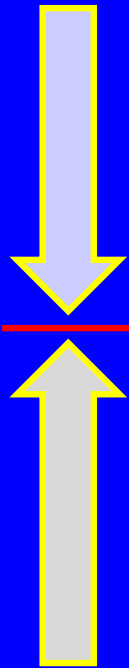


# Grid Scale Energy Storage: Building Value

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IMRE GYUK, DIRECTOR,  
ENERGY STORAGE RESEARCH, DOE-OE

# Designing a Business Case:



The **Cost** of a Storage System depends on the Storage Device, the Power Electronics, and the Balance of Plant

The **Value** of a Storage System depends on Multiple Benefit Streams, both monetized and unmonetized

Metrics will depend crucially on Regulatory Structure and Locality!

Power Electronics  
20-25%

Energy Storage Device  
25-50%

Facility 20-25%

Arbitrage

Frequ. Reg.

Dem. Charges  
month, year

Resiliency

Values such as Resiliency, Military Energy Assurance, Emergency Preparedness' or Social Equity are difficult to Monetize, yet they are often the primary Reason for a Project.

Microgrids with Renewables and Storage provide a good Solution for Resiliency.

But the Business case of a project must rest on Monetizable Benefit Streams.

Building and Validating  
Business Cases:  
Resilience, Sustainability,  
Grid Stability

# Sterling, MA: Microgrid/Storage Project

Sterling Municipal Light Department.

\$1.5M Grant from MA Community Clean Energy Resiliency Initiative (Dept. of Energy Resources). Further Funding from DOE/Sandia.

2MW/2hr storage with existing 3.4 MW PV to provide **resiliency** for Police HQ and Dispatch Center. Li-ion batteries provided by NEC.



Sterling, MA, October 2016



Sterling, MA, December 2016

**2016 Dec. till 2017 Nov.**  
**Actual Savings:**

- Arbitrage \$11,731
- Monthly Peaks \$143,447
- Annual Peak \$240,660
- Total \$395,839



Sean Hamilton

Chart: Carina Kaainoa

*April 2019: 1 million Avoided Cost!*

**Visitors:** Germany, Switzerland, Denmark, Sweden, England, Ireland, Australia, Japan, Malaysia, Taiwan, Brazil, Chile, .... Thailand

# Cordova, Alaska, Municipal System



Cordova, Grid Isolated



6MW Run of River Hydro Power

Total Generating Capacity:

6MW + 1.25MW Hydro; 2x 1MW Diesel

0.5MW Deflected as Spinning Reserve

Hydro: \$0.06/kW; Diesel: \$0.60/kW



Ribbon Cutting with Sen. Murkowski



1 MW / 1 hr Li-ion Storage

## Commissioned June 7, 2019

- Frequency Regulation
- Load following
- Emergency Supply

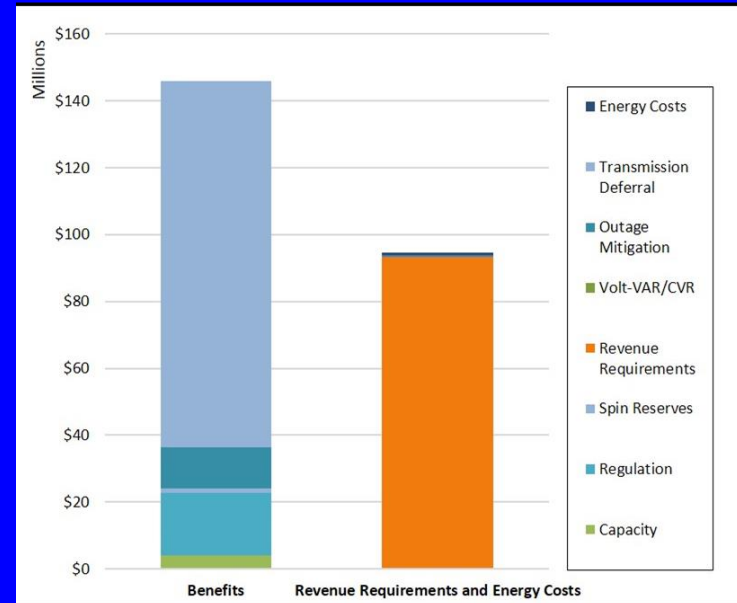
Thanksgiving, Nov. 2019  
2 days: 4hrs diesel vs. 48 hrs  
\$10,000 in savings



# Nantucket – National Grid, Tesla, PNNL/DOE



71 MW Submarine Cables



Analytics: Balducci et al. PNNL

*\$110 million Deferral Value + \$36 million Operational Benefits*

Installation: 6MW/8hr Storage + 6-10 MW Generator to yield required 91MW Peaking Capacity



PNNL evaluated technical and financial benefits of energy storage:

- Financial benefits of ES
- Technical impact on distribution system
- Control strategies to maximize financial benefits while achieving resiliency goals.

**Ribbon Cutting: Oct. 8, 2019. Return on Investment: 1.55**

In addition to transmission deferral, other potential economic benefits could include:

- ISO-NE demand response program participation
- ISO-NE ancillary service markets
- ISO-NE forward capacity and reserve markets
- Energy arbitrage, Outage mitigation



# National Scope - Local Relevance!

- ABQ NM Public Schools: demonstrate economic & resilience benefits of ES available to public schools  
13 high schools, 140 campuses. Atrisco Heritage project.
- Project with Picuris Pueblo, NM to install storage in combination with solar for “Energy Independence”.
- Iowa: Develop 6-8 hour backup for existing/planned renewables
- 3 projects involving Rural Co-ops and Military Reservations.
- Decatur Island, WA. Microgrid. 1MW Storage + 570MWh/yr solar
- Puerto Rico: 5 town consortium to form Central Mountain micro-grid powered by 250MW solar and hydro with 75 MW storage backup

With new Technologies  
Cost will go down, Safety and  
Reliability will increase

With every successful Project  
the Value Propositions will  
continue to increase!

More jobs will be created!!

Energy Storage  
should be in  
the Toolbox of every Utility!