

CESA Webinar

Developing non-Lithium Ion Energy Storage Technologies to Support California's Clean Energy Goals

September 24, 2020



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CleanEnergy States Alliance



Webinar Speakers



Mike Gravely

Senior Engineer and
Team Lead, California
Energy Commission



Val Stori

Project Director,
Clean Energy States
Alliance (moderator)





Assessing the Role of Energy Storage in Meeting California's Future Energy Policy Goals

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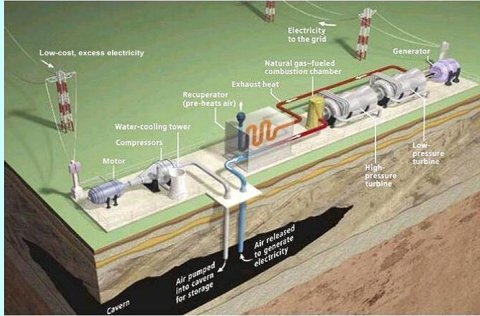
California Energy Commission Major Research Programs



- **Electric Program Investment Charge (EPIC)—Administered by the CPUC**
 - Ratepayer-funded program to benefit ratepayers
 - Administered by the Energy Commission and three Investor Owned Utilities (PG&E, SCE, and SDG&E)
 - Energy Commission Program ~ \$130 M/year
- **Natural Gas RD&D—Administered by the CPUC**
 - Approximately \$24 M/year
- **Special Funds** (e.g., climate vulnerability, transportation research)



California Energy Commission has a Long History of Energy Storage Research



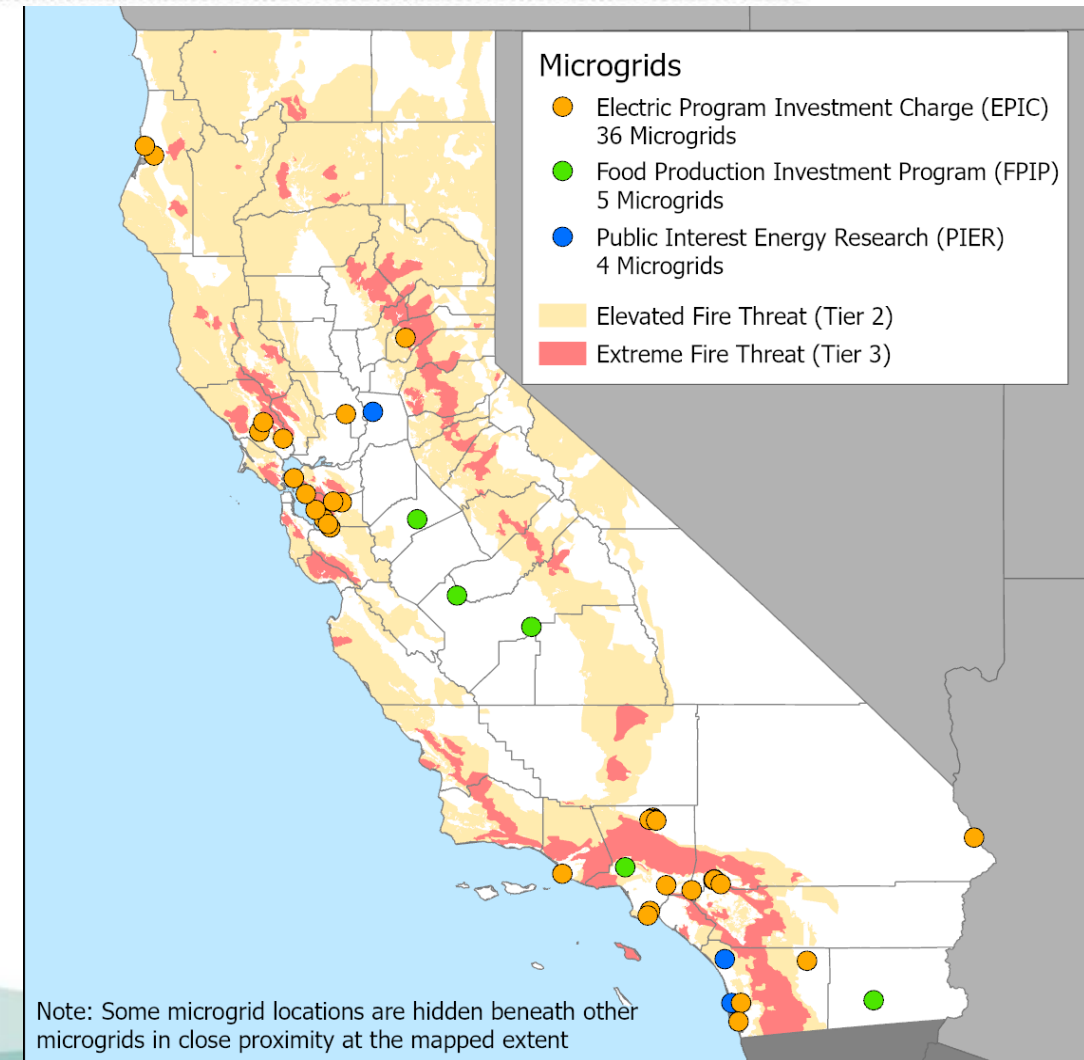
A Decade of Microgrid Research

*Deploying the Largest Number of Installed Microgrids
(Energy Storage is a Key Component of Each Microgrid)*



45 microgrids | \$136M invested | \$101M match funding

- Increasing resiliency
- Track energy storage performance, reliability and safety
- Learning best approaches to integrating multiple resources
- Sharing lessons learned and best practices
- Driving down costs and establishing deployment norms



Diverse Combination of Microgrid Demonstration Projects by End Use



Critical Facilities



Shelter



Medical Center



Fire Stations



City Hall, Police HQ, and Community Centers



Waste Water Treatment Plant



Airport

Ports



Military



Communities



Industrial



Digester

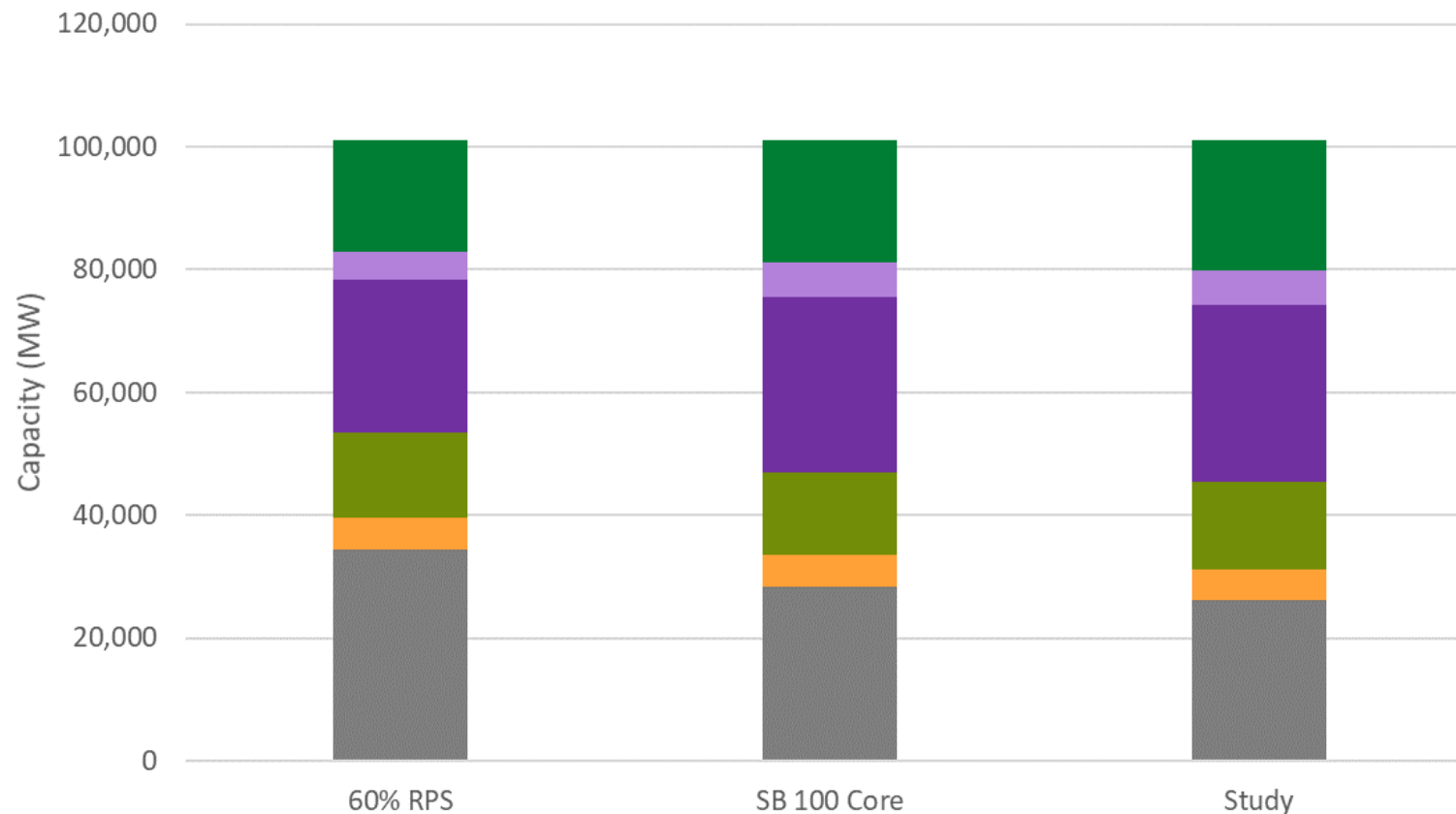


Distribution Center



Planning for California's SB-100 Goals

Latest Modeling Results: System Resource Adequacy



Solar Marginal ELCC: 2%
Wind Marginal ELCC: 19%

- Variable Renewable ELCC (incl. BTM)
- Long Duration Storage
- Battery (incl. BTM)
- Zero Carbon Firm
- Import Capacity
- Fossil Firm

“Variable renewable” resources include wind and solar.
“Zero carbon firm” resources include hydro, nuclear, geothermal, hydrogen, biomass.

For reference, the 2018 August CPUC committed System RA resources totaled 47 GW.

2020 is a Pivotal Year for Critical Energy Storage Research



- Over \$100 Million Invested in Energy Storage in 2020 (EPIC Funds and Awardee Provided Match Funding)
- Evaluating the Performance of Lithium Ion and Non-Lithium Ion Energy Storage Technologies in a Variety of Microgrid Applications
- Supporting New and Emerging non-Lithium Ion Technologies
- Field Demonstrations of non-Lithium Ion Longer Duration Energy Storage
- Validating Capability of Second-Life Batteries to Cost-Effectively Integrate Solar Power for Small-Medium Commercial Building Applications
- Assessing Long-duration Energy Storage Deployment Scenarios to Meet California's Energy Goals

Developing non-Lithium Ion Energy Storage Technologies to Support California's Clean Energy Goals

Group 1 Develop and Validate New and Emerging Non-Lithium Ion Energy Storage Technologies that Focus on Customer Side of the Meter Applications

(\$8.6M EPIC Funding, \$8.0M Match Funding)



Antora Energy

Solid-state Long Duration Energy Storage for Industrial Applications

Testing in industrial application



Aqueous Air-Breathing Energy Storage System for Multi-Day Resiliency

Targeting commercial / wholesale grid applications



Commercialization of Lowest-Cost, Long Duration Energy Storage Systems

Testing in agricultural application

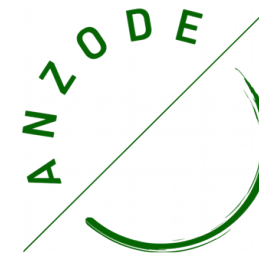
Developing non-Lithium Ion Energy Storage Technologies to Support California's Clean Energy Goals

Group 1 Develop and Validate New and Emerging Non-Lithium Ion Energy Storage Technologies that Focus on Customer Side of the Meter Applications



California Zinc-ion Energy Storage Development and Validation Project

A high-capacity and long-life aqueous rechargeable zinc battery using a metal oxide intercalation cathode



Zinc Batteries for California Electrical Customer Power Backup

Anzode's rechargeable zinc-manganese batteries provide good performance, safety, and low cost for backup power and energy storage, compared to gas generators and lithium-ion.

Developing non-Lithium Ion Energy Storage Technologies to Support California's Clean Energy Goals

Group 2: : Develop and Validate Green Electrolytic Hydrogen Storage Systems in Customer Side of the Meter Applications with an Electricity-In and Electricity-Out Capability

(\$2.3M EPIC Funding, \$1.7M Match Funding)



Demand Based Renewable Hydrogen
Power-to-Power Project

The Palmdale Water District (PWD) wind-to-hydrogen project will be the nation's first integrated grid connected hydrogen-based energy storage system.



Ultra-high Efficiency, Lower-Cost, Green Electrolytic H2 for
Microgrids in California

T2M Team proposes to develop and validate a 100-kW Class Green Electrolytic H2 Energy Storage System - Advanced Electrolysis System (AES) with Waste Heat Integrated Fuel Cell - as a sustainable electricity-in/-out solution for microgrids in disadvantaged communities in CA.

Demonstrating Long Duration and Title 24-Compatible Energy Storage Technologies

Group 1 Longer-duration Storage –(400 kw/10 hours)

(\$20.6M EPIC Funding, \$26.6M Match Funding)



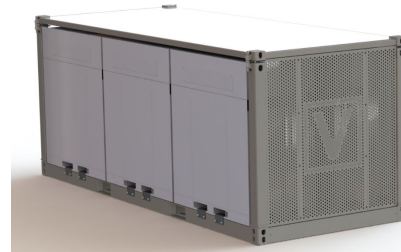
Rincon Band of Luiseno Indians

- Vanadium Redox Flow Battery + Flywheel
- Casino and Resort



Indian Energy

- Vanadium Redox Flow Battery, Zinc Hybrid Cathode Battery, And Flywheel
- Camp Pendleton military base



Kinetic Energy Storage Corporation

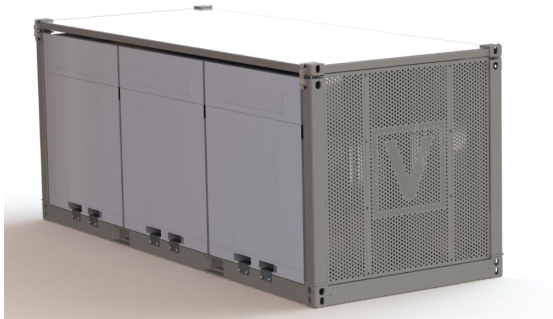
Demonstrating Long Duration and Title 24-Compatible Energy Storage Technologies

Group 2: Native American Tribal Communities - (50 kw/10 hours)
(\$4.9M EPIC Funding, \$6.6M Match Funding)



GRID Alternatives

- Vanadium Redox Flow Battery
- Fire station for the Soboba Band of Luiseño Indians



Indian Energy

- Flywheel
- Drinking water for the Viejas Band of Kumeyaay Indians



**Kinetic Energy
Storage Corporation**

Demonstrating Long Duration and Title 24-Compatible Energy Storage Technologies

Group 3: Low-Income & Disadvantaged Communities - Awards Summary (50 kw/10 hours) (\$4.0M EPIC Funding, \$1.0M Match Funding)

Antelope Valley Water Storage

- Aquifer Pumped Hydro
- Groundwater storage facility

MADISON FARMS ECHO, OREGON
ASR REGENERATION



200 HP MOTOR WITH VERTICAL LINE
SHAFT PUMP – 8” PIPE, AQUIFER LEVEL
520 FEET BELOW LAND SURFACE.



200 HP MOTOR STARTING VFD &
100 HP REGENERATION VFD
WITH LOCAL CONTROL PANEL.



Willow Springs
Water Bank

Demonstrating Long Duration and Title 24-Compatible Energy Storage Technologies

Group 4: Residential Storage - 15 Sites for each Grant with Locations in 3 Climate Zones (\$3.0M EPIC Funding, \$800K Match Funding)

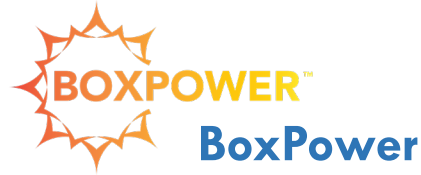


UC Riverside

New Technology for Autonomous, Plug And Play, Behind-the-meter Solar-battery Unit



TESLA



Modular Containerized Solar Plus Energy Storage System



Electric Power Research Institute

Evaluate Performance Among Multiple Commercial Systems and Compare Home Performance With And Without Energy Storage



sonnen



LG Chem



GENERAC

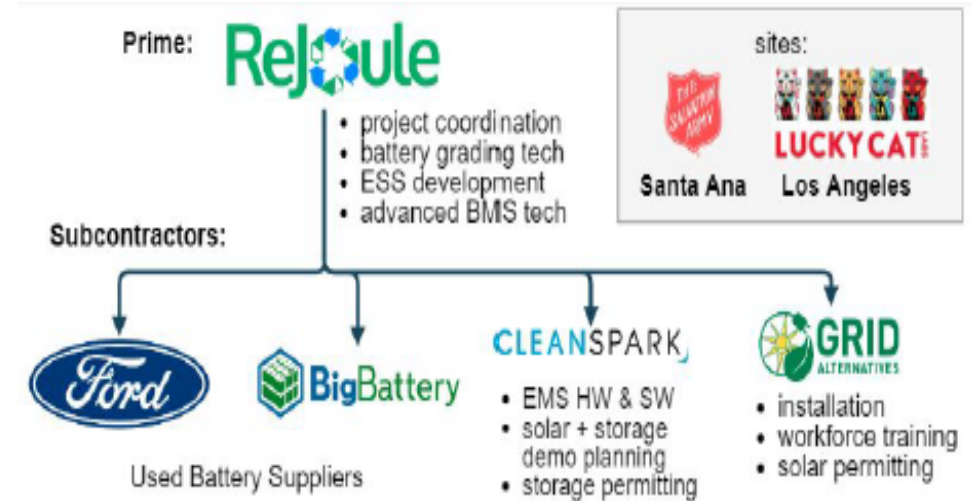
Validating Capability of Second-Life Batteries to Cost-Effectively Integrate Solar Power for Small-Medium Commercial Building Applications (\$10.8M EPIC Funding, \$3.1M Match Funding)

RePurpose Energy Inc.—

To design, build, test, and demonstrate an integrated solar and energy storage system—a microgrid—incorporating second-life batteries originally used in Nissan electric vehicles (EV).

To validate the batteries' ability to integrate solar PV and provide energy resilience to the food co-op.

RePurpose Energy will also conduct a series of laboratory-based cycling tests to identify the degradation rate and effective useful life of used EV battery cells.



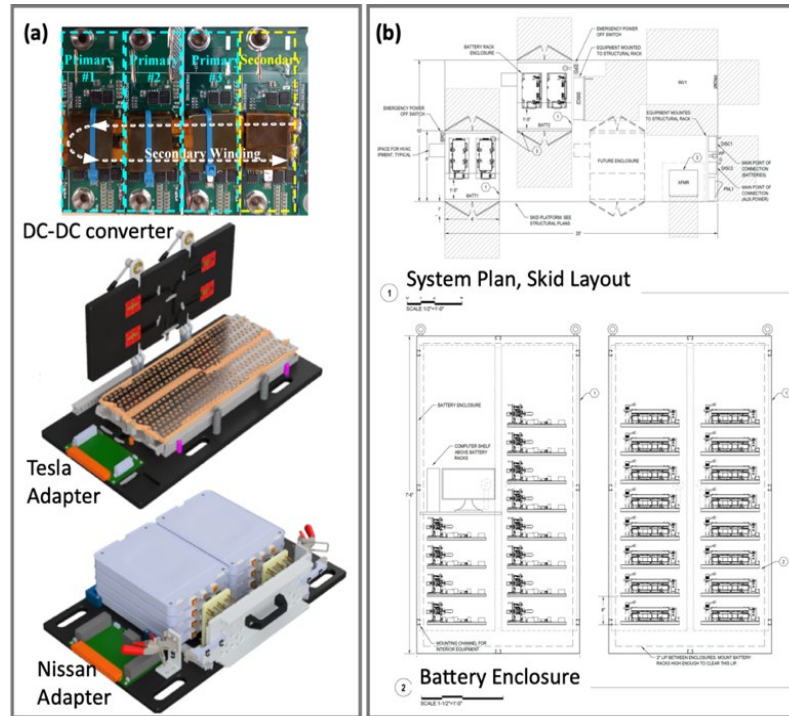
Rejoule Inc.—

The goal of this project is to validate the technical and economic feasibility of repurposing used electric vehicle (EV) batteries in a solar + storage application to provide resiliency benefits for commercial buildings.

Validating Capability of Second-Life Batteries to Cost-Effectively Integrate Solar Power for Small-Medium Commercial Building Applications

Smartville, Inc--

Characterize the degradation of repurposed electric vehicle battery modules and validate the ability of these resources to provide building resiliency and load shifting services. The goal is to allow multiple second-life battery form factors and module types, from multiple original equipment manufacturers, to be integrated and actively exchanged within a single system architecture.



San Diego State University Research Foundation—

Develop and integrate of cost-effective second-life EV batteries with a solar photovoltaic system.

The goal of this project is to ensure that second-life EV batteries will last for a minimum of 10 years as part of a grid storage application with a degradation rate of 3% or less annually.

The proposed algorithms (predictive thermal management, proactive maintenance, active balancing, and demand management) will greatly extend the durability of the second-life EV batteries in grid energy storage applications.

Assessing Long-duration Energy Storage Deployment Scenarios to Meet California's Energy Goals

(\$2.8M EPIC Funding, \$821K Match Funding)



- Will consider a variety of specific energy technologies in the categories of storage, generation, and grid structure
- Will utilize cost modeling to forecast the future costs of long duration energy storage



- Will develop a new modeling toolkit to assess the long duration energy storage needs of California.
- Will work with energy storage and microgrid experts from UCSD and long duration energy storage system developers from Form Energy

Developing Lessons Learned, Best Practices, Training Materials and Guidebook for Customer Side of the Meter Energy Storage

(\$1.0M EPIC Funding, \$244K Match Funding)



- Create an Electronic Energy Storage Guidebook (Guidebook) to help Authorities Having Jurisdiction (AHJs) fully understand and conduct a comprehensive permitting review, approval, and inspection process.
- Conduct interviews with AHJs and stakeholders to gather feedback on their lessons learned and best practices, which will form the framework for the Guidebook.
- After Guidebook completion, the team will develop training materials and work with leading AHJ and industry stakeholders to deliver comprehensive trainings throughout California.
- The Guidebook will interface with The Solar Foundation and NREL's SolarAPP, an instant online solar permitting tool for code compliant residential systems.
- Grant provides funding for 2 years of training and guidebook update/maintenance support.

Open Discussion

Thank you for attending our webinar

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Learn more at www.cesa.org



Upcoming Webinars

An Introduction to Virtual Power Plants

Monday, September 28, 1-2pm ET

Nantucket Island Energy Storage: Batteries for Reducing Peak and Deferring Infrastructure Investment

Friday, October 9, 2020

Read more and register at: www.cesa.org/webinars