** for the Climate Innovation Program through the California Energy Commission to provide financial incentives for clean energy projects, including lithium processing, manufacturing, and recovery
- **$345M** over three years for advanced manufacturing sales tax exclusions for clean investments, with $45M reserved for projects that manufacture, refine, extract, process, or recover lithium
- **$120M** for California Competes Grants for qualified businesses that invest and create jobs in California
- **$80M** for a STEM Facility at SDSU Imperial Valley

State: California Budget 2021-2022 (as passed)

- **$4B** for ZEVs, including $250M for direct manufacturing grants
- **$6B** in investment to expand broadband infrastructure, including both middle-mile and last-mile connections
- **$600M** for the Community Economic Resilience Fund (CERF) program for regional collaborations to plan and implement regional and industry-specific recovery and transition strategies
- **$1B** for the State Small Business Credit Initiative to strengthen programs that support financing for small businesses and entrepreneurs
- **$245M** for workforce development, including $100M for High Road Training Partnerships in new sectors
- **$15M** for UC Riverside Center of Environmental Research and Technology
- **$270M** for the circular economy, including $100M for expansions of the Recycling Market Development Zone Program
- **$120M** for California Competes Grants for qualified businesses that invest and create jobs in California
- **$300M** in tax credits through California Competes for qualified businesses that invest and create jobs in California