CESA State Projects and Policy Development

DOE-OE Peer Review
Washington, DC, September 27, 2016

Todd Olinsky-Paul
Project Director
Energy Storage Technology Advancement Partnership
Clean Energy States Alliance

Agenda for this presentation:

- Introduction to CESA and ESTAP
- Grid economics
- Three current ESTAP projects
- State policy landscape for storage (markets)

Energy Storage Technology Advancement Partnership (ESTAP)

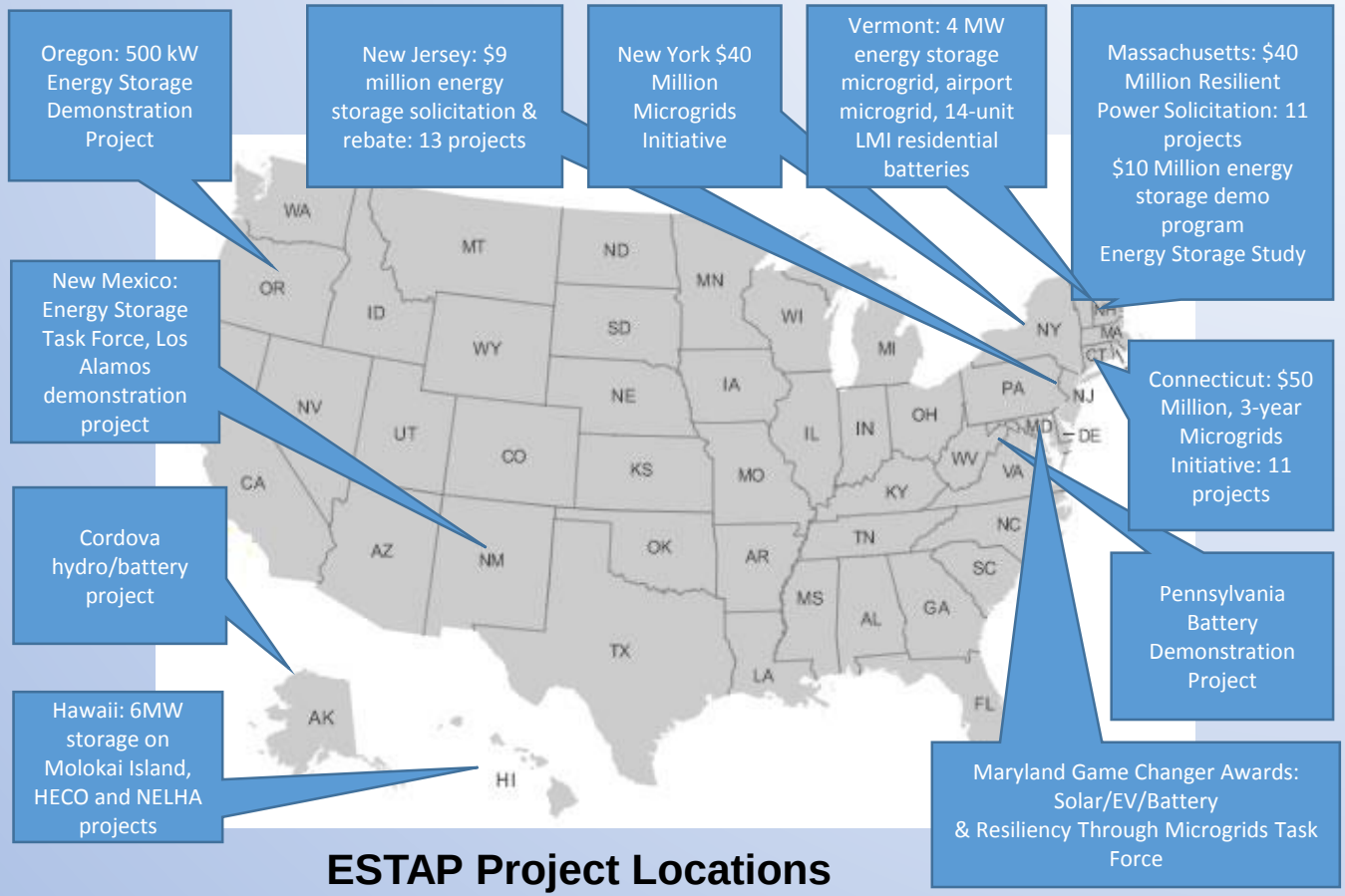
- A project of Clean Energy States Alliance (CESA)
- Conducted under contract with Sandia National Laboratories, with funding from US DOE-OE

ESTAP Key Activities:

1. Disseminate information to stakeholders
   - ESTAP listserv >3,000 members
   - Webinars, conferences, information updates, surveys.

2. Facilitate public/private partnerships to support joint federal/state energy storage demonstration project deployment

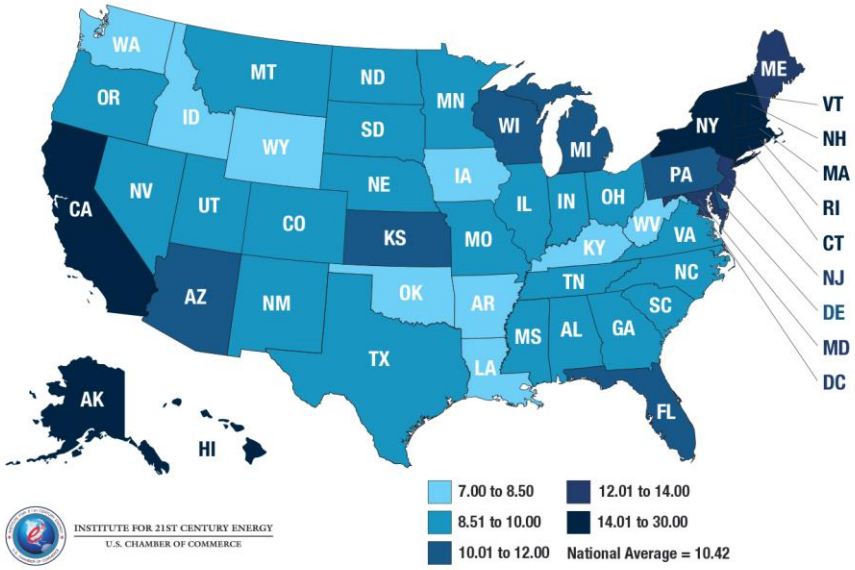
3. Support state energy storage efforts with technical, policy and program assistance



ESTAP Project Locations

2015 U.S. Average Electricity Retail Prices

(cents per kilowatt hour)



2015 U.S. Average Electricity Retail Prices

(cents per kilowatt hour)

Alabama	9.37	Kentucky	8.03	North Dakota	8.85
Alaska	17.94	Louisiana	7.64	Ohio	9.90
Arizona	10.40	Maine	12.97	Oklahoma	7.83
Arkansas	8.15	Maryland	12.14	Oregon	8.82
California	15.50	Massachusetts	16.86	Pennsylvania	10.41
Colorado	9.78	Michigan	10.84	Rhode Island	17.05
Connecticut	17.76	Minnesota	9.69	South Carolina	9.48
Delaware	11.21	Mississippi	9.55	South Dakota	9.31
Dist. of Columbia	12.08	Missouri	9.30	Tennessee	9.35
Florida	10.64	Montana	8.93	Texas	8.63
Georgia	9.52	Nebraska	9.04	Utah	8.61
Hawaii	26.17	Nevada	9.48	Vermont	14.36
Idaho	8.12	New Hampshire	16.03	Virginia	9.31
Illinois	9.28	New Jersey	13.93	Washington	7.41
Indiana	8.79	New Mexico	9.68	West Virginia	8.12
Iowa	8.47	New York	15.28	Wisconsin	10.93
Kansas	10.06	North Carolina	9.36	Wyoming	7.95

Source: U.S. Energy Information Administration; Electric Power Monthly: February 2016

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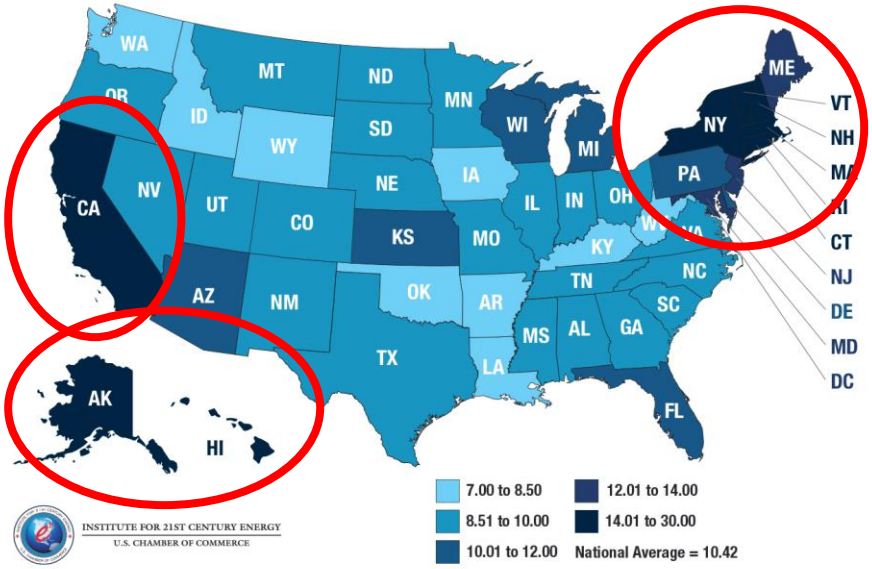

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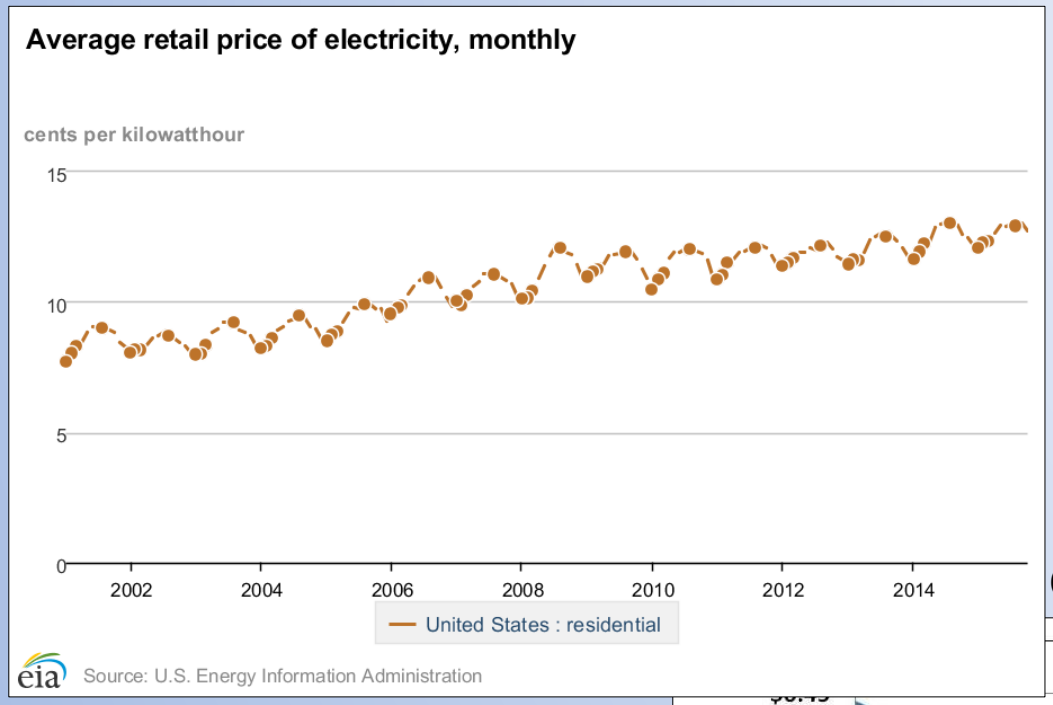


Price of electricity increases, while cost of battery storage decreases

Cost of battery storage (by technology)

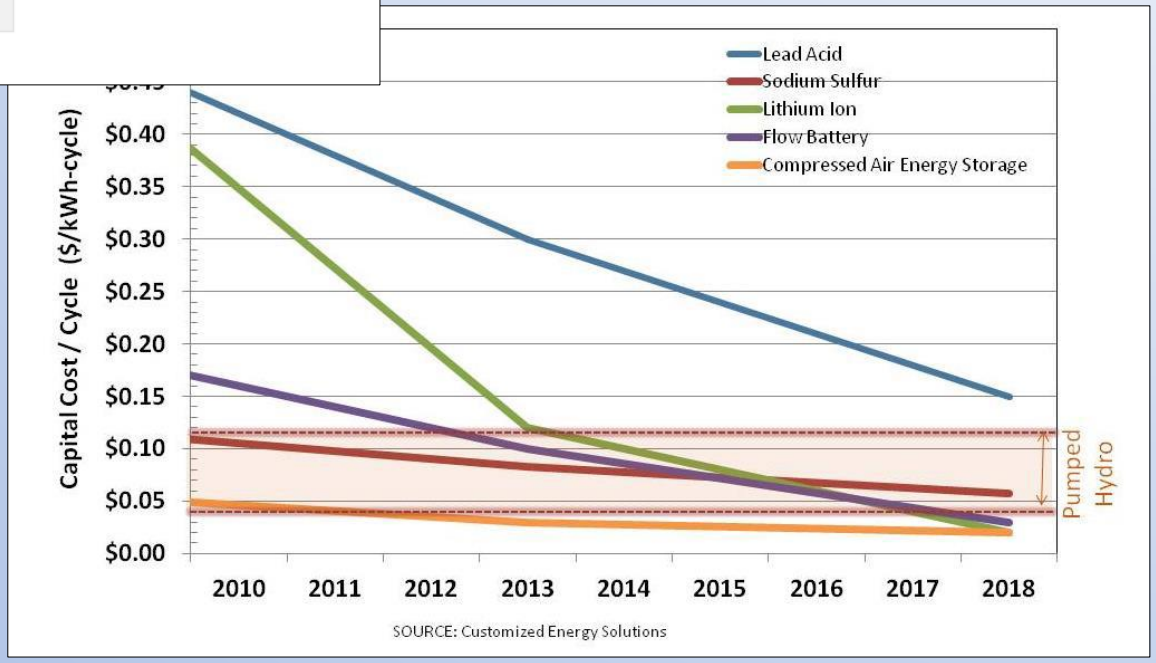


FIGURE 1

Explanation of Charges Commonly Found on an Electric Bill

Charges on an Electric Bill

Electric bills are primarily composed of three types of charges: energy charges, demand charges, and fixed charges.

Energy charges: Energy charges (measured in kilowatt-hours) are based on the amounts of electricity consumed from the grid over each billing cycle. Energy charges can vary depending on season and the time of day electricity is consumed (time-of-use rates) or the amount of electricity consumed (tiered rates).

SDG1 Annual Electric Bill

ENERGY

		Usage (kWh)	Cost ($/kWh)	Total cost ($)
Max	Summer	13,085	0.11447	1,497.82
	Winter	7,827	0.10565	826.97
Peak	Summer	15,259	0.10568	1,612.59
	Winter	35,189	0.09132	3,213.46
Part-Peak	Summer	26,959	0.07920	2,135.17
	Winter	46,612	0.07160	3,337.42
TOTAL		144,932		$12,623.43

49%

DEMAND

		Avg peak (kW)	Cost ($/kW)	Total cost ($)
Max	Summer	33	22.55	2,958.56
	Winter	30	22.55	5,195.52
Peak	Summer	33	19.19	2,517.73
	Winter	24	6.86	1,279.49
Part-Peak	Summer	30	0.00	0.00
	Winter	30	0.00	0.00
TOTAL				$11,951.30

46%

FIXED

	Total cost ($)
Meter charge	1,397.28
TOTAL	$1,397.28

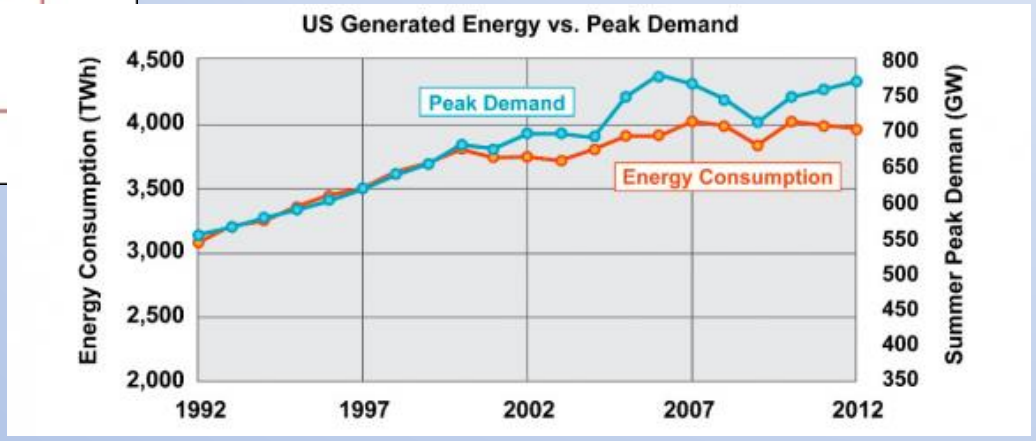
5%

TOTAL ANNUAL BILL $25,972.01

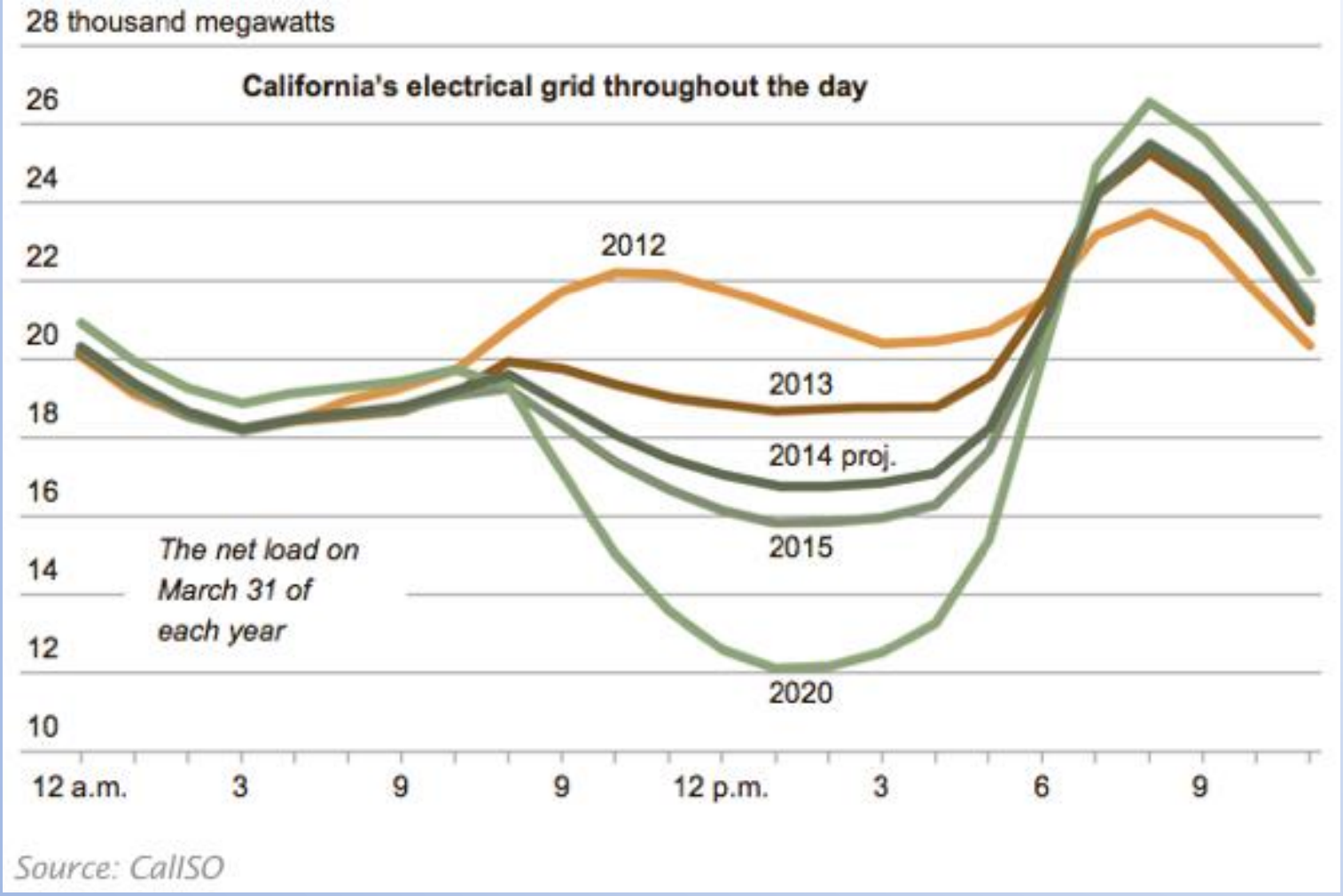
Demand charges: Demand charges (measured in kilowatts) are based on the highest rate of electricity consumption during a billing cycle, called peak demand. Utilities assess peak demand by measuring the highest average demand that occurs over any 15-minute period each billing cycle. Demand charges can vary depending on season and the time of day when peak demand occurs. Demand charges are typically found only on commercial or industrial customer accounts, where they often represent about half of the cost of an electric bill. Residential customers are usually not assessed these charges.

Fixed charges: Fixed charges are usually static and do not vary from one billing cycle to the next. These charges typically cover the costs of metering, billing, and other customer-related operating expenses not accounted for in energy and demand charges. Fixed charges can also include additional fees to cover system benefits programs such as energy efficiency and renewable energy programs. For simplicity, only fixed charges related to billing and metering are considered in this analysis.

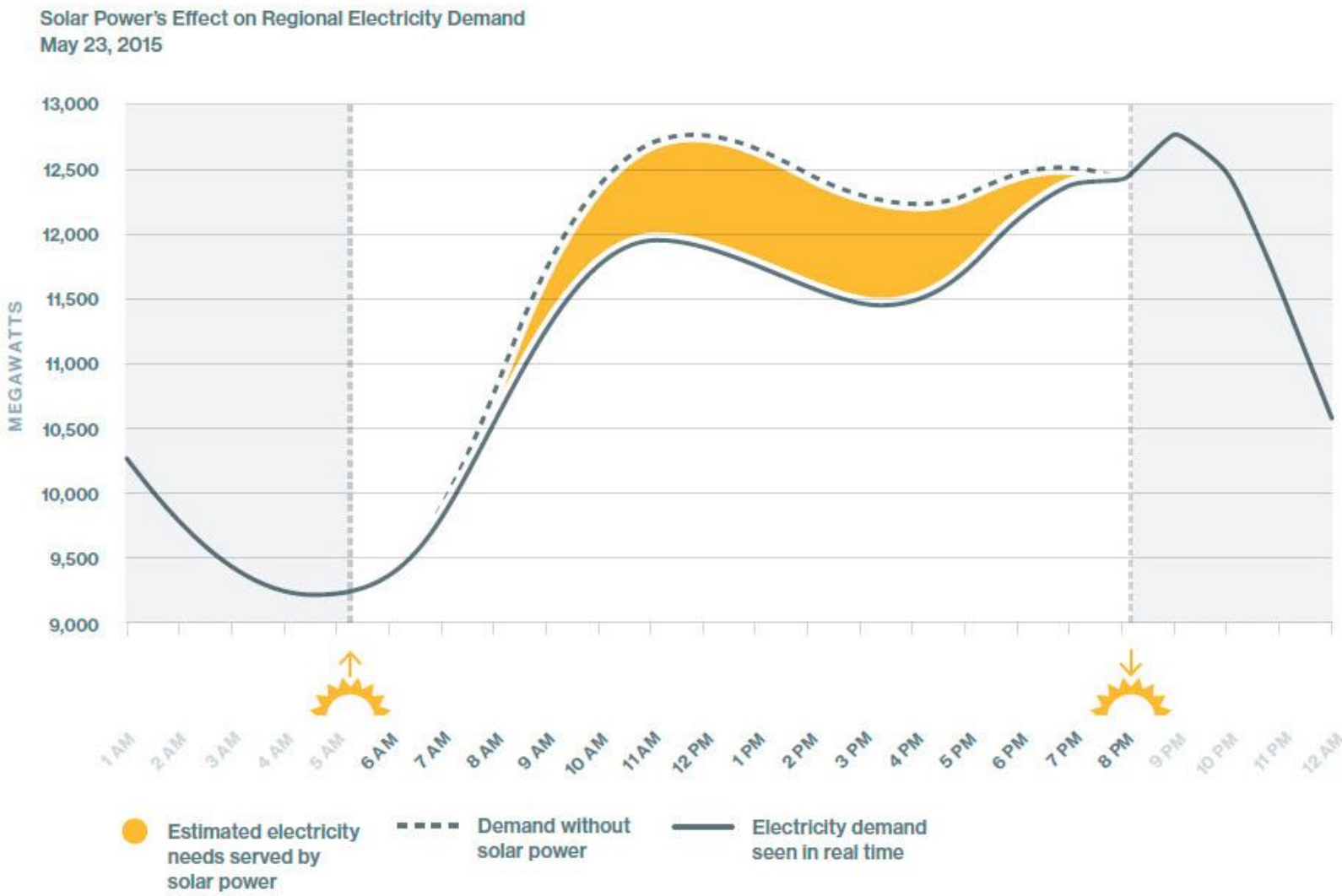
Electricity consumption is **flat** while peak demand is **rising**



California “Duck” Curve



ISO-NE: Does this curve look familiar?



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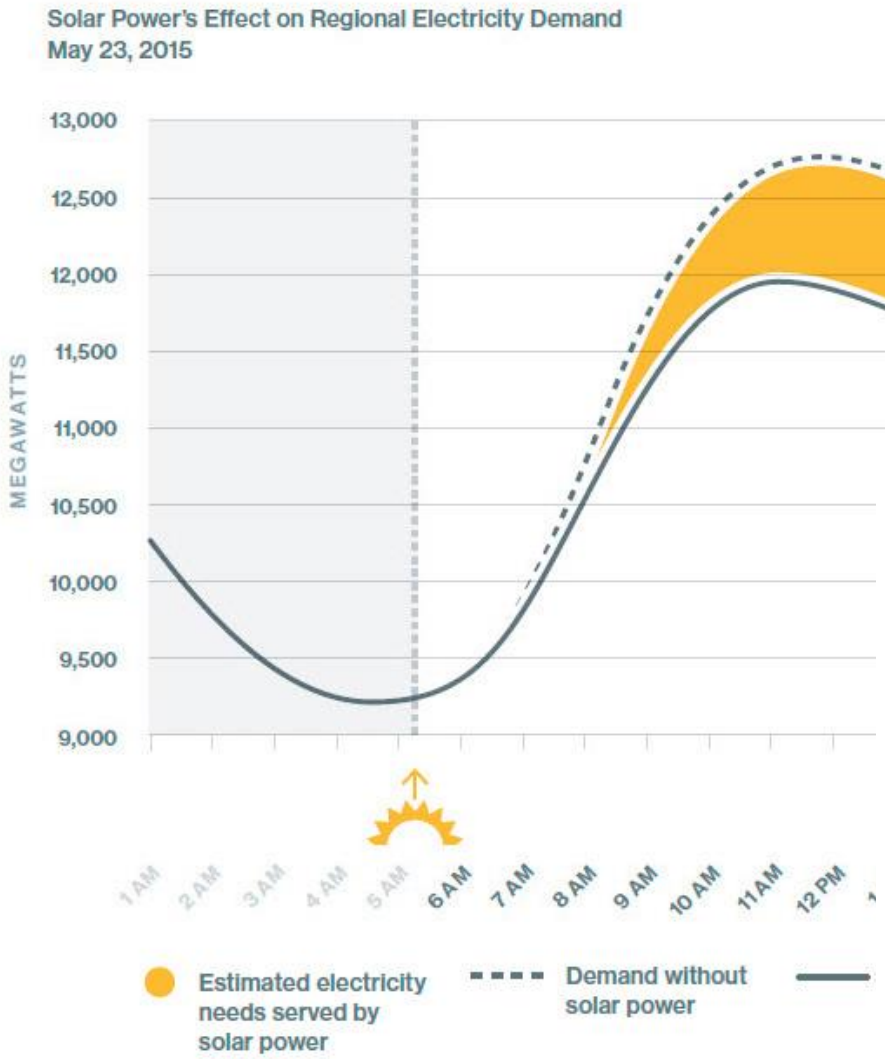


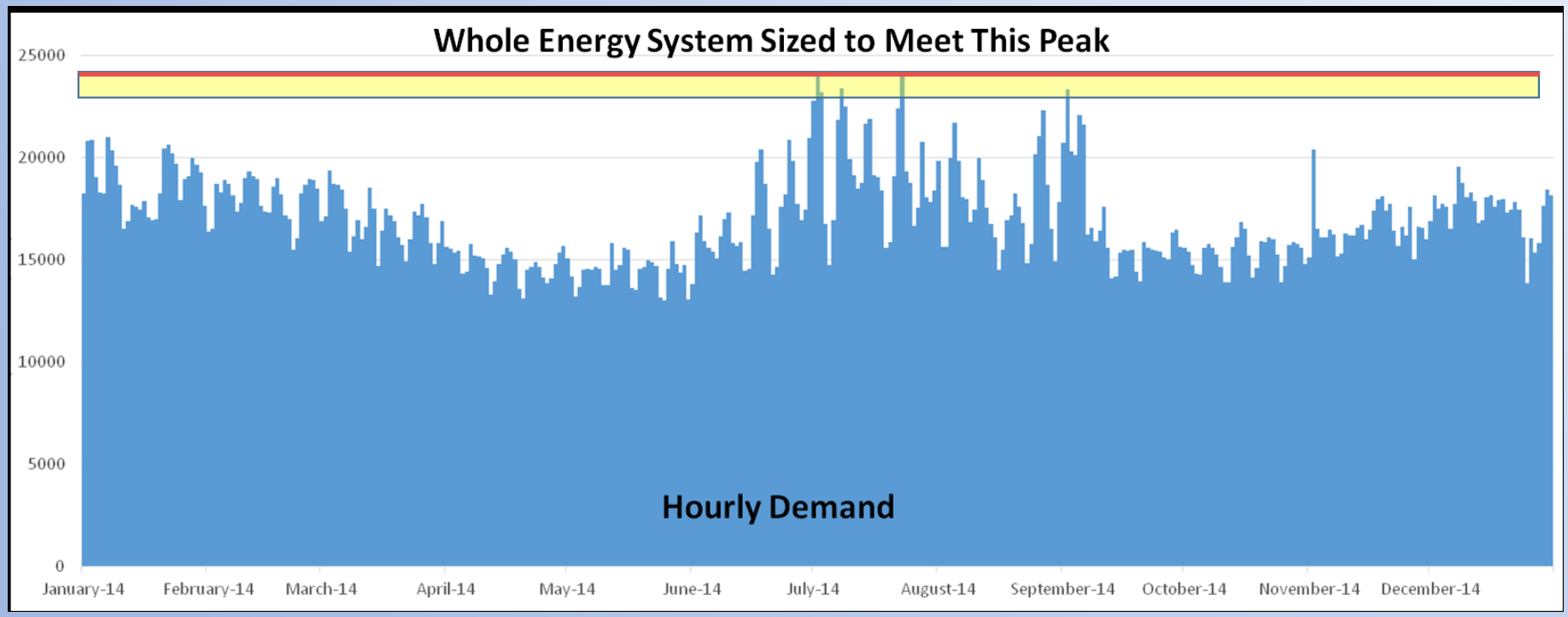
SMLD Capacity Clearing Price, ISO-NE.

Year	Price ($/kW-Month)
2010-2011	$4.254
2011-2012	$3.119
2012-2013	$2.535
2013-2014	$2.516
2014-2015	$2.855
2015-2016	$3.129
2016-2017	$3.150
2017-2018	$7.025
2018-2019	$9.551

Modernizing the Grids

In addition to these resilient power initiatives, a few states have begun a process of revisioning the electric grid:

- New York REV
- Massachusetts grid modernization



Three recent ESTAP Demonstration Projects

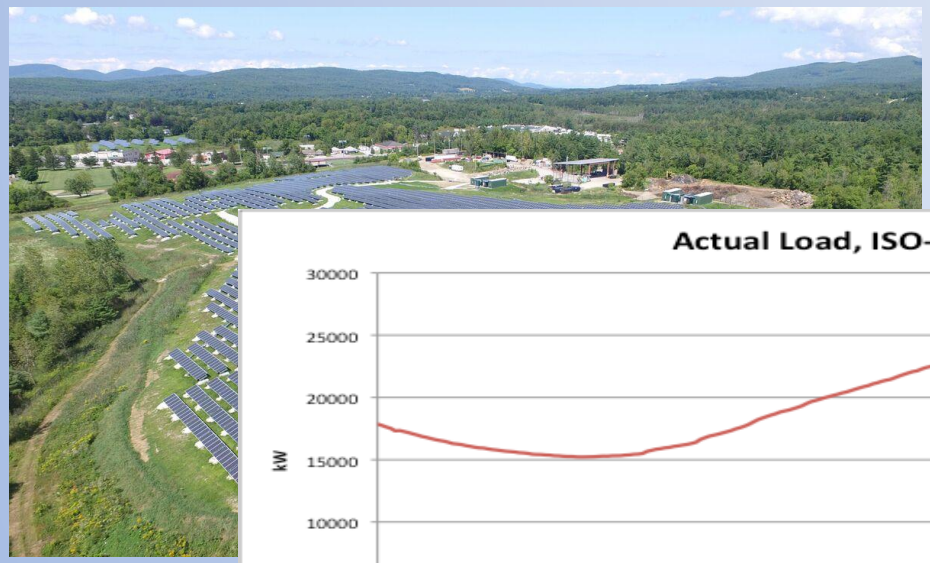
- Vermont: Rutland Microgrid
- Massachusetts: Sterling Microgrid
- Oregon: Eugene Microgrid

Vermont: GMP Microgrid, Rutland (Stafford Hill)

- 4 MW batteries (lithium ion and lead acid) + 2 MW PV microgrid
- Sited on closed landfill (brownfield redevelopment)
- Provides resilient power for school (public shelter)
- Project partners: Green Mountain Power, Dynapower, VT DPS, DOE, Sandia, CESA

- Funding: $40K VT DPS, $250K DOE-OE
- Total cost: $12 M
- Payback < 7 years via utility capacity and transmission cost reductions
- Follow-on projects:
  - 14 LMI high-efficiency modular homes equipped with resilient power solar+storage (rural mobile home replacement project)
  - Burlington Electric Dept solar+storage microgrid at Burlington Airport

Vermont: GMP Microgrid, Rutland (Stafford Hill)



- 4 MW batteries (lithium ion and lead acid) + 2 MW PV microgrid
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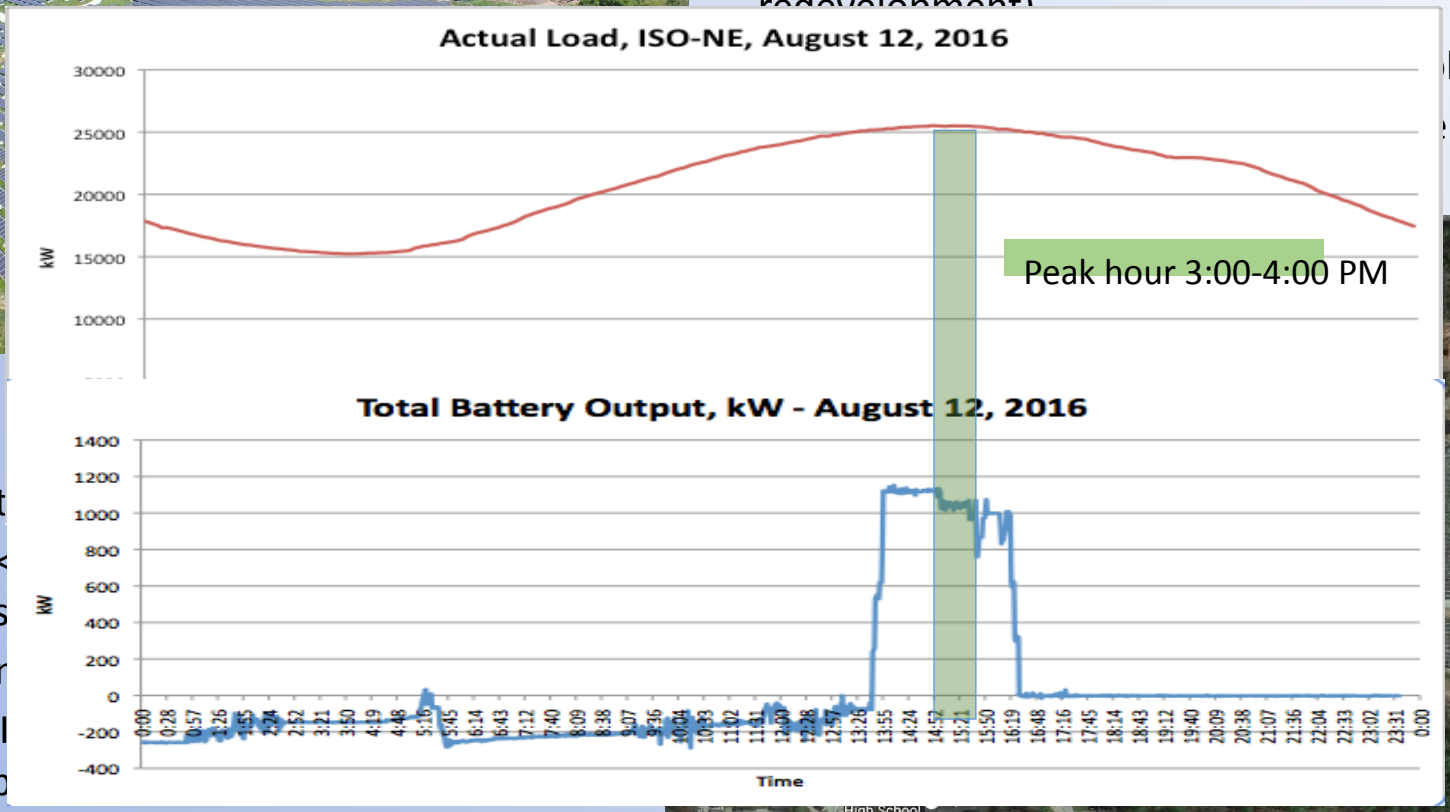

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  - Burlington Electric Dept solar+storage microgrid at Burlington Airport

Sterling, MA 2MW/3MWh Solar+Storage Microgrid

Project partners: SMLD, DOER, DOE-OE, SNL, CESA

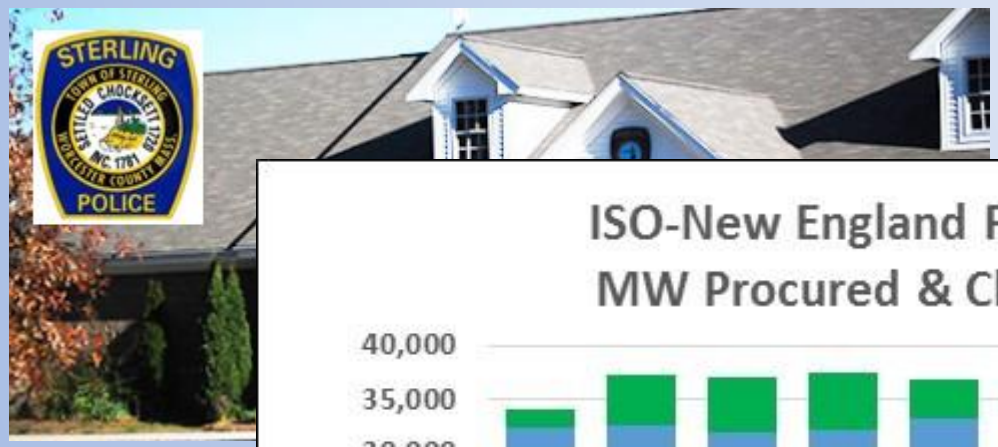
Project timeline: Groundbreaking in October 2016, commissioning by end of year

Project Summary: 2 MW / 3 mWh lithium ion battery project, connected with 3.4 MW solar PV at utility substation;
islanding capability to support municipal emergency facility.

Project Benefits and Revenue Streams:

- Backup power to support town police station / dispatch center during grid outages;
- Cost savings through reduction of SMLD's capacity and transmission obligations to ISO-NE;
- Revenues from electricity arbitrage
- Integration of intermittant solar PV

Sterling, MA 2MW/3MWh Solar+Storage Microgrid



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- Revenues from electricity arbitrage
- Integration of intermittant solar PV

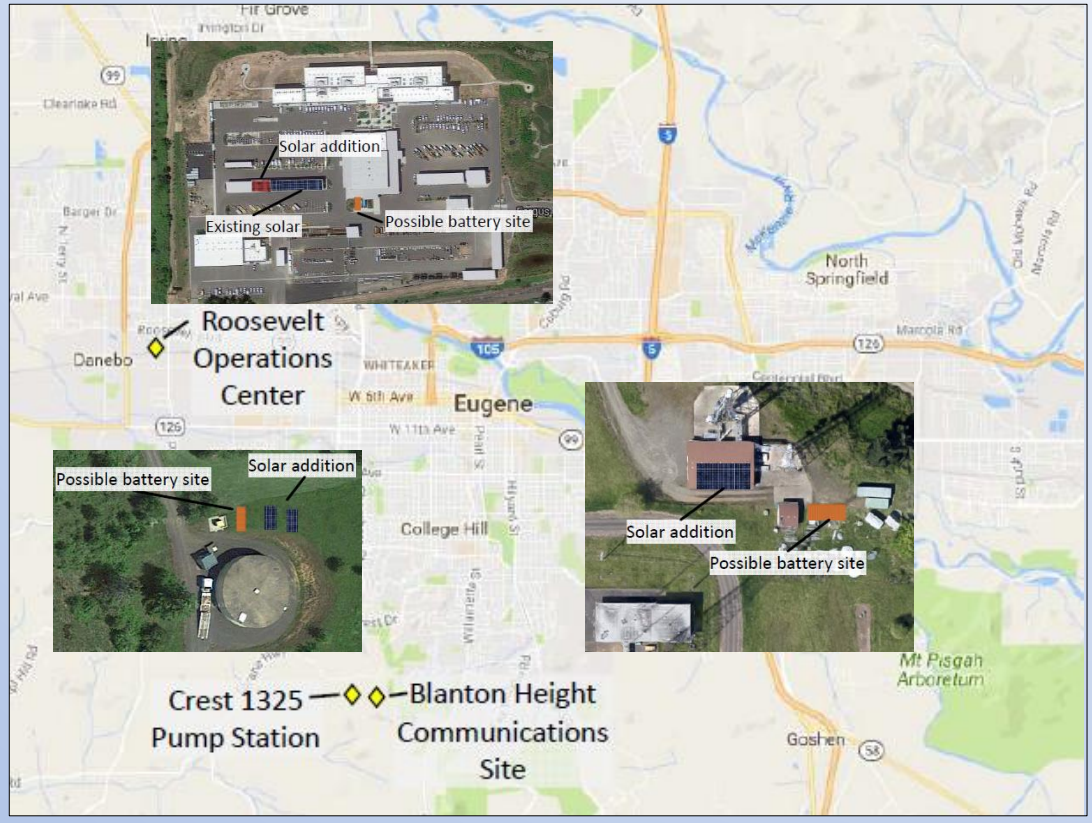
Oregon: EWEB Grid Edge Demonstration

- Joint federal/state, public/private demonstration project
- 500 kW / 900 kWh batteries (lithium ion) with 125 kW PV microgrid over three critical sites
- Partners: Eugene Water & Electric Board, ODOE, DOE, Sandia, CESA
- Funding: ODOE $45K, DOE-OE $250K
- Provides resilient power to utility operations center, communications facility and water pumping station

EWEB project has been awarded federal/state funding and is now contracting with vendors

Demonstration goals:

- transmission and distribution upgrade deferral
- peak demand management
- service reliability/resiliency
- power quality
- voltage support
- grid regulation
- renewable energy firming
- ramp control
- energy shifting.



How can states support energy storage?

States have a number of policy tools at their disposal to support energy storage deployment. These include:

- Competitive solicitations/RFPs
- Renewable Portfolio Standards and Stand-Alone Mandates
- Adders, multipliers and carve-outs
- Prescriptive rebates
- Integrating energy storage into longer-term state policy (energy reports, roadmaps, emergency planning)
- Green banks and energy resilience banks
- Tax credits/depreciation
- PACE loans
- Industry development (training/education, business incubators etc)

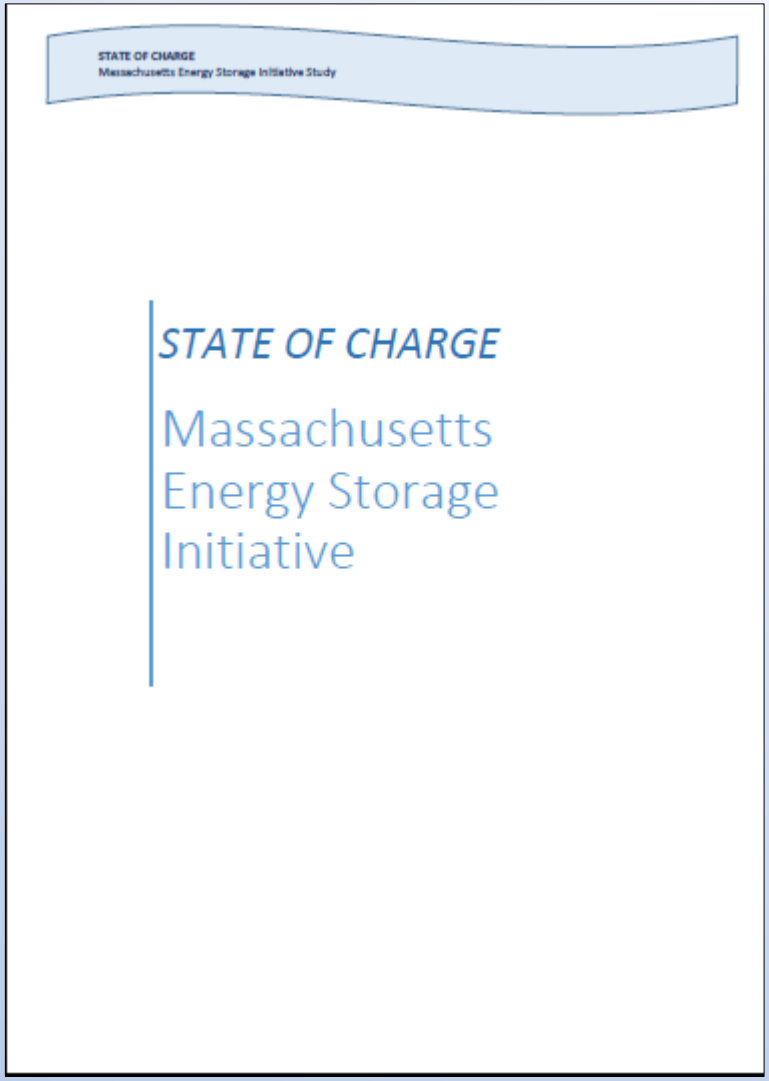
Note that these tools are available to various state agencies that often do not work together

Massachusetts Energy Storage Report: State of Charge

- Optimization modeling results: 1,766 GW energy storage in MA by 2020
- Policy recommendations: 600 MW energy storage in MA by 2025

Massachusetts energy diversity bill, signed in August:

- DOER directed to assess whether a utility storage mandate is appropriate, by December 2016; utilities would have to meet targets by 2020
- Distribution utilities may now own storage in MA



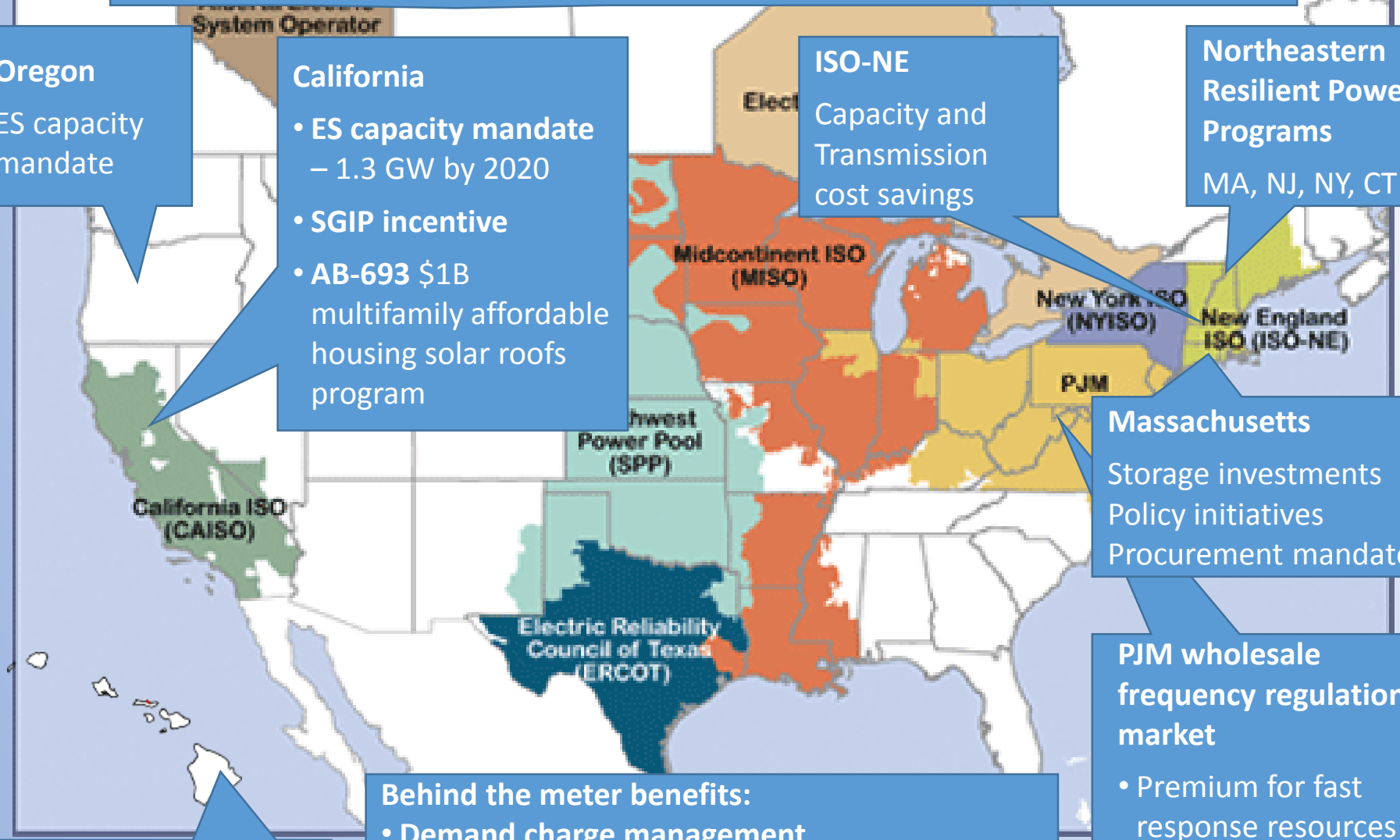
Policy Recommendations from MA State of Charge Report

1. $10 M ESI demonstration project grant funding (recommend increase to $20M)
2. $20 M rebate program for BTM C&I projects
3. $150 K grants for solar+storage site assessments at C&I (manufacturing) facilities
4. $14.2 M remaining CCERI grant funding (round 3) to focus on hospitals
5. $10 M/year Green Communities Competitive Grant Program (recommendation is to add storage as an eligible technology to this existing program. Cap is $10 M / year total expenditure)
6. $4.5 M demonstration project grants (over three years) for utility and market actors to test and demonstrate peak demand management.
7. Add storage to Alternative Portfolio Standard (currently only flywheels are eligible)
8. Include storage in new Next Gen Solar Incentive Program (replaces SREC II)
9. Clarify regulatory treatment of utility storage (IOUs revise grid mod plans)

Policy Recommendations from MA State of Charge Report

10. Support demand reduction demonstration programs using energy storage in the 2016-2018 Three-Year Energy Efficiency Investment Plan
11. Allow storage to be part of all future long-term energy procurements (requires statutory change)
12. Adopt safety and performance codes & standards for storage (probably with support from DOE and national labs)
13. Clarify and streamline interconnection requirements for storage
14. Education, sharing of use cases (with DOE/national lab support)
15. Facilitate sharing of utility customer load data and other info (such as transformer loading at substations) to allow storage developers to offer tailored products for specific customer classes (possibly in collaboration with a university or national lab that could serve as the data repository)

The Landscape for Storage: a patchwork quilt of markets, regulations, utility programs and state incentives



Oregon

ES capacity mandate

California

- **ES capacity mandate** – 1.3 GW by 2020
- **SGIP incentive**
- **AB-693** $1B multifamily affordable housing solar roofs program

ISO-NE

Capacity and Transmission cost savings

Northeastern Resilient Power Programs

MA, NJ, NY, CT

Massachusetts

Storage investments
Policy initiatives
Procurement mandate?

PJM wholesale frequency regulation market

- Premium for fast response resources
- Lowered barriers to entry for distributed resources

Behind the meter benefits:

- **Demand charge management**
- **Solar self-consumption (High electricity prices/net metering caps)**
- **Resiliency**

Hawaii

Net metering cap, high electricity rates

Thank You to:

Imre Gyuk, US DOE-OE

Dan Borneo, Sandia National Laboratories

Todd Olinsky-Paul

Project Director

CEG/CESA

Todd@cleanegroup.org

ESTAP Website: http://bit.ly/CESA-ESTAP

ESTAP Listserv: http://bit.ly/EnergyStorageList

CleanEnergy States Alliance