California Energy Commission Activities Supporting the Evaluation of Energy Storage and Long Duration Energy Storage to Support California's Zero Carbon Future.

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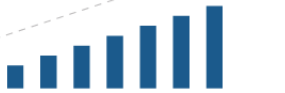
Mike Gravely, Energy Storage Technical Lead
Energy Research and Development Division
California Energy Commission
Mike.Gravely@energy.ca.gov

PRIMARY FUNCTIONS OF THE

CALIFORNIA ENERGY COMMISSION



Advancing State Energy Policy

Investing in Energy Innovation

Developing Renewable Energy

Preparing for Energy Emergencies

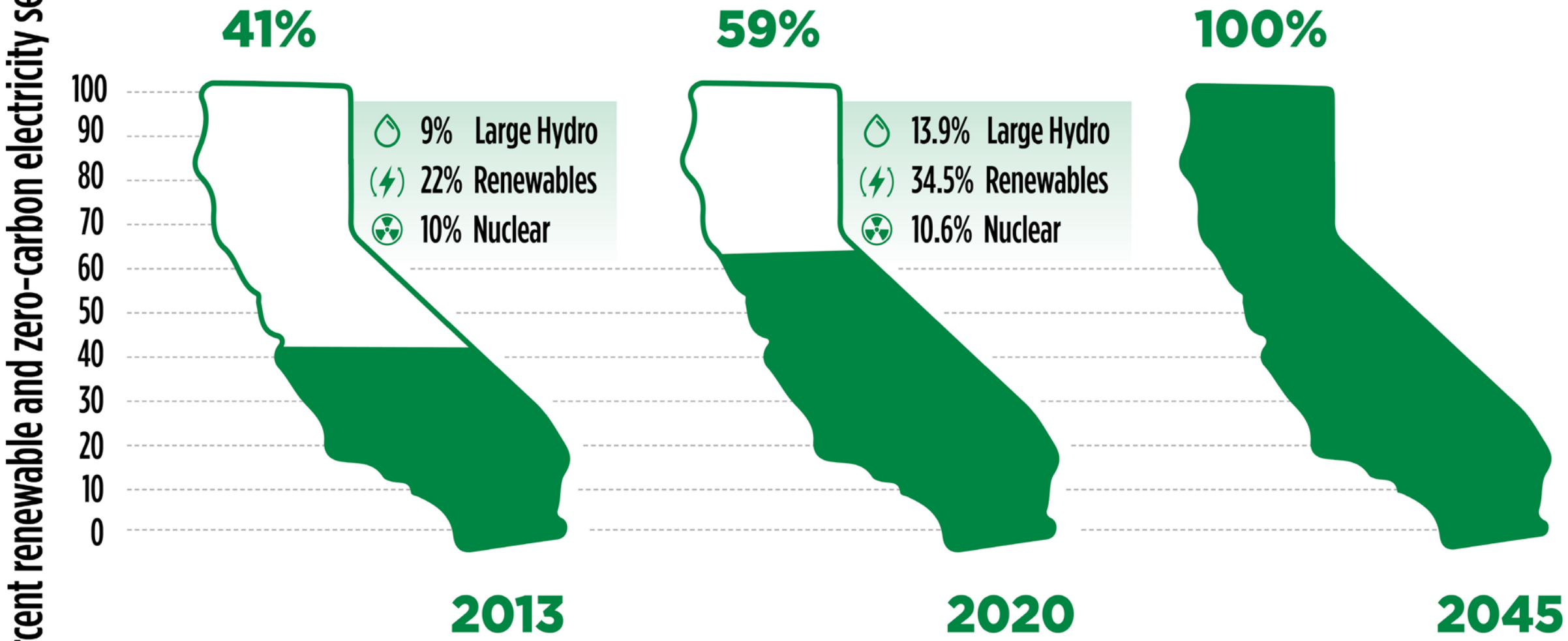
Achieving Energy Efficiency

Transforming Transportation

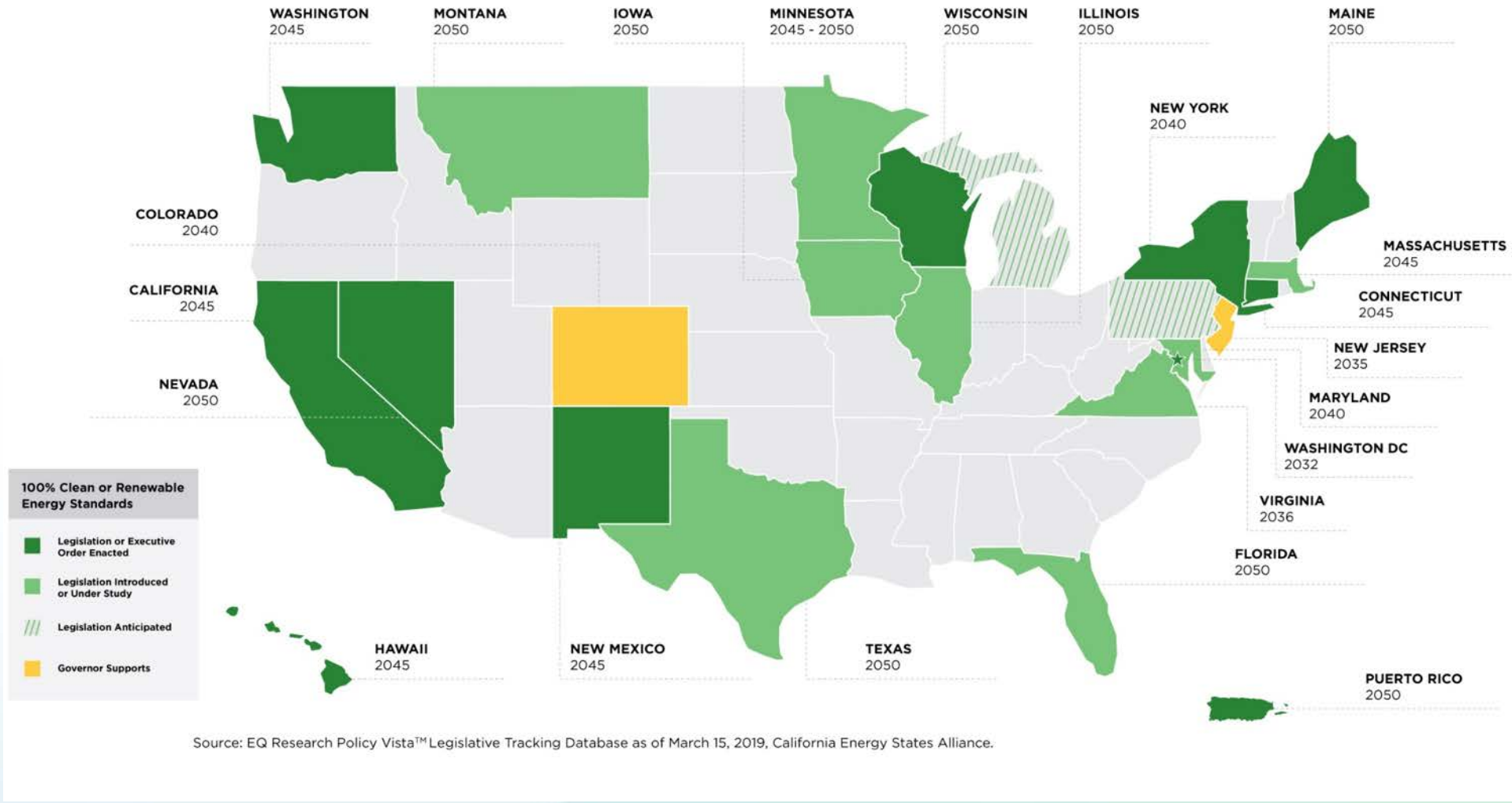
Overseeing Energy Infrastructure

Intergovernmental Collaboration

Progress to 100% Clean Electricity



National Acceptance of New Clean Energy Goals



Source: EQ Research Policy Vista™ Legislative Tracking Database as of March 15, 2019, California Energy States Alliance.

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 for research
  - In 2020 the EPIC Program was extended by the CPUC for an additional 10 years

CALIFORNIA'S INVESTMENT IN CLEAN ENERGY INNOVATION

EPIC is California's premier public interest research program investing over $130 million annually to unleash innovation.

Entrepreneurial Ecosystem

$143 million invested

Through EPIC, the CEC is building a world-class ecosystem supporting clean energy entrepreneurship.

Resiliency & Safety

$106 million invested

Helping communities, businesses, and public agencies build a safer, more resilient energy system.

Building Decarbonization

$170 million invested

Improving the affordability, health, and comfort of buildings.

Grid Decarbonization & Decentralization

$154 million invested

Improving the cost competitiveness and performance of key technologies.

Industrial & Agricultural Innovation

$113 million invested

Scaling specialized technology solutions to drive energy efficiency without compromising production.

Transportation Electrification

$33 million invested

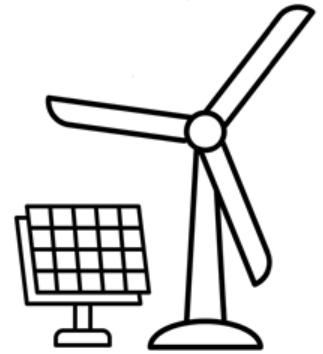
Supporting advances that reduce the cost of electric vehicle ownership and support the grid.

**Total investment, 2012-2019*

Energy Storage is a Big Part of California's Future

- 5.0 GW battery storage currently installed
- 15 GWs battery storage needed by 2032 (per CPUC)
  - 1 GW identified for Long Duration Energy Storage
- 40 – 50 GWs of energy storage needed by 2045

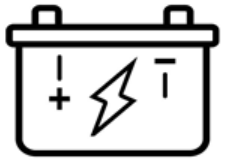
Planning for California's SB-100 Goals To Achieve Clean Energy



Solar & Wind

3X

Solar and wind build rates need to nearly triple*



Battery

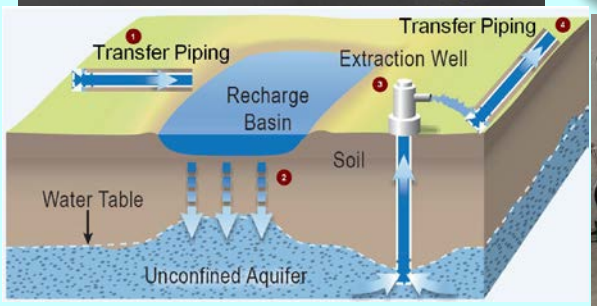
8X

Battery storage build rates need to increase by nearly eightfold**

California Investments in Emerging Energy Storage Technologies

- California Energy Commission has invested in a diverse portfolio of energy storage technologies
  - Short-term, long-term and seasonal energy storage technologies
    - Lithium-Ion
    - Advanced battery chemistries
    - Flow batteries
    - Flywheel systems
    - Thermal energy storage
    - Advanced pumped hydro
    - Compress air energy storage
    - Green hydrogen

CEC EPIC Program has Over a Decade History of Energy Storage Research



2020 was Pivotal Year for Long Duration Energy Storage Research

- CEC invested $100 million+ in energy storage in 2020
- Field demonstrations of non-Lithium-ion long duration storage
  - **8 sites** demonstrating **10+ hours** of energy storage duration
  - **3 early-stage grants** providing **up to 100+ hours** of energy storage duration

LDES Strategy

Goal: Demonstrate commercial readiness of non-lithium-ion LDES for large-scale utility procurement in 2025-2028 timeframe.

Getting There:

- A portfolio of programs and funding opportunities for LDES
  - Early-stage, smaller-scale projects through EPIC (<1MW)
  - Larger scale demonstrations through LDES Program

- **Next Steps:**
  - Early LDES awards to provide near term support grid (6-8MWs for 8-10 hours)
  - EPIC $30M solicitation in early 2023 for smaller systems
  - Large LDES open solicitation planned for July 2023

Opportunities for Non-Lithium-ion Technologies

- **Supply chain security:** Not reliant on Lithium-ion supply chain elements
- **Safety:** Reduce thermal runaway and improve safety
- **Cost and performance:** Improve $/kWh, energy density, charge time, and cycle life
- **Demonstrate Field Performance:** Validate performance and stability, enabling future financing opportunities

Investments in Energy Storge Continues: 2022 California's State Budget

- $140M in 2022-23 for non-lithium-ion long-duration energy storage
- First LDES grant:
    1. **Viejas Native American Tribe Microgrid**
        - 45MWh hybrid system (flow battery and Zinc hybrid system)
        - Integrated microgrid system with 15MWs PV and distribution system upgrade
        - Provided critical support for key tribe facilities
        - Provides emergency services to community during outages
        - Provide grid resiliency support when needed

$31 Million to Viejas Tribe for 45 MWH Long Duration Energy Storage

Project Overview

Microgrid with LDES on the Viejas Band of Kumeyaay Indians Reservation

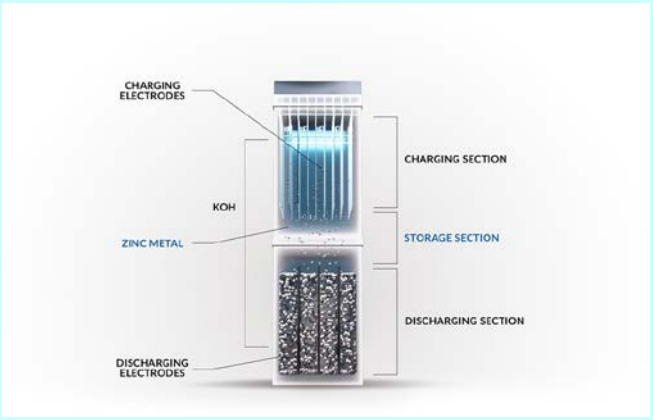
Project Overview

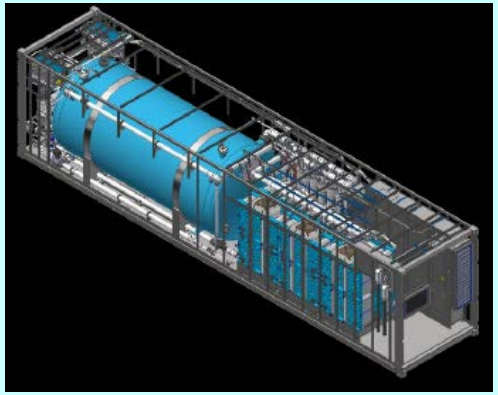
Non-Lithium-Ion Long-Duration Energy Storage Technologies

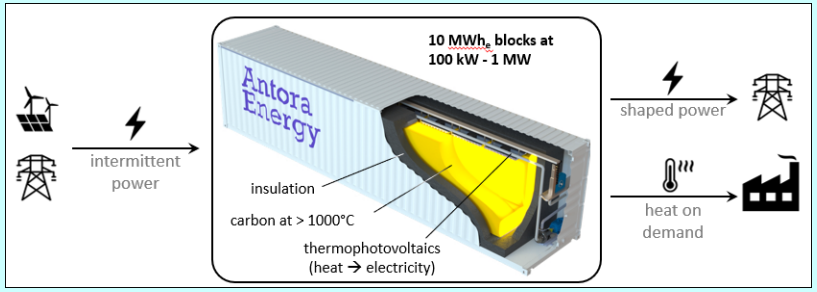
- Zinc electrolyte-based chemistry
- No rare earth minerals required, de-risked supply chain
- Wider operating temperature range
  - -20 to 45°C vs 15 to 25°C (Lithium-Ion)
- Designed and manufactured in United States

- Flow Battery chemistry
- Safe and stable chemistry of the vanadium electrolyte
- Can perform in the field for 25+ years
- Deployed around the world

Examples of Promising Non-Lithium-ion Energy Storage Technologies







Open Discussion