

# Recent Developments in California Related to Energy Storage

2<sup>nd</sup> NELHA Conference on Energy Storage Trends and Opportunities

Mike Gravely, Team Lead, Energy Technology systems Integration, CEC and

Terry Surles, CIEE

December 5, 2018

# There Has Been On-Going Legislative Interest in Storage Following Passage of AB2514

## 2010: Genesis

- AB 2514 directed CPUC to establish utility storage procurement framework.
- Storage mandate set policy goals of **GHG reduction**, **renewable integration**, and **grid optimization**.
- CPUC adopted a multi year storage procurement mandate of 1,325 MW by 2020.

## 2016: Refinement

- SB 801 directed utilities to procure a minimum of 20 MW storage to address Aliso Canyon reliability
- AB 2868 directs utilities to procure up to 500 MW of distributed connected storage
- AB 33 requires the CPUC to consider long duration bulk storage (was done in conjunction with IRP)

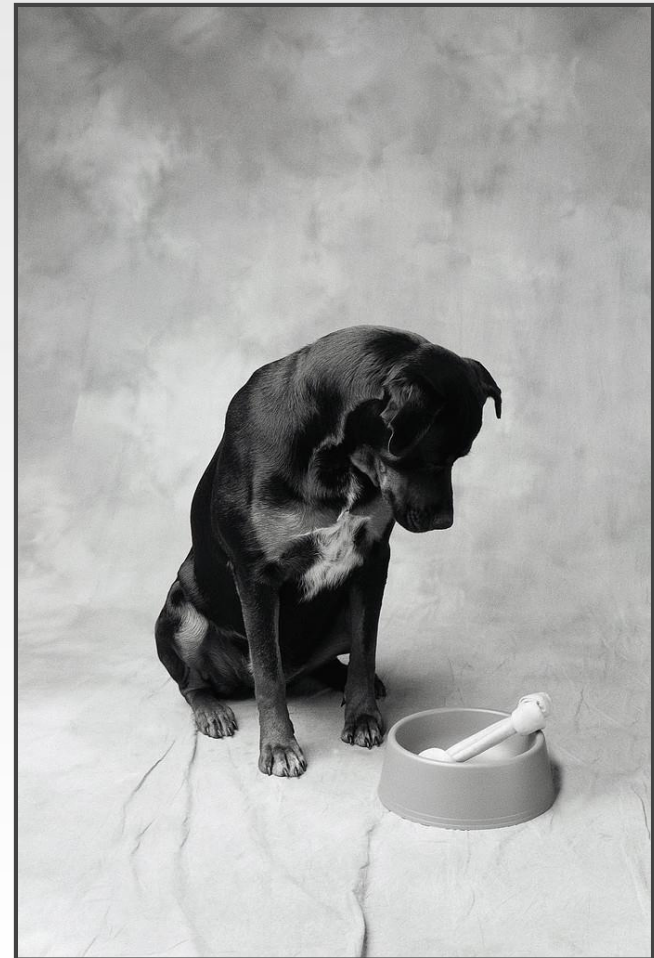
## 2018: Stretches Goals Further

- SB 100 increases the RPS to 60% by 2030 and requires renewable and zero carbon resources to supply 100% of CA's electricity by 2045
- SB 700 extends SGIP program administration to 2026.
- SB 1339 directs CPUC to evaluate microgrid tariff design, including assessing role of storage.



# Coherent Direction Is Needed for Regulatory and Institutional Changes

- **Blizzard of legislation can overwhelm regulators leading to implementation of new rules that have unintended consequences**
- **Major energy technology initiatives require that institutional and regulatory barriers be addressed in addition to technical, societal, and financial aspects of the technology**
- **Failure to consider inter-relationships leads to a “dog’s breakfast” of sometimes conflicting rules**



# Energy Systems' Complexity, Risk, and the Attendant Policies and Politics - The Future

- “The road that I have turned on, the road that I have taken, it might be the beginning, it might be near the end.”
- Enya, circa 2000



# **CAISO Policies Developed by Other Legislation Can Lead to “Debates” Between CPUC and CAISO: CAISO planning, rules and participation models:**

- Proxy demand response (PDR), non-generator resource (NGR) and distributed energy resource provider (DERP)**
- Storage in CAISO Transmission Planning Process (TPP)**
- Storage as Transmission Asset (SATA)**
- Energy Storage and Distributed Energy Resources (ESDER) stakeholder initiative that will address Multi-Use Applications (MUA)**
- Also must address FERC and NERC requirements**

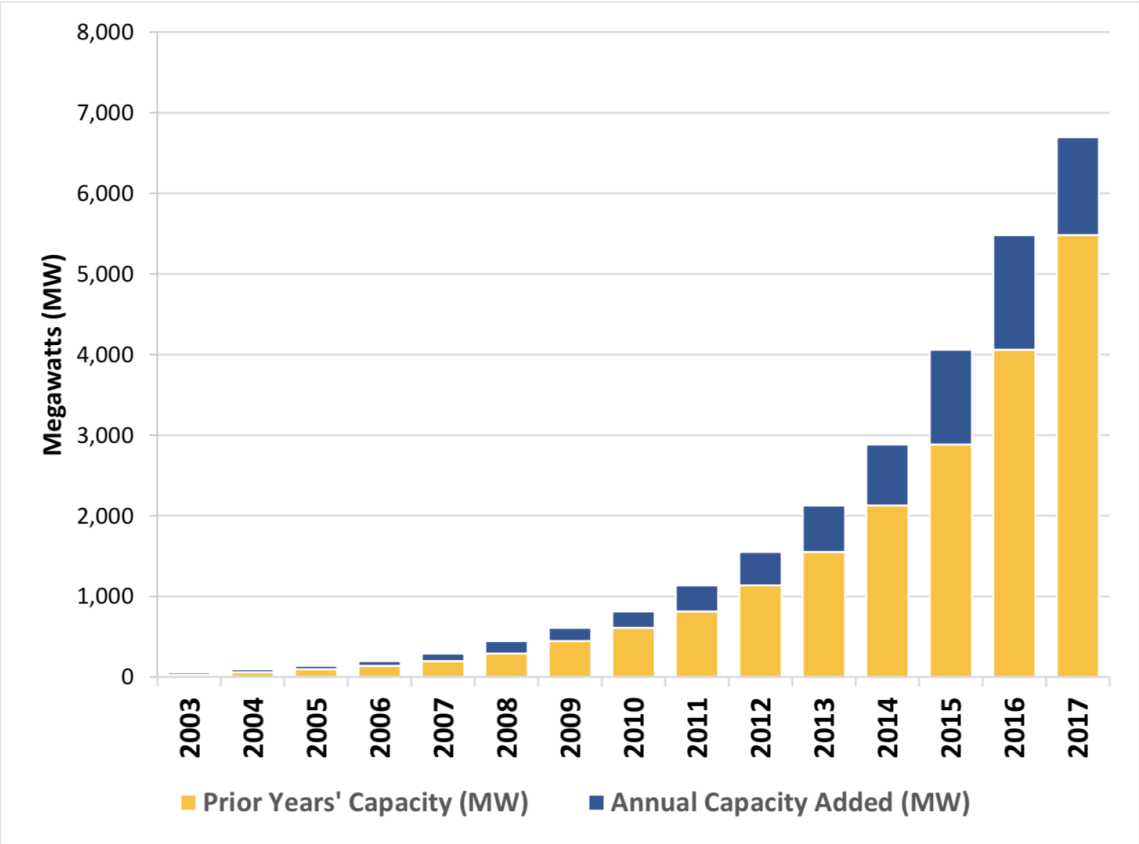
# Energy Storage Critical for Reaching Renewable Goals: Now Set at 60% by 2030 (SB100)

California RPS Target Keeps Increasing:  
50% Renewable Energy by 2030



# Installed BTM Solar Capacity

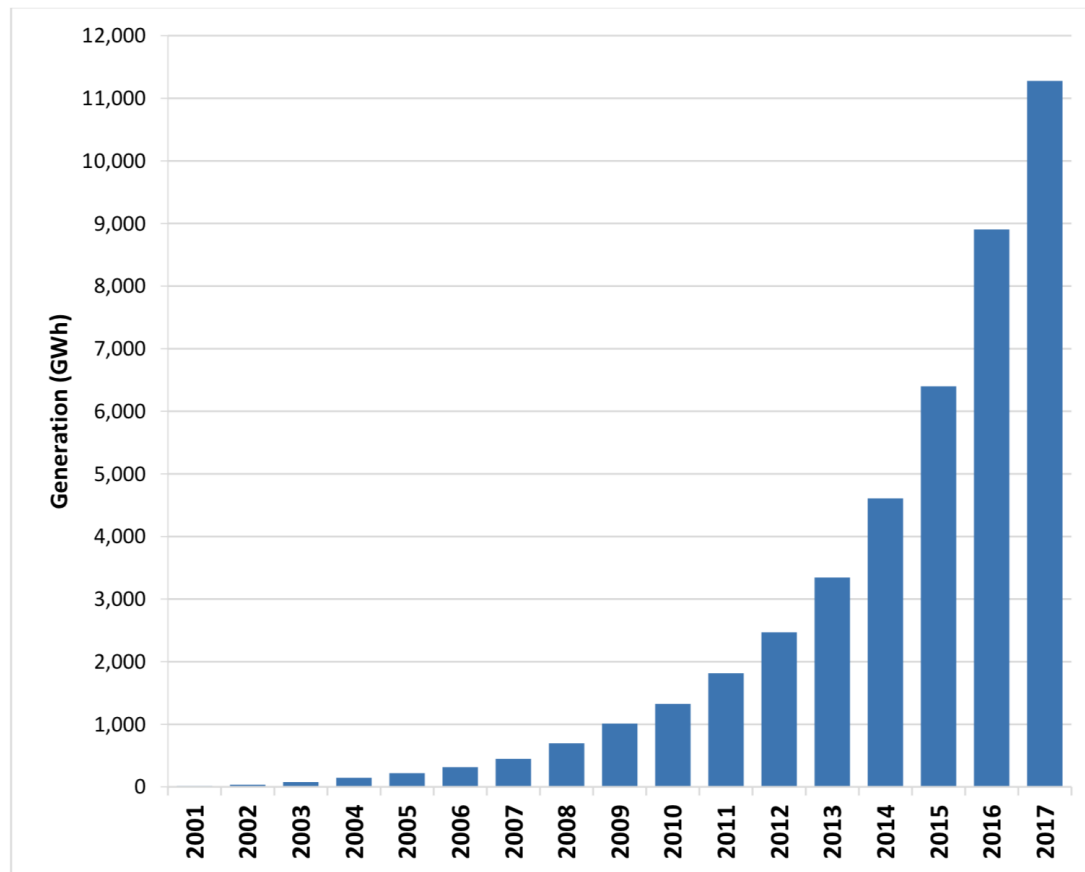
Figure 10: Total and incremental behind-the-meter solar capacity by year



Source: California Energy Commission staff analysis, June 2018

# BTM Generation - Does NOT Count Towards California's RPS Goals - Estimated in Hawaii

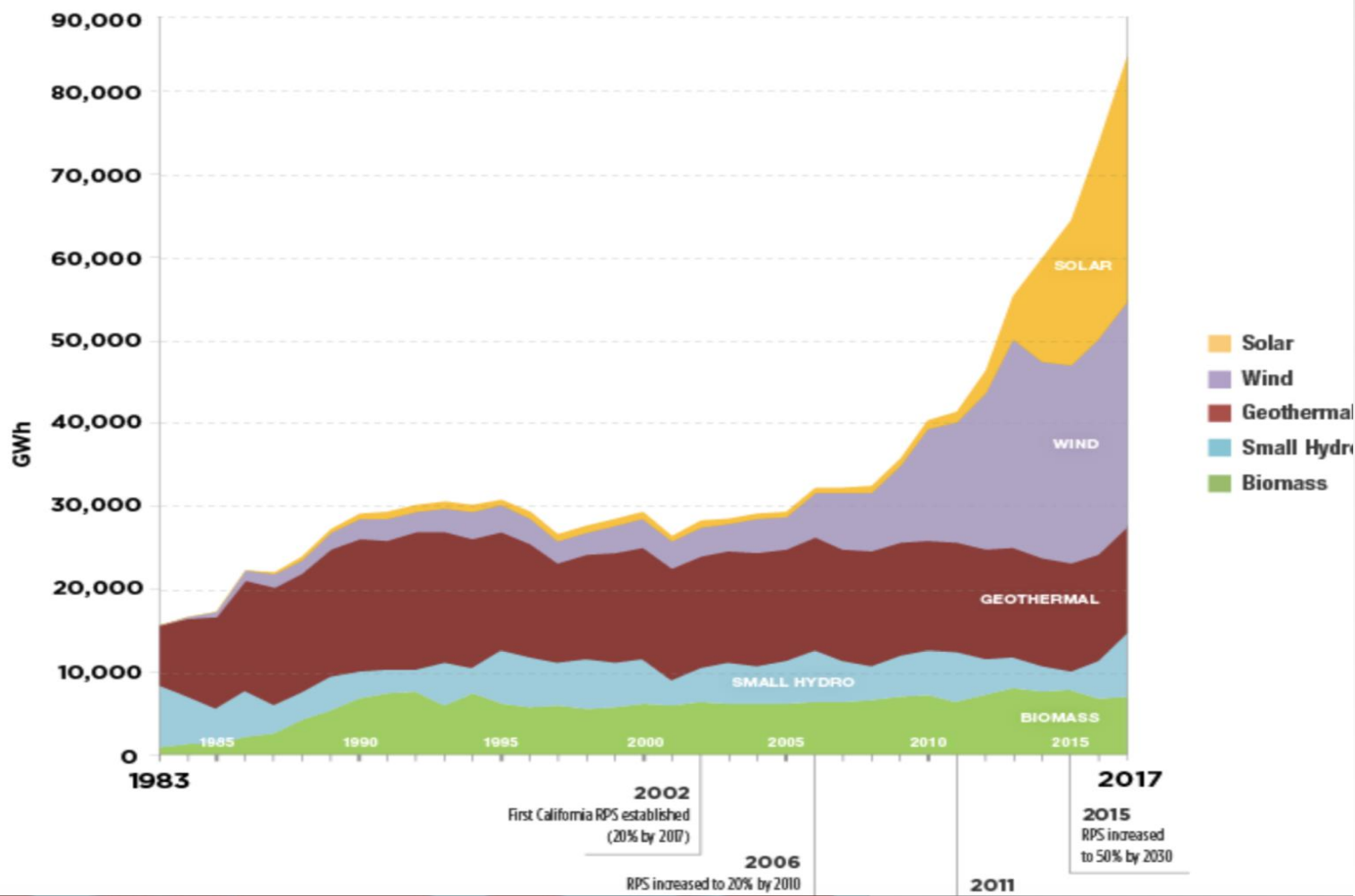
Figure 11: Estimated Generation From Behind-the-Meter Solar, 2001-2017<sup>xiv</sup>



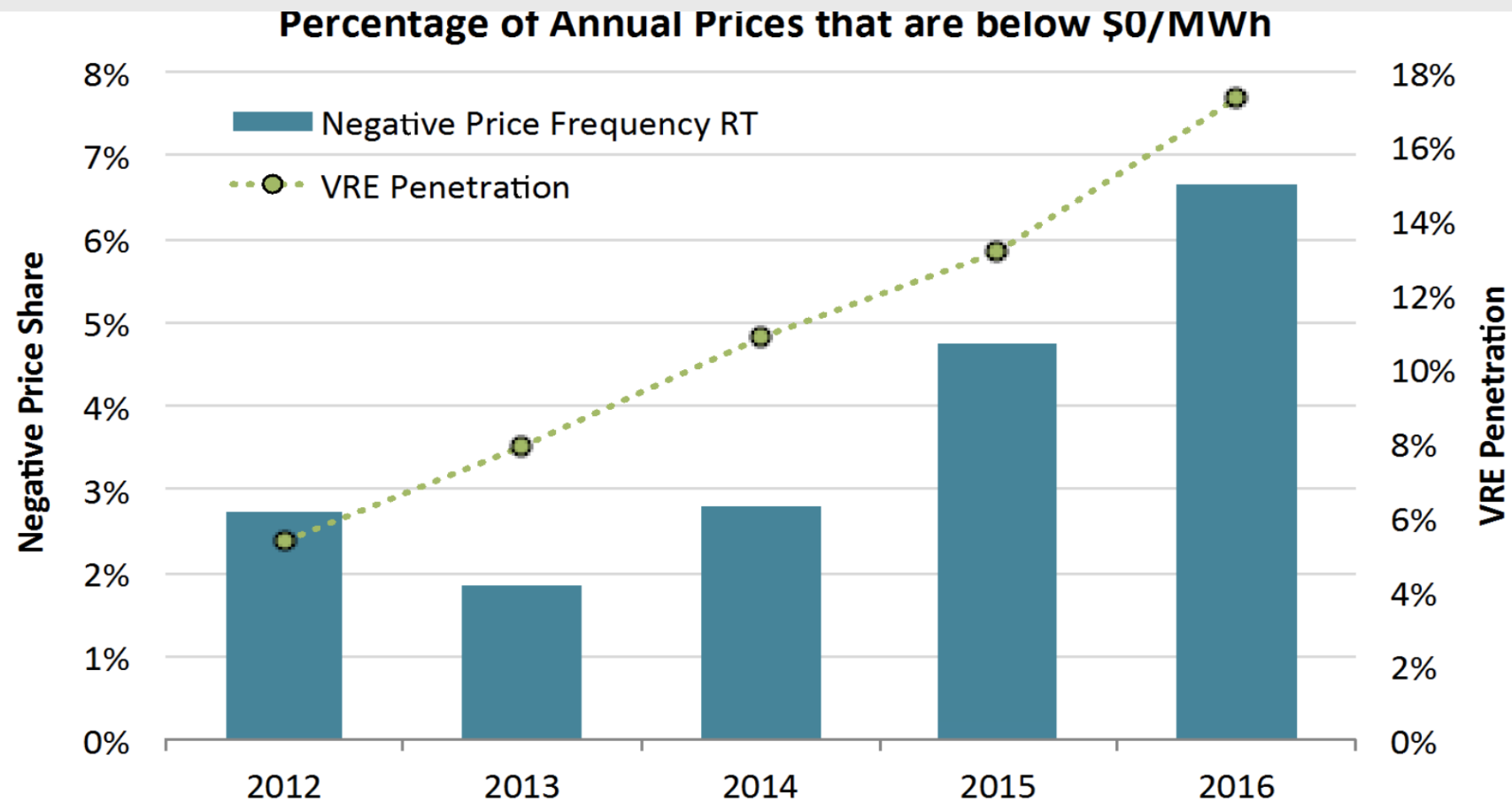


# Aggregated Amount of Renewables in California – Does NOT Include Large-Head Hydro

Figure 6. Renewable Energy Generation 1983-2017 by Resource Type

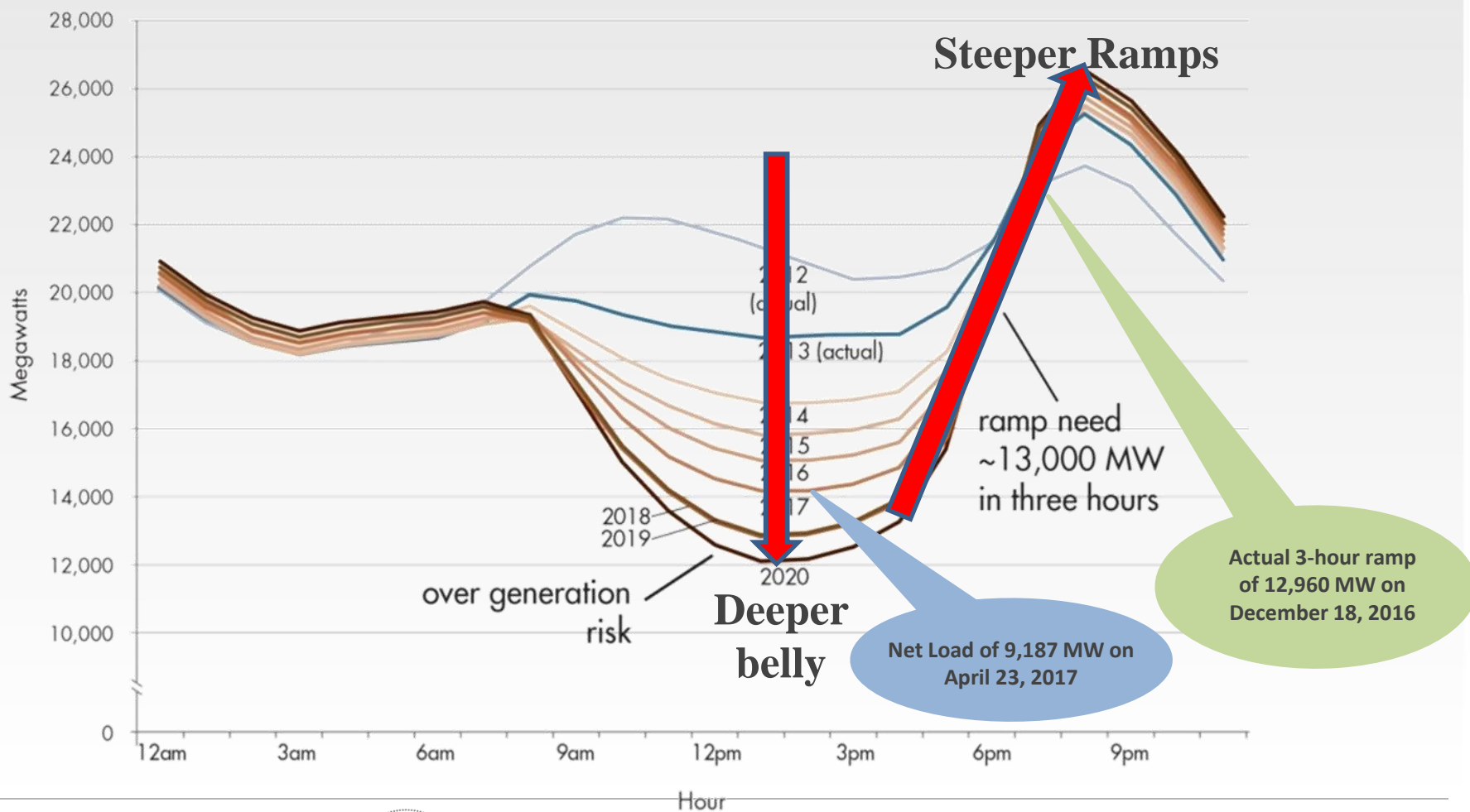


# Variable Renewables Impact on Thermal Generation Causes Increased Amounts of Electricity to Be Sold at Negative Prices



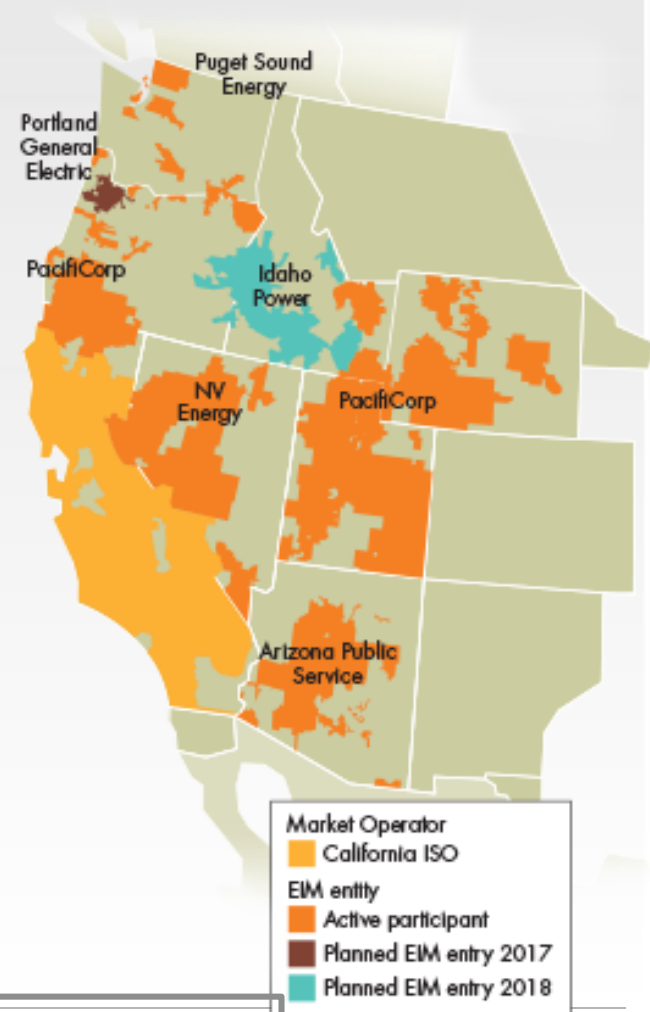
# Storage, Coupled with Demand Response, Necessary to Avoid Curtailment: Actual net-load and 3-hour ramps are about four years ahead of CAISO's original estimate

Typical Spring Day



# Energy Imbalance Market (EIM) Established to Address – in Part – Curtailment Issues

- In 2014, regional market system launched to increase coordination and interconnection between CAISO and other Western Basin orgs, in 2017, expansion to Southwest Power Pool
- Operated by CAISO, EIM enables real-time coordination (15- and 5-minute) and reserve sharing across a larger resource base
- Continued political problems in CA
- Demonstrated benefits during first two years include reductions of system costs, renewables curtailment, and GHG emissions



Gross Benefits (Million\$)	Curtailment Reductions (MWh)	GHG Emission Reductions (MMTon CO <sub>2</sub> -e)
\$114.36	335,930	143,695

# Storage as Part of Tool Kit: SONGS Shutdown, Aliso Canyon Natural Gas Issue, etc.

## **San Onofre Nuclear Gen Station (SONGS) Once Through Cooling (OTC)**

**SCE: 261 MWs in LCR RFO**  
25.6 MWs thermal – customer  
135 MWs battery – customer  
100.5 MWs battery – transmission

**SDGE: 83.5 MWs in LCR RFO**  
13.5 MWs battery – distribution  
70 MWs battery – transmission

**SCE: 125 MWs in PRP2**  
60 MWs battery – distribution  
65 MWs battery - customer



## **Aliso Canyon (expedited)**

**SCE: 62 MWs BESS- distribution**

**SDG&E: 37.5 MWs BESS – distribution**



## **SB 801 (Stern, 2017)**

Required CPUC to direct SCE to procure at least 20 MWs of energy storage. Resolution E-4937 fulfilled that requirement.

## **Reliability Must Run**

**CPUC Resolution E-4909**, 01.11.18, CPUC directs PG&E to hold RFO for storage and preferred resources to reduce need for three conventional power plant reliability must run (RMR) contracts.

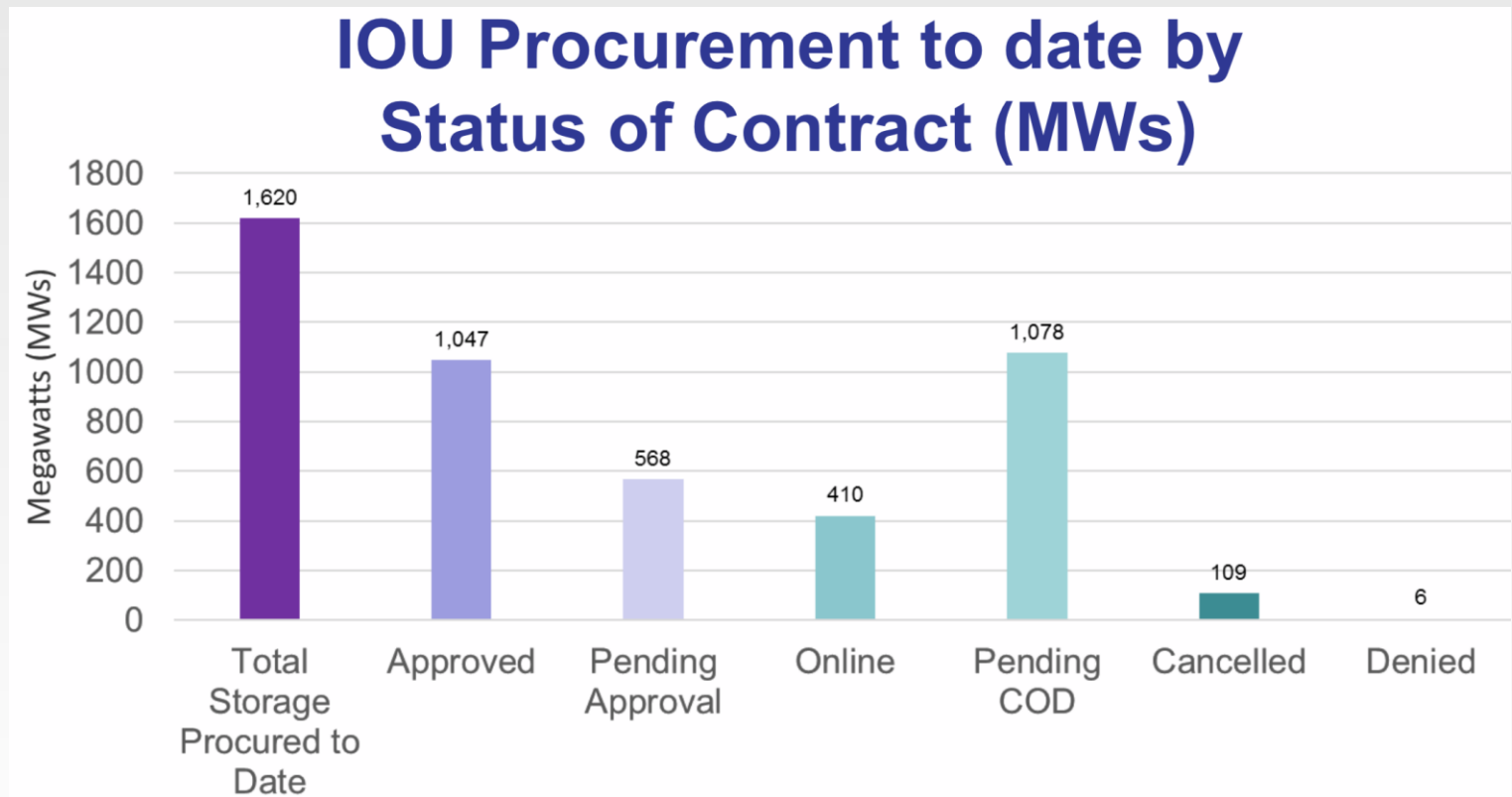
**PG&E 567.5 MW RFO** for energy storage projects in South Bay Moss Landing Local Capacity Area. CPUC Draft Resolution E-4949 recommends approval.



# IOU Procurement Status Disaggregated by Grid Domains

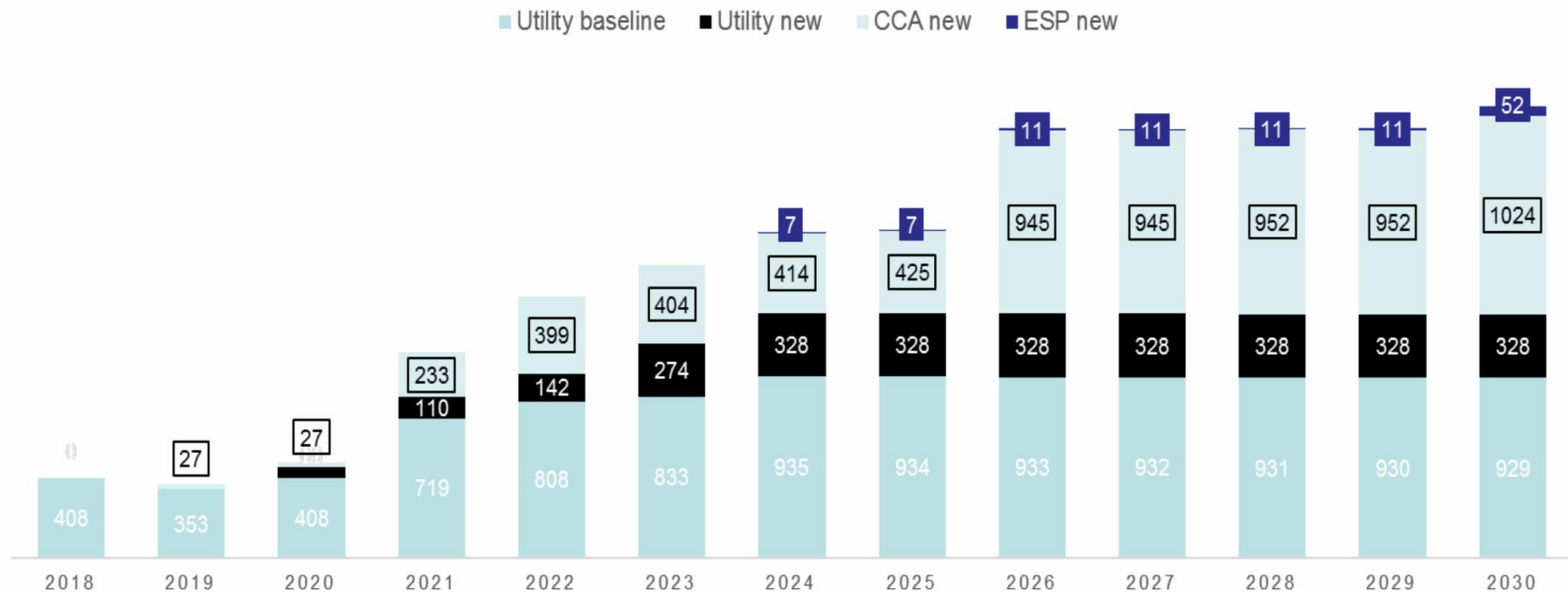
	Grid Domains	Storage Procurement Mandate Target	Mandate Driven Storage Procurements	Other Storage Procurements	Total Storage Procurement To Date	Total Procurement Adjusted per Mandate Rules	Current Excess/Deficiency Relative to Storage Mandate
PG&E	Transmission	310	135	557	692	544	234
	Distribution	185	36	0	36	185	0
	Customer-Side	85	36	10	46	46	-39
SCE	Transmission	310	0	120	120	171	-139
	Distribution	185	27	112	134	185	0
	Customer-Side	85	100	205	306	221	136
SDG&E	Transmission	80	-	110	110	80	0
	Distribution	55	-	57	57	56	1
	Customer-Side	30	-	29	30	30	0
<b>IOU Total</b>		<b>1,325</b>	<b>334</b>	<b>1,200</b>	<b>1,531</b>	<b>1,518</b>	

# Investor-Owned Utility Procurement Status



- Most storage procurement is approved or pending approval.
- Approximately 25% of project MWs are online

# Li-ion Projections Including CCAs and ESPs, Concern that Very Few New Systems Are NOT Li-ion



Source: LSE 2018 IRP Plans filed with the CPUC August 1, 2018

**Baseline:** Planned or existing procurement, including AB 2514 storage mandate, as of 2018.

**New:** Resources that do not yet exist, but which the LSEs have included in their 2018 IRP Plans to meet CA 42 MMT electric sector carbon goal by 2030.

## Total 2018 LSE IRP Li Ion Proposals

2030	Utility	1257 MW
2030	CCA	1024 MW
2030	ESP	52 MW



# Continued Analytical Efforts at CPUC Required Under CPUC D.18-01-003: Findings

- **Legislative directives, regulatory program design, and market dynamics have led to procurement of 1,620 MWs of new California storage capacity from 2010 to 2018, of which 420 MWs are on line.**
- **Utility storage procurement to meet reliability needs has outpaced the storage procurement mandate.**
- **Storage MUAs are occurring under existing rule framework, but additional refinements are needed to achieve the full economic potential of storage to provide multiple services and grid value.**
- **Programmatic refinement of the utility storage mandate and storage grid integration measures could support California in accelerating GHG reduction, renewable integration and grid optimization goals.**
- **CPUC has pending RFP to contract for comprehensive storage market evaluation report focused on assessing achievement of key storage policy goals.**

# Recommended Policy Refinements to Utility Storage Procurement Framework

- **Implement Multiple Use Applications (MUA) Recommendations in a New Storage Rulemaking**
- **Refine Storage Procurement Requirements**
- **Consider how BTM Storage can provide Grid Services**
  - **Consider how to enable BTM storage to help meet grid operational needs, including voltage support, resiliency and reliability, and grid services in IDER proceeding.**
  - **SGIP-funded storage offering grid services in IDER and Distributed Resource Planning (DRP) proceedings**
- **Refine Storage Interconnection & Consider New Tariff Design**

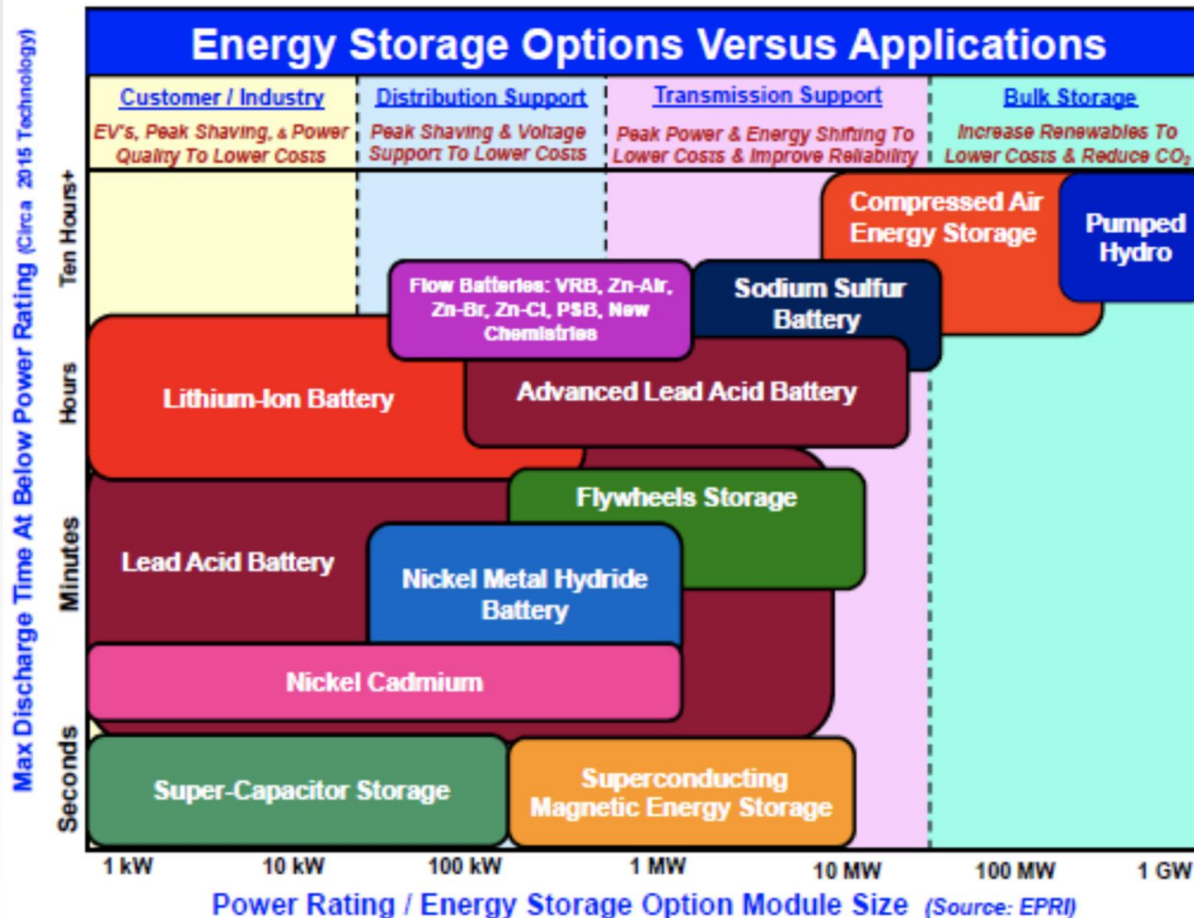
# CPUC Recognized Potential of MUAs in D.18-01-003

<b>Customer</b>	TOU bill management
	Demand charge management
	Increased consumption of on-site generation
	Back-up power
	DR Program Participation
<b>Distribution</b>	Distribution capacity/deferral
	Reliability (back-tie) services
	Voltage support
	Resiliency/microgrid/islanding
<b>Transmission</b>	Transmission deferral
	Black start
	Voltage Support
	Inertia
	Primary frequency response
<b>Wholesale Market</b>	Frequency regulation
	Imbalance energy
	Spinning Reserves
	Non-spinning reserves
	Flexible Ramping Product
<b>Resource Adequacy</b>	System RA capacity
	Local RA capacity
	Flexible RA capacity

# Refine Storage Interconnection and Consider New Tariff Design

- Explore opportunity for next Rule 21 OIR to streamline interconnection of solar paired with storage configurations, while current Rule 21 OIR continues to streamline storage interconnection.
- Continue to identify tariff options that enable storage and storage paired with solar to address duck curve issues such as seasonal over-generation and need for fast evening supply ramps.
- Implement aspects of SB 1339 (Stern) which calls on CPUC to develop microgrid tariffs that include storage and solar integration measures.
- Consider the value energy storage could provide to grid and customers as part of the NEM 3.0 revisit
- Recent analysis found BTM storage could significantly mitigate the grid integration costs at high penetration PV scenarios.

# California Energy Commission (CEC) Is a Leader in Funding Storage RDD&D Projects



Energy Commission research:

- 3 CAES projects
- 6 flow batteries
- 2 zinc-air batteries
- 8 lithium-Ion batteries and 4 electric vehicle solutions
- 2 sodium sulfur batteries
- 2 flywheels
- sodium nickel battery

# CEC Energy Storage Technology Demonstrations



**Amber Kinetics**



**Primus Power**

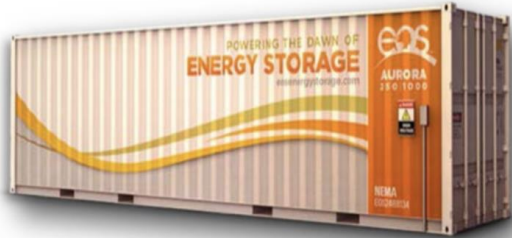


**Eos Energy Storage**



**UET**

# CEC Examples Build on DOE Funding

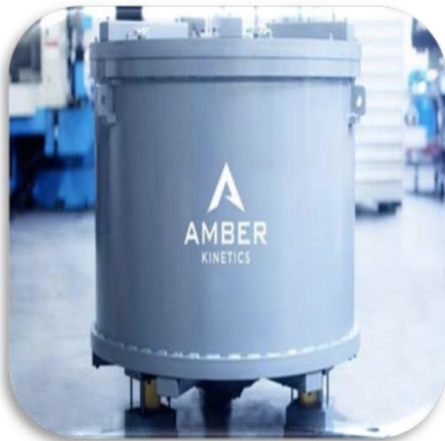


EOS Zinc Hybrid Cathode  
Battery Technology



EPIC Awardees  
are Successful  
in IOU State  
Wide Energy  
Storage  
procurement  
AB 2514

Company projects their  
Solar + energy storage  
cost could drop 20% below  
current market price



Amber Kinetics Flywheel Technology



Company announces game  
changing energy storage  
contract with PG&E for 20  
megawatt flywheel system

# Primus Power Is Example of How Government Funding Allows for Equity Investment

Commercialize a world class new battery system

*Molecules to MegaWatts*



**Patents**  
49 granted by 12 countries

**Equity Investment**  
\$94M over 8 years

**Grants**  
\$22M from DOE,  
ARPA-E and  
USTADA

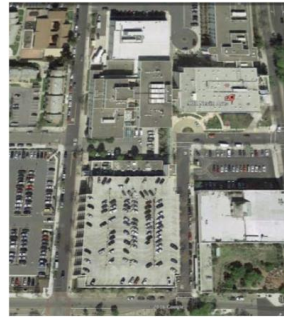
Primus Power  
co-founder  
receives  
\$100k PIER  
grant



# As NELHA Is Considering Microgrid Development, CEC Funded These Activities Since 2004



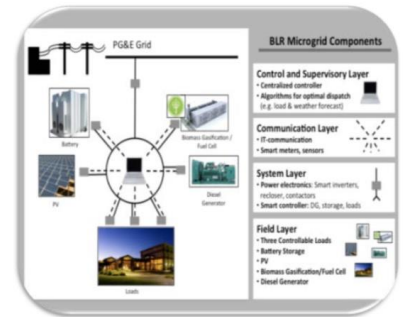
Laguna Waste Water Treatment



Charge Bliss-Kaiser



Borrego Springs



Blue Lake Rancheria



Bosch DC Microgrid

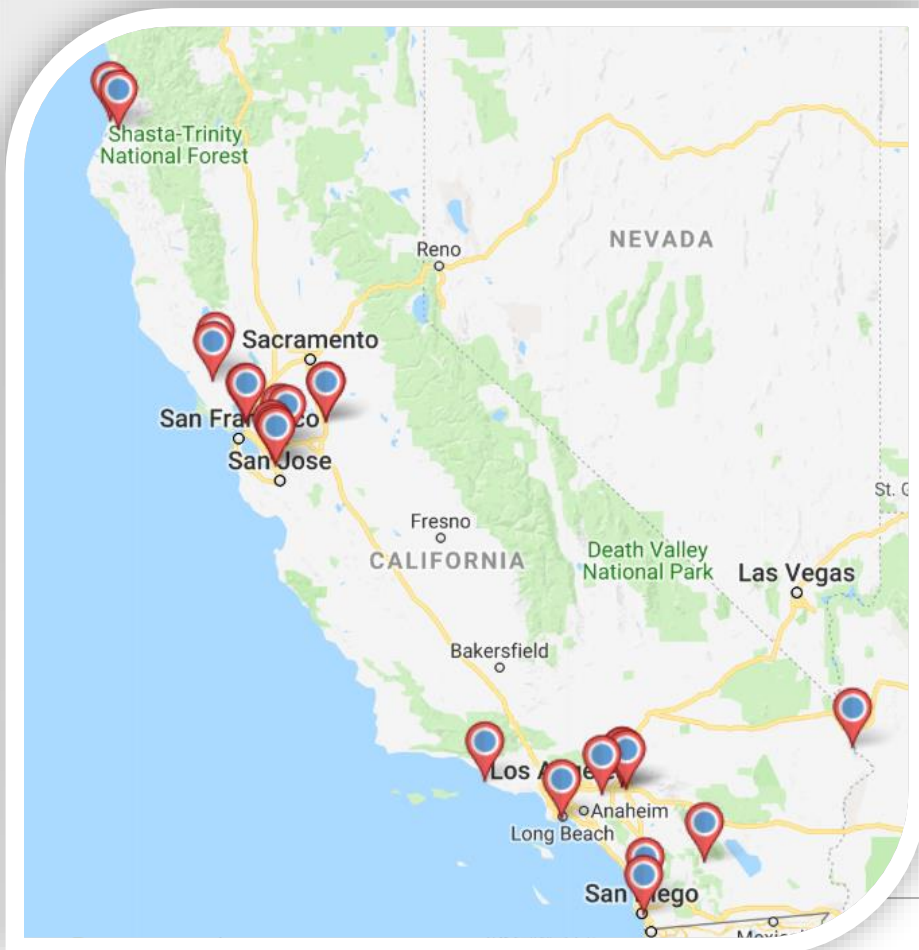


Las Positas Campus

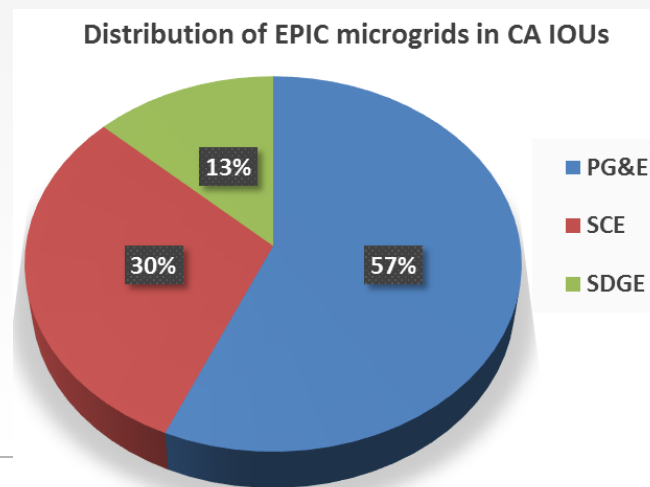


City of Fremont Fire Station

# Energy Commission Microgrid Landscape



- After 2015, 17 microgrid projects with total of 23 sites.
- \$75.6 million Energy Commission fund and \$71.4 million match fund.
- All the projects are located in the CA IOU territories. 57% project sites are within PG&E.

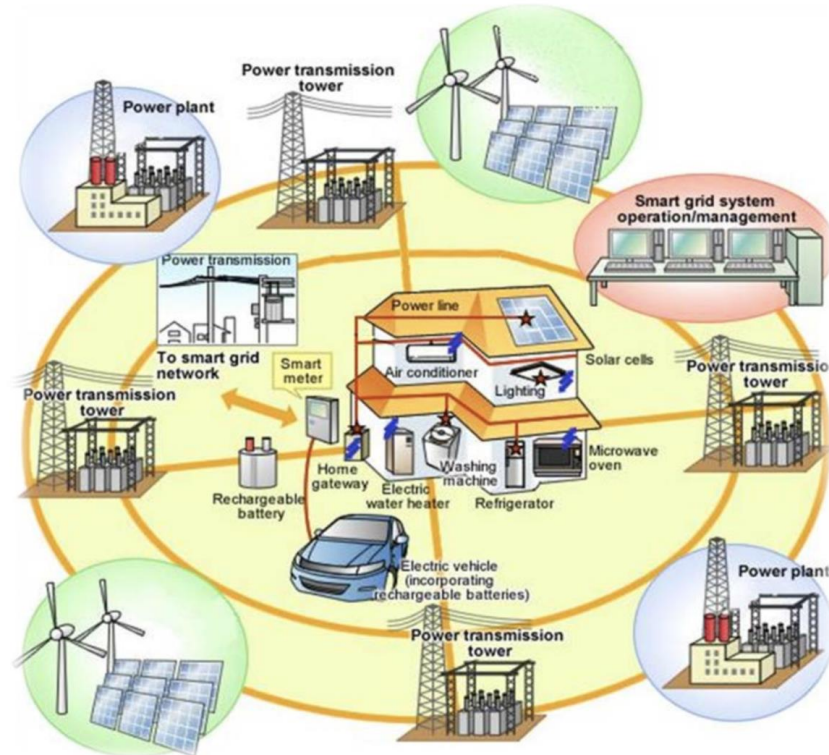


# Incorporation of Storage into Energy Policy, Technology Development, and Demonstration: Also, Factor in ZNE New Construction Starting in 2020

Increase RPS to 50% by 2030

Reduce GHG to 40% below 1990 levels by 2030

1.8 GW of storage by 2020



- Double energy efficiency savings by 50%
- 5 million ZEVs by 2025
- Increase access to clean energy in disadvantaged communities

# California Agency Perspective on Challenges Facing the Energy Storage Market

- Lithium Ion Technology
  - Matching the demand for the EV market and stationary battery market
  - Obtaining critical materials needed for manufacturing
  - Future recycling needs – going back to ZEV issues in 1990s
  - Thermal Management
- Non-Lithium Ion Technology
  - Obtaining Project Financing for large projects and PPAs
  - Building customer confidence
  - Developing a proven record of performance
  - Demonstrating cost competitiveness