Creating A Cleaner Energy Future For the Commonwealth

Massachusetts Department of Energy Resources

Energy Storage Public Stakeholder Forum

May 30, 2018

Boston, MA

Panel 4: Additional Policy Considerations

Energy Storage Rebate Program Opportunities

MOR-Storage, EE Plans, and Beyond

DOER Energy Storage Public Stakeholder Forum
May 30, 2018

Northeast Clean Energy Council

NECEC's mission is to create a world-class clean energy hub in the Northeast, delivering global impact with economic, energy, and environmental solutions.

NECEC helps clean energy companies start, scale, and succeed with our unique business, innovation, and policy leadership.

Rebates in *State of Charge*

- Massachusetts Offers Rebates for Storage Program (**"MOR-Storage"**) for Customer-sited Projects

7.2.2 Massachusetts Offers Rebates for Storage ("MOR-Storage") Program

Summary	Rebate Program for Behind the Meter Storage Projects (customer-sited)
Duration of the program	Rolling grant opportunity
Funding	$20 million of ACP funds
Targeted Use Cases	Storage located on-site (either paired with on-site solar generation or stand-alone) at commercial and industrial businesses
Implementation requires	Development of program scope and incentives

What *State of Charge* found

- "Buy-down" rebate programs = very successful in rapidly accelerating new technology adoption
- Modeled after DOER's successful MOR-EV Rebate program, providing funding for EV purchases
- Goal = encourage commercial and industrial customers to invest in storage that will:
  - Assist in lowering electricity bills,
  - Better utilize any on-site generation, and
  - Provide benefits to the grid by reducing peak demand.

SGIP-off-the-ol'-block

- MOR-Storage could emulate and build upon California's **Self Generation Incentive Program (SGIP)**
- SGIP by the numbers in 2017:
  - 165 MW of storage (20 MW resi; 144.7 MW C&I)
  - 3,669 projects (2,992 resi; 677 C&I)
  - $128,144,709 in incentive payments
- Storage incentives based on:
  - Energy capacity (kWh) – Incentive rate based on kWh
  - Hours duration of the system
  - Power capacity (kW) – Determines budget category and performance (cycling) requirements.
  - The active/current step – declining rate per step

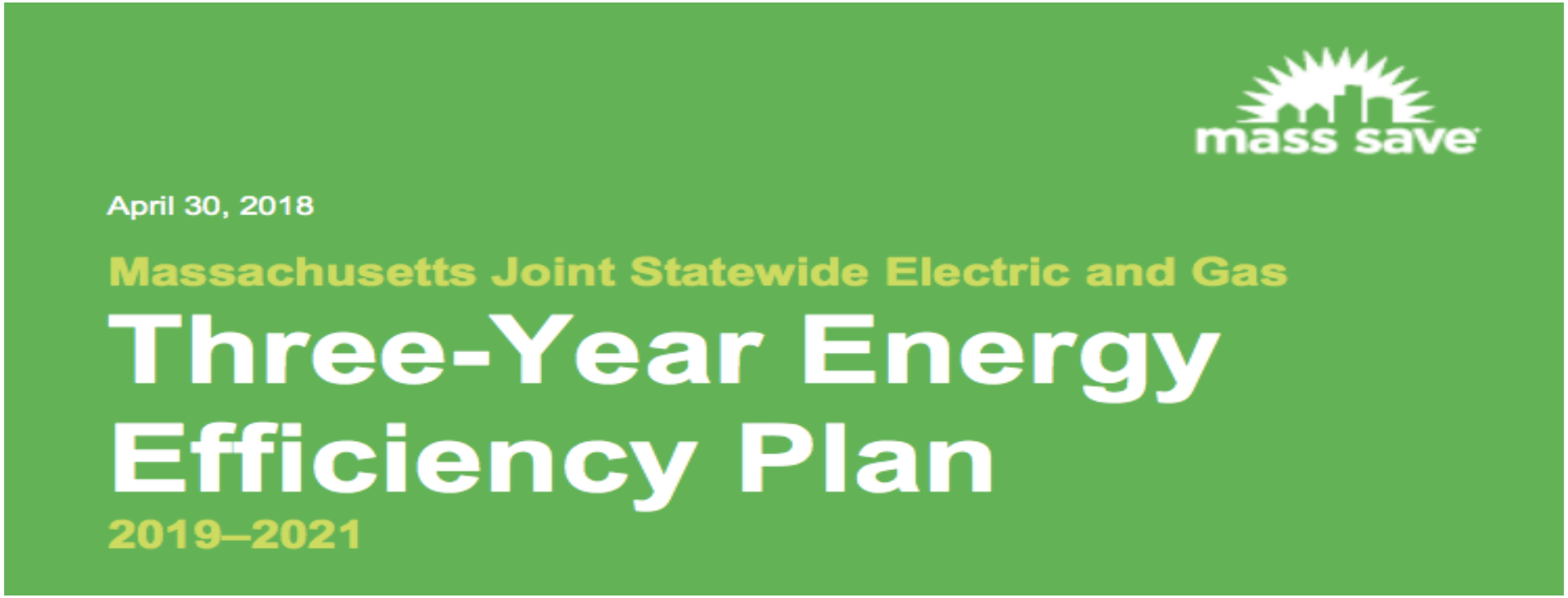
SGIP-off-the-ol'-block (cont'd)

- 2017 SGIP storage incentive began at $0.50/Wh ($0.36/Wh if claiming ITC).
- Incentive declines by $0.05/Wh per step
- Storage incentives are reduced as the duration (hours) and energy capacity (MWh) increase:

>4-6 hours	25%	12.5%	6.25%
>2-4 hours	50%	25%	12.5%
0-2 hours	100%	50%	25%
	0-2 MWh	>2-4 MWh	>4-6 MWh

The Missing Piece: **$$$**

- Alternative Compliance Payment (ACP) revenues not likely to be available.
- Need to identify additional funding possibilities.
  - Enter:



Storage as Energy Efficiency: *Active Demand Management*

- Authority for storage in EE plans:
  - Green Communities Act – MGL Ch. 25 § 21

Section 21. (a) To mitigate capacity and energy costs for all customers, the department shall ensure that, subject to subsection (c) of section 19, electric and natural gas resource needs shall first be met through all available energy efficiency and demand reduction resources that are cost effective or less expensive than supply. The cost of supply shall be determined by the department with consideration of the average cost of generation to all customer classes over the previous 24 months.

  - Statute allows investments in measures that reduce demand (efficiency, conservation, demand response load management, etc.).

Storage as Energy Efficiency: *Active Demand Management*

necec
Your Partner in the Clean Energy Economy

- Authority for storage in EE plans (cont'd):
  - Energy Diversity Act – Chapter 188 of the Acts of '16

SECTION 15. (a) On or before December 31, 2016, the department of energy resources shall determine whether to set appropriate targets for electric companies to procure viable and cost-effective energy storage systems to be achieved by January 1, 2020. As part of this decision, the department may consider a variety of policies to encourage the cost-effective deployment of energy storage systems, including the refinement of existing procurement methods to properly value energy storage systems, the use of alternative compliance payments to develop pilot programs and the use of energy efficiency funds under section 19 of chapter 25 of the General Laws if the department determines that the energy storage system installed at a customer's premises provides sustainable peak load reductions on either the electric or gas distribution systems and is otherwise consistent with section 11G of chapter 25A of the General Laws.

  - Explicitly contemplates the use of energy efficiency funds to drive storage adoption for purposes of meeting energy storage target(s).

Draft 2019-2021 EE Plans

- Include extremely modest proposals for active demand management in C&I sector.
  - $17,675,209 in participant incentives over 3 years.
  - C&I active demand reduction initiatives propose a *technology-agnostic* approach.
    - *"Customers will earn an incentive for verifiably shedding load during expensive, electric system peak periods in response to events called by Program Administrators based on specific conditions."*
- Based primarily on recent evaluated demonstration efforts; storage NOT adequately contemplated.
  - PAs say "not yet": they will evaluate Eversource demonstration projects (DPU 16-178) for prospects of deploying cost-effectively at scale, *via mid-term modification or in next three-year plan.*

Cracking the Cost-Effectiveness Code

- To justify a full storage rebate program, stakeholders will need to demonstrate storage **cost-effectiveness**.
- All EE investments must surpass the benefit-cost threshold of the **Total Resource Cost (TRC) test**.
  - Draft plans: C&I active demand management (w/out storage) has 3-year B/C ratio of 1.51.
- Normal TRC benefits: avoided energy, avoided capacity valued at peaking periods, avoided transmission, avoided distribution, and effects on energy market prices, and non-energy impacts.
- Due to unique characteristics (time-specific) of ADM measures, the PAs have developed an adjusted methodology for "appropriate B/C accounting" in the TRC test (*draft plans, p. 120*).

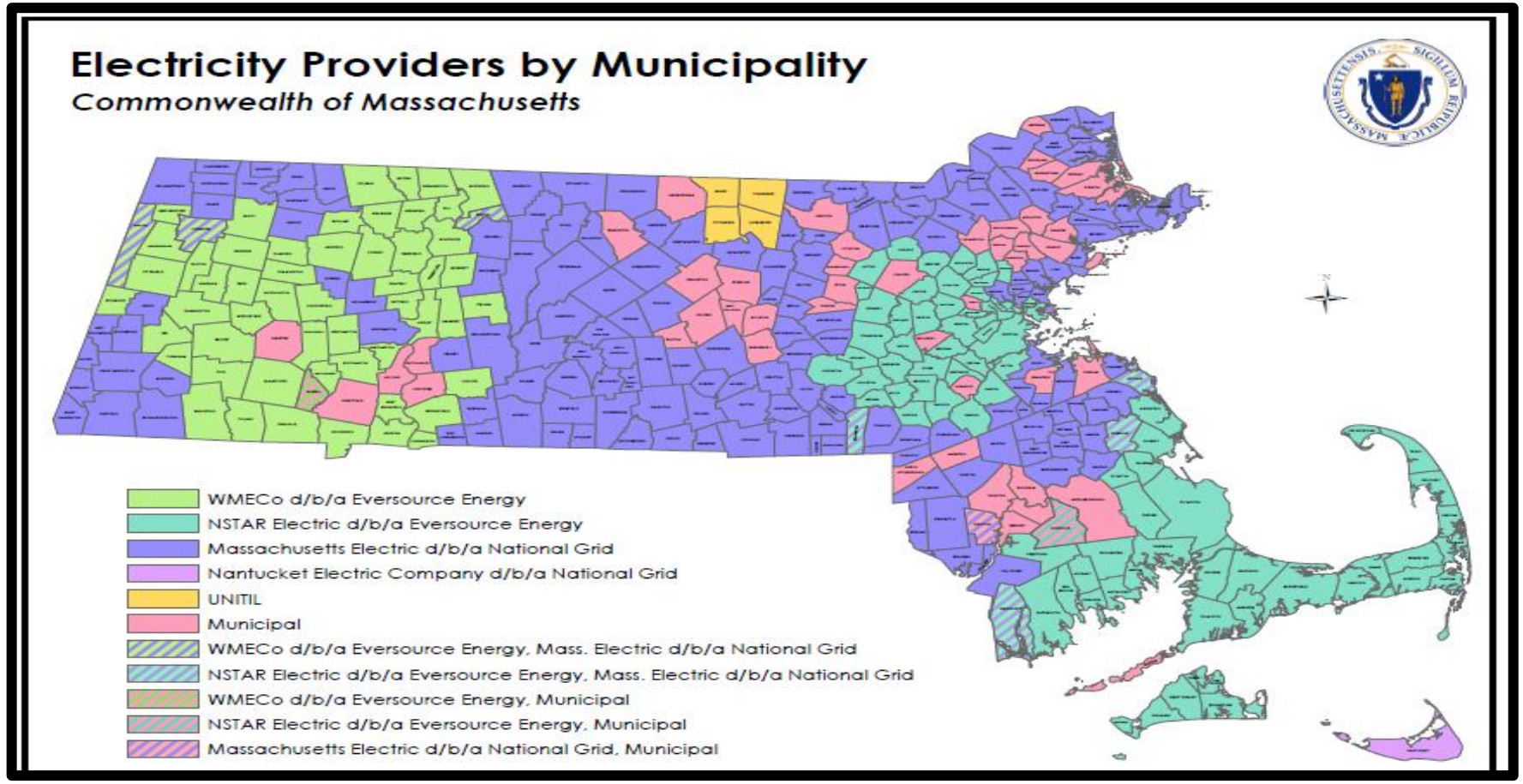
Storage TRC Benefits

- Work underway to demonstrate TRC cost-effectiveness for a robust energy storage offering.
  - Critical need? Access to "live" TRC spreadsheets, showing assumptions on costs and benefits, discount rate, rate of inflation, avoided costs, and more.
- Not directly captured by TRC: substantial customer bill savings.
  - Outside of dispatch signals, customers would be allowed to optimize for **demand charge** and **Installed Capacity ("ICAP") tag** management.
  - Current model for ADM: focused on reducing demand during summer peak events typically targeting **fewer than twenty hours** per summer.
    - Ample opportunity for beneficial operation outside of these hours (especially for winter peak management).

Scale of the Opportunity

More than **70,000** commercial customers in Massachusetts *currently* pay demand charges that would make energy storage economical (>$15/kW)

via Clean Energy Group



(Light blue areas are highest demand charges)

The Ask: MOR-Storage, Now

- Draft 2019-2021 EE plans include active demand management, but exclude storage.
- Overall, draft plans reflect a significant decrease in program-wide electric investments and savings, suggesting opportunity (and need) for new offerings.
- So, let's find a robust role for MOR-Storage rebates within the finalized ADM portfolio for 2019-2021.
  - Funding level could be $15m-$30m per year, proportionate with SGIP's $128m funding in 2017.
  - Deployment focus:
    - C&I sector, along with residential
    - Standalone energy storage systems
    - Solar+storage retrofits of SREC I+II systems
    - Promoting beneficial projects with adders for resiliency, LMI, critical facilities, and co-location with DG.

The Ask: MOR-Storage, Now

- Including a storage rebate program in the EE plans will:
  - Provide a near-term, storage-exclusive incentive to jumpstart statewide deployment.
  - Be complementary to any actions taken to boost storage's role in portfolio standards.
  - Be easy to tailor for the purposes of capturing and driving the unique benefits energy storage can provide, such as resiliency (via adders).
  - Ensure funding security/certainty through EE funding streams.

Thank you!

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Policy Analyst

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Sterling Municipal Light Dept.

DOER Energy Storage Portfolio Stakeholder Forum

May 30, 2018

Sean Hamilton General Manager

Sterling 2MW / 3.9 MWHR Battery Storage Project


Ice Storm 2008

Resiliency Benefits
2mw/3.9mwhr -Battery Energy Storage System

1. BESS provides Power up to 12 Days.
2. BESS Located in Main Substation.
3. Substation 2,300’ from Critical Facility.
4. Separate Circuit for BESS and CF.
5. MicroGrid Capable with Solar.
6. Live Test Performed April 27,2017

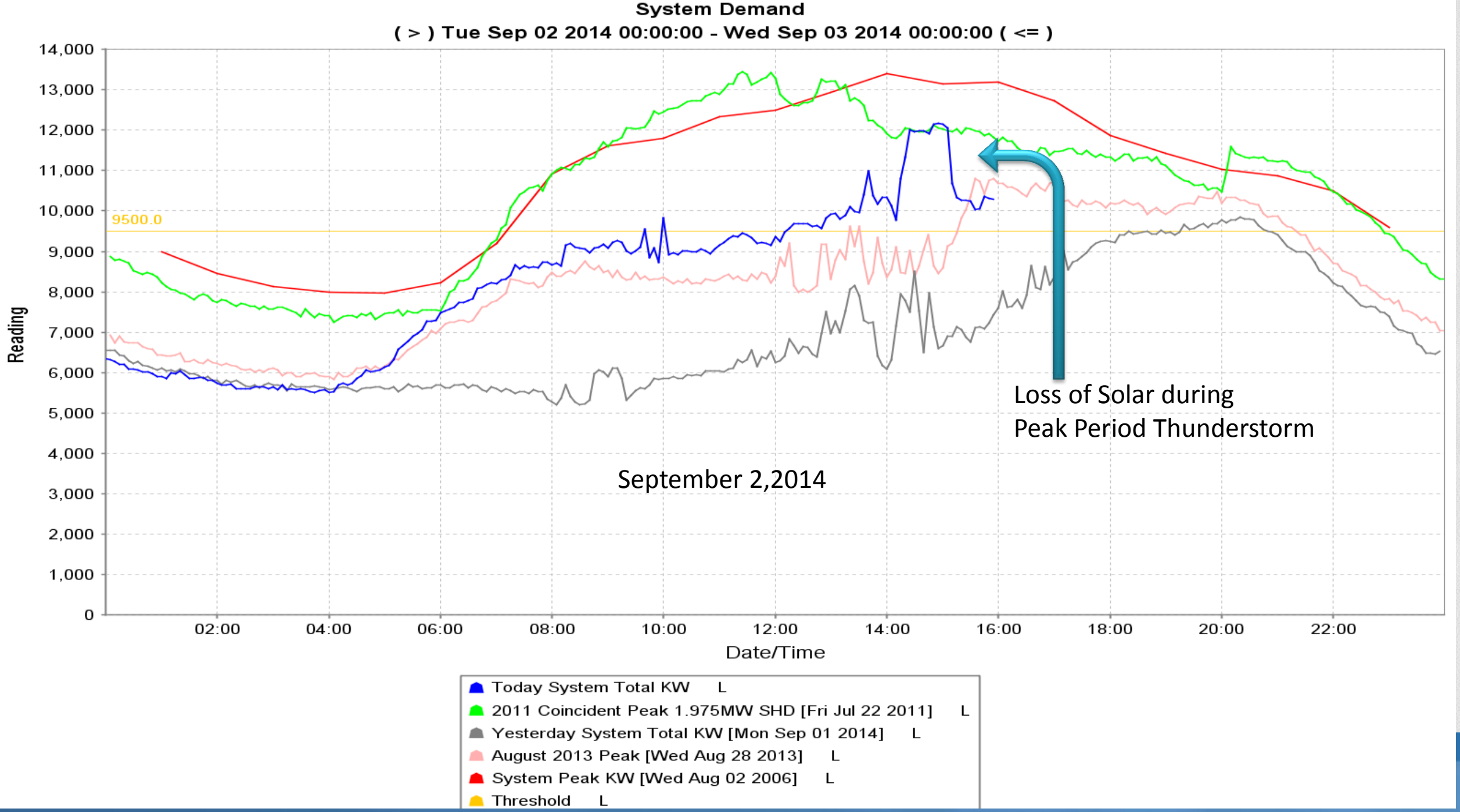
Value of Battery Energy Storage

$481,629 as of 5/15/2018

- **Grid Resiliency-Police and Dispatch Center**
- **Smoothing Intermittent Resources**
- **Regional Network Service (RNS) -Monthly Peak**
  - **Captured 14/17 monthly peaks for a value of $222,507**
- **Capacity Load Obligation Payments –Annual Peak**
  - **Captured Annual Peak (June 13) for a value of $244,460**
- **Energy Arbitrage-Value to Date $14,662, 54 Round Trip Operations**
- **Frequency Regulation-Not Participating in this Market**

Source: The Value proposition for Energy Storage for Sterling Municipal Light Department

Author Dr. Raymond Byrne, Sandia National Laboratories. www.energysterling.com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Date/Time
Loss of Solar during
Peak Period Thunderstorm
September 2,2014
Today System Total KW L
2011 Coincident Peak 1.975MW SHD [Fri Jul 22 2011] L
Yesterday System Total KW [Mon Sep 01 2014] L
August 2013 Peak [Wed Aug 28 2013] L
System Peak KW [Wed Aug 02 2006] L
Threshold L

Visitors to the **Sterling Community Clean Energy Resiliency Initiative Battery Storage Project** include:

Representatives from the following countries: (12)

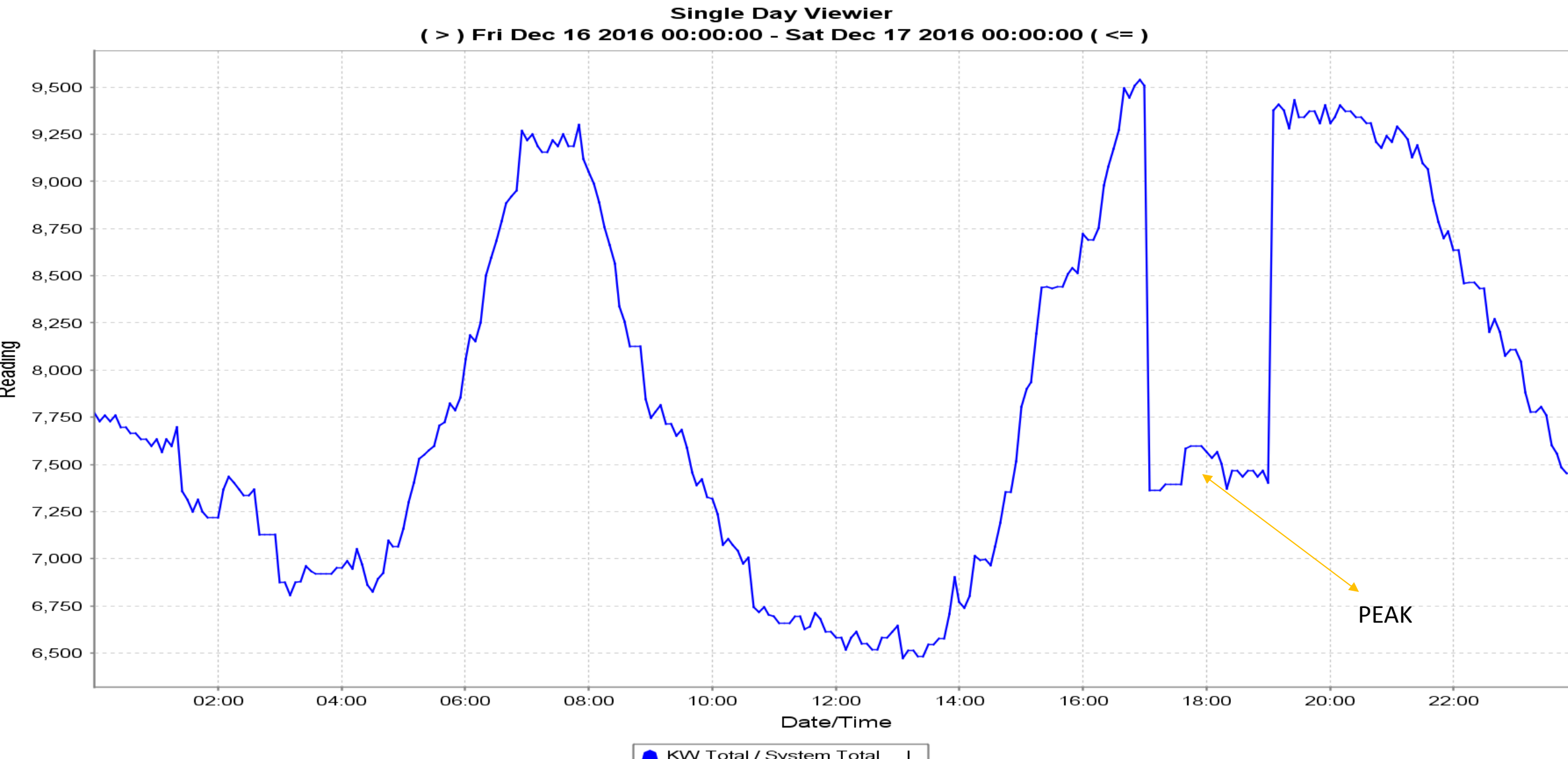
Japan, Sweden, Denmark, Germany, Sweden,
England, Taiwan, Switzerland, Brazil, Malaysia, Chile, Ireland

visitors also include representatives From:

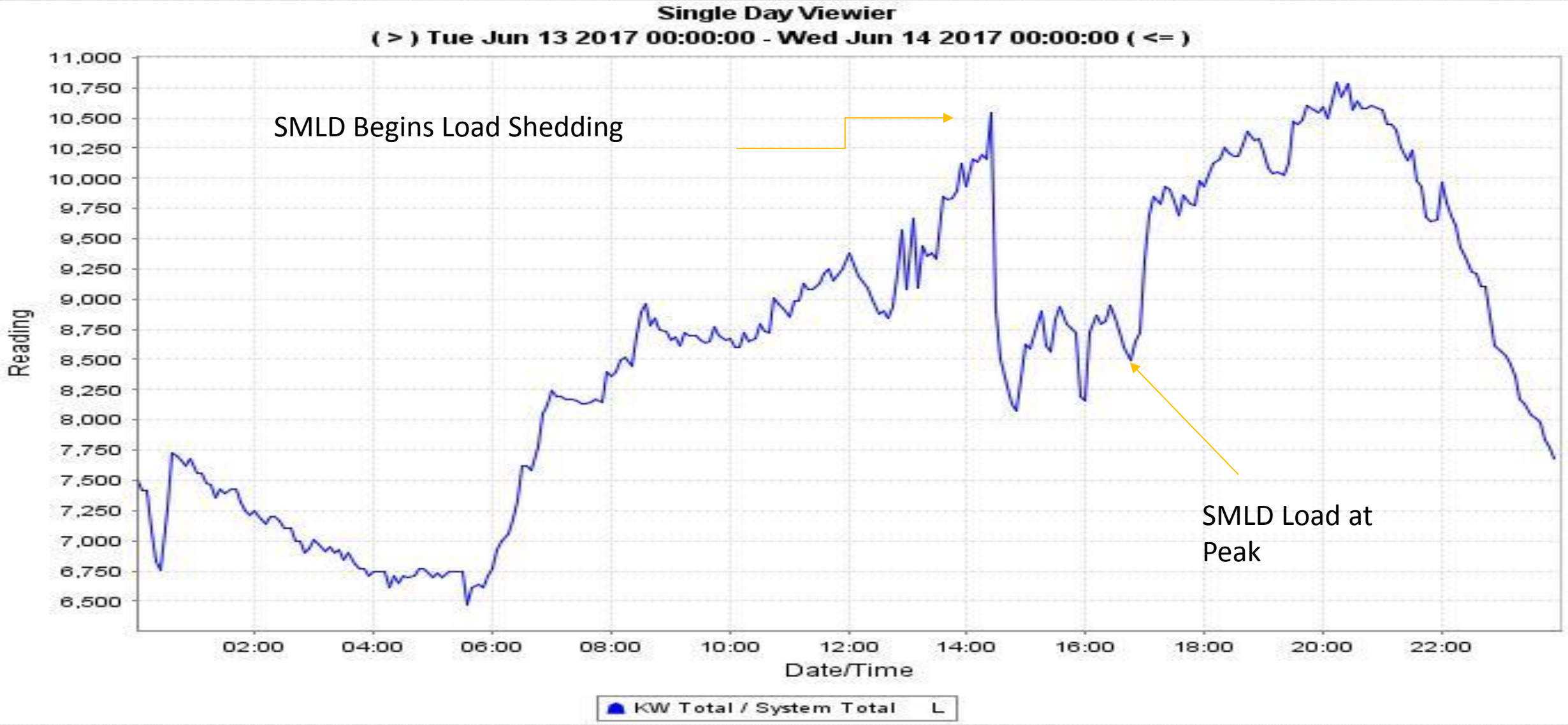
Washington DC- General Accounting Office (GAO)
Alaska-Utility representatives
Puerto Rico
Duke Energy
Clean Energy States Alliance (CESA)
Smart Energy Power Alliance (SEPA)
Massachusetts Municipal Wholesale Electric Company (MMWEC)
Energy New England (ENE)
Massachusetts Citizens Action Network (MCAN)
Northeast Public Power Association (NEPPA)

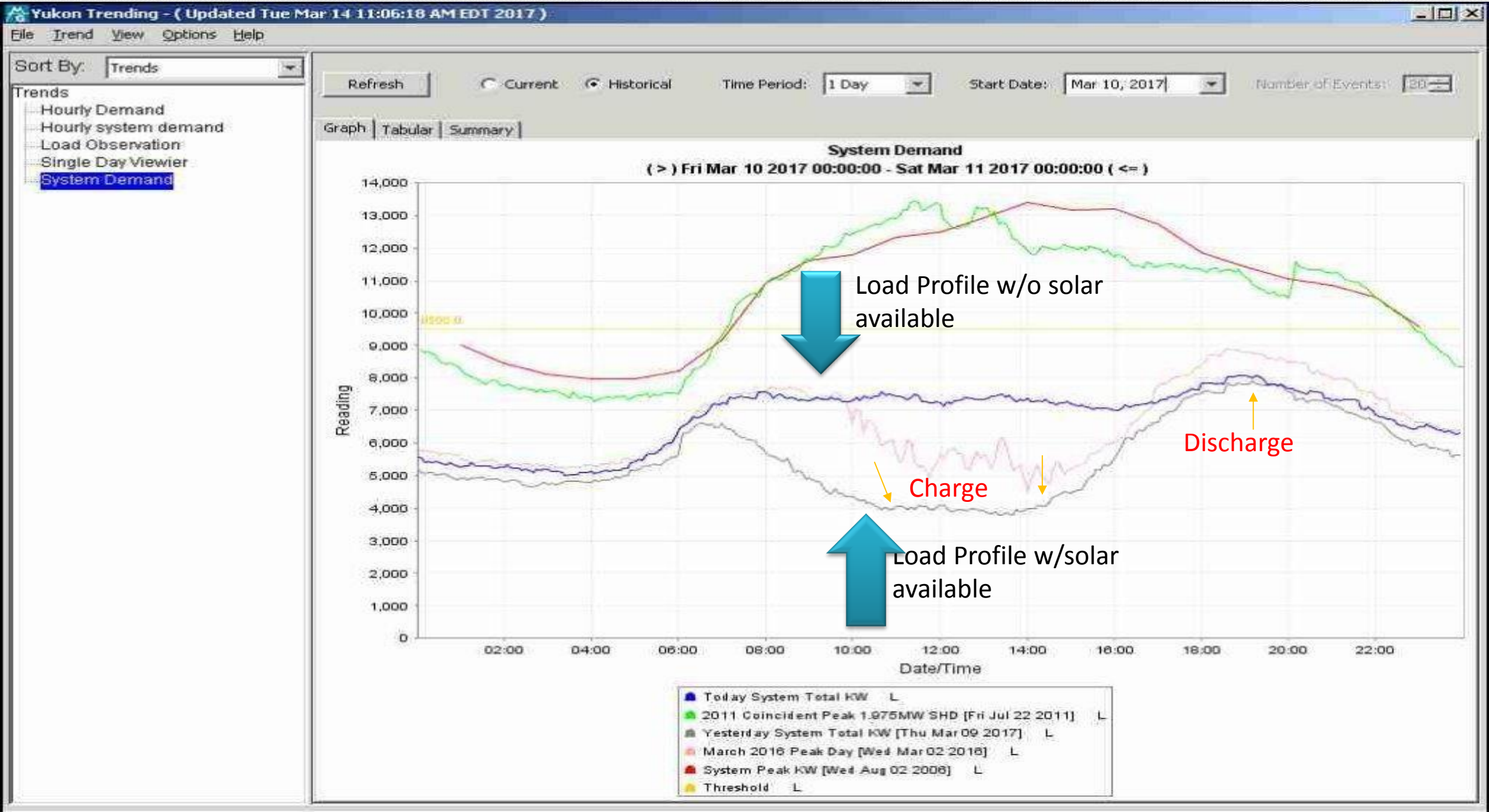
Other representatives From Utilities:
Municipal Light Departments- (23 total), New Hampshire Electric Coop
National Grid, Unitil, Eversource, United Illuminating, Con Edison

Began Construction 10-12-2016
Reduces RNS Peak on 12-16-2016



June 13,2017 – ISO-NE Peak Day




Yukon Trending - (Updated Tue Mar 14 11:06:18 AM EDT 2017)
File Trend View Options Help
Sort By: Trends
Trends
Hourly Demand
Hourly system demand
Load Observation
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Refresh
Current
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Time Period: 1 Day
Start Date: Mar 10, 2017
Number of Events: 30
Graph Tabular Summary
System Demand
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18:00
20:00
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Date/Time
Load Profile w/o solar available
Discharge
Charge
Load Profile w/solar available
Today System Total KW L
2011 Coincident Peak 1.975MW SHD [Fri Jul 22 2011] L
Yesterday System Total KW [Thu Mar 09 2017] L
March 2016 Peak Day [Wed Mar 02 2016] L
System Peak KW [Wed Aug 02 2006] L
Threshold L

Costs To Install*

>Engineering	$116,212.03
>Feasibility Study	$7,000.00
>BESS (with Inverter)	$2,034,075.00
>Other Equipment	$154,129.61
>Labor Incl- Line Crew	$76,390.25
>Legal	$62,725.06
>Testing/Commissioning	$11,293.95
>Admin, Ops Supv ,GM, Acct.	$80,893.14
	$2,542,719.04

* Does not include Optional Substation Communication or Relay Panel upgrades

Sterling Video Produced by CESA and the Barr Foundation

This Video has been shown around the world

https://youtu.be/w3It2lwLCm4

https://vimeo.com/217842952/a63a69cd1e

Sterling Municipal Light Department

New Project

1 MW Community Solar with
1 MW/2 MWHRs Battery Storage

- Battery charging achieved with solar
- Shift low cost solar to peak periods
- Allows residents access to solar , otherwise unavailable
- Peak Shaving Benefits shared with all ratepayers
- Program Subscription roll out expected April 2018

Sterling Dedicates Massachusetts First Community 1 MW Solar + 1 MW/2 MWHR Battery Storage, April 14,2018


2017
TOP 10
SEPA
UTILITY ENERGY STORAGE RANKINGS
TOP 10 ANNUAL WATTS-PER-CUSTOMER
1
Sterling Municipal Light Department
533 Watts-per-customer
2
Glasgow EPB
248 W/C
3
Imperial Irrigation District
198 W/C
4
American Samoa Power Authority
109 W/C
5
Indianapolis Power & Light Company
42 W/C
6
Duke Energy Ohio
23 W/C
7
Maui Electric
17 W/C
8
San Diego Gas & Electric
12 W/C
9
Green Mountain Power
8 W/C
10
Commonwealth Edison, an Exelon Company
6 W/C

Special Thanks to :

- SMLD Commissioners/Operations - For their support of this project
- Town of Sterling - For their continued support
- Judith Judson – MA DOER Commissioner
- Dr. Imre Gyuk - U.S. Dept of Energy, Energy Storage Program Director
- Sandia National Laboratories - Daniel Borneo PE., Dr. Raymond Byrne
- Todd Olinsky-Paul - Director of CEG and CESA.
- MMWEC - Market Observation, Peak Forecasting and Operations
- Scott Reynolds, OPM and Mike Barrett, PLM, Design Engineering
- Jared Carpenter, Jim Frawley-Grant Technical Information

Massachusetts Energy Storage Projects

May 30, 2018

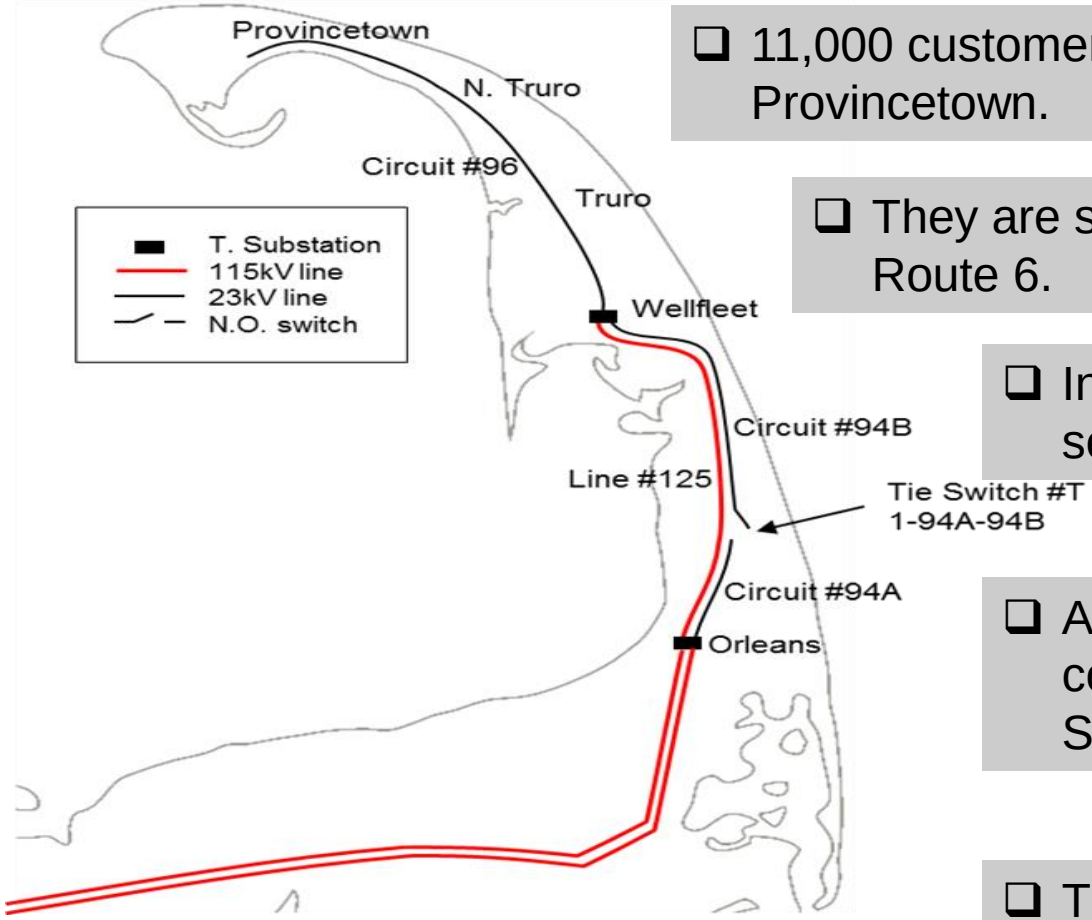
Executive Summary

- On 11/30/17, the Massachusetts DPU authorized Eversource to construct two battery storage projects, one on the Outer Cape and one on Martha's Vineyard.
- These projects are currently under development with land use permitting expected to commence in 2018.
- We expect the projects will go into service in the 2020 – 2021 timeframe.
- We are using the projects to demonstrate the value of storage as a distributed resource for our customers.

Energy Storage Project Number One:

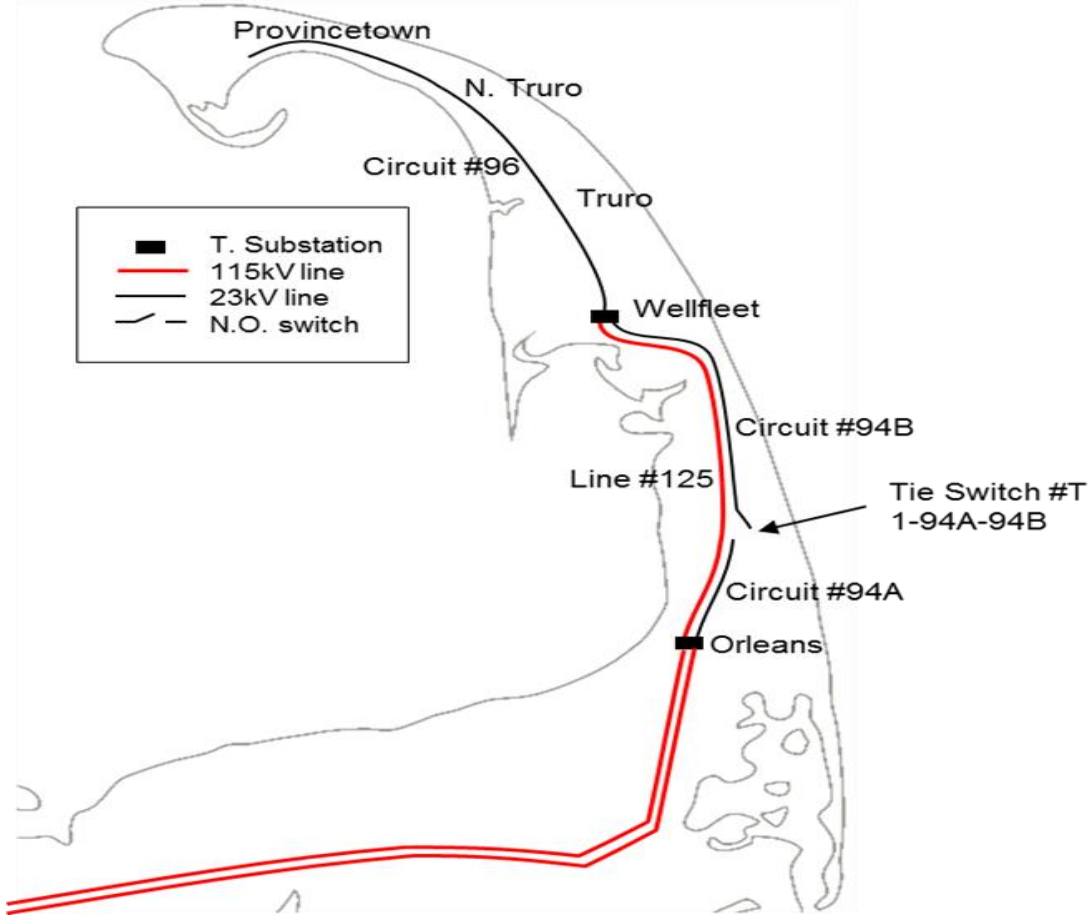
The Outer Cape Community Battery Project

Snapshot of the Outer Cape Today



- ❑ 11,000 customers downstream of the Wellfleet substation from Wellfleet to Provincetown.
- ❑ They are served by a single line with no redundancy that runs along Route 6.
- ❑ In the last 5 years, these customers have experienced several multi-hour outages.
- ❑ Adding a redundant line to improve reliability would require construction through 13 miles of the Cape Cod National Seashore.
- ❑ This is among the top circuits we have targeted for improved performance in our service territory across all three states.

We Are Designing The Outer Cape Community Battery Project To Address These Issues.



What It Is:

A lithium ion battery, projected to provide up to three hours of back up supply in the summer and 10 hours in the winter.

What It Looks Like:

The battery will be housed in an estimated 11,000 square foot Cape Style Building (gray shingles, white trim) on about half an acre in the Outer Cape.

What It Will Do:

Improve reliability in Provincetown, Truro, and Wellfleet by an estimated 50% on the distribution and transmission system.

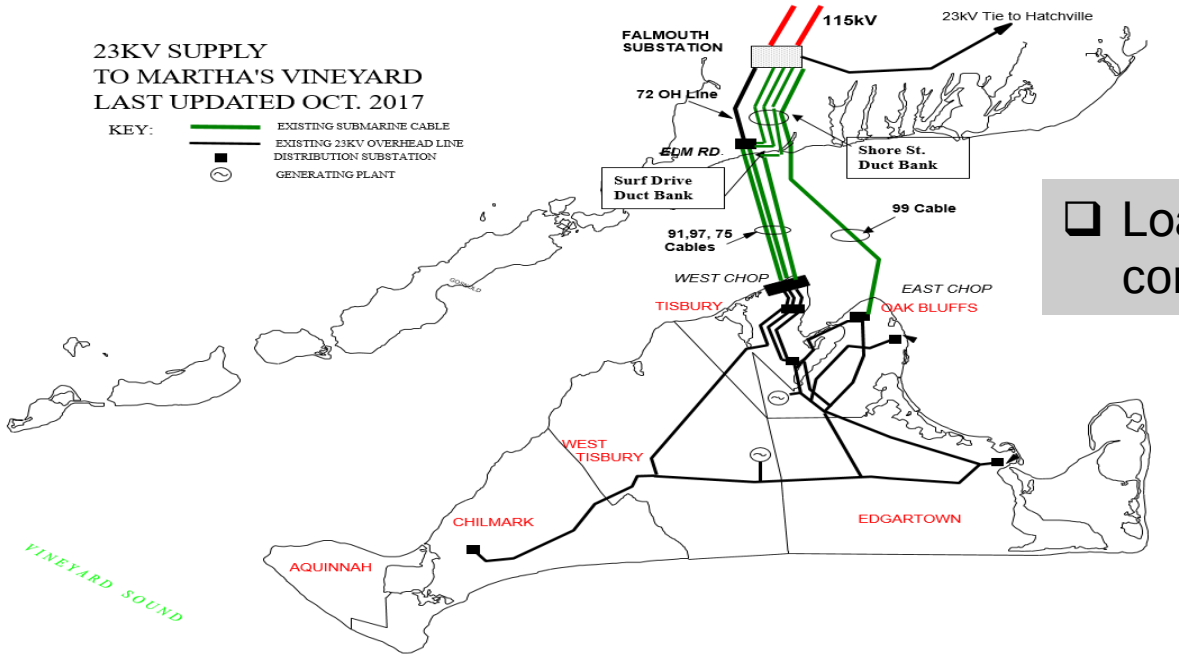
Avoid the need to build 13 miles of distribution line through the Cape Cod National Seashore area.

Act as the equivalent to taking approximately 25,000 homes off the grid during peak hours.

Energy Storage Project Number Two:

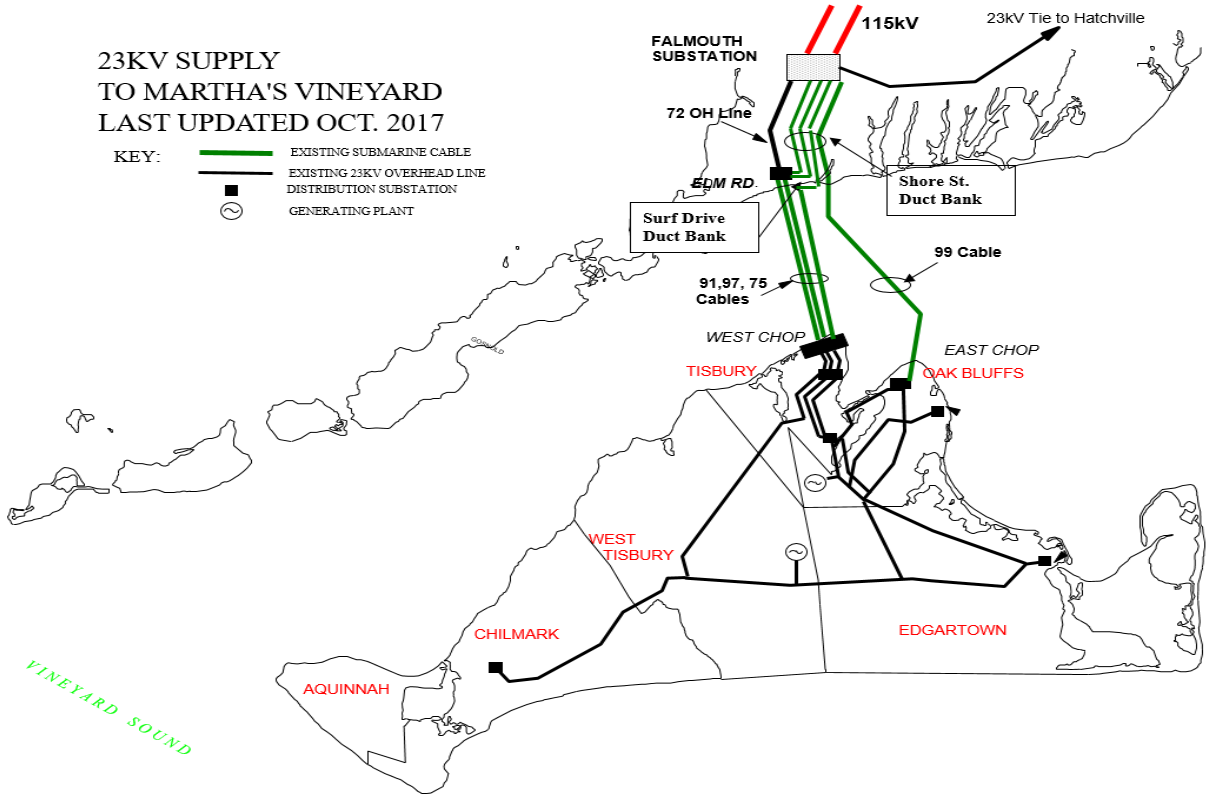
The Martha's Vineyard Community Battery Project

Snapshot of Martha's Vineyard Today



- Served by 4 underground cables from Falmouth.
- Load on Martha's Vineyard is growing and expected to continue.
- During peak loading conditions the cables can become overloaded, necessitating reliance on diesel fired peakers located on the Island.

What We Are Designing The Martha's Vineyard Community Battery Project To Do



What It Is:

A lithium ion battery sited in Cape Style Building on 1/3 an acre.

What It Does:

Demonstrates the ability to retire 2 diesel fired peakers in the future.

Provides the equivalent of powering an estimated 5,000 homes with cleaner energy for 4 hours.

Enhances reliability for all Martha's Vineyard customers.

Supports installation of additional distributed solar.

Helps Martha's Vineyard achieve its energy goals.

Customized Energy Solutions

MA DOER Energy Storage Public Stakeholder Forum – Wholesale Market Considerations

May 30, 2018

Analyze · Simplify · Implement

Outline

- CES Overview
- ISO New England
  - Overview
  - Rules for energy storage resource participation
    - Current, Enhanced Storage Participation, FERC Order 841
  - Value drivers
- Interactions of state programs with ISO Markets

CES Overview

Market Intelligence Reporting

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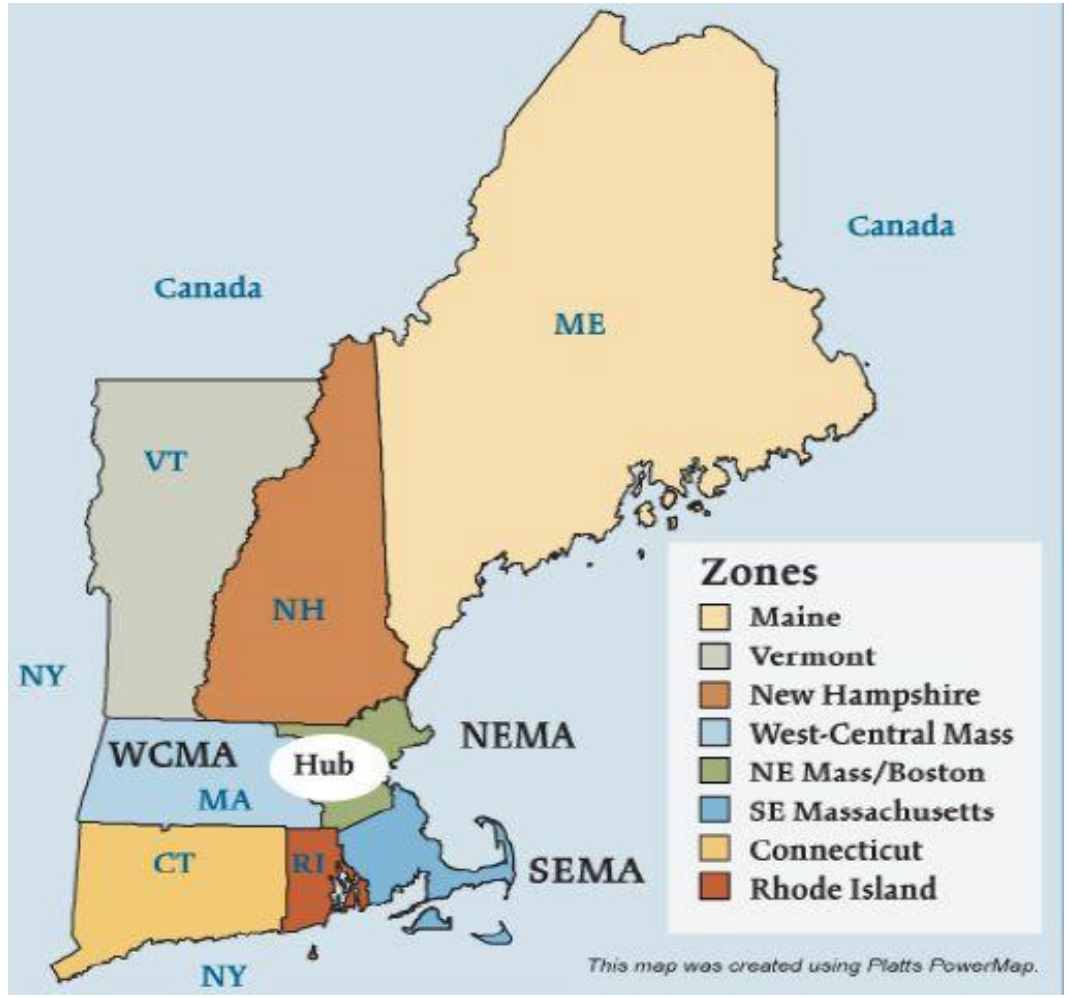
ISO New England Overview

- Not-for-profit corporation responsible for keeping electricity flowing across New England
- Created in 1997 to plan and operate regional power grid, administer wholesale markets, and ensure open access to transmission lines
- 14.8 million people over six states
- Peak load of 28.1 GW (2006)
- Total annual energy served of 121,061 GWh (2017)
- 350 generators
- 31 GW of generating capacity
- >2,700 MW of demand response (DR) registered
- 9,000 miles of transmission network
- $0.5-2.0 billion in annual transmission investments
- ~$6 billion in annual market transactions



Current Rules for Storage Resource Participation in ISO-NE

- Markets – Capacity (FCM), Energy (DA & RT), Ancillary Services (Regulation, Reserves, other)
- FOM – Hydro pumped storage operating since 1970s – as a combined generator and load asset
- 2015 created new asset class: Alternative Technology Regulation Resource (ATRR)
  - Created testing environment for new technologies
  - Energy-neutral Regulation dispatch signal
- Net energy settlement options – front-of-meter assets can settle net energy at wholesale prices
- BTM – DR – Transitional Demand Response Program (TDRP), Real-Time Demand Response (RTDR) type, sell Capacity and Energy
  - Starting June 1, 2018 Price Responsive Demand Response (PRDR) program will fully integrate DR, meaning into Energy and Reserve markets
- Minimum size - for generators, 100 kW or 1 MW; for DR, 100 kW
- Many asset registration options

ISO-NE Enhancements for Storage Resources

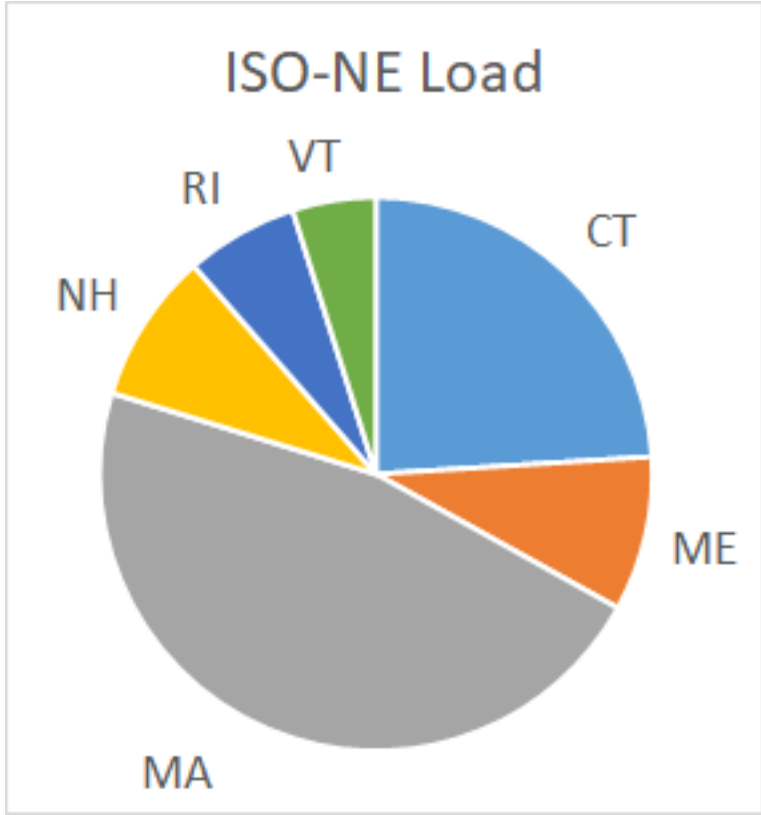
- "Enhanced Storage Participation" - Enhance the ability of electric storage facilities to participate in the New England wholesale electricity markets
- Acknowledges newer storage technologies have different characteristics than pumped storage
- Addresses gaps between market rules and storage technologies' unique physical capabilities
- Stakeholder meetings April – July
- Implementation Q1 2019
- Brings ISO-NE much of the way towards compliance with FERC Order 841

FERC Order 841 and ISO-NE

- Issued February 2018, Enabling Full Wholesale Market Participation by Storage (RM16-23)
- ISOs to establish a "participation model" for Electric Storage Resources, recognizing physical and operational characteristics
  - Eligibility to Participate in Markets
  - Bidding Parameters
  - Eligibility to Bid, Be Dispatched, and Set Prices as Wholesale Seller/ Buyer
  - Minimum Size Requirement
  - Energy Used to Charge
- Compliance filings due Dec 2018; Implementation due Dec 2019
- ISO-NE to hold stakeholder meetings August – October

Storage Value Drivers Within ISO Markets

- Wholesale cost reduction
- Behind a meter – wholesale or retail
- Capacity (FCM)
- Transmission (RNL or RNS)
- Load reconstitution may limit value
- Other benefits (from *State of Charge*), including: Energy cost reduction, ancillary service cost reduction, other wholesale market cost reduction, reduce emissions, increase reliability and resiliency



Interaction of State Programs with ISO Markets

- Integrating Markets and Public Policy (IMAPP) – ISO-NE stakeholder process began in 2016, recently received FERC approval for supplemental Capacity auction
  - Competitive Auctions with Sponsored Policy Resources (CASPR)
  - Old – subsidized resources had high minimum offer price rule (MOPR) -> might not clear FCM
  - New – secondary auction, with SPR and retiring resources, laws in effect 1/1/18
- RPS
- SMART
- Net Metering
- Clean Peak Standard
- TVR Portfolio

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THANK YOU!

Mike Berlinski
Director, Emerging Technologies
mberlinski@ces-ltd.com

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Creating a Clean, Affordable and Resilient Energy Future for the Commonwealth

Massachusetts Department of Energy Resources

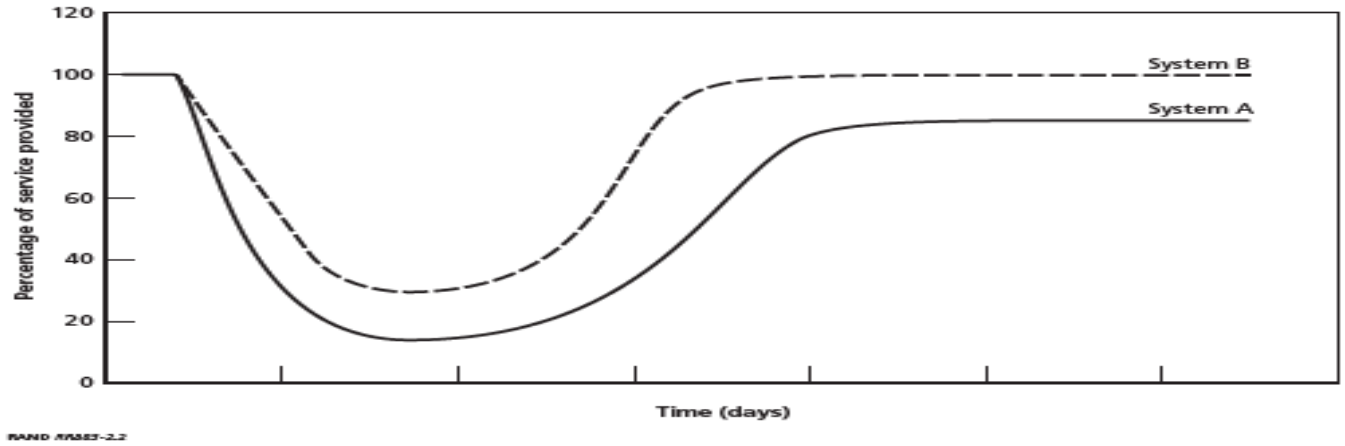
Opportunity to Value Resilience in a Portfolio

Will Lauwers

Defining Energy Resilience

- RAND study Measuring the Resilience of Energy Distribution Systems;
- "Resilience describes the state of service being provided by a system in response to a disruption. When assessing resilience, key questions would be whether the service has been degraded, how much of the service has been degraded, how quickly the service has been restored, and how completely the service has been restored. Therefore, resilience does not describe a dichotomous state of whether or not a disruption has occurred. Rather, resilience describes the degree of disruption across multiple dimensions, which could include type, quality, time, and geography of service provision."

Figure 2.2
Different Systems Will Have Different Resilience to the Same Disruption



Massachusetts Department of Energy Resources

Storage Improves Resilience In Commodity Supply Chains

FOOD

Warehouses
Grocery stores
Freezers & refrigerators

WATER

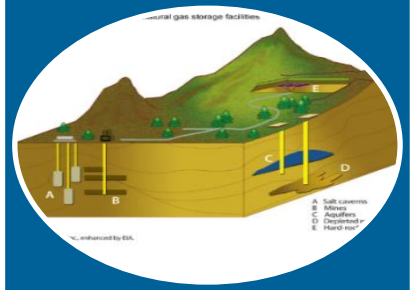
Reservoirs
Above-ground tanks
Water bottles

GASOLINE

Underground tanks
Above-ground tanks
Tank trucks
Portable fuel tanks

OIL

Above-ground tanks
Piping



NATURAL GAS

Depleted fields
Aquifers
Salt caverns
Pipelines
Above-ground tanks

ELECTRICITY

Energy Storage Technologies

Currently less than 1% of daily electricity consumption for MA

Storage capacity more than 10% of daily consumption

In most commodities storage is key to mitigating of the impact of a supply disruption. Due to the low amount of electric storage currently on the grid, the system is sized with sufficient redundancy for generation and transmission to meet peak demand.

Generation, Transmission, & Distribution is a Supply Chain

- The electricity system exists to supply electricity services to end loads
- Customers pay same price for a kWh for their vacuum as a kWh for their sump pump, however they may value energy service provision to one over the other
- When configured in a way to island, energy storage can be used to provide energy services to load through a disruption
- We are currently evaluating proposals within the Community Clean Energy Resilience Initiative for advanced analytics to assess the ability to buy down risk with energy storage technologies
- Valuing resilience improvements may be something to consider when adding energy storage to a Portfolio Standard

Considerations for a Resilience Multiplier in a Portfolio Standard

- Adding a resilience multiplier in a portfolio to assets which provide energy service through an outage will;
  - Consider climate mitigation and adaptation in a single portfolio
  - Help address the incremental cost of installing an ‘islandable’ system
  - Reduce the effects of outages
  - Improve customer awareness of opportunities to improve resilience
  - Improve the resilience of the Commonwealth