



Lessons Learned in Advancing Non-Lithium-Ion Long Duration Energy Storage Technologies in California

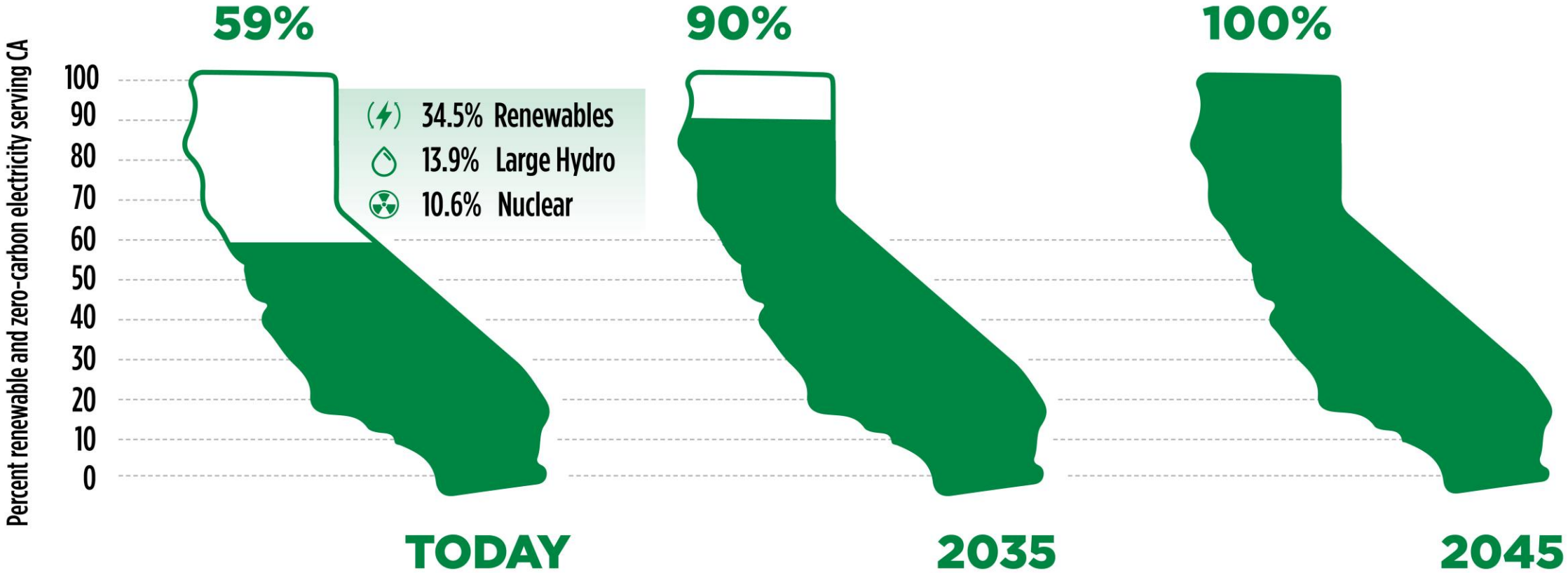
Mike Gravely--Energy Storage Team Lead
California Energy Commission
Mike.Gravely@energy.ca.gov

THE CALIFORNIA ENERGY COMMISSION



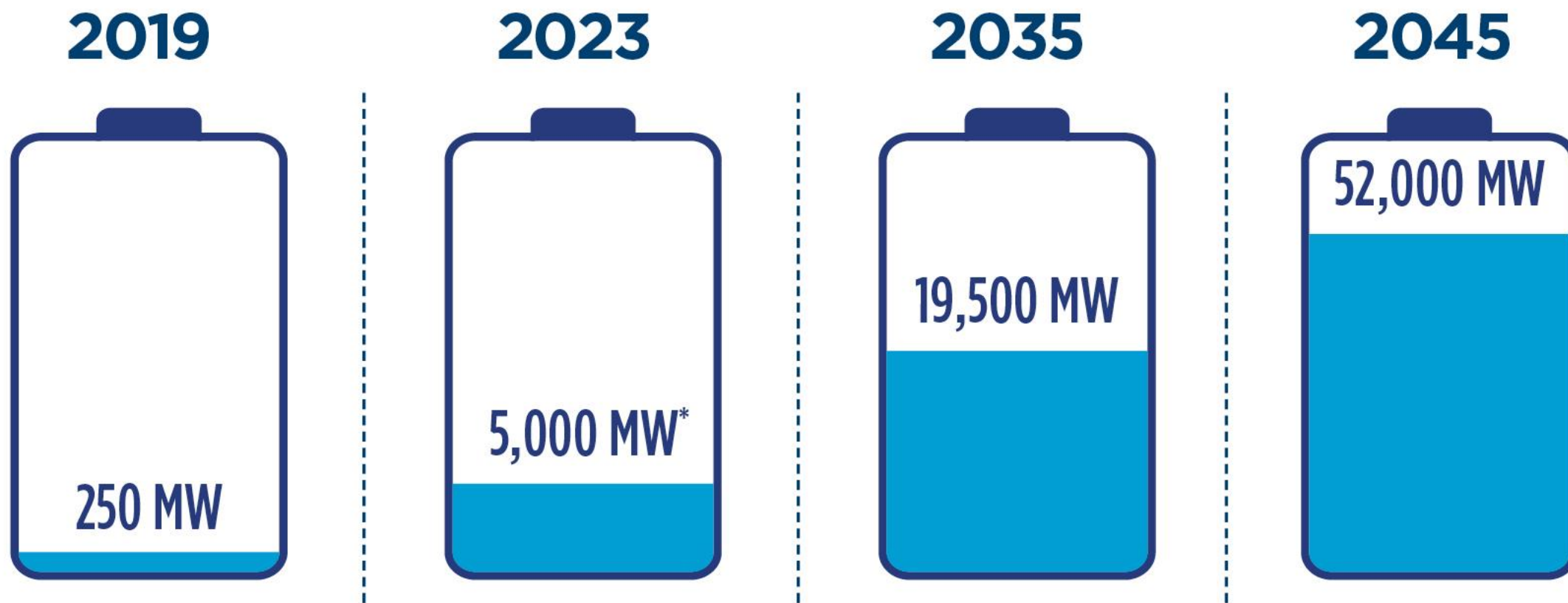
Moving California to 100% Clean Energy

California Progress Toward 100% Clean Electricity by 2045



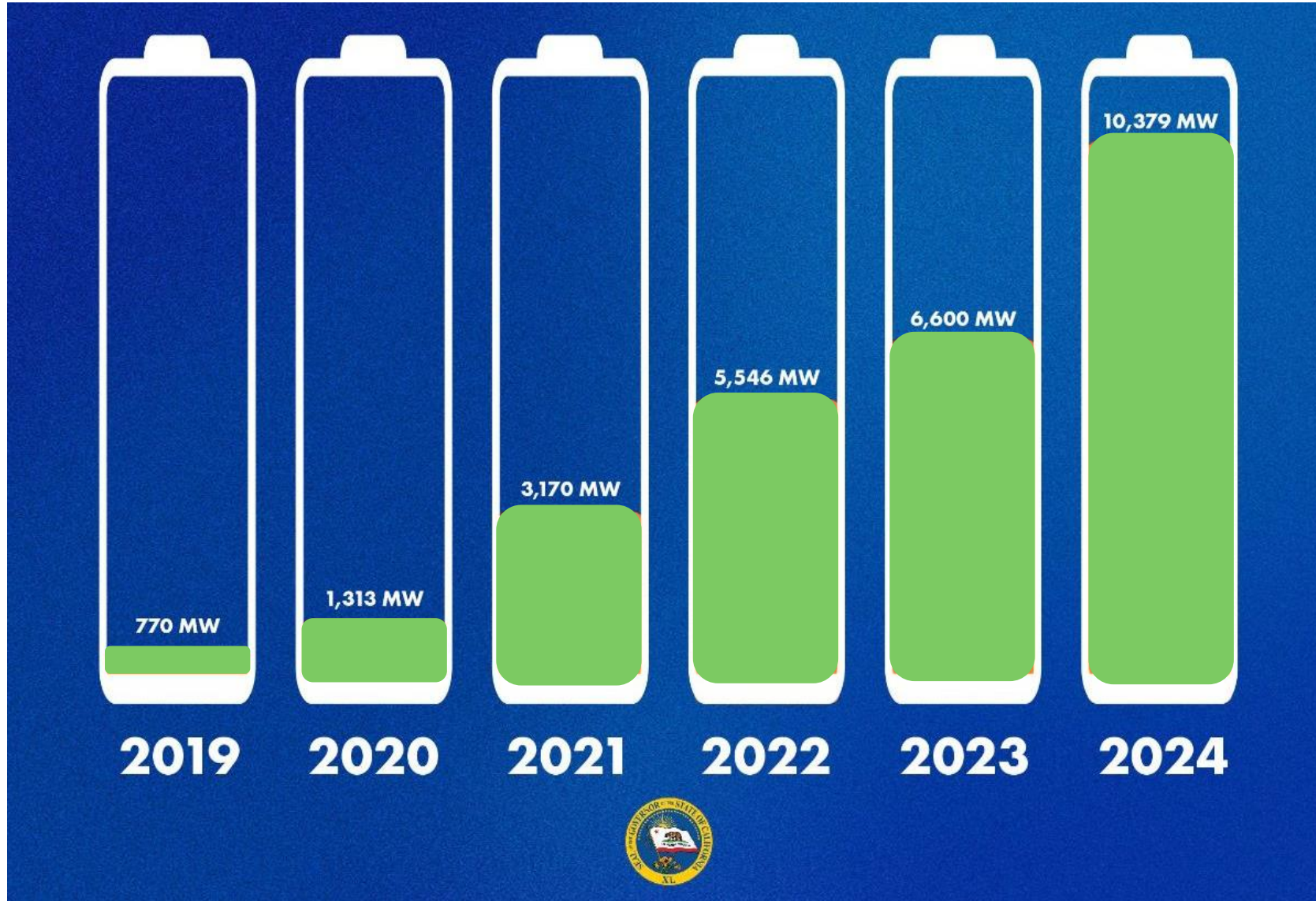
California's growing battery storage capacity

captures the state's abundant renewable resources



*Projected as of June 1, 2023 based on California ISO interconnection queue.

California Hits 10,000 MW of Energy Storage





CA Non-Lithium-Ion LDES Demonstration Program

- In July 2022, CEC Approved for \$273M in LDES Demonstration Funding
 - CEC awarding 10 different projects:
 - 3 Microgrids with Native American Tribes
 - 2 Projects on DOD Bases
 - 2 Projects with Utilities
 - 1 Project with Hospital in Disadvantaged Community
 - 1 Project with Industrial Facility
 - 1 LDES Testing and Evaluation Facility
 - Durations 8 hours to 100 hours. System sizes 8MWHs to 500 MWHs
 - First system operation in November 2024, remaining in 2025/2026



Key Technology Advancements

- Five Different Non-Lithium-Ion technologies
 - Zinc hybrid
 - Vanadium redox flow battery
 - Iron Flow battery
 - Iron air
 - Zinc Air



Viejas Band of Kumeyaay Indians Microgrid

- 70 MWh Microgrid with LDES on Viejas Band of Kumeyaay Indians tribal lands providing:
 - Critical support for key tribe facilities
 - Emergency services to community during outages
 - Grid resiliency support
- All Phase 1 batteries placed, undergoing installation & commissioning
- Expect to turn on first 35 MWhs in November 2024

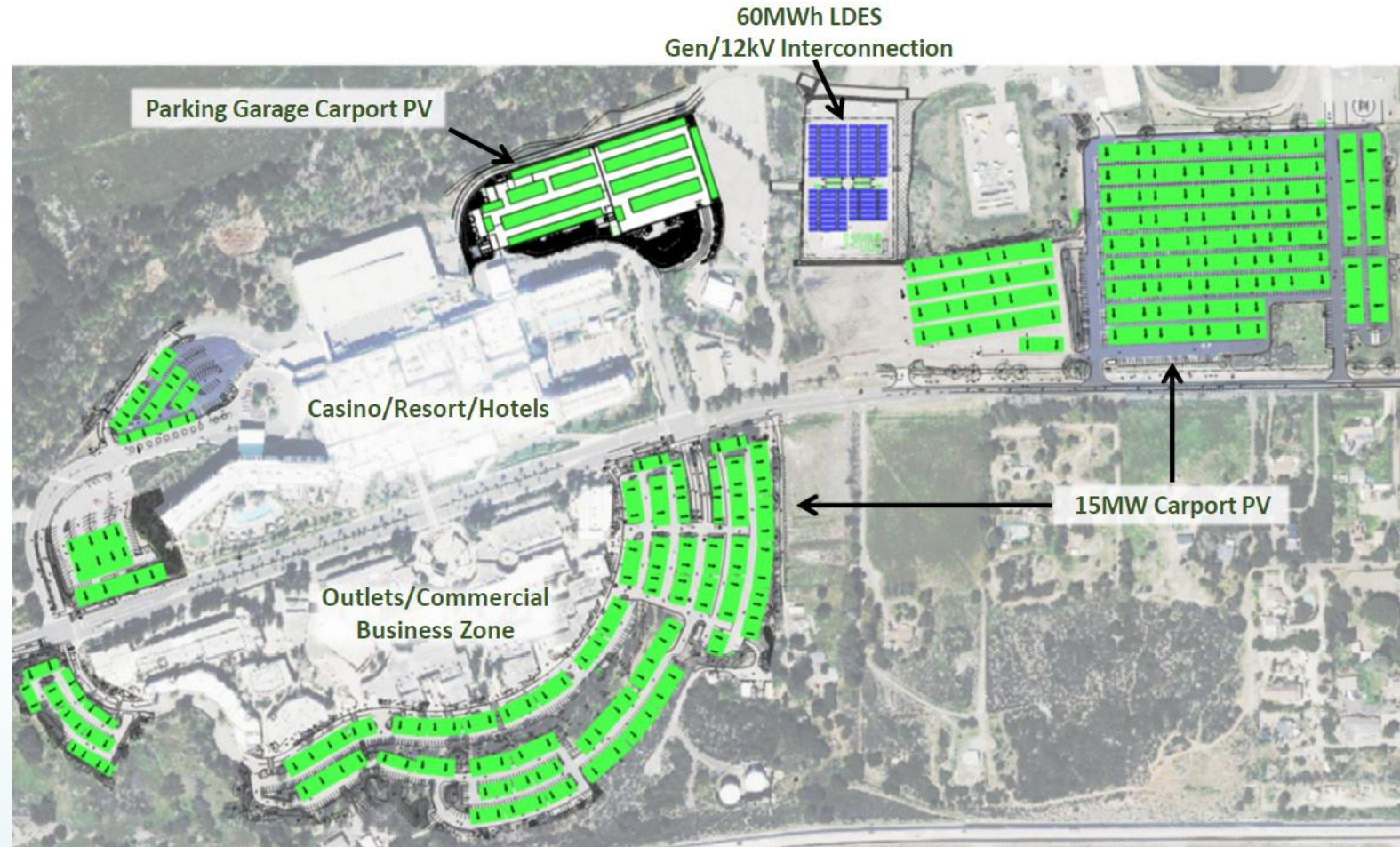


Viejas Microgrid battery yard. Top: Eos batteries. Left: Invinity batteries. Right: Eos trenching.



Agreement Background

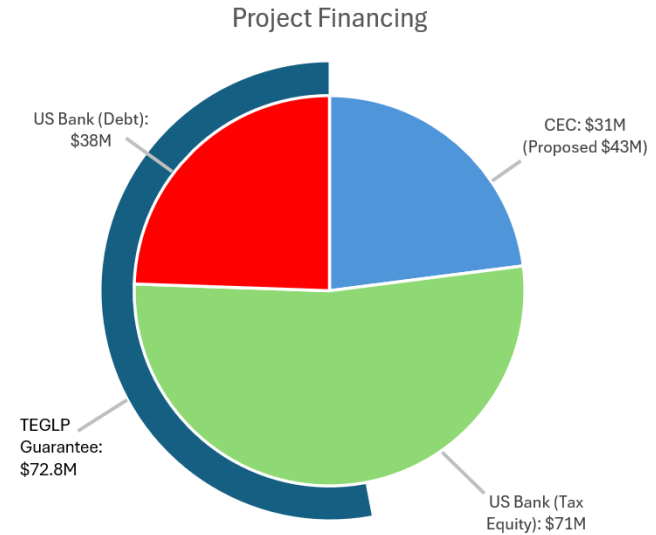
- Energy storage project is part of a larger renewable development
 - \$140 million project
 - 15 MW PV through solar carports
 - 418 EV charging stations
 - Distribution system upgrade
- Indian Energy has 30-year PPA with Viejas tribe





Agreement Financing

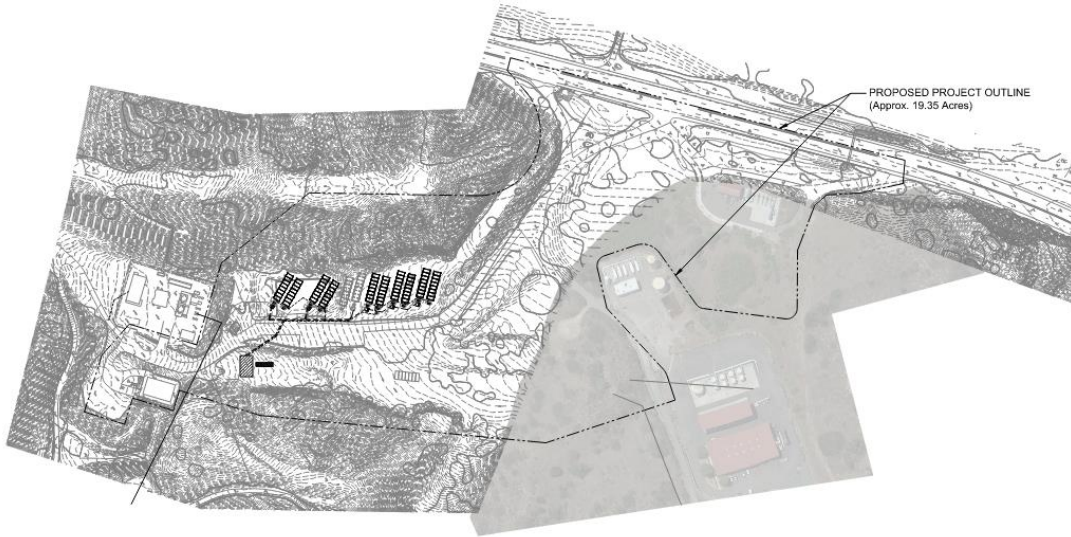
- Project backed by mix of CEC funds, tax equity financing, and debt financing
- Debt financing backed by DOE Tribal Energy Loan Guarantee Program
 - Largest DOE loan guarantee awarded to a NAT--\$72M
- During financing negotiations, addressing concerns about project bankability
 - Largest CA grant to NAT
 - Domestic Content for tax credits
 - Projected revenue



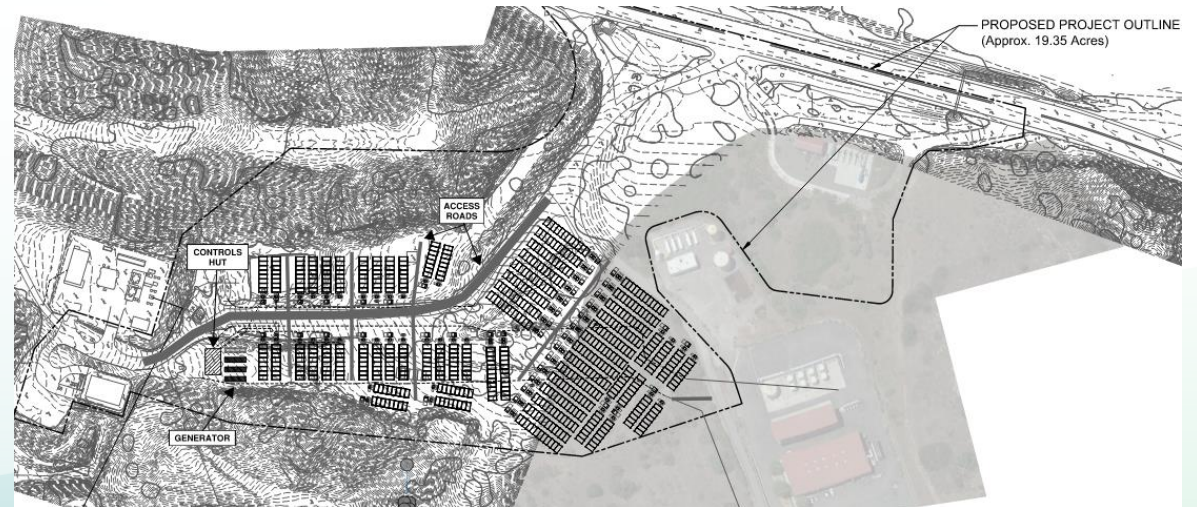


Camp Pendleton Project

Phase 1 – 6MW/48MWh – COD 2026



Phase 2 – 44MW/352MWh –
COD 2029



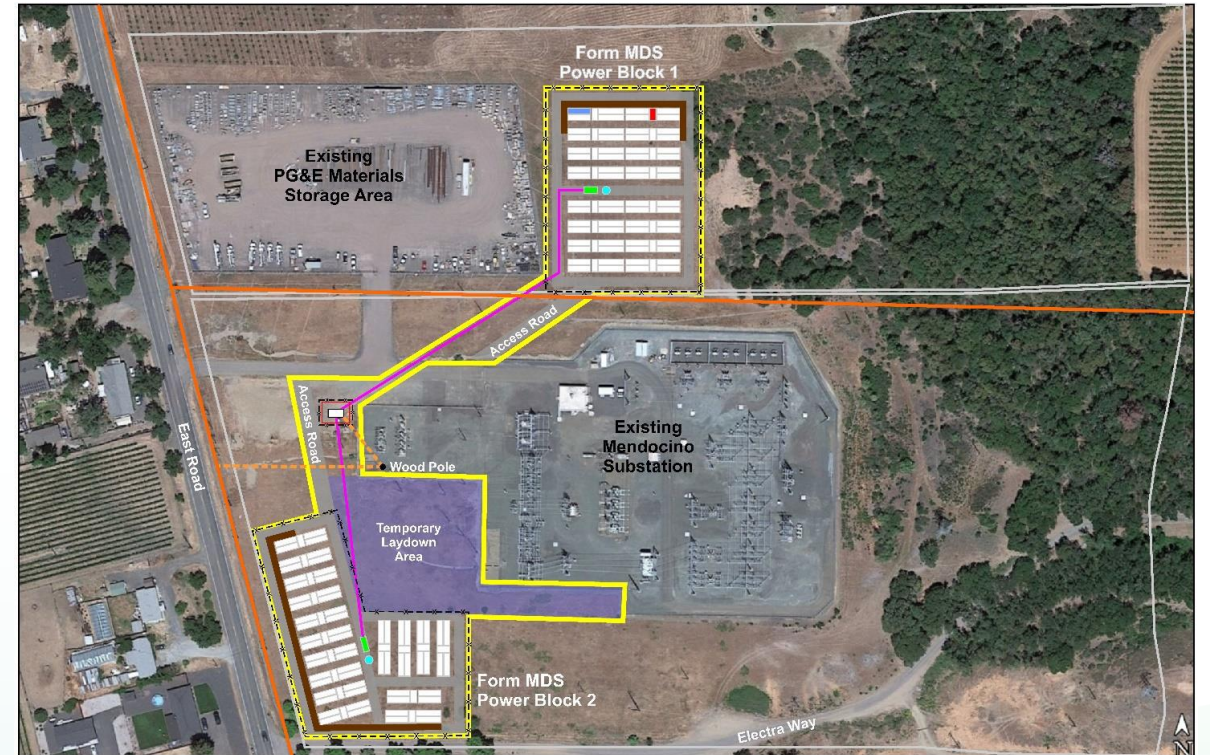
Combined – 50MW / 400MWh
– COD 2029



Utility Application Project Overview

Form Energy's Multi-day Storage System

- 100-hour duration, 5 MW, 500 MWh
- Front-of-the-meter grid application
- PG&E's substation at Redwood Valley, Mendocino County
- Use case and market application analysis
- Design, construction and operation of the multi-day storage system





Rapid Integration and Commercialization Unit





Addressing First Responder Training





Key Future LDES Activities Planned for California

- August 2024 CPUC Decision
- Two LDES Procurements
 - 1 GW of 12 Hour LDES to be procured in 2026
 - 1 GW of Multi-Day LDES to be procured in 2027
- System operational by 2031-2033
- State Procurements Managed by CA Department of Water Resources



LDES Lessons Learned to Date

- LDES size drives more complex projects but critical to technology growth
 - CEQA is special challenge in California
- Project financing difficult or impossible to obtain
 - Lack of technology maturity a challenge
 - Predicting future revenue challenge
 - Preferred financial model is a 20–30-year Power Purchase Agreement
 - Investment Tax Credit (ITC) adds to bankability but not able to close deals with just ITC

Operational Challenges in California

1. Interconnection approvals impact program progress
 - Slow response impacting third-party financing and insurance negotiations
2. Obtaining Queue Position for Large New Proposed LDES systems real challenge
3. Third-party investors interested in supporting California energy storage growth however identified delays impacting their confidence and willingness to commit to long term debt financing



Developing Fair Price Comparison Methodology for Evaluating True Costs of LI and LDES Solutions

Factors to Consider

- Upfront Capital Cost
- Support Costs
 - Air Conditioning Cost
 - Fire suppression system
 - Increase on site safety monitoring
- Operational considerations for warranty--do not charge over 80% or under 20%
- Degradation of maximum output over time (2-5% vs 30%-50% for 10 years)
- System Longevity (20-30 years vs 7-10 years)
- Performance Characteristics
 - Round Trip Efficiency
 - Response time`

Open Discussion

