



# California's Energy Storage Momentum

Prepared for the NELHA International Conference on Energy Storage

September 12, 2016

# Extensive Clean Energy Experience

## Strategen Consulting

- Strategic advisory in renewable energy & energy storage since 2005
- Government, utility and corporate clientele



## California Energy Storage Alliance (CESA)

- 501(c)(6) founded in January 2009
- 70+ member companies
- Active at CPUC, CAISO and State Legislature



## Energy Storage North America (ESNA)

- Largest storage conference in North America
- 42 countries in attendance, 100+ exhibitors
- Next event: **October 4 - 6, 2016 in San Diego**



## Global Energy Storage Alliance (GESA)

- 501(c)(3) founded in January 2014
- Promotes international best practices



# Strategen Clients

Strategen provides insight to global corporations, utilities and public sector leaders, helping them to develop impactful and sustainable clean energy strategies

## A Sampling of Our Clients



FLUIDICENERGY



FMC



RECURRENT ENERGY

ROCKPORT CAPITAL

SHARP solar electricity



SUNPOWER

US Department of Energy

Walmart

3M

# CESA Members

## Steering Committee Members



## General Members

1 Energy Systems Inc.

Adara Power

Alstom Energy

Amber Kinetics

Aquion Energy

Bright Energy Storage

Brookfield Renewables

CA Environmental Associates

Consolidated Edison Development

Cumulus Energy Storage

Customized Energy Solutions

Demand Energy

Eagle Crest Energy

EDF Renewable Energy

ElectrIQ Power

ELSYS Inc.

Energy Storage Systems

eMoterWerks

Enphase Energy

Geli

Gordon & Rees

Greensmith Energy

Gridscape Solutions

Gridtential Energy

Hitachi Chemical Company

Ice Energy

Invenergy

Johnson Controls

K&L Gates

Lockheed Martin AES

Mercedes Benz R&D NA

Nature & People First

NEC Energy Solutions

NGK Insulators

OutBack Power Technologies

Parker Hannifin Corporation

Powertree Services

Qnovo

RES Americas

Saft America

Samsung SDI

Sharp Electronics

Skylar Capital Management

Southwest Generation

Sovereign Energy

Sumitomo Electric

SunPower

Sunrun

Swell Energy

Tri-Technic

Trina Energy Storage

Yunicos



**ENERGY<sup>®</sup>  
STORAGE**  
NORTH AMERICA



# **ESNA** *The Marketplace for Energy Storage*

- Largest North American gathering of energy storage policy, technology and market leaders
- Part of Energy Storage World conference family including Europe, China, India, Japan
- Growth from 2013 to 2015
  - 250% more attendees
  - 265% more exhibitors
  - Twice as many speakers

## What Attendees are Saying:

*“ESNA has quickly established itself as the go-to conference for engaging with high-level prospects and other leaders in the storage industry.”*

- Director of Sales and Marketing,  
Lockheed Martin Advanced Energy Storage

*“Everybody I wanted to meet was there.”*

- Director, EDF Renewables

# Global Energy Storage Alliance

- Founded in January 2014
- 501(c)(3) enables charitable donations



*A collaboration of 6 storage alliances  
and key partner organizations:*



**GESA's Mission:**  
"Advance education, collaboration, knowledge and proven frameworks about the benefits of energy storage and how it can be used to achieve a more efficient, cleaner, reliable, affordable and secure electric power system globally"

# Topics for Today

- California clean energy drivers and goals
- Legal and regulatory context for energy storage in California
- Foundational energy storage procurement experience: SCE LCR
- Case study of true optionality of energy storage: Aliso Canyon!
- Lessons learned

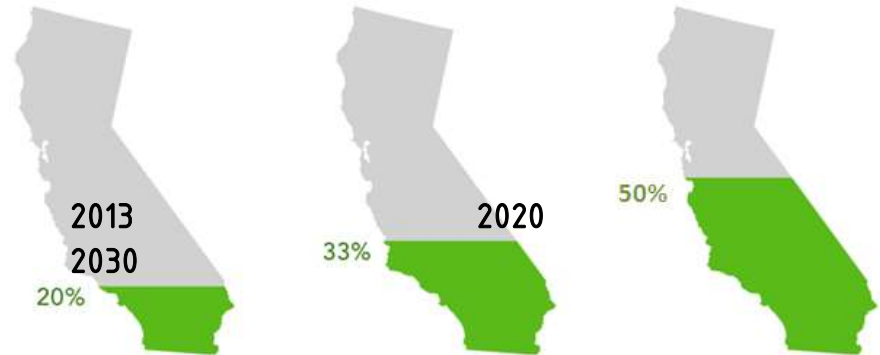
# Disclaimer

- This is a very California-centric presentation (by request)
- Contrary to the impressions (or beliefs) of some Californians you may have met, California's particular path to progress is NOT the path for everyone and is full of many mistakes along the way
- California has MUCH TO LEARN from Hawaii and elsewhere!
- By telling California's story, I hope to share simple lessons learned that transcend location, geography or jurisdiction:
  1. Leadership
  2. Focus
  3. Collaboration
  4. Fair Evaluation of Benefits vs. Costs
  5. Learning by Doing
- PS. I'm originally from Philadelphia, but WISH I was from Hawaii!



# California Policy Landscape: Leadership From Our Governor

Governor Jerry Brown's State of the State Address - January 5, 2015



**Governor's ambitious clean energy 2030 goals:**

- Increase renewable electricity use from 33% to 50%
- Reduce petroleum use in cars & trucks by up to 50%
- Double the efficiency of existing buildings and make fuels cleaner

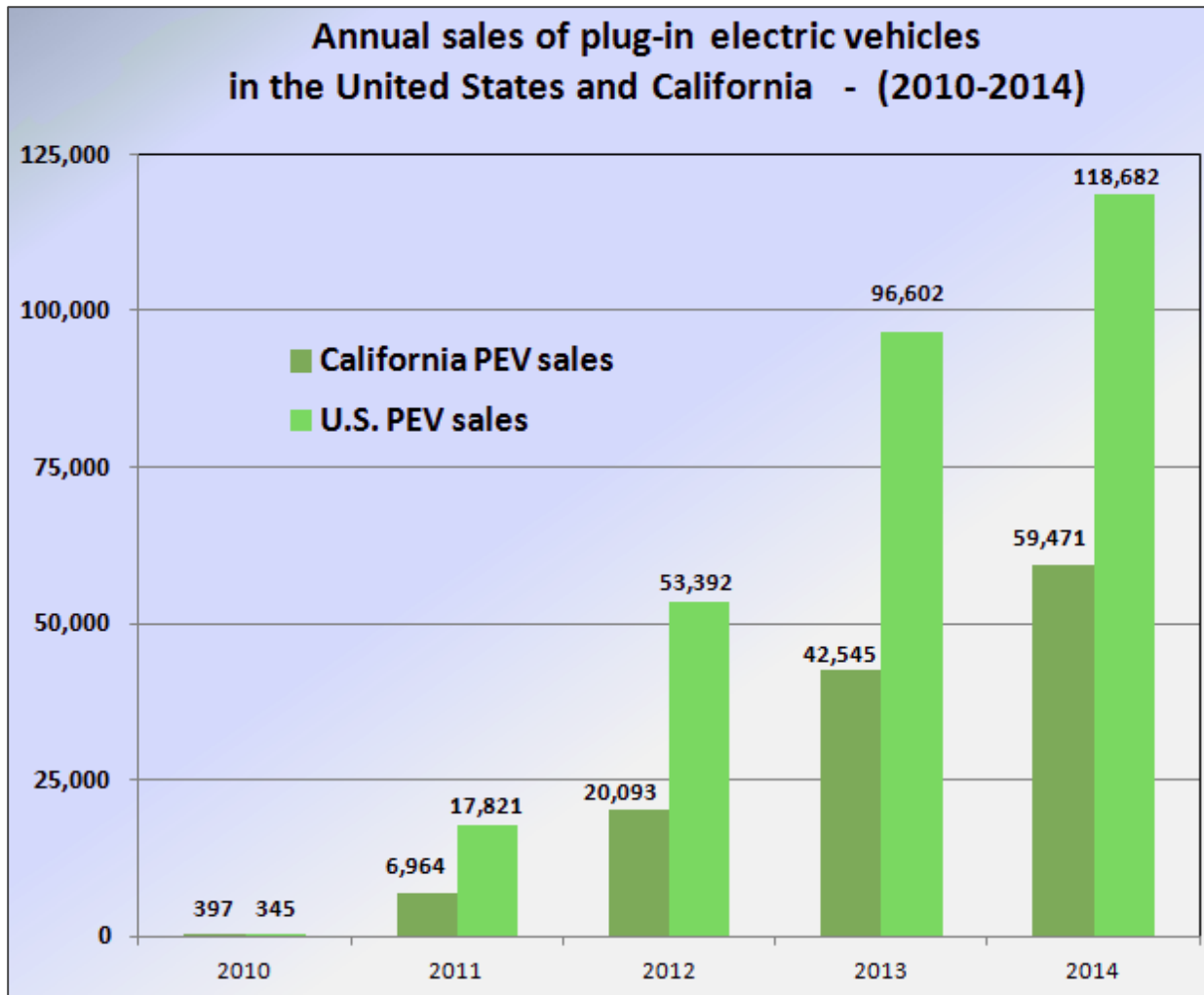
# Governor's Executive Order: 1,500,000 EVs by 2025



Infrastructure is needed for:

- 1 MM EVs by 2020
- 1.5 MM EVs by 2025

# CA Leads US in EV Deployment, still long way to go!



**325,000** Tesla Model 3 reservations for delivery in 2017



Sources: HybridCars.com and Baum & Associates. "[HybridCars Dashboard](#)". HybridCars.com  
California New Car Dealers Association (CNCDA) (February 2015). "[California Auto Outlook Covering Fourth Quarter 2014: New Light Vehicle Registrations Likely to Exceed 1.9 million units in 2015](#)" (PDF). CNCDA. Retrieved 2015-03-15. Registrations through December 2014 since 2010. <http://nseavoice.com/wp-content/uploads/2015/12/tesla-model-3-concept.jpg>

# SB 350: Clean Energy & Pollution Reduction Act

Signed into law October 7, 2015:

- 50% RPS by 2030
- 50% Reduction in Building Energy Use
- Directs CPUC to oversee integrated resource planning
- Directs IOUs to file applications for transportation electrification
- Identifies role of small and large scale energy storage

# Governor Brown Sponsored AB 2514 (2010)

Provided necessary **FOCUS & COLLABORATION** needed to evaluate grid storage

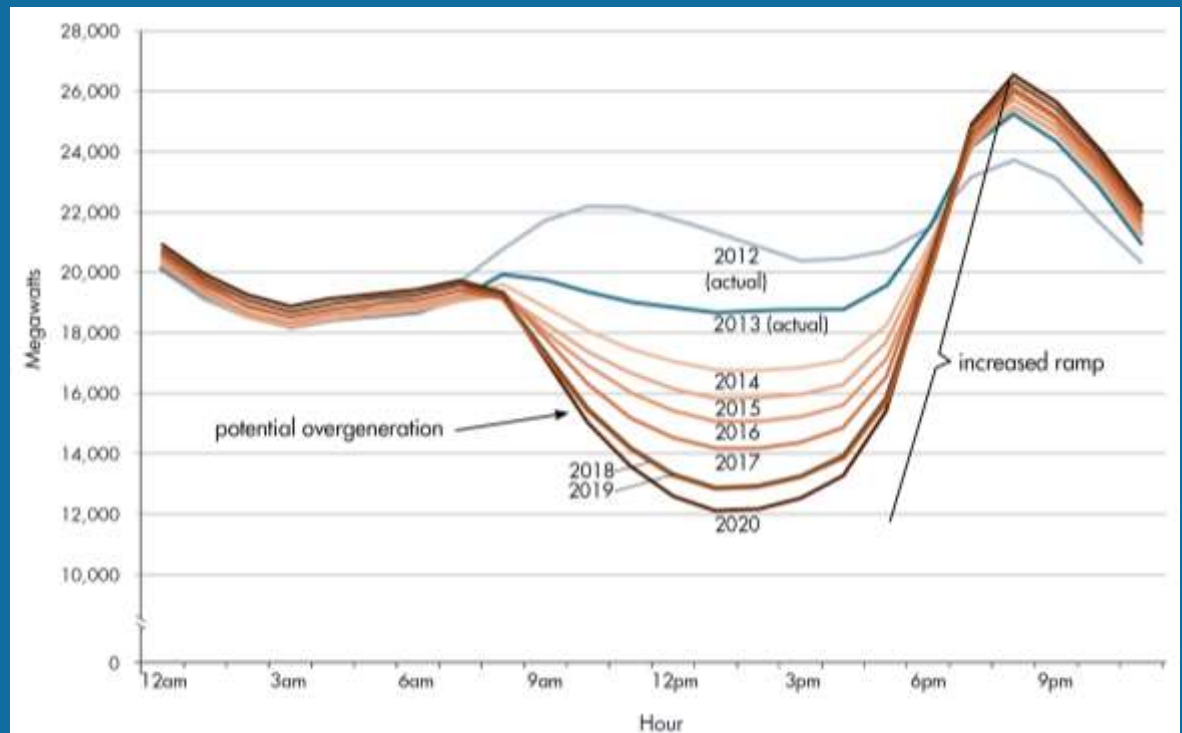
Resulting CPUC Requirement: 1.325 GW in operation by 2024

Use case category, by utility	2014	2016	2018	2020	Total
<b>Southern California Edison</b>					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
<b>Subtotal SCE</b>	<b>90</b>	<b>120</b>	<b>160</b>	<b>210</b>	<b>580</b>
<b>Pacific Gas &amp; Electric</b>					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
<b>Subtotal PG&amp;E</b>	<b>90</b>	<b>120</b>	<b>160</b>	<b>210</b>	<b>580</b>
<b>San Diego Gas &amp; Electric</b>					
Transmission	10	15	22	33	80
Distribution	7	10	15	23	55
Customer	3	5	8	14	30
<b>Subtotal SDG&amp;E</b>	<b>20</b>	<b>30</b>	<b>45</b>	<b>70</b>	<b>165</b>
<b>Total – all 3 Utilities</b>	<b>200</b>	<b>270</b>	<b>365</b>	<b>490</b>	<b>1,325</b>

# Key Role of Storage: Help CA Integrate Renewables

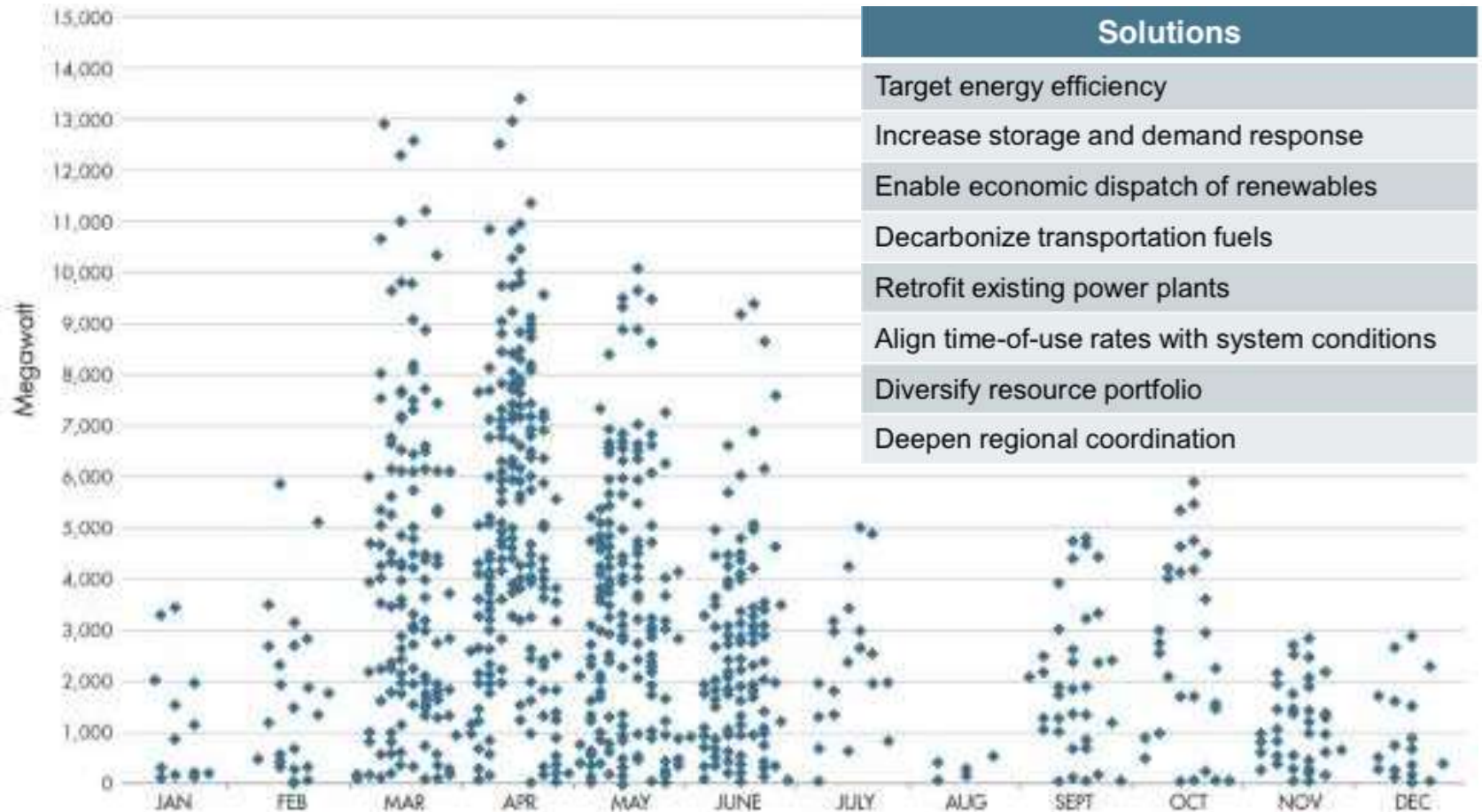
California's growth in renewables has produced significant *ramping needs* as evidenced by the "duck curve"

### CAISO Net Load (2012-2020)



# CA RPS Drives Need for Distribution System Reform

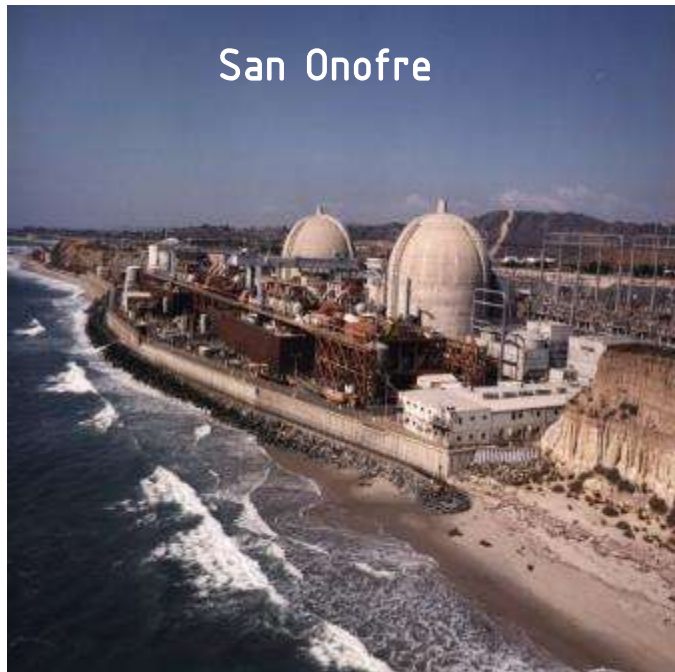
Estimated Renewable Curtailment Frequency & Magnitude in 2024 at 40% RPS



Source: Phil Pettingill, Governor's Greenhouse Gas Reduction Goals [http://www.caiso.com/Documents/Presentation\\_Governor50Workshop\\_PPettingill\\_7-9-15.pdf](http://www.caiso.com/Documents/Presentation_Governor50Workshop_PPettingill_7-9-15.pdf)

# CA's Grid Faces Big Challenges

Many power plants could go offline in the next decade for a variety of reasons



San Onofre

San Onofre Nuclear Generation Station (SONGS) permanently shut down in January 2012, taking **2,254 MW** offline.

Phase-Out Schedule <sup>(1)</sup>		
Plant Name	MW	Scheduled Phase-Out Date
El Segundo, Harbor (LADWP), Morro Bay	550	Dec. 31, 2015
Encina, Contra Costa, Pittsburg, Moss Landing	950	Dec. 31, 2017
Haynes (LADWP)	1,581	Dec. 31, 2019
Huntington Beach, Redondo, Alamitos, Mandalay, Ormond Beach, Scattergood (LADWP)	888	Dec. 31, 2020
Diablo Canyon Power Plant	2,240	Dec. 31, 2024

(1) Sierra Club Report: "Meeting California's Electricity Needs Without San Onofre or Diablo Canyon Nuclear Power Plants". CEC Docket 13-IEP-1D, TN 71790, Jul 29, 2013

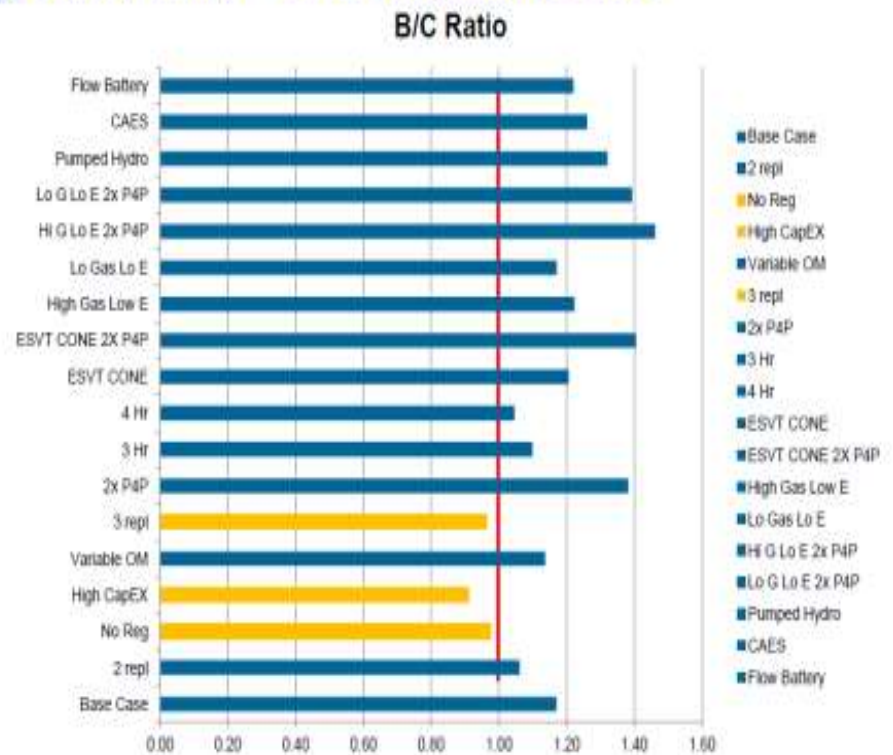


# Prior Cost Effectiveness Results from Storage Rulemaking were promising!

Study results by EPRI using stakeholder input and showed a benefit to cost ratio over one for nearly every scenario

- Assumed utility scale projects starting in 2015 and 2020
- Cost effectiveness results did not include GHG benefits of storage or GHG costs due to AB32 implementation
- High renewable penetration cases had the highest benefit to cost ratios for storage
- GHG benefits of storage increase with higher renewable penetration

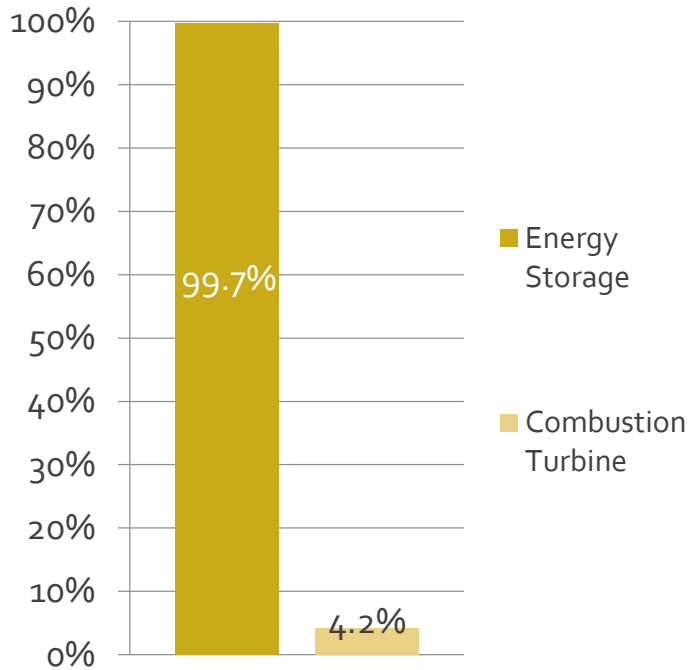
## Summary of B/C ratio results for Bulk Storage (Peaker Sub) – CPUC Inputs / Costs



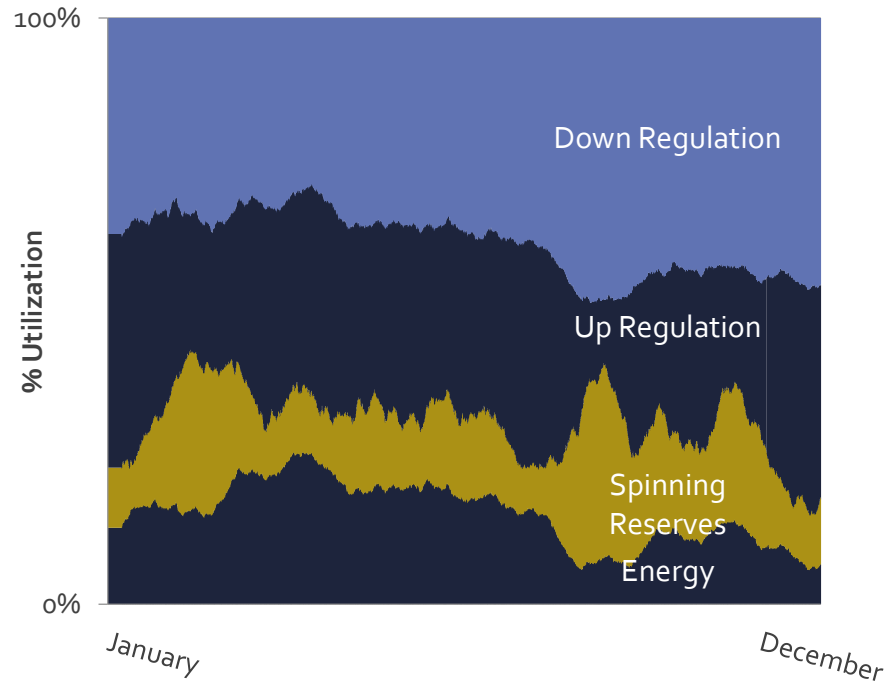
# Energy Storage Can Capture Multiple Benefits from the Same Asset

Energy storage can be fully utilized throughout the year, providing multiple services from a single asset

% Total Annual Hourly Asset Utilization



Services Provided by Energy Storage Over the Year\*



Energy storage is a cost effective way to provide numerous benefits to many stakeholders, few of which can be monetized today.

Graphs based on EPRI cost effectiveness model data, "Bulk Peaker substitution application" CPUC Workshop March 25, 2013

\*All services include charging and discharging bids

Collaborative stakeholder engagement & analysis helped change the framework....



...from pure cost comparison to a 'net benefits' comparison

# Historic 2013 Southern California Edison Local Capacity Procurement

...SCE purchased 5X their CPUC requirement (50MW)!

## SCE procured:

- 100 MW bulk energy storage
- 161 MW BTM distributed energy storage
- 1587 MW other resources:
  - 1284 MW combined cycle gas
  - 130 MW energy efficiency
  - 98 MW peaking gas
  - 75 MW demand response

## SCE Energy Storage LCR Procurement

Seller	Resource Type	Total Contracts	MW
Adv. Microgrid Solutions	BTM Battery	4	50.0
AES	FTM Battery	1	100.0
Ice Energy	BTM Thermal	16	25.6
NRG	FTM Battery	1	0.5
Stem	BTM Battery	5	85.0
<b>Total</b>		<b>27</b>	<b>261.1</b>

*Diversity of resource mix was a key objective of this procurement*

# SCE LCR Procurement: A Historic Success Story



SCE's LCR procurement was foundational --  
enabled energy storage to be part of the  
solution for Aliso Canyon

# 2015–2016 Aliso Canyon: Real Time Case Study

One of the largest natural gas storage facilities in the US:

- Serves 11 million people in the LA basin
- 86 billion cubic foot (bcf) capacity
- 18 generators representing about 9800 MW capacity

Timeline:

- Oct. 23, 2015 – SoCal Gas discovers a natural gas leak
- Nov. 18, 2015 – State Regulator issues 1st Emergency Order
- Nov. 26, 2015 – Families begin relocations
- Dec. 10, 2015 – State Agency issues 2nd Emergency Order
- Jan. 6, 2016 – Gov. Brown declares State of Emergency
- Feb. 18, 2016 – Leak officially stopped
- April 5, 2016 – Joint Agencies release Action Plan

Following the leak, CPUC reduced allowable amount of stored gas from 86 to 15 bcf, an **80% reduction**

**“Summer reliability is unclear” – CPUC presentation 2/4/16**

# Aliso Canyon Delivery Area

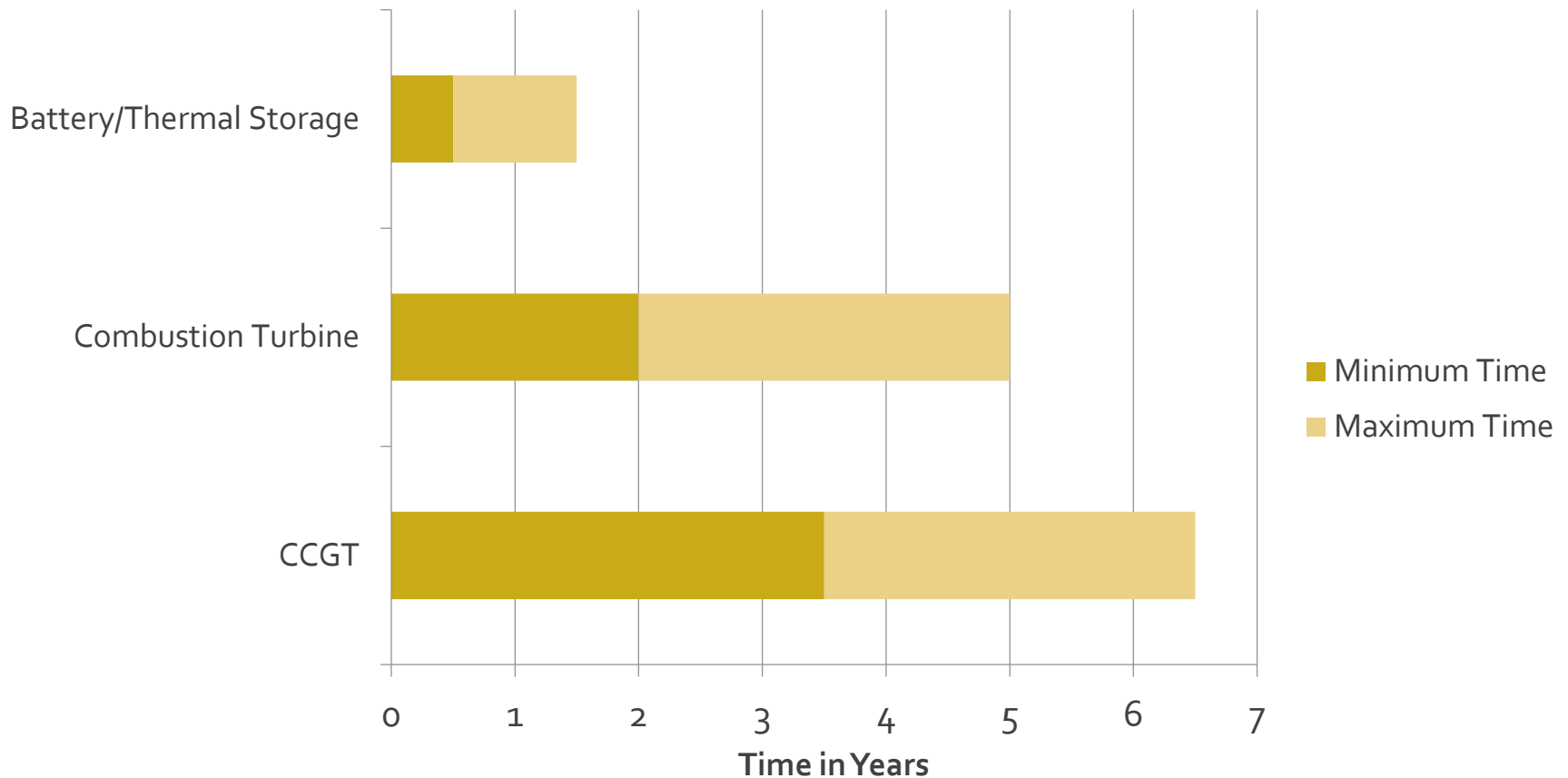




# CESA proposed solution: Energy Storage!

Diverse, modular, faster to install than traditional resources ... reduces risk and increases portfolio diversity & flexibility

Siting, Permitting, and Installation Time by Resource



# May 12, 2016: CPUC Energy Storage & Aliso Canyon Resolution Issued (E-4791)

- Joint Agency Task Force Leadership (CPUC, CEC, CAISO, LADWP, SCE) Issues Resolution E-4791 May 12, 2016:

*“Authorizing expedited procurement of storage resources to ensure electric reliability in the Los Angeles Basin due to limited operations of Aliso Canyon Gas Storage Facility.”*

- New summer 2016 storage capacity *only possible* because of pre-existing LCR procurement and SGIP experience

# May 27, 2016: SCE Aliso RFOs Issued

SCE is pleased to announce the launch the 2016 Aliso Canyon Energy Storage Request for Offers in response to Resolution E-4791, issued to address electrical reliability risks due to the moratorium on injections into the Aliso Canyon Natural Gas Storage Facility.

**The 2016 ACES RFO** is for Products from eligible Energy Storage Resources (“ESRs”) and is open to energy storage resource facilities as defined in CPUC Decision 13-10-040. ESRs must not be less than 0.5 megawatt (MW) and must be fully-deliverable transmission or distribution connected market resources.

**The 2016 DBT RFP** is a solicitation for proposals to design, build, and transfer to SCE energy storage systems ready for placement into commercial operation, including performance guarantees, on a fixed-price, turnkey basis, and separately, additional maintenance services. Proposals with guaranteed discharge powers of 5, 10, 15, and 20 MW (if within the seller capabilities), each with a guaranteed discharge duration of at least 4 hours, and each with 5, 10, 15, and 20 year periods of guaranteed performance are solicited.

*Requires all offers must be online and operational by December 31, 2016!!!*

For more information please see: [https://scees.actionpower.com/\\_scees\\_1601/accionhome.asp](https://scees.actionpower.com/_scees_1601/accionhome.asp)

## June 1, 2016: CPUC Orders Additional 169.4 MW for Local Capacity

- CPUC denies all Applications for Rehearing SCE 2013 LCR procurement and instead orders SCE to procure an additional 169.4 MW of energy storage or preferred resources!

*"We further find that additional procurement is required by D.13-02-015 and D.14-03-004. SCE is required to procure a minimum of 169.4 MW of preferred resources or energy storage as required by those decisions. SCE may undertake such additional procurement, following additional analysis, either through additional RFOs or via other authorized procurement mechanisms."*

- Application for Rehearing enables planned 2013 LCR projects to move forward expeditiously

## July 18, 2016: SDG&E files application for 150MWh of energy storage capacity

- Bi laterally negotiated, turnkey engineering procurement and construction contracts with AES Energy Storage LLC
  - Escondido Substation 30 MW, 120 MWh
  - El Cajon Substation 7.5MW, 30 MWh
- Requires online date of January 31, 2016

## August 18, 2016: CPUC approves SDG&E energy storage application

## August 15, 2016: SCE Files Application for 108 MWh of energy storage capacity

- 5 MW, 20 MWh for Santa Paula 1 Project, Santa Paula, CA – Lithium Ion (Western Grid)
- 20 MW, 80 MWh MW Pomona Battery Storage Project, Pomona, CA – Lithium Ion (Alta Gas Ltd.)
- 2 MW, 8 MWh Grand Joanna BESS Project, Irvine, CA – Lithium Ion (Powin Energy)
- Commercial Online Date (COD) of December 31, 2017
- Stand-alone projects interconnecting at 66 kV or lower (12 kV)
- Approval expected on September 15.

“The prices for all offers are below the price competitiveness benchmark...”

*CPUC Draft Resolution E-4804, Dated for 9/15/16, pg. 4.*

Aliso Canyon procurement demonstrated the 'option' value of storage ...

...and was only possible due to pre existing procurement experience from the SCE LCR

# SGIP: Enabling Customer Sited Behind the Meter Applications

Self Generation Incentive Program (SGIP) is one of the longest-running and most successful distributed energy resource incentive programs in the US

- Launched in 2001 to encourage customer-sited distributed generation & market transformation
- Provides financial incentives for the installation of qualifying technologies that meet all or a portion of a facility's electric energy needs.
- Annual Budget: \$83 MM (through 2019) - **DOUBLED to \$166 MM (via AB 1637 - Low)**
- Administered by CA utilities

## Recently Revised Incentive Structure:

- Clarifies goals: 1) Environmental, 2) Grid Support, and 3) Market Transformation
- Allocates 75% of remaining funds to storage
- Storage incentives lowered and changed to a Wh incentive (vs. kW)
- Starting Incentive:
  - "Large Scale" >10 kW = \$0.50/Wh
  - "Small Scale" projects <= 10 kW = \$0.60/Wh
- 5 steps for storage at a declining \$0.05 *and* each step evenly splits 20% of budget
- No limit on storage capacity duration



# Other Key 2016 Legislation Relevant to Storage ...currently awaiting Gov. Brown's signature!

- **Distributed Storage Deployment (AB 2868 - Gatto)**
  - Directs CPUC to direct IOUs to file applications for programs and investments for up to 500MW of energy storage statewide
  - Maximum of 125 MW can be located behind the meter, prioritizing low income and public sector customers
  - Requires CPUC to evaluate applications within 12 months
- **Interconnection Bill (AB 2861 - Ting)**
  - Establishes first ever Rule 21 interconnection arbitration function at the CPUC, augmented with a panel of technical experts
- **Long Duration Storage Bill (AB 33 - Quirk)**
  - Directs the CPUC and the CEC to evaluate and analyze the potential for all long duration bulk energy to help integrate renewable energy

Energy Storage – a growing California industry



- Parker
- Panasonic
- LightSail Energy stem
- GE Energy Storage
- FORESIGHT RENEWABLE SOLUTIONS
- POWER TREE
- SolarCity
- Christenson ELECTRIC, INC. OVERSIGHT BUSINESS CONTRACTORS
- EnerVault
- NEXtera ENERGY RESOURCES
- SUMITOMO ELECTRIC
- EAST PENN manufacturing co., inc.
- BYD BYD AUTO Build Your Dreams
- LA DWP

- Bright Source Limitless
- FAFCO THERMAL STORAGE SYSTEMS
- BLACK & VEATCH
- SMUD
- GreenSource
- GreenCharge Networks
- CODA
- nrg
- UET UniEnergy Technologies
- SAMSUNG SAMSUNG SDI

Finding New Storage Champions is Critical....

It takes a village





Storage uses  
a time-tested  
tradition

We can bottle  
sunshine and  
wind



Power System Gamechanger:  
**ENERGY STORAGE**



# Conclusions – 5 Essential Ingredients

- California is making progress, but not only pathway forward
- Legislation is helpful, but realizing benefits of energy storage doesn't require new legislation
- Realizing benefits of energy storage DOES require 5 essential ingredients that transcend market structure and geography:
  1. Leadership
  2. Focus
  3. Collaboration
  4. Fair Evaluation of Benefits vs. Costs
  5. Learning by Doing





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## Projects

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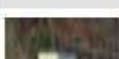
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Use Table Scroll Bar to View Results, Click Header Rows to Sort

Name	Description	Technology	Rated Power (kW)	Duration (HH:MM)	Location	Status
 <a href="#">Prudent Energy VRB-ESS® - Gills Onions, California</a>	Gills Onions has a bio waste-based advanced energy recovery system that produces methane and biogas from onion production waste. Prudent Energy's VRB® energy storage system provides peak-shaving and demand charge avoidance services to reduce Gills Onions' monthly electric utility bill.	Vanadium Redox Flow Battery	600	6:00.00	1051 South Pacific Avenue, Oxnard, California 93030, United States	
 <a href="#">Kahuku Wind Farm</a>	Xtreme Power installed a 15 MW fully integrated energy storage and power management system designed to provide load firming for a 30 MW wind farm in Hawaii, as well as provide critical grid integration services. The project is supported by a U.S. DOE Office of Electricity loan guarantee. This is one of at least 3 other wind farm projects either planned or operational in Hawaii.	Advanced Lead Acid Battery	15,000	0:15.00	56-1101 Kamehameha Hwy, Kahuku, Hawaii 96731, United States	
 <a href="#">Bath County Pumped Storage Station</a>	This project consists of a 3GW Pumped Hydro storage plant in Virginia that pumps water to an elevated reservoir at night and lets it run back down to generate electricity during	Open Loop Pumped	3,030,000	10:18.00	State Route 705, George Washington National	

# More Information

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  - <http://www.storagealliance.org>
- Energy Storage North America
  - Oct 4–6, 2015 San Diego
  - <http://www.esnaexpo.com>
- GESA
  - <http://www.globalesa.org>



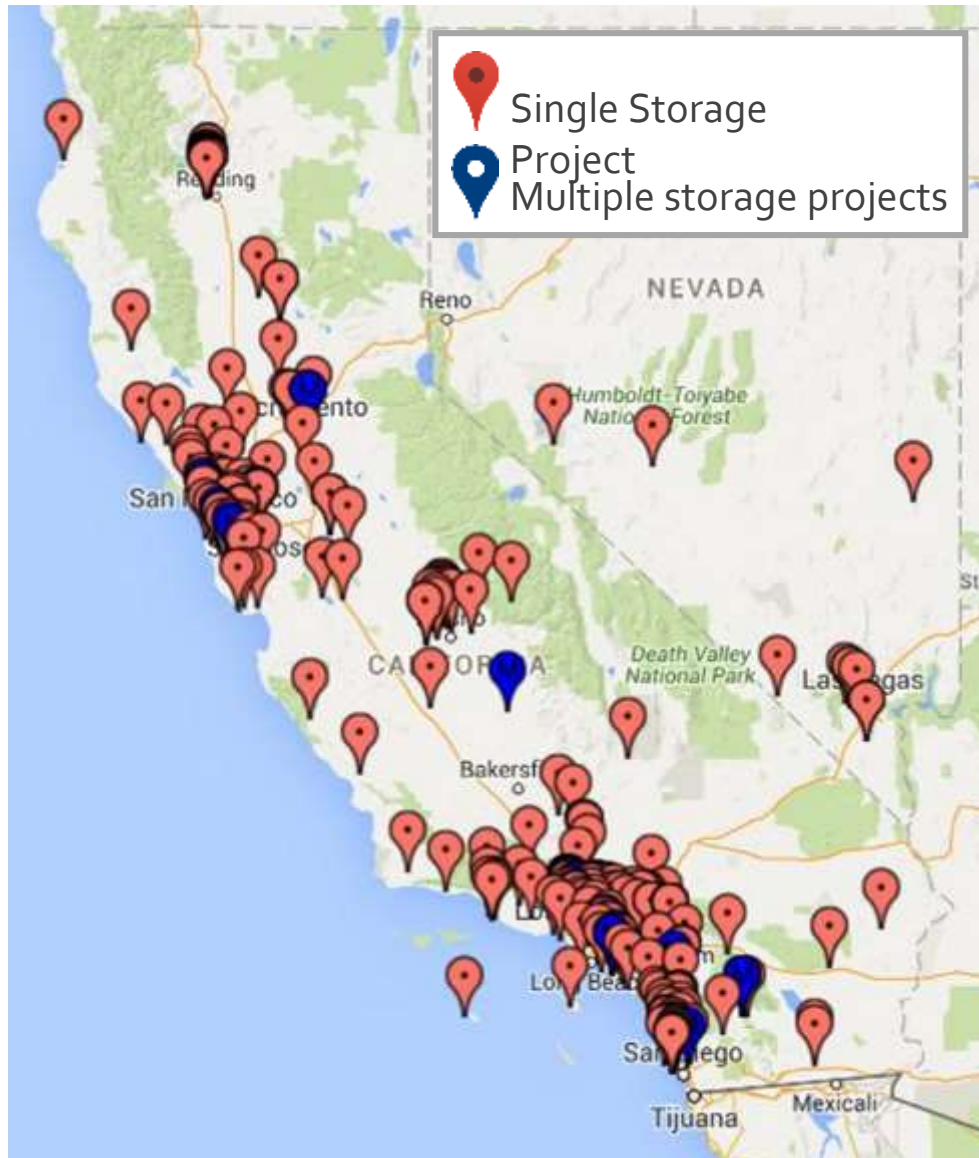
# Results of Strategen's Production Cost Modeling with Storage

	0.4125 GW Storage (only 2 hour storage)	1.325 GW Storage (2, 4, & 6 hour storage)	2.65 GW Storage (2, 4, & 6 hour storage)
% of total CA Generation Capacity	0.5%	1.7%	3.4%
Unit Starts Reduced in CA*	3,000	8,000	13,000
Curtailment Reduction in CA	8.1%	23.3%	40.0%

\*Numbers are rounded for simplicity

- Even a small amount of energy storage makes a big system impact
- There are diminishing returns to additional storage, but the benefits have not yet plateaued
- Under the storage scenarios, 3-4 emergency peaker natural gas plants were removed from dispatch

# California is Already Utilizing Many Storage Resources



Data from the  
DOE Energy  
Storage  
Database in May  
2016