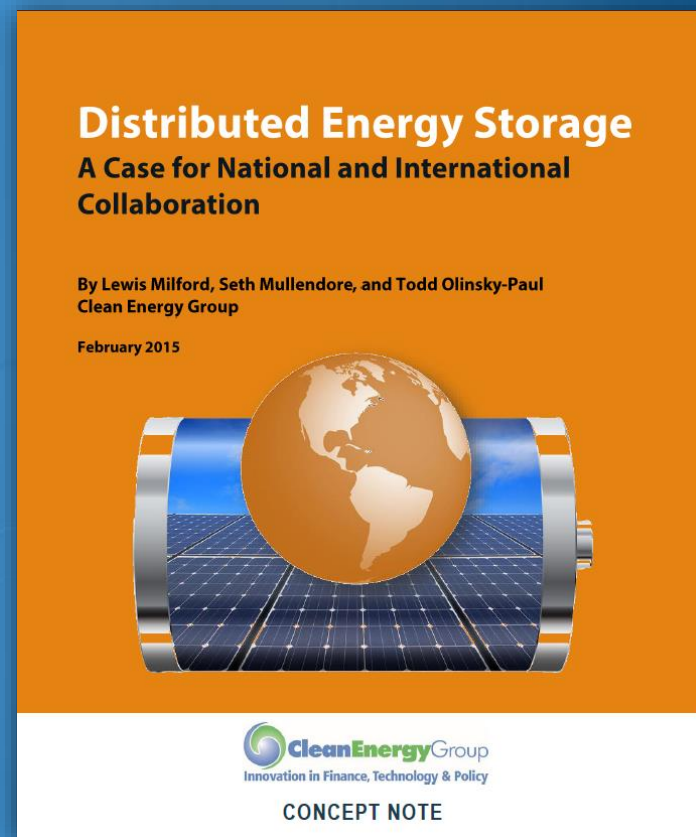


The Need for National Collaboration on Distributed Energy Storage

Lewis Milford
President
Clean Energy Group

April 16, 2015



Housekeeping



All participants are in listen-only mode. Please select if you are using your telephone or mic & speakers in the Audio Box.

Please submit questions throughout the broadcast by typing them into the Questions box and hitting the “Send” button.

This webinar is being recorded. You will find this and other webinar recordings on our website at www.cleanegroup.org/ceg-resources.

About Clean Energy Group

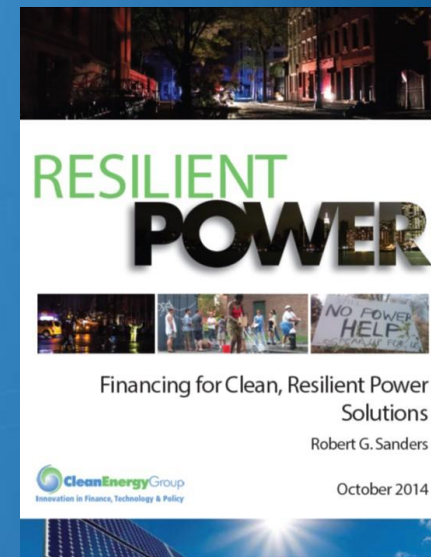
Clean Energy Group is a leading national, non-profit advocacy organization working in the U.S. and internationally on innovative technology, finance and policy programs in the area of clean energy and climate change.

Clean Energy Group manages the Clean Energy States Alliance (CESA), a national nonprofit organization of public agencies and organizations working together to advance clean energy. CESA's members include many of the most innovative, successful, and influential public funders of clean energy initiatives in the U.S. (www.cesa.org)



Clean Energy Group's Resilient Power Project

- Goal: significantly increase public/ private investment for clean, resilient power systems.
- Support state energy agencies in developing resilient power policy and programs.
- Engage city officials to develop resilient **power** policies/ programs, link to state energy policies.
- Protect low-income and vulnerable communities; focus on affordable housing
- Technical assistance & targeted support for pre-development costs for resilient power projects to help agencies/ project developers get deals done.
- See www.resilient-power.org for reports, newsletters, webinar recordings, and more.



Energy Storage Technology Advancement Project (ESTAP)

ESTAP is a project of CESA and is conducted under contract with Sandia National Laboratories, with funding from the U.S. Department of Energy Office of Electricity.

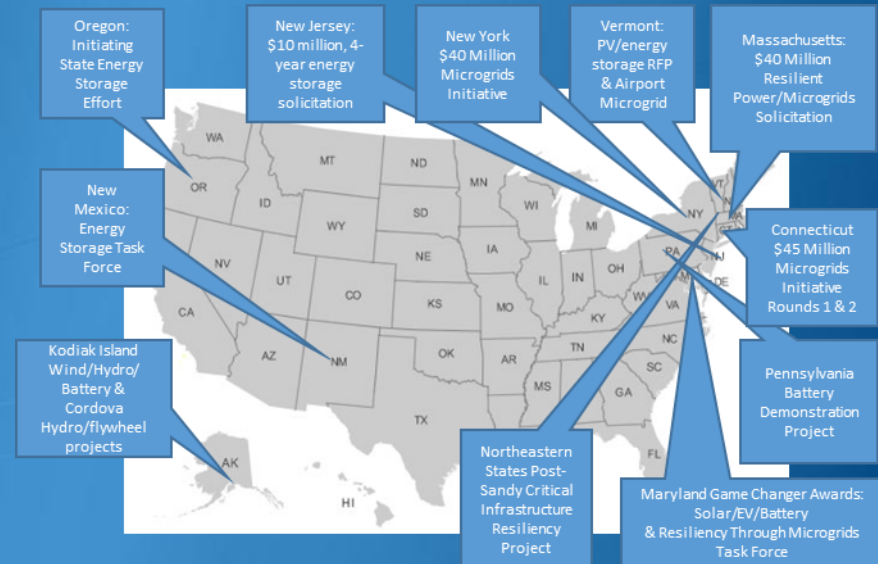
ESTAP Key Activities

Disseminate information to stakeholders

- ❖ ESTAP listserv > 2000 members
- ❖ Webinars, conferences, information updates, surveys

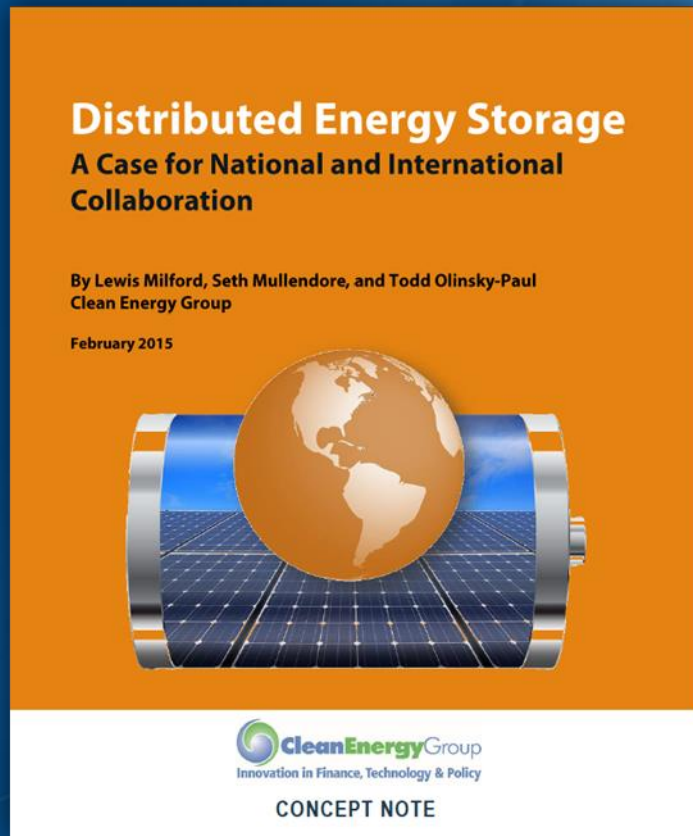
Facilitate public/private partnerships at state level to support energy storage demonstration project development

ESTAP Webpage:
<http://bit.ly/CESA-ESTAP>



Sandia National Laboratories

Energy Storage Collaboration



- Paper to solicit interest and reactions
- Need for collaboration among NGOs, industry and government seems clear
- But is there interest to take next step?
- Support, structure and funding issues

www.cleanegroup.org/assets/Uploads/Distributed-Energy-Storage-Concept-Paper-Feb2015.pdf

Today's Guest Speakers

- Katherine Hamilton, Policy Director, Energy Storage Association



- Seth Mullendore, Program Associate, Clean Energy Group



Energy Storage: National Collaboration for Policy Success

Clean Energy Group

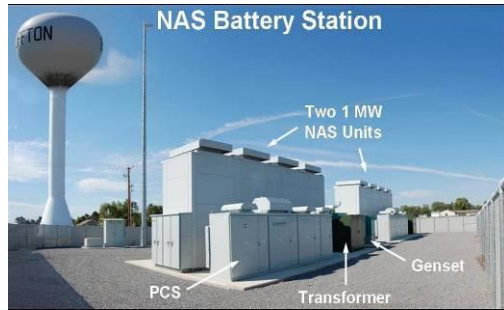
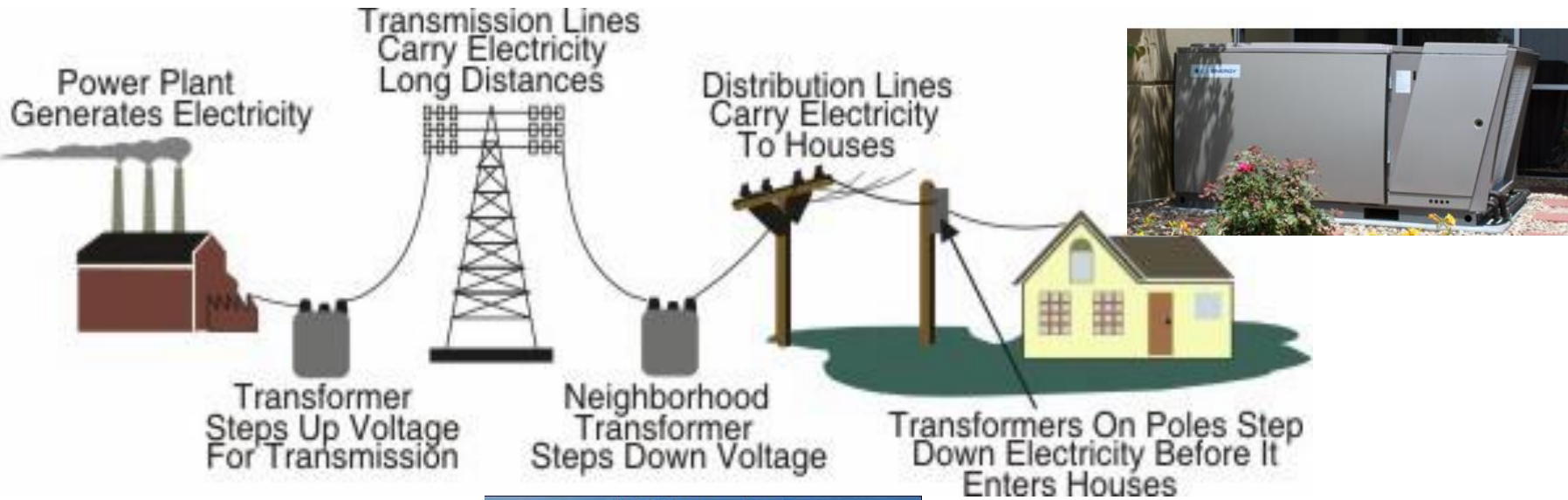
April 16, 2015



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Storage Technologies: Across the Grid



Our Members



Trajectory of the Industry


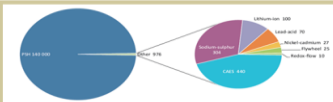













According to market research firm IHS, energy storage growth will “explode” from .34 GW in 2012-2013 to 6 GW by 2017 and over 40 GW by 2022.

GTM/ESA: U.S. Energy Storage Monitor

- The U.S. installed 61.9 MW of energy storage in 2014, up 40% from 2013, and completed 180 individual installations.
- 2015 is expected to be the biggest year in the market's history with 220 MW of deployments, two times the capacity installed in 2013 and 2014 combined.
- 90% of 2014 energy storage deployments by capacity were in front of the meter, while 10% were behind the meter.
- 70% of all 2014 energy storage deployments (measured by capacity) used lithium-ion batteries.
- The vast majority of energy storage deployments in the U.S. take place in a small number of markets with the right policy, regulatory drivers, and wholesale market designs.

Courtesy GTM Research/ESA U.S. Energy Storage Monitor

Example Grid-Scale Storage Projects in the Pipeline

Organization	Size (Power)/Duration	Status	Description
	<ul style="list-style-type: none"> 14 GW/6 hours 	<ul style="list-style-type: none"> 140,000 MW PHS; 800 MW CAES, NAS, and Flow 250 MW Li-ion, Pb-acid, flywheel 	
	<ul style="list-style-type: none"> 35 MW / 7 hours 	<ul style="list-style-type: none"> Installed NAS 	<ul style="list-style-type: none"> Contract awarded (May 2013)
	<ul style="list-style-type: none"> 12 MW / 5 hours 	<ul style="list-style-type: none"> Underway 	<ul style="list-style-type: none"> Contract awarded (July 2013)
	<ul style="list-style-type: none"> Min 1.5 MW / 4 hours 	<ul style="list-style-type: none"> In Contracting 	<ul style="list-style-type: none"> RPS RFO (Dec 2013) PV+ Storage; 1.9X TOD, penalize intermittency, curtail rights
	<ul style="list-style-type: none"> 50 MW 	<ul style="list-style-type: none"> 34 of 50 MW selections announced 	<ul style="list-style-type: none"> RFP issued (March 2014), selections announced (July 2014) to increase wind and solar use
	<ul style="list-style-type: none"> 50 MW/4 hours 	<ul style="list-style-type: none"> In contract negotiations 	<ul style="list-style-type: none"> RFP issued (October 2013) for local capacity requirements
	<ul style="list-style-type: none"> 150 MW /12 hrs 	<ul style="list-style-type: none"> In short-listing (Mar 2014) 	<ul style="list-style-type: none"> RFP issued (November 2014) post Superstorm Sandy
	<ul style="list-style-type: none"> Avg 58 MW >2 GW Storage Interconnects 	<ul style="list-style-type: none"> Cluster 7 Applications closed (April 2014) 	<ul style="list-style-type: none"> Interconnect application increased from 0 (cluster 6, 2013) to 36 projects Typical size 25 and 50 MW Average application fee: \$105k
	<ul style="list-style-type: none"> 58 MW / 12 hours 	<ul style="list-style-type: none"> RFI July 2014 	<ul style="list-style-type: none"> 12 hour demand reduction beginning 2016
	<ul style="list-style-type: none"> 60 MW / 0.5 hours 	<ul style="list-style-type: none"> RFP July 2014 	<ul style="list-style-type: none"> HECO response to PUC over-ruling capital plan because not solving problems of DG
	<ul style="list-style-type: none"> >25 MW / 4 hours 	<ul style="list-style-type: none"> RFP September 2014 	<ul style="list-style-type: none"> To meet Local Capacity Requirements, alternative to CT
	<ul style="list-style-type: none"> 2MW / 4 hours 	<ul style="list-style-type: none"> RFP Oct 2014 	<ul style="list-style-type: none"> Flow battery demonstration
	<ul style="list-style-type: none"> PG&E: 80.5 MW / 4 hours SCE: 16 MW / 4 hours SDG&E 16.3 MW / 4 hours 	<ul style="list-style-type: none"> RFP Dec 2014 	<ul style="list-style-type: none"> First procurement for AB 2514, 1325 MW (October 2013), Procurement plan approved July 2014 

Courtesy of EnerVault

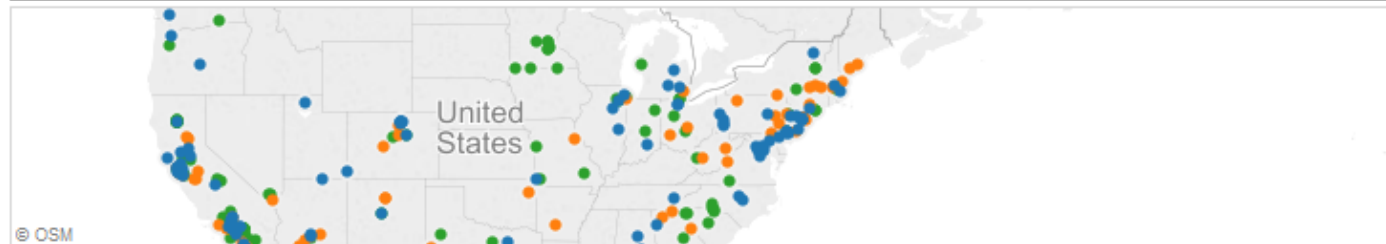


Energy Storage Association



Regional Hubs for US Deployment

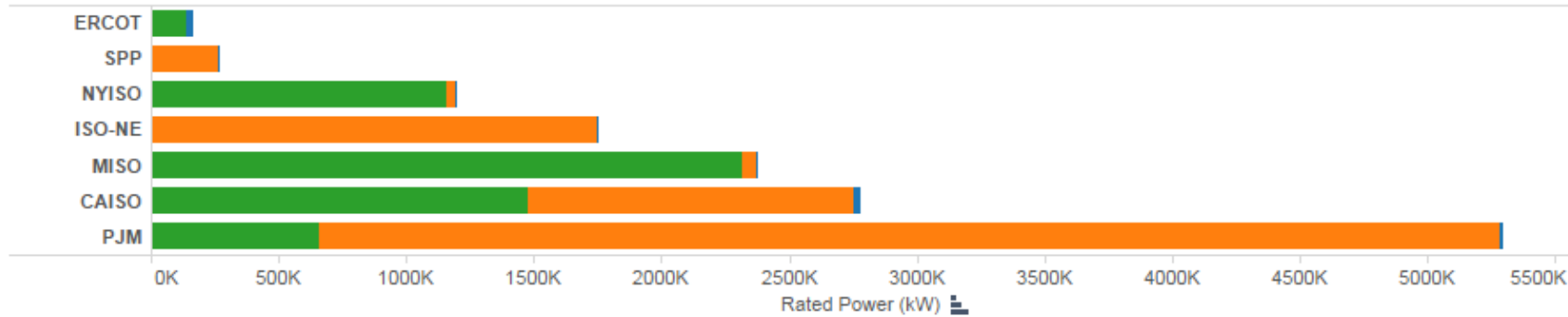
US Projects by Ownership and ISO/RTO*



Technology

Status

- Customer-Owned
- Third-Party-Owned
- Utility-Owned



	Customer-Owned		Utility-Owned		Third-Party-Owned	
	Rated Power (kW)	Number of Projects	Rated Power (kW)	Number of Projects	Rated Power (kW)	Number of Projects
CAISO	31,775	36 Projects	1,476,886	31 Projects	1,273,524	22 Projects
ERCOT	28,492	16 Projects	135,815	6 Projects	5,100	1 Projects
ISO-NE	1,200	4 Projects	250	5 Projects	1,750,150	8 Projects
MISO	5,825	6 Projects	2,314,367	14 Projects	58,750	2 Projects
NYISO	1,575	4 Projects	1,160,000	1 Projects	30,350	8 Projects
PJM	11,398	24 Projects	659,100	7 Projects	4,625,160	13 Projects
SPP	1,000	1 Projects	1,100	2 Projects	263,000	3 Projects

*Independent System Operator (ISO) and Regional Transmission Organization (RTO)

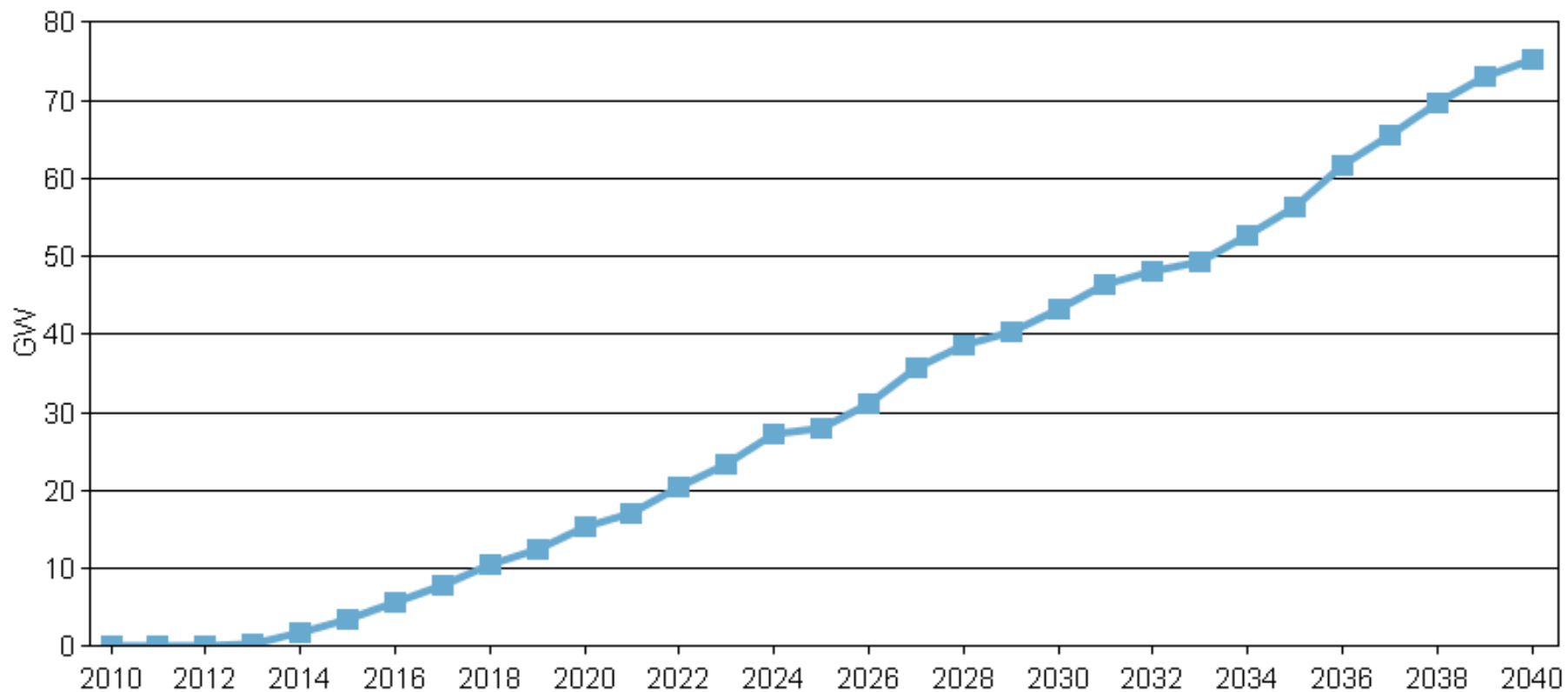
The DOE Global Energy Storage Database (<http://www.energystorageexchange.org/>) is powered by Sandia Corporation (<http://www.sandia.gov/>) and Strategen Consulting, LLC (<http://strategen.com/>)



Energy Storage Association

Problem: 40 GW peak generation needed in next 15 years

Electricity Capacity : Cumulative Unplanned Additions: Combustion Turbine/Diesel: Reference case



Independent Statistics & Analysis
U.S. Energy Information
Administration



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Opportunity: Greenhouse Gas Emission Caps

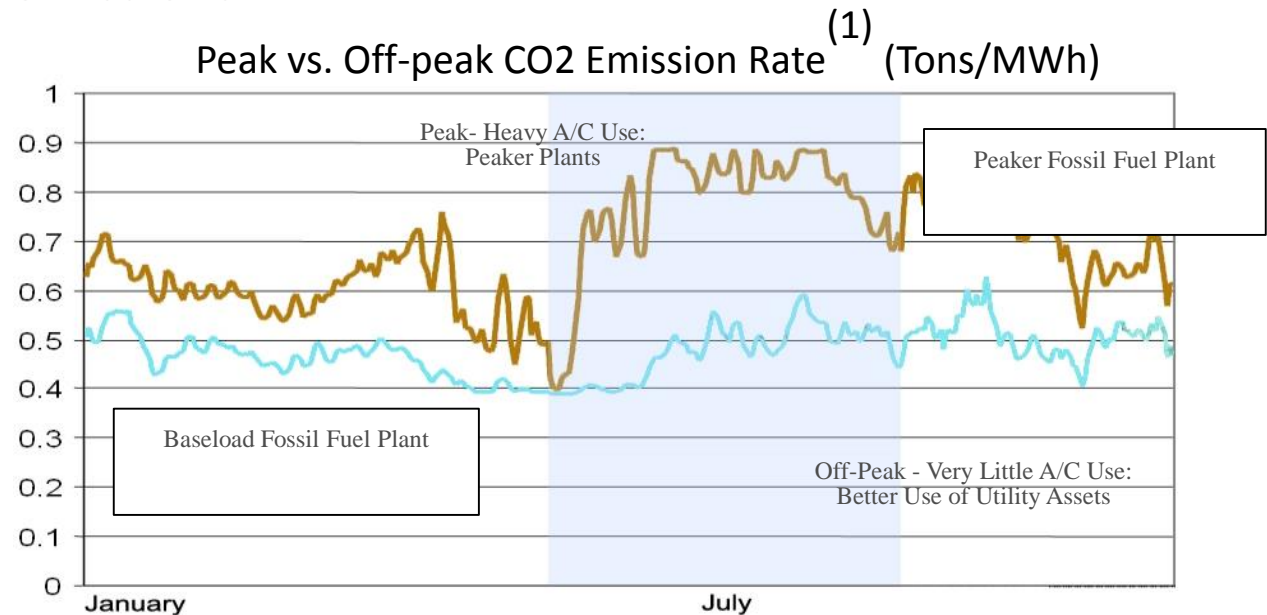
Percent CO₂ / MWh Reduction Shifting
from Peak to Off-Peak:

SCE: 33% reduction

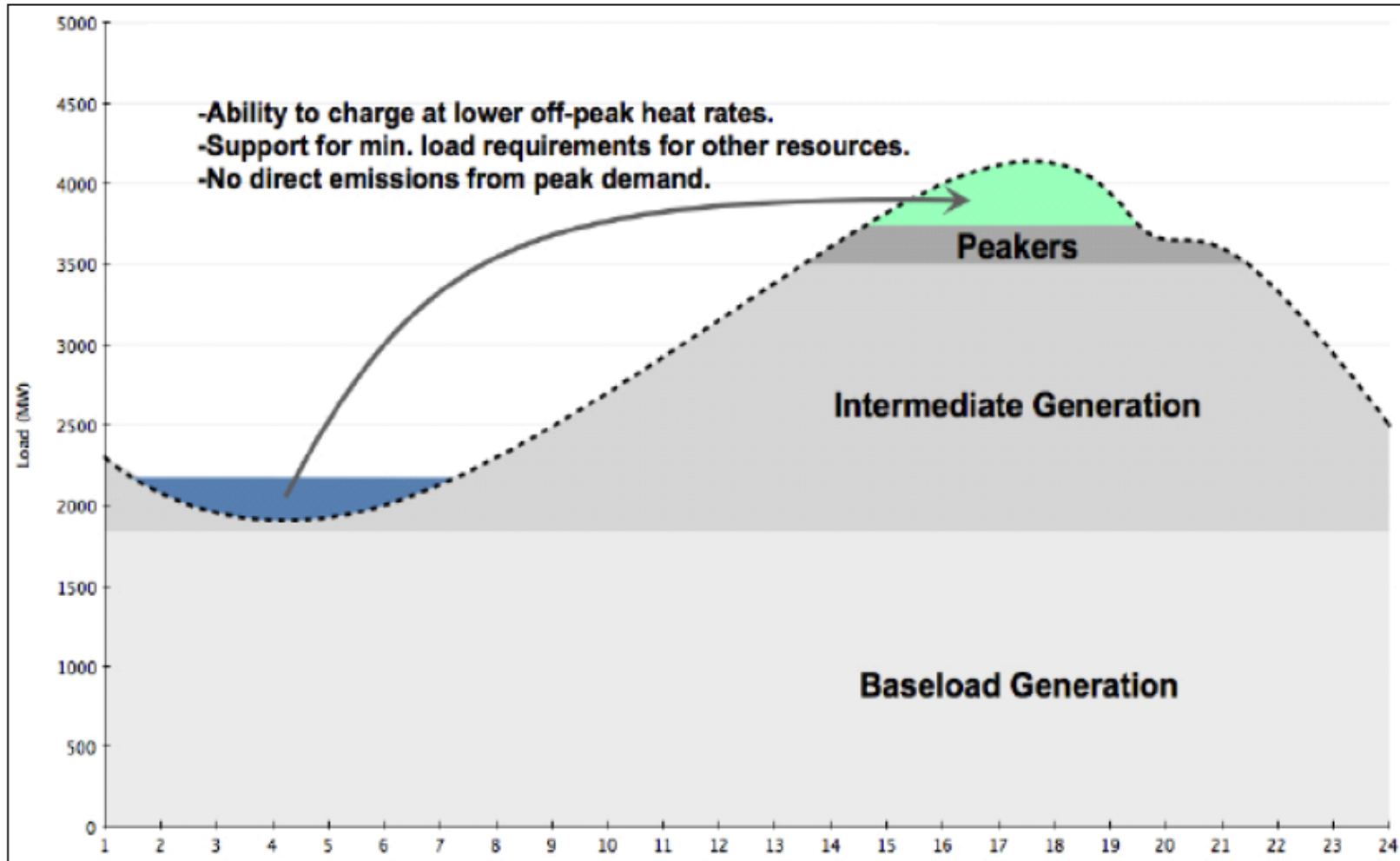
PG&E: 26% reduction

SDG&E: 32% reduction

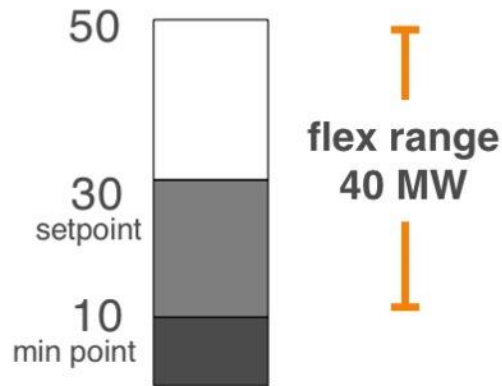
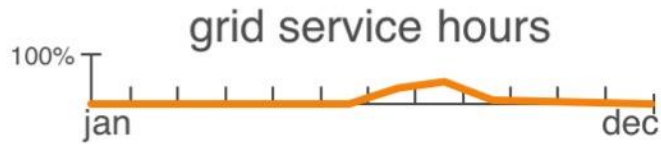
Also ~56% lower NO_x emissions



Value: Energy Storage for Peak Shaving



Value: Energy Storage as Flexible Resource

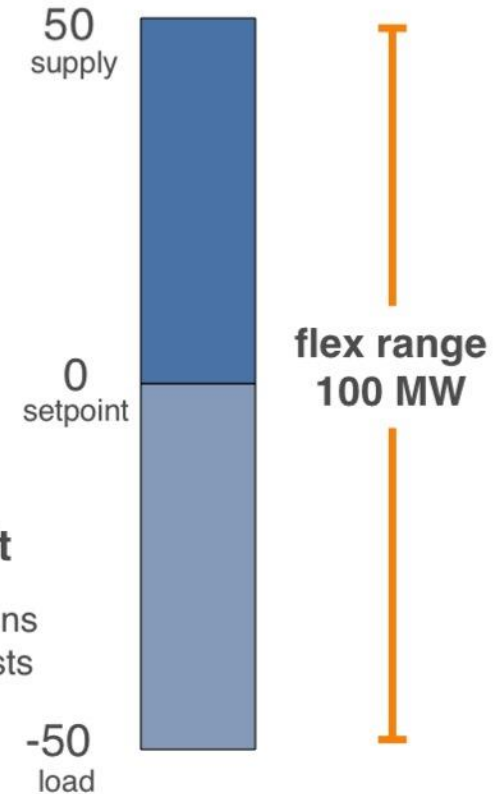


50 MW

Gas Peaker

- out of merit generation
- significant standby costs
- standby emissions

minutes to dispatch



50 MW

Storage Unit

- 0 direct emissions
- low standby costs

seconds to dispatch

Value: With Coal—Energy Storage for 15% Output Increase, 10% Efficiency Increase, 7% GHG Reduction



Photo Courtesy Alevo



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Value: Energy Storage for Renewable Energy Integration



Photo Hawaii Kaheawa Wind Power



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Value: Energy Storage for T&D Deferral, Transmission Capacity Relief, Frequency Regulation, Spinning Reserve



Photo Courtesy S&C Electric



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Value: Energy Storage with Microgrid for Increased Efficiency, Reliability



Photo Courtesy Saft



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Value: Community Energy Storage for Peak Shaving, Reliability, VAR Support



Photo Courtesy S&C Electric

Value: Residential Energy Storage Back-Up for Rooftop Solar Support

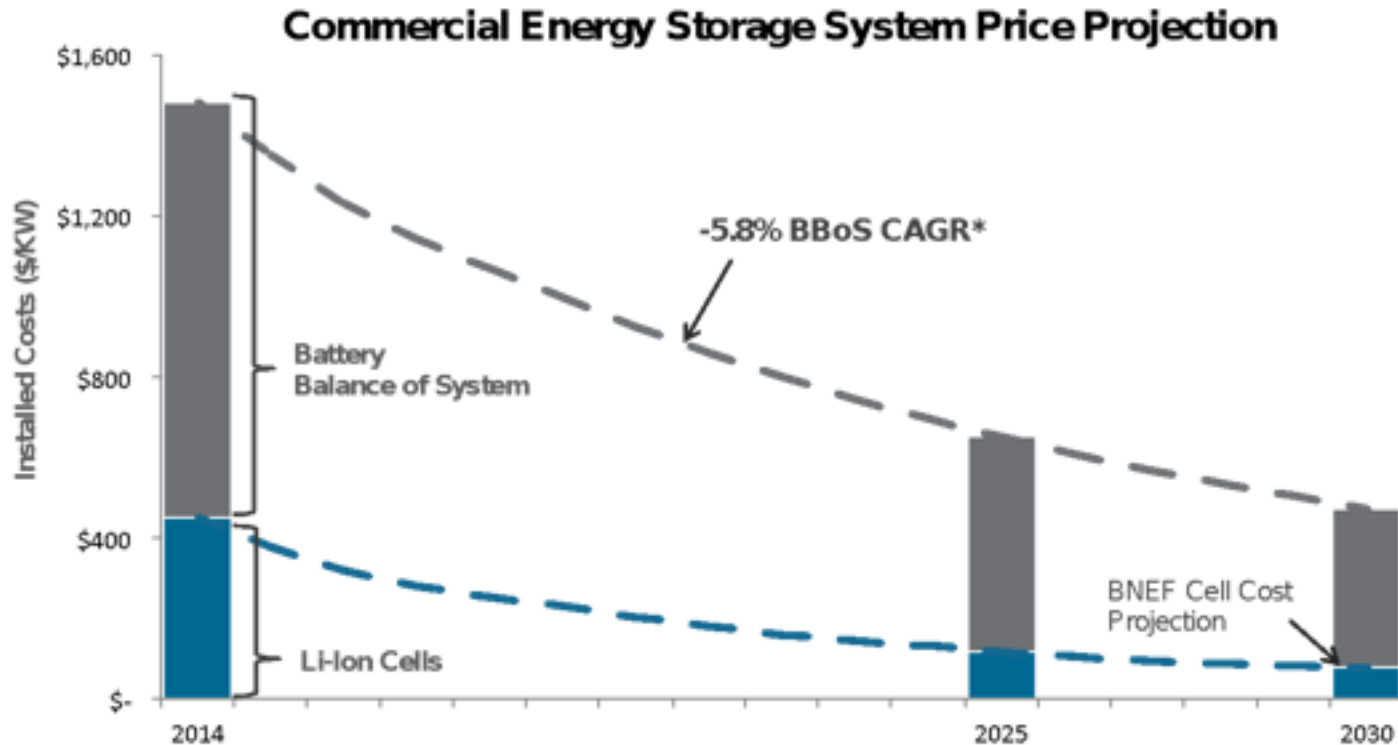


Photo SMA Courtesy PV-Tech



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Cost: Illustrative Trajectory (RMI)



Based on: 200 kW system with 1 hour discharge capacity; Sandia, BNEF, RMI
* Based on CAGR of Solar BOS from 2008-2014



Cost: Declines Predicted

Navigant: current cost 4-hr battery \$720–\$2,800/kWh depending on scale (battery only \$500–700)

Oncor: \$350/kWh installed cost projection based on discussions with vendors, consistent with industry sources

Morgan Stanley: battery-only costs may reach \$125–\$150/kWh down from the \$500/kWh

Tesla: battery-only cost \$110/kWh



Brattle Group Study of Texas Market

“Given the significant benefits that storage can bring to the system as a whole, enabling cost-effective investments in electricity storage will require a regulatory framework that helps investors capture both the wholesale market and the T&D system values associated with the storage devices.”

*The Value of Distributed Electricity Storage in Texas,
prepared for Oncor, November 2014*

Policy Levers

- Congress
- Federal and state agencies
- State regulators and legislators
- FERC and ISOs

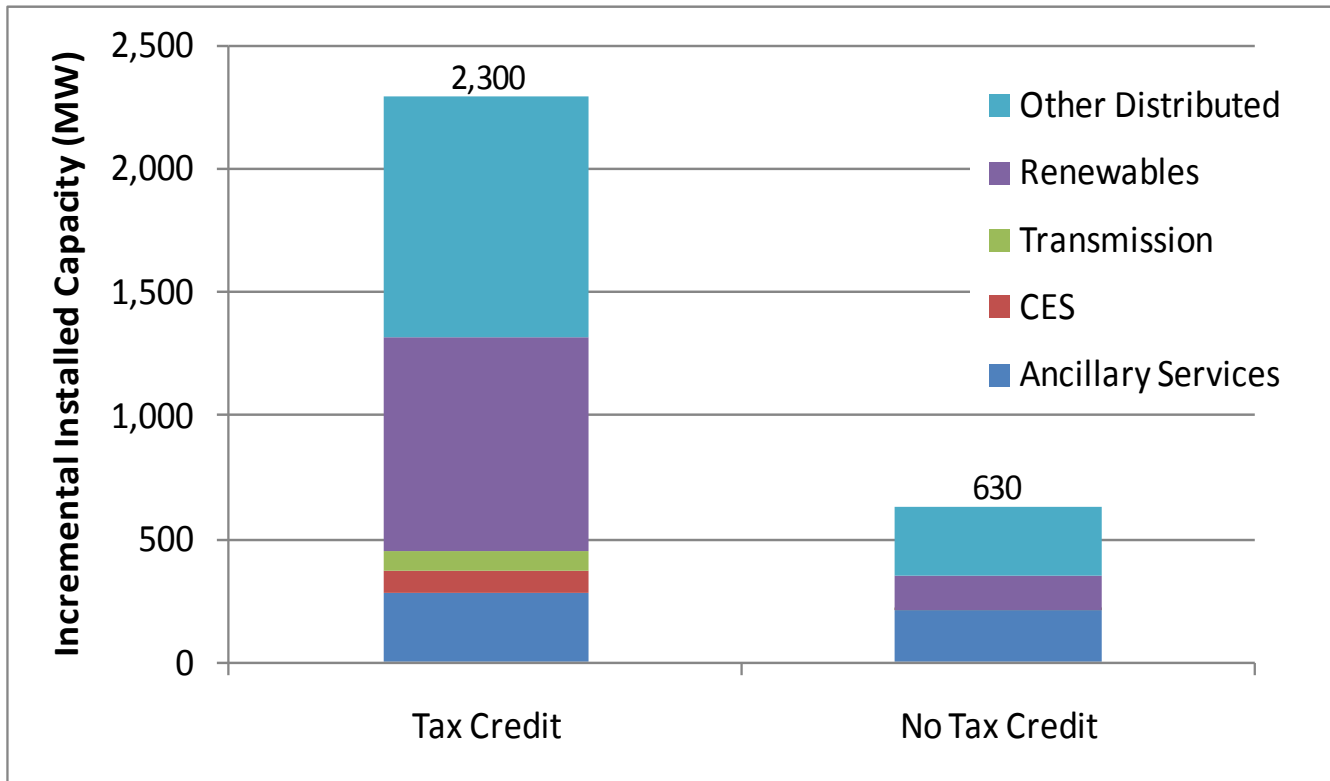


Congressional Policy Outreach

- ❑ Educational Series
- ❑ Investment Tax Credit
- ❑ Master Limited Partnerships
- ❑ R&D Tax Treatment
- ❑ Energy Resilience and Infrastructure Policy Opportunities



Example of Success: Investment Tax Credit (5 year market)



Courtesy Copper Development Association and KEMA 2/3/12

Federal and State Agency Policy

Outreach

- Department of Energy
- Department of Commerce
- State Department
- General Services Administration
- Department of Defense
- Environmental Protection Agency
 - State Implementation Plans



Energy Storage and Clean Power Plan

- ❑ Building Block #1: Power Plant Efficiency Improvements
- ❑ Building Block #2: Redispatch
- ❑ Building Block #3: Nuclear and Renewable
- ❑ Building Block #4: Demand Side
- ❑ State Implementation Plans



State Example of Success: California Roadmap Goals (CEC, CPUC, CAISO)

- ❑ Increase revenue opportunities consistent with values provided
- ❑ Reduce cost of interconnection, integration, and operations
- ❑ Streamline policies and processes to give certainty



State Example of Success: California Procurements

- ❑ Requirement: 1.3 GW by 2022
- ❑ Southern California Edison: 260 MW awarded Nov, additional 16 MW RFO due April 2015
- ❑ Pacific Gas and Electric: 75 MW RFO due February 2015
- ❑ San Diego Gas and Electric: between 25-800 MW RFO due January 2015



Other State Examples

- ❑ **New York** Reforming the Energy Vision (REV)
- ❑ **Arizona** Settlement for Peaker Planning
- ❑ **Hawaii** Renewables Integration
- ❑ **Texas** Potential for Multiple Uses



FERC/ISO Policy Outreach

☐ FERC Initiatives

- Order 755: Pay for Performance
- Order 784: Third Party Services and Accounting
- Order 792: Small Generator Interconnection
- Order 794: Frequency Response
- Order 1000: “Non-Transmission” Alternatives

☐ ISO/RTO Market Products

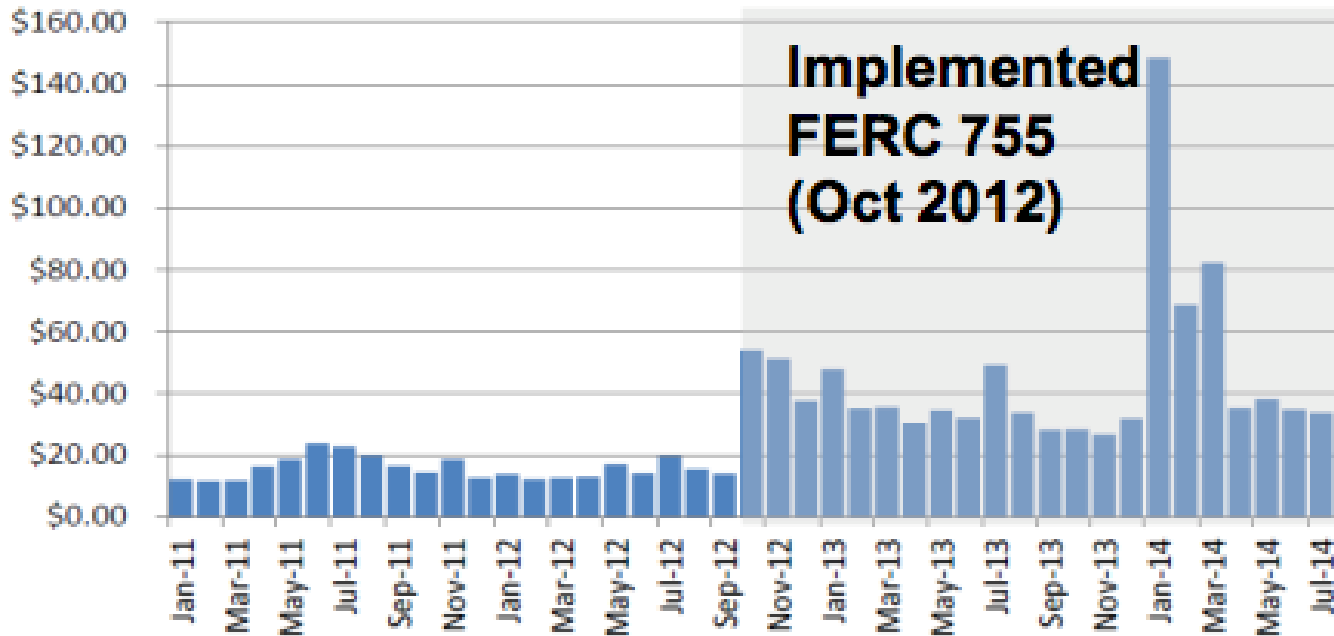
- Continue to remove barriers and create rules for storage to provide full suite of services



Example of Success: Pay for Performance

PJM

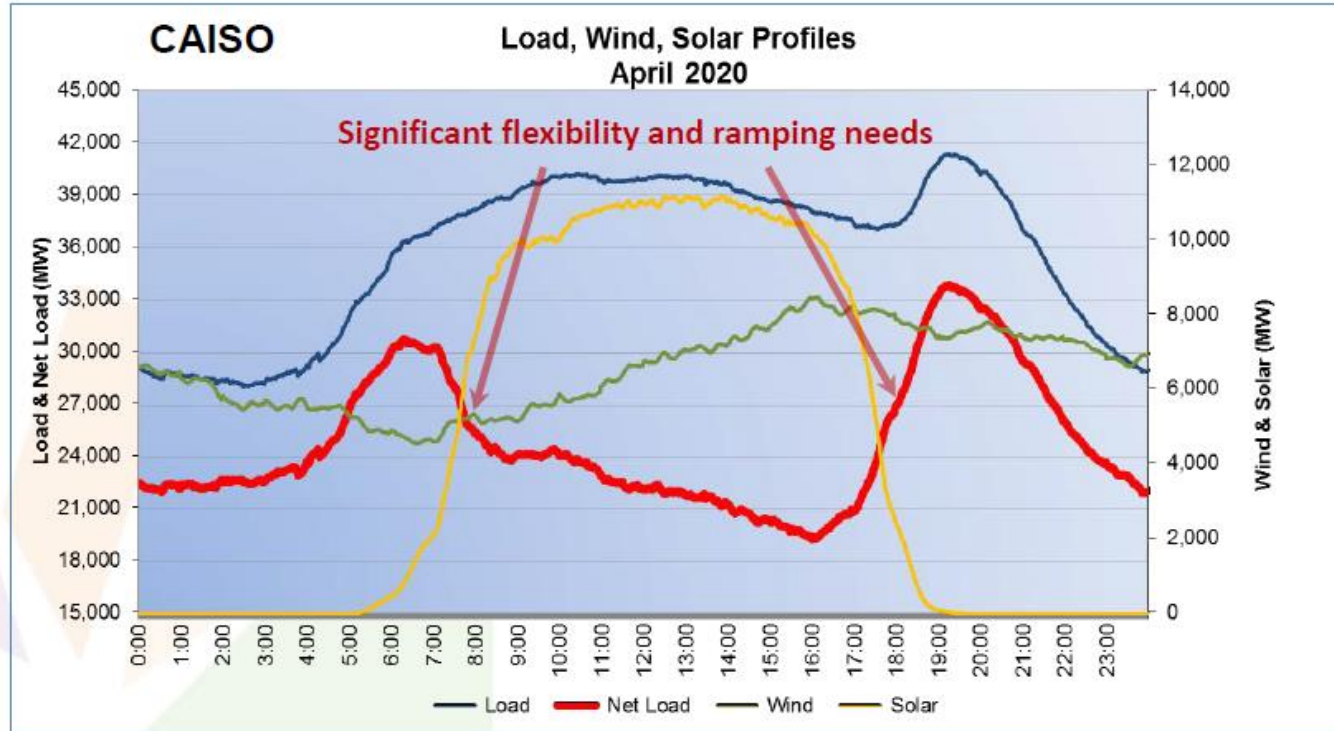
Fast Storage Revenue \$/MW/hour



ISO/RTO Market Initiatives

Flexible Ramping

- ISO/RTOs creating ramping products to integrate renewables



Policy Opportunities

- Storage considered an energy resource
- Storage included in utility planning processes
- Interconnection and safety standards
- State and federal incentive programs
- Settlement rules for storage at distribution
- Rates and accounting for storage
- Additional ISO market access and products
- Getting storage on the menu...



Energy Storage: Natural Allies

- ❑ Renewable resources (solar, hydro)
- ❑ Clean energy/environmental organizations
- ❑ Start-up industries cross-sector
- ❑ Innovation and manufacturing groups
- ❑ Department of Defense and others with resilience/security needs
- ❑ Utilities and ISOs
- ❑ Consumer advocates
- ❑ States developing SIPs





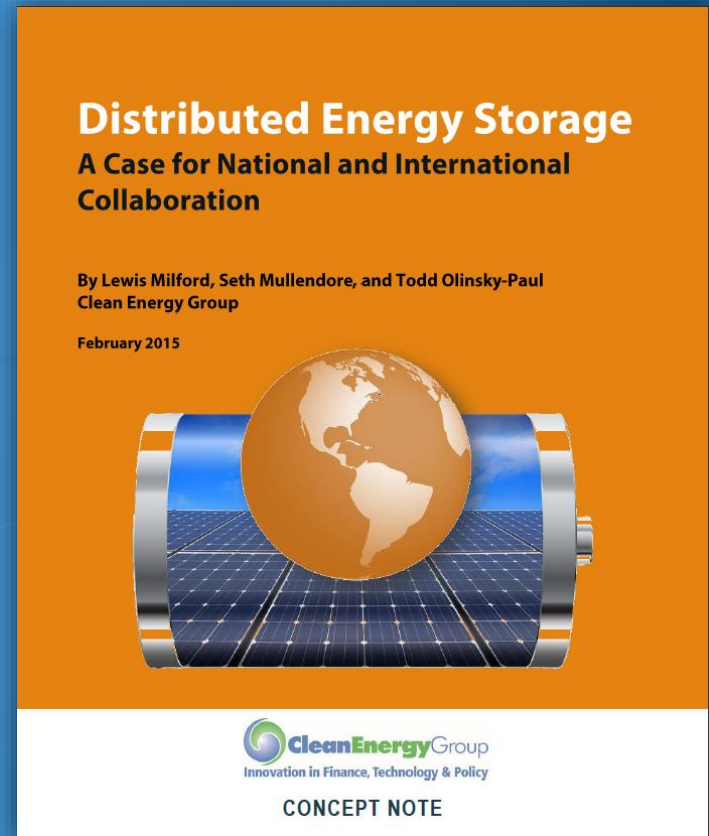
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www.energystorage.org

Making the Case for National Collaboration

Seth Mullendore
Program Associate
Clean Energy Group

April 16, 2015



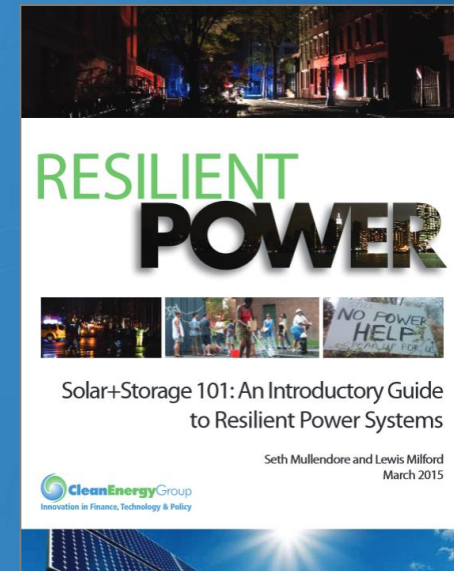
Why energy storage?

Key to grid modernization and incorporating higher levels of renewable integration

- Can provides numerous valuable grid services
- Reduces need for expensive and inefficient peaker plants
- Help alleviate grid congestion

Adds resiliency to power system

Costs rapidly decreasing



<http://www.cleangroup.org/assets/2015/Energy-Storage-101.pdf>

Why is policy intervention needed?

Energy storage value streams fragmented

- Utilities, grid operators, system owners

Challenging to finance

- Unwelcome risk proposition
- No widespread financing model
- Difficult to overcome initial cost barrier

Energy storage is still an emerging technology

- Unfamiliar to many developers
- Lack of standardized permitting and regulations



Why a national energy storage network?

Energy storage is happening

- \$1 billion U.S. solar+storage market by 2018 – GTM Research

Different development strategies in different places

- CA, NY, NJ, HI
- Primarily supporting grid-scale

No clear agenda for federal energy storage development

- Support similar to solar 15 years ago



What could a network accomplish?

Develop roadmap for energy storage deployment

Support and share results of innovation projects

- Policy and technology exchange

Encourage financial, market, and policy support

Simplify and standardize regulation and permitting

Increase availability and access to information

- Newsletters
- Webinars

Thank you for attending today's event

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