

Critical Minerals in California

Building the Supply Chain for Tomorrow

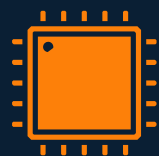


Table of Contents for this Packet

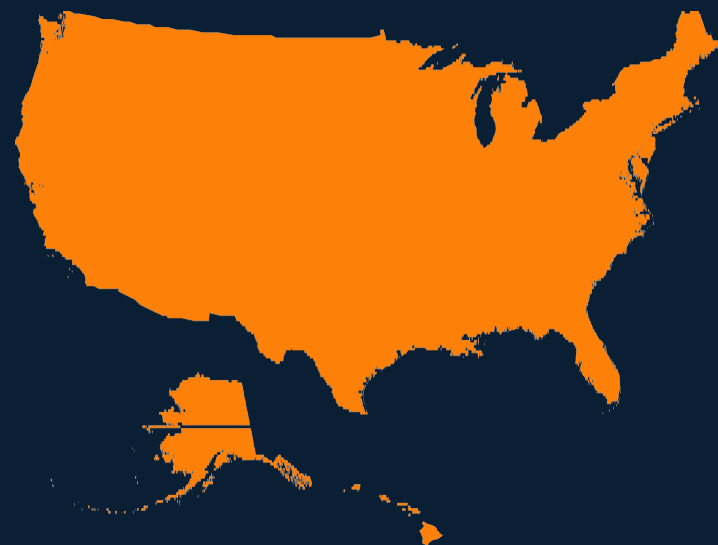
1. U.S. Department of Energy – Slide 5
2. MP Materials, Rare Earths – Slide 32
3. Rio Tinto, U.S. Borax, Boron and Lithium – Slide 39
4. 5E Advanced Materials, Boron and Lithium – Slide 45
5. Berkshire Hathaway - CalEnergy, Lithium - Slide 59
6. EnergySource Minerals, Lithium – Slide 66
7. Controlled Thermal Resources, Lithium – Slide 80
8. UC Riverside, Earth & Planetary Sciences – Slide 90
9. Lawrence Berkeley National Laboratory – Slide 100
10. UC Riverside, CFAMM – Slide 108
11. CSU San Bernardino – Slide 120
12. California Office of Small Business Advocate – Slide 127
13. Employment Training Panel – Slide 133
14. Imperial Valley College – Slide 143
15. Barstow Community College – Slide 153

Welcome & Opening Remarks, Palm Desert, UCR



Rodolfo Torres
*Vice Chancellor for
Research and Development
at the University of
California, Riverside*

*Catalyzing Deployment of Secure, Resilient Domestic
Clean Energy Supply Chains*

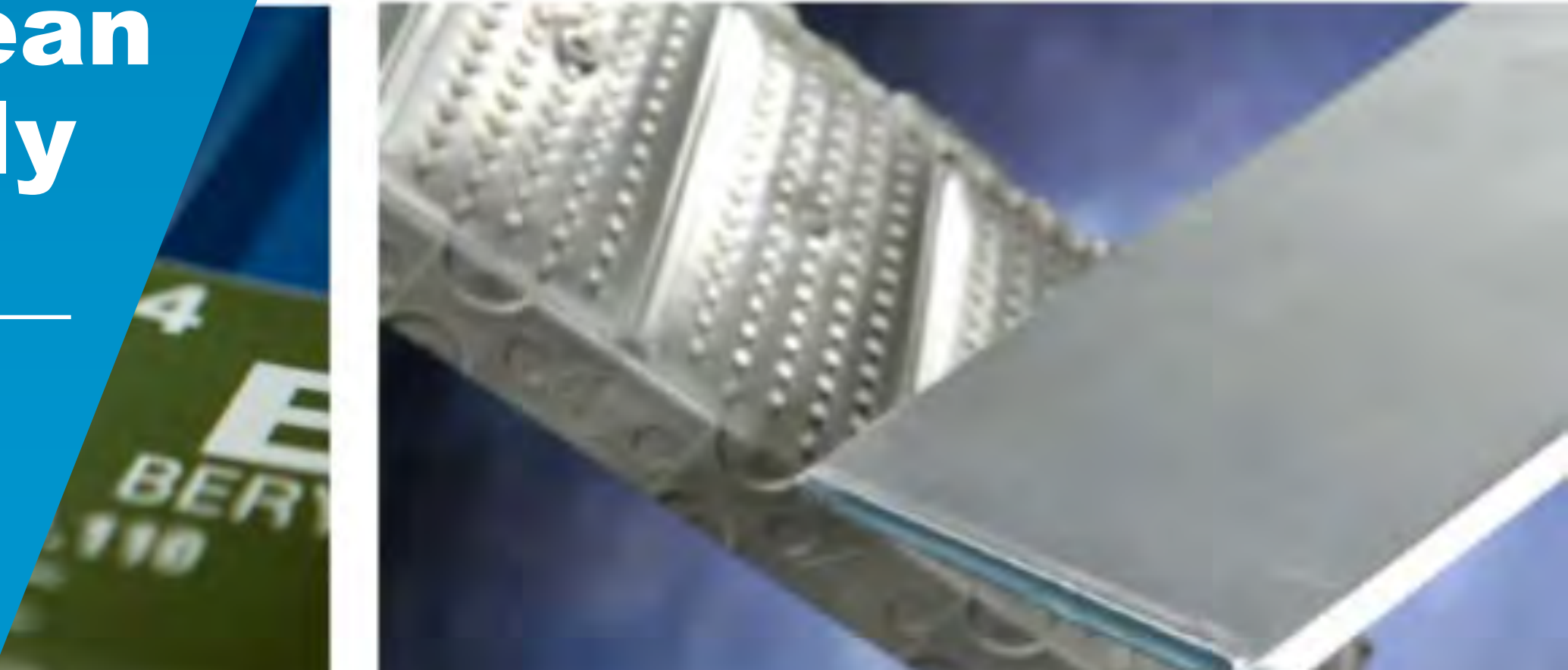


Lane Dilg

*Senior Advisor for the Office
of the Undersecretary of
Infrastructure at the U.S.
Department of Energy*

Catalyzing Deployment of Secure, Resilient Domestic Clean Energy Supply Chains

January 18, 2022



A \$23 Trillion Global Opportunity

“There’s a \$23 trillion global market for clean energy opportunities. Let’s build them in America and make them the backbone of communities that have been left behind. The innovative spirit of the American workforce is our greatest strength.” Secretary Jennifer Granholm, U.S. Department of Energy

The US poised to become the world’s leading energy provider: *“[T]he US is well positioned to become a global leader in clean energy given competitive advantage in low-cost clean electricity and hydrogen production, infrastructure, geologic storage, and human capital. The IRA magnifies the strategic advantages the US already holds (natural resources, infrastructure, geologic storage, technical expertise and technology talent) and enables the industry to become a dominant energy supplier in the low carbon economy.”* **Credit Suisse 2022**

Onshoring the critical materials supply chain is an essential step toward energy independence, economic prosperity for American communities, and lower costs for American consumers.

**DOE
Office
of the
Under
Secretary
for
Infrastructure**

Optimizing DOE Structure for Demonstration & Deployment

“The Bipartisan Infrastructure Law and the Energy Act of 2020 supercharge the Department of Energy to propel the U.S. economy towards cheaper, cleaner and more reliable energy. These structural changes set DOE up for success in carrying out all of our missions – and to carry them forward for the coming years and decades.”

**- U.S. Secretary of Energy
Jennifer M. Granholm (Feb.
2022)**

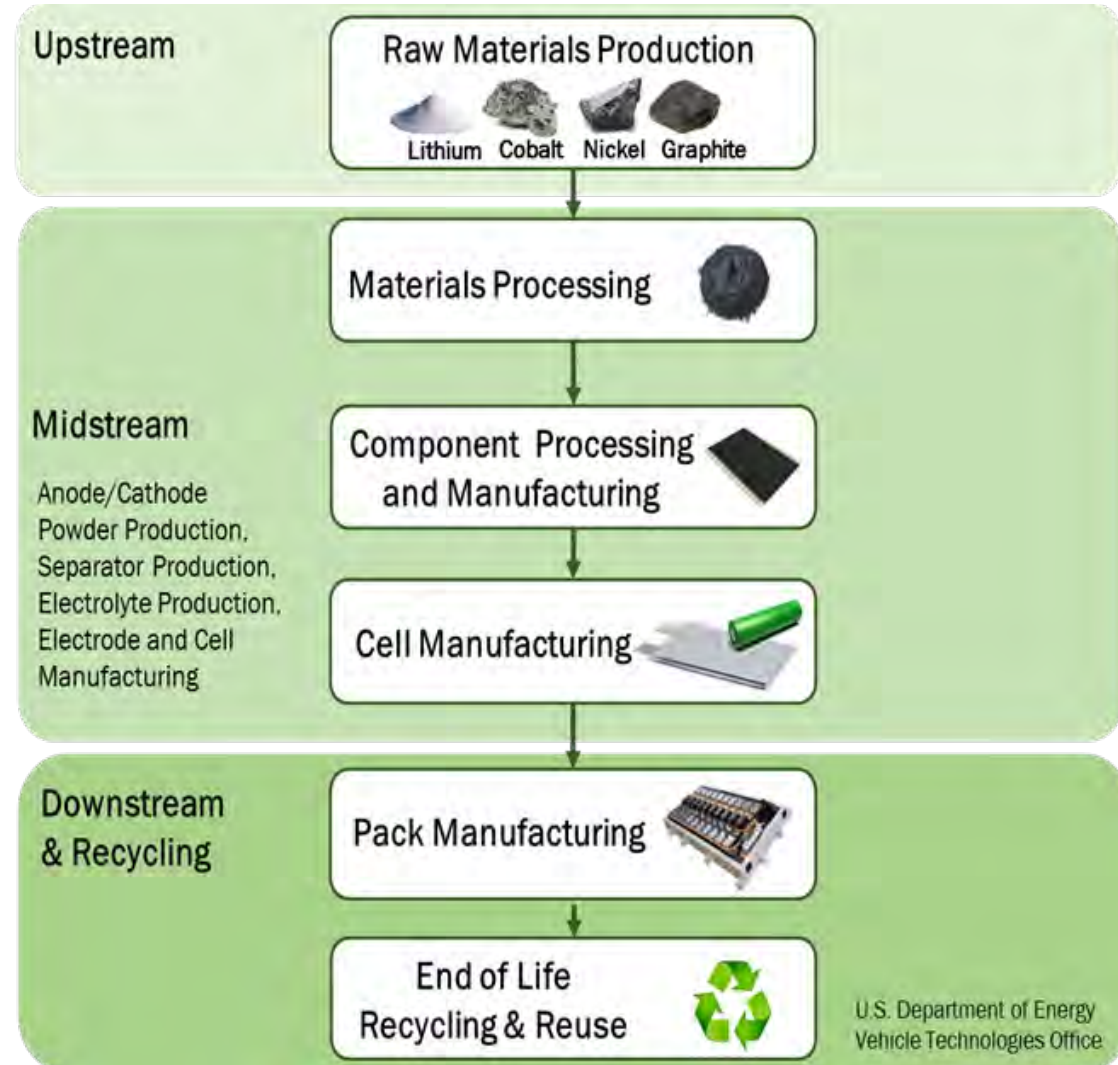
Office of Manufacturing & Energy Supply Chains

- **Catalyzing development of an energy sector industrial base** through targeted investments that establish and secure domestic clean energy supply chains and manufacturing
- **Engaging with private-sector companies, other Federal agencies, and key stakeholders** to collect, analyze, respond to, and share data about energy supply chains to inform future decision making and investment

Executive Order 14017: America's Supply Chains (2/24/21)

The United States needs resilient, diverse, and secure supply chains to ensure our economic prosperity and national security.

100-Day Report on the High-Capacity Battery Supply Chain



Up Stream

- **Primary vulnerabilities:** Class I nickel, lithium, cobalt, graphite, manganese.

Mid Stream

- **Vulnerability:** U.S. has a significant deficit in mineral refining and processing.
- **Vulnerability:** Domestic battery materials production capacity sorely lacking.
- **Vulnerability:** The U.S. has less than 10 percent of global market share for cell fabrication.

Down Stream

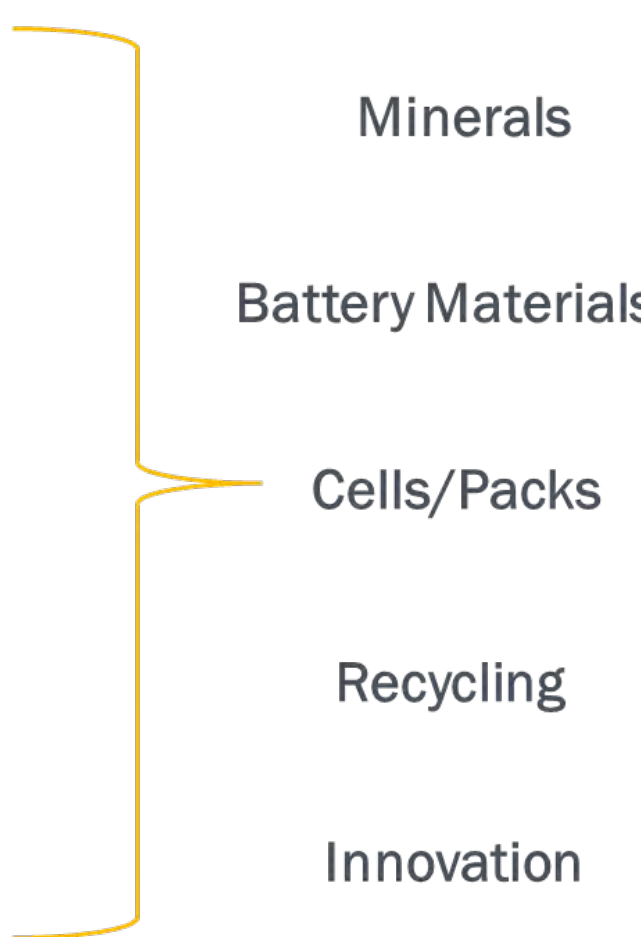
- **Vulnerability:** U.S. lags other markets in lithium battery recycling, with less than 5% of lithium-ion batteries estimated are recycled each year.
- **Vulnerability:** U.S. lacks policy incentives needed to accelerate domestic demand and production of lithium batteries

National Blueprint for Lithium Batteries (6/27/21)

By 2030, the United States and its partners will establish a secure battery materials and technology supply chain that supports long-term U.S. economic competitiveness and job creation, enables decarbonization goals, and meets national security requirements.



<https://www.energy.gov/eere/vehicles/articles/national-blueprint-lithium-batteries>



GOALS TO ACHIEVE OUR VISION

-  **1** Secure access to raw and refined materials and discover alternates for critical minerals for commercial and defense applications
-  **2** Support the growth of a U.S. materials processing base able to meet domestic battery manufacturing demand
-  **3** Stimulate the U.S. electrode, cell, and pack manufacturing sector
-  **4** Enable U.S. end of life reuse and critical materials recycling at scale and a full competitive value chain in the United States
-  **5** Maintain and advance U.S. battery technology leadership by strongly supporting scientific R&D, STEM education, and workforce development

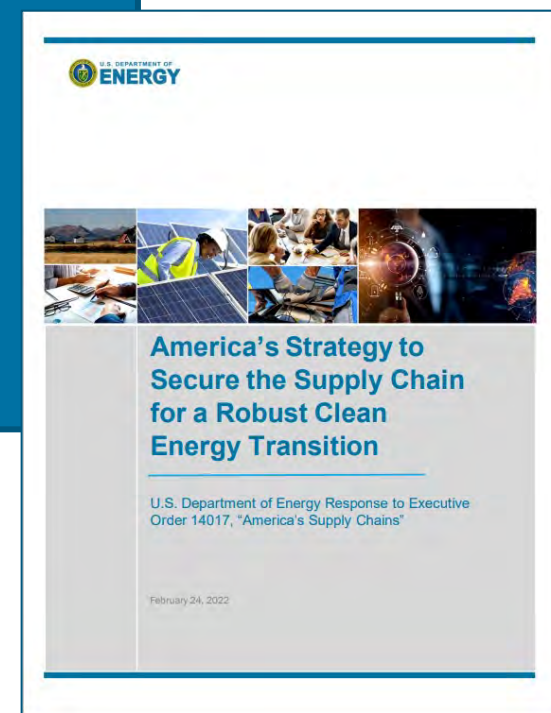
America's Strategy to Secure the Supply Chain for a Robust Clean Energy Transition (2/24/22)

- DOE released **14 reports on the energy sector supply chains**, including 13 issue-specific deep dive assessments and an overarching strategy report
- “America’s Strategy to Secure the Supply Chain for a Robust Clean Energy Transition” (2/24/22) is the **first-ever comprehensive U.S. government strategy to secure our domestic energy supply chains and an Energy Sector Industrial Base**
- Lays out dozens of **critical strategies and actions** to build secure, resilient, and diverse domestic energy supply chains

Deep-Dive Assessment Report Topics

- Carbon capture materials
- Electric grid including transformers and high voltage direct current
- Energy storage
- Fuel cells and electrolyzers
- Hydropower including pumped storage hydropower
- Neodymium magnets
- Nuclear energy
- Platinum group metals and other catalyst
- Semiconductors
- Solar photovoltaics
- Wind
- Commercialization and competitiveness
- Cybersecurity and digital components

<https://www.energy.gov/policy/securing-americas-clean-energy-supply-chain>



“Dynamic Dozen” Critical Materials

- 100% clean electricity by 2035: 30 GW offshore wind by 2030 •
- Zero-emission transportation: 50% EV adoption by 2030 •

• Neodymium, Praseodymium and Dysprosium for magnets

→ Magnets enable efficient electric machines including wind generators, electric and fuel cell vehicle motors, industrial motors

• Lithium, Cobalt, Nickel, Graphite, and Manganese for energy storage

→ Batteries are needed for electric vehicles and grid storage to enable high penetration of zero-emission transportation and intermittent clean power generation

• Iridium & Platinum for electrolyzers; Platinum for fuel cells

→ Iridium and platinum for electrolyzers are needed for green hydrogen production and platinum for fuel cells used in transportation and stationary energy storage.

• Gallium for wide bandgap semiconductors, LEDs

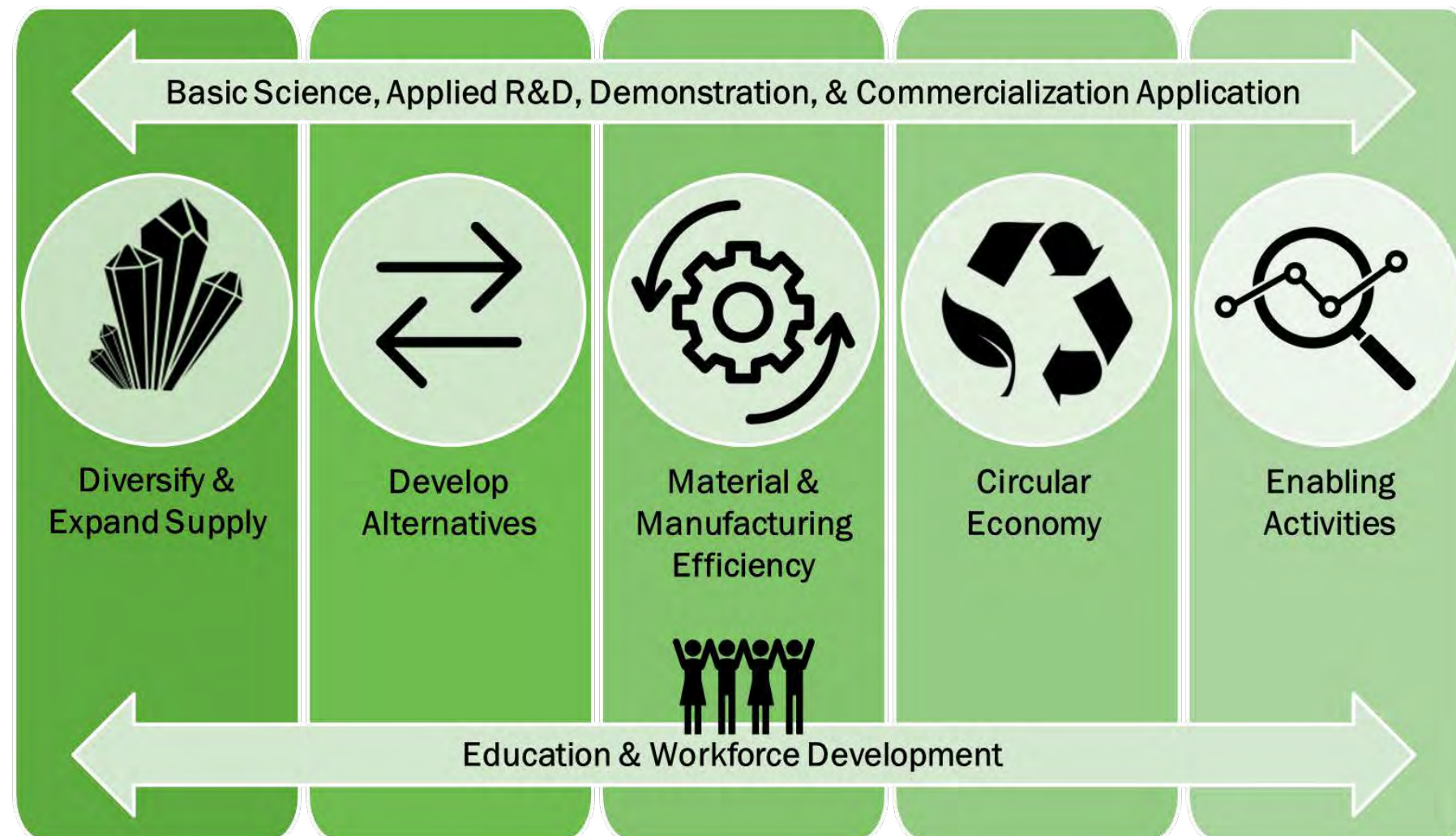
→ Wide bandgap power electronics enable high voltage power generation (like wind) to connect to the grid

• Germanium for microchips (semiconductors)

→ Microchips for sensors, data, and control play an important role in SMART manufacturing, which will be needed to increase efficiency and minimize waste (inclusion GHGs); Fiber and infrared optics

DOE Critical Minerals/Materials (CMM) Vision & Strategy

Reliable, resilient, affordable, diverse, sustainable, and secure domestic critical mineral and materials supply chains that support the clean energy transition and decarbonization of the energy, manufacturing, and transportation economies while promoting safe, sustainable, economic, and environmentally just solutions to meet current and future needs.



DOE is an integral part of an All-of-Government Strategy

Defense Production Act

March 2022

“To promote the national defense, the United States must secure a reliable and sustainable supply of such strategic and critical materials.”

DOD investing more than \$200 million in the rare earth supply chain to facilitate the re-establishment of an end-to-end American supply chain for rare earth permanent magnets, used in wind turbines and electric vehicle motors, by 2025.

\$35M to **MP Materials** to separate and process heavy rare earth elements in **Mountain Pass**, California, establishing a full end-to-end domestic permanent magnet supply chain, with private investment of \$700M and creating > 350 jobs by 2024.

Increase domestic mining and processing of **lithium, cobalt, graphite, nickel, and manganese.**

Enables feasibility studies and modernization projects for mining, beneficiation, and value-added processing projects to increase productivity, environmental sustainability, and workforce safety

Allows for by-product and co-product production at existing mining, mine waste reclamation, and other industrial facilities

Consistent with strong environmental, sustainability, safety, labor, Tribal consultation, and impacted community engagement standards.

Bipartisan Infrastructure Law (BIL)

November 2021

The \$550 billion in new BIL spending (\$1.2 trillion total authorization) is the largest long-term investment in our infrastructure in nearly a century.

Transportation:

- Devotes \$42 billion to strengthen ports, airports, and rail
- Appropriates \$110 billion for roads and bridges
- Invests more than \$750 million in electric vehicle and sustainable transportation initiatives

Broadband:

- Appropriates \$42.45 billion for reliable high-speed internet across the country

Resilience and Longevity of the Grid:

- Invests \$11 billion to enhance grid resilience
- Provides \$1 billion for modernizing electric generation facilities

Manufacturing:

- Invests > \$7 billion in batteries supply chain
- \$750 million to support clean energy manufacturing and recycling
- **Buy America** provision to build infrastructure projects with American iron, steel, and construction materials.

Clean Energy Demonstrations:

- \$8 billion for clean hydrogen
- >\$10 billion for CCUS, direct air capture, industrial emission reduction
- \$2.5 billion for advanced nuclear

High Quality Jobs

- Expected to create **nearly half a million manufacturing jobs**
- >80% of funding covered by prevailing wage provisions. **~75% of jobs do not require an advanced degree.**

CHIPS (Creating Helpful Incentives to Produce Semiconductors) and Science Act

July 2022

The CHIPS Act will keep the United States the leader in the industries of tomorrow, including nanotechnology, clean energy, quantum computing, and artificial intelligence.

- Designed to boost American semiconductor research and production and unlock hundreds of billions in private investment
- Strengthening American manufacturing, supply chains, and national security, while investing in research and development, science and technology, and the workforce of the future
- Includes > \$1B focused on deploying wireless technologies and interoperable radio access networks to support wireless supply chains
- \$67B in the DOE to enable cutting-edge R&D in areas including advanced manufacturing and advanced materials
- Follow-on private investment:
 - Micron: \$40B memory chip manufacturing
 - Qualcomm: ↑ output ~50% over 5 yrs
 - Wolfspeed: Opening largest silicon carbide materials facility in the world in North Carolina in 2030

Inflation Reduction Act (IRA)

August 2022

The largest climate and clean energy investment in American history

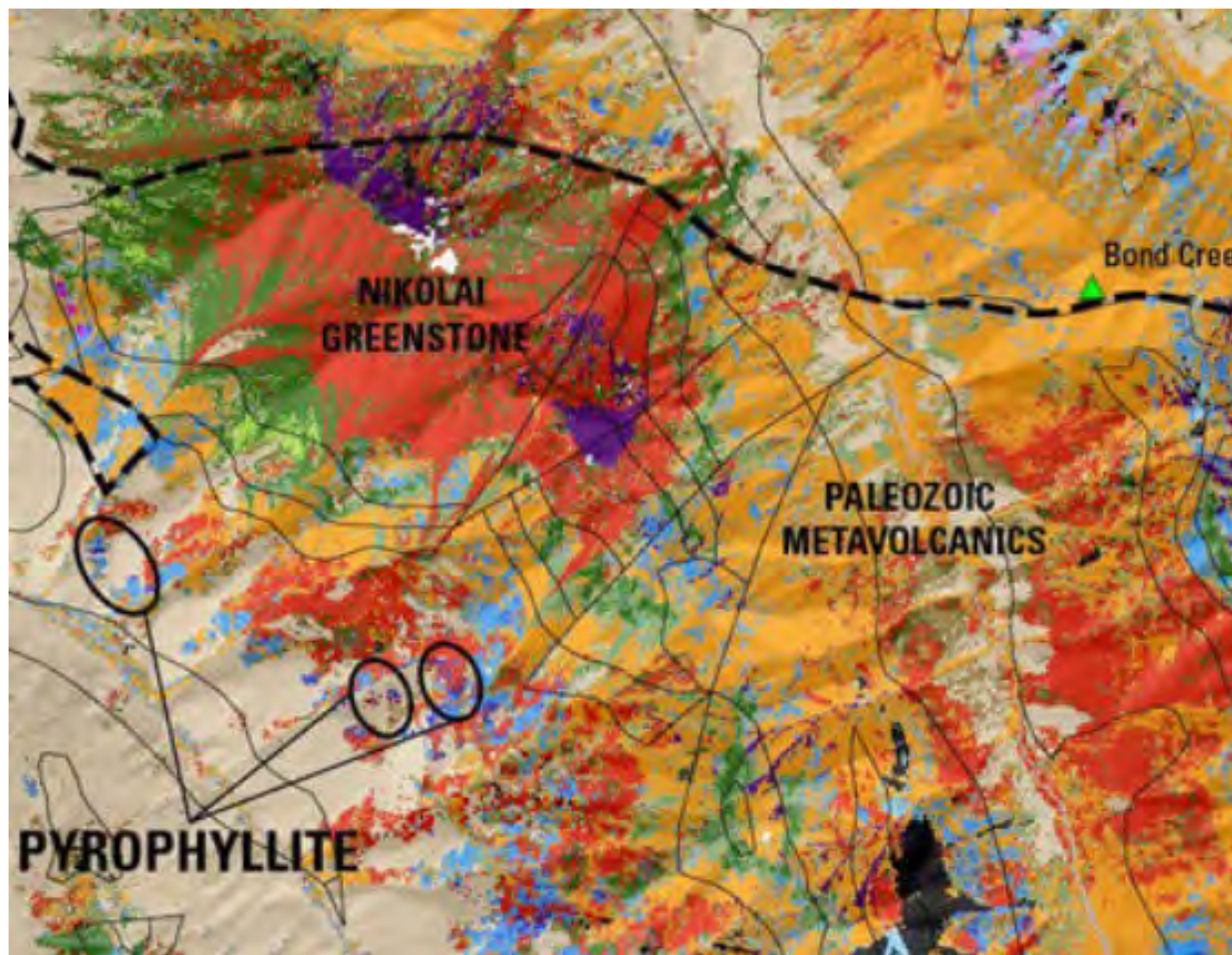
Provides 10 years of certainty and support to manufacturers, installers, and investors

Delivers a historic focus on domestic job creation with strong incentives for prevailing wages and apprenticeships

Saves American families thousands of dollars in home and transportation energy costs

Focused investment in energy communities and historically underserved communities; specific benefits for low- and middle-income consumers

Expected to reduce greenhouse gas (GHG) pollution to ~40% below 2005 levels by 2030



\$510.7M in BIL funding for the United States Geological Services (USGS) to better map the nation’s mineral resources both still in the ground and in mine wastes, to preserve historical geologic data and samples, and to construct a USGS energy and minerals research center in partnership with the Colorado School of Mines.

Bipartisan Infrastructure Law R&D to Diversify and Expand Supply

Resource Sustainability Funding Opportunity

Rare Earth Element Demonstration Facility

U.S. DEPARTMENT OF ENERGY | Fossil Energy and Carbon Management

\$140M in BIL funding for design, construction and operation of a new facility to demonstrate the commercial feasibility of a full-scale rare earth element (REE) and critical minerals (CM) extraction and separation refinery using unconventional resources

The Bipartisan Infrastructure Law: Battery Supply Chains

\$2.8B Announced in Oct. 2022 to Boost Battery Manufacturing & Processing

- 21 Projects; \$9.083B Total Investment
- Battery-grade lithium: ~2M EVs / yr
- Battery-grade graphite: ~1.2M EVs / yr
- Battery-grade nickel: ~400,000 EVs / yr
- First large-scale, commercial lithium electrolyte salt (LiPF₆) facility in the U.S.
- First commercial scale domestic silicon oxide facilities: anode materials for ~600,000 EV batteries / yr
- First lithium iron phosphate cathode facility in U.S.

Li-Bridge Alliance Launched in November 2021: Facilitating industry-government interaction to support a resilient high-capacity battery supply chain for the United States (14 federal agencies, >600 industry partners)

Battery Workforce Initiative Launched in December 2022: “American leadership in the global battery supply chain will be based not only on our innovative edge, but also on our skilled workforce of engineers, designers, scientists, and production workers.” Secretary Jennifer Granholm

American Battery Materials Initiative will be led by a White House steering committee and coordinated by the Department of Energy with support from the Department of the Interior.

Bringing the Private Sector Off the Sidelines

Advanced Energy Investment Tax Credit (48C) (\$10B)	<p>Up to 30% of the qualified investment in property used in a qualifying advanced energy project, including projects that re-equip, expand, or establish new facilities for the processing, refining, or recycling of critical materials.</p> <p>Prevailing wage and apprenticeship requirements must be met for full 30% tax credit.</p>
Advanced Manufacturing Production Tax Credit (45X)	<p>Supports production of critical minerals at 10% of project costs incurred</p>
Clean Vehicle Tax Credit (30D)	<p>Supports an independent domestic EV industry by providing tax credits for the purchase of EVs, if a minimum percentage of the value of the critical minerals in the batteries are sourced from North America or allies. The required percentage of critical minerals starts at 40% and increases over time.</p>
Domestic Manufacturing Conversion Grants (\$2B)	<p>Grants to support the transition of domestic manufacturing facilities to manufacture EVs, hybrids, and hydrogen fuel cell vehicles</p>

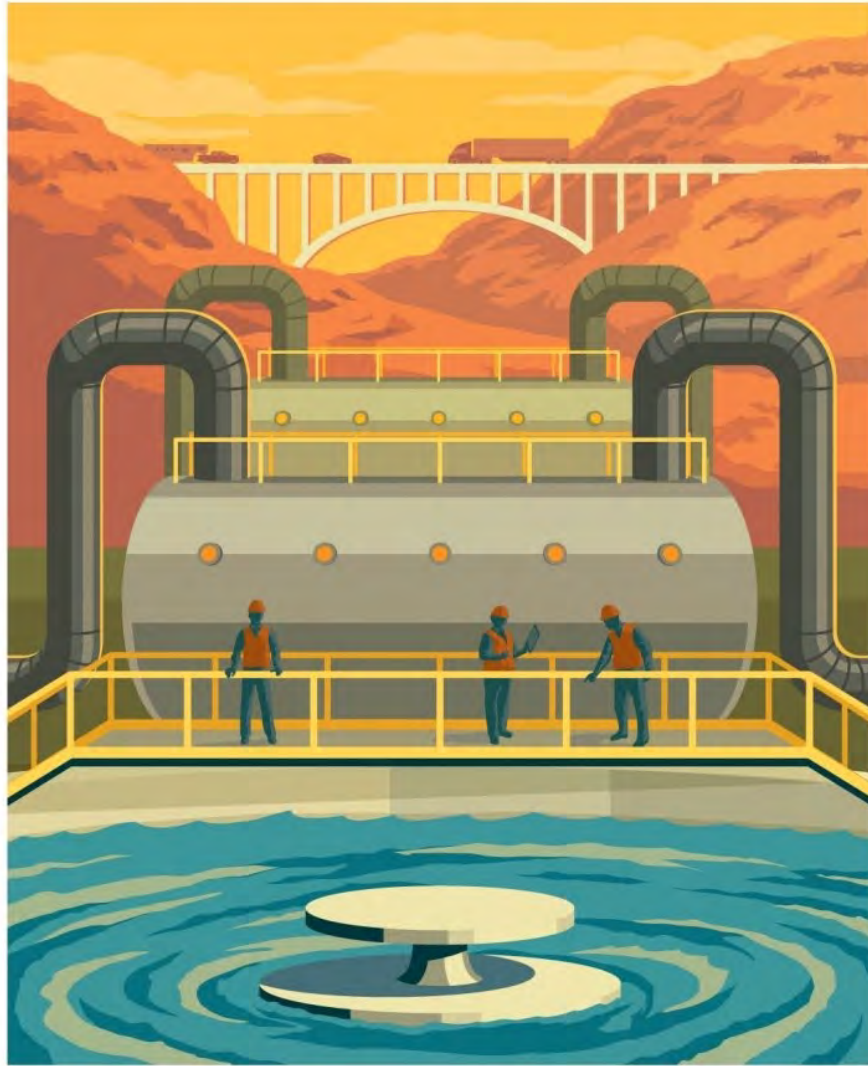
DOE Loan Programs Office Expansion



- **Expansion of LPO's existing loan programs:**
 - **Triples** loan authority for innovative energy technologies (\$40 billion)
 - **Eliminates cap** on loan authority for clean vehicle manufacturing
 - Provides **10x increase** in loan authority for Tribal energy programs (\$20 billion)

CRITICAL MATERIALS

Extraction • Manufacturing • Mining • Processing • Recovery • Recycling




LPO
Loan Programs Office

BUILDING A BRIDGE
TO BANKABILITY

BUILT IN AMERICA

ENERGY.GOV/LPO

CRITICAL MATERIALS

SYRAH VIDALIA

VIDALIA, LOUISIANA



The first battery-grade natural graphite active anode material supplier in the U.S., supporting the growing EV industry.

**DIRECT LOAN:
CONDITIONAL
COMMITMENT**

Up to \$107M

CRITICAL MATERIALS

RHYOLITE RIDGE

ESMERALDA COUNTY, NEVADA



Rhyolite Ridge will process lithium carbonate to support the domestic EV battery supply chain.

**DIRECT LOAN:
CONDITIONAL
COMMITMENT**

Up to \$700M

FINANCED BY
U.S. DEPARTMENT OF
ENERGY



LPO
Loan Programs Office



LPO
Loan Programs Office

DOE Approach to Community Benefits: Four Priorities

Justice 40

Meet or exceed the objectives of the Justice40 initiative that 40% of benefits accrue to disadvantaged communities

Diversity, Equity, Inclusion, and Accessibility

Equitable access to wealth building opportunities (teaming, access to good jobs, business and contracting opportunities, etc.)

Good Jobs

Create good-paying jobs to attract and retain skilled workers and ensure workers have a voice on the job over decisions that affect them (wages, working conditions, safety, etc.)

Workforce and Community Agreements

Meaningful engagement with community and labor partners leading to formal agreements



*In most cases, these plans equate to 20% of the technical merit points for project proposals

Justice40 Initiative

**Executive Order 14008:
Tackling the Climate
Crisis at Home and
Abroad
(1/27/21)**

40% of the overall benefits of certain Federal investments must flow to disadvantaged communities, including:

- Climate change
- Investments in clean energy and energy efficiency
- Clean transit
- Affordable and sustainable housing
- Training and workforce development
- Remediation and reduction of legacy pollution
- Development of clean water infrastructure

Diversity, Equity, Inclusion, and Accessibility

- The Community Benefits Plan must describe how diversity, equity, inclusion, and accessibility (DEIA) objectives will be incorporated into the project.
- Should detail how the applicant will partner with:
 - Underrepresented businesses
 - Minority Serving Educational institutions
 - Training organizations that serve workers who face barriers to accessing quality jobs, and/or other project partners to help address DEIA.



DOE Jobs Priorities

Access to economic opportunity creates a virtuous cycle.

“I’m confident that as the American people see and feel the benefits from our efforts to transform America’s economy, lower costs, create jobs, and strengthen our national security, we will build momentum and broaden support for further action.”

Secretary Granholm

Re: Inflation Reduction Act

Grow American jobs

By investing in infrastructure and domestic supply chains and adopting/enforcing domestic content, manufacturing, and assembly requirements

Improve the quality of energy jobs

By supporting responsible employers, adopting and ensuring accountability with strong labor standards, and encouraging collective bargaining.

Facilitate diversity, inclusion and equitable access

By focusing workforce development efforts on removing barriers to career-track training, quality jobs, and career advancement

Good Jobs and Investing in Workers

- Funding applicants must detail commitments to:
 - Pay **above average wages** and benefits in both the construction AND operations jobs
 - Ensure workers have a **free and fair chance to form or join a union**
 - Invest in workforce training to **support a skilled workforce** and provide pathways to advancement
 - Ensure worker voice in workplace **health and safety** plan design and implementation



Workforce and Community Agreements

Describe the applicant's plans to engage with labor unions, tribal governments, and community-based organizations representing local stakeholders including disadvantaged communities.

Describe plans to negotiate formal workforce and community agreements to detail benefits, partner obligations, and remedies to ensure accountability.



Lane Dilg
Senior Advisor
Office of the Under Secretary for Infrastructure



U.S. DEPARTMENT OF
ENERGY

Complete Supply Chain for Tomorrow



David Hochschild, *Chair of the California Energy Commission (CEC)*

Dee Dee Myers, *Senior Advisor to the Governor and Director at the Governor's Office of Business and Economic Development (GO-Biz)*

Jody A. Breckenridge, *Vice Admiral - United States Coast Guard (Ret.) and Chair of the Governor's Military Council*

Patty Monahan, *Commissioner at the California Energy Commission (CEC)*

Elizabeth Romero, *Assistant Vice Chancellor for Government and Community Relations at UC Riverside*

Critical Minerals in California, High Desert



Matt Sloustcher, *Senior Vice President for Communications and Policy at MP Materials*

Ryan Harnden, *Chief Operating Officer - California Operations at Rio Tinto - U.S. Borax*

Dr. Dino Gnanamgari, *Chief Commercial and Technical Officer at 5E Advanced Materials*

Dr. Gil Keinan, *Managing Director at Local Equity*

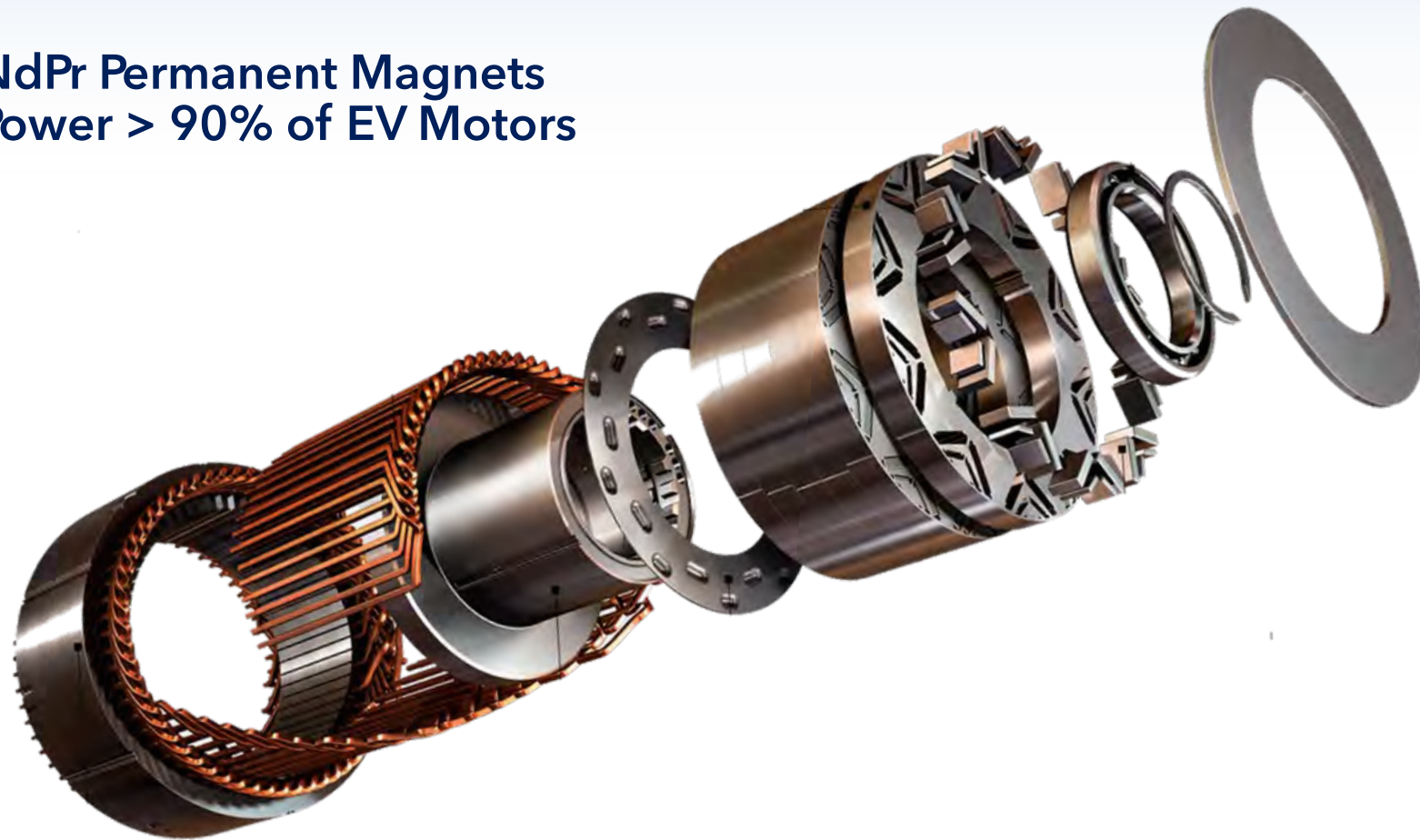


Critical Minerals in California

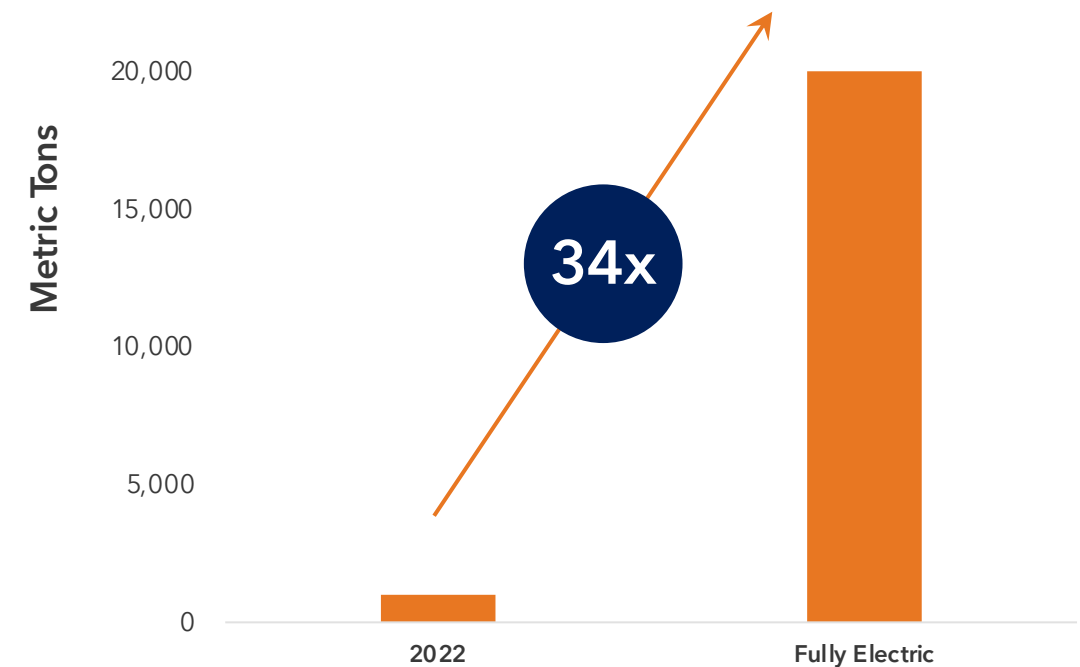
JANUARY 18, 2023

Magnets Are Synonymous With Electric Motion and Vital to EVs, **Regardless of Battery Chemistry.**







NdPr Permanent Magnets
Power > 90% of EV Motors

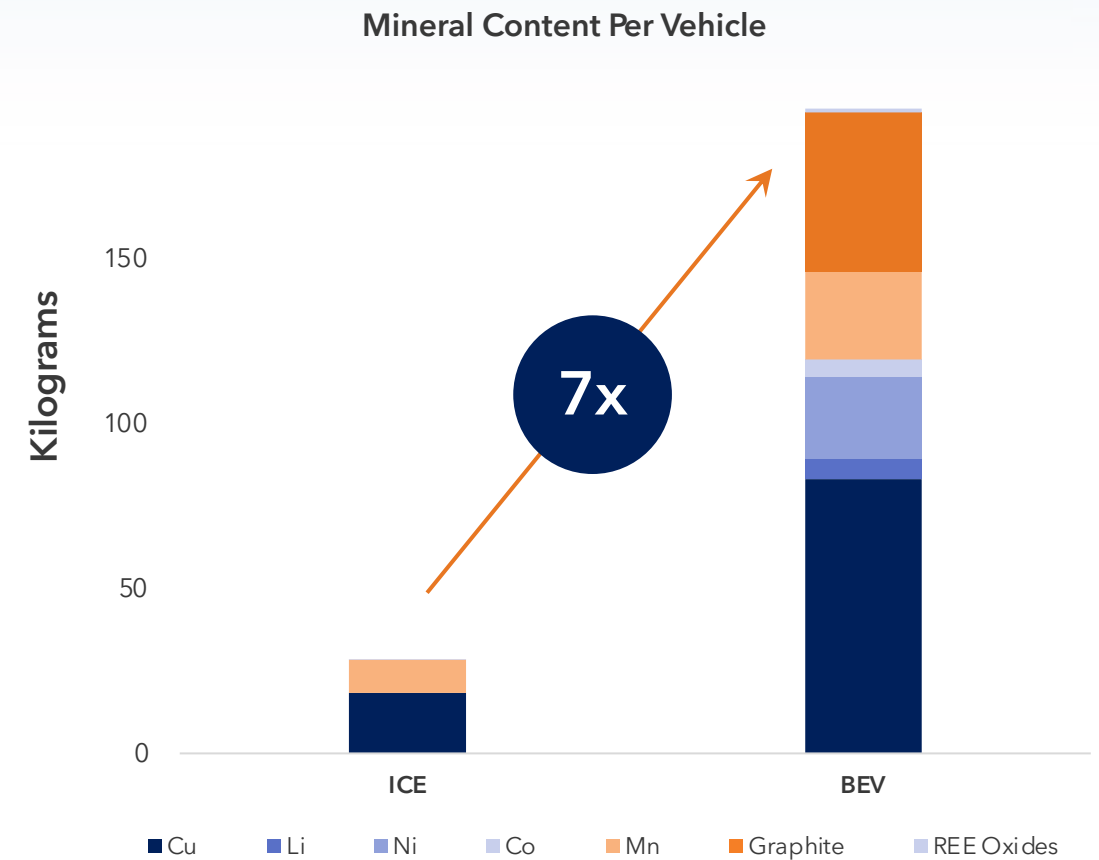


Illustrative North American NdPr Demand



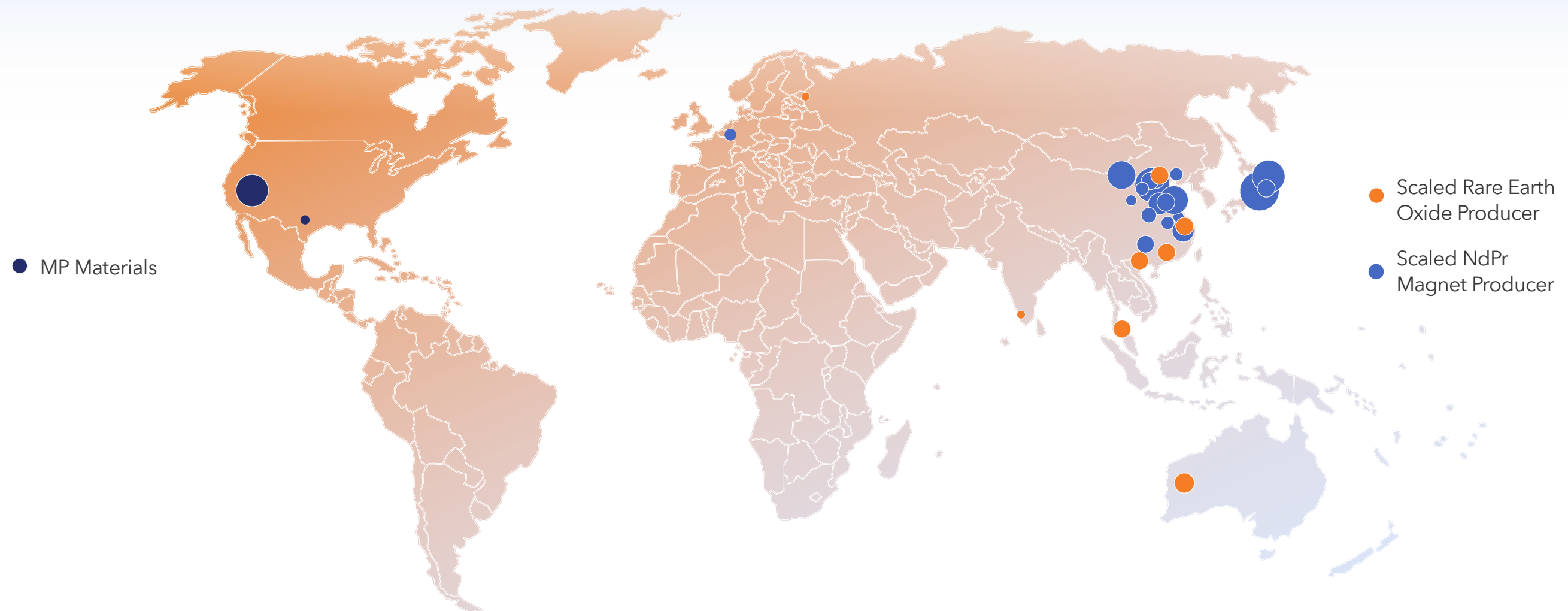
We Are Shifting From a Fuel-Intensive to a Mineral-Intensive System.

Transport Type	Propulsion System	Energy Security Framework
		
		



The West is Acutely Challenged.

Rare earths exemplify the substantial upstream supply chain risks that exist across the electrification economy.





Mountain Pass, California

Our Mission is to Restore The Full Rare Earth Supply Chain to the United States



Stage I - Concentrate production

Stage II - Separations & refining



Stage III - Magnetics production w/ integrated recycling

Environmental Sustainability



Water Reclamation Facility - Enabling sustainable water usage



Cactus Nursery - Cultivating biodiversity

MP operates the world's most sustainable rare earth production facility under stringent California standards.

High-risk wet tailings ponds were eliminated with dry-stack tailings process.

Developing a multi-pronged approach to material recycling.

Issued \$690 million convertible green bond in March 2021.

Maintaining biodiversity with cactus nursery and other reinvestments into local ecology.

California Impact



Operational Jobs - Equipment operators, mechanics, skilled trades

Technical Jobs - Engineers, geologists, laboratory staff

MP has created approximately 420 California FTEs and is growing rapidly. We provide competitive compensation and generous benefits. Virtually every employee is a shareholder.

We spend approximately \$40 million with more than 100 California suppliers annually.

MP incurs more than \$20 million in annual state and county tax liability.

We are leading the onshoring of a critical supply chain while demonstrating the highest environmental standards.

RioTinto

Critical Minerals High Desert Panel

Ryan Harnden, Chief Operating Officer, Borates
Rio Tinto, U.S. Borax

January 2022



Rio Tinto Borates: Essential for Life, Critical for the Future

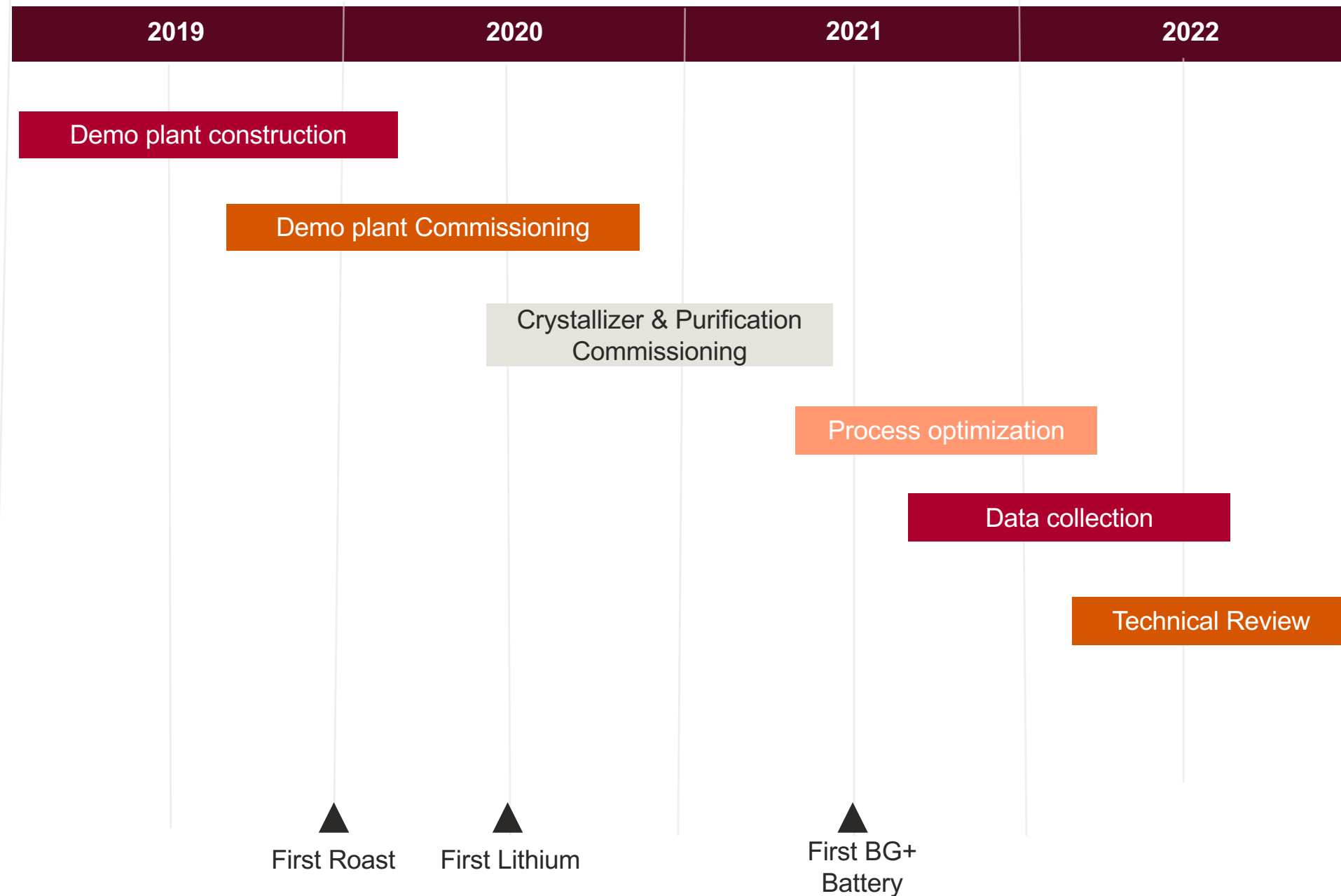
It's more than a mine, it's a sustainable solution.



- 600 Customers
- 80 Countries
- 1000 locations

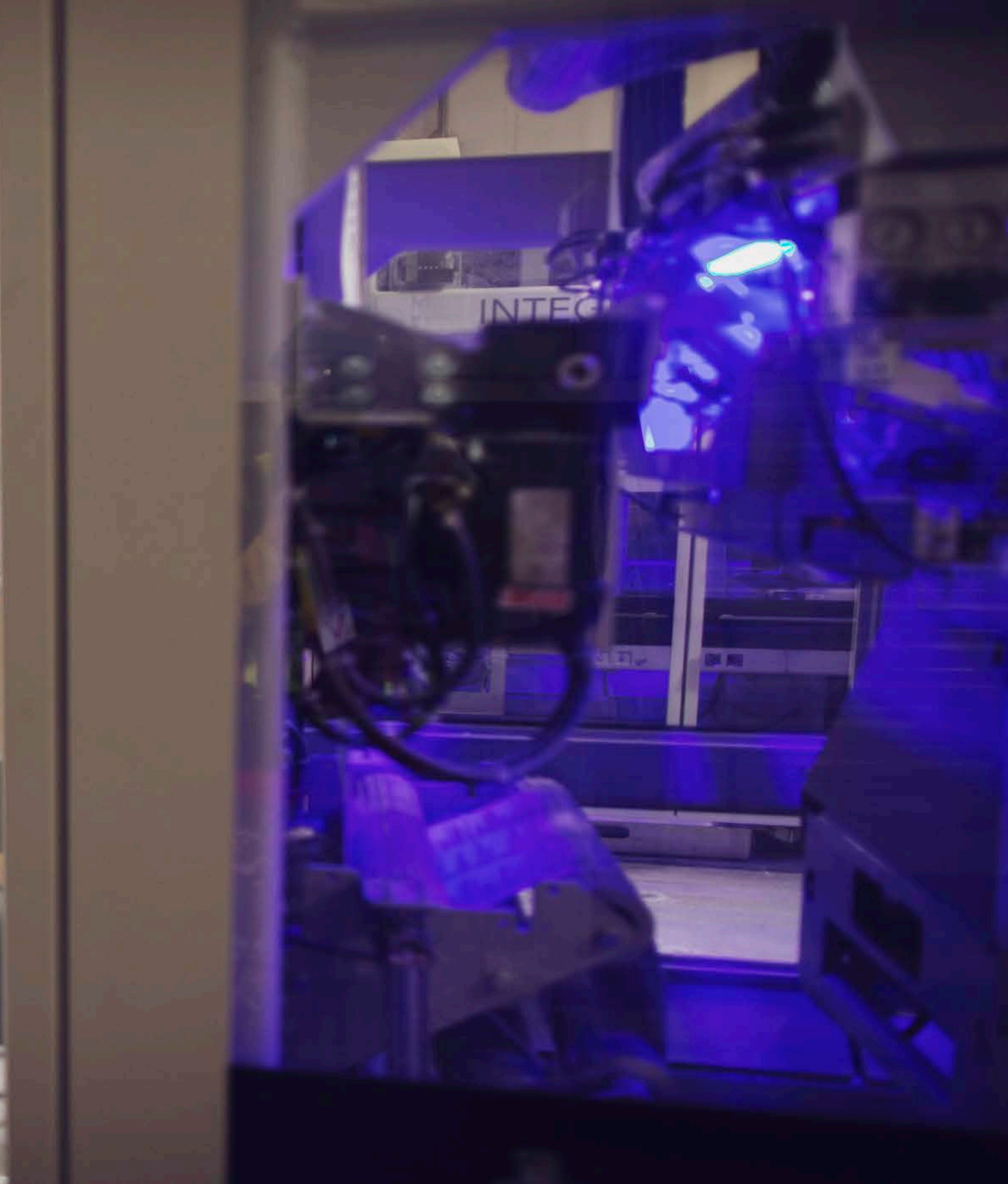
- 1000 Employees
- Largest Open Pit Mine in California
- 30% of the World's Borates supply

Lithium timeline





Challenges



Opportunities



RioTinto



Corporate Presentation

Boron and Lithium
Enabling Three Global Mega-trends

5
B
Boron
10.811

3
Li
Lithium
6.941

January 2023



Disclaimer



FORWARD-LOOKING STATEMENTS

The information in this Presentation includes “forward looking statements”. All statements other than statements of historical fact included in this Presentation regarding our business strategy, plans, goals and objectives are forward looking statements. When used in this Presentation, the words “believe”, “project”, “expect”, “anticipate”, “estimate”, “intend”, “budget”, “target”, “aim”, “strategy”, “estimate”, “plan”, “guidance”, “outlook”, “intend”, “may”, “should”, “could”, “will”, “would”, “will be”, “will continue”, “will likely result” and similar expressions are intended to identify forward looking statements, although not all forward looking statements contain such identifying words. These forward looking statements are based on 5E’s current expectations and assumptions about future events and are based on currently available information as to the outcome and timing of future events. We caution you that these forward looking statements are subject to all of the risks and uncertainties, most of which are difficult to predict and many of which are beyond our control, incident to the extraction of the critical materials we intend to produce and advanced materials production and development. These risks include, but are not limited to: our limited operating history in the borates and lithium industries and no revenue from our proposed extraction operations at our properties; our need for substantial additional financing to execute our business plan and our ability to access capital and the financial markets; our status as an exploration stage company dependent on a single project with no known Regulation S-K 1300 mineral reserves and the inherent uncertainty in estimates of mineral resources; our lack of history in mineral production and the significant risks associated with achieving our business strategies, including our downstream processing ambitions; our incurrence of significant net operating losses to date and plans to incur continued losses for the foreseeable future; risks and uncertainties relating to the development of the Fort Cady Integrated Boron Facility (“Fort Cady”), including our ability to timely and successfully complete our Small Scale Boron Facility; and other risks. Should one or more of these risks or uncertainties occur, or should underlying assumptions prove incorrect, our actual results and plans could differ materially from those expressed in any forward looking statements. No representation or warranty (express or implied) is made as to, and no reliance should be placed on, any information, including projections, estimates, targets and opinions contained herein, and no liability whatsoever is accepted as to any errors, omissions or misstatements contained herein.

You are cautioned not to place undue reliance on any forward looking statements, which speak only as of the date of this Presentation. Except as otherwise required by applicable law, we disclaim any duty to update and do not intend to update any forward looking statements, all of which are expressly qualified by the statements in this section, to reflect events or circumstances after the date of this Presentation.

MARKET AND INDUSTRY DATA

This Presentation has been prepared by 5E and includes market data and other statistical information from third party sources, including independent industry publications, government publications or other published independent sources. Although 5E believes these third party sources are reliable as of their respective dates for the purposes used herein, neither the Company nor any of its affiliates, directors, officers, employees, members, partners, shareholders or agents makes any representation or warranty with respect to the accuracy or completeness of such information. Although the Company believes the sources are reliable, it has not independently verified the accuracy or completeness of data from such sources. Some data is also based on 5E’s good faith estimates, which are derived from its review of internal sources as well as the third party sources described above. Additionally, descriptions herein of market conditions and opportunities are presented for informational purposes only there can be no assurance that such conditions will actually occur or result in positive returns.

CAUTIONARY NOTE REGARDING RESERVES

Unless otherwise indicated, all mineral resource estimates included in this Presentation have been prepared in accordance with, and are based on the relevant definitions set forth in, the SEC’s Mining Disclosure Rules and Regulation S-K 1300 (each as defined below). Mining disclosure in the United States was previously required to comply with SEC Industry Guide 7 under the Exchange Act (“SEC Industry Guide 7”). In accordance with the SEC’s Final Rule 13-10570, Modernization of Property Disclosure for Mining Registrant, the SEC has adopted final rules, effective February 25, 2019, to replace SEC Industry Guide 7 with new mining disclosure rules (the “Mining Disclosure Rules”) under sub-part 1300 of Regulation S-K of the Securities Act of 1933, as amended (the “Securities Act”) (“Regulation S-K 1300”). Regulation S-K 1300 replaces the historical property disclosure requirements included in SEC Industry Guide 7. Regulation S-K 1300 uses the Committee for Mineral Reserves International Reporting Standards (“CRIRSCO”) - based classification system for mineral resources and mineral reserves and accordingly, under Regulation S-K 1300, the SEC now recognizes estimates of “Measured Mineral Resources”, “Indicated Mineral Resources” and “Inferred Mineral Resources”, and require SEC-registered mining companies to disclose in their SEC filings specified information concerning their mineral resources, in addition to mineral reserves. In addition, the SEC has amended its definitions of “Proven Mineral Reserves” and “Probable Mineral Reserves” to be substantially similar to international standards. The SEC Mining Disclosure Rules more closely align SEC disclosure requirements and policies for mining properties with current industry and global regulatory practices and standards, including the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves, referred to as the “JORC Code”. While the SEC now recognizes “Measured Mineral Resources”, “Indicated Mineral Resources” and “Inferred Mineral Resources” under the SEC Mining Disclosure Rules, investors should not assume that any part or all of the mineral deposits in these categories will be converted into a higher category of mineral resources or into mineral reserves.

For additional information regarding these various risks and uncertainties, you should carefully review the risk factors and other disclosures in our amended Form 10 filed with the U.S. Securities and Exchange Commission (SEC) on March 7, 2022, and our Form 10-Q filed with the SEC on May 12, 2022, and our Form 8-K filed with the SEC on August 11, 2022. Additional risks are also disclosed by 5E in its filings with the Securities and Exchange Commission throughout the year, as well as its filings under the Australian Securities Exchange.

Why 5E Advanced Materials?



Boron and 5E sit at the convergence of three global mega-trends

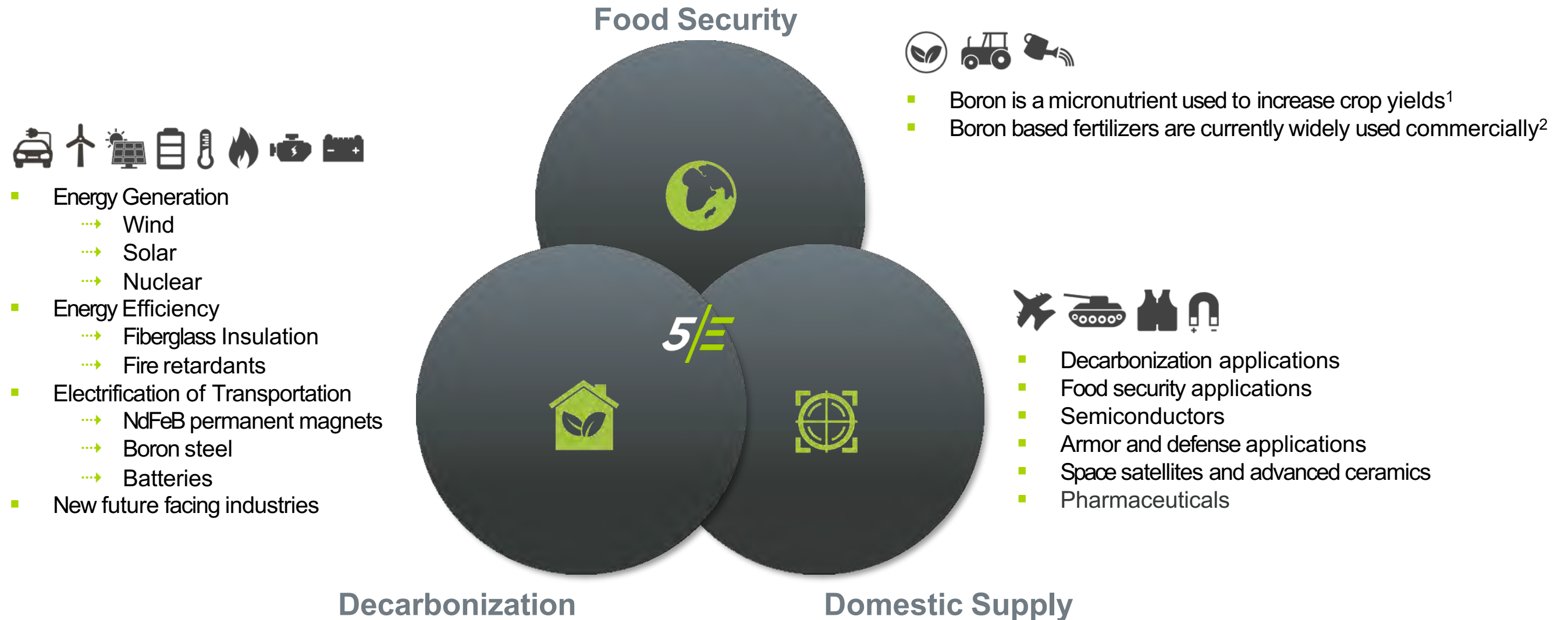
- Unique boron opportunity – scarce and valuable
- Favorable supply / demand dynamics
- Vertically integrated business model focused on high value advanced materials
- Optionality with co-product lithium production and many boron end markets
- Catalyst rich



Boron and 5E at the Center of Three Global Mega-Trends



The element and 5E straddle three global mega-trends



¹ Company commissioned University of Connecticut crop trial test: May 25, 2020.

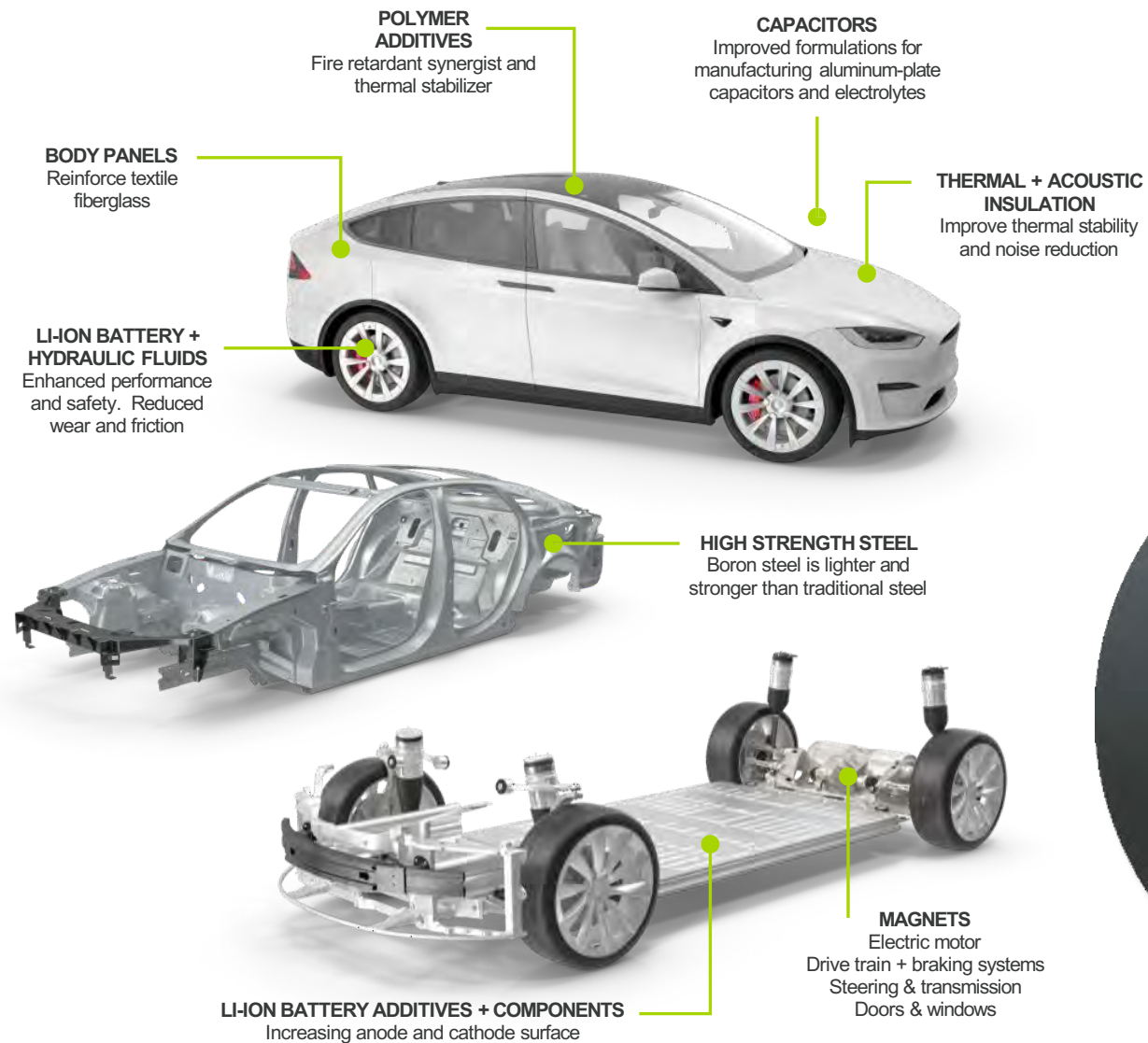
² Credit Suisse Climate Transition Super Materials Equity Research Report dated December 7, 2021; and Boron and SOP Market Overview Report, April 6, 2018, prepared by Context.

Decarbonization

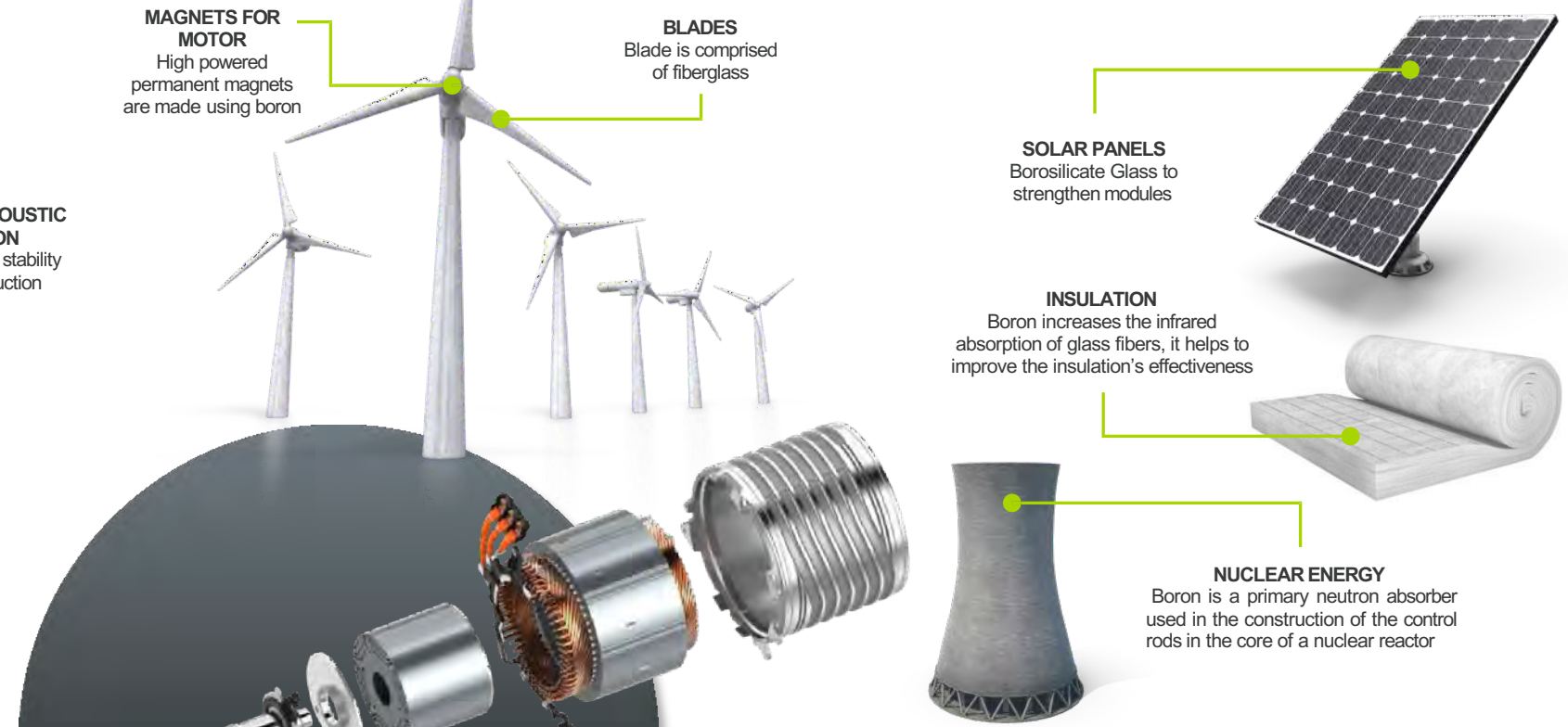


Boron is an enabler of many decarbonization technologies¹

Electric Vehicles



Clean Energy and Efficiency



Electric Motors

NdFeB - neodymium, iron, and boron

Neodymium Magnets are most commonly used in electric motors to power electric vehicles and wind turbine motors

¹ Credit Suisse Climate Transition Super Materials Equity Research Report dated December 7, 2021.

Food Security

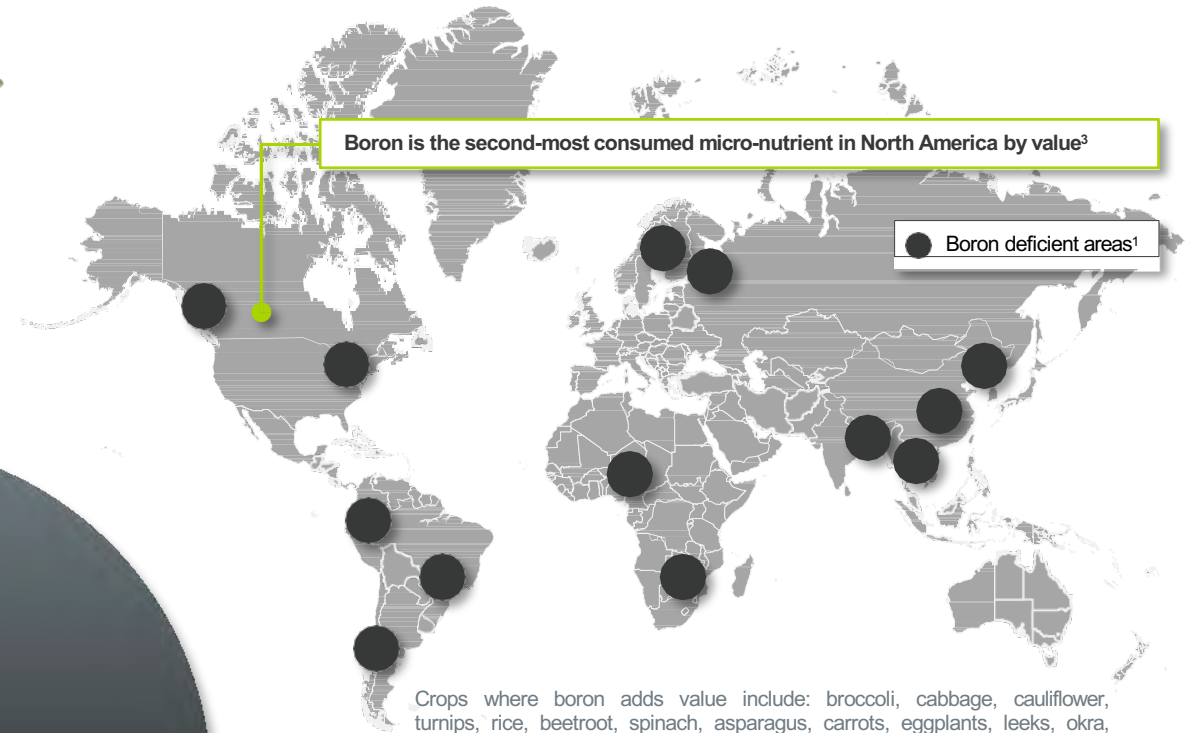
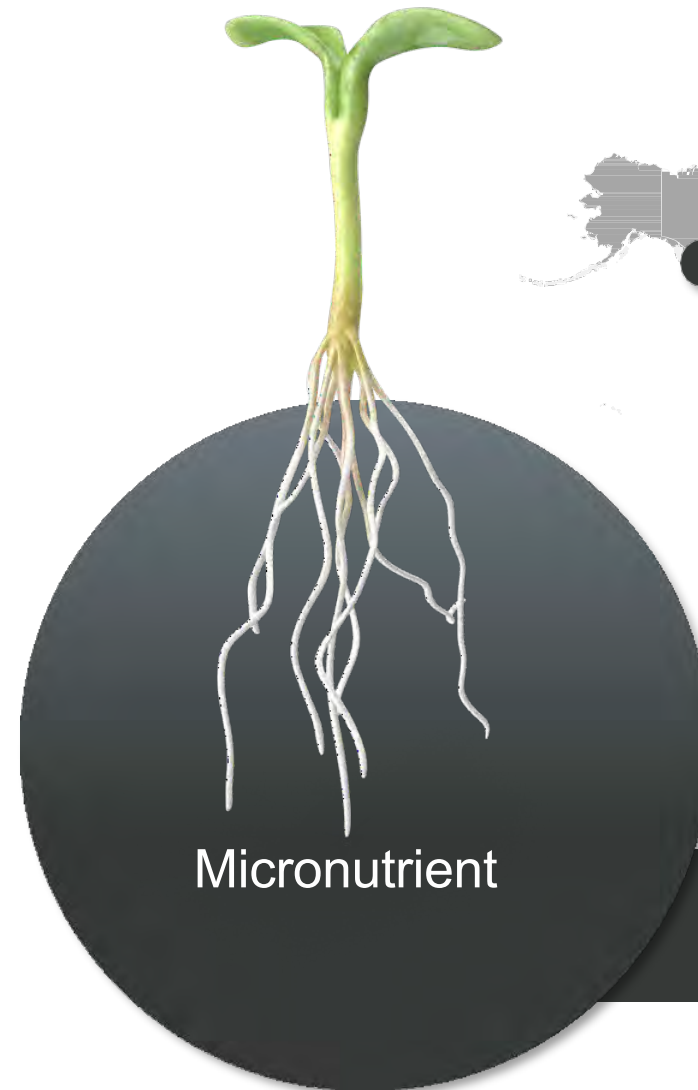


Boron is helping to keep the world fed as an essential micronutrient required by crops

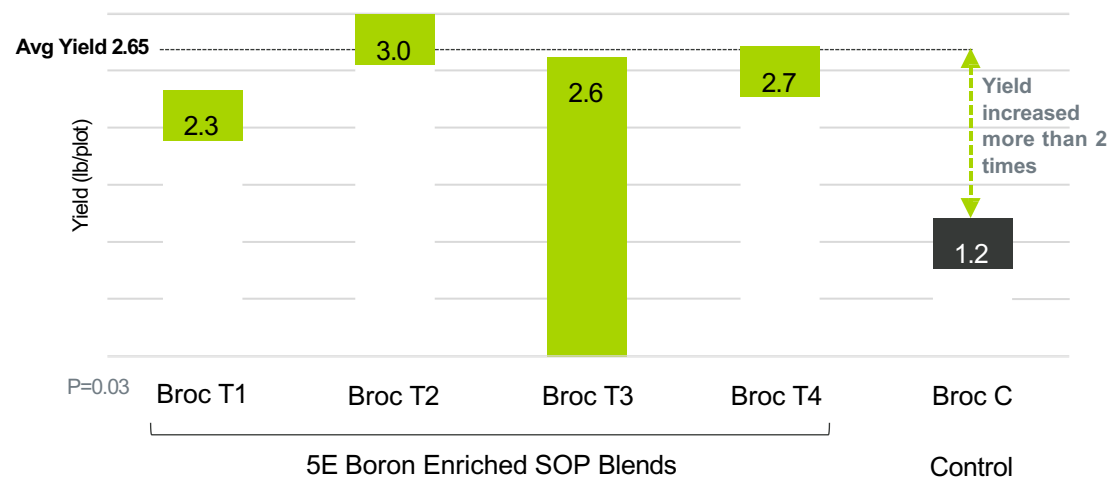
7	15	19	12	16	20		
N	P	K	Mg	S	Ca		
Nitrogen	Phosphorus	Potassium	Magnesium	Sulfur	Calcium		
Primary Macro-Nutrients			Secondary Macro-Nutrients				
5	17	25	26	28	29	30	42
B	Cl	Mn	Fe	Ni	Cu	Zn	Mo
Boron	Chlorine	Manganese	Iron	Nickel	Copper	Zinc	Molybdenum
Micro-Nutrients							

Crop yield is becoming an important food security issue as the availability of arable land has decreased by 15% over the last 30 years²

Boron is an important micronutrient in feeding a growing global population. World population is forecasted to grow 35% to 9.8B by 2050², requiring higher farming yields to meet global food production needs.



5E/UConn Broccoli Crop Yield Trials⁴



Pressure on Farming Yield

Boron is an essential micronutrient or trace element

¹ The University of Adelaide Fertiliser Technology Research Centre "Boron fertilizers: use, mobility in soils and uptake by plants" presentation, International Agriculture Symposium of Boron (AGROBOR 2016).

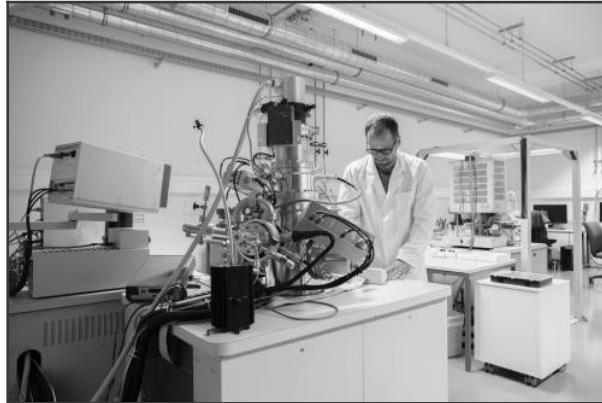
² The World Population Prospects report: The 2017 Revision, published by the UN Department of Economic and Social Affairs.

³ Boron and SOP Market Overview Report, April 6, 2018, prepared by Context.

⁴ Company commissioned University of Connecticut crop trial test: May 25, 2020.

Future Facing Technology and Markets

High value-in-use as an enabler of new technologies and markets



Cancer Treatment¹

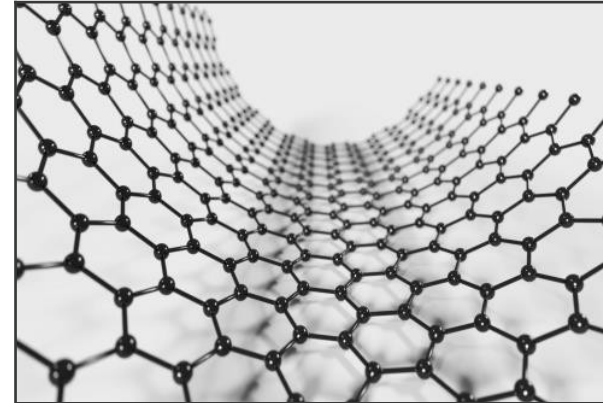
Boron Neutron Capture Therapy (BNCT) is a type of radiation therapy. A substance that contains boron is injected into a blood vessel. The boron collects in tumor cells. The patient then receives radiation therapy with atomic particles called neutrons. The neutrons react with the boron to kill the tumor cells without harming normal cells. Boron neutron capture therapy is being studied as a treatment for glioblastoma multiform and recurrent head and neck cancer.



Nano Technology²

Boron Nitride Nanotubes (BNNT) is a new material with great potential. It is considered one of the world's strongest and most advanced fiber. BNNT offers significant material benefits in:

- aviation
- automotive
- space travel
- advanced fabrics
- insulation
- filtration
- electronics and
- defense systems



Advanced Materials³

Boron is one of the most chemically and physically versatile elements, and can be manipulated to form a strong but flexible 2-dimensional structure called borophene.

Borophene applications include:

- supercapacitors
- energy storage devices
- biosensors
- batteries
- flexible electronics
- hydrogen storage



Novel Technology

5E Advanced Materials is currently focused on advancing a research collaboration with Georgetown University for the development of boron-based materials in permanent magnets.

This research has the potential to create novel intellectual property and commercialization pathways for 5E as it pertains to the manufacturing of boron enhanced permanent magnets with a specific focus on enhancing performance through increased usage of boron.

¹ National Cancer Institute "Dictionary of Cancer Terms"

² Dr Catharine Fay, Senior NASA Scientist (NASA Langley Research Center) TEDx talk Arendal, Norway

³ National Library of Medicine "The Emergence and Evolution of Borophene" Ou M, Wang X, Yu L, Liu C, Tao W, Ji X, Mei L. The Emergence and Evolution of Borophene. Adv Sci (Weinh). 2021 May 2;8(12):2001801. doi: 10.1002/advs.202001801. PMID: 34194924; PMCID: PMC8224432.

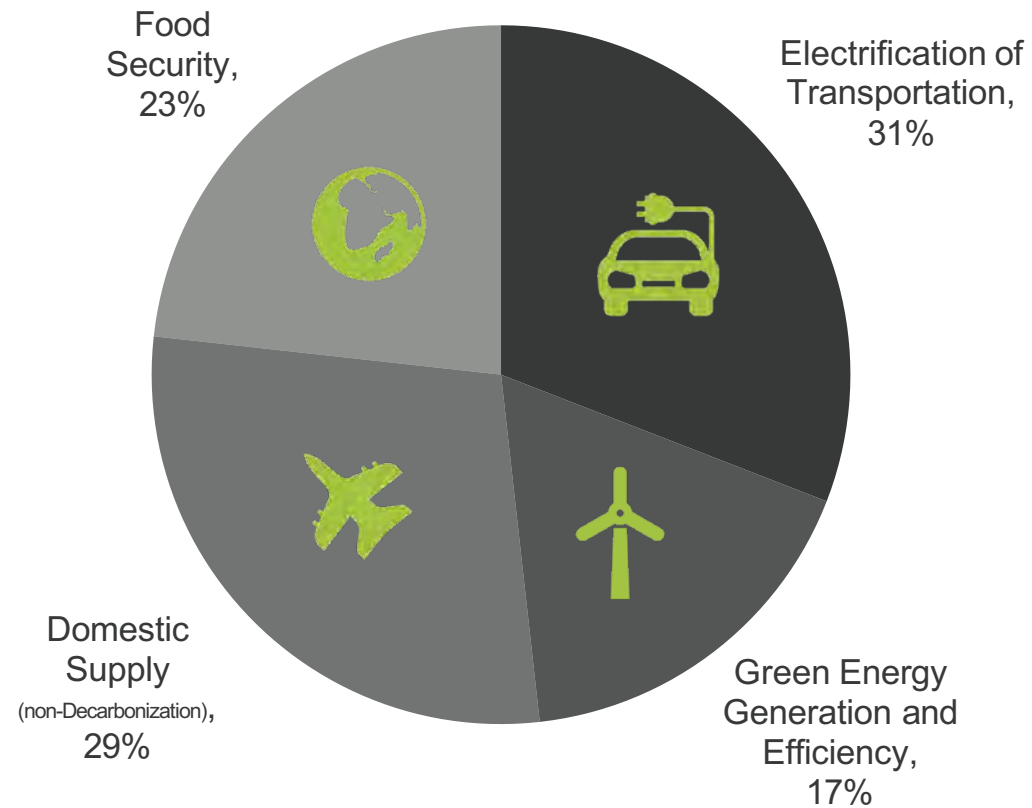
Substantial Optionality

Major existing and new boron markets with co-product lithium opportunities

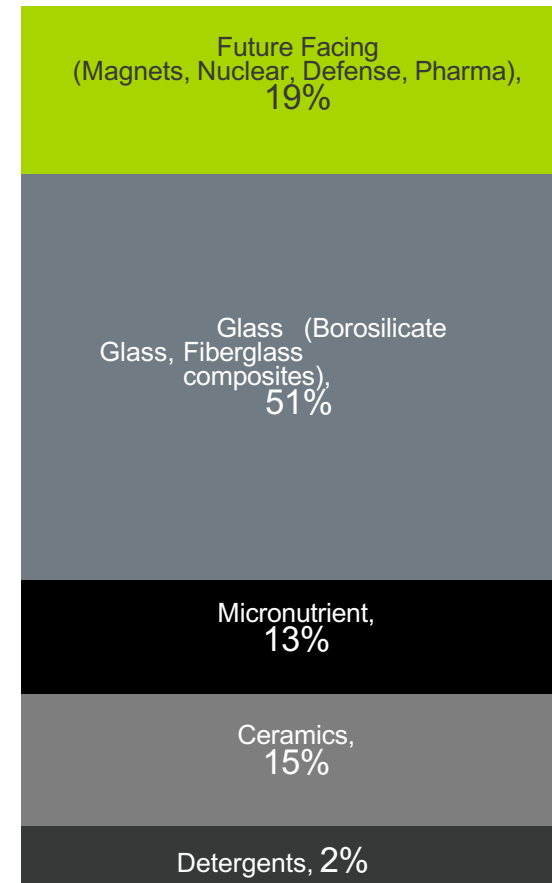


Emerging Boron Markets¹

1.6M tons of demand expected across industry verticals

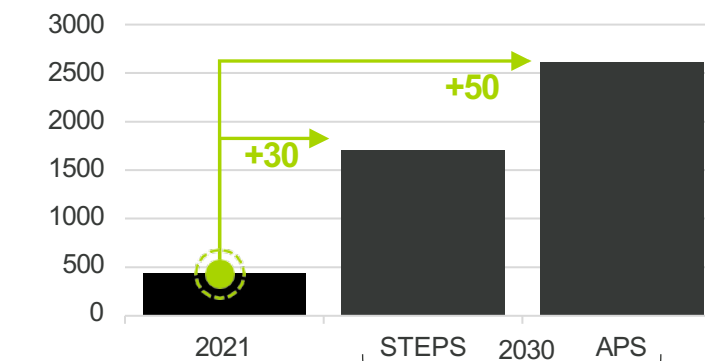
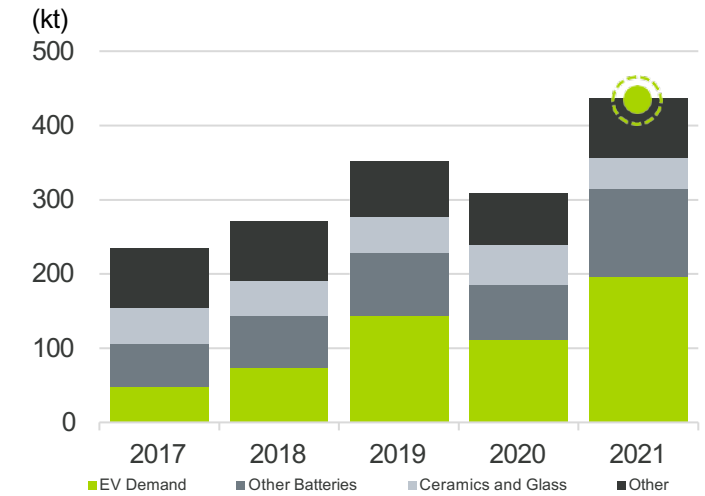


Boron Markets Today¹



Wide Range of Traditional Applications, with Limited Substitutability

Lithium Market²



50 new Lithium projects are required to meet stated market demand by 2030

¹ Global Market Insights, Inc.

² International Energy Agency Report, "Global Supply Chains of EV Batteries", July 2022 (STEPS and APS scenario) - Note: Original Lithium data converted to Lithium Carbonate using 5.323 times conversion ratio

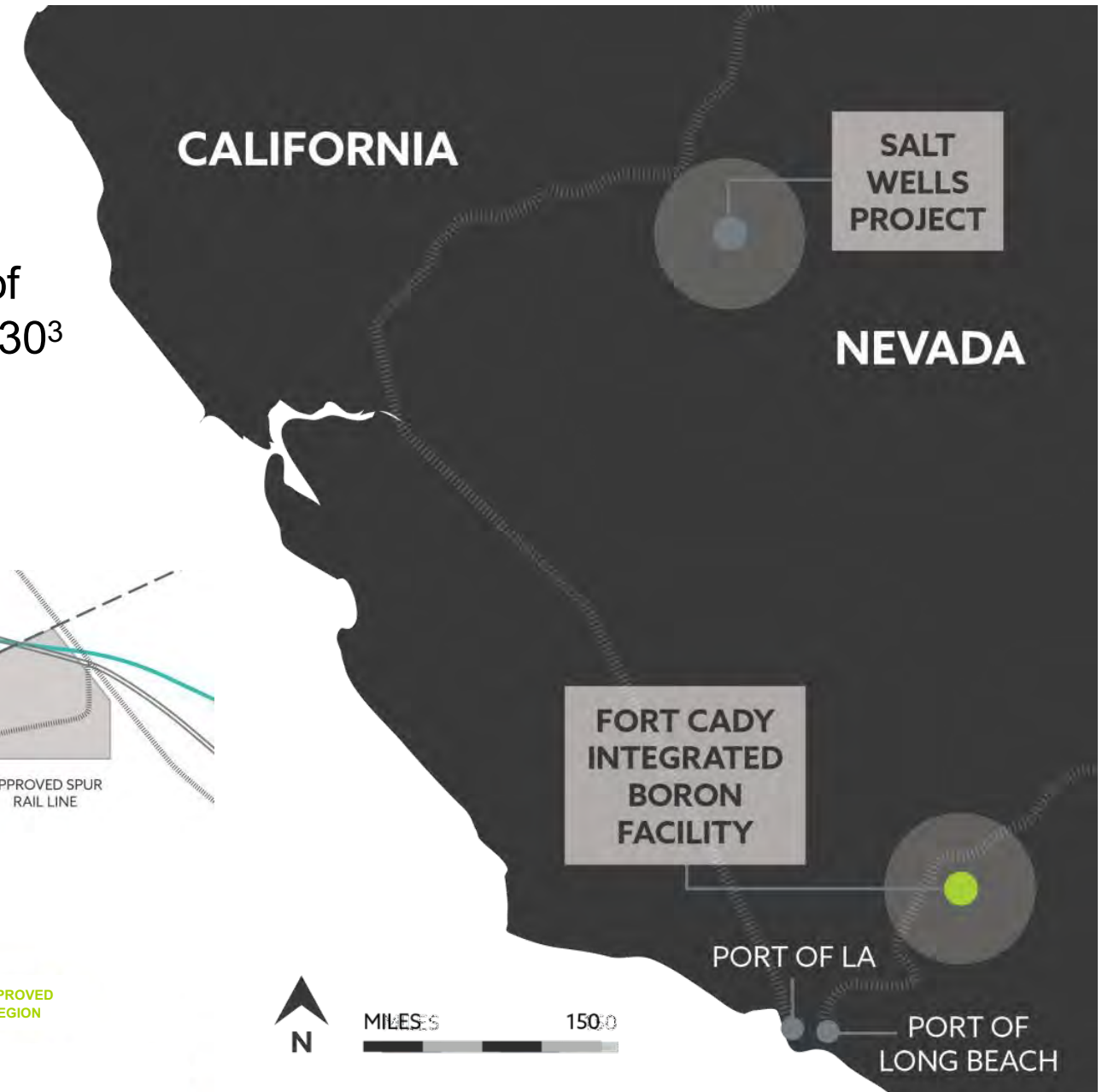
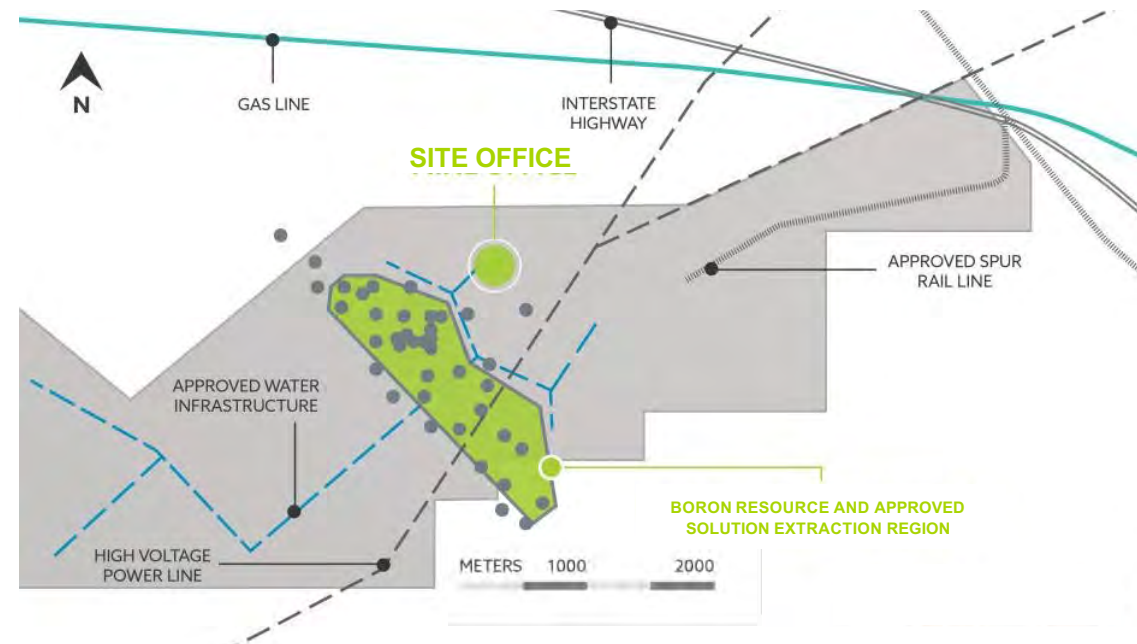
Unique Boron Opportunity



Initial production on schedule for 2023

- Duopoly Supply Market - 65% Turkish Government / 20% Rio Tinto
- Rio Tinto reserves expire in 2042 after +100 years of operation¹
- Only six new visible projects globally - Only 5E substantially permitted
- 5E targeting 500kstp^a of boric acid equivalent and several thousand tons of lithium carbonate at full production – Less than 5% of global demand in 2030³

Significant Asset ⁴	
~327m Tons	
8.22% Boric Acid Content	0.17% Lithium Carbonate Content



¹ Rio Tinto 2017 Annual Report “write back of Ore Reserves the operating life of RTB Boron has been reduced by 7 years and is anticipated to run until 2042.”

² 5E company aspirational target consistent with disclosure provided in Form 10-Q released May 12, 2022.

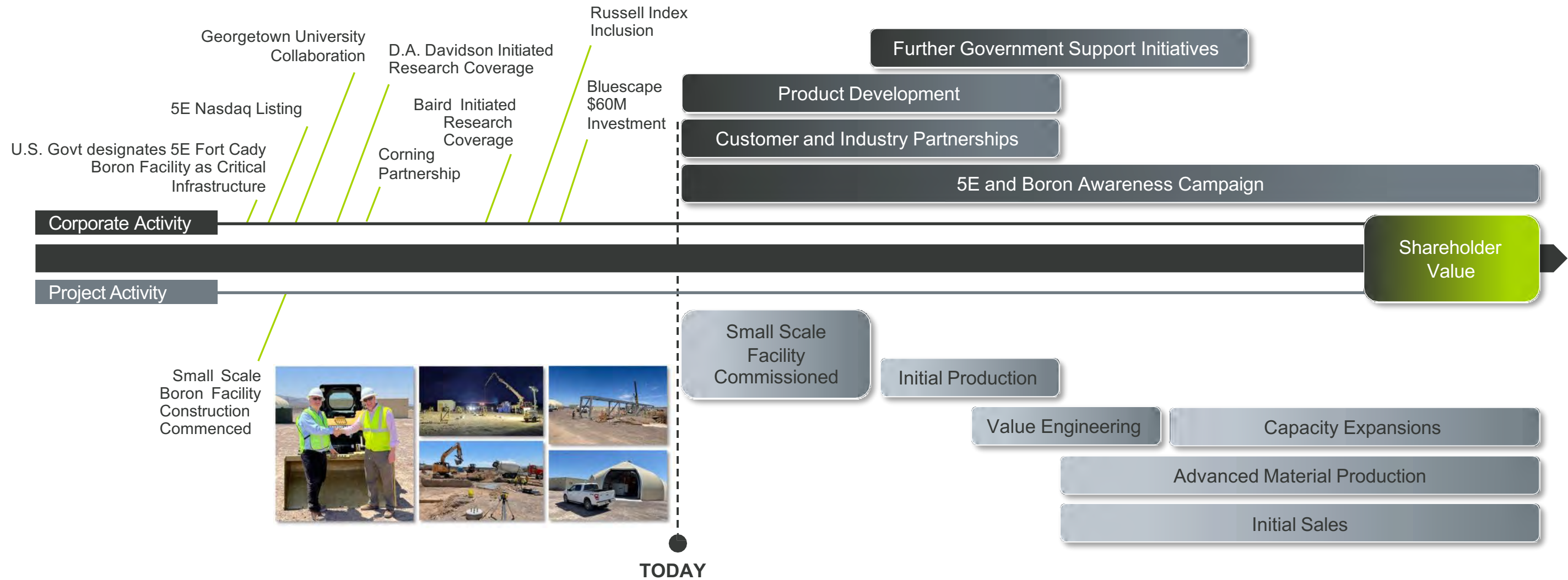
³ Credit Suisse Climate Transition Super Materials Equity Research Report December 7, 2021 (High Demand case).

⁴ Regulation S-K 1300 Initial Assessment Report dated 18 October 2021 (using 2% cut-off grade), Millcreek Mining Group.

Potential Catalysts to Come



Further project and corporate catalysts in the pipeline to deliver shareholder value



Sustainability is an Important Focus for the Business



Building Blocks of 5E's Sustainability Strategy



PRODUCTION IMPACTS

Consume fewer resources

- In-situ extraction
- Closed loop water use
- Pre-heated solution
- Process energy management
- Integrated derivative production

COMMUNITY IMPACTS

Community prosperity

- Growing workforce
- Specialized training
- Local procurement and investment



ENERGY TRANSITION

Applications enable decarbonization

- Emissions reduction
- UN Sustainable Development Goals (SDG's)

BUILT-IN SUSTAINABILITY

'Clean sheet' advantage

- Board engaged
- Sustainability work underway
- Diverse Board and leadership
- Culture and mindset

FOCUS ON INNOVATION

New applications

- University research agreement
- Joint Development Agreements with customers
- Technical / research collaborations



Boron and Lithium

5Eadvancedmaterials.com

J.T. Starzecki
Chief Marketing Officer
jstarzecki@5advancedmaterials.com

Paul Weible
Chief Financial Officer
pweibel@5advancedmaterials.com

Critical Minerals in California, High Desert



Matt Sloustcher, *Senior Vice President for Communications and Policy at MP Materials*

Ryan Harnden, *Chief Operating Officer - California Operations at Rio Tinto - U.S. Borax*

Dr. Dino Gnanamgari, *Chief Commercial and Technical Officer at 5E Advanced Materials*

Dr. Gil Keinan, *Managing Director at Local Equity*

Critical Minerals in California, Imperial Valley



Jonathan Weisgall, *Vice President for
Legislative and Regulatory Affairs at Berkshire
Hathaway Energy*

Derek Benson, *Chief Operating Officer at
EnergySource Minerals*

Rod Colwell, *Chief Executive Officer at
Controlled Thermal Resources*

Priscilla Lopez, *Director Workforce and
Economic Development at Imperial County*



Critical Minerals in California

UC Riverside – Palm Desert Campus

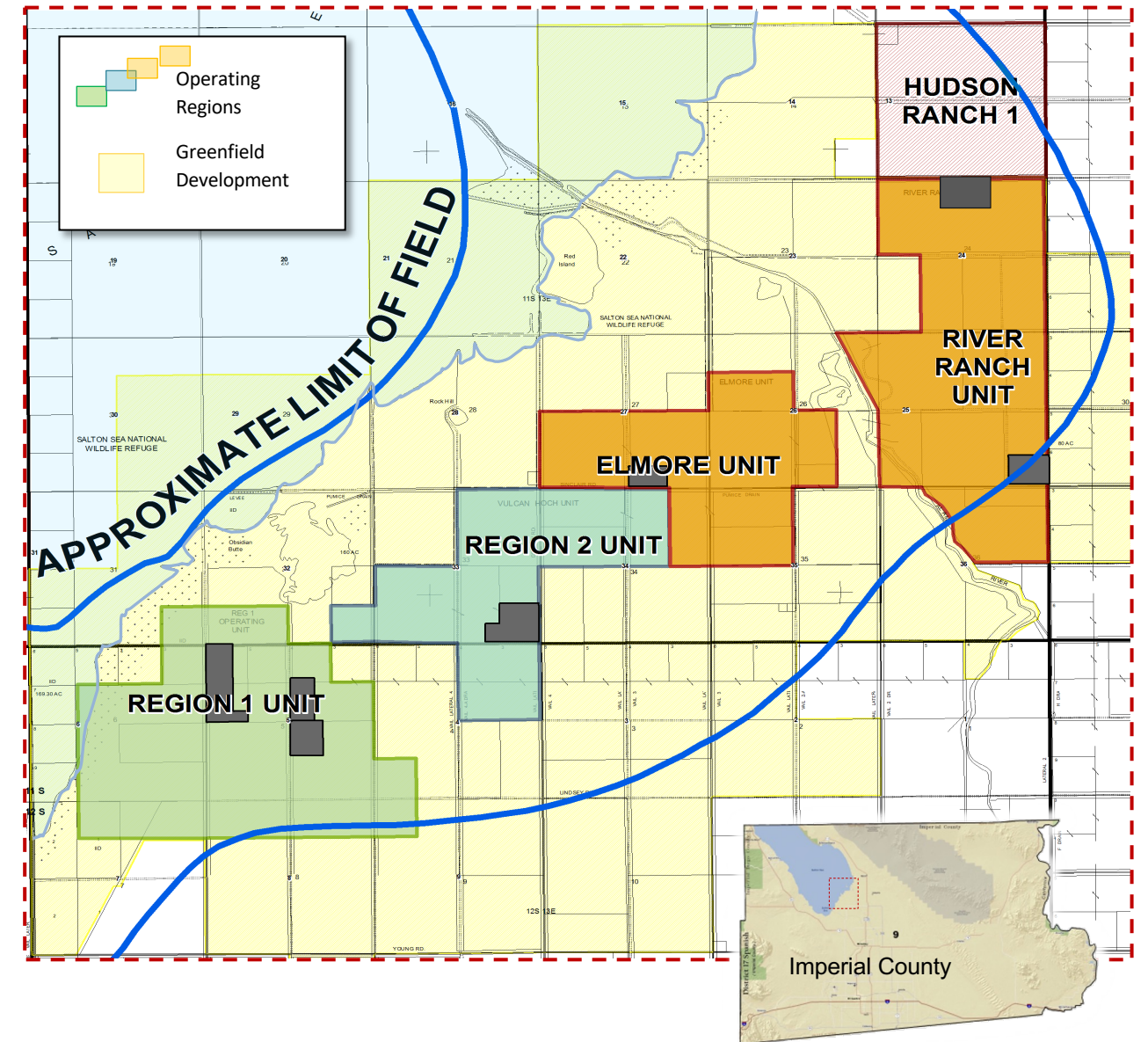
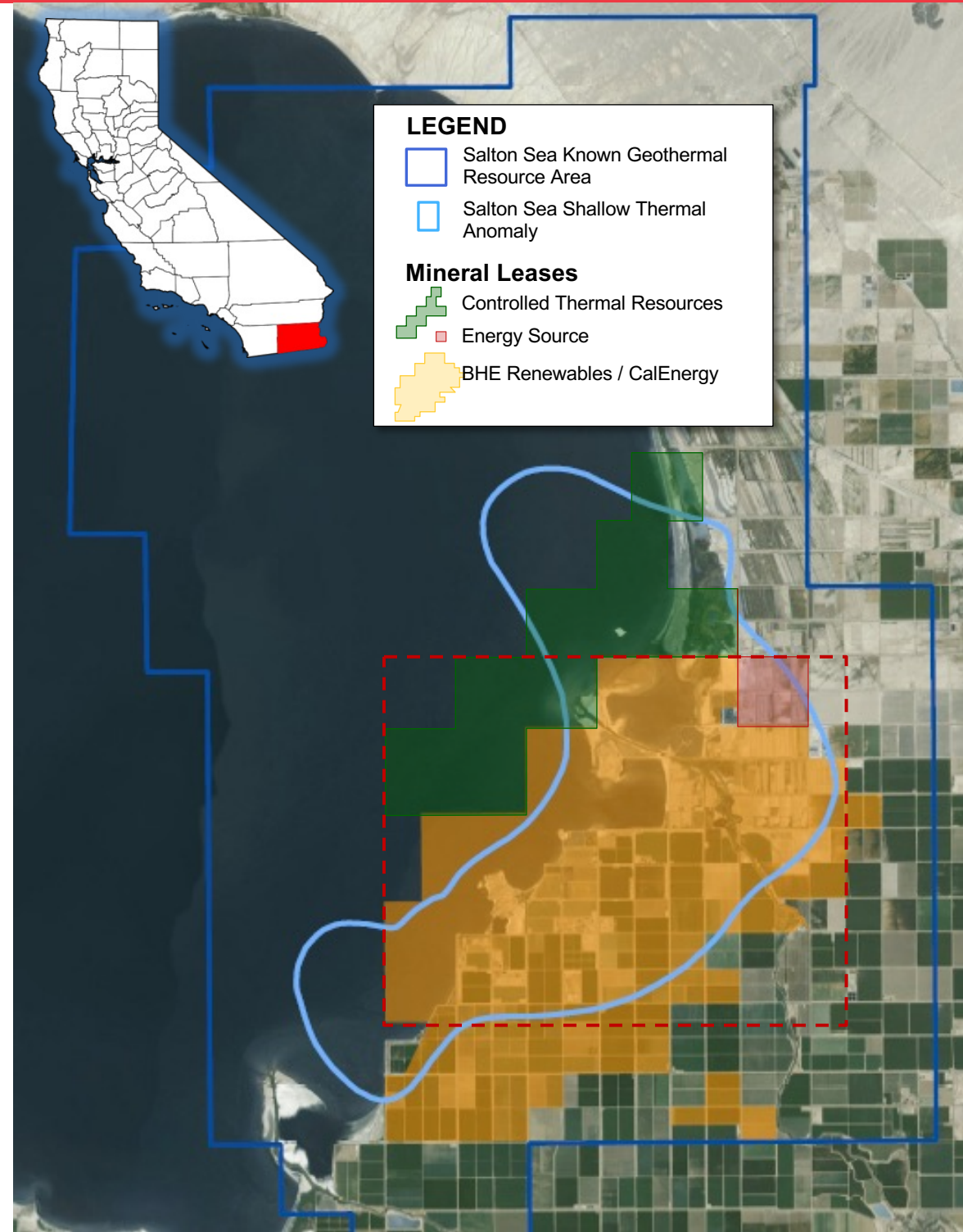
January 18, 2023

Lithium Valley and Geothermal Expansion

Jonathan M. Weisgall

Berkshire Hathaway Energy

CalEnergy Geothermal and Mineral Resources



CalEnergy's Imperial County Geothermal Plants



Power Production

- 10 power plants
- 345 MW capacity

29 Production Wells:

- 2,900 to 8,700 feet deep
- 450 to 480 degrees Fahrenheit at wellhead

30 Injection Wells:

- 2,650 to 9,200 feet deep
- 205 to 230 degrees Fahrenheit at wellhead

CalEnergy's 50 MW Elmore Facility



Lithium Recovery Demonstration Interior





Lithium Development





Critical Minerals in California

UC Riverside – Palm Desert Campus

January 18, 2023

Lithium Valley and Geothermal Expansion

Jonathan M. Weisgall

Berkshire Hathaway Energy



Sustainable Lithium. Delivered.

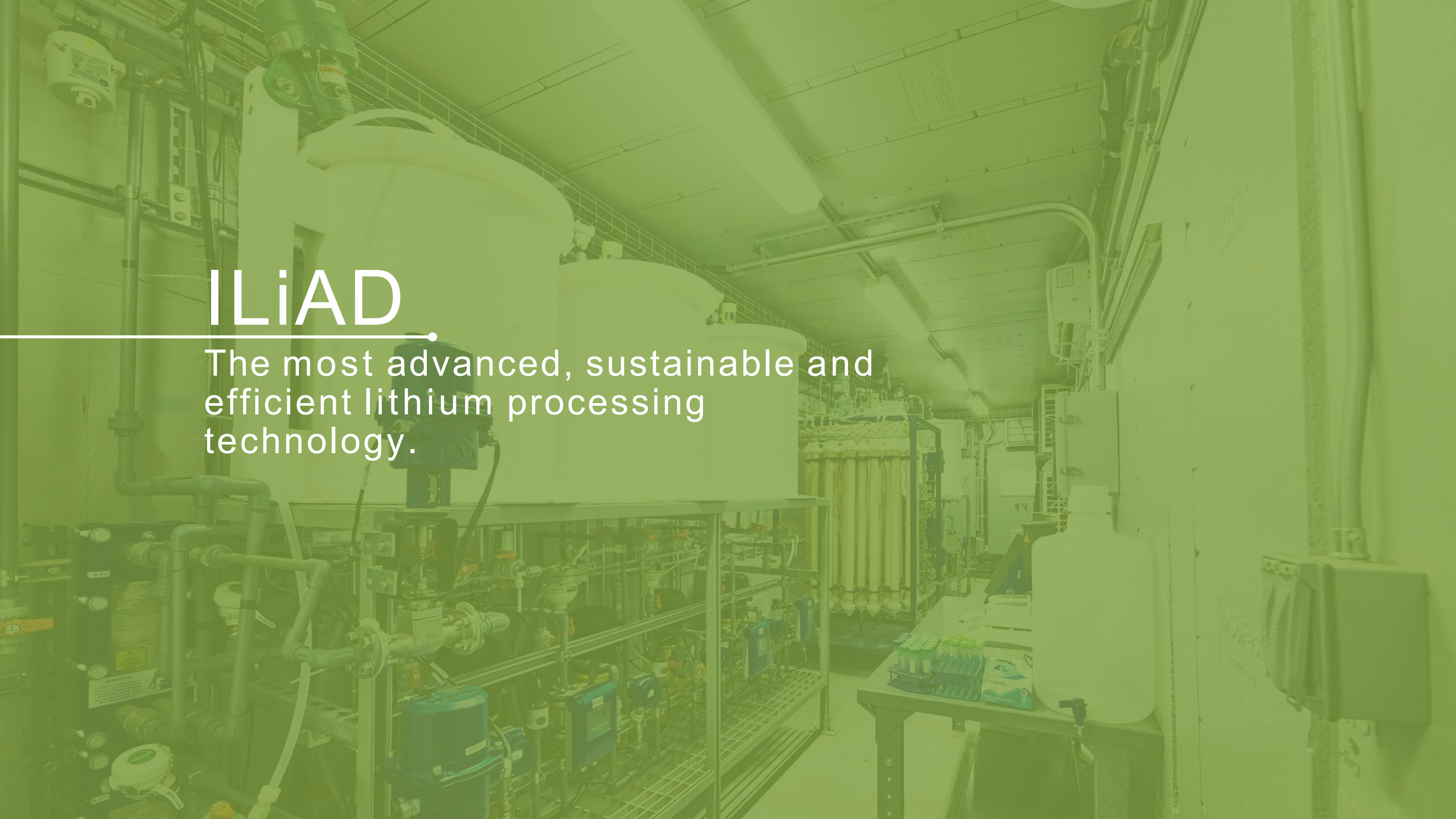
January 2023



ENERGYSOURCE
MINERALS

LiAD

The most advanced, sustainable and efficient lithium processing technology.



LiAD.

1

Patented Low Risk Process that has Been Proven Using Real Brine Flows

2

Reduces Environmental Impact with Low CO2 Emissions, Land and Water Usage

3

Commercialization Underway to Address Significant Global Total Addressable Market (TAM)

ATLiS

Lithium production from Geothermal
Brine near the Salton Sea using ILiAD.



ATLiS.

1

One of the Most Advanced Lithium Development Projects in the U.S., with All Key Permits in Place

2

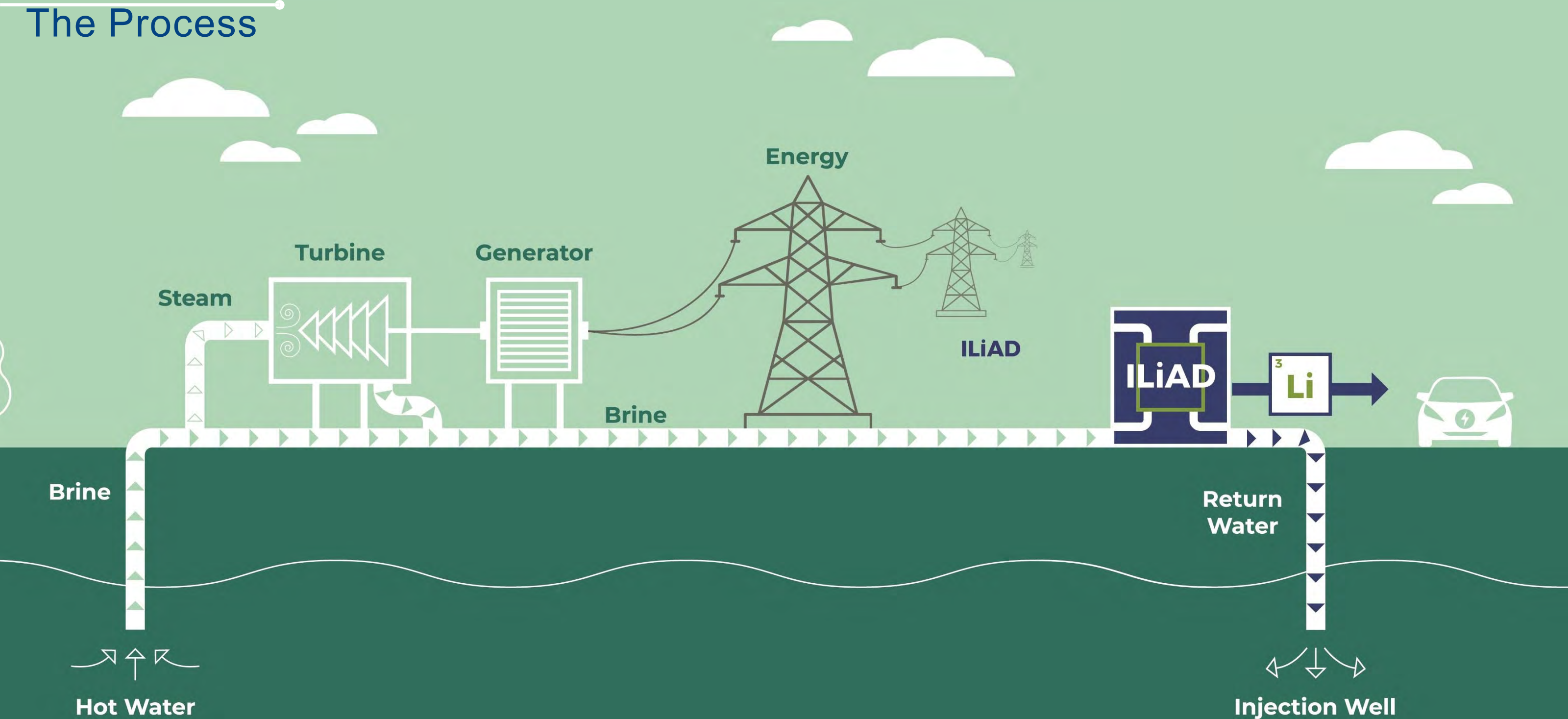
Proven Pilot Operations for Widespread Adoption

3

Strong Backing from Shareholder Base and Experienced Team with Best-in-Class Technology Partners

ATLiS

The Process



ATLiS

The Process



Just hours to produce LiOH products



Average ~93%+ lithium recovery rates



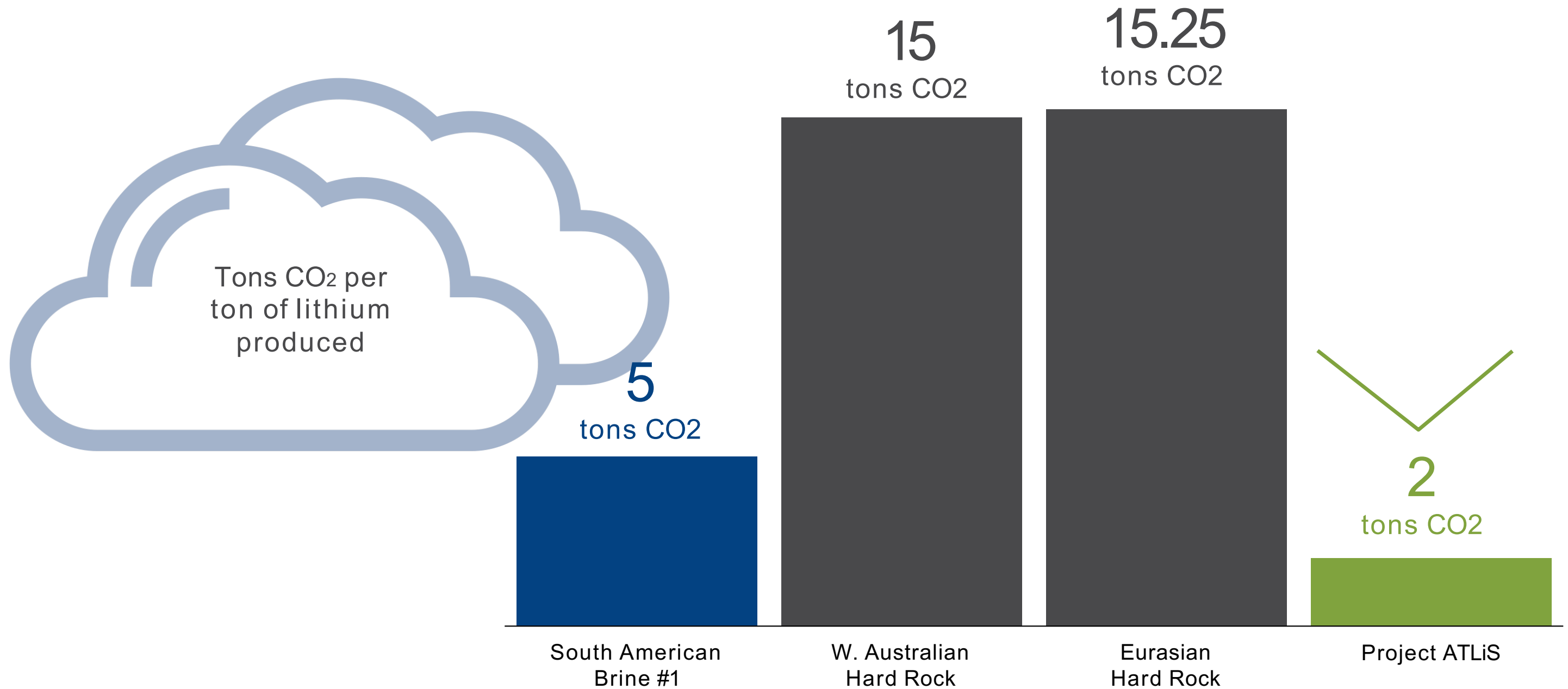
Utilizes renewable steam and energy for processing



No weather dependency and can operate 24 hours a day

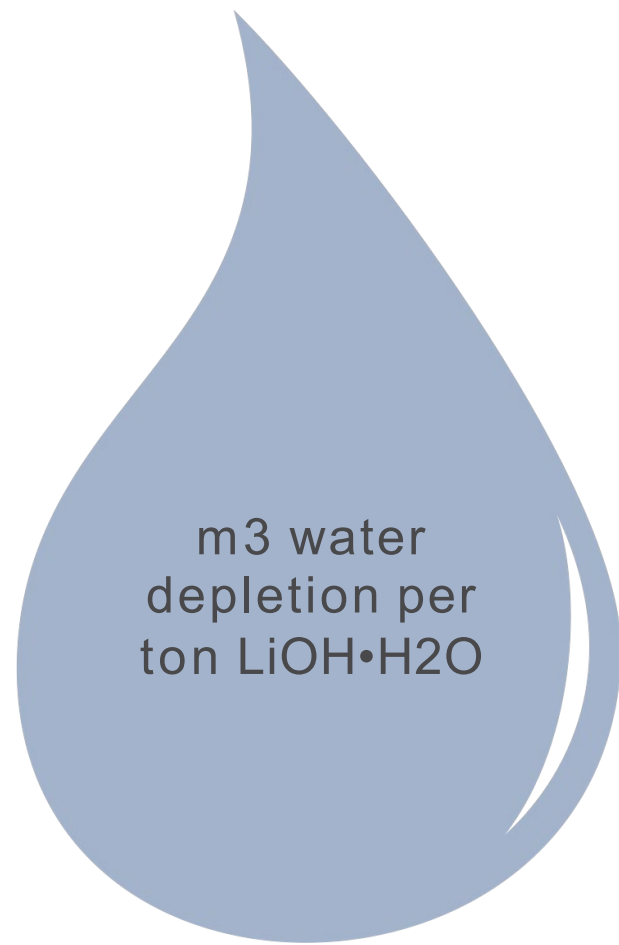
PROJECT ATLiS

Lowest CO₂ emissions

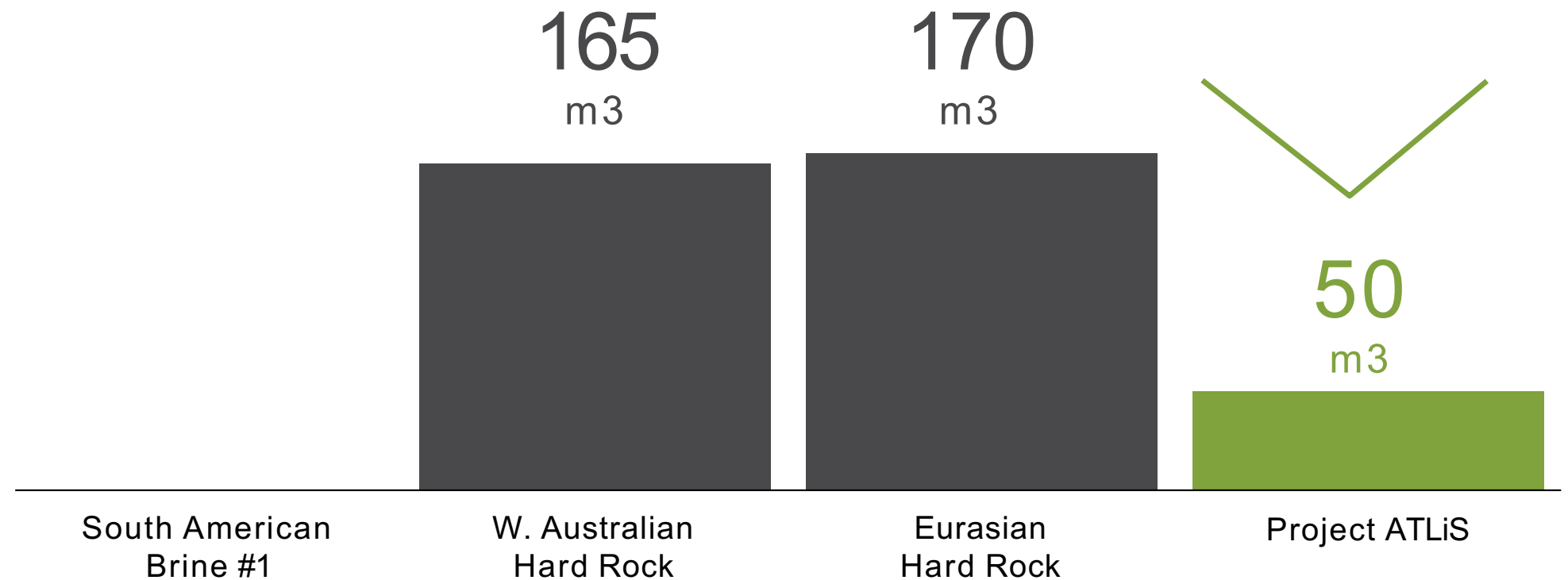


PROJECT ATLIS

Lowest water depletion

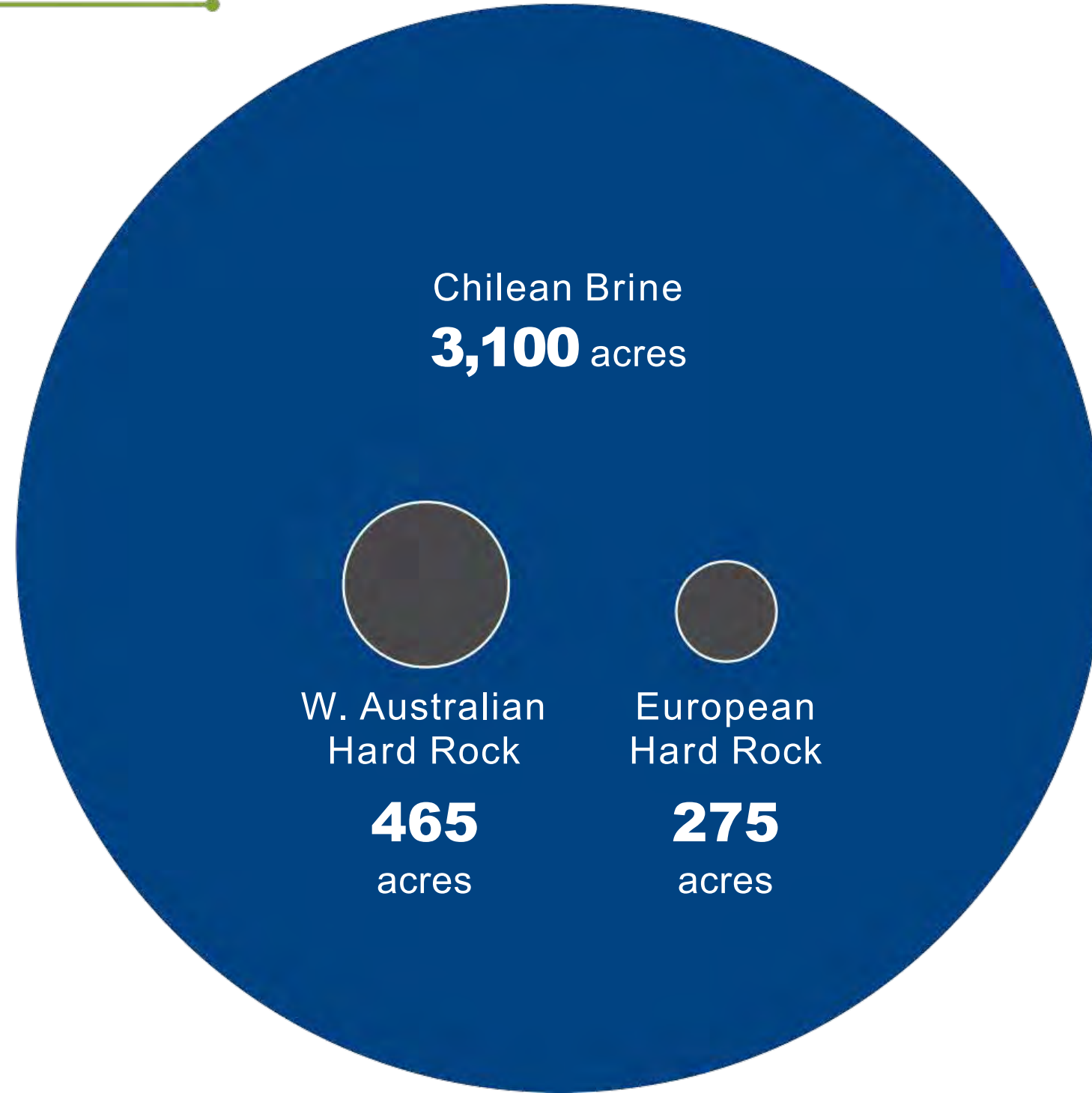
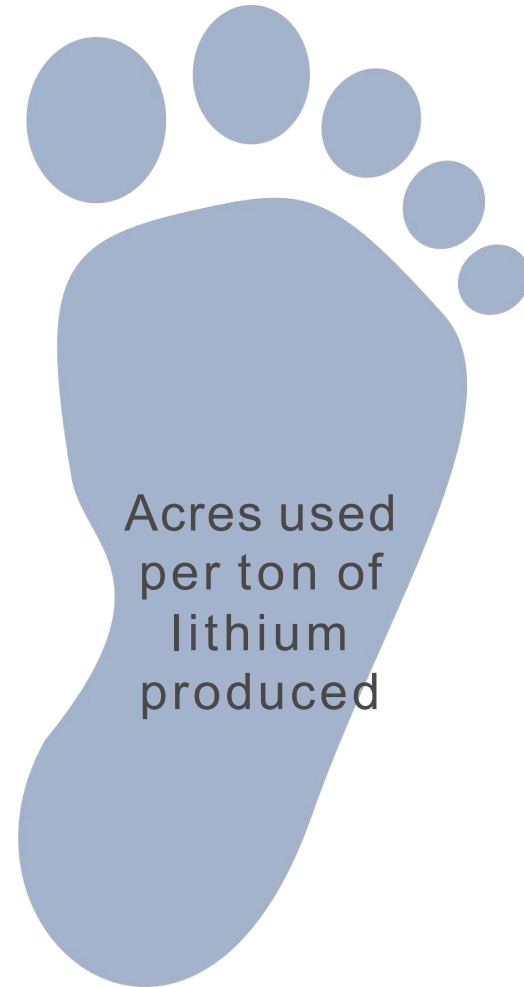


475
m3



PROJECT ATLiS

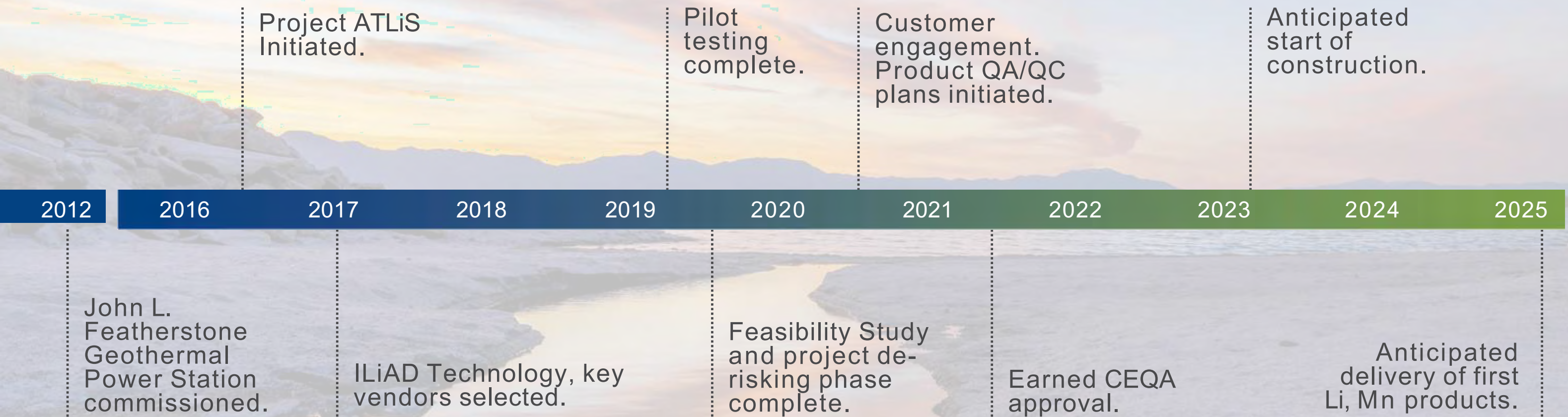
Smallest land use



PROJECT ATLiS
40
acres

TIMELINE

ESM lithium development



ILiAD™

Technology with world wide potential



ESM's Project, Project ATLiS - with its patented ILiAD processing technology - is located in Imperial County, California and is the only project, permitted and shovel ready on the Salton Sea.

With ILiAD, ESM is engaged with more than a dozen lithium projects around the world.

ESM anticipates kicking off Project ATLiS in Q1 2023.

CURRENT CHALLENGES

ESM's ATLiS faces **HIGHER COSTS DUE TO IMPURITIES** impacting CAPEX and OPEX costs at the Salton Sea.

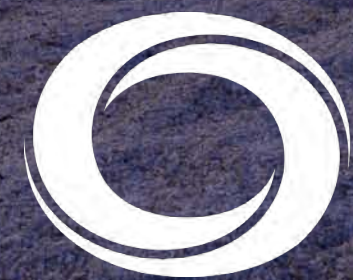
California recently passed a state flat tax on lithium process that **DOES NOT RECOGNIZE MARKET FLUCTUATIONS** or a wide range of quality.

GOAL

Deploy ILiAD at brine resources across the world to reduce the environmental impact and **ENABLE THE CLEAN ENERGY TRANSITION.**



Sustainable Lithium. Delivered.



ENERGYSOURCE
MINERALS

Lithium + Renewable Energy Powerfully Combined



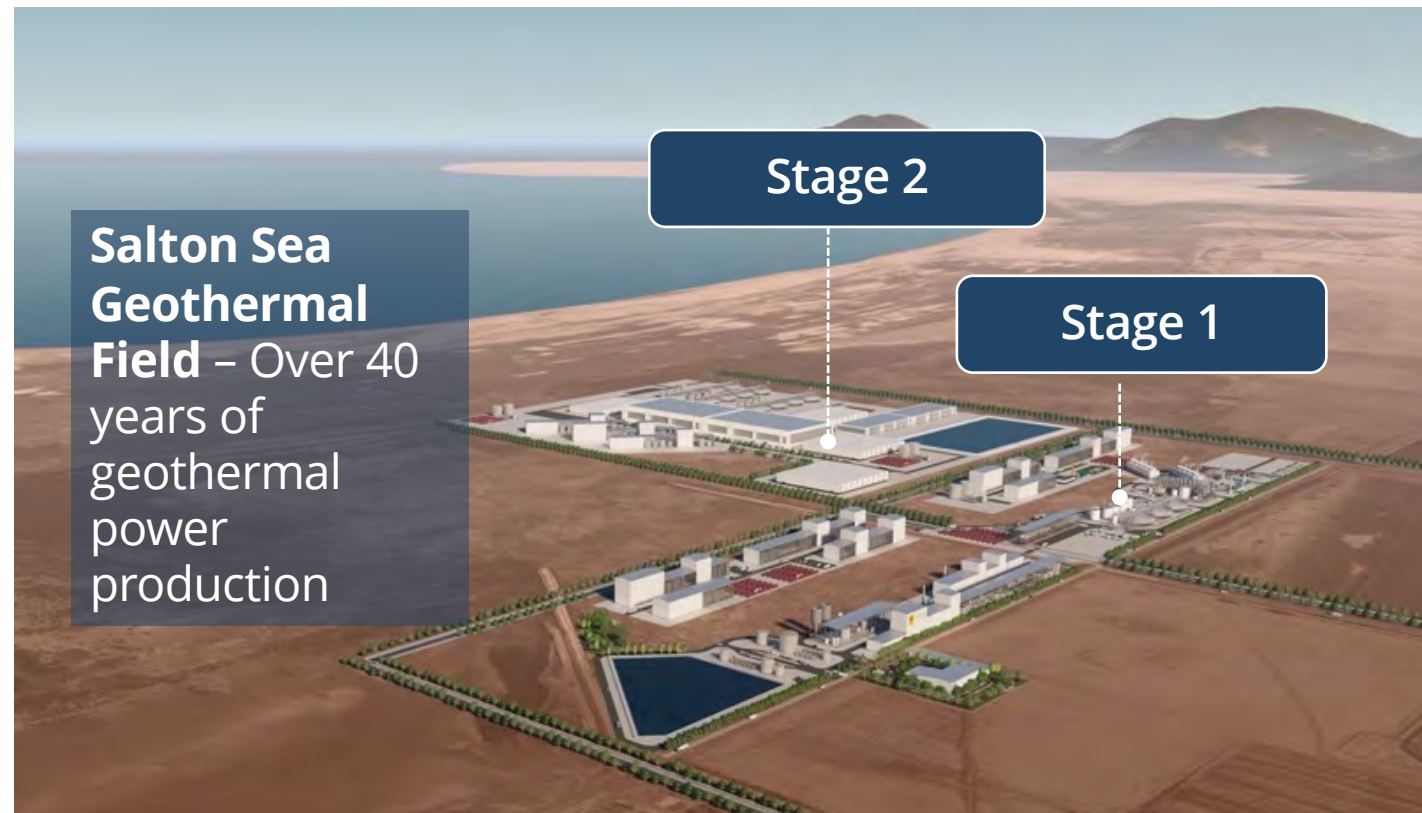
CONTROLLED
THERMAL
RESOURCES

Hell's Kitchen Lithium and Power
Salton Sea, Imperial County
California

Sustainable, high value, U.S. critical minerals and power production

Controlled Thermal Resources

A large-scale power and critical minerals development company positioned to provide clean power and lithium via the Hell's Kitchen Project.



Key Facts

- 2024 – Stage 1 Power:
50 MW (net output)
 - 2024 – Stage 1 Lithium:
25,000 t/yr LHM
 - 2025/26 – Stage 2 Power:
130 MW
 - 2025/26 – Stage 2 Lithium:
50,000 t/yr LHM
 - Total Capacity ~**1,100MW power¹ + 300,000 tonnes LCE per year**
- Utilizes **100% renewable energy + steam**
 - Closed-loop production process with minimal land footprint and a **near-zero carbon footprint**

¹ Gross power output, including reserve.

CTR recovers Lithium Chloride from Hell's Kitchen Optimization Plant

- CTR's engineering team improved several process stages including optimizing brine in the preparation stage to achieve highly efficient recovery of lithium - **as lithium chloride** - from the CTR's live Salton Sea geothermal brine resource.



Rod Colwell with Bill Whitaker from
60 Minutes - January 6, 2023

What does this mean for CTR and Lithium Valley?

- Better design parameters for optimized construction program
- Increased confidence in Salton Sea resource
- Increased investment interest for the region
- Increased support from governments
- Clean, Green Jobs!



Clean, Green Jobs

- Workforce and education development programs
- 95% Local workforce
- Direct project and jobs awareness
- Support for local schools, colleges, and the community

Direct Project Jobs*

Stage 1
220

Stage 2-5
950

Stage 6+
1,400

Total anticipated project, construction and ancillary jobs at full operating capacity

4,000+

4,000+
Jobs for
Imperial
County

95%+
Workforce
Local to
Imperial
County



*Cumulative job growth estimates across all project stages
Source: Imperial Valley Economic Development Corporation –
Hell's Kitchen Lithium and Power Economic Impact Analysis 2020

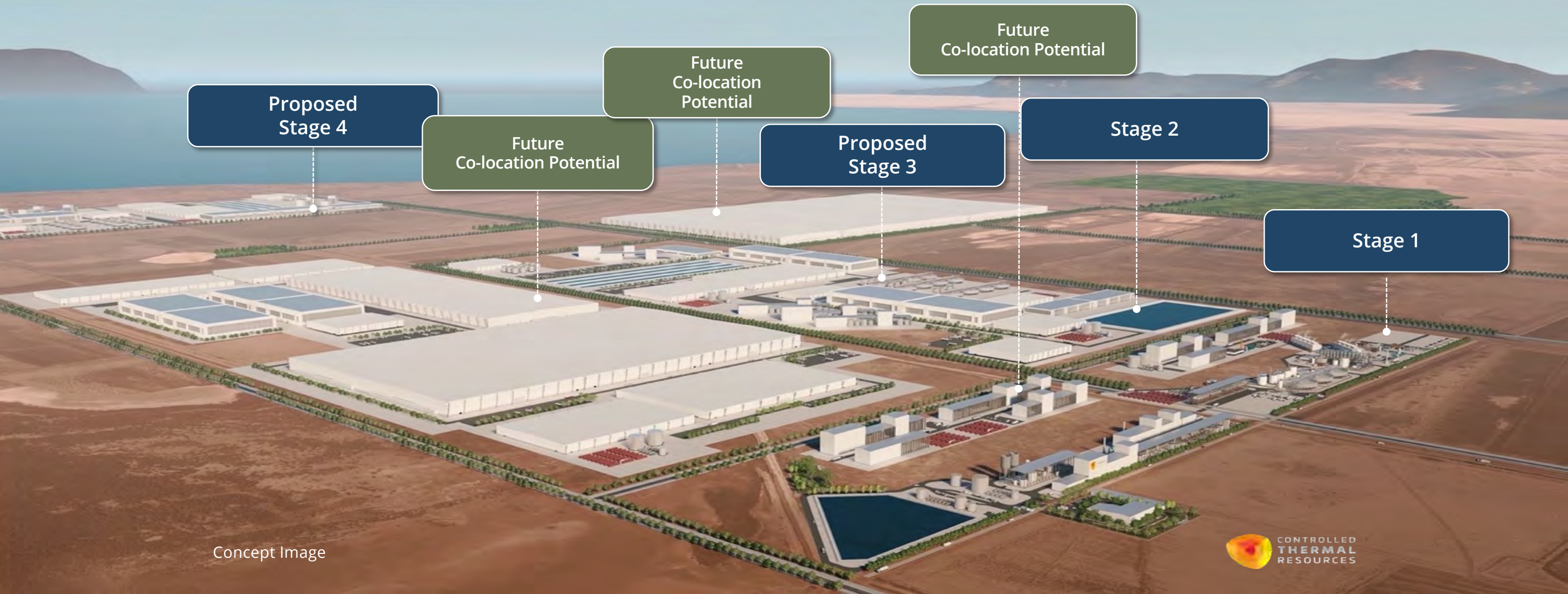
CTR bringing immense value to the U.S. Lithium Battery Supply Chain

Colocation of pCAM & CAM Operations will bring:

- CAPEX Reductions
- OPEX Reductions
- Environmental Emissions Savings

Inflation Reduction Act ITC/PTC Savings

- Co-location Interest from
 - Auto Manufacturers
 - Tier 1 Battery OEMs
 - Cathode / pCAM/CAM



Concept Image

Turning **Challenges** into **Solutions**

- Sustainable leadership projects should receive priority support for **permitting and funding**
- Additional support and incentives required to attract **Cathode and Battery Manufacturing** to the region
- Support for **roads, bridges, and high-speed internet** should take priority over additional transmission lines
- Co-location of new industry will require localized clean power usage
- Developing lithium projects and attracting the battery supply chain will **create more local investment, more jobs, and more opportunities.**





CONTROLLED THERMAL RESOURCES

Disclaimer: This Presentation was prepared by Controlled Thermal Resources (US) Inc., a Delaware corporation (the “Company”), in order to provide preliminary or general information and should be treated confidentially. This Presentation does not constitute an offer to sell or the solicitation of an offer to buy any securities of the Company or its affiliates. No offer of securities shall be made except by means of a prospectus meeting the requirements of the Securities Act of 1933, as amended, and no offer to sell or solicitation of an offer to buy shall be made in any jurisdiction in which such offer, solicitation or sale would be unlawful prior to registration or qualification under the securities laws of any such jurisdiction. This Presentation, and the exhibits hereto if any, contains estimates, predictions, opinions, projections and other “forward-looking statements” as that phrase is defined in the Private Securities Litigation Reform Act of 1995. Such statements that are not historical facts, including statements about our current beliefs or expectation of future events, are forward-looking statements, and you should not place undue reliance on them. Such forward-looking statements are based on various assumptions, many of which are beyond the control of management and are subject to risks and uncertainties and other factors which could cause actual results to vary materially from those currently anticipated and such variations may be material. Industry experts may disagree with these assumptions and with management’s view of the market and the prospects for the Company. No representations or warranties are made by the Company or any of its officers as to the accuracy of any such statements or projections. Statements contained herein describing documents and agreements are summaries only and such summaries are qualified in their entirety by reference to such documents and agreements. All forward-looking statements in this Presentation are qualified by these cautionary statements and are made only as of the date of this Presentation. Except as required by applicable law, the Company undertakes no obligation to revise or update any forward-looking statements, whether as a result of new information, future events or otherwise.

www.cthermal.com

Critical Minerals in California, Imperial Valley



Jonathan Weisgall, *Vice President for
Legislative and Regulatory Affairs at Berkshire
Hathaway Energy*

Derek Benson, *Chief Operating Officer at
EnergySource Minerals*

Rod Colwell, *Chief Executive Officer at
Controlled Thermal Resources*

Priscilla Lopez, *Director Workforce and
Economic Development at Imperial County*

The Opportunity, Critical Mineral Research in CA



Maryjo Brounce, *Associate Professor of Geology for Earth and Planetary Sciences at UC Riverside*

Patrick Dobson, *Geothermal Program Systems Lead at Lawrence Berkeley Lab*

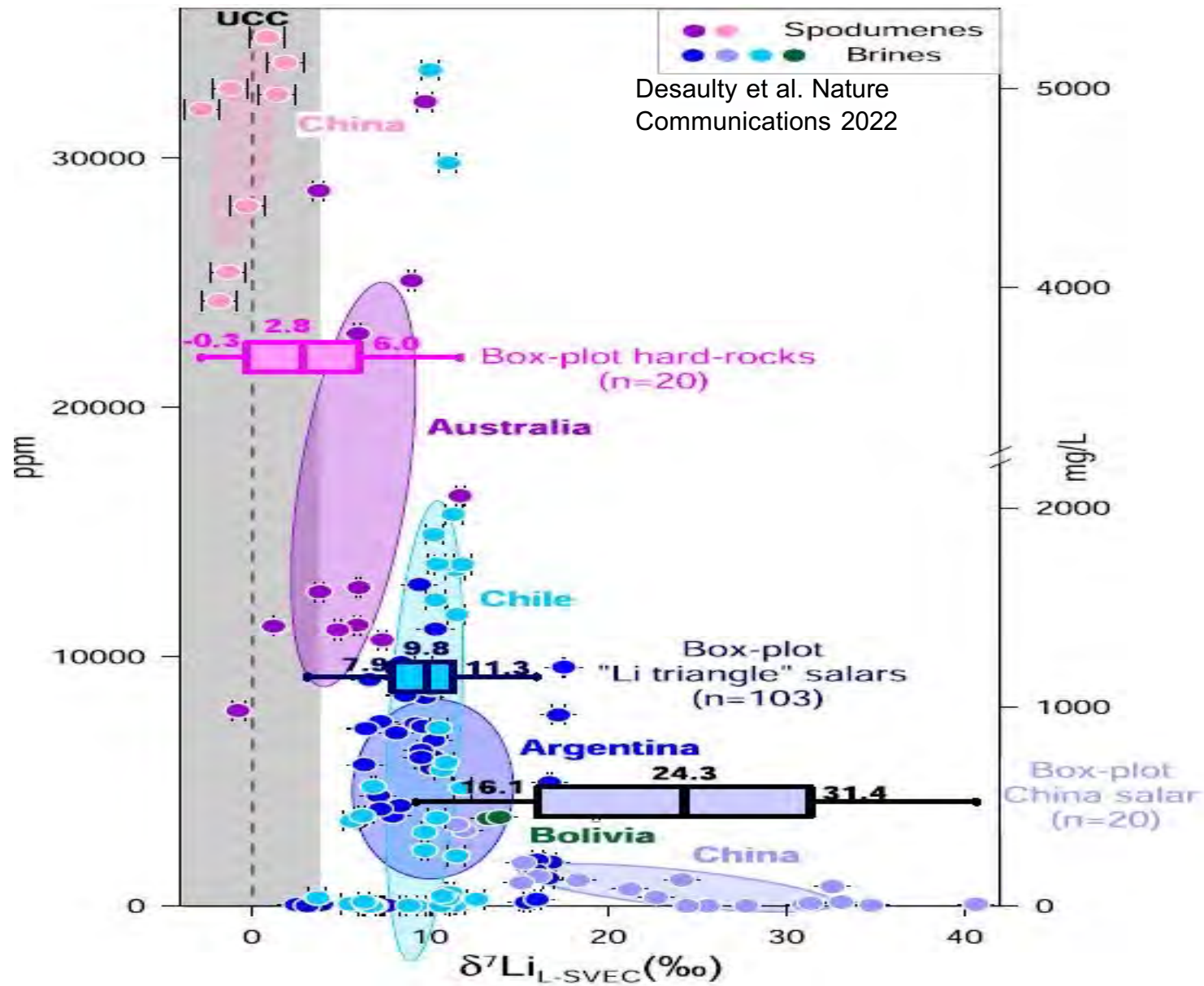
Krassi Bozhilov, *Director of CFAMM at UC Riverside*

Codi Lazar, *Associate Professor of Geological Sciences at CSU San Bernardino*

Chris Lynch, *Dean - Bournes College of Engineering and Professor at UC Riverside*

Academic Panel
*Examples of Research on Critical Mineral
Resources*

Profs. Michael McKibben and Maryjo Brounce Dept. of Earth &
Planetary Sciences
University of California, Riverside



Where on Earth does Li come from? (cost ~\$300 per brine sample)

Two isotopes of Li: mass 6 and 7.

Various geological processes concentrate one or the other mass preferentially.

Results in brines from South America and China – low Li concentrations with a high proportion of ^7Li . Very different from Li in Australian or Chinese spodumene mines having very high Li concentrations with lower proportions of ^7Li .

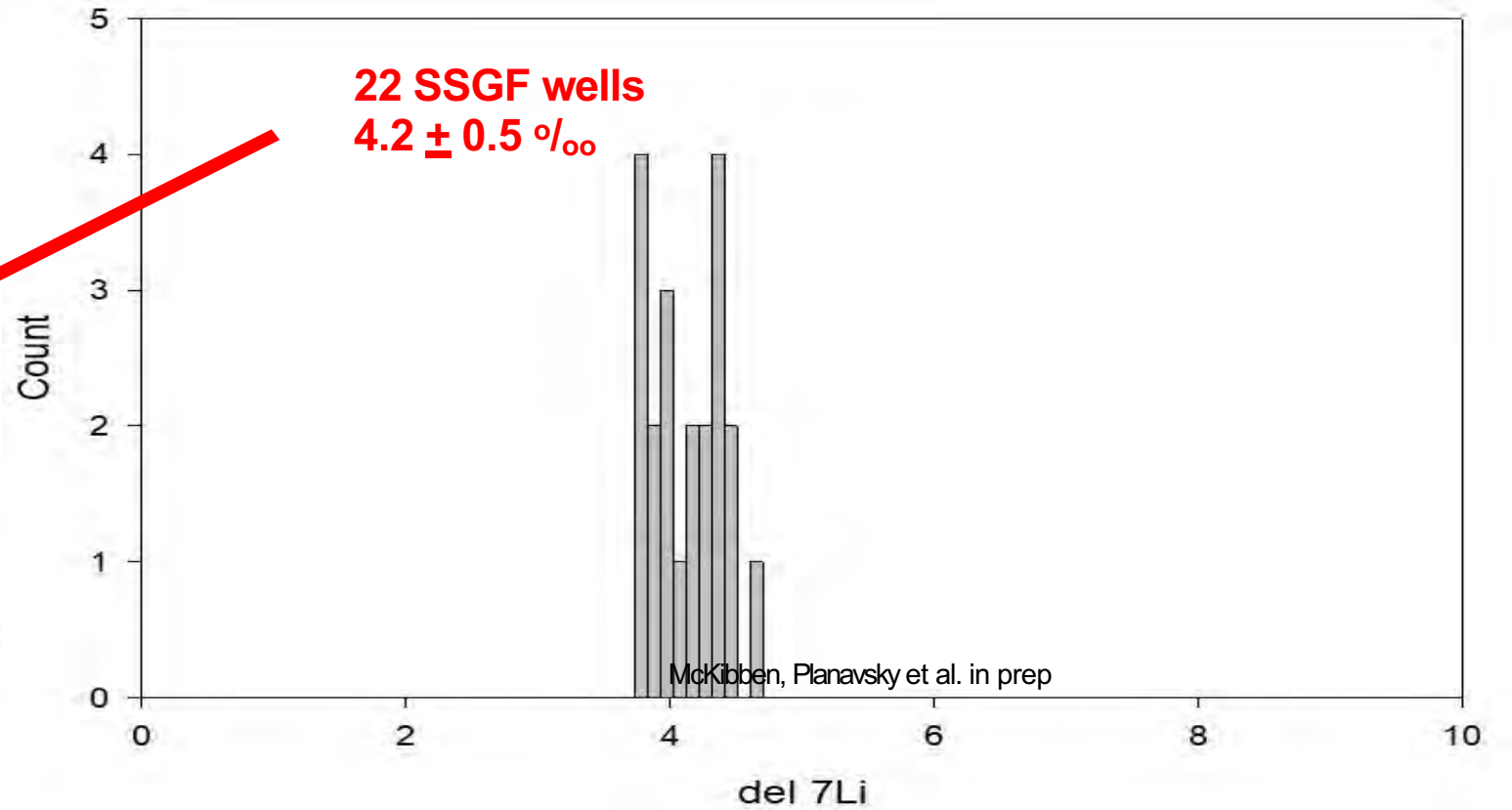
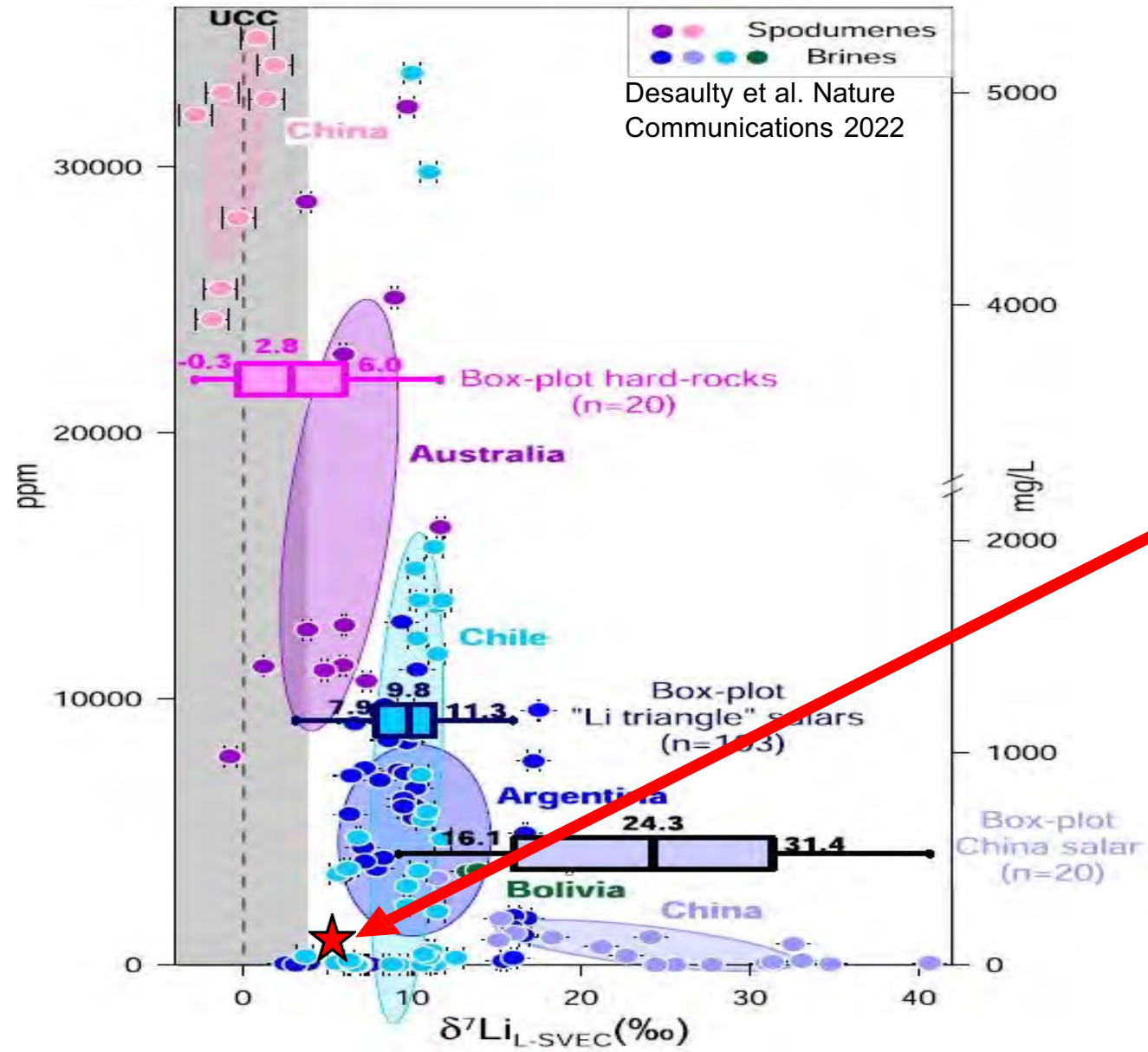
The Li concentration and isotopic composition fingerprints – where on Earth did this Li ore originate?

The refining and battery manufacturing processes can also change the isotopic composition – where on Earth was that Li ore refined? Where was that battery component manufactured?

Li isotopes can be used to help verify country of origin of battery components.

Where on Earth does Li come from? (cost ~\$300 per brine sample)

SSGF brine Li is relatively light in ^{87}Li compared with most "cold" salar Li brines from around the world - closer to hard rock Li



**In which minerals/materials is Li (REE/B/etc) concentrated?
What geological processes drove this distribution?**

(cost ~\$100 per crater)

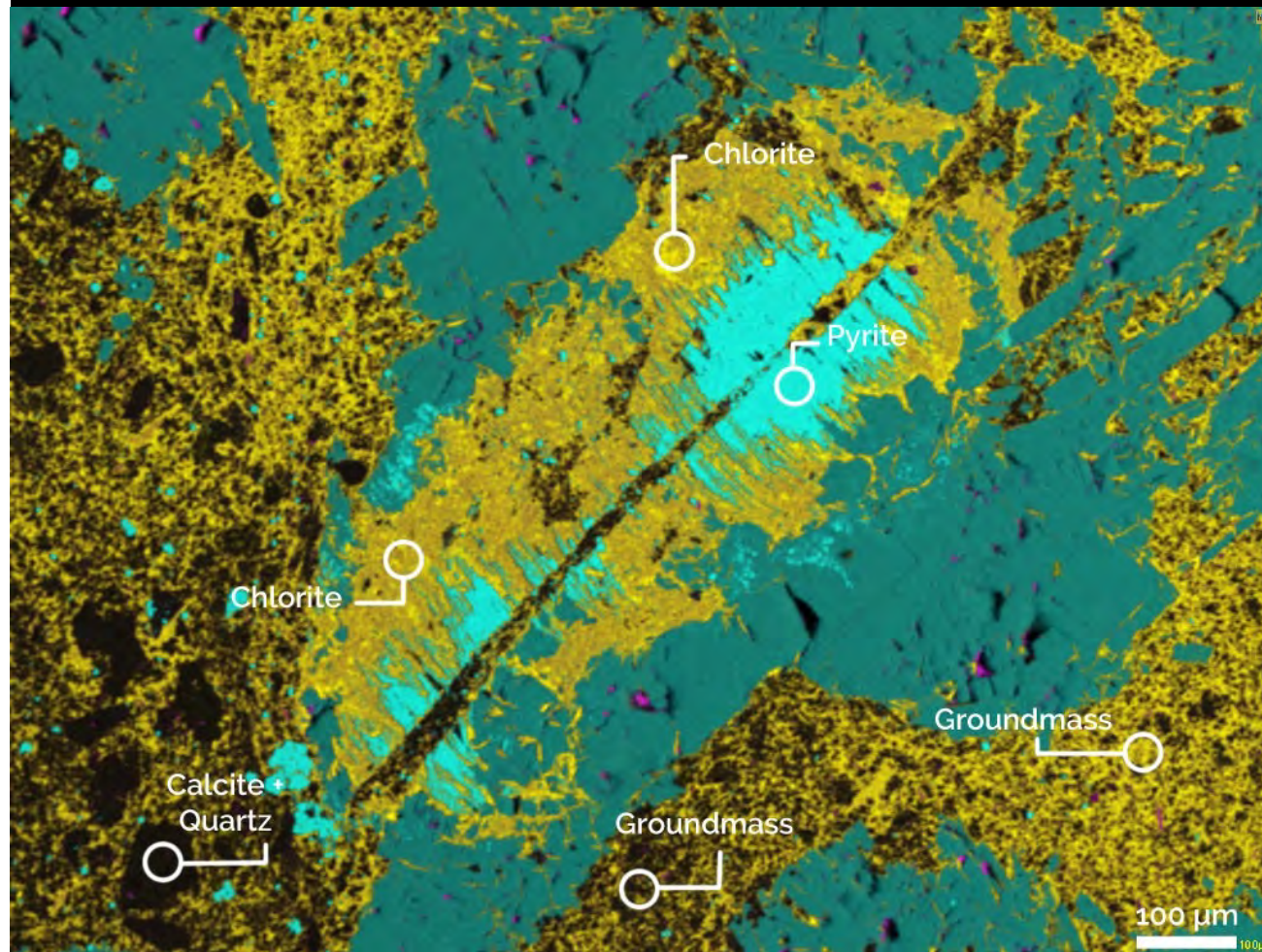
***In situ* analytical petrology and geochemistry via SEM and LA-ICPMS**

map out precisely where Li and other critical elements are found in rocks, ores, concentrates and DLE adsorbents.

30 μm wide laser ablation craters in polished sections can determine the entire periodic table of elements down to ppm levels.

Altered shale with anhydrite ~ 325°C

Li is stored in hydrothermal chlorite & chloritic groundmass



Al S Mg

Humphreys, Brounce, McKibben, Dobson et al. in prep

Well Code: State 2-14
Depth: 7738 ft (2358.5 m)

Calcite + Quartz: 87.4 ± 2.4 ppm

Chlorite: 580.6 ± 12.2 ppm &
 303.0 ± 4.5 ppm

Chlorite: 557.4 ± 8.4 ppm &
 396.7 ± 4.6 ppm

Pyrite: 0.8 ± 0.0 ppm

Groundmass: 165.2 ± 3.2 ppm &
 105.1 ± 1.6 ppm

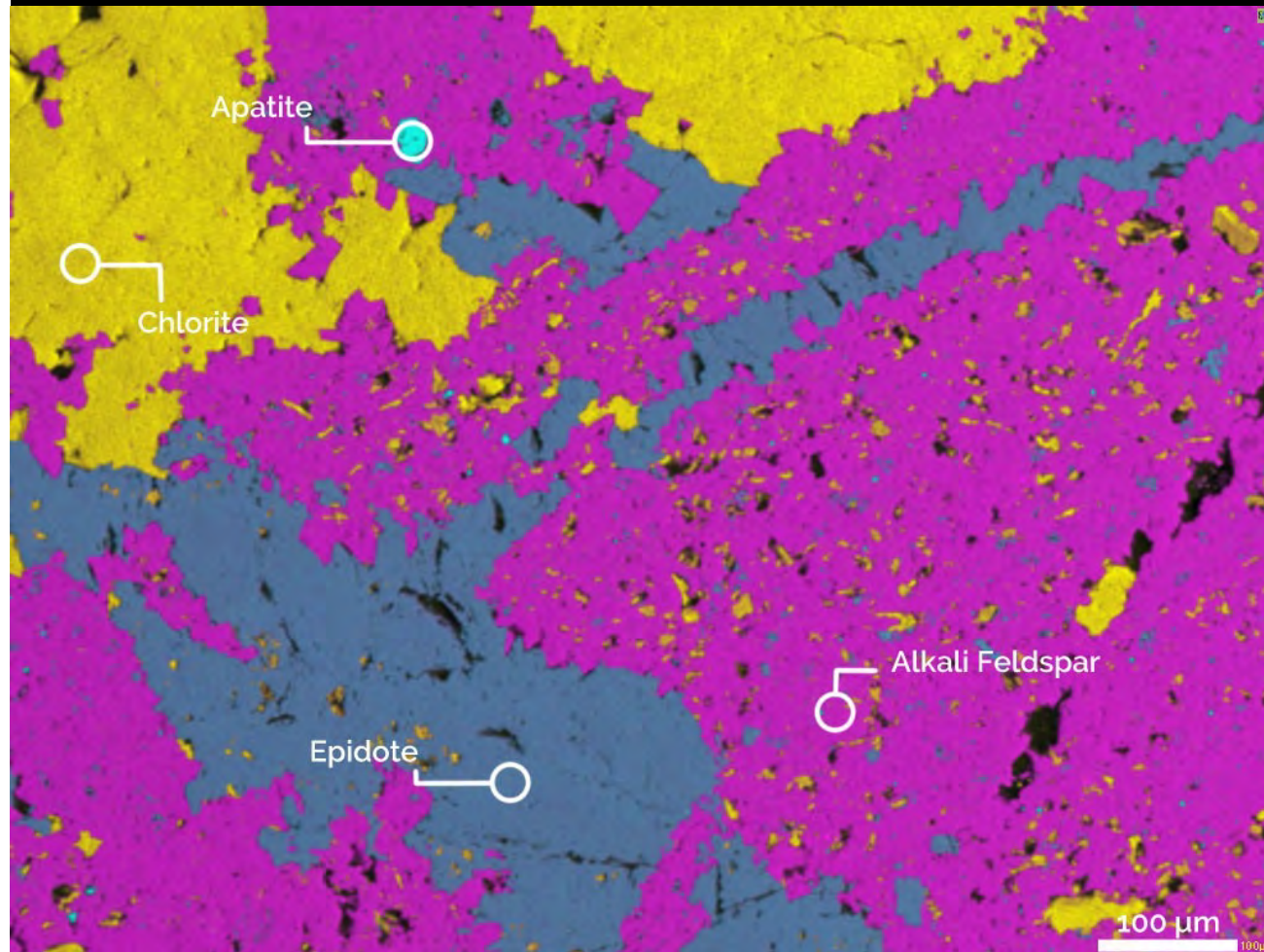
Groundmass: 160.9 ± 3.0 ppm &
 245.7 ± 2.7 ppm



Well Code: State 2-14

Depth: 9456.6 ft (2882.4 m)

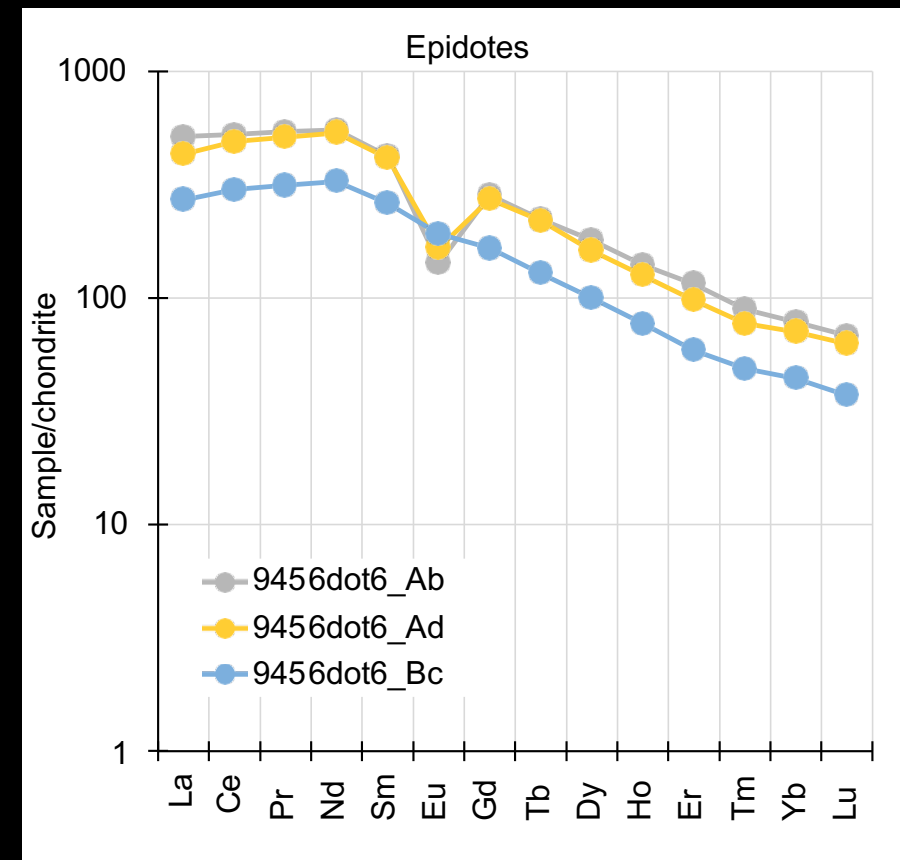
In contrast, REEs are locked up in the mineral epidote



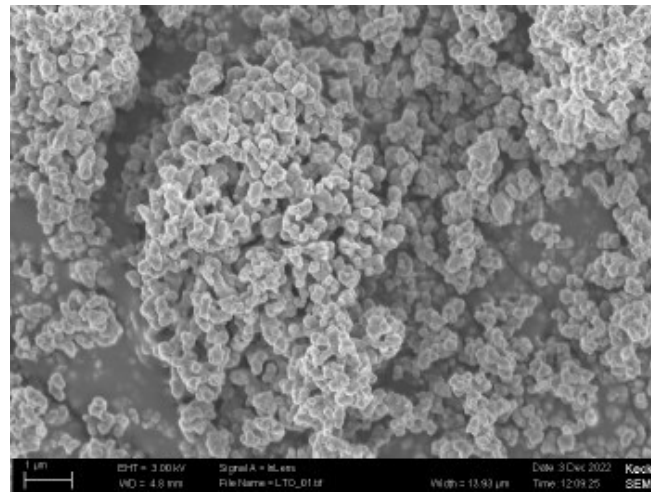
La = 89-170 ppm

Gd = 46-79 ppm

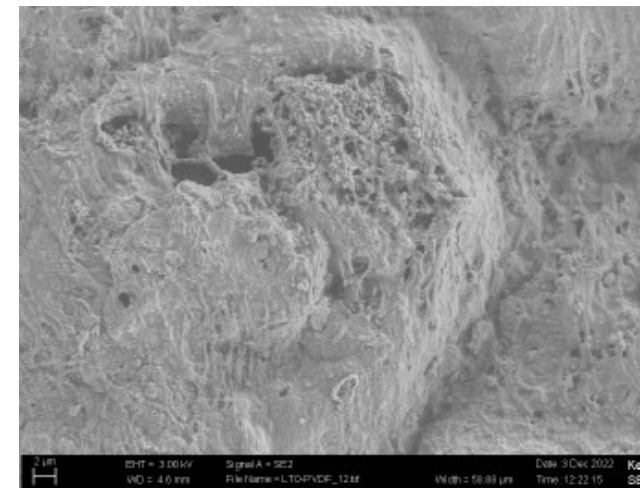
Lu = 1.3-2.3 ppm



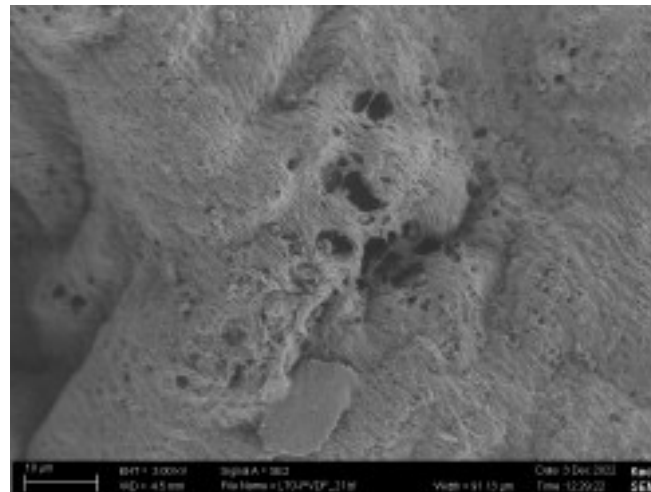
What adsorbent and substrate most efficiently extracts Li from briney fluids?



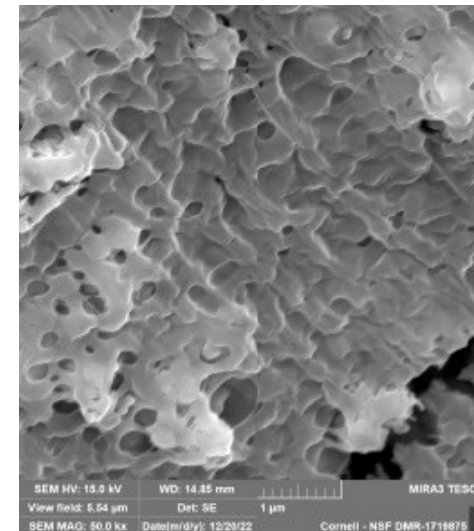
Fabricated Ti oxide adsorbent starting materials.



“Clumping” of Ti oxide particles in substrate bead (unwanted).



Uneven porosity distribution in substrate bead (unwanted).



Perfect porosity distribution in substrate bead.

We are also doing LA-ICP-MS characterization of Li adsorption profiles in bead cross-sections after adsorption.

Meeting common challenges and needs of producers/manufacturers/regulators

A regional **critical mineral commodity supply chain research and training center** could be established to assist companies, county/state/federal governments, and educational institutions in solving complex **mineral extraction problems** and meeting **challenging supply chain issues** via:

Third party critical materials characterization and certification of composition:

- **ores (mineralogy, grades)**
- **brines (salinity, concentrations)**
- **adsorption media (beads, pellets)**
- **raw products (LiCl, LCE, LHM, boric acid, REEOx)**
- **refined products (battery, magnet components)**

Third party certification of battery/magnet component **country of origin (provenance) (EV tax credit eligibility)**

Battery and magnet fabrication and testing

Dissemination of critical mineral knowledge and policy development via workshops, conferences, webinars

Mentoring of businesses and start-ups

Student and workforce training



Southern California Critical Minerals Research and Training Center

Li, Mn, Zn, REEs, B

Instrumentation for Materials Characterization and Analysis:

Laser-ablation inductively-coupled plasma mass spectrometers with multi-collectors (LA-ICP-MS-MC)*

Electron Microprobe

Powder X-ray Diffractometer***

Automated X-Ray Fluorescence (XRF) spectrometer

Hand-held XRF scanners***

Ore and IR microscopes

Battery/Magnet Fabrication and Testing tools

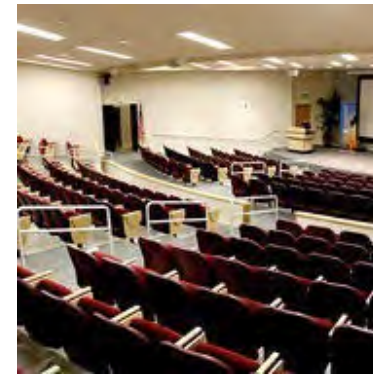
*** Received \$2M seed funding for an LA-ICP-MS-MC machine**

**** LBNL can also offer virtual remote access to their instruments**

***** CSU San Berdo will pool availability of their devices**

Faculty:

Endowed Professorships in Mineral & Energy Resources,
Battery Technology, Supply Chain Management



Center staffing and support:

Director
Ph.D. staff scientist
lab technicians
student interns

Scholarships and bus transportation for So. Cal. community college and university students.

Credential program for certificate curriculum and hands-on training.

Space and land:

~1,800 sq ft of available lab and office space.

11 acres of developable land.



Critical Mineral Research in California – The Role of Berkeley Lab

Critical Minerals in California Workshop

Patrick Dobson

January 18, 2023



Berkeley Lab Capabilities and Expertise in Critical Minerals Research

- **Lab User Facilities**
 - Advanced Light Source (ALS) <https://als.lbl.gov/>
 - Molecular Foundry <https://foundry.lbl.gov/>
 - National Energy Research Scientific Computing Center (NERSC) <https://www.nersc.gov/>
- **Research centers focused on critical materials and their supply chains**
 - Lithium Resource Research and Innovation Center (LiRRIC) <https://lirric.lbl.gov/>
 - Energy Storage Center <https://energystorage.lbl.gov/>
- **Industry partnerships**
 - Intellectual Property Office <https://ipo.lbl.gov/>
 - Cyclotron Road <https://cyclotronroad.lbl.gov/>

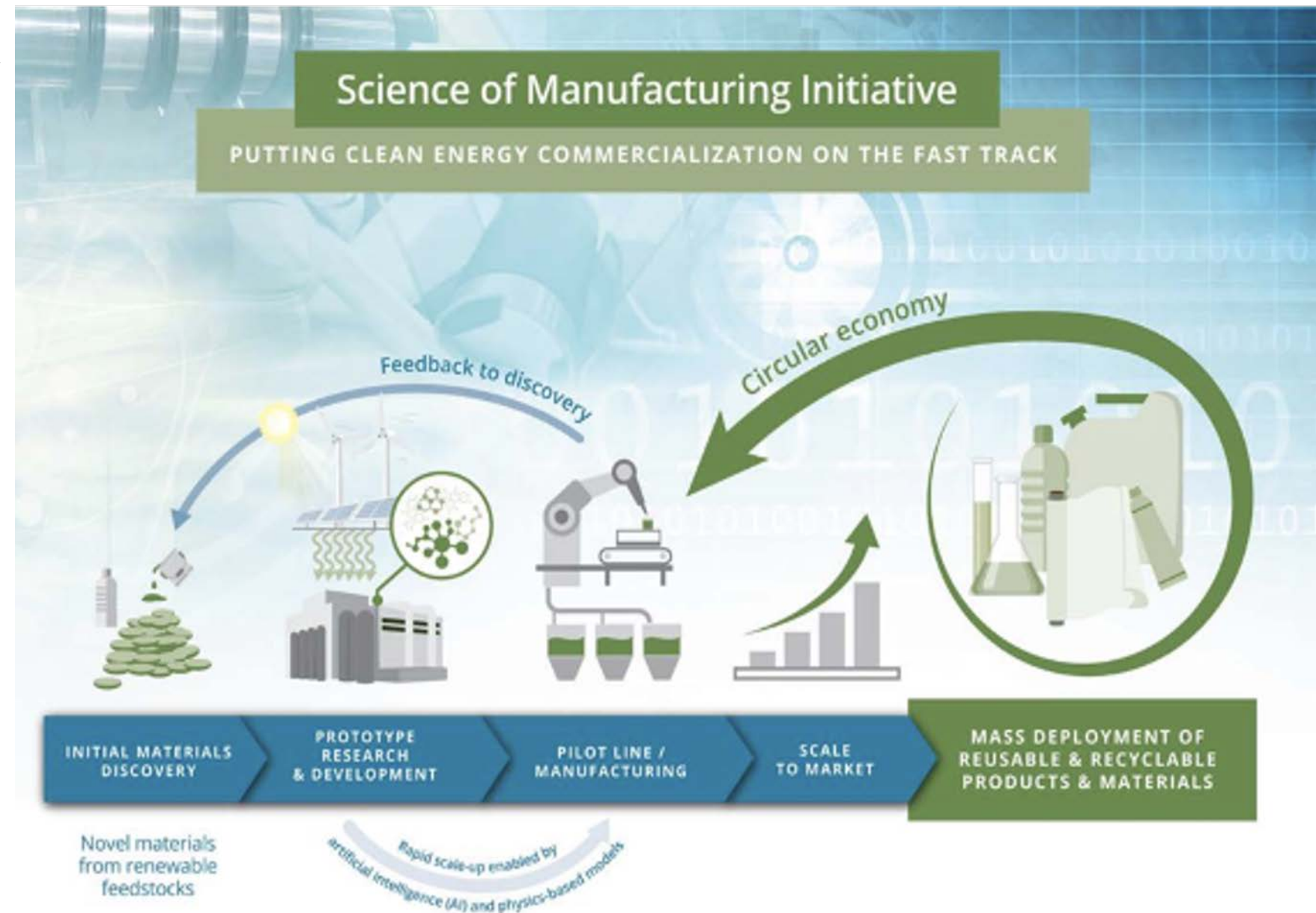




Characterization		Fabrication	Theory	Synthesis		
NCEM National Center for Electron Microscopy	Floor 1 Imaging and Manipulation of Nanostructures	Floor 2 Nanofabrication	Floor 3 Theory of Nanostructured Materials	Floor 4 Inorganic Nanostructures	Floor 5 Biological Nanostructures	Floor 6 Organic and Macromolecular Synthesis
Electron microscopy and nano-characterization	Characterization and manipulation of nanostructures	Advanced lithographic and thin-film processing techniques	Studies to guide understanding of new principles, behavior and experiments	Science of semiconductor, carbon and hybrid nanostructures	Bio-materials; new probes for bio-imaging; synthetic biology techniques	Soft materials: organics, macromolecules, polymers and their assemblies

Relevant Berkeley Lab Research Activities

- Lithium resource assessments & critical material/vulnerability analyses
- Techno-economic analysis (TEA) of energy storage systems and Li-ion battery manufacturing
- Life-cycle assessment (LCA) of Li production, Li-ion battery manufacturing and recycling, and mining tailings
- Cost assessments of cost reduction drivers and market opportunities
- Cost and impact assessments of opportunities for energy efficiency improvement and GHG emission reduction
- Science of Manufacturing Initiative



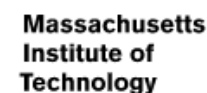
Basis of Lithium Valley – Recoverable geothermal Li

Key questions (LBNL-UC Riverside-Geologica-MIT-UC Davis study):

1. **How much Li is present** in the Salton Sea geothermal reservoir and **where does it come from?**
2. How much Li is **recoverable?**
3. How rapidly will the **Li concentration of the brine decrease** as Li is recovered and spent brine is reinjected (resource sustainability)?
4. What are the **potential environmental impacts** (water & chemical use, air and water quality, induced seismicity) associated with Li recovery from geothermal brines?



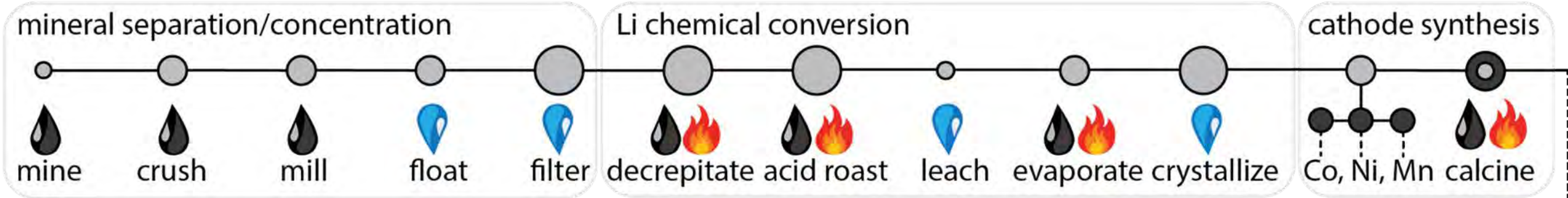
BHE Renewables LiCl pilot plant



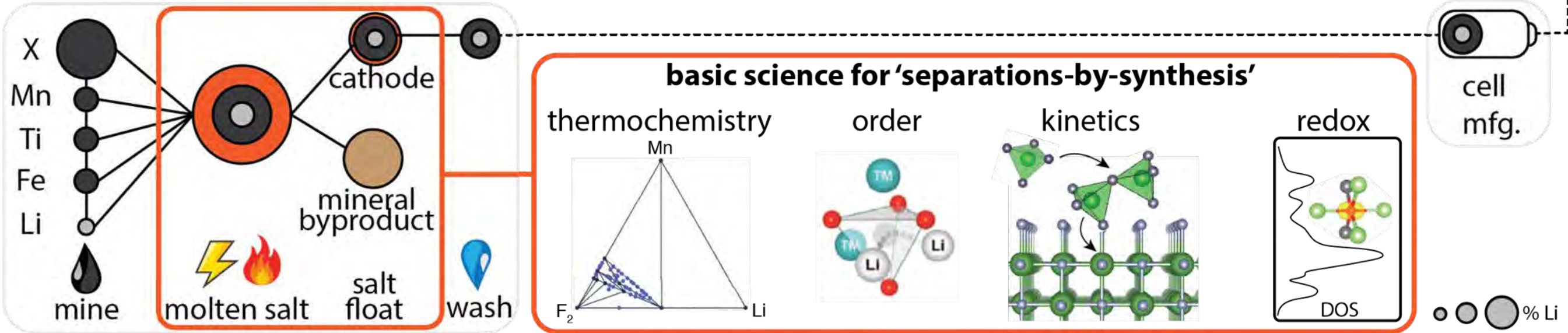
MINES - Minerals for Energy Storage

'Separations-by-synthesis' - flowsheet optimization using fundamental thermodynamics

conventional Li hardrock



MINES



Diversifying CMM supply with selective membranes

Selective removal of CMMs from mining influenced waters

Unlocking new supply chains

- 47M tons of copper sit idle in waste rock dumps worth \$2.4 trillion

Replace current carbon intensive AMD treatment routes

- > 100k tons CO₂ and \$0.5B chemical costs per year in US.

Tuning selectivity

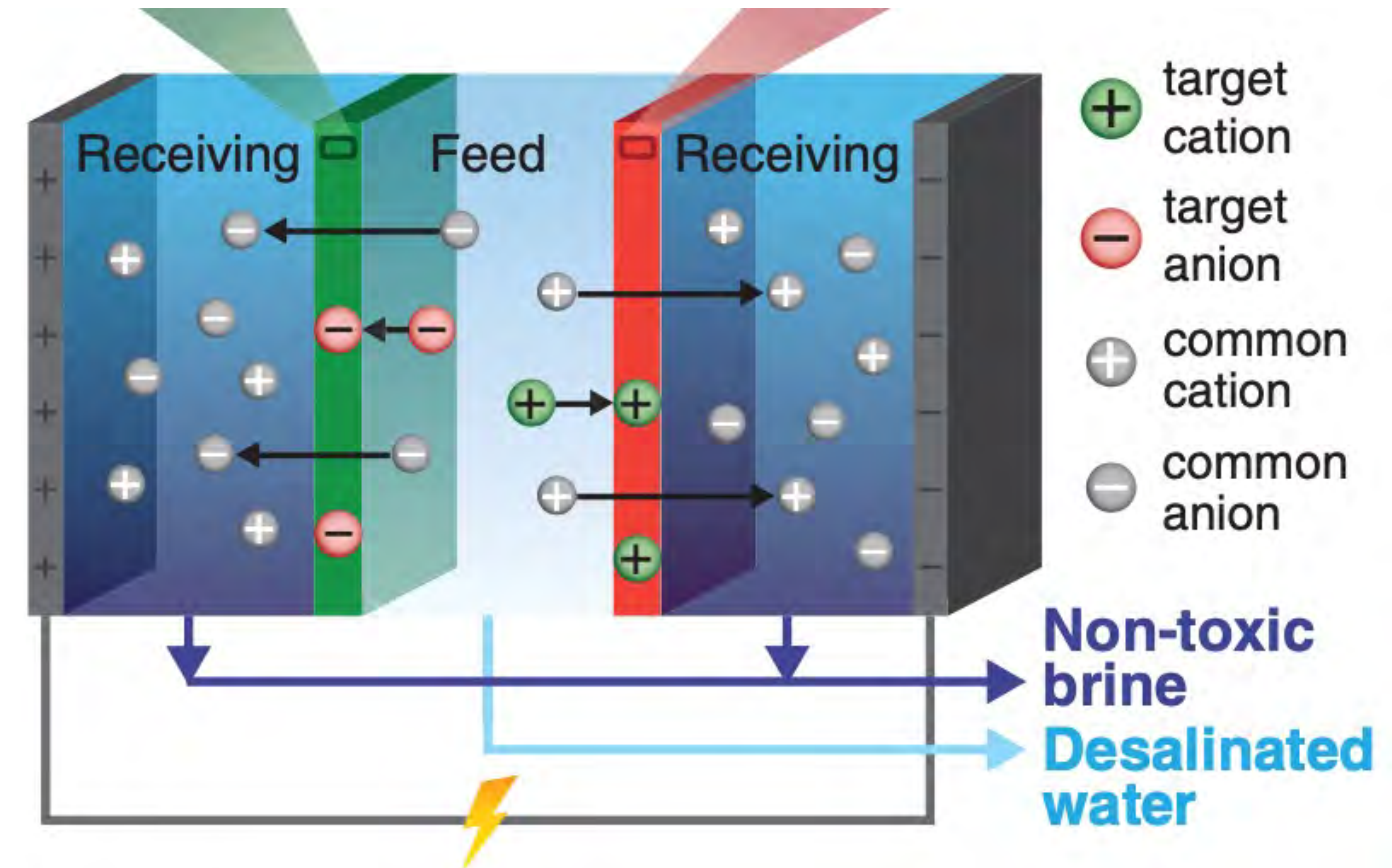
- Active for Cu, Zn, Ni, Fe, and others

Minimizing environmental water impact of AMD

- Fresh water production and preservation

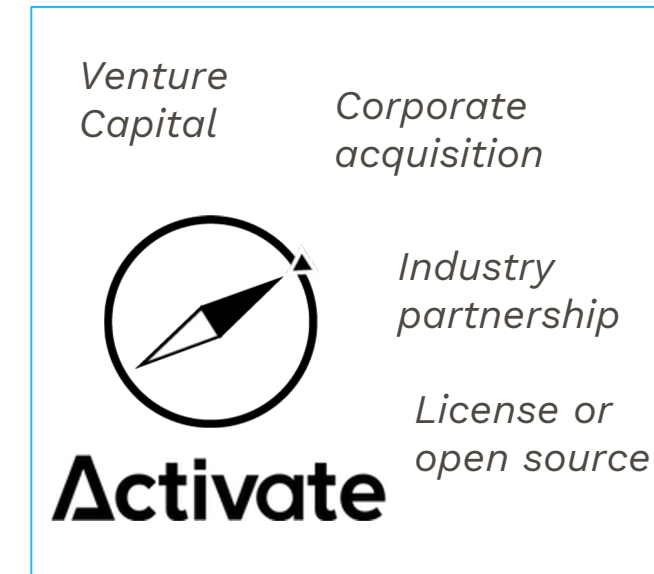
TEA driven implantation

Valorization from waste creates new CMM supply chains



Bui et al., *Nature Comms* (2020); Uliana et al., *Science* (2021)

The Cyclotron Road Fellowship Model



TWO-YEAR FELLOWSHIP

Support top science innovators. Recruit world-class entrepreneurial scientists.

PARTNER RESEARCH LABS

Provide research facilities & expertise. Empower them to make rapid progress toward a first product.

MARKET CONNECTIVITY

Test product and business viability. Position their technologies for path to market.

We partner with [Activate](#), a non-profit started in Berkeley

**Electron Microscopy:
Analysis of Minerals, Materials and
Reactions at Nanoscale**

Krassimir N. Bozhilov

Central Facility for Advanced
Microscopy and Microanalysis
(CFAMM)

UC Riverside, CA

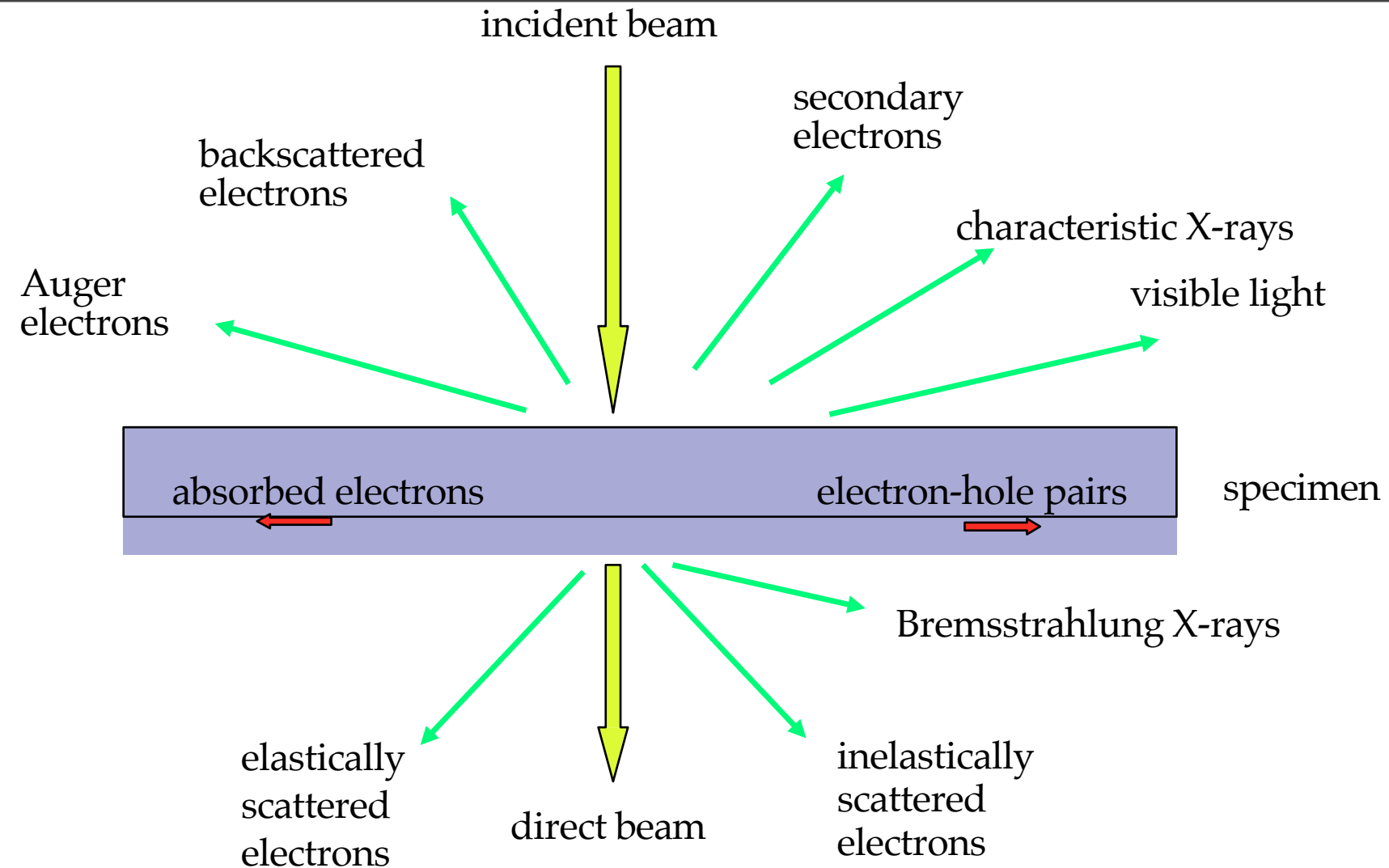
Outline

- ❖ CFAMM mission and equipment
- ❖ EM capabilities
- ❖ Example of application of EM

Central Facility for Advanced Microscopy and Microanalysis (CFAMM)

- ❖ The CFAMM is a research, service, and consulting laboratory using electron and ion beam techniques to characterize materials and minerals at sub-micron and nanometer scale level.
- ❖ Established in 1996 with start-up funding from the National Science Foundation and supported by permanent funding through the Office of Research and Economic Development at UC Riverside.
- ❖ The facility personnel conduct research and provide collaborative assistance, training, service and access to the equipment to faculty, staff, and students as well as clients in industry, government, and academia.
- ❖ cfamm.ucr.edu

Versatility of Electron Microscopy



Electron imaging and diffraction, Electron Backscatter Diffraction (EBSD)

Energy Dispersive X-ray Spectroscopy (EDX), Wavelength Dispersive X-ray Spectroscopy (WDX)

BSE and SE imaging, Auger spectroscopy, Electron Energy Loss Spectroscopy (EELS)

Scanning Electron Microscopes in CFAMM



ThermoFisher Sci. **NNS450**
Variable-Pressure SEM
Oxford Inst. EDX EBSD
\$800K



ThermoFisher Sci. **Quanta**
3D Focus Ion Beam/ESEM
\$600K



TESCAN **Mira3**
Variable-Pressure SEM
Bruker GmbH dual EDX
\$700K

Transmission Electron Microscopes (TEM) in CFAMM



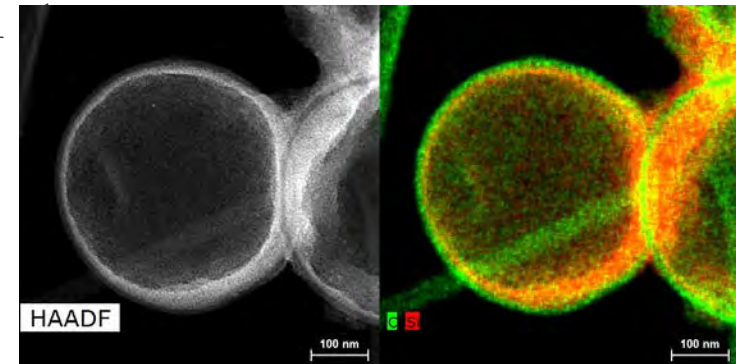
ThermoFisher Sci.
Titan Themis 300 S/TEM
SuperX EDX, \$2,500K



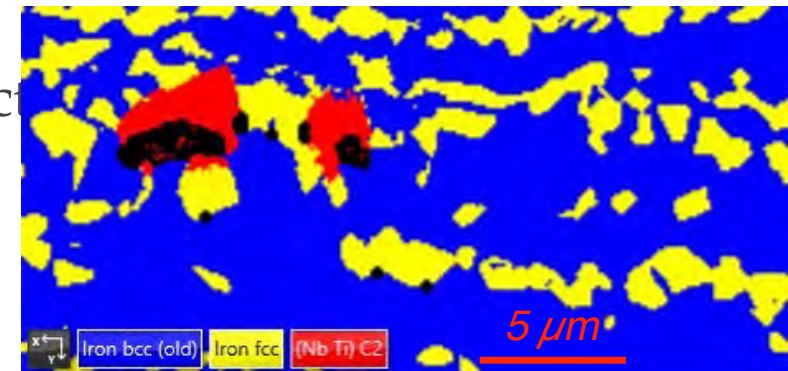
ThermoFisher Sci. Talos120C TEM
\$750K

CFAMM Capabilities

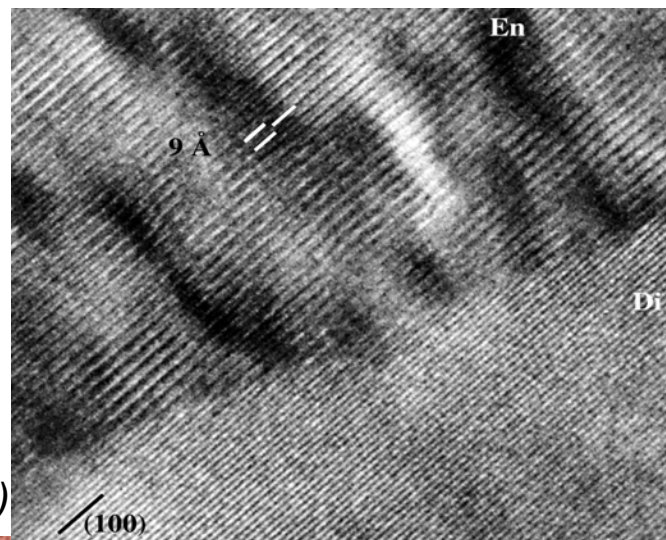
- chemical analysis of minerals and solid phases down nanometer scale
- phase identification by electron diffraction, EBSD
- mapping of spacial distribution of mineral phases, chemically and structurally distinct phases and mineral inclusions - BSE, Z-contrast and EBSD
- crystal structure characterization of mineral phases by electron diffraction, HR TEM
- analysis and characterization of structural relationships and crystalline defects in minerals



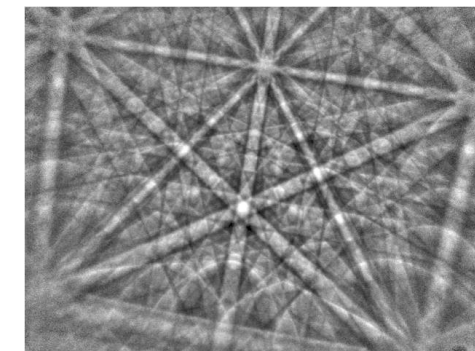
Carbon distribution on Si nanoparticles



EBSD mapping of NbTi carbides.



HRTEM imaging of APD in enstatite ($MgSiO_3$)

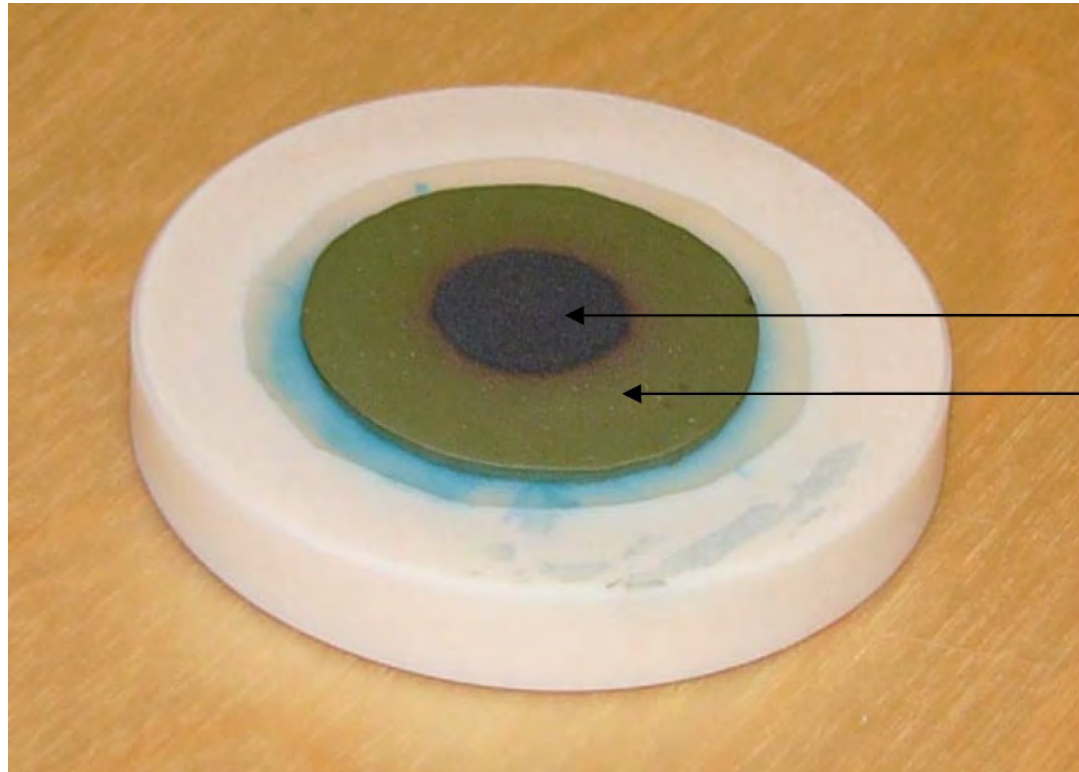


EBSD pattern of NbTi carbide

EM Application Example

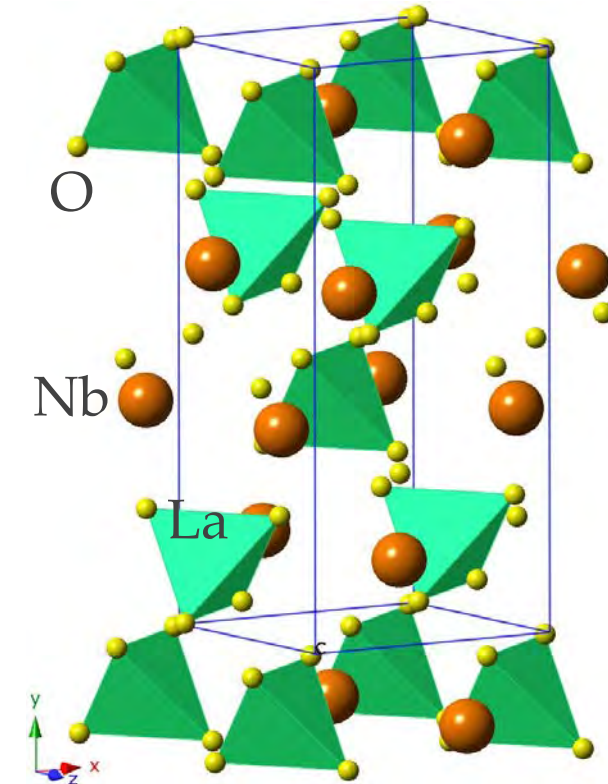
Lanthanum Niobate (LaNbO_4)

superelastic material - shape memory potential
- proton conductivity
potential electrolyte in fuel cells or hydrogen sensors
operating in CO_2 -rich and other acidic atmospheres



Cathode
Electrolyte with
anode underneath

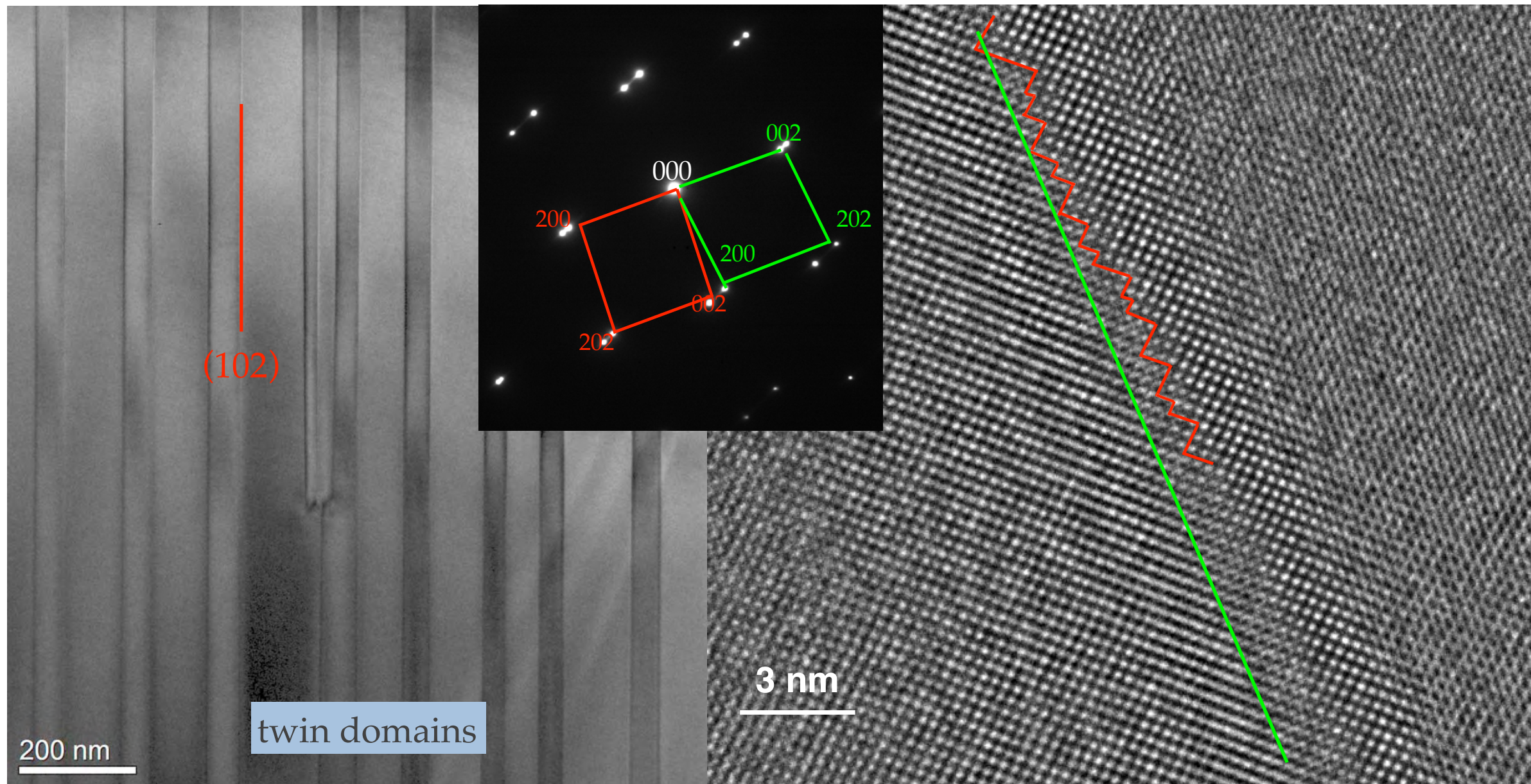
Proton conducting Solid Oxide Fuel Cells
Protia AS company, Norway



tetragonal form stable above 530°C
monoclinic form stable at RT
ferroelastic phase transition

synthesized at 1200°C
applying multiple cooling and re-heating
stages

Lanthanum Niobate domains



- domain boundaries accommodate mismatch at the interface by forming narrow distorted interface zone
- domain size can be controlled by adjusting the cooling and re-heating rates

Minimum detectable mass (MDM)

example - Fe impurities in MgO

WDS

500 nm electron range

$\tau = 100$ sec.

specimen current 200 nA

$n = 16$

$P = 150,000$ counts

$\alpha = 1.0$

$P/B = 200$

$C_{DL} > 15$ ppm

Excitation vol. $\sim 2.6 \times 10^8$ nm³

MDM for Fe = 1.5×10^5 atoms

EDS - SEM

500 nm electron range

$\tau = 100$ sec.

specimen current 2 nA

$n = 16$

$P = 3,000$ counts

$\alpha = 1.0$

$P/B = 10$

$C_{DL} > 470$ ppm

Excitation vol. $\sim 2.6 \times 10^8$ nm³

MDM for Fe = 4.6×10^6 atoms

EDS - AEM

50 nm thick foil, 5 nm probe

$\tau = 100$ sec.

specimen current 2 nA

$n = 16$

$P = 500$ counts

$\alpha = 1.0$

$P/B = 5$

$C_{DL} > 1600$ ppm

Excitation volume ~ 980 nm³

MDM for Fe = **168** atoms



Thank you

Credits:

Hamed Hosseini
Olivia Graeve
UC San Diego

David Kisailus
UC Irvine



CALIFORNIA STATE UNIVERSITY
SAN BERNARDINO

Department of
Geological Sciences

Codi Lazar, Associate Professor



Our department: open for
collaboration!

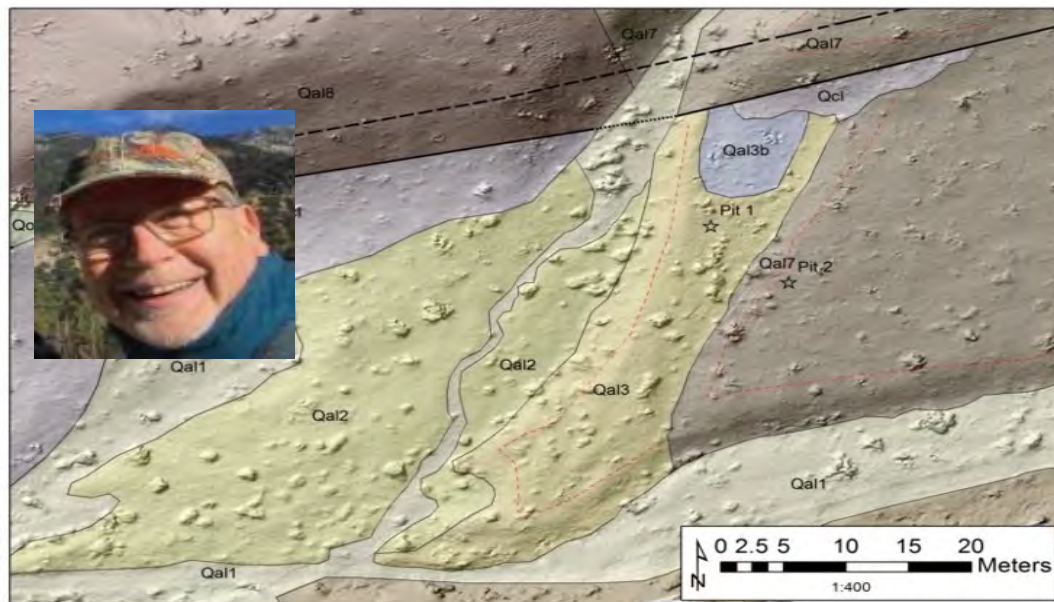
- Expertise
- Instrumentation
- Proximity
- Local, quality students

Expertise (7 full-time faculty)

ore deposits, environmental, geochemistry, petrology, tectonics structural, engineering geology, geochronology, quaternary geo., etc.

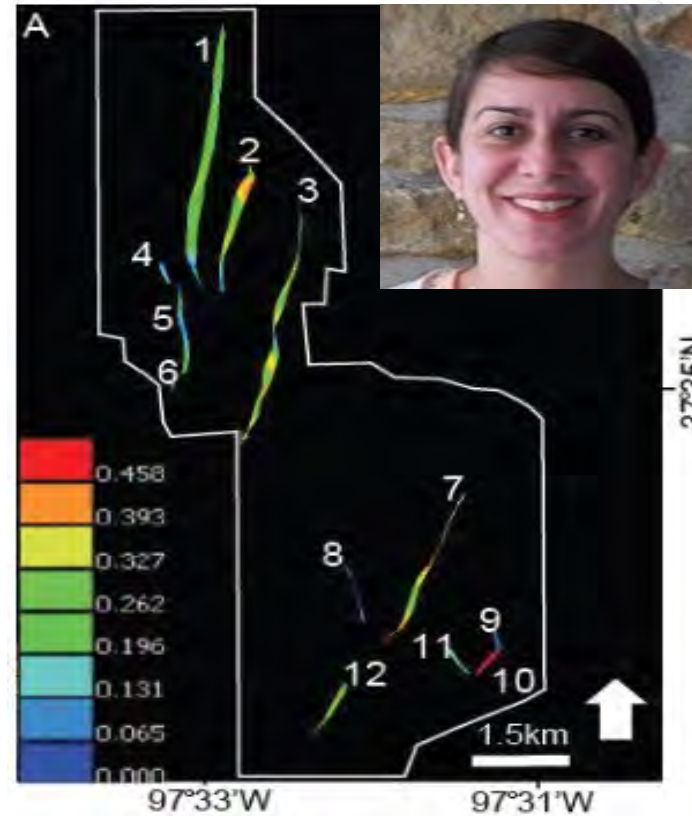


Erik Melchiorre



Kerry Cato

Tandis Bidgoli



New Idria (Lazar)



Teaching-focused

Our priority is employable students.

—85% of grads work in geosciences

Industry collaborations welcome!

—Key need: grad student support

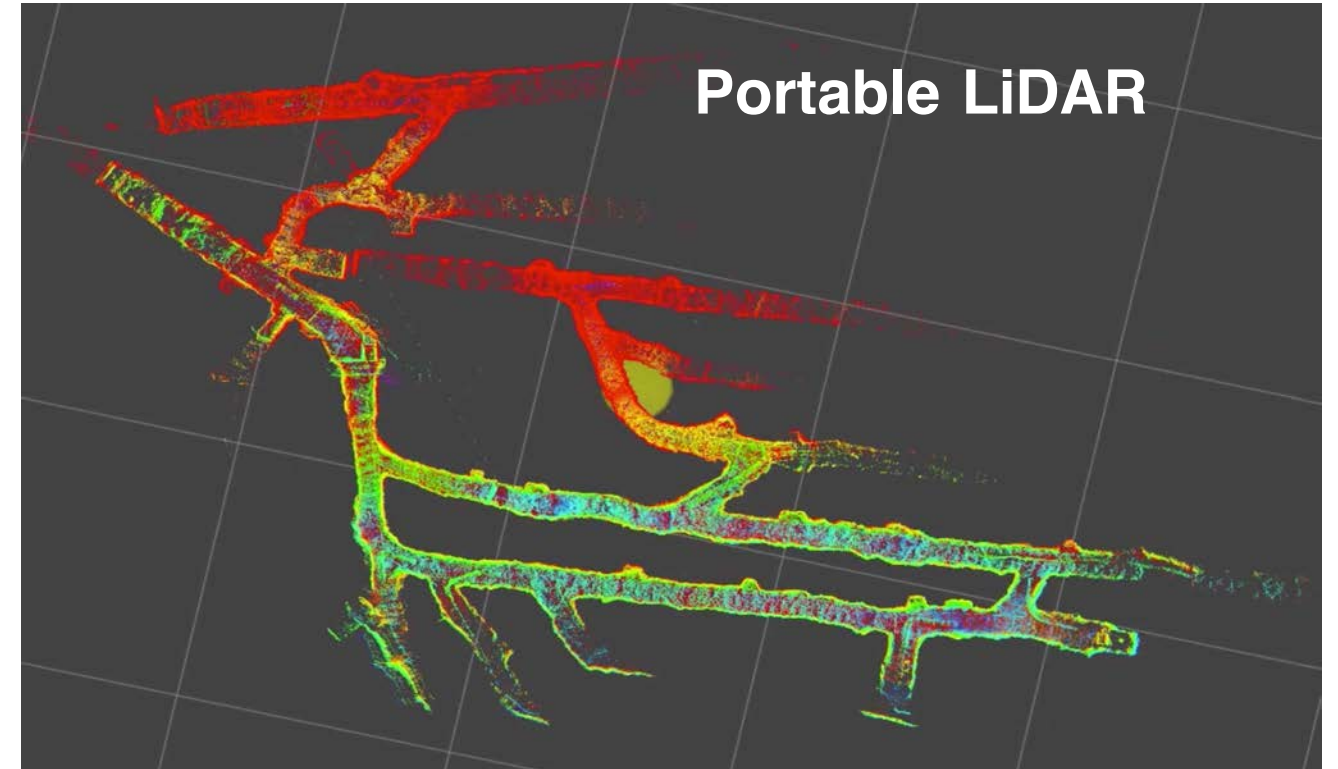
Instrumentation:

Student-focused instruments: easy to use, low maintenance

LiDAR drones



Portable LiDAR



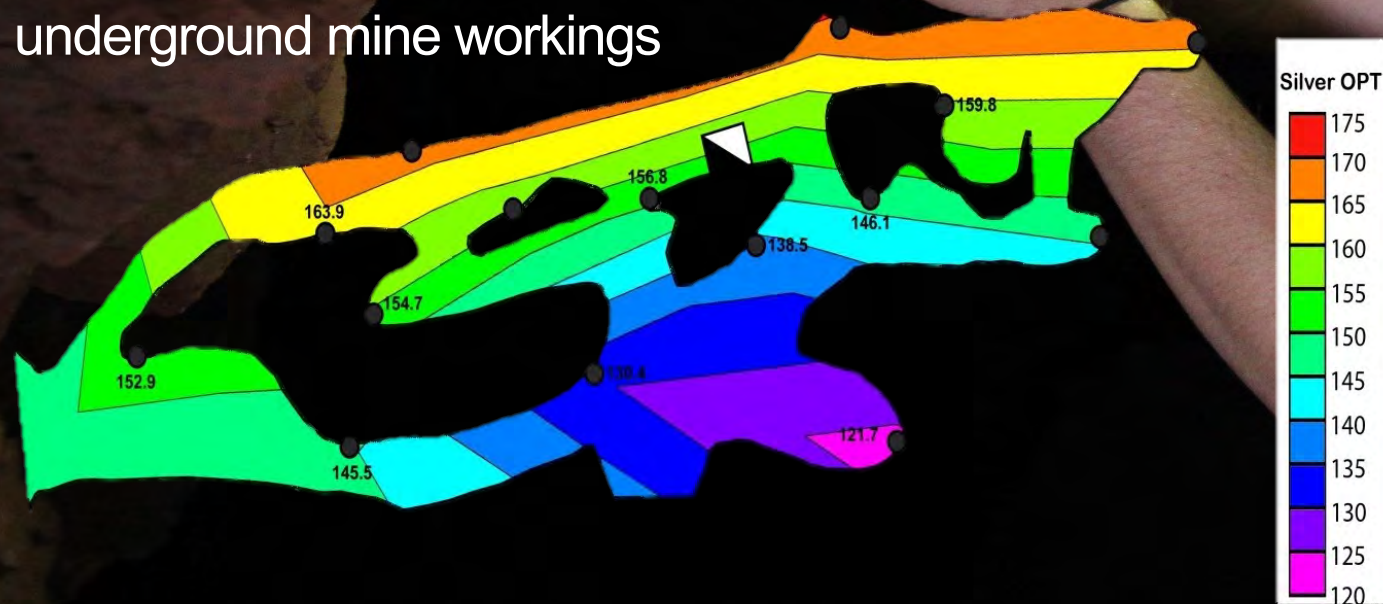
Handheld Raman spectrometer



NITON Handheld XRF Detectors with on-board GPS for real-time *in-situ* chemical analyses in the field

Past Projects have included work in the Calico, Mountain Pass, Blackhawk, Quartzite, Dale, and Holcomb Valley Mining Districts and includes geochemical and ore-grade surveys.

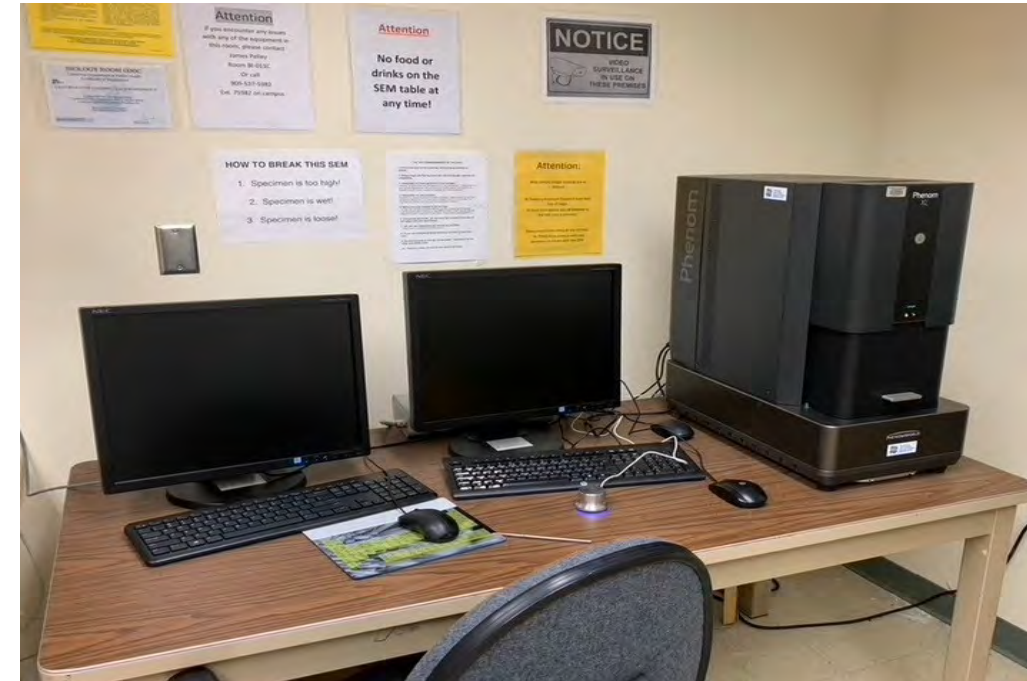
Sample data set of original ore grade
Extrapolated from ore-remnant
XRF survey of stopes from
underground mine workings



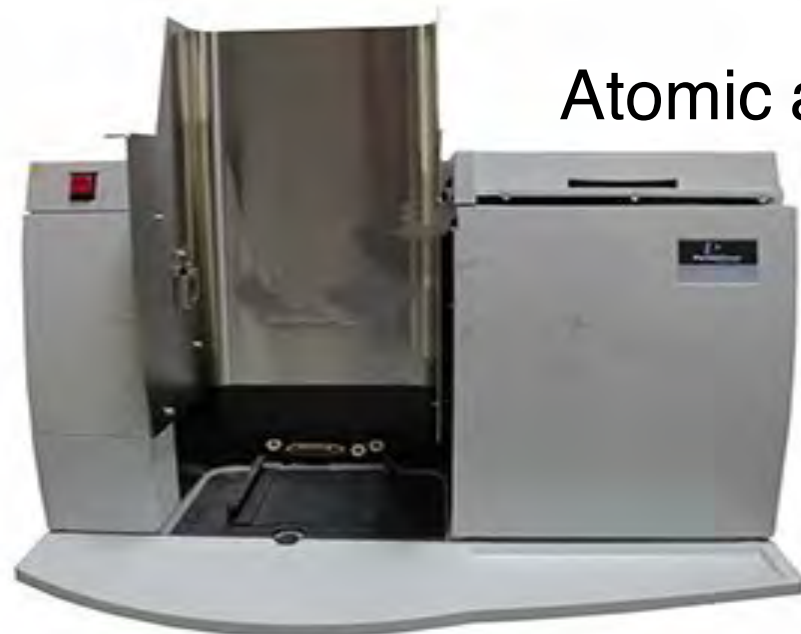
X-ray diffraction



Desktop scanning electron microscope



Atomic absorption



Many instruments in collaboration with chemistry department

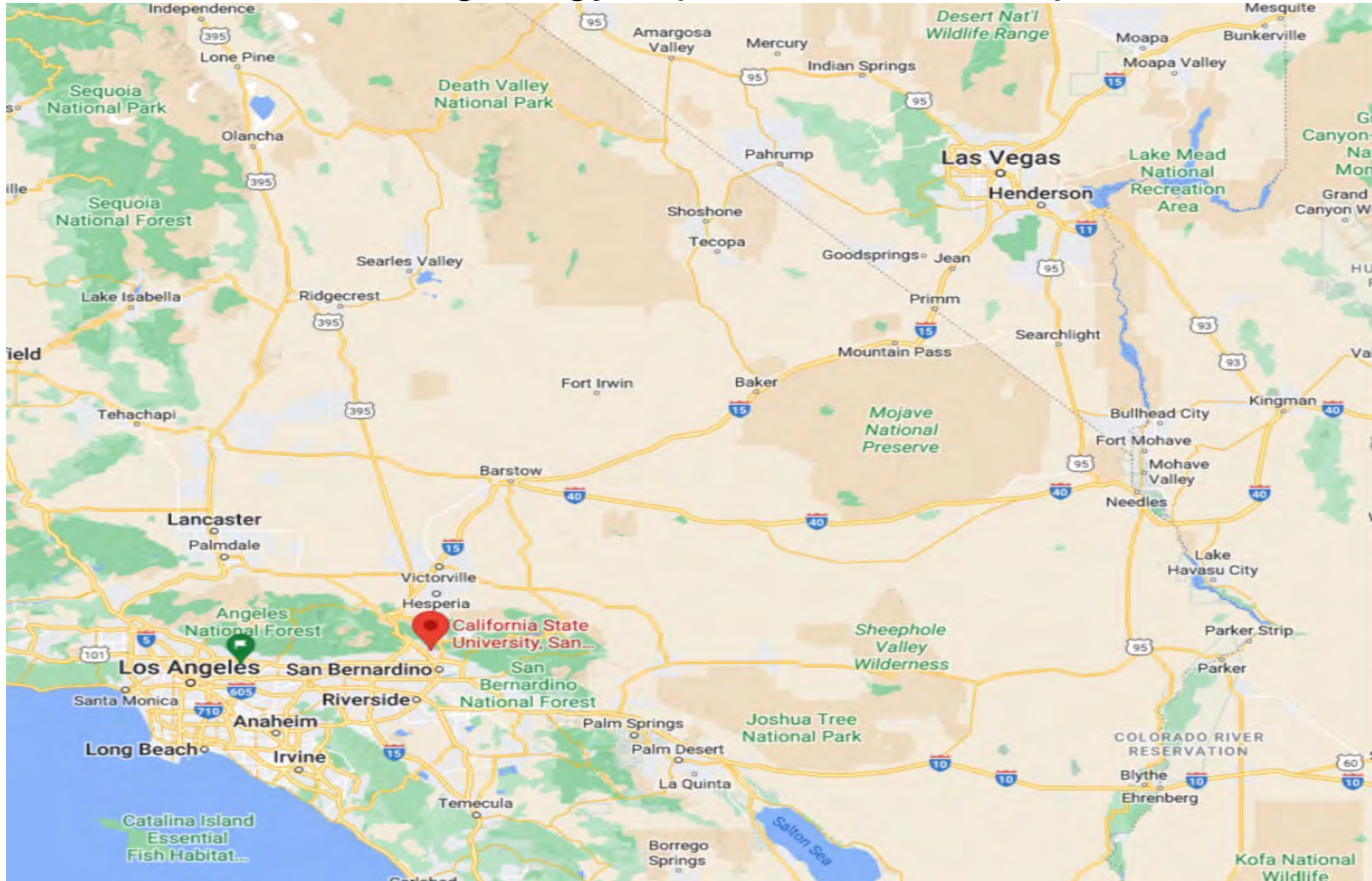
ICP-OES

Ion chromatography

GCMS

GC

Closest geology department to the Mojave

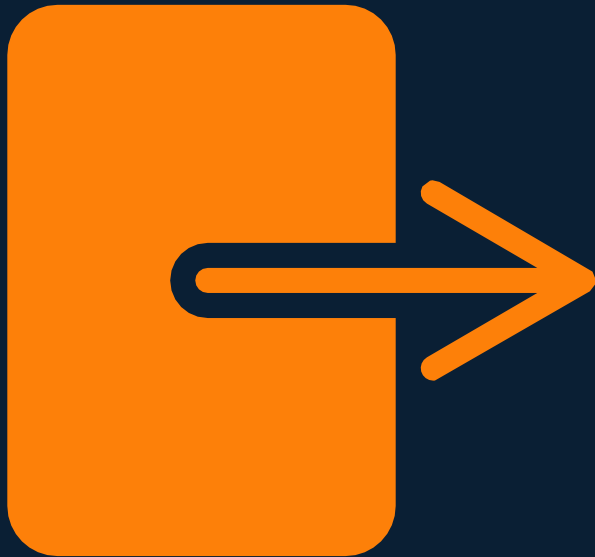


Codi Lazar clazar@csusb.edu

Breakout Sessions

Breakout #1

***Advancing Workforce and
Regional Innovation***



Breakout #2

***Driving Regional Partnerships and
Infrastructure***



Office of the Small Business Advocate

Tara Lynn Gray
Director

www.calosba.gov



CalOSBA Mission & Objectives

Mission: CalOSBA supports economic growth and innovation and ensures that ALL California small businesses and innovative startups have the information and direct support they need to better navigate resources, programs and regulations.

CalOSBA serves as the voice of small business, representing their views and interests across the state and advocating for equitable access to capital, markets, and networks so that all California small businesses successfully start, manage, grow and become more resilient.

Objective: Information and Resources | Advocacy | Resilience



Foster Innovation, Accelerate California

Diversify and expand high-growth economy with state-backed innovation ecosystem

1. Develop regional innovation economies
2. Expand support for small business Research & Development activities
3. Increase access to investment capital for minority founders
4. Cultivate and amplify resources and partnerships

Point Person: *Chris Earl*



Accelerate CA
\$20M



IHUB²
ACCELERATING DIVERSITY
in California's Science and Tech Based Economy

Accelerate CA Inclusive Innovation Hubs

Program: The iHub network will stimulate partnerships, economic development, and job creation for underserved geographic areas, industry sectors, and business owners.

In 2022-23, budget increased to approved 13 new designations with operational funds for four years + Entrepreneurship Seed Fund

Current Inclusive Innovation Hub Designations:

San Diego County: University of San Diego, *The Brink SBDC*

Kern County: 3C Capital Fund, *Kern Inclusive Entrepreneurship Hub*



Explore all Inclusive Innovation Hubs:

[iHub2 | California Office of the Small Business Advocate \(CalOSBA\)](#)

COUNTIES	Total Population July 1, 2021	Population per Sq. Mile 2020	2021 State Unemployment Ranking	Non-Employer Establishments 2019	Employer Firms 2020	1-9 Employees 2020	Percentage White-Only Population 2021	% of Employer Firms Minority Owned 2017	2021 Travel Related Spending
Imperial	179,851	43	58	10,075	2,558	1,770	9.2%	35.2%	\$429.8M
Inyo	18,970	2	13	1,357	486	364	59.5%	0%	\$204.9M
Kern	917,673	111	54	50,942	13,447	9,276	31.1%	23.4%	\$1.7B
Los Angeles	9,829,544	2,467	49	1,112,641	291,833	226,418	25.3%	27.9%	\$19.6B
Orange	3,167,809	4,020	15	324,958	101,681	75,865	38.5%	26.3%	\$10.7B
Riverside	2,458,395	336	35	183,757	41,795	30,330	32.0%	22.5%	\$8.6B
San Bernardino	2,194,710	109	37	159,530	38,018	26,666	25.4%	28.2%	\$5.2B
San Diego	3,286,069	784	24	292,558	88,654	66,266	43.8%	18.8%	\$9.4B

Sources: U.S. Census, Quick Facts and County Business Patterns, State of CA Employment Development Dept. Labor Market Information Division, Visit California 2021 Travel Impacts Report. California's travel and tourism industry is represented by accommodations, transportation and rental cars, restaurants, retail stores, attractions, gasoline service stations, and other businesses that serve travelers.



THANK YOU

Find Us Online & Subscribe to updates at: business.ca.gov/calosbasubscribe



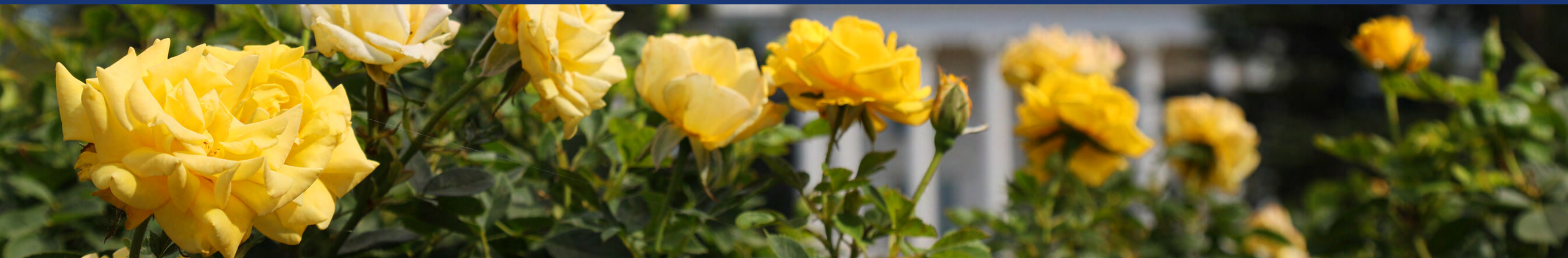
@CaliforniaOSBA



@CaliforniaOSBA



business.ca.gov/zendesk



Employment Training Panel

Critical Materials in CA: Advancing Workforce and Regional Innovation

Robert Meyer
Director of Economic
Development

January 18, 2023
UC Riverside – Palm Desert



Essential ETP

ETP is a business and labor supported State agency that uses a **pay-for-performance contract** to reimburse the costs for employer-customized job skills training.

ETP works because employers define the occupations to be trained, training topics, delivery methods and training providers.

ETP will fund nearly \$93 Million in training for FY2022/2023 under the core program.



Key Initiatives for FY2022/2023

Job Creation, Equity and Impact

Priority Industries and Small Business

Critical Proposal (GO-Biz)

CASCADE and CADENCE (OPR)

RESPOND (Natural Disaster)

Zero Emission Vehicle Technology (GO-Biz)

Apprenticeship, Pre-Apprenticeship and
Journey Worker Training

Aligned with State and Federal Grants

SEED Initiative, PFL



ETP Program Details

Trainees: New and Existing Full-time Workers
Unemployed Individuals
Apprenticeship and Journey Workers
Small Business Owners

Training: Employer-Customized Job Skills
May include job readiness training and
exclude legally-mandated training

Flexible Delivery Methods and Provider Choices

Requires an In-Kind Contribution



ETP Contract Models

Single Employer

ETP eligible employer trains new and existing employees in employer-customized job skills training. *Targets: Manufacturing, Engineering, Construction, Energy, Clean Technology Healthcare, IT and Biotechnology*

Multiple Employer Contractor (MEC)

ETP contractor aggregates training needs to train and place job seekers and/or upskill new and existing workers.



MEC serving this ecosystem

Educational Institutions

University of California Riverside Extension

Riverside Community College District

San Bernardino Community College District

Chambers of Commerce/EDC

Murrieta Chamber of Commerce

East County Economic Development Council

Imperial Valley Economic Development
Corporation



MEC serving this ecosystem

Trade Associations

California Manufacturing Technology Consulting
California Manufacturers and Technology
Association

National Tooling Machining Association Training
Centers of Southern California

Workforce Development Boards

Workforce Development Corporation of Southeast
Los Angeles County, Inc.

South Bay Workforce Investment Board, Inc.



Contracting within the MEC

Flexibility of building and controlling your training:

- course selection, trainers, delivery method, and scheduling are the same
- costs are lower for employers in the MEC
 - administrative and development services are performed by the contractor
- help with the ETP learning curve

Employers can maintain an on-going relationship for training and additional resources, e.g. grants, tax credits, networking, recruitment assistance



Connecting to ETP

The ETP Economic Development Unit provides presentations, interactive program overviews and assistance for all interested applicants. We explore and develop leveraged funding opportunities and provide free direct engagement for potential contractors.

Northern and Bay Area: Renee Pierce (916)327-5258
renee.pierce@etp.ca.gov

Central Valley / Sierra: Elise Candelaria (916)327-5262
elise.candelaria@etp.ca.gov

Greater Los Angeles: Elsa Wadzinski (818)755-3634
elsa.wadzinski@etp.ca.gov

Greater San Diego: Rebecca Eusey (619)881-2417
rebecca.Eusey@etp.ca.gov

Statewide: Robert Meyer (916)327-4391
robert.meyer@etp.ca.gov



Connecting to ETP

ETP Website has approved contracts, Panel Meetings, requirements and updates: <https://www.etp.ca.gov>

Multiple Employer Contract partners:

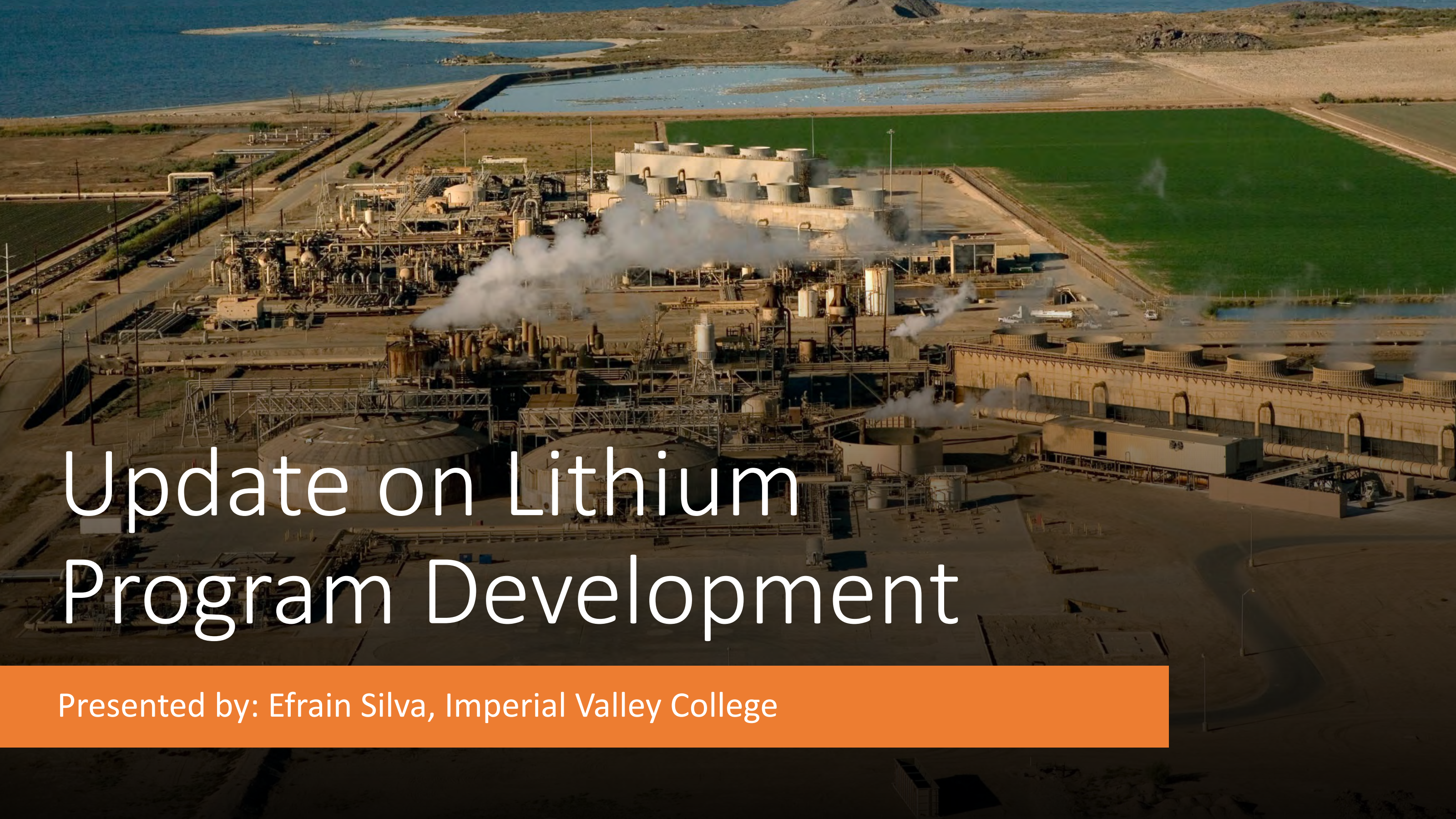
<https://etp.ca.gov/training-opportunities/>

Interactive Orientation for interested entities

<https://etp.ca.gov/getting-started/apply-for-funds/interactive-orientation/> or call (916)327-5258

Free Application Process and Technical Assistance!





Update on Lithium Program Development

Presented by: Efrain Silva, Imperial Valley College

History

- IVC solicited input from the primary lithium companies:
 - Controlled Thermal Resources
 - Energy Source
 - Cal-Energy (Berkshire Hathaway)
- Job descriptions projected lithium related hires.
- IVC determined that many of this work projected workforce could be provided with existing programs such as Welding Technology, HVAC, Electrical technology, Accounting, and Office Technician.



History Continue...

- Three significant workforce gaps were identified upon the review of the job descriptions and concurrence from the lithium companies.
 - Chemical Lab Technician
 - Instrumentation Technician
 - Plant Operator
- IVC conducted a series of industry meetings with the lithium companies, geothermal companies and Biotech companies.
- In September 2022, these companies reviewed and approved the final curriculum including courses and course objectives for all three programs.

Update



PROGRAM CONTENT AND COURSE OUTLINES HAVE BEEN FINALIZED.



APPROVAL IS PROJECTED IN FEBRUARY 2023.



PROGRAM SLATED TO START IN FALL 2023 (AUGUST).



ANTICIPATED COMPLETERS IN SUMMER 2024.



WE ANTICIPATE THAT EACH PROGRAM WILL HAVE 15-20 COMPLETERS.



PROGRAMS ARE DESIGNED TO BE YEARLY COHORTS.

Plant Operator

Course #	Title	Units	Lecture/Lab
BLDC 010	HAZMAT Cal/OSHA 10-Hour Card	1	18 Hours Lecture
CIS 120	Microsoft Word I	1	18 Hours Lecture
CIS 124	Excel I	1	18 Hours Lecture
MATH 105	Integrated Math for Technical Fields	3	54 Hours Lecture
PLNT 080	Plant Operator I	3	36 Hours Lecture/54 Hours Lab
PLNT 085	Plant Operator II	3	36 Hours Lecture/54 Hours Lab
PLNT 090	Plant Operator III	3	36 Hours Lecture/54 Hours Lab
WE 220	Internship	1	60 Hours
		Total Units	16

Instrumentation Technician

Course #	Title	Units	Lecture/Lab
BLDC 010	HAZMAT Cal/OSHA 10-Hour Card	1	18 Hours Lecture
CIS 120	Microsoft Word I	1	18 Hours Lecture
CIS 124	Excel I	1	18 Hours Lecture
MATH 105	Integrated Math for Technical Fields	3	54 Hours Lecture
EWRR 110	Electrical Principles	4	36 Hours Lecture/108 Hours Lab
ELTR 120	Electronic Devices	4	54 Hours Lecture/54 Hours Lab
INST 080	Industrial Instrumentation I	3	36 Hours Lecture/54 Hours Lab
INST 085	Industrial InstrumentationII	3	36 Hours Lecture/54 Hours Lab
INST 090	Industrial InstrumentationIII	3	36 Hours Lecture/54 Hours Lab

Equipment Purchases

Equipment	Program	Quantity	Total
Scissor Lift	Plant Operator	1	\$5,411.41
Mini Excavator	Plant Operator	1	\$32,467.53
Clarus SQ8T MS 120	Chemistry Tech	1	\$60,354.85
Avio 220 Max Cyl/Concentric System	Chemistry Tech	1	\$69,352.40
Portable AC/DC Electrical Learning System	Plant Operator	3	\$25,155.00
Basic Electrical Machines Learning System	Plant Operator	1	\$17,745.00
Centrifugal Pump Learning System	Plant Operator	1	\$21,027.00
AC/DC Learning System	Instrumentation Tech	3	\$25,665.00
Basic Electrical Machines Learning System	Instrumentation Tech	1	\$17,745.00
Centrifugal Pump Learning System	Instrumentation Tech	1	\$21,027.00
Misc. Equipment			\$124,285.81
Total			\$420,236.00

Example of Curriculum-Plant Operator

MEASURABLE COURSE OBJECTIVES AND MINIMUM STANDARDS FOR GRADE OF "C":

- Understand basic water treatment processes.
- Perform PH adjustment, scaling, Filtration, Precipitation
- Understand wet chemistry, titration, sampling procedures.
- Understand basic industrial hand tools and methods
- Perform standard procedures appropriate to the plant operation.
- Recognize and deal with hazardous materials in the plant operation
- Understand emergency response guide (SDS)
- Understand and properly use personal protective equipment (PPE)
- Perform lock-out-tag-out (Mechanical & Electrical) process safety.
- Understand emergency shut-down systems
- Understand 2 abnormal operations and how to handle the situations.
- Understand hazardous materials awareness
- Understand and perform confined space training/safe work
- Perform air monitoring.
- Understand Environmental Compliance
- Understand the principles of steam turbines
- Understand steam turbine generator, turbine control, and generator operations

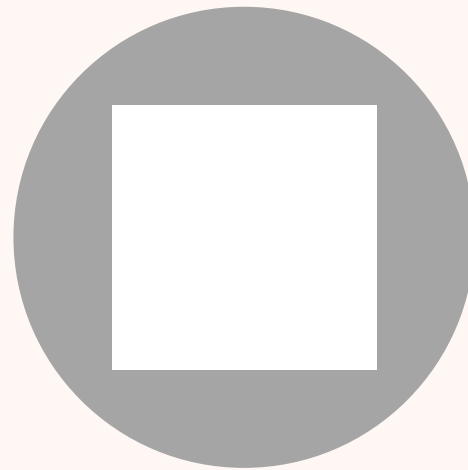
Lab Outline

- Buffer capacity of water in relation to chemical treatment of coagulation of solids.
- PH adjustment measurements using various monitoring systems.
 - Use of industrial hand tools through proper means and methods.
 - Practice and perform standard procedures appropriate to plant operations.
 - Practice emergency response scenarios and protocols in plant operations.
 - Air sampling using ambient air.
 - Perform and follow environmental compliance procedures.
 - Basic troubleshooting of steam turbine generators, turbine controls, and generator operations

Program Needs



NEED TO UPDATE PROJECTED WORKFORCE
NEEDS WITHIN THESE THREE NEW
PROGRAMS.



ADDITIONAL 1.5 MILLION
DOLLARS INSTRUCTIONAL EQUIPMENT.



QUESTIONS?



Advancing Workforce & Regional Innov

Presenter: Dr. Crystal Nasio, Executive Dean

January 18, 2023

INLAND EMPIRE-RIVERSIDE COUNTY

Subregional Labor Market and Demographics

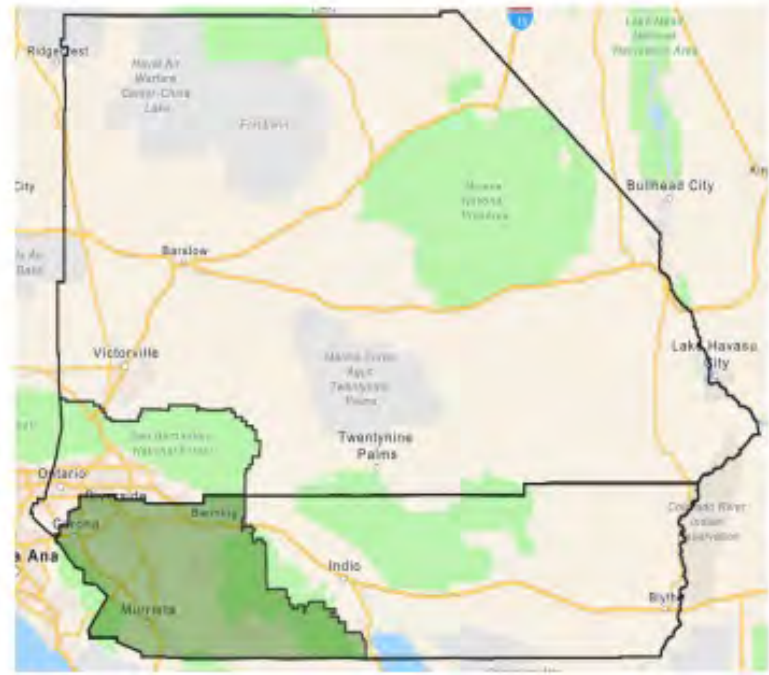
Labor Availability

I.E.-Riverside County Subregion Industry & Occupation Jobs

Contains approximately 39% of regional jobs.

2021 Jobs: 684,925
 2026 5-yr Job Change/Growth: +56,874 jobs/+8.3%

Businesses (industries) hire various workers (occupations) to produce goods and provide services that support the local economy. The following list provides a sample of high-opportunity industry groups and the types of high-quality occupations they employ.



High-Opportunity Industry Group Criteria

- Positive Job Growth Over the Next 5 years
- Avg. Annual Salary meets or exceeds \$45,400 1 adult living wage standard
- High Concentration

High-Quality Occupation Criteria

- 100+ Annual Job Openings in Region
- Med. Hourly Earnings meet or exceed \$21.82 (\$45,400 annual) 1 adult living wage standard
- Note: Occupation counts are the total for the subregion



Labor Availability

Building Equipment Contractors (Construction)



- 2021 Jobs: 16,663
- 2026 5-year Job Change: +2,048/ +12%
- Avg. Earnings Per Job: \$70,300
- Concentration: 6.5x

Electricians

- 2021 Jobs: 3,746
- 2026 Five-year Job Change: +612/ +16%
- Annual Job Openings: 534
- Avg. Hourly/Ann. Earnings: \$23.98/\$49,900

Warehousing and Storage



- 2021 Jobs: 45,421
- 2026 5-year Job Change: +10,863/ +24%
- Avg. Earnings Per Job: \$59,100
- Concentration: 1.9x

First-line Supervisors of Transportation and Material Moving Workers

- 2021 Jobs: 3,335
- 2026 Five-year Job Change: +544/+16%
- Annual Job Openings: 493
- Avg. Hourly/Ann. Earnings: \$28.42/\$59,100



High-Opportunity Industries

High-quality Occupations (total subregion job counts)

Outpatient Care Centers

- 2021 Jobs: 6,449
- 2026 5-year Job Change: +1,601 jobs/ +25%
- Avg. Ann. \$ Per Job: \$94,600
- Concentration: 1.4x

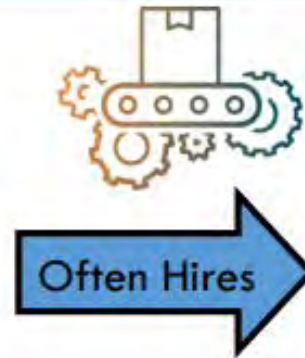


Registered Nurses

- 2021 Jobs: 10,503
- 2026 Five-year Job Change: +1,335/ +13%
- Annual Job Openings: 846
- Avg. Hourly/Ann. Earnings: \$52.44/\$109,100

Office Furniture (including Fixtures) Manufacturing

- 2021 Jobs: 748
- 2026 5-year Job Change: +102 jobs/ +14%
- Avg. Ann. \$ Per Job: \$76,200



Carpenters

- 2021 Jobs: 9,682
- 2026 Five-year Job Change: +470 jobs/ +5%
- Annual Job Openings: 1,011
- Avg. Hourly/Ann. Earnings: \$23.81/\$49,500

Grocery and Related Product Merchant Wholesalers

- 2021 Jobs: 4,022
- 2026 5-year Job Change: +462 jobs, /12%
- Avg. Ann. \$ Per Job: \$99,900



Sales Representatives, Ex. Technical and Scientific

- 2021 Jobs: 4,510
- 2026 Five-year Job Change: +243 jobs/ +5%
- Annual Job Openings: 505
- Avg. Hourly/Ann. Earnings: \$28.62/\$59,500

Labor Availability



Workforce Development

- CA Workforce Development Board
 - High Road Training Partnerships
 - Focus: The High Road Training Partnerships (H RTP) initiative started as a \$10M demonstration project designed to model partnership strategies for the state. Ranging from transportation to health care to hospitality, the H RTP model embodies the sector approach championed by the Board — industry partnerships that deliver equity, sustainability, and job quality.
- CCC Support
 - Strong Workforce Programs
 - Focus: To develop more workforce opportunity and lift low-wage workers into living-wage jobs, California took a bold step in 2016 to create one million more middle-skill workers. The “more” is increasing the number of students enrolled in programs leading to high-demand, high-wage jobs. The “better” is improving program quality, as evidenced by more students completing or transferring programs, getting employed or improving their earnings.



Partnerships & Pipelines

- Premier Partners
 - MP Materials
 - Rio Tinto
 - Clean Energy Initiatives
- BNSF
 - Welding Training (180 Students)





Thank you!

*If you are interested in
partnering
with Barstow Community
College please
email Dr. Crystal Nasio,
cnasio@barstow.edu*