

Southern California Edison

Recent Energy Storage Projects

November 8, 2017

Agenda

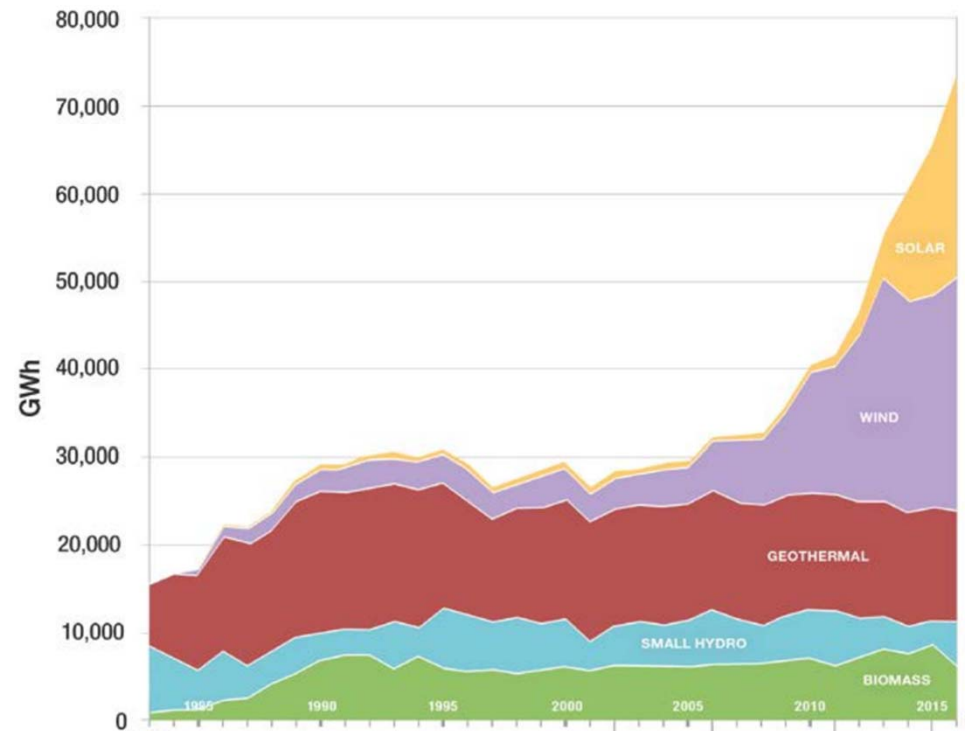
1. California Energy Trends and Recent Events
2. SCE's Storage Projects

California Energy Trends

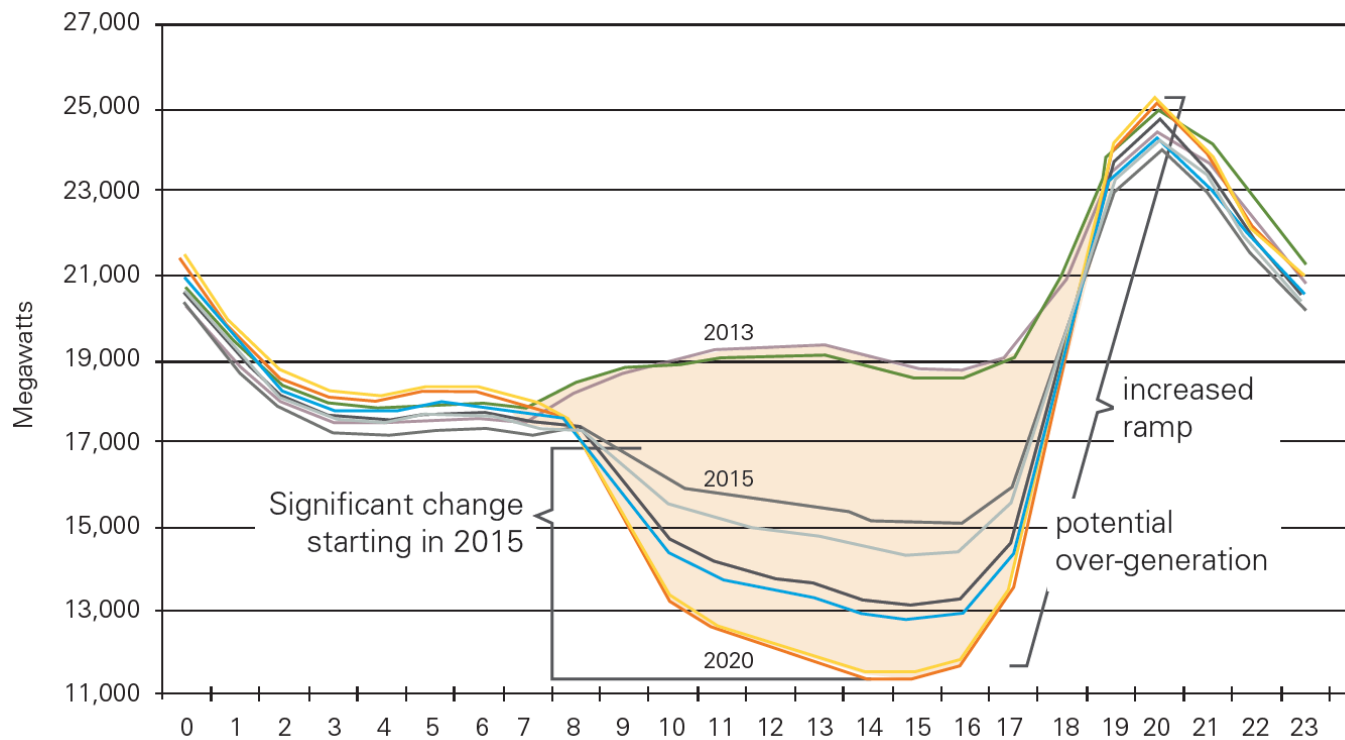
- California's GHG and Renewable Energy Targets
 - Greenhouse gas (GHG) emissions to 40% below 1990 levels by 2030
 - 50% renewable energy in California, also by 2030
- Increasing need for flexible generation



Source: California Energy Commission



CAISO's "Duck Curve"



The abrupt fall-off of solar in the evening coincides with sharp rise in consumer demand, leading to the need for additional flexible generation

Aliso Canyon and Electric System Flexibility

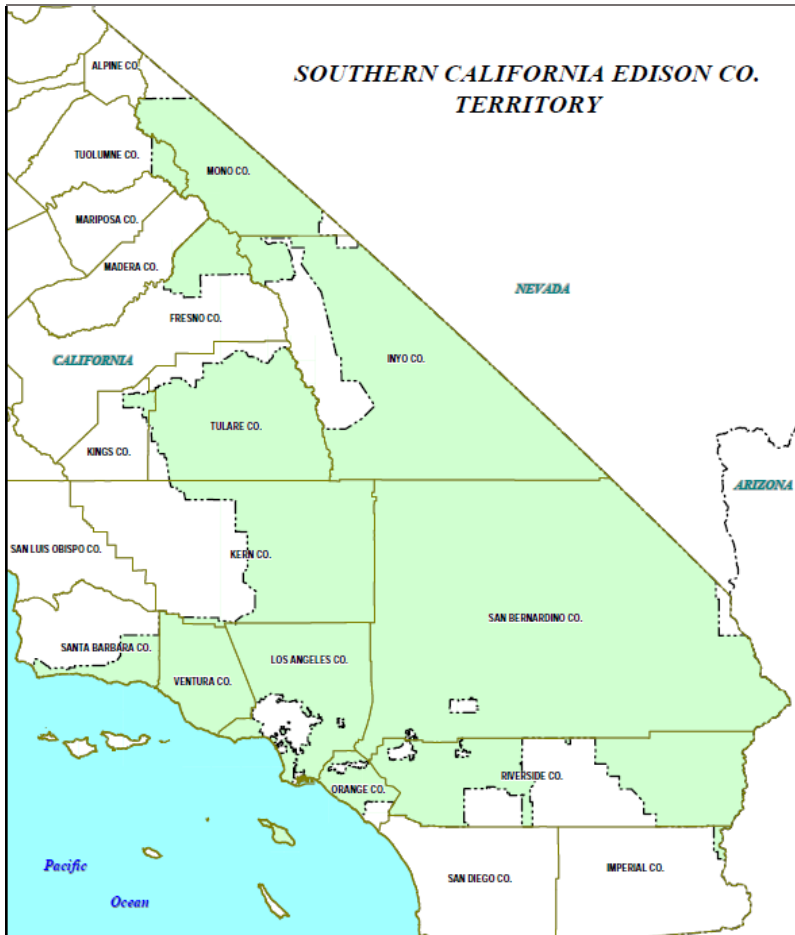
- In Southern California a significant portion of electric system flexibility has been due to the Aliso Canyon gas storage facility
- A massive natural gas leak was discovered on October 23, 2015
- Injections and withdrawals from Aliso Canyon have been limited since
 - Operations resumed July 31, 2017 with capacity limited to 28%
- Battery Energy Storage is one way to provide electric system flexibility without full use of Aliso Canyon

Aliso Canyon and Energy Storage

- On January 6, 2016, Governor Brown issued an Executive Order regarding the Aliso Canyon Natural Gas Leak declaring the situation an emergency.
- To address the state of emergency the CPUC issued Resolution E-4791 requiring:
 - "Southern California Edison Company to hold an expedited competitive energy storage procurement solicitation to help alleviate an outage risk during the upcoming summer and winter of 2016-2017." "SCE shall solicit in-front-of-the-meter (IFOM) energy storage that can be operational by December 31, 2016."
- This resolution is driver for many of SCE's recent storage projects.

SCE's Storage Projects

SCE Highlights



- One of the nation's largest investor-owned utilities, with 130 years of service
- Service Area
 - 50,000 square miles
 - Over 430 cities and communities
- Population Served
 - Nearly 14 million residents
 - 4.9 million customer accounts
- 85 TWh Retail Sales
- System peak load > 23,000 MW
- Industry leader in renewable energy, energy efficiency, electric transportation, smart grid and smart metering

SCE's Energy Storage

Procurement Activity	Contracted Transmission Capacity (MW)	Contracted Distribution Capacity (MW)	Contracted Customer Capacity (MW)
LCR RFO	100.5	0	160.5
2014 Energy Storage RFO	0	16.3	0
PRP 2 RFO	0	60	20
2016 ACES RFO	0	22*	0
2016 ACES DBT RFP (UOS)	0	20*	0
Peaker EGT Projects (UOS)	20*	0	0

SCE is positioned to respond to grid needs and strategically pursue innovative use cases for energy storage.

* Over 60 MW of contracted energy storage is already online

List of Acronyms

LCR RFO: Local Capacity Requirement Request for Offers
PRP 2 RFO: Preferred Resources Pilot 2nd Request for Offers

2016 ACES RFO: Aliso Canyon Energy Storage Request for Offers
2016 ACES DBT RFP: 2016 Aliso Canyon Energy Storage Design, Build & Transfer Request for Proposals
Peaker EGT Projects: Peaker Enhanced Gas Turbine Projects

A photograph of the SCE Mira Loma Tesla Battery Energy Storage System. The image shows a row of white Tesla battery storage containers in an outdoor industrial setting. In the background, there are power lines, a tall cooling tower, and a clear blue sky. A green text box in the upper left corner contains the title.

SCE Mira Loma Tesla Battery Energy Storage System

Purpose:

Governor Brown's Emergency Proclamation → CPUC Resolution E-4791

Location:

Ontario, CA
Adjacent to SCE's Mira Loma Peaker & Substation

Size:

- 20 MW/80 MWh
- Energy for 15,000 homes for 4 hours

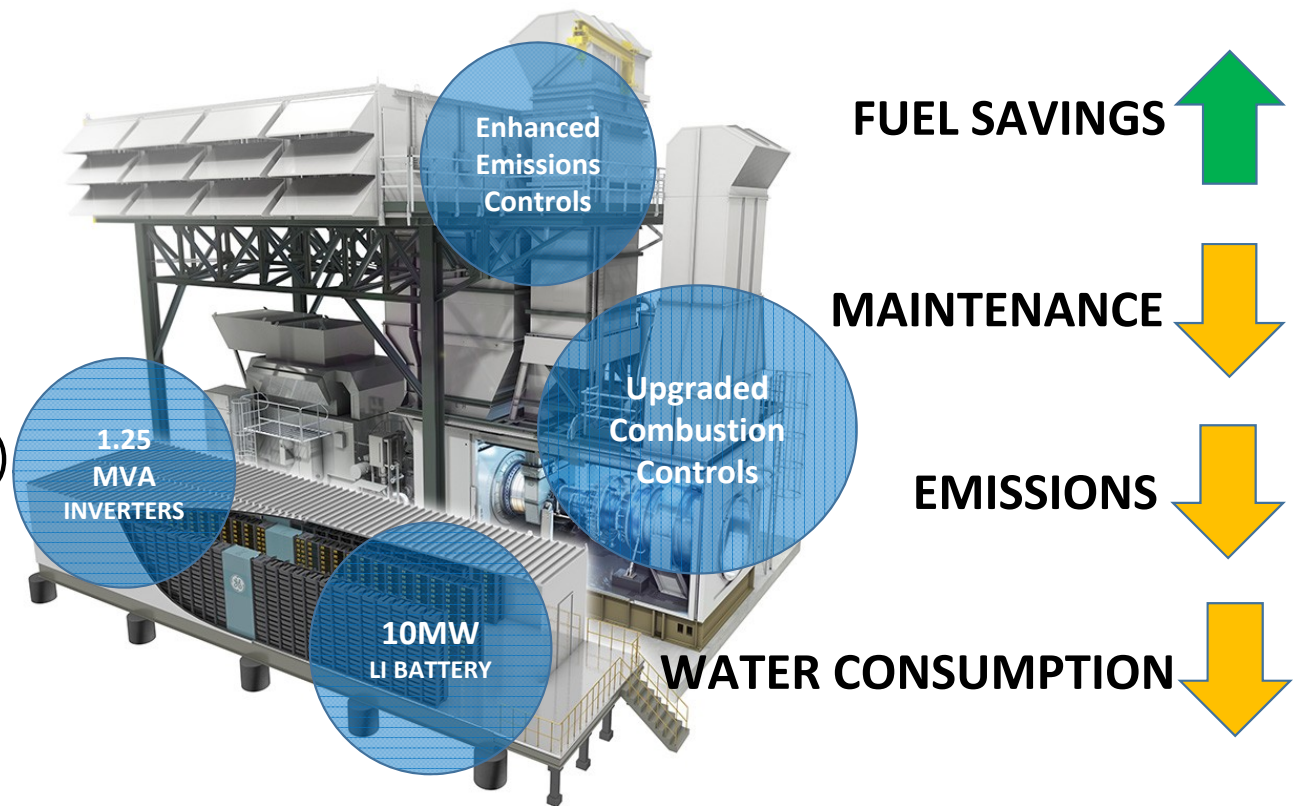
Commercial Operation:

Received CAISO confirmation on 12/30/16

Systems are bid into CAISO wholesale generation market for day ahead and real time dispatch

SCE's Hybrid EGTs

- Built in partnership with GE and Wellhead Energy Solutions
- Combines a Gas Turbine (GT) and Battery Energy Storage System (BESS)
- BESS online end of 2016
- GT and BESS integrated Q1 2017



CENTER EGT



Purpose:
Emergency Proclamation→CPUC
Resolution E-4791 & Operational
Flexibility

Location:
Norwalk, CA

BESS Size:
• 10 MW/4.3 MWh

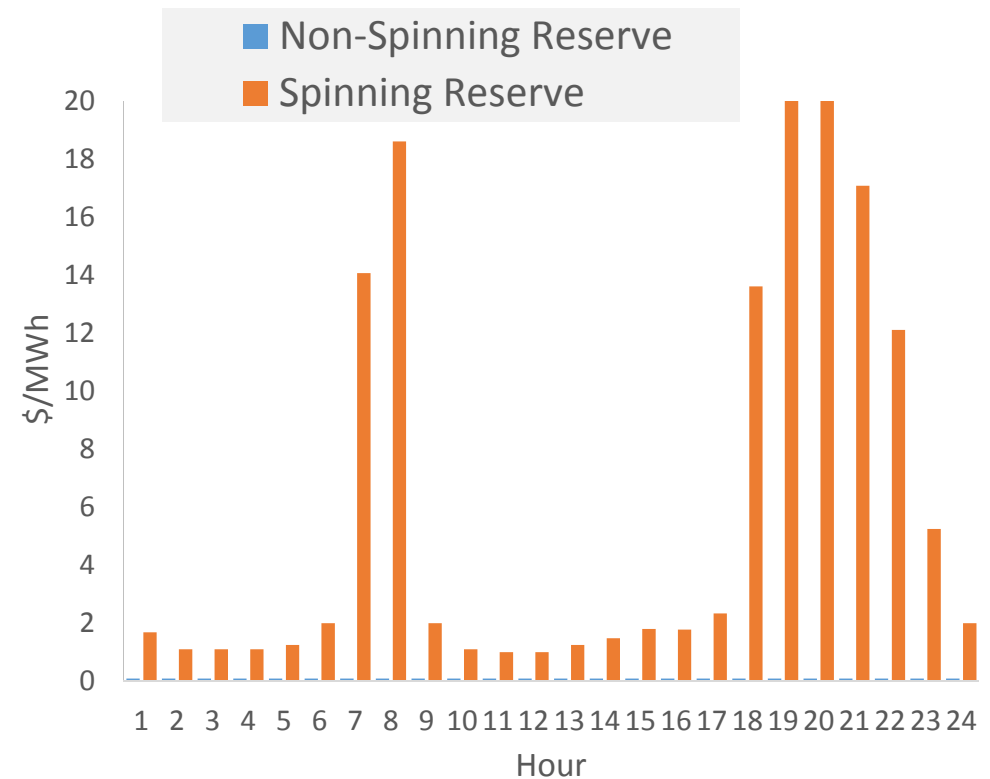
Gas Turbine Size:
• 50 MW

Commercial Operation:
Received CAISO confirmation on
12/30/16

Systems are bid into CAISO
wholesale energy market

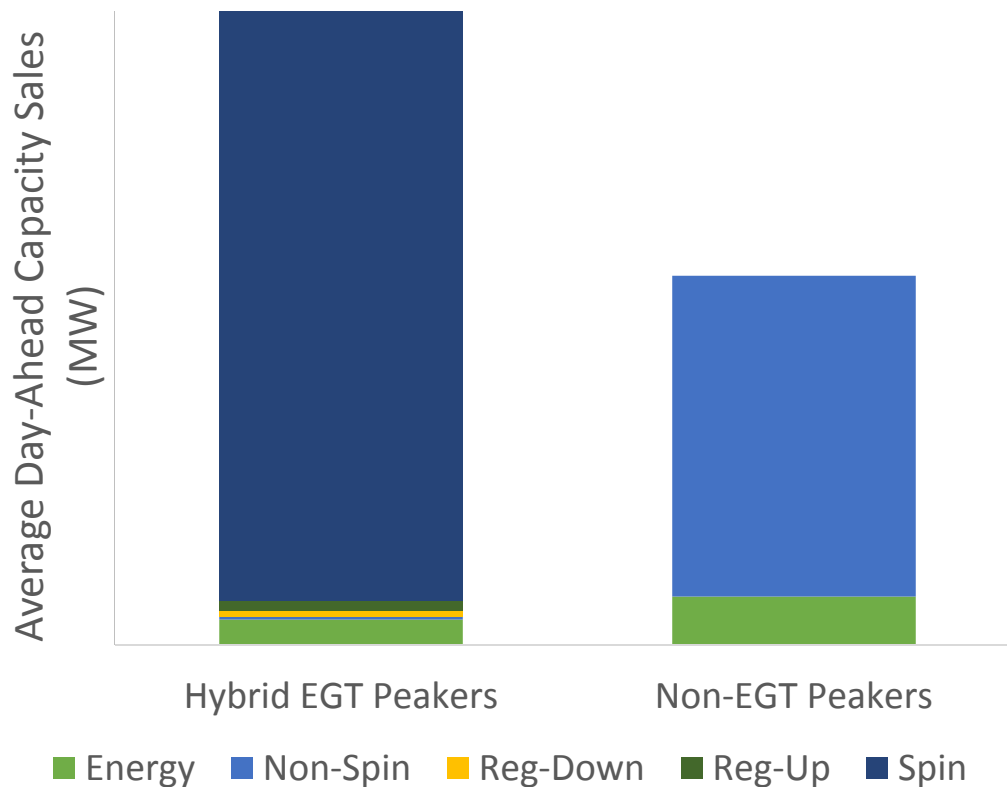
Market Benefits of Increased Flexibility

- Increased existing Ancillary Services sales and revenues
- Enable new market products
 - Non-Spinning Reserve
 - Spinning Reserve
- More optimal Day-Ahead energy dispatch
- Ability to respond to shorter negative and positive price spikes in Real-Time



Hybrid EGT Market Results Since Go-Live

SCE Peakers Capacity Utilization



Compared with SCE's non-hybrid peakers over the same period:

- Higher capacity utilization
- Lower fuel gas usage
- Lower emissions
- Higher market revenues

Hybrid EGT Recognition and Accolades

- *“The SCE-GE project is a perfect example that distributed energy resources can be used in innovative ways and still fully participate in the wholesale energy market managed by the ISO.”*

Steve Berberich

President and CEO

California Independent System Operator

- To date the Hybrid EGT has won four awards:
 - Edison Electric Institute (EEI) Edison Award
 - Energy Storage North America (ESNA) Innovation Award
 - South Coast Air Quality Management District (SCAQMD) Innovative Clean Air Technology Award
 - Power Magazine’s Top Plant Award