The Electric Program Investment Charge (EPIC) Program:

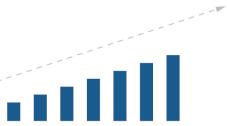
Highlights from 10 Years of Research and Development and the Future of Clean Energy Research

Anthony Ng, Energy Research and Development

September 16, 2025

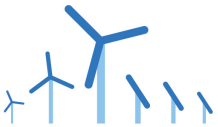
PRIMARY FUNCTIONS OF THE

CALIFORNIA ENERGY COMMISSION



Advancing State Energy Policy

Investing in Energy Innovation



Developing Renewable Energy

Preparing for Energy Emergencies

Achieving Energy Efficiency

Transforming Transportation

Overseeing Energy Infrastructure

CEC R&D Programs

- Electric Program Investment Charge (EPIC) (~$150M/year)
- Gas R&D ($24M/year)
- Food Production Incentive Program ($150M)
- Long-Duration Energy Storage ($273M)
- Clean Hydrogen ($40M*)
- Carbon Removal Innovation Support ($21M)
- Industrial Grid Support and Decarbonization ($40M)
- Community Energy Reliability and Resilience Investment (~$180M)
- California Harnessing Advanced Reliable Grid Enhancing Technologies for Transmission (CHARGE 2T) ($630M^)

*Pending $34M proposed for FY25-26

^ Agreement development in progress with U.S. DOE

EPIC Overview

- Established by the California Public Utilities Commission (CPUC) in 2012
- Funded by California electric utility customers
- Clean energy innovation - research, development, and commercialization
- Benefits to ratepayers
- Administered by CEC and electric IOUs

Mission Statement:

EPIC shall invest in "innovation to ensure equitable access to safe, affordable, reliable, and environmentally sustainable energy for electricity ratepayers."

CPUC Decision 21-11-028, November 18, 2021

EPIC Program Areas

Applied Research and Development

Pre-commercial technologies and approaches that are designed to solve specific problems in the electricity sector

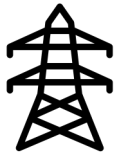
Technology Demonstration and Deployment

The installation and operation of pre-commercial technologies or strategies at a scale sufficiently large and in conditions sufficiently reflective of anticipated actual operating environments to enable appraisal of the operational and performance characteristics and the financial risks.

Market Facilitation

A range of activities including program tracking, market research, education and outreach, regulatory assistance and streamlining, and workforce development to support clean energy technology and strategy deployment.

Benefits to CA Ratepayers



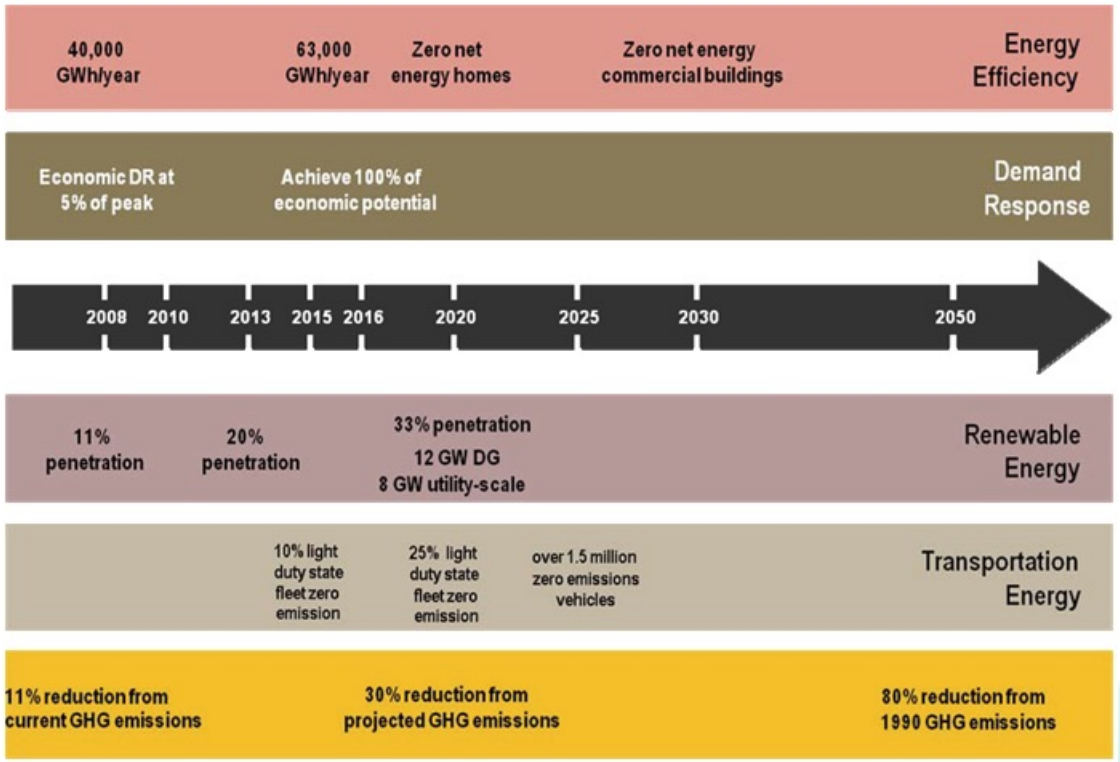
Increase Reliability

Improve Safety

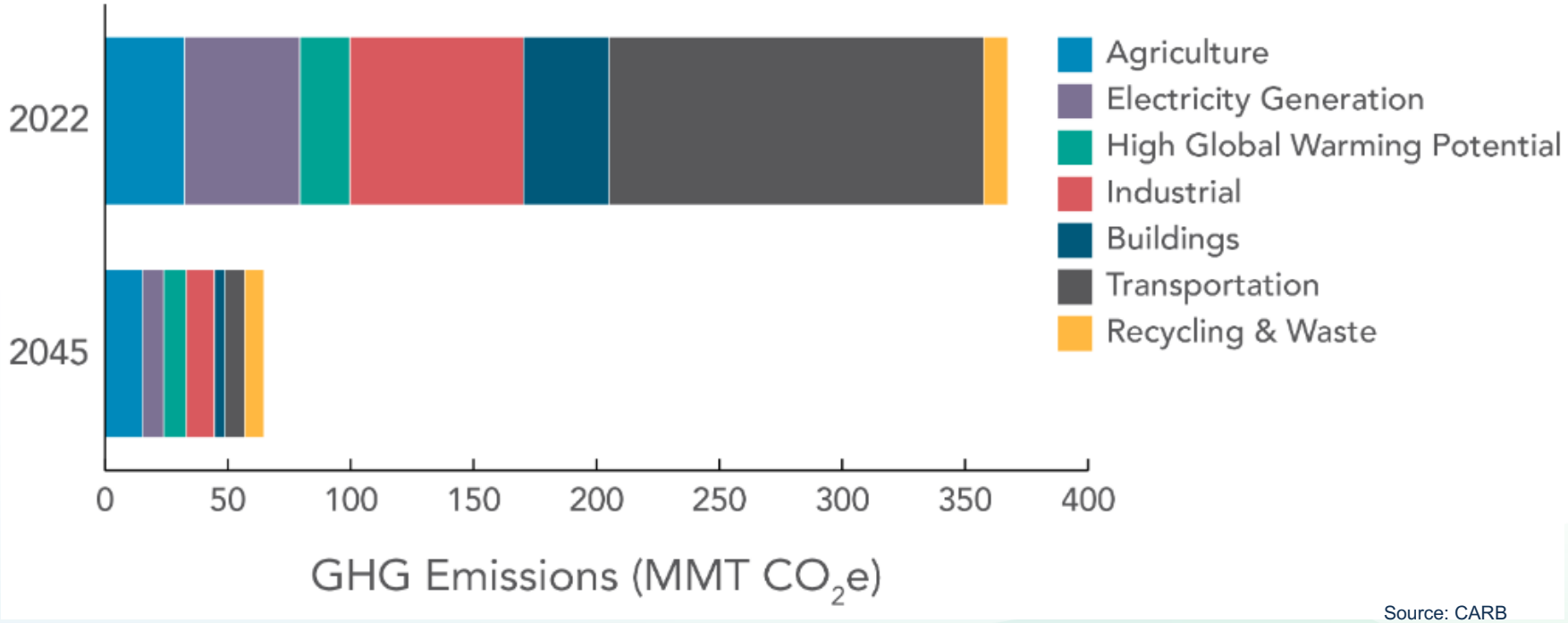
Increase Affordability

Improve Environmental Sustainability

California Energy Policy - 2012

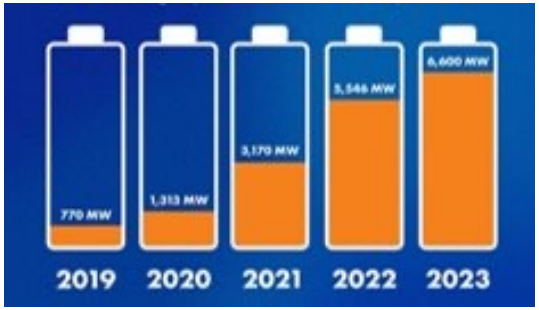


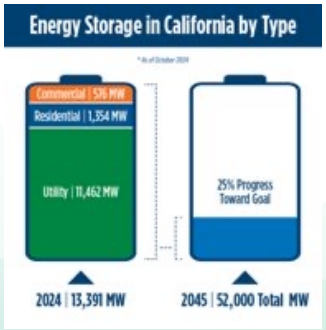
Carbon Neutrality in California by 2045



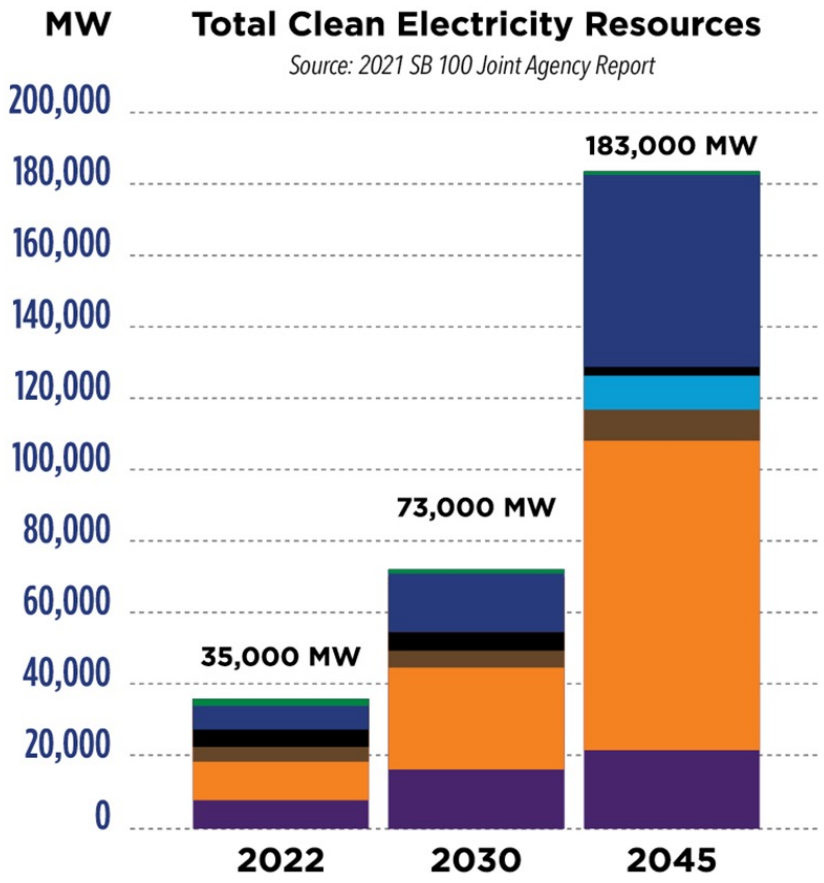
Source: CARB

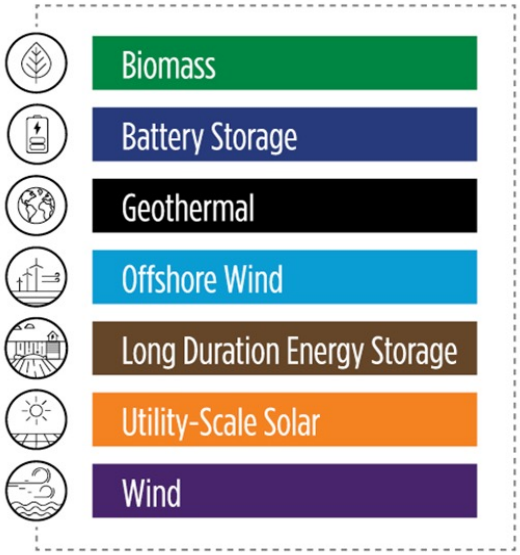
Electricity: Goals, Progress, Challenges





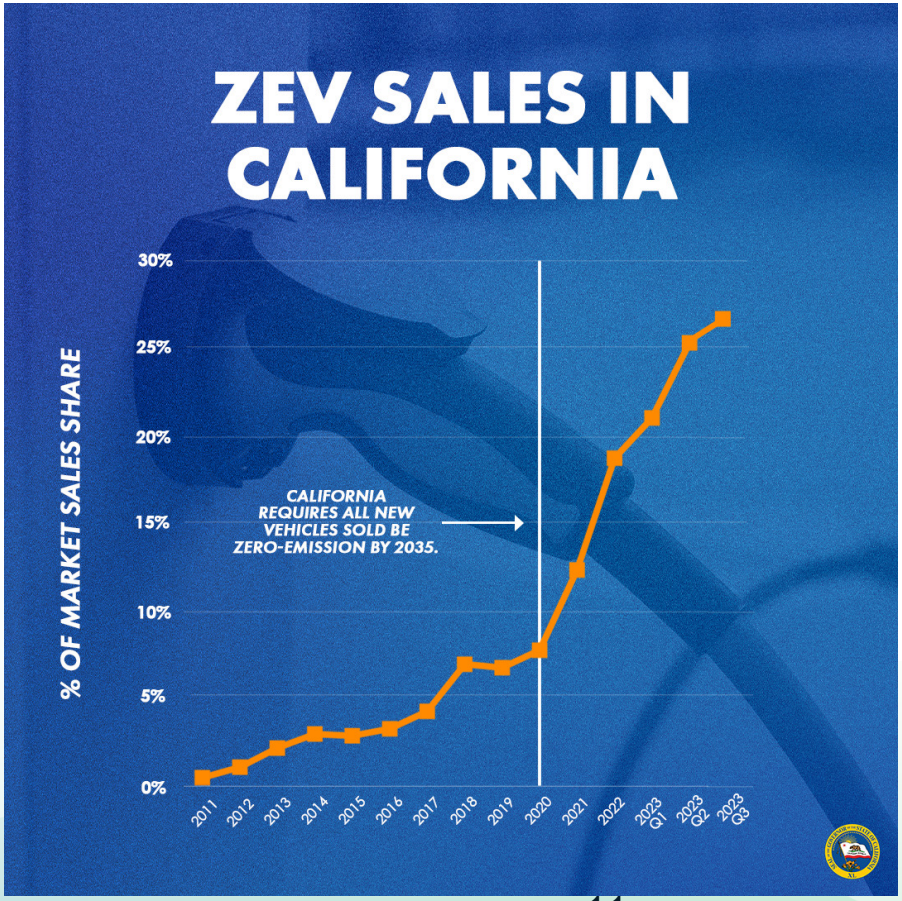
Electricity: Goals, Progress, Challenges





Transportation: Goals, Progress, Challenges

- 100% ZEV sales by 2035 for light duty
- 100% ZEV sales and operations by 2045 for medium and heavy duty, where feasible
- Over 150,000 public and shared private chargers statewide
- Nearly 15,000 fast chargers



Source: Governor's Office

Buildings: Goals, Progress, Challenges

Analysis of 40% GHG reduction in buildings by 2030 (AB3232):

Identified decarbonization strategies

- Building energy code progress
- 6 million heat pumps by 2030
- 7 GW load flex by 2030

EPIC Investment Areas

Entrepreneurial Ecosystem

Grid Decarbonization & Decentralization

Resiliency & Safety

Industrial & Agricultural Innovation

Building Decarbonization

Low-Carbon Transportation

EPIC by the Numbers*

$1.4B
EPIC FUNDS INVESTED

543
PROJECTS

$18.9B
PRIVATE INVESTMENT AFTER RECEIVING EPIC SUPPORT

60%
OF EPIC DEMONSTRATION AND DEPLOYMENT FUNDING IN DISADVANTAGED AND LOW-INCOME COMMUNITIES

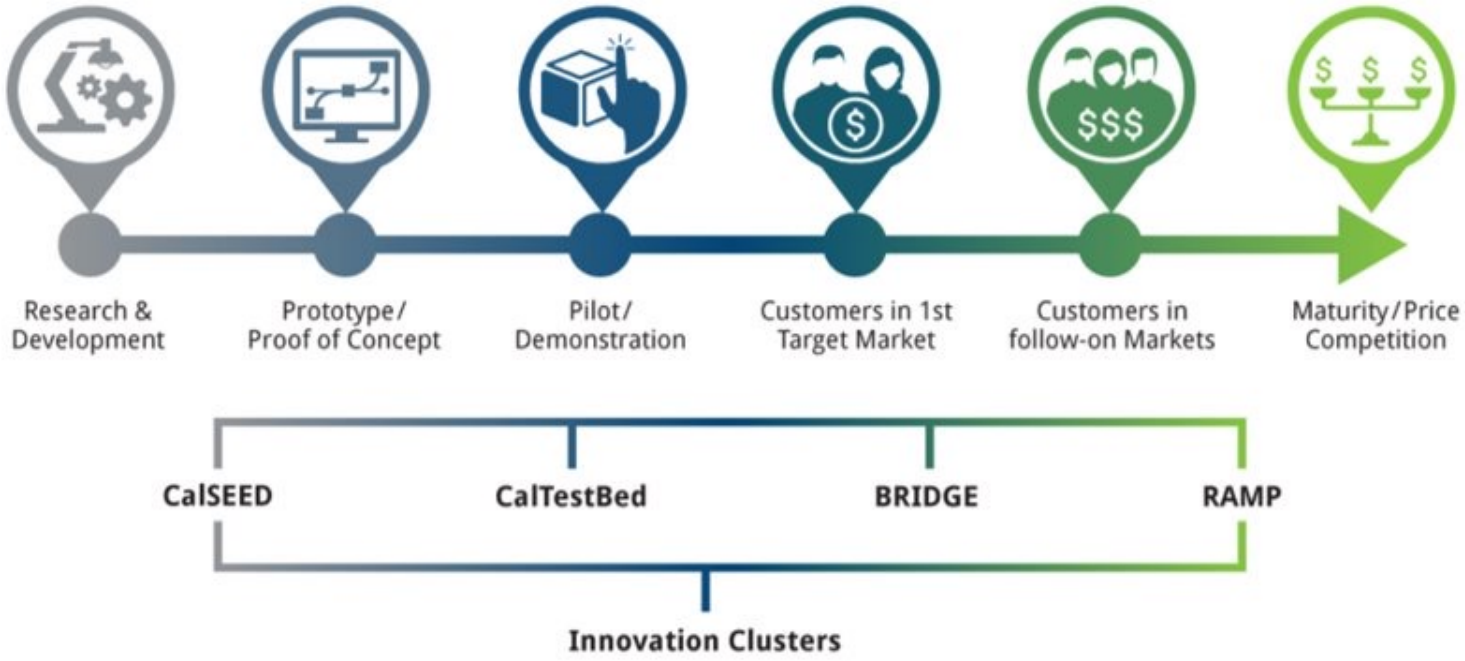
$30.4M
OF EPIC DEMONSTRATION AND DEPLOYMENT FUNDING FOR PROJECTS ON CA NATIVE AMERICAN TRIBAL LANDS

since program establishment in 2011 through December 31, 2024

CEC EPIC Research Overview

Entrepreneurial Ecosystem

Targeted Support through EPIC



Targeted funding initiatives enable the path to commercialization for innovative technologies.

CalSEED

- $200,000 for early-stage concepts
- $500,000 for follow-on prototype development
- Access to networking events, workshops, and webinars to support technology and business development

CalTestBed

- Vouchers up to $300,000 to test and validate technologies
- Access to over 60 testbed facilities across the University of California System and Lawrence Berkeley National Lab

Building a Statewide Ecosystem

SOUTHERN CALIFORNIA ENERGY INNOVATION NETWORK

Imperial | Riverside | San Bernardino | San Diego

LACI

BLUETECH VALLEY

- Since mid-2017:
  - Start-up companies have attracted over **$220 million** in private and public funding.
  - Ecosystem partners have secured **$4.4 million** in federal funding to expand entrepreneurial services.
  - **Over 1,000 employees** at supported companies
  - **Over 400** patents received

Battery Manufacturing & Supply Chain

Lithium Metal Cells

CUBERG

SONOCHARGE

Anode Material Innovation

TYFAST

AMERICAN LITHIUM ENERGY

solid energy

Advanced Membrane Separator

SEPION TECHNOLOGIES

Coreshell

Advanced Electrolytes

SOUTH 8 TECHNOLOGIES

anthro

Cathode Manufacturing

SVX

LICAP

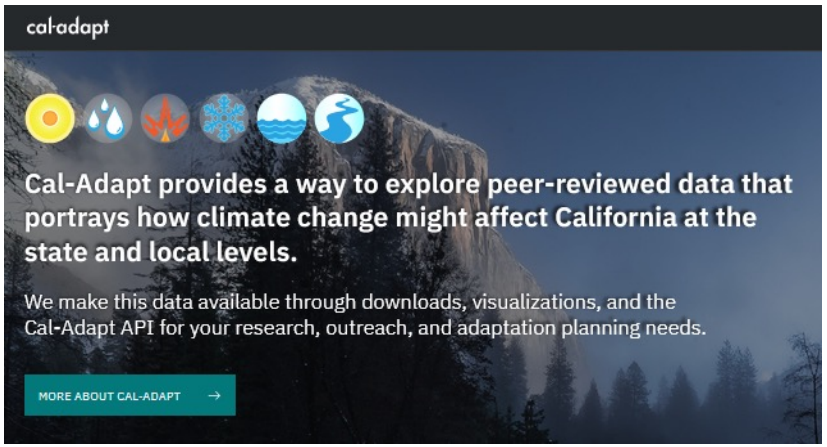
Battery Inspection Platforms

liminal

Lookin Inc.

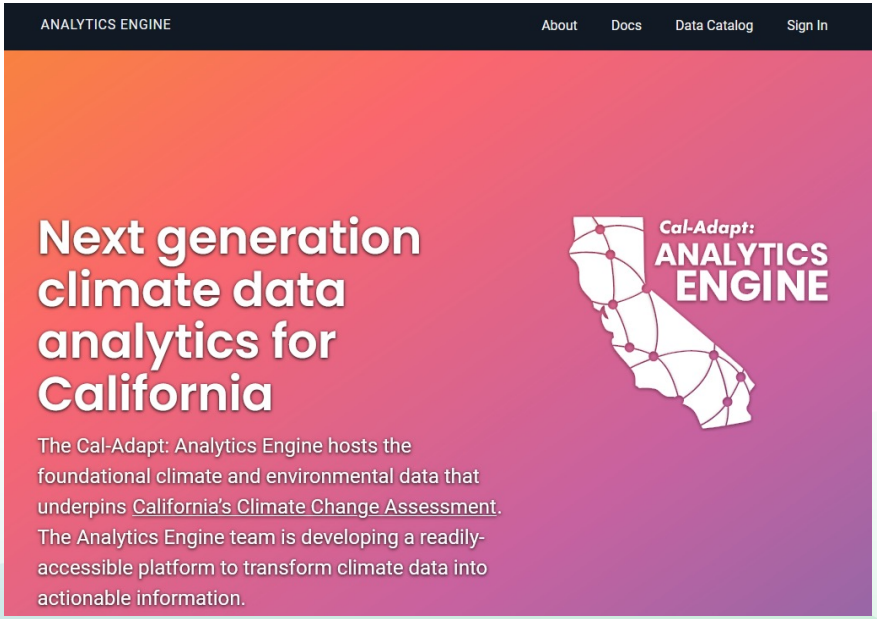
Resilience and Safety

Cal-Adapt Data



Interactive web application
- ~10 Tb data
- Easy data download
- Explore data visually
- General users

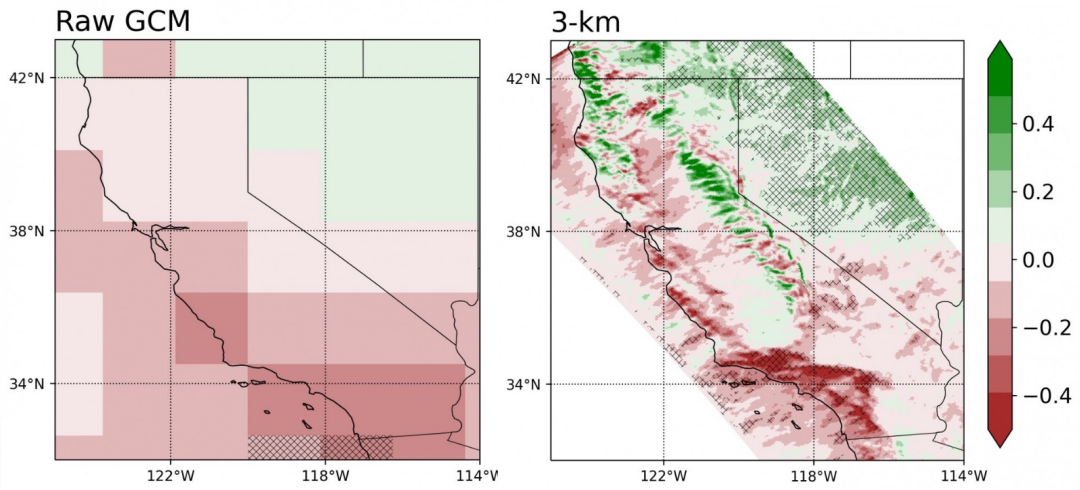
Analytics engine
- ~ 2.5 Pb data
- Advanced analyses
- Direct support for energy resilience
- "Pro" tool



Sources: https://cal-adapt.org/ , https://analytics.cal-adapt.org/

High-Resolution Climate Projections for Energy Resilience

- Leverages global climate models
- Downscaled climate data (to 3 km) through 2100
- Informs analysis of future electricity demand, renewables (solar, wind, hydro), wildfire risk



Example of resolution improvement in downscaled climate data.
Projected change in average precipitation (mm/day) at end of century.

Blue Lake Rancheria

(**EPC-14-054**/$5,000,000; **EPC-24-053**/$5,000,000)

- **Topic:** Microgrids
- **Location:** Blue Lake (Humboldt Co.)
- **Innovation:** One of CA's first demonstration microgrids
- **Impact:** Provides energy resiliency and reliability in tribal area; supplied backup power and life-saving services during multiple emergencies.
- **Funding:** EPIC
- **Notable Mentions:**
  - ~$200k annual energy savings in 2017 after microgrid completed.
  - $87.6 million DOE award for Blue Lake Rancheria, Hoopa Valley, Yurok, and Karuk Tribes to transform one of the state's least reliable electrical circuits.
  - Follow-on EPIC funding to develop nested community microgrids with Schatz Energy Research Center, Cal Poly Humboldt (June 2025).
- **Site Visit Highlights:**
  - Operational microgrid with microgrid controller and control systems, Tesla battery systems, and PV panels

***"Having state programs [like EPIC] is absolutely critical to our journey**...it's programs like these that absolutely need continuous funding for us to be able to achieve these clean energy goals."*
-- Linnea Jackson, General Manager of the Hoopa Valley Public Utilities District, EPIC Symposium 2024

Building Decarbonization

High-Efficiency Room Heat Pump

Technology Description

High efficiency, low-cost, easy-to-install, low global warming potential refrigerant heat-pump system.

Application

Single and multi-family residential buildings

Demonstrated Performance

- Cooling @ 95° F – Energy Efficient Ratio: 10.0
- Heating @ 5° F – Coefficient of Performance: 2.35
- 120V application
- Quiet system – 38-47 dB(A)

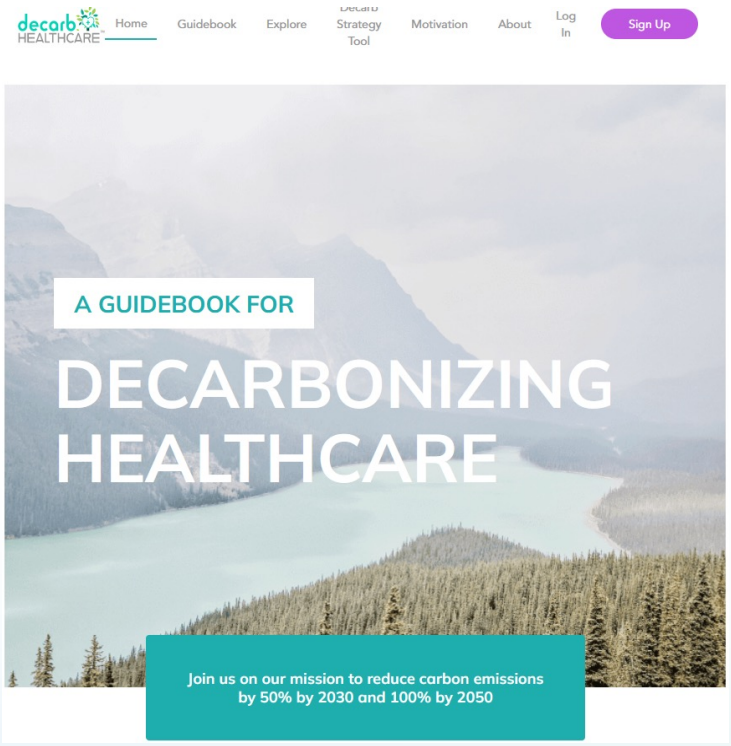
SkyCool Systems

Refrigeration and Air Conditioning

- **42.5K:** Approximate number of supermarkets and cold storage facilities in the United States
- **~60%:** The electricity used for refrigeration in those facilities
- **10-40%:** Efficiency improvement when SkyCool Panels are integrated with a refrigeration system
- **$3K:** Monthly electricity bill savings one grocery store achieved with SkyCool Panels

SkyCool Panels
Source: SkyCool Systems

Decarbonizing Healthcare Guidebook



Decarbonizing Healthcare Guidebook website
Source: decarbhealthcare.com

- **30 percent:** The increase in healthcare-related greenhouse gas emissions in the United States between 2006 and 2016.
- **339:** The number of hospitals in California in 2022.
- **$0:** The cost to the public for use of the Decarbonizing Healthcare Guidebook, which highlights existing and emerging energy efficiency technologies to support hospital decarbonization.
- **25+:** The number of technology areas, from variable-air-volume ventilation and heat recover chillers to building envelope improvements and alternative steam generation, covered by the guidebook.

Thermal Energy Storage for Commercial HVAC

Technology Description

Packaged thermal energy storage system for HVAC peak load reduction and load shift

Application

Small to medium commercial buildings

Demonstrated Performance

- Average 13% energy efficiency savings
- Average 60% reduced peak demand (kW)
- 50% kWh load shift from peak to off-peak

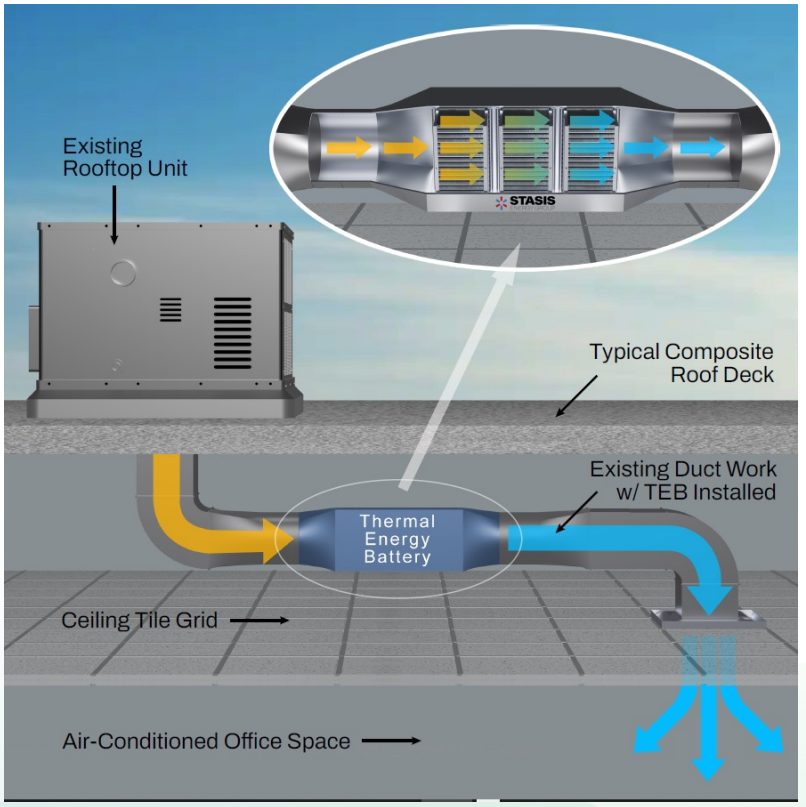


Image Source: Stasis Energy Group, LLC

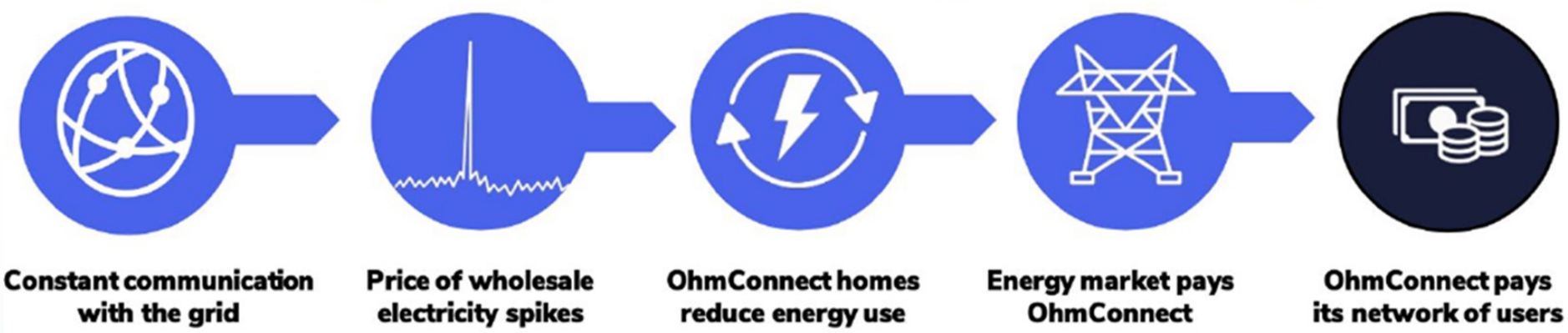
Indoor Air Quality Studies

- Offerman et al. (2009): Formaldehyde concentrations in new homes exceeded health thresholds
  - Informed building code update for mechanical ventilation; CARB regulation for composite wood
- Singer et al. (2017): Moderate gas burner use without ventilation often yields NO_2 concentrations above health-based standards
- Singer et al. (2021): Provides health-protective "capture efficiency" framework for stove exhaust to maintain air quality
  - Informed building code update for kitchen ventilation

Grid Decarbonization and Decentralization

OhmConnect
Residential Demand Response

Aggregating residential user demand reductions to support grid reliability



CalFlexHub
Load Flexibility R&D

- Prepare controls and communications for transitioning to dynamic electricity rates
- Support rate design, price server development, communication standards
- 15 demonstration and testing projects underway
- calflexhub.lbl.gov

Enables Heat Pump Water Heaters in Commercial Buildings to Shift Load.
Source: LBNL

Smartville, Inc.

Giving EV Batteries a Second Life

Smartville MOAB™ Energy Storage System, powered by repurposed EV battery packs and charged by a UC San Diego solar energy array
Source: The San Diego Union-Tribune

- **15,000 MW:** Storage capacity that needs to come online in California by 2032
- **48+:** Hours of back-up power in pilot test at UC San Diego
- **4 MWh:** Total planned capacity at Wellhead Electric—a San Joaquin Peaker Plant
- **100 MWh:** Smartville manufacturing production capacity planned by 2025—10x scale-up

Long Duration Energy Storage

Industrial and Agriculture Innovation

Polaris
Demand Flexibility in Irrigation Pumping

- **~4%:** Percentage of state's total electricity used in agricultural pumping
- **>25MW:** Ag pumping demand flexibility enabled through project
- **30%:** Reduction in labor costs for some growers using Polaris

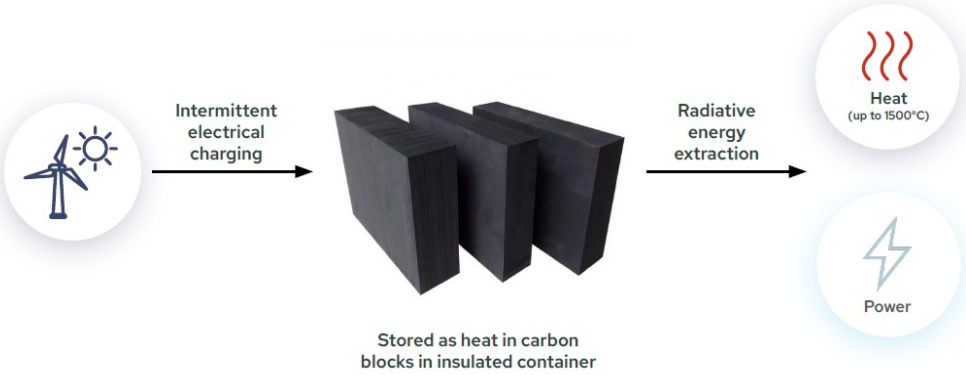
Polaris software being used in the field
Source: Polaris Energy Services

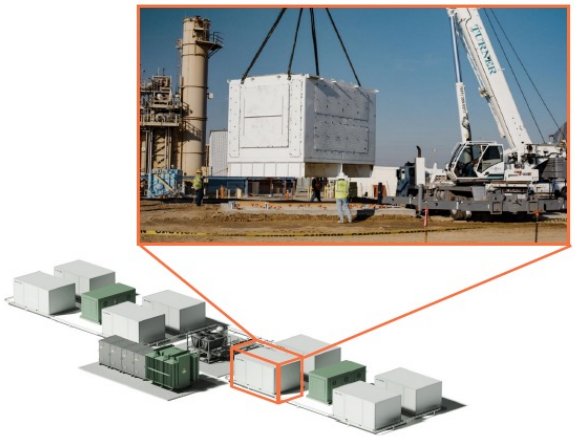
AgMonitor (**EPC-14-081**/ $ 2,292,829)

- **Topic:** Agricultural energy and water efficiency; load management
- **Location:** Hanford (Tulare Co.). Site visit at Terranova Ranch (Helm | Fresno Co.)
- **Innovation:** Software tool assessing groundwater conditions and smart meter data to optimize irrigation and pumping practices.
- **Impact:** Reduces water and energy consumption while maximizing crop yields.
- **Funding:** EPIC
- **Notable Mentions:**
  - Terranova Ranch, which has 25 different crops on 6,000 acres, uses AgMonitor.
  - Terranova Ranch recognized for 2018 Governor's Environmental and Economic Leadership Award.
- **Site Visit Highlights:**
  - Working farm with operational tool
  - Moisture sensors and automated irrigation valves used in farming operations

Antora Energy

Long Duration Thermal Storage





Above: Graphical depiction of Antora's storage technology

(Source: Antora Energy)

Right: Installation of Antora's pilot scale system and rendering of Antora's full storage plant

(Source: Antora Energy)

- **1500 Wh/L:** Energy density of carbon – Antora's thermal storage medium
- **1500°C:** Temperature Antora's system can deliver to industrial customers
- **>40%:** Conversion efficiency of Antora's thermophotovoltaic heat engine
- **5 MWh:** Capacity of Antora's pilot-scale system
- **$150M**: Amount of Series B funding raised in 2024

Twelve
Carbon Utilization

Etosha Cave, co-founder and Chief Scientific Officer of Twelve, holding the company's reactor.

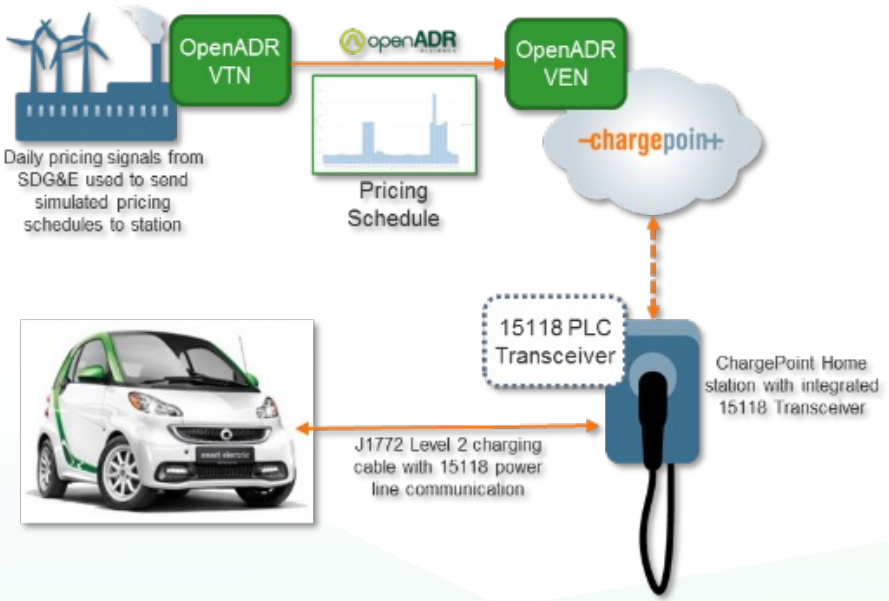
Source: Twelve

- **50%:** Potential amount of process emissions that can be reduced by replacing fossil feedstocks using Twelve's technology
- **260M:** Gallons of sustainable aviation fuel Twelve will provide to five airlines, using its carbon utilization technology
- **4:** Number of employees at time of CalSEED award in 2016
- **369:** Number of employees at the end of 2024
- **$645M**: Amount of private funding raised in 2024

Low-Carbon Transportation

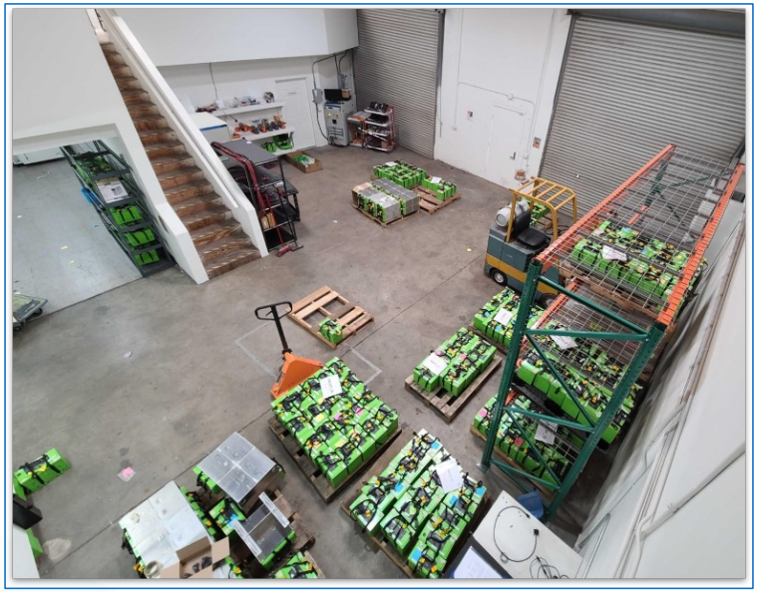
Creating Next-Gen Grid Communication for EVs

- **30** plug-in electric vehicle (PEV) pilot study
- Assess real-time potential for residential smart chargers to respond to utility signaling and support the grid
- Receiving signals from utility to optimize PEV charging that benefits customers and the utility
- **45% cost savings** per charge over a 3 month period

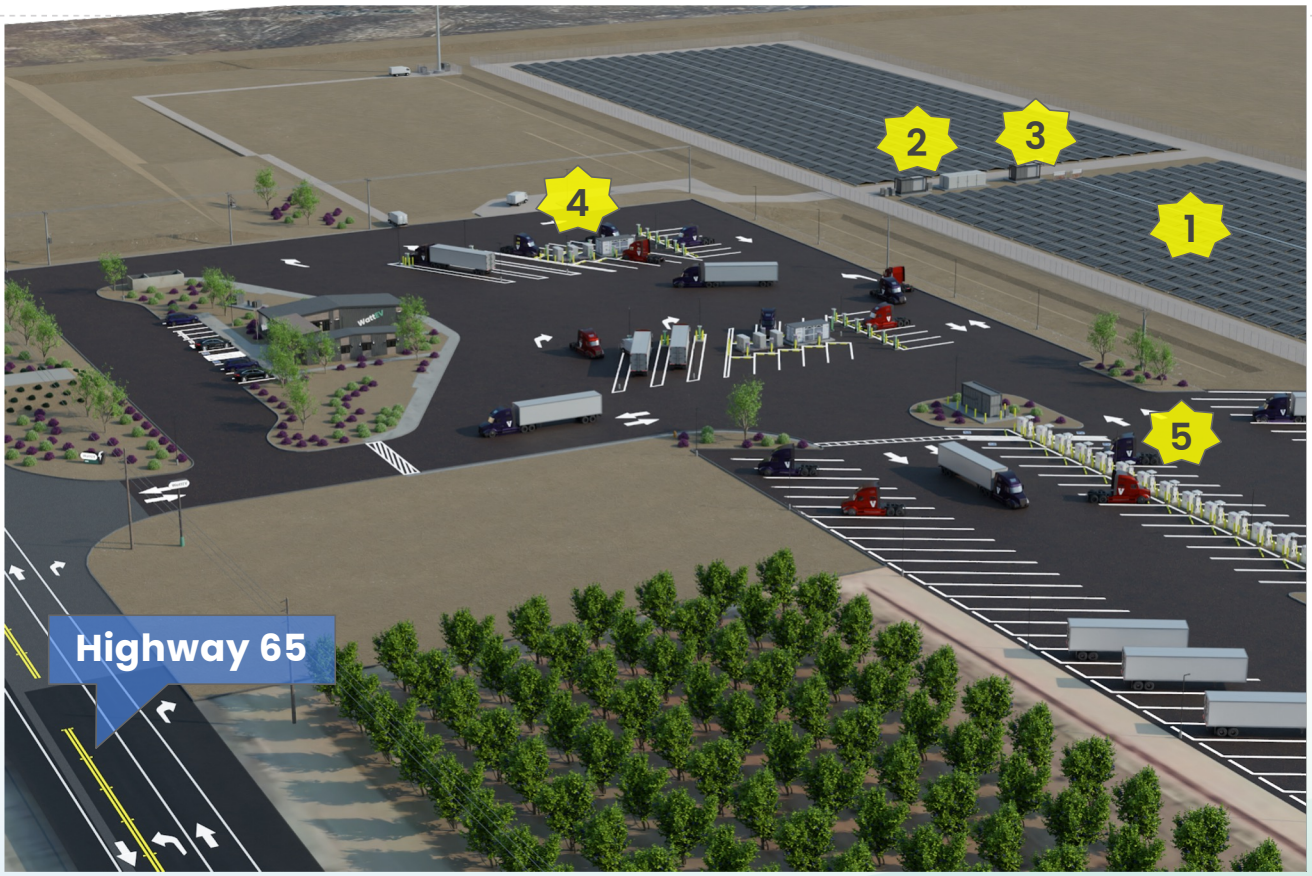


ReJoule (EPC-19-055/$2,970,774)

- **Topic:** Second-life batteries
- **Location:** Pomona (Los Angeles Co.)
- **Innovation:** Battery diagnostics tool to assess used batteries for repurposing.
- **Impact:** Strengthens path for new battery energy storage systems (BESS) to use second-life batteries; reduces demand for critical minerals
- **Funding:** EPIC
- **Notable Mentions:**
  - Demonstration at American Museum of Ceramic Art (Pomona).
  - $10M in DOE funds in 2023 for long-duration energy storage.
- **Site Visit Highlights:**
  - Facility floor at headquarters with prototype models, completed batteries, testing devices, and battery unit assembly. Ribbon cutting anticipated for Nov 2025
  - Operational system at American Museum of Ceramic Art



WattEV: 21st Century Truck Stop



5.2 MW Solar PV 1

2.75 MWh Battery Energy Storage System 2

Controllers/Software 3

15 chargers - 240 kW 4

3 chargers - 1.2 MW

Charge ~50 electric trucks daily off-grid

+Grid-tied chargers 5

WattEV site rendering layout adjacent to Highway 65 in Bakersfield, CA.
(Source: WattEV)

Electric Truck Research and Utilization Center (eTRUC) (**EPC-21-010**/ $12,999,155)

- **Topic:** Transportation electrification
- **Location:** Pomona (Los Angeles Co.)
- **Innovation:** Outdoor test lab to support testing of heavy-duty trucks at megawatt power levels.
- **Impact:** Validates and commercializes new electric truck charging infrastructure technologies.
- **Funding:** EPIC
- **Notable Mentions:**
  - Ribbon cutting in May 2025.
  - Partnership with SoCal Edison (SCE); co-located at SCE's Electric Vehicle Technical Center.
- **Site Visit Highlights:**
  - Equipment onsite for testing (e.g., electric trucks, mobile batteries/chargers)*
  - Utility equipment used to power the site*

*The site must be de-energized for safety during tours.

Sierra Northern Railway:

Hydrogen Fuel Cells and Cleaning Up California's Railyards

- **800+:** Number of switcher locomotives in use in California.
- **10,000 gallons:** Estimated annual diesel consumption displaced.
- **3 tons:** Amount of NOx displaced annually.

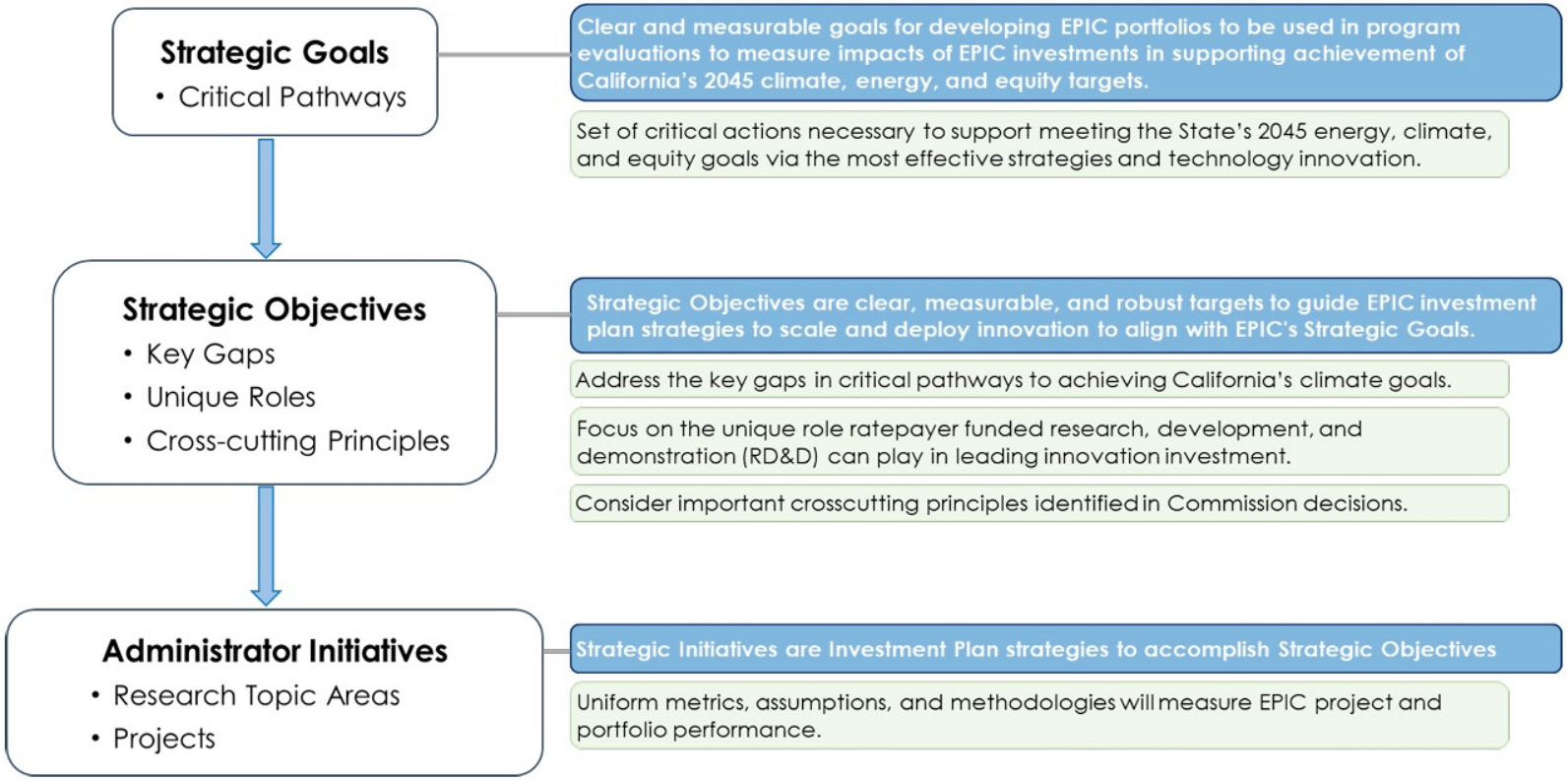
Sierra Northern's Zero-Emission Hydrogen Switching Locomotive
Source: Sierra Northern Railway

Looking Ahead

EPIC 5 Investment Plan

- Next EPIC Investment Plan beginning development
- Cover investments from 2026 - 2030

EPIC 5 Development Process

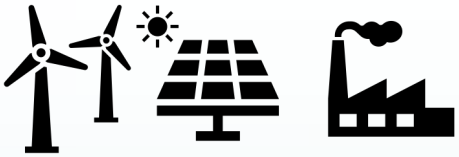


EPIC 5 Strategic Goals

Transportation Electrification

Building Decarbonization

DER Integration



Getting to 100% Net-Zero Carbon and the Coordinated Role of Gas

Climate Adaptation

EPIC 5 Draft Strategic Objectives

- Reducing Medium and Heavy-Duty Vehicle Charging Infrastructure Costs
- Overcoming Barriers to Electric Vehicle (EV) Benefits in DVCs
- Smart Systemwide Planning Tools for New Load
- Reducing Cost of Whole Home Electrification
- Innovative Approaches for Difficult-to-Decarbonize Sectors
- Community-Scale Decarbonization
- Impacts Research for New Generation and Storage

EPIC 5 Draft Strategic Objectives

- Increase Predictability of Weather, Intermittent Resources, and Load
- Leveraging DERs for Grid and Community Resiliency
- Expediting and Streamlining Interconnection and Energization Processes
- Providing Data Input into a Value of DER Framework
- Reducing Feeder/Circuit Peaks
- Cost-Effective Grid Hardening for Long-Term Climate Impact

Full CPUC Staff Draft Report on proposed Strategic Objectives:

https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M558/K340/558340127.PDF

EPIC 5 Development Participation

CPUC R&D Website:

https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/energy-research-development-and-deployment

CEC EPIC 5 Website:

https://www.energy.ca.gov/proceeding/electric-program-investment-charge-2026-2030-investment-plan-epic-5

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