Examination of the Value of and Need for Energy Storage Resources in Rhode Island

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Report to the Rhode Island Senate in Response to Resolution 416

Rhode Island Public Utilities Commission

October 18, 2023

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Executive Summary

Introduction

On June 23, 2022, the Rhode Island Senate passed Senate Resolution 416 (the Resolution). The Resolution requested the Public Utilities Commission (PUC) to study the costs and benefits of energy storage resources in Rhode Island, identify any barriers and market inefficiencies facing energy storage resource deployment today, and to report on whether new tariffs or programs for energy storage resources are necessary to achieve the state's goals related to reducing the cost of the electric power system and facilitating the transition to carbon-free electricity. Additionally, the Resolution requested the PUC adopt a framework for an electric service tariff to apply to energy storage resources connected to the electric distribution system in Rhode Island.[1] The PUC presents the results of the requested analysis and review in this Report.

The Commission acknowledges the significance and timeliness of the questions raised by the Rhode Island Senate in its Resolution and welcomes the opportunity to evaluate energy storage resources with stakeholders. As an economic regulator, the Commission serves the role of market designer for the state's public utilities. Through that role, the Commission has developed unique expertise in cost-benefit analysis and market design, particularly related to the electric power system. The Commission and its staff drew from this expertise to carry out the critical analysis requested by the Resolution.

Recognizing the importance of stakeholder collaboration to delivering a fair, balanced Report, the Commission initiated a stakeholder engagement process in December 2022. For administrative purposes, the Commission conducted the stakeholder engagement process in Docket No. 5000, a preexisting and open investigation into the treatment of storage as an electric distribution resource.[2] The stakeholder engagement process consisted of a public kickoff meeting and five PUC staff-led workshops between December 2022 and September 2023. Over the course of the workshops, staff led stakeholders[3] in a qualitative review of storage costs and benefits using the Rhode Island Benefit-Cost Framework, invited stakeholders to present on existing storage procurement mechanisms, and moderated roundtable discussions among stakeholders regarding barriers facing energy storage deployment in Rhode Island. The results presented in this Report are directly informed by the discussions and analysis from the Docket No. 5000 stakeholder workshops.

Costs and Benefits of Energy Storage

Chapters 1 and 2 of the Report present the results of staff and stakeholders' qualitative analysis of the costs and benefits of energy storage resources. As with all electric power resources, the value of energy storage resources is dependent on the actual needs of the electric power system and the ability of resources to meet those needs, recognizing that the needs of the electric power system change from moment to moment and from location to location. For that reason, evaluating the potential values and/or benefits from a resource requires careful consideration of how that resource could perform during different power system conditions.

Energy storage resources are inherently flexible and can perform a wide variety of functions to meet system needs. Whereas traditional load or generation resources can only perform a single function (consuming

[1] The Resolution also requested the PUC adopt targets for installed storage capacity. The Commission communicated to the sponsors of the Resolution and to stakeholders alike that it did not have sufficient resources to perform the necessary quantitative technical and economic analysis to recommend specific deployment targets for energy storage in this proceeding.

[2] The RIPUC Docket No. 5000: https://ripuc.ecms.ri.gov/eventsactions/docket/5000page.html

[3] Participating stakeholders represented a range of interests and backgrounds, from private developers to environmental advocates to state agencies. A list of stakeholders who participated in the workshops can be found in Appendix A.

energy or generating energy, respectively), energy storage resources can perform four different functions: charging, discharging, sitting as an empty vessel, and sitting as a full vessel. Because of this functional flexibility, storage resources have vast *theoretical* potential to create useful value. Whether or not they will deliver *actual* value at any given moment depends on the *actual potential* to perform a specific function in that moment. It is important to keep in mind that while storage resources are technically capable of performing many different functions, they can only perform one function at a time. Even if multiple functions would be beneficial at a given moment, a storage resource can only deliver those benefits associated with the single function it performs in that moment.

To illustrate the importance of time, location, and function to the actual value of energy storage, staff and stakeholders qualitatively analyzed the function(s) an energy storage resource would likely perform under five illustrative power system scenarios and the resulting costs and benefits of that performance. The five scenarios represent a typical range of system conditions that occur on the local electric power system in Rhode Island and the regional electric power system in New England.

The results of the scenario analysis are presented in Chapter 2 of the Report. The results indicate that energy storage resources are capable of performing many different functions that have value to the electric power system and to society. The magnitude of that value depends on the condition(s) of the power system when and where storage performs the function(s). Qualitatively, the Commission finds that, across the full range of power system conditions represented by the five scenarios, energy storage can deliver broad benefits. These benefits, discussed in greater detail in Chapters 2.1 and 2.2 of the Report, are:

- **Benefits associated with power generation.** By charging when electricity prices or emissions (and associated externalities) are low and discharging when prices or emissions are high, energy storage can reduce the market price for electricity and the negative externalities caused by electricity generation. Because the need for electricity generation is constant, storage resources always have the opportunity to perform these functions and deliver the associated benefits.
- **Benefits associated with power quality and performance.** When power imbalances or other negative conditions arise on the electric power system that diminish the quality of the power served to customers, storage resources can improve power quality by charging or discharging as needed.
- **Benefits associated with relieving capacity constraints.** When peak conditions near or exceed the capacity of the power system (e.g. generation capacity, transmission capacity, distribution capacity), utilities and system operators must upgrade or expand their existing infrastructure. By performing during these peak conditions, storage can avoid the need for new capacity investments. Unlike the constant need for power generation, capacity constraints – and the opportunity for storage to relieve them – are periodic.
- **Backup power benefits during outage conditions.** Storage can supply backup power to individual customers or groups of customers (e.g. a microgrid) during grid outages. Unlike the prior benefits that are shared between all electric customers, backup power benefits flow only to those customers who are in the right location to receive power from the storage resource (as is the case with backup diesel generators). To supply backup power, a storage resource must be fully charged going into an outage and located on the "right side" of the outage near customers who are out of service. Charging up and holding on to stored energy may require a storage resource to forego performing otherwise valuable functions outside of outage conditions, which could limit its actual value.

Energy storage is not the only resource that can perform valuable functions for the power system. Alternative resources include new generation capacity (including distributed generation), new transmission or distribution capacity, demand response, and energy efficiency. Given current technology costs, these alternative resources are often capable of meeting the same system needs (and delivering the same values) as energy storage at a lower cost.

In the future, the value of energy storage may increase in response to changing system conditions driven by increasing customer demand and investment in clean intermittent generation, and the costs of energy storage may fall. If that happens, the net benefits (i.e. cost savings) of energy storage will increase. Chapter 2.2 contemplates future system needs and presents a detailed outlook on the future of energy storage value under each of the five power system scenarios. Highlights from such future outlooks include:

- Differences in the price and emissions of power generation across unconstrained hours may increase in the future, which could increase the net benefits from energy storage resources.
- Without intervention, such as infrastructure investments, the frequency and duration of clean energy curtailment will likely increase, which will increase the value that energy storage resources provide by avoiding clean energy curtailment. Storage may also be necessary in the future to maintain compliance with the Renewable Energy Standard and the Act on Climate.
- In the near- to mid-term future, peak demand is expected to increase in response to new demand from electrified heating and transportation, and the timing of peak demand is expected to shift from summer to winter. The value that energy storage resources can deliver by serving peak demand will likely increase in response to these evolving conditions.

Existing procurement mechanisms for energy storage resources

In collaboration with stakeholders, PUC staff identified four existing procurement mechanisms (i.e. programs and tariffs) through which storage resources are procured in Rhode Island. These four existing procurement mechanisms include: the ConnectedSolutions demand response program and the System Reliability Procurement program administered by Rhode Island Energy; the energy storage incentive program administered by the Renewable Energy Fund (REF); and ISO-NE wholesale market tariffs. Through these procurement mechanisms, storage developers and owners receive revenue for certain values that their storage resources create. Chapter 3 reviews these procurement mechanisms in greater detail.

In terms of the scale of existing storage procurements, more than 250 residential customers already participate in the ConnectedSolutions program with a battery storage device; commercial customers participate with individual battery storage devices as large as 10 MW. The REF storage incentive program awarded more than $250,000 in storage incentives to 88 small scale storage facilities and 4 commercial storage facilities in 2022. While Rhode Island Energy's System Reliability Procurement plans have led to contracts with energy storage resources, no storage facility supported by those plans has achieved commercial operation yet. Regarding the ISO-NE wholesale markets, stakeholders identified at least one utility-scale storage facility located in Rhode Island that was installed to avoid system capacity constraints and participate in ISO-NE's wholesale markets.[4]

The existing storage programs and tariffs have been instrumental in the early deployment of energy storage resources in Rhode Island. However, the four programs operate in a patchwork. As a result of design inefficiencies, they may not incentivize the full range of net positive value that energy storage resources are capable of delivering today. This potentially leaves significant value on the table.

Are new tariffs or programs for energy storage resources necessary to achieve state goals?

Chapter 4.1 presents an analysis of whether the existing storage procurement mechanisms presented in Chapter 3 are sufficiently designed and administered to procure the full range of net benefits from energy

[4] Agilitas Energy owns and operates a 3 MW/9 MWh battery in Pascoag, Rhode Island.

storage resources. The Report concludes that Rhode Island's existing storage procurement mechanisms feature critical design limitations that can be addressed and improved through the implementation of at least two new tariffs: a retail service tariff for standalone energy storage resources and an interconnection tariff specific to storage resources. Chapter 5 presents a procedural framework for developing such tariffs.

Chapter 4.2 addresses whether new programs or tariffs are needed to facilitate the transition to carbon-free electricity. Here, the analysis is premised on meeting the state's decarbonization mandates for the electric sector defined in the Renewable Energy Standard (RES) and the Act on Climate. Chapter 4.2 presents a forecast of renewable energy supply and demand through 2032, based on publicly-available data. The forecast demonstrates that even without new storage programs or tariffs, there will likely be sufficient RES-eligible renewable energy supply to meet the RES and Act on Climate until at least 2032. While the output of these renewable energy resources is sold in a regional market and could be used to meet the mandates of other New England states, the PUC expects Rhode Island's retail electricity suppliers are likely to be able to capture enough of that supply of renewable energy to meet Rhode Island's RES and Act on Climate mandates due to regional market dynamics, which are discussed in greater detail in Chapter 4.2.

While storage is not likely needed in the near term to meet the RES and Act on Climate mandates, the PUC expects storage likely will be needed sometime after 2030 to balance new supplies of renewable generation with load and to avoid renewable energy curtailment. At that point, storage will likely be needed to cost-effectively meet the RES and Act on Climate.

Final Note

Energy storage resources are capable of delivering potentially significant benefits to the electric power system and to society. The specific magnitude of benefits that a storage resource is capable of delivering at any given moment will depend on the function it chooses to perform in that moment and the underlying power system conditions. Some of these benefits will flow to a specific customer (or customers), some will flow to the entire power system and/or energy market, and some will flow to society at large. For a storage resource to be net beneficial, the value of its benefits must exceed its costs. As recognized above, there are alternative resources available in the market today that, in some instances, can deliver the same benefits as storage for a lower cost; there are also likely instances in which storage is the best alternative in terms of both cost and net benefits. The cost-effectiveness of energy storage will likely change in the future as the needs of the electric power system and the costs of different technologies evolve.

Recognizing the significant value potential of energy storage and the need for alignment between who receives those benefits and who pays for them, the Public Utilities Commission identifies that existing tariffs could be improved to ensure that energy storage resources in Rhode Island are able to sell all of the benefits they're capable of creating. The Commission also identifies that existing tariffs could be improved to ensure that the benefits that flow locally to Rhode Island ratepayers are paid for by Rhode Island ratepayers, that the benefits that flow to the region are paid for by the region, and that the benefits that flow broadly to society are paid for by society. With these improvements, energy storage investors and developers will gain assurance that there is a market for their products, and Rhode Island electric ratepayers will gain assurance that they are buying net beneficial products from energy storage resources.

Chapter 1. Introduction

1.1 How Energy Storage Resources Serve the Needs of the Electric Power System

In Senate Resolution 416[5] (the Resolution), the Senate requested the Public Utilities Commission (PUC, or Commission) identify which electric system needs can be served by energy storage resources. The electric system needs two things to function.

First, the power system needs power generation to convert some initial form of energy into electrical energy. Electricity generation and consumption must be balanced at all times. Second, the power system needs a delivery system to move electrical energy from where it is generated to where it is consumed. The delivery system may comprise various components that serve different functions, such as a high-voltage transmission system that moves electricity over longer distances and a lower-voltage distribution system that moves electricity from the transmission system to the location where it will be consumed. Delivery system equipment has limits that must be respected. If not, damage will occur.

Energy storage resources can serve both of these power system needs. Storage can balance electricity generation and consumption in real time. To do so, storage must be in the right state (charged or discharged) at the right time. Additionally, storage can relieve constraints on the delivery system. Whereas balancing electricity generation and consumption is a matter of timing, relieving delivery constraints is a matter of timing *and location*.

For a given power system, the usefulness of energy storage always depends on the timing of its operations. In some situations, the usefulness of energy storage also depends on the location of its operations. Recognizing this, the goal of this Report is to identify when and where energy storage can create value on the current and future electric system. Before identifying those value streams, it is useful to recognize how the PUC evaluates the needs of the electric power system, how that evaluation applies to the functions of energy storage resources, and how the PUC would evaluate the costs and benefits of serving system needs with storage resources versus storage alternatives.

1.2 The Rhode Island Benefit Cost Framework

The PUC's Rhode Island Benefit Cost Framework (Framework) was developed through a stakeholder process in Docket No. 4600[6] and adopted by the PUC in 2017 in Docket 4600A, along with goals for the electric system and rate design principles.[7] The Framework includes the following components: more than 30 individual categories of benefits and costs that the PUC considers when evaluating proposals related to Rhode Island Energy's regulated electric business; identification and evaluation of the system attributes that drive costs and benefits in each category; and potential methodologies to quantify or qualify the value of those costs and benefits. The Framework represents a comprehensive list of the needs of the electric

[5] Rhode Island Senate Resolution 416, passed on June 23, 2022: http://webserver.rilegislature.gov/BillText/BillText22/SenateText22/S3064.pdf

[6] Stakeholder Committee Final Report, RIPUC Docket No. 4600. Report available at: https://ripuc.ecms.ri.gov/sites/g/files/xkgbur841/files/eventsactions/docket/4600-WGReport_4-5-17.pdf

[7] Public Utilities Commission's Guidance on Goals, Principles and Values for Matters Involving The Narragansett Electric Company d/b/a National Grid, Docket No. 4600A: https://ripuc.ri.gov/eventsactions/docket/4600A-GuidanceDocument-Final-Clean.pdf.

system, customers, and society. In this regard, it is the appropriate tool for answering the questions presented in the Resolution.

The Framework has two uses. First, the benefit and cost categories comprise a benefit-cost test known as the Rhode Island Test. The Rhode Island Test represents the PUC's standard for determining cost-effectiveness through benefit-cost analysis. Cost-effectiveness is explicit and implicit in much of the PUC's statutory authority, and therefore represents a critical element of the overall business case for most proposals.[8] Second, the Framework can serve as a guide for identifying current and future power system needs. Even without a specific project in mind, one can use the Framework's benefit and cost categories to explore how system attributes might change in the future, thereby identifying potential unmet system needs and value opportunities. For example, forecasted increases in demand might indicate an opportunity to reduce the cost of power generation and delivery relative to some baseline; alternatively, forecasted increases in fuel costs might indicate an opportunity to reduce the cost of power generation relative to some baseline.

1.3 Organization of the Report

Following this introduction, Chapter 2 presents a stakeholder-informed qualitative answer to the question "what are the potential benefits of energy storage resources in Rhode Island?" To do this, the analysis uses the Framework as a guide to identify power system needs (including the need to meet the Renewable Energy Standard and the Act on Climate) that could be served or achieved through deployment of energy storage resources. The chapter presents five scenarios that illustrate present and future power system conditions in which energy storage resources could be useful and identifies which benefits are likely to be created under each scenario.

Building on Chapter 2 and with additional input from stakeholders, Chapter 3 reviews design elements of procurement and analyzes Rhode Island's existing storage procurement mechanisms (programs and tariffs) against those design elements.

Chapter 4 addresses the central question of the Resolution: whether new storage tariffs or programs are needed to meet certain goals. The question is addressed in two parts. Chapter 4.1 addresses whether new tariffs and programs are needed for energy storage resources to reduce the cost of the electric power system. Chapter 4.2 addresses whether new tariffs or programs are needed for energy storage resources to facilitate the transition to carbon-free electricity.

Finally, Chapter 5 presents potential next steps for the PUC to advance cost-effective energy storage development in Rhode Island.

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[8] For example, if Rhode Island Energy proposes to execute a contract to purchase the generation output from an offshore wind farm, the cost-effectiveness of the specific project is determined by quantifying the costs and benefits caused by executing the contract (for each Framework category) relative to a baseline in which the contract is not executed.

Chapter 2. RI Benefit Cost Framework Evaluation of Energy Storage Resources

In order to build familiarity with the Framework, Chapter 2.1 provides an introduction to the Framework and a review of how it can be used to analyze the flexible functions of energy storage. Chapter 2.2 follows with a qualitative analysis of the potential benefits of time- and location-specific storage configurations.

2.1 Applying the Framework to Energy Storage Resources

In its review of the Framework with stakeholders, staff presented the functions of energy storage resources as four separate states: charging, discharging, empty vessel, and full vessel. While a storage resource may be able to perform multiple functions, its ability to perform multiple functions at the same time will depend on their requisite state(s). A storage resource can only perform multiple functions simultaneously if each of the functions require it to be in the same state at the same time (e.g. if all functions require it to be charging). If the different functions require it to be in different states at the same time (e.g. charging and discharging), the storage resource cannot perform them simultaneously – it must choose one at a time.

Conceptualizing storage as separate functions dependent on the state of the storage resource can help simplify the analysis of how storage can impact the individual benefit and cost categories of the Framework. For example, regarding those Framework categories related to energy and power, an energy storage resource discharging stored energy is no different than an electric generation resource supplying energy. Therefore, qualitatively identifying the energy and power impacts of discharging an energy storage resource is an identical exercise to qualitatively identifying the energy and power impacts of an electric generation resource. On the other hand, a storage resource charging from the grid is no different than another customer consuming electricity. As a result, qualitatively identifying the energy and power impacts of a storage resource that is charging up from the grid is an identical exercise to qualitatively identifying the energy and power impacts of traditional customer consumption.

After staff familiarized stakeholders with the Framework categories, staff and stakeholders qualitatively analyzed whether and how storage resources can create positive value for each benefit category when acting in each of its four states (charging, discharging, empty vessel, and full vessel). Staff provided stakeholders with a template Framework for analysis and invited stakeholders to complete the Framework with their qualitative benefits analysis. In addition to receiving responses from multiple stakeholders, staff also completed their own qualitative benefits analysis. After reviewing their own initial analysis alongside the submissions and input of stakeholders, staff developed a consolidated analysis of the potential qualitative benefits of energy storage resources.[9] The results of that consolidated qualitative benefits analysis are summarized in Table 1.[10]

[9] The consolidated analysis does not represent a consensus document, but rather the PUC's analysis, informed by stakeholders through direct participation and input. Staff and stakeholders performed independent analyses and reviewed them together over the course of a 4-hour stakeholder workshop on January 10, 2023.

[10] Table 1 presents a reorganized version of the Framework relative to the version published and adopted in Docket 4600A. Although the categories in Table 1 are not identical to the list of categories in the original Framework, staff assures that each Framework category is captured in Table 1.

Table 1. Applying the Framework to Energy Storage Resources

Ref. #	Benefit-Cost Category	Charging	Discharging
Group 1: Benefits related to displacing or avoiding generation			
1	Market Value of Energy	Possible when generation is export-constrained	When economically dispatched
2	Energy Market Price Effects	Increases demand	Decreases demand or increases supply
3	Non-Electric: Oil, Gas, Water, Wastewater	Increases demand	Decreases demand or increases supply
4	Public Health	Increases demand	Decreases demand or increases supply
5	National Security	Increases demand	Decreases demand or increases supply
6	RGGI Compliance	Increases demand	Decreases demand or increases supply
7	Act on Climate Compliance	Increases demand	Decreases demand or increases supply
8	Incremental Greenhouse Gas Externality	Increases demand	Decreases demand or increases supply
9	Other Environmental Compliance (e.g. Criteria Air Pollutant)	Increases demand	Decreases demand or increases supply
10	Other Environmental Externality	Increases demand	Decreases demand or increases supply
Group 2: Benefits related to avoiding or relieving system constraints			
11	Generation Capacity (and Capacity Market Effects)	Could only increase power demand (not expected)	Can reduce peak demand for power or provide incremental power supply
12	Delivery Capacity (Trans. & Distr.)	Could only increase need for delivery capacity to serve load	Can reduce demand for delivery capacity to serve load
13	Export Capacity Infrastructure for Resources (Trans. & Distr.)	Can reduce T & D needed for generation export	Could only increase need for export capacity
14	Renewable Energy Certificates (RECs)	Charging from export-constrained renewables	Discharge is necessary to create net benefit when RPS/RES is 100%
15	Investment Under Uncertainty: Real Options Value	Can reduce forecasted T & D needed for generation export	Can reduce any forecasted capacity needed for serving demand
Group 3: Benefits related to system operation			
16	Trans. & Distr. Delivery (Line Losses & Equipment Cycling)	Can enable siting generation closer to load and reduce equipment cycling	
17	Trans. & Distr. System Safety	Can reduce the exposure of system risks by slowing growth and/or reducing risk of operational error	
18	Incremental Trans. & Distr. System Performance	Storage can increase the flexibility and operational options and asset management of the system	
Group 4: Benefits related to resilience			
19	System and Customer Reliability & Resilience Impacts	Maintain/restore power when located downstream from fault	
20	Net Risk Benefits to Utility and System Operations	Storage can increase resource diversity and adaptability of the system	
Group 5: Benefits related to the size and volatility of the market			
21	Retail Supplier Risk Premium	Flexibility can reduce costs to mitigate supply portfolio risk and customer demand risk	
22	Incremental Avoided Ancillary Services Value	Can provide ancillary services at lower cost	
23	Consumer Empowerment & Choice	Can increase power system and home power options that increase customer empowerment and choice	
Group 6: Benefits related to Equity and LMI customers			
24	Incremental Utility LMI Customer Service	Incremental operational benefits specific to low-income customer impacts	
25	Incremental LMI Participant Benefits	Incremental savings/participant benefits specific to low-income customer impacts	
26	Incremental Societal Impacts related to LMI Customers	Incremental benefits of avoided societal costs specific to low-income customer impacts	
27	Rate and Bill Impacts on Equity	Can enable least-cost procurement that lowers the risk of inequitable cost allocation	
Group 7: Other benefits			
28	Innovation and Market Transformation	Local and regional potential for operational, development, and market innovation through storage	
29	Option value of individual resources	Can enable greater economies of scale for a single site	
30	Conservation and community benefits	Can reduce the nameplate capacity of the clean and intermittent fleet needed to meet environmental mandates	
31	Economic Development	Can create desired economic benchmark impacts	

In Table 1, green boxes indicate that energy storage resources could create the given benefit category under the right set of conditions.[11] Gray boxes indicate that energy storage resources either have no impact on the benefit category or could create costs.[12] When reviewing Table 1, it is important to remember that green boxes only indicate that storage can *potentially* have a positive impact on the given benefit category. Table 1 does not address whether or not the necessary time and location conditions exist for storage to actually create positive value for the given benefit category nor whether that value is net positive when considering the cost of storage. Rather, Table 1 is intended to demonstrate how to apply the Framework to energy storage resources. It should not be used to infer the actual value of energy storage under specific system conditions. The value of storage under specific system conditions is qualitatively analyzed and presented in Chapter 2.2.

Staff organized the Framework into seven groups of individual categories. Because the usefulness of energy storage is so tightly connected to time and location, these groups comprise individual categories with similar time and location triggers or characteristics. The groups are explained below in greater detail.

Group 1: Benefits Related to Displacing or Avoiding Generation. This group comprises the direct and indirect market costs of electric power generation. Because power generation is a continuous event (with the exception of unexpected disruptions), the green boxes in this group indicate that storage has the potential to create these benefits at any given moment. Specifically, storage always has the potential to create benefits when discharging. In contrast, storage never has the potential to create benefits when charging, with one exception: the Market Value of Energy. The Market Value of Energy is unique because storage may be able to create these benefits by charging when prices are negative.[13]

Group 2: Benefits Related to Avoiding or Relieving System Constraints. This group recognizes to the need for generation capacity (i.e., a fleet of power plants) as well as transmission and distribution delivery capacity (i.e. appropriately rated power lines and equipment). Whereas the opportunity to create Group 1 benefits is effectively continuous, Group 2 benefits are driven by peak conditions on the power system (e.g. peak demand or peak generation) that occur during brief periods of time.[14] When peak conditions near or exceed the capacity of some element of the power system, utilities and system operators will upgrade or expand existing infrastructure. By discharging stored energy during peak demand (to avoid a demand-

[11] For example, the first category in Table 1 is the Market Value of Energy. This category includes the wholesale market cost for (electric) energy. When storage is discharging, it supplies electricity to the market. Energy supply from storage will always add value if it is economically dispatched. To indicate this in Table 1, the discharging box is marked green for this benefit category.

[12] For example, the second category in Table 1 is Energy Market Price Effects. This category captures the economic expectation that price increases when demand increases and that price decreases when supply increases. When storage charges, it can increase the market price for energy by increasing demand. For that reason, the charging box is marked gray for this benefit category.

[13] In their comments on the Draft Report, RENEW Northeast noted that "the Report provides no mention of ramping benefits (hourly and sub-hourly) in the Table 1 analysis. These would be appropriate for consideration in relation to energy market price effects (Group 1) and benefits related to system operation (Group 3) as storage's ramping capabilities give system operators better tools for matching load, and fast-responding storage units could play a role in reducing the cost of needed reserves." While Table 1 does not include individual categories for ramping benefits, they are intended to be captured in Groups 1 and 3.

[14] Within Group 2, export capacity infrastructure benefits are unique in that they are driven not by peak demand. Instead, they are driven by peak generation. If the output from a generation resource (or group of generation resources) exceeds the physical limits of the delivery system, the delivery system will be unable to move that power from where it is generated to where it will be consumed. With nowhere for the energy to go, limits must be placed on the generating resources' output. By charging from the generating resource during such an export constraint, storage can avoid the need to limit the power generation while simultaneously avoiding the need for new export capacity investments. The benefit category of Renewable Energy Certificates (REC) is included in Group 2 because the value of energy storage to the REC market comes from relieving constraints that would otherwise result in renewable energy curtailment.

related constraint) or charging up during peak generation (to avoid a generation export-related constraint), storage can avoid the need for new capacity investments.

Group 3: Benefits Related to System Operation. This group comprises categories related to delivering power safely and reliably. Similar to Group 2, these benefits come from improving the performance of the delivery system. However, similar to Group 1, achieving these benefits is associated with continuous performance rather than a short period of peak demand. The special ability of energy storage to create these benefits derives from its flexibility to either discharge to the power system or charge from it. For that reason, charging and discharging are not disaggregated in Table 1.

Group 4: Benefits Related to Resilience. This groups comprises categories related to creating a more resilient and reliable power system that is more adaptable to disruptive events or less exposed to the risk of such events. As in Category 3, the ability of energy storage to create these benefits derives from its flexibility to either discharge to the power system or charge from it. For that reason, charging and discharging are not disaggregated in Table 1. Note that some portion of these benefits may be captured in Groups 1-3. To the extent that this overlap occurs, Group 4 only refers to the incremental value of storage beyond what is already captured by Groups 1-3.

Group 5: Benefits related to the Size and Volatility of the Market. This group comprises categories related to the incremental risks, costs, and benefits of the electricity market not already covered by other categories. Staff notes that the ancillary services benefits included in Group 5 comprise specific market products such as forward reserves and black start service[15] that are intended to be incremental to the ancillary services benefits captured in Group 3. The need for these benefits and services is continuous in nature and, except for black start service, is not differently created through charging or discharging. For example, to provide forward reserve benefits, a storage resource must be charged and at the ready, not actively charging or discharging. For this reason, charging and discharging are not disaggregated.

Group 6: Benefits Related to Equity and Low and Moderate Income (LMI) Customers. This group comprises categories that assure social equity is considered in any cost-benefit analysis. The Framework distinguishes average utility, participant, and societal benefits from the incremental utility, participant, and societal benefits that flow to or are caused by LMI customers. The Framework does this to account for the risk that the unique energy consumption patterns and socioeconomic characteristics of LMI customers might not be well represented by the residential population average. Separately, the category of rate and bill impacts addresses the risk that rate design may allocate to LMI customers more than their fair share of costs. These four benefits are not dependent on whether storage is charging or discharging. For that reason, charging and discharging are not disaggregated.

Group 7: Other Benefits. This group comprises the remaining benefit categories that do not fall into one of the previous groups. It includes innovation, option value, conservation benefits, and economic development benefits.

Innovation captures incremental benefits not already included in other market categories. It is a useful category to consider when evaluating pre-market products and pilots. The category may have less relevance for developed products and programs.

Option value benefits and conservation benefits are separate but related categories. If energy storage enables greater economies of scale for a generation resource, it may enable the generation resource to build at a

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[15] In their comments on the Draft Report, RENEW Northeast offered that "black start is mentioned under Group 5 concerning benefits related to the size and volatility of the market. RENEW suggests black start benefits should fall under resilience/reliability, recognizing that pairing storage with fossil fuel generating resources can enhance system black start capabilities."

larger nameplate capacity, thereby creating option value for that individual generation resource. The option to build a larger nameplate capacity may have the effect of reducing land conservation at the project site. However, if energy storage is deployed to improve the option value of the generation resource as well as to reduce the intermittency of its generation profile, it may reduce the total nameplate capacity needed to serve customers. This can have the effect of increasing land conservation.

Regarding economic development, in recent proceedings the PUC has taken the approach of considering economic impacts alongside, but apart from, the monetary benefit-cost analysis of the Rhode Island Test. The PUC's approach recognizes that the achievement of economic development goals may not be appropriate to include in the Rhode Island Test but should be considered as part of the overall business case of a proposal.[16] It is in this spirit that the economic development benefit category was included in Table 1. Notably, progress on some economic development goals (e.g. local job creation) could be met by deploying storage resources even if the resources never operate once constructed. Thus, achieving economic development goals with energy storage may be independent of creating net benefits through storage deployment.

2.2 Energy storage benefits under different power system scenarios

Evaluating how energy storage resources can meet the needs of the electric power system requires consideration of time and location. For the functions of energy storage to be useful to the power system, the timing and location of those functions must align with the timing and location of system constraints. To illustrate the importance of time and location to storage value and to facilitate discussions with stakeholders, staff designed five scenarios with unique time and location constraints.

The five scenarios represent a typical range of system conditions that occur on the local electric power system in Rhode Island and the regional electric power system in New England. Under the idealized conditions presented in these scenarios, energy storage resources perform different functions to serve different system needs, thereby causing different benefits.

The five scenarios include:

1. Unconstrained hours on the power system,
2. Hours when clean or renewable energy is export-constrained,
3. Peak demand on the power system,
4. A present-day cold snap, and
5. A transmission or distribution line fault

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[16] Economic impact analyses are a common tool used to identify economic development benefits. These analyses aim to reveal the macroeconomic effects of a proposal, such as changes to gross state or domestic product, increases in tax revenue, increases in local spending, and job growth. Experts believe these benefits are largely included in the other categories of the Framework and caution that including the effects identified through an economic impact analysis would double-count a significant portion of benefits. For example, job growth spurred by deploying energy storage is already included the Rhode Island Test as part of the cost of deploying storage. There is, however, some disagreement whether economic development benefits are entirely counted or mostly counted in the other categories. One panel of witnesses found that there may be incremental indirect and induced economic impacts from increased local spending and recommended that these economic impacts be included in the Rhode Island Test as incremental monetary benefits. *See*, Review *of RI Test and Proposed Methodology Prepared for National Grid*, Mark Berkman and Jürgen Weiss, January 31, 2019. https://ripuc.ri.gov/media/93046/download. However, a separate witness recommended the full macroeconomic impacts be presented alongside the results of the Rhode Island Test rather than within the Test in order to avoid double-counting. *See*, *Division of Public Utilities and Carriers Joint Pre-Filed Direct Testimony (Part 2), Direct Testimony of Tim Woolf And Ben Havumaki*, Docket 5189, November 17, 2021. https://ripuc.ri.gov/eventsactions/docket/5189-DIV-Woolf-Havumaki Testimony (11-17-21).pdf.

Through roundtable discussions, staff and stakeholders reviewed the usefulness of energy storage under each scenario and qualitatively analyzed the potential value of storage given the specific constraints represented by each scenario. Where potential value differed between scenarios, staff and stakeholders examined the reasons behind such differences. Informed by this stakeholder process, the PUC presents the potential value of energy storage resources in the section below.

The PUC's analysis finds that across all five scenarios, the potential to create benefits in Groups 6 and 7 are unchanged from Table 1. In other words, the potential to create these benefits always exists and is independent of system conditions. Thus, the analysis presented below focuses on the benefits in Groups 1 through 5 and how those benefits change between scenarios.

Table 2 provides a summary of the potential value of energy storage resources under the five scenarios. For each scenario, Table 2 indicates the potential storage "value stack" given the specific system conditions represented by the scenario. [17] The composition and magnitude of the storage value stack under any given scenario are shaped by two factors: the needs of the power system and the primary functionality of storage under that scenario.

First, within a given scenario, the values that comprise the storage value stack and the magnitude of those values are defined, in part, by the needs of the electric power system. Within each scenario, some benefits are simply unachievable because the power system conditions do not present a need for them. For example, when the power system is outside of a peak event, storage cannot create Group 2 benefits. This is described below as "benefits that fall outside the primary function's values stack."

Second, the values that comprise the value stack within each scenario and the magnitude of those values are defined, in part, by what functions one assumes the storage resource will perform in response to system needs and what state (charging, discharging, sitting empty, or sitting full) it must be in to perform those functions. At any given moment, there may be multiple benefits that a storage resource can technically create but that are mutually exclusive because they require the resource to perform multiple incompatible functions at the same time. For example, a storage resource may receive a price signal from the wholesale market to charge because energy prices are low, while simultaneously receiving a signal from the distribution utility to discharge because the local delivery lines are at capacity. Because the storage resource cannot simultaneously charge and discharge, it must choose one function to perform and forgo the other.

The analysis presented below in Chapter 2.2 addresses this nuance by postulating a "primary function" that a typical storage resource would perform under each scenario. For each scenario, the primary function is based on the unique needs of the power system given the unique conditions envisioned by the scenario. In turn, the primary function defines what a storage resource must be doing before, during, and/or after the scenario. By doing so, the designation of a primary function determines the components of the storage value stack under the scenario.

The primary function for each scenario is intended to represent the largest, most reliable value-generating opportunity for a storage resource given the specific conditions envisioned by the scenario. However, recognizing that there may be other valuable functions beyond the primary function, the PUC acknowledges that alternative value stacks may prove to be more cost-effective in reality than the illustrative primary value stack. Accordingly, each scenario description presented below describes "alternative functions and value stack benefits" that a storage investor may consider when designing and evaluating the performance of their resource under the given scenario.

Whereas Table 1 is intended only to introduce the Framework and should not be used to infer the potential value of energy storage resources, Table 2 can be used to infer storage value potential. To do this, one must

[17] "Value stack" refers to the full range of values and benefits that storage is capable of providing.

evaluate the size of the potential benefits and multiply that value by the frequency and/or duration of the different scenarios over the course of a given period of time (e.g. one year, the life of the energy storage resource, etc.). Each scenario discussion below provides a brief description of the scenario and an outlook for the qualitative value of storage in the near future.

Table 2. Value Potential of Energy Storage Resources in Scenarios 1-5

		Theoretical Value		Scenario 1: Unconstrained Hours		Scenario 2: Clean or Renewable Export Constraint		Scenario 3: Peak Demand		Scenario 4: Present-Day Cold Snap		Scenario 5: Service Disruption, Line Fault	
Ref.	**Benefit-Cost Category**	**Charge**	**Disch.**	**Charge**	**Disch.**	**Charge**	**Disch.**	**Charge**	**Disch.**	**Charge**	**Disch.**	**Charge**	**Disch.**
	Operational Hours			**Anytime**		**During**	**After**	**Off Peak**	**During**	**Before**	**During**	**During**	
Group 1: Benefits related to displacing or avoiding generation													
1	Market Value of Energy												
2	Energy Market Price Effects												
3	Non-Electric: Oil, Gas, Water, Wastewater												
4	Public Health												
5	National Security												
6	RGGI Compliance												
7	Act on Climate Compliance												
8	Incremental Greenhouse Gas Externality												
9	Other Environmental Compliance (e.g. Criteria Air Pollutant)												
10	Other Environmental Externality												
Group 2: benefits related to avoiding or relieving constraints													
11	Generation Capacity (and Capacity Market Effects)												
12	Delivery Capacity (Trans. & Distr.)												
13	Export Capacity Infrastructure for Resources (Trans. & Distr.)												
14	Renewable Energy Certificates (RECs)												
15	Investment Under Uncertainty: Real Options Value												
Group 3: Benefits related to system operation													
16	Trans. & Distr. Delivery (Line Losses & Equipment Cycling)												
17	Trans. & Distr. System Safety												
18	Incremental Trans. & Distr. System Performance			*		*		*		*		*	
Group 4: Benefits related to resilience													
19	System and Customer Reliability & Resilience Impacts												
20	Net Risk Benefits to Utility and System Operations												
Group 5: Benefits related to the size and volatility of the market													
21	Retail Supplier Risk Premium												
22	Incremental Avoided Ancillary Services Value			*		*		*		*		*	
23	Consumer Empowerment & Choice												

**Asterisks indicate benefit categories that a storage resource can potentially deliver in the scenario, but only when operating to serve a secondary function. Therefore, they are not included in the value stack of the primary function for the scenario.*

Scenario 1: Unconstrained hours on the power system

In Scenario 1, both the power generation and delivery systems are unconstrained. In this hypothetical scenario, whatever amount of demand consumers have, there is always sufficient generation and delivery capacity to serve it. A real-world example of Scenario 1 might occur on a mild spring day when the range of demand throughout the day is far below the limits of the generation fleet and the delivery system.

<u>Primary Function and Key Value Stack Categories</u>
Even on an unconstrained system, power generation will vary over time. If there is diversity within the power generation fleet, prices will vary with time, as will GHG emissions, public health impacts, and other market externalities caused by power generation. Storage located anywhere on an unconstrained power system can deliver benefits by charging from the power system when prices and market externalities are low and discharging to the system when prices and externalities are high. Under this scenario, storage resources can deliver Group 1 benefits associated with displacing or avoiding generation.

In this scenario, alternative solutions to energy storage include any dispatchable generation or load resource that can respond to a market signal (e.g. a gas-fired power plant, demand response, etc.).

<u>Benefits Outside the Primary Function's Value Stack</u>
Under this scenario, storage cannot deliver Group 2 benefits associated with relieving capacity constraints because, by definition, there are none to relieve. Additionally, storage cannot create benefits associated with backup and resiliency benefits because the power system is up and running. Although storage could behave like an insurance policy against power outages, doing so will only yield benefits when an outage occurs. Just like an insurance policy, there is no backup power benefit from storage (only cost) until and unless the unwanted event occurs. Note that discharging a storage resource in response to a market price signal limits the amount of stored energy available to serve as a backup power during an outage.

<u>Alternative Functions and Value Stack</u>
In this scenario, energy storage resources can improve system performance by providing ancillary services related to power quality and frequency support. However, the price signals sent by the wholesale electricity market (around which a storage resource will likely organize its charging and discharging activity under this scenario) may not align with the charging and discharging performance requirements to serve operational needs and improve system performance. If they do not align, a storage investor or operator would have to choose which signal to respond to and which function to perform. These benefits are marked with and asterisk in Table 2 to convey the expectation that they are assumed to be inaccessible when a storage resource is performing its primary function under this scenario.

<u>Outlook</u>
Under this scenario, energy price benefits represent a potentially significant revenue opportunity for storage resources today. That revenue opportunity only exists when prices differ across time (e.g. when periods of low pricing are followed by high pricing or vice versa). The size of this revenue opportunity is likely larger than the size of the revenue opportunity associated with system performance and operations benefits given the current size of the respective markets. However, in the New England region today, differences in electricity prices and emissions are relatively small across most of the hours when the power system is unconstrained. Accordingly, the net benefits from charging when prices or emissions are low and discharging when prices or emissions are high are relatively small and likely do not outweigh the cost of energy storage.

Price differences across unconstrained hours may get larger in the future as more intermittent renewable energy is added to the system and consumption patterns become more variable due to the electrification of the heating and transportation sectors. These same changes may also increase the need for system performance regulation, which may shift value that is typically paid for by the energy market to the ancillary services market. In either case, future system conditions may increase the need for storage during unconstrained hours.

Scenario 2: Hours when clean or renewable energy is export-constrained

Under this scenario, the power system is generally unconstrained, with one key exception: clean or renewable energy is stuck behind a congested transmission or distribution delivery element and cannot export all of the electricity it is technically capable of generating onto the system for end-use consumption. This event is called "curtailment."

<u>Primary Function and Key Value Stack Benefits</u>
Curtailment deprives the market of clean energy. Under this scenario, storage can avoid curtailment of clean energy by charging during congestion and discharging after the delivery element returns to an unconstrained state. Storage can avoid curtailment if located downstream of the congested delivery element. Figure 1 illustrates four examples where clean energy is trapped behind an export constraint (indicated in red). In each example, storage located at any location marked by a yellow star can provide value by charging when clean energy would otherwise be curtailed and discharging once the export constraint is relieved.

By avoiding clean energy curtailment, storage can increase the total amount of energy generated by the existing low carbon generation fleet without requiring new transmission or distribution capacity. Additionally, periods of renewable energy curtailment likely correspond to periods of negative energy market prices. If a storage resource charges when wholesale electricity prices are negative, the resource will be paid to charge.[18]

Additionally, by enabling the delivery of clean energy that would otherwise be curtailed, storage will enable incremental supply of Renewable Energy Certificates (RECs). This can reduce REC prices, which would lower the cost to meet the mandates of the Renewable Energy Standard and the Act on Climate.

In this scenario, an alternative solution for avoiding curtailment is to invest in more transmission and/or distribution capacity. If the cost of curtailment avoidance from storage is less than the cost of curtailment avoidance from building incremental transmission or distribution capacity, then storage can deliver Group 2 benefits associated with avoiding the need to build higher-cost delivery infrastructure.

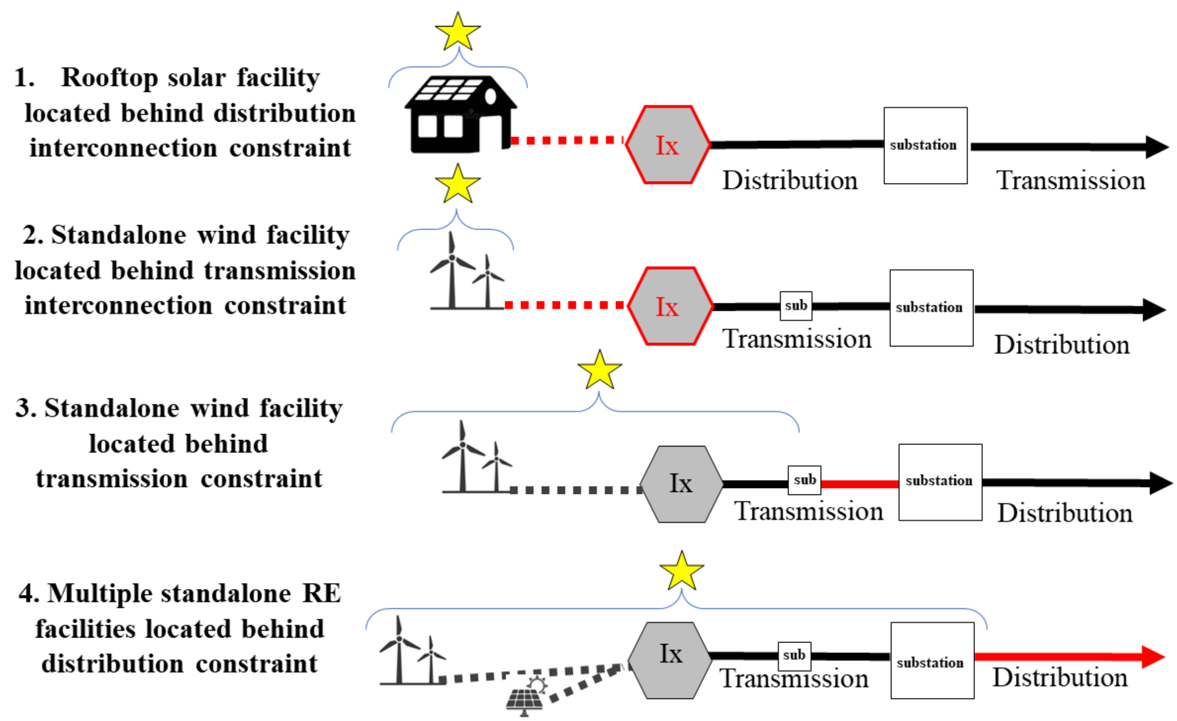
<u>Benefits Outside the Primary Function's Value Stack Primary</u>
Under this scenario, storage cannot deliver benefits associated with relieving demand-related delivery constraints because, by definition, there are no demand-related constraints to relieve. The delivery constraints under this scenario are caused by generation, not consumption. As in the previous scenario, storage cannot create benefits associated with backup and resiliency benefits because there has not been a disruption to the electric power system. Note that if a storage resource discharges its stored energy in response to multiple, consecutive periods of high generation are expected (e.g., daily), it may not have any stored energy available to serve as backup power during an outage if the outage coincides with the periods of high generation.

<u>Alternative Functions and Value Stack Benefits</u>
As in the case with Scenario 1, it is possible for energy storage resources to improve system performance by providing ancillary services related to power quality and frequency support. However, to avoid clean energy curtailment, a storage resource must respond to the specific physical conditions created by the clean energy resource and the delivery constraint that limits it. To reliably perform this task, a storage resource

[18] Notably, while the "resource will be paid to charge," the entity that actually receives that payment depends on who is exposed to the wholesale market prices at the time of charging - the storage resource owner or another entity.

must be in the appropriate physical state to respond to the export constraint. While performing other secondary functions may be valuable, they may not align with what is required to avoid clean energy curtailment.

Figure 1: Timing and Location Requirements During Renewable Energy Export Constraint



Outlook

To relieve the export constraint and avoid clean energy curtailment, an energy storage resource must be able to do two things. First, it must be able to charge fast enough from the clean generating facility so that all of the generation that would have otherwise been curtailed gets stored. Second, it must have large enough storage capacity to hold on to all of the generation that would otherwise be curtailed during a single curtailment event. These two factors tend to make energy storage a more expensive alternative for curtailment avoidance than a traditional wires upgrade given current technology costs. The cost of storage may exceed the benefits under this scenario given the cost of storage today.

Additionally, on today's power system, clean energy curtailment occurs infrequently and for relatively short durations.[19] Accordingly, the net benefits from avoiding renewable and clean energy curtailment are relatively small today. Opportunities to avoid curtailment may be sporadic and hard to predict and/or respond to, especially given their locational specificity.

Without investment in the delivery system or alternatives like energy storage, clean energy curtailment will become more frequent and last longer in the future as more clean energy resources are added to the system. In turn, this will increase the value opportunity for storage and any other curtailment avoidance solution.

[19] US DOE found that average onshore wind curtailment in ISO-NE was less than 2% in 2021. US DOE Land-Based Wind Market Report, 2022 Edition. https://www.energy.gov/sites/default/files/2022-08/land_based_wind_market_report_2202.pdf

Scenario 3: Peak demand on the power system

Peak demand occurs when customers' consumption of electricity is at its highest. Peak demand can be measured over different time increments such as hours, days, months, or seasons. The examples provided in this scenario assume peak demand on the order of minutes or hours. When peak demand exceeds the capacity of an element on the electric system (e.g. bulk generation, transmission elements, or distribution elements), new infrastructure must be built to safely and reliably serve customers.

Peak demand can occur across all sections of the power system at the same time (coincident) or can occur in specific locations at different times (non-coincident). Figure 2 presents various examples of peak demand on different sections of the system. The first example assumes insufficient generation capacity. The second example assumes insufficient transmission capacity to transmit the power from where it is generated into a local distribution network. The third example assumes insufficient distribution capacity to deliver the power between two sections of the distribution system. The fourth example assumes insufficient localized distribution capacity (e.g. a line drop) to deliver power to the end-user.

Primary Function and Key Value Stack Benefits

Storage can provide relief for the relatively brief period of time during which peak demand occurs by discharging stored energy. This can avoid the need for additional generation, transmission, or distribution infrastructure.

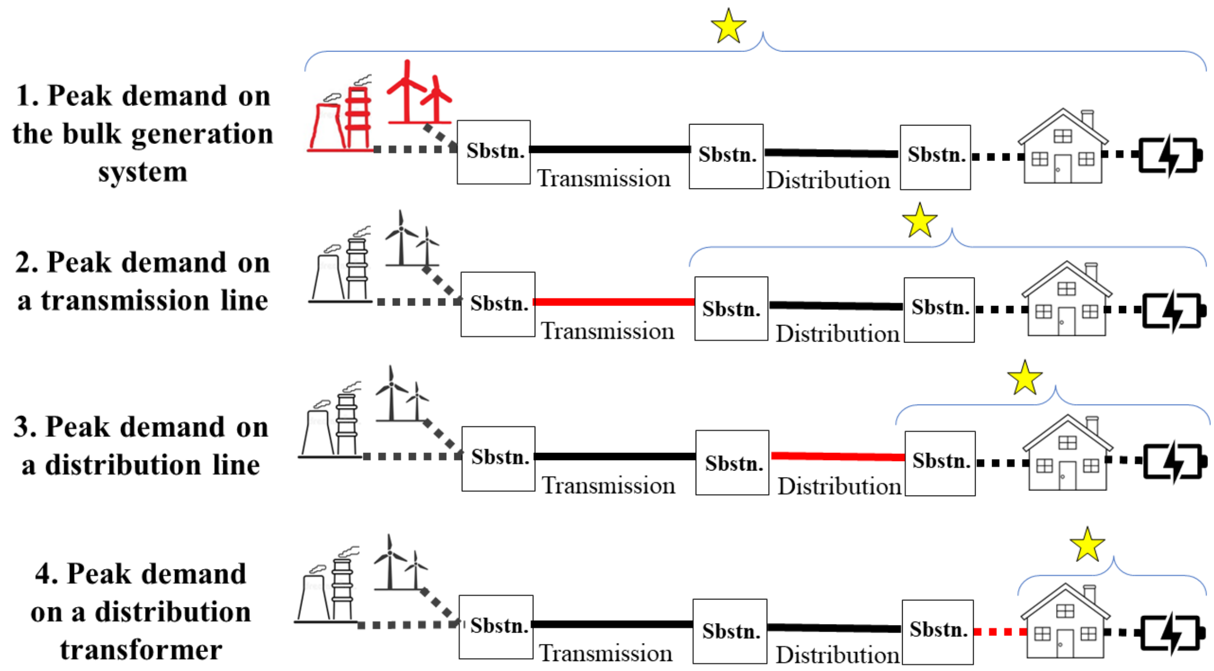
Figure 2 depicts four different constraints on the power system caused by peak demand (the constrained element is indicated in red). To avoid the costs caused by peak demand under each example, storage must be located downstream of the element that is constrained during the peak demand conditions (depicted by the yellow stars). Operationally, storage must be charged before the peak demand period and must have sufficient stored energy and power output capabilities to discharge for the entire duration of the peak demand until customers lower their consumption and the peak period ends.

As depicted in Figure 2, the locations where storage can provide value by discharging during peak demand gets smaller as the congestion becomes more localized. For example, when peak demand exceeds the capacity of generation fleet (example 1), storage located anywhere on the system can deliver value by discharging on-peak. However, when peak demand exceeds the delivery capacity of a specific transmission line, storage can only deliver value by discharging on-peak from a location that is downstream of the congested line (example 2).

Notably, discharging during a peak period is likely aligned with creating Group 1 benefits because when congestion occurs, it results in less efficient generation or delivery of power compared to when the system is unconstrained. This inefficiency raises energy prices, emissions, and other externalities caused by power generation. When storage functions to alleviate peak demand-related constraints, it will also reduce the cost of electricity generation and associated externalities.

In this scenario, an alternative solution for serving peak demand is to invest in more generation, transmission or distribution capacity. If the cost of on-peak capacity from storage is less than the cost of building incremental capacity (e.g. a bigger wire), then storage can deliver Group 2 benefits associated with avoiding the need to build higher-cost new infrastructure.

Figure 2: Timing and Location Requirements During Peak Demand



The primary value stack for this scenario presented in Table 2 assumes that peak demand occurs at the same time on all sections of the power system and that the storage resource is located as close to the customer demand as possible. Accordingly, when it discharges stored energy to serve peak demand on any one section of the system, it will automatically serve peak demand on all sections of the system upstream of the storage resource that would otherwise need to be improved in order to serve the downstream demand. This assumption results in largest possible value stack for the scenario.

On a real system, peak demand conditions on different sections of the power system may not overlap in time. For example, a local transmission and distribution delivery peak may occur later in the day than the bulk power system peak. If that happens, a storage resource that discharges stored energy to reduce peak demand on the bulk system will not simultaneously reduce peak demand on the local delivery system (because it is not experiencing peak demand conditions in that moment). In that moment, the benefits of reducing transmission and distribution capacity investment represent "benefits that fall outside the primary function's value stack." Eventually, however, peak demand conditions on the local transmission and distribution systems will arise and the storage resource may then respond to those peaks. At that time, the benefits of reducing transmission and distribution capacity investment can be added back into the storage value stack.

If peak demand conditions arise on different sections of the system at different times, a storage resource must pick a primary demand peak around which to organize its charging and discharging cycle. In doing so, the resource faces the risk that discharging to serve one peak will leave it physically unable to respond to another peak if there isn't sufficient time to recharge or if prices aren't sufficiently low to support recharging. Thus, serving a secondary peak represents an "alternative function and value stack." In the most extreme case, the timing of peak demand conditions could be so misaligned that a storage resource that recharges in order to respond to future peak demand conditions on one element of the system might end up exacerbating peak demand conditions on another section of the system. None of this nuance is captured in the simple value stack presented in Table 2, but would be captured in the decision-making of a storage developer and in the application of the Rhode Island Test to a specific storage resource.

Benefits Outside the Primary Function's Value Stack

This scenario is defined as having no constraints that limit the ability of the power system to generate clean electricity and move it to where it will be consumed. Thus, there are no Group 2 benefits related to relieving an export constraint. Additionally, energy storage has no net impact on the REC market under this scenario. While energy storage will decrease total demand for electricity by discharging stored energy on-peak, it will have previously increased total demand for electricity by charging up.[20] Because the power system is fully operational, there are no backup power or resiliency benefits under this scenario. Note that if an outage occurs after a storage resource has discharged its stored energy on-peak and before it can recharge, it will not be able to serve backup power supply if outage conditions arise.

Alternative Functions and Value Stack Benefits

As in the previous two scenarios, it is possible for energy storage resources to improve system performance by providing ancillary services related to power quality and frequency support. The limitation on simultaneously performing this function as well as the primary function of serving peak demand is that storage must be sufficiently charged before the peak demand conditions arise. Gaining and maintaining the requisite supply of stored energy during this period may cause a storage resource to miss out on other valuable revenue-generating opportunities associated with discharging (e.g. Group 1 benefits and other benefits related to system performance and regulation).

Outlook

Today, peak demand typically occurs on sections of the power system for 1-2 hours during the summer.[21] Across all sections of the power system in New England (including the local distribution system), peak demand has decreased in recent years primarily driven by energy efficiency and distributed generation resources (e.g., rooftop solar). Despite this downward trend, there is value in providing on-peak capacity, as there are discrete locations on the grid where consumption is increasing and new capacity is needed. Across the entire regional bulk power system, ISO-NE forecasts peak demand will increase by as much as 6% by 2032, driven by consumers adopting electric heating and vehicles.[22]

Changes in peak demand conditions will change the value proposition of energy storage under this scenario. Given the summer-peaking nature of today's power system, storage resources primarily time their peak demand reduction around summer peak(s). In the future, peak demand reduction will likely be valuable in both the winter and summer in response to new electrified heating and transportation loads. As this occurs, not only will the timing, frequency, and duration of the winter peak differ from the timing, frequency, and duration of the summer peak, but the locations at which storage is needed to serve peak demand may shift between summer and winter.

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[20] Most RES/RPS compliance obligations are annual in nature. So long as charging and discharging occur during the same annual compliance period, storage will have no net impact on the total volume of load subject to RES/RPS compliance, and therefore no impact on the REC market.

[21] Peak demand on the regional bulk power system peaked at 28,130 MW on August 2, 2006. Peak demand on the local distribution system peaked at 1,985 MW on that same day. Source: The Narragansett Electric Company's 2022 Electric Peak Demand Forecast.
https://systemdataportal.nationalgrid.com/RI/documents/RI_PEAK_2022_Report.pdf

[22] ISO-NE "New England's Electricity Use" statistics. https://www.iso-ne.com/about/key-stats/electricity-use

Scenario #4: Present-day cold snap

During a present-day cold snap, there may be insufficient fuel supply to serve electricity demand over some portion of the day or days. In contrast to the prior scenario, a winter cold snap creates conditions under which there is sufficient electric generating capacity to serve demand but not enough fuel supply to run the generation fleet. Much of New England's power generation fleet relies on fossil fuels to generate electricity, particularly natural gas. When home heating begins in the winter, the supply of natural gas coming into New England via interstate natural gas pipelines can be insufficient to serve both demand for natural gas caused by home heating as well as demand for natural gas caused by electric power generators. Whereas natural gas utilities, on behalf of their "firm supply customers" (e.g. home heating customers), have long-term contracts for pipeline natural gas supply, power plants do not. As a result, when demand for both home heating and electricity spike during a cold snap, gas-fired power plants may not be able to access sufficient pipeline gas supply to generate electricity.

To ensure sufficient fuel supply during a cold snap, many of the region's power plants store liquid fuels (e.g. oil) on-site. Throughout the region, liquid natural gas (LNG) is also stored. If pipeline natural gas supply becomes unavailable or uneconomic, the power plants will burn these stored liquid fuels. In the winter of 2021/2022, New England power plants burned approximately 80 million gallons of stored fuel oil for electricity generation.[23]

If a cold snap persists for so long that power plants deplete their liquid fuel stocks, the region's power generation fleet may be unable to generate sufficient electricity to serve demand. This could result in future bulk system outages.[24] Furthermore, stored liquid fuels can be higher-emitting and higher cost than pipeline gas supply. Considering these dynamics, cold snaps present winter reliability, price, and climate risks.

<u>Primary Function and Key Value Stack Benefits</u>

During a cold snap, storage resources located anywhere on the power system can discharge their stored energy to relieve fuel constraints and avoid the need to burn liquid fuels. To do so, storage resources must charge before the cold snap, hold on to that energy, and discharge it once power plants start to burn stored fuels.

Under this scenario, storage can deliver Group 1 benefits by charging before the cold snap when cleaner, cheaper fuels are powering electricity generation and then later discharging that stored energy to avoid or offset the burning of oil or LNG. Table 2 shows that the potential to create Group 1 benefits during a cold snap is similar to the other scenarios (especially Scenario 3), with a few key caveats.

First, present-day cold snaps cause fuel constraints that can last for multiple consecutive days, a duration beyond what most energy storage technologies today can perform. In 2022, 4,798 MW/12,181 MWh of energy storage was deployed in the U.S.[25] On average, those resources had an average discharge time of 2.5 hours at their maximum power output.[26] If summer peak demand lasted for 2.5 hours, those storage resources could discharge energy for the entirety of the peak-demand related fuel constraint. However, winter fuel constraints caused by a cold snap can last far longer than 2.5 hours.

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[23] ISO-NE Winter 2022/23 Analysis: Assessment and Recommendations. https://www.iso-ne.com/static-assets/documents/2022/07/a09_mc_2022_07_12-14_winter_2022_2023_presentation.pptx

[24] The bulk generation system is not currently experiencing outage conditions under this scenario. However, because of fuel availability constraints, there is a risk that outage conditions could arise.

[25] U.S. Energy Storage Monitor, 2022 Year-End Review. Wood Mackenzie. https://www.woodmac.com/industry/power-and-renewables/us-energy-storage-monitor/

[26] 12,181 MWh / 4,798 MW = 2.53 hours

Second, while storage can undoubtedly reduce or offset liquid fuel combustion during a cold snap, the power plant generating the electricity from which a storage resource will charge before the cold snap is likely to be a natural gas-fired unit. Thus, the emissions reductions likely to be delivered by storage during a cold snap today are not as significant as those that could occur in the future if storage charges from a clean electricity generation fleet.

Under this scenario, storage resources can create Group 2 benefits in a similar manner to Scenario 3 (peak demand), again with some caveats. To create Group 2 capacity benefits, there must be non-fuel resources that would otherwise be deployed. For example, if incremental offshore wind capacity is the chosen alternative to meet energy needs during winter cold snaps, storage resources could reduce the amount of incremental offshore wind capacity necessary to endure cold snaps so long as the wind resource has sufficient excess energy to charge the storage resources before the cold snap occurs. Similarly, storage can offset transmission investments if the transmission investment is designed to deliver energy from a non-fuel resource.

Finally, storage can reduce the cost of investment risk associated with winter reliability. In the absence of storage, existing power generators may invest in incremental on-site oil or LNG storage tanks. There is a risk that those investments may prove to be unneeded. If energy storage is a cheaper alternative than building incremental on-site oil or LNG storage tanks, it can delay the need for those costlier investments and buy time to reduce investment uncertainty.

Benefits Outside the Primary Function's Value Stack

Under this scenario, the benefits that fall outside the value stack are identical to those that fall outside the value stack under Scenario 3 (peak demand), for similar reasons. During a fuel constraint caused by a winter cold snap, the risk of clean energy curtailment is very low. Export capacity is likely unconstrained, as is the supply of RECs. Without export capacity or REC supply constraints to relive, there is no value to relieving them. Similarly, the power system is not experiencing outage under this scenario. Thus, storage cannot deliver backup power or resilience benefits. Note that a storage resource that discharges during a cold snap will be unavailable if outage conditions arise unless it has an opportunity to recharge.

Alternative Functions and Value Stack Benefits

Under this scenario, the alternative functions are identical to Scenario 3. It is possible for energy storage resources to improve system performance by providing ancillary services related to power quality and frequency support. The conflict with this alternative function and the primary function of supplying energy during a cold snap is similar. To provide value during a present-day cold snap, storage must be sufficiently charged before the start of the cold snap event. Holding energy to serve demand during a cold snap may be inconsistent with charging and discharging patterns necessary to improve system performance.

It is also notable that even after the cold snap ends, a storage resource looking to recharge may need to wait a long period of time before prices drop low enough to justify the cost of recharging. Recharging when electric prices are high only makes economic sense if you expect a subsequent period of even higher prices during which you can discharge again. Given this, if electric prices remain high after a cold snap, a storage resource may forego immediately recharging. In that case, the resource will be unavailable to serve other valuable functions until prices drop low enough to recharge.

Outlook

As discussed above, fuel constraints caused by present-day cold snaps can last for multiple days or longer. In recent winters, the region has relied on approximately 12,000 MW of oil-fueled generation capacity to serve demand during cold snaps when pipeline gas supply is constrained.[27] Available power (MW) from storage resources is small by comparison.[28]

If the winter reliability issues associated with cold snaps are to be mitigated with energy storage, only long-duration, high-capacity energy storage projects will meet the reliability need. Stakeholders agree that long-duration storage is not readily available in the New England market today. Therefore, while the potential benefits of storage during today's winters are significant, the likelihood that those benefits will exceed the cost of storage is low given current technological and economic limitations.

The value of energy storage during a cold snap could change in the future as renewable generators displace natural gas in the region. Rather than supporting natural gas units when cold snaps draw down fuel supplies, these storage units could transition to balancing intermittent wind and solar PV generators when unfavorable natural conditions (e.g., windspeed and solar irradiance) lead to extended periods of low output.

Scenario #5: A transmission or distribution line fault

In this scenario, a specific transmission or distribution line experiences a fault, thereby interrupting electric service to customers who are served by that line. A real-world example of Scenario 5 might occur after a local storm event during which a tree branch falls on a distribution feeder, knocking out power to all of the customers served by that feeder.

Primary Function and Key Value Stack Benefits

During an electric service disruption, demand for energy is no longer served by the electric power system because power cannot physically travel over the delivery system. To maintain electricity supply, a backup power resource must be deployed. Backup power resources include, but are not limited to, backup diesel generators, an islanded distributed generation resource,[29] or energy storage.

Energy storage can supply backup power during an electric service disruption. This benefit is specifically captured in Group 4 (benefits related to resilience and risk). Table 2 depicts the potential value of energy storage during such a wires-related service disruption. The primary function contemplated for storage during this scenario is to support the use of intermittent or fuel-limited generation resources as backup power supply. While a standalone storage resource can supply backup power during an outage if it is charged, its value as a backup power resource may be severely limited if it is not paired with a generating resource like solar PV. Without being paired with a generating resource, it will not be able to recharge once it discharges all of its stored energy, at which point its backup power value will be exhausted.

Similar to Scenarios 2 and 3, storage must be located on the customer-side of the line fault in order to provide value. To supply backup power during a service disruption, storage must also be sufficiently charged before the disruption.

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[27] ISO-NE Oil Depletion Charts. https://www.iso-ne.com/static-assets/documents/2023/04/2023-04-18_oil_depletion_graphs.pdf

[28] The largest storage facility in New England (the Northfield Mountain Pumped Hydro Storage Station) can discharge energy at a maximum rating of 1,168 MW for up to 7.5 hours.[28] While there is no question that the Northfield Mountain Pumped Hydro Storage Station is extremely valuable to the region, this example illustrates that New England could need 11 more Northfield Mountain Pumped Hydro Stations to fully displace the combustion of liquid fuels during winter cold snaps. Source: https://www.firstlightpower.com/facilities/?location_id=346

[29] "Islanded" refers to the ability of a distributed generation resource to continue generating electricity during a grid outage for purposes of supplying it to a co-located customer, as opposed to exporting it to the wider distribution system. Islanding requires incremental technology.

Under this scenario, the value of energy storage is not in preventing an outage but in serving backup power supply once the outage has occurred. Once a power outage occurs, storage becomes part of a smaller electric power system. For example, a storage resource may be a component in a single-residence power system or a microgrid that serves multiple residences. At that time, the smaller power system will be in one of the previous conditions described in Scenarios 1 through 4. For example, the microgrid may be unconstrained or may be experiencing peak demand conditions. Thus, to serve the primary function of backup power, the storage resource must perform the primary function needed to serve the smaller power system.

Unlike the other scenarios above, the value of energy storage as a backup power resource is independent from the electric power system (and the markets that support it) because customer demand for energy is no longer served by the power system. Instead, it is served by the microsystem that supports it (including the power generation resource that serves it, such as a diesel generator) or not served at all. As a result, the value of energy storage during a service disruption differs potentially significantly from the value of energy storage under the prior four scenarios.

Storage resources can reduce the price of and emissions from backup power supply by offsetting dirtier, more expensive backup generation fuels. Those values are captured by the non-electric resource benefits in Group 1. Storage resources also have the potential to create Group 2 benefits by offsetting incremental investment in intermittent backup generation capacity (e.g. adding panels to an existing solar PV system) or by enabling new REC supply that would not have otherwise been created (e.g. charging from a renewable generator that would have otherwise sat idle while electric power system is down).

<u>Benefits Outside the Primary Function's Value Stack</u>

Once a storage resource begins to serve as a backup power resource during a grid outage, nearly all of the benefits achievable in Scenarios 1 through 4 are achievable on the smaller power system in effect during the outage (e.g. the single residence being powered by the storage resource or a larger microgrid). Delivering benefits to that smaller power system is subject to the same conditions and rules as deliver benefits to the larger power system under Scenarios 1 through 4.

It is reasonable to assume that during the outage, the delivery system used to move power from where it is generated to where it is consumed will simply comprise a smaller section of the existing delivery system. For example, on a microgrid that serves 5 neighboring homes, the delivery system that delivers power from the generation resource to those homes will likely consist of the utility's existing distribution wires (enabled by incremental microgrid islanding technology). Whereas a new source of generation capacity is required to provide power during an outage, we assume that the existing delivery system is used to move power from that new generation capacity resource to the end user. In other words, we do not assume that an independent backup delivery system springs into action during a power outage. Accordingly, it would be impossible for a storage resource to provide avoided transmission or distribution capacity benefits during an outage. We also assume that benefits related to equipment cycling and line losses are not possible during an outage because the storage resource will be sited similarly close to load as any other backup power resource.

Notably, the electricity market value and electric energy market price effect benefits vanish from the value stack because the consumer is physically disconnected from the electricity market. Thus, their energy usage has no bearing on electricity market outcomes. Finally, because the consumer and the storage resource are disconnected from the electricity market, incremental ancillary services benefits and benefits associated with reducing supplier risk premium are also not possible to create during an outage.

<u>Alternative Functions and Value Stack Benefits</u>

Similar to all other scenarios, storage may be able to improve operations and power quality. However, to dedicate capacity to serving that task, a storage resource may undermine its availability to charge or discharge in response to customer demand for backup power. Even when storage is part of a smaller electric power system, it can still only move in one direction at a time, and therefore may not be able to provide operational benefits at the same time that it is supplying power or charging up.

In order to guarantee that it is sufficiently charged when outage conditions arise, a storage resource must hold on to its stored energy for the eventuality of an outage and forego participating in other revenue-earning opportunities during normal system operations. It is worth noting that retaining stored energy for a future grid outage can be subject to greater risk than other market activities, as forecasting power outages may prove more difficult than forecasting peak demand or cold snaps. While the timing of outages may correlate with the same weather conditions that drive peak demand or a winter cold snap, other hard-to-measure environmental factors may make predicting the location of outages harder than predicting the locations where peak demand conditions or and cold snaps may arise.

Outlook

The value of storage as a backup power resource depends on the frequency and duration of outages on the delivery system, the cost of alternative backup power resources, and the value of personal energy reliability (in those cases where storage serves as an onsite backup power resource).

Regarding outages, Rhode Island electric distribution customers have made significant investments in distribution system reliability, many of which are designed to reduce the frequency and duration of outages. In Rhode Island, tree-related events represent the leading cause of customer interruptions (excluding major storm events).[30] To minimize the risks of tree-related disruptions, Rhode Island Energy customers invest anywhere from $10-$25 million per year in vegetation management. As a result of these and other reliability investments, the distribution system has consistently met or exceeded system reliability goals. In 2021, the System Average Interruption Duration Index (SAIDI)[31] for Rhode Island Energy distribution customers was 68.8 minutes.[32] According to the US Energy Information Administration, the 2021 national average SAIDI was 121 – 125 minutes.[33] Given the relatively high reliability of Rhode Island's electric distribution system, storage may not be able to provide net benefits during a service interruption today.

Regarding costs, current battery prices are considerably higher than the costs of other backup power alternatives, particularly when considering that storage resources only gain the ability to refuel during an outage when paired with investments in distributed generation. Given the potentially significant cost differential between storage resources and other backup power resources, customers seeking backup power may choose to invest in cheaper alternatives.

The future reliability of the distribution system is unknown. On the one hand, grid modernization and system hardening investments could improve reliability. If the frequency and duration of outages decreases, the value of backup power supply from any resource – including storage - may decrease. On the other hand, future reliability might be threatened by weather- or climate-related disruptions. If the frequency and duration of outages increases, the value of backup power supply may increase. As existing storage

[30] Division Testimony in Electric ISR Docket No. 22-53-EL (page 71 of 80); RI Energy Response to DPUC Data Requests 1-1 and 1-11 (Bates pages 5, 52).

[31] SAIDI is a measurement of how long, in minutes, the average customer is without power during a year.

[32] The Narragansett Electric Company's Proposed FY 2024 Electric Infrastructure, Safety, and Reliability (ISR) Plan. RIPUC Docket No. 22-53-EL. Staff notes that the Company excludes major event days from its SAIDI metrics. Major event days are defined as any day on which the daily system SAIDI exceeds a Major Event Day threshold value (6.67 minutes for CY 2021).

[33] Table 11.1 Reliability Metrics of US Distribution System. US EIA: https://www.eia.gov/electricity/annual/html/epa_11_01.html. Staff nots that the national average SAIDI metrics exclude major event days.

technologies improve and costs decrease – or if the cost of alternative backup fuels increases - storage may become a more cost-competitive backup power resource.

Finally, the value of uninterrupted power service is customer-specific. A customer who uses an electric medical device at home may value power reliability differently than their neighbor. That being said, the value of uninterrupted power service often moves in the same direction for groups of customers. For example, as more residential customers worked from home in recent years, home energy reliability may have become more important for the collective residential customer group than in the past. Regardless of individual customer preferences and values, it is difficult to imagine a scenario in which reliable power supply is valued less in the future than today.

2.3 Summary of Scenario Analysis

The scenario analysis presented above illustrates the storage value stack under different power system conditions, given the primary functions a storage resource could perform to serve the unique conditions of each scenario. Taken together, the scenarios illustrate the range of opportunities for using storage resources to create value and can provide a gauge for how storage resources might operate throughout the day, season, or year. The magnitude of the storage value stack under each scenario is related to the real-world frequency and duration of the power system conditions presented by the scenario.

Storage resources could potentially create value under all of these scenarios as they occur on the real-world system. Actual conditions on the power system change throughout time. For storage resources to be able to perform valuable functions across time and across changing system conditions, one of two things must be true: the ability of the storage resource to perform valuable functions under the next (i.e. upcoming) set of system conditions must not have been fully exhausted by the activities it previously performed (e.g., if a line fault occurs during peak demand, the storage resource must not have fully discharged if it wants to have some stored energy available to serve backup power supply), or there must be enough of a predictable time gap between system conditions for the storage resource to transition from serving the previous set of system needs to serving the next set of system needs (e.g., if a storage resource discharges all of its stored energy for purposes of serving peak demand, it must have enough time to recharge before providing backup power should outage conditions arise).[34]

Regarding grid outage conditions, it may be challenging for a storage resource to perform the primary (or even secondary) functions associated with Scenarios 1 through 4 and simultaneously preserve its ability to serve as backup power supply during a grid outage. To serve as backup power supply, storage must be fully charged going into the outage. Charging up and holding on to that energy may be inconsistent with the functions required to deliver the full value of the resource outside of outage conditions.

Qualitatively, the PUC finds that across the range of power system conditions represented by the five scenarios, storage can create potentially significant value. However, even if one assumes that a storage resource can maximize its total value by carefully designing its real-time performance around current and future system conditions, this value may not exceed the cost of storage. Additionally, alternative resources

[34] Regarding the importance of transition time between system conditions, energy storage is often likened to a Swiss army knife because of its ability to perform different functions from a single device. Borrowing from the Swiss army knife comparison, having multiple different tools available in a single gadget is only useful if the need for each individual tool is separated by enough time to fold away one tool and unfurl the next. If, for example, someone needed the screwdriver in one instant and immediately needed the scissors in the next, there might not be enough time to fold up the screwdriver and pull out the scissors. If there wasn't enough time to do so, that person might be better off having a discrete screwdriver tool and a discrete pair of scissors, as opposed to a Swiss army knife that contained both.

exist that can serve the needs of the power system under the specific conditions discussed above. Currently, the cost of these alternatives is often lower than the cost of storage.

In the future, as storage costs fall, energy storage resources will increasing be able to provide value at least-cost under certain time- and location-based constraints. The PUC also expects the magnitude of the storage value stack under each scenario may grow in the future in response to changing system conditions driven by changes in customer demand and investment in clean, intermittent generation. The outlook presented for each scenario confirmed that future conditions on the power system will likely increase the need for the functions that energy storage resources (and alternative resources) can perform, thereby increasing the value that storage will be able to deliver.

Chapter 3. Qualitative Analysis of Existing Energy Storage Procurement

In its storage Resolution, the Senate directed the PUC to analyze whether new programs or tariffs are necessary for storage resources. To answer that question, staff identified two guiding questions:

What are the necessary elements of any good procurement strategy?

How is value procured from energy storage resources in Rhode Island today?

To answer these questions, staff and stakeholders reviewed the basic elements of procurement and analyzed existing storage procurement mechanisms in Rhode Island. The results of staff and stakeholders' discussion of procurement supported the PUC's analysis presented below.

3.1 Procurement Guide

Drawing from the PUC's expertise in market design and procurement, staff developed a procurement guide to simplify discussions about energy storage procurement with stakeholders. The procurement guide can apply to any product in any market. It is designed to be a useful tool for reviewing existing storage procurement mechanisms or designing future ones.

The procurement guide presented to stakeholders contains five basic elements:

1. **Identify the need and define the product:** Procurement begins with identifying a specific need and translating that need into a specific product that can be purchased. Often, the identified need and defined product are the same. For example, if one needs additional power, there is only one product that can serve it: more power. Other times, the need and product are different. For example, if one needs additional reliability, there is not a single reliability product to buy. In this case, the consumer needs to further define what "reliability" means to them. Clearly identifying and defining need is a critical first step for any procurement. The scenario analysis of power system needs presented in Chapter 2.1 was motivated by this step.
2. **Defining eligible supply:** Defining eligible supply entails articulating one's supply preferences and translating them into eligibility criteria. Prospective suppliers will be screened against that criteria before being able to participate in the market.
3. **Building the demand curve:** The demand curve for a given product or value reflects the quantities of product that demand (e.g. a consumer) is willing to buy at a given price. Typically, a demand curve is a downward-sloping graphical curve, indicating consumers' willingness to buy more of a product as its price decreases. Demand curves can also be vertical (indicating that demand will pay anything to get a specific quantity of product or value), horizontal (indicating that demand will buy potentially infinite quantity of product or value at a fixed price), and anything in between.
4. **Executing procurement:** Executing procurement consists of allowing suppliers to make offers, determining which offers should be accepted based on the demand curve, and transacting the procurement. Procurement can be executed through many different design mechanisms (e.g. auctions, request for proposals, retail and wholesale electric tariffs, program enrollments, etc.). Determining the best mechanism to procure a given product or value will depend on the nature of the product or value, the characteristics of suppliers, and the characteristics of demand.
5. **Validating the transaction:** Validation applies the rights and obligations of both supply and demand over the term of the transaction to ensure performance. If the transaction is instantaneous, validation can be very limited. For longer-term performance periods, such as those that might apply

to resources within the electricity market, continuous validation of performance can be critical to ensuring consumers actually receive the products they paid for.

3.2 Existing storage procurement mechanisms in Rhode Island

Staff and stakeholders used the procurement guide to review existing procurement mechanisms in Rhode Island: Rhode Island Energy's ConnectedSolutions program; Rhode Island Energy's System Reliability Procurement program; the Renewable Energy Fund (REF) storage grant program; and wholesale electricity market participation. The first three represent existing programs, and the fourth is enabled by existing ISO-NE tariffs. In roundtable discussions, staff and stakeholders evaluated how the five elements of the procurement guide manifest in each of the storage procurement mechanisms. Staff also conducted one-on-one conversations with stakeholders to confirm and expand on what was learned in the roundtable discussions.

Based on the input from stakeholders, the PUC presents its review of each of the storage procurement mechanisms below, with the intent to explore the adequacy (or inadequacy) of these programs for enabling net beneficial procurement of energy storage resources. Related to this review, Chapter 4.1 of this Report addresses the question posed by the Resolution of whether new programs or tariffs are needed to reduce the cost of the electric system.

Rhode Island Energy's ConnectedSolutions program

Need and product: On-peak demand reduction
Eligible Supply: Demand response, energy storage
Demand Curve: Annual program size and incentive level
Procurement: Open enrollment at fixed incentive price
Validation: Equipment controls, direct and indirect metering
Limitations: Only procures one product, short term price signal, action-based incentive

The goal of the ConnectedSolutions program is to reduce retail customers' demand for electricity during the peak hour(s) of demand on the regional power generating system. As illustrated in Chapter 1.1, discharging energy storage during peak demand (Scenario #3) can avoid significant power system costs, as well as other costs. The avoided costs from reducing bulk system peak demand will be shared among all customers of Rhode Island Energy and potentially the region. In return for lowering their demand during the peak, participating customers receive an incentive payment in addition to sharing in the avoided costs.

All Rhode Island Energy electric customers are eligible to participate in ConnectedSolutions. Eligible technology differs between Commercial and Residential customers. Both groups can participate with battery energy storage. Residential customers are specifically incentivized to participate using batteries. Outside of a demand response call, the battery charges and stores that energy for a future call.

Rhode Island Energy forecasts the timing of peak demand on the bulk power system and calls a series of demand response events with the intent that one will coincide with actual bulk system peak demand for that year.[35] During a demand response call, participating customers receive a signal from the utility to reduce demand. For customers participating with a battery, the call will signal the battery to discharge its stored energy. If the participant reduces demand in response to that signal, they are eligible to earn incentive

[35] While peak demand products on the bulk generation system are measured in hourly and sub-hourly units, the demand response events called through the ConnectedSolutions program typically last 3-4 hours.

payments.[36] Given the current summer-peaking nature of the bulk system, all demand response calls occur in the summer.

The utility sets the size of the program (in MW) and the incentive rates on an annual basis and allows for open enrollment. In determining the program size and incentives, the utility balances the benefits of demand reduction against the costs of incentives and program administration. At the end of the summer, participating customers are paid for each kW that they reduced when called upon to do so. Notably, the payment of the incentive is not based on whether the ConnectedSolutions fleet actually offsets peak demand. If RIE forecasts peak incorrectly, participating customers are still paid for their participation. In 2022, the incentive rates offered by the utility were $400 per kW for residential battery participants and $300 per kW for commercial and industrial participants. The total cost of incentives paid to program participants in 2022 was $5.87 million.[37]

In 2022, the ConnectedSolutions program reduced peak demand by 51 MW. [38] That demand reduction was delivered by 6,432 participants, 256 of whom were residential customers participating with batteries.

System Reliability Procurement – Non-wires alternatives

Need and product: Demand reduction to relieve a distribution system (delivery) constraint
Eligible Supply: Demand response, energy storage, distributed generation, energy efficiency
Demand Curve: Sized to meet a specific need and must cost less than the utility-owned alternative
Procurement: Requests for Proposals (typically)
Validation: Equipment controls, direct and indirect metering
Limitations: Only contracts for the specific relief needed, RFP participation barrier, timeline requirements, sporadic opportunities

The Least Cost Procurement (LCP) statute requires electric distribution companies[39] to procure distribution system reliability in a cost-effective, least-cost manner. [40] The utility SRP Plan, approved by the PUC, includes screening criteria and procurement processes for identifying needs on the distribution system that can be met at least-cost with non-utility investments. These needs typically arise when the utility's demand forecast for a specific distribution asset exceeds the capacity of that asset, thereby requiring a capacity upgrade to reliably serve demand. In SRP, the product that is needed is reduction in or reversal of load growth at the specific distribution system location. As illustrated in Chapter 1.1 (Scenario #3), avoiding or delaying distribution capacity constraints can save power delivery costs and other related costs.

Neither the LCP statute nor the Commission's LCP standards limit the range of technologies that can compete to serve SRP needs. The utility can and does evaluate energy storage resources as potential SRP

[36] Demand response performance involves a customer foregoing the consumption of power from the electric grid at a specific time (either by reducing total consumption or by consuming power from a source other than the electric grid, such as a behind-the-meter battery). Because the utility cannot meter consumption that was never consumed in the first place, demand response performance is not directly measured. Instead, the utility imputes a customer's demand response performance by comparing their actual consumption of grid power to a historic baseline.

[37] 2022 Annual Energy Efficiency Plan Q4, RIPUC Docket No. 5189

[38] The Narragansett Electric Company's 2022 Performance-Based Incentive Mechanism Year-End Report, page 2. RIPUC Docket No. 4770

[39] Rhode Island General Laws § 39-1-2 defines electric distribution company as "a company engaging in the distribution of electricity or owning, operating, or controlling distribution facilities and shall be a public utility pursuant to subsection (20) of this section."

[40] Rhode Island General Laws § 39-1-27.7

solutions. Targeted energy efficiency, demand response, and distributed generation have also been eligible SRP solutions in past projects.

Through its distribution system planning process, the utility forecasts demand on its distribution system, identifies where existing distribution infrastructure is insufficient to serve that demand, and plans and completes system upgrades to serve growth. If the distribution system need that would otherwise be served by traditional system upgrades meets the SRP screening criteria, the utility will issue a Request for Proposals (RFP) for third-party solutions to avoid the upgrade.[41] To be selected, an alternative proposal is expected to be lower cost than the traditional utility investment.

If selected, an SRP proposal may be compensated up to the deferral value (or avoided cost) of the traditional utility investment. This compensation would be incremental to other compensation the proposal earns through other revenue streams (e.g., a distributed generation resource would still be eligible for net metering credits in addition to SRP compensation).

There have been multiple RFPs for projects in the past, including at least one RFP in which the sole eligible technology was battery storage. In 2017, the Narragansett Electric Company issued an RFP for the Little Compton Battery Storage Project. The Company selected a winning bidder and moved toward implementation, but construction delays and equipment unavailability ultimately resulted in project cancellation.[42]

If an energy storage resource were to be selected for an SRP project and achieve commercial operation, its performance might be validated in a stricter manner than storage projects in ConnectedSolutions. That is because non-performing ConnectedSolutions projects are responding to timing only. There are likely other resources throughout the system available at the time of non-performance, so the consequence of that non-performance is tempered. On the other hand, delivery constraints addressed by SRP solutions have both timing *and location* requirements. An SRP project may be the only resource available in the needed location that is able to respond at the needed times. As a result, the consequence of its non-performance may be more significant (e.g. reliability degradation).

During the procurement workshop, stakeholders addressed barriers facing storage participation in SRP. Stakeholders highlighted the cost differential between batteries and traditional distribution solutions as a primary barrier to storage proposals being selected through SRP. A stakeholder from the utility explained that they have received various battery storage proposals through SRP, but the costs of the proposals were five to ten times higher than the cost of the next best utility-owned solution. Stakeholders also acknowledged that the needs of the distribution system can change faster than the utility's pace of procurement through SRP and faster than bidders' ability to redesign proposals in response to changing conditions. In the instance of the Little Compton Battery Storage Project, the selected project faced financial and construction challenges that could not be overcome on the timescale needed to meet the SRP project requirements. In other words, it may be that SRP RFPs are too sporadic in their timing and requirements to represent a clear signal of market opportunity to energy storage developers. This may limit the ability or interest of the storage market to respond to SRP RFPs, thereby limiting the role that storage resources can play in serving distribution system needs.

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[41] SRP RFPs are published on Rhode Island Energy's Non-Wires Alternatives homepage: https://www.nationalgridus.com/Business-Partners/Non-Wires-Alternatives/

[42] The Narragansett Electric Company d/b/a National Grid 2019 System Reliability Procurement Plan Report, Docket 4889, at 30. https://ripuc.ri.gov/eventsactions/docket/4889-2019-NGrid-SRPReport(10-15-18).pdf.

Rhode Island Renewable Energy Fund's energy storage incentives

Need and product: Participants, peak power demand reduction
Eligible Supply: Residential battery storage paired with new renewable generation
Demand Curve: Incentives and programs size vary periodically
Procurement: Open enrollment
Validation: None/Unknown
Limitations: Must be paired with new solar, lacks validation, lacks product definition

The Rhode Island Commerce Corporation (Commerce) administers the Renewable Energy Fund (REF). The REF offers various grants and incentives to support the customer development of renewable energy resources. Through the REF, Commerce offers an energy storage incentive.[43] The storage incentives are funded by $1.5 million in Regional Greenhouse Gas Initiative (RGGI) auction proceeds.[44] Eligibility for the storage incentives extends to all electric customers in Rhode Island regardless of their utility. To be eligible for the incentive, customers must pair their energy storage facility with a new renewable energy generation facility (e.g. solar PV).[45] The incentives are available to small scale storage facilities and commercial scale storage facilities. The incentive for small scale storage facilities is $2,000 per project. The incentive for commercial scale storage facilities is $0.50/Watt[46], capped at $40,000 per project. The incentives are disbursed on a first-come-first-served basis.

While the REF obligates incentive recipients who are customers of Rhode Island Energy to participate in the ConnectedSolutions program, thereby indicating some intent to reduce peak power demand, incentive recipients can opt-out of the program at any time without consequence. If they do, their REF storage incentive amounts to an incentive to build, not a payment in return for delivering value or benefit.

In 2022, the REF awarded $266,000 in storage incentives to 88 small scale storage facilities and 4 commercial scale storage facilities.[47] According to a representative from the Office of Energy Resources, more than 20% of all battery storage projects in Rhode Island have received the REF storage incentives.

Wholesale electric market participation

Need and product: Various (energy, capacity, ancillary services)
Eligible Supply: All resources
Demand Curve: for the energy market, defined by customer demand; for the capacity market, set administratively
Procurement: supply and demand bids (energy), reverse auction (capacity)
Validation: Metering, data communication and analysis
Limitations: Does not procure local system products, does not procure wholesale products that lack existing market definition, market volatility, market entry barriers

[43] RI REF Energy Storage Incentive Program: https://commerceri.com/wp-content/uploads/2020/09/REF-Storage-Adder-RFP-FINAL-.pdf

[44] OER allocated $1.5 million to the REF through its 2019-B RGGI Proceeds Allocation Plan.

[45] Energy storage systems that are added on to an existing renewable energy generation facility are ineligible to receive the REF energy storage adder.

[46] The commercial scale incentive is equal to $.50/Watt based on the battery's maximum continuous power rating over three hours.

[47] RI REF Annual Financial Performance Report for the Calendar Year Ending 12/31/2022. https://commerceri.com/wp-content/uploads/2023/03/REF_Financial-and-Performance-Report-CY22-FINAL_signed.pdf

ISO-NE administers multiple wholesale markets including the spot energy market, Forward Capacity Market (FCM), and ancillary services market. Participation in the wholesale markets is open to energy storage resources. Market participation involves offering a product that is needed, meeting the eligibility requirements and rules of the market, and transacting the product to earn revenue. Storage participation in wholesale markets is relatively new but growing. As of May 2022, battery resources comprised 20% of all generating capacity in ISO-NE's Interconnection Queue.[48] Those resources may be sited anywhere in the region, including Rhode Island.

Wholesale market participation differs from the retail utility programs described above. Wholesale electricity markets require all resources to compete on price, whereas the retail utility programs described above do not necessarily facilitate competition among supply. For example, rather than procure on-peak power generation via an open enrollment with a static price (as in ConnectedSolutions), ISO-NE administers annual auctions in which thousands of different resources compete to supply generating capacity at the lowest price. Resources that offer their capacity for less than the market clearing price will secure a place in the market, thus ensuring least-cost market outcomes. In contrast, the incentives offered through ConnectedSolutions are not set competitively, and participating storage resources do not have to outcompete others on their cost of capacity to secure a spot in the program.

ISO's wholesale markets are designed to drive down costs through competition. This benefits electricity customers, who will pay less for their bulk power system needs. However, competition should reduce wholesale revenues for market participants, as competition can improve efficiency. If a participating resource's costs are higher than their market revenues, market participation may be financially infeasible.

One stakeholder representing a battery storage developer presented the following illustrative example: their batteries are capable of earning monthly revenues of $8/kW from the energy, capacity, and ancillary services markets. The monthly cost to run their 4-hour, 100-MW battery can be as low as $15/kW and as high as $27/kW. That leaves a monthly revenue gap of $7/kW to $19/kW. To remain operational, that missing money must come from some other source. The stakeholder acknowledged that their batteries are able to sell all of the wholesale products they are capable of producing, and that the barriers to wholesale market participation are cost-based, not rules- or eligibility-based.

3.3 Summary of Existing Storage Procurement Mechanisms

In summary, energy storage resources are already being developed in Rhode Island through the state's existing storage programs and tariffs. These procurement mechanisms vary in terms of their procurement design and the range of values they procure from participating storage resources. While existing programs and tariffs have been instrumental in the early deployment of energy storage resources in Rhode Island, staff and stakeholders identified several limitations within existing procurement mechanisms that limit their usefulness and leave potentially significant value on the table. The next chapter will analyze storage procurement policy in greater detail and offer recommendations on whether new programs or tariffs are necessary.

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[48] https://www.iso-ne.com/about/what-we-do/in-depth/batteries-as-energy-storage-in-new-england

Chapter 4. Procurement Policy Analysis

The Senate Resolution requested the PUC to report on whether new tariffs or programs are needed to achieve energy storage deployment goals. The Resolution identified three such goals: 1) reducing the costs of the electric generation, transmission, and distribution systems; 2) facilitating the transition to a safe and reliable carbon-free electricity supply; and 3) reducing peak demand on and improving the efficiency of the electric distribution system. Recognizing the overlap between the first and third storage deployment goals, staff reorganized the Resolution inquiry into two questions to investigate with stakeholders:

> *Are new tariffs or programs needed for energy storage resources to reduce the cost of the electric power system?*
>
> *Are new tariffs or programs needed for energy storage resources to facilitate the transition to carbon-free electricity?*

Below, Chapter 4.1 addresses whether new storage programs or tariffs are needed to reduce the cost of the electric system. Chapter 4.2 addresses whether new storage programs or tariffs are needed to facilitate the transition to carbon-free electricity.

4.1 Tariffs to Reduce the Cost of the Electric Power System

In Chapter 4.1, we examine the whether the existing storage procurement mechanisms presented in Chapter 3 are sufficiently designed and administered to procure the net benefits identified in Chapter 2.[49]

4.1.1 Analysis of Existing Procurement Mechanisms

Need and product

The procurement mechanisms presented in Chapter 3.2 represent the programs and tariffs that exist today to procure benefits from storage resources under some of the scenarios from Chapter 2.2. When examining the products they procure, it became apparent that existing programs along with utility and wholesale tariffs do procure many of the power system benefits included in the Framework. Notably, these existing programs and tariffs represent individual procurements, not a unified procurement mechanism. While they each procure some value(s) from storage, none of them procures all of the valuable benefits that storage can provide through a single, cohesive procurement design. Developers can attempt participation in multiple of these compensation programs or tariffs. In some unique circumstances, they might have trouble (or even be prohibited from) participating in the various existing programs and tariffs at the same time.

For example, if a resource participates in ConnectedSolutions, there is no compensation for energy market revenue or local distribution system benefits outside of the demand response calls issued by Rhode Island Energy. The resource would have to separately register and participate in the wholesale energy market to earn energy market revenue outside of those demand response calls. The same resource would also have to sign a contract for a site-specific SRP project to receive revenue for local distribution system benefits

[49] Chapter 2 concludes that energy storage resources can save electric system costs given the functions they are capable of performing and current and future conditions on the electric power system. In the future, one could build on the work of Chapter 2 to examine whether those potential cost savings are net savings. In other words, are the costs of owning and operating energy storage systems less than the benefits they create and lower than the cost of storage alternatives?

created outside of Rhode Island Energy's demand response calls, if such an opportunity even exists where the resource is located.

To summarize, Rhode Island's existing storage procurement mechanisms do procure some useful power system values from energy storage resources, as do wholesale market tariffs. However, the siloed nature of these programs may be leaving significant value on the table. For this reason, existing procurement mechanisms may not procure the maximum useful value from energy storage resources today or in the future. Thus, new solutions are likely needed to overcome the limitations of existing storage procurement mechanisms.

Eligible Supply

Taken as a whole, the existing procurement mechanisms do allow for energy storage participation. ConnectedSolutions and the REF storage incentive program define eligibility more narrowly than SRP or wholesale market tariffs. Whereas SRP and wholesale market tariffs are technology-agnostic, ConnectedSolutions (specifically, the residential battery carve-out) and the REF storage incentive are specifically targeted at energy storage resources. As a result, storage resources have a procurement advantage in ConnectedSolutions and the REF program compared to other resources. In contrast, SRP and wholesale market tariffs may define supply eligibility more broadly, thereby forcing storage to compete against alternative resources.

Demand Curve

In SRP and the wholesale markets, demand for the respective products is well-founded and well-defined. For example, the market clearly understands that the amount of capacity being procured through the ISO-NE Forward Capacity Market is based on total regional demand for power during the annual peak hour. However, the volumes and prices of demand for the products being procured through SRP and the wholesale markets can be volatile. For example, the Tiverton/Little Compton SRP project showed that the need for a multi-MW battery resource might materialize one year, disappear the next, and then reappear the year after that. It is difficult for suppliers – including energy storage developers—to gain traction when the market is subject to volatile forecasts, however real and appropriate they may be.

On the other hand, in the ConnectedSolutions and REF incentive programs, demand for the respective products may not always be well understood by the market and the way in which the programs set their respective demand curves may lack sophistication. This injects more risk into the market. In their current state, the simplified way in which the ConnectedSolutions and REF incentive programs determine their demand curves creates a risk that customers are paying too high a price for too much product or, conversely, that customers are buying too little because prices are inappropriately low. Simultaneously, the simplified way in which the ConnectedSolutions and REF incentive programs determine their demand curves creates a risk that suppliers offer too much or too little supply.

Staff heard from some stakeholders that the price signals sent by existing programs lack clarity and reliability. One stakeholder explained that because the ConnectedSolutions price signal (i.e. incentive level) can change from one program year to the next, it may not be reliable enough to entice large storage resources to patriciate in the program. Regarding the amount of demand in a year, the stakeholder representing Rhode Island Energy explained that the utility sets the program size annually by considering the prior year's program size (MW) and budget, and then adjusting the next program year based on the utility's estimates of supplier availability at the chosen incentive level. These factors are not always transparent to storage developers and may render them unable or unwilling to rely on the size of the ConnectedSolutions market. Like an unreliable price, an unreliable market size may lead to suboptimal supplier participation.

Procurement Execution

SRP and the wholesale market tariffs are advanced procurement mechanisms that require participating resources to have a high level of market sophistication, which can be cost-prohibitive for some resources. For example, taking on the responsibility of a market participant in the wholesale markets requires the participant be able to respond to volatile changes in market conditions as well as administrative changes in the tariff. This responsibility derives from the sophistication of the market. The sophistication of the market is a benefit to customers and established resources. However, if market participation requirements pose a barrier to entry for new and emerging resources that might otherwise be least-cost, then a market inefficiency exists. This could result in suboptimal outcomes. In contrast, the open enrollment participation model of ConnectedSolutions and the REF incentive program are likely easier processes for storage developers to participate in.

Validation

On the electric system, the gold standard for validation is billing-quality metering. Direct and indirect device metering are also reliable validation methods. While energy storage resources can be directly metered, some existing procurement mechanisms require them to compete against other resources (e.g. demand response) that are not subject to direct metering and must be indirectly metered. For this reason, when energy storage directly competes with other resources, the method of validation may create inequities between storage and its competitors. Whether that validation inequity creates a significant advantage or disadvantage for storage is dependent on the specific program or tariff and may be difficult to identify. Regardless, the validation process should not reduce the fairness and neutrality of the market.

4.1.2 Improving procurement with new tariffs

Throughout the stakeholder process, representatives of storage developers expressed a desire that energy storage resources be allocated costs and benefits according to their unique use of and provision of benefits to the electric power system. Costs and benefits are typically allocated through retail rate design. While costs and benefits can technically be allocated through programs, programs will necessarily sit atop retail service tariffs. For example, standalone energy storage resources must charge from the electric system. As a customer of the electric system, standalone storage resources will be allocated costs and benefits through their retail service tariff. If the state wanted to develop a program for standalone storage resources, whatever costs and benefits were allocated through the program would be incremental to the costs and benefits allocated by the underlying retail service tariff.

Without a separate retail service tariff for standalone storage resources, they will be grouped with the next closest rate class and take service under the retail service tariff that corresponds to such rate class. It is likely that a standalone storage resource in Rhode Island will be assigned to the large commercial or industrial rate class; in that case, they will pay the same rates to charge as any other customer in that rate class. All rate classes are allocated costs through rates based on the typical characteristics of the average customer in that class. In the large commercial and industrial classes, the average customer is a consumption-only load customer (e.g. manufacturing facility) whose usage of the electric power system represents a one-way flow of power from the system to the customer.

However, unlike traditional load customers who only consume power from the grid, standalone storage resources consume power from the grid *and* deliver power to it. This difference in power system usage reflects the fact that storage resources have a fundamentally different relationship to the power system than traditional load customers. Traditional load customers consume energy for the purpose of creating new value in some other market (e.g., frozen lemonade, plastics, etc.). In contrast, storage resources consume energy for the purpose of increasing the value of that energy within the same electric market. For this reason, the power system usage characteristics of storage resources (and the resulting costs and benefits) can be significantly different from the usage characteristics (and the resulting costs and benefits) of traditional load customers. Assigning the same costs to standalone storage resources as consumption-only load customers and making them pay the same rates may be inaccurate and may pose a hinderance to the deployment of net beneficial storage resources.

Given this, the state's ability to procure useful power system values from energy storage resources could be improved by the development and implementation of a new retail service tariff specifically for energy storage resources. Developing such a tariff would clarify the size of the market for the products and values storage resources can deliver, formalize their basic rights and responsibilities, and establish a fair method for allocating them the costs and benefits of their unique usage of the power system. In total, this can reduce the risk of developing energy storage resources in Rhode Island.

Designing such a tariff is a necessary prerequisite for new storage programs. Designing and implementing such a tariff before layering on incremental programs (and any associated incremental incentives) will yield better outcomes than implementing new programs and attempting to layer on a new retail service tariff at a later date. For example, consider a scenario wherein the retail service tariff for storage resources perfectly allocates costs and benefits between other customers and energy storage customers, but the revenue a storage resource can expect to earn under the service tariff is not enough to secure project financing and spur storage investment. This would suggest that the benefits of storage do not exceed its costs. In this case, if the State wishes to spur more storage development than a service tariff alone would, the State could create an out-of-market program to subsidize energy storage resources and provide the missing revenue. Under this example, the State would be able to carefully identify what need(s) it is trying to meet from storage and choose the appropriate out-of-market revenue source(s) to fund the subsidy program.

In Chapter 5.1 of this Report, the Commission proposes the basic elements of a retail service tariff for energy storage resources and outlines a process through which it could develop and adopt such a tariff.

4.1.3 Improving procurement outcomes with an interconnection tariff

Before energy storage resources can start delivering value to the power system, they must first interconnect to it. Currently, storage resources seeking to interconnect to the electric distribution system in Rhode Island must do so under Rhode Island Energy's standards for connecting distributed generation, a PUC-approved interconnection tariff. Based on discussions with stakeholders, Rhode Island Energy's interconnection tariff does not sufficiently recognize the potential flexibility and dispatchability of energy storage resources.

Under the existing interconnection tariff, the utility studies the interconnecting resource's impact to the system under the most extreme operations – that is, the operational configuration that will result in the most significant impact to the distribution system. This "stress-test" interconnection study process may be appropriate for inflexible loads or non-dispatchable generators. However, energy storage resources are flexible and thus capable of ramping up or down in response to a signal. A more flexible interconnection tariff could allow energy storage resources to interconnect to the system with dynamic operating allowances, which could potentially reduce their interconnection timeline and costs and improve their ability to deliver value to the power system.

In Chapter 5.2 of this Report, the Commission outlines a process through which it could develop a flexible interconnection tariff for storage resources.

4.2 Facilitating the transition to safe and reliable carbon-free electricity supply

The Resolution identifies the State's need to meet the Act on Climate and the related transition to carbon-free electricity as a motivation for the Resolution. Subsequently, the Resolution specifically requests the PUC report on whether new tariffs or programs for storage are necessary to facilitate the transition to a safe and reliable carbon-free electricity supply.

The PUC has interpreted the request as a question of whether and how electric energy storage can help the state meet the Renewable Energy Standard (RES) and/or meet the carbon emissions reduction mandates of the Act on Climate. The remainder of Section 4.2 describes the requirements of each statute, explains why each statute needs to be read with consistency, and analyzes the effect that energy storage could have on compliance today and in the future. Based on that analysis, the PUC finds that energy storage is not likely needed to meet the RES or the Act on Climate before 2032 but may be needed after that if laws or regulations change.

4.2.1 Compliance with The Renewable Energy Standard

The RES (R.I. Gen. Laws § 39-26) requires the State's retail electricity providers (referred to as Obligated Entities)to supply a defined proportion of their annual retail electricity sales from Eligible Renewable Energy Resources.[50] Legislative and regulatory actions have altered the annual RES requirement since its original passage in 2004. Most recently, the RES statute was amended in 2022 to speed up the annual percentage increases beginning in Compliance Year 2023, which now culminate in a 100% RES in Compliance Year 2033 and each year thereafter.[51]

The PUC is the state agency that regulates and administers the RES. Per the statute and the PUC's RES regulations, Obligated Entities can comply with the RES through two methods. First, Obligated Entities can meet the RES by purchasing and retiring eligible New England Power Pool Generation Information System (NEPOOL GIS) Certificates. One NEPOOL GIS Certificate is created for each megawatt-hour (MWh) of electrical energy generated within, or imported into, the ISO New England (ISO-NE) control area, which includes Rhode Island. A single NEPOOL GIS Certificate for one MWh of eligible renewable energy generation is also commonly referred to as a Renewable Energy Certificate (REC).[52] Rhode Island meets its RES when Obligated Entities retire sufficient eligible RECs for compliance.

Alternatively, Obligated Entities can also comply with the RES by paying Alternative Compliance Payments (ACP) to the Rhode Island Commerce Corporation (Commerce) in lieu of retiring eligible RECs.[53] For example, if at the end of the Compliance Year, an Obligated Entity is required to have served 100 MWh of renewable energy, the Obligated Entity can retire 100 eligible RECs or make a payment to

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[50] The RES specifically exempts the Pascoag Utility District and Block Island Utility District from compliance obligation.

[51] R.I. Gen. Laws § 39-26-4(a); P.L. 2022, ch. 218, § 1, effective June 27 http://webserver.rilin.state.ri.us/PublicLaws/law22/law22218.htm.

[52] As explained on its website, NEPOOL GIS "issues and tracks certificates for each megawatt-hour (MWh) of generation produced in the ISO New England control area, including imports from adjacent control areas, and all load served." The terms "GIS Certificate" and "Renewable Energy Certificate," or "REC," are often used interchangeably in the marketplace. While REC is the more general term used to denote a generator's descriptive characteristics (i.e. fuel type, vintage and geographic location), it is the settlement of GIS Certificates within the Obligated Entity's NEPOOL GIS account that substantiates RES compliance.

[53] The PUC notes that while Obligated Entities can technically comply with the RES by paying ACPs, the state will not meet the goals of the RES if Obligated Entities only ever pay ACPs as opposed to purchasing and retiring RECs.

Commerce of 100 times the applicable ACP rate. The ACP rate is calculated annually by the PUC. For 2023, the ACP rate stands at $80.59. In contrast, the average cost of a REC is typically $40.[54]

The RES statute delineates which generation technologies meet the definition of "renewable" for the purpose of the RES. The statute also requires the PUC to formally certify each renewable generation unit before its output can be used by an Obligated Entity to comply with the RES. In this regard, every wind and solar PV facility (among other generation technologies) in New England and New York are likely capable of generating RECs that could be used to meet the RES. However, only those facilities that have formally registered with the PUC can actually generate Rhode Island-eligible RECs. NEPOOL GIS tracks which facilities have established eligibility in Rhode Island and marks those RECs as Rhode Island-eligible.

4.2.2 Compliance with The Act on Climate

The Act on Climate (R.I. Gen. Laws § 42-6.2) establishes mandatory and economy-wide greenhouse gas (GHG) emissions reductions of 45% and 80% below 1990 emissions by 2030 and 2040, respectively, and net-zero emissions by 2050. Whereas the RES places the burden of compliance on private entities, the Act on Climate places the mandate to reduce emissions on the State and the obligation to implement coordinated actions on state agencies. Further, while the RES explicitly defines compliance, the Act on Climate leaves it to the Executive Climate Change Coordinating Council (EC4) to annually report on "its findings, recommendations, and progress on achieving the purposes and requirements of [the Act on Climate]." [55]

It is not controversial to assume that achieving even the first mandate of the Act (a 45% reduction by 2030) will require nearly all—if not all—electricity use to be 100% clean by 2030. The EC4 establishes how to account for and report on electric sector emissions. Currently the Rhode Island Department of Environmental Management (DEM) executes the emissions inventory for the state.

In order to calculate annual electric sector emissions, DEM uses a REC-based accounting system that is consistent with the RES.[56] DEM determines the emissions caused by Rhode Islanders' electricity consumption by looking at how much electricity was consumed and what specific NEPOOL GIS Certificates are associated with that consumption. DEM then sums the GHG emissions associated with these specific NEPOOL GIS Certificates to calculate electric sector emissions.

Under this methodology, if every MWh of electricity consumed in Rhode Island in 2033 was associated with RECs from non-emitting resources like solar PV and wind generators, Rhode Island's electric sector emissions would be zero. Alternatively, if no RECs or clean-energy NEPOOL GIS certificates are legally associated with Rhode Island's energy consumption in 2033, the emissions would be equivalent to the New England System Residual Mix, which is the generic average pool of NEPOOL GIS Certificates not associated with specific energy use. New England System Residual Mix is expected to have high GHG emissions for the foreseeable future given the makeup of the regional power generation fleet.

[54] The PUC notes that while the use of ACPs is considered "compliance" with the RES, it is not considered "meeting" the RES, as these payments represent a lack of renewable energy used to serve retail usage. In turn, while an ACP can be used to comply with the RES, an ACP would not represent incremental compliance with the Act on Climate.

[55] R.I. Gen. Laws § 42-6.2-7.

[56] Rhode Island Department of Environmental Management 2019 Rhode Island Greenhouse Gas Emissions Inventory, at 12. https://dem.ri.gov/sites/g/files/xkgbur861/files/2022-12/ridem-ghg-inventory-2019.pdf.

4.2.3 The Usefulness of Consistent Statutory Compliance

Consistency between the requirements of the RES and the Act on Climate is necessary to ensure that the incremental money Rhode Islanders pay for the right to claim the renewable attributes associated with RECs—which includes the right to claim low-to-no GHG emissions—also counts toward the emissions reduction requirements of the Act on Climate. Without that consistency, Rhode Island electric customers might pay to be 100% renewable per the RES and pay again to be 100% emissions-free per the Act on Climate.

Unified accounting between the RES and Act on Climate is also consistent with a little-known but essential section of the RES known as the Energy Source Disclosure Requirements. The Energy Source Disclosure Requirements define how emissions from electricity consumption shall be determined and reported. This section of the RES requires Obligated Entities to disclose to their customers "what sources of energy were used to generate electricity for each electrical energy product…" and "… the emissions created as a result of generating the electricity."[57] The disclosure is required to "take into consideration and account for voluntary purchases of generation attributes or related products."[58] Finally, the section directs the PUC to "allow for or require the use of NE-GIS certificates for the calculation of the energy source disclosure."[59] For consistency with the requirements of the RES,[60] the PUC's Rules Governing Energy Source Disclosure state "NE-GIS certificates shall be used for the calculation of the Energy source disclosure."[61]

Together, the tracking, trading, retirement, and eligibility status of RECs and other NEPOOL-GIS Certificates creates a simple, transparent method to assure compliance with the RES, Act on Climate, and the Energy Source Disclosure Requirement of the RES. This system helps prevent double-counting of renewable and clean generation toward our goals and assures that Rhode Islanders do not pay twice to be 100% renewable and 100% emission-free. Additionally, this accounting methodology enables Rhode Island to protect its rights associated with claiming the emissions attributes of the RECs that have been purchased and retired for Rhode Island RES compliance, in the event that another entity attempts to claim those attributes.

4.2.4 Restating the Resolution's Problem Statement

Because electric sector compliance with the RES and Act on Climate can be primarily achieved through the procurement and retirement of RECs and other emissions-free NEPOOL GIS Certificates, the question of whether new tariffs or programs for storage are necessary to facilitate the transition to a safe and reliable carbon-free electricity supply can be restated as:

> *Are new tariffs and programs for storage necessary to facilitate an attainable supply of eligible RECs and clean NEPOOL GIS certificates to match Rhode Island's annual consumption of electric energy?*

In Chapter 2.2, the PUC illustrated specific times and locations under which energy storage resources can increase the supply of RECs and decrease the emissions of the System Residual Mix (presented in Scenario 2). The usefulness of energy storage under those system conditions depends on whether there is a sufficient, lower-cost supply of Rhode Island-eligible RECs to meet the mandates.

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57 R.I. Gen. Laws § 39-26-9(b).

58 R.I. Gen. Laws § 39-26-9(d).

59 R.I. Gen. Laws § 39-26-9(c).

60 Promulgation of the PUC's Rules Governing Energy Source Disclosure predate enactment of the Act on Climate.

61 PUC 810-RICR-40-05-3

Based on publicly available information, the following sections examine whether there will likely be sufficient supply of Rhode Island-eligible RECs under current and future conditions. Sections 4.2.5 through 4.2.7 present expectations for the balance of REC supply and demand over the next ten years forecastable period. The need for energy storage to lower the cost of the REC market will be based on that balance. Section 4.2.8 then examines what changes to markets and laws could affect those assumptions, thereby affecting the need for energy storage.

4.2.5 Forecasting Demand for RECs to meet the RES and Act on Climate

The RES statute requires the PUC to report annually on compliance with the RES. The PUC's most recent Annual Report on the RES includes an examination of current and future demand for RECs based on the ISO New England (ISO-NE) forecast of energy use in Rhode Island.[62]

Table 3 below shows historical and forecasted obligated energy sales and the associated number of RECs that would be necessary to meet the RES.[63]

Table 3. Forecast of RES Compliance Year Obligations for New and Existing Resources

Compliance Year	Actual or *Forecasted* RES-Obligated Retail Sales [a] (MWhs)	Minimum MWhs from New Renewable Energy Resources [b, c]	MWhs from *either* New *or* Existing Renewable Energy Resources [b, c] (2.0%)
2021 (Actual)	7,663,780	1,187,900	153,290
2022	*7,764,000*	*1,320,000*	*155,000*
2023	*7,799,000*	*1,638,000*	*156,000*
2024	*7,869,000*	*2,046,000*	*157,000*
2025	*7,900,000*	*2,528,000*	*158,000*
2026	*7,954,000*	*3,102,000*	*159,000*
2027	*8,028,000*	*3,693,000*	*161,000*
2028	*8,172,000*	*4,372,000*	*163,000*
2029	*8,301,000*	*5,105,000*	*166,000*
2030	*8,477,000*	*5,934,000*	*170,000*
2031[d]	*8,676,000*	*6,854,000*	*174,000*

[a] Based on 2022 ISO-NE CELT forecast and assumes 2.86% of load is exempted from RES obligation in future years.

[b] The historical actual RES obligations include effects of rounding protocols for individual Obligated Entities.

[c] The annual targets are listed in Table A5 of Appendix 5.

[d] The 2022 ISO-NE CELT forecast ends in 2031.

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62 RIPUC Annual RES Report for Compliance Year 2021: https://rhodeislandres.com/wp-content/uploads/2023/05/2021-RES-Annual-Compliance-Report-1.pdf

63 Table 3 is taken from the Annual Report, which distinguishes between "New" and "Existing" Renewable Energy Resources. Rhode Island General Laws § 39-26-2(15) defines both terms. The PUC notes that "New" does not mean a resource recently added, nor does "Existing" mean all resources that were in existence prior to a Compliance Year. Rather, "New" is defined as renewable generation resources in service after December 31, 1997. "Existing" is defined as renewable generation resources in service before December 31, 1997.

The forecast presented in Table 3 shows that by 2031, approximately 6,854,000 RECs from New Resources will need to be retired to meet the RES. To decarbonize electric consumption by 2030 using only Rhode Island-eligible RECs, the state will require approximately 8,477,000 RECs from New Resources.

4.2.6 Conservative Forecasted Supply of RECs from New Resources

The Annual RES Report also includes an examination of the current REC supply based on NEPOOL GIS Certificate statistics and PUC data on the capacity of eligible facilities. In 2021, NEPOOL GIS's public report for certificate statistics indicates that 6,843,587 certificates were generated from facilities that were eligible as a "RI New Renewable Energy Resource."[64] This large quantity of Rhode Island-eligible RECs is not surprising (or unintentional) given the size of the renewable generation fleet that Rhode Island ratepayers have invested in and that the PUC has certified as RES-eligible. In 2021, the Rhode Island-eligible renewable generation fleet comprised nearly 850 MW of solar PV, more than 2800 MW of onshore and offshore wind, and more than 380 MW of other facilities like bio-generators and small-scale hydroelectric facilities. While not all of these RECs are truly available to be used for compliance with Rhode Island RES (for example, they may be under contract to settle in other states), the facility owners' registration of their generation units with the PUC indicates some willingness to sell these RECs to Rhode Island entities that have RES obligations.

In 2021, the total potential supply of Rhode Island-eligible RECs was 6,843,587. The actual RES obligation was only 1,187,900 MWh. Furthermore, in 2031, the RES obligation is only forecast to be 6,854,000. In this regard, the in-place fleet of renewable generators operating 2021 is very nearly technically capable of supplying enough renewable energy to meet the forecasted RES requirements through at least Compliance Year 2031.

It is important to note that the fleet of eligible New Resources presented in Table 3 does not include the 400 MW Revolution Wind I power purchase agreement between Revolution Wind, LLC and the Narragansett Electric Company. The terms of the power purchase agreement require the facility to register with the PUC for RES eligibility.[65] Annual energy generation from the 400 MW of Revolution Wind I capacity is forecast to be 1,631,795 MWh. Thus, on an annual basis, the facility is expected to supply 1,631,795 additional RECs to meet Rhode Island's RES and Act on Climate needs.[66] The terms of the power purchase agreement specify that Rev Wind I must be commercially operational no later than January 15, 2028.[67]

Adding the 1,631,795 RECs expected from Revolution Wind I to the 2021 supply of RECs from eligible New Resources, the total Rhode Island-eligible REC supply forecast for 2028 is 8,475,382. Only an additional 1,618 MWh of eligible renewable energy would need to be generated to meet a 100% RES obligation in that year (i.e., 2028, two years earlier than required) and in time to have 100% renewable electricity to support achieving the 2030 mandate of the Act on Climate. A single 1 MW solar PV facility could fill this annual gap.

Assuming the Revolution Wind I output begins operation before 2030, there exists today an eligible generating fleet capable of producing a sufficient annual supply of RECs to meet the demand driven by the RES and Act on Climate. Beyond the existing eligible fleet, there are many more renewable generating

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[64] *See* NEPOOL GIS Public Report, GIS Certificate Statistics, accessible at https://www1.nepoolgis.com/myModule/rpt/ssrs.asp?rn=104&r=%2FPROD%2FNEPOOLGIS%2FPublic%2FNEPOOL_CertificateStatistics&apxReportTitle=GIS%20Certificate%20Statistics.

[65] Schedule NG-1, Offshore Wind Generation Unit Power Purchase Agreement Between The Narragansett Electric Company d/b/a National Grid as Buy and DWW REV I, LLC as Seller December 6, 2018 at 5. https://ripuc.ri.gov/eventsactions/docket/4929-NGrid-PPA-NG-1.pdf.

[66] *Id*. at 69.

[67] *Id*. at 18.

facilities that exist today that have not taken the simple, low-cost step to register with the PUC as eligible resources. If they were to register with the PUC, their output would create even more Rhode Island-eligible REC supply. Furthermore, the PUC expects many new eligible facilities will begin operating between now and 2030, in response to the state's robust renewable energy programs. This will further increase the supply of eligible RECs and will likely result in a total supply of Rhode Island-eligible RECs that far exceeds the requirements of the RES and Act on Climate.

Whether or not this supply of RECs remains or becomes economically viable for use to meet the RES and Act on Climate will depend on various factors, including the value of Rhode Island's ACP compared to other states' ACPs, actual energy use in the region, the continued operation of Rhode Island's eligible renewable generation fleet, and the ability and willingness of eligible resources that generate RECs to sell their RECs for use in Rhode Island. Notably, Rhode Island has highest ACP rate for general New/Class I RECs in the region (excluding resource-specific carveouts). Given the current ACP rate, Rhode Island's RES sets the highest value for New/Class I RECs in the region and will likely continue to do so through the foreseeable future. For this reason, even if a regional shortage of RECs occurs, there is fair likelihood that suppliers of RECs will sell their RECs to Rhode Island obligated entities, who are willing to pay more for them than obligated entities in any other state. As a result, it is likely that obligated entities in Rhode Island will be able to purchase sufficient RECs to meet their RES obligations even if regional REC supply becomes tighter.

4.2.7 Storage is not Likely Needed to Meet the RES or Act on Climate Before 2032

At present, neither Rhode Island's existing eligible renewable fleet nor the expected commercial operation of Revolution Wind 1 requires energy storage to deliver the quantity of renewable energy and RECs described above. Based on this, the PUC forecasts that new storage resources will not be needed to meet the requirements of the RES and Act on Climate between now and 2032.

While this conclusion may be new to some readers, it should not be new to energy stakeholders who have contributed to energy policy development in Rhode Island in recent years. For example, the 'Road to 100% Renewable Energy Electricity by 2030 in Rhode Island Report' (often referred to as the 100% Renewable Report) prepared for the Rhode Island Office of Energy Resources by The Brattle Group in December 2020 reached a similar conclusion regarding the timing of the need for energy storage for purposes of meeting the RES:

> *"Beyond 2030, the regional power system will also continue to evolve towards greater penetration of renewable energy resources, driven by other states' policies and the declining costs of renewable energy resources. The increased reliance on renewable energy resources will increase the importance of short-term balancing issues, where a supply mix that contains a higher share of intermittent resources must still be matched with demand minute-by-minute. Longer-term, seasonal energy balancing issues are likely to become more important and the structure of wholesale electricity markets and products … Most of these challenges are unlikely to be major issues by 2030, though they will be emerging by then and will become increasingly important beyond 2030."* [emphasis added][68]

4.2.8 Storage may be Needed Beyond 2030 or if Law and Regulations Change

Although the PUC did not conduct its own market or engineering analysis, the PUC agrees with Brattle's general assessment that, as the penetration of intermittent resources increases in New England, energy storage may become necessary to balance the generation output of these facilities with customer demand for electricity. Without the ability to balance load and generation in the future as renewable penetration

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[68] *Id*. at 16.

increases, incremental renewable nameplate capacity will generate fewer and fewer incremental RECs to meet the RES and Act on Climate.

This issue represents a possible physical constraint that storage could mitigate or resolve. When this physical constraint will actually arise depends on many factors, including load growth, the effectiveness of demand response and demand management programs, the growth of solar PV and offshore wind, and the addition of regional and interregional transmission facilities.

Finally, the PUC seeks to clarify that if the nature of RES or Act on Climate compliance is changed by amendment to either or both laws, storage might become needed in the nearer term to meet such mandates. For example, if either the RES or Act on Climate required seasonal or hourly matching of electricity generation and consumption, there may be hours or seasons wherein the supply of RECs becomes constrained relative to demand, given the generation profiles and intermittency of wind and solar PV generating facilities. Alternatively, if the RES or Act on Climate required RECs to be sourced exclusively from generation within the borders of Rhode Island, such a strict location-based compliance requirement could increase the need for storage locally.

4.2.9 The need for Tariffs and Programs to Facilitate Meeting the RES and Act on Climate

The PUC's forecast shows that there will likely be sufficient REC supply to meet the RES and Act on Climate until at least 2032. Rhode Island also has a fair likelihood to procure these RECs because its ACP rate is the highest in New England.

The stability and viability of the REC compliance pathway is the direct result of Rhode Island's nation-leading clean energy and climate policy. Not every state has such a stable, viable compliance pathway for its climate and clean energy policies. Having spent years developing and implementing the foundational programs that yield this stable, viable compliance pathway for the next decade, Rhode Island can now focus its efforts on carefully evaluating how best to pace the deployment of more complex new resources like storage and how to balance those resources against other alternatives like new transmission and distribution facilities, demand response, and incremental renewable generation.

Thus, while storage is not likely needed in the near term to meet the RES and Act on Climate, it may not be long before storage is needed to cost-effectively meet the RES and Act on Climate. For this reason, the PUC believes it is advisable to consider reasonable tariffs and limited programs today that provide the State and the storage market with the necessary experience to prepare for significant growth in electricity demand and compliance obligations after 2030.

Chapter 5. Outline for PUC Tariff Framework Proceeding

The final element of the Resolution "requests the PUC to adopt a framework for electric rate tariffs to apply to energy storage systems interconnecting and providing retail service to their distribution system and targets for installed storage capacity by 2032." The PUC agrees that these are worthy objectives but concedes that the effort required to produce a high-quality tariff framework and procurement targets are beyond what could be completed with the resources available for this Report.

Fortunately, as discussed above in Section 4.2, the progressive and successful clean and renewable energy policies enacted in Rhode Island and New England over the previous two decades have created a brief but reliable cushion of time during which there is sufficient supply of renewable energy to meet the State's renewable energy and GHG emissions mandates. During that brief but reliable cushion of time, more advanced resources like energy storage are unlikely to be needed to meet the state's goals. To prepare for a future scenario wherein available renewable energy supply may be insufficient to meet the Rhode Island's renewable energy and GHG emissions mandates, the PUC believes that prudent, measured progress on energy storage should be the near-term goal.

Separately from the need to meet the RES and Act on Climate, energy storage resources have the potential to deliver significant value to the power system. Some of those power system values are procured today through existing markets or programs. However, the design of existing procurement mechanisms may not enable procurement of maximum useful value from storage resources.

As described in Section 4.1, the Commission believes a retail service tariff for standalone storage resources and an accompanying flexible interconnection tariff could overcome the limitations of existing storage procurement mechanisms in Rhode Island. Consistent with this analysis, the remainder of this Chapter presents how the PUC would develop and implement these storage tariffs and perform the other procurement-related functions raised by the Resolution once the necessary resources become available to it.

5.1 Developing a Retail service tariff framework for standalone energy storage resources

In a typical regulatory proceeding, Rhode Island Energy, as the incumbent electric utility, proposes new tariffs by filing them with the PUC for review and approval, supported by evidence and testimony, and subject to cross-examination and rebuttal by other parties. The process can be a difficult way to explore and advance useful but complicated ideas like a storage service tariff. In a typical regulatory proceeding, the utility is not required to seek input from the Commission nor stakeholders on the design of a proposal before filing it with the PUC. Given the novel nature of a service tariff for standalone storage resources[69], the PUC does not believe that a typical regulatory proceeding would be the most efficient or inclusive process for developing an energy storage service tariff. Instead, a better method would be for the PUC to lead a process to:

[69] The objective of the service tariff is to more fairly allocate costs and benefits to storage resources than currently occurs through existing rate design. The PUC believes it is appropriate to focus the service tariff on standalone storage resources rather than behind-the-meter load-coupled storage resources. Future time of use (TOU) rates will present behind-the-meter load-coupled storage resources will an enhanced opportunity to liquidate their products. However, because standalone storage resources are not coupled with any load, they will not be able to take advantage of TOU rates in the same way behind-the-meter load-coupled storage resources will be able to. For that reason, the PUC recommends focusing the retail service tariff on standalone storage resources.

1. create a framework for a standalone storage retail service tariff, developed with stakeholder input; then
2. adopt the service tariff framework; then
3. review a model tariff suitable for Rhode Island Energy's service territory with stakeholder input; then
4. adopt the model tariff; then
5. through an appropriate regulatory action, require Rhode Island Energy file a completed tariff at an opportune time that is consistent with the model tariff or show cause why the model tariff should not be filed.

A service tariff has three basic elements: a definition of the eligible customer class; rate structures and the derivation of rates; and additional terms and conditions for service. To be consistent with the PUC's Guidance Document adopted in Docket 4600A, an energy storage service tariff should recognize the unique characteristics of energy storage resources and the costs and benefits caused by their unique usage of (and provision to) the electric system. [70]

The service tariff framework development would build upon the work of Chapters 2 and 3 of this Report to identify net beneficial products and values from standalone energy storage resources, the specific charging and discharging activities through which those products and values are delivered, and the time- and location-based constraints under which values from standalone storage resources are actually exchanged. The Commission would develop the service tariff framework through an informal stakeholder process that welcomes stakeholder participation and input.

The development of a service tariff framework would serve to inform the later development of a model tariff. The model tariff would be filed with the PUC by a party (the utility or a third party) in a formal docketed proceeding. If there was sufficient time between the filing of the model service tariff and the utility's next distribution rate case, the PUC would review the model tariff through its formal review procedures. should there be enough time between now and the next rate case.[71]

Whereas the service tariff framework will identify net beneficial products or values from standalone storage resources, the necessary charging or discharging activities required to deliver them, and the costs and benefits of such activity, the model tariff will formalize how those costs and benefits will be allocated to storage customers taking service under the service tariff, as well as the terms of such service. At a minimum, the model tariff should address each the following elements:

- Eligibility: which customers should be eligible to take service under the future tariff?
- Allowable activity: what charging and discharging activity should be allowed for customers taking service under the future tariff?
- Metering: what should be the metering requirements for customers taking service under the future tariff?
- Cost and benefit allocation: how should storage customers taking service under the future tariff be charged for the cost of their charging and discharging activity? What should customers taking service under the future tariff be paid for the benefit of their charging and discharging activity?

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[70] Rhode Island Energy's service tariffs applicable to electric customers, see here: https://www.rienergy.com/media/pdfs/billing-payments/tariffs/ri/a16_ripuc_2224.pdf, which makes incorporates other tariff provisions by reference that can be found here: https://www.rienergy.com/ri-home/rates/tariff-provisions.

[71] Alternatively, if a model tariff is deemed not subject to the PUC's jurisdiction, it may alternatively serve as the basis for a regulatory filing of a Wholesale Distribution Access Tariff with the Federal Energy Regulatory Commission. It may also be possible that a Whole Distribution Access Tariff and service tariff are appropriate to enable storage resources with different wholesale market participation models.

- Rate design: how should storage customers taking service under the future tariff pay for their costs and be compensated for their benefits? (e.g. demand charge vs. energy charge, fixed charge, etc.)

Before adopting the model tariff, the PUC would need to find that the model tariff is consistent with all requirements of state and federal law, including the requirement that rates be just and reasonable, and consistent PUC policies, including those adopted in RIPUC Docket 4600A.

Upon adopting a model tariff, the PUC may then require Rhode Island Energy to either file an actual service tariff that includes actual rate schedules informed by a cost-of-service study or other industry-standard analysis sufficient for setting rates or to file an explanation why no tariff should be filed.

Developing the service tariff framework and adopting a model tariff requires more time and resources than were available to the PUC as part of its energy storage stakeholder proceeding. The Commission is committed to carrying out this work once additional resources become available.

5.2 Developing an Interconnection tariff framework for energy storage resources

Chapter 4.1.3 explained that Rhode Island Energy's interconnection tariff does not recognize the potential flexibility and dispatchability of energy storage resources. At a staff-led roundtable discussion on storage business models, stakeholders discussed the business model and value proposition differences between having an interconnection that is based on nameplate capacity versus operational capacity. With an interconnection that is based on a nameplate capacity, storage resources can expect to charge from and discharge to the distribution system without restrictions. With an interconnection that is based on operational capacity, storage resources trade-off operational flexibility and the revenue potential associated with that operational flexibility for shorter interconnection timelines and lower interconnection costs.

Based on the roundtable discussion, it is unclear whether providing for interconnection based on operational capacity would be useful in the near future given likely business models for storage resources. However, clarity on the interconnection rights and obligations of storage could lower barriers for storage resources looking to site in Rhode Island.

Given this, the PUC could initiate a stakeholder proceeding to develop a framework for an energy storage interconnection tariff once resources become available at the PUC. At the conclusion of the proceeding, if it was determined that the interconnection tariff framework was useful, the PUC would provide next steps for developing and approving a storage interconnection tariff.

5.3 Periodic storage market assessment and procurement

In the normal course of its business, pursuant to prudent regulation and multiple provisions of the law, the PUC reviews the status of various markets for procurement opportunities that would benefit ratepayers. This includes, but is not limited to, energy supply, energy efficiency, distributed generation, utility scale energy projects, and demand response resources including energy storage systems.

To enable opportunities for electric utilities to procure net beneficial storage capacity, the PUC could formally conduct a periodic assessment of local and regional markets for energy storage. The PUC could conduct this periodic storage market assessment itself if resources were provided to it. Otherwise, Rhode Island Energy could conduct the periodic storage market assessment and file the results of the assessment as part of its three-year review of system reliability and three-year least-cost procurement plan, as reviewed by the PUC pursuant to R.I. Gen. Laws § 39-1-27.7.

The periodic market assessment could evaluate existing and forecasted time and locational constraints on the electric distribution and bulk power systems that have the potential to increase costs. When reviewing bulk power system values, the PUC could specifically assess market opportunities for long-duration and short-duration energy storage resources and identify any differences in value between the two. The periodic storage market assessment could serve as the basis for an evidentiary record upon which the PUC could adopt or amend prudent procurement targets for energy storage.

Final Note

This final document was prepared by the PUC with review and input from stakeholders. After publishing a Draft Report on July 10, 2023, the PUC initiated a month-long public comment period during which stakeholders and members of the public could submit written comments on the Draft. The PUC received ten sets of written comments from individual stakeholders and multi-stakeholder collaboratives.[72] Staff thoroughly reviewed the stakeholder comments and identified two overarching themes: technical comments and policy comments. The technical comments addressed discrete technical assertions or statements contained the Draft Report and were limited in scope. In contrast, the policy comments consisted of statements of stakeholder policy positions and assertions of policy preferences. Staff notes that most of the written comments addressed policy preferences, while very few of the comments were technical in nature.

In response to the technical comments it received, staff reviewed the content of the Draft Report and incorporated limited technical clarifications into the body of the Final Report. Separately, staff convened a final stakeholder workshop on September 12, 2023, to engage stakeholders on their written policy comments and to identify whether there were any sections of the Draft Report wherein stakeholders did not agree with the PUC's policy analysis or recommendations. In the PUC's opinion, the workshop discussion revealed that the technical analysis presented in the Draft Report was consistent with stakeholders' understanding of the current and future value potential of energy storage, and that the policy analysis presented in the Draft Report was consistent with stakeholders' interpretations of existing or future policy requirements. However, there were multiple instances in which stakeholders expressed that language in the Draft Report was ambiguous, which posed a risk that a reader might interpret the language to suggest an outlook for energy storage value that was more negative than intended. The PUC has attempted to eliminate such ambiguity in response to those comments in the Final Report.

The PUC appreciates stakeholders' written comments on the Draft Report as well as their ongoing participation and input over the course of the Docket No. 5000 proceeding. In part, through that input, the PUC believes the Final Report offers a fair and balanced response to the questions raised by the Rhode Island Senate in Resolution 416.

The PUC transmits this Final Report to the Rhode Island Senate on October 18, 2023. The Final Report and all supporting documents, presentations, and docket materials will be published and archived on the PUC's webpage at https://ripuc.ri.gov/eventsactions/docket/5000page.html

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[72] The following stakeholders submitted written comments on the Draft Report: BlueWave Energy, Clean Energy Group, CPower, Green Development, Handy Law, joint comments of Advanced Energy United and NECEC, RENEW Northeast, Rhode Island Energy, the Rhode Island Office of Energy Resources, and the Rhode Island Attorney General. Copies of the public comments are attached to this Report in Appendix B.

Appendix A: Stakeholder Workshop Participants

		Stakeholder Workshop Date				
Stakeholder Name	**Stakeholder Organization**	**12-Dec-22**	**10-Jan-23**	**26-Jan-23**	**21-Feb-23**	**12-Sept-23**
Shauna Beland	Office of Energy Resources	x	x			
Stephanie Briggs	Rhode Island Energy	x				
Sean Burke	BlueWave	x			x	x
Kat Burnham	Advanced Energy United					x
Kathy Castro	Rhode Island Energy	x				
Ryan Constable	Rhode Island Energy	x	x	x	x	x
Al Contente	Division of Public Utilities and Carriers	x	x			x
Brett Feldman	Rhode Island Energy	x		x		
Carrie Gill	Rhode Island Energy			x	x	x
Kate Grant	Rhode Island Energy	x	x	x	x	x
Seth Handy	Handy Law	x	x	x		x
Maggie Hogan	Division of Public Utilities and Carriers	x	x		x	x
Craig Johnson	Optimal Energy	x			x	
Kaitlin Kelly O'Neill	ECA Solar	x	x	x	x	
Sevag Khatchadourian	Oak Square Partners	x				
Oliwia Krupinska	NECEC					x
Emma Marshall-Torres	Convergent Energy and Power	x	x	x		x
Rob Mastria	Flatiron Energy	x				
William Owen	Office of Energy Resources					x
Tony Paradiso	E3	x	x	x	x	
Jamie Rhodes	Rhodes Consulting	x	x	x	x	x
Erica Russell-Salk	Rhode Island Energy	x				x
Doug Sabetti	Newport Solar					x
Tom Saunders	BW Solar	x				
Katie Sause	Mass American	x	x			
Matt Sullivan	Green Development	x	x	x	x	
Hannah Morini	Green Development					x
Natalie Treat	NECEC	x				
John Typadis	Oak Square Partners	x				
Matt Ursillo	Green Development	x				
Nick Vaz	Office of the Attorney General	x	x	x	x	x
Hank Webster	Acadia Center	x	x			
Stephen Wollenburg	Sustainable Energy Advantage	x	x		x	x

x = Stakeholder Workshop attendance

Appendix B: Stakeholder Comments on Draft Report

BLUEWAVE

VIA ELECTRONIC FILING

August 4, 2023

Emma Rodvien, Senior Economic and Policy Analyst
Rhode Island Public Utilities Commission
89 Jefferson Boulevard
Warwick, RI 02888

re: Examination of the Value of and Need for Energy Storage Resources in Rhode Island – Report to the Rhode Island Senate in Response to Resolution 416

Dear Ms. Rodvien,

BlueWave appreciates the opportunity to provide comment to the Rhode Island Public Utilities Commission ("Commission") in response to the July 10th draft report on the Examination of the Value of and Need for Energy Storage Resources in Rhode Island ("Draft Report"). BlueWave further appreciates the Commission's efforts to conduct a stakeholder process culminating in the Draft Report. The Draft Report's findings are clear: storage can provide significant value to the state of Rhode Island and its ratepayers, and the barriers to deployment (e.g., lack of appropriate rate design) should be removed to enable storage to deliver this value.

BlueWave's vision is to protect our planet by transforming access to renewable energy. As a pioneering clean energy developer, BlueWave has developed and built more than 150 MW of solar projects to date. As built, these projects collectively generate enough solar energy to avoid more than 144,000 metric tons of carbon emissions annually. BlueWave is also actively developing energy storage projects to ensure our grid is reliable and efficient in a clean energy future. BlueWave is proud to be a certified B Corp, scoring in the top 5% of companies assessed towards certification in Governance, and named Best for the World for Governance.

The Draft Report makes clear that storage can deliver significant potential value to the distribution system in the near term and will further be critical to the maintenance of a cost-effective, decarbonized electric grid beyond 2030. Below, BlueWave provides comment on the Draft Report.

Chapter 2 – RI Benefit Cost Framework Evaluation of Energy Storage Resources

BlueWave agrees with the finding that "storage can create potentially significant value."[1] BlueWave is concerned, however, with the subsequent statement that the value may not exceed the cost. There is no data underlying this assumption, and it is a premature conclusion to reach before the benefits have even been quantitatively evaluated. As such, we encourage the Commission to move forward with its ultimate recommendation to design an import and export tariff that recognizes the value that energy storage provides to today's ratepayers, future ratepayers, the state's clean energy and climate goals, long term system reliability, economic development, and more.

The Commission's scenario analysis investigates, at a high level, the different benefits that storage can provide during different states of charge and during charge or discharge. These benefits, if internalized

[1] Draft Report, at 21.

and properly incentivized, will lead to a cleaner and more efficient distribution system. A full quantitative exploration of these benefits is warranted.

Chapter 3 – Qualitative Analysis of Existing Energy Storage Procurement

BlueWave acknowledges that there are several existing programs intended to drive storage deployment, though we agree with the Commission's finding that these programs could be structured more efficiently to drive meaningful deployment. Specifically, for front-of-the-meter ("FTM") energy storage, the only option available is wholesale market participation. Wholesale market participation does provide significant benefits to Rhode Island ratepayers, however it is difficult to develop an energy storage project on wholesale market participation alone. This is due to many factors, including: difficulty receiving financing for wholly merchant revenue, relatively low capacity market revenue, externalized environmental and emissions benefits, and externalized distribution system benefits. Thus, BlueWave strongly supports the finding that the existing procurement paradigm leaves significant value on the table.

Chapter 4 – Procurement Policy Analysis

While the Commission may not view storage as necessary to meeting the 100% Renewable Energy Standard by 2033, storage may still be necessary to meeting and maintaining that commitment reliably. As New England states decarbonize, it is well-recognized that energy storage (in varying durations) will be needed to maintain reliability.[2]

BlueWave believes that the near-term development of a FTM storage-specific tariff is a prudent step for the Commission to take. Our experience with storage tariff development in Massachusetts and Connecticut is that these processes are exceedingly long, due in part to the complexity and flexibility of energy storage. The processes in Massachusetts and Connecticut have each been ongoing for over two years since initial steps were taken. Thus, we encourage Rhode Island to begin this process now. Preparing for the decarbonized future by taking the initial step of designing a storage-specific tariff will set the state up well for a changing grid. Then, should policymakers decide to incent storage deployment beyond the tariff, policymakers would have a good sense of the necessary incentive, leading to the most efficient outcome.

Lastly, BlueWave strongly supports incorporation of flexible interconnection into the interconnection tariff. Energy storage presents an opportunity to reevaluate interconnection for distributed energy resources. Leveraging technological advancement and innovation both on the developer and on the utility side of interconnection can lead to a smoother process and we encourage consideration of flexible interconnection.

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[2] For instance, see Brattle Group. (2019). *Achieving 80% GHG Reduction in New England by 2050*, at page 15. Available at: https://www.brattle.com/wp-content/uploads/2021/05/17233_achieving_80_percent_ghg_reduction_in_new_england_by_20150_september_2019.pdf.

Chapter 5 – Outline for PUC Tariff Framework Proceeding

BlueWave appreciates the thoughtfulness of the proposal for how to develop a retail service tariff framework. We agree with the conclusion that storage tariffs are novel and should not follow the same process as a normal tariff proceeding. This process being led by the Commission, as opposed to the utility, is more likely to drive meaningful stakeholder engagement and deliver a tariff that works for all parties involved. Again, we encourage this process to begin as soon as possible as the five steps outlined in the Draft Report will likely take substantial time and effort.

Other Comments

The Draft Report appears focused on storage connected to the distribution system. We acknowledge this is likely due to the fact that the transmission system is beyond the Commission's jurisdiction, however we note that transmission-connected storage can also deliver significant benefits to the state of Rhode Island, its ratepayers, and its climate policy.[3,4] Leveraging economies of scale, transmission-scale storage can help cost-effectively develop the grid of the future.

Conclusion

BlueWave appreciates the opportunity to submit comments on the Draft Report. We are encouraged that the Commission finds potential significant value in energy storage deployment and we look forward to engaging in the contemplated processes to properly value storage deployment. We similarly look forward to continuing engagement with the Legislature on removing additional barriers to distribution- and transmission-scale storage deployment in the state. Please contact me with any questions.

Sincerely,

/s/ Sean Burke
Sean Burke
Policy Manager
sburke@bluewave.energy

[3] For instance, see: New York State Energy Research and Development Authority. (2022). *New York's 6 GW Energy Storage Roadmap: Policy Options for Continued Growth in Energy Storage*. Available at: https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Programs/Energy-Storage/ny-6-gw-energy-storage-roadmap.pdf.

[4] See also: State of Maine Governor's Energy Office. (2022). *Maine Energy Storage Market Assessment*. Available at: https://www.maine.gov/energy/sites/maine.gov.energy/files/inline-files/GEO_State%20of%20Maine%20Energy%20Storage%20Market%20Assessment_March%202022.pdf.

To: Rhode Island Public Utility Commission
From: Todd Olinsky-Paul, senior project director, Clean Energy Group (CEG)
Re: CEG comments on "Examination of the Value of and Need for energy Storage Resources in Rhode Island" report
Date: August 4, 2023

Clean Energy Group (CEG) appreciates this opportunity to comment on the Public Utility Commission's draft report, "Examination of the Value of and Need for energy Storage Resources in Rhode Island," produced in response to Senate Resolution 416.

Clean Energy Group, a national nonprofit organization, works at the forefront of clean energy innovation to enable a just energy transition to address the urgency of the climate crisis. CEG fills a critical resource gap by advancing new energy initiatives and serving as a trusted source of technical expertise and independent analysis in support of communities, nonprofit advocates, and government leaders working on the frontlines of climate change and the clean energy transition. CEG collaborates with partners across the private, public, and nonprofit sectors to accelerate the equitable deployment of clean energy technologies and the development of inclusive clean energy programs, policies, and finance tools.

Regarding the "Examination of the Value of and Need for energy Storage Resources in Rhode Island" report, CEG agrees with the comments of the Rhode Island Office of Energy Resources, as expressed in their letter of August 4, 2023.

CEG also agrees with some of the Commission's conclusions, in particular:

1. The need for a new energy storage retail service tariff
2. The need for a new energy storage interconnection tariff

Regarding energy storage interconnection, CEG recently published a report identifying several interconnection barriers that have frustrated energy storage market development across the nation. That report, "The Interconnection Bottleneck: Why Most Energy Storage Projects Never Get Built," is available online.[1] We hope it may be useful if the Commission moves forward to develop a new energy storage interconnection tariff.

In addition to the above, CEG would like to submit the following comments regarding the Commission's draft report.

1. **Building markets for new technologies takes time – so don't wait until the last minute!**
   The Commission notes in its draft report that state RES rules require 100% renewable electricity by 2033, and that Act on Climate rules will likely require 100% renewable electricity by 2030. Yet, the Commission asserts that "energy storage is not likely needed to meet the RES or the Act on Climate before 2032." The Commission concludes, "Thus, while storage is not likely needed in

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[1] The Interconnection Bottleneck report is available at https://www.cleanegroup.org/publication/the-interconnection-bottleneck-why-most-energy-storage-projects-never-get-built/

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(802) 223-2554 • Todd@cleanegroup.org • www.cleanegroup.org

the near term to meet the RES and Act on Climate, it may not be long before storage is needed to cost-effectively meet the RES and Act on Climate. For this reason, the PUC believes it is advisable to consider reasonable tariffs and limited programs today that provide the State and the storage market with the necessary experience to prepare for significant growth in electricity demand and compliance obligations after 2030."

As previously noted, CEG agrees with the Commission's conclusion regarding the need for new tariffs that take into account the unique operational attributes of energy storage. However, updating tariffs will not in itself build robust energy storage markets in Rhode Island; and waiting until 2032 to begin to build an energy storage market will be far too late to contribute to 100% clean energy requirements that come due in 2030 and 2033.

Experience in other states has shown that building a dynamic, competitive and equitable energy storage market can take years. For example, Massachusetts launched its energy storage initiative in 2015 and published the landmark State of Charge[2] report in 2016. Since then, Massachusetts has implemented numerous new programs including the SMART solar incentive with energy storage adder, the ConnectedSolutions energy storage incentive, the Clean Peak Standard and the Community Clean Energy Resiliency Initiative and Advancing Commonwealth Energy Storage grant programs, with the goal of deploying 1 GW of energy storage in the state by 2025. After eight years of work, energy storage deployment in Massachusetts has grown from approximately 2 MW in 2015 to 200 MW today, and Massachusetts is now ranked among the top five states in the nation for energy storage deployment. However, it is still far short of its energy storage target and is unlikely to achieve 1 GW of installed capacity by 2025.

Recommendation: **Rather than put off thinking about energy storage until 2032, the Commission should act now to begin designing energy storage programs to spur market development. To signal the state's intentions, Rhode Island should also set an energy storage procurement target.**

2. **Meeting state clean energy targets is an important goal, but it should not be the only goal.** The Commission rightly points out that insofar as RES and AoC targets are concerned, there are more than sufficient RECs available, now and in the immediate future, to meet the state's obligations. In other words, Rhode Island does not need to install more renewables and storage right now to meet RES and AoC targets, because it can simply continue to purchase RECs from neighboring states. Because RI has a relatively high ACP rate, it is willing to pay a relatively high price for RECs, and therefore anticipates no immediate shortfall in the REC supply.

   However, the Commission also states that "as the penetration of intermittent resources increases in New England, energy storage may become necessary to balance the generation output of these facilities with customer demand for electricity." This points to the fact that the value of energy storage is not merely in helping to achieve a set quantity of RECs. Energy storage plays numerous essential roles in transitioning to a clean energy economy, including balancing intermittent generation with demand in real time. Other valuable storage applications include

[2] https://www.mass.gov/service-details/energy-storage-study

enabling the retirement of the dirtiest and most expensive fossil fuel generators (such as peaker plants), providing ancillary grid services, and keeping the lights on when the electric grid goes down.

In fact, in Table 1 of its draft report, the Commission identifies 31 beneficial services that can be provided by energy storage, only a few of which may be needed to enable the state to meet its RES and AoC obligations. Some of these services generate monetary value in existing markets, while others do not. As the Commission notes in its draft report, "Rhode Island's existing storage procurement mechanisms do procure some useful power system values from energy storage resources, as do wholesale market tariffs. However, the siloed nature of these programs may be leaving significant value on the table. For this reason, existing procurement mechanisms may not procure the maximum useful value from energy storage resources today or in the future. Thus, new solutions are likely needed to overcome the limitations of existing storage procurement mechanisms."

As the Commission itself recognizes, energy storage offers numerous valuable services – but market failures currently limit the monetization of energy storage benefits, leaving tremendous value on the table. Focusing on identifying opportunities to correct or compensate for these market failures will help to build the storage market in Rhode Island while helping both ratepayers and investors to realize the full value of energy storage investments.

Recommendation: **The Commission should act now to identify potential benefits of energy storage that are being "left on the table" by existing markets, work to update market rules, and create incentive programs to compensate for these market failures.**

3. **Equity is important in energy storage policy**
As we have seen with other clean energy technologies, such as solar PV, corporations and wealthy first adopters will make early investments in new clean energy technologies and reap the rewards. Meanwhile, low-income and underserved communities who need the benefits of these technologies the most will be unable to gain access to them. The arc of energy storage adoption will surely follow this pattern, unless concrete steps are taken to provide equitable access.

Low-income and underserved communities need distributed energy storage for two primary reasons:

    1. Resilience – low-income communities are hardest hit by electric grid outages associated with natural disasters such as floods, fires, winter storms and heat waves. These communities are typically less resilient to begin with and have fewer resources for recovery. When properly configured, BTM solar+storage systems can provide clean, dependable backup power to help homes and businesses ride through grid outages.

    2. Cost savings – low-income communities spend a larger portion of their income on energy, and are hardest hit by rising energy costs. BTM solar+storage can help to reduce energy costs and increase energy independence.

When designing energy storage programs and policy, it is important to include equity provisions that will provide historically underserved communities with access. CEG recommends the following types of equity provisions:

- Carve-outs, such as a Justice40 commitment in distributed battery incentive programs (40% of awards go to projects benefiting underserved communities)
- Incentive adder or multiplier for income-eligible participants and commercial entities serving historically underserved communities
- Front-loaded incentive payments for income-eligible participants
- Low- or no-cost financing
- Pre-development technical assistance to determine technical and economic project feasibility and optimization
- Optional on-bill financing
- Community benefits requirements
- Incentives for owned and leased systems

Discussion of these equity recommendations follows.

Justice40 Commitment/Carve-out

When designing energy storage incentive programs or setting procurement targets, a carve-out is necessary to ensure that historically overburdened communities will have the opportunity to participate. Without a carve-out, there is a risk that distributed storage incentives will be fully subscribed by more advantaged customers before overburdened communities are able to access the program. With regard to the size of a carve-out for overburdened communities, the Commission should consider the Justice40[3] standard as recommended by the federal government and adopted by Connecticut in their Energy Storage Solutions[4] program, which includes not only a 40% carve-out for low-income and historically underserved communities, but also a 2X incentive multiplier for qualifying low-income participants.

Incentive adder or multiplier

A carve-out, while important, will not by itself be sufficient to overcome the additional cost and risk barriers associated with equity projects (for an example, the California Self Generation Incentive Program initially had a carve-out but no adders for low-income communities; there was no uptake until CA instituted equity adders, at which time the LMI budget was fully subscribed almost immediately). Therefore, we recommend that the Commission consider both a separate, reserved capacity block and an additional incentive adder for overburdened communities.

Front-loaded payments

An up-front incentive is important to help offset both higher costs and higher risks of financing for historically overburdened communities, because the initial cost barrier to an energy storage

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[3] https://www.whitehouse.gov/environmentaljustice/justice40

[4] https://portal.ct.gov/pura/electric/office-of-technical-and-regulatory-analysis/clean-energy-programs/energy-storage-solutions-program

project can be difficult or impossible to overcome. While annual or seasonal incentive payments do add up over time, this type of payment structure requires a greater initial investment and the ability to wait a number of years to fully recoup costs. Additionally, financiers may view future payments as riskier, and therefore less bankable, than up-front payments (note also that the net present value of an incentive is greater when offered up-front than when paid out in a series of annual installments). Therefore, CEG recommends that fixed incentives/rebates be provided to equity projects up-front in full, and/or that a separate up-front equity incentive is provided, to reduce the initial cost barrier for these communities.

Financing

Several existing state energy storage incentive programs offer low- or no-cost financing for equity or income-qualifying customers. Examples include the Massachusetts ConnectedSolutions program, which is housed within the state's energy efficiency plan and includes access to interest-free HEAT loans, and the Connecticut Energy Storage Solutions program, which is co-administered by the Connecticut Green Bank, which provides low-cost financing. While it is true that many energy storage developers offer private financing programs to their customers, it can be helpful for the state to provide low- or no-cost loan options that do not require high credit scores to qualify.

Technical assistance

Clean Energy Group has regranted more than $1 million in technical assistance fund grants for hundreds of equity solar+storage projects, with individual technical assistance grants averaging about $8,000. These small grants allow an equity project to obtain pre-development technical-economic analysis, which is necessary to determine A) whether the project makes sense, and B) how to design the system to optimally provide benefits that are important to the customer. Several early energy storage and resilience grant programs launched shortly after Superstorm Sandy in the Northeast did not include provisions for pre-development technical assistance, or provided insufficient technical assistance, and, as a result, some of the grantee projects have not moved forward to construction. For example, a number of the Massachusetts Community Clean Energy Resiliency Initiative grantee projects have still not been completed nearly a decade after grants were announced. CEG therefore recommends that technical assistance funds be included in an energy storage incentive or grant program, especially for equity customers.

On-bill financing

This is an option that can be useful for some equity customers, and it should be considered in combination with other financing options.

Community benefit requirement

When awarding equity incentives or project grants, it is not enough for equity projects to be located in overburdened communities – they must provide real benefits to those communities. We therefore recommend that developers of equity energy storage projects be required to demonstrate how their project will benefit the host community, in order to qualify for equity project incentives. Note that such community benefits need not be monetary in nature, and in fact in some cases they cannot be (because monetary benefits may negatively impact other benefits such as housing credits). Benefits such as increased energy independence, critical facility resilience, increased deployment of distributed solar PV, and the retirement of polluting fossil fuel generators can all be important non-monetary benefits to historically underserved communities.

Incentives for owned and leased systems

In some communities, there is a premium placed on ownership of clean energy resources. Energy independence can be an important benefit; also, owning clean energy resources such as solar PV and battery storage increases property values, whereas leasing such resources does not. Therefore, incentive program design should include provisions (such as low- or no-cost financing) that would help income-eligible customers to purchase and own battery storage.

On the other hand, it can be very helpful to some customers if leasing options are available. Solar leasing played a large role in scaling up solar PV, and we believe that battery leasing is likely playing the same role with distributed energy storage in markets where it is available.

To provide the broadest set of options and make battery storage accessible to the most customers, it makes sense to provide incentives for both owned and leased systems; to provide a range of financing options; and to encourage the participation of developers and aggregators, who will bring their own financing to the market and may play a significant role in enrolling customers.

Recommendation: **The Commission should design programs and policy with equity provisions, to ensure that historically underserved communities that are most in need are able to take part in Rhode Island's clean energy transformation.**

Clean Energy Group respectfully submits these comments and recommendations in the hope that they will be of use to the Commission. We will be happy to discuss further or provide additional resources at the Commission's convenience.

Todd Olinsky-Paul
Clean Energy Group

CPower

August 4, 2023

Rhode Island Public Utilities Commission
89 Jefferson Blvd.
Warwick, RI 02888

Re: Docket No. 5000 – CPower Comments on RI PUC's Storage Report, "Examination of the Value of and Need for Energy Storage Resources in Rhode Island"

Dear PUC Commissioners and Staff,

CPower appreciates the opportunity to provide comments on the Rhode Island Public Utilities Commission's ("PUC's") July 10, 2023 report, "Examination of the Value and Need for Energy Storage Resources in Rhode Island" (the "Storage Report").

CPower is a leading Demand Response ("DR") and Distributed Energy Resource ("DER") Service Provider, with over 6 GW of capacity under management across the nation. CPower participates in all the organized wholesale markets in the United States as well as over 60+ retail programs designed to incent energy storage and load reductions. CPower was actively involved in the development of the recently launched Connecticut Energy Storage Solutions ("CT ESS") program and has qualified over a dozen resources for participation in that program.

Comments

1. **Storage may be needed to transition to a carbon-free electricity supply sooner than anticipated.**

The Storage Report focuses on when storage will be needed to enable the transition to an emissions-free electricity supply consistent with the RES and Act on Climate. Notably, however, the development of clean energy resources is driven by a variety of forces, including state procurements, customer preferences, merchant investor decisions, and other factors. Given this, it is difficult to predict when the supply of clean energy will begin to outstrip demand during parts of the day, and thus equally difficult to guess when storage will be able to provide benefits in terms of shifting zero emissions generation to hours where its benefits can be maximized. As such, CPower recommends that the PUC take a proactive approach to incenting storage, and begin developing a unified incentive approach now, so that incentives will be in place and storage will be on-line in time to meet the needs of the system.

2. **Storage resources of any significant size take multiple years to develop, therefore, the PUC should ensure sufficient incentives are in place *well before* storage is needed.**

CPower is in the process of developing multiple storage projects for participation in Connecticut's Energy Storage Solutions (ESS) Program and therefore has firsthand experience with the lengthy process of bringing a storage project of half a megawatt or more to fruition. The interconnection process alone may take multiple years for some projects. We are finding that almost all large projects and many relatively small projects are required to perform both a study at the distribution level (a utility level study) and a study at the transmission level (an ISO-New England level study); the addition of a transmission study can add as much as 9-12 months to the development process. We expect this requirement to perform dual System Impact Studies to become more frequent as the number of distribution resources on the system grows. In addition, the supply chain for battery components, including lithium carbonate, transformers, and inverters continues to be challenging, resulting in lengthy delivery timeframes for equipment. To illustrate this, we've included the table below, which shows recent quotes from equipment suppliers.

Energy Storage Equipment Supplier *(in no particular order/ranking)*	Battery Containers *(Weeks from PO to delivery)*	Inverters *(Weeks from PO to delivery)*	Transformers *(Weeks from PO to delivery)*	Switchgear *(Weeks from PO to delivery)*
Supplier 1	52	30	40	55
Supplier 2	42-46	20	52	46
Supplier 3	42-52	25	46	70
Supplier 4	52-60	20	60	60

In short, the PUC should recognize that developing storage is a multi-year process and therefore, it should ensure that the proper incentives are in place well before it sees the need for storage on the system. Further, as noted above, the need for storage to maximize the benefits of clean energy may materialize sooner than expected. Given this, the PUC should be proactive in developing robust incentives for storage.

3. **ConnectedSolutions will become much less effective (or potentially ineffective) at incenting storage at Commercial and Industrial (C&I) sites if Rhode Island Energy (RIE) caps the incentive as planned.**

RIE has informed CPower that it plans to cap the ConnectedSolutions Performance Incentive available to C&I batteries at 150% of the host customer's load. Such a cap is likely to make a large portion of C&I storage unviable because the economics are much more challenging for smaller batteries. The majority of C&I storage projects are sized larger than the host load because this creates resilience benefits for the customer and provides economies of scale on the cost of the battery. If C&I projects' incentives are capped at 150% of the customer's peak load, it's likely that all but those associated with the largest customers will become financially unviable. CPower anticipates that most, if not all, large customer-sited projects in the interconnection queue today would drop out due to deteriorated economics if the planned incentive cap moves forward.

One simple step that the PUC could take today to reduce barriers to C&I storage development would be to direct RIE not to implement a an incentive cap of 150% of peak load on C&I batteries in ConnectedSolutions. CPower is not opposed to implementing a cap on the performance incentive in the program; this is probably a prudent measure to ensure that storage that is many multiples of peak load is not eligible for an incentive on this extreme over-sizing. The proposed cap of 150% of peak load, however, is overly restrictive and will be damaging to project economics. CPower believes that a cap in the range of 6x to 7x peak load would be appropriate; this sizing would deliver meaningful resilience to customers while ensuring that the Program does not pay for "extreme oversizing".

4. **CPower agrees that the current "patchwork" of storage programs leaves value on the table; it would be more effective to create a single unified approach to incenting storage**

CPower suggests that the PUC consider adopting a program similar to Connecticut's Energy Storage Solutions Program. This program provides both an up-front incentive and a performance incentive to projects in the program. Incentive rates are locked in for 10 years. This lock-in feature is a very important aspect of the program. Customers and investors are generally unwilling to invest in storage without some certainty on the value streams available to recoup their costs.

Any storage program should include incentives for both front of the meter and behind the meter (customer-sited) storage. Both types of storage are important to the grid. Notably customer-sited storage provides customers with valuable resilience benefits and can help maintain the reliability of the distribution system.

5. **Any storage tariff should include rates for both front of the meter storage and behind the meter (customer-sited) storage**

As noted above, both behind the meter and customer-sited storage provide important benefits to the grid, and therefore the development of a storage tariff should include rates for both classes of storage.

Conclusion

CPower appreciates this opportunity to provide comments to the RI PUC on the Storage Report and looks forward to working with the PUC to facilitate the transition to a zero-emissions electricity supply.

Respectfully,

Nancy Chafetz

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People. Power. Purpose.

via electronic mail: Emma.Rodvien@puc.ri.gov

August 4, 2023

Emma Rodvien, Senior Economic and Policy Analyst
Rhode Island Public Utilities Commission
89 Jefferson Blvd, Warwick RI, 02888

Comments on Docket 5000 Draft BESS Report

(Main Point/Action in **Bold)** below with additional insight unbolded:

- **Requesting increased state-level interconnection queue transparency can improve energy storage development reporting and responsible development potential in Rhode Island.** This can be done by amending the existing generator interconnection queue to represent energy storage and publishing an electric load queue to display future load expansions, which can support strategic energy storage deployment.
    - **Generator Interconnection Queue Improvements:** We respectfully suggest that the RI PUC consider requesting a refinement to the monthly Rhode Island interconnection queue reports to include Battery Storage as a "Fuel Type". The current monthly queue reports (accessible on RIE's interconnection portal) only identify "Battery Add-On" applications, which attribute to behind-the-meter energy storage. At this time, any other type of energy storage application, including front-of-the-meter energy storage, would be relegated to the "Other" category. We also suggest that the reporting electrical distribution companies within Rhode Island make available the archived history of submitted monthly reports. Both items referenced above are standard processes in neighboring New England states. These two actions will help to appropriately reflect the distribution-level interconnection queue and the increased transparency will be beneficial for developers, utility regulators and ratepayers by defining preferred and cost-effective locations to develop projects, gauging energy storage interest in RI and evaluating storage tariffs and procurements.
    - **Creation of a Load Queue:** The PUC can recommend in the Draft Report that the state EDCs and municipal electric co-ops create and maintain a public queue for electric load additions just like generator applications, which can best direct necessary energy storage and demand response infrastructure. A majority of the information needed for a report is already included in the applicants' submissions. This could be organized in a near-identical format to the generator queue report and can identify the uses like new facilities, demand response, EV charging station (Level 1-3, etc), new residential, commercial or industrial load. The report could also document details like kW, duration, scheduled seasonal or daily use. These facilities connect to the same feeders as generators

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and an updated and transparent report documenting the progression of this large electrification movement will help to channel resources to adaptively address the Scenario 3 outlooks referenced in Page 15 of the Draft Report.

- **We understand the value of the Page 12 reference to US DOE land-based wind report states ISO-NE's 2021 transmission curtailment as less than 2%, but want to remind that this curtailment value and occurrence/duration may vary because the report only reflects land-based wind.** The contribution of wind (on-shore and off-shore) to the ISO-NE supply pool has been between 3-4% since 2021 (per ISO-NE's Net Energy and Peak Load), while renewables (wind, solar, hydro) represent 13-19% of the supply during the same periods, so the impact of transmission curtailment, congestion and generator profiles by all renewables may increase the curtailment frequency and duration, which could be benefited by energy storage.
- **We support the development of energy storage into the interconnection tariff in the forms of standalone front and behind-the-meter and pairing with generating facilities and suggest that the Draft Report includes engagement from existing groups/committees for participation or tariff initiation.** Some of the aspects covered in Page 42 Section 5.2 may have been discussed in the *RI Interconnection Technical Standards Committee* and communication with that group is suggested prior to initiating a stakeholder process to develop an energy storage interconnection tariff. This group was created by the RI Narragansett Electric Company's Standards for Connecting Distributed Generation and is composed of representatives from the utility, DG providers and state and ISO-level staff with charge to "facilitate the timely flow of technical information and introduce potential changes to the technical requirements of interconnection as national standards change". **We recommend establishing interconnection tariff language for paired and standalone storage by 6/30/2024 through the RI Interconnection Technical Standards Committee with collaboration by the PUC and stakeholders.**
  - It's understood that the current interconnection tariff considers and studies the energy storage facility as a typical generator, accounting worst-case scenario charge and discharge assumptions into the system studies. This puts energy storage applications at a disadvantage, since they may be requested to build expensive infrastructure upgrades that may never be needed. Refining the tariff to allow energy storage applicants the option to be studied at selected charge/discharge times/duration could improve the study review process and reduce overall expenses by reflecting realistic upgrade costs based on their anticipated needs. Discussion in the Docket 5000 stakeholder meetings identified drawbacks such as requiring application resubmissions if the application's desired charge/discharge times change after a study begins. The opportunity to include these aspects are covered in the 2022 NREL Use of Operating Agreements and Energy Storage to Reduce Photovoltaic Interconnection Costs (Conceptual framework, Tech and Econ Analysis), in which the RI OER and National Grid participated.
  - New tariffs and procurement programs for standalone energy storage and the amendment of existing state-mandated procurements to include storage pairing can contribute to generating RI RECs and clean NEPOOL GIS certificates to mirror Rhode Island's electric consumption. RI RES compliance reports over the past 5 years show that new RES distribution sourced from RI has accounted for less than 50% of the State's electric need, with the other half representing out-of-

state and regional imports. The 2022 amendment to RES procurement drives the goal of reaching 100% RES compliance by 2033 and improvements to existing and installing new storage procurement methods can be utilized to increase the distributed and diversified in-state resources contributing to this total.
    - Amending REG to include BESS pairing and a Clean Peak Standard will enable Rhode Island to drive closer to 100% RES compliance, but with a majority in-state commitment. Doing this will show that the in-state RES developments are directly reflected in the infrastructure investments, emission reductions and reliable electricity supply from resources that generate the least carbon emissions.
- **The development of a cohesive and practical energy storage procurement far in advance of the anticipated need-by dates within the Draft Report is critical.**
    - The interconnection study timelines for any RI project over 1 MW are complicated and can take multiple years before an impact study is completed. This is due to additional review requirements to the state EDC interconnection process that are overseen by ISO-NE (Section I.3.9 - PPA) to assess impacts on the electric power system. These additional study durations (like Level 3 Comprehensive Studies) in combination with the required delivery time per completed Interconnection Services Agreements can set the delivery schedules for DG renewable energy projects as far out as up to 5 years from application submission. Energy storage is studied in the exact same manner and has the same study expectations.
    - Following 2023 energy siting legislation, the deployment of ground-mounted utility-scale renewables in Rhode Island will be significantly reduced the next couple years. Excluding offshore wind, this will shift in-state solar deployment to canopies, feasible brownfields and rooftops. It's known that these deployments have greater overall costs and will need to be located within more congested load areas and these scenarios drive a greater need to evaluate the equitable implementation of BESS.
- **The energy storage procurement framework should consider export relief opportunities for existing and planned distributed and transmission-level renewable energy facilities producing power within Rhode Island.** Like in Scenario #2, a focus would be placed on reducing in-state curtailment and congestion situations by unlocking the optimal potential of previously curtailed or restrained electricity and REC production. This will increase the opportunity of a larger number of "homegrown" RECs sourced in RI and more efficient management of the needs for in-state electricity exports and out-of-state electricity imports. Creating a procurement for energy storage as standalone FTM DG/Transmission can be utilized to relieve current and future generation constraints within RI and enable additional capacity within the state. Standalone FTM BESS can be used to reduce Rhode Island's export of electricity beyond state boundaries and maximize the potential of it's in-state generation.
- **The draft report doesn't appear to reference the review of policies or programs in neighboring states like Connecticut or Massachusetts. Were any of the existing programs with association to energy storage in those states (Clean Peak Standard, SMART, CT NRES) reviewed when creating the draft report?**
- **We agree with the need for a standalone storage retail tariff and suggest an implementation deadline of 12/31/2024 and initiating a procurement by 12/31/2025.**

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- **In parallel to energy storage electric tariffs, we suggest a PUC-led cost-benefit analysis for the applicability of time-of-use rates for all retail rate classes, including future energy storage, microgrids and electric vehicles.** Rhode Island is currently the only New England state that has yet to adopt a time-of-use rate for retail customers or electric vehicles. Establishing TOU rates in RI can be used to naturally define and contain the coincident peak demand by influencing the end consumers' usage schedule. Using TOU to maintain the peak allows a timely and predictable need for BESS applications that can most efficiently create benefits from reducing Scenario 2's curtailment/congestion impacts and Scenario 3 from peak shaving.
- **The Draft Report should consider the qualitative impacts of localized energy development as a result of recent legislative initiatives that may impact the State's ability to achieve its short and long-term climate goals.** Renewable energy development and installation within Rhode Island is expected to decrease starting in the next couple years due to legislation passed in 2023 severely restricting facility siting. That same legislation also sets expansions to the REG and net metering programs with high targets, but the quantity of eligible projects will be lower. The remaining eligible facilities will be ground-mounted PV on brownfields, PV canopy and rooftop PV in regions of Rhode Island where congestion issues are pre-existing and site control, labor and installation costs are at a premium. The integration of energy storage pairing into REG and net metering programs will help to manage facility's electric discharge to the grid, reducing interconnection upgrade costs and regionalizing generation closer to the load areas that need it.
  - **We recommend the integration of paired storage as an optional adder to the REG program by the 2024 enrollment.** Amending existing state procurements, like REG, to include an incentive for BESS pairing with renewable resources will support RI's expansion of in-state generation and supply contributing to the RES goals, while reducing the infrastructure expansion costs when compared to standalone resources without BESS pairing.

Thank you for your time and consideration of our comments. We are available for follow-up questions or comments at your convenience.

Signed,

Hannah Morini

VP Business Development & Policy

HANDY LAW LLC

Memorandum

From: Seth Handy
To: RI PUC
Date: August 4, 2023
Regarding: Docket 5000 - Storage

Thank you for this opportunity to comment on the PUC recommendations arising out of this docket.

The general assembly ordered the PUC "to undertake a docket with storage participation to study energy storage value streams and compensation mechanisms" and then "report on whether new tariffs or programs are necessary to achieve energy storage goals."

1) Procedural Concerns

The stakeholder participation in this docket was overly prescribed and incomplete. It started with PUC staff's instruction not to comment until/unless as specifically requested. That alone indicates limited opportunity for stakeholder participation in the recommendations as they were developed. Open dialogue is the means to a best reasoned result. Once stakeholders, including this firm, began to comment robustly, the stakeholder process quickly shut down and us stakeholders were deprived of any further opportunity to participate. At that point we had to just await the PUC recommendations.

We remain very concerned about the recent trend that would give stakeholders much less opportunity to meaningfully participate in administrative proceedings at the PUC and the DPUC. That includes attempted and successful utility challenges to intervention, claims that state administrative agencies can and should represent private interests that are based on specific experience and are commercial and hence inherently unknown to public entities, proceedings allowing limited and prescribed right to stakeholder scope of participation and comment, procedural schedules that do not allow for or allow inadequate time for real stakeholder consideration and response. It is very different to have the opportunity to comment on recommendations after they issue than to actively participate in the formation and testing of the recommendations.

In this proceeding, it was unclear whether/how input from storage stakeholders, if ever formally acknowledged/accepted, was actually incorporated into the PUC's recommendations. Having now received the recommendations, it seems clear that this was less about "storage participation" and more about agency decision making despite stakeholder input. This process inappropriately truncated stakeholder participation in the formation of storage recommendations.

2) The PUC's substantive recommendation

In section 4.2.7, the PUC concludes that "storage is not Likely Needed to Meet the RES or Act on Climate Before 2032." There is absolutely not a chance that such a recommendation would have been made given robust stakeholder participation. That recommendation severely and fundamentally undermines the goals of the Act on Climate, the RI Energy Plan (Energy 2035) and many other sources of RI energy policy, all of which set the goal of becoming more self-reliant, more secure, and making our energy system more affordable through building our own a local and more distributed clean energy economy. That clearly cannot happen without robust regulatory support for and development of energy storage.

To rely on the RES and RECs to achieve compliance with the Act on Climate and our firmly established calls for energy transformation is an insecure, unstable and unaffordable strategy. The report itself admits fundamental uncertainty about the availability of RECs in RI:

> While not all of these RECs are truly available to be used for compliance with Rhode Island RES (for example, they may be under contract to settle in other states), the facility owners' registration of their generation units with the PUC indicates some willingness to sell these RECs to Rhode Island entities that have RES obligations. (p 36)
>
> Whether or not this supply of RECs remains or becomes economically viable for use to meet the RES and Act on Climate will depend on various factors, including the value of Rhode Island's ACP compared to other states' ACPs, actual energy use in the region, the continued operation of Rhode Island's eligible renewable generation fleet, and the ability and willingness of eligible resources that generate RECs to sell their RECs for use in Rhode Island. (p 37)

To undermine our own need for storage resources in RI by relying on an uncertain stream of largely imported RECs coming from the development of projects predominantly outside of RI, is not good policy. It fundamentally contradicts our resolve to "Act on Climate" by ceding our obligation and opportunity to other states that are more proactive in embracing the transformation to a new energy economy.

This is an "opportunity" because despite the PUC's monomaniacal focus on cost, this transformation promises great economic opportunity for RI. We cannot seize the positive economic benefit of a local, distributed energy economy unless we stop relying on imports and effectively exporting our energy jobs and immediately put the mechanics in place to upstart this distributed energy economy here at home. As the report indicates, one essential element and mechanic of such a transformation to a more sustainable, secure and affordable energy system is robust development of storage.

We submit (as we have long submitted, as have others, including perhaps most clearly the expert Karl Rabago, see eg https://ripuc.ri.gov/eventsactions/docket/4568page.html) that unless regulators and the utility acknowledge and compensate distributed generation for the system benefits storage provides, you/they will always undervalue and (consequently) will not get the benefits. Docket 4600 clearly says that - we cannot expect to get benefit that we will not pay for. Recently, RI's energy regulators have too long allowed the undervaluing of the systemic benefits of a distributed energy system. As examples, they have allowed a failure to identify non-wires alternative to infrastructure investment and they have refused to require a locational incentive in the Renewable Energy Growth program. Our utility's interest in wires alternatives does not incent it to analyze system constraints, structure proposals or select third party proposals that are more economical than its preferred wires alternative.

The Power Sector Transformation Report observed that

> While many industries have become more efficient over the last few decades by leveraging information technologies to more fully utilize capital investment, Rhode Island's peak to average demand ratio is 1.98, meaning that nearly half of the utility's capital investment is not utilized most of the time. (pp. 14-15). . .Over the last decade, Rhode Island did not need more than 1200 MW of capacity during most hours. The electric grid has been built to ensure that those few hours a year that approach 2000 MW of demand can be met. The top 1% of hours cost the state ratepayers around 9% of spending, at around $23 million, while the top 10% of hours cost 26% of costs at $67 million, as illustrated in Figure 4. To meet peak demand, our system currently invests in solutions that are more expensive than is necessary. https://ripuc.ri.gov/sites/g/files/xkgbur841/files/utilityinfo/electric/PST-Report_Nov_8.pdf (pp. 14-15)

Any least cost procurement analysis has to consider the opportunity to reduce existing and established system costs rather than just the value of offsetting need for incremental investment. RIGL 39-1-1 reads:

> **(d)** The legislature also finds and declares, as of 1996, the following:
>
> **(1)** That lower retail electricity rates would promote the state's economy and the health and general welfare of the citizens of Rhode Island;
>
> **(2)** That current research and experience indicates that greater competition in the electricity industry would result in a decrease in electricity rates over time;
>
> **(3)** That greater competition in the electricity industry would stimulate economic growth;
>
> **(4)** That it is in the public interest to promote competition in the electricity industry and to establish performance-based ratemaking for regulated utilities;
>
> **(5)** That in connection with the transition to a more competitive electric utility industry, public utilities should have a reasonable opportunity to recover transitional costs associated with commitments prudently incurred in the past pursuant to their legal obligations to provide reliable electric service at reasonable costs;
>
> **(6)** That it shall be the policy of the state to encourage, through all feasible means and measures, states where fossil-fueled, electric-generating units producing air emissions affecting Rhode Island air quality are located to reduce such emissions over time to levels that enable cost-effective attainment of environmental standards within Rhode Island; and

(7) That in a restructured electrical industry the same protections currently afforded to low-income customers shall continue.

(e) The legislature further finds and declares as of 2006:

(1) That prices of energy, including especially fossil-fuels and electricity, are rising faster than the cost of living and are subject to sharp fluctuations, which conditions create hardships for many households, institutions, organizations, and businesses in the state;

(2) That while utility restructuring has brought some benefits, notably in transmission and distribution costs and more efficient use of generating capacities, it has not resulted in competitive markets for residential and small commercial-industrial customers, lower overall prices, or greater diversification of energy resources used for electrical generation;

(3) That the state's economy and the health and general welfare of the people of Rhode Island benefit when energy supplies are reliable and least-cost; and

(4) That it is a necessary move beyond basic utility restructuring in order to secure for Rhode Island, to the maximum extent reasonably feasible, the benefits of reasonable and stable rates, least-cost procurement, and system reliability that includes energy resource diversification, distributed generation, and load management.

Our state energy plan and our renewable energy statutes all indicate that distributed energy resources (efficiency, demand side management, distributed generation) can and will reduce system costs. DER can reduce the need for and cost of existing requirements for transmission. After a very thorough and data-driven analysis, the RI Energy Plan concludes that continuing business as usual is our most expensive alternative.

In a transformative scenario, a locally managed and self-reliant energy system promises to significantly reduce total operating costs, including (as one example) the cost of utility infrastructure investment and maintenance expenses and associate overhead. This is evidenced by the recent authorization and trend of RI municipalities reacquiring their streetlights and by the adoption of municipal aggregation programs.

The answers to cost benefit questions pivot depending on the framework and context within which they're considered. If you answer based on the status quo the conclusions will go one way, but if you answer based on the implementation of the current state law mandates and policy they will go another. As you know, RI law now not only mandates hugely scaled reliance on clean and largely intermittent energy sources but also demands large scale electrification of our thermal and transportation sectors. Low electric load scenarios will be exceedingly rare in that future, even considering variability between night and day. The general assembly has mandated that we plan for that world of high and variable load. Incremental compartmentalization of value propositions based on long lists of individual factors undermines the role storage plays in a transformed energy economy. Under any low load scenario, the use of storage to consume otherwise curtailed renewable energy will reduce overall grid emissions. Storage can also be used to balance fossil generation operations to run more efficiently. Use of storage for ancillary services (e.g., frequency reg) can reduce the stress and maintenance costs that fossil generation would otherwise incur when providing such ancillary services.

The role of storage in reducing the need to invest in incremental transmission or distribution wires and equipment is especially important in light of the clean energy economy mandated by the general assembly.

The Act on Climate holds all administrative agencies responsible to take all measures they can to achieve the statutory climate objectives. Given those mandates, the PUC is an environmental and health regulator (as is every state agency in RI) in addition to being an economic regulator.

<u>Please</u> rethink your recommendation to wait until 2032 before we put the mechanics in place to build storage.

Via Electronic Filing

August 4, 2023

Emma Rodvien, Senior Economic and Policy Analyst
Rhode Island Public Utilities Commission
89 Jefferson Blvd, Warwick, Rhode Island, 02888

Re: RI PUC Docket 5000, Comments on Draft Examination of the Value of and Need for Energy Storage Resources in Rhode Island

Dear Ms. Rodvien,

On behalf of Advanced Energy United ("United") and the Northeast Clean Energy Council ("NECEC" or "The Council"), thank you for the opportunity to provide these written comments on the draft Staff report, "Examination of the Value of and Need for Energy Storage Resources in Rhode Island" ("Draft Report").

Advanced Energy United is the only national industry association that represents the full range of advanced energy technologies and services, including wind, solar, hydro, energy storage, energy efficiency, demand response, electric vehicles, the smart grid, grid enhancing technologies, and more. The businesses we represent are lowering consumer costs, creating millions of new jobs, and providing the full range of clean, efficient, and reliable energy and transportation solutions needed to achieve the transition to 100% clean energy in the United States.

NECEC leads the just, equitable, and rapid transition to a clean energy future and a diverse climate economy. NECEC members span the broad spectrum of the clean energy industry, including clean transportation, energy efficiency, wind, solar, energy storage, microgrids, fuel cells, and advanced and "smart" technologies. The Council's 250+ members include companies based in Rhode Island and those from elsewhere who do business here or hope to make future investments in the state.

Introduction

While the transition to clean energy is currently underway in Rhode Island and the broader region, we need to strategically accelerate the pace. There is critical urgency to decarbonize the energy system to avoid the worst impacts of climate change and to control costs and mitigate risks in a market that is overly reliant on natural gas and other fossil fuels.

Energy storage technologies are an essential component of the clean energy transition and serve multiple functions. They can provide essential reliability services and enhance grid resilience, improve the integration of clean energy resources in a manner that maximizes and optimizes their use, and reduce electricity system peak demand, a major driver of utility costs.

As storage is a relatively new market entrant, smart planning and robust analysis are necessary to understand how to best leverage energy storage as a system asset. As we explain in further detail below, while the Public Utilities Commission ("PUC" or "Commission") has a relatively narrow statutory charge, Rhode Island policymakers need to take a broad view of storage that includes job growth and economic development, achieving 100% clean electricity, and getting to net zero greenhouse gas emissions.

Finally, while we are grateful for the opportunity to provide these comments; we understand that some stakeholders had expressed concern that the stakeholder process for Docket 5000 seemed to terminate abruptly before participants had the ability to fully contribute and comment on the resulting recommendations.

Comments

The five scenarios laid out by the PUC staff, and the various categories used to group benefits, offer a framework to organize the range of system needs and technology options. It is a useful exercise to contemplate options that address challenges associated with, for example, a cold snap or a distribution line failure. Staff apply the Rhode Island Benefit Cost Framework ("Framework") to present a list of potential qualitative benefits from storage. It is a snapshot of conditions and considerations to assist the PUC and stakeholder evaluation of storage.[1]

The Framework gives illustrative examples of how storage can provide grid and customer services and offer tangible benefits, such as addressing a transmission constraint, or relieving a local distribution constraint during a period of peak demand. The overall approach in Chapter 2 of the Draft Report could be a useful tool to consider storage in different use cases and in a Rhode Island-specific context. For Rhode Island to fully understand the value of storage, it needs to consider the full range of potential use cases, the locations and scale for storage assets, and examine how to stack multiple value streams across wholesale and retail markets. The Draft Report only goes part way to fully examining this potential.

The Draft Report explicitly asserts that the analysis was conducted through the lens of fulfilling obligations for Rhode Island's Renewable Energy Standard (RES) and the Act on Climate

[1] We encourage Staff to review/revisit the National Standard Practice Manual (NSPM) for DERs, a resource that provides a comprehensive framework for cost-effectiveness of distributed energy resources, including storage. See:

obligations (the "Act").[2] Indeed, the conclusion of the Draft Report significantly focuses on those two pieces of legislation. We have concerns that the Draft Report is too narrow in scope and fails to fully address other vital components such as future cost savings and other system benefits.

Senate Resolution 416,[3] which initiated the PUC staff analysis into storage, specifically called for an investigation into "reducing costs of electric generation, the transmission system and the distribution system to ratepayers." The resolution further stipulates that the PUC explore whether new policies are needed to deploy storage to unlock a reliable clean energy supply, lower peak demand, and enable more efficient distribution grid operation.

We have concerns that the PUC staff projection of Rhode Island's near-term RES compliance paints an untested, rosy picture and ignores the role that storage can play between now and 2032. If we wait on advancing storage until 2032, as recommended in the Draft Report, Rhode Island will lag behind on climate. Regarding the approach in Section 4.2 of using the RES and RECs to satisfy the requirements of the Act on Climate, PUC staff have no way to be sure that the projected RECs will be available for use in Rhode Island. Indeed, given the stringent energy and climate requirements across the region and Rhode Island's relatively small load, we recommend that Staff apply an appropriate offset for credits that will be applied elsewhere. Importantly, to passively rely on already projected RECs denies Rhode Island the opportunity that comes with developing home grown own renewable energy and energy storage resources here in Rhode Island.

The PUC staff assessment provides a rather static view of energy storage technologies and their application to the power system. In the Draft Report, present-day values on various metrics of performance are used to represent storage attributes.[4] This is an unrealistic approach because it does not adequately consider long-duration storage and improved battery performance management. It also attributes very little value to greenhouse gas ("GHG") emissions reduction.[5] While the PUC Staff do qualify their assessments in the Draft Report,[6] noting that costs, capabilities, and needs may change over time, that information is not sufficiently incorporated into the analysis or final conclusions. Specifically, Scenario #4 relies on 2022 average values of discharged storage currently deployed and its conclusions do not

[2] See Draft Report, Section 1.3, at 2.
[3] http://webserver.rilegislature.gov/BillText/BillText22/SenateText22/S3064.pdf
[4] See Section 2.1, Scenario #4
[5] See Section 2.2, Scenario #1
[6] See Section 2.3 where the PUC acknowledges that value of storage under each scenario may grow as storage costs come down, as well as due to changes in customer demands and increase of intermittent generation.

take into account anticipated development of long-duration storage[7] (which could presumably benefit from specific programming and support).[8]

The obligations of complying with the Act and RES should indeed be an important focal point for the Draft Report; yet the final report should reflect a broader assessment of storage that includes the value of storage for customers reliability, resilience, and cost-savings. With increases in extreme weather events[9] in Rhode Island that can damage infrastructure, for example, it is reasonable to anticipate that additional reliability measures will be needed to minimize outages and interruptions of service. Energy storage is well-suited to address those issues. The Draft Report highlights that Rhode Island has a smaller number of outage minutes than the average state, but that does not mean there is no value for storage in reliability.

As the Draft Report is revised, we encourage the PUC Staff to take account of the current dynamics of existing programs. For example, in the Draft Report, PUC Staff notes that the ConnectedSolutions Program[10] has incented customer-sited storage; however, it is not clear whether the Program will continue to be effective in incenting commercial and industrial (C&I) storage because Rhode Island Energy (RIE) is contemplating a change that will cap a C&I battery's incentive at 150% of the host facility's peak load. This is likely to make most of the large C&I batteries currently in the queue uneconomic to build. One proactive step toward incenting battery development that the Commission could take now is to direct RIE not to cap the incentive as planned. That said, we agree with Staff that the four existing storage programs in the state operate as a patchwork and leave significant value on the table. As such, it would make sense to develop one unified storage program. Connecticut's Energy Storage Solutions Program could serve as the model for this. That program provides an upfront incentive plus a performance incentive to storage resources, and locks in the rates for 10 years.[11]

Advanced Energy United and NECEC respectfully encourage the PUC to consider the following recommendations to enhance the report draft:

As noted earlier, Section 4.2 of the Draft Report should be expanded to include additional review of how storage may serve Rhode Island in the context of supporting reliability needs. We encourage the PUC to explore how to enable more third-party participation in meeting

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[7] https://www.sciencedirect.com/science/article/pii/S2352152X22017753

[8] https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/electric-power/062723-updated-market-designs-policies-can-accelerate-us-long-duration-energy-storage-growth-expert

[9] https://www.providencejournal.com/story/news/2022/02/18/climate-change-status-each-new-england-state-noaa/6813339001/

[10] See section 3.2

[11] Nearby states have had several years of lessons learned in implementing energy storage incentive and grid services compensation programs. Rhode Island should leverage the experience of successful efforts like the New York Energy Storage Roadmap to quickly design and launch initial storage programs. Our association members would be eager to help Rhode Island accelerate this effort.

distribution system needs. Creating a regulatory framework that facilitates and encourages Rhode Island Energy to procure services from competitive providers of storage and other distributed energy resources will help lower costs to ratepayers and encourage innovation. We need a range of providers and solutions to facilitate the clean energy transition in a manner that is cost-effective, equitable, and prompt. Simply procuring clean energy and RECs will not be sufficient.

We also recommend that the Commission include in the final version of the Report a timeline to support storage-specific tariff development. This will enable transparency and accountability. The development of a tariff should include storage rates for behind-the-meter (BTM) and front-of-the-meter (FTM) storage. We encourage the Commission to review storage proceedings and studies underway in other states, particularly those in New England,[12] to take advantage of the extensive analysis and stakeholder processes that are currently or soon will be underway in Massachusetts and Connecticut, two neighboring states working to develop FTM wholesale distribution tariffs for Energy Storage Solutions ("ESS"). Maine will likely soon follow. Similarly, the New York Energy Storage Roadmap to design and launch initial storage programs represents a proactive, ongoing process that Rhode Island should observe.

These processes have already taken years – learning from them will allow Rhode Island to move expeditiously and avoid unnecessary delays. Otherwise, it will likely be years before a tariff can be approved and projects can be developed and interconnected in response to that tariff. For the sake of time and resources across state agencies, utility companies and other market actors, Rhode Island can and should learn from the experiences of its neighbors.

As Rhode Island—through the PUC, the Office of Energy Resources (OER), and the legislature—develops a set of energy storage policies, we must recognize that time is of the essence. Developing storage projects can be a multi-year process. The state has ten years to meet its 100% renewable electricity target and energy storage is likely to play a significant role in meeting and maintaining it over time. We agree that energy storage centered tariffs will be necessary to effectively and efficiently incorporate ESS into the Rhode Island grid. However, given the uncertainty of energy markets, development patterns, and interconnection processes, United and NECEC urge the PUC to be proactive on storage and drive tariff changes forward expeditiously.

Waiting until 2030 or later to establish a foundation for storage rules carries too much risk for ratepayers, for the storage industry, and the grid. Such a process should commence promptly and have established dates for tariff filings, stakeholder engagement, and Commission review. During the development of the tariff(s), the Commission should take care to recognize the

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[12] https://legislature.maine.gov/doc/3710

value of allowing asset owners to operate storage systems in ways that maximize their utility to the grid.

While necessary, tariffs alone will be insufficient to stimulate the development of robust energy storage activities in Rhode Island. In parallel, the PUC and OER should work to develop programs that encourage the deployment of energy storage systems to provide firming for renewables, reliability, and other grid services. Well-designed compensation and/or incentive programs can lead to the type of grid development and innovation needed for Rhode Island to achieve both its climate and renewable energy mandates.

On behalf of Advanced Energy United and NECEC, we appreciate your consideration of our observations and recommendations.

Signed,

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August 4, 2023

By E-Mail to Emma.Rodvien@puc.ri.gov

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Subject: Comments on Energy Storage Report in Docket 5000

Ms. Rodvien:

RENEW Northeast, Inc. ("RENEW")[1] submits these comments in response to the Public Utilities Commission ("Commission" or "PUC") request for comments on its report, *Examination of the Value of and Need for Energy Storage Resources in Rhode Island*, submitted to the Rhode Island Senate in Response to Senate Resolution 416 ("the Report"). Thank you for the opportunity to participate in your working group over the winter and offer these comments today.

RENEW is a non-profit association uniting environmental advocates and the renewable energy industry whose mission involves coordinating the ideas and resources of its members with the goal of increasing environmentally sustainable energy generation in the Northeast from the region's abundant, indigenous renewable resources. RENEW members own and/or are developing large-scale renewable energy projects, energy storage resources and high-voltage transmission facilities across the Northeast. They are supported by members providing engineering, procurement, and construction services in the development of these projects and members that supply them with multi-megawatt class wind turbines. Its members are developing stand-alone transmission-interconnected energy storage systems and energy storage systems virtually or physically paired with renewable energy resources.

I. Summary

Energy storage can cost-effectively provide new capacity to the grid and complement renewable energy resources by absorbing their excess low-cost energy and storing it for later use. The purpose of the Report, as established by the Senate Resolution, is to study the costs and benefits of energy storage resources in Rhode Island today, identify any barriers and market

[1] The comments expressed herein represent the views of RENEW and not necessarily those of any particular member of RENEW. They were prepared with the assistance of Louisa Lund, Marc D. Montalvo, and Chris Jylkka of Daymark Energy Advisors, Inc.

inefficiencies facing energy storage, and explain whether new tariffs or programs for energy storage resources are necessary to achieve the state's goals related to reducing the cost of the electric power and facilitating the transition to carbon-free electricity.

Although the general focus of the Report is on providing recommendations for actions within the direct authority of the PUC, these comments also address some issues that may be more relevant to the Rhode Island legislature as it may have an interest in developing programs that could contribute to lowering electric power system costs, meeting Rhode Island's carbon reduction goals, and enhancing reliability.

RENEW makes these general observations about the Report:

- While it recognizes the "significant value potential" of energy storage and offers constructive recommendations on dedicated tariffs for storage, its qualitative cost-benefit analysis is not sufficient to support any conclusions about whether more storage in Rhode Island would benefit consumers in the near-term, as well as the longer term. Many factors are omitted.

- Its analysis of Rhode Island's ability to meet its Renewable Energy Standard and Act on Climate requirements without storage overlooks ways in which storage supports the transition to carbon-free electricity and reduces the cost of the electric power system by enabling low cost, no fuel, renewable resources.

- Beyond implementing the recommendations related to dedicated storage tariffs, additional opportunities exist to consider a more unified storage support mechanism and/or an outreach that facilitates potential efficiencies of bulk storage development of medium term and longer-term storage.

II. Comments

A. The Report Offers Constructive Recommendations for Dedicated Storage Tariffs.

The Report's recommendations related to a dedicated retail tariff and interconnection tariff are positive steps towards creating a market environment that more accurately represents how the cost of storage on the grid is different from other resources. Storage interacts differently with the grid than load or other generation resources. For example, a dedicated storage tariff should consider how to recognize storage's benefits in easing demand peaks by discharging during peak demand and charging during off-peak periods. Distribution system charges assigned to storage should reflect storage's actual use of the system.

Work on these dedicated storage tariffs should begin as soon as possible. Experience in Massachusetts and Connecticut suggests that storage tariff development can take years. Coupled with long interconnection timelines, this might mean that, even if work begins immediately, the appropriate conditions for meaningful deployment of storage on the state's distribution system may not be in place until late in the decade.

B. The Report Falls Short of Meeting the Senate Resolution's Directives.

1. Some Elements of the Report's Analysis Are Incomplete.

The Report recognizes storage "can create potentially significant value," but raises concerns that the value "may not exceed the cost of storage," and that alternatives may be lower in cost. The Report does not provide any quantification behind this assessment, so it is impossible to fully assess this claim. However, there are several gaps in the analysis that we were able to identify based on what was presented, which we discuss below.

Additional benefits that fit within the Benefit Cost Framework:

- The Report provides no mention of ramping benefits (hourly and sub-hourly) in the Table 1 analysis. These would be appropriate for consideration in relation to energy market price effects (Group 1) and benefits related to system operation (Group 3) as storage's ramping capabilities give system operators better tools for matching load, and fast-responding storage units could play a role in reducing the cost of needed reserves.

- The Report provides mention of health benefits of avoided emissions other than CO2. To the extent that storage resources can be used to reduce the use of high-emitting plants during peak periods, they can play a significant role in reducing particulate emissions and their associated negative health effects. This would be appropriate for consideration in the category of "Conservation and community benefits."

- Storage's contribution to meeting system capacity requirements is recognized among the Group 2 benefits. In thinking about the importance of this benefit, RENEW recommends the Report consider the ISO New England ("ISO-NE") ongoing capacity accreditation work in its Resource Capacity Accreditation ("RCA") project[2], which ISO-NE is aiming to implement in time for the 2028/29 Capability Year. This structure may better recognize the capacity benefits of storage, increase the locational importance of storage, and provide price discovery on the value of different storage durations.

- Black start is mentioned under Group 5 concerning benefits related to the Size and Volatility of the market." RENEW suggests black start benefits should fall

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[2] ISO-NE, *Resource Capacity Accreditation in the Forward Capacity Market* (June 7-8, 2023), https://www.iso-ne.com/static-assets/documents/2022/06/a02_mc_2022_06_7-8_resource_capacity_accreditation_in_the_forward_capacity_market.pptx#:~:text=Accredited%20capacity%20%E2%80%93%20measures%20a%20resource's,combination%20of%20ICAP%20and%20heuristic

under resilience/reliability, recognizing that pairing storage with fossil fuel generating resources can enhance system black start capabilities.

- Due to Rhode Island's development density and siting challenges, available space for clean resource development may be at a premium. An additional benefit of storage is its small footprint relative to other resource classes, as well as its ability to pair with renewable generation to maximize the ability of wind and solar to provide renewable energy when it is most needed. This may already be included under conservation and community benefits.

The scenarios discussion is a helpful way of presenting some of the different situations in which storage can contribute to the power system. RENEW suggests the following additional factors be considered:

- Scenario 2 focuses on how storage can lower the risk of curtailment. However, the potential importance of this service does not seem to be fully recognized by the Report, which cites a 2021 onshore wind curtailment figures to suggest that the benefits of avoiding curtailment are "relatively small."[3] The figure relied upon here, referencing onshore wind at a single point in time, is not a good indicator of likely future trends as new renewables are added to the system. The Report does go on to recognize that "clean energy curtailment will become more frequent and last longer in the future as more clean energy resources are added to the system." For clarity, it may be helpful to reference some specific forecast—for example the Analysis Group *Pathways* study prepared for ISO-NE that projects onshore wind curtailment to rise to almost 20% by 2027.[4]

- There is no consideration of long-duration storage and its potential capabilities under the various scenarios. For example, the "Cold snap analysis" only contemplates 2.5-hour storage, and the Report notes that this falls far short of the "multiple consecutive days" a cold snap can persist. Consideration of how long-term storage could provide value in this scenario would lead to a more complete picture.[5]

2. The Report's Finding of Storage Being "Not Needed" Prior to 2030 to Allow Rhode Island to Reach Its Climate Goals Reflects Ignores the Senate Resolution's Directive that the Report Examine Reducing Power System Costs and Facilitating the Clean Energy Transition.

The Report defines the Senate's question as whether Rhode Island will have access to enough RECs to meet its renewable energy requirements. It concludes the state will have ample Rhode-Island eligible Renewable Energy Certificate ("RECs") available to meet its compliance

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[3] Report at 12.
[4] Schatzki, Todd. *Pathways Study: Evaluation of Pathways to a Future Grid* 26 (April 26, 2022), https://www.iso-ne.com/static-assets/documents/2022/04/ag-pathways-april-final.pdf
[5] Report at 16.

obligations, specifically because Rhode Island obligated entities are willing to pay a higher price than those in any other New England state.[6] Rather than asserting that storage is not needed until at least 2030 because Rhode Island can out-pay other states for RECs, RENEW recommends the Report consider how storage can lower the cost of the state complying with these renewable energy mandates.

Specifically, storage can help lower the cost of RECs by minimizing curtailment and increasing the demand for renewable energy. Storage can help smooth energy prices over the day so that renewables are less likely to face negative or zero prices. Over the long term, storage can improve the economic outlook though better price stabilization which increased the likelihood of financing for renewables. By improving the economics of renewable energy, storage can potentially allow Rhode Island to meet its renewable energy targets sooner and at lower REC prices and overall cost.

While RENEW acknowledges these kinds of cost and portfolio benefits are hard to quantify in terms of a single state, other states in ISO-NE, notably Massachusetts and Connecticut, have taken significant steps to support storage, so any benefits flowing outward from Rhode Island programs would likely be more than matched by benefits flowing inward to Rhode Island from programs in neighboring states.

Finally, even without challenging the Report's suggestion that significant additional storage may not be needed until 2030, it will be important to act soon even to meet that target. Energy storage projects can take five to seven years to complete the ISO-NE interconnection process. Similarly, for larger-scale distribution-interconnected storage, electric distribution utility interconnection timelines can stretch over multiple years. If grid-connected storage and/or larger-scale distribution-connected storage projects are going to be needed in 2030, programs may need to start now to be available in the targeted timeframe.

3. The Discussion of Rhode Island's Storage Programs Reveals Some Potential Opportunities Beyond the Suggested Tariff Reform.

RENEW agrees that the storage tariffs recommended in the Report represent an important starting point for realizing the benefits of storage in Rhode Island and is an action within the purview of the PUC. Additional steps could be taken by Rhode Island policymakers that could result in additional benefits to the state's electricity consumers.

- The potential benefits provided by storage to Rhode Island consumers in the areas of support for efficient, cost-effective decarbonization; reduction of other forms of pollution; and other system reliability benefits, will not all be compensated, even with revised distribution tariffs. To encourage optimal deployment of storage, Rhode Island policymakers may wish to consider additional incentive programs. There may be benefits to Rhode Island in looking at other programs such as Massachusetts' Clean Peak Standard and the SMART program, to expedite future program creation.

[6] *Id.* at 38.

- Rhode Island policymakers may also want to consider whether there are potential benefits in additional support for bulk storage development. Currently, distribution-level storage is the major focus of existing programs. As a result, economies of scale in storage likely are not being captured.

C. Recommendations

RENEW Northeast makes the following recommendations based on the Report and the need for further storage analysis:

- Rhode Island should swiftly implement the Report's recommendations on developing tariffs that reflect unique characteristics of storage.

- Future work should include in any qualitative or quantitative analysis a consideration of some of the additional storage benefits identified above and how the availability of storage effects renewable generator revenue streams and thus the potential availability of renewable energy.

- Rhode Island programs should be expanded potentially using existing Massachusetts programs as models, to capture fully the benefits offered by storage that are not otherwise recognized in the energy markets. Rhode Island policymakers may also want to consider programs to capture wholesale storage benefits.

- To gain efficiency and speed with future programs, Rhode Island should study, evaluate, and take best practices from the adjacent state's programs before developing their own.

III. Conclusion

Thank you, again, for the opportunity to offer these comments.

Sincerely,

Francis E Pullaro

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Executive Director

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August 4, 2023

Public Utilities Commission
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Re: Attorney General's Comments on Draft Report Concerning Examination of the Value and Need for Energy Storage Resources in Rhode Island Report to the Rhode Island Senate in Response to Resolution 416

Dear Public Utilities Commission:

The following comments are provided by the Attorney General of the State of Rhode Island ("Attorney General") with respect to the above-referenced *Draft Report* provided by the Public Utilities Commission ("PUC") on July 10, 2023 in response to Rhode Island Senate Resolution 416 (the "Resolution"). As set forth herein, the Attorney General urges the PUC to take the opportunity with this Draft Report to acknowledge that (1) even strict compliance with Rhode Island legal mandates contained in the Renewable Energy Standard and 2021 Act on Climate do not guarantee carbon-free electricity, (2) potential, if not likely, changes in the renewable energy markets must be accounted for in energy policy; and (3) resources are needed to develop effective tariff systems and other programs to maximize the potential of energy storage.

I. Rhode Island Must Address Climate Change at Every Opportunity

In its very first line, the Senate Resolution which triggered the Draft Report highlights that "emissions from fossil fuels into the atmosphere have changed the earth's climate leading to surface temperature rise." The Resolution explicitly states that "[t]o reduce emissions, a transition to clean and renewable technologies is necessary" and highlights the important role of wind and solar to "provide clean energy and reduce dependency on fossil fuels." The Senate further acknowledged that "[t]o achieve a clean energy future, new technologies must be deployed to support the transition to safe and reliable carbon-free electricity supply[.]"

As we are all increasingly aware, climate change is impacting Rhode Island in multiple ways, including rising average temperatures and sea levels, rising precipitation rates, and rising coastal flooding events. In the past century, Rhode Island temperatures have risen by 4 degrees, with the state experiencing both the highest numbers of above-average days and above-average nights between 2015 and 2020. Jennifer Runkle & Kenneth E. Kunkel, *National Centers for Environmental Information State Climate Summaries 2022: Rhode Island*, https://statesummaries.ncics.org/downloads/RhodeIsland-StateClimateSummary2022.pdf. The state has also experienced a below-average number of very cold nights since the 1980s. *Id.* Precipitation rates have also increased in Rhode Island. Overall, Rhode Island has averaged about 54 inches of precipitation per year, which is 8 inches higher than the long-term average. *Id.* This increased precipitation is expected to increase in the coming years, especially in the winter and spring seasons, which bring severe storms. The Ocean State's coastlines are highly susceptible to flooding from winter weather events and hurricanes. Rhode Island sought FEMA disaster declaration status in 6 of the last 10 years due to substantial coastline flooding. *Id.*

The State's predisposition to flooding means that Rhode Island is also disproportionately impacted by rising sea levels. Tidal measurements in Newport have risen by about 0.11 inches (2.83 mm) per year, which is equivalent to about 11 inches over a century. *Id.* These sea level changes are expected to bring about both large increases in tidal flood events and smaller, local flooding events. The current sea level rise has already impacted Rhode Island, as the number of tidal flood days has increased overall, with the highest number of days occurring in 2017. *Id.* As sea levels continue to rise, New England is expected to be impacted severely due to the makeup of the land in the area. The National Flood Insurance Program ("NFIP") expects an increase in expected annual flood damage to rise by 38% to 52% by 2100. By that year, the NFIP predicts that sea levels will rise by 1 to 4 feet. *Id.* All global pathways modelling a path towards limiting the negative consequences of climate change require a "rapid and deep, and in most cases, immediate greenhouse gas emissions reductions in all sectors[.]" Intergovernmental Panel on Climate Change, *2023 Synthesis Report: Summary for Policymakers*, 20, https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_SPM.pdf.

In light of this dire reality, Rhode Island has recently amended its Renewable Energy Standard ("RES") and passed the 2021 Act on Climate. As a state, we have committed to achieve 100% renewable energy by 2033. *See* R.I. Gen. Laws § 39-26-4(a). We have also committed to reach net zero by 2050 and to meet the Act on Climate's interim greenhouse gas emission reduction mandates in 2030 and 2040. *See* RI Gen Laws § 42-6.2-9. Failure to do so will result in enforcement against the state and/or its agencies. *See e.g.* RI Gen Laws § 42-6.2-10. These policies were enacted in an effort to incentivize and effectuate practical change and to avoid the disastrous impacts on Rhode Islanders' health and safety should we fail to allay the worst impacts of climate change.

II. The Draft Report Must Clearly Acknowledge that Technical Compliance With the Law, While Essential, Does Not Guarantee Carbon-Free Electricity

Accordingly, Section 4.2 of the Draft Report, entitled "Facilitating the transition to safe and reliable carbon-free electricity supply", should clearly acknowledge both the need for technical compliance and the very real need to combat climate change. It may be fair for the PUC to limit its report to its view of ability to achieve compliance with the RES and the Act on Climate given the available information and the PUC's limited resources. However, it is not inconsequential that the Senate expressed desire to achieve "carbon-free electricity supply" separate and apart from also noting that the State is "on a pathway to achieving net-zero emissions by 2050." Accordingly, the PUC should be more explicit about the fact that technical compliance does not necessarily equate to actually achieving the greatest possible greenhouse gas emission reductions. The report should also clearly distinguish *technical* compliance with the law and achieving truly "carbon-free electricity supply."

III. Renewable Energy Credit and Alternative Compliance Payment Markets Could Change and Energy Policy Must Hedge Against Unknowns

The potential for disparity between true emission reductions and technical compliance with the law is particularly great when it comes to the purchase of Renewable Energy Credits ("RECs") or Alternative Compliance Payments ("ACPs") in order to offset actual emissions. Where RECs represent actual renewable energy generation deemed acceptable to offset emissions, ACPs do not. Instead, ACPs enable financing of additional renewable energy projects through the Renewable Energy Fund. However, there is no quantitative comparison of Renewable Energy Fund projects to their REC value equivalents. These information gaps leave the true value and benefits of ACP purchases unknown.

As noted by the PUC:

> Whether or not this supply of RECs remains or becomes economically viable for use to meet the RES and Act on Climate will depend on various factors, including the value of Rhode Island's ACP compared to other states' ACPs, actual energy use in the region, the continued operation of Rhode Island's eligible renewable generation fleet, and the ability and willingness of eligible resources that generate RECs to sell their RECs for use in Rhode Island.

Draft Report at 38. This potential risk is also noted in the most recent Renewable Energy Standard Annual Compliance Report. See RIPUC Annual RES Report for Compliance Year 2021: https://rhodeislandres.com/wpcontent/uploads/2023/05/2021-RES-Annual-Compliance-Report-1.pdf at 13. Without thorough review of the effectiveness of ACPs, it cannot be known whether the existence or set prices of ACPs are sufficient to ensure the RES program is capable of achieving net-zero. One complication that could frustrate the effectiveness of ACPs is exactly the problem this Draft Report is designed to address—as more distributed and intermittent resources are added to the grid, the capacity of our current transmission infrastructure is used up. Already, community, small commercial, and residential solar face long lead times for interconnection approvals. At some point, interconnection may no longer be viable or may need to wait general transmission upgrades. There is therefore a ceiling on the effectiveness of ACPs to catalyze new renewable energy generation, as is their intent. Accordingly, the future of ACPs or their price relative to the price of RECs should not be assumed when determining the need for alternatives such as battery storage. Although the PUC determines that there is a "fair likelihood" that there will be sufficient RECs to comply with the RES and the Act on Climate, the report should make clear that relying on that probability presents an unmitigated risk. *See id.* at Section 4.2.6, *see also id.* at Section 4.2.9. The State's climate mandates are just that, mandatory, and therefore the PUC's assessment of need should consider more explicitly the potential for energy storage to help guard against volatility in the REC/ACP market.

As noted in Section 4.2.8 of the Draft Report, "as the penetration of intermittent resources increases in New England, energy storage may become necessary to balance the generation output of these facilities with customer demand for electricity." Moreover, "[w]ithout the ability to balance load and generation in the future as renewable penetration increases, incremental renewable nameplate capacity will generate fewer and fewer incremental RECs to meet the RES and Act on Climate." Changes in law and policy can also impact whether technical compliance with the RES or Act on Climate is sufficient. For instance, the RES was accelerated as recently as 2022.

Accordingly, the Attorney General encourages the PUC to adopt a stronger conclusion in Section 4.2.9 that highlights these unknowns to in turn support the need for tariffs and programs today that can build a stronger storage market in the event these resources are needed in the near- to mid-term.

IV. The State Should Devote Resources to Further Studies and Analysis and Should Develop Tariff Frameworks and Programs to Achieve the Benefits That Storage Can Provide

Effective and scalable energy storage is a relatively-new opportunity for the State as it continues as a leader in the fight against climate change. As noted in the Draft Report, energy storage is unique in that it is "inherently flexible and can perform a wide variety of functions to meet system needs." *Draft Report* at i. As highlighted in the Draft Report, storage has great potential to provide significant benefits – both societal and financial - to the people of Rhode Island. These benefits include the potential to avoid curtailment of traditionally intermittent renewables such as wind and solar, and to reduce the price of Renewable Energy Certificates ("RECs") and the cost to comply with the Act on Climate. *See e.g., Draft Report* at 11. Accordingly, it is essential that we use this initial review process and report as a catalyst towards more robust analysis that can facilitate careful and targeted policy enactment as soon as possible.

As noted in the Draft Report, the PUC was limited in its resources and was ultimately unable to conduct the necessary studies and analysis to adopt targets for installed storage capacity, or to develop tariff frameworks. At the same time, the PUC notes that it is committed to undertaking that analysis once resources are available. The Attorney General supports future efforts to fully fund additional research and analysis so that the State can effectuate policies that fairly and adequately incentivize development and use of storage resources in a manner consistent with its energy policies and with achieving the greenhouse gas emission reduction mandates of the 2021 Act on Climate.

Sincerely,

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Rhode Island Attorney General

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Rhode Island Energy™
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Rhode Island Public Utilities Commission
Docket No. 5000

IN RE: INVESTIGATION INTO THE TREATMENT OF STORAGE AS AN ELECTRIC DISTRIBUTION SYSTEM RESOURCE

Rhode Island Energy Comments
August 4, 2023

The Narragansett Electric Company d/b/a Rhode Island Energy ("Company") respectfully submits the following comments on the Rhode Island Public Utilities Commission's draft Report to the Rhode Island Senate in Response to Resolution 416, entitled *Examination of the Value of and Need for Energy Storage Resources in Rhode Island* ("Report") dated July 10, 2023.

Rhode Island Energy supports the Report's recommendations to develop an energy storage interconnection tariff and an energy storage electric service tariff. Rhode Island Energy focuses its comments below on gaining clarity on and informing the Report's recommendations for next steps. If the recommendations for future action in the Report are adopted, Rhode Island Energy would be an eager partner in those discussions and would provide additional technical comments as appropriate for the discussions at that time.[1]

Rhode Island Energy appreciates the thoughtful exposition about the evolving role of energy storage in the Report. Energy storage is a tool that can provide value, and our collective objective is to procure and compensate the specific components of the value stack easily and appropriately. To that end, Rhode Island Energy agrees that "prudent, measured progress on energy storage should be the near-term goal" and that strategic, collaborative development of tariffs is a way to advance that short-term goal in a systematic manner.

Energy storage service tariff

Rhode Island Energy agrees that developing a service tariff for energy storage would be valuable and appropriate. For example, an energy storage system that charges from the electric power system mid-day where local solar production saturates the feeder may not be a cost causer that warrants a demand charge. In developing an energy storage service tariff, Rhode Island Energy – in collaboration with the Commission and stakeholders – could more accurately identify, quantify, and allocate costs and benefits specific to energy storage systems. Rhode Island Energy suggests an additional topic of discussion could be whether a tariff(s) applying to electrically paired distributed generation and energy storage systems may (or may not be) warranted, and whether/what revisions may be necessary for differential treatment of energy storage charged from a paired renewable energy system or from the electric power system.

[1] Technical comments include specifics regarding balancing electricity generation and consumption as a matter of *both* timing and location, consideration of round-trip energy shift implications of charging and discharging, Group 1 benefits during charging in Scenario 2, and nuances in characteristics of Scenario examples.

The Report states "The service tariff framework development would build upon the work of Chapters 2 and 3 of this Report to identify net beneficial products and values from standalone energy storage resources, the specific charging and discharging activities through which those products and values are delivered, and the time- and location-based constraints under which values from standalone storage resources are actually exchanged."

Rhode Island Energy is interpreting the Report as suggesting that an energy storage service tariff should perhaps differentiate between energy storage systems that participate in different markets or provide different value, and that the rates themselves should incorporate these value streams. Doing so may introduce several risks. First, the rates may become stale as markets and market valuation changes over time. Second, an energy storage resource may need to switch between different rates as it changes its market participation, or otherwise be locked into participation in a certain manner. Third, some value streams may not be able to be realized at this time but may become available at a future time (e.g., with increased visibility and control of the electric power system through grid modernization).

Perhaps another way to consider an energy storage service rate is to consider the cost-of-service of energy storage devoid of participation in any market or program. Then, any market or program participation, which is optional and at the discretion of the energy storage operator, can be layered on the service rate by the operator in order to build the value proposition and deliver clear market signals to energy storage operations. Whether the Commission and stakeholders consider the top-down approach described in the Report or the bottom-up approach offered here, Rhode Island Energy respectfully requests the authors remove the specifics from the Report and instead collaborate with stakeholders to develop the foundation of an energy storage service tariff during its proceedings.

Regarding process: Rhode Island Energy appreciates the stepwise process outlined in the Report. Readers of the Report, including Rhode Island Energy, may benefit from additional clarity around (i) the definitions of a 'tariff framework' and 'model tariff', (ii) whether the intention is to draft a model tariff or find a model tariff from another jurisdiction, (iii) whether the model tariff includes specific rates, and (iv) what the process looks like if there are multiple model tariffs filed or if time constraints prevent the Commission's review of the model tariff as described in the Report. Rhode Island Energy observes that any future energy storage service tariff should also be compatible with future dynamic rate structures and programs, which the Commission may take into consideration in determining the timing appropriate regulatory action to direct the Company to file an energy storage service tariff.

Interconnection Tariff

Rhode Island Energy agrees that a critical review of its interconnection tariff to ensure transparency and consistent application to energy storage systems would be beneficial. The Report suggests potentially developing an interconnection tariff specific to energy storage. Rhode Island Energy offers that having a single interconnection tariff – for both distributed generation, standalone energy storage, and paired systems – may be more streamlined for users. The Company currently applies its distributed generation interconnection tariff to standalone and paired energy storage systems. Indeed, the Company currently provides interconnection applicants the option to study an electrically paired distributed generation and energy storage system in aggregate (e.g., adding nameplate capacities) or with export to the electric power system limited, such as by inverter size. Rhode Island Energy's existing interconnection tariff – with amendments – may be a viable solution for specifying the terms of interconnection for energy storage.

In addition to improving clarity and transparency for interconnecting energy storage systems, Rhode Island Energy is eager to discuss terms and conditions for dispatching distributed energy resources, including to facilitate communication between the Company and those resources. Dispatchability has the potential to unlock local distribution system values that would otherwise be unavailable.

Periodic Market Assessment

Rhode Island Energy agrees that the location- and time-dependent nature of the products and values offered by energy storage may not be well-served by a static, system-wide target level of energy storage deployment. As such, a periodic market assessment would be a helpful tool to encourage the right level of energy storage development in the right place at the right time.

Rhode Island Energy welcomes further discussion about the objectives of a periodic market assessment and the appropriate organization to advance each objective. For example, Rhode Island Energy's role as distribution system operator provides Rhode Island Energy unique insight into hyper-local and timely value of energy storage. However, it may be less appropriate for Rhode Island Energy to assess and opine on the market efficiency of regional transmission markets in which energy storage may participate.

Thank you for your consideration of these comments. Rhode Island Energy looks forward to further engagement with the Commission and stakeholders.

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August 4, 2023

Emma Rodvien, Senior Economic and Policy Analyst
Public Utilities Commission
89 Jefferson Boulevard
Warwick, RI 02888

RE: Office of Energy Resources comments on Draft Examination of the Value of and Need for Energy Storage Resources in Rhode Island

Dear Ms. Rodvien:

The Office of Energy Resources (OER) appreciates this opportunity to submit comments on the Public Utility Commission's (PUC) draft report, Examination of the Value of and Need for Energy Storage Resources in Rhode Island (the Draft Report), produced in response to Senate Resolution 416. Examining the benefits and costs of, barriers to, and potential need of programs to support energy storage is a substantial and complex undertaking, and OER recognizes and is thankful for the effort the PUC staff took in producing the Draft Report. OER views a sustained effort to enable and foster the energy storage industry in Rhode Island to be conducive to managing total costs of the electric power system and necessary for meeting and maintaining the state's climate and renewable energy goals and mandates.

Energy storage is already operating and demonstrating its value in Rhode Island today. The Draft Report finds that "alternative resources are often capable of meeting the same system needs (and delivering the same values) as energy storage at a lower cost." It notes that energy storage resources have submitted bids in response to System Reliability Procurements but have not been selected due to cost. Still, a 3 MW, 9 MWh energy storage facility installed by Pascoag Utility District (PUD) was found to be a cost-effective alternative to transmission upgrades in 2022. The Draft Report highlights discrete modes of operation and revenue streams for energy storage; while the PUD energy storage project is an anecdote, it participates in ISO-NE wholesale markets, helps manage Regional Network System costs, and provides resiliency benefits, demonstrating the ability of energy storage to produce multiple benefits that alternative resources may not be capable of providing.

While the Draft Report concludes that "energy storage is not likely needed to meet the RES or Act on Climate by 2032 [the year referenced in SR 416]," it also finds that it is "advisable to consider… limited programs today that provide the State and the energy storage market with the necessary experience to prepare for significant growth in electricity demand and compliance obligations after 2030." As demonstrated by the PUD energy storage project, there are already instances in which energy storage is the most cost-effective solution. As we progress towards 2032, these opportunities will only increase. OER agrees with the PUC that, regardless of the specific need for and economic superiority of energy storage today, deliberate energy storage market transformation efforts now will pay dividends for Rhode Islanders in the future, as the

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need for energy storage (including long-duration energy storage) becomes more acute in advancing our energy goals with Act on Climate.

Among the Draft Report's findings, OER fully supports the following:

- **Importance of programs to support the development of a mature energy storage industry.** As noted above, the Draft Report asserts the limited technical need for energy storage before 2032 but acknowledges the value of supporting the development of a energy storage industry in Rhode Island. As of June 2023, there were over 850 interconnected energy storage projects, mostly residential batteries co-located with solar. While OER agrees that there may be an opportunity for existing programs that have enabled these projects (and tariffs) to be better coordinated, OER believes that programs such as ConnectedSolutions and the Renewable Energy Fund's storage incentive are in line with the need to make sustained efforts to grow the energy storage industry in Rhode Island and should be continued (and regularly examined for opportunities for improvement).

- **Need for energy storage-specific retail service tariff.** OER agrees that applying retail rates designed for traditional customer load to charging batteries "may be inaccurate and may pose a hinderance to the development of net beneficial storage resources." Developing a tariff that better reflects the costs (and potential benefits) of energy storage to the electric power system will reduce the need for incentives to support energy storage, and, ultimately, reduce costs passed onto Rhode Islanders. Before engaging in this effort, however, OER would recommend careful consideration of whether such a tariff is likely to be accessed by a substantial number of projects. As discussed below, most front-of-the-meter energy storage resources participate in wholesale markets; such resources are likely eligible for a wholesale distribution access tariff.

- **Need for interconnection tariff suitable for energy storage.** The existing interconnection tariff was developed with distributed generation (primarily solar) in mind. Energy Storage, a dispatchable asset capable of both importing and exporting power, presents unique questions with respect to interconnection. A tariff that provides more predictability around questions such as how energy storage should be modeled (e.g., should it be assumed that energy storage will charge during periods of peak demand?) will help direct energy storage projects to areas where they are of most value to the grid and reduce project development costs. This will also provide certainty about interconnection timelines, fees and clarify the interconnection process for standalone batteries as well as those installed co-located with renewable resources.

- **Process for developing energy storage retail service tariff.** OER agrees that, given the complexity of the task, convening an informal stakeholder process to provide guidance for energy storage tariffs ultimately filed by Rhode Island Energy would be more

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efficient than relying upon Rhode Island Energy to initiate and file such a tariff unilaterally.

OER offers the following comments related to the Draft Report:

- **Affirm the value of setting an energy storage target.** While OER understands that the PUC found that it did not have the resources necessary to study and set a specific target, OER's position is that developing and instituting an incremental energy storage target or mandate can help focus the efforts of those that can contribute to energy storage's success. Adopting a energy storage target would signal that Rhode Island is invested in the sustained development of a energy storage industry, which, in turn, will encourage the energy storage industry to invest in Rhode Island. In the Northeast, Maine, Connecticut, Massachusetts, and New York all have statutes setting energy storage targets or mandates for 2025 and/or 2030.

- **Address the potential need for a wholesale distribution access tariff for energy storage.** The Draft Report addresses the value of a retail service tariff for standalone energy storage. Recent activity in other states (including New York, Maine, Massachusetts, and Connecticut)[1], highlights that FERC-jurisdictional tariffs for energy storage assets connected to the distribution system but participating in wholesale markets (often referred to as a wholesale distribution access tariff) may be a critical component for supporting the development of the energy storage industry. While approving such a tariff may be outside of the PUC's authority, OER suggests that referencing this issue will enhance the value of the Draft Report.

- **Incorporate feedback from residential installers in the future.** As noted above, most energy storage projects currently operating in Rhode Island are residential. While the stakeholder group assembled by the PUC represented some industry interests, it did not represent entities with extensive experience currently installing energy storage in Rhode Island. OER encourages the PUC to include these installers in future energy storage-related processes and we can assist with coordinating those stakeholders for future discussions.

- **Expand tariff considerations to include energy storage co-located with renewables.** The Draft Report focuses on standalone energy storage in proposing revised retail charge and interconnection tariffs. While OER agrees that standalone and co-located energy storage each have unique considerations, energy storage co-located with renewables is also distinct from load or standalone renewables.

[1] See for example: Section 72 of Chapter 179 of Massachusetts Acts of 2022 and Connecticut Public Utilities Authority Decision in Docket 22-08-05

- **Consider OER role in interconnection proceedings.** OER played a role in the development of the current interconnection tariff by providing support in stakeholder engagement, organizing stakeholder meetings, and providing feedback. OER enjoyed working with PUC staff on that effort. OER can provide similar support to the PUC staff with stakeholder engagement and meeting organization for the next update to the interconnection tariff. Additionally, OER can assist with developing suggested amendments to the current interconnection tariff to better account for energy storage or in the creation of a new interconnection tariff specifically for energy storage. Current and recent OER staff were lead authors of a National Renewable Energy Laboratories report[2] outlining the use of operating agreements and energy storage to manage interconnection costs; OER would be happy to leverage this experience and insight in discussion around a energy storage interconnection tariff, OER also recommends that such interconnection tariff reforms should be tied to larger distribution system planning efforts.

- **Consider additional energy storage incentive programs.** While OER agrees that energy storage incentive programs will be most effective and cost-effective with more suitable energy storage retail charge and interconnection tariffs in place, modeling performed by Sustainable Energy Advantage, LLC, on behalf of OER suggests that adding energy storage to solar installations may be cost effective. OER believes that animating the market now (which may produce net benefits) will help smooth the transition to a future in which energy storage will be needed to achieve climate mandates and maintain system reliability. Waiting for the completion of proposed energy storage activities may unnecessarily delay meaningful progress towards building beneficial energy storage incentive programs.

Again, OER greatly appreciates the PUC's diligent examination of energy storage and the opportunity to provide comments on the Draft Report. If the PUC needs analyses completed for future meetings or docket proceedings on energy storage subjects, OER would be happy to discuss and provide support. We look forward to working with the PUC and stakeholders to progress energy storage in Rhode Island.

Thank you,

Chris Kearns

Chris Kearns
Acting Commissioner
Rhode Island Office of Energy Resources

[2] https://www.nrel.gov/docs/fy22osti/81960.pdf