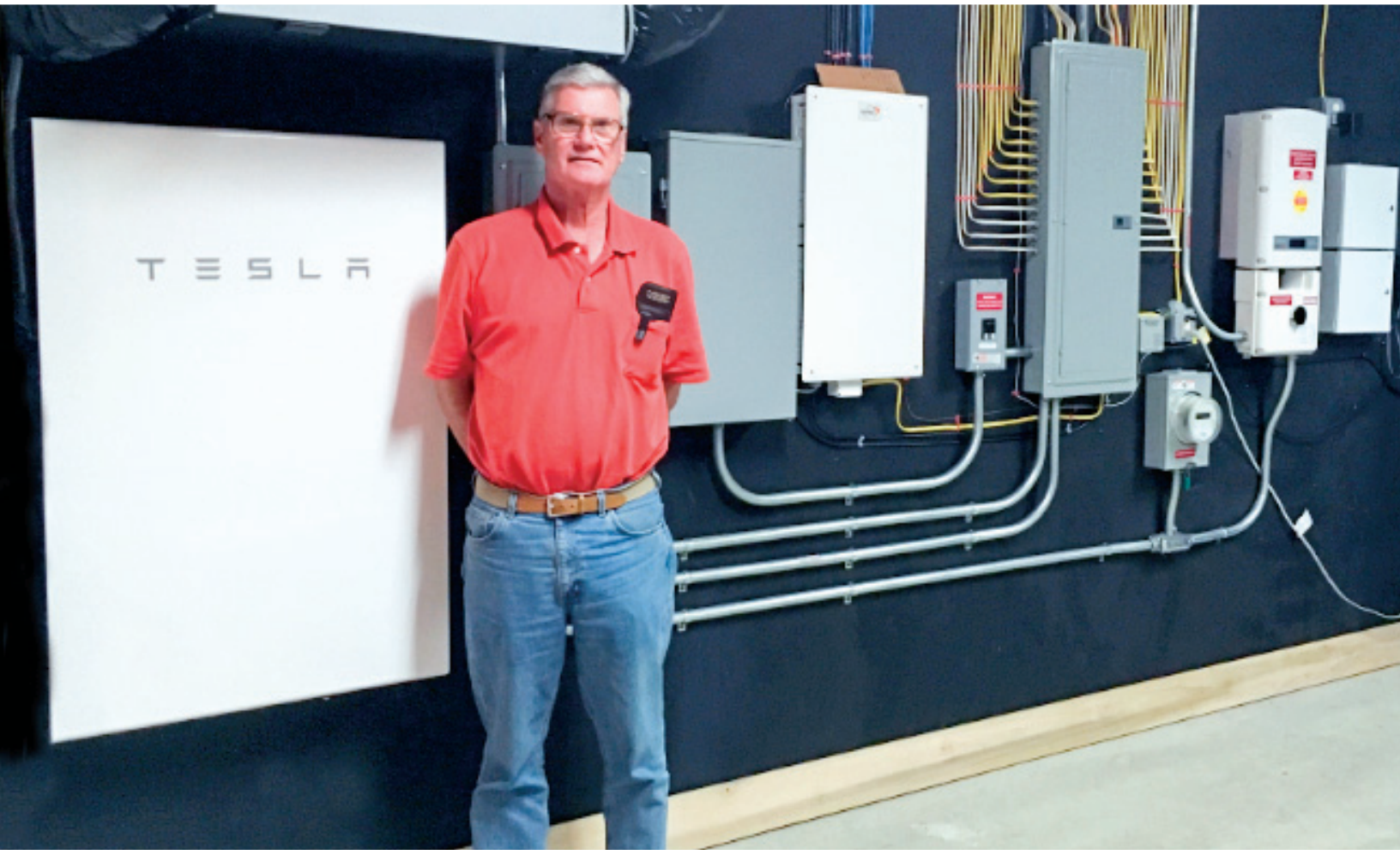
ConnectedSolutions

A PROGRAM ASSESSMENT FOR MASSACHUSETTS



Prepared by Applied Economics Clinic for Clean Energy Group

SEPTEMBER 2021

Applied Economics Clinic
Economic and Policy Analysis of Energy, Environment and Equity

CleanEnergyGroup

About This Report

This report, prepared by the Applied Economics Clinic (AEC) on behalf of Clean Energy Group (CEG), presents an assessment of the ConnectedSolutions customer battery program, as it has been administered in Massachusetts in its first three-year cycle, from 2019 through the report's publication date in September 2021. The report describes the ConnectedSolutions program, discusses how it has been implemented, and provides recommendations for program administrators and state policymakers to consider when revising the program for the 2022-2024 cycle of the Massachusetts Three-Year Energy Efficiency Plan.

Clean Energy Group previously advocated for the addition of energy storage as a demand reducing measure within the Massachusetts energy efficiency program. In the course of this work, CEG contracted with AEC to produce a cost-benefit analysis for behind-the-meter energy storage in Massachusetts, and also for analysis valuing seven non-energy benefits of energy storage. This prior work was published in CEG's April 2019 report, *Energy Storage: The New Efficiency - How States Can Use Efficiency Funds to Support Battery Storage and Flatten Costly Demand Peaks*. CEG followed this with two additional reports published in February 2021: *ConnectedSolutions: A New State Funding Mechanism to Make Battery Storage Accessible to All* and *ConnectedSolutions: The New Economics of Solar+Storage for Affordable Housing in Massachusetts*. The current report represents a furtherance of this earlier work. Learn more about CEG's work on energy storage policy at www.cleanegroup.org.

Acknowledgments

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About the Applied Economics Clinic

Founded in 2017, the Applied Economics Clinic (AEC) is a mission-based non-profit consulting group that offers expert services in the areas of energy, environment, consumer protection, and equity from seasoned professionals while providing on-the-job training to the next generation of technical experts. AEC's clients are primarily public interest organizations who work on issues related to AEC's areas of expertise and our work products include expert testimony, analysis, modeling, policy briefs, and reports. AEC works proactively to support and promote diversity in our areas of work by providing applied, on-the-job learning experiences. AEC is based at 1012 Massachusetts Avenue, Arlington, Massachusetts, 02476. Find out more at www.aeclinic.org.

Cover photo courtesy of ReVision Energy.

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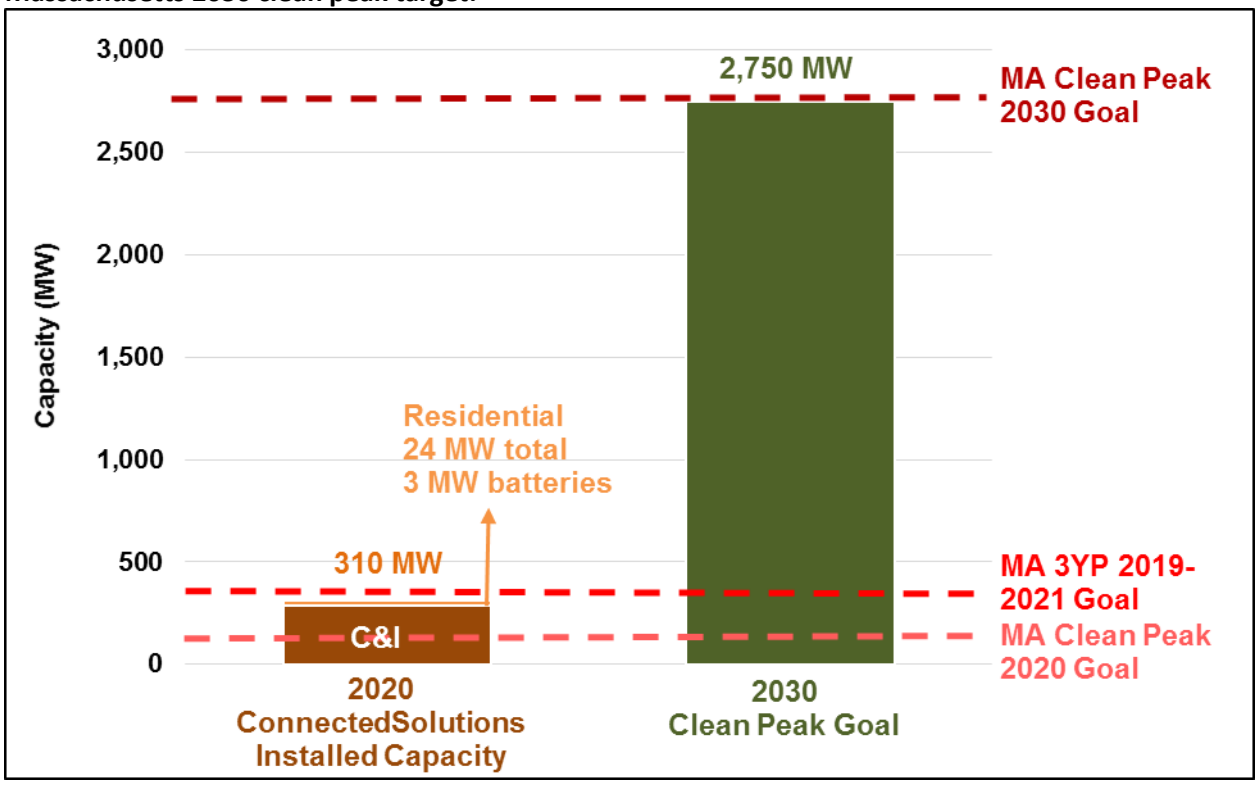
Executive Summary

On behalf of Clean Energy Group, this Applied Economics Clinic report assesses the design and performance of the Massachusetts ConnectedSolutions program. Massachusetts' ConnectedSolutions program offers incentives to customers in exchange for allowing their electric supplier to draw on the energy stored in their grid-connected batteries and/or to curtail energy use via smart thermostats or electric vehicle charging at times of peak electric demand. Launched as a full program offering in 2019, ConnectedSolutions had about 34,000 customer participants with 310 megawatts (MW) of capacity enrolled by the end of 2020—more than triple the 2020 goal of Massachusetts' Clean Peak Energy Standard (100 MW) but 27 MW short of the Massachusetts energy efficiency program administrators' 2019-2021 Three-Year Plan state-wide cumulative peak demand reduction goal (337 MW, see Figure ES-1 below). If the ConnectedSolutions program were to increase between 2020 and 2030 to the amount necessary to meet the Commonwealth's 2030 clean peak target of 2,750 MW, ConnectedSolutions installed capacity would need to grow by approximately 800 percent (see Figure ES-1).

Figure ES-1. 2020 ConnectedSolutions total installed capacity and forecasted installed capacity to meet Massachusetts 2030 clean peak target.



Note: ConnectedSolutions 2020 installed commercial and industrial capacity totaled 286 MW—all of which was batteries. Residential installed capacity totaled 24 MW—3 MW of which was batteries. It is reasonable to expect that some of the 2030 clean peak goal will be met by utility-owned or merchant resources.

The Massachusetts ConnectedSolutions program is a nation-leading program that has reduced expensive peak demand, provided cost savings, enhanced resiliency for participating residential, commercial, and industrial customers, and it has contributed to meeting the Commonwealth's energy storage and clean peak goals. Initial results have been impressive; in the first three years of the program, overall participation nearly doubled from 2019 to 2020, and planned benefits relative to costs were significantly higher than had been anticipated based on preliminary cost-benefit analysis conducted by the program administrators.

It is important to note that, although the ConnectedSolutions battery program originated in Massachusetts, all six New England states have adopted some form of customer battery funding program.[1] Although these programs differ in their particulars, they share three core elements:

- All the New England customer battery programs provide incentives to the customer in the form of performance payments, through a contract with their electric utility. Some also employ other types of incentives, such as up-front rebates or low-cost/no-cost financing.
- All the New England customer battery programs enable the formation of virtual power plants—that is, a system of aggregated distributed battery resources that can be dispatched by the utility in concert during peak demand hours to lower costs associated with serving regional demand peaks.
- All the New England customer battery programs support customer resilience—that is, enrolled customers receive incentive payments during normal grid operations, but they can also use their battery systems to provide energy during grid outages. Resilience has been shown to be the most important benefit for residential battery customers.[2]

In this report, we compare the Massachusetts ConnectedSolutions program, as it has been administered in the first three-year program cycle, with related programs in other states across the country. In several important areas, the Massachusetts program administrators could benefit from best practices implemented elsewhere; chief among these is the treatment of income-eligible customers and those in historically underserved communities.

Lessons from the program's performance to date and program structures from related programs elsewhere in the country indicate four needed improvements to the Massachusetts ConnectedSolutions program (see Table ES-1).

[1] Olinsky-Paul, T. August 23, 2021. "Connecticut Powers into the Lead with Breakthrough Customer Battery Program." *Clean Energy Group*. Available at: https://www.cleanegroup.org/connecticut-powers-into-the-lead-with-breakthrough-customer-battery-program/.

[2] 1) Olinsky-Paul, T. August 2021. "Energy Storage Policy Best Practices from New England." *Clean Energy Group* and *Clean Energy States Alliance*. Available at: https://cdn.cesa.org/wp-content/uploads/Energy-Storage-Best-Practices-from-New-England.pdf. 2) Olinsky-Paul, T. February 11, 2021. "ConnectedSolutions: A New State Funding Mechanism to Make Battery Storage Accessible to All." *Clean Energy States Alliance*. Available at: https://www.cesa.org/resource-library/resource/connected-solutions-policy/.

Table ES-1. Recommended ConnectedSolutions program improvements for 2022-2024 energy efficiency program cycle

1)	Massachusetts should develop specific ConnectedSolutions income-eligible enrollment targets or carve-outs for its 2022-2024 energy efficiency and demand management plan, broken out by technology (including specific income-eligible battery enrollment targets).
2)	ConnectedSolutions should offer higher incentive rates for income-eligible customers. Other equity provisions, such as up-front rebates and on-bill payment, should also be considered.
3)	ConnectedSolutions administrators should provide more detailed program data to track progress towards the Commonwealth's energy storage goals.
4)	ConnectedSolutions needs to scale up rapidly to meet the Commonwealth's clean peak goals. To drive clean peak resource development at the scale desired, ConnectedSolutions must offer higher incentive rates and longer-term customer contracts.

Implementing these four improvements would help ensure that Massachusetts' next Three-Year Plan for energy efficiency and demand management is more in line with the Commonwealth's broader efficiency program and equity goals and is in the best possible position to meaningfully contribute to Massachusetts' long-term clean peak and energy storage goals.

The authors hope this report will prove useful to the Massachusetts ConnectedSolutions program administrators, the Energy Efficiency Advisory Council, the Commonwealth's energy agencies, and stakeholders.

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I. Introduction

Massachusetts' ConnectedSolutions program is a first-in-the-nation[3] initiative that offers electricity customers incentives to allow their electric supplier to draw on the energy stored in customer-owned or leased batteries and/or curtail energy use via the customers' smart thermostat or electric vehicle at times of peak electric demand. The goal of the ConnectedSolutions program is to increase efficiency across the electric system by lowering peak electric usage (the most expensive times to supply energy), lowering customer costs, and reducing the need to build excess system capacity. Customers who elect to participate are paid for the performance of their battery systems (or smart thermostat or electric vehicle) during peak periods, when they are called upon by utilities. When they are not actively being dispatched to provide peak reductions, these behind-the-meter (BTM) batteries may provide other customer services, such as demand charge management, solar PV integration and resilience.

A 2016 report—*State of Charge*—published by Massachusetts' Department of Energy Resources and the Massachusetts Clean Energy Center found that 40 percent of each year's electric expenditures in Massachusetts are devoted to the 10 percent of hours with the highest demand,[4] demonstrating just how much more expensive it is to meet electric demand during times of peak (high demand) than off-peak (low demand). Not only is meeting peak demand expensive, but it also contributes to harmful air emissions because the peaker power plants used to meet that demand are predominantly fossil fuel-fired plants.[5] Moreover, because the entire electricity supply system is sized to meet peak demand, the system is oversized relative to average electric demand. This means there is generation, transmission, and distribution capacity sitting idle much of the year that would not be needed if peak demand were reduced. The economic and environmental cost of peak demand was the impetus behind the Massachusetts Clean Peak Energy Standard, signed into law in 2018 as a result of the Senate's passage of *An Act to Advance Clean Energy*, a program that requires retail electric suppliers to meet a certain percentage of their sales with "clean peak resources" like battery storage.[6]

ConnectedSolutions represents the first program[7] designed to incorporate distributed battery storage into a state energy efficiency program for the purpose of meeting state peak electricity demand reduction

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[3] Olinsky-Paul, T. August 23, 2021. "Connecticut Powers into the Lead with Breakthrough Customer Battery Program." *Clean Energy Group*. Available at: https://www.cleanegroup.org/connecticut-powers-into-the-lead-with-breakthrough-customer-battery-program/.

[4] Massachusetts Department of Energy Resources; Massachusetts Clean Energy Center; Customized Energy Solutions, Ltd. 2016. *State of Charge: Massachusetts Energy Storage Initiative.* Available at: https://www.mass.gov/doc/state-of-charge-report/download.

[5] ISO New England. March 2021. "2019 ISO New England Electric Generator Air Emissions Report." Available at: https://www.iso-ne.com/static-assets/documents/2021/03/2019_air_emissions_report.pdf.

[6] Massachusetts Department of Energy Resources. N.d. "Clean Peak Energy Standard History of Program Development." *Mass.gov.* Available at: https://www.mass.gov/info-details/clean-peak-energy-standard-history-of-program-development.

[7] Olinsky-Paul, T. August 23, 2021. "Connecticut Powers into the Lead with Breakthrough Customer Battery Program." *Clean Energy Group*. Available at: https://www.cleanegroup.org/connecticut-powers-into-the-lead-with-breakthrough-customer-battery-program/.

goals. ConnectedSolutions was launched as a full program offering in 2019 by the Commonwealth's investor-owned electric utilities and Cape Light Compact, and by the end of 2020, had about 34,000 customer participants with 310 megawatts (MW) of capacity enrolled[8]—more than triple the 2020 clean peak goal (100 MW) of Massachusetts' Clean Peak Energy Standard,[9] although it has not yet met the energy efficiency program administrators' 2019-2021 Three-Year Plan state-wide cumulative peak demand reduction goal of 337 MW.[10]

On behalf of the Clean Energy Group, this Applied Economics Clinic report assesses the design and performance of the Massachusetts ConnectedSolutions program over its initial three-year implementation period, including its low-income specific provisions and how it has contributed to Massachusetts' clean peak and energy storage goals; compares the design of the ConnectedSolutions program with battery programs elsewhere across the United States; and recommends potential improvements to the ConnectedSolutions program for the upcoming 2022-2024 program cycle.

[8] 1) Mass Save. May 13, 2020. "Massachusetts Energy Efficiency Program Administrators Quarterly Report | Fourth Quarter, 2020". https://ma-eeac.org/wp-content/uploads/Quarterly-Report-of-the-PAs-2020-Q4-Final.pdf; 2) MA Energy Efficiency Advisory Council. 2020. "4th Quarter 2020 Program Administrators' Data". Master Data Tab. Available at: https://ma-eeac.org/results-reporting/quarterly-reports/.

[9] The Massachusetts Clean Peak Energy Standard is a program that sets mandatory clean peak targets for the state's electric utilities. It functions much like a renewable portfolio standard but is focused on certain pre-defined peak demand hours. For more information on this program, see https://www.mass.gov/clean-peak-energy-standard.

[10] Mass Save. October 31, 2018. *Massachusetts Joint Statewide Electric and Gas Three-Year Energy Efficiency Plan.* D.P.U. 18-110—D.P.U. 18-119. Exhibit 1. Available at: https://3jy14ha9u771r7qzn35g0s6c-wpengine.netdna-ssl.com/wp-content/uploads/2018/11/Exh_1_Final_Plan_10-31-18.pdf. p. 17. Note that the reported peak savings goal for the entire 2019-2021 period do not align with the annual 2019, 2020 and 2021 peak savings goals.

II. What is ConnectedSolutions?

The *Massachusetts Green Communities Act* (GCA) of 2008 requires—among other provisions—that the Commonwealth's investor-owned electric utilities (IOUs) (i.e., Eversource, National Grid and Unitil) develop and administer three-year energy efficiency plans that pursue all cost-effective efficiency and demand reduction measures (that is, any measure that results in greater benefits than costs must be made available to customers). The IOUs, together with Cape Light Compact (Compact), submit three-year energy efficiency and demand reduction plans for approval by the Massachusetts Department of Public Utilities (DPU), which also receives regular reporting on the electric suppliers' performance. Massachusetts' Energy Efficiency Advisory Council (EEAC) oversees the energy efficiency and demand reduction program administrators and makes their progress reports publicly available on the EEAC website.[11] The current Three-Year Plan spans the 2019 to 2021 period and targets energy savings averaging 2.7 percent of annual electric sales and summer peak savings of 694 megawatts (MW),[12] equal to 5 percent of Massachusetts' 2019 peak hour demand (14,888 MW).[13]

"ConnectedSolutions" refers to Massachusetts' battery and direct load control programs that are part of a broader Three-Year Plan offering known as "Active Demand Reduction (ADR)" that also includes additional direct load control (for example, via smart thermostats), demand response, and thermal storage programs.[14] The goal of all Massachusetts' ADR programs, including ConnectedSolutions, is to lower the cost of peak energy by allowing the electric suppliers to draw on customer-stored energy and/or curtail customer energy use during high-demand, expensive periods. ConnectedSolutions programs offer customer incentives (credits made to customer accounts with their electric supplier) in exchange for allowing the utility to (1) draw on the energy stored in customer-sited batteries, (2) curtail customer energy use via smart thermostats, and (3) delay electric vehicle charging during times of expensive peak demand.[15] Customer credits are calculated based on the average performance of their batteries when called upon.

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[11] MA Energy Efficiency Advisory Council. N.d. "Results & Reporting". Available at: https://ma-eeac.org/results-reporting/.

[12] Mass Save. October 31, 2018. *Massachusetts Joint Statewide Electric and Gas Three-Year Energy Efficiency Plan.* D.P.U. 18-110—D.P.U. 18-119. Exhibit 1. Available at: https://3jy14ha9u771r7qzn35g0s6c-wpengine.netdna-ssl.com/wp-content/uploads/2018/11/Exh_1_Final_Plan_10-31-18.pdf. p. 3

[13] ISO New England. 2020. CELT Report. Available at: https://www.iso-ne.com/system-planning/system-plans-studies/celt/.

[14] MA Energy Efficiency Advisory Council. November 5, 2020. *2022-2021 Planning Workshop #1 Briefing Document.* "Topic 2: Active Demand Management". Available at: https://ma-eeac.org/wp-content/uploads/ADM-Briefing-Workshop-1-11.3.20v2.pdf.

[15] MA Energy Efficiency Advisory Council. November 5, 2020. *2022-2021 Planning Workshop #1 Briefing Document.* "Topic 2: Active Demand Management". Available at: https://ma-eeac.org/wp-content/uploads/ADM-Briefing-Workshop-1-11.3.20v2.pdf.

After a demonstration period conducted by Eversource, National Grid, and Unitil during the summers of 2016 to 2019, ConnectedSolutions was launched in 2019 as a full program offering across all IOUs and the Compact. ConnectedSolutions includes battery program offerings to residential, commercial, and industrial customers. Commercial and industrial customers receive incentives to enroll their batteries in one or two of the three offered dispatch programs (summer targeted dispatch, summer daily dispatch and winter dispatch). Residential customers receive incentives to enroll their battery in a summer and/or winter dispatch program (known as the "Bring Your Own Device (BYOD)" program) that allows for load reductions behind the meter as well as providing power back to the grid. In addition to these battery programs, residential customers are also offered incentives to enroll their smart thermostat or electric vehicle in a load-reduction program (with electric vehicle incentive amounts that remain to be determined—see Table 1).

Table 1. 2019-2021 Three-Year Plan ConnectedSolutions program options

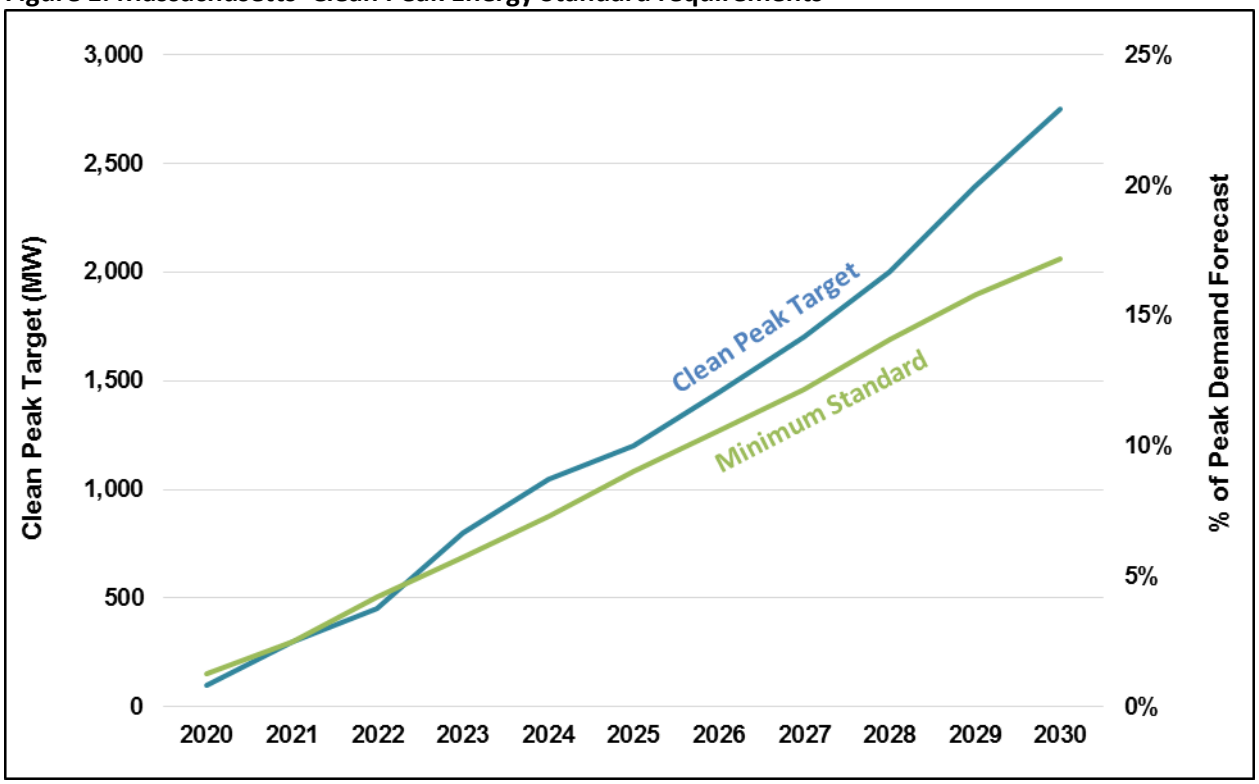
		Number of events	Hours per event	Summer incentive	Winter incentive
Residential	Battery	30 to 60	2 to 3	$225/kW	$50/kW
	Thermostat	13 to 17	3	No seasonal distinction: $25 for signing up and $20 per year	
	Electric Vehicle	2 to 8	3	No seasonal distinction: $150 for signing up and $50 per year*	
Commercial and Industrial	Targeted dispatch	3 to 8	3	$35/kW*	N/A
	Daily dispatch	30 to 60	2 to 3	$200/kW	N/A
	Winter dispatch	5	3	N/A	$25/kW

**Notes: Only Eversource currently offers incentives for its residential electric vehicle program, the same program is not yet active for the other utilities. The summer incentive for Eversource's targeted dispatch program is $100/kW. Sources: 1) MA Energy Efficiency Advisory Council. November 5, 2020. 2022-2021 Planning Workshop #1 Briefing Document. "Topic 2: Active Demand Management". Available at: https://ma-eeac.org/wp-content/uploads/ADM-Briefing-Workshop-1-11.3.20v2.pdf. 2) Eversource. N.d. "EV Home Charger Demand Response". Available at: https://www.eversource.com/content/ema-c/residential/save-money-energy/explore-alternatives/electric-vehicles/ev-charger-demand-response.*

ConnectedSolutions is related to—but separate from—the Massachusetts Clean Peak Energy Standard. Signed into law in 2018 as a result of the Senate's passage of *An Act to Advance Clean Energy*, the Clean Peak Energy Standard requires retail electric suppliers to meet a certain percentage of their sales with

"clean peak resources" like battery storage.[16] As of 2020, the standard required 100 MW of clean peak resources, equal to 1.5 percent of electric sales—the percentage must grow by at least 1.5 percentage points each year, reaching 46.5 percent in 2050.[17] The Clean Peak Energy Standard's goals increase rapidly between 2020 and 2030 (see **Figure 1**), when the program aims to achieve a minimum of 2,063 MW and, ideally, 2,750 MW of clean peak resources—equal to 16.5 percent and 22 percent, respectively, of forecasted peak demand those years. According to a cost-benefit analysis performed by the Massachusetts Department of Energy Resources, the Clean Peak Energy Standard will reduce emissions by more than 560,000 metric tons of carbon dioxide equivalent between 2020 and 2030, with net ratepayer savings of $390 million per year.[18]

Figure 1. Massachusetts' Clean Peak Energy Standard requirements



Source: Massachusetts Department of Energy Resources. 2018. Clean Peak Energy Portfolio Standard (CPS). Available at: https://www.mass.gov/doc/225-cmr-21-clean-peak-energy-portfolio-standard-cps/download.

[16] Massachusetts Department of Energy Resources. N.d. "Clean Peak Energy Standard History of Program Development." *Mass.gov.* Available at: https://www.mass.gov/info-details/clean-peak-energy-standard-history-of-program-development.

[17] Massachusetts Department of Energy Resources. N.d. "225 CMR 21.00: CLEAN PEAK ENERGY PORTFOLIO STANDARD (CPS)." *Mass.gov.* Available at: https://www.mass.gov/doc/225-cmr-21-clean-peak-energy-portfolio-standard-cps/download.

[18] Mass.gov. May 12, 2020. "MA Leading by Example Council." Available at: https://www.mass.gov/doc/may-12-2020-lbe-council-presentation-responding-to-peak-demand/download. Slide 73.

ConnectedSolutions customers may receive both ConnectedSolutions and Clean Peak Energy Standard incentives.[19] Performance in ConnectedSolutions is evaluated according to the "ConnectedSolutions Performance Calculation," regardless of a customer's participation in the Clean Peak Energy Standard.[20] Performance payments under the ConnectedSolutions and Clean Peak Energy Standard programs are stacked; that is, if a battery is dispatched for ConnectedSolutions and the timing aligns with a Clean Peak Energy Standard dispatch period, that battery customer can be compensated by both programs.[21] Other kinds of savings may also be stacked; for example, a commercial customer may realize demand charge savings on their electric bill from discharging a battery in response to a ConnectedSolutions dispatch call, and customers installing solar and battery storage may be eligible for additional incentives from the Solar Massachusetts Renewable Target (SMART) solar incentive program.

ConnectedSolutions and Low-Income Residential Customers

As part of its 2019 and 2020 priorities,[22] Massachusetts EEAC requested that efficiency program administrators provide quarterly updates on battery storage program offerings and their implementation progress—including "[p]rogram enhancements for renters, moderate income, non-English speaking, and small business, including the new renter participation regular tracking and reporting."[23] In 2020, the EEAC noted its expectation that "all [program administrators] will continue to offer and ADR offerings in line with approved 2020 budgets and savings levels."[24]

Massachusetts' current Three-Year Plan promised 175 participants and over 673 kilowatts (kW) of net summer capacity savings from income-eligible residential customers[25] (defined according to the number of people in a household—up to $39,105 for a one-person household and up to $75,301 for a four-person household[26]) in ConnectedSolutions and other demand response programs over the 2019-2021 period (see **Table 2**; given publicly available data, it is impossible to determine whether these goals have been met). The 2019-2021 Three-Year Plan also noted that ADR programs are "available to all residential and low-

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[19] Mass Save. 2021. *Program Materials for ConnectedSolutions for Commercial/Industrial Customers*. Available at: https://www.nationalgridus.com/media/pdfs/bus-ways-to-save/connectedsolutions-ciprogrammaterials.pdf. p.8.

[20] Ibid. p.10.

[21] Olinsky-Paul, T. February 2021. Connected Solutions: A New State Funding Mechanism to Make Battery Storage Accessible to All. Clean Energy Group. Available at: https://www.cleanegroup.org/wp-content/uploads/connected-solutions-policy.pdf.

[22] Massachusetts Energy Efficiency Advisory Council. 2019. *Final 2019 EEAC Priorities.* Available at: https://ma-eeac.org/wp-content/uploads/MA-EEAC-Council-Priorities-2019.pdf; Massachusetts Energy Efficiency Advisory Council. 2020. *Draft* 2020 *EEAC Priorities.* Available at: https://ma-eeac.org/wp-content/uploads/DRAFT-2020-EEAC-Priorities-4.6.2020.pdf.

[23] Ibid. p.3.

[24] Ibid. p.2.

[25] Note that that the reported summer peak reduction goal for the entire 2019-2021 period is not the same as the result of summing the annual 2019, 2020 and 2021 peak savings goals for the residential and commercial/industrial sectors (except for the peak saving goals for the income eligible sector).

[26] MassSave. 2021. Income Eligible Programs. Available at: https://www.masssave.com/saving/income-based-offers/income-eligible-programs.

income customers and [include] a direct load control offering and a storage performance offering."[27] The inclusion of income-eligible participants would be in line with general three-year energy efficiency program guidelines, as well as with the Affordable Access to Clean and Efficient Energy Initiative ("Affordable Access Initiative") adopted by Massachusetts in 2016.[28]

Table 2. Projected Three-Year Plan participants (#) and summer net savings (kW) for income eligible ADR

Income Eligible ADR	Annual Incremental			Cumulative
	2019	2020	2021	2019-2021
Participants (#)	0	75	100	175
Net Savings (kW)	0	289	385	673

Source: Recreated from Mass Save. October 31, 2018. Massachusetts Joint Statewide Electric and Gas Three-Year Energy Efficiency Plan: 2019-2021. Exhibit 1, Appendix C. Available at: https://3jy14ha9u771r7qzn35q0s6c-wpengine.netdna-ssl.com/wp-content/uploads/2018/11/Exh_1_Final_Plan_10-31-18.pdf. p.30-31.

At the time of the approval of the current Three-Year Plan, the Compact proposed (1) a "Cape and Vineyard Electrification Offering" (CVEO)—which aimed to provide battery storage, solar panels and air source heat pumps to 700 participants, including 350 low- and moderate-income customers[29]—and (2) an enhanced storage incentive (ESI)—which aimed to install 1,000 battery storage systems at no cost to the customer for households that currently use oil, propane, or electric baseboard heat. ESI participants would receive the batteries in exchange for permitting the Compact to draw on the energy stored in the batteries during times of peak demand over the ten-year lifetime of the battery equipment.[30] The Compact contended that offering free batteries would be "appropriate for these customers because without coincident peak or demand charges, or time-varying rates, these customers lack a direct financial incentive to reduce demand during peak times."[31]

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[27] Mass Save. October 31, 2018. Massachusetts Joint Statewide Electric and Gas Three-Year Energy Efficiency Plan: 2019-2021. Available at: https://3jy14ha9u771r7qzn35g0s6c-wpengine.netdna-ssl.com/wp-content/uploads/2018/11/Exh_1_Final_Plan_10-31-18.pdf. p.66 of 209.

[28] For more information see https://www.mass.gov/service-details/affordable-access-to-clean-and-efficient-energy-initiative.

[29] Mass Save. October 31, 2018. Massachusetts Joint Statewide Electric and Gas Three-Year Energy Efficiency Plan: 2019-2021. Available at: https://3jy14ha9u771r7qzn35g0s6c-wpengine.netdna-ssl.com/wp-content/uploads/2018/11/Exh_1_Final_Plan_10-31-18.pdf. Exhibit 1, Appendix K, page 2 of 4.

[30] Massachusetts Department of Public Utilities. 2019. *Order on 2019-2021 Energy Efficiency Plans*. D.P.U. 18-110 through D.P.U. 18-119. Available at: https://www.mass.gov/doc/2019-2021-three-year-plans-order/download. p.114-115.

[31] Massachusetts Department of Public Utilities. 2019. *Order on 2019-2021 Energy Efficiency Plans*. D.P.U. 18-110 through D.P.U. 18-119. Available at: https://www.mass.gov/doc/2019-2021-three-year-plans-order/download. p.120.

The Massachusetts DPU rejected the ESI proposal, asserting that "the Compact has not provided sufficient support for its proposal to deploy a daily dispatch offering at scale,"[32] "the Compact has not provided sufficient support for the design of its enhanced incentive"[33] and because "the Department finds no evidence that a ten-year term is either necessary or appropriate."[34] DPU also requested revisions to the CVEO, at which time the DPU would review the proposal again.[35] In May 2020, the Compact submitted its revised CVEO proposal to the DPU, but a final decision has not yet been rendered.[36]

In its approval of the 2019-2021 Three-Year Plan, DPU noted that "[t]he program administrators assert that they can reasonably collect low-income participation data by zip code and will comply with the Council's request to provide these data bi-annually."[37] However, none of the evaluated or planned data made publicly available by the EEAC contains any information about low-income ADR or ConnectedSolutions participation, savings, benefits, or costs. Without this reporting it is impossible to know whether this is: (1) because no low-income customers have signed up for these programs, (2) because low-income data are being included in total residential data, (3) because data cannot be adequately aggregated to mitigate potential privacy concerns, or (4) for some other reason. In sum, there has been no public accounting of income-eligible peak savings targets or income-eligible participation in peak savings programs.

[32] Ibid. p.127.
[33] Ibid. p.128.
[34] Ibid. p.129.
[35] Ibid. p.131.
[36] Massachusetts Department of Public Utilities. Docket 20-40. Docket opened May 15, 2020. "Petition of the Cape Light Compact JPE for Approval to Implement a Strategic Electrification and Energy Optimization Offering and Associated Budget."
[37] Massachusetts Department of Public Utilities. 2019. *Order on 2019-2021 Energy Efficiency Plans*. D.P.U. 18-110 through D.P.U. 18-119. Available at: https://www.mass.gov/doc/2019-2021-three-year-plans-order/download. p.162.

III. ConnectedSolutions Performance

The ConnectedSolutions program has grown substantially since it was first launched as a pilot program in 2016, and it has contributed to progress regarding Massachusetts' clean peak, peak shaving, and energy storage policy goals. This section summarizes the performance of ConnectedSolutions programs to date and presents scenarios that demonstrate how this program could grow into the future, including how much the programs would need to grow to reach the Commonwealth's 2030 Clean Peak Goal.

The ConnectedSolutions program began with a demonstration period that took place in the summers of 2016 to 2019 (see **Table 3)**. The performance of these pilots was convincing enough to warrant a full-scale program launch in 2019. A study of the residential pilot BYOD incentive programs conducted by Eversource, National Grid, and Unitil during the summer of 2019 demonstrated that BYOB programs are technically feasible, effective at reducing demand during times of peak, popular with customers, and cost-effective.[38] National Grid's pilot program was the most extensive of the three in terms of the number of participants (see Table 3) and had average savings of about 0.14 MW per event, and 64 percent of maximum potential impact reached during peak events.[39]

Table 3. ConnectedSolutions pilot programs, 2016-2019

Pilot Study	# Participants	# Events	Incentive ($/kW)	Max Discharge (MW)	Average Savings (MW)
National Grid	50	3 Hour Max 27 Events	$225	0.32	0.14
Unitil	4	Daily 4-Hour Events 61 Days	None	0.02	0.01
Eversource	3	Daily 2-3 Hour Events 136 Days	$200	2.80	0.97

**Note: Unitil did not offer $/kW incentives for its pilot programs, rather, Unitil paid for and installed a battery storage system for each of the pilot program participants.[40]*

Sources: 1) Energy & Resource Solutions. February 3, 2020. Daily Dispatch Battery Project Evaluation Report. Prepared for Eversource. Available at: https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/12189502 2) Navigant. February 10, 2020. 2019 Residential Energy Storage Demand Response Demonstration Evaluation. Prepared for National Grid and Unitil. Available at: https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/12190985. p. 3-4.

[38] Navigant. February 10, 2020. *2019 Residential Energy Storage Demand Response Demonstration Evaluation.* Prepared for National Grid and Unitil. Available at: https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/12190985.

[39] Ibid. p.38.

[40] Navigant. February 10, 2020. *2019 Residential Energy Storage Demand Response Demonstration Evaluation.* Prepared for National Grid and Unitil. Available at: https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/12190985. p.2.

A survey of National Grid participants found that 97 percent would opt to continue in the program. Eversource's pilot program was the most extensive of the three in terms of the average per-event savings, which equaled 0.97 MW, though this was across just three participants. If we assume all three pilot programs were operating during Massachusetts' 2019 peak hour demand (14,888 MW),[41] the pilot programs would have reduced peak by about 1.1 MW, equal just 0.01 percent of total peak load.

Commercial and Industrial Customers

In 2019, ConnectedSolutions was rolled out as a full program offering by the program administrators. Commercial and industrial customers were offered per-kW incentives to enroll their batteries in one or two of the three offered dispatch programs: targeted dispatch, daily dispatch, and winter dispatch. Both the targeted dispatch and daily dispatch programs are summer programs, but customers may only participate in one or the other, not both. The winter dispatch program is separate from the summer programs. The program administrators make the same data available for commercial, industrial, and residential customers; these data include:

- ConnectedSolutions participants
- ConnectedSolutions incentive amounts
- ConnectedSolutions enrolled capacity (MW)
- Active Demand Reduction (ADR)-level data on planned costs and planned benefits
- ADR-level net savings (in MW)

Note that some data are made available at the ADR-level (including ConnectedSolutions but not specific to ConnectedSolutions) while some data are made available at the ConnectedSolutions program-level, including battery storage incentives.

The total number of commercial and industrial participants increased significantly from the pilot period—from 57 to 769 (see **Table 4**). Incentive amounts ranged from $25/kW for customers in the winter dispatch program to $200/kW for customers in the daily dispatch program. Net savings for industrial and commercial customers (for all ADR programs that also include direct load control, demand response and thermal storage programs) totaled 77 MW—equal to about 0.5 percent of Massachusetts peak load in 2019.

[41] ISO New England. 2020. CELT Report. Available at: https://www.iso-ne.com/system-planning/system-plans-studies/celt/.

Table 4. ConnectedSolutions performance: commercial and industrial, 2019

	2019 Participants	2019 Planned Costs ($)	Incentive ($/kW)	2019 Enrolled Capacity (MW)	2019 Net Savings (MW)	2019 Planned Benefits ($)
National Grid	**530**	**$3,766,108**		**124.1**	**56**	**$20,067,971**
Targeted	414		$35	82		
Daily	0		$200	0		
Winter	116		$25	42.1		
Unitil	**3**	**$46,500**		**1.0**	**1**	**$84,483**
Targeted	3		$35	0.95		
Daily	0		$200	0		
Winter	0		$25	0		
Eversource	**236**	**$3,335,000**		**50.9**	**21**	**$10,930,582**
Targeted	175		$100	38.2		
Daily	1		$200	0.5		
Winter	60		$50	12.24		
CLC		**$28,283**			**-**	**$46,562**
TOTAL	**769**	**$7,175,891**		**176**	**77**	**$31,129,597**

Sources: 1) Mass Save. May 13, 2020. "Massachusetts Energy Efficiency Program Administrators Quarterly Report | First Quarter, 2020". Available at: https://ma-eeac.org/wp-content/uploads/Quarterly-Report-of-the-PAs-2020-Q1-Final.pdf. p.6; 2) MA Energy Efficiency Advisory Council. 2020. "4th Quarter 2020 Program Administrators' Data". Master Data Tab. Available at: https://ma-eeac.org/results-reporting/quarterly-reports/; 3) MA Electric Program Administrator 2019 Annual Energy Efficiency Reports. 2020. D.P.U. 20-50. Available at: https://ma-eeac.org/results-reporting/annual-reports/.

In 2020, even as incentive amounts remained unchanged, the total number of commercial and industrial participants increased dramatically, again, from the year prior—from 769 to 1,105 (see **Table 5**). While the number of participants rose by 44 percent, the total planned benefits (across all ADR programs) increased by 76 percent between 2019 and 2020. For every dollar in total program planned costs (including program planning and administration, marketing and advertising, participant incentives, and sales and technical assistance and training) in 2020, planned benefits totaled $4.18—this is *higher* than what the Program Administrators expected in their planned C&I ADR 2020 benefit-cost ratio, which was $3.80 in benefits for every dollar in costs.[42]

[42] MA Energy Efficiency Advisory Council. 2019 Electric Statewide Summary. Available at: https://ma-eeac.org/wp-content/uploads/Statewide-2019-PYR-Data-Tables-Electric.xlsx.

Table 5. ConnectedSolutions performance: commercial and industrial, 2020

	2020 Participants	2020 Planned Costs ($)	Incentive ($/kW)	2020 Enrolled Capacity (MW)	2020 Net Savings (MW)	2020 Planned Benefits ($)
National Grid	**599**	**$5,754,542**		**159.9**	**79**	**$27,689,286**
Targeted	440		$35	90.9		
Daily	5		$200	7.8		
Winter	154		$25	61.2		
Unitil	**3**	**$94,000**		**0.8**	**-**	**$290,394**
Targeted	3		$35	0.8		
Daily	0		$200	0.0		
Winter	0		$25	0.0		
Eversource	**474**	**$7,325,000**		**122.8**	**58**	**$26,814,136**
Targeted	315		$100	88.4		
Daily	8		$200	4.4		
Winter	151		$50	30.0		
CLC	**29**	**$1,115,629**		**2.6**	**-**	**$4,997,326**
Targeted	24		$35	1.5		
Daily	0		$200	0.0		
Winter	5		$25	1.1		
TOTAL	**1,105**	**$14,289,171**		**286**	**137**	**$59,791,141**

Sources: 1) Mass Save. May 13, 2020. "Massachusetts Energy Efficiency Program Administrators Quarterly Report | Fourth Quarter, 2020". https://ma-eeac.org/wp-content/uploads/Quarterly-Report-of-the-PAs-2020-Q4-Final.pdf, p. 6; 2) MA Energy Efficiency Advisory Council. 2020. "4th Quarter 2020 Program Administrators' Data". Master Data Tab. Available at: https://ma-eeac.org/results-reporting/quarterly-reports/; 3) MA Electric Program Administrator 2019 Annual Energy Efficiency Reports. 2020. D.P.U. 20-50. Available at: https://ma-eeac.org/results-reporting/annual-reports/.

Residential Customers

In 2019, when energy efficiency and ADR program administrators first launched ConnectedSolutions as a full program offering, residential customers were offered incentives to enroll their battery, smart thermostat and/or electric vehicle in dispatch/load curtailment programs. Nearly 17,000 residential customers signed up for the battery and smart thermostat programs (the electric vehicle program was still in development) with annual incentives of $225/kW per customer for their battery and smart thermostat incentives that include a $20 upfront rebate and $20 annual performance payments (see **Table 6**, p. 20).

Table 6. ConnectedSolutions performance: residential, 2019

	2019 Participants	2019 Planned Costs ($)	Incentive	2019 Enrolled Capacity (MW)	2019 Net Savings (MW)	2019 Planned Benefits
National Grid	**9,340**	**$1,295,912**		**6.6**	**5**	**$1,561,645**
Smart Thermostats	9,300		$25 instant rebate plus $20 annually	6.5		
DLC - Batteries	40		$225/kW	0.14		
Unitil	**56**	**$51,595**		**0.0**	**1**	**$39,496**
Smart Thermostats	56		$25 instant rebate plus $20 annually	0.03		
Eversource	**7,500**	**$786,250**		**3.7**	**4**	**$794,921**
EVs	0		Up to $300 over 3 years	0		
Smart Thermostats	7,500		$25 instant rebate plus $20 annually	3.70		
DLC - Batteries	0		$225/kW	0.00		
CLC		**$265,241**				**$419,274**
TOTAL	**16,896**	**$2,398,999**		**10**	**10**	**$2,815,336**

Sources: 1) Mass Save. May 13, 2020. "Massachusetts Energy Efficiency Program Administrators Quarterly Report | First Quarter, 2020". Available at: https://ma-eeac.org/wp-content/uploads/Quarterly-Report-of-the-PAs-2020-Q1-Final.pdf. p.6; 2) MA Energy Efficiency Advisory Council. 2020. "4th Quarter 2020 Program Administrators' Data". Master Data Tab. Available at: https://ma-eeac.org/results-reporting/quarterly-reports/; 3) MA Electric Program Administrator 2019 Annual Energy Efficiency Reports. 2020. D.P.U. 20-50. Available at: https://ma-eeac.org/results-reporting/annual-reports/.

As with the commercial and industrial ConnectedSolutions programs, even as residential incentive amounts remained unchanged from 2019, 2020 saw the total number of participants nearly double—from about 17,000 to about 33,000—while the number of battery participants increased by more than 20-fold, from 40 to 844 (see **Table 7**, p. 21). Total planned benefits (across all residential ADR programs) increased by almost 450 percent, while total planned costs (across all ADR programs) grew by 200 percent. For every dollar in total program planned costs in 2020, planned benefits totaled $2.14—higher than what the program administrators indicated in their planned Residential ADR 2020 benefit-cost ratio, which was $1.78 in benefits for every dollar in costs.[43]

[43] MA Energy Efficiency Advisory Council. 2019 Electric Statewide Summary. Available at: https://ma-eeac.org/wp-content/uploads/Statewide-2019-PYR-Data-Tables-Electric.xlsx.

Table 7. ConnectedSolutions performance: residential, 2020

	2020 Participants	2020 Planned Costs ($)	Incentive	2020 Enrolled Capacity (MW)	2020 Net Savings (MW)	2020 Planned Benefits ($)
National Grid	**14,975**	**$1,925,661**		**15.0**	**9**	**$3,978,280**
Smart Thermostats	14,155		$25 instant rebate plus $20 annually	12.6		
DLC - Batteries	820		$225/kW	2.4		
Unitil	**170**	**$44,334**		**0.1**	**-**	**$47,395**
Smart Thermostats	170		$25 instant rebate plus $20 annually	0.1		
Eversource	**16,768**	**$880,000**		**8.7**	**3**	**$1,370,642**
EVs	215		Up to $300 over 3 years	0		
Smart Thermostats	16,529		$25 instant rebate plus $20 annually	8.3		
DLC - Batteries	24		$225/kW	0.4		
CLC	**876**	**$4,357,400**		**0.4**	**-**	**$10,019,147**
Smart Thermostats	876			0.4		
TOTAL	**32,789**	**$7,207,394**		**24**	**12**	**$15,415,464**

Sources: 1) Mass Save. May 13, 2020. "Massachusetts Energy Efficiency Program Administrators Quarterly Report | Fourth Quarter, 2020". https://ma-eeac.org/wp-content/uploads/Quarterly-Report-of-the-PAs-2020-Q4-Final.pdf, p. 6; 2) MA Energy Efficiency Advisory Council. 2020. "4th Quarter 2020 Program Administrators' Data". Master Data Tab. Available at: https://ma-eeac.org/results-reporting/quarterly-reports/; 3) MA Electric Program Administrator 2019 Annual Energy Efficiency Reports. 2020. D.P.U. 20-50. Available at: https://ma-eeac.org/results-reporting/annual-reports/.

The data provided by the program administrators allows us to assess the benefits of ConnectedSolutions battery programs for customers by calculating the average annual incentive amounts being paid to residential, commercial, and industrial customer participants in battery storage programs. **Table 8** shows the results of AEC's calculations of based on program administrator data on the number of customers, installed capacity and incentive amounts (for battery programs only):

- Massachusetts' average battery system size per customer (in MW) in 2020, calculated by dividing evaluated 2020 data for the total enrolled capacity by the total number of participants
- The average incentive paid per customer (in dollars) in 2020, calculated by multiplying the incentive offered for the program in question by the average battery system size per customer in 2020

- The total incentives paid out for each ConnectedSolutions battery program (in dollars) in 2020, calculated by multiplying the incentive amount by the evaluated 2020 total enrolled capacity and summing by utility. The battery programs in question include:
    - Commercial and industrial (C&I) targeted dispatch
    - C&I daily dispatch
    - C&I winter dispatch
    - Residential battery direct load control

Table 8. ConnectedSolutions 2020 average customer battery size and average customer incentives

	Average System Size (kW)	Average Incentive Paid per Customer ($)	Total Incentives ($)
National Grid			**$6,271,500**
C&I Targeted	207	$7,231	$3,181,500
C&I Daily	1,560	$312,000	$1,560,000
C&I Winter	397	$9,935	$1,530,000
Residential Battery	3	$659	$184,500,000
Unitil			**$28,000**
C&I Targeted	266.67	$9,333	$28,000
Eversource			**$11,220,000**
C&I Targeted	281	$28,063	$8,840,000
C&I Daily	550	$110,000	$880,000
C&I Winter	199	$9,934	$1,500,000
Residential Battery	18	$3,938	$5,400,000
CLC			**$80,000**
C&I Targeted	63	$2,188	$52,500
C&I Winter	220	$5,500	$27,500

Sources: 1) Mass Save. May 13, 2020. "Massachusetts Energy Efficiency Program Administrators Quarterly Report |Fourth Quarter, 2020". Available at: https://ma-eeac.org/wp-content/uploads/Quarterly-Report-of-the-PAs-2020-Q4-Final.pdf. 2) MA Energy Efficiency Advisory Council. 2020. "4th Quarter 2020 Program Administrators' Data". Master Data Tab. Available at: https://ma-eeac.org/results-reporting/quarterly-reports/. 3) MA Electric Program Administrator 2019 Annual Energy Efficiency Reports. 2020. D.P.U. 20-50. Available at: https://ma-eeac.org/results-reporting/annual-reports/.

We find that largest average customer battery size, by far, are National Grid's daily dispatch commercial and industrial participants, who also receive the largest average incentive payments. Of all the utilities, Eversource has paid out the most in total incentives to its customers—over $11 million in 2020, nearly twice as much as National Grid. Unitil offers the fewest types of battery programs. Residential customers have smaller batteries and smaller incentive payments than commercial and industrial customers do, although Eversource's residential battery customers appear to have larger battery systems and are therefore earning much larger incentives than their counterparts at National Grid (about $4,000 and $650, respectively). It is important to note that AEC's calculations of total incentives do not align with data on

planned 2020 program costs: the utilities report approximately $16 million in planned costs in 2020 across all their ADR programs, while we find that total incentives for battery programs alone exceed $17.5 million; the reasons for this disparity are unclear.

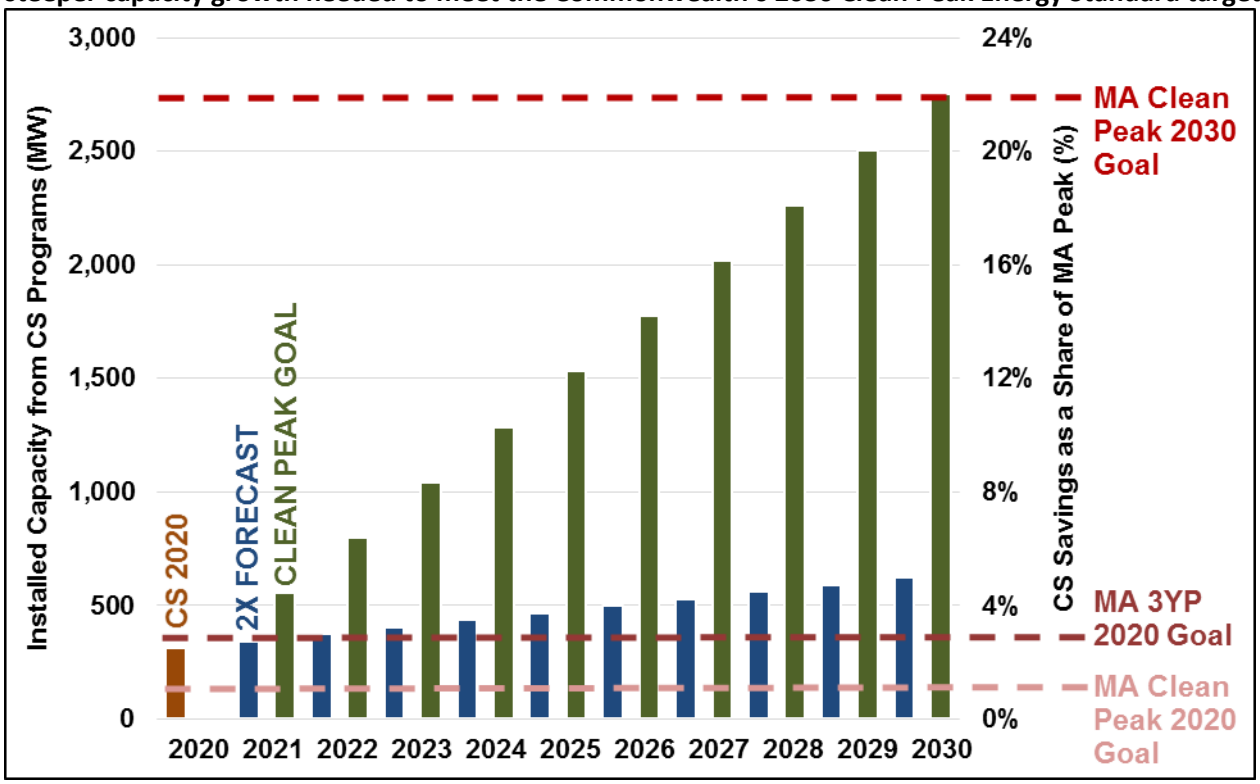
Contribution to MA Clean Peak, Peak Shaving and Battery Storage Goals

The ConnectedSolutions program has contributed to the accomplishment of Massachusetts' clean peak, peak shaving, and energy storage policy goals. Figure 2 below compares the ConnectedSolutions program's installed capacity in 2020 with the 2020 and 2030 Clean Peak Energy Standard goals and the 2020 peak demand reduction goals of the DPU-approved 2019-2021 Three-Year Plan. The programs' installed capacity in 2020 across its commercial, industrial, and residential participants (310 MW) has already achieved more than triple the 2020 goal (100 MW) of the Clean Peak Energy Standard but falls 27 MW short of the Three-Year Plan's state-wide cumulative peak demand reduction goal of 337 MW.[44] In 2020, ADR programs—inclusive of ConnectedSolutions battery programs—reduced statewide peak summer load by 0.9 percent, with benefits that far exceeded costs. (Note that ConnectedSolutions programs are not the only ones providing peak savings needed to meet the Commonwealth's peak demand reduction goals: energy efficiency programs also contribute peak savings.)

AEC projected future peak savings from the Massachusetts' ConnectedSolutions battery programs (excluding the smart thermostat and EV programs), based on two scenarios where the ConnectedSolutions installed capacity increases between 2020 and 2030: the "2X Forecast" scenario doubles 2020 installed capacity by 2030, while the "Clean Peak Goal" scenario increases the program to the amount necessary to meet the Commonwealth's 2030 clean peak target of 2,750 MW – an approximately 800 percent increase (see **Figure 2**, p. 24). These two scenarios are illustrative and were chosen to demonstrate the scale of peak savings from ConnectedSolutions battery programs needed to achieve the Commonwealth's clean peak goals.

[44] Mass Save. October 31, 2018. *Massachusetts Joint Statewide Electric and Gas Three-Year Energy Efficiency Plan.* D.P.U. 18-110—D.P.U. 18-119. Exhibit 1. Available at: https://3jy14ha9u771r7qzn35g0s6c-wpengine.netdna-ssl.com/wp-content/uploads/2018/11/Exh_1_Final_Plan_10-31-18.pdf. p. 17. Note that the reported peak savings goal for the entire 2019-2021 period do not align with the annual 2019, 2020 and 2021 peak savings goals.

Figure 2. ConnectedSolutions installed capacity and future scenarios: The brown line shows actual 2020 installed capacity. The blue lines show capacity doubling by 2030, while the green lines show the much steeper capacity growth needed to meet the Commonwealth's 2030 Clean Peak Energy Standard target.



Note: The shares of residential versus commercial and industrial installed capacity in 2020 was 8 percent versus 92 percent, respectively.

Sources: 1) National Grid. 5 January 2021. Program Materials for ConnectedSolutions for Small Scale Batteries. Available at: https://www.nationalgridus.com/media/pdfs/resi-ways-to-save/program-materials-for-connectedsolutions-for-small-scale-batteries-ma.pdf; 2) Massachusetts Department of Energy Resources. August 7, 2020. Clean Peak Energy Portfolio Standard (CPS). 225 CMR 21.00. Available at: https://www.mass.gov/doc/225-cmr-21-clean-peak-energy-portfolio-standard-cps/download; 3) Massachusetts Department of Energy Resources. May 12, 2020. "MA Leading by Example Council". Available at: https://www.mass.gov/doc/may-12-2020-lbe-council-presentation-responding-to-peak-demand/download; 4) Mass Save. October 31, 2018. Massachusetts Joint Statewide Electric and Gas Three-Year Energy Efficiency Plan. D.P.U. 18-110—D.P.U. 18-119. Exhibit 1. Available at: https://3jy14ha9u771r7qzn35q0s6c-wpengine.netdna-ssl.com/wp-content/uploads/2018/11/Exh_1_Final_Plan_10-31-18.pdf; 5) Mass Save. February 10, 2021. Massachusetts Energy Efficiency Program Administrators Quarterly Report. Fourth Quarter, 2020. Available at: https://ma-eeac.org/wp-content/uploads/Quarterly-Report-of-the-PAs-2020-Q4-Final.pdf.

In 2020, battery programs for commercial, industrial, and residential customers provided clean peak resources totaling 310 MW, equal to just 2.7 percent of statewide peak summer load. In the "2X Forecast" (see Figure 2), ConnectedSolutions would deliver 5.0 percent in peak savings in 2030 (assuming Massachusetts peak load grows at the rate forecasted by DOER).[45,46] The Massachusetts Clean Peak Energy Standard requires retail electric suppliers in 2030 to meet 22 percent (2,750 MW) of peak demand with "clean peak resources," including battery storage.[47] In the "Clean Peak Goal" scenario, ConnectedSolutions installed battery capacity would need to increase by approximately nine-fold between 2020 and 2030 to meet the Commonwealth's clean peak target.

In addition, the Massachusetts Energy Storage Initiative (ESI)—launched in 2015—aimed for 1,000 megawatt-hours (MWh) of energy storage in the Commonwealth by the end of 2025.[48] As ConnectedSolutions performance data does not include MWh reporting, we cannot evaluate how much ConnectedSolutions programs have contributed towards the ESI 2025 target. As part of the ESI, the *State of Charge* report[49] was published in 2016 to investigate potential policies and programs to support energy storage development. In March 2017, the Massachusetts Clean Energy Center and Department of Energy Resources launched the second phase of the ESI called Advancing Commonwealth Energy Storage, which allocated $10 million for energy storage demonstration projects. In 2017, Governor Baker announced up to $10 million in additional funding for energy storage demonstration projects and announced a new goal of 200 MWh of battery storage by January 1, 2020.[50] The $20 million was awarded to a total of 26 storage demonstration projects expected to provide 32 MW of capacity. Although *An Act Relative to Energy Diversity*[51] (passed in 2016) requires that each electric distribution company submit a report to the Department of Energy Resources by January 1, 2020 with information about their efforts towards reaching the Commonwealth's energy storage target, these reports do not appear to be publicly available.

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[45] ISO New England. 2020. CELT Report. Available at: https://www.iso-ne.com/system-planning/system-plans-studies/celt/.

[46] Assumed 2028-29 growth level for 2030 forecasted peak in calculating the share of ConnectedSolutions savings.

[47] Massachusetts Department of Energy Resources. Last updated August 7, 2020. "Clean Peak Energy Portfolio Standard (CPS)". *225 CMR 21.00.* Available at: https://www.mass.gov/doc/225-cmr-21-clean-peak-energy-portfolio-standard-cps/download

[48] Massachusetts Department of Energy Resources. N.d. "ESI Goals & Storage Target." *Mass.gov.* Available at: https://www.mass.gov/info-details/esi-goals-storage-target.

[49] Massachusetts Department of Energy Resources and Massachusetts Clean Energy Center. September 16, 2016. State of Charge: Massachusetts Energy Storage Initiative Study. Available at: https://files.masscec.com/uploads/attachments/2016StateofChargeReport.pdf.

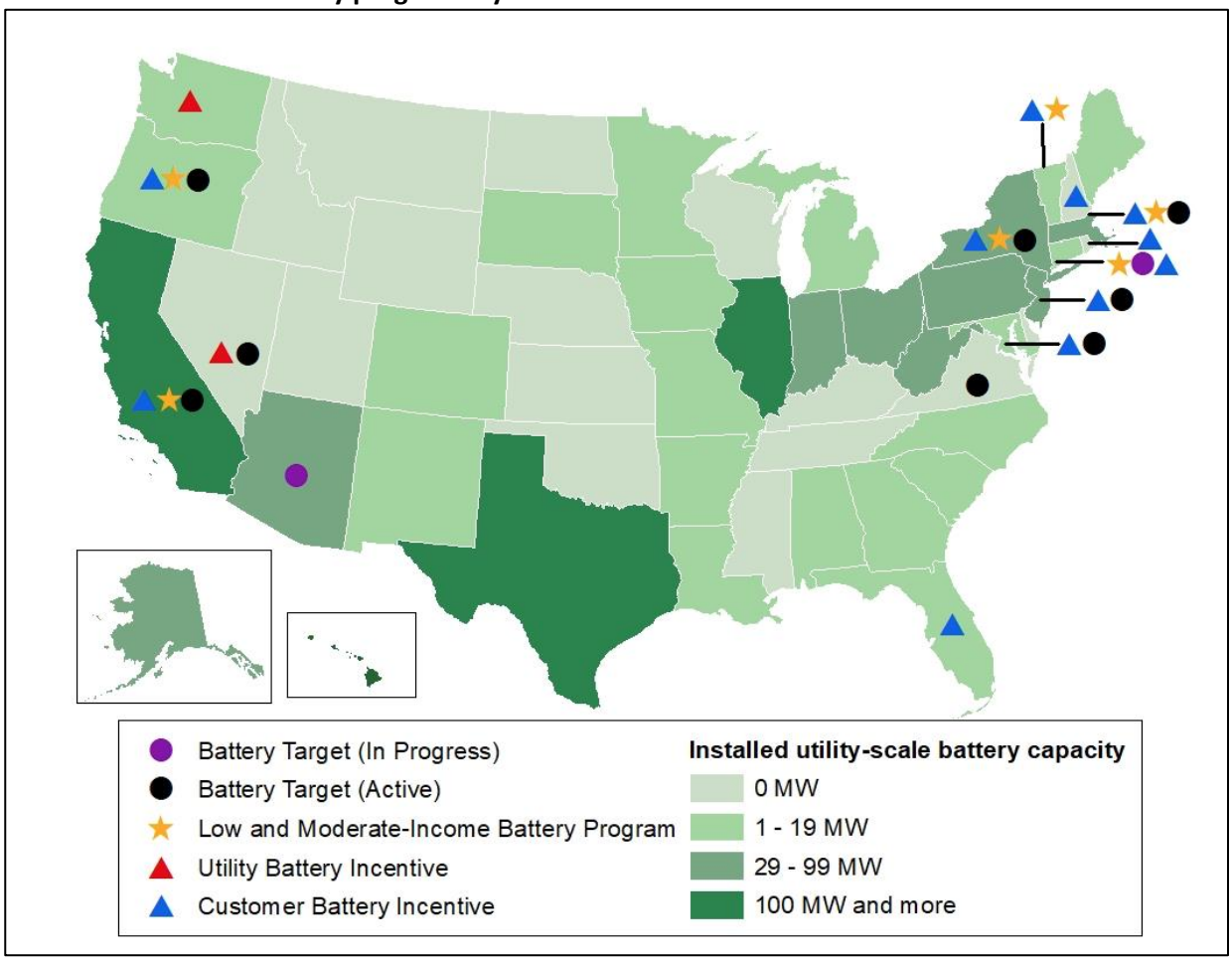
[50] Mass.gov. June 30, 2017. Press release: Baker-Polito Administration Sets 200 Megawatt-Hour Energy Storage Target. Available at: https://www.mass.gov/news/baker-polito-administration-sets-200-megawatt-hour-energy-storage-target.

[51] The 192nd General Court of the Commonwealth of Massachusetts. August 8, 2016. An Act to Promote Energy Diversity. Available at: https://malegislature.gov/Bills/189/House/H4568.

IV. Battery Program Design across the United States

Based on a review of battery storage program design across U.S. states, we compare Massachusetts' ConnectedSolutions battery program with similar programs elsewhere across the country. While U.S. Energy Information Administration (EIA) data do not include customer-sited battery information, they do include the amount of installed utility-scale battery capacity. As of 2019, over 1,000 MW of utility-scale battery storage was installed across the U.S. (see **Figure 3**). States with the most utility-scale battery storage include California, Illinois, and Texas, while 17 states have no utility-scale battery storage at all.

Figure 3. 2019 installed utility-scale battery storage, battery storage targets, battery incentives, and low- and moderate-income battery programs by U.S. state



Note: "Utility Battery Incentive" represents utility-only battery incentive programs. Incentives for utilities and residential, commercial, and industrial customers or for residential, commercial, and industrial customers only are both shown as "Customer Battery Incentive". The Maine battery incentive program, which was included in legislation adopted during final production of this report, is not represented here. Data sources: See Appendix A.

Ten U.S. states have a mandatory energy storage goal or target (both complete and in progress), ten states offer (or are developing) battery storage incentives (two of them are for utilities only, six are for utilities and residential, commercial, and industrial customers, and seven are for residential, commercial, and industrial customers only), and six offer low- and moderate-income battery storage incentives specifically.[52]

AEC assessed the design of battery storage programs across the country, including:

- whether the battery program is a result of legislation or not
- the type of battery program—for example, a rebate program or an energy storage target
- whether the program batteries are owned by utilities and/or customers
- whether the program is a pilot project
- whether the program offers season-based incentives
- who is eligible to participate in the program
- whether the program offers low-income incentives

AEC's review resulted in a total of 29 battery programs across 15 states dominated by those along the East and West coasts: California, Connecticut, Florida, Massachusetts, Maryland, New Hampshire, New Jersey, Nevada, New York, Oregon, Rhode Island, Virginia, Vermont, Washington, and Wisconsin. Of the 29 battery programs listed in

Table 9a and **Table 9b** (p. 28-29), we find that these programs are more likely to target customer-sited batteries than utility-owned batteries, more likely to offer financial incentives for customers (including rebates and tax credits) than not to, but less likely to offer low-income incentives or seasonal battery incentives than to offer low-income or seasonal incentives. In other words, customer-sited battery incentive programs are the more common than utility-owned battery programs, however, and battery programs that offered seasonal-based incentives and low-income incentives were less common those that did not. Failing to offer seasonal incentives could limit a program's effectiveness at addressing seasonal peak demand, particularly winter peak.[53] Failing to offer low-income incentives could limit a program's effectiveness at equitable distributions of program benefits and costs.

[52] While this report was in final production, Maine adopted legislation setting state energy storage procurement targets and directing its energy agencies to develop battery incentive programs. The Maine programs are yet to be developed and are not included here.

[53] Because battery incentive programs that offer seasonal incentives offer either both summer and winter rates or summer-only rates.

Table 9a. U.S. State battery programs – type and resource ownership

State	Program Name	Legislation?	Program Type	Utility or customer owned?
CA	Sales and Use Tax Exemption	AB 1817	Tax Credit	Either
CA	An act to amend Section 9620	AB 2514	Energy Storage Target	Utility
CA	Self-Generation Incentive Program	D. 20-01-021	Rebate	Customer
CT	Straw Proposal	D. 17-12-03	Energy Storage Goal	Customer or third-party
CT	Low-Income Multifamily Energy	Public Act 14-94	Financing	Customer or third-party
FL	JEA Battery Incentive Program	No	Rebate	Customer
MA	Cape and Vineyard Electrification Offering	DPU 20-40	Incentive *(PENDING)*	Customer
MA	Energy Storage Target	H.B. 4857	Energy Storage Target	Utility
MA	SMART Program	D.P.U. 20-145	Incentive	Either
MD	Energy Storage Tax Credit	HB 980	Tax Credit	Customer
MD	Maryland Energy Storage Pilot Program	Order No. 89240	Energy Storage Goal	Utility
NH	Tax Exemption for RE and Storage	Ch. 72:61 et seq.	Tax Credit	Customer
NJ	Energy Storage Procurement Target	AB 3723	Energy Storage Target	Utility
NJ	Renewable Electric Storage Program	No	Rebate	Either
NJ	PSEG Electric Storage Efforts	No	Energy Storage Goal	Public
NV	Energy Storage Procurement Target	SB 204	Incentive	Utility
NY	NYSERDA Bulk Energy Storage Incentive	Case 18-E-0130 Order	Incentive	Either
NY	Energy Conservation Tax Exemption	No	Tax Credit	Customer
NY	Affordable Solar Predevelopment	No	Grant	Either
OR	Portland Electric Storage Program	H.B. 2193	Energy Storage Target	Utility
OR	Oregon Solar & Storage Rebate Program	No	Rebate	Either
RI	Rhode Island Energy Storage Adder	No	Incentive	Customer
RI	Connected Solutions	No	Incentive	Customer
VA	Energy Storage Target	H.B. 1526	Energy Storage Target	Utility
VT	Resilient Home	No	Incentive	Customer
VT	GMP Tesla Powerwall	No	Rebate	Utility
VT	GMP Bring Your Own Device	No	Incentive	Customer
WA	Clean Energy Fund	No	Grant	Utility
WI	Energy Grant Innovation Program	No	Grant	Customer

Sources: See Appendix B.

Table 9b. U.S. State battery programs – participation and low-income incentives

State	Program Name	Pilot project?	Seasonal incentives?	Who can participate?	Low-income incentives?
CA	Sales and Use Tax Exemption	No	Both	Commercial, Industrial, Agricultural	No
CA	An act to amend Section 9620	No	Both	Investor-Owned Utility	No
CA	Self-Generation Incentive Program	No	Both	Commercial, Industrial, Residential, Agricultural	Yes
CT	Straw Proposal	No	Summer	Commercial, Industrial, Residential	Yes
CT	Low-Income Multifamily Energy	No	No	Low- and Moderate-Income Residential	Yes
FL	JEA Battery Incentive Program	No	Both	Multifamily Residential	No
MA	Cape and Vineyard Electrification Offering	No	No	Low- and Moderate-Income Residential	Yes
MA	Energy Storage Target	Yes	Both	Investor-Owned Utility	No
MA	SMART Program	No	No	Commercial, Industrial, Residential, Agricultural	Yes
MD	Energy Storage Tax Credit	No	Both	Commercial, Industrial, Residential, Agricultural	No
MD	Maryland Energy Storage Pilot Program	Yes	No	Investor-Owned Utility	No
NH	Tax Exemption for RE and Storage	No	Both	Commercial, Industrial, Residential, Agricultural	No
NJ	Energy Storage Procurement Target	No	Both	Investor-Owned Utility	No
NJ	Renewable Electric Storage Program	No	Both	Commercial, Industrial, Nonprofit, Government	No
NJ	PSEG Electric Storage Efforts	Yes	No	Government	No
NV	Energy Storage Procurement Target	Yes	No	Investor-Owned Utility	No
NY	NYSERDA Bulk Energy Storage Incentive	Yes	No	Commercial, Industrial, Residential, Agricultural	No
NY	Energy Conservation Tax Exemption	Yes	No	Residential	No
NY	Affordable Solar Predevelopment	No	No	Residential	Yes
OR	Portland Electric Storage Program	No	No	Investor-Owned Utility	No
OR	Oregon Solar & Storage Rebate Program	Yes	No	Residential, Commercial	Yes
RI	Rhode Island Energy Storage Adder	Yes	No	Residential, Commercial	No
RI	Connected Solutions	No	Summer	Residential, Commercial	No
VA	Energy Storage Target	Yes	No	Investor-Owned, Municipal, Cooperative Utilities	No
VT	Resilient Home	Yes	No	Residential	No
VT	GMP Tesla Powerwall	No	No	Residential	Yes
VT	GMP Bring Your Own Device	Yes	No	Residential, Commerical	No
WA	Clean Energy Fund	No	No	Investor-Owned, Municipal, Cooperative Utilities	No
WI	Energy Grant Innovation Program	Yes	No	Public Sector, Manufacturers	No

Sources: See Appendix B.

Of the 29 battery programs listed in **Table 9b**, just eight programs (in six states) offer low-income incentives (see **Table 10** , p. 31. We find that all eight low-income battery programs provide targeted incentives for income-qualifying customers, but the form of the incentives differs widely. For example, both California and Oregon offer income-qualifying rebates, though Oregon's is a flat amount ($15,000) while California's is variable and based on battery output ($/kilowatt-hour). Most programs target all low- or low-to-moderate income residents; a couple also specify eligible housing type (California and Connecticut specify multi-family housing residents). The major difference between low-income programs is whether they appear to target upfront costs (by, for example, offering competitive interest rates on loans or offering rebates or funding up to certain amounts) or attempt to pay customers on an ongoing basis (by, for example, offering per kilowatt-hour incentives), though some programs do both.

Table 10. U.S. state battery programs with low-income incentives available

State	Program Name	Program Type	Battery Specific?	Low-Income Qualifications?	Low-Income Incentive Details
CA	Self-Generation Incentive Program	Rebate	Yes	Low-income apartments and multifamily affordable housing residents	Equity Rebates: $850/kWh Equity Resiliency Rebates: $1,000/kWh
CT	Statewide Electric Storage Program	Energy Storage Target	Yes	All low-to-moderate income residents	Starts with $560/kWh in 2022 and ends with $260/kWh in 2024
CT	Low-Income Multifamily Energy	Financing	No	Low-to-moderate income multifamily residents	Low-income interest rate of 6-7 percent with terms of 5-20 years
MA	Cape and Vineyard Electrification Offering	Incentive *(pending)*	No	150 low-income residents	150 low-income customers will receive heat pumps, solar, and battery technologies to convert their oil, propane, or electric resistance heat at no cost
MA	SMART Program	Incentive	No	All low-income residents	Low-income solar under 25 kW receive a 15 percent higher incentive. Low-income community solar receive an adder $0.01/kWh greater than standard systems
NY	Affordable Solar Predevelopment	Grant/Funding	No	All low-to-moderate income residents	Low-income solar and/or energy storage project proposals receive funding up to $200,000
OR	Oregon Solar & Storage Rebate Program	Rebate	Yes	All low-income residents	$15,000 rebate for low-income storage systems
VT	GMP Tesla Powerwall	Rebate	Yes	100 low-income residents	A $150,000 grant for 100 low-income customers with significant need for backup power due to health and mobility needs

Sources: See Appendix C.

Massachusetts is among the states leading the country in battery storage efforts. Massachusetts energy storage policy includes the following important elements:

- Offers low-income incentives[54] that target both upfront costs and ongoing costs via its Solar Massachusetts Renewable Target (SMART) program (which does not target storage specifically but in which storage resources are eligible to participate)
- Has a mandatory, statewide Clean Peak Energy Standard, which requires retail electric suppliers to meet 46.5 percent of their 2050 sales with "clean peak resources" like battery storage[55]
- Has a mandatory, statewide battery storage target of 1 GWh by 2025, and has achieved 32.5 MW of installed utility-scale batteries (as of 2019)[56]
- Via the ConnectedSolutions program, offers seasonal-based customer performance incentives for battery storage that best enhance the program's effectiveness at reducing winter and summer peak demand

It is clear that Massachusetts has made impressive advances in distributed energy storage policy. However, it is also important to note that the Commonwealth's main battery incentive, the statewide ConnectedSolutions program, currently does not include any equity participation target or carve-out for equity customers. (Cape Light Compact's *Cape and Vineyard Electrification Offering* aims for half of its participants to be low- and moderate-income customers,[57] but is still awaiting DPU approval.) The lack of equity targets and supports within the Commonwealth's groundbreaking distributed storage program is a glaring omission, and it should be addressed in the program's second three-year cycle that begins in January 2022.

The incentives offered in Massachusetts cannot easily be compared with those in most other states because they are offered on a different unit basis (Massachusetts offers incentives on a per kW basis while most other states offer flat rates for program participation or per kWh incentives). However, there are lessons for Massachusetts to learn from the experience of other states' battery programs insofar as we can make direct comparisons.

For example, Rhode Island's ConnectedSolutions program offers $400/kW summer incentives,[58] which is nearly double the equivalent offering in Massachusetts ($225/kW). Rhode Island also offers incentives over

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[54] Via "adders" that enhance the base compensation rate by a set percentage amount. Source: Massachusetts DPU. Docket 20-145. December 2020. "Joint EDC Petition for Approval of Revised Model SMART Tariff." Available at: https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/12941497.

[55] Massachusetts Department of Energy Resources. N.d. "225 CMR 21.00: CLEAN PEAK ENERGY PORTFOLIO STANDARD (CPS)." *Mass.gov.* Available at: https://www.mass.gov/doc/225-cmr-21-clean-peak-energy-portfolio-standard-cps/download.

[56] US EIA. September 15, 2020. "Form EIA-860 detailed data with previous form data (EIA-860A/860B)". 2019. Available at: https://www.eia.gov/electricity/data/eia860/.

[57] Mass Save. October 31, 2018. Massachusetts Joint Statewide Electric and Gas Three-Year Energy Efficiency Plan: 2019-2021. Available at: https://3jy14ha9u771r7qzn35g0s6c-wpengine.netdna-ssl.com/wp-content/uploads/2018/11/Exh_1_Final_Plan_10-31-18.pdf. Exhibit 1, Appendix K, page 2 of 4.

[58] National Grid. 2021. "Learn About Solar." Available at: https://www.nationalgridus.com/RI-Home/Ways-to-Save/Learn-About-Solar.

a five-year period,[59] whereas Massachusetts offers a three-year incentive period. Longer contract periods provide assurance regarding the duration of incentive payments and can increase customers' willingness to make investments in battery storage. However, like Massachusetts, Rhode Island's ConnectedSolutions program lacks specific equity targets and provisions that would encourage participation among low-income and other underserved, vulnerable, and marginalized groups.

Connecticut's new Statewide Electric Storage Program targets 580 MW of distributed battery capacity by 2030, aims to enroll 10,000 residential customers in the first three years alone, and directs program administrators to deploy 40 percent of residential systems in low-income and underserved communities. The program also includes specific equity provisions like low- and moderate-income (LMI) adders. The program will run for nine years—starting January 1, 2022 and running through at least December 31, 2030—organized into three-year planning cycles. It features both an upfront customer incentive and ongoing performance payments. There are five up-front incentive rate blocks with declining rates, ranging from the lowest rate of $130/kWh for non-LMI customers in Block 5, to the highest rate of $560/kWh for LMI customers in Block 1. LMI up-front incentives are double that of the non-LMI rate in every block.[60] Performance payments are seasonal and similar to the Massachusetts ConnectedSolutions program rates, at $225/kW for the summer season and $50/kW for the winter season.

California's Self Generation Incentive Program (SGIP) is the longest-running, largest, and best-funded distributed battery storage program in the country. SGIP offers "equity" rates of $850/kWh for customers who live in low-income housing or Native lands, and "equity resilience" rates of $1,000/kWh for customers who meet additional criteria, like having experienced two or more power shutoffs and serious illness.[61] It is important to note that initially the SGIP program featured an equity carve-out but only a very small equity incentive rate adder, with the result that none of the $72 million equity incentive budget was expended. The state then increased its equity rate adder significantly, with the result that the program was soon fully subscribed.[62] This shows the importance of not simply setting a target for LMI participation, but also providing substantial incentive adders to help overcome investment barriers in underserved communities.

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[59] National Grid. June 25, 2019. "Program Materials for ConnectedSolutions for Small Scale Batteries." Available at: https://www.nationalgridus.com/media/pdfs/resi-ways-to-save/ri-program-materials-for_-connectedsolutions-for-small-scale-batteries-v16.pdf.

[60] State of Connecticut. Public Utilities Regulatory Authority. July 28, 2021. Docket No. 17-12-03RE03. Pura Investigation into Distribution System Planning of the Electric Distribution Companies – Electric Storage. http://www.dpuc.state.ct.us/dockcurr.nsf/8e6fc37a54110e3e852576190052b64d/38cb46347a645ee585258720004d0e3e/$FILE/171203RE03-072821.pdf

[61] California Public Utilities Commission (CPUC). No date. "Self-Generation Incentive Program (SGIP)." Available at: https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/News_Room/NewsUpdates/2020/SGIP_residential_web_120420.pdf.

[62] CPUC. Decision 19-09-027. September 12, 2019. "DECISION ESTABLISHING A SELF-GENERATION INCENTIVE PROGRAM EQUITY RESILIENCY BUDGET, MODIFYING EXISTING EQUITY BUDGET INCENTIVES, APPROVING CARRY-OVER OF ACCUMULATED UNSPENT FUNDS, AND APPROVING $10 MILLION TO SUPPORT THE SAN JOAQUIN VALLEY DISADVANTAGED COMMUNITY PILOT PROJECTS." Available at: https://www.sce.com/sites/default/files/inline-files/313975481.PDF.

A review of the Rhode Island, Connecticut, and California battery incentive programs shows that other states have more successfully addressed the needs of low-income and historically underserved communities to provide these communities access to the benefits of distributed battery storage. If equity-centered provisions like these were adopted in the ConnectedSolutions program, they would strengthen the performance of its offerings and enhance its equity benefits.

V. Recommendations for ConnectedSolutions in Massachusetts

Based on the performance of ConnectedSolutions to date and how it compares with similar battery programs from elsewhere in the United States, in this section, AEC recommends four potential improvements to the ConnectedSolutions program for the consideration of the Massachusetts Energy Efficiency Program Administrators and the Massachusetts Energy Efficiency Advisory Council (EEAC) (see **Table 11**).

Table 11. Recommended ConnectedSolutions program improvements for the 2022-2024 energy efficiency program cycle

1)	Massachusetts should develop specific ConnectedSolutions income-eligible enrollment targets or carve-outs for its 2022-2024 energy efficiency and demand management plan, broken out by technology (including specific income-eligible battery enrollment targets).
2)	ConnectedSolutions should offer higher incentive rates for income-eligible customers. Other equity provisions, such as up-front rebates and on-bill payment, should also be considered.
3)	ConnectedSolutions administrators should provide more detailed program data to track progress towards the Commonwealth's energy storage goals.
4)	ConnectedSolutions needs to scale up rapidly to meet the Commonwealth's clean peak goals. To drive clean peak resource development at the scale desired, ConnectedSolutions must offer higher incentive rates and longer-term customer contracts.

1. Massachusetts should develop specific ConnectedSolutions income-eligible enrollment targets or carve-outs for its 2022-2024 energy efficiency and demand management plan, broken out by technology (including specific income-eligible battery enrollment targets).

The Massachusetts 2019-2021 energy efficiency plan promised a small amount of LMI customer participation and installed capacity for demand reduction programs, but it did not include specific enrollment targets or carve-outs for income-eligible battery storage participants. A specific carve-out would have set aside a portion of the incentive budget to support income-eligible battery storage customers and would have made it easier to track participation of these customers in the program. This should be done in the 2022-2024 program cycle.

The current Three-Year Plan promised 175 participants and 0.7 MW of summer capacity savings from income-eligible customers in peak savings programs—a very small share of the approximately 34,000 participants and nearly 300 MW of capacity enrolled in ConnectedSolutions as of the end of 2020—but did

not set aside a portion of the program budget for income-eligible participants.[63] The plan also did not assess the cost effectiveness of income-eligible battery storage, and plan administrators did not report any low-income participation, savings, benefits, or costs publicly. This is at odds with Massachusetts EEAC's expectation that program administrators would offer low-income storage programs and report implementation progress according to the savings targets outlined in the Three-Year Plan.[64] At present, it is impossible to measure the Commonwealth's progress towards its equity goals or to know why no income-eligible demand reduction has been reported.

The next Three-Year Plan (2022-2024) should address these shortcomings by setting specific demand reduction and participation targets and/or carve-outs for income-eligible customers and allocating a portion of the program budget to income-eligible demand reduction programs. This will help ensure that the next Three-Year Plan is more in line with the Commonwealth's energy efficiency program goals—such as the commitment to "ensuring equitable access to energy efficiency programs for all Massachusetts customers across all demographics"[65]—as well as the state's overarching commitment to providing access to clean and efficient energy resources for low- and moderate-income communities.[66]

2. ConnectedSolutions should offer higher incentives for income-eligible customers. Other equity provisions, such as up-front rebates and on-bill payment, should also be considered.

To help achieve the most equitable distribution of customer load reduction benefits, the customer incentives offered by ConnectedSolutions should both target upfront costs and offer ongoing performance payments, with lower-income customers receiving higher incentives. Examples of state battery programs that have done this include Connecticut's Statewide Electric Storage Program and California's Self Generation Incentive Program (SGIP). It is also possible to expand the income-eligible category to include customers with various needs—for example, California's SGIP program offers enhanced performance payments for customers in low-income housing, households that have experienced power shutoffs, customers with serious illnesses, and more "equity" criteria of this kind.[67] In Massachusetts, Cape Light

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[63] 1) Mass Save. May 13, 2020. "Massachusetts Energy Efficiency Program Administrators Quarterly Report | Fourth Quarter, 2020". https://ma-eeac.org/wp-content/uploads/Quarterly-Report-of-the-PAs-2020-Q4-Final.pdf; 2) MA Energy Efficiency Advisory Council. 2020. "4th Quarter 2020 Program Administrators' Data". Master Data Tab. Available at: https://ma-eeac.org/results-reporting/quarterly-reports/; 3) MA Electric Program Administrator 2019 Annual Energy Efficiency Reports. 2020. D.P.U. 20-50. Available at: https://ma-eeac.org/results-reporting/annual-reports/.

[64] Mass Save. October 31, 2018. Massachusetts Joint Statewide Electric and Gas Three-Year Energy Efficiency Plan: 2019-2021. Available at: https://3jy14ha9u771r7qzn35g0s6c-wpengine.netdna-ssl.com/wp-content/uploads/2018/11/Exh_1_Final_Plan_10-31-18.pdf. p.66 of 209.

[65] Ibid. p. 35 of 209.

[66] Mass.gov. 2021. "Affordable Access to Clean and Efficient Energy Initiative." Available at: https://www.mass.gov/service-details/affordable-access-to-clean-and-efficient-energy-initiative.

[67] California Public Utilities Commission (CPUC). No date. "Self-Generation Incentive Program (SGIP)." Available at: https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/News_Room/NewsUpdates/2020/SGIP_residential_web_120420.pdf.

Compact has proposed a "Cape and Vineyard Electrification Offering" (CVEO) that would provide solar panels, batteries and heat pump systems at zero cost to 250 LMI customers.[68] While the DPU has not yet ruled on the Compact's proposed program, the Compact's proposed CVEO program shows what is possible in Massachusetts.

If equity-centered provisions were adopted in the ConnectedSolutions statewide program, they would strengthen the performance of its offerings and enhance low-income participation and achieve progress towards equity goals. To identify what kind of equity provisions would be most beneficial for underserved communities, ConnectedSolutions' program administrators should work with community groups and advocates to define needs and target equity provisions accordingly.

In general, higher performance payment rates for low-income customers would make the statewide ConnectedSolutions program more equitable in Massachusetts. It would also be beneficial to provide up-front incentives to income-eligible customers, as the Connecticut program does. Reducing the upfront cost of battery storage would allow a greater number of customers to participate.

3. ConnectedSolutions administrators should provide more detailed program data to track progress towards the Commonwealth's energy storage goals

Currently, Massachusetts efficiency and ADR program administrators provide the following state-wide data on ConnectedSolutions: number of participants and enrolled capacity (in MW) in the Commonwealth. For the larger umbrella of programs called Active Demand Reduction (ADR, which includes ConnectedSolutions programs), program administrators also provide data on planned costs, planned benefits, and net savings (in MW). The current Three-Year Plan for energy efficiency promised modest benefits for income-eligible customers (those with low or moderate incomes) for demand reduction programs including battery programs; however, state and utility reporting has so far omitted any low-income participation, savings, benefits, or costs that may have occurred to date.

To assess the performance of the ConnectedSolutions program more robustly—including whether low income/equity battery customers are participating, and the contribution of ConnectedSolutions to the Commonwealth's 2025 energy storage goal of 1,000 megawatt-hours (MWh)—more data are needed, including:

- ConnectedSolutions program-level data on planned costs and planned benefits (in $)
- ConnectedSolutions program-level data on net savings (in MW)
- New data on the number of peak events called
- New data on the duration of each peak event
- New data on the performance of customer-sited battery storage in MWh
- Data at the zip code level, to better identify distributional issues

[68] Massachusetts Department of Public Utilities. Docket 20-40. Docket opened May 15, 2020. "Petition of the Cape Light Compact JPE for Approval to Implement a Strategic Electrification and Energy Optimization Offering and Associated Budget."

- Data on the number of battery storage participants, differentiated by category (residential, income-eligible and commercial), and the installed capacity (in MW) associated with each category

The current Three-Year Plan reported inconsistent peak reduction goals[69] and program administrators failed to report on low-income implementation. The next Three-Year Plan should provide more clarity on peak reduction targets and require that program administrators provide publicly available planned and evaluated data on the participation, savings, benefits, and costs of these programs, including participation by income-eligible customers. Setting specific low-income provisions for ConnectedSolutions battery and direct load control programs and mandating robust low-income reporting will help ensure that the next Three-Year Plan is more in line with the Commonwealth's energy efficiency program and broader equity goals.

4. ConnectedSolutions needs to scale up rapidly to meet Massachusetts clean peak goals. To drive clean peak resource development at the scale desired, ConnectedSolutions must offer higher incentive rates and longer-term customer contracts.

The Massachusetts Clean Peak Energy Standard requires retail electric suppliers to meet a certain percentage of peak demand with "clean peak" resources, including battery storage: in 2020, ConnectedSolutions programs for commercial, industrial, and residential customers provided 310 MW of clean peak capacity—more than triple the 100 MW of clean peak resources required. ConnectedSolutions programs are not the only ones providing peak savings needed to meet the Commonwealth's clean peak goals: Energy efficiency programs also contribute peak savings, as does the Massachusetts SMART program. Nevertheless, to achieve the amount of peak savings necessary to meet the Commonwealth's 2030 clean peak target (2,750 MW with ConnectedSolutions programs only), AEC finds that the ConnectedSolutions program would need to scale up rapidly—growing by approximately nine-fold between 2020 and 2030. Iterations of the ConnectedSolutions program in the next Three-Year Plan (and beyond) should set longer-term goals for peak reductions from energy efficiency planning (beyond the three-year planning period). Future iterations of ConnectedSolutions should also consider how program performance to-date stacks up relative to the Commonwealth's existing long-term goals, including:

- 1 GWh of energy storage by the end of 2025[70]

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[69] The peak reduction goals do not match between the 2018 Three-Year Plan (484,593 kW) and its 2019 data appendices (483,613 kW). Sources: 1) Mass Save. October 31, 2018. Massachusetts Joint Statewide Electric and Gas Three-Year Energy Efficiency Plan. D.P.U. 18-110—D.P.U. 18-119. Exhibit 1. Available at: https://3jy14ha9u771r7qzn35g0s6c-wpengine.netdna-ssl.com/wp-content/uploads/2018/11/Exh_1_Final_Plan_10-31-18.pdf. p. 3; 2) MA Electric PAs. February 19, 2019. Statewide Electric Data Tables, Savings Summary Table. Available at: https://ma-eeac.org/wp-content/uploads/Exhibit-1-Appendix-C-2019-2021-Plan-Data-Tables-2-19-19-Statewide-Electric.xlsx.

[70] Massachusetts Department of Energy Resources. N.d. "ESI Goals & Storage Target." Mass.gov. Available at: https://www.mass.gov/info-details/esi-goals-storage-target.

- Net-zero greenhouse gas emissions by 2050[71]
- Clean Peak Energy Standard that requires retail electric suppliers to meet 46.5 percent of their 2050 sales with "clean peak resources" like battery storage[72]

Generally, higher customer incentives drive greater program participation. To increase customer incentives, Massachusetts should look at similar programs in neighboring states, such as Rhode Island, which offers $400/kW summer incentives[73]—nearly double the equivalent offering in Massachusetts ($225/kW)—and Connecticut, which combines performance payments with significant up-front incentives. High incentive rates and up-front rebates are particularly important for low-income customers, who may not be able to afford to wait years to recoup their investment.

Another way to increase program participation in Massachusetts is to lengthen customer contract terms to reduce the perception of risk. In Massachusetts, the ConnectedSolutions customer contract is five years in duration, with no assurance that the contract will be renewed (or that rates will be comparable) in year six. Other state and utility programs have offered longer contracts. For example, Green Mountain Power's Bring Your Own Device battery program offers ten-year customer contracts.[74] Given that it may take more than five years to achieve payback of the customer's investment, a five-year contract may seem risky to some potential program participants. To scale up the ConnectedSolutions program as rapidly as possible, Massachusetts battery storage contract periods should be longer. Alternatively, program administrators could provide assurances to battery customers that renewal contracts will be offered after the initial contracts end.

[71] Mass.gov. March 26, 2021. "Press Release: Governor Baker Signs Climate Legislation to Reduce Greenhouse Gas Emissions, Protect Environmental Justice Communities." Available at: https://www.mass.gov/news/governor-baker-signs-climate-legislation-to-reduce-greenhouse-gas-emissions-protect-environmental-justice-communities.

[72] Massachusetts Department of Energy Resources. N.d. "225 CMR 21.00: CLEAN PEAK ENERGY PORTFOLIO STANDARD (CPS)." *Mass.gov.* Available at: https://www.mass.gov/doc/225-cmr-21-clean-peak-energy-portfolio-standard-cps/download.

[73] National Grid. 2021. "Learn About Solar." Available at: https://www.nationalgridus.com/RI-Home/Ways-to-Save/Learn-About-Solar.

[74] Green Mountain Power. 2021. "Bring Your Own Device." Available at: https://greenmountainpower.com/rebates-programs/home-energy-storage/bring-your-own-device/.

VI. Conclusion

The Massachusetts ConnectedSolutions program is a nation-leading program that has reduced peak demand, provided ratepayer cost savings, funded customer battery adoption, enhanced resiliency for participating residential, commercial, and industrial customers, and contributed to meeting the Commonwealth's energy storage and clean peak goals. Since its launch as a full program offering in 2019 by the Commonwealth's investor-owned electric utilities and Cape Light Compact, the ConnectedSolutions program has grown rapidly: over 1,000 commercial and industrial customers and about 33,000 residential customers participated in the ConnectedSolutions program in 2020. For every program dollar spent in 2020, benefits totaled $2.14 for residential customers and $4.18 for commercial and industrial customers.

However, lessons from the program's performance to-date and lessons from battery storage programs elsewhere in the United States indicate that the ConnectedSolutions program could be improved in four primary ways:

1) Massachusetts should develop **specific ConnectedSolutions income-eligible enrollment targets or carve-outs** for its 2022-2024 energy efficiency and demand management plan, broken out by technology (including specific income-eligible battery enrollment targets).
2) ConnectedSolutions should offer **higher incentive rates for income-eligible customers**. Other equity provisions, such as up-front rebates and on-bill payment, should also be considered.
3) ConnectedSolutions administrators should provide **more detailed program data to track progress** towards the Commonwealth's energy storage goals.
4) ConnectedSolutions needs to **scale up rapidly** to meet the Commonwealth's clean peak goals. To drive clean peak resource development at the scale desired, ConnectedSolutions must offer higher incentive rates and longer-term customer contracts.

As the Massachusetts Energy Efficiency Program Administrators and the Massachusetts Energy Efficiency Advisory Council finalize the Commonwealth's 2022-2024 plan for energy efficiency and demand management, it is important that the next iteration of the ConnectedSolutions program be more in line with the Commonwealth's broader efficiency program and equity goals, placing the program in the best possible position to meaningfully contribute to Massachusetts' long-term clean peak and energy storage goals in the most equitable fashion possible. We hope that this report will provide useful information and inform needed improvements to Massachusetts' ConnectedSolutions program for the 2022-2024 program cycle.

Appendix A. Sources for Figure 3: 2019 installed utility-scale battery storage, battery storage targets, battery incentives, and low- and moderate-income battery programs by U.S. state

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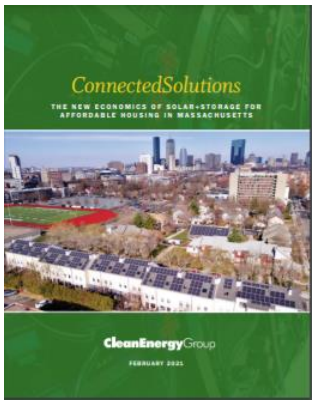
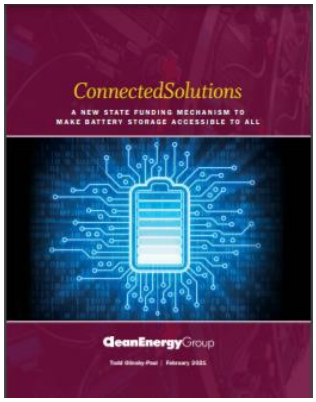
Additional Resources from Clean Energy Group



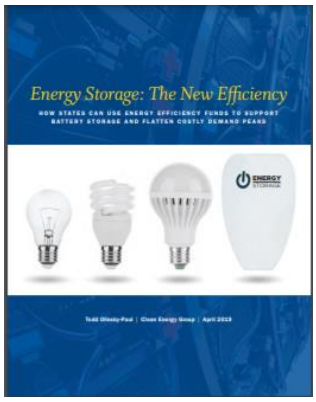
ConnectedSolutions: The New Economics of Solar+Storage for Affordable Housing in Massachusetts by Amy Simpkins, Dr. Travis Simpkins, Geoff Oxnam, Seth Mullendore, Todd Olinsky-Paul (February 2021)

An analysis of multifamily affordable housing properties in Massachusetts finds that participation in the state's new battery storage incentive program, called ConnectedSolutions, significantly improves the financial viability of solar+storage at affordable housing developments.



ConnectedSolutions: A New State Funding Mechanism to Make Battery Storage Accessible to All by Todd Olinsky-Paul (February 2021)

This report aims to inform state policymakers about the structure and benefits of the ConnectedSolutions battery storage program model. It summarizes barriers to scaling up distributed battery storage, explains how the ConnectedSolutions program was developed in the Northeast, and discusses why the program has been successful.



Energy Storage: The New Efficiency — How States Can Use Efficiency Funds to Support Battery Storage and Flatten Costly Demand Peaks by Todd Olinsky-Paul (April 2019)

This report describes the process of enabling use of state energy efficiency funds to support the deployment of energy storage with performance incentives offered for demand reduction.

ConnectedSolutions

A PROGRAM ASSESSMENT FOR MASSACHUSETTS

Clean Energy Group (CEG) is a leading national, nonprofit advocacy organization working on innovative policy, technology, and finance strategies in the areas of clean energy and climate change.

CEG's energy storage policy work is focused on the advancement of state, federal, and local policies that support increased deployment of energy storage technologies. Battery storage technologies are critical to accelerate the clean energy transition, to enable a more reliable and efficient electric power system, and to promote greater energy equity, health, and resilience for all communities.

Learn more about Clean Energy Group and its Energy Storage Policy Project at *www.cleanegroup.org/ceg-projects/energy-storage-policy*.

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