

February 15, 2019

Via Electronic Mail

Judith F. Judson, Commissioner
Massachusetts Department of Energy Resources
100 Cambridge Street, Suite 1020
Boston, MA 02114

Re: Massachusetts Electric Company and Nantucket Electric Company d/b/a National Grid
Energy Storage Target Annual Report for the Year Ended December 31, 2018

Dear Commissioner Judson:

On behalf of Massachusetts Electric Company and Nantucket Electric Company d/b/a National Grid (“National Grid” or the “Company”), I am enclosing National Grid’s Energy Storage Target Annual Report (“Report”) to the Department of Energy Resources (“DOER”) for the year ended December 31, 2018. This Report is submitted in accordance with Section 20 of Chapter 227 of the Acts of 2018, An Act to Advance Clean Energy (the “Act”).

The Act establishes an energy storage target of 1000 megawatt hours to be achieved by December 31, 2025 and requires each electric distribution company (“EDC”) to submit an annual report to the DOER by February 15 of each year documenting the energy storage installations in their service territory. As discussed further in the Report, as of December 31, 2018, National Grid has 5.7 MWh (AC) or 1.7 MW (AC) of energy storage systems (“ESS”) installed in its service territory, representing less than 1% of the new statewide target. Additionally, the Company has approximately 341 MWh (AC) and 433 MWh (DC) of ESS in the pipeline to be installed in its service territory.

The enclosed Report closely follows the form of National Grid’s 2018 Energy Storage Target Annual Report, as requested by DOER. National Grid, in collaboration with the other EDCs, has made minor adjustments to the presentation of the Report to address changes in the energy storage target pursuant to the Act. Specifically, the Report identifies ESS projects as either “installed”¹ or “pipeline,”² which is a change from the terminology used in the EDC’s energy storage reports to DOER for the year ended December 31, 2017, which identified ESS projects as either “procured” or “pipeline.” The EDCs have made this change to align with the Commonwealth’s energy storage target and the EDCs’ related reporting requirements established by the Act. This change in terminology is also reflected in Attachment A to National Grid’s Report. To protect customer confidentiality, National Grid has withheld personal information

¹ For purposes of the Report, “installed” ESS means an ESS project that has been interconnected to the Company’s electric distribution system.

² ESS in the Company’s “pipeline” refers to ESS projects that are in process but not yet interconnected.

(e.g., name of customer) associated with each residential, commercial and industrial project, but has included the “DG WR Number”, or unique project identification number.

Similarly, the EDCs have deleted the description of “Project Eligibility Criteria,” which was Section II.C of their respective reports last year, because “procurement” is no longer a relevant criterion under the Act and accordingly, defining events that will count as progress towards procurement is no longer relevant. “Eligible Sources of Procurement,” which was Section II.B of the Reports last year, has been renamed “Policy Sources of ESS” and is Section II.C of this Report. Several other conforming terminology changes to reflect the change from a “procured” to an “installed” ESS target have made in this Report.

Thank you for your attention to this matter. Please contact me if you have any questions regarding this Report.

Sincerely,

A handwritten signature in blue ink that reads "Nancy D. Israel". The signature is written in a cursive, flowing style.

Nancy D. Israel

Enclosures

cc: Will Lauwers, DOER

MA DOER Energy Storage Target Annual Report

I. Introduction

Massachusetts law sets a target for 1,000 MWh of energy storage systems (“ESS”) to be installed by December 31, 2025.

National Grid is strongly committed to serving as a clean energy catalyst for the region and views energy storage as a core component of the clean energy transformation required to achieve the Commonwealth’s goal of an 80 percent greenhouse gas emission reduction by 2050.

National Grid has approximately 5.7 MWh AC of installed ESS representing less than one percent of the new statewide ESS target. National Grid also has approximately 341 MWh AC and 433 MWh DC of ESS in the pipeline in its service territory.

National Grid has been proposing and deploying grid-connected ESS since 2009. National Grid is actively investigating how energy storage can potentially play a role in energy system optimization, that is, support operational flexibility, enhance the integration of renewable distributed generation, and reduce customer costs and constraints, while ensuring safety and reliability. In general, National Grid views ESS as offering a wide range of potential benefits for customers and for the electric power system, including enabling customers to manage their on-site energy use, providing heightened reliability, enhancing power quality, and reducing coincident and non-coincident demand on the electric power system. In addition, as allowed by the Independent System Operator-New England (“ISO-NE”), ESS can offer benefits to the grid by discharging when it is needed either at the distribution level or system level, to meet local or system level demand. To this end, National Grid is actively exploring a variety of use cases and benefits of utility-owned ESS and continuing to support the deployment of customer-owned and operated storage that can also deliver substantial benefits.

Additionally, and with the leadership of the Department of Energy Resources (“DOER”), National Grid’s new three-year efficiency plan contemplates National Grid incenting the use of customer-owned distributed energy resources (“DERs”) to reduce regional, statewide, and local peaks. We expect that storage will be a key part of this important target.

What follows is National Grid’s detailed 2019 Energy Storage Target Annual Report (“Report”) to the DOER for the year ended December 31, 2018.

II. Reporting Requirements

An Act to Advance Clean Energy, Section 20 of Chapter 227 of the Acts of 2018, amended An Act Relative to Energy Diversity, Section 15 of Chapter 188 of the Acts of 2016, by striking out Section 15 in its entirety and replacing it with a new statewide energy storage target of 1,000 MWh, to be achieved by December 31, 2025, and a new requirement for the electric distribution companies (“EDCs”) to report annually to the DOER by February 15, beginning in 2019, documenting the energy storage installations in their respective service territories.

As set forth in An Act to Advance Clean Energy, to achieve this new statewide energy storage target of 1,000 megawatt hours, DOER “may consider a variety of policies to encourage the cost-effective deployment of energy storage systems, including the refinement of existing procurement methods to properly value energy storage systems, inclusion in energy portfolio standards, the use of alternative compliance payments to develop pilot programs and the use of energy efficiency funds under section 19 of chapter 25 of the General Laws if the department determines that the energy storage system installed at a customer’s premises provides sustainable peak load reductions on either the electric or gas distribution systems and is otherwise consistent with section 11G of chapter 25A of the General Laws.”

This is National Grid’s first annual Report pursuant to An Act to Advance Clean Energy and covers the period January 1, 2018 through December 31, 2018.¹

A. Data Collection

National Grid seeks to obtain uniform data and information for EDC-owned and non-EDC-owned ESS projects through the distributed generation (“DG”) interconnection process. For purposes of annual Reports to the DOER, the EDCs have been requesting data and information for ESS projects they do not own from customers and developers of existing ESS projects already connected to their electric distribution systems and are requesting such data and information from customers and developers of new projects that have applied to interconnect to their respective electric distribution systems. The collected data and information will be used to demonstrate measurable progress towards the achievement of the ESS 1,000 MWh target of installed ESS. These data and information include:

- ESS Installed, that is, Interconnected (MWh_{ac} and MW_{ac});
- ESS in the Pipeline to be Installed (MWh_{ac} and MW_{ac});
- Policy Sources of ESS (e.g., SMART program);
- ESS Specifications (e.g., technology type, manufacturer);
- Operational Information (e.g., installation type, system configuration); and
- Applications/ Intended Use Cases (e.g., Peak Shaving/ Load Leveling).²

The EDCs are including the above-mentioned data and information on the ESS installed and pipeline projects in their annual reports to the DOER, to the extent such data and information has been provided to them. However, for non-EDC-owned projects, such data and information must be obtained from customers and developers, who currently are not required to provide such data and information under the current DG interconnection tariff. The EDCs may be unable to obtain some or all of this customer

¹ Although more customer-owned ESS projects will be included in this report than in the EDCs’ first ESS report to DOER, submitted on February 15, 2018, pursuant to An Act Relative to Energy Diversity, the data and information on each ESS projects in Massachusetts is still limited at this early stage of ESS installation in the Commonwealth as customers are not required to provide detailed ESS project data.

² *State of Charge* report, issued on September 16, 2017. According to the report, a use case is defined as an integrated set of grid services performed by a technology at a distinct site or location on the grid.
<http://www.mass.gov/eea/docs/doer/state-of-charge-report.pdf>.

data and information and the level and type of data and information included for each such project may vary in the Reports.

B. Attachment A

Attachment A to this Report includes installed ESS projects, and ESS projects in the pipeline as of December 31, 2018. For purposes of this Report, an “installed” ESS project means an ESS project that has been interconnected to an EDC’s electric distribution system.

C. Policy Sources of ESS

The EDCs have jointly identified several state policies, programs, and funding sources intended to drive the installation of ESS in the Commonwealth. Where the EDCs are aware of the state policy, program or funding source associated with an ESS project, the EDCs have identified that policy source in Attachment A. Policy sources of ESS projects include, but are not limited to:

- Utility-owned ESS for transmission and distribution operation and management for the benefit of customers (“Utility-Owned T&D”);
- Utility-owned ESS for research and development purposes, such as those projects supported by U.S. Department of Energy grants, or utility-scale solar plus storage projects developed to support research programs (“Utility-Owned R&D”);
- ESS to be paired with newly authorized large-scale energy procurements featuring 9,450,000 MWh of clean energy and 1,600 MW of offshore wind generation under Sections 83C and 83D of the Green Communities Act (“Section 83C or 83D”);
- Customer-owned ESS enrolled in an EDC’s energy efficiency/ demand response demonstration project or program (“Energy Efficiency/DR program”);
- Customer-owned ESS enrolled in the EDC’s Solar Massachusetts Renewable Target (“SMART”) program that qualify for the SMART storage adder (“SMART program”); and
- Customer-owned ESS funded by the DOER’s or Massachusetts Clean Energy Center’s (“MassCEC”) Advancing Commonwealth Energy Storage (“ACES”) and Peak Demand Reduction Grant programs, which include projects to which the EDC has provided in-kind and/or financial support (“DOER/ MassCEC Funded Projects”).³

D. Applications and Intended Use Cases

Based on the *State of Charge* report and the EDCs’ own expertise, the EDCs have identified the following primary applications and use cases for ESS. This list may be modified as the EDCs monitor relevant industry trends and gain further hands-on experience with energy storage.

- i. Wholesale Market (i.e., Energy, Capacity, Ancillary Services): ESS have the potential to participate in all major categories of the wholesale market.

³ Any ACES or Peak Demand Reduction Grant project where the EDC is the award recipient or the EDC partner on the project.

- a. In the wholesale energy market, ESS may be able to produce revenue by arbitraging hourly electricity prices, charging when the wholesale price is low and discharging when the wholesale price is high.
- b. ESS may participate in the ISO-NE Forward Capacity Auction and earn revenue by contributing to ISO New England's installed capacity.
- c. ESS may also be able to generate revenue by participating in the ancillary services market (e.g., black start and frequency regulation).

While energy arbitrage, capacity, and ancillary service revenues have the potential to be monetized for the benefit of the ESS owner, individual customers may potentially benefit from reduced system costs.

- ii. Peak Shaving / Load Leveling: ESS can store energy during hours of low demand and discharge energy when the system is peaking. This may reduce the entire system peak and result in lower utilization of inefficient and expensive gas and oil units. It may also reduce ISO-NE capacity and regional network service costs.
- iii. Generation Support (e.g., Peaker Replacement): ESS can discharge when the system is peaking, thus acting in place of peaking capacity. ESS have the potential to be cleaner and more reliable than a traditional combustion turbine unit.
- iv. T&D Asset Deferral: Strategic deployment of ESS has the potential to defer or eliminate transmission and distribution upgrades in specific locations. The potential for transmission and distribution deferrals need to be studied on an individual basis in consideration of local circumstances and system characteristics.
- v. Power Quality (e.g., Voltage/VAR Support): ESS can provide voltage/VAR support. Reactive power cannot be efficiently transmitted over long distances, which makes distributed ESS an attractive alternative to traditional voltage/VAR support supplied by generating units in some locations.
- vi. Customer Bill Savings (e.g., Demand Charge Management): Individual customers can utilize ESS to shave the peaks and fill the troughs of their load. By reducing peak load, customers may be able to mitigate their installed capacity tag. Commercial and industrial customers may also have the potential to realize bill savings by lowering their peak demand and avoiding a demand charge. Customers with time varying rates can also use ESS to perform arbitrage by charging the ESS during less expensive off-peak times and discharging for their own use during more expensive peak periods.
- vii. Renewable Energy Integration (e.g., Ramping, Smoothing): ESS can quickly follow the variable and unpredictable generation of an intermittent renewable resource making it smooth and dispatchable. ESS can thus support the further integration of renewable resources.

- viii. Renewable Energy Shifting: ESS have the potential to store energy generated by renewable resources when system demand is low and discharge when system demand is high.
- ix. Reliability and Resiliency: ESS can support reliability and resiliency by locally providing energy during an outage event.
- x. Microgrid: ESS can help promote a cost-effective and reliable microgrid. By storing energy produced by renewable resources or by combined heat and power (CHP) for use when those assets are not generating, ESS can support microgrid “islanding” and going off the main grid at times when there is an electric distribution system outage or when it would be otherwise advantageous to the microgrid operator.

E. Target Results

See Attachment A for data and information regarding installed (e.g., interconnected) ESS projects and ESS projects in the pipeline to be installed.

i. Installed Projects

As of December 31, 2018, National Grid had approximately 5.74 MWh AC MWh of ESS installed, that is, interconnected, in its Massachusetts service territory.

ii. Pipeline Projects

As of December 31, 2018, National Grid had approximately 340.9 MWh AC and MW 433.3 MWh DC of ESS in the project pipeline.⁴

F. Cost-Effectiveness and Viability

Energy Efficiency/ Demand Response

In Massachusetts, the energy efficiency program administrators (“PAs”) use a Total Resource Cost (“TRC”) test to determine the cost-effectiveness of an offering. For the purposes of determining the cost-effectiveness of storage included as part of energy efficiency and demand response, the PAs would apply the TRC standard. The PAs look at the total cost of the project, regardless of funding source, and compare that against the total benefits of the project and determine if the benefits exceed the costs. In the 2019-2021 Three Year Energy Efficiency Plan, the PAs proposed a pay for performance program design for storage assets. For pay for performance specifically, the PAs are not incenting the equipment itself, only the performance of the equipment assuming it is already in a customer’s home or facility. Therefore, when assessing the cost effectiveness of the pay for performance storage offerings, the PAs will look only at the

⁴ The exact amounts of energy and power of the proposed projects in AC and DC ratings could not be confirmed at the time of Report submittal, but will be known as the projects move from the pipeline to the installed list.

amount of the incentive they are proposing to offer and compare that against the level of benefits the kW reduction is expected to produce.

G. Market Barriers and Solutions to the Adoption of Energy Storage

Market Barriers: Dual Participation

The Federal Energy Regulatory Commission (“FERC”) recently issued Order 841, which is designed to remove barriers to the participation of electric energy storage resources in the capacity, energy, and ancillary service markets. The Order requires each Regional Transmission Organization (RTO) or Independent System Operator (ISO) to establish a market participation model for electric energy storage resources that ensure that energy storage resources are “eligible to provide all capacity, energy, and ancillary services that the resource is technically capable of providing in the RTO/ISO markets” and that the markets “account for the physical and operational characteristics of electric storage resources through bidding parameters or other means.”⁵ FERC Order 841 addresses market barriers to electric energy storage resources participating in the various wholesale markets under the energy storage participation models; however, the Order has not addressed barriers to electric storage resources that seek to dually participate in the wholesale electricity markets and serve some alternative use case, such as a transmission or distribution deferral.

Within the context of National Grid’s company-owned or operated energy storage programs, one of the primary use cases for energy storage is in the deferral of a transmission or distribution investment through Non-Wires Alternative (“NWA”) projects. In some instances, the NWA projects may only be required for the primary T&D deferral use case in certain seasonal peak hours and could feasibly participate in the ISO-NE wholesale electricity markets during the remainder of the year. In other cases, an NWA project may be capable of achieving the T&D deferral goal and maintaining system reliability while simultaneously participating in the ISO-NE wholesale electricity markets. In these instances, the revenue earned through participation in the ISO-NE wholesale electricity markets could reduce the cost to customers of implementing energy storage resources in NWA applications. ISO-NE’s market rules require that if a resource participates in the wholesale markets as a modelled generator at any point throughout the year, the operation of that facility falls under the jurisdiction of ISO-NE and must meet the requirements for dispatch and scheduling in the Day-Ahead and Real-Time energy markets specific to that resource size and class. Participating as a modelled generator is also required for the ESS to provide wholesale ancillary products, such as frequency regulation. This can be an impediment to NWA projects participating in the ISO-NE markets, as the EDC must maintain the ability to dispatch the underlying energy storage resource at times when it is required to

⁵ Federal Energy Regulatory Commission Docket Nos. RM16-23-000; AD16-20-000; Order No. 841 at i.

maintain reliability, and the timing of these dispatches may not align with the timing required to ensure that ISO-NE schedules the resource for dispatch.

FERC is currently exploring the issue of dual participation of energy storage resources from a policy and operational standpoint in Docket No. AD16-25-000. If energy storage projects in T&D deferral use cases are authorized to participate in the ISO-NE markets it will lower the cost to customers to fund these types of investments and make energy storage technologies more cost-competitive with traditional infrastructure upgrades.

Market Barriers: DC Coupled Solar Facilities with Storage

National Grid is aware that many solar facility developers seek to pair their solar capacity with battery storage capacity to take advantage of the Commonwealth's SMART program storage adder and enhance the operational capabilities of the solar generation asset. Many of these are designed to be co-located and AC-connected, meaning that each component, the solar PV and battery storage system, has its own dedicated inverter(s) and the battery charges from AC-power flowing into its inverter. However, an increasingly popular design is to connect the battery storage to the solar PV output behind the inverter, or multiple inverters, as a direct current (DC) connection. Such systems have combined AC output for both resources.

This type of connection is allowed by National Grid's Standards for Interconnection of Distributed Resources, and the regulations of the SMART program from DOER. ISO-NE also does not restrict DC-coupled solar and storage from connecting to and participating as an energy exporter. However, DC-coupling creates limitations for such systems to participate in ISO-NE markets. At present, ISO-NE indicates that it will allow solar-plus-storage "combined assets" to register and participate in ISO-NE's real-time energy market, but such participation may only be as a "settlement only generator," or SOG. ISO-NE will not allow such facilities to register as modelled generators, apparently due to constraints in its generation dispatch modelling software, and as such DC-coupled assets will not be able to participate in ancillary service markets, such as frequency regulation and generation reserve markets. This market constraint will limit the potential benefits from and market-based financial support to those resources until it is addressed by ISO-NE.

H. Recommendations for Future Energy Storage Programs and Policies

Clean Peak Standard

In 2019, National Grid expects that DOER will continue with and potentially conclude the process of developing and promulgating regulations to implement the Clean Peak Standard, which was enacted on August 9, 2018, when Governor Baker signed into law An Act to Advance Clean Energy. Included in this statute was the addition of the Clean Peak Standard. This section of the law requires DOER to establish a baseline minimum

percentage of kWh sales to end use customers that shall be met with Clean Peak Certificates (“CPCs”). As part of the regulations DOER can include the following: (i) establishment of seasonal peak periods; (ii) methodology by which CPC values shall be established, which may include a process by which the EDCs competitively procure CPCs from Clean Peak Resources (“CPRs”) and enter into Long Term Contracts, subject to approval from the Department of Public Utilities (“Department”); (iii) establishment of minimum percentage of CPCs that must be derived from demand response resources; (iv) an alternative compliance mechanism for retail electricity suppliers; and (v) procedures by which each retail electricity supplier shall annual submit for DOER’s review and filing demonstrating its compliance with the requirement of this section.

Energy storage is a central element of the Clean Peak Standard, as it is defined to qualify for the CPS when it is “primarily charge by eligible renewable resources.” National Grid sees the development of the CPS as an opportunity for DOER to advance the Commonwealth’s energy storage goals while also addressing GHG and local pollutants, and the high costs associated with periods of peak demand.

Each EDC submitted its specific comments on the Clean Peak Standard in response to DOER’s 36 initial stakeholder questions.

Installed Projects																									
Energy Storage System																			Generation						
DG WR Number	Common Project Name	Policy Source 1	Policy Source 2	Other - Source	Year Installed	Customer Type	City/Town	Technology Type	Other - Technology	Manufacturer	Energy kWh (DC)	Capacity kW (DC)	Energy kWh (AC)	Capacity kW (AC)	Installation Type	Application/ Intended Use #1	Application/ Intended Use #2	Application/ Intended Use #3	Other - Application/ Intended Use	DG WR Number	Storage Co-Located with DG/ Generation?	System Configuration Type	DG/ Generation Type	Capacity kW (DC)	Capacity kW (AC)
20270685	Vionx Energy - Holy Name High School	Utility-Owned Storage R&D			2015	Utility-Owned Distribution	WORCESTER	Flow Battery		Vionx Energy	3,180	530	3,000	500	FTM	Renewable Energy Integration (e.g., Ramping, Smoothing)	Customer Bill Savings (e.g., Demand Charge Management, TOU Arbitrage)	Wholesale Market (i.e., Energy, Capacity, Ancillary Services)		20270685	Yes	AC Coupled	Wind Turbine		600
19351038	Solar phase II - Patterson Rd, Shirley	Utility-Owned Storage R&D			2017	Utility-Owned Distribution	SHIRLEY	Lithium Ion		Tesla			1,000	500	FTM	Renewable Energy Integration (e.g., Ramping, Smoothing)	Peak Shaving/ Load Leveling	Power Quality (e.g., Voltage/VAR Support)		23564918	Yes	AC Coupled	Solar PV	530	500
173816					2018	Commercial	NANTUCKET	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		11
162623					2018	Industrial	NORTH ANDOVER	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		11
177730					2018	Residential	ANDOVER	Lithium Ion		Tesla			27	10	BTM						Yes	AC Coupled	Solar PV		20
178069					2018	Residential	NORTH ANDOVER	Lithium Ion		Tesla			27	10	BTM						Yes	AC Coupled	Solar PV		20
178419					2018	Residential	ANDOVER	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		19
172168					2018	Residential	SEEKONK	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		17
186415					2018	Residential	NORTHAMPTON	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		14
187717					2018	Residential	ROCKPORT	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		14
161654					2018	Residential	NORTHBOROUGH	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		13
166770					2018	Residential	SEEKONK	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		13
160119					2018	Residential	HARVARD	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		12
162629					2018	Residential	NORTH ANDOVER	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		12
167700					2018	Residential	WESTMINSTER	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		10
178240					2018	Residential	NEWBURY	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		10
184850					2018	Residential	LINWOOD	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		10
189988					2018	Residential	LANCASTER	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		10
196522		MA - SMART Program			2018	Residential	FOXBORO	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		10
197623		MA - SMART Program			2018	Residential	N BILLERICA	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		10
198903		MA - SMART Program			2018	Residential	TOPSFIELD	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		10
168823					2018	Residential	UPTON	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		10
170684					2018	Residential	HAMILTON	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		10
171438					2018	Residential	REVERE	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		9
148173					2017	Residential	ATTLEBORO	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
162079					2018	Residential	WORCESTER	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
162533					2018	Residential	W STOCKBRIDGE	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
162751					2018	Residential	WEYMOUTH	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
166159					2018	Residential	WESTMINSTER	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
166355					2018	Residential	SOUTHBRIDGE	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
166357					2018	Residential	LOWELL	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
166920					2018	Residential	GLOUCESTER	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
168459					2018	Residential	MANCHESTER	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
168812					2018	Residential	WESTPORT	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
170735					2018	Residential	LAWRENCE	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
171535					2018	Residential	LEEDS	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
171670					2018	Residential	LOWELL	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
173514					2018	Residential	MILFORD	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
173653					2018	Residential	CLINTON	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
172456					2018	Residential	WORCESTER	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
172531					2018	Residential	BROCKTON	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
172586					2018	Residential	FLORENCE	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
173035					2018	Residential	RANDOLPH	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
173112					2018	Residential	CHARLTON	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
173982					2018	Residential	BROCKTON	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
177286					2017	Residential	NORWELL	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
183631					2018	Residential	DUNSTABLE	Lithium Ion		Tesla			13.5	5	BTM						Yes	AC Coupled	Solar PV		8
18383																									

Pipeline Projects																										
Energy Storage System																										
DG WR Number	Common Project Name	Policy Source 1	Policy Source 2	Other - Source	Interconnection Status	Customer Type	City/Town	Year	Technology Type	Other - Technology	Manufacturer	Energy kWh (DC)	Capacity kW (DC)	Energy kWh (AC)	Capacity kW (AC)	Installation Type	Application/ Intended Use #1	Application/ Intended Use #2	Application/ Intended Use #3	Other - Application/ Intended Use	DG WR Number	Storage Co-located with DG/ Generation?	System Configuration Type	DG/ Generation Type	Capacity kW (DC)	Capacity kW (AC)
23564918	Vionx Energy - Groton Rd, Shirley	Utility-Owned Storage-R&D			ISA Issued	Utility-Owned Distribution	SHIRLEY	2017	Flow Battery		Vionx Energy	3,180	530	3,000	500	FTM	Renewable Energy Shifting	Customer Bill Savings (e.g., Demand Charge Management, TOU Arbitrage)	Wholesale Market (i.e., Energy, Capacity, Ancillary Services)		23564918	Yes	AC Coupled	Solar PV	991	1,000
24079885	Solar phase III - NEDC	Utility-Owned Storage-R&D			Application Submitted	Utility-Owned Distribution	NORTHBRIDGE	2017	Lithium Ion		Power Electronics/ Princeton Power			2,000	1,750	FTM	Renewable Energy Shifting	Power Quality (e.g., Voltage/VAR Support)	Reliability and Resiliency		24079885	Yes	AC Coupled	Solar PV	3,600	3,220
24231710	Solar phase III - Stafford St, Leicester	Utility-Owned Storage-R&D			Application Submitted	Utility-Owned Distribution	LEICESTER	2017	Lithium Ion		NEC	1,020		990	560	FTM	Renewable Energy Shifting	Power Quality (e.g., Voltage/VAR Support)	Reliability and Resiliency		24231710	Yes	AC Coupled	Solar PV	1,361	1,475
23580296	Solar phase III - Horne Homestead Rd, Charlton	Utility-Owned Storage-R&D			Application Submitted	Utility-Owned Distribution	CHARLTON	2017	Lithium Ion		NEC	2,040		1,980	1,120	FTM	Renewable Energy Shifting	Power Quality (e.g., Voltage/VAR Support)	Reliability and Resiliency		23580296	Yes	AC Coupled	Solar PV	1,978	2,000
24210886	Solar phase III - Cedar Rd, Attleboro	Utility-Owned Storage-R&D			ISA Issued	Utility-Owned Distribution	ATTLEBORO	2017	Lithium Ion		NEC	1,020		990	560	FTM	Renewable Energy Shifting	Power Quality (e.g., Voltage/VAR Support)	Reliability and Resiliency		24210886	Yes	AC Coupled	Solar PV	2,518	2,399
178048	Solar phase III - Bearfoot Road, Northborough	Utility-Owned Storage-R&D			ISA Issued	Utility-Owned Distribution	NORTHBOROUGH	2017				500	250			FTM					178048	Yes	DC Coupled	Solar PV		
	Nantucket BESS - Bunker Road	Utility-Owned Storage-T&D				Utility-Owned Transmission	NANTUCKET		Lithium Ion		Tesla			48,000	6,000	FTM	Reliability and Resiliency	T&D Asset Deferral				Yes	AC Coupled	Diesel/Grid supplied		10,000
176307	ACES - Brockton Walmart	MA - DOER/ MassCEC Funded Projects				Commercial	BROCKTON		Lithium Ion		Lockheed Martin			1,000	500	BTM	Renewable Energy Integration (e.g., Ramping, Smoothing)	Customer Bill Savings (e.g., Demand Charge Management, TOU Arbitrage)			Yes	AC Coupled	Solar PV	252		
	ACES - Leicester Walmart	MA - DOER/ MassCEC Funded Projects				Commercial	LEICESTER		Lithium Ion		Lockheed Martin			1,000	500	BTM	Renewable Energy Integration (e.g., Ramping, Smoothing)	Customer Bill Savings (e.g., Demand Charge Management, TOU Arbitrage)	Peak Shaving/ Load Leveling		Yes	AC Coupled	Solar PV			
202096	ACES - UMass/ Marlborough Memorial Hospital	MA - DOER/ MassCEC Funded Projects	MA - SMART Program		Application Submitted	Commercial	MARLBOROUGH	2018	Flow Battery		ViZn Energy Systems			800	125	BTM	Microgrid	Customer Bill Savings (e.g., Demand Charge Management, TOU Arbitrage)	Peak Shaving/ Load Leveling		Yes	AC Coupled	CHP + Solar PV		450	
	ACES - Tesla Nantucket Residential	MA - DOER/ MassCEC Funded Projects				Residential	NANTUCKET		Lithium Ion		Tesla			6,750	2,500	BTM	T&D Asset Deferral	Customer Bill Savings (e.g., Demand Charge Management, TOU Arbitrage)	Reliability and Resiliency		No	AC Coupled				
	ACES - Sunrun/ National Grid Ventures	MA - DOER/ MassCEC Funded Projects				Residential	VARIOUS TOWNS		Lithium Ion		Sunrun/ LG Chem			1,860	1,000	BTM	Renewable Energy Integration (e.g., Ramping, Smoothing)	Reliability and Resiliency	Customer Bill Savings (e.g., Demand Charge Management, TOU Arbitrage)		Yes	AC Coupled	Solar PV			
	DOER Peak Demand Reduction Grant - Tesla Residential	MA - DOER/ MassCEC Funded Projects				Residential	VARIOUS TOWNS		Lithium Ion		Tesla			2,430	900	BTM	Peak Shaving/ Load Leveling				Yes	AC Coupled	Solar PV			
	DOER Peak Demand Reduction Grant - Genbright Residential	MA - DOER/ MassCEC Funded Projects				Residential	NANTUCKET		Thermal Storage		Genbright			6,020	3,010	BTM	Peak Shaving/ Load Leveling	T&D Asset Deferral			No	AC Coupled				
177840		MA - SMART Program			ISA Issued	Commercial	NORTHBRIDGE	2017						8,000	4,000						Yes	AC Coupled	Solar PV		8,980	
178146					Application Submitted	Commercial	BELCHERTOWN	2017						6,020	3,010						Yes	AC Coupled	Solar PV		9,380	
178147					Application Submitted	Commercial	BELCHERTOWN	2017						8,000	4,000						Yes	AC Coupled	Solar PV		9,380	
178148					Application Submitted	Commercial	BELCHERTOWN	2017						8,000	4,000						Yes	AC Coupled	Solar PV		9,380	
178149					Application Submitted	Commercial	BELCHERTOWN	2017						8,000	4,000						Yes	AC Coupled	Solar PV		9,380	
178150					Application Submitted	Commercial	BELCHERTOWN	2017						8,000	4,000						Yes	AC Coupled	Solar PV		9,380	
17841		MA - SMART Program			ISA Issued	Commercial	NORTHBRIDGE	2017						8,000	4,000						Yes	AC Coupled	Solar PV		8,980	
178492		MA - SMART Program			ISA Issued	Commercial	NORTHBRIDGE	2017						2,000	1,000						Yes	AC Coupled	Solar PV		8,980	
178151					Application Submitted	Commercial	BELCHERTOWN	2017						8,000	4,000						Yes	AC Coupled	Solar PV		8,980	
178179					Application Submitted	Commercial	BELCHERTOWN	2017						8,000	4,000						Yes	AC Coupled	Solar PV		8,980	
178180					Application Submitted	Commercial	BELCHERTOWN	2017						8,000	4,000						Yes	AC Coupled	Solar PV		8,980	
178493		MA - SMART Program			ISA Issued	Commercial	NORTHBRIDGE	2017						8,000	4,000						Yes	AC Coupled	Solar PV		8,980	
178572		MA - SMART Program			ISA Issued	Commercial	MILLBURY	2017						8,000	4,000						Yes	AC Coupled	Solar PV		8,730	
178105					Application Submitted	Commercial	PHILLIPSTON	2017						3,750	3,750						Yes	AC Coupled	Solar PV		8,730	
178110					Application Submitted	Commercial	HUBBARDSTON	2017						3,750	3,750						Yes	AC Coupled	Solar PV		8,730	
178463					ISA Issued	Commercial	BLACKSTONE	2017						2,340	6,000						Yes	AC Coupled	Solar PV		3,638	
178795		MA - SMART Program			ISA Issued	Commercial	PLAINVILLE	2017						4,638	2,310						Yes	AC Coupled	Solar PV		7,260	
178050					ISA Issued	Commercial	BARRE	2017						4,620	2,240						Yes	AC Coupled	Solar PV		6,740	
185409					Application Submitted	Commercial	DUNSTABLE	2017					20,000	5,000							Yes	DC Coupled	Solar PV		8,300	
178055					Application Submitted	Commercial	ATHOL	2017						2,240	2,240						Yes	AC Coupled	Solar PV		8,148	
192365					Application Submitted	Commercial	PALMER	2018						5,658	3,000						Yes	AC Coupled	Solar PV		7,959	
184857					Application Submitted	Commercial	LANCASTER	2017						1,800	3,000						Yes	AC Coupled	Solar PV		7,980	
178155					Application Submitted	Commercial	BELLINGHAM	2017						16,800	2,800						Yes	AC Coupled	Solar PV		7,680	
177920					Application Submitted	Commercial	WINCHENDON	2017						5,280	2,640						Yes	AC Coupled	Solar PV		7,640	
178051		MA - SMART Program			ISA Issued	Commercial	PALMER	2017						4,620	2,240											

186432					Full Payment Received	Residential	ANDOVER	2017	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			
189490					Full Payment Received	Residential	ESSEX	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			
178174	MA - SMART Program				ISA Issued	Residential	FLORENCE	2017	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			
186384	MA - SMART Program				ISA Issued	Residential	NORTH EASTON	2017	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
186757					ISA Issued	Residential	RANDOLPH	2017	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
188740					ISA Issued	Residential	METHUEN	2017	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
189551					ISA Issued	Residential	METHUEN	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
190277	MA - SMART Program				ISA Issued	Residential	MENDON	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
190719	MA - SMART Program				ISA Issued	Residential	BROCKTON	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
202729	MA - SMART Program				Application Submitted	Residential	WESTFORD	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			10
194320					ISA Issued	Residential	LOWELL	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
194659					ISA Issued	Residential	DRACUT	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
191419					ISA Issued	Residential	NORTH OXFORD	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
193221	MA - SMART Program				ISA Issued	Residential	LEOMINSTER	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
192438					ISA Issued	Residential	METHUEN	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
193047					ISA Issued	Residential	WILBRAHAM	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
193373	MA - SMART Program				ISA Issued	Residential	NORTHAMPTON	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
197508					ISA Issued	Residential	NORTHBOROUGH	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
187912	MA - SMART Program				Full Payment Received	Residential	NORTH QUINCY	2017	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
197842	MA - SMART Program				ISA Issued	Residential	HAVERHILL	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
197857	MA - SMART Program				ISA Issued	Residential	SCITUATE	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
198566					ISA Issued	Residential	LAWRENCE	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
190453					Full Payment Received	Residential	RANDOLPH	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
199977	MA - SMART Program				ISA Issued	Residential	BOLTON	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
200622	MA - SMART Program				ISA Issued	Residential	BILLERICA	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
206678	MA - SMART Program				ISA Issued	Residential	WENHAM	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
203075	MA - SMART Program				ISA Issued	Residential	SOUTHBRIDGE	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
204063	MA - SMART Program				ISA Issued	Residential	METHUEN	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
197699	MA - SMART Program				ISA Issued	Residential	S HAMILTON	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			6
159375					ISA Issued	Residential	WORCESTER		Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			6
201010					ISA Issued	Residential	SAUGUS	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			5
173543					ISA Issued	Residential	WESTBOROUGH		Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			5
193952	MA - SMART Program				ISA Issued	Residential	E LONGMEADOW	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			5
192755	MA - SMART Program				ISA Issued	Residential	MANCHESTER	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			4
198971	MA - SMART Program				Full Payment Received	Residential	MILFORD	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			4
196581					ISA Issued	Residential	BROCKTON	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			4
199757	MA - SMART Program				Full Payment Received	Residential	NORTON	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8
178635					Full Payment Received	Residential	DRACUT	2017	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			5
197736	MA - SMART Program				Full Payment Received	Residential	ROCKPORT	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			4
170773					ISA Issued	Residential	ANDOVER		Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
173388					ISA Issued	Residential	DRACUT		Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
173891					ISA Issued	Residential	AVON		Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
172244					ISA Issued	Residential	BROCKTON		Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
172580					ISA Issued	Residential	SHUTESBURY		Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
172860					ISA Issued	Residential	SCITUATE		Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
183752					ISA Issued	Residential	TOPSFIELD	2017	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
185639					ISA Issued	Residential	WESTFORD	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
186856					ISA Issued	Residential	GLOUCESTER	2017	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
189024					ISA Issued	Residential	BOXFORD	2017	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
197819					ISA Issued	Residential	TOPSFIELD	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
199765					ISA Issued	Residential	GLOUCESTER	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
206891					ISA Issued	Residential	ATHOL	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
202797					Application Submitted	Residential	ANDOVER	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
201831	MA - SMART Program				ISA Issued	Residential	FOXBORO	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
202902					ISA Issued	Residential	SUTTON	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
203369					Application Submitted	Residential	BOXPORD	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
203337	MA - SMART Program				ISA Issued	Residential	NORWELL	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
203444					ISA Issued	Residential	WESTBOROUGH	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
204210					Application Submitted	Residential	GLOUCESTER	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
204363					Application Submitted	Residential	WESTPORT	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
203910					ISA Issued	Residential	MANCHESTER	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			0
194521					Full Payment Received	Residential	NORTH ANDOVER	2018	Lithium Ion	Tesla	13.5	5 BTM						Yes	AC Coupled	Solar PV			8