



CEC EPIC Symposium

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Coast to Coast: The Need For *Locational Capacity* In T&D Constrained Load Pockets

New York



California



- CA and NY IOUs soliciting low-cost distributed energy storage to reduce peak load and provide system flexibility
- Three value streams:
 1. **Contracted Capacity:** 4-hr discharge to qualify for resource adequacy
 2. **T&D Deferral:** locational infrastructure value
 3. **Wholesale Market Revenues:** frequency regulation, energy arb

Transmission & distribution constraints create acute need for locational capacity and flexibility



Eos' compact, zero emissions batteries can replace gas peaking generation and de-bottleneck T&D constraints in congested load centers

Eos Aurora Product is Uniquely Designed to Meet Market Need for Energy Storage

The **Aurora 1000|4000** is a 1MW/4MWh DC battery system optimized to provide lowest levelized cost of energy, in both utility and behind-the-meter applications



Pictured above: 500kW/2000KWh subsystem



 Low Price	\$160/kWh @ >10MW \$200/kWh @ <10MW
 Long Cycle Life (Full DoD)	5,000 Cycles w/ >80% capacity retention
 Energy Density	2 MWh (12' x 40' x 8')
 Efficiency	75% - 80%
 Safety	Non-hazardous Non-flammable

Eos has a significant cost advantage compared to other energy storage solutions



Eos Znyth™ Technology Overview

- * Zinc hybrid cathode technology (Znyth) uses **abundant, low-cost materials**
- * Proprietary **corrosion-resistant coating** on current collectors enables long life
- * **aqueous, near neutral electrolyte**
- * Simple **membrane-less design** allows for low-cost manufacturing and rapid scale up

Industrial Zinc Electrowinning Process



1.6kWh Battery



DC System



Eos Aegis Program: Partnering with Major Global System Integrators



- **Eos** will provide the Aurora DC system, including Battery Management System; Eos will also provide technical training to Aegis Partner at the outset
- **Aegis Partner** to provide power conversion and controls beyond the DC system required for a turnkey AC-integrated product, including installation, O&M, and full product warranty



Active Aegis Partners



Utility Demonstration of Znyth™ Battery Technology to Characterize Performance and Grid Benefits

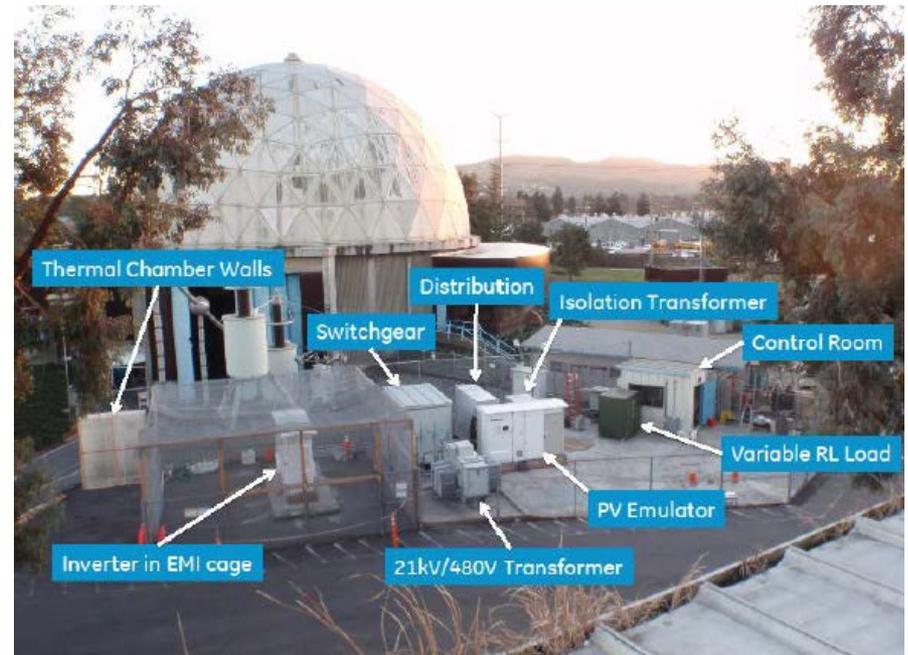
Project Overview:

- Eos will perform phased pilot testing of a 125kW/500kWh kWh AC-integrated Aurora energy storage system
- The system will be installed and tested at PG&E's Advanced Technology Services laboratory in San Ramon, CA.
- LBNL to model a portion of PG&E's distribution network to simulate grid conditions that will allow for dynamic testing of the battery
- Eos will also model, simulate, and extrapolate the economic impacts of installed grid scale systems and quantify the expected benefits to California utilities and ratepayers.

Project Team:



Project Location: PG&E SRTC



Issues or Challenges Addressed by CEC Project

1. Integration of Eos' novel Znyth™ battery technology with high-voltage inverter systems to create AC-product that meets CPUC cost and performance goals
 - Reduce the capital cost of energy storage to: less than \$1,000/kW installed; less than \$200/kWh installed; and less than 15 cents/kWh/cycle levelized
 - Improve energy storage system performance (system cycle efficiency to greater than 80%, and system life to greater than 5,000 cycles)
2. In lab testing of kW-scale AC-integrated Eos system to validate safety and performance in target applications
3. Installation and interconnection of product representative Eos system on the distribution network
4. Interoperability with utility communication/control systems to provide prioritized functionality in response to real-time grid conditions



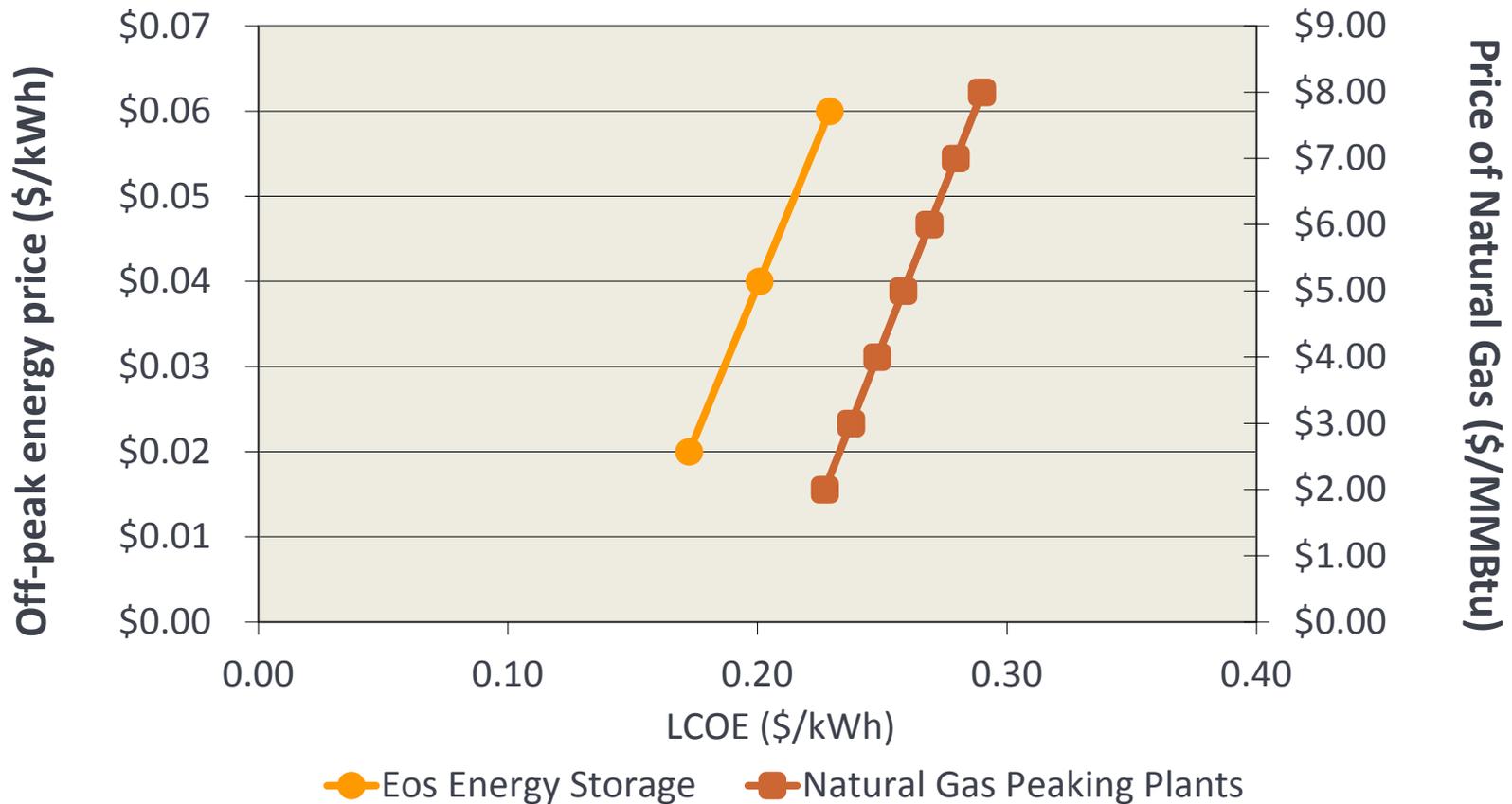
Application Specific Performance Evaluation

Storage Grid Domains (Grid Interconnection Point)	Regulatory Function	Use-Case Examples
Transmission-Connected	Generation/Market	(Co-Located Energy Storage) Concentrated Solar Power, Wind + Energy Storage, Gas Fired Generation + Thermal Energy Storage
		(Stand-Alone Energy Storage) Ancillary Services, Peaker, Load Following
	Transmission Reliability (FERC)	Voltage Support
Distribution-Connected	Distribution Reliability	Substation Energy Storage (Deferral)
	Generation/Market	Distributed Generation + Energy Storage
	Dual-Use (Reliability & Market)	Distributed Peaker
Behind-the-Meter	Customer-Sited Storage	Bill Mgt/Permanent Load Shifting, Power Quality, Electric Vehicle Charging



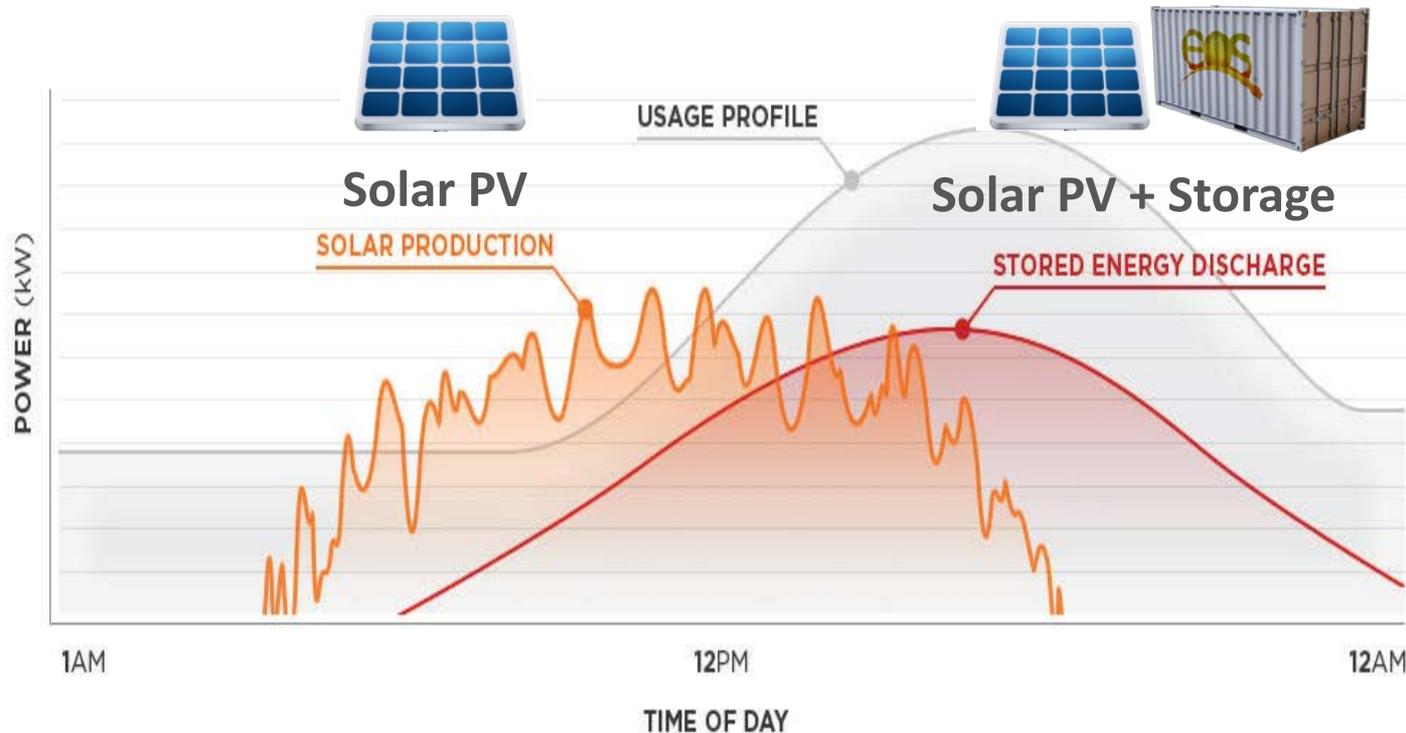
Eos' Levelized Cost of Energy Outcompetes Natural Gas Peaker Across Range of Fuel Costs

LCOE (\$/kWh): Eos vs Natural Gas Peaking Plants



Non-Eos data source: EPRI, Electricity Energy Storage Technology Options, 2010. Natural gas fuel cost range: \$2-8/MMBtu. Levelized cost of energy includes cap. fix, and var. costs. Gas peaking cost estimate from Lazard, 2009, midpoint of est. range; assumes: 150MW facility, Capital cost \$1,125/MW, Heat rate 10.5 MMBtu/MWh, Cap. factor 10%, Facility Life 35 years, Construction time 25 months. Eos: 10MW plant, 17% cap. factor (4hrs of energy production), AC to AC roundtrip efficiency of 71%, Cap. cost for entire system with Eos battery \$1.4/watt, O&M costs: \$10,000/year per 1MW/4MWh system, Facility Life 15 years.

1+1>2, Storage Creates Value & Cost Synergy When Combined With Solar PV



Storage Value

- Avoided T&D Infrastructure Cost and/or PV Curtailment
- Market Revenue Streams (Capacity, Energy, Regulation)
- Reduced Demand Charges
- Improved Power Reliability

Cost Synergy

- DC coupling to reduce Inverter requirements
- Installation/EPC
- Grid connection and permitting
- Customer acquisition

Storage can store and shift solar PV production to better align with customer and utility demand



Energy Storage Supports Key CA Energy Policies

Table 2, CPUC Energy Storage Procurement Targets

(From CPUC Decision 13-10-040, Table 2, p. 15)

Storage Grid Domain Point of Interconnection	2014	2016	2018	2020	Total
Southern California Edison					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
Subtotal SCE	90	120	160	210	580
Pacific Gas and Electric					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
Subtotal PG&E	90	120	160	210	580
San Diego Gas & Electric					
Transmission	10	15	22	33	80
Distribution	7	10	15	23	55
Customer	3	5	8	14	30
Subtotal SDG&E	20	30	45	70	165
Total - all 3 utilities	200	270	365	490	1,325

Law/Regulation:

- Assembly Bill (AB) 2514 - Energy Storage Systems
- 33 percent by 2020 Renewable Portfolio Standard goal (required by SB X1-2)
- Reducing greenhouse gas emissions to 1990 levels by 2020 (required by AB 32).



Introducing the **Aurora 1000 | 4000**,
the Industry's lowest cost DC battery solution

Order Now



Orders can be placed at sales@eosenergystorage.com