Genbright LLC

AEE Technical Round Table

11/15/2017

About Genbright

- Founded in 2013, Genbright was created to develop and monetize distributed energy technologies across the power industry including distributed generation, energy storage and demand side resources.
- The Genbright team is comprised of power market experts, each with 15+ years experience for several of the largest power producers in the US; this team has deep expertise in power asset management, market optimization, trading and risk management across multiple power markets, including ISO New England, New York ISO, PJM and ERCOT.
- Genbright's clients include: distributed energy resource owners/developers, new technology OEMs, utilities, C&I customers.
- Genbright has been engaged as a trusted development partner and advisor to industry-leading public and private entities.

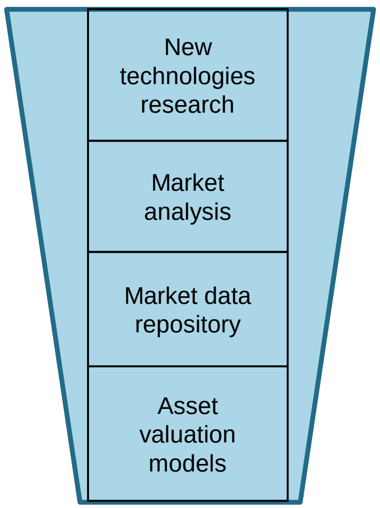
Select clients and partners

EVERSOURCE ENERGY	Genbright was adviser related to demand response activities in CT. Eversource participating on Genbright's DOE Sunshot Task Force.
DOER Massachusetts Department of Energy Resources	MA DOER has awarded Genbright grants for two projects aimed at reducing peak demand in MA, including battery storage and thermal storage.
greencharge networks / ENGIE	Partnering on energy storage projects in New England
nrg®	Partnering on the development of up to 50 MW of low emissions behind-the-meter generators in ISO-NE.
IceEnergy	Partnering on the development of behind the meter thermal storage projects in New England.
EDISON ENERGY® An EDISON INTERNATIONAL® Company	Advised on the launch of a competitive electrical transmission business
Powered by SunShot U.S. Department of Energy	Recipient of prestigious US DOE Sunshot Award to enhance DER commercial management software

Genbright product development process

Genbright will develop business models around multiple DER asset classes in parallel to how we developed our low-emissions back up generation business model. Genbright's goal is to meet the unique needs of each customer with a suite of DER offerings.

Product research and development

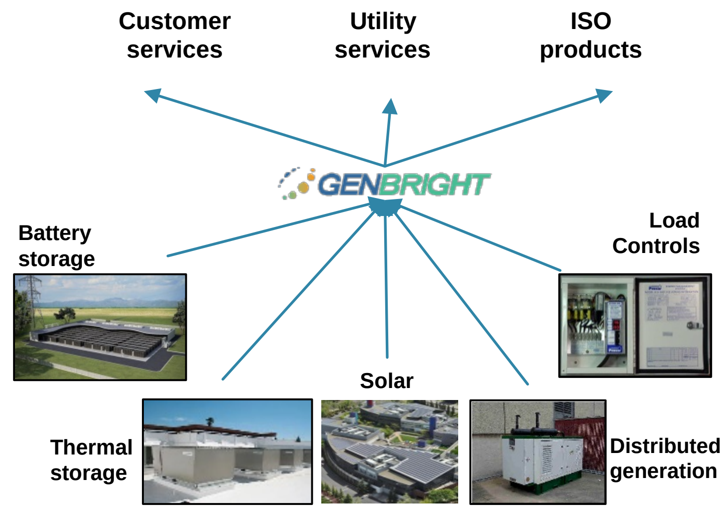


- Evaluate/filter new technologies
- Identify profitable markets and use cases

Business model development

- Demonstrate project(s)
- Build/prove commercial revenue models
- Begin product/service enhancements

Full-scale DER portfolio management



- Bring in project capital providers to scale projects
- Build/prove financial models
- Prove portfolio benefits
- Product/portfolio enhancements

Opportunities for Energy Storage in Northeastern U.S.

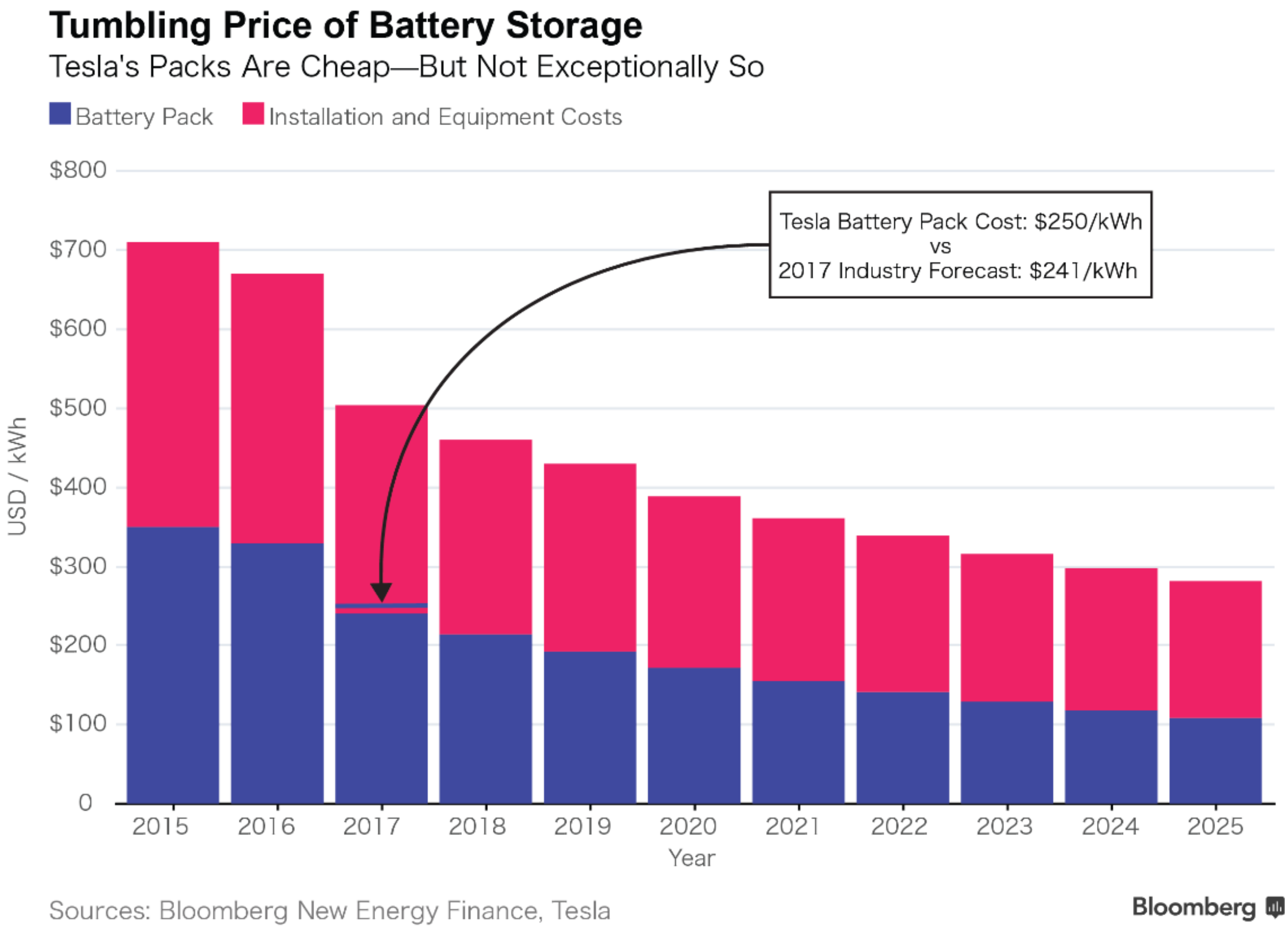
Here in New England, PJM and NYISO, there are new opportunities for Energy Storage (ES) development due to the following:

- This region has among the highest energy, capacity and ancillary prices in the US,
- States such as MA, NY and NJ have aggressive Clean Energy goals for solar and storage,
- ISOs are implementing further integration of Behind the Meter (BTM) DERs into ancillary markets,
- New Renewable Incentives will expand on over 2,500 MWs of potential sites for co-locating ES, and
- New State level initiatives to integrate active ES into ratepayer funded programs may soon be available.

To capitalize on new opportunities for ES, requires both merchant and utility sponsored business lines, to deploy actively managed DER technology applications:

- Battery Storage Co-Located with Existing Grid Connected Renewable Projects
- Battery Storage Co-Located with New Grid Connected Renewable Projects
- Behind the Meter Battery Storage Enrolled in Demand Response (or Energy Efficiency)
- Behind the Meter Thermal Storage Enrolled in Demand Response (or Energy Efficiency)
- Other New ES Technologies

Battery Storage Economics: Cost Trends



http://www.energynetworks.com.au/news/energy-insider/does-size-matter-economics-grid-scale-storage

Battery Storage Economics - Revenue Models:
Why “Stacking Values” is Essential

Enovation Partners Estimates of Market Attractiveness for Behind the Meter Storage

Use Case	2016 Standalone: Demand Mgmt[1]	2016 Standalone: Frequency Regulation[2]	2016 Stacked: Demand Mgmt. + Markets[3]	2020 Standalone: Demand Mgmt	2020 Standalone: Frequency Regulation	2020 Stacked: Demand Mgmt. + Markets
California	Green	Orange	Green	Green	Green	Green
ISO-NE	Red	Green	Green	Green	Green	Green
ERCOT	Red	Red	Orange	Red	Green	Green
PJM	Red	Green	Orange	Red	Green	Green
New York	Red	Red	Green	Green	Orange	Green

Green: IRR: >10% Orange: IRR: 3-9% Red: IRR: <2%

1. Demand Management: C&I system designed lower demand charges
2. Frequency Regulation: C&I system designed to rapidly charge and discharge to provide frequency regulation
3. Demand Management + Markets: Large scale C&I system designed to provide capacity, spinning reserve, and non-spinning reserve in addition to demand management

http://events.cleantech.com/wp-content/uploads/2016/10/2016-Investment-Summit_Slides_10-20-16.pdf

Energy storage as a service case study: value streams

Value stream	Description
ISO-NE Capacity Market Revenues	• Capacity is provided to ISO-NE as a Demand Response Resource for each planning year (June – May). • Customers will consume energy from the ESS rather than the grid during dispatch. • Performance Audits of approximately 1 hour occur twice per year in the early Summer and Winter months. • Performance criteria are based on Capacity Scarcity Conditions which are predicted occur less than once per year.
ISO-NE Reserve Market Revenues	• Reserves are provided to ISO-NE as a Demand Response Resource on either a daily or a forward seasonal basis. • Customers will consume energy from the ESS rather than the grid during dispatch. • Performance Audits are approximately 1 hour. • More frequent than capacity events but typically shorter in duration.
ISO-NE Regulation Market Revenues	• Regulation resources providing frequency in the ISO-NE system includes smaller Alternative Technology Regulation Resources acquired on a daily basis. • Performance is measured by the ability to respond to a 4 second regulation up/down signal. • ATRR include aggregations of small resources and energy neutral dispatch for technologies that operate under a limited fuel condition such as batteries.
Retail Installed Capacity Tag Reduction	• "Capacity Tags" determine the amount of ISO-NE capacity charged to a customer and are based on a customer's contribution to ISO-NE system peak demand during the previous year. • Capacity charges are often bundled into the energy charge on a competitive supplier's bill. However, most competitive energy suppliers provide retail energy products that "unbundle" capacity charges, allowing a customer to benefit from a lower Capacity Tag. • The ESS can be used to lower a customer's Capacity Tag by discharging to lower the customers load during the ISO-NE system peak demand hour.
Distribution Demand Charge Reduction	• Demand charges on a customer's utility bill are based on their monthly peak demand. • An ESS can lower peak demand discharging to shave peak demand. • In addition, for some customers, demand charges are based on kVA rather than kW and additional savings can be achieved by supplying reactive power to reduce kVA during peak demand hours.
Co-Gen Optimization	• For customers that have a co-generator, often, co-generator cannot operate if load at the facility is less than a certain threshold. This can happen frequently during weekends and sometimes during weekdays. • Net savings when operating the co-generator are often \$0.10 to \$0.15 per kWh. • Charging the battery when load falls below the minimum threshold in order to continue operation of the co-generator can therefore save \$0.10 to \$0.15 per kWh. (The stored energy eventually be discharged to serve load.)

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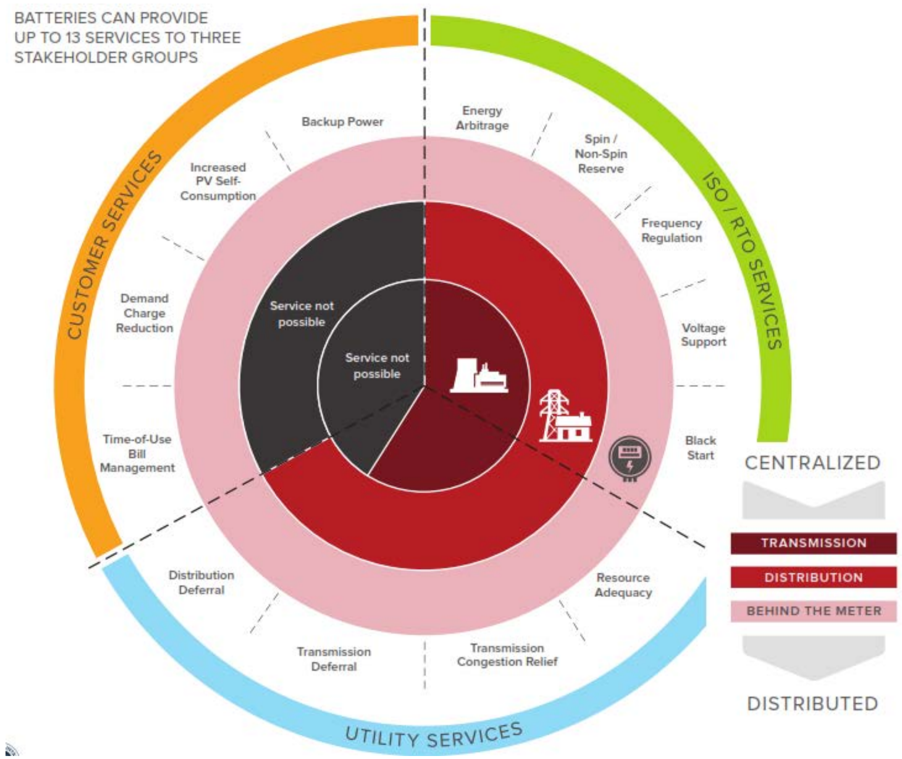
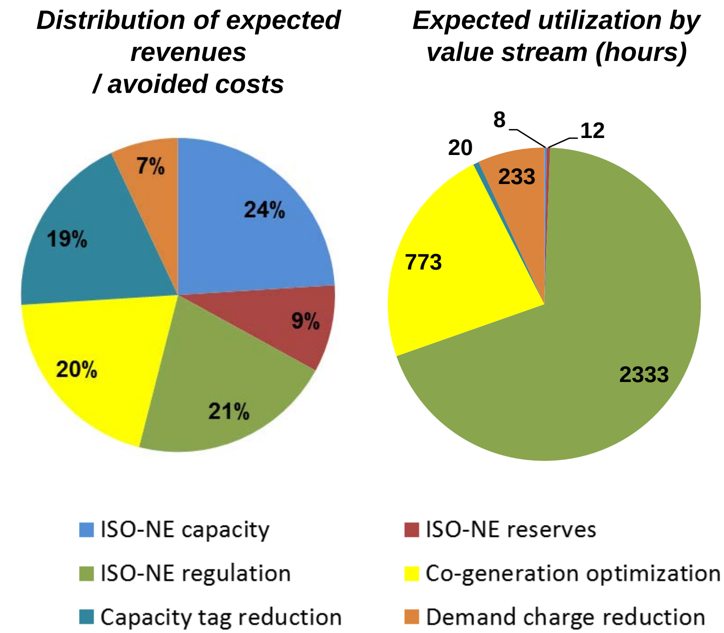
Example Battery ESS project financials

Energy storage can provide multiple services and value streams across the electric power grid.



As an example, for a manufacturer in MA, Genbright estimates that total revenues from a 1.5 MW / 3 MWh lithium-ion battery system will be more than $400K annually from 6 revenue and savings streams.



Graphic source: Rocky Mountain Institute, The Economics of Battery Storage

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Example Thermal Storage project financials

Engineering estimates can tell us the kW reduction in load.

Peak Capacity Demand Offset Table for Package Unit Air Conditioning (kW)																	
		Equipment Nominal Tonnage (in Tons)															
SEER	Vintage	1.0	1.5	2.0	3.0	3.5	4.0	5.0	6.0	7.0	7.5	8.5	9.0	10.0	12.5	15.0	20.0
8	Before 1984	1.4	2.2	3.0	4.6	5.4	6.2	7.8	9.4	11.0	11.8	13.4	14.2	15.8	19.8	23.8	31.8
8.9	1984 - 1991	1.2	1.9	2.7	4.1	4.8	5.6	7.0	8.5	9.9	10.7	12.1	12.8	14.3	17.9	21.6	28.9
9.7	1992 - 2005	1.1	1.8	2.4	3.8	4.5	5.1	6.5	7.8	9.2	9.9	11.2	11.9	13.2	16.6	20.0	26.7
12	2006-2009	0.9	1.4	2.0	3.1	3.7	4.2	5.4	6.5	7.6	8.2	9.3	9.9	11.0	13.8	16.6	22.2
13	2010-2014	0.8	1.3	1.9	2.9	3.4	4.0	5.0	6.1	7.1	7.6	8.7	9.2	10.3	12.9	15.5	20.8
14	6/2014 After	0.7	1.2	1.7	2.7	3.2	3.7	4.7	5.7	6.7	7.2	8.2	8.7	9.7	12.1	14.6	19.6

Energy Efficiency Cost/Benefit Analysis can tell us what each kW of load reduction is worth.

Avoided Per-Unit Costs at Source:	
Avoided Gen Capacity Cost (Capital+FOM)	$/kW-yr
Avoided T&D Facility Costs	$/kW-yr
Avoided On-Peak Energy from TES	$/MWh
Incurred Off-Peak Energy for TES	$/MWh
Avoided On-Peak Energy from DR	$/MWh
Avoided Energy from HVAC Replacements	$/MWh
Avoided Transmission and Ancillary Services (Fixed)	$/kW-yr
Avoided Transmission and Ancillary Services (Variable)	$/MWh
Avoided Voltage Support Cost	$/MWh

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Energy Storage "Active" or "Passive Dispatch"

The chart below provides an example of how following a same day load forecast can increase the success of reducing coincident peak load.

	Annual			Summer			Summer
Daily Peaks Missed	2 hours	3 hours	4 hours	2 hours	3 hours	4 hours	1 pm to 6 pm
Total Days	1826	1826	1826	610	610	610	610
Success Rate	86.7%	92.9%	96.3%	72.6%	85.7%	92.1%	71.0%

"Active" dispatch can outperform "Passive" for more than just coincident demand Cost/Benefit Analysis can tell us what "active" dispatch is worth.

Avoided Per-Unit Costs at Source:	
Avoided Gen Capacity Cost (Capital+FOM)	$/kW-yr
Avoided T&D Facility Costs	$/kW-yr
Avoided On-Peak Energy from TES	$/MWh
Incurred Off-Peak Energy for TES	$/MWh
Avoided On-Peak Energy from DR	$/MWh
Avoided Energy from HVAC Replacements	$/MWh
Avoided Transmission and Ancillary Services (Fixed)	$/kW-yr
Avoided Transmission and Ancillary Services (Variable)	$/MWh
Avoided Voltage Support Cost	$/MWh

Keys to the Future Success of Energy Storage

- The future success of storage will require continued reductions in cost.

- It will also require policy aimed at identifying and monetizing “value stacks”
  - ISO Product and Market Rule Refinements
  - Expansion of Energy Efficiency Programs

- Finally, customer education and adoption is essential in order for these technologies to be successfully deployed.

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Thank you for your interest

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