Maine Energy Storage Market Assessment

Sponsored by the State of Maine Governor’s Energy Office

Stakeholder Session #2: Preliminary Modeling Results & Policy Discussion

February 14, 2022
Maine Won’t Wait: Maine’s four-year climate action plan identified energy storage as an important factor in achieving emissions reduction goals, maximizing the value of renewable energy on the grid.

Targets: L.D. 528 signed into law June 2021, established state storage targets, directed an Energy Storage Market Assessment.

Assessment: This assessment of existing and emerging technologies, market factors, and a technical cost-benefit analysis is meant to inform policy makers to help develop a landscape ready to deploy storage to meet our 2030 goal of 400 MW and to most effectively capture the benefits of storage for the grid, society, and for ratepayers. Assessment due to EUT Committee early March.

Feedback: We’re engaging stakeholders in this assessment to build key storage relationships in Maine, inform factors for analysis, and to most effectively share key takeaways from analysis with legislature.
Using the ‘Chat’/’Raise Hand’ feature to ask questions in WebEx

Introductions

Project Schedule & Session #1 Recap/Feedback Summary

Selected Benefit-Cost Analysis Results (Preliminary, Not Exhaustive)

- Wholesale Standalone Storage
- Wholesale Storage + Solar
- Customer-sited Commercial-scale Storage

Preliminary Policy Considerations

Q&A with Stakeholders

Feedback

Feedback on study may be provided at: https://forms.office.com/r/ZDVLXHrquX
Using ‘Chat’ and ‘Raise Hand’ in WebEx to ask questions
Questions will be answered at the end of the presentation portion

Please use the ‘Raise Hand’ or ‘Chat’ feature to ask questions

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Option 2: Chat to “All Panelists” to ask a question in writing and these will be answered at the end of the presentation
Introductions
About E3

90+ full-time consultants | 30 years of deep expertise | Engineering, Economics, Mathematics, Public Policy…

San Francisco | New York | Boston | Calgary

300+ projects per year across our diverse client base

E3 Clients

Recent Related Projects


Investors, Developers & Asset Owners

Utilities & System Operators

Public and Non-Profit Sector
Stakeholders have an opportunity to submit comments in advance of the report being published in early March 2022

1. **Stakeholders** submit feedback on preliminary results and policy considerations by Feb. 16, 2022
2. **GEO and E3** conclude the report and analysis in the latter half of February 2022
3. Report summarizing study findings will be released in early March 2022
4. **GEO and E3** to present results in March 2022
E3 is working with the Governor’s Energy Office to assess the energy storage market in Maine

- Satisfies the requirements set forth in 2021 *Act to Advance Energy Storage in Maine*, which also sets Maine storage targets
  - 300 MW by 2025
  - 400 MW by 2030

Study questions:

- **Technology Assessment**: Which storage technologies and use cases are likely to be valuable to Maine, today and in the future?
- **Policy and Market Factors**: What market and policy factors may influence the speed and predictability of storage deployment in Maine?
- **Cost-Benefit Analysis**: What are the costs and benefits of energy storage deployment over the next decade? What are the considerations for policy?

Study output will include public report with findings and policy recommendations
The cost-benefit spreadsheet model evaluates different use cases for Li-ion batteries, given the following factors analyzed in the storage technology assessment:

- The ability to provide a range of high value services in the near term and long term
- Maturity and commercial availability
- Low capital cost or cost reduction potential
- Able to be deployed in Maine within the study period (2022-2031)

Emerging and long-duration storage technologies are evaluated in the storage technology assessment and the report.
**Modeling Methodology**

**INPUTS**
- Day-Ahead Energy Prices
- Ancillary Services Prices
- Solar Profiles
- Storage Operating Parameters
- Retail Rates
- Load Shapes
- Capacity Prices
- Capital Costs
- Avoided T&D Cost
- Marginal Emissions & Social Cost of Carbon

**MODEL LOGIC**
- **Front-of-the Meter Storage Dispatch**
  *Determine storage dispatch to maximize market revenues*
- **Behind the Meter Storage Dispatch**
  *Determine storage dispatch to reduce customer bills and maximize self-consumption of solar*

**OUTPUTS**
- AS Revenues
- Net Energy Revenues
- Energy Charge Bill Savings
- Demand Charge Bill Savings
- Resiliency
- Capacity Revenue
- Capital Costs
- Avoided Energy, T&D, Capacity Costs
- Avoided Emissions

**COST / BENEFIT COMPARISON PERSPECTIVES**
- Storage Owner
- Ratepayers
- State
## Key Data Sources

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<th>Key Data Items</th>
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### AESC Energy Prices (Maine) – 2021 $/MWh

![AESC Energy Prices Graph](image)

### AESC Capacity Prices – 2021 $/MWh

![AESC Capacity Prices Graph](image)
SUMMARY OF STAKEHOLDER SESSION #1 COMMENTS

GEO and E3 received many constructive and helpful comments after the first session – thank you to all who provided feedback and/or data. Key points (not exhaustive):

**Technologies, Costs & Use Cases:** General alignment on near-term focus on battery storage; received requests to review certain technologies, including long-duration storage and hydrogen, and use cases including C&I customer-sited storage:

- Action: Reviewing broader list of technologies, including LDES in report, and including customer-sited storage in modeling

**Modeling:** A few participants asked about modeling additional value streams, e.g., emissions, resilience; some asked about modeling dynamic price effects of storage

- Action: Added avoided emissions costs and resiliency as value streams
- Action: Agree price-taker framework is imperfect, but note adjustments made; AESC prices adjusted to reflect expectations of increased renewables, ELCCs for capacity markets, etc.

**Hurdles:** Multiple participants noted storage costs, monetizing benefits, permitting and interconnection, transparency regarding where storage can bring highest value, coordination with utilities, rate design, etc.

- Action: Addressed through report assessment and the policy considerations
Preliminary Benefit-Cost Analysis Results
+ Value stacking is important for storage cost-effectiveness
+ Both wholesale and customer-sited storage provide diverse and important benefits for society
+ Wholesale storage, both with and without solar, appears to be cost-effective from the owner perspective by the mid-2020s
+ Customer-sited storage can provide high value benefits through bill savings and resiliency
+ From the societal perspective, avoided T&D costs can provide a large benefit but realizing that can be project-specific and location-dependent
Preliminary BCA Results: Wholesale Standalone Storage
Regulation provides an important revenue source in the near term, but may decline quickly as the market saturates.

Energy arbitrage revenues increase annually as ancillary services prices drop and daily price spreads widen as more renewables are brought online.
Benefits > Costs

Lifetime benefits are greater than costs for storage installed in 2024 and later

- Increased revenue is driven by better energy arbitrage opportunities in later years
- Cost declines are driven by expectations for decreasing capital costs
Considering the societal perspective, wholesale standalone storage has net benefits

- Benefit/cost ratios increase from 2023 to 2030 installations

Avoided T&D costs are a large driver of the total benefits but realizing them can depend on the specifics of that project and its location

Avoided emissions costs are based on a social cost of carbon less the RGGI price, reflecting avoided risk of climate damages
Preliminary BCA Results: Wholesale Storage + Solar
Wholesale Storage + Solar Installed by Mid-2020s Provides Net Positive Benefits From Owner Perspective

Like standalone storage, lifetime benefits are greater than costs in most years of installation
- Federal Incentives (ITC) make up a significant portion of total benefits, especially in earlier years

Energy and capacity markets both provide significant revenue streams
- Storage is assumed to charge solely from solar to capture the ITC, impacting its dispatch and revenues
- Storage paired with solar is assumed to not participate in AS markets, which can depend on storage configuration
Wholesale Storage + Solar has Similar Outlook on Balance to Standalone Storage

Storage + solar shows similar cost-effectiveness to standalone storage in 2025 despite differences in specific costs and benefits

- Storage + solar qualifies for the federal ITC, but the solar charging requirement results in less flexibility and lower energy arbitrage revenues
- Storage + solar is assumed to not participate in AS markets, further lowering revenue opportunities
- Capital costs are lower for the storage portion of storage + solar systems due to construction cost savings*

* 2021 LBNL Study explores the energy price coupling penalty for storage + solar systems given geographic constraints – [https://emp.lbl.gov/publications/are-coupled-renewable-battery-power](https://emp.lbl.gov/publications/are-coupled-renewable-battery-power)
Preliminary BCA Results: Customer-sited C&I Storage
Storage has significant revenue from bill savings, but these revenues are still lower than costs, even by 2030.

Customer-sited C&I Storage is assumed to have additional resiliency benefits but quantifying them can be highly uncertain

- Resiliency is based on an assumed value of lost load along with historical outages in the region
- The value of lost load attempts to capture the economic losses associated with power outages, but can vary significantly depending on customer type, outage duration, and location.

Note: The C&I Storage scenario uses Central Maine Power’s LGS-S-TOU rate.
Societal perspective demonstrates net benefits to Maine

- Resiliency benefits can vary, given function of value of lost load
- Realizing avoided T&D costs for any specific project can depend on location

Avoided emissions are negative

- TOU periods do not currently correlate well with marginal emissions rates
- Using current TOU periods for 2030 modeling is a known limitation of this analysis
Technology: Support a technology neutral approach to policies aimed at growing a Maine energy storage market, with both near- and long-term development supported by a focus on innovation.

Rate Design: Continue pursuit of designs that allow for energy storage value to be maximized, and more closely align storage operation with outcomes supported by state policy goals.

Programs: Continue pursuit of options for development of incentive programs for energy storage, particularly customer-sited behind-the-meter storage, targeted to reduce peak demand and integrate renewable generation.

Stakeholders: Consider formation of an ongoing energy storage stakeholder group to share information and coordinate storage policy in Maine, as well as other New England states.

Information: Develop and make available resources for municipalities and tribes to support energy storage deployment given a rapidly developing industry.

Planning: Monitor guidance from federal agencies and national laboratories to support planning for energy storage decommissioning, recycling, and other end-of-life considerations.

Policy Leadership: Consider how energy storage can support Maine’s Lead By Example efforts related to energy efficiency and renewables.
Q&A with Stakeholders
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<td>BCA Results</td>
<td>What considerations should be made for future cost-benefit analysis modeling?</td>
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<td>What uncertainties or modeling limitations should be highlighted?</td>
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<td>Policy Considerations</td>
<td>What are areas for future study to support growth of storage industry in Maine?</td>
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Please submit your responses and feedback at: [https://forms.office.com/r/ZDVLXHrqX](https://forms.office.com/r/ZDVLXHrqX)
How to Submit Feedback

+ Link to submit feedback:
  - [https://forms.office.com/r/ZDVLXHrquX](https://forms.office.com/r/ZDVLXHrquX)
  - Link also posted on the GEO Energy Storage Market Assessment webpage

+ Your feedback will be considered as the report is finalized later this month

+ If you would like to submit an attachment, please email [Caroline.Colan@maine.gov](mailto:Caroline.Colan@maine.gov)

+ We request that feedback is submitted by close of business 2/16/2022
Thank You

Caroline Colan, Caroline.Colan@maine.gov
Tristan Wallace, Tristan.Wallace@ethree.com