Maine Energy Storage Market Assessment

Sponsored by the State of Maine Governor's Energy Office

Stakeholder Session #1: Scenario Design and Assumptions

January 10, 2022

Energy+Environmental Economics

ENERGY STORAGE & MAINE ENERGY AND CLIMATE POLICY

Since taking office, Governor Mills has committed to combatting climate change and to advancing clean energy in Maine.

Renewable Portfolio Standard: RPS increased to 80% by January 1, 2030, 100% goal by 2050.

GHG Reduction: Target of 45% GHG emission reduction from 1990 levels by 2030 and 80% by 2050. Carbon neutral by 2045.

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.

Storage Commission: In 2019, the Legislature established a Storage Commission which recommended setting state energy storage targets.

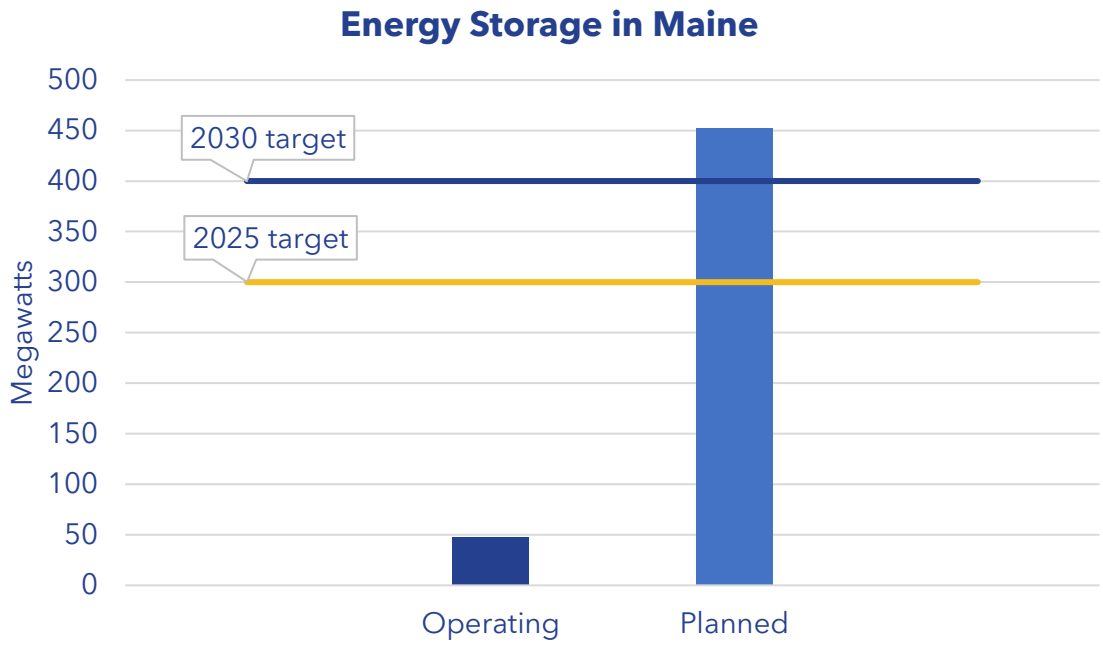
Targets: LD 528 signed into law June 2021, establishing state storage targets and directing an Energy Storage Market Assessment.

ENERGY STORAGE IN MAINE

LD 528 – An Act To Advance Energy Storage in Maine
Signed on June 21, 2021

Established Storage Goals:

- 300 MW by December 31, 2025
- 400 MW by December 31, 2030



ENERGY STORAGE MARKET ASSESSMENT

LD 528 – An Act To Advance Energy Storage in Maine
Signed on June 21, 2021

Energy Storage Market Assessment: GEO will conduct an assessment to include in-depth analysis of the opportunities and potential challenges faced by the state in achieving its storage goals. This study will:

- Examine commercially viable energy storage technologies;
- Examine policy and regulatory options that may influence development of storage;
- Examine costs and benefits for ratepayers; and
- Examine the potential implications for the achievement of the state storage goals.

The GEO has retained Energy & Environmental Economics (E3) to develop this assessment, to be completed by March 1, 2022.

Agenda

- Using the ‘Chat’/’Raise Hand’ feature to ask questions in WebEx
- Introductions
- Study Objectives & Context
- Storage Technologies
- Scenario Design
- Modeling Approach & Data Sources
- Study Q&A with Stakeholders
- Feedback and Next Steps

Feedback on study may be provided at: https://forms.office.com/r/XLhevxzP5E

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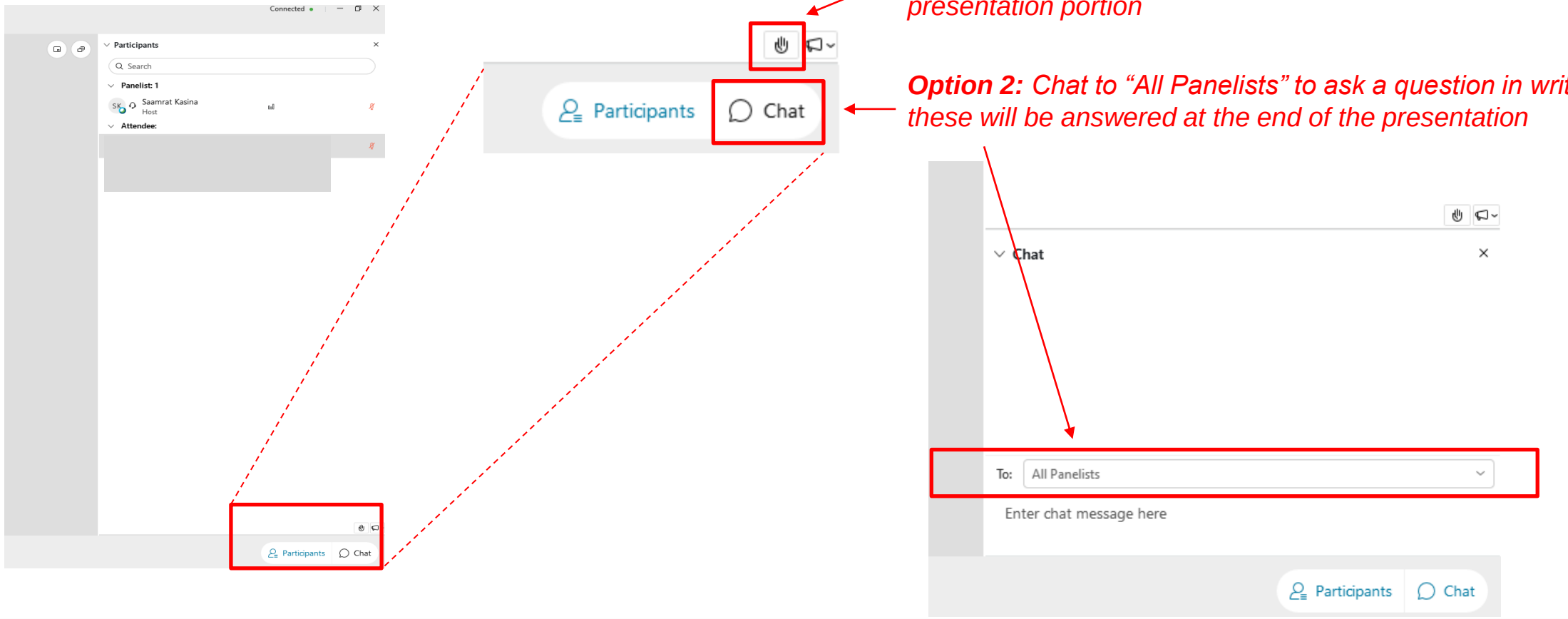
Using ‘Chat’ and ‘Raise Hand’ in WebEx to ask questions

Two Ways 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

Option 1: *“Raise Hand” to ask questions at the end of presentation portion*

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



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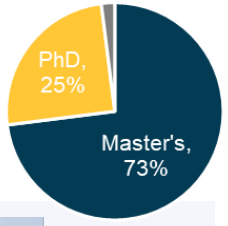
Introductions

About E3

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




San Francisco

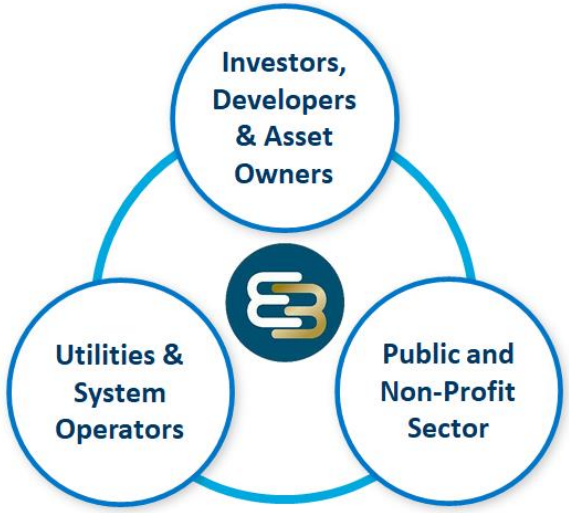

New York


Boston


Calgary

E3 Clients

300+ projects per year across our diverse client base



Recent Related Projects

- Maine Renewable Energy Goals Market Assessment (2021)
- Net Zero New England: Electric Reliability under Deep Decarbonization (2020)
- New York Energy Storage Roadmap – NYSERDA (2018)
- New York Peaker Repowering/Replacement Study – NYSERDA (2019)
- Minnesota Dept. of Commerce, Minnesota Energy Storage Cost-Benefit Analysis (2019)
- Energy Storage Market Analysis, Business Model Review, and Strategic Advice – Macquarie Capital (2016, 2018 – 2019)
- California Energy Commission, EPC-19-056, Assessing the Value of Long Duration Storage (2020-present)

Project Team

E3 Team:

Project Partner	Senior Advisor	Project Lead	Project Manager	Analyst
				
Lakshmi Alagappan	Eric Cutter	Liz Mettetal	Tristan Wallace	Tara Katamay-Smith

Maine GEO Team:

+ Dan Burgess, Director
+ Celina Cunningham, Deputy Director
+ Ethan Tremblay, Energy Policy Analyst
+ Caroline Colan, Solar and Storage Fellow

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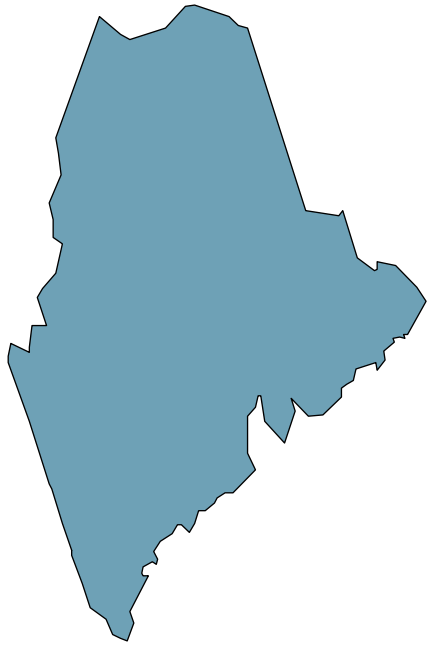
Study Objectives & Context

Project Overview

- **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

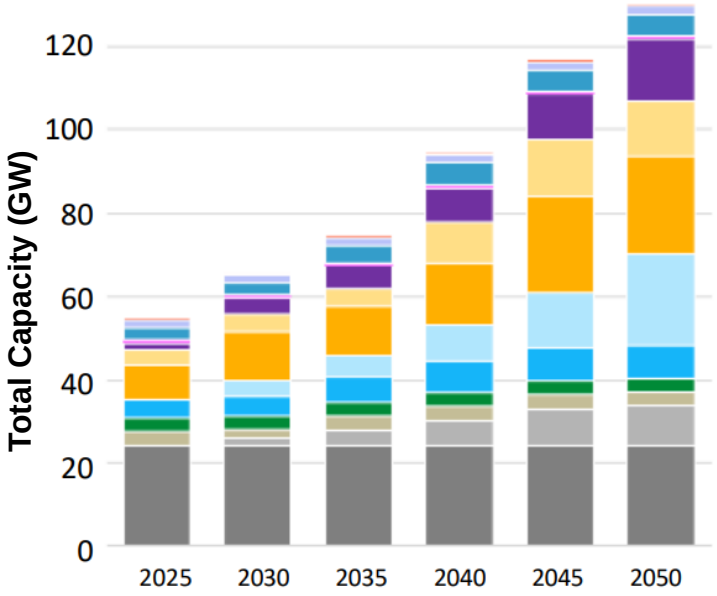
- **Study questions:**
  - **Technology Assessment:** Which storage **technologies and use cases** are likely to be valuable to Maine, today and in the future?
  - **Policy and Market Factors:** What **market and policy factors** may influence the speed and predictability of storage deployment in Maine?
  - **Cost-Benefit Analysis:** What are the costs and benefits of energy storage deployment between 2021 and 2030? What are the implications for policy?
- **Study output will include public report with findings and policy recommendations**



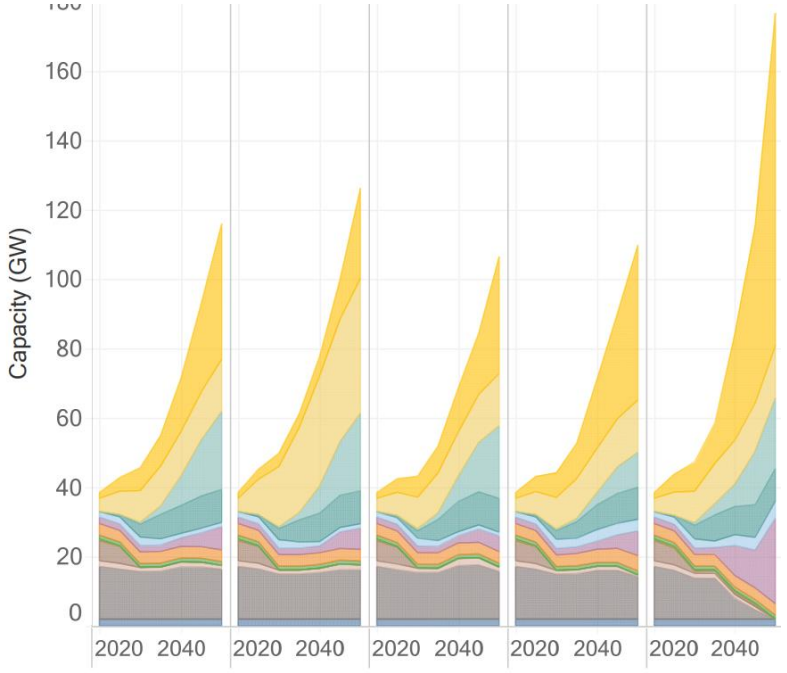
Storage is Expected to Contribute to Decarbonizing New England as Renewables are Built

+ Recent public modeling done by different groups and across a range of scenarios demonstrates an important role for storage in decarbonizing New England's power sector

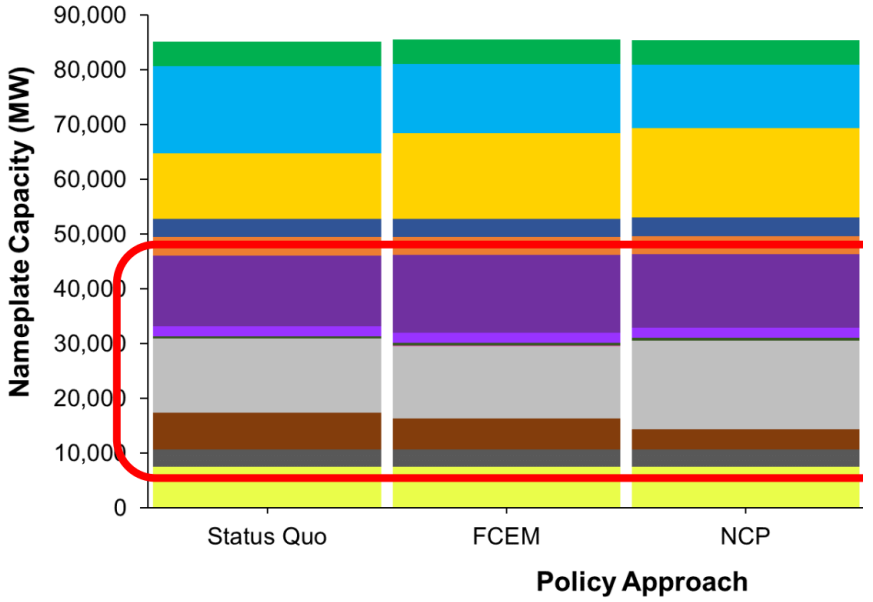
ISO-NE Modeling by E3 (Calpine)



ISO-NE Modeling by Evolved Energy Research (State of MA)

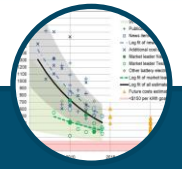


ISO-NE Modeling by Analysis Group (NEPOOL)



Note: All studies above show storage in purple.

Multiple Factors are Driving Storage Growth, Particularly Cost Declines and Ambitious Policy Targets



Cost Declines

- Li-ion battery costs
- Financing ecosystem
- Solar+storage tax credit

Technology Improvement

- New storage technologies

Flexibility Need

- Variable renewables
- Evening ramp as sun sets
- Localized system needs

Policy Targets

- NY: 1.5 GW by 2025
- VA: 3.1 GW by 2035
- NJ: 600 MW by 2021
- MA: 1 GWh by 2025, Clean Peak 16.5% x 2030
- **Maine: 300 MW by 2025; 400 MW by 2030**

Regulatory Changes

- FERC Order 841
- FERC Order 2222

Market Evolution

- Energy-limited products
- Small storage participation

+ **400 MW is ~17% of Maine's 2021 peak, making it one of the most ambitious storage targets across the U.S.**
+ **Maine's storage target is part of the state's broader decarbonization goals that include an 80% RPS by 2030 and 100% RPS by 2050, along with carbon neutrality by 2045**

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Storage Technologies

Storage Technology Comparison

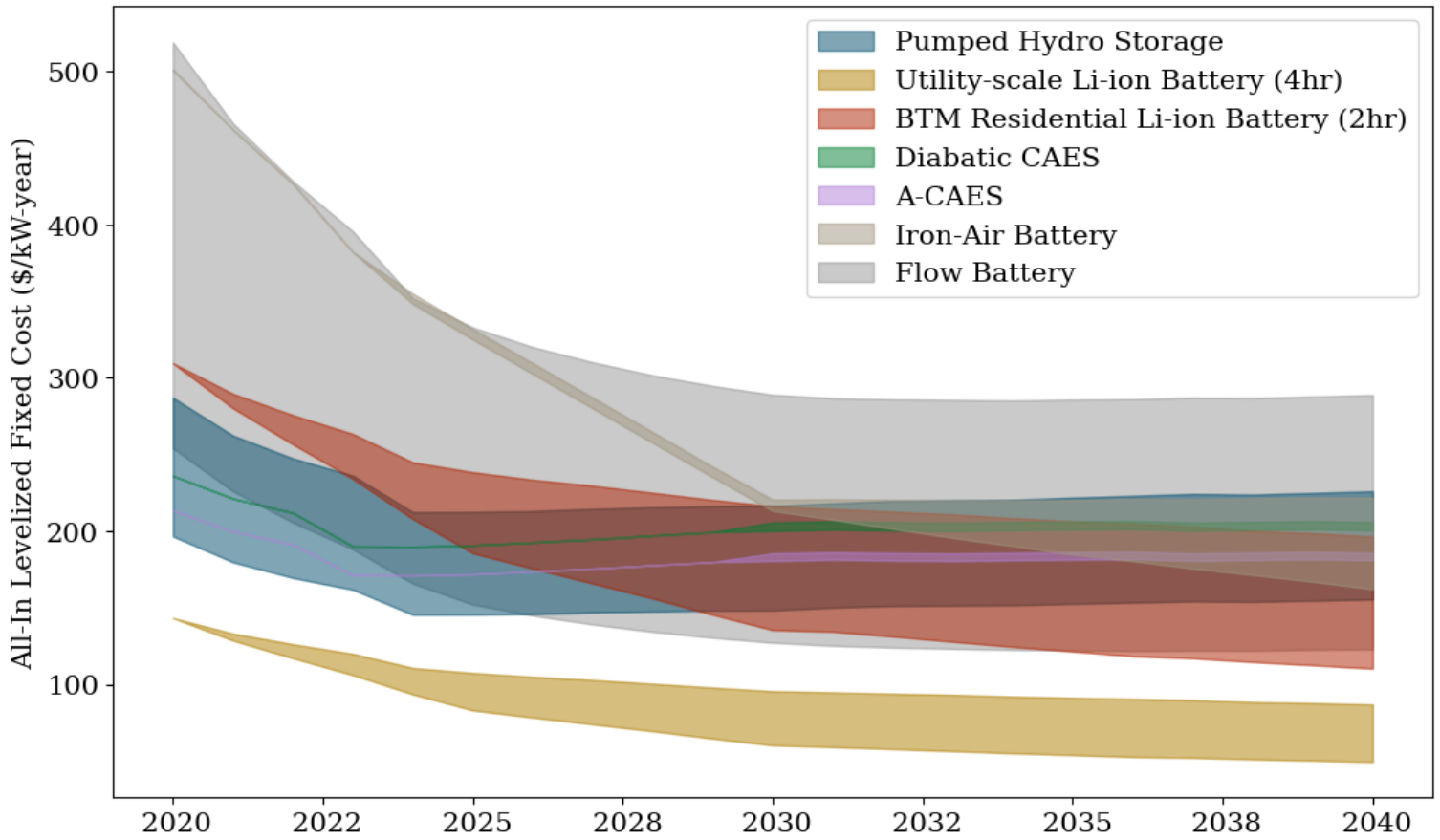
+ **Most existing energy storage in the US is pumped hydro, but there are limited new development opportunities**
+ **Li-ion batteries score high on commercial readiness, siting flexibility, scalability, efficiency and response time**

	Pumped hydro	Li-ion Battery	CAES	Iron-Air Battery	Flow Battery
Commercial readiness	High	High	Medium	Medium	Medium
Siting flexibility	Low	High	Low	High	High
Scalability	Low	High	Low	Medium-High	Medium-High
Duration	Long (6-10 hrs)	Flexible (1-6 hr)	Long (8-48 hrs)	Long (100+ hrs)	Flexible (6+ hrs)
Roundtrip efficiency	65-85%	85-95%	40-80%	>45%	70-85%
Response time	Minutes	Seconds	Minutes	Seconds	Seconds

Note: As a fuel, hydrogen is not included in the primary storage technology analysis/modeling, but its costs and outlook for Maine will be evaluated in report.
*Adiabatic CAES does not require natural gas and is free of emissions

Question for Stakeholders:
What other factors should be used to assess different storage technologies?

Storage Technology Costs



*Storage costs do not include ITC. Hybrid solar + storage systems could see cost reduction due to ITC (e.g. $40/kW-yr for utility-scale Li-ion battery). Costs including ITC will be included for relevant scenarios in storage modeling.
**Costs in $2019

Cost-Benefit Analysis Leverages Storage Technology Assessment, with Focus on Near-Term Deployment

- **Using the storage technology assessment, E3 is building a cost-benefit spreadsheet model focused on near-term storage deployment (2022-2031)**
- **The spreadsheet model will focus on different use cases for Li-ion batteries, given the following key factors**
  - 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 next 5-10 years
- **Other technologies, including potential emerging technologies and long-duration storage technologies, will still be evaluated in the storage technology assessment and the report**
  - For example, long duration energy storage may be valuable and needed in the future deeply decarbonized grid for providing capacity during cold winter days with limited wind and solar

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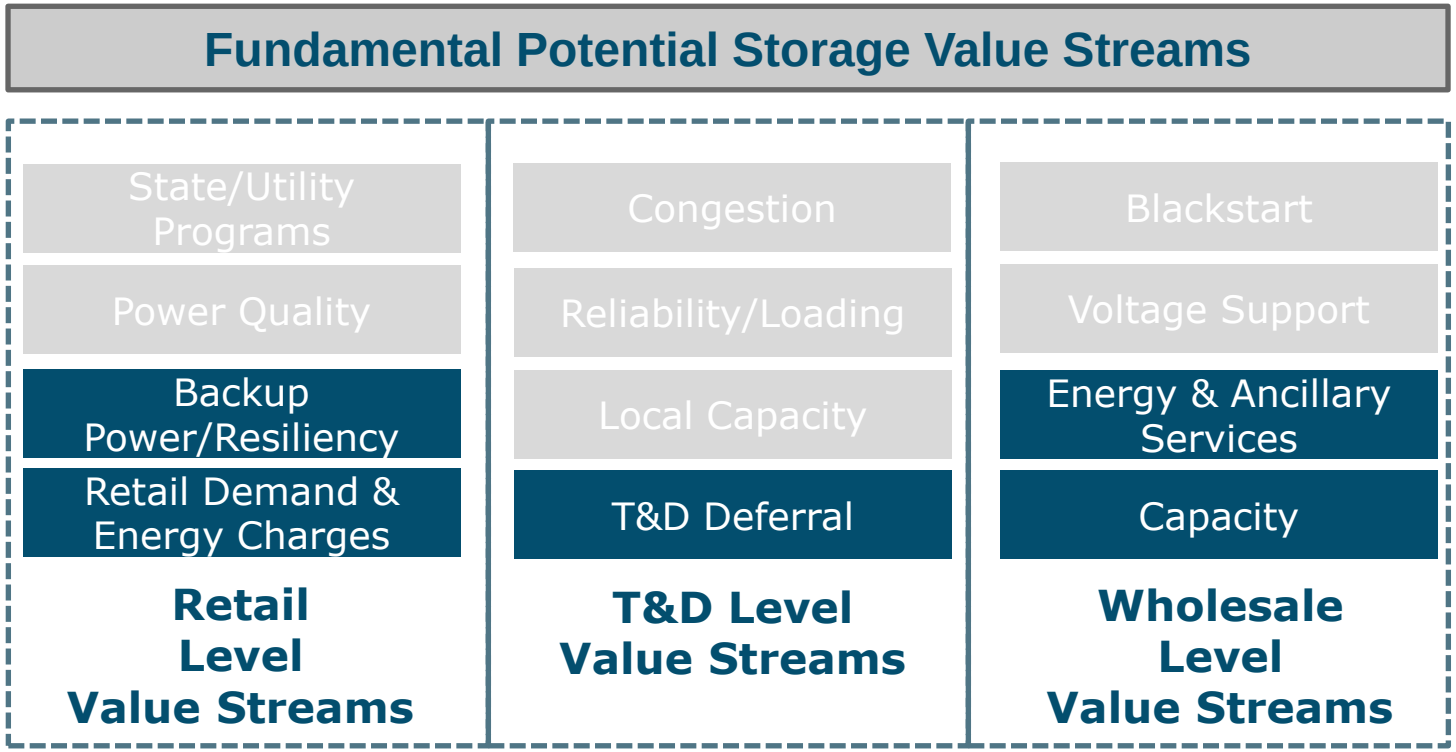
Scenario Design

Storage Value Streams



+ **Storage use cases vary across market segment and can be dependent on co-location with renewables**
+ **Challenges include both monetizing these value streams, and forecasting their potential future value**
  - **The blue values are those we plan to estimate quantitatively in this study, given they are generally measurable and potentially realizable in the next decade (but welcome feedback)**
  - **Non-quantified benefits will be qualitatively discussed**

Question for Stakeholders:
Are there any key value streams missing?

Storage Use & Value Streams Cases

Potential Measurable & Monetizable Value Streams →

Potential Modeling Use Cases	Wholesale			Transmission and Distribution	BTM	
	Energy arbitrage	Avoided generation capacity	Ancillary services	T&D deferral	Bill savings	Backup power/ Resiliency
Wholesale standard	✓	✓	✓			
Distribution deferral	✓	✓	✓	✓		
Wholesale solar + storage	✓	✓	✓			
BTM storage only	TBD given FERC Order 2222				✓	✓
BTM solar + storage (res)	TBD given FERC Order 2222				✓	✓
BTM solar + storage (C&I)	TBD given FERC Order 2222				✓	✓

Questions for Stakeholders:
Which use cases are the most applicable over the next decade?
Are any important use cases missing?

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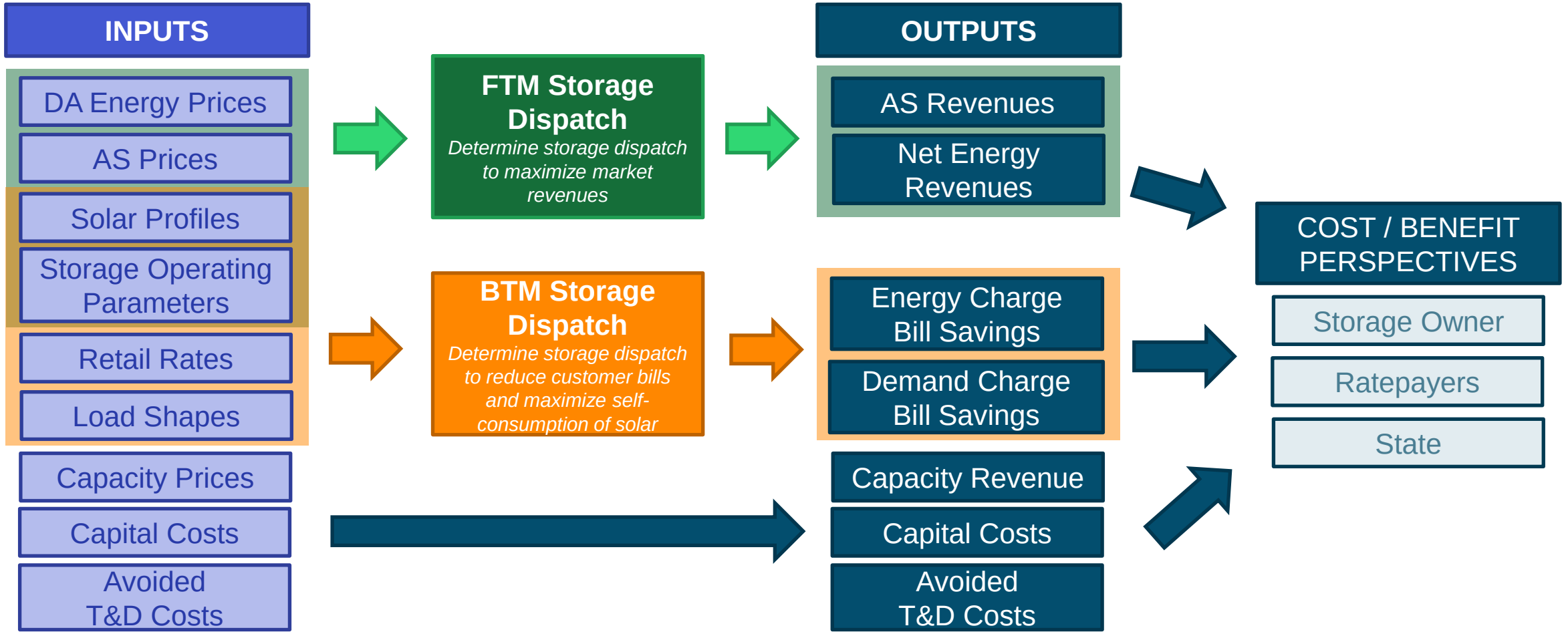
Modeling Approach & Data Sources

Modeling Methodology



Question for Stakeholders:
Are there any other inputs or outputs to consider that can be quantitatively modeled?

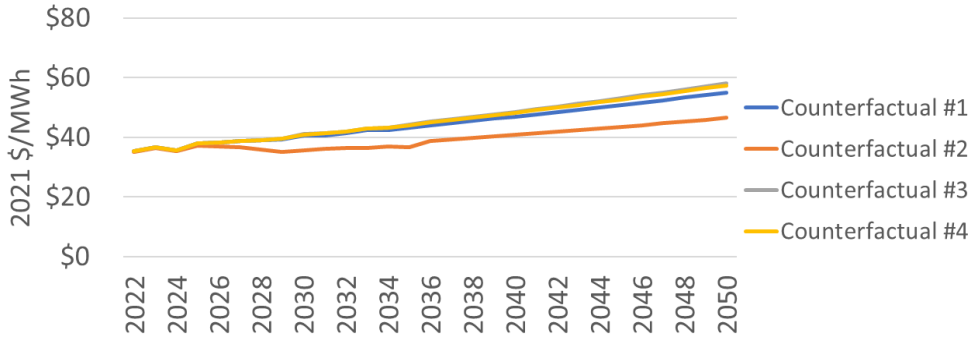
Benefit-Cost Tests

Participant Cost Test (PCT)	Ratepayer Impact Measure (RIM)	Total Resource Cost Test (TRC)
Participating Customers	Non-Participating Ratepayers	The State

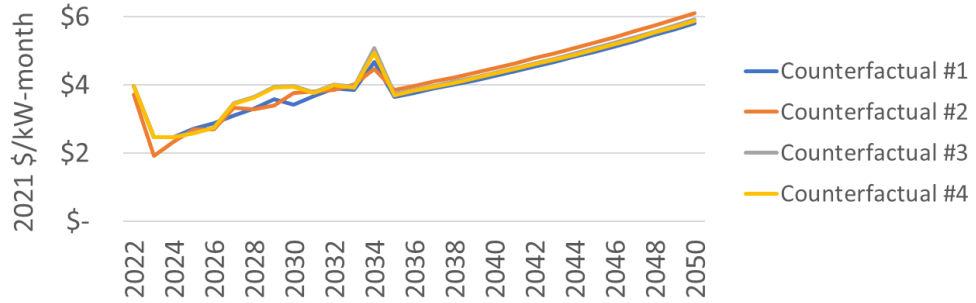
Key Data Sources

Key Data Items	Sources
Storage costs and operating characteristics	Lazard, NREL, E3's Pro Forma
Historical data (unit operations, prices)	EIA, EPA, ISO-NE
Retail rates	Central Maine Power, Versant
Energy prices	Avoided Energy Supply Components in New England (AESC), with adjustments based on E3's professional judgement
Capacity prices	
Marginal emission rates	
T&D deferral	
Ancillary services	E3 estimate based on historical
Value of Lost Load	LBNL

AESC Energy Prices (Maine) – 2021 $/MWh



AESC Capacity Prices – 2021 $/MWh



Questions for Stakeholders:
Are there other publicly-available data sources that should be considered?

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Study Q&A with Stakeholders

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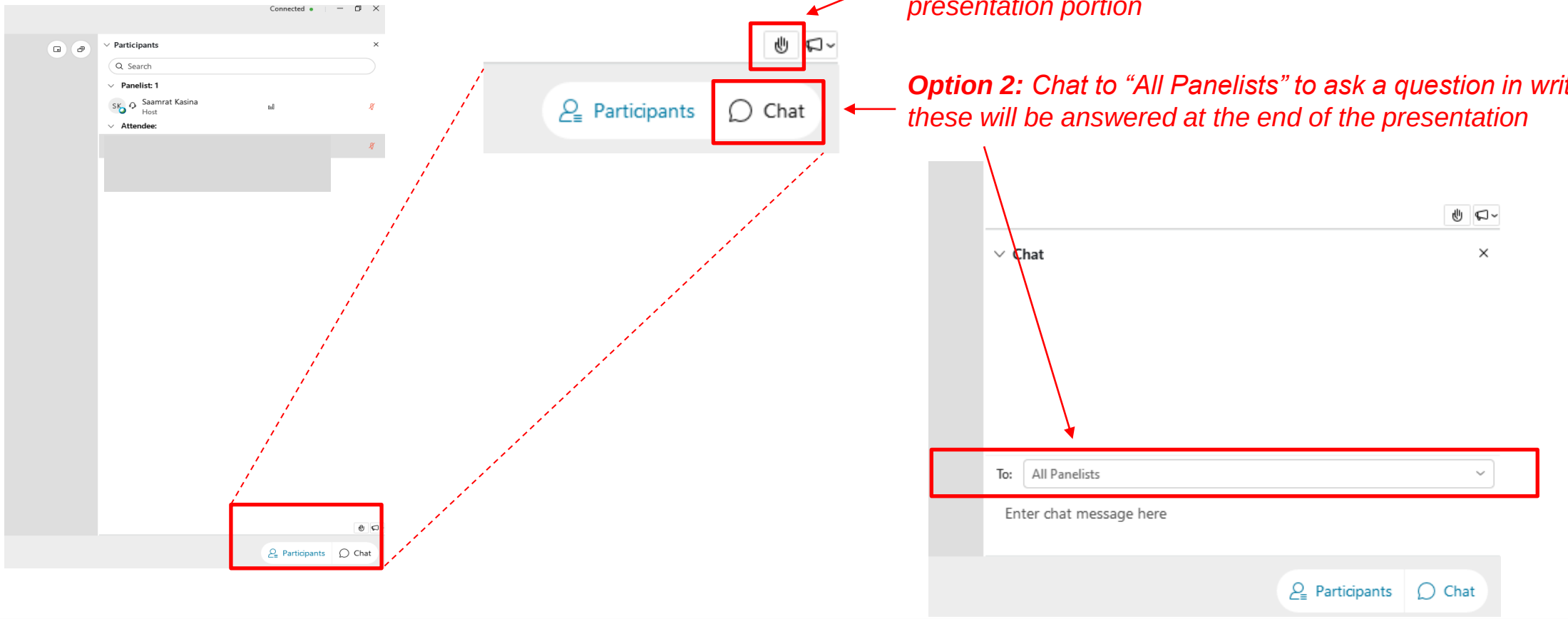

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Feedback and Next Steps

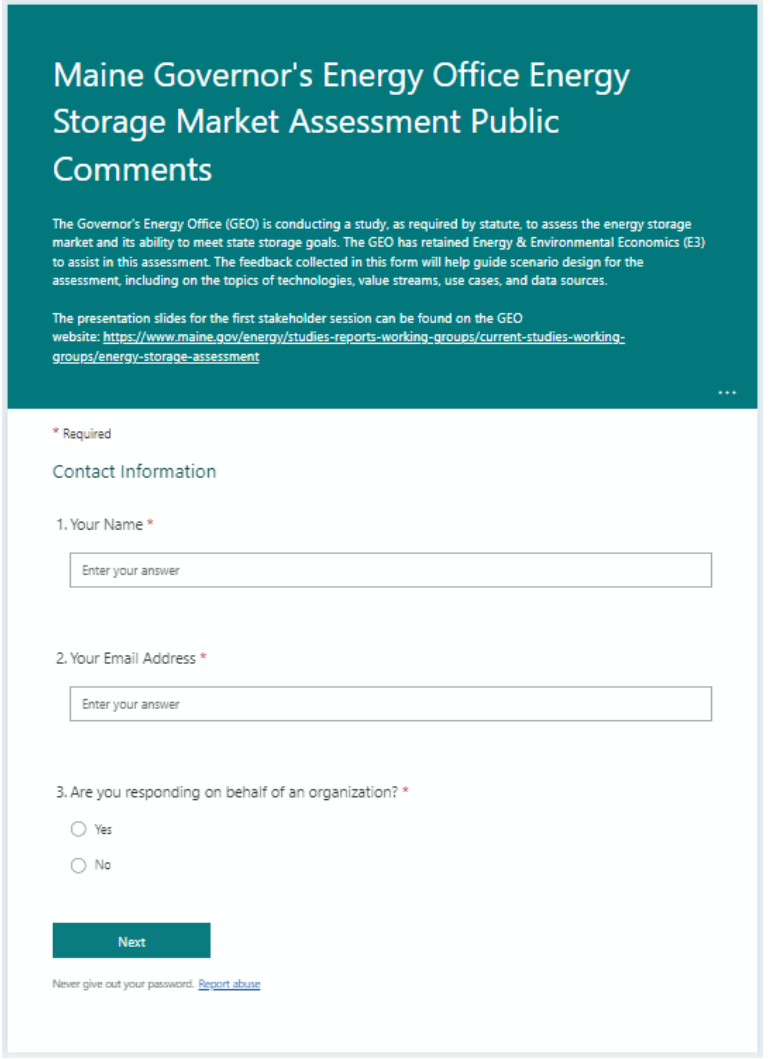
Feedback Questions

Topic	Question(s)
Technologies	What other factors should be used to assess different storage technologies?
Value Streams	Are they any key value streams missing?
Use Cases	Which use cases are the most applicable over the next decade? Are any important use cases missing?
Modeling	Are there any other inputs or outputs to consider that can be quantitatively modeled?
Data Sources	Are there other publicly-available data sources that should be considered?
Other	What are the biggest hurdles to energy storage resource development in Maine?

Please submit your responses and feedback at: **https://forms.office.com/r/XLhevxzP5E**

How to Submit Feedback

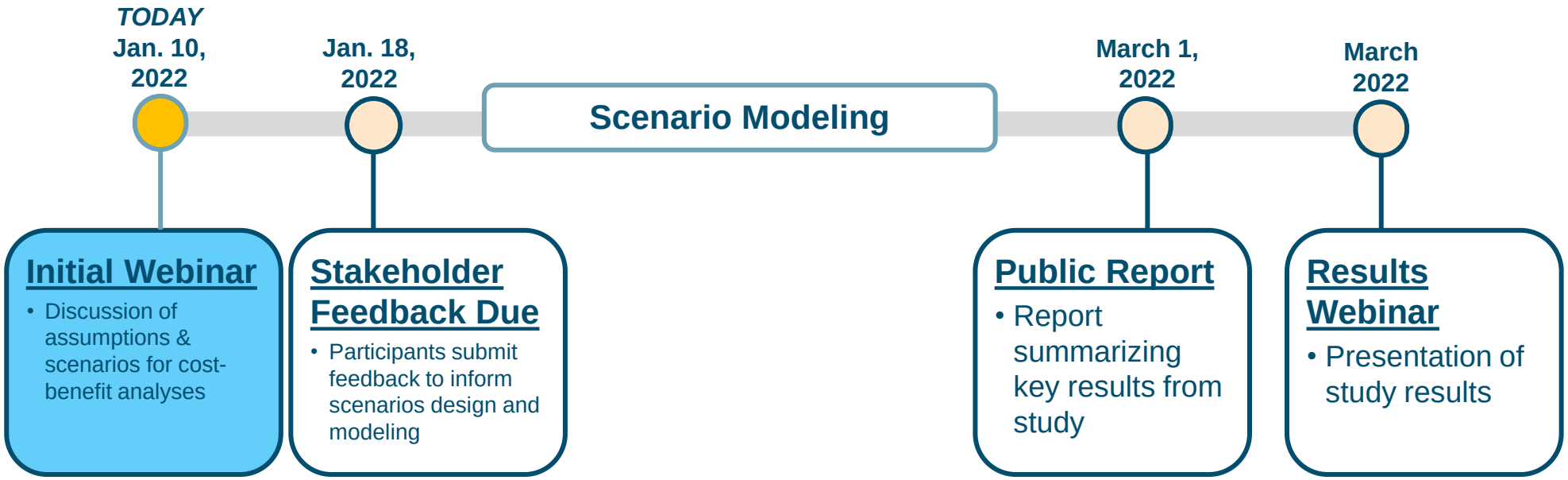
- **Link to submit feedback:**
  - https://forms.office.com/r/XLhevxzP5E
  - Link also posted on the GEO Energy Storage Market Assessment webpage
- **What we are looking for:**
  - Specific responses to questions posed in this presentation
  - General feedback on study
- **Your feedback will be considered as scenarios are finalized and modeling begins**
- **If you would like to submit an attachment, please email Caroline.Colan@maine.gov**
- **We request that feedback is submitted by close of business 1/18/2022**



Process and Schedule

Stakeholders have an opportunity to submit input into the assumptions and scenario design process for the storage cost-benefit analyses.

1. **Stakeholders submit feedback on scenario design and modeling by Jan. 18, 2022**
2. **GEO and E3 conduct analysis in January and February 2022**
3. **Report summarizing study findings will be released by March 1, 2022**
4. **GEO and E3 to present results in March 2022**



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Thank You

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