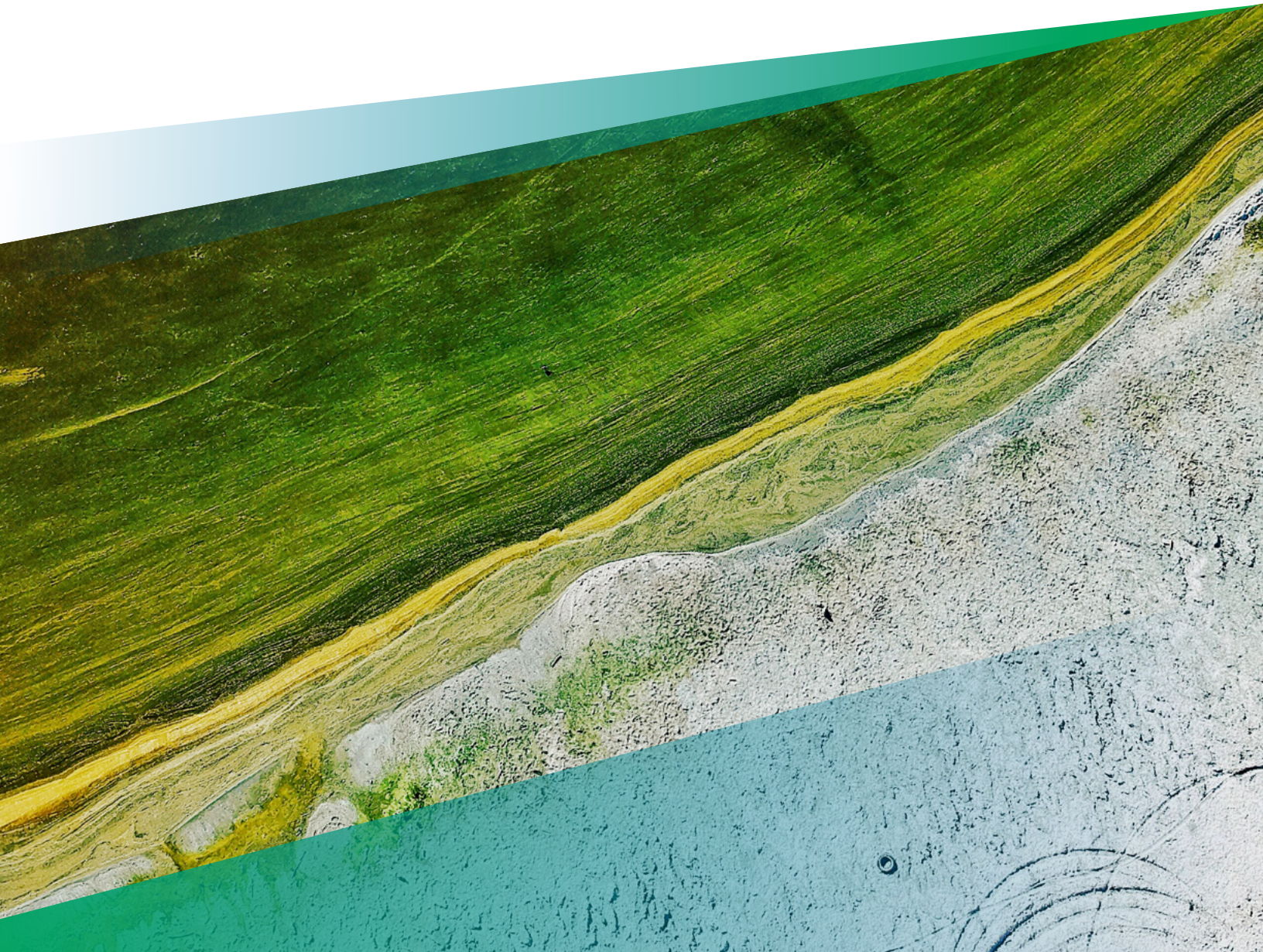




2020

EPIC ELECTRIC PROGRAM INVESTMENT CHARGE HIGHLIGHTS

California's premier public interest research
program driving clean energy innovation and
entrepreneurship to help meet the state's climate
and energy goals



LETTER TO CALIFORNIA



California Energy Commission
Chair David Hochschild

The year 2020 brought colossal challenges to all Californians. Together, Californians faced the COVID-19 pandemic and the ongoing impacts of climate change with record-setting wildfires and an extreme heat wave that pushed the state grid to the limit. But it was also a year brimming with hope as Californians witnessed a renewed push for social justice and racial equity, reimagined how and where work takes place (and the associated benefits of reduced environmental impact), and saw a ground swell of support from Californians for bold action on climate change.

For public-interest energy research, 2020 was a watershed year as the CPUC approved the renewal of the Electric Program Investment Charge (EPIC). With another 10 years of equitable, reliable, and transparent EPIC investment assured, California’s innovators and entrepreneurs can continue forging ahead, scaling up the latest in energy technology, making scientific breakthroughs, and maintaining California’s clean energy leadership. EPIC has put nearly \$850 million back into the economy, investing in more than 730 organizations. EPIC awards attract further investments and awardees have attracted **\$3.5 billion** in private investment. To date, more than **45 EPIC-funded technologies** and related services have

been successfully commercialized, including smarter electric vehicle (EV) chargers, better battery chemistries, more intuitive energy and water management software, and others.

EPIC is advancing energy equity with **68 percent** of demonstration and deployment funds spent in underresourced communities. The CEC is working to expand outreach and engagement in these communities to better understand needs, challenges, and ways that EPIC funds can be best invested for ALL Californians. These geographically diverse projects are enhancing grid resiliency and safety, unlocking the promise of greener buildings, changing how Californians use energy and water in industry and agriculture, driving advancements in clean medium- and heavy-duty transportation, supporting nascent clean energy companies to build local manufacturing capabilities in California, and so much more. These California-grown innovations, driven by bar-setting energy and environmental policy, are the tools the state needs to reduce emissions more quickly, decarbonize every part of California’s economy, and avoid the worst impacts of a changing climate.

As California works to recover from the economic impacts of COVID-19 and ensure all its inhabitants enjoy more healthful and prosperous communities, EPIC’s sustained public-interest research investments are more important than ever. Embracing the state’s motto – EUREKA! – California’s best and brightest are delivering the innovations that underpin the state’s 100-percent clean energy future: a future built on a clean, affordable, and resilient energy system for all Californians.

Sincerely,

CALIFORNIA’S INVESTMENT IN CLEAN ENERGY INNOVATION

The Electric Program Investment Charge (EPIC) unleashes innovation, enabling a safer, more reliable, equitable, decarbonized, and affordable electricity system. EPIC funds are competitively awarded to support the most promising technologies and approaches across six investment areas: the entrepreneurial ecosystem, resilience and safety, building decarbonization, grid decarbonization and decentralization, industrial and agricultural innovation, and low-carbon transportation. EPIC invests in technologies at every stage of development, progressing them from the lab to market competition.



Entrepreneurial Ecosystem
\$143 million invested

The CEC is building a world-class ecosystem that provides the resources, expertise, and information to foster and support successful clean energy entrepreneurship across the state, making California the destination for cleantech venture capital funding.



Resiliency & Safety
\$151 million invested

Equipping communities, businesses, and public agencies with breakthrough technology solutions and tools to build a safe and resilient energy system, providing essential services even during emergencies.



Building Decarbonization
\$194 million invested

Transforming the built environment by investing in new sustainable energy technologies that improve the affordability, health, and comfort of homes and businesses.



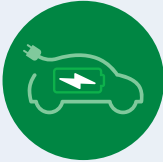
Grid Decarbonization & Decentralization
\$207 million invested

California is building a fully decarbonized and more decentralized electric grid. To accelerate this transition, EPIC is investing to make renewable energy even more affordable and drive market adoption of low-carbon technologies, such as energy storage, that improve grid reliability.



Industrial & Agricultural Innovation
\$119 million invested

The agricultural and industrial sectors have helped California become the fifth largest economy in the world. EPIC is helping validate technology solutions that reduce electricity use while increasing production of goods and products on which much of the world relies.



Transportation Electrification
\$32 million invested

EPIC advances technology solutions that reduce the cost and enhance the benefits of electric vehicle ownership and enable electric vehicles to harmonize with the larger electric grid.

EPIC NUMBERS

Since 2012, EPIC investments have yielded spectacular benefits for Californians.

INVESTMENTS

\$846
MILLION

EPIC funds invested in California-grown innovation

\$3.5
BILLION

private investment raised by businesses following EPIC support

385

projects funded in every corner of California*

68%

OF TECH DEMONSTRATION AND DEPLOYMENT FUNDS

invested in underresourced communities**

730
ORGANIZATIONS

funded by EPIC across California

BENEFITS

3,500
JOBS

estimated average jobs per year from EPIC and associated economic activities.***

\$18.6
BILLION

projected Californians' energy bill savings through 2045 from 19 EPIC-funded energy efficiency technologies.

\$86-\$191
BILLION

in health benefits from improved air quality projected through 2045 from 19 EPIC-funded energy-efficiency technologies.

MORE THAN
2,900
CITATIONS

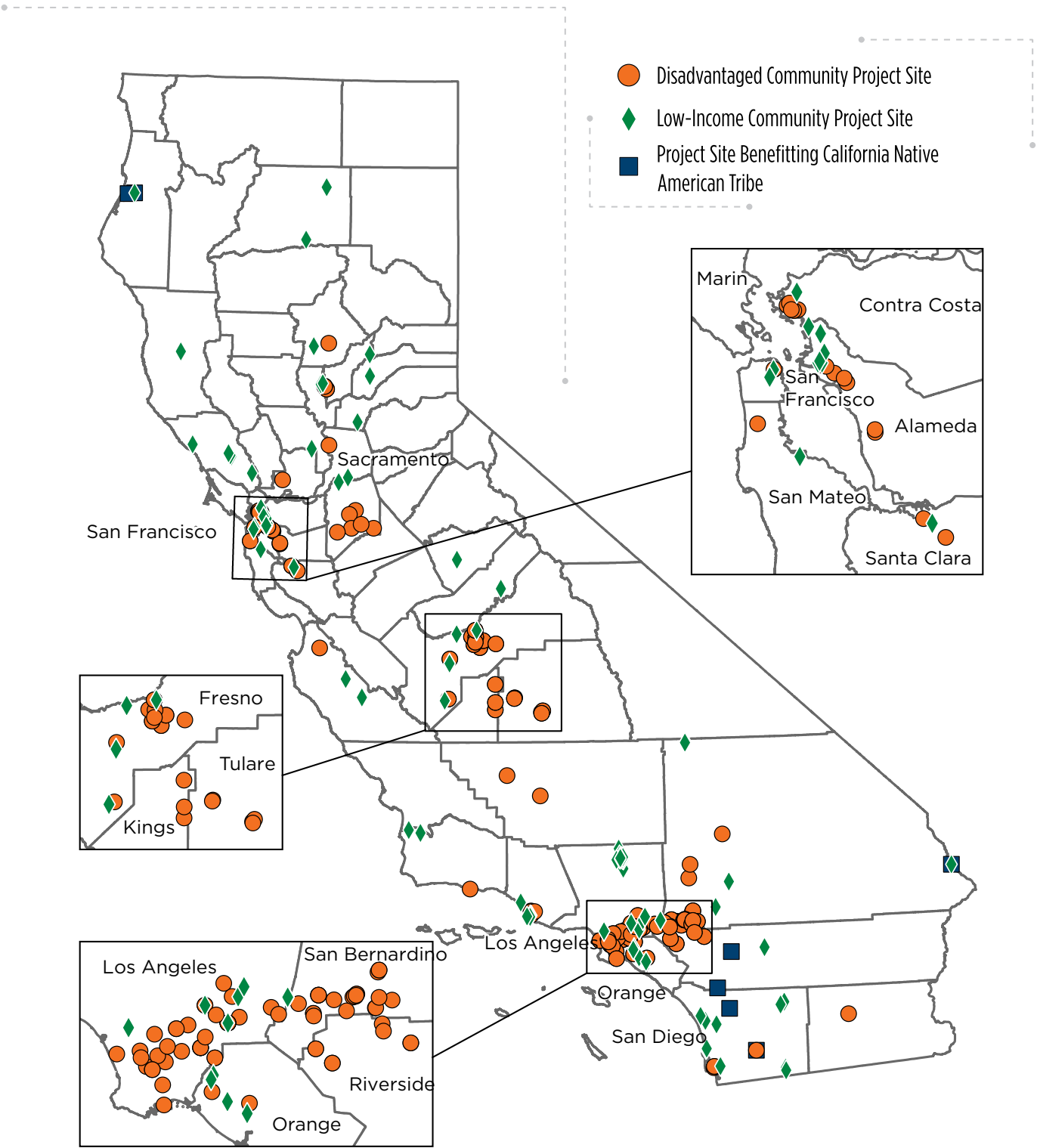
of EPIC-funded research results.

850,000
USERS

of EPIC-funded online tools that make complex data more accessible and advance clean energy solutions.

* The section on ideas to "Discover the Power of Energy Innovation" maps EPIC projects, including headquarters and project sites. | **Including projects in disadvantaged communities and low-income communities, as defined by AB 523, as well as projects benefitting California Native American Tribes. | ***Projected from 2014 through 2024.

EPIC DEMONSTRATION PROJECTS IN UNDERRESOURCED COMMUNITIES



Source: California Energy Commission

YEAR IN REVIEW

BUILDING MOMENTUM DURING A CHALLENGING YEAR

During the pandemic, the EPIC investments supported the state's clean energy economy, including small businesses and entrepreneurs, by continuing to fund innovation. The CEC continued to issue competitive solicitations and make awards, quickly pivoting to a virtual environment in March 2020. The CEC worked closely with its funding recipients to overcome COVID-related challenges to EPIC projects, including extending agreement terms to account for challenges researchers had getting into their facilities or delays arranging access to demonstration sites.

10
YEARS

of additional EPIC funding following renewal by the California Public Utilities Commission in 2021.

26

clean energy start-up companies gained access to California's premier testing facilities through the EPIC-funded CalTestBed program to collect validated performance data to share with potential investors.

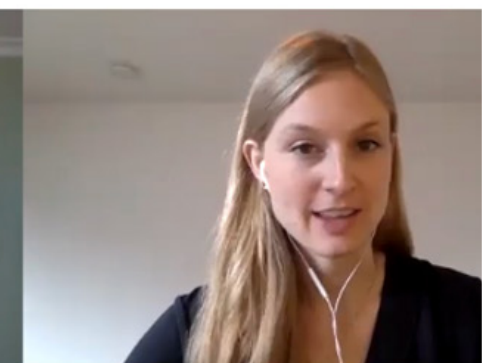
5 MW

of load reduction provided by CEC-funded microgrids during the multistate extreme heat wave in August and September.

MORE THAN
2000

people attended CEC events showcasing EPIC projects and technologies.

KNOWLEDGE SHARING AT THE 2020 ELECTRIC PROGRAM INVESTMENT CHARGE VIRTUAL SYMPOSIUM



From top to bottom, starting top left: Governor Gavin Newsom, Chair David Hochschild, former Vice Chair Janea Scott, Commissioner Andrew McAllister, David Nemtsov (Director of Building Technologies, U.S. Department of Energy), California State Senator Nancy Skinner, California State Senator Bob Wieckowski, California State Assemblymember Autumn Burke, Julia Pyper (Political Climate Podcast), California State Assemblymember Cristina Garcia.

EPIC PROJECT PROFILES

Entrepreneurial Ecosystem



“ Our Smart Splitters take the hassle and expensive costs out of home charging installation. With our Smart Splitting technology, home charging access is as easy as plugging in your phone. ”

– Spencer Harrison, Co-Founder and CEO of NeoCharge

NEOCHARGE

As consumers switch to EVs, many confront a confounding issue: the initial cost, time investment, and complexity of adding a home charger. EV chargers typically require a dedicated 240V service that, in an older home, can mean an electric panel upgrade costing \$1,500 or more, including permits, labor, and parts. With seed funding from the California Sustainable Energy Entrepreneur Development Initiative (CalSEED)* and business development support from the Los Angeles Cleantech Incubator, NeoCharge has developed its Smart Splitter technology. The Smart Splitter enables EV owners to safely and easily use existing 240V service, as is used for clothes dryers, to charge an EV. The Smart Splitter intelligently switches the flow of energy and tracks power usage. In a home with two EVs, the Smart Splitter can share energy and charge both EVs. By reducing the cost of going electric and giving consumers an affordable option to maximize the utility of what they already have, NeoCharge is making going electric more accessible.

* The CalSEED initiative, administered by the New Energy Nexus, provides assessment of applications from clean energy startup companies, submittal of proposed small grant awardees for consideration by the CEC, and provision of business development training for participating startup companies.

\$1,500

Average cost of installing a typical residential EV charger and electricity panel upgrade.

\$450

Average cost of the NeoCharge Smart Splitter, which does not require costly installation; simply plug the charger into an existing socket for an electric clothes dryer.

7x

faster charging: compared to a 120-volt (V) outlet.



EPIC PROJECT PROFILES

Resilience and Safety

CABAN SYSTEMS



“Recent storms and wildfires have shown the need for California’s critical infrastructure to evolve beyond the grid, as power emergencies can leave communities without access to communications. This grant enables us to meet demand faster and we look forward to working with the CEC as we expand our manufacturing operations,”

—Alexandra Rasch, Founder & CEO, Caban Systems



131° temperature Caban’s ruggedized energy storage system can withstand.

<1 day to install and commission Caban’s energy storage system at a telecommunication tower.

LESS THAN A BLINK OF AN EYE to bring a telecommunications tower back on-line once it has lost power from the grid. Caban’s energy storage system restores power in less than 10 milliseconds, barely noticeable.

30x increase in production capacity thanks to EPIC funding.

California’s telecommunications infrastructure is increasingly vulnerable to power outages from electrical equipment and infrastructure failures, brownouts, wildfires, earthquakes, severe storms, landslides, and public safety power shutoffs. Caban Systems is working to shore up telecommunications infrastructure by scaling up production of its battery systems in California. Already installed at 38 sites, Caban’s ruggedized energy storage systems can withstand fire and extreme heat (up to 131°F), be controlled via remote access, and be installed and commissioned on a tower in less than a day. These energy storage systems are plug-and-play capable with batteries from different manufacturers. When paired with onsite power generation like solar, the systems can keep information moving at crucial times. Since beginning this project, this start-up company has created six manufacturing jobs and plans to add another 19 manufacturing jobs by the end of the project.



STREAMLINED ENERGY-EFFICIENCY RETROFITS IN MULTIFAMILY BUILDINGS

ROCKY MOUNTAIN INSTITUTE

Below is the multifamily building before the building-envelope retrofit (Corona, California).

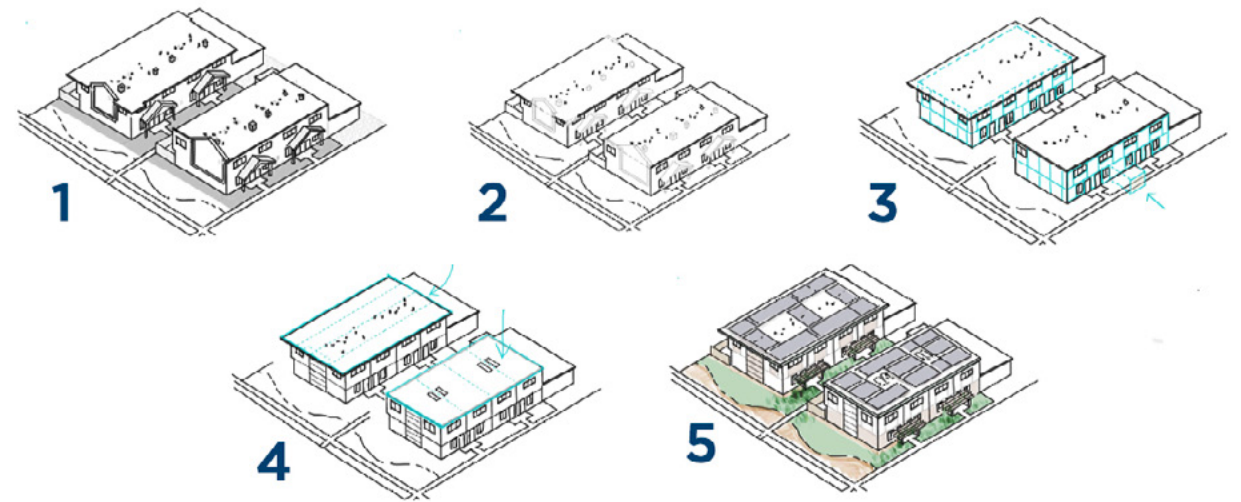


Diagram of process this project will use to install prefabricated exterior building envelope panels. This diagram shows the step-by-step transformation of the building envelope: 1) existing building; 2) roof and parts of the exterior façade that are removed, such as the porch and other architectural features; 3) prefabricated insulated wall panels with insulation, air barrier, cladding, windows, and doors contained into one panel and installed; 4) new installed roof panel that includes PVs; and 5) finished retrofitted building.

Source: Rocky Mountain Institute

2 MILLION

low-income multifamily housing units in need of energy-efficient retrofits in California.

<1 WEEK

average time to insulate, seal, and weatherize the building envelope using the panelized approach being demonstrated in this EPIC project. This compares to three weeks average time using conventional approaches.

>20%

reduction in HVAC energy use due to insulation, air tightness, and use of higher-quality manufactured prefabricated retrofit façade panels compared to standard retrofit methods.

Building-envelope retrofits are critical to improving energy efficiency and reducing energy costs for residents but are rarely included in renovations because of cost, time constraints, and disruption to occupants. Multifamily buildings are especially challenging to retrofit. The Rocky Mountain Institute is assessing the commercial feasibility of using prefabricated exterior envelope panels in California through a demonstration project in a multifamily building in a California underresourced community. These panels, placed over existing exteriors, could decrease the cost, time, and complexity of retrofitting multifamily buildings, better sealing the building and reducing residents' energy costs.

EPIC PROJECT PROFILES

SRI, EXSORBTION

Grid Decarbonization
and Decentralization



\$6 BILLION

the estimated annual economic value of lithium carbonate that could be produced from the Salton Sea area.*

600K TONS

the potential annual lithium carbonate production from the Salton Sea area, enough to produce about 11.3 million EV batteries each year.

90%

of lithium can be recovered using SRI's technology.** This is a substantial improvement over conventional lithium recovery methods, which have less than 50 percent efficiency.

MORE THAN 6X

reduction in upfront costs compared to conventional lithium recovery methods.

** Estimate based on a price of \$10,000 per metric ton lithium carbonate equivalent.*
*** Performance of this emerging technology has been demonstrated in a lab setting.*

Energy storage is crucial to California's clean energy future, and demand for lithium-based batteries is increasing. Ensuring a steady, domestic, and ecofriendly supply of lithium for batteries is an investment to strengthen local control of a critical supply chain ingredient. The CEC is investing EPIC funds in such a supply by producing lithium from geothermal brine in the Salton Sea area in Imperial County. Menlo Park-based SRI International used EPIC funds to develop an innovative sorbent material and regeneration process to capture lithium from geothermal brine to produce lithium carbonate, the

metallic salt used to make lithium batteries. This technology extracts lithium carbonate from geothermal brine in hours, a tremendous improvement over conventional lithium extraction technologies, which require up to two years to process geothermal brine. The technology has been licensed to ExSorbtion, Inc. to pursue commercialization, and additional EPIC funding was awarded for a pilot demonstration. As this supply scales up, California could become home to more lithium battery production, supporting a speedy transition to a 100 percent renewable grid and a more electrified transportation sector.



Hudson Ranch I geothermal power plant, March 2012, Salton Sea, California/U.S. (Source: EnergySource)

EPIC PROJECT PROFILES

Industrial, Agricultural,
and Water Innovation



TERZO POWER
SYSTEMS



\$19 MILLION

annual electricity cost savings if
9 percent of California’s industrial
hydraulic power units adopt Terzo’s
Hydrapulse electrohydraulic
technology.

124K

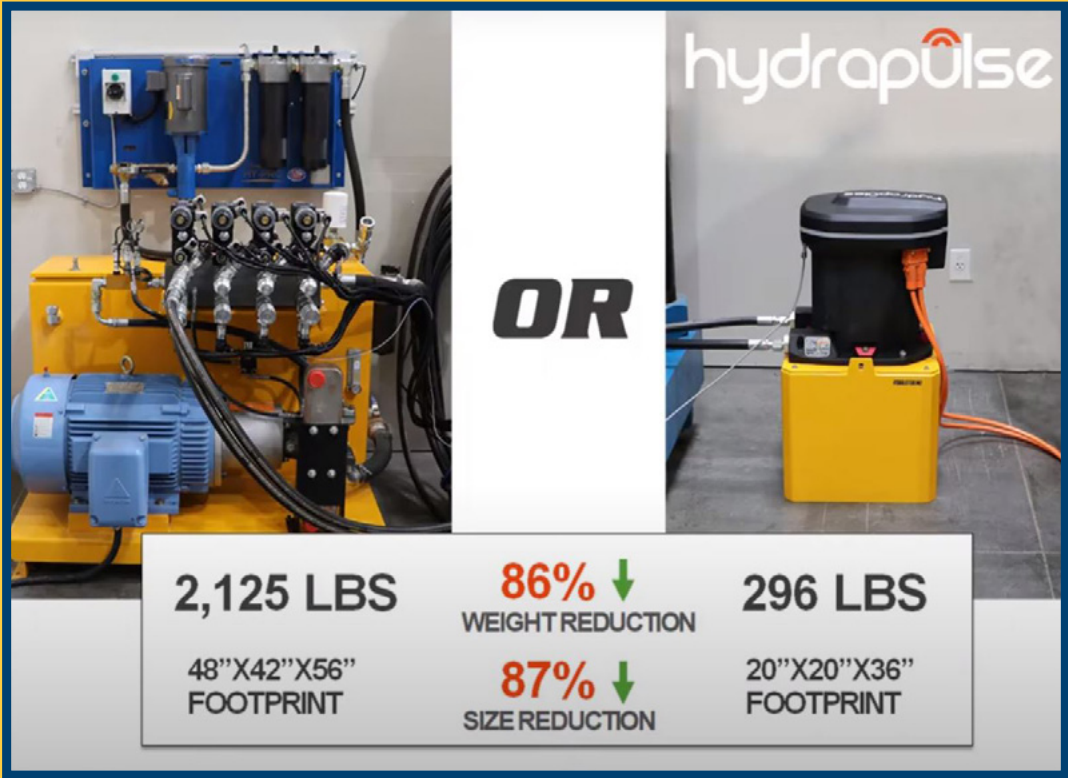
hydraulic power motors currently in use in
California’s industrial, agricultural, and water
sectors.

80%

potential increase in energy efficiency
using Terzo’s Hydrapulse hydraulic
pump compared to conventional
hydraulic pumps.

MORE THAN 80%

reduction in size and weight compared to
standard hydraulic pump units.



This figure compares the conventional hydraulic pump unit with Terzo's Hydrapulse hydraulic pump unit (Source: Terzo Power Systems).

Hydraulic power systems use a significant amount of energy and are found in nearly every industrial setting. The greatest barriers to adopting energy-saving technology in industrial hydraulic power systems are high cost and long payback periods. Terzo Power Systems has developed an economical and efficient configuration for these systems using highly efficient liquid-cooled permanent magnet motors coupled with fully integrated, liquid-cooled motor controls. These innovations offer reduced cost, size, weight, and noise. Built for large-scale integration and adoption, this hydraulic pump technology can quickly be commercialized and adopted statewide. This technology increases the efficiency of hydraulic pump systems up to 80 percent.

EPIC PROJECT PROFILES

Transportation Electrification



NUVVE



\$800

Maximum monthly electric bill reduction at campus parking garage from Nuvve control system for three bidirectional EV chargers.

>1.2 MW

Load reduced by Nuvve's energy management system at the University of California, San Diego, during the August 2020 extreme heat wave.

MORE THAN \$18 MILLION

in subsequent private capital investment received by Nuvve.

EV adoption is accelerating in California, and the growing number of EVs with larger batteries have significant potential to participate as flexible assets in California's transition to a zero-carbon, renewable electricity system. Nuvve, a member of the EPIC-funded Southern California Energy Innovation Network, received EPIC funding to develop and demonstrate vehicle-to-grid technology in the UC San Diego microgrid. By making EV charging controllable and bidirectional, Nuvve enables EVs to support electric system needs alongside other distributed energy resources. For example, Nuvve used EVs to participate in demand-response auctions to alleviate grid

stress during the summer 2020 extreme heat wave. Nuvve received more than \$18 million in subsequent private capital investment and is planning a public listing with a valuation potentially exceeding \$100 million. Recognizing its potential impact on expanding the use of renewable energy to fuel electric vehicles, Nuvve was awarded two California Visionary Awards at the 2020 EPIC Symposium — Best in Storage and Mobility and Biggest Impact for Energy Equity.

EPIC OPPORTUNITIES

IN **2021**

Opportunities to help plan future EPIC investments are coming up this year. The CEC is looking for your involvement to help shape priority research areas for 2022-2025 in the next EPIC investment plan.

Furthermore, opportunities to compete for EPIC funding continue in 2021 in the following areas:



- “Realizing Accelerated Manufacturing and Production for Clean Energy Technologies,” a competitive funding opportunity to provide financial assistance to help clean energy entrepreneurs successfully advance their emerging best-of-class innovative technology to the low-rate initial production stage.



- Load flexibility and decarbonization for cold storage facilities.



- Climate resiliency research.
- Understanding health and equity issues related to electrification.
- Mobile, renewable, clean energy.
- Offshore wind platform advances and environmental research to reduce species impact.
- Recycling pathways for lithium-ion batteries.



- “Bringing Rapid Innovation Development to Green Energy,” a competitive funding opportunity to continue support for the most promising clean energy technologies that have already attracted interest from the market as they continue the path to market adoption.
- Green hydrogen in industry.
- Energy efficiency and load flexibility in farms near urban areas.



- Design-build competition for affordable and resilient zero-emission mixed-use buildings.
- Zero-net-carbon prefabricated homes.
- Vehicle-to-building resiliency solutions for homes and other buildings.

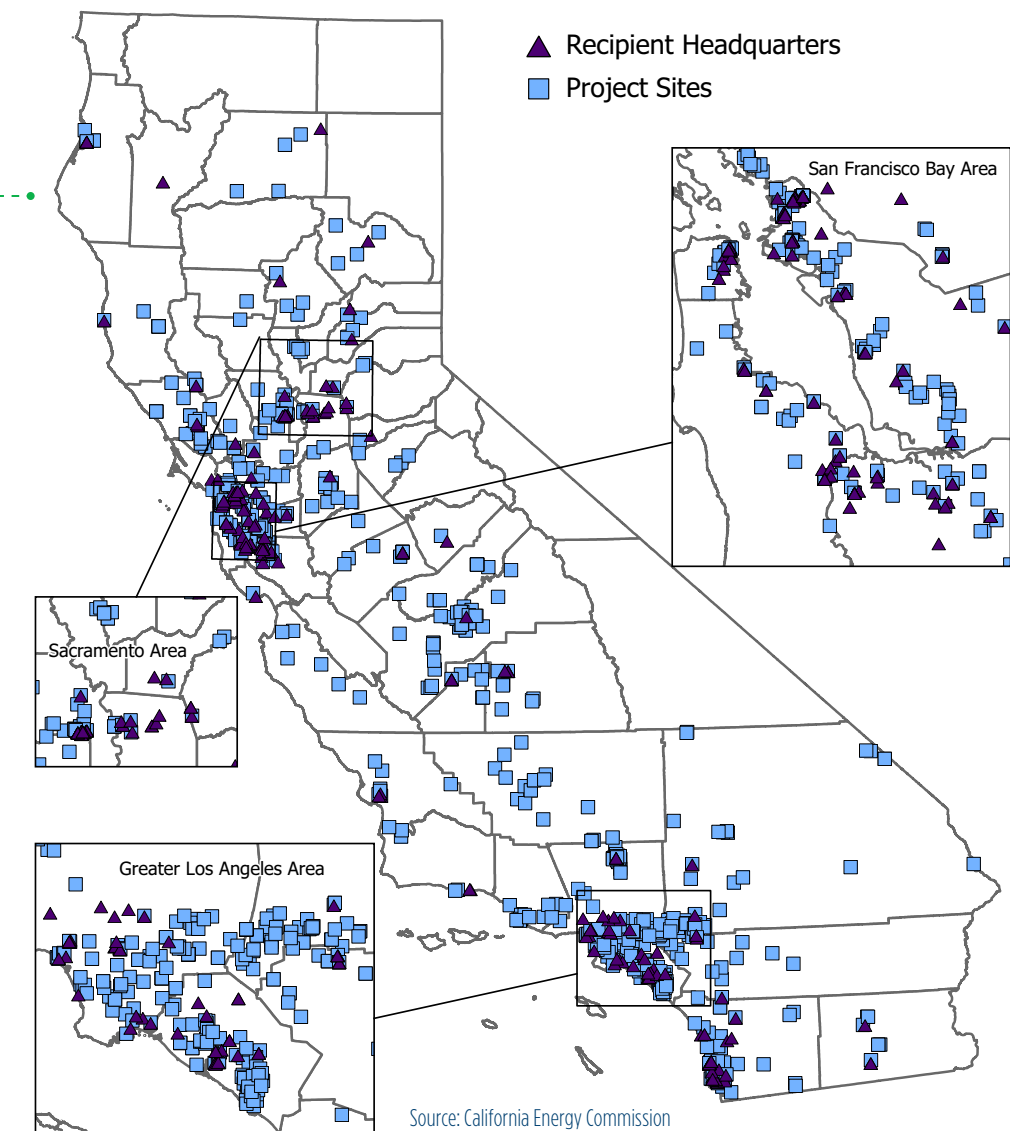


- Vehicle-to-grid research for medium- and heavy-duty vehicles.
- Accelerating heavy-duty truck electrification.

DISCOVER THE POWER OF ENERGY INNOVATION

Successful transfer of clean energy innovations from lab to market requires technological learning and feedback from local installers, early adopters, inspectors, and regulators. This map includes active and completed CEC EPIC awards through 2020 for applied research and development, technology demonstration and deployment, and market facilitation projects.

Electric Program Investment Charge Recipient Headquarters and Project Site Locations



Source: California Energy Commission



EMPOWER
INNOVATION

empowerinnovation.net



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MAY 2021

CEC-500-2021-029-SUM

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