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Report of the Commission to Study the Economic, Environmental and Energy Benefits of Energy Storage to the Maine Electricity Industry

Maine State Legislature

Maine Office of Policy and Legal Analysis

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Executive Summary

The 129th Maine Legislature established the Commission to Study the Economic, Environmental and Energy Benefits of Energy Storage to the Maine Electricity Industry (referred to in this report as the "commission") with the passage of Resolve 2019, chapter 83. Pursuant to the resolve, 14 members were appointed to the commission: two members of the Senate appointed by the President of the Senate; three members of the House of Representatives appointed by the Speaker of the House; four public members appointed by the President of the Senate including: a representative of the energy storage industry, a representative of the hydroelectric energy storage industry, a representative of an electric utility in the State and an academic in the field of energy storage; four public members appointed by the Speaker of the House including: a representative of a conservation organization, a representative of a business that uses significant electric power in the State, a representative of a large-scale energy storage owner and a representative of a small-scale energy storage owner; and the Public Advocate.

The resolve set forth the following duties for the commission:

- Review and evaluate the economic, environmental and energy benefits of energy storage to the State's electricity industry, as well as public policy and economic proposals to create and maintain a sustainable future for energy storage in the State;

- Consider the challenges of the broad electricity market in the State, including challenges with transmission and stranded renewable energy generation in the northern part of the State, and analyze whether energy storage is part of the transmission solution;

- Consider whether the environmental, economic, resiliency and energy benefits of energy storage support updating the State's energy policy to strengthen and increase the role of energy storage throughout the State;

- Consider the economic benefits of energy storage systems procurement targets, including: benefits of cost savings to ratepayers from the provision of services, including energy price arbitrage, capacity, ancillary services and transmission and distribution asset deferral or substitution; direct cost savings to ratepayers that deploy energy storage systems; an improved ability to integrate renewable resources; improved reliability and power quality; the effect on retail electric rates over the life of a given energy storage system compared to the effect on retail electric rates using a nonenergy storage system alternative over the life of the nonenergy storage system alternative; reduced greenhouse gas emissions; and any other value reasonably related to the application of energy storage system technology and compare those economic benefits to the effects of leaving current policies in place;

- Review economically efficient and effective implementation approaches to energy storage targets;

- Consider bring-your-own-device programs that offer credits for sharing stored energy With electric utilities and storm outage and response management programs for behind the-meter energy storage to reduce peak reduction and increase resiliency; and

- Examine any other issues to further the purposes of the study.

In addition, the commission was required to seek public input and consult and collaborate with stakeholders and relevant experts. The commission is required to submit a report, with findings and recommendations, including suggested legislation, to the Joint Standing Committee on Energy, Utilities and Technology in December 2019.

Over the course of four meetings the commission received presentations from stakeholders, state utility regulators, state office representatives, and subject matter experts. With this information and through several discussions the commission developed four findings and seven recommendations that seek to promote energy storage opportunities in the State.

The commission unanimously agreed on the following four findings:

1. Energy storage has the potential to reduce costs and improve reliability;
2. Energy storage complements and supports renewable energy;
3. Energy storage technology is dynamic and evolving and presents cost-effective options; and
4. Energy storage development may be inhibited by market barriers or a lack of clear regulatory signals.

The commission developed the following recommendations to capture the economic, environmental and energy benefits of energy storage:

1. Establish state targets for energy storage development;
2. Encourage energy storage paired with renewable and distributed generation resources;
3. Advance energy storage as an energy efficiency resource;
4. Address electricity rate design issues relating to time variation in costs;
5. Clarify utility ownership of energy storage;
6. Advocate for energy storage consideration in regional wholesale markets; and
7. Conduct an in-depth Maine-specific analysis of energy storage costs, benefits and opportunities.

In accordance with the resolve, and in order to provide more clarity and to assist the Joint Standing Committee on Energy, Utilities and Technology in its deliberations, the commission is including in Appendix F, model draft language for legislation to address the recommendations in this report.

In making its recommendations, the commission was deliberate in suggesting achievable near-future policy actions, paired with further study and investigation to inform future policy action. This reflects the commissions' recognition that while it is important to move forward now, long-term advancement of energy storage needs to be based on well-developed policy, informed by quantitative data that is specific to Maine and that is technology neutral.

I. Introduction

The Commission to Study the Economic, Environmental and Energy Benefits of Energy Storage to the Maine Electricity Industry was established during the First Regular Session of the 129th Legislature by Resolve 2019, chapter 83. A copy of the enabling legislation is provided in Appendix A. The enabling legislation establishes the membership of the commission to include members with various expertise and interests in energy storage matters. Specifically, the 14-member commission includes:

- Two members of the Senate appointed by the President of the Senate;
- Three members of the House of Representatives appointed by the Speaker of the House;
- Four public members appointed by the President of the Senate including: a representative of the energy storage industry, a representative of the hydroelectric energy storage industry, a representative of an electric utility in the State and an academic in the field of energy storage;
- Four public members appointed by the Speaker of the House including: a representative of a conservation organization, a representative of a business that uses significant electric power in the State, a representative of a large-scale energy storage owner and a representative of a small-scale energy storage owner; and
- The Public Advocate.

A list of commission members is provided in Appendix B.

Resolve 2019, chapter 83, outlines the following duties to guide the commission in its study of energy storage:

- Review and evaluate the economic, environmental and energy benefits of energy storage to the State's electricity industry, as well as public policy and economic proposals to create and maintain a sustainable future for energy storage in the State;

- Consider the challenges of the broad electricity market in the State, including challenges with transmission and stranded renewable energy generation in the northern part of the State, and analyze whether energy storage is part of the transmission solution;

- Consider whether the environmental, economic, resiliency and energy benefits of energy storage support updating the State's energy policy to strengthen and increase the role of energy storage throughout the State;

- Consider the economic benefits of energy storage systems procurement targets, including: benefits of cost savings to ratepayers from the provision of services, including energy price arbitrage, capacity, ancillary services and transmission and distribution asset deferral or substitution; direct cost savings to ratepayers that deploy energy storage systems; an improved ability to integrate renewable resources; improved reliability and power quality; the effect on retail electric rates over the life of a given energy storage system compared to the effect on retail electric rates using a nonenergy storage system alternative over the life of the nonenergy storage system alternative; reduced greenhouse gas emissions; and any other value reasonably related to the application of energy storage system technology and compare those economic benefits to the effects of leaving current policies in place;

- Review economically efficient and effective implementation approaches to energy storage targets;
- Consider bring-your-own-device programs that offer credits for sharing stored energy with electric utilities and storm outage and response management programs for behind-the-meter energy storage to reduce peak reduction and increase resiliency; and
- Examine any other issues to further the purposes of the study.

In carrying out its work, the commission was required to seek public input and consult and collaborate with stakeholders and relevant experts.

The enabling legislation charges the commission with submitting a report of its findings and recommendations, including any suggested legislation, to the Joint Standing Committee on Energy, Utilities and Technology by December 4, 2019. Under the Joint Rules of the Legislature, the Joint Standing Committee on Energy, Utilities and Technology, after review of the commission's report, may submit a bill to the Second Regular Session of the 129th Legislature based on the report (Joint Rule 353).

II. Commission Process

The commission held a total of four meetings to conduct its work. These meetings were held on October 22, November 6, November 19 and December 2, 2019. All meetings were open to the public and live audio of each meeting was made available over the Internet through the Legislature's webpage.

The balance of the first two meetings centered on information gathering. To inform its work, the commission sought input from: individuals with expertise in the energy storage policy arena at the national and regional level; state agencies engaged directly or indirectly in energy storage issues; and industry stakeholders engaged in energy storage project development and operation on the ground in Maine. The commission also reviewed several key published reports on state and national energy storage policy issues.

The first meeting focused on providing commission members with necessary background information to lay the foundation for the commission's work. The meeting included a review of the enabling legislation (see Appendix A), covering the duties, process and timeline for the commission's work, as described above; a presentation from a regional expert on energy storage policy, programs and activities; and a discussion of individual commission members goals and priorities for the study.

At this meeting, Todd Olinsky-Paul of the Clean Energy Group and Clean Energy States Alliance made a presentation on "Energy Storage Landscape in New England: Policies, Programs and

Activities." Mr. Olinsky-Paul provided an overview of current federal and state policies that are shaping the landscape for energy storage and discussed energy storage development activity, with particular focus on Massachusetts and other New England states. His presentation reviewed different types of state policies and incentives for energy storage, including procurement targets, renewable portfolio standards, rebate programs and tax incentives. He also discussed the use of energy efficiency funds to provide incentives for energy storage, with reference to his recent publication: "Energy Storage: The New Efficiency."[1]

At its second meeting, the commission focused on learning more about the state and national energy storage landscape. The meeting included: two presentations from state agency officials; a presentation by a national expert from the United States Department of Energy (DOE) Pacific Northwest National Laboratory (PNNL); and a discussion of several key energy storage study reports.

To begin the meeting, the Public Utilities Commission (PUC) and the Efficiency Maine Trust (EMT) provided presentations on the regulatory and programmatic landscape for energy storage in Maine. PUC Chairman Philip Bartlett focused his presentation on opportunities for energy storage development under recent legislation relating to renewable portfolio standards, solar and other distributed generation resources, non-wires alternatives to grid investments and beneficial electrification. He also touched on regulatory barriers and cost trends for energy storage technology. The commission then heard from Michael Stoddard and Ian Burnes of EMT regarding the EMT Innovation Program and how that program can encourage the development of energy storage opportunities through pilot projects. Mr. Burnes described several innovation pilot projects relevant to energy storage. Ongoing pilot projects include:

- Demand Response: Residential Distributed Energy Resources;
- Battery Storage: Controlling Demand Charges;
- Passive Load Shifting: Refrigerated Space as Storage; and
- Load Shifting Using Transactive Controls and Storage.

At this meeting, the commission received an in-depth presentation on energy storage issues from Jeremy Twitchell from the PNNL of U.S. DOE. Offering a national perspective, Mr. Twitchell reviewed:

- The U.S. DOE Energy Storage Program;
- Different energy storage technologies, their advantages, challenges and applications and cost trends;
- The range of services energy storage can deliver and how these relate to energy resource planning; and
- Current state energy storage policies.[2]

[1] Olinsky-Paul, Todd, "Energy Storage: The New Efficiency," April 2019, https://www.cleanegroup.org/wp-content/uploads/energy-storage-the-new-efficiency.pdf
[2] Twitchell, Jeremy, "A Review of State-Level Policies on Electrical Energy Storage," April 2019, https://doi.org/10.1007/s40518-019-00128-1

The final component of the second meeting was commission review and discussion of two reports that members had read in preparation for the meeting. These reports are as follows:

- The "State of Charge, Massachusetts Energy Storage Initiative Study"[3] report provides a detailed look at national and state energy storage industry landscape, economic development and market opportunities for energy storage and potential policies and programs to better support energy storage deployment in Massachusetts. This study was completed by a team of consultants in conjunction with the Massachusetts Department of Energy Resources and the Massachusetts Clean Energy Center as part of the state's Energy Storage Initiative. The study was based on an in-depth quantitative modeling and analysis of detailed costs, benefits and feasibility of specific energy storage use cases for Massachusetts.

- The "Economics of Battery Energy Storage"[4] report examines the range of services that battery energy storage can provide to the electrical grid and the economic values associated with those services. The report considers the different types of value batteries can generate at different locations on and levels of the grid and for different sectors (for example, end-use customers, transmission and distribution, wholesale markets), the barriers that exist for the utilization of batteries and the implications for stakeholders.

Commission staff provided several handouts to members that synthesized key information from these two reports. Copies of these handouts are included as Appendix C.

At both the second and third meetings, the commission heard presentations from stakeholders engaged in energy storage development and/or operations with a connection to Maine or other New England states. The commission received brief informational presentations from the following individuals:

- Eben Perkins, Competitive Energy Services, LLC
- Brett Cullen, ENGIE
- Matt Doubleday, SunRaise
- Benjamin Lavoie, Ameresco
- Kurt Adams, Summit Natural Gas
- Brad Bradshaw, Velerity
- Michael Connelly, LS Power
- Jason Houck, Form Energy, Inc.
- Greg Geller, Enel X
- Tom Murley, Two Lights Energy Advisors

Additional information regarding the energy storage activities of each presenter is provided as Appendix D.

[3] "State of Charge, Massachusetts Energy Storage Initiative Study," September 2016, https://www.mass.gov/media/6441/download
[4] "The Economics of Battery Energy Storage," Rocky Mountain Institute, September 2015, https://rmi.org/wp-content/uploads/2017/03/RMI-TheEconomicsOfBatteryEnergyStorage-FullReport-FINAL.pdf

The balance of the third meeting was dedicated to discussion of findings and recommendations. In preparation for this discussion, the commission chairs asked each member to submit, in advance, a list of up to three key findings, or takeaways, and up to three key recommendations they would like considered by the commission. Of the 14 commission members, 10 provided input in response to this request. Based on these submissions, commission staff prepared summary documents organizing the input received for use at the third meeting; copies of these summary documents are provided in Appendix E. At the meeting, the commission members worked through the summary documents to identify priorities, clarify information, refine key points and develop a consensus on draft findings and recommendations to be included in the report.

At its fourth and final meeting on December 2, 2019, the commission reviewed and finalized its draft report.

III. Commission Findings

To develop its findings, the commission solicited input from individual members on their key findings or takeaways from material presented to and reviewed by the commission. As noted above, members were each asked to submit up to three key findings for consideration which were then compiled by staff and organized by common elements. In this process six overarching findings emerged, each with multiple specific supporting findings submitted by members (see Appendix E). After careful review and discussion of the individual submissions and the overarching findings identified, the commission unanimously agreed on the following four findings:

1. Energy storage has the potential to reduce costs and improve reliability;
2. Energy storage complements and supports renewable energy;
3. Energy storage technology is dynamic and evolving and presents cost-effective options; and
4. Energy storage development may be inhibited by market barriers or a lack of clear regulatory signals.

1. Energy storage has the potential to reduce costs and improve reliability.

The commission finds that energy storage offers potential to reduce electricity costs and to improve reliability of the electric transmission and distribution system.

The commission identified and discussed several key ways in which energy storage has the potential to reduce costs for electric ratepayers. Energy storage can shave demand peaks, which has the potential to reduce costs for individual customers[5] and for all ratepayers. At the individual customer level, energy storage provides cost saving opportunities particularly for commercial and industrial (C&I) customers who pay demand charges. For these customers, behind-the-meter energy storage offers the opportunity to manage peak demand by using stored energy during peak periods thereby reducing their need to purchase energy. Energy storage allows a customer to use electricity from the grid with less variation, reducing any dramatic peaks in load from the grid that a C&I customer may have depending on the nature of their business's energy needs. In a scenario

[5] Anywhere in this report where the term "customer" is used refers to both residential and commercial and industrial customers unless otherwise noted.

with time-differentiated rates for energy supply, energy storage also allows C&I customers to store energy during time periods with lower rates and use that energy during periods when rates are higher, which could also result in a reduction of charges paid for that energy.

Energy storage, whether behind the meter or in front of the meter, also provides the opportunity to reduce system peak demand and system-wide costs for all ratepayers. This is important because the overall system of generation, transmission and distribution infrastructure needs to be sized to serve the highest peak usage. A system sized to meet these short peak periods results in inefficiencies and the underutilization of assets at the expense of ratepayers. Energy storage can be used to meet system requirements at times of peak electricity consumption by discharging energy stored during non-peak periods, instead of using generation assets. This can eliminate the need to use "peaker" generation plants (often fossil-fueled plants) to meet peak demand, which usually occurs during periods of high electric and fuel prices and which results in greenhouse gas emissions. The usage of storage during these peak usage periods also could delay or defer the need to invest in new generation capacity, as well as delay, defer or reduce the need for upgrades to transmission and distribution systems. A well-planned electrical system that incorporates energy storage in an effective manner has the potential to reduce costs to ratepayers as it shifts away from the need to build expensive facilities to meet these peak periods.

In addition to the potential for cost savings, the commission also finds that energy storage can improve grid reliability, which is measured by the percent of time the grid is "available and functional". [6] Well-placed and planned deployment of energy storage can both increase the efficiency of the electrical grid and make it less susceptible to disruptions. Energy storage can provide several distinct services that directly impact grid reliability, including: frequency regulation, voltage regulation, spinning and non-spinning reserves and black start asset services (see Appendix C). As discussed in conjunction with the commission's review of "State of Charge, Massachusetts Energy Storage Initiative Study,"[7] energy storage can help in the management of power flows and alleviate reliability issues caused by reverse power flows[8] when located at substations. In California, where over 1.3 gigawatts of energy storage will be deployed by 2020, it has been found that energy storage is a "key reliability tool that is used to support a changing and more dynamic grid. In many cases, it is faster to implement than generation facilities and it can be more cost effective than alternative reliability solutions." [9] On numerous occasions, the commission noted that it is important for Maine to look to the lessons learned from other states as it moves forward on energy storage policy.

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[6] Susser, Jonathan. "Understanding and Managing Grid Reliability and Resiliency," July 25, 2018. https://www.advancedenergy.org/2018/07/25/gridreliabilityandresiliency/

[7] "State of Charge, Massachusetts Energy Storage Initiative Study," September 2016, https://www.mass.gov/media/6441/download

[8] Reverse power flow or backfeeding is a flow of electrical energy in the reverse direction from its normal flow. For example, reverse power flow may occur when there is an excess of solar power flowing from a solar generator into the grid.

[9] Electricity Advisory Committee. "Securing the 21st–Century Grid: The Potential Role of Storage in Providing Resilience, Reliability, and Security Services, Recommendations for the U.S. Department of Energy." June 25, 2018. https://www.energy.gov/sites/prod/files/2018/06/f53/EAC_Role%20of%20Storage%20in%20Providing%20Resilience%20Reliability%20Security%20Services%20%28June%202018%29_0.pdf

2. **Energy storage complements and supports renewable energy.**

The commission finds that the deployment of energy storage complements and supports renewable energy generation resources. Maine law makes a clear commitment to encouraging renewable energy as a source of electricity:

> **1. Policy.** In order to ensure an adequate and reliable supply of electricity for Maine residents and to encourage the use of renewable, efficient and indigenous resources, it is the policy of this State to encourage the generation of electricity from renewable and efficient sources and to diversify electricity production on which residents of this State rely in a manner consistent with this section.
>
> (35-A MRSA, section 3210, subsection 1)

During the First Session of the 129th Legislation, the State's commitment to renewable energy was strengthened through several laws. Under Public Law 2019, chapter 477 the following goals were enacted:

> **1-A. State goals for consumption of electricity from renewable resources.** The State's goals for increasing consumption of electricity in the State that comes from renewable resources are as follows:
>
> A. By January 1, 2030, 80% of retail sales electricity in the State will come from renewable resources; and
>
> B. By January 1, 2050, 100% of retail sales electricity in the State will come from renewable resources.
>
> (35-A MRSA, section 3210, subsection 1-A)

In addition, Public Law 2019, chapter 477 requires the procurement of new renewable generation resources and Public Law 2019, chapter 478 requires the procurement of distributed generation resources defined as generation facilities with a nameplate capacity of less than five megawatts that uses renewable fuel or technology. With these additional commitments to renewable energy, there is a key opportunity for energy storage.

Energy storage plays an important supporting role for renewable resources and address certain limitations of these resources. In particular, while renewable energy has many benefits, certain renewable resources have variable production and this is where storage can be of great value. For example, renewable energy generated from solar or wind is only produced when there is sun shining or wind blowing, respectively. Energy storage can be used to store excess power generated during periods with sun and wind availability. During periods of time when the sun or wind is not available, energy storage can be used to address that gap by discharging stored energy. Long duration energy storage, such as pumped hydropower facilities, as well as emerging technologies offering longer duration capabilities, offer the potential to increase deployment of certain types of renewable energy such as wind. For example, in times of consistent wind and low-electricity demand, that excess energy produced from wind is lost. If there is longer duration energy storage available, that excess energy can be captured, making the renewable energy more valuable and efficient. As the penetration of variable renewable generation resources increases in the State, the need to address variable output through system flexibility increases.

3. Energy storage technology is dynamic and evolving and presents cost-effective options.

During the study process, the commission reviewed the classification of energy storage technologies (see Appendix C) and discussed how the advantages and applications of energy storage can vary by technology type, size and location. For example, long-duration storage such as pumped hydropower may be complementary to short-duration advanced storage technologies given differing capabilities and grid requirements. Over the course of its discussions, the commission expressed numerous times that Maine needs remain technology neutral when developing energy storage policy. Any policy developed related to energy storage should not just focus on a singular technology, but rather should be flexible to realize the benefits that differing technologies provide to address differing needs.

From the presentations made by energy storage stakeholders (see Appendix D), it became clear that energy storage options and technologies are ever evolving and what may seem ideal today may be replaced any time by an option that addresses a need in a more effective and efficient manner in the future. Commission members expressed that they do not want to miss out on opportunities to maximize storage benefits because policy was too narrowly crafted. Members also discussed the importance of considering behind-the-meter storage solutions as these solutions also generate socialized benefits.

The commission also learned through its study, especially from the presentation provided by Jeremy Twitchell of the Pacific Northwest National Laboratory, that storage technology costs are declining and that storage is cost-effective in many applications. As more entities deploy storage technology the experiences learned can provide a greater understanding of storage technology benefits and inform opportunities for cost-effective storage technology solutions in Maine.

4. Energy storage development may be inhibited by market barriers or a lack of clear regulatory signals.

The commission identified that there are still some barriers to the deployment of energy storage in Maine. While some of these challenges can be addressed at the state level, others will require coordinating with other states in the region to try to affect change.

At the state level, the commission discussed whether Maine law provides clear direction regarding whether an investor-owned transmission and distribution utility (IOU) could own or have a financial interest in an energy storage facility. In current law, 35-A MRSA section 3204, subsection 6 "allows an investor-owned transmission and distribution utility to own, have a financial interest in or otherwise control generation and generation-related assets" only "to the extent that the commission finds that ownership, interest or control is necessary for the utility to perform its obligations as a transmission and distribution utility in an efficient manner." This provision does not provide clarity on the instances in which an IOU could have any interest in energy storage. While IOU's understand they can earn revenue from traditional transmission and distribution projects, it is not at all clear when they can earn revenue on energy storage projects and this lack of clarity provides a disincentive for the IOU to look at alternatives to transmission and distribution projects.

At the regional level, the commission discussed the current role for energy storage in the markets operated by ISO-NE. As stated in the "State of Charge" report for energy storage development to grow clear rules need to be in place at ISO-NE to enable full participation of energy storage projects in the wholesale markets.[10] The commission noted that ISO-NE markets accommodate energy storage but do not fully value energy storage capabilities. Furthermore, the markets that energy storage can participate in are not large enough to incent significant new energy storage deployment and ISO-NE system planning and modeling cannot currently accommodate all market functions. Whether behind-the-meter or on a larger scale, in order to invest in storage that will provide system benefits to all ratepayers, an investor needs to be monetarily compensated for the value the storage project is providing to the system since the investor is bearing all of the costs.

In moving forward, Maine does not need to reinvent the wheel. There are many other states Maine can look to, especially those in the New England region, for ways in which to encourage storage in a manner that will benefit all ratepayers. The important thing is that the state needs to start to act quickly so we do not lose pace and fall behind in the New England market.

IV. Recommendations

As highlighted in section III of this report, the commission observed that energy storage has the potential to play an important and valuable role in Maine's energy future through its potential to increase grid reliability, reduce inefficiencies, complement renewable energy generation especially as its deployment grows and create cost savings for electric ratepayers. Based on available research and information presented by experts in the field, the commission has identified several initial steps the State can take without delay to advance energy storage in the State. The commission also recognizes that to move beyond these first steps to create and implement a longer-term plan for State energy storage policy additional investigation is required. The remainder of this section outlines the commission's recommendations, including specific short-term actions as well as targeted research and analysis to map out the long-term path forward for energy storage development and policy in the State. Model draft language for legislation to address these recommendations is included in Appendix F of this report. The recommendations are as follows:

1. Establish state targets for energy storage development;
2. Encourage energy storage paired with renewable and distributed generation resources;
3. Advance energy storage as an energy efficiency resource;
4. Address electricity rate design issues relating to time variation in costs;
5. Clarify utility ownership of energy storage;
6. Advocate for energy storage consideration in regional wholesale markets; and
7. Conduct an in-depth Maine-specific analysis of energy storage costs, benefits and opportunities.

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[10] "State of Charge, Massachusetts Energy Storage Initiative Study," September 2016, https://www.mass.gov/media/6441/download

The commission recommends that all energy storage policy efforts, as well as analysis conducted to inform future policy, include careful consideration of the needs of low-income populations and strategies to ensure low-income households and communities in the State have access to the benefits of energy storage and that the benefits of energy storage are distributed equitably equally across customer classes.

1. Establish Targets for Energy Storage Development

The commission recommends that the State set a short-term target for the development of energy storage capacity and develop longer term goals based on further research and analysis. In the short-term, the commission recommends establishing a State goal of reaching 100 megawatts (MW) of energy storage capacity located in the State by the end of 2025. This is specified as a goal not a mandate; it does not require any particular action or procurement activity by the State. By creating a goal of 100 MW of available storage capacity by 2025, the commission's intent is to signal the State's recognition of the value and benefits that strategic investment in energy storage can provide to energy consumers and the electrical grid. The commission selected 100 MW by 2025 as a modest initial target to encourage investment and development activity. In developing this target, the commission considered energy storage targets established by other states, which are summarized in Table 1. The commission recommends that the Governor's Energy Office (GEO) developed and propose future targets as part of the in-depth energy storage study outlined in recommendation 7.

Table 1 – Statewide Energy Storage Targets[11]

State	Target Level	Target Date	Type
Arizona	3,000 MW[12]	2030	Goal
Massachusetts	200 MWh 1,000 MWh	2020 2025	Goal
New York	1,500 MW 3,000 MW	2025 2030	Goal
New Jersey	600 MW 2,000 MW	2021 2030	Goal
California	1,325 MW	2024	Requirement

2. Encourage Energy Storage in Renewable Energy Procurement

To realize the benefits energy storage can provide in conjunction with renewable energy generation, the commission recommends that the State enhance opportunities for energy storage under the long-term contracts (procurements) for renewable resources and distributed generation (DG) resources required by recent legislation. In 2019, the State enacted two laws which explicitly allow for energy storage paired with generation to participate in certain resource procurements administered by the PUC. First, LD 1494, "An Act to Reform Maine's Renewable Portfolio Standard" (Public Law 2019, chapter 477) includes requirements for procurements of new renewable generation resources and specifically allows grid-connected energy storage systems paired as a complementary

[11] Source: https://www.eesi.org/papers/view/energy-storage-2019
[12] MW refers to the capacity of the energy storage; MWh refers to the product of capacity and storage time (MW*hours of storage).

resource with a renewable generation resource to participate in the procurement under certain conditions.[13] Second, LD 1711, "An Act to Promote Solar Energy Projects and Distributed Generation Resources" (Public Law 2019, chapter 478), requires procurements of shared DG resources (output owned by or allocated to subscribers) and commercial/institutional DG resources. This law authorizes, but does not require, the PUC to establish incentives in the DG procurements, which may include incentives to support DG resources paired with energy storage.

The commission recommends the State take the next step beyond allowing storage paired with renewable generation in these procurements and create an incentive for energy storage paired with renewables. Specifically, the commission recommends:

- Providing an adder for energy storage in procurements of new renewable generation resources under 35-A MRSA section 3210-G and of DG resources under 35-A MRSA, section 3484 in the contract price when: (a) the generation resource is paired with energy storage and (b) the bidder demonstrates that the paired storage alleviates congestion on the transmission or distribution system or provides some other demonstrated benefit to grid reliability, grid resiliency or electricity ratepayers; and

- Requiring the PUC, through a rulemaking or other appropriate PUC proceeding, to determine the specific value (or formula) along with eligibility criteria for the "adder", including the consideration of power rating, capacity rating, minimum efficiency requirements, data reporting and operational requirements as eligibility criteria.

3. Advance Energy Storage as an Energy Efficiency Resource

The role of energy storage in peak demand reduction provides a direct link between energy storage and the work of the EMT. Current law specifically directs EMT to advance the goal of reducing peak demand (35-A MRSA section 10104) and to consider programs that reduce electricity costs for all consumers through peak demand reduction (35-A MRSA section 10110, subsection 2, paragraph A, subparagraph 4). Energy storage provides a mechanism to reduce peak demand by storing energy during off-peak periods and discharging stored energy during peak periods thereby reducing demand on the grid during the peak period; this is often referred to as peak shaving or peak shifting.

To ensure that EMT is empowered to pursue energy storage initiatives, the commission recommends that the Legislature provide additional clarity in law and specific policy directives to EMT regarding energy storage. In particular, to solidify and clarify the role of EMT with respect to energy storage and energy efficiency, the commission recommends:

- Amending the laws governing the EMT (Title 35-A, chapter 97) to ensure that the trust's authority explicitly and affirmatively includes energy storage, by adding direct references to energy storage in relevant sections of statute, including definitions;

[13] To participate storage must be co-located with the generation or located separately from the generation provided that the PUC finds the inclusion of the energy storage system would result in a reduction in greenhouse gas emissions

- Directing the EMT to study and consider developing opportunities through existing or new programs and initiatives to use energy storage to reduce peak electricity demand. In developing energy storage opportunities, the commission recommends that the trust consider:

    - Expanding energy storage pilot projects within the existing Innovation Pilot Program and implementing any cost-effective pilots as statewide programs;
    - Bring-your-own-device (BYOD) programs in which customer-owned and customer-sited battery storage is aggregated and performance incentives are provided for reducing load at times of system peak;
    - Rebate programs or funding programs (for example, programs that pay for dispatch of storage) for all customer class storage paired with renewable energy; and
    - Customer education initiatives regarding demand management and energy storage, including education targeted to low-income and rural areas; and

- Directing the EMT to explore alternative methods to demonstrate cost-effectiveness for energy storage projects or programs.

4. Address Rate Design and Energy Storage

To harness the value offered by energy storage and concurrently address limitations in current electricity rate structures, the commission recommends the PUC investigate and, where appropriate, implement rate designs that account for variation in the cost components of electricity as the load (or demand) on the electricity system fluctuates. Even in the absence of energy storage, time differentiated electricity rates can provide valuable signals to energy consumers about the cost of energy at different times and encourage consumer to adjust consumption to periods of lower demand, providing benefits to the overall system. Time differentiated rates also create incentives for energy storage to shift demand away from high cost peak periods. Energy storage increases the value of time differentiated rates by creating the opportunity to bank excess generation (supply) during non-peak periods when prices are lower and discharge that energy for consumption during peak periods when prices are high.
The commission recommends that the PUC take the following specific steps to address rate design:

- Open a docket to: investigate opportunities to modernize electricity rate design through time-of-use or other time-differentiated, rates that send appropriate price signals and incentives to consumers to reduce demand during peak periods and
  develop and implement a pilot program to test and evaluate time-of-use rates in conjunction with energy storage;

- Develop and implement a schedule for regular review and update of electricity rate designs and ensure that the review include consideration of time differentiated rates; and

- Evaluate fixed charges, as the commission agrees that fixed charges are currently moving in the wrong direction.

5. Clarify Utility Ownership of Energy Storage

The commission has identified a need for increased regulatory clarity regarding ownership and dispatch of energy storage resources by investor-owned transmission and distribution utilities. Current law provides that the PUC may allow an investor-owned transmission and distribution utility to own generation-related assets to the extent that the commission finds it is necessary for the utility to perform its obligations in an efficient manner (35-A MRSA section 3204, subsection 6). From the perspective of utilities, this language and its interpretation by the PUC results in a degree of uncertainty that creates a barrier to investment. The commission is interested in having the PUC carefully examine and evaluate whether investor-owned transmission and distribution utilities should be permitted to own energy storage resources, beyond what is currently allowed by law. The commission recognizes that the question of utility ownership of energy storage resources is both unsettled and debated; therefore, it will be important to closely examine this issue to make sure that if ownership is allowed it is done so with appropriate "guardrails," such as applications limited to distribution level investment, as well as establishing processes that adequately allow private investment to satisfy identified needs, to ensure that ownership does not undermine the intent of the restructuring of the electricity sector.

Specifically, the commission recommends directing the PUC to open a docket to examine issues related to the ownership and operation of energy storage by transmission and distribution utilities. In order to ensure that private developers as well as electricity consumers are not disadvantaged the commission recommends the PUC consider the following:

- Whether an investor-owned transmission and distribution utility, if allowed to own or operate energy storage beyond what is allowed under current law, can add the costs to own or operate energy storage to its rate base;
- The overall cost implications for electricity ratepayers;
- Implications for the private market for storage development, construction and operation; and
- Potential benefits of utilities installing energy storage at or near utility substations to address transmission congestion issues.

6. Advocate for Energy Storage in the Regional Energy Markets

Given the potential value and range of services that energy storage can provide at the wholesale market level, the commission recommends that the State take steps to ensure that ISO-NE continues to address and integrate energy storage in wholesale markets. The commission recognizes that the ISO-NE wholesale markets and associated market rules provide some avenues for energy storage to participate. As these markets continue to evolve, the commission wants to ensure that ISO-NE considers, and values, the full range of energy storage in regional system planning and market development. As the regional transmission operator, ISO-NE is uniquely positioned to create wholesale market opportunities to realize the potential of energy storage, particularly with respect to certain aspects of grid operation and performance, including but not limited to frequency and voltage regulation, spinning and non-spinning reserves and restoring generation during grid outages (known as black start assets).

While Maine alone cannot change the ISO-NE rules, it can provide the ISO-NE with signals that change needs to occur. The commission recommends that the PUC, GEO and other state agencies as appropriate seek opportunities to advocate for consideration of energy storage opportunities by ISO-New England in regional market planning and design. These opportunities may include direct intervention as well as engagement with ISO-NE through regional organizations, such as the New England States Council on Energy (NESCOE) and the New England Conference of Public Utility Commissioners (NECPUC). The commission highlights the following issues for the PUC and GEO to raise in efforts to advance energy storage issues at the regional level:

- Addressing variation in locational value of new grid-scale energy storage, for example in relation to transmission-constrained areas and renewable energy generation; and

- Creating market opportunities for the full range of energy and reliability services that can be delivered by grid-scale and behind-the-meter customer aggregated storage. Examples could include establishing new market products for fast ramping and long-duration load following capabilities and expanding existing ancillary service markets including the Frequency Regulation market.

7. Conduct In-depth Analysis of Energy Storage Costs, Benefits and Opportunities

As an important complement to the preceding recommendations, the commission strongly recommends that the State, under the direction of the GEO, concurrently conduct a comprehensive analysis to evaluate and quantify the costs, benefits and opportunities for energy storage in the State and develop specific recommendations for future policy and program development. The preceding six recommendations offered by the commission outline critical first steps Maine can take in the energy storage arena based on existing research and analysis and experience of other states. To move beyond these first steps, the commission recognizes the need for Maine to conduct an in-depth, data driven study that includes quantitative modeling and analysis.

The commission recommends that the GEO be directed to conduct this study over a period of time that is determined to be sufficient to allow for the meaningful evaluation of data and information and deliver a report to the Legislature upon the conclusion of the study. To maximize the value and efficiency of this study initiative, the commission recommends that the study include:

- A review of existing state-specific energy storage studies, including but not limited to the Massachusetts State of Charge report (2016) and the Vermont Act 53 Report (2017),[14] and consultation with relevant staff and organizations in those States. This will ensure that Maine does not reinvent the wheel and capitalizes on lessons from similar efforts completed to date;

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[14] "Act 53 Report: A Report to the Vermont General Assembly on the Issue of Deploying Storage on the Vermont Electric Transmission and Distribution System," Vermont Department of Public Service (November 2017) https://legislature.vermont.gov/assets/Legislative-Reports/Storage-Report-Final.pdf

- Input from and involvement of the relevant state agencies including the PUC, the EMT, and the newly formed Climate Council and relevant subcommittees of that council;

- Quantitative data analysis modeling of energy storage needs, opportunities and cost-benefit analysis based on Maine-specific data, using existing energy storage modeling software available from reputable sources when possible and appropriate;[15]

- Comprehensive consideration of relevant issues including, but not limited to:

  - Emerging storage technologies and technological developments;
  - Access to energy storage for low-income households and communities;
  - Impacts of energy storage on carbon emissions;
  - Energy storage permitting and interconnection requirements;
  - Safety and performance codes and standards; and
  - Decommissioning and end-of-life remediation of storage technology;

- Recommendations for future energy storage targets beyond the 100 MW by 2025 target outlined in Recommendation 1. The commission recommends that the GEO carefully consider how to set targets optimally to support achievement of the state's renewable energy goals of 80% by 2030 and 100% by 2050 (35-A section 3210, subsection 1-A).; and

- Comprehensive recommendations that include a prioritized list and timeline of Maine-specific goals and needs for energy storage and associated policy and statutory changes necessary to achieve those goals.

The commission recognizes this study will require technical and analytical expertise and resources and therefore recommends that the Governors' Energy Office be provided the necessary resources to carry out this work effectively.

Finally, the commission recommends that the GEO address energy storage in all future updates to the comprehensive State Energy Plan, which GEO is required to provide the Governor and the Legislature every two years in January (2 MRSA section 9, subsection 3, paragraph C). To provide clarity and specificity, the commission recommends amending the State Energy Plan statute to require the plan, and biennial updates to the plan, specifically address energy storage development.[16]

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[15] The commission recommends consideration of: Battery Storage Evaluation Tool available from the U.S. Department of Energy, Pacific Northwest National Laboratory and the Storage Value Estimation Tool (Storage VET) available from the Electric Power Research Institute.

[16] This could be modeled on the current statutory requirement that the plan include a section on wind energy development (see 2 MRSA section 9, subsection 3, paragraph C, subparagraph (1), sub-subparagraph (c)).

V. Conclusion

The commission recognizes that Maine is behind other New England states in the development of policies to encourage energy storage. While it is important that comprehensive energy storage policy development is informed by thorough research and quantitative data, Maine cannot afford to wait for those results before acting. If the State fails to move forward with the small steps suggested in this report to promote energy storage development in Maine, ratepayers will pay the price of this inaction. As the other states in New England increasingly invest in energy storage and reduce peak demand, Maine will be left carrying more peak load resulting in more costs shifted to Maine ratepayers.

APPENDIX A

Authorizing Resolve

APPROVED | CHAPTER
JUNE 19, 2019 | 83
BY GOVERNOR | RESOLVES

STATE OF MAINE

IN THE YEAR OF OUR LORD

TWO THOUSAND NINETEEN

H.P. 1166 - L.D. 1614

Resolve, Establishing the Commission To Study the Economic, Environmental and Energy Benefits of Energy Storage to the Maine Electricity Industry

Sec. 1. Commission To Study the Economic, Environmental and Energy Benefits of Energy Storage to the Maine Electricity Industry established. Resolved: That the Commission To Study the Economic, Environmental and Energy Benefits of Energy Storage to the Maine Electricity Industry, referred to in this resolve as "the commission," is established.

Sec. 2. Membership. Resolved: That, notwithstanding Joint Rule 353, the commission consists of 14 members appointed as follows:

1. Two members of the Senate appointed by the President of the Senate, including a member from each of the 2 parties holding the largest number of seats in the Legislature;

2. Three members of the House of Representatives appointed by the Speaker of the House, including members from each of the 2 parties holding the largest number of seats in the Legislature;

3. Four public members, one of whom must be from the northern part of the State, appointed by the President of the Senate as follows:

A. A representative of the energy storage industry;

B. A representative of the hydroelectric energy storage industry;

C. A representative of an electric utility in the State; and

D. An academic in the field of energy storage;

4. Four public members appointed by the Speaker of the House as follows:

A. A representative of a conservation organization;

B. A representative of a business that uses significant electric power in the State;

C. A representative of a large-scale energy storage owner; and

D. A representative of a small-scale energy storage owner; and

5. The Public Advocate or the Public Advocate's designee.

Sec. 3. Commission chairs. Resolved: That the first-named Senator is the Senate chair of the commission and the first-named member of the House is the House chair of the commission.

Sec. 4. Appointments; convening of commission. Resolved: That all appointments must be made no later than 30 days following the effective date of this resolve. The appointing authorities shall notify the Executive Director of the Legislative Council once all appointments have been made. When the appointment of all members has been completed, the chairs of the commission shall call and convene the first meeting of the commission. If 30 days or more after the effective date of this resolve a majority of but not all appointments have been made, the chairs may request authority and the Legislative Council may grant authority for the commission to meet and conduct its business.

Sec. 5. Duties. Resolved: That the commission shall hold at least 4 meetings and shall:

1. Review and evaluate the economic, environmental and energy benefits of energy storage to the State's electricity industry, as well as public policy and economic proposals to create and maintain a sustainable future for energy storage in the State;

2. Consider the challenges of the broad electricity market in the State, including challenges with transmission and stranded renewable energy generation in the northern part of the State, and analyze whether energy storage is part of the transmission solution;

3. Consider whether the environmental, economic, resiliency and energy benefits of energy storage support updating the State's energy policy to strengthen and increase the role of energy storage throughout the State;

4. Consider the economic benefits of energy storage systems procurement targets, including benefits of cost savings to ratepayers from the provision of services, including energy price arbitrage, capacity, ancillary services and transmission and distribution asset deferral or substitution; direct cost savings to ratepayers that deploy energy storage systems; an improved ability to integrate renewable resources; improved reliability and power quality; the effect on retail electric rates over the life of a given energy storage system compared to the effect on retail electric rates using a nonenergy storage system alternative over the life of the nonenergy storage system alternative; reduced greenhouse gas emissions; and any other value reasonably related to the application of energy storage system technology and compare those economic benefits to the effects of leaving current policies in place;

5. Review economically efficient and effective implementation approaches to energy storage targets;

6. Consider bring-your-own-device programs that offer credits for sharing stored energy with electric utilities and storm outage and response management programs for behind-the-meter energy storage to reduce peak reduction and increase resiliency; and

7. Examine any other issues to further the purposes of the study.

In conducting the duties under this section, the commission shall seek public input and shall consult and collaborate with stakeholders and experts in the fields of economic development, natural resources and energy policy.

Sec. 6. Staff assistance. Resolved: That, notwithstanding Joint Rule 353, the Legislative Council shall provide necessary staffing services to the commission, except that Legislative Council staff support is not authorized when the Legislature is in regular or special session.

Sec. 7. Report. Resolved: That, no later than December 4, 2019, the commission shall submit a report to the Joint Standing Committee on Energy, Utilities and Technology that includes its findings and recommendations, including suggested legislation. The report may consider a review of economically efficient and effective implementation approaches for energy storage targets. The suggested legislation must include, but is not limited to, adopting procurement targets for the State for energy storage systems, both behind a customer meter and connected to transmission and distribution facilities, if proven beneficial for ratepayers in the cost-benefit analysis under section 5.

APPENDIX B

Membership List

Commission to Study the Economic, Environmental and Energy Benefits of Energy Storage to the Maine Electricity Industry
Membership List

Appointments by the President

Sen. Eloise A. Vitelli - Chair	Members of the Senate including a member from each of the 2 parties holding the largest number of seats in the legislature
Sen. David Woodsome	Members of the Senate including a member from each of the 2 parties holding the largest number of seats in the legislature
Sharon Klein	Academic in the field of energy storage
Fortunat Mueller	Representative of the energy storage industry
Tim Pease	Representative of an electric utility in the State
Steve Zuretti	Representative of the hydroelectric energy storage industry

Appointments by the Speaker

Rep. Christina Riley - Chair	Members of the House including members from each of the 2 parties holding the largest number of seats in the legislature
Rep. Steven Foster	Members of the House including members from each of the 2 parties holding the largest number of seats in the legislature
Rep. Nicole Grohoski	Members of the House including members from each of the 2 parties holding the largest number of seats in the legislature
William Birney	Representative of a business that uses significant electric power in the State
Jeff Bishop	Representative of a large-scale energy storage owner
Jeremy Niles	Representative of a small-scale energy storage owner
Rob Wood	Representative of a conservation organization

Public Advocate

Barry Hobbins	Public Advocate

Staff:
Lucia Nixon, Legislative Analyst
Deirdre Schneider, Legislative Analyst
Office of Policy and Legal Analysis

APPENDIX C

Work Session Handouts

Commission to Study the Economic, Environmental and Energy Benefits of Energy Storage to the Maine Electricity Industry

Energy Storage Applications and Economic Value Streams

Application	Value Streams
Electricity Customer	
Demand Charge Reduction	Energy storage can be used to reduce electricity demand charges by shifting the profile of building-level energy loads. By charging an energy storage system during off-peak periods and discharging at key times throughout the day, a customer can prevent its load profile from exceeding a demand charge threshold.
Time-of-Use Bill Management	Energy storage can be used to reduce customer's electricity purchases made when time-of-use rates are high (peak electricity-consumption hours) by relying on stored power and shifting purchases to periods when time-of-use rates are lower (off-peak periods).
Backup Power/ Resiliency	Energy storage paired with a generator can provide backup power when a power outage or grid failure occurs. This can be done at multiple scales, ranging from backup for residential customers to second-to-second power quality maintenance for industrial customers.
Increased Self-Consumption	Energy storage can be used to increase customer self-consumption of behind-the-meter generation and reduce export of that generation to the grid. The degree of benefit depends on how exported distributed generation is treated in the utility rate structure.
Energy Supply and Generation	
Resource Adequacy (Asset Deferral)	Energy storage can serve as a resource to meet system requirements during peak electricity-consumption hours (peak demand periods). This can defer or reduce the need for investment in new generation assets and minimize the risk of overinvestment in generation.
Renewables Integration	Energy storage can smooth out the delivery of energy from variable or intermittent resources such as wind and solar, by storing excess energy when the resource is active (e.g. windy or sunny) and delivering stored energy when the resource is inactive (e.g. lack of wind or sun).
Transmission and Distribution System	
Transmission and Distribution System Upgrade Deferral	Energy storage can shave the peak of the projected system load and reallocate demand on the system to non-peak periods. This can provide a means to defer, reduce the size of, or avoid the need for investments in transmission and distribution system upgrades.
Transmission Congestion Relief	Energy storage installed downstream of congested transmission corridors can be discharged during congestion periods to reduce congestion, creating value because grid operators (ISOs/RTOs) charge utilities to use transmission corridors during congested periods.
Wholesale Market and Grid Operation	
Wholesale Market Arbitrage	Energy storage can be used to purchase wholesale electricity at times when the locational marginal price is low (typically during the night) and sell electricity back to the wholesale market at times when the locational marginal price is high (buy low, sell high).
Spinning and Non-spinning Reserves	Energy storage can provide supply reserves to serve load on the grid in response to a contingency event, such as a generation outage. Spinning reserves are online and able to serve load immediately. Non-spinning reserves can respond to events and serve load within a short period of time (<10 minutes) but not instantaneously.
Frequency Regulation	Energy storage can be charged or discharged in response to a change in grid frequency in order to maintain the alternating current frequency on the grid within an acceptable range. Frequency regulation is necessary to ensure that system-wide generation is matched with system-wide demand to avoid spikes or dips in frequency, which create grid instability.
Voltage Regulation	Energy storage can be used to address variations in voltage on the grid by providing a means to insert or absorb "reactive power." Using storage this way helps resolve voltage variations and ensure voltage remains within allowed limits. (Reactive power is the portion of electricity that establishes/sustains electric and magnetic fields required by alternating current equipment; it exists in a circuit when the current and voltage are not in phase.)
Black Start Asset	Energy storage can serve as a black start asset during a grid outage. Black start refers to the ability to restore generation at a facility without relying on external resources; generation at the facility can then restore operation to larger power stations to bring the grid back online.

Prepared by the Office of Policy and Legal Analysis (11/6/19)

Sources: Developed from "The Economics of Battery Energy Storage," Rocky Mountain Institute (2015), and other Internet resources.

Commission to Study the Economic, Environmental and Energy Benefits of Energy Storage to the Maine Electricity Industry

Classification of Energy Storage Technologies

Mechanical Storage	Battery Storage	Thermal Storage	Electrical Storage	Hydrogen Storage
Stores energy using kinetic or gravitational forces.	Stores energy in a chemical form that can be converted to electricity. (Also called electrochemical storage.)	Stores energy produced in the form of heat (or cold) energy.	Stores energy in electric and and electromagnetic fields.	Stores energy in hydrogen created by electrolysis, a process that splits water into hydrogen and oxygen.
Pumped Hydro: Stores electrical energy as potential energy of water. Electricity is used to pump water from a lower level to a higher level. When electricity is needed, water is released to generate power through a hydraulic turbine. **Compressed Air Energy Storage (CAES):** Converts electricity to compressed air, which is stored in an underground cavern or above ground containers. When electricity is needed, compressed air is released to generate power through an expansion turbine. **Flywheel:** Stores electrical energy as kinetic rotational energy by accelerating a flywheel. When energy is needed, the spinning of the flywheel turns a generator.	**Solid Rechargeable Battery:** Stores chemical energy in solid-based electrodes. (Examples: lead acid, lithium ion, sodium sulfur and sodium nickel chloride.) **Flow Battery:** Stores chemical energy in flowing liquid electrolytes kept in tanks separate from the actual electrochemical cells. (Examples: vanadium redox and zinc-bromine.)	**Sensible Heat Storage:** Stores thermal energy in a material by changing the temperature of the material. (Examples: water, molten salt, sand or rocks.) **Latent Heat Storage:** Stores thermal energy created when a material goes through a phase change, such as melting, boiling or freezing. **Thermochemical Storage:** Stores thermal energy as chemical energy; energy is absorbed and released in a reversible chemical reaction (breaking and reforming of molecular bonds).	**Supercapacitor:** Uses static electricity to stores electrical charge. This technology consists of two metal plates coated with a porous substance, soaked in an electrolyte and separated by a thin insulator; it can be charged and discharged quickly and recharged almost indefinitely. **Superconducting Magnetic Energy Storage (SMES):** Stores electricity within the magnetic field of a superconducting wire coil, with near zero loss of energy.	**Power-to-Power:** Uses electrolysis to produce produce hydrogen which is then converted to electricity via fuel cells or engines. **Power-to-Gas:** Uses electrolysis to produce hydrogen which is then injected into natural gas pipelines or used as transportation fuel, or put through a second process to produce methane for use in a natural gas pipeline or converted to liquified petroleum gas (LPG).

Prepared by the Office of Policy and Legal Analysis (11/6/19)

Sources: Developed from the “State of Charge, Massachusetts Energy Storage Initiative,” State of Massachusetts (2016), and other internet resources.

APPENDIX D

Stakeholder Presentations

Commission To Study the Economic, Environmental and Energy Benefits of Energy Storage to the Maine Electricity Industry

Wednesday, November 6, 2019

Stakeholder Presentations: Energy Storage Projects

Project Sponsor/ Developer	Presenter	Technology	Location(s)
Ameresco	Benjamin Lavoie	Battery storage , with CHP and microgrid	Kittery, ME (Portsmouth Naval Shipyard)
Competitive Energy Services	Eben Perkins	Battery storage, with Solar	Massachusetts (multiple sites)
Engie	Brett Cullen	Battery storage, with Solar	Madison, ME Holyoke, MA; Acushnet, MA
SunRaise	Matt Doubleday	Battery storage, with Solar	Winchendon, MA
Summit Natural Gas	Kurt Adams	Power-to-gas	TBD
Velerity	Brad Bradshaw	Power-to-gas	Brunswick, ME Farmington, ME

Commission To Study the Economic, Environmental and Energy Benefits of Energy Storage to the Maine Electricity Industry

Tuesday, November 19, 2019

Stakeholder Presentations: Energy Storage Projects

Project Sponsor/ Developer	Presenter	Technology	Location(s)
LS Power	Michael Connelly	Battery Storage and Pumped Storage	California Pennsylvania Virginia New York Maine (Kibby Wind Farm)
Form Energy, Inc.	Jason Houck	Long-duration battery storage systems for grid-scale applications	
Enel X	Greg Geller	Battery storage, solar+storage	Various New England sites UMass Boston
Two Lights Energy Advisors	Tom Murley		

APPENDIX E

Member Takeaways and Findings and Member Suggested Recommendations

Commission to Study the Economic, Environmental and Energy Benefits of Energy Storage to the Maine Electricity Industry - Member Takeaways and Findings
November 19, 2019

Lesson #1: Energy Storage can Reduce Costs and Improve Reliability

1.1 Energy storage has the potential to help Maine decrease the cost of electricity by decreasing need for (high cost) "peaker plants" to meet peak demand (Sen. Vitelli)

1.2 Energy storage can result in cost savings for ratepayers through: reducing electricity prices, lowering peak demand, deferring T&D investments, reducing greenhouse gas pollution compliance costs, deferring capital investments in capacity, and increasing grid reliability and resiliency. (Rep. Grohoski)

1.3 Energy storage can improve the overall efficiency of the grid and reduce costs for all consumers by shifting load and reducing peak demand. Behind-the-meter storage can aid commercial electricity customers by decreasing demand charges and reducing electricity costs. (Wood)

1.4 Storage can help shave demand peaks which are major divers of both generation and T&D spending/investment (Mueller)

1.5 Energy storage applications and preferred locations/functions can be identified through distribution system planning and used to address system overloads and defer new distribution infrastructure costs to the benefit of ratepayers. (Zuretti)

Notes/Decisions

Lesson #2: Energy Storage Complements and Supports Renewable Energy

2.1 Energy storage has the ability to help Maine increase its use of clean renewable energy that can be intermittent in supply, i.e. wind and solar. (Sen. Vitelli)

2.2 Energy storage can play a key role in addressing intermittency in renewable energy production, supporting the grid as Maine drives toward its renewable energy targets. (Wood)

2.3 Increasing penetration of variable, renewable generation increases need for system flexibility; developing policies to fully account for the benefits of energy storage in planning and procurement targets will help build flexibility in the system to accommodate a high-renewable future. (Pease)

2.4 Many benefits of storage can be complemented with intermittent renewable energy (solar and wind) and vice versa. Storage will be necessary for higher and higher penetrations of renewable energy and could be very beneficial to distributed energy resources. (Klein)

2.5 The importance and value of storage will only grow as low cost but variable renewables make up a higher fraction of the total generation on the grid; opportunity to use longer duration storage (of which power to gas is one option, but certainly not the only one) to take advantage of locked-in renewable generation (wind and solar) potential in the northern and western parts of the State. (Mueller)

Notes/Decisions

Lesson #3: Energy Storage Technology is Diverse and Advancing	
3.1	Energy storage technologies are continually advancing; it is important to ensure our policies are flexible enough to take advantage of the benefits of these advancements--decreasing (technology) costs; increasing storage capacities and lifespans. (Sen. Vitelli)
3.2	Advantages and applications of energy storage can vary by technology type, size and location; long-duration storage such as pumped hydropower may be complementary to short-duration advanced storage technologies given differing capabilities and grid requirements. (Zuretti)
3.3	The greatest and most efficient storage is pumped hydro storage (US 94% pumped water storage); brings up the question of do we have potential in Maine for pumped storage and if so, what policy would be required to develop it; option seems to be the cleanest long-term solution for Maine. (Birney)
3.4	Power to gas (Summit presentation) also seems to be a positive use of power we already have and do not use to store energy for demand peaks. (Birney)
3.5	Demonstration projects are likely not as relevant (at this stage) as more technology is already proven. (Bishop)
Notes/Decisions	

Lesson #4: Issues with Market and Regulatory Signals for Storage	
4.1	The biggest challenge to increasing storage deployment is lack of clear market mechanisms to transfer some portion of the system benefits (e.g. cost savings to all ratepayers) to the storage project developer. (Massachusetts State of Charge report, page xiii) (Rep. Grohoski)
4.2	Proper valuation of energy storage requires identifying and optimizing all value streams. Although the ISO-NE market can accommodate energy storage, it does not fully value all energy storage capabilities. The ISO-NE markets that allow energy storage participation are not large enough to incent significant new energy storage investment, and ISO-NE planning and modeling cannot currently accommodate all market functions. These are significant barriers to expanding the energy storage market in Maine. (Zuretti)
4.3	Upfront cost is the key barrier to deploying more energy storage; key policy opportunity to monetize the values that energy storage provides to consumers and the grid (to overcome the upfront cost hurdle) for developers/owners. (Wood)
4.4	Rate structure and deregulated nature of electricity industry (utilities not allowed to own generation) provide a disincentive for utilities to support distributed energy resources and energy storage on a large scale. Because utilities earn revenue by building out T&D capacity and customers buying more electricity, there is not an incentive to defer/prevent T&D build out or encourage customers to reduce consumption, switch to renewable generation, or add storage. (Klein)
Notes/Decisions	

Lesson #5: Opportunities for Cost-Effective Energy Storage	
5.1	Recent trends of declining storage technology costs and the growing body of research and experience contributing to a greater understanding of storage technology benefits, are creating increased opportunities for cost-effective energy storage solutions. (Pease)
5.2	Storage is cost-effective today in many applications. (Mueller)
5.3	Many of the most attractive near term markets for storage are behind the customer meter (BTM), because in those cases the benefit (value) to the individual customer (e.g. demand charge management, resiliency) offsets a significant portion of the capital costs, even though a lot of the benefits extend to all ratepayers (lower capacity costs, reduced T&D investment, demand response induced price effect, etc). (See also Lesson #4) (Mueller)
Notes/Decisions	

Lesson #6: Other Observations	
6.1	Grid information and modernization seem particularly relevant as we move to more distributed generation and need to respond to and reduce peak load; for example, info on most effective storage siting, time of use metering, ability for utility or ISO-NE to control storage discharge to get greatest benefit. (Rep. Grohoski)
6.2	While many of the results from the Massachusetts State of Charge report are applicable to Maine, there are certain differences between the states (lower demand charges compared to Mass, small islands with resiliency issues, transmission bottlenecks at Keene Road, etc.) that lead to different economic outcomes. (Bishop)
6.3	There are items that could could help open the market for energy storage and create little cost to net benefit for Maine ratepayers (additional parameters around nonwires alternatives and transmission rate design). (Bishop)
Notes/Decisions	

Commission To Study the Economic, Environmental and Energy Benefits of Energy Storage to the Maine Electricity Industry – Member Suggested Recommendations

Recommendation #1: Establish Procurement Targets for Storage

1.1 Specific storage procurement targets for storage set by PUC through rulemaking that are cost effective for Maine. (Sen. Vitelli)

1.2 Enact a legislatively mandated storage procurement target (50 MWh by 2021; 150 MWh by 2023). (Mueller)

1.3 Establish a state procurement target based on the amount of storage projected to be needed to support Maine's 80% by 2030 RPS requirement and 100% by 2050. Establish eligibility criteria for projects (newly built; located in ME; demonstrably reduce GHG emissions; reduce costs for all consumers or low to moderate income consumers; avoid/minimize wildlife habitat impacts; etc.) (Wood)

1.4 Establish 100 MW storage target by 2025. (Bishop)

1.5 Establish a procurement target similar to minimums established in other states similar to Maine or scaled to Maine's market. (Klein)

Notes/Decisions:

Recommendation #2: Incorporate Storage into Renewable Energy Policy and Procurements

2.1 Include adders for storage along with existing procurements for renewable energy. (Klein)

2.2 Explicitly give adders for storage in state procurements for renewable resources if the storage alleviates congestion. (Bishop)

2.3 Adopt policies for storage in new renewable development. (Birney)

2.4 Require future RPS long-term procurements include bids paired with energy storage or a dispatchable renewable resource such as hydropower with reservoir storage. (Zuretti)

2.5 Utilize existing policy related to the State's aggressive renewable energy goals to facilitate the construction of storage projects. (Pease)

Notes/Decisions:

Recommendation #3: Create Incentives Through Programs* or Tax Initiatives

3.1 Provide property tax abatement or sale tax exemptions for energy storage equipment. (Zuretti)
3.2 Incentivize the development of storage for large energy users. (Birney)
3.3 Develop a program similar to MA's Advancing Commonwealth Energy Storage Program (ACES) which provides grants to energy storage projects that test various, multi-use business cases for storage. (Pease)
3.4 Offer storage rebates (like the MA STORM Bill) for outage affected customers and critical infrastructure/first responders. In ME this would incentivize storage in rural areas that are often subject to extended outages during storm events. (Mueller)
3.5 Implement a Bring-Your-Own-Device (BYOD) program like other NE states which uses customer sited, non-utility owned battery storage to meet peak demands thus reducing costs for all customers. (Mueller)

*See more program-based suggestions under Recommendation #4

Notes/Decisions:

Recommendation #4: Incorporate Storage into Energy Efficiency Programs

4.1. Amend provisions of Title 35-A, chapter 97 to ensure definitions of "efficiency" affirmatively include energy storage so that the Efficiency Maine Trust has express authority to incentivize behind the meter storage options for Maine energy consumers. (Sen. Vitelli)
4.2 Ensure the EMT has the statutory authority necessary to advance energy storage as a measure to improve overall grid efficiency. (Wood)
4.3 Provide additional funding for the EMT to reduce the impact on peak demand and require more education to manage energy use in a manner that curtails use during peak times in order to reduce the need to add storage to the system. (Birney)
4.4 Investigate to determine if the EMT needs to offer additional incentives or perform targeted advertising/networking/etc. to advance pilots, especially those that could have a storage component. (Klein)
4.5 Residential batteries should be added to the list of things the EMT gives rebates for, especially in concert with distributed renewable energy systems. (Klein)

Notes/Decisions:

Recommendation #5: Direct Further Study of Energy Storage Policy

5.1 Request that the Climate Council and its subcommittees study storage for the long-term and ensure that a clear cost-benefit analysis is performed before enacting any long-term goals. Direct the PUC and Climate Council to consider storage a part of any plans to enhance Maine's grid stability. (Sen. Vitelli)

5.2 Perform quantitative modeling and Maine specific data analysis to develop a detailed and prioritized list of Maine specific needs and goals related to the potential benefits of storage then develop a coordinated set of policy actions to incentivize the amount and type of storage needed. (Klein)

5.3 Look further into the extent to which properly formulated and deployed time-of-use programs, based on innovative best practices could send the right price signals to consumers and which policies are friendlier to increasing energy storage. (Klein)

5.4 An additional study should be performed into the overall impact of energy storage on carbon emissions and study the long-range effects on Maine for each of the option reviewed (or recommended) by the commission. (Birney)

Notes/Decisions:

Recommendation #6: Explore/Implement Rate Design Options to Encourage Storage

6.1 Cost savings from peak shaving would create additional economic incentives to invest in behind the meter storage if there was time of use rates for both the transmission and distribution and supply portions of a customer's bill. (Rep. Grohoski)

6.2 Offer some type of incentive or regulatory directive for utilities to deploy and consumers to adopt time-of-use rates based on existing best practices. (Klein)

6.3 Look into and enact regulations to improve utility rate design to account for the value to ratepayers of avoided transmission. (Rep. Grohoski)

6.4 Move towards modernized rate design. (Rep. Riley)

Notes/Decisions:

Recommendation #7: Ensure Proper Codes and Standards are in Place

7.1 Improve/streamline interconnection requirements for storage and adopt safety and performance codes for storage. (Rep. Grohoski)

7.2 Amend interconnection tariff, and implement safety and performance codes/standards. (Bishop)

Notes/Decisions:

Recommendation #8: Address Decommissioning and End-of-Life Remediation

8.1 Require decommissioning plans for storage facilities. (Rep. Grohoski)

8.2 Adopt policy for remediation of equipment, especially hazardous waste when its life cycle is complete. (Birney)

Notes/Decisions:

Recommendation #9: Encourage Utilities to Invest in Storage

9.1 Create a regulatory structure to allow investor-owned T&D's to own and dispatch storage at or near utility substations that considers how the costs are recovered and the field is leveled with non-utility investors. (Rep. Grohoski)

9.2 Create mechanisms to incent T&D utilities to invest in storage infrastructure that enables renewable generation by allowing utilities to place those costs into customer rates outside of a general rate case. (Pease)

Notes/Decisions:

Recommendation #10: Encourage ISO-NE to Create Favorable Markets for Storage

10.1 Direct the PUC to promote changes to ISO-NE wholesale markets that: (a) acknowledge the locational value of new grid-scale energy storage; and (b) ensure grid-scale energy storage, regardless of vintage or technology is adequately compensated for all energy and reliability service each resource provides. (Zuretti)

10.2 Create a coalition of state government officials from the member states of ISO-NE to work toward advancing ISO-NE thinking relating to storage and renewable. (Klein)

Notes/Decisions:

Recommendation #11: Other Recommendations

11.1 Include strategies in any policy recommendation to ensure low-income customers have access to benefits of storage. (Sen. Vitelli)

11.2 Support emerging technologies that create renewable natural gas and hydrogen. (Rep. Riley)

11.3 Streamline the permitting process to advance energy storage at all scales. (Zuretti)

Notes/Decisions:

APPENDIX F

Model Draft Language for Legislation

1. Establish Targets for Energy Storage Development

- In the short-term, the commission recommends establishing a State goal of reaching 100 megawatts (MW) of energy storage capacity located in the State by the end of 2025.

35-A MRSA section 3145 is enacted to read:

§3145. State energy storage policy goals

The state goal for energy storage system development is that there be 100 megawatts of installed capacity located within the state by December 31, 2025. For the purposes of this section, "energy storage system" has the same meaning as in section 3481, subsection 6.

2. Encourage Energy Storage in Renewable Energy Procurement

- Providing an adder for energy storage in procurements of new renewable generation resources under 35-A MRSA §3210-G and of distributed generation resources under 35-A MRSA §3484 in the contract price when: (a) the generation resource is paired with energy storage and (b) the bidder demonstrates that the paired storage alleviates congestion on the transmission or distribution system or provides some other demonstrated benefit to grid reliability, grid resiliency or electricity ratepayers.
- Requiring the PUC to determine the specific value (or formula) along with eligibility criteria for this "adder" through a rulemaking or other appropriate PUC proceeding conducted for this purpose.

Renewable Portfolio Standard Procurement

Amend Title 35-A §3210-G sub-§1 paragraph D, subparagraph (6) to read:

D. The commission shall, in accordance with this paragraph, allow energy storage systems to participate in solicitations or be awarded contracts under this section.

(1) The commission shall permit an energy storage system to bid on solicitations or to be contracted under this section only if the energy storage system is connected to the State's electricity grid, paired as a complementary resource with a Class IA resource and either:

(a) Colocated with the Class IA resource, whether metered jointly with or separately from the Class IA resource; or

(b) Located at a different location from the Class IA resource and the commission finds that inclusion of the energy storage system would result in a reduction in greenhouse gas emissions.

(2) A bid under this section that includes an energy storage system must include 2 separate bid proposals, one with the energy storage system and one without. The

commission shall assess the bid proposals based on the benefits to ratepayers, which may include, but are not limited to:

(a) Reduction in costs;
(b) Decrease in peak electricity demand;
(c) Deferral of investments in the transmission and distribution system;
(d) Deferral of capital investments in new generating capacity;
(e) Increase in the electricity grid's overall flexibility, reliability and resiliency; ~~and~~
(f) Reduction in greenhouse gas emissions~~.~~; and
(g) Meeting state goals for energy storage pursuant to section 3145.

(3) An energy storage system that is not colocated with a Class IA resource may receive renewable energy credits only for stored energy generated from a Class IA resource.

(4) If chosen for a contract under this section, an energy storage system must remain stationary and under the same ownership throughout the contract term.

(5) The commission may permit an energy storage system to be paired with and added to a Class IA resource after that resource has been awarded a contract.

(6) An energy storage system contracted under this section is eligible for an adder in the contract compensation rate provided that the bidder demonstrates that the paired storage alleviates congestion on the transmission or distribution system or provides some other demonstrated benefit to grid reliability, grid resiliency or electricity ratepayers. The commission shall by rule establish a methodology for determining the value of the energy storage adder and specific eligibility criteria which may include, but are not limited to: power rating, capacity rating, and minimum efficiency, data reporting and operational requirements.

For the purposes of this paragraph, "energy storage system" means a commercially available technology that uses mechanical, chemical or thermal processes for absorbing energy and storing it for a period of time for use at a later time.

Distributed Generation Procurements

Amend Title 35-A §3484, sub-§2 paragraphs E, F and G:

E. Each contract awarded pursuant to this subsection reduces the available capacity in the current procurement block. If an awarded contract exceeds the remaining capacity of its procurement block, then that block is closed and the next block opened and the contract rate is set at the block contract rate for the block filled by this award and any overprocurement in one block is subtracted from the quantity available in the next block. If a contract award exceeds the capacity of procurement block 5, the entire quantity of the offer is awarded at the block contract rate for procurement block 5 and no further contracts may be awarded except under subsection 7; ~~and~~

F. The commission may by rule establish incentives in the procurement of distributed generation resources including, but not limited to, incentives to support resources that pair with energy storage systems, development of dual-use projects, siting of resources that provide locational benefits to the distribution system and other siting criteria developed in consultation with the Department of Environmental Protection and the Department of Agriculture, Conservation and Forestry~~.~~<u>; and</u>

<u>G. The commission shall by rule establish an adder in the contract compensation rate for resources that pair with energy storage systems, when the paired storage alleviates congestion on the transmission or distribution system or provides some other demonstrated benefit to grid reliability, grid resiliency or electricity ratepayers. The commission by rule shall establish a methodology for determining the value of the energy storage adder and specific eligibility criteria which may include, but are not limited to: power rating, capacity rating, and minimum efficiency, data reporting and operational requirements</u>

3. Advance Energy Storage as an Energy Efficiency Resource

- Amending the laws governing the Efficiency Maine Trust (Title 35-A chapter 97) to ensure that the Trust's authority explicitly and affirmatively includes energy storage, by adding direct references to energy storage in relevant sections of statute, including definitions;
- Directing the Efficiency Maine Trust to consider expanding existing opportunities or developing new opportunities through its programs and initiatives to use energy storage to reduce peak electricity demand.
- Directing the Efficiency Maine Trust to explore alternative methods to demonstrate cost-effectiveness for energy storage projects or programs.

Amend 35-A section 10102 to add subsection 5-A as follows:

<u>**5-A. Energy storage system.** "Energy storage system" has the same meaning as in section 3481, subsection 6.</u>

Amend 35-A section 10109 (Regional Greenhouse Gas Initiative Trust Fund), subsection 4, paragraph A to read:

A. Trust funds must be allocated for measures, investments, loans, technical assistance and arrangements that reduce electricity consumption, increase energy efficiency or reduce greenhouse gas emissions and lower energy costs at commercial or industrial facilities and for investment in measures that lower residential heating energy demand and reduce greenhouse gas emissions. The measures that lower residential heating demand must be fuel-neutral and may include, but are not limited to, energy efficiency improvements to residential buildings, energy storage systems and upgrades to efficient heating systems that will reduce residential energy costs and greenhouse gas emissions, as determined by the board. The trust shall ensure that measures to reduce the cost of residential heating are available for low-income households as defined by the trust. When promoting electricity cost and consumption reduction, the trust may consider measures at commercial and industrial facilities that also lower peak capacity demand, including energy storage systems. Subject to the apportionment pursuant to this subsection, the trust shall fund conservation programs that give priority to measures with the highest benefit-to-cost ratio, as long as cost-effective collateral efficiency opportunities are not lost, and that:

(1) Reliably reduce greenhouse gas production and heating energy costs by fossil fuel combustion in the State at the lowest cost in funds from the trust fund per unit of emissions; or

(2) Reliably increase the efficiency with which energy in the State is consumed at the lowest cost in funds from the trust fund per unit of energy saved.

Amend 35-A section 10109(Regional Greenhouse Gas Initiative Trust Fund), subsection 4, paragraph A to read:

§10110. Electric efficiency and conservation programs

2. Programs. The trust shall develop and implement conservation programs to help reduce energy costs for electricity consumers in the State by the maximum amount possible. The trust shall establish and, on a schedule determined by the trust, revise objectives and an overall energy strategy for conservation programs. Conservation programs implemented by the trust must be consistent with the objectives and an overall energy strategy developed by the trust and approved by the commission and be cost-effective, as defined by the board by rule. In defining "cost-effective," the board may consider the extent to which a program promotes sustainable economic development or reduces environmental damage to the extent the board can quantify or otherwise reasonably identify such effects. Consistent with the other requirements of this section, the trust, in adopting and implementing conservation programs, shall seek to encourage efficiency in electricity use, provide incentives for the development of new, energy-efficient business activity in the State and take into account the costs and benefits of energy efficiency and conservation to existing business activity in the State.

A. The trust shall consider, without limitation, conservation programs that:

(1) Increase consumer awareness of cost-effective options for conserving energy;

(2) Create more favorable market conditions for the increased use of energy-efficient products and services;

(3) Promote sustainable economic development and reduce environmental damage;

(4) Reduce the price of electricity over time for all consumers by achieving reductions in demand for electricity during peak use periods, including by the implementation of beneficial electrification and energy storage systems; and
(5) Reduce total energy costs for electricity consumers in the State by increasing the efficiency with which electricity is consumed.

Unallocated Language

Section X. Energy storage measures. The Efficiency Maine Trust shall explore and evaluate options to support energy storage measures that reduce peak demand through its electric efficiency and conservation programs and its programs funded by the Regional Greenhouse Gas Initiative Fund established pursuant to Maine Revised Statutes, Title 35-A, section 10109. The Trust shall consider expanding existing opportunities under the Innovation Pilot Program and developing new opportunities through other Trust programs and initiatives. In evaluating the cost-effectiveness of energy storage measures, the Trust shall explore various cost-effectiveness methodologies and tests. In fulfilling the duties of this section, the Trust shall consider:

1. Expanding energy storage pilot projects within the Trust's existing Innovation Pilot Program, and implementing any cost-effective pilots as statewide programs;
2. Bring-your-own-device programs in which customer-owned and customer-sited battery storage is aggregated and performance incentives are provided for reducing load at times of system peak;
3. Rebate or funding programs for all customer class storage paired with renewable energy; and
4. Customer education initiatives regarding demand management and energy storage, including education targeted to low-income and rural areas

4. Address Rate Design and Energy Storage

- Direct PUC to open a docket to investigate opportunities to modernize electricity rate design through time-of-use, or other time-differentiated rates, that send appropriate price signals and incentives to consumers to reduce demand during peak periods.
- Direct PUC to develop and implement a pilot program to test and evaluate time-of-use rates in conjunction with energy storage
- Direct PUC to develop and implement a schedule for regular review and update of electricity rate designs and ensure that the review include consideration of time differentiated rates.

Unallocated language

Section X. Rate design. The Public Utilities Commission shall investigate and, where appropriate, implement rate designs that account for variation in the cost components of electricity as the load or demand on the electricity system fluctuates. The commission shall take the following specific steps to address rate design:

1. Open a docket to investigate opportunities to modernize electricity rate design through time-of-use, or other time-differentiated, rates that send appropriate price signals and incentives to consumers to reduce demand during peak periods and to develop and implement a pilot program to test and evaluate time-of-use rates in conjunction with energy storage;

2. Develop and implement a schedule for regular review and update of electricity rate designs, including consideration of fixed charges, and ensure that the review include consideration of time differentiated rates.

5. Clarify Utility Ownership of Energy Storage

- Direct PUC to open a docket to examine issues related to the ownership and operation of energy storage by transmission and distribution utilities.

Unallocated language

Section. X. Utility ownership of energy storage. The Public Utilities Commission shall open a docket to examine and evaluate whether and how transmission and distribution utilities could participate in energy storage ownership and operation activities with appropriate safeguards to ensure that private developers as well as electricity consumers are not disadvantaged. The docket must include, but is not limited to, consideration of:

1. Whether an investor-owned transmission and distribution utility, if allowed to own or operate energy storage, beyond what is allowed under current law can add the costs to own or operate energy storage to its rate base;
2. Cost implications for electricity ratepayers;
3. Implications for the private market for storage development, construction and operation;
4. Potential benefits of utilities installing energy storage at or near utility substations to address transmission congestion issues;

6. Advocate for Energy Storage in the Regional Energy Markets

- Direct PUC, Governor's Energy Office (GEO) and other state agencies as appropriate to seek opportunities to advocate for consideration of energy storage opportunities by ISO-New England in regional market planning and design.

No Legislation recommended. However, the commission suggests the EUT committee send a letter to the Public Utilities Commission and Governor's Energy Office requesting that each entity

Take all available and reasonable steps to advocate for consideration of energy storage opportunities by ISO-New England in regional market planning and design, including the wholesale electricity, capacity and ancillary service markets.

7. Conduct In-depth Analysis of Energy Storage Costs, Benefits and Opportunities

- Direct the State, under the direction of the GEO to conduct a comprehensive analysis to evaluate and quantify the costs, benefits and opportunities for energy storage in the State and develop specific recommendations for future policy and program development; provide necessary resources to carry out this work.
- Require the GEO to address energy storage in all future updates to the comprehensive State Energy Plan, which GEO is required to provide the Governor and the Legislature every 2 years in January (2 MRSA section 9, subsection 3, paragraph C). To provide clarity and specificity, the commission recommends amending the State Energy Plan statute to require the plan, and biennial updates to the plan, specifically address energy storage development.

<u>Study – Unallocated</u>

Sec. 1 Energy planning. Resolved: That the Governor's Energy Office shall, in coordination with development of the state energy plan prepared pursuant to Title 2, section 9, subsection 3, paragraph C, conduct a comprehensive analysis to evaluate the costs, benefits and opportunities for energy storage in the State and develop specific recommendations for future policy and program development. The study must include, but is not limited to:

1. A review of existing state-specific energy storage studies, including but not limited to the Massachusetts State of Charge report (2016) and the Vermont Act 53 Report (2017), and consultation with relevant staff and organizations in those States.
2. Input from and involvement of the relevant state agencies including the Public Utilities Commission, the Efficiency Maine Trust, and the Climate Council created pursuant to Maine Revised Statutes, Title 38, section 577-A and relevant subcommittees of that Council.
3. Quantitative data analysis modeling of energy storage needs, opportunities and cost-benefit analysis based on Maine-specific data, using existing energy storage modeling software available from reputable sources when possible and appropriate.
4. Comprehensive consideration of relevant issues including, but not limited to:
    a. Emerging storage technologies and technological developments;
    b. Access to energy storage for low-income households and communities;
    c. Impacts of energy storage on carbon emissions;
    d. Energy storage permitting and interconnection requirements;

   e. Safety and performance codes and standards; and
   f. Decommissioning and end-of-life remediation of storage technology
5. Recommendations for future energy storage targets beyond the 100 MW by 2025 target identified in the report made pursuant to Resolve 2019, chapter 83. . The office shall carefully consider how to set targets optimally to support achievement of the state's renewable energy goals pursuant to Maine Revised Statutes, Title 35-A, section 3210, subsection 1-A.
6. Comprehensive recommendations that include a prioritized list and timeline of Maine-specific goals and needs for energy storage and associated policy and statutory changes necessary to achieve those goals.

Sec. 2 Report. Resolved: That the Governor's Energy Office shall provide a report on the study along with any recommended policy initiatives, to the Joint Standing Committee on Energy, Utilities and Technology by [ADD date / to be determined]. The committee may report out legislation related to the report.

State Energy Plan

Amend 2 MRSA section 9, subsection 3, paragraph C to read:

C. In consultation with the Efficiency Maine Trust Board, established in Title 5, section 12004-G, subsection 10-C, prepare and submit a comprehensive state energy plan to the Governor and the Legislature by January 15, 2009 and submit an updated plan every 2 years thereafter. Within the comprehensive state energy plan, the director shall identify opportunities to lower the total cost of energy to consumers in this State and transmission capacity and infrastructure needs and recommend appropriate actions to lower the total cost of energy to consumers in this State and facilitate the development and integration of new renewable energy generation within the State and support the State's renewable resource portfolio requirements specified in Title 35-A, section 3210 ~~and~~, wind energy development goals specified in Title 35-A, section 3404 and energy storage development goals specified in [ADD cross-reference]. The comprehensive state energy plan must include a section that specifies the State's progress in meeting the oil dependence reduction targets in subsection 5. The office shall make recommendations, if needed, for additional legislative and administrative actions to ensure that the State can meet the reduction targets in subsection 5. The recommendations must include a cost and resource estimate for technology development needed to meet the reduction targets.

(1) Beginning in 2015, the update to the plan must:

(a) Be submitted to the joint standing committee of the Legislature having jurisdiction over utilities and energy matters and the joint standing committee of the Legislature having jurisdiction over natural resources matters;

(b) Address the association between energy planning and meeting the greenhouse gas reduction goals in the state climate action plan pursuant to

Title 38, section 577. The director shall consult with the Department of Environmental Protection in developing this portion of the plan;

(c) Include a section devoted to wind energy development, including:

(i) The State's progress toward meeting the wind energy development goals established in Title 35-A, section 3404, subsection 2, including an assessment of the likelihood of achieving the goals and any recommended changes to the goals;

(ii) Examination of the permitting process and any recommended changes to the permitting process;

(iii) Identified successes in implementing the recommendations contained in the February 2008 final report of the Governor's Task Force on Wind Power Development created by executive order issued May 8, 2007;

(iv) A summary of tangible benefits provided by expedited wind energy developments, including, but not limited to, documentation of community benefits packages and community benefit agreement payments provided;

(v) A review of the community benefits package requirement under Title 35-A, section 3454, subsection 2, the actual amount of negotiated community benefits packages relative to the statutorily required minimum amount and any recommended changes to community benefits package policies;

(vi) Projections of wind energy developers' plans, as well as technology trends and their state policy implications;

(vii) Recommendations, including, but not limited to, identification of places within the State's unorganized and deorganized areas for inclusion in the expedited permitting area established pursuant to Title 35-A, chapter 34-A and the creation of an independent siting authority to consider wind energy development applications;

(d) Include a description of activities undertaken pursuant to paragraph H; ~~and~~

(e) Include a description of the State's activities relating to the expansion of natural gas service, any actions taken by the office to expand access to natural gas in the State and any recommendations for actions by the Legislature to expand access to natural gas in the State~~.~~; and

(f) Include a section devoted to energy storage development, including:

(i) The State's progress toward meeting the energy storage development goals established in [ADD cross reference], including an assessment of the likelihood of achieving the goals. (ii) Projections of energy storage developers' plans, as well as technology trends and their state policy implications;

(ii) Recommendations for any changes to the energy storage development goals or addition of future goals; and

(iii) Recommendations for policy and statutory changes necessary to achieve the energy storage development goals.

The joint standing committee of the Legislature having jurisdiction over utilities and energy matters may report out legislation by February 1st of each odd-numbered year relating to the content of the plan. The joint standing committee of the Legislature having jurisdiction over natural resources matters may make recommendations regarding that legislation to the joint standing committee of the Legislature having jurisdiction over energy matters.