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October 31, 2018

Massachusetts Joint Statewide Electric and Gas

Three-Year Energy Efficiency Plan

2019–2021

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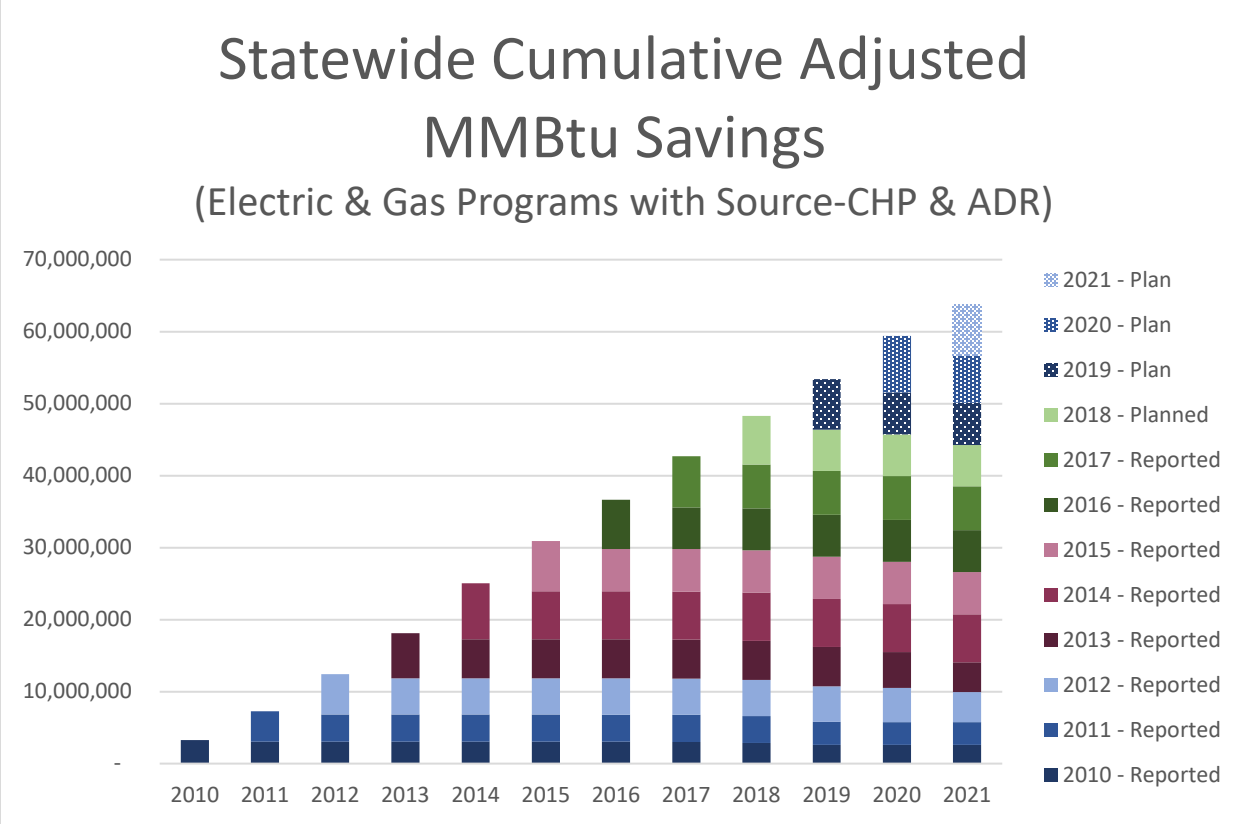
2019-2021 MASSACHUSETTS JOINT STATEWIDE THREE-YEAR ELECTRIC & GAS ENERGY EFFICIENCY PLAN

I. EXECUTIVE SUMMARY

Program Administrators propose a sustained, intense energy efficiency effort in 2019-2021

- The 2019-2021 Three-Year Energy Efficiency Plan ("Plan") builds on the historic success of the energy efficiency programs delivered since the implementation of the Green Communities Act, and represents sustained efforts and creative new ideas to achieve high total energy reductions over the term. This Plan represents a pivot point, where the Program Administrators will embrace a broader, holistic energy system view by providing new tools to help all customers reduce their overall energy bills in addition to system costs by reducing energy usage and lowering demand at peak periods.
- **Stronger Investments in Energy Efficiency and Demand Savings** – The Program Administrators propose a statewide three-year investment in energy efficiency programs of **$2.77 billion** – an investment that saves customers money, helps the environment, and creates and keeps jobs. The gas and electric Program Administrators are proposing an investment of over $200 million more this Plan compared to the 2016-2018 Three-Year Plan. The Plan includes a suite of innovative programs that will continue to weatherize homes, increase the comfort of customers, make businesses more competitive, and drive down total energy bill costs.
- **Aggressive Energy Reduction Goals** – Overall, the Plan sets forth aggressive goals, which translate to:
  - Electric lifetime savings (excluding fuel conversion and active demand reduction) of 36,295,524 MWh for electric Program Administrators.
  - Gas lifetime therm savings of 1,249,921,626 therms for gas Program Administrators.
  - Total statewide adjusted energy savings across all fuels (excluding active demand reduction) of 270,011,315 MMBtu savings.



- **Targeting Significant Greenhouse Gas Emission Reductions** – In this Plan, the Program Administrators are proposing a suite of measures and strategies that achieve even greater levels of greenhouse gas reductions than in the current 2016-2018 Plan. The 2019-2021 Plan proposes CO2e reductions of over 2.6 million short tons—over 400,000 short tons more in reductions than in the current 2016-2018 plan.

- **Delivering the Higher Level of Benefits to Customers than Prior Plans** – The proposed energy savings levels represent an aggressive commitment to reducing overall customer energy usage, while providing at least **$8.5 billion** in benefits to customers and contributing to the Commonwealth's economic, environmental, and job creation goals. [1]

The 2019-2021 Plan builds on past success and embraces new challenges and opportunities

- The Program Administrators have a long and unparalleled track record of success in implementing energy efficiency programs. This success has contributed to Massachusetts' nation-leading position in energy efficiency and made the programs a model for the rest of the country. This success has earned the Program Administrators the trust of customers

[1] The benefit value includes benefits identified by DOER's study of avoided costs of compliance with the Global Warming Solutions Act. The Program Administrators have provided tables showing the benefits without the values identified in the study for reference purposes.

and stakeholders in the Commonwealth. Program Administrators achieve success because of their ability to look forward and analyze technologies and the marketplace, and evolve programs to best serve the energy goals of customers under the mandate and framework of the Green Communities Act.

- The Program Administrators, with the support of the Council, have been able to accelerate the adoption of efficient lighting and support increased building codes through the successful implementation of the energy efficiency programs. Due to these efforts, the lighting market has been substantially transformed. In addition new standards have increased lighting baselines, creating enduring economic and environmental benefits for all customers, but the savings associated with standard practice and rising baselines reduce the savings claimable by the Program Administrators.

The proposed 2019-2021 investment will continue to expand the Program Administrators' robust contractor infrastructure

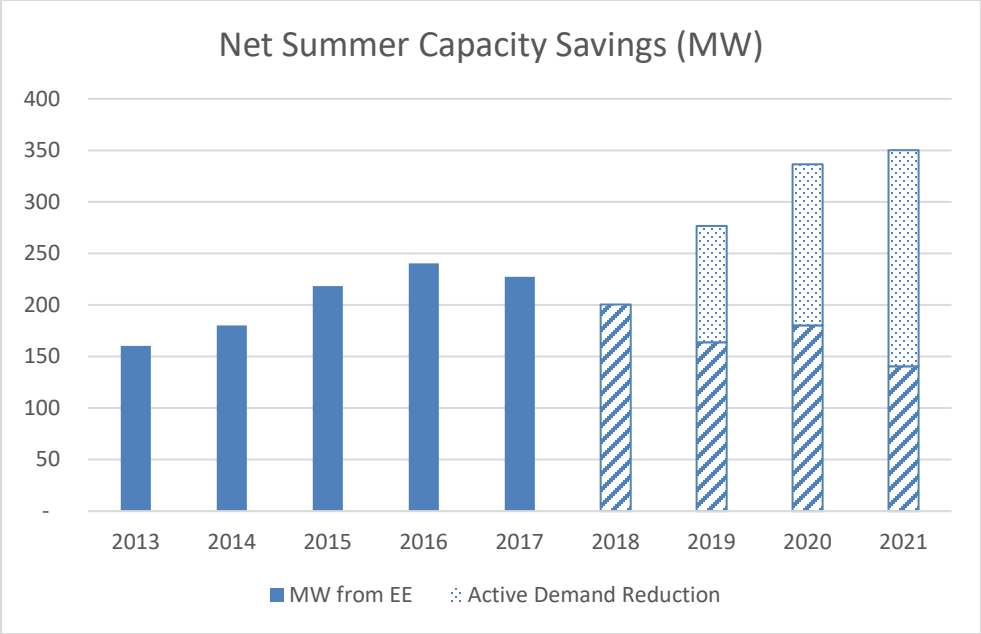
- According to MassCEC's 2017 Clean Energy Industry Report, the energy efficiency, demand management, and clean heating and cooling industries are estimated to support the employment of about 78,000 workers. In this Plan, the Program Administrators are committed to maintaining its robust, well-trained contractor infrastructure. To do this, the Program Administrators will modify contractor training to ensure contractors have the skills and knowledge to match the evolution of the programs.

The Plan describes a holistic approach to customer-focused energy efficiency called Energy Optimization.

- The Program Administrators are introducing an overarching "**Energy Optimization**" philosophy across all sectors. Under the Energy Optimization philosophy the Program Administrators will provide a more holistic and integrated approach to helping customers address their energy use and associated costs based on their individual needs and goals, while aligning with the broader Commonwealth energy and greenhouse gas emissions reduction goals. The Energy Optimization approach builds on the successful integrated gas and electric program delivery, and will include strategies that target customers' overall energy costs, as well as provide broader energy and economic benefits both for participating customers as well as all ratepayers. The approach will include providing fuel neutral educational materials and assistance on all options for heating and cooling. In some instances, for example, this may mean helping customers utilize energy more efficiently and reduce greenhouse gas emissions by increasing electric usage through the adoption of **state-of-the-art cold climate air source heat pumps**.
- The Plan embraces a broader energy system view by providing new tools and strategies to help reduce system costs for the benefit of all customers by **reducing energy and lowering demand at peak demand periods**. The Plan has a focus on peak demand reductions in both summer and winter that can help minimize total system costs and the use of inefficient generation sources.

The Program Administrators maintain their passion for excellence in program design and serving all customers

- The Program Administrators propose a **bold rethinking of residential program delivery**, designed to better serve customers, provide more opportunities for engagement, more effectively address barriers, and leverage relationships with contractors and market actors.
- The Program Administrators will continue their intense focus, working with the deeply committed team at LEAN, to serve **income eligible customers** with successful energy efficiency programs that provide myriad benefits that extend well beyond lower energy costs.
- The Program Administrators are amplifying efforts to serve all customers, including moderate income customers. The Program Administrators are expanding offerings and simplifying delivery channels to all customers, in order to ensure all customers are being served effectively. The Plan will offer enhanced strategies and community outreach efforts targeting **renters, moderate income customers, and non-English speaking customers**. Highlights of new efforts are:
  - No-cost weatherization for moderate income customers and, to assist renters, 90% incentives for insulation for landlords of all low-rise buildings (three stories and under) who are willing to complete all recommended insulation and air sealing.
  - Proactive engagement with municipalities and communities with historically low participation rates through a partnership model that will provide marketing materials, trainings, and networking check-ins to share program updates and outreach best practices.
  - Optimization of the customer journey for non-English speakers by providing more consistent language services via the Mass Save® phone line and in follow-up communications for those customers who communicated that English is not a primary language. The Program Administrators will offer additional translated program materials in the most commonly spoken languages across Massachusetts.
- The Program Administrators will continue their diligent focus to serve **commercial and industrial customers** with successful programs that reach customers through many different pathways and target existing and emerging technologies including lighting with integrated controls, HVAC and controls, and industrial processes including heat recovery.
- The 2019-2021 Plan includes new statewide **Active Demand Reduction Offerings** for residential and commercial and industrial sectors designed to reduce summer and winter peak demand. Customers will earn an incentive for verifiably shedding load in response to events called by Program Administrators. The Program Administrators will offer a technology agnostic approach in order to encourage innovations and capture all cost-effective demand reductions. In addition, the Program Administrators are excited to offer specialized performance based incentive options for storage designed to provide enhanced incentives to customers in a manner to spur the emerging market, and that are complementary to other state sponsored storage programs.



- The Program Administrators have developed a new **Passive House** approach for new construction projects for both residential and commercial customers.
- The Plan will also target savings to support the Commonwealth's **winter reliability** efforts and drive down winter electric demand by approximately 500 MW. The PAs will introduce new active demand offerings targeting winter demand. Savings from weatherizing buildings delivered by gas Program Administrators increase year-over-year during the Plan term, which significantly decreases the demand for natural gas during the winter period. The PAs will also introduce a **temperature optimization** approach that will strategically reduce winter energy use by automatically adjusting customer set points on eligible Wi-Fi enabled thermostats.
- The Plan incorporates new strategies that will promote **strategic electrification** and assist customers seeking to **switch to renewable energy and clean energy technologies**, where cost-effective.
  - The Program Administrators are targeting the following number of cold climate air source heat pump installations: 37,993 residential customers, 6,082 income eligible customers, and 17,980 C&I units.

The Plan fulfills the requirements of the Green Communities Act and provides value for customers

- The programs and core initiatives are cost-effective statewide and are designed to deliver portfolio benefits of at least **$8.5 billion**, more than double the total program costs (inclusive of customer contributions) of **$3.8 billion**.
- Through statewide collaboration and coordination, the Program Administrators continue to share best practices, leverage collective resources, and use competitive procurement to

minimize administrative costs. This results in **almost three-quarters of program budgets being allocated to participant incentives that flow back to customers**.

The Plan reflects the unique collaborations that are the hallmark of Massachusetts energy efficiency.

- The Program Administrators greatly appreciate the efforts of DOER, the Attorney General, Council members, LEAN, and other stakeholders. Assembling a statewide plan for an endeavor as expansive as the 2019-2021 Plan is a challenging and rewarding process that benefits greatly from thoughtful and positive engagement by stakeholders. Engagement occurs through multiple avenues ranging from public comments to workshops to deep dives between DOER experts, the consultants, and the PA Management Committees. With so many perspectives and priorities on how to best pursue cost-effective energy efficiency and demand reduction, the Program Administrators recognize that differing views legitimately exist, but believe that through the extensive collaboration during Plan development process the overall end product – and results for the Commonwealth and customers – is ultimately improved.

  This aggressive Plan reflects the Program Administrators' commitment to a robust and dynamic investment in energy efficiency and continued leadership during 2019-2021.

II. OVERVIEW

A. Introduction

Bay State Gas Company d/b/a Columbia Gas of Massachusetts ("CMA"), The Berkshire Gas Company ("Berkshire"), Boston Gas Company, Colonial Gas Company, Massachusetts Electric Company and Nantucket Electric Company, each d/b/a National Grid ("National Grid"),[2] Fitchburg Gas and Electric Light Company d/b/a Unitil ("Unitil"), Liberty Utilities (New England Natural Gas Company) Corp. d/b/a Liberty Utilities ("Liberty"), Cape Light Compact JPE ("Compact" or "CLC"),[3] and NSTAR Electric Company and NSTAR Gas Company, each d/b/a Eversource Energy ("Eversource") (collectively, "Program Administrators" or "PAs") developed and prepared this 2019-2021 Energy Efficiency Plan ("2019-2021 Plan" or "Plan") pursuant to the mandates of An Act Relative to Green Communities, Acts of 2008, c. 169, codified at G.L. c. 25 §§ 19, 21-22, amended by An Act Relative to Competitively Priced Electricity in the Commonwealth, Acts of 2012, c. 209, and by An Act to Advance Clean Energy, Acts of 2018, c. 227[4] ("Green Communities Act" or "GCA").[5]

The 2019-2021 Plan includes multiple parts that, taken together as an integrated whole, describe the Program Administrators' strategy for acquiring cost-effective energy efficiency and demand reduction resources through a sustained effort while considering short term customer bill impacts. The provisions of the entire Plan must be considered as a whole to fully appreciate and understand both the Program Administrators' energy efficiency programs and their strategy for satisfying the mandates of the GCA over the next three years. While detailed, an energy efficiency investment plan under the GCA ("Three-Year Plan") is a strategic plan, not an implementation guide. This strategic plan approach provides the Program Administrators with the flexibility necessary to respond to changing circumstances in order to deliver on their Plan goals and comply with the GCA.

The tremendous success of energy efficiency programs in Massachusetts is directly related to the collaboration amongst the Program Administrators in developing and delivering integrated programs and services, as well as the robust stakeholder and customer engagement process. Engagement through the Energy Efficiency Advisory Council ("Council"), as well as informal

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2 Pursuant to D.P.U. 15-79, National Grid offers energy efficiency services to Blackstone Gas Company customers. National Grid and Blackstone Gas Company renewed the agreement for these services through the 2019-2021 Plan Term.

3 The Cape Light Compact is the only publicly funded, municipal aggregator (as defined by G.L. c. 164, § 134) energy efficiency program administrator in Massachusetts. Since it is a public entity consisting of twenty-one towns and one county, it does not participate in performance incentives or collect lost-based revenues. As such, any discussion of these topics contained in the Three-Year Plan does not pertain to the Compact and general references to Program Administrators in these topic narratives do not include the Compact.

4 Acts of 2018, c. 227 was signed on August 9, 2018 and is effective November 7, 2018 (the Act does not include an emergency preamble).

5 The integrated Plan represents both the electric Program Administrators' jointly prepared energy efficiency investment plan and the gas Program Administrators' jointly prepared gas efficiency investment plan pursuant to G.L. c. 25, § 21(b)(1), as amended by An Act Relative to Competitively Priced Electricity in the Commonwealth, Acts of 2012, c. 209.

outreach and engagement, have contributed to this success. Program Administrators have also engaged with customers and organizations, researched and analyzed evaluations and best practices, and participated in collaborative discussions with key stakeholders including the Council, its consultants, Department of Energy Resources ("DOER"), the Office of the Attorney General (the "Attorney General"), and the Low-Income Energy Affordability Network ("LEAN"). The Program Administrators coordinate closely with LEAN in serving income eligible customers and appreciate LEAN's continued commitment to the Commonwealth's most vulnerable residents.

B. Sustaining Excellence in 2019-2021

The energy marketplace is evolving quickly, and the Massachusetts Program Administrators have been at the center, driving the changing landscape of energy efficiency. The Program Administrators' nation-leading and collaborative efforts have accelerated market transformation, and contributed to lower demand, lower energy prices, and a more efficient energy system. Sustaining very high claimable savings goals becomes increasingly difficult in each subsequent year as markets become saturated, "easy" savings no longer exist, and rising baselines continue to reduce claimable savings opportunities. Over the next three years, the Program Administrators will need to find ways to mine savings from more costly and challenging projects and market segments. To maintain the robust levels of energy efficiency investments, the Program Administrators will undertake a paradigm shift focused on positioning the Program Administrators as energy advisors to empower customers to make educated decisions about their energy use and **ensuring that energy efficiency remains consumers' first choice**. Opportunities for efficiency still exist, and in the 2019-2021 Plan the Program Administrators continue to innovate and raise the bar for energy efficiency programs, despite increased challenges.

The 2019-2021 Plan sets an ambitious agenda to build on the success of prior plans through a more holistic and integrated effort. The Program Administrators have defined a new approach: Energy Optimization. This approach includes a combination of energy efficiency, active and passive demand reduction, and targeted approaches for reducing customers' overall energy use, particularly for space and water heating. This aligns with the recent revisions to the GCA and focuses on the customers' individual energy needs and goals, such as customers' desires for cleaner and less expensive energy, in order to provide significant energy and economic benefits to customers and the Commonwealth. The Program Administrators are seeking to engage customers and provide effective combinations of fuel neutral education and incentives to drive efficiency and optimize energy use.

The 2019-2021 Three-Year Plan introduces several new strategies and redesigned programs:

Residential and Income Eligible

- *Program Realignment*: designed to target customer-specific opportunities and provide multiple engagement paths for customers
- *Enhanced Customer and Ally Support*: structuring initiatives to provide enhanced support for customers and relationships with trade allies, tailoring energy savings packages for direct delivery to customers, and leveraging in-home assessments to provide deeper education and more facilitated options to support adoption of major measures

- *Moderate Income*: simplifying communications and providing seamless, uncomplicated pathways to mitigate structural barriers in order to serve all customers, including addressing the needs of moderate income customers, as well as providing no-cost weatherization for moderate income customers
- *Renters*: developed tailored pathways to access energy efficiency services and address barriers to participation. To further assist renters, the Program Administrators are offering 90% incentives for insulation for landlords of all low-rise buildings (three stories and under) who are willing to complete all recommended insulation and air sealing
- *Addressing Language Barriers*: working with industry experts to implement a best-in-class optimized program experience that ensures customers are able to communicate in their preferred language
- *Active Demand Reduction*: a new bring-your-own device active demand reduction initiative that allows residential and income eligible customers to expand the use of controllable efficiency equipment that can provide demand reduction during peak hours
- *Storage Performance*: a new specialized storage performance offering will provide enhanced incentives to customers to dispatch energy storage during daily peak hours in the summer and winter months
- *New Partnerships with Communities*: proactive engagement with municipalities and communities with historically low participation rates through a partnership model that will provide marketing materials, trainings, and networking check-ins to share program updates and outreach best practices
- *Pay for Savings*: fully optimized incentive structure that rewards builders for savings based on energy modeling in the New Homes & Renovations initiative
- *Passive House*: offering training, technical support, and incentives for evolved design approach that focuses on super-efficient shell or building envelope design and optimized energy systems
- *Market Rate and Income Eligible*: better alignment of market rate and income eligible programs to support increased awareness and drive customer participation, and align auditor and contractor protocols, program measures, and service delivery
- *Income Eligible Workforce*: developing training and retention strategies to ensure a knowledgeable workforce to continue on-the-ground success in income eligible programs

Commercial and Industrial

- *Active Demand Reduction*: offering an innovative technology-agnostic curtailment initiative allowing customers to work with experts to develop facility-tailored curtailment strategies and receive incentives for verifiable load shedding during peak periods
- *Storage Performance*: specialized storage performance offerings will provide enhanced incentives to customers to dispatch energy storage to either shave peak demand or during daily peak hours in the summer and winter months
- *Enhanced Technical Assistance and Design Support*: advanced, integrated design path that fosters collaboration among owners, designers, and Program Administrators to incorporate

high performance characteristics into the earliest design schemes and optimize performance

- *Whole Building Project Approaches*: testing new approaches to engage with design teams early to encourage designers and customers to set energy use intensity targets that can lead to more zero net energy or Passive House criteria projects
- *Operations and Maintenance Savings*: providing simplified and expedited paths for implementing common low-cost/no-cost measures or actions through a prescriptive incentive as a means to help capture and achieve consistent, verifiable operations and maintenance savings
- *Advanced Systems Training*: including new training offers for advanced lighting controls to ensure that contractors have the expertise to optimize the specifications and installation of energy efficiency equipment combined with system controls
- *Franchised Businesses*: offering customized and specialized industrial engineering services for franchised businesses
- *Streetlight Conversion Outreach*: providing additional outreach to municipalities that have not completed conversions to LED streetlights and an educational webinar that walks through the Program Administrators' offerings and clarifies the pathways and resources available for municipalities

Fundamentally, the 2019-2021 Plan will provide customers with the tools and knowledge to save energy and lower bills, improve the comfort of homes and businesses, and increase business productivity.

C. Core Ways to Measure Success for 2019-2021

In the 2019-2021 Plan, the Program Administrators are expanding their scope of services in order to provide energy efficiency and demand reduction benefits to customers in a more holistic manner. This innovative, comprehensive energy efficiency service can be examined through a multi-prong approach that shows the overall impact and success of the Program Administrators.

Several measures and strategies in the 2019-2021 Plan reduce energy use from one fuel source but may increase use of another fuel. For example, efficient lighting measures produce less heat waste than traditional lighting, and therefore result in an increase in heating fuel usage to replace the heat previously produced by inefficient lighting. New active demand reduction strategies may shift energy consumption from one time period to another, producing peak savings but not necessarily overall energy savings. Additionally, pre-cooling of air conditioning for a demand event may result in higher kWh consumption, but can provide significant peak demand savings and benefits that are important to both customers and the Commonwealth. Also, storage technologies may have efficiency losses during use, resulting in lower peak kW but higher kWh consumption. Further, the recently amended statute encourages strategic electrification, which may reduce the use of oil or propane but increase the use of electricity and increase peak demand. The Program Administrators have determined that these measures are cost effective, providing benefits to customers in a more holistic, integrated approach.

As the Program Administrators transition to this more holistic approach of reducing and optimizing overall energy use, the Program Administrators recognize the need to provide key data points to measure success of the Plan and provide comparable metrics to prior Plans for stakeholders to understand the impact of the programs. Accordingly, the Program Administrators will provide the following key data sets quarterly:

- Net lifetime all-fuel savings (MMBtu) (excluding MMBtus associated with active demand reduction efforts) to transparently illustrate the net effect of all fuel savings efforts (electric, gas, oil, and propane), as well as the impact of fuel conversions that result in overall lower energy use. MMBtus savings will be reported based on source savings for combined heat and power and site savings for all other measures. Statewide MMBtus are expressed as adjusted MMBtus to reflect the MMBtu savings from energy efficiency and combined heat and power measures.
- Demand savings (MW) for electric Program Administrators, which provides total peak demand savings from passive and active[6] demand reduction measures and strategies.[7]
- Net lifetime electric savings (MWh) (excluding fuel conversions and active demand reduction efforts) for electric Program Administrators, which provides total electric savings for measures designed to reduce total electric use. Excluding new initiatives that may increase kWh but provide significant overall energy and demand reduction benefits provides a comparable metric to the electric savings metric used in prior terms.
- Net lifetime gas savings (therms) for gas Program Administrators, which provides total gas savings for measures designed to reduce total gas use.

While the above data points will serve as the primary metrics for planning and measuring success in this Plan, the Program Administrators will continue to transparently report all savings metrics that are currently reported, including any and all positive and negative annual and lifetime MWh, therms, MMBtu of oil, MMBtu of propane, and gallons of water. The Program Administrators will continue to report benefits and calculate cost-effectiveness consistent with the Department's Energy Efficiency Guidelines.[8]

In setting forth goals and budgets in this Plan, the Program Administrators have carefully considered new program structures and strategies, lessons learned from past three-year plans, changing baselines, new technologies, market opportunities, individual territory characteristics, PA-specific potential studies, and the desire to foster a sustainable energy efficiency infrastructure

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6 Passive demand reduction includes measures that provide kWh reductions and summer and winter demand kW savings, which have cumulative benefits. Active demand reduction includes measures and strategies that primarily provide kW savings (but may increase kWh) and are dispatched over specific periods of time through automation, programming, or control.

7 Through the measure and core initiative reporting, stakeholders will be able to view active and passive demand measures separately. This will provide transparency into all demand measures (passive and active) so stakeholders will have insight into the impact of each demand measure/approach.

8 The current Guidelines were established in Investigation by the Department of Public Utilities on its Own Motion into Updating its Energy Efficiency Guidelines, D.P.U. 11-120-A, Phase II (2013).

in the Commonwealth. The Program Administrators will pursue available cost-effective energy efficiency and demand reduction, with consideration of reasonable short-term customer bill impacts, consistent with Department precedent, and will seek to maximize benefits to the Commonwealth and its residents. Specifically, the Program Administrators have sought to minimize bill impacts by proposing only the necessary levels of funding required to achieve the aggressive mandates of the GCA. An overview of the statewide savings (presented as discussed above), benefits, and budgets described further in this Plan are set forth below.

	2019	2020	2021	2019-2021
Net Adjusted Lifetime All Fuel (MMBtu excluding ADR)	83,185,379	101,059,477	85,766,460	270,011,315
Peak Demand Reduction (kW)	276,731	336,566	340,002	694,259
Net lifetime electric savings (MWh) (excluding fuel conversions and ADR)	10,827,480	14,976,480	10,491,565	36,295,524
Net lifetime gas savings (therms) (excluding fuel conversions)	411,231,897	417,269,281	421,420,448	1,249,921,626
Total Statewide Budget ($)	896,022,104	938,270,767	935,873,633	2,770,166,505
Benefits ($)	2,744,227,320	3,037,802,488	2,752,249,626	8,534,279,434

D. Continuing Innovation Under the Green Communities Act

The initial passage of the GCA transformed energy efficiency efforts in Massachusetts, and the GCA continues to lead Massachusetts on a path of innovation. The enactment of the GCA expanded energy efficiency mandates by requiring the Program Administrators to develop three-year energy efficiency plans that will "provide for the acquisition of all available energy efficiency and demand reduction resources that are cost effective or less expensive than supply." G.L. c. 25, § 21. To date, the GCA's framework and statewide collaborative approach has produced unprecedented results. The Program Administrators are able to embrace new strategies and adopt emerging technologies in order to continuously pursue new cost-effective opportunities and meet the goals of the Commonwealth, including supporting greenhouse gas emission reduction goals.

The recently updated GCA maintains the same scope and objective to pursue all available cost-effective energy efficiency and demand reduction resources, but clarifies the opportunities to deliver holistic energy efficiency services. For example, the updated GCA clarifies that electric Program Administrators may deliver non-electric energy efficiency services, which is a feature that has been included in prior electric Program Administrators' residential and multi-family programs. See 2016-2018 Three-Year Plans Order at 104-105. The updated GCA also specifically discusses the ability of the Program Administrators to pursue active demand reduction strategies, including energy storage, which the Program Administrators already have been exploring under

approved demonstration offerings during the 2016-2018 term and now are part of the Program Administrators' overall demand reduction strategy.[9] In addition to clarifying activities already undertaken by the Program Administrators, the updated GCA provides that the Program Administrators may pursue holistic ways to reduce overall energy use through strategic electrification (that result in cost-effective reductions in greenhouse gas emissions and minimize ratepayer costs) and conversions to renewable energy sources or other clean energy technologies. These specific strategies are included in the Plan and further the Program Administrators' overall energy optimization approach, which focuses on working with customers to provide holistic education on ways to reduce and optimize overall energy use.

In delivering energy efficiency programs under the GCA, the Program Administrators have already achieved over $20 billion in total benefits (significantly greater than the cost of delivering them). Using the strategies set forth in this Plan, including new statewide active demand and fuel conversion offerings, the Program Administrators plan to deliver at least another $8.5 billion in total benefits in 2019-2021.[10] The benefits delivered under the Program Administrators' programs directly tie to customer savings and other benefits. Delivering programs under the GCA provides an optimal framework for delivering broad and innovative programs, while at the same time ensuring a direct benefit for customers, and always consider short term and long term customer bill impacts. The GCA framework also provides stability for the energy efficiency market and contractors, which help drive innovations and provide high quality, consistent services for customers.

E. Statutory and Regulatory Context and Process

1. Overview

Energy efficiency in Massachusetts is governed by the statutory framework set out in the GCA. The Program Administrators are responsible for administering energy efficiency programs pursuant to the GCA. G.L. c. 25, §§ 19, 21. The GCA requires the Program Administrators to pursue all available energy efficiency and demand reduction resources that are cost-effective or less expensive than supply. G.L. c. 25, § 21(b)(1). The GCA sets up a multi-level framework in which the Program Administrators work with a diverse Council on program development and implementation, and also appear before the Department for Plan approval, reporting, and cost recovery.

[9] The new law also requires that energy storage supported under the energy efficiency programs provide sustainable peak load reductions. Acts of 2018, c. 227, § 20.

[10] The benefit value includes benefits identified by DOER's study of avoided costs of compliance with the Global Warming Solutions Act. The Program Administrators have provided tables showing the benefits without the values identified in the study for reference purposes. See Exh. 4.

2. Roles and Responsibilities

a. Energy Efficiency Advisory Council

The Department appoints and convenes the Council, which consists of 15 voting members of diverse backgrounds and expertise.[11] G.L. c. 25, § 22(a). The Council's membership is composed of governmental and non-governmental members. G.L. c. 25, § 22(a). The Council also includes one "non voting, ex-officio member"[12] from each of the Program Administrators (composed of Massachusetts electric and natural gas distribution companies and municipal aggregators with certified energy plans). G.L. c. 25, § 22(a). There is also one non-voting member from each of the heating oil industry, energy efficiency businesses, and ISO-NE. G.L. c. 25, § 22(a).

The statutorily defined composition of the Council ensures that the Program Administrators can benefit from a broad range of unique perspectives, such as non-profits, business, manufacturing, and real estate associations, environmental advocates, municipalities, state agencies, and residential and income eligible customers. The expertise of the Council's diverse membership and consultants allows it to provide strategic, objective advice to the Program Administrators. The Council also provides a forum for coordinating stakeholder feedback on a statewide basis. The Council is tasked with coordinating with the Program Administrators in developing a three-year plan, periodically reviewing program cost-effectiveness, and providing a report to the Legislature regarding the implementation of the Program Administrators' three-year plan. G.L. c. 25, § 22(b), (c). The Council may retain energy efficiency experts. G.L. c. 25. § 22(c). To conduct its business, the Council holds meetings, which are subject to the open meeting law, typically on a monthly basis. They Council may also create subcommittees to assist with its business (e.g., the Executive Committee). The Council is designed to engage the expertise of its diverse members and consultants to provide strategic, object advice to the Program Administrators and the Council.

b. Department of Public Utilities

The Department is a quasi-judicial regulatory agency with extensive statutory authority over the Program Administrators.[13] The Department is responsible for ensuring that the electric

[11] The 15 voting members include one person representing each of the following: (1) residential customers; (2) the low-income weatherization and fuel assistance program network; (3) the environmental community; (4) businesses, including large C&I end-users; (5) the manufacturing industry; (6) energy efficiency experts; (7) organized labor; (8) the Department of Environmental Protection; (9) the Attorney General; (10) the Executive Office of Housing and Economic Development; (11) the Massachusetts Non-profit Network; (12) a city or town in the Commonwealth; (13) the Massachusetts Association of Realtors; (14) a business employing fewer than 10 persons located in the Commonwealth that performs energy efficiency services; and (15) DOER. The Commissioner of DOER serves as chair of the Council. G.L. c. 25, § 22.

[12] The dictionary defines "ex officio" as meaning "by virtue of one's position or status." The Oxford English Dictionary (2013). Ex-officio members have exactly the same rights and privileges as do all other members, except as otherwise specified by statute. See http://www.robertsrules.com/faq.html#2.

[13] The Department's authority extends beyond energy efficiency to all aspects of the operations of electric and gas distribution companies including, but not limited to, rate setting, service quality, customer care, and the operation of a safe and reliable utility. See G.L. c. 164, § 76. Since its establishment by the Legislature in 1919, the Department has comprehensively regulated the operations of electric and gas utility companies

and gas utilities provide safe, reliable, and least-cost service to Massachusetts customers. Having the resources, technical expertise, and the statutory obligation to regulate in the public interest, the Department is uniquely structured to ensure that energy efficiency funds are spent cost-effectively, that customers are receiving energy efficiency services, and that energy savings are being achieved.

Under the GCA, the Department has oversight authority over the Program Administrators and the Council and is responsible for final administrative review of energy efficiency determinations. G.L. c. 25, §§ 19, 21, 22. The Department has ultimate jurisdiction with respect the final plan approval, cost-effectiveness, rates, and cost-recovery.[14] The Department has established Guidelines that set forth the requirements for energy efficiency, including the elements, review process, and mid-term modifications related to the Three-Year Plan, the method for determining cost-effectiveness, and the mechanisms for cost recovery. The Department conducts its review of Three-Year Plans and Program Administrator performance through individual adjudicatory proceedings consistent with the Massachusetts Administrative Procedure Act, G.L. c. 30A, which requires the Department to maintain standards of fair procedure such as notice, an opportunity to be heard, and the ability to appeal decisions.[15] Funding for the programs is also approved by the Department and reconciled annually through separate proceedings discussed in Section V.B below.

The Department is also responsible for determining the effectiveness of the Three-Year Plan annually consistent with G.L. c. 25, § 21(d)(2). Annually, the Program Administrators submit detailed reports to the Department documenting program participation, savings, benefits, and expenditures, summarizing and providing completed evaluation studies, and explaining any variances from anticipated performance levels. Plan-Year Reports filed following the initial two years of a term are not adjudicated; however, if a Program Administrator has not reasonably complied with its Three-Year Plan, the Department may open an investigation into the Program Administrator's performance. G.L. c. 25, § 21(e). At the conclusion of the program term, each Program Administrator files a detailed Term Report demonstrating compliance with the requirements of the GCA and Department Guidelines and directives. The Department reviews the Term Report through an adjudicatory proceeding and provides final approval of costs and performance incentives.

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in Massachusetts pursuant to G.L. c. 25 & 164 to ensure that electric and gas services are provided pursuant to just and reasonable rates.

[14] The GCA states that, in authorizing energy efficiency programs, the Department "shall ensure that they are delivered in a cost effective manner capturing all available efficiency opportunities, minimizing administrative costs to the fullest extent practicable and utilizing competitive procurement processes to the fullest extent practicable." G.L. c. 25, § 19(a, b). To mitigate capacity and energy costs for all customers, the GCA also requires the Department to ensure that electric and natural gas resources are first met "through all available energy efficiency and demand reduction resources that are cost effective or less expensive than supply." G.L. c. 25, § 21(a).

[15] See G.L. c. 30A, §§ 5, 10-12, 14 (outlining adjudicatory proceedings and availability of judicial review). Additionally, to comply with c. 30A, the Department must maintain a record of its adjudicatory proceedings, afford parties the opportunity to present evidence and argument and issue decisions in writing or on the record with a statement of reasons. G.L. c. 30A, §§ 10-11. Finally, Department decisions are subject to appeal to the Supreme Judicial Court on the record formed during the c. 30A adjudicatory proceeding. G.L. c. 30A, § 5.

3. Three-Year Plan Process

a. Development of the Plan

The process established by the GCA for developing the energy efficiency plans is designed to provide extensive and meaningful stakeholder input into the design and implementation of the Three-Year Plans. The Program Administrators engage with the Council on the development of each new Plan, including through regular meetings, topic-specific Council workshops, and through regular communications with the Council's consultants. In 2017 and 2018, the Program Administrators actively participated in six sector-specific workshops convened by the Council. Following the workshops in 2018, the Council issued a resolution on February 28, 2018 memorializing certain strategic and tactical recommendations to the Program Administrators from the Council workshops. See Appendix D. The Program Administrators also participated in nine public comment listening sessions organized by the Council in 2018, as well as listened to and reviewed oral and written public comments at regular Council meetings. The Program Administrators closely reviewed the Council's recommendations from workshops in the February Resolution, as well as comments from the listening sessions, and incorporated many of the themes and comments into the program designs for the April and Final Plan.

The submission of the Plan to the Council every three years on or before April 30th commences the formal stakeholder process, which entails opportunities for public comment and formal review and recommendations from the Council. G.L. c. 25, § 21(c). The Council's formal role in the development of a Three-Year Plan concludes three months after submission of the plan (i.e., end of July), at which time the Council offers its approval or comments to the Program Administrators. G.L. c. 25, § 21(c). In this role, the Council "shall review and approve demand resource program plans and budgets, work with program administrators in preparing energy resource assessments, determine the economic, system reliability, climate and air quality benefits of efficiency and load management resources, conduct and recommend relevant research, and recommend long term efficiency and load management goals to maximize economic savings and achieve environmental goals." G.L. c. 25, § 22(b). As part of its review of Three-Year Plans, the Council must approve "efficiency and demand resource plans and budgets" with a two-thirds majority vote. G.L. c. 25, § 22(b).

On July 31, 2018, the Council passed a resolution with comments on the April 30, 2018 draft Three-Year Plan. See Appendix E. Since the passage of the July Resolution, the Program Administrators have worked collaboratively with the Council to refine the Plan to address the concerns of the Council and enhance opportunities to provide energy efficiency services to customers. On September 14, 2018, the Program Administrators submitted an additional draft Plan to the Council with full benefit-cost screening models and energy efficiency data tables. Through Council meetings and one-on-one meetings, Councilors provided additional feedback and suggestions to the Program Administrators.

In addition to the formal and collaborative process with the Council, the Program Administrators also engaged myriad stakeholders, including customers, past participants, contractors, energy experts, trade allies, manufacturers, and distributors. The Program Administrators value and appreciate the input and strong interest in energy efficiency from

Councilors, stakeholders, and customers. The Program Administrators weigh the diverse input of the Council against the Program Administrator's responsibility to administer the Programs in accordance with the statutory framework of the GCA, including an assessment of customer bill impacts. Pragmatically this has resulted in the Program Administrators adopting some, but not all, individual Councilor requests and Council recommendations.

The Program Administrators also worked closely with the Attorney General, DOER, and the Council consultants to closely review aspects of the Plans and savings and cost assumptions. On October 19, 2018, the Program Administrators, the Department of Energy Resources and the Attorney General's Office reached an agreement on 2019-2021 goals, budgets, and performance incentive pool, and other key terms reflected in the Plan. See Appendix F. On October 22, 2018, the Program Administrators submitted updated data tables and a memorandum summarizing additional enhancements to the Plan and reporting commitments. On October 30, 2018, the Council unanimously passed a resolution supporting the 2019-2021 Three-Year Plan. See Appendix G.

Throughout this process, the Program Administrators refined their program designs and goals, based on Council and stakeholder input, and prepared this final Plan for review and approval by the Department of Public Utilities – the next phase of the Three-Year Plan process.

b. Department Review and Approval of the Plan

i. Overview

On or before October 31, every three years, the Program Administrators file their joint energy efficiency plan, together with the Council's approval or comments and a statement of any unresolved issues, with the Department for its review and approval. G.L. c. 25, § 21(d)(1). The Department reviews the plan to ensure that each Program Administrator acquires all cost-effective energy efficiency and demand reduction resources, delivers energy efficiency programs while minimizing administrative costs, and complies with the other requirements of the GCA. Within 90 days after submission, the Department "shall approve, modify and approve, or reject and require the resubmission of the plan accordingly." G.L. c. 25, § 21(d)(2).[16] In reviewing the Program Administrators' Three-Year Plans, the Department reviews the elements set forth below to determine whether the Program Administrators have met their obligations under the GCA and other Department precedent.

ii. All Cost-Effective or Less Expensive than Supply

In approving a Three-Year Plan, the Department seeks to mitigate capacity and energy costs for all customers "through all available energy efficiency and demand reduction resources

[16] Due to the deadlines set forth in the GCA, the Department does not approve the three-year plan until after the start of the new three-year program term (i.e., the end of January). In recognition of the need for continuity of energy efficiency programs, the Department has allowed for the interim continuation of existing energy efficiency programs, pending approval of proposed new programs under review. See 2013-2015 Three-Year Plans Order, D.P.U. 12-100 through 12-111, at 160-161; Massachusetts Electric Company and Nantucket Electric Company, d/b/a National Grid, D.P.U. 09-116, Order Approving Motion for Interim Continuation (December 30, 2009).

that are cost effective or less expensive than supply." G.L. c. 25, § 21(a). The Department is charged with ensuring that the Program Administrators "have identified and shall capture all energy efficiency and demand reduction resources that are cost effective or less expensive than supply." G. L. c. 25, § 21(d)(2). To comply with the GCA, a Three-Year Plan must provide for the acquisition of these resources "with the lowest reasonable customer contribution." G.L. c. 25, § 21(b)(1). There is no simple, algebraic method to evaluate whether the mandate of all available cost-effective energy efficiency has been met. 2013-2015 Three-Year Plans Order at 36. The Department weighs (1) the steps the Program Administrators have taken to implement energy efficiency given the current state of energy efficiency supply and demand; (2) the steps the Program Administrators will take to expand future energy efficiency opportunities; and (3) the results of potential studies.[17] 2013-2015 Three-Year Plans Order at 36-37; 2016-2018 Three-Year Plans Order, D.P.U. 15-160 through D.P.U. 15-169 at 24-25.

The Department has determined that the acquisition of these resources, however, must be achieved through a sustained effort. 2013-2015 Plans Order, at 37 (2013); 2010-2012 Gas Order, at 71 citing G.L. c. 25, § 22(b); 2010-2012 Electric Order, at 85. To determine the rate at which Program Administrators must acquire these resources, the GCA requires the Program Administrators, Council, and Department to consider a number of factors.

> Determining a reasonable pace for a sustained acquisition requires the Program Administrators and the Council (in developing the Three-Year Plans) and the Department (in reviewing the Three-Year Plans) to strike an appropriate balance between several factors, including: (1) identifying the potential level of cost-effective resource currently available; (2) exploring ways in which this level can be increased; (3) assessing the capability of the energy efficiency vendor and contractor industry to support increased program activity; and (4) assessing the capacity of the Program Administrators to administer increases in program activity efficiently and effectively. The Department must take into consideration an additional factor: the rate and bill impacts that result from increased program activity.

2010-2012 Gas Order, at 71-72 and 2010-2012 Electric Order, at 85-86.

In developing their 2019-2021 Plan, the Program Administrators considered what an optimal pace is for acquiring all cost-effective energy efficiency resources for the period from 2019 to 2021, to ensure long-term sustainability for energy efficiency program offerings. In developing savings goals for 2019-2021, the Program Administrators took into consideration the four factors above, as well as rate and bill impacts on their customers. The Program Administrators provide detailed information on the development of their goals in Section IV.C,[18] demonstrating

[17] Potential studies are only one component of the planning process, but can help the Program Administrators understand the remaining technical, economic, and achievable energy efficiency opportunities within their service territories, which play a key role in helping Program Administrators set savings goals. 2016-2018 Three-Year Plans Order at 24-25.

[18] The Program Administrators have provided their individual benefit/cost ratio ("BCR") models with the Plan, further demonstrating that they are seeking to acquire all cost-effective energy efficiency and demand reduction resources for the 2019-2021 term.

that they are seeking to acquire all cost-effective energy efficiency and demand reduction resources for the 2019-2021 term.

iii. Program Cost-Effectiveness

The GCA specifically requires cost-effectiveness screening for energy efficiency programs. G.L. c. 25, §§ 19(c), 21(b)(3).[19] The Department has determined that a Total Resource Cost ("TRC") test that weighs the impact of all benefits and costs associated with each program satisfies this requirement D.P.U. 08-50-A at 14; Guidelines § 3.4.3. A program is cost-effective under the TRC test if the cumulative present value of its benefits is equal to or greater than the cumulative present value of its costs. Guidelines § 3.4.3.1. Benefits calculations include the cost of energy supply that is avoided when energy efficiency efforts are utilized and therefore the TRC test satisfies the GCA's requirement that energy efficiency programs be less expensive than supply. D.P.U. 08-50-A at 14-15.

Under the updated GCA, for the purpose of cost-effectiveness review, programs are aggregated by sector. If a sector fails the cost-effectiveness test as part of the review process, its component programs shall either be modified so that the sector meets the test or shall be terminated. G.L. c. 25, § 21(b)(3).

For the 2019-2021 Plan, the Program Administrators applied the results of the regional Avoided Energy Supply Components in New England: 2018 Report ("2018 AESC Study"), which was completed on March 30, 2018, and is attached hereto at Appendix H.[20]

iv. Program Budgets

A Program Administrator's budget is comprised of its energy efficiency program implementation costs, performance incentives, and recovery of lost base revenue ("LBR"), if any, as approved by the Department. Guidelines § 3.3.1. Program implementation costs include all costs incurred by a Program Administrator to implement its energy efficiency programs, including, but not limited to: (a) program planning and administration ("PP&A"); (b) marketing and advertising; (c) program participant incentives; (d) sales, technical assistance and training ("STAT"); and (e) evaluation and market research. Guidelines §§ 3.3.3, 3.4.5. Performance incentives are included as costs per the Guidelines §§ 3.3.4, 3.6. Program participant costs must include all expenses incurred by a program participant as a result of its participation in an energy

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19 The GCA requires energy efficiency programs included in Program Administrators' Three-Year Plans to "be screened through cost effectiveness testing which compares the [economic] value of program benefits to the program costs to ensure that the program is designed to obtain energy savings and other benefits with value greater than the costs of the program." G.L. c. 25, 21(b)(3), as revised by Acts of 2018, c. 227.

20 DOER conducted an additional study examining avoided costs of compliance with the Global Warming Solutions Act. See Appendix I. The costs of complying with reasonably foreseeable environmental laws and regulations (i.e., those costs that are, or are expected to be, included in electricity or gas prices) may be included in the TRC test. See D.P.U. 08-50-A at 2; see also, Massachusetts Electric Company v. Department of Public Utilities, 419 Mass. 239, 246 (1994). For the purpose of this Plan, the Program Administrators have included these additional benefit values identified in the DOER study in the benefit goals and calculations. The Energy Efficiency Data Tables are provided both with and without these additional values for reference purposes.

efficiency program, including, but not limited to: (a) the net cost of energy efficient equipment; (b) the cost to plan for and install energy efficient equipment; and (c) the cost of energy efficiency services. Guidelines § 3.4.5.3.

In reviewing and authorizing Program Administrator energy efficiency programs, the Department must ensure that: (1) the Program Administrators have minimized administrative costs to the fullest extent practicable; (2) sufficient funding is allocated to income eligible programs; and (3) competitive procurement processes are used to the fullest extent practicable. G.L. c. 25, § 19(a), (b), (c); Guidelines §§ 3.3.6, 3.3.7; 2013-2015 Three-Year Plans Order at 75-76. With respect to the income eligible program budgets, the GCA requires electric and gas Program Administrators to spend at least 10 percent and 20 percent, respectively, of their total energy efficiency budget on comprehensive income eligible demand side management and education programs. G.L. c. 25, § 19(c).

The Program Administrators have addressed each one of these issues throughout the Plan, and specifically in Section IV.E, below. In addition, the Program Administrators seek to minimize bill impacts when setting their respective budgets. From a statewide perspective, the Program Administrators' three-year budget is about 10% higher than the 2016-2018 Plan budget, which is approximately the same level of increase in benefits from 2016-2018.

v. Bill Impacts

As discussed previously, the GCA requires the acquisition of all available cost-effective energy efficiency resources. G.L. c. 25, § 21(b)(1). However, the pace at which the Program Administrators must acquire these resources is informed by the associated rate increases on residential and commercial customers' bills. See 08-50-D at 9-10 and n.11; see also 2013-2015 Three-Year Plans Order at 122-124; Gas Three-Year Plans Order at 71-72 and n.63; Electric Three-Year Plans Order at 84-86 and n.77; G.L. c. 25, § 19(a). The Department has determined that a bill impact analysis with a short-term perspective that isolates the effect of a proposed change in the energy efficiency surcharge ("EES") is appropriate because it provides an accurate and understandable assessment of the impact that customers will experience on their bills. 2013-2015 Three-Year Plans Order at 122; D.P.U. 08-50-D at 11-12. The Department has recognized, however, that when considering the reasonableness of a short-term bill impact, it is also important to look at the long-term benefits that energy efficiency will provide because, unlike some other activities that cause rate increases, investments in energy efficiency will result in direct customer benefits, in terms of reduced consumption and reduced costs, which will persist for the lives of the energy efficiency measures installed. 2013-2015 Three-Year Plans Order at 122; see also D.P.U. 08-50-D at 11-12.

The Program Administrators discuss consideration of bill impacts throughout the Plan, and specifically in Section V.C, below

vi. Program Funding

The GCA authorizes the Department to review the funding of energy efficiency programs administered by the Program Administrators. G.L. c. 25, § 19. For electric Program Administrators, the GCA identifies four specific funding sources for energy efficiency programs: (1) revenues collected from ratepayers through the System Benefit Charge ("SBC"); (2) proceeds from the Program Administrators' participation in the Forward Capacity Market ("FCM"); (3) proceeds from cap and trade pollution control programs, including but not limited to the Regional Greenhouse Gas Initiative ("RGGI"); and (4) other funding as approved by the Department, including revenues to be recovered from ratepayers through a fully reconciling funding mechanism (i.e., EES). G.L. c. 25, §§ 19(a); 21(b)(2)(vii). The Guidelines specify the method the electric Program Administrators must use to allocate revenue from each funding source and the manner in which the Program Administrators calculate the EES for each customer sector. Guidelines §§ 3.2.1.2 through 3.2.1.6.

For gas Program Administrators, the GCA does not identify multiple funding sources for energy efficiency programs and instead requires the gas Program Administrators to include a fully reconciling funding mechanism to collect energy efficiency program costs from customers (i.e., EES). G.L. c. 25, § 21(b)(2)(vii); see also G.L. c. 25, § 21(d)(2). The gas EES is included in each gas Program Administrator's Local Distribution Adjustment Clause tariff (the "LDAC"). Guidelines § 3.2.2. Funding from sources other than the gas Program Administrator LDAC are to be allocated to the gas Program Administrator's residential, low income and commercial and industrial ("C&I") customer sectors in proportion to the sector's therm consumption. Guidelines § 3.2.2.1. The Department must consider the effect of bill impacts when approving customer funds to support energy efficiency programs. G.L. c. 25, § 19; 2016-2018 Three-Year Plans Order at 93; D.P.U. 08-50-A at 58; Guidelines §§ 3.2.1.5, 3.2.1.6.3, 3.2.2.1, 3.2.2.2.

For a detailed discussion of the funding sources that are currently available to the Program Administrators, please refer to Section V.B, below.

III. STATEWIDE PROGRAMS

Statewide Programs

A. Strategic Overview of Residential, Income Eligible, and C&I Programs

The 2019-2021 Energy Efficiency Plan sets an ambitious agenda to continue to drive energy saving benefits for Massachusetts residential and commercial energy consumers, while proposing new approaches to meet the challenges of the rapidly changing energy landscape.

A History of Customer Engagement and Market Transformation

Over the past three plan cycles, Program Administrators have become ever more accomplished at working with customers to encourage adoption of efficient measures for homes and businesses. The major challenges were finding the best channels and entry points to engage all customers and devising effective combinations of incentives and support to encourage efficiency sales. The Program Administrators' continued focus on developing clear, uncomplicated participation pathways has helped to improve the equitable distribution of benefits by making it easier for all customers to engage in their programs. This has been done by making transactions easier, communicating the benefits to customers more compellingly, and incorporating customer benefits, such as employee productivity, comfort, and health, as part of the efficiency sale. This is a major achievement.

Program Administrators have taken advantage of data analytics to look at both customer demographics and marketplace trends to better understand Massachusetts customers' energy use. Program Administrators have continuously applied this learning to build program enhancements and deliver energy efficiency solutions through more targeted and refined go-to-market strategies. This continuous innovation cycle has allowed for the introduction and scaling of efficient technologies and the successful spread of energy efficiency measures in new markets.

The 2016-2018 Plan drove unprecedented levels of savings for Massachusetts energy consumers. Massachusetts' success in driving energy efficiency for homes and businesses has in many instances transformed the market, ensuring that the baseline efficiency of Massachusetts homes and businesses is high. Massachusetts has been recognized with multiple awards for nation-leading energy efficiency programs and policy, both by federal agencies and national non-governmental energy organizations.

LED Lighting: A Success Story

Beginning with the 2013-2015 Plan, and refined in the 2016-2018 Plan, the Program Administrators developed initiatives to drive the lighting revolution. The intentional transformation of the lighting market with light-emitting diode ("LED") technology is a signature achievement of the prior plans' design and implementation. LED lighting was an emerging technology only a few years ago. The Program Administrators quickly recognized this valuable opportunity for customers and pushed for rapid adoption through a multichannel approach,

harnessing upstream and retail channels and direct-install opportunities across the portfolio while leveraging the power of mature programs to drive volume and pricing.

The Challenge

High Efficiency residential lighting adoption and associated program savings reached their highest levels in 2016 and 2017. But program-related savings is falling in the first half of 2018, a trend expected to continue. There is considerably less opportunity going forward for savings in connection with residential lighting, and for screw-in LEDs in the commercial and industrial sector. We therefore anticipate a substantial decline in savings associated with high efficiency lighting beginning in 2019. Residential Lighting provided an irreplaceable low-cost electric energy saving opportunity within the Program Administrators' energy efficiency portfolio. Program Administrators must now find new ways to continue to achieve the efficiency savings residential lighting programs have delivered in recent years.

The challenge of maintaining high levels of savings attributable to the efficiency programs is intensified by the success to date the Program Administrators have had in supporting broad adoption of high efficiency technologies across the residential and commercial and industrial sectors. Program Administrators are now experiencing significant deterioration in claimable savings for HVAC and water heating measures, as success in scaling technologies and supporting customer acceptance results in the standard practice, or default consumer choice, of high efficiency equipment, which has had the effect of raising the baseline from which savings are calculated. Saturation of high efficiency equipment has also reduced the opportunities Program Administrators have for upgrading equipment. The problem is further compounded by the recent relatively low gas prices, which have suppressed customer interest in energy efficiency savings.

The Response

For Massachusetts to remain the nationwide energy efficiency leader Program Administrators must innovate and create new models. The comprehensive projects the Program Administrators must pursue will have longer development cycles. Newer technologies and integrated systems come with significant product, design, and training costs, even as the lower incremental savings constrain incentive budgets. Structural barriers facing customer market segments like moderate-income customers and renters must be addressed. The Program Administrators' high historic penetration rates with customers mean the Program Administrators must go deeper and broader to secure the next unit of efficiency. Program Administrators must now focus on projects with leaner savings and greater barriers, and engage customers who, to this point, have been less inclined to pursue energy efficiency.

The core value of the 2019-2021 program design, across both the residential and commercial sectors, **is to keep the customer at the center of program design and evolution**. This means organizing and presenting efficiency measures to customers as easy-to-understand and easy-to-implement improvements to their homes and businesses. The Program Administrators firmly believe that serving all customers, with a particular focus on addressing the needs of moderate-income customers and small businesses, requires programs that are simple to communicate, take time-constraints into account and are easy to access. This requires flexible

design that helps customers to see energy efficiency as making their lives better and their businesses more successful.

The next step in the evolution of cost-effective energy efficiency program design will not be scaling new efficient technology (like LED lighting), but implementing new systems for incrementally ramping down or turning off equipment, and new techniques for minimizing energy use through passive building systems utilizing daylighting, insulation, and optimized scheduling of use. The new paradigm requires more investment in training and education at every stage. Program Administrators will be working with manufacturers to make interoperable systems and controls that offer greater efficiency and to ensure that distributors stock and support these new systems. Program Administrators will help property owners, vendors, contractors, and builders understand the connection between energy-conservation measures and improved building operation and provide businesses and homeowners with the education and tools they need to control and manage their energy future.

To meet the challenges of the next decade the Program Administrators are proposing a strategic set of programs and initiatives that are both flexible and targeted. Navigating this transition to a greatly changed energy efficiency landscape will not happen quickly or easily. It will require intensive trial and error and leaps of innovation, followed by retrenchment and refinement.

2019-2021 Priorities and Highlights

The Program Administrators' primary strategy to continue to deliver savings and benefits over the coming three-year term is to implement strategic enhancements to existing designs that increase the breadth and depth of the portfolios' reach. This includes multiple enhancements to drive weatherization and high efficiency HVAC, and to ensure optimal operation of building energy systems. The Program Administrators are using an *Energy Optimization approach* that provides customers with enhanced education regarding energy use and related costs and helps customers reduce total energy use based on their individual needs and goals.

The Program Administrators are also redoubling efforts to expand the portfolios' reach with special attention to hard-to-reach populations including small businesses, renters, moderate-income customers, and non-English speaking customers.[21] Program Administrators are developing a statewide municipal and community partnership strategy to target communities identified as having lower participation and to work more intensively with municipalities to secure additional savings for municipalities including continued efforts to convert municipal owned street lights.

Program Administrators are also deploying multiple forward-looking strategies and innovations that pivot the portfolio to ensure continued robust savings and benefits for customers. The innovations in this Plan include new active demand reduction efforts that will have an impact

[21] The Program Administrators will conduct tailored evaluations in 2019 that address participation levels and potential unaddressed barriers for (a) businesses (small, medium and large) and (b) residential customers by income levels and by non-English speaking populations (utilizing proxy methods that do not rely on specific income or demographic information from Mass Save® participants). The Program Administrators will leverage the existing EM&V framework, and present full results of the studies to the Council.

on summer peak demand and winter reliability, while strongly supporting the Commonwealth's greenhouse gas reduction goals. New Active Demand offerings are included for all customers. A new Passive House offer, an expanded Zero-Net Energy Ready offer and expanded support for the development of enhanced energy codes and product standards at the state and national levels are being added to continue to drive Massachusetts buildings and the energy systems within them to the highest levels of energy efficiency.

The charts below provide a detailed listing of the many strategic enhancements and innovations, which are further described in the Residential and Commercial and Industrial Program sections which follow.

Residential Programs and Initiatives

<table>
<tr><th colspan="2">Strategic Enhancements and Innovations</th></tr>
<tr><td>Pivoting to the Future
Zero Energy and Zero Energy Ready
Passive House Offer
Point-of-Purchase Instant-Rebate Platform
Broadened Partnerships with Distributors and Contractors
Tailored Energy Savings Packages
Active Demand Reduction Offering
Pay for Savings
Temperature Optimization
Heat Pump Trials</td><td>Serving All Customers
Additions and Renovations
Special Attention to Customers with Language Barriers – Customer Journey for Non-English Speakers
Proactive Engagement of Municipalities and Communities and Collaboration on Targeted Strategies to Serve All Residents
Better Alignment between Income Eligible and Market Rate Protocols and Services</td></tr>
<tr><td colspan="2">Driving Increased Conversions to Weatherization
Expanded online assessments and program enrollment options
One residential phone number to simplify access
Enhanced support at customer intake, capturing and connecting additional detail to triage customers to targeted program offerings
Leveraging the in-home assessment to provide deeper customer education and more facilitated options to support customer adoption of major measure savings opportunities (i.e., weatherization and HVAC Measures) including an expedited pathway to resolve knob and tube and combustion safety issues and increased financing for pre-weatherization barrier resolution
Enhanced relationships with trade allies (HVAC, electrical, and insulation contractors) to capture customers at all entry points and help them to secure ancillary services
Enhanced relationship management for customers, with tracking of the adoption of measures and continuous re-engagement with additional opportunities</td></tr>
<tr><td colspan="2">Facilitating Workforce Retention, Recruitment, and Development</td></tr>
</table>

Commercial and Industrial Programs and Initiatives

<table>
<tr><th colspan="2">Strategic Enhancements and Innovations</th></tr>
<tr><td>Pivoting to the Future
Enhanced Technical Assistance and Design Support for Whole Building New Construction
New Passive House Offer and Market Development Strategy
Addition of an Active Demand Reduction Initiative
Investigating and Testing New Approaches to Whole-Building Projects
Expanded Support for the Development of Enhanced Energy Codes and Product Standards at the State and National levels.
Expanded Advanced Systems Training for HVAC and Lighting controls.</td><td>Serving All Customers
Small Business Enhancements
Expanding Upstream Offerings
Customized Services to Franchise Businesses
Expanded Resource Offer within the Industrial and Process Segment-targeted approach
Expedited Paths to HVAC Optimization including Operations & Maintenance (“O&M”) Savings and Retro-Commissioning (“RCx”)
Testing Strategic Energy Management Cohort Approach</td></tr>
<tr><td colspan="2">Implementation of Mass Save Application Portal (“MAP”)</td></tr>
<tr><td colspan="2">Increased leveraging of training and workforce development to transition to an era of integration of energy efficiency strategies, smart technologies and energy using equipment.</td></tr>
</table>

B. **Residential and Income-Eligible Programs**

Residential & Income-Eligible Programs

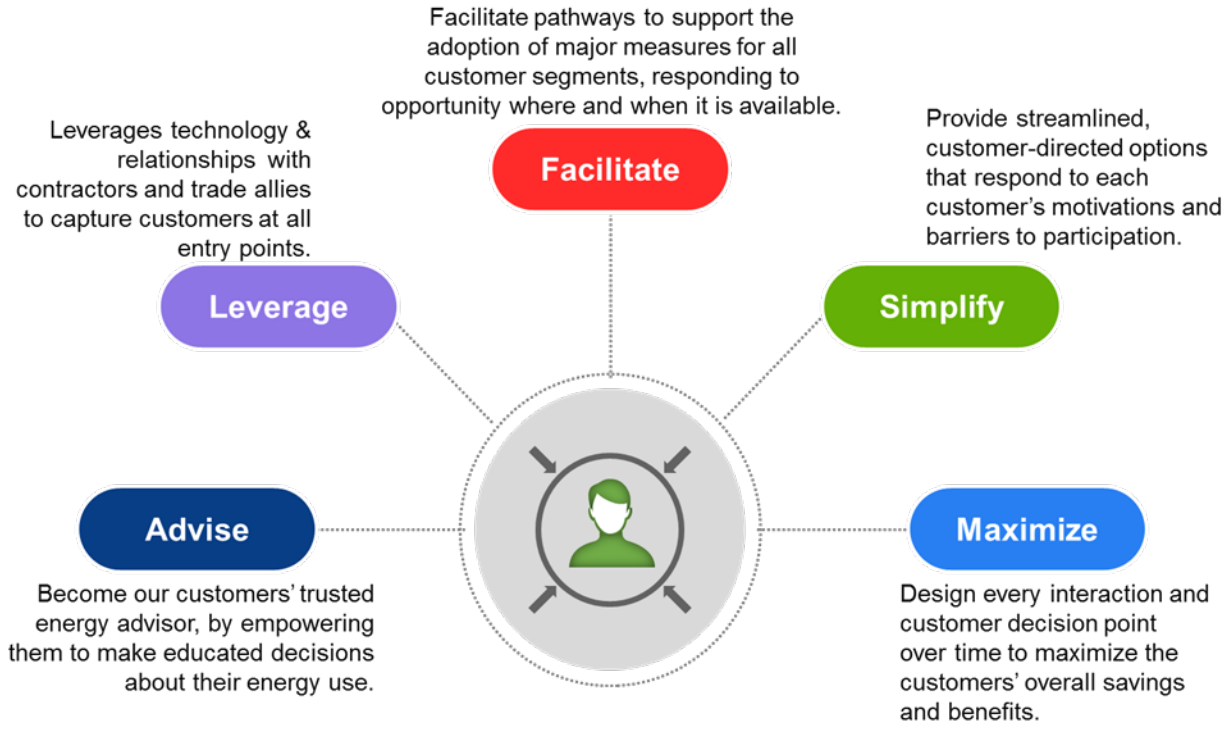
Overview

The Massachusetts Program Administrators' residential sector portfolio is one of the most successful home energy saving programs in the nation, reaching over 225,000 homes with in-home assessments and weatherizing over 75,000 over the 2016-2018 Plan term. The Program Administrators have successfully driven a rapid, market-transforming consumer adoption of high efficiency lighting in homes and have pioneered multiple first-in-the-nation delivery innovations, including fully integrated gas and electric efficiency programs for multi-family buildings. The Program Administrators have accomplished this while simultaneously maintaining an award-winning partnership with the Low-Income Affordability Network ("LEAN") to serve Massachusetts' most vulnerable energy consumers.

Now, the Massachusetts residential energy efficiency market is at a turning point. In part due to the Program Administrators' success, and in part due to additional market and regulatory factors, the claimable savings available for residential lighting are in rapid decline. Residential lighting provided an irreplaceable low-cost, electric, energy saving opportunity within the Program Administrators' energy efficiency portfolio. Claimable savings per bulb will decline 50% from 2018 to 2019 and continue to decline by 10% each year. This decrease is compounded by a loss of potential, as 50% of Massachusetts homes are saturated with long-life efficient bulbs and these efficient bulbs further decrease the future opportunities to support customers' installation of new efficient bulbs. In addition to the significant reduction in claimable electric savings, the residential programs are at risk of losing significant visibility to customers as lighting becomes a diminishing portion of the efficiency portfolio. High efficiency bulbs directly installed in customers' homes during home energy assessments provided an instant value for customers, a simple and tangible energy savings. Similarly, program-supported discounting of high efficiency lighting options in retail settings provided a strong anchor to help Program Administrators work with partners in the retail market to showcase energy efficiency opportunities directly to customers. The substantial loss of residential lighting requires Program Administrators to pivot and begin the process of transforming our programs to meet a changing landscape.

The Program Administrators' 2019-2021 Residential Plan builds on our history of successful innovation. The program design represents a major realignment of the residential portfolio. This realignment, along with multiple enhancements and innovations, is intended to meet the challenge posed by the decline of residential lighting savings by increasing participation across all customer segments, driving broader penetration of energy efficiency and demand reduction to new participants, and securing deeper savings from existing program participants.

Vision for Residential & Income-Eligible Participants



The anticipated results include:

- ✓ **Increased number of weatherized homes**
- ✓ **Enhanced targeted efforts to reach renters, moderate-income customers, and non-English speaking customers**
- ✓ **Streamlined pathways and new technologies for participation**
- ✓ **Improvements in winter reliability and reductions in summer demand**
- ✓ **Increased support for emerging technologies and innovative approaches, such as Passive House, Zero-Net Energy Ready buildings, and central and cold climate heat pumps**
- ✓ **Deployment of an Energy Optimization approach to maximize customer value**

Driving Increased Conversions to Weatherization

The Plan includes multiple integrated enhancements that are designed to increase the number of weatherized homes in Massachusetts. The Program Administrators examined each point along the customer's journey to weatherization and worked to optimize the experience and remove existing barriers.

Significant enhancements are being made to ease customer access to the Program Administrators' weatherization offer, including promotion of the 24/7 available online home energy assessment as an initial entry point and simplification of customer entry with one Mass Save Residential phone number that lets customers access all Program Administrator efficiency offers. The background support systems—both online and call center—are being transitioned to use industry best practices, integrate customer and public data, and employ algorithms and human resources to match customers effectively to comprehensive energy savings offers that are specific to opportunities in their home.

These intake enhancements described above will support Program Administrators efforts to better target in-home energy assessments to customers with weatherization opportunities. The new, optimized systems will likely reduce the total number of customers who receive an in-home assessment, as customers who don't identify as candidates for weatherization opportunities will be encouraged to receive other Program Administrator offers that are more appropriate to their specific needs. This means that wait times and other inefficiencies created by using an in-home energy assessment as the default intervention will be reduced, and the overall customer experience improved. The information collected through the optimized intake process will be provided to the Mass Save energy specialist prior to entering the customer's home. This will allow energy specialists, during the in-home assessment, more time to concentrate on homeowner education and support services.

The Program Administrators are adding no cost knob-and-tube-assessment and combustion safety testing along with remediation of minor combustion safety issues for customers who sign a contract committing to install weatherization measures, thus providing an expedited pathway for resolving the most frequent causes of customers not completing weatherization recommendations after an in-home assessment.

Program Administrators are also increasing the allowable financing amount and expanding the list of barriers eligible for financing through the Mass Save HEAT Loan® to include the most common pre-weatherization barriers identified during the Home Energy Assessment. Barriers eligible for financing include knob-and-tube wiring, combustion safety issues, mold, vermiculite and asbestos, and certain structural concerns.

The Program Administrators also recognize that customers who are engaging in traditional renovations have similar energy savings opportunities and follow a similar process of contracting with a builder to complete their projects. As a result, the Program Administrators are adding a tailored offer that leverages the existing new construction delivery path. This new offer for additions and renovations will help maximize the capture of efficiency opportunities that exist when there is a builder on site, including installation of highest-efficiency systems and maximization of shell improvement opportunities. This new offer combines the unique opportunities to secure energy efficiency measures during new construction and renovation activity with the potential for securing all of the traditional energy upgrades, including weatherization and other envelope improvements, for the portions of the home that are not undergoing renovation.

Serving All Customers

The Program Administrators remain committed to ensuring equitable access to energy efficiency programs for all Massachusetts customers across all demographics. By committing to meet our customers where they are, Program Administrators are taking a focused approach to identify the specific barriers and challenges faced by customer sub-segments that are frequently highlighted as "hard to serve". The Program Administrators have systematically responded to these challenges, with multiple program enhancements and innovations across the Plan, focused on simplifying access, tailoring offers to overcome barriers, and increasing opportunities for overall program participation.

As Program Administrators address specific access barriers for sub-segments currently considered hard to serve, access for all customers improves.

Special Attention to Customers with Language Barriers

The Program Administrators are committed to serving all customers with energy efficiency services and incentives and understand that there are challenges non-English speakers have when accessing or participating in the programs. In order to support non-English speakers, the Program Administrators have translated the Mass Save website into the most common languages spoken across the Commonwealth, including English, Spanish and Portuguese. Further improvements will expand the statewide Mass Save phone line to five different language options (English, Spanish, Portuguese, Russian, and Mandarin).

The Program Administrators are also reviewing the customer journey from the perspective of non-English speakers to ensure we are communicating with customers in their preferred language from beginning to end. Suggested improvements include the review of the transfer protocols from the statewide line to the vendor/Program Administrator call centers to ensure continuity in the customer's selected language preference. Additionally, the Program Administrators are working to ensure that all follow-up written communications are also sent to the customer in their preferred language. The Program Administrators continue to translate marketing material into multiple languages, which is in turn used by local community groups, municipalities, vendors and contractors. The Program Administrators have launched various marketing campaigns in languages other than English and will continue to implement these campaigns over the next term.

Increased Target Marketing and Partnerships with Communities

Over the past several plan cycles, the Program Administrators have worked with municipalities and community stakeholders to test various strategies for community-wide engagement. During the planning period for the 2019-2021 Term, the Program Administrators closely reviewed the elements of different community and municipal partnership efforts and attended sessions with stakeholders interested in providing input into how Program Administrators work with municipalities and communities. A consensus emerged that partnering with municipalities and communities is a critical pathway, particularly to gain insights on reaching renters/landlords and multilingual populations. Program Administrators are focused on developing

a statewide municipal and community partnership strategy ("Partnership Strategy") to target communities identified as having lower program participation.

The new statewide Partnership Strategy will include a stronger connection to municipal governments, whose local knowledge and trusted relationships can be a valuable connection point for increasing awareness and participation in Program Administrator efficiency offers. The Partnership Strategy will support municipally led outreach for cities and towns of all sizes to enroll local participants. As a core element, Program Administrators will establish a two-way communication channel for municipalities by offering regular check-in calls, periodic trainings, and a suite of marketing materials. The two-way communication channel will provide a forum for Program Administrators and municipal staff to share program updates and communicate strategies for targeting hard-to-reach populations.

Improving Renter Access to Program Savings and Benefit

The Program Administrators are committed to ensuring equitable access to program savings and benefits for renters. The Program Administrators designed the first-in-the-nation statewide renter offer in the 2016-2018 Three-Year Plan and gained unique insight about the challenges renters face in participating in energy efficiency programs.

The Program Administrators learned that we have good success in targeting landlords, and that when landlords are successfully engaged, Program Administrators successfully deliver the whole building comprehensive weatherization work that produces the greatest energy benefits for renters. Data from the renter offer indicates that landlords are very interested in energy efficiency upgrades for their properties (8,733 full HEAs provided to landlords in 1-4-unit buildings from April 2016 to March 2018[22]). The efficiency upgrades that can be delivered to renters without landlord engagement remain limited, as most major energy efficiency upgrades require landlord permission for the replacement of equipment, changes to the building envelope, or other enhancement to the property. The programs acknowledge this challenge by delivering as many renter benefits as possible while targeting the landlord for measures like heating systems and weatherization.

Program Administrators are planning to offer scaled incentives to encourage landlords of buildings under four stories, to install energy efficiency measures for all units in a building, with a 90% insulation incentive for landlords willing to complete all recommended insulation and air sealing.

The new Residential Coordinated Delivery initiative creates greater flexibility for Program Administrators to provide a more customized path for larger or more complex multi-unit buildings, with custom incentives and savings methodologies that allow Program Administrators to best capture the unique opportunities of larger and mixed-use multi-family structures. Using a more customized approach for the complex multi-unit properties also allows Program Administrators to provide property owners with a tailored business case that makes energy efficiency upgrades for residents an easier decision.

[22] Data from the renter & moderate income offer 2016-2017

Program Administrators recognize that situations remain in which renters do not wish to engage with their landlords, or where the property in which they live is not a candidate for major measures (e.g., HVAC or weatherization). Program Administrators are increasing the scope and sophistication of online assessments and telephone intake to better connect customers to additional solutions, particularly for those customers who do not have opportunities for major measure adoption. For renters who do not wish to have a traditional in-home assessment, or who live in a home that does not have major measure opportunities, the enhanced online systems and enhanced information captured at intake will allow Program Administrators to provide the renter with a tailored energy savings package that responds to remaining savings opportunities. While renters may prove to be a receptive audience for these tailored energy savings packages, the Program Administrators' priority is to drive whole building energy efficiency upgrades, including weatherization and heating systems upgrades, along with the full complement of in-unit measures, as these comprehensive, whole building upgrades provide residents with the greatest savings and benefits.

Reducing barriers to participation for Moderate-Income Customers

Program Administrators recognize that moderate-income customers may also face difficulty in paying energy bills, which represent a greater percentage of their income than for higher income customers. Program Administrators will continue to offer enhanced incentives for moderate-income customers, including no-cost weatherization.

In addition, a recent evaluation of the current moderate income offer found that "time and availability, perception of their need for energy efficiency, and the need for more information are the greatest barriers to participation in the Moderate Income offering."[23] Many of the program enhancements that simplify access and streamline the customer experience will reduce the time commitment required of customers and provide additional information, directly addressing the primary barriers moderate-income customers face.

Innovations

Increasing winter reliability and reducing summer demand

The Program Administrators intend to offer winter temperature optimization in 2019-2021. Temperature optimization uses wi-fi thermostats connected to gas heating equipment to lower customer energy consumption throughout the winter heating season and is later described in detail under the Residential Behavior Initiative. This approach to winter gas savings, combined with the plan's aggressive weatherization focus, will reduce winter energy consumption. Incentives for reducing demand during winter peak periods may also be offered if discretionary loads are identified and can be controlled.

A statewide active demand offer has been added to the Behavior Initiative. The offer is focused on reducing cooling demand during summer peak events. Customers who enroll will receive financial incentives for participating in summer peak demand reduction events. Customers

[23] 2018 Moderate Income Market Characterization Survey, Finding 7, at 7 http://ma-eeac.org/wordpress/wp-content/uploads/Moderate-Income-Market-Characterization-Report-Final-16Mar2018.pdf

with eligible communicating thermostats controlling central air conditioning units will be the first to be targeted for enrollment. Program Administrators will promote this opportunity to customers with existing eligible technology and to customers installing eligible technology through the Residential Coordinated Delivery and Retail initiatives. Over time, the Program Administrators will review the possibility of adding additional devices, such as water heaters and pool pumps, if it can be done cost-effectively.

The electric Program Administrators will also offer active demand reduction with battery storage during the 2019-2021 term. Rather than targeting a limited number of peak hours each summer, the battery storage model will be designed around daily (summer only) or targeted call events (when customers are asked to shift to electricity stored in the battery) during both summer and winter. To support investment in this technology, battery storage will be added to HEAT Loan eligible equipment for customers who agree to participate in the active demand offer.

Supporting emerging technologies and new approaches

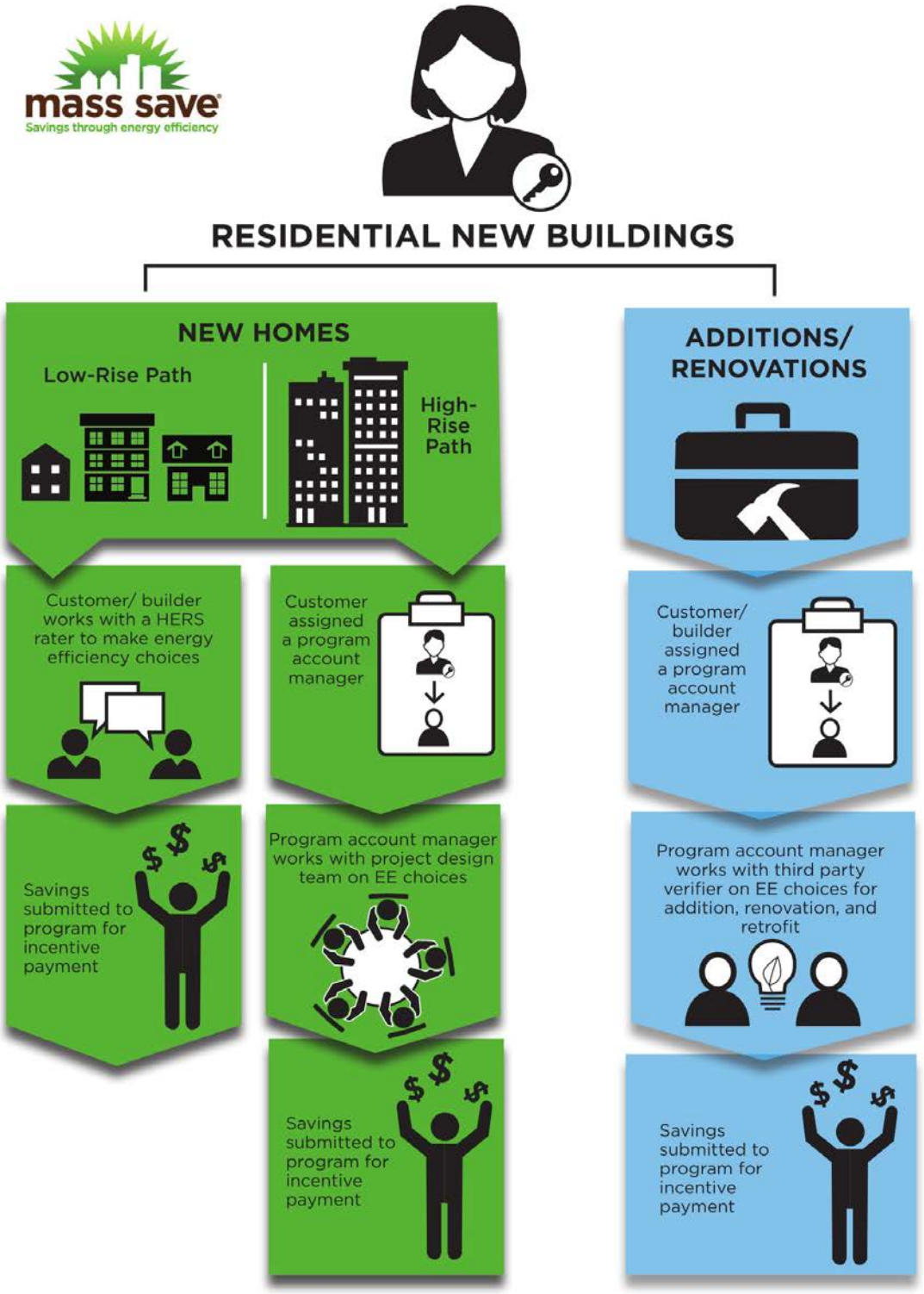
The Program Administrators are deploying an "**Energy Optimization"** approach that shifts the programs from a focus on reducing electric and gas energy usage to a new focus on helping customers reduce total energy use. The Plan introduces an overarching Energy Optimization philosophy across all sectors. For the residential programs this means customers will be offered more information and technology choices to support their personal energy savings goals. In some instances, this may mean increasing electric or gas usage in order to help customers utilize energy more efficiently, for example, through the adoption of high-efficiency air source heat pumps.

Program Administrators are excited to launch a new **Passive House** offer. The statewide effort will provide incentives to residential new construction design teams and owners at critical stages, including modeling subsidies, design charette support, pay for savings incentives for energy performance, and an adder per unit for achieving certification.

The Program Administrators will continue to offer, in partnership with the Massachusetts Clean Energy Center, Zero-Net Energy trainings, including a more intensive series that moves beyond the basics of Zero-Net Energy to training on how to incorporate high-efficiency heat pumps in new construction homes. The Program Administrators will also add a per-unit incentive to support enrollment in the U.S. Department of Energy Zero-Net Energy Ready Home Programs.

These enhancements, innovations, and new approaches will help Massachusetts meet its climate and energy goals, while continuing to deliver direct energy savings to customers through reliable programs that customers, contractors, and other market actors have learned to rely on since the Program Administrators' first Three-Year Plan.

Residential New Buildings Program



1. Residential New Homes and Renovations Initiative

Overview and Objectives

The primary objective of the Residential New Homes and Renovation initiative is to reduce energy use and demand in construction of new homes and existing homes undergoing renovation. The secondary objective is to support the transition of the residential new-construction market toward the highest-efficiency building standards and equipment installations.

The greatest opportunities to maximize the performance of a home, particularly its shell (the exterior walls, foundation, and roof), comes during the initial construction and when the home is undergoing a renovation. The Residential New Homes and Renovations initiative provides financial incentives, coupled with education, training, and technical support to builders and home owners, to help residential new construction and renovation projects meet the highest energy performance standards, including ENERGY STAR® certification and Zero-Net Energy Ready status. In the 2019-2021 Plan, the Program Administrators will also introduce additional technical assistance and an enhanced incentive structure to help customers achieve Passive House certification.

The Residential New Homes and Renovations initiative also supports the development, adoption and implementation of increasingly stringent codes and standards and the demonstration and normalization of the highest-efficiency practices. The initiative supports the training of municipal code officials to continue to increase compliance with existing code and to prepare for future codes and standards.

Strategic Enhancements and Major Innovations: Major Milestones Complete by Q1 2019

- ✓ **Pay for Savings**
- ✓ **Additions and Renovations**
- ✓ **Zero Energy and Zero Energy Ready**
- ✓ **New Passive House Offer**

Initiative Design

The Residential New Homes and Renovations initiative promotes comprehensive integrated design that maximizes the use of insulation and other high-performance materials, building orientation, and other passive measures to minimize the overall energy consumption. This approach focuses builders on right-sizing energy equipment and incorporating highest-efficiency heating, cooling, water heating, lighting, and appliances.

The initiative provides two pathways. There is a Low-Rise pathway for homes three stories and under, including single-family and multi-unit projects, and a Master-Metered/High-Rise pathway for residential master-metered buildings and/or those with four or more stories. The pathways provide tailored technical support, outreach, recruitment, training, verification, and incentive structures that encourage and support participation from all residential new construction and renovation projects in the Commonwealth.

Incentives are directly tied to a dwelling's modeled energy performance or installed prescriptive measures, and all participating homes must pass a final verification inspection. Overall energy savings are determined by modeling the electric savings and fuel savings and comparing them to the average new home in Massachusetts, the User Defined Reference Home ("UDRH"). The pay-for-savings incentive structure rewards builders and customers for each unit of energy savings secured, driving participants to capture each additional incremental savings opportunity.

For the Low-Rise pathway, the Program Administrators will continue working with the Home Energy Rating System ("HERS") rater infrastructure. HERS raters play a critical role in recruiting builders to enroll projects in the Low-Rise pathway. HERS raters can directly enroll projects into the initiative via an online intake tool and provide verification of savings at project completion.

The new additions-and-renovation offer provides customers with all the technical support of the Residential New Homes and Renovation initiative, including training and education for builders and connection of builders to the HERS raters. This enables customers to leverage the most advanced building science and efficiency technology and push for highest efficiency in both the existing and renovated portions of their projects. For this offering, customers will have the opportunity, while their builder and rater support are in place, to add traditional retrofit energy savings measures to their project, securing the maximum energy savings presented by the renovation opportunity. The savings will be modeled, and incentives will continue to reward participants for each unit of energy savings secured.

In the Master-Metered/High-Rise pathway, account managers from the lead vendor work directly with larger developers and builders to enroll projects. The High-Performance Housing Working Group (formerly the Joint Management Committee or "JMC"), includes residential and commercial new-construction technical experts from Program Administrator staff and the initiative's lead vendor. This working group will assist in recruiting and defining performance targets while providing guidance on maximizing incentives, energy efficient construction practices, and highest-efficiency technologies and systems.

Strategic Enhancement - Pay for Savings

In the 2016-2018 Plan, the program transitioned from using tiered savings thresholds to a pay-for-savings model. The pay-for-savings incentive structure rewards builders and customers for each unit of energy savings secured, based on energy modeling. The pay-for-savings incentive structure is being closely monitored for any potential impacts to participation and savings. Program Administrators will have a fully optimized pay-for-savings incentive structure for the Residential New Homes and Renovation initiative for the 2019-2021 plan. Early results suggest that the design is pushing builders to seek additional incremental savings, resulting in higher average project savings.

Innovation - Additions and Renovations

An Additions and Renovations offer is being added to the Residential New Homes and Renovations initiative. While total gut renovations have long been part of the program, the new

offer provides a pathway for customers who are engaging in a partial renovation and/or building an addition to their existing home, thus leveraging the program's effective model of supporting builders and verifiers during design and construction to secure energy savings and avoid lost opportunities.

Recognizing that customers who engage in traditional renovations have similar energy savings opportunities and work through a similar process of contracting with a builder to complete their projects, the initiative will add a tailored offering that leverages the existing new construction delivery path. The new Additions and Renovations offer will help maximize the opportunities that exist when there is a builder on site, including installing the highest-efficiency systems and maximizing shell improvement opportunities. This new offer combines the unique opportunities to secure energy efficiency measures during new construction and renovation activity with the potential for securing all the traditional energy upgrades, including weatherization and other envelope improvements, for the portions of the home that are not otherwise undergoing renovation. The new offer provides a streamlined process for customers to access holistic and comprehensive energy efficiency.

Innovation – Zero-Net Energy Ready

Program Administrators are continuing their partnership with the Massachusetts Clean Energy Center for Net-Zero Energy training and education. A more intensive training series led by the Massachusetts Clean Energy Center to move beyond the basics of Net-Zero Energy, offers continuing education credits, and includes training on how to incorporate heat pumps in new construction. The Program Administrators will also be offering a per unit incentive to support participant enrollment within the U.S. Department of Energy Zero-Net Energy Ready Home program for both low-rise and high-rise multi-unit buildings.

Innovation – Passive House

Program Administrators are excited to launch a forward-looking Passive House offer within the Residential New Homes and Renovations initiative. Passive House offers the ultimate goal in high efficiency design; a building that uses little or no energy with additional resiliency benefits. As a result, the Program Administrators are committed to supporting Passive House new construction in Massachusetts through a combination of targeted outreach and education, training and certification (also described under workforce development), and technical support and incentives. To begin these efforts Program Administrators will focus on low-rise multi-unit construction projects in the Residential Sector, and mixed use and/or high-rise multi-unit projects in the Commercial Sector, as Passive House techniques are shown to be best applied to larger facilities. The Passive House Institute US ("PHIUS") and the Passive House Institute ("PHI") establish standards and provide certifications for such homes. The Program Administrators will support certification through either organization.

Passive House techniques offer an evolved approach that focuses on super-efficient shell or building envelope and optimized energy systems. The Passive House approach also manages solar gain to take advantage of the sun's energy for heating and to minimize overheating during the cooling season. These fundamental design considerations require intervention at the earliest stages of project conception to achieve Passive House certification.

To ensure early intervention and guarantee more design teams and owners are ready to make a commitment to Passive House projects, the Program Administrators plan to nearly double the number of trained and certified Passive House professionals across the state over the next three years, with a target of adding approximately 90 Passive House professionals. As part of this workforce development effort, the Program Administrators will offer subsidized trainings and certifications to develop the expertise needed to achieve certified buildings, including Certified Passive House Consultant ("CPHC"), Certified Passive House Designer/Consultant, Certified Passive House Builder, Certified Passive House Tradesperson ("CPHT-E", "CPHT-MBS"), Rater and Verifier certifications. The Program Administrators will require a small cost share from participants for these trainings and certifications. Additionally, the Program Administrators will provide Passive House outreach and education to other project stakeholders, such as architects and lenders, and provide hands-on building science technical trainings to installation contractors to ensure that all involved in a Passive House project have the information and skills necessary to achieve Passive House certification.

The Program Administrators also plan to provide additional Passive House project support and incentives including:

- An early modeling subsidy for building owners to motivate design teams, architects and engineers, to take the time to integrate energy efficiency into building plans from the start.
- Support and incentives for architects and design teams to bring building owners, architects, and design teams to the table early to consider efficiency as integral to the project design and provide independent review of the strategies through precertification.
- Certification incentives for owners to ensure follow-through on Passive House enhancements.
- $/kWh and $/therm performance incentives for owners to motivate the inclusion of more efficiency into the design. The more energy saved, the more the building owner is incentivized.

Passive House Incentives		
Incentives	Recipient	Details
Modeling Subsidy	Owner	Cost-share of Warme Und Feuchte Instationar or Passive House Planning Package modeling costs or early feasibility study
Design Team Incentive	Architect, Design Team	$/kWh and $/therm incentives for projects achieving precertification and certification (if applicable)
Design Charrette	Architect, Design Team	Sustainability charrette incentive in either Programming and Schematic or Design Development design phases, directed to design team lead
Certification Subsidy	Owner	Adder per multi-family unit for achieving PHIUS or PHI certification
Performance Incentive*	Owner	$/kWh and $/therm incentives for savings where projects are performing more efficient than the User Defined Reference Home for the residential portion and Mass Save baseline for the commercial spaces.

*The PAs are actively working to include infiltration incentives for High Rise buildings to better quantify performance savings. The PAs and DOER are committed to changing the process by which savings are claimed to be a more whole building performance based approach for the Passive House offer. The PAs and DOER will work expeditiously with EM&V to pursue this change using Passive House certification modeling tools to quantify savings.

Statewide Coordination

A working group of residential and commercial sector experts from each Program Administrator collaborate to oversee the Low-Rise and Master-Metered/High-Rise implementation strategies with the statewide lead vendor. The lead vendor provides the direct field implementation.

The lead vendor is responsible for developing and deploying training, education, and outreach efforts, as well as tracking and reporting program activity to each Program Administrator. The lead vendor has principal responsibility for recruiting and enrolling projects. Many Program Administrators maintain additional account representatives and field personnel that also help support project recruitment and maintain relationships with the target market and allies. HERS raters, as noted above, play a key role in the Low-Rise path for recruiting and enrolling projects.

Marketing

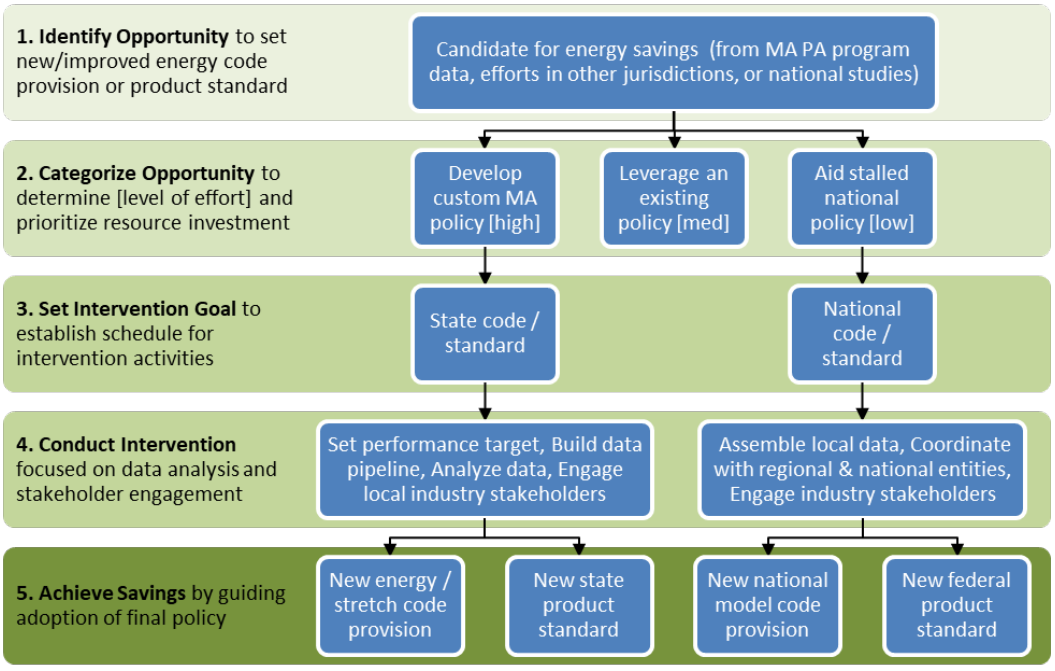
The Residential New Homes and Renovation initiative targets marketing and outreach efforts to homebuilders, developers, and contractors. Program Administrators also provide outreach to the associated market actors that interact with program participants, such as architects, designers, and trade allies. A third critical focus in marketing the initiative is on key decision makers and influencers in the residential real estate market, including homebuyers, real estate professionals, code officials, appraisers, and mortgage bankers. This multi-pronged strategy guarantees that at each touch point in the new home construction and delivery process, Program Administrators build awareness and demand for highest efficiency homes and provide potential participants clear and easy access to the residential new homes offerings.

Codes & Standards

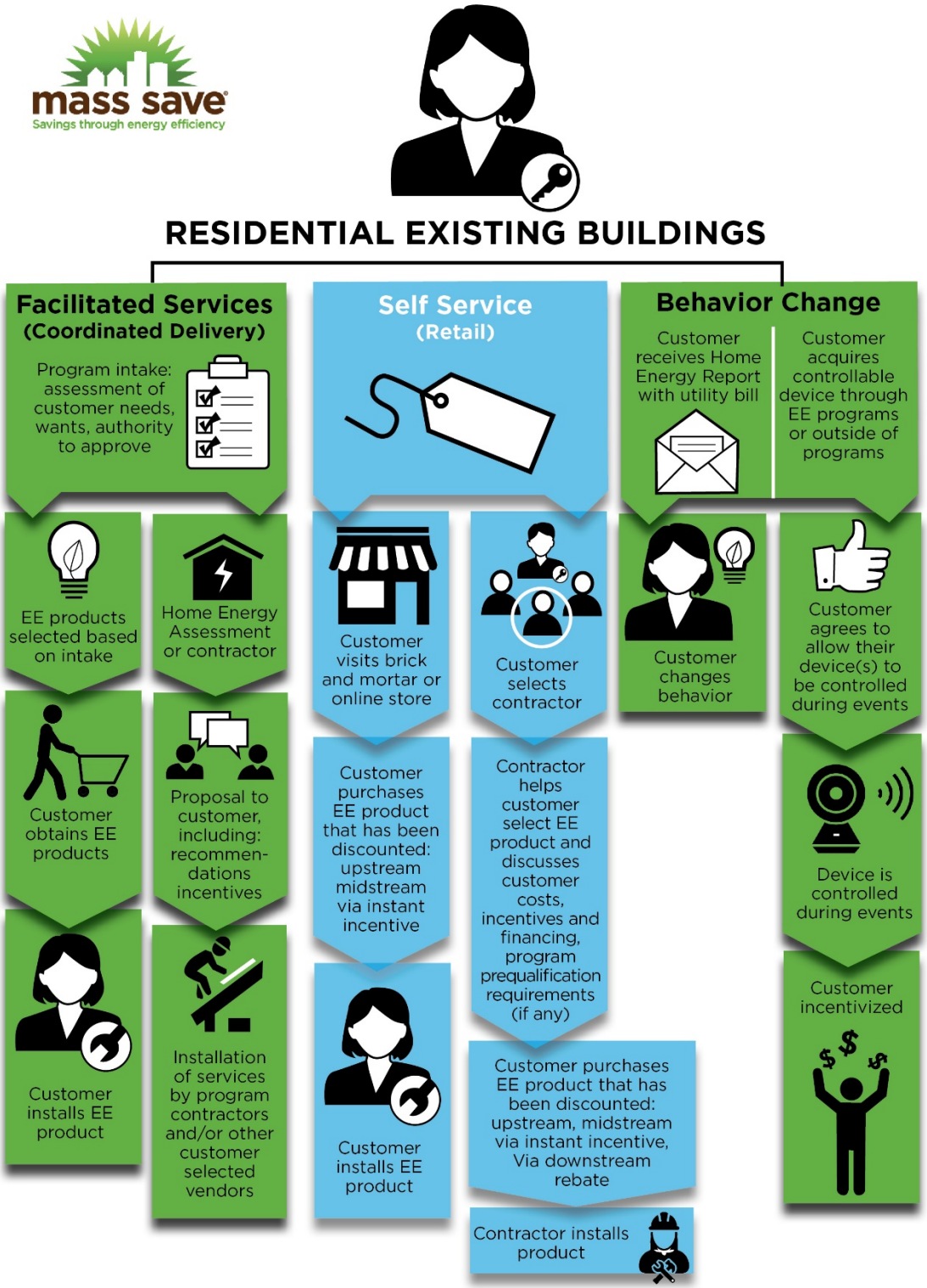
The Program Administrators will continue to focus on improving compliance with the current energy code for both new construction and renovation projects through education, technical assistance, stakeholder engagement, and resource development and delivery. The Program Administrators will expand this effort to advance the adoption of progressively more efficient energy codes, including stretch codes, and efficiency standards for appliances and equipment.

Innovation – Supporting Development of State and National Energy Codes and Appliances

The Program Administrators will research and support the development of enhanced energy codes and product standards at the state and national levels. The Program Administrators will implement a formulaic, multi-year approach based on information collection, data analysis, and stakeholder engagement described in the programs overview as a cross cutting effort encompassing both commercial and residential programs. Program Administrators expect to claim savings for this initiative starting in 2021 based on efforts already underway to provide technical assistance and research in order to: (1) support improvement of the efficiency of the statewide energy code during the Commonwealth's current building code update process; and (2) support the adoption of product efficiency standards during the Commonwealth's forthcoming legislative session. The expansion of the Program Administrators' codes work to include appliance standards and to work both at the state and national level is a significant element of the Programs Administrators' overarching strategy to proactively move markets to increasingly high levels of energy efficiency and to continue to build a culture that moves the Commonwealth forward on a path of maximizing clean energy from energy efficiency. The PAs' strategy to promote appliance and equipment standards under this plan is expected to increase the Commonwealth's ACEEE State Energy Efficiency score by at least two points by 2020.


1. Identify Opportunity to set new/improved energy code provision or product standard
Candidate for energy savings (from MA PA program data, efforts in other jurisdictions, or national studies)
2. Categorize Opportunity to determine [level of effort] and prioritize resource investment
Develop custom MA policy [high]
Leverage an existing policy [med]
Aid stalled national policy [low]
3. Set Intervention Goal to establish schedule for intervention activities
State code / standard
National code / standard
4. Conduct Intervention focused on data analysis and stakeholder engagement
Set performance target, Build data pipeline, Analyze data, Engage local industry stakeholders
Assemble local data, Coordinate with regional & national entities, Engage industry stakeholders
5. Achieve Savings by guiding adoption of final policy
New energy / stretch code provision
New state product standard
New national model code provision
New federal product standard

Residential Existing Buildings Program



2. Residential Coordinated Delivery Initiative

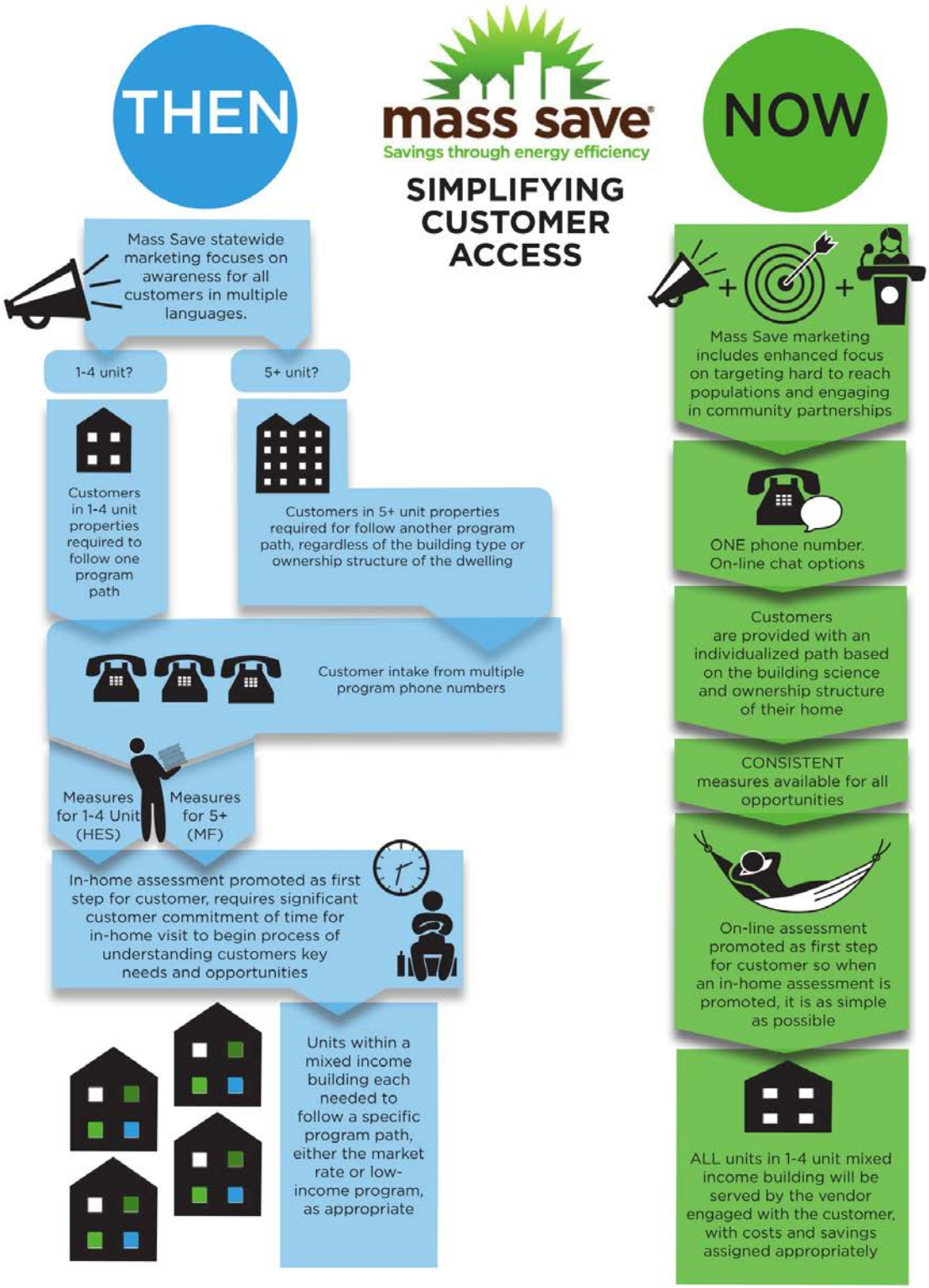
Overview and Objectives

Residential Coordinated Delivery ("RCD") facilitates comprehensive weatherization and home energy efficiency upgrades in existing homes in order to reduce whole-home energy consumption. The initiative provides access to the information, technical support services, and implementation contractors who can assist customers from the identification of cost-effective energy efficiency opportunities through final implementation of energy-efficient measures. The Residential Coordinated Delivery initiative is fuel blind, providing incentives and services to customers regardless of their primary heating fuel.

The goal is to deliver a seamless experience and maximum energy savings to every customer, regardless of unit type or ownership structure. By focusing the delivery of services on building science, opportunity, customer choice, and what each customer has the authority to implement, the new design aims to put customers in control of their energy future and reduce the number of customer confusion points along the way. Focusing on clear, uncomplicated participation pathways will result in a more equitable distribution of benefits by making it easier for all customers to engage in our programs. The Residential Coordinated Delivery initiative will help establish the Program Administrators as the customer's trusted energy advisor, building long-term relationships that lead to ongoing, comprehensive energy-efficiency upgrades to Massachusetts' homes.

Strategic Enhancements and Major Innovations: Major Milestones Complete by Q1 2020

- ✓ **Expanded online assessments and program enrollment options**
- ✓ **Enhanced support at customer intake, capturing and connecting additional detail to triage customers to targeted program offerings**
- ✓ **Leveraging the in-home assessment to provide deeper customer education and more facilitated options to support customer adoption of major measure savings opportunities (i.e., weatherization and HVAC Measures) including an expedited pathway to resolve knob and tube and combustion safety issues and increased financing for pre-weatherization barrier resolution**
- ✓ **Enhanced relationships with trade allies (HVAC, electrical, and insulation contractors) to capture customers at all entry points and help them to secure ancillary services**
- ✓ **Tailored energy savings packages designed for direct delivery to consumers**
- ✓ **Enhanced relationship management for customers, with tracking of the adoption of measures and continuous re-engagement with additional opportunities**
- ✓ **Proactive engagement of municipalities and communities and collaboration on targeted strategies to serve all residents**


THEN
mass save
Savings through energy efficiency
SIMPLIFYING CUSTOMER ACCESS
NOW
Mass Save statewide marketing focuses on awareness for all customers in multiple languages.
1-4 unit?
5+ unit?
Customers in 1-4 unit properties required to follow one program path
Customers in 5+ unit properties required for follow another program path, regardless of the building type or ownership structure of the dwelling
Customer intake from multiple program phone numbers
Measures for 1-4 Unit (HES)
Measures for 5+ (MF)
In-home assessment promoted as first step for customer, requires significant customer commitment of time for in-home visit to begin process of understanding customers key needs and opportunities
Units within a mixed income building each needed to follow a specific program path, either the market rate or low-income program, as appropriate
Mass Save marketing includes enhanced focus on targeting hard to reach populations and engaging in community partnerships
ONE phone number. On-line chat options
Customers are provided with an individualized path based on the building science and ownership structure of their home
CONSISTENT measures available for all opportunities
On-line assessment promoted as first step for customer so when an in-home assessment is promoted, it is as simple as possible
ALL units in 1-4 unit mixed income building will be served by the vendor engaged with the customer, with costs and savings assigned appropriately

Initiative Design

The Residential Coordinated Delivery initiative helps customers acquire comprehensive home energy efficiency upgrades, with a focus on weatherization and heating and cooling systems. The initiative uses incentives, financing, outreach and education, and relationships with trade ally partners to make it easy, clear, cost-effective and compelling for customers to implement energy efficiency upgrades.

RCD will continue to deliver services using a team of highly skilled and coordinated lead vendors, energy specialists, insulation contractors, electricians and HVAC contractors who use a systems approach, considering all components of the home (base load, envelope, mechanical) to support customers in achieving deeper energy savings.

Single-family homes, including free-standing town homes, will use the delivery and incentive structure of the former Home Energy Services ("HES") initiative. Smaller multi-unit buildings, such as those with three stories or less, will also be directed through an HES-style delivery process. These buildings will be directed to qualified vendors and contractors, which may include lead vendors, Home Performance Contractors ("HPCs"), and Independent Insulation Contractors ("IICs"), according to specific building types and will be offered a scaled set of prescriptive incentives based on the number of units participating to encourage landlords and condo associations to install energy efficiency measures for all units in a building.

Larger multi-unit buildings, such as those with four stories or more, or with a centralized heating system, will follow a more customized path that builds on the Project Point of Contact ("PPC") model established during the 2016-2018 Energy Efficiency Plan via the former Multi-Family Retrofit initiative. The PPC will provide property owners an individualized path with custom incentives and savings, using a Pay for Savings incentive structure. This approach will maximize capture of the unique opportunities of larger and mixed-use multi-unit structures, and provide a strong business proposition that makes energy efficiency upgrades an easy decision. Program Administrators will work with larger multi-unit customers who are not ready to undertake this whole building approach but have an immediate need or desire to install a specific energy savings measure. Program Administrator representatives will follow up with these customers to promote more comprehensive savings and work to enroll the customer in the comprehensive whole building process.

All energy savings measures will be facilitated for customers through the Residential Coordinated Delivery path, regardless of the customer's building type. Eligible measures include lighting, water saving devices, weatherization (i.e., air sealing and insulation), duct sealing, heating, cooling, and water heating equipment and other qualified efficient products. Since multi-unit buildings may contain residential and/or commercial metering, with building-level systems more traditionally found in commercial facilities, a number of measures more often found in the C&I Retrofit program will also be available for upgrades in these multi-unit buildings, as appropriate. Energy-efficiency measure costs and savings will be allocated to the appropriate sector when both residential and commercial meters are present in a building. These measures may include:

- Heating Ventilation and Air Conditioning ("HVAC") high-efficiency equipment upgrades and controls;
- Variable speed drives and motors;
- Chillers;
- Air compressors;
- Water heating equipment;
- Energy-management systems; and
- Custom measures.

Energy Assessments

The Residential Coordinated Delivery initiative will provide all customers an opportunity to take advantage of an energy assessment. The goal in the 2019-2021 term is to tailor the assessment to the customer. Program Administrators are working to expand the usefulness and precision of online assessments available through the initiative for customers choosing to pursue this option. Increasing the use of online assessments will help bring more customers into the initiative and better direct customers to the most appropriate pathway for their home's energy upgrades. Online assessments and digital pathways are critical to providing time-constrained customers the 24/7 access to opportunities and education that consumers have come to expect. The data collected from the online assessment will help support tailored follow up with customers. In-home assessments/site visits will be strongly encouraged for customers who are seeking major measures (i.e., weatherization and HVAC upgrades).

The Program Administrators will provide a comprehensive intake screening and promote the type of assessment that is most appropriate for each customer's situation. All customers will be offered some means to participate in our programs, and their participation will be facilitated, even in instances in which the involvement of other parties (landlords, other unit owners, etc.) is a priority.

Program Administrators will offer customers who lack the ability to implement major-measure opportunities (e.g., weatherization or HVAC measures) tailored energy savings suggestions, through an online assessment process, including recommendations for any measures they may be eligible to receive. These measures could include a selection of eligible energy savings measures, such as lighting, water-saving devices, and other efficiency products that respond to specific opportunities to increase the efficiency of their home. Through the web portal, customers can select the measures they will install, and a tailored package, with instant incentives applied, will be sent directly to the customer.

Costs related to energy assessments/site visits will be charged to the Residential Conservation Services ("RCS") budget line, in accordance with the Department's directives and the RCS statute.[24] See 220 C.M.R. § 7.02; St.2012, c. 209, § 32.

Innovation - Expanded intake and assessment

The Residential Coordinated Delivery initiative enables Program Administrators to create a more integrated experience for residential customers. The integration will be supported by an enhanced intake and assessment experience that provides solutions based on a customer's interests, opportunity, decision-making authority, and building type. The Program Administrators will support a single statewide phone intake line that serves as a clearing house for all residential customer calls. The clearinghouse will be managed by a vendor(s)/PA call center who will handle interactions with customers interested in the Residential Coordinated Delivery services.

In all customer interactions, the goal of the intake process will be to resolve as many customer inquiries as possible without the need for transfers. This includes answering questions about the full portfolio of the Program Administrators' services. In instances in which transferring a customer is required, a warm transfer, in the customer's preferred language will be made whenever possible. Intake representatives will also be able to assist customers through other communication channels, including online chat.

For customers interested in RCD, the intake process will include screening for opportunity and interest, and scheduling the customer for an in-home visit, or connecting them with a savings package, as appropriate. The Multifamily Market Integrator ("MMI") role of the 2016-2018 Plan will be folded into this new intake process. Additionally, the intake process will include:

- Tracking all customer interactions. This includes maintaining databases that track project history, current project stats, and other relevant information;
- Enrolling additional units within a facility, when applicable;
- Managing a "primary" vendor for each facility;
- Using the customer's online assessment results to inform services offered and reduce redundant information collection;
- Assessing whether a customer is eligible for income-based incentives or programs; and
- Coordinating across Program Administrators in instances of facilities or buildings with multiple heating fuels.

Strategic Enhancement -Customer Journey for Non-English Speakers

The highly marketed Mass Save residential telephone number will continue to be the primary public facing residential phone-intake system. Currently the language options include

[24] The Program Administrators will implement residential scorecards as part of the in-home audit in coordination with DOER. The budgets and design for this innovative new effort to be undertaken in accordance with the RCS State Plan section 2.B.1 issued by DOER in September 2018 pursuant to the Residential Conservation statute have not yet been developed, and will be collaboratively worked on by the Program Administrators and DOER. The target date for the roll-out of this scorecard effort is July 2019.

English, Spanish and Portuguese. The language options are being expanded to include Russian, and Mandarin.

The Program Administrators are currently reviewing the customer journey from a language perspective to identify and close any existing gaps to ensure we are communicating with customers in their preferred language throughout their entire experience. The review of the customer journey will be completed by July 31, 2019. Suggested improvements include the review of the transfer protocols from the statewide line to supplementary vendor call centers to ensure fluidity in the customers' selected language preference. Additionally, the Program Administrators would like to ensure all follow up communications are also sent to the customer in their preferred language. The Program Administrators will offer additional translated program materials in the most commonly spoken languages across Massachusetts. Enhancements described above will be implemented by September 2019.

Increased customization of the in-home assessments

Program Administrators have learned, through program evaluations[25] and consultations with program vendors, that a primary challenge during in-home assessments has been having time to fully educate the customer about their energy-saving opportunities. By capturing key information on customer opportunities through the enhanced intake screening and focusing on those measures that require in-home visits, Energy Specialists will have more time to spend educating the customer. This education is not limited to the specific energy efficiency opportunities available and the potential financial savings and incentives. Many customers have concerns about the time, disruption, and risks that may be associated with the installation of some major measures, such as insulation and air-sealing. Increasing the time spent on education and customer support during an in-home assessment will allow customers to be more in control of their energy decisions and give them a trusted partner to help navigate major energy savings opportunities. The Energy Specialist can dedicate time to help customers understand how the actual implementation of weatherization and heating systems upgrades will unfold. Energy Specialists will be encouraged to facilitate the connection to heating contactors and prepare customers for major-measure installation, including working with trade allies to address the mitigation of pre-weatherization barriers.

In order to receive weatherization incentives, customers are required to have an in-home assessment through a Program Administrator approved contractor. The initiative continues to implement set pricing for weatherization. The set pricing model provides certainty regarding cost-effective energy-efficiency upgrades for customers, contractors, and Program Administrators alike. This prevents claims or concerns of price gouging by customers, provides ease of participation (e.g., no requirement of the customer to solicit multiple bids), allows for the application of instant incentives and helps generate and support further business within the market. Set pricing also allows contractors and Program Administrators to plan more accurately and ensure that measures remain cost-effective. Without set pricing, the in-home energy assessment could not result in the production of an executable weatherization contract for the customer, which is a

[25] 2018 Home Energy Services Process Evaluation, Effectiveness of Home Energy Assessments, Finding 2

unique and valuable program design within the Massachusetts Residential Coordinated Delivery initiative. The Program Administrators carefully select weatherization materials and measures based on energy savings, customer costs, total costs, scalability/ease of installation, and other pertinent characteristics. A strong focus on weatherization during in-home assessments, in addition to having set pricing, eases participation for homeowners.

Strategic Enhancement - Driving Increased Conversions to Weatherization

Program Administrators have analyzed the factors that most frequently prohibit customers' completion of the weatherization recommendations provided after an in-home energy assessment. Knob and tube wiring as well as combustion safety issues continue to dominate the pre-weatherization issues that prevent customers from continuing on their path to implementing weatherization. In many cases, the effort needed to overcome this barrier is modest, but the sense of complication and time for customers is sufficient to create a stopping point on their journey. To overcome this obstacle, Program Administrators are adding an expedited pathway for the two most common barriers to weatherization: knob and tube assessment and combustion safety testing.

For customers who sign a contract committing to install weatherization measures, the program will offer to facilitate a visit from an electrician to provide knob and tube evaluation at no charge. For customers with identified minor combustion safety issues, the program will offer to facilitate a visit by a qualified HVAC technician to address those issues at no charge. The Program Administrators will continue to offer the incentive to those customers who wish to work with a contractor of their own choosing. Customers are offered an incentive of up to $250 for all other additional pre-weatherization barriers such as attic storage or moisture to assist the customer in assessing/rectifying the barrier. The Program Administrators will continue to enhance and evolve the facilitation of pre-weatherization barrier mitigation over the course of the term. To further assist with the mitigation of pre-weatherization barriers, the Program Administrators are expanding the list of eligible barriers allowed for financing through the HEAT Loan to include the most common pre-weatherization barriers identified during the in-home Energy Assessment and raising the allowable financing caps on pre-weatherization barriers. Barriers eligible for financing include knob and tube wiring, combustion safety issues, mold, vermiculite and asbestos, and certain structural concerns.

The Program Administrators are excited to add pre-weatherization financing to the HEAT Loan, given that pre-weatherization barriers can be costly to remediate. Customers with identified pre-weatherization barriers will still be eligible for the pre-weatherization barrier incentive of up to $250 to evaluate the barrier; however, if it is determined that the barrier is unable to be corrected at that time, customers will be able to finance the costs associated with remediation of the barrier through the HEAT Loan. Customers will be required to move forward with their recommended weatherization installation in order to be eligible for the pre-weatherization HEAT Loan financing. The anticipated updated barriers and financing amounts are noted below.

Pre-Weatherization Barrier	Financing Amount
Asbestos*	Up to $4,000
Knob & Tube Wiring	Up to $10,000
Vermiculite	Up to $10,000
Mold Abatement	Up to $4,000
Structural Concerns	Up to $1,000
Combustion Safety	Up to $1,000

*to enable heating equipment improvements

Innovation – Development of Municipal and Community Partnership Strategy

The Program Administrators have worked with municipalities and community stakeholders to test multiple strategies for community wide engagement over the past several plan cycles. During the planning period for the 2019-2021 Term, the Program Administrators have closely reviewed the elements of different community and municipal partnership efforts and have attended sessions with stakeholders interested in providing input into how Program Administrators work with municipalities and communities. Partnering with municipalities and communities is a critical pathway, particularly to gain insights on reaching renters/landlords and multilingual populations. Program Administrators are focused on developing a statewide Municipal and Community Partnership strategy, to target communities identified as having lower participation.

The new statewide Partnership strategy will include a stronger connection to municipal governments, whose local knowledge and trusted relationships can be a valuable connection point for increasing awareness and participation in the Program Administrators' efficiency offerings. The Partnership strategy will support municipally-led outreach for cities and towns of all sizes to enroll local participants. As a core element, Program Administrators will establish a two-way communication channel for municipalities by offering check-in calls, periodic trainings, and a suite of co-branded marketing materials. The two-way communication channel will provide a forum for Program Administrators and municipal staff to share program updates and communicate strategies for targeting hard-to-reach populations. Program Administrators will also explore inclusion of a similar strategy for Non-Governmental Organizations whose municipalities have not yet joined the statewide Partnership strategy.

Serving all Customers

The Program Administrators remain fully committed to ensuring that all customers have access to the benefits of energy efficiency. While the economic, environmental, comfort, and health impacts of our programs benefit all participants, lower income households have the potential to gain the most.

The Program Administrators' dedication to delivering the benefits of energy efficiency to all is evident through the many initiatives the Program Administrators have implemented to help ensure equitable distribution of energy efficiency benefits. Past examples include partnerships with municipalities and community organizations, targeted outreach and events to landlords, the Efficient Neighborhoods+® initiative. Efficient Neighborhoods+ included tailored creative pieces geared towards each specific community, and more personalized tactics including door to door marketing and the use of lawn signs. Geographic areas were pre-qualified for Efficient Neighborhoods+ based on income levels, and population of 2-4 buildings. Customers were

provided special enhanced incentives as part of the initiative. Initiatives within the 2016-2018 Plan continue to demonstrate the Program Administrators commitment to equitable distribution through the moderate income and renter offers, and trial with LEAN to serve moderate-income customers in a similar delivery structure to the Income Eligible Program. With each effort, the Program Administrators learn more and use these experiences to improve processes and offerings to reach every household.

The moderate income and renter offers in the 2016-2018 Plan were premised on the assumption that money is the primary barrier for this customer segment, and incentive levels are the most critical motivational levers to secure customer participation. Recent evaluations require the Program Administrators to take a broader view of the factors influencing participation of different targeted populations. For example, a recent evaluation[26] suggests that time is the greatest challenge moderate-income customers face in participating in the Programs. This finding aligns with the Program Administrators' extensive experience in delivering the programs to all customers and closely working with stakeholders. It demands a reexamination of the current approach to more effectively reach all customers.

The Program Administrators fully understand that financial burdens remain a challenge among moderate-income households and therefore will continue to offer this segment of customers weatherization upgrades and income verification services at no cost. However, taking an exclusive focus on income has come at the expense of addressing more fundamental barriers to participation such as time and complexity.

Ensuring simplicity and ease of participation for customers is the core principle underlying the realignment of the residential programs, which drives out unnecessary roadblocks, and focuses on ensuring each customer is afforded a positive experience where their needs are the primary focus of every interaction. The new alignment allows for increased accessibility to all programs for all customers by expanding pathways for entry and increasing presence in preferred customer channels while continuing Program Administrators' unwavering commitment to deliver ever greater access to customer segments that have been highlighted in the past, such as moderate income and renters. Program Administrators are redoubling efforts to use evaluations and market research, along with community partner and stakeholder input, to ensure we are continuously learning and expanding to equitably serve all customers. While maintaining a focus on delivering clear and accessible programs, the Program Administrators will continue to look for innovative, data-driven ways to ensure all customers are able to access the programs.

Consistency in offerings, eligibility, and incentives is fundamental to all Program Administrator program design and delivery. Consistency assures customers that they will receive uniform services no matter where their home or facilities are located in the Commonwealth and ensures that the benefits of ratepayer-funded programs are distributed both widely and equitably. That said, it is important to recognize that innovation by individual Program Administrators in program design and delivery is equally important. The flexibility of individual innovation allows Program Administrators to respond to the variations of local markets and market conditions, but more importantly it is through this experimentation – be it in program design, product promotion, or a unique focus on distinct market segments of local importance – that concepts that might have

[26] http://ma-eeac.org/wordpress/wp-content/uploads/Moderate-Income-Market-Characterization-Report-Final-16Mar2018.pdf

statewide applicability can be tested and evaluated in a limited low-risk/low-cost environment, with the results then shared and scaled up statewide as appropriate and practicable.[27]

To help respond to specific council and public comments, Eversource is currently reviewing moderate and lower-income customers, in hopes of creating a more holistic and integrated approach to serving these customers and communities under the Green Communities Act. The focus be on three interrelated initiatives:

1. Understanding low- and moderate-income customers and their journey including the personal and emotional impact of authentic customer engagement.
2. Examining the energy efficiency career pipeline and providing a direct pathway that fosters both economic development and careers in these communities as well as ensuring a skilled and knowledgeable energy efficiency workforce.
3. Reviewing supplier diversity applicable to the procurement of energy efficiency services to offer best practices to further advance supplier diversity in energy efficiency vendor networks.

The findings will be reviewed and shared with all Program Administrators, and depending on an assessment of its effectiveness, an approach may be expanded statewide.

Enhanced relationships with trade allies to increase weatherization and HVAC system upgrades

In 2019 and early 2020 Program Administrators will explore new ways of partnering with trade allies, including HVAC contractors and electricians. Based on these explorations, the Program Administrators will develop new and improved tools and pathways to help customers who have identified opportunities take the next step in implementing recommended energy upgrades. Our delivery teams can help customers with the next step, such as evaluation of knob-and-tube wiring or supporting customers in linking to HVAC providers to install a new heating, cooling, or hot water system. Vendor responsibilities will need to include coordination across these partners to provide customers with a more tailored and connected experience.

Program Administrators are also leveraging their relationships with HVAC contractors and electricians facilitate their ability to serve customers who participate in the Residential Coordinated Delivery initiative. Similar to helping lead vendors and contracted partners make connections to trade allies, Program Administrators are examining similar inducements for HVAC contractors and electricians to connect their customers to the additional facilitated solutions Residential Coordinated Delivery can offer.

[27] A good example of an innovation that transferred from a subset of Program Administrators to statewide deployment is when electric Program Administrators experimented with using an online store which then was expanded to include all Program Administrators. An example of learning in one geography that was used to not expend resources with a statewide deployment was Cape Light Compact's testing of a behavior model which while initially quite successful as a small pilot, was found to be too difficult to deploy at scale.

Enhanced Heating Equipment Education

The energy marketplace has evolved quickly and is becoming increasingly complex. This complexity is especially apparent in heating equipment decisions, with many choices available to customers, including systems that provide both heating and cooling functions (e.g., heat pumps), new Wi-Fi and automated control systems, and alternative fuel options. To assist customers in moving forward with energy efficiency and meeting their energy goals, the Program Administrators are seeking to help educate customers, so they can make informed decisions.

For the 2019-2021 term, the Program Administrators will provide education about all heating options available to help customers optimize energy consumption at their premises. Customers will receive information regarding the costs, financial incentives, other government agency incentives, estimated payback periods, energy savings, and emissions reductions of various heating options, regardless of fuel type, that are offered through the programs and are appropriate to their premises. If a customer chooses to install a cold climate heat pump, Program Administrators will also provide information on the implications of retaining or removing the prior heating system and the options to address concerns of prolonged extreme cold weather.

Program Administrators will educate customers and encourage the use of available technology, as appropriate, to help customers operate their new systems optimally and efficiently. This effort focuses on fostering informed customer choices. While the Program Administrators will not be recommending specific or preferred technologies beyond Program Administrator-specific trial offerings, the Program Administrators are expecting the increased education will result in some customers electing to convert from oil or propane to highly efficient cold climate heat pumps or highly efficient clean heating equipment when those choices are cleaner and less expensive than their current system. Incentives will continue to be set to encourage greater efficiency and energy reductions at the customer's home. Customers converting to natural gas will only be eligible for the same incentives for high efficiency gas equipment as an existing gas customer; the incentive level will not differ depending on a customer's initial fuel source. Further, the PAs will not claim any savings associated with reducing a customer's former fuel source in the event the customer converts to natural gas. Customers may also leverage incentives offered by other government entities, such as DOER and the Massachusetts Clean Energy Center ("MassCEC"), which are designed to encourage adoption of specific technologies. The Program Administrators will include MMBtu savings from the reductions in usage of the original fuel (including oil and propane) in their claimed savings and account for the increase in primary fuel usage. This new focus is intended to be a holistic approach to lowering a customer's total energy use and costs and providing additional value to customers through education efforts.

Energy Optimization of Heating Systems for Residential Customers

As discussed above, Energy Optimization is a more holistic and integrated approach to helping customers address their energy use and associated costs based on their individual needs and goals. Consistent with the GCA and DPU precedent, the objective of Energy Optimization is to move customers toward lower total energy usage and increased environmental benefits. In the context of addressing heating systems under Energy Optimization, the Program Administrators will provide customers with cost effective, economic, fuel blind options for heating their homes

beyond increasing the efficiency of their existing equipment using their existing primary heating fuel.

Program Administrators propose to educate customers about converting from delivered heating fuels or electric baseboard heat to either electric air source heat pumps or high efficiency natural gas equipment. The Program Administrators will not recommend one fuel over another; however, Program Administrators would provide information that allows customers to compare the installed costs, operating costs, and environmental impact of their primary heating fuels with other available options. Program Administrators will also be able to provide customers links to resources to help them take the next step whether it be upgrading their existing equipment on their existing fuel, converting to electric air source heat pumps, or converting to natural gas. The ultimate decision remains, of course, with the customer, but the customer will be armed with information to make an informed decision. The Program Administrators will also encourage customers to adopt weatherization measures in order to obtain additional efficiency, minimize the impacts if a customer converts to an alternative energy source, and "right size" new heating equipment.

By educating customers on available fuel choices, cost, and environmental impacts, some customers may choose to change their existing heating fuel and install high efficiency equipment utilizing a different fuel. More specifically, oil or propane customers will be provided with information about the installed cost, cost/energy savings and environmental benefits of converting from a standard efficiency oil or propane system to a high efficiency oil, propane, electric or gas system. The Program Administrators will provide an incentive to encourage adoption of high efficiency equipment. Incentives will be offered for strategic electrification that reduces greenhouse gas emissions and minimizes ratepayer costs, and switching to renewable or clean energy technologies, including wood pellet heating where cost-effective. Customers converting to natural gas will be eligible for the same incentives for high efficiency gas equipment as an existing gas customer; the incentive level will not differ depending on a customer's fuel source.

Information will be provided to customers through several avenues. The Program Administrators are exploring the development of an online calculator to be available on MassSave.com with the intention of allowing users to estimate and make comparisons of oil, propane, electric and natural gas heating equipment. Use of the online calculator is intended to be available to the public. The Mass Save website will provide additional information and instructions about the process of converting to more efficient heating.

Consistent with the 2016-2018 Retail Products initiative, customers will not be required to have an on-site home energy assessment to receive incentives provided that existing fuel and equipment information can be confirmed prior to installation. Program Administrators are investigating strategies other than an onsite visit to confirm a customer's existing fuel and heating equipment. An example could include customers submitting past heating fuel bills in order to confirm their existing fuel, or installation contractors documenting existing equipment. Communications and materials will however, recommend that weatherization opportunities are considered prior to a heating system upgrade should a customer decide to convert to a new system without obtaining a home energy assessment.

In addition to the availability of an online calculator, the Program Administrators will provide guidance and tools to energy specialists to allow them to present customers with education

about available fuel choices. The Program Administrators will support customers interested in switching with the appropriate next steps, including by providing Program Administrator gas conversion contacts and qualified manufacturer heat pump contractor contacts.

3. Residential Retail Initiative

Overview and Objectives

The goal of the Residential Retail initiative is to provide a broader integrated marketplace where energy efficient products are positioned as attractive, primary choices for customers making purchasing decisions, whether online, in-store, or through independent contractors.

The Residential Retail initiative ensures that all residential customers can access high-efficiency lighting, heating, cooling, and water heating equipment, including thermostats, lighting controls, appliances and other energy efficient products. The initiative works to place the most energy efficient options in front of customers who prefer to navigate their energy efficiency journey themselves or with their contractors, rather than participating through the Program Administrators' highly facilitated Residential Coordinated Delivery Path.

Strategic Enhancements and Major Innovations: Major Milestones Complete by Q3 2019

- ✓ **Point-of-Purchase Instant-Rebate Platform**
- ✓ **Broadened Partnerships with Distributors and Contractors**
- ✓ **Tailored Energy Savings Packages**

Initiative Design

The Residential Retail initiative helps customers acquire a full complement of energy saving equipment, from simple self-install items (such as LED light bulbs and shower heads), to products that are selected by consumers but often installed and serviced by specialized technicians (such as appliances and lighting fixtures), to larger equipment that requires professional installation (such as heating equipment). Energy saving products that the Residential Retail initiative support include lighting and associated controls, smart strips, water saving devices (such as shower heads and faucet aerators), appliances, efficient electric heating and cooling equipment, water heating equipment, heat-pump water heating technologies, gas heating (hot water boilers and warm air furnaces), and associated controls such as wireless and programmable thermostats and outdoor reset controls. Additional products are continuously being evaluated and added to the portfolio.

To successfully influence consumer choices for this broad portfolio of products, Program Administrators will use a multi-channel strategy supported by extensive marketing to and training of trade allies and retail partners. Trade ally training plays a significant role in driving product placement and acceptance. Customer-facing rebates are also critical to building demand for and acceptance of high-efficiency products. Rebates and incentives may be upstream, midstream, or downstream.

Product Placement

The initiative seeks to create opportunities for customers to access efficient options by working with big box and other retailers, with manufacturers, distributors, and supply houses, and through the Mass Save online store. In addition to working with traditional retail outlets, a major focus of program activity is to provide support to plumbing, and heating and cooling contractors

and others in the supply chain (manufacturers, distributors, and suppliers) to ensure the availability, promotion, and proper installation of the highest efficiency equipment.

Program Administrators continuously engage their partners. Program Administrators recruit and train retailers (including discount retail outlets) to participate midstream. Retailers are reimbursed by Program Administrators for incentives provided to customers at check out, and provide and support placement of point of purchase materials in retail stores. Program Administrators also work closely with supply houses and support trade allies' education.

The purchase and installation of heating and water heating equipment in customers' homes is heavily influenced by the installing contractor and the supply chain behind them. For this reason, a major focus of this initiative is to work with influential market actors, including plumbing and HVAC contractors and technicians to promote and install efficient equipment and ultimately engage them as true partners with Program Administrators in moving customers to adopt more comprehensive energy efficiency.

The installation and service practices of these same key trade allies further influence how well energy efficient equipment performs once it is installed. Therefore, Program Administrators promote installation best practices for a wide assortment of energy efficient equipment, including central-air-conditioning equipment and air-source heat pumps, hot water boilers, warm air furnaces (with electronically commutated motor or equivalent advanced furnace fan systems), select heating system controls (including after-market boiler reset controls and programmable and wireless-enabled thermostats), water heating equipment, and heat-recovery ventilator equipment ("HRV"). This contractor education is done through online and in-person classes, as well as manufacturer and distributor trainings offered at the GasNetworks® conference and in supply houses. Program Administrators also own the GasNetworks® website, which is a valuable channel for reaching plumbing and heating contractors.

Incentives

The Program Administrators have offered generous incentives to customers to help offset the higher cost of their investments in high-efficiency lighting, products, heating, cooling, and water heating equipment for many years. Available incentives and rebates are listed on Masssave.com. In addition to the direct financial support to help customers make the purchase, the highly visible incentives help customers to recognize efficient products and to position efficient products as premium products. These efforts will continue in the 2019-2021 Plan, even as the methods to provide customers with incentives evolve.

Innovation – Point-of-Purchase Rebates Platform

A central strategic priority for the 2019-2021 plan is to meet our customers where they normally seek goods and services. This approach will provide a customer experience that is more tailored to the individual customer, reduce customer effort, and build a customer's long-term relationship with energy efficiency programs. The Program Administrators' remarkable success in driving lighting savings and the diminished retail lighting savings that the Program Administrators can claim moving forward requires innovations to continue to capture customers' interest and engagement in retail settings.

The rebate process itself – submitting an application and waiting for reimbursement – does not make effective use of the evolution of modern digital platforms, including smart phones, home computers, and retail marketplace point-of-purchase digital systems.

Program Administrators have been working in 2018 with their rebate processing vendor to trial systems that improve the customer experience and ensure that energy efficiency remains a prominent message in brick-and-mortar retail spaces. Program Administrators plan to release a request for proposals in the first half of 2019 to develop an "instant rebate" system across the majority of energy efficiency measures in retail stores. In the longer term, Program Administrators are working to ensure that as customers move back and forth between brick-and-mortar and online shopping our retail engagement platforms can seamlessly serve them.

The instant rebate system will allow customers to validate and redeem rebates at point of sale in brick-and-mortar retail stores for the majority of retail energy efficiency measures purchased directly by residential consumers. This system will connect a purchase to the customer's utility account quickly and with minimal customer inputs, ensuring that only eligible customers receive incentives and that customer activity is tracked for future outreach to support a continuing customer engagement. Customers will be able to enter their information either on a smart phone in the store or on a computer at home, to validate their eligibility. Customers will then receive a bar code to scan at the register during checkout to have their incentive instantly applied to their purchase.

While conceptually simple, there is a considerable amount of fine tuning and testing to ensure the system has sufficient accuracy and all qualified products are tailored for each retailer that is added. Retailers have individualized point-of-sale systems and instant rebates must be integrated to each system. There must also be an effective mechanism of data transfer and payment to retailers for the rebates they have honored. A significant factor in the success of instant rebates will be enrollment of major retailers in the program, so designing a system that is fast and easy for them to use is important to gain their participation. Additionally, education of store managers and associates at each retailer is crucial, so they can accurately respond to customer questions in the moment and ensure a smooth transaction.

Program Administrators will explore expanding instant rebates to allow contractors to offer them to customers when working in the field, and for online channels such as Amazon.com, BestBuy.com, and Lowes.com, to offer them

Strategic Enhancement – Broadened Partnerships with Distributors and Contractors

Program Administrators are increasingly working with distributors in a midstream channel strategy to support stocking and promotion of larger residential energy efficient equipment. As new energy saving products come on the market, a midstream approach provides an effective mechanism to increase measure volume and savings for items not yet well known to customers and contractors. For example, in the 2016-2018 term, Program Administrators began offering Electronically Commutated Motor ("ECM") pumps as a residential midstream measure. In 2019-2021, Program Administrators plan to expand to other measures and align with Commercial and Industrial midstream efforts in order to increase supply house participation.

Program Administrators will continue to evaluate opportunities for midstream offerings via the same point-of-purchase instant-rebate platform, as is planned for retail stores, or an alternative platform targeted to supply houses and contractors. A system that digitally captures customer information and allows for instant rebates allows collection of better customer information for evaluation and follow-up outreach.

Mass Save Online Marketplace

As social media and online marketing have grown in influence for consumer products, Program Administrators have successfully leveraged online marketing opportunities to promote residential energy efficiency. This marketing is supported by a branded online Mass Save store which provides instant incentives on energy efficient products. Only verified customers of a Program Administrator can receive discounts on energy efficient products through the Mass Save online store. The Program Administrators will continue to maintain a stock of energy efficient products offered through the Mass Save online store, staff a toll-free line for customers, and process purchases, as well as conduct short-term promotional pricing and related marketing in partnership with retailers, which has proven very successful in the past.

Program Administrators plan to more fully leverage this channel to supply tailored packages to customers from the comfort of their keyboard directly to their home.

Innovation – Tailored Energy Savings Packages

The Program Administrators plan to expand and enhance the existing Mass Save online store to include customized packages for customers who may be identified through the intake process as having no opportunity for major measures installation. Through the web portal, the customer can select the measures they will install, an instant incentive will be applied, and the tailored package of measures will be sent directly to the customer. The majority of these products will mirror the instant-savings products that would be installed through an in-home energy assessment and provided at no cost to the customer. For a customer without major opportunity, or the ability to approve installation of those measures, this process is a convenient and connects them with the energy savings solutions they are seeking.

4. Residential Behavior Initiative

Overview and Objectives

The primary goal of the Residential Behavior core initiative is to encourage customers to engage in behavior that will result in energy conservation or demand reduction. The Residential Behavior core initiative seeks to leverage the motivational factors that cause residential customers to actively employ personal energy saving actions or participate in energy efficiency and demand reduction offerings.

Program Administrators engage in extensive education, marketing, and workforce development and training activities, all of which are focused on building a climate of energy efficiency awareness and conservation. The Program Administrators' behavioral offerings must be able to accurately capture the direct impact in measured energy savings or demand reductions that result from promoting behavioral actions. Customers must therefore be actively targeted for behavioral interventions, and their specific behavior or action must be rigorously connected to measured savings or demand reduction outcomes.

Customers may participate in the program activity through passive receipt of program treatment or active enrollment in a specific behavioral program offering. Behavioral programs do not claim savings that result from decisions by customers to upgrade or install energy efficient equipment, as those savings are captured in the Residential Coordinated Delivery and Retail initiatives.

Not all residential customers can participate in Residential Behavior offerings given the requirement for a control group against which to compare the treatment group. In addition, certain customers are better candidates for treatment than others given the amount of seasonal or annual usage or the specific installed technology that is required by the intervention.

Strategic Enhancements and Major Innovations

- ✓ **Active Demand Reduction Offering**
- ✓ **Temperature Optimization**

Initiative Design

Home Energy Reports

In previous plan terms several Program Administrators introduced and evaluated behavior-based designs to promote energy conservation within their respective territories. The Home Energy Report ("HER") model remains the mainstay behavior model with proven evaluation results. It provides reliable and predictable savings.

The HER model assigns qualifying customers to treatment and control groups. The treatment groups receive electronic and/or mailed reports on a regular basis and have access to an online portal showing details about their home's energy usage. The control groups are retained as untreated to allow for comparison and identification of the savings impact of the treatment on the treated group (i.e., the difference in energy savings experienced by the treated group over the

untreated control group). Customers in the treatment group are treated as a group indefinitely, or until the Program Administrators decide to stop treating customers with HERs.

The HER design promotes energy savings through two primary paths:

- Educational reports
- Educational reports *and* customer interaction with their online portal.

The HER details and benchmarks customers' energy usage against their past usage and against similar homes in their area. Customers have the option of opting in to an online portal to get more specific feedback on their energy usage. Data collected from the Program Administrators' third-party datasets and customers are used to provide behavioral tips specific to the customer. In addition, these reports cross-market other energy efficiency programs offered by the Program Administrators, spurring greater participation in those programs.

The HER model requires a substantial upfront financial and time investment in mapping information-technology systems (from Program Administrator to vendor and back) to allow for data transfer. This critical infrastructure development is a prerequisite for being able to develop effective treatment groups and tailored HERs.

There is limited flexibility in influencing the design. For Program Administrators with smaller populations available for treatment, it has been challenging to start or implement an HER model program cost-effectively. Several Program Administrators have been told directly by the leading vendors that they cannot provide the HER for their service territory at a reasonable cost (i.e., that would meet regulatory cost-effectiveness requirements).

A statewide request for proposals would not increase availability, as the required investment is specific to Program Administrators' internal billing and usage monitoring systems. These large upfront costs cannot be reduced by aggregating Program Administrator customers into one contract because the required investment is specific and unique to each Program Administrators' internal systems. That said, the majority of Massachusetts customers are treated with HERs, because the largest Program Administrators have fully operational offers.

Innovation - Active Demand Reduction offers

Background

During the 2019-2021 term, the Program Administrators will enhance ongoing efforts to reduce system peak demand by implementing active demand reduction initiatives. The proposed initiatives are based on the extensive work by the Program Administrators' Demand Savings Working Group and the lessons learned from recent evaluated demonstration efforts. The initiative is available to all residential and low-income customers and includes a direct load control offering and a storage performance offering.

National Grid and Cape Light Compact conducted residential active demand reduction demonstrations in the summer of 2016, 2017, and 2018 targeting summer cooling loads. Unitil

plans to run the demonstration approved by the Department in D.P.U. 16-184 in the summer of 2019. National Grid and Cape Light Compact shared evaluations of their demonstrations with Eversource and Unitil, and collectively, the electric Program Administrators have designed a new active demand offering for residential customers incorporating the lessons learned from the demonstrations. Program Administrators believe the modifications will allow the program to reach scale and operate cost-effectively.

Residential active demand offerings present unique challenges for recruitment and implementation. Unlike large C&I customers, residential customers currently do not pay demand charges or time varying rates, and therefore have no inherent, direct incentive to decrease usage during specific peak demand periods. Further, some active demand technologies, such as thermostat adjustments and storage, can actually increase monthly kWh consumption due to snapbacks from load shifting and energy loss due to the roundtrip efficiency of storage. Since most residential customers' electric rates are fixed, use of active demand technologies for peak load reductions may increase customer bills. Accordingly, there is no beneficial value proposition for individual residential customers to participate in active demand offerings absent Program Administrator incentives. However, peak demand reductions through active demand management can have a system benefit that reduces overall capacity and temporal-energy costs for all customers, and therefore, the Program Administrators have designed a model for residential active demand offerings that provides incentives for peak demand reductions to capture these system benefits.

Residential Active Demand Reduction Approach

Residential Direct Load Control

The core model for the residential direct load control offering remains focused on reducing demand during summer peak load, typically targeting twenty hours per summer. The design is a bring-your-own-device model, starting first with communicating thermostats controlling central air conditioning units and cooling loads. Additional eligible connected devices may include water heaters, pool pumps, and other devices. Incorporation of additional devices will depend on device saturation, manufacturer concentration, and the costs associated with integrating and enabling load control on each type of device. Eligible customers' devices will be connected to a demand response management platform through an application programming interface ("API"), a mechanism that allows two different electronic systems to exchange core data and interact in a common language. Program Administrators, through the demand response management platform, will send a signal to the device during an event that causes the controller to reduce the demand of the connected device. Events will be called in advance, primarily in the months of June, July, August, and September. Customers can opt-out of events; however, they will be removed from the program if they regularly do not participate.

Delivery Pathways for Residential Direct Load Control Offerings

Customers with eligible technology (controllable communicating device) will be offered the opportunity to enroll in the active demand offering and incentivized to participate in demand reduction during summer peak events. Program Administrators will seek to enroll both customers with devices already installed and customers installing devices through the energy efficiency

delivery pathways during the 2019-2021 plan period. By targeting customers with devices already installed, the Program Administrators can seek to ramp up enrollment by recruiting adopters of technology already incentivized by efficiency efforts or other means, while also seeking to expand the pool of eligible devices through energy efficiency efforts. When an eligible device (e.g., communicating thermostat) is incentivized or installed through the energy efficiency programs, the Program Administrators will seek to simultaneously market and enroll that customer into the active demand direct load control offering. This co-marketing and integrated approach will help customers fully understand the potential benefits of new active demand reduction technologies, streamline the customer acquisition process, and increase enrollment in active demand reduction offerings.

The primary method of customer recruitment will be through the communicating device manufacturers, which was shown to be a successful method during the 2016-2018 demonstration offerings.

Residential Storage Performance

The Program Administrators proposed residential storage performance offering is specifically tailored to build on the lessons learned from successful pay for performance active demand demonstrations and encourage the performance of energy storage by providing higher incentives than the Direct Load Control offering assuming storage that does not impact customer comfort will be more robust, more available, and less likely to be overridden. By using a pay for performance approach, the Program Administrators will be able to utilize ratepayer funds in a manner that maximizes the benefits of peak demand reduction, while providing a predictable revenue stream to customers. The enhanced incentive levels under this option are designed to encourage performance of storage, which comparatively has a high upfront cost but also provides opportunities for demand reduction without significant interference with customer comfort and operations. To further assist residential customers seeking to install energy storage, the Program Administrators will allow customers who agree to participate in demand response to finance the costs of the energy storage system through the HEAT Loan, thereby mitigating some of the significant upfront investment for storage which is a barrier for many customers.

Under this offering, customers will be incentivized to decrease demand through the discharge of energy from storage in response to a signal or communication from the Program Administrators during daily peak hours in the summer and some targeted hours in winter months. Lowering daily summer peak demand will have an impact on overall capacity requirements and provides substantially higher system benefits compared to targeting the top peak demand hours alone. Storage provides an opportunity to secure predictable daily demand reductions without the potentially significant and adverse impacts on customers of shedding demand on a daily basis through other means.

Delivery Pathways for Residential Storage Offerings

The Residential Storage Performance offering recognizes that residential customers do not have the same value proposition for storage as a Large C&I customer with demand charges, direct capacity costs, and time of use rates. The Program Administrators anticipate that most energy

storage installed by a residential customer will be paired with solar PV systems. Since residential customers can receive retail value net metering credits for any net exports of energy, residential and low-income customers are generally financially better off if they net meter rather than utilize storage due to the round-trip efficiency losses associated with storage. However, the Program Administrator incentives can offset some of the financial losses from storage cycling and provide the customer with an additional revenue stream that complements other state programs, such as SMART, which offers adders for combining solar and storage. Customers may also chose storage for personal resiliency benefits, in addition to offsetting energy costs. The overall offering balances giving customers flexibility in using energy storage systems for multiple purposes and ensuring that ratepayer funds are used in a manner that provides substantial peak demand reductions.

Innovations – Electric Vehicle Demand Control

The Program Administrators continue to explore additional cost-effective opportunities that seek to minimize the peak demand impacts of various strategic electrification policies advanced by the Commonwealth. The Commonwealth has established the goal of 300,000 zero emission vehicles registered in Massachusetts by 2025. The increase in electric vehicles, spurred in part by DOER's MOR-EV rebate program, will reduce the greenhouse gas emissions associated with the transportation sector but will add load to the electric system.

During the 2019-2021 term, the Program Administrators are exploring ways to cost-effectively mitigate the peak demand impacts associated with the growth of electric vehicle ownership by potentially offering a performance-based incentive. Please see PA-specific proposals in Appendix H.

Innovation – Temperature Optimization

The Program Administrators are excited to offer a new statewide offering – temperature optimization – that leverages connected Wi-Fi thermostats to help customers reduce energy use and demand. Temperature optimization involves manufacturers adjusting thermostat setpoint schedules based on outside temperatures and user behavior to save energy and reduce demand over an entire season. Customers opt in currently by answering a yes/no question on the thermostat.

Currently, only one manufacturer that offers temperature optimization (branded by the manufacturer as "Seasonal Savings"). It is important to note that the manufacturer does not share customer identifying information with the Program Administrators but does provide the number of customers enrolled in the Program Administrator's service territory. While it is relatively simple for the manufacturer to identify a customer's Program Administrator for summer temperature optimization, identifying the fuel type for winter temperature optimization is more difficult. Program Administrators are actively working with the manufacturer to determine a reliable way to correctly determine each customer's fuel type so that the costs and energy savings may be appropriately allocated among PAs.

While there is no incentive payment to customers for enrolling in temperature optimization, they will have modest savings on their energy bills. National Grid offered summer temperature optimization in 2017, and based on the evaluation of that demonstration, all electric Program Administrators will offer it in the 2019-2021 period. All Program Administrators expect to offer

winter temperature optimization in 2019-2021. Program Administrators will also pursue other opportunities with additional manufacturers as they arise to ensure a competitive marketplace as temperature optimization is scaled.

Income-Eligible Existing Buildings Program

5. *Income-Eligible Coordinated Delivery Initiative*

The Income Eligible Coordinated Delivery initiative provides cost-effective, energy efficiency products and services to income eligible residential customers in a fuel blind approach. Income eligible is defined as at or below 60 percent of the state median income level for 1-4 unit buildings and at or below 60 percent of the area median income level for 5+ unit buildings. Customers that qualify for the utility discount rate are also considered income eligible. Customers qualify for the utility discount rate by meeting low-income home energy assistance ("LIHEAP") eligibility or by meeting the eligibility requirements for other means-tested programs, such as Chapter 115 Veterans' Service Benefits, Supplemental Security Income, and Supplemental Nutrition Assistance Program services. The initiative is administered in coordination with LEAN and implemented by local Community Action Program ("CAP") Agencies. Revenue streams are leveraged with the Department of Housing and Community Development ("DHCD") Weatherization Assistance Program ("WAP") and the Heating Emergency Assistance Retrofit Task Weatherization Assistance program ("HEARTWAP"). This approach provides a seamless, integrated experience leveraging all applicable revenue streams for income eligible participants with no co-payments required from customers.

Strategic Enhancements and Major Innovations: Major Milestones Complete by Q1 2020

- ✓ **Better Alignment between Income Eligible and Market Rate Protocols and Services**
- ✓ **Heat Pump Trials Communicating Thermostats and Active Demand Management**
- ✓ **Facilitate workforce retention, recruitment, and development**

Initiative Design

The initiative is implemented by local CAP Agencies and integrated with resources from DHCD's WAP and HEARTWAP programs. LEAN and the CAP Agencies fully engage with Community Based Organizations as part of their marketing strategy. To continue to align with leveraged funding sources and as stated within the Green Communities Act, the Income Eligible Coordinated Delivery initiative will preserve existing implementation strategies. The Program Administrators and LEAN are evaluating deployment of US Department of Energy-approved electronic audit tools.

1-4 Unit Buildings

Income Eligible Coordinated Delivery serves residential customers living in one to four-unit dwellings who are at or below 60 percent of the state median income level and/or are qualified to receive fuel assistance and/or utility discount rates. Once customers are deemed eligible, they will receive an in-home energy assessment from their local CAP agency. The assessment evaluates the building shell, efficiency, and (for electric Program Administrators only), the appliance conditions. All assessments include an evaluation of home health and safety. The lead vendor/CAP

agency will then arrange for all applicable measures and services to be installed by a qualified contractor.

The initiative is seamlessly offered in conjunction with the current DHCD WAP and HEARTWAP programs. All applicable revenue streams available are leveraged to enhance services. Federal money will primarily be used to address health and safety issues, as well as repairs, to allow for cost-effective energy efficient measures to be installed safely and cost-effectively. Program Administrator energy efficiency funds can be used to push for deeper measures on the cost-effective priority list, including approved weatherization-related repairs. As federal support has decreased over recent years, an increasing portion of both repair and energy efficiency measures are covered solely by the Mass Save energy efficiency budgets.

The Program Administrators will fund 100 percent of the cost of installed measures. All applicable revenue streams from each program are leveraged and offered jointly to income eligible residents.

As mandated by DHCD, all projects that receive Department of Energy ("DOE") funding, must receive CAP agency post-installation quality assurance inspections to ensure that all work is performed to the program guidelines. The CAP agencies also perform a minimum of 50 percent in-process inspection of projects.

Because the Program Administrator initiative is run on top of the DHCD program, many weatherization jobs have multiple funding streams with associated requirements; therefore, quality control is completed for both DOE and Program Administrator-funded projects at the same time. DHCD Technical Field Monitors perform another level of visual inspection for 20 percent of all DOE-funded projects; 10 percent of these total units also receive a full Quality Control Inspection that includes complete testing on the dwelling. During these inspections, DHCD reviews both DOE and Program Administrator-funded work. Additionally, the Program Administrators have an independent third-party vendor perform quality assurance inspections on up to 5 percent of all jobs, which are exclusively funded by the Program Administrators.

5+ Unit Buildings

Income Eligible Coordinated Delivery also serves properties that have five or more units in which at least 50 percent of the occupants are at or below 60 percent of the area median income level, including properties owned by public housing authorities, non-profit organizations and for-profit organizations. Eligibility for the initiative measures and services is based on the established cost-effectiveness of measures and services, which includes agreed upon non-energy benefit calculations specific to income eligible populations and is not restricted by the rate class associated with the meter(s) for the facility. The program also offers the opportunity for multi-unit property applicants to participate in benchmarking their building's energy usage pre- and post-improvement. The program covers the cost of this service for the initial year.

The Income Eligible Coordinated Delivery initiative is structured to ensure 5+ unit buildings are provided with a whole building, fully integrated offering that targets both gas and electric end uses. Assessments and services for buildings that are going through the refinance process will be coordinated with relevant stakeholders.

Once a property is deemed eligible, an energy assessment is performed by the local CAP agency. The assessment evaluates the building shell, efficiency, and (for electric Program Administrators only), the appliance conditions. All assessments include a building health and safety evaluation. The CAP agency will then arrange for all applicable measures and services to be installed by a qualified contractor. Savings will be deepened by installing additional energy efficiency measures, to the extent the overall project remains cost-effective.

Energy efficiency products and services are implemented within the common interior and exterior areas of the building as well as directly within the dwellings of residential customers, benefiting both income eligible occupants and owners of multi-unit buildings. The Program Administrators will provide up to 100 percent of the funding for cost-effective projects with established limits based on projected savings. All available and applicable revenue streams from each program are leveraged and offered jointly to income eligible residents.

Measures promoted

Measures are provided at no cost to 1-4 unit customers with established limits. For 5+ unit buildings, Program Administrators will pay 100 percent of the project cost with established dollar limits where applicable. The measures available to Income Eligible Coordinated Delivery properties include:

- Insulation (attic, wall, pipe, and duct)
- Air sealing
- Heating system repair and replacement
- Efficient thermostats
- Domestic water heating, including low-flow showerheads, faucet aerators, pipe wrap, heat pump water heater (electric)
- Lighting, including LEDs, lighting fixtures, and torchieres
- Appliances, including refrigerator and freezer replacement, second refrigerator removal, advanced power strips, clothes washer replacement, dehumidifier replacement, and window air conditioner replacement
- HVAC/mechanical systems, including Energy Management System (“EMS”), motors and drives, chillers, air compressors, ventilation system repair adjustment or replacement, heat recovery ventilation/energy recovery ventilation, redistribution systems, temperature building controls
- Some repairs required for weatherization (electrical, roofs, etc.)
- Health and safety testing and improvements (combustion safety testing, ventilation, etc.)

In coordination with LEAN, the Program Administrators will work with the Massachusetts Technology Assessment Committee (“MTAC”) to include new measures or technologies as appropriate.

Customer Education

Energy efficiency education and information is provided to all participating customers. The primary form of energy education is verbal communication between the energy specialist and the customer accompanied by leave-behind materials. Educational materials have been translated into multiple languages and will continue to be updated and provided to customers as applicable. Additionally, the CAPs notify all customers verified for fuel assistance of the energy efficiency programs available to them and to encourage enrollment in the program.

The Program Administrators will work in collaboration with the Low-Income Best Practices working group, including LEAN, DHCD, lead vendors (where applicable), and CAP agencies to coordinate statewide on all aspects of Income Eligible Coordinated Delivery initiative, including but not limited to planning, delivery, implementation, education, marketing, training, cost-effectiveness, evaluation, and quality assurance.

Innovation – Heat Pump Trials

LEAN is conducting trials on the installation of air source heat pumps for income eligible single-family homes. Findings to-date indicate that housing type/stock influences the cost-effectiveness of heat pumps. To-date, air source heat pumps have not proven to be a cost-effective opportunity for the single-family income eligible market segment but decreasing system costs and increased market knowledge of best practices for installation may make them a viable heating and cooling solution.

Innovation – Communicating Thermostats and Active Demand

Program Administrators and LEAN will conduct a demonstration for the direct installation of communicating thermostats through the income eligible initiatives. These same customers will be given the opportunity to enroll in the Program Administrators' active demand management offer. Program Administrators and LEAN hope the demonstration will lead to similar rates of energy efficiency savings and active demand reductions as market rate customers.

Strategic Enhancement- Better Alignment between Income Eligible and Market Rate Protocols and Services

The Program Administrators and LEAN are collaborating to identify and deploy more coordinated solutions and partnerships between the Income Eligible and Market Rate programs to support increased awareness and drive customer participation for both income eligible and market rate customers.

Initial Program Administrator and LEAN efforts will focus on implementing a new procedure for 1-4 unit mixed income buildings (buildings that include both income eligible and market rate customers). The Program Administrators and LEAN are committed to maximizing weatherization opportunities and streamlining the customer experience in these buildings through new coordination guidelines between income eligible and market rate contractors. The coordination guidelines will allow for insulation and air sealing services to be delivered by a single

contractor, with the appropriate division of costs and savings allocated to the respective initiative on the back end. As a part of this process, the Program Administrators and LEAN are aligning, to the extent possible, all assessment and weatherization protocols to ensure that energy specialists and contractors can count on consistency between the two initiatives.

Strategic Enhancement - Facilitate Workforce Retention, Recruitment, and Development

In collaboration with LEAN, the Program Administrators will develop and implement new workforce retention, recruitment, and training strategies to ensure a knowledgeable and sustainable workforce for income eligible weatherization. CAP agencies are trusted energy service providers in communities across Massachusetts. Program Administrators and LEAN want to ensure their continued on-the-ground success through an increased investment in the professionals that provide these valued services.

C. **Commercial & Industrial Programs**

Commercial & Industrial Programs

Overview

The Commercial and Industrial ("C&I") portfolio has driven unprecedented energy efficiency savings while suppressing the overall costs of achieving Program Administrator's efficiency portfolio, providing Massachusetts ratepayers with extraordinary value for their energy efficiency investments. The Program Administrators' 2019-2021 Commercial & Industrial portfolio leverages the leadership and maturity in program design to continue to harvest remaining available savings through strategic enhancements to existing designs and cutting-edge innovations that expand to harvest emerging savings opportunities and penetrate new markets.

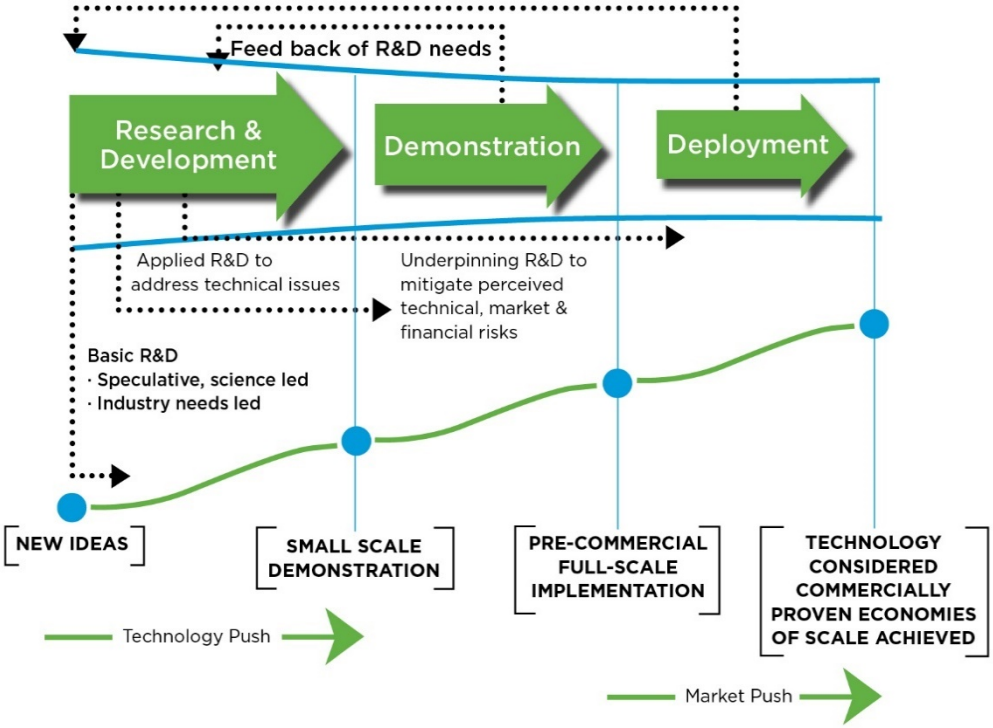
The vision of the Program Administrators is to increase overall program awareness, customer and vendor engagement and participation to enable businesses within the Commonwealth to be more sustainable and stable, thus improving regional competitiveness.

This Plan positions Program Administrators for the future employing strategies that keep customers at the center of program design and evolution while maintaining their commitment to supporting all customers. The Program Administrators will undertake additional targeting and support to populations identified by the Energy Efficiency Advisory Council as *hard to reach* including small businesses and municipal customers. The innovations in this Plan include new demand reduction efforts that will have an impact on peak demand and help winter reliability while strongly supporting the Commonwealth's greenhouse gas reduction goals. The Plan also includes an increasing emphasis on training as well as customer and business partner support services that will enhance the culture of efficiency that exists in Massachusetts and support transformations necessary to ensure energy efficiency remains the bedrock of a robust Massachusetts clean energy economy.

Leveraging Our Strengths – Innovation Framework

The Massachusetts Program Administrators have been in the unique position of leading the nation on program design and evolution. There is a continuous engagement with efficiency programs across the country to find novel approaches and enhancements while recognizing limitations based on regulatory differences across jurisdictions. Program Administrators have leveraged their position as leaders and the unique structure of having multiple Administrators to actively use Massachusetts as an innovation laboratory. With a concentration of expertise in Massachusetts Program Administrator implementation teams and the vendor and allied contractor community, there is a constant feedback loop - seeking and offering enhancements and innovations. Ideas whether generated in-house, in collaboration with other states, or via discussions with vendors and distributors or stakeholders, are vetted and broader research is conducted to determine likely efficacy. Additionally, independent evaluations, industry best practices review and research into programs throughout the country serve to inform the Program Administrators in this early stage of the innovation process. As an idea evolves it is translated into an application or design that can be implemented in the field. These early design forms are often

tested by individual Program Administrators or a subset of the larger group. Often simultaneous trials by different Program Administrators allow for testing of modest variations in the concept execution. This trial stage maximizes learning while minimizing disruption and confusion on the part of our customers, supporting vendors and contractors regarding the statewide core offerings. As trials run learning and refinements take place until the innovation has evolved to a clear best practice that can be moved to common deployment. Program Administrators must ensure that the enhancement or innovation can scale to full deployment and be delivered cost effectively, protecting and maximizing rate payer investments. Once an innovation is fully deployed at scale as a core element of the statewide programs, there is a process of continuous review, evaluation, and improvement.



Based on Non-Linear Innovation Framework (Energy Research Partnership, 2007)

Program improvements rarely happen quickly, and successful offerings must go through iterations before reaching performance levels that match the potential opportunity. These program improvements tend to follow a thoughtful process to research, test, design and then deliver using existing or completely new energy efficiency program delivery methods. The evolution of innovations that have taken place over time include delivery models for small businesses that leverage or solve customer challenges, direct multi-year customer partnerships ("MOUs"), application of proven approaches into new customer subsets (such as taking the MOU approach pioneered for use with large customers and applying to New Construction in the *Whole Building Solution*) and incorporating technological improvements.

Strategic Evolution from Technology Centric to Customer Centric

As the programs have matured, the need to drive comprehensive, system-based savings has increased. The Program Administrators' approach to lighting is a prime example of the evolution over time from simple equipment, in this case bulb for bulb replacement (incandescent to CFLs to LEDs) to integrated, dynamic control offerings available through multiple pathways. Capitalizing on the existing lighting go-to-market infrastructure, the expansion of the Upstream-delivery model equally demonstrates the Program Administrators' drive towards beneficial partnerships that results in ever-increasing participation volumes while supporting the growth of local businesses and the economy.

The Program Administrators increasingly look to streamline customers' entry, increase customer engagement and modify programs to maximize customer value and ultimately transform markets. Program design and delivery improvements seek to address customer barriers and maximize engagement opportunities with the goal of successful acceptance and adoption of high efficiency technologies and transformation of the market. There is increasing evidence of success in driving customer adoption of energy efficiency. This market transformation raises the baseline against which savings are measured, which in turn leads to reductions in claimable savings for the Program Administrator efficiency efforts.

Program Administrators are increasingly focused on ways to drive increased customer engagement and marketplace innovations to influence and ensure maximally efficient outcomes and less on singular technologies. While the need to continue promoting individual measures is an important element of achieving savings, in many ways the complexity of designing and delivering programs as markets transform requires innovation focused on integrating technology, advanced data, controls and operations into a comprehensive systems-based offering to customers.

Streamlined Programs

The C&I programs are being reorganized and simplified for the 2019-2021 plan period. All layers of detail remain. The Program Administrators will continue to be able to provide the same level of detail on participation as in previous terms, such as through the small business turnkey pathway.

There are two overarching programs corresponding to the types of building efficiency opportunities found in the C&I sector: New Buildings and Major Renovations, and Existing Buildings. The program initiatives have been reconfigured to reflect the way customers identify with and access energy efficiency services. The model respects the customer's role as the primary partner with the Program Administrators in pursuing energy efficiency and active demand-reduction strategies.

The Program Administrators work with a broad base of trade allies to offer every participating customer a compelling value proposition that is easily understood, that meets the customer's business needs and objectives, and that can be implemented in a streamlined manner. Organizing the portfolio this way ensures that Program Administrators can focus on efficient paths to the deepest savings for each customer, addressing each customer's immediate circumstances

while building a long-term relationship that allows the Program Administrators to continue to help customers harvest energy efficiency and active demand reduction opportunities as their businesses, technology solutions, and energy markets evolve.

The C&I sector is inherently complex, including many types and sizes of customers, buildings, business types, and ownership structures. Unlike the residential sector, where buildings have greater homogeneity, commercial buildings often host multiple uses (i.e., manufacturing, offices, storage, parking, food service, laboratories), and some have multiple uses housed in the same structure. Commercial buildings also have opportunities across the full spectrum of end uses (HVAC, lighting, domestic hot water, process), and customers can operate in existing buildings while expanding and constructing or renovating new ones. The more open structure of this Plan helps to clarify the main delivery strategies, while recognizing that Program Administrators can work simultaneously with customers across multiple initiatives and savings activities.

For simplicity, program pathways and delivery channels such as the managed account approach and segment-targeted delivery have been explained under the Existing Buildings Retrofit initiative, but these structures also support and inform delivery to existing customers engaging in New Construction. Similarly, the New and Replacement Equipment Initiative has been placed under the Existing Building Program, as most new and replacement equipment is installed in existing buildings, but this initiative supports and informs delivery of new equipment being deployed in the new construction market, albeit to a smaller extent, because new buildings represent a small fraction of all buildings in Massachusetts. A strength of the Program Administrators' implementation is minimizing the silo effect between programs and initiatives, which ensures efficient interaction with our market partners as we serve C&I customers.

Program Design Highlights

This plan maintains the Program Administrators' leadership in energy efficiency program design and delivery by continuing to optimize programs and offerings, increasing the clarity and consistency of offers while expanding and further tailoring solutions for customers. The plan also includes an increasing emphasis on training and customer support services to continue to enhance the culture of efficiency that exists in Massachusetts.

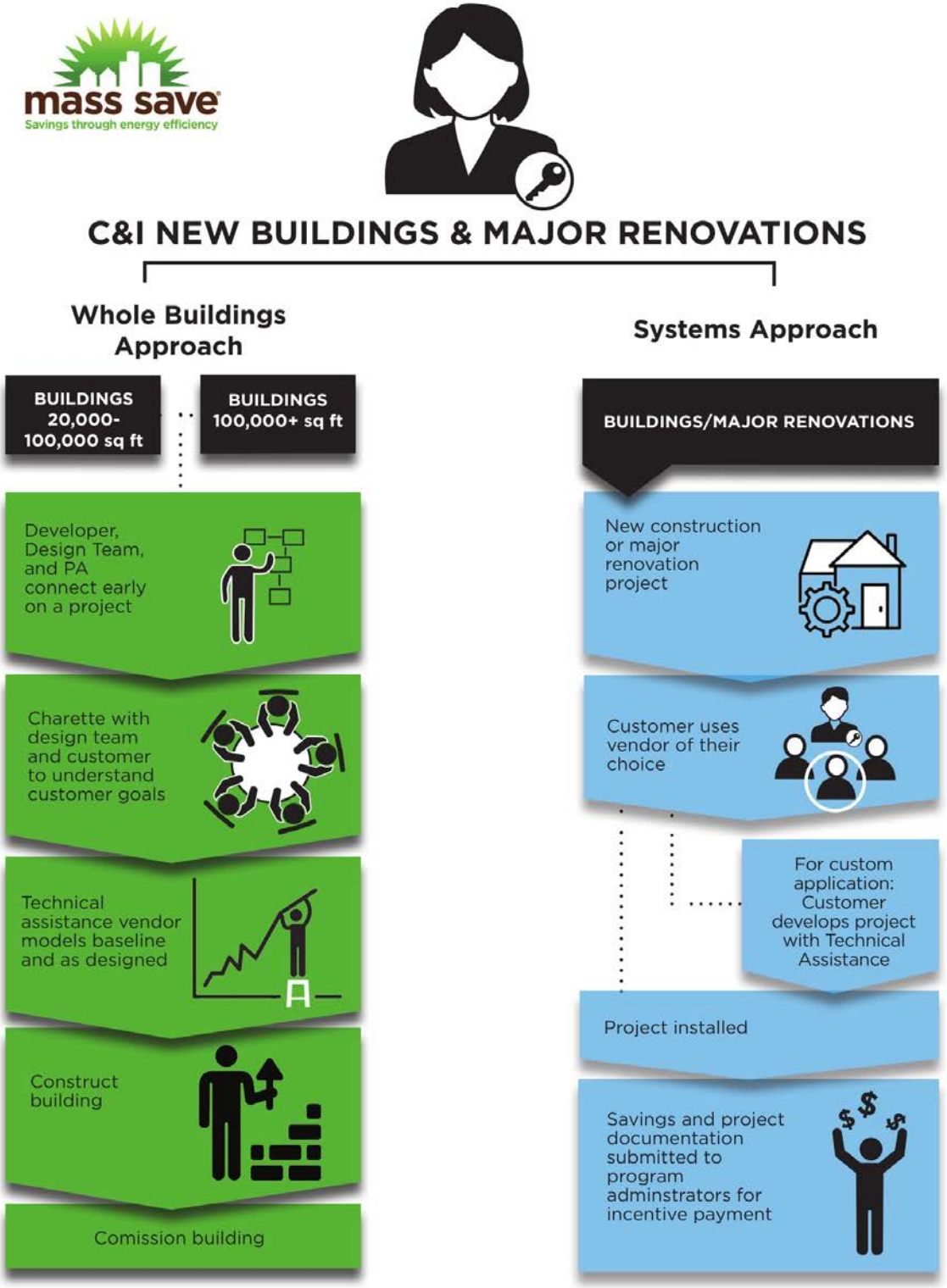
The singular transformative technologies that were the initial foundation of efficiency programming are becoming increasingly rare. As a result, Program Administrators are focused on developing more innovative and creative methods to drive increased customer engagement and market interventions. Together these will work synergistically to maximize availability, awareness, adoption and installation of the broadest and most impactful array of energy savings measures possible by the nearly 200,000 C&I customers in the Commonwealth.

The C&I programs have been remarkably successful in engaging customers directly, as well as intervening strategically with manufacturers and distributors to increase the availability of high-efficiency technologies. The Program Administrators have worked with designers, engineers, and code officials to increase the efficiency of commercial buildings to deliver cost-effective and cost-efficient energy savings for Massachusetts businesses. The programs' success has also resulted in ever-increasing baselines that the Program Administrators offerings must continually

exceed in order to harvest additional incremental efficiency savings. In the face of these rising baselines and more limited opportunities to secure savings from the increasing efficiency of industry standard equipment, Program Administrators have designed a plan that sets the foundation for a renewed and aggressive drive for energy efficiency in the coming decade. It is based on a customer-first focus centered on two primary strategic imperatives – to serve all customers by expanding our reach and depth of engagement with our customers, and pivoting programs to put our customers in position for a rapidly changing energy marketplace.

Strategic Enhancements and Innovations	
Pivoting to the Future	Serving All Customers
Enhanced Technical Assistance and Design Support for Whole Building New Construction	Small Business Enhancements
New Passive House Offer and Market Development Strategy	Expanding Upstream Offerings
Addition of an Active Demand Reduction Initiative	Customized Services to Franchise Businesses
Investigating and Testing New Approaches to Whole-Building Projects	Expanded Resource Offer within the Industrial and Process Segment-targeted approach
Expanded Support for the Development of Enhanced Energy Codes and Product Standards at the State and National levels.	Expedited Paths to HVAC Optimization including Operations & Maintenance ("O&M") Savings and Retro-Commissioning ("RCx")
Expanded Advanced Systems Training for HVAC and Lighting controls.	Testing Strategic Energy Management Cohort Approach
Implementation of Mass Save Application Portal ("MAP")	
Increased leveraging of training and workforce development to transition to an era of integration of energy efficiency strategies, smart technologies and energy using equipment.	

C&I New Buildings Program



1. C&I New Buildings & Major Renovations Initiative

Overview and Objectives

The goal of the New Buildings and Major Renovations initiative is to capture energy saving opportunities in new commercial, industrial, institutional, and municipal construction projects. These projects include ground-up new construction of whole buildings or additions, major renovations that trigger the energy code, or substantial alterations in connection with events like tenant or space-use changes. The initiative is the Program Administrators' primary vehicle for leading the Massachusetts construction industry toward higher-performing buildings, including developer attainment of LEED, Energy Star, Zero-Net Energy Ready, and Passive House certifications for commercial buildings.

The Program Administrators' vision is to empower building developers, design teams, and end-use customers to create buildings that deliver exceptional performance and have the most efficient energy systems, lowered operating costs, and work environments that support happier and healthier occupants and higher productivity for the Commonwealth's businesses.

The initiative targets property owners and managers, developers, architects, and engineers who are involved in the initial stages of either new construction or major renovation projects. Through this initiative Program Administrators also influence the market conditions by promoting continuous improvement in energy codes and standards (as well as comliance) to move markets to greater efficiency. This is done through targeted training of market participants on exceeding minimim codes and standards and working to protmote improvements to statewide energy codes and appliance standards.

Strategic Enhancements and Major Innovations

- ✓ **Enhanced Technical Assistance and Design Support for New Construction.**
- ✓ **New Passive House Offer and Market Development Strategy**
- ✓ **Investigating and Testing New Approaches to Whole-Building Projects**
- ✓ **Expanded Support for the Development of Enhanced Energy Codes and Product Standards at the State and National levels**

Initiative Design

The New Buildings and Major Renovations initiative offers developers of new buildings and owners conducting significant renovations (such as gut rehabs) or expanding their existing buildings a suite of efficiency services and incentives tailored to their unique ownership objectives and investment criteria. The initiative is designed to add value regardless of where a building is on the continuum from planning to design to construction, and without impeding the design/build schedule.

The greatest opportunity to secure deep cost-effective energy savings exists at the earliest stage of new construction design, therefore Program Administrators aggressively seek to recruit owners and designers at the earliest stage of project development, typically before schematic

design. This requires multiple strategies, because early stages of development take place largely out of the public eye years in advance of the first obvious signs of site work. The Program Administrators' use multiple industry sources of information, such as networks of architects and engineers, construction lead services, industry trade groups, and strong relationships with existing customers to gain market intelligence. This allows Program Administrator representatives to engage with customers as early as possible in their process and influence the fundamental design decisions that most impact lifecycle energy use.

Whole Building Solution

The Program Administrators have created an enhanced and optimized integrated design path to engage new construction projects at the earliest stages of development. The refined whole building path is an evolution of the C&I New construction program. Resulting improvements are based on responding to the market dynamics of increasingly stringent building code and equipment standards and years of successful market development by the Program Administrators, which has resulted standard adoption of higher efficiency options by Massachusetts customers as standard, thereby elevating Massachusetts' baselines. The path has been refined based on the strong two-way communication Program Administrators have built with our customers and design teams, including architects and engineers. Program Administrators have worked collaboratively across geographies and delivery experiences to emphasize the best practices, create a consistent offer and customer experience, and ensure that all customers - no matter size or geography - are benefiting from the cumulative expertise gained by the Program Administrator and their partners over the years.

The offer provides a clear, consistent, and transparent approach to the design and development community, outlined in two standard packages:

- ✓ Small Buildings Whole Building Solution for all new construction projects between 20,000 and 100,000 square feet; and
- ✓ Large Buildings Whole Building Solution for all new construction projects greater than 100,000 square feet.

Both the Small and Large Building Solution paths provide a consistent set of technical assistance support and customer and design team incentives structure statewide. Both require customers and their designers to review and sign a Memorandum of Understanding, which clearly articulates the program offering, but more critically ***creates mutual commitments among the owners, designers, and Program Administrators to engage in the integrated design process***. This commitment to an integrated design process is essential to the Programs Administrators' strategy to motivate owners and design teams to pivot to adopt the high-performance building techniques and technologies that allow more net zero and Passive House and other highest-performing buildings.

Both the Small and Large Buildings Whole Building Solutions have incentive structures to

- ✓ reward owners and designers,
- ✓ provide support for design charrettes, and
- ✓ connect customers with subsidized technical and design assistance.

Each Solution also requires a minimum beyond-code energy performance and has a performance-based incentive structure to push higher levels of achievement. The Small Building path has additional flexibility for customers to rely on the Program Administrator technical teams for energy modeling. It also offers a more streamlined design exploration commensurate with the potential savings opportunities, and design/engineering investment limits typical of smaller projects. These additional enhancements in the Small Buildings path are aimed at supporting smaller customers and providing the highest quality early design investments that allow for high performance outcomes. This exemplifies the Program Administrators' overarching strategy to offer all our customers more tailored services that meet their unique circumstances and motivate deeper energy savings.

The development of the statewide MOUs promotes the consistency of the offering statewide and strives towards consistent policies across all Program Administrators for reviewing and approving projects.

Strategic Enhancement - Technical Assistance and Design Support

When Program Administrators can engage with design teams in the early concept phase of projects, they can provide comprehensive project review, design assistance, guide scenario modeling, and support for whole-building equipment specification. Program Administrators partner with a team of energy design experts to provide these comprehensive support services. Building orientation and site considerations, envelope improvements, motors and drives, HVAC equipment and system design, lighting design and controls, and equipment selection can all be considered.

Even when a customer's interests are focused on single systems like lighting, early engagement with designers and engineers is still highly encouraged. In these instances, the Program Administrators provide support through the recently expanded Lighting Design Initiative ("LDI") in order to ensure deeper energy savings opportunities are considered and optimized. With the considerable advancement of lighting technology and controls in recent years, additional opportunities beyond daylight harvesting and occupancy controls are now available to provide even greater efficiency of LED lighting systems. Advanced lighting controls are an area of focus in this Plan. Specifically, the Program Administrators have included a number of education and training approaches, in collaboration with manufacturers, distributors, lighting designers, and installers/contractors to promote proper specification, installation and operation of modern lighting systems to maximum energy savings.

Influencing these early design decisions can fundamentally shape the energy costs of a building for its entire lifecycle. For many participants, the greatest value of the New Buildings and Major Renovations initiative is the access to expert, unbiased technical assistance provided by

Program Administrators and the network of technical experts that is made available through the program.

The intensive design collaboration with owners, designers, engineers and contractors provided by new buildings engagement is a central mechanism for Program Administrators to introduce and promote adoption of cutting-edge equipment and integrated solutions (i.e., systems design, equipment and controls) to the Massachusetts new construction market. Program Administrators are proactive about standardizing, streamlining the requirements and promoting training for customers, designers, engineers and building operators to complement the installation of these advanced systems. The trainings support optimizing and right-sizing of systems and provide critical tools for maximizing realized savings through understanding of proper system operation and management. These trainings will also help influence the types of operator behavior change required to ensure buildings operate as designed once completed and occupied.

Innovation - Passive House for Multi-family New Construction Offer

Program Administrators are excited to be launching an innovative forward-looking Passive House offer within the C&I New Construction Initiative using the Whole Building Solution approach in coordination with the Residential New Construction team. In the prior Plan the modeling subsidy, design team incentives, and charrette stipends that were include in the Whole Buildings approach tended to be utilized by the largest multifamily projects (over 10 stories or 100,000 sq ft). The Passive House for Multi-family New Construction offer will give this level of support to all Passive House projects enrolling with our multi-family High-Rise and Low-Rise pathways. Because achievement of Passive House certification requires attention at the earliest stages of project conception, Program Administrators have an aligned outreach and marketing, and workforce development strategy (further described in the overview and workforce development sections). The outreach and training are designed to result in more design teams and owners coming into the Whole Building Solutions path with a commitment to Passive House certification. In addition to all the support offered through the Whole Buildings Solutions path, the Passive House offer provides additional support and incentives including:

- an early modeling subsidy for owners,
- support to design teams for sustainability charette in either the schematic design (“SD”) or design development (“DD”) design phases,
- certification incentives for owners, and
- $/kWh and $/therm performance incentives for both owners and design teams.

Passive House Incentives		
Incentives	Recipient	Details
Modeling Subsidy	Owner	Cost-share of Warme Und Feuchte Instationar or Passive House Planning Package modeling costs or early feasibility study
Design Team Incentive	Architect, Design Team	$/kWh and $/therm incentives for projects achieving precertification and certification (if applicable)
Design Charrette	Architect, Design Team	Sustainability charrette incentive in either Programming and Schematic or Design Development design phases, directed to design team lead
Certification Subsidy	Owner	Adder per multi-family unit for achieving PHIUS or PHI certification
Performance Incentive*	Owner	$/kWh and $/therm incentives for savings where projects are performing more efficient than the User Defined Reference Home for the residential portion and Mass Save baseline for the commercial spaces.

*The PAs are actively working to include infiltration incentives for High Rise buildings to better quantify performance savings. The PAs and DOER are committed to changing the process by which savings are claimed to be a more whole building performance based approach for the Passive House offer. The PAs and DOER will work expeditiously with EM&V to pursue this change using Passive House certification modeling tools to quantify savings.

The Program Administrators will support various certifications including the Passive House Institute US ("PHIUS") and Passive House Institute ("PHI") certifications. The Program Administrators, as part of the aligned workforce development effort, will be offering training and subsidized certification to develop the workforce needed to achieve certified buildings including offering Certified Passive House Consultant ("CPHC"), Certified Passive House Designer/Consultant, Certified Passive House Builder, Certified Passive House Tradesperson ("CPHT-E", "CPHT-MBS"), Rater, and Verifiers training and certification, with a small cost share from participants. Program Administrators have a goal of doubling the number of trained and certified Passive House Professionals within Massachusetts, resulting in 95 additional Passive House professionals over the next three years. This will include adding approximately 10 Verifiers and Raters who are critical to the certification process.

Innovation - Investigating and Testing New Approaches to Whole Building Projects

The traditional new construction framework, which focused on incentivizing energy efficiency measures, will become increasingly challenging to support as available incremental savings decline, driven by code or industry standard practice progress. The shift during this three-year plan cycle to a focus on integrated design will be complemented by an investigation and testing of more far-reaching design innovations in anticipation of continued market evolution. The Program Administrators will explore approaches to capture whole building efficiency improvements that include:

- ✓ Engaging with design teams early to encourage the designers and customers to set energy use intensity ("EUI") targets that can lead to more Zero-Net Energy Ready or Passive House criteria projects.
- ✓ Considering performance-based incentives for new construction based on actual-versus-modeled building performance while balancing the capital needs of the construction cycle.

As each successive energy code becomes increasingly stringent, the claimable savings for Program Administrators' New Construction offerings grows increasing thin, necessitating new and creative approaches to driving deeper savings, while still supporting code improvements. While driving energy efficiency above code continues to be an important effort given that the Program Administrators have only one chance to avoid missing an opportunity to influence energy efficiency construction practices, it will become increasingly difficult to capture a building's full potential with an equipment-focused delivery model. In recognition of this fact, over the next three years the Program Administrators will be investigating and testing an outcome-based approach to whole building projects. The Program Administrators will test this approach with a select group of projects (approximately 6 across National Grid and Eversource territories) while the standard program remains in place for the majority of projects. These initial projects will provide a base of understanding that inform whether the approach warrants deployment more broadly. Best practices and winning strategies from a larger set of demonstrations over this plan cycle will form the basis of the program design in the next plan cycle (2022-2024) of the Whole Buildings Solutions delivery model.

The new approach involves collaborating with customers to establish performance goals for their new construction project (e.g., Energy Use Intensity or kBtu/sf/yr goals) prior to the commencement of design. A design team, once selected by the developer, would proceed with the EUI target in mind from day one. The approach provides additional technical assistance throughout design to support teams in meeting these performance targets. Program Administrators will also work with customers to establish a measurement and verification ("M&V") plan so that actual building performance is measured and checked against the performance goals. With this approach, design teams must find creative ways to achieve energy targets and prove that the goals were met post commissioning.

Program Administrators will investigate tying incentives to EUI reductions and actual measured outcomes after occupancy. Because it will be "building-occupied" energy consumption that is measured, designers will be motivated to examine loads that they may have ignored – such as plug loads and plug load management.

There are many challenges to setting EUI targets and establishing EUI baselines for buildings. EUI target setting will be unique to each building. Measurement and verification standards are still evolving. The entire concept is new to developers, designers, and owners alike. Over the next three-year period the Program Administrators will explore ways to test this concept and to help bring the market along to an understanding of its benefits, rewards, and challenges, as it represents a fundamentally different way of designing buildings and measuring building performance.

Systems and Equipment Solutions

Once a new construction or major renovation project is beyond the design development or construction document phase, a more prescriptive approach to individual systems, or a custom approach to discrete building systems, can still capture considerable energy savings, so there should be no opportunity lost. This path is also the primary mechanism for serving new-building and major renovation projects under 20,000 square feet, where a more intensive design process may hold less potential to uncover additional savings or performance benefits while at the same time increasing design costs for developers. Medium and large buildings can also use this system and equipment-solutions approach when buildings are undergoing equipment or lighting replacement and the planned improvements do not affect the building envelope.

There is substantial overlap between the C&I New and Replacement Equipment Initiative found under the C&I Existing Building programs. The Program Administrators use many cross-cutting strategies to ensure the highest efficiency technologies and the associated best installation and operations strategies are available to our customers regardless of which entry point customers have taken into efficiency offers.

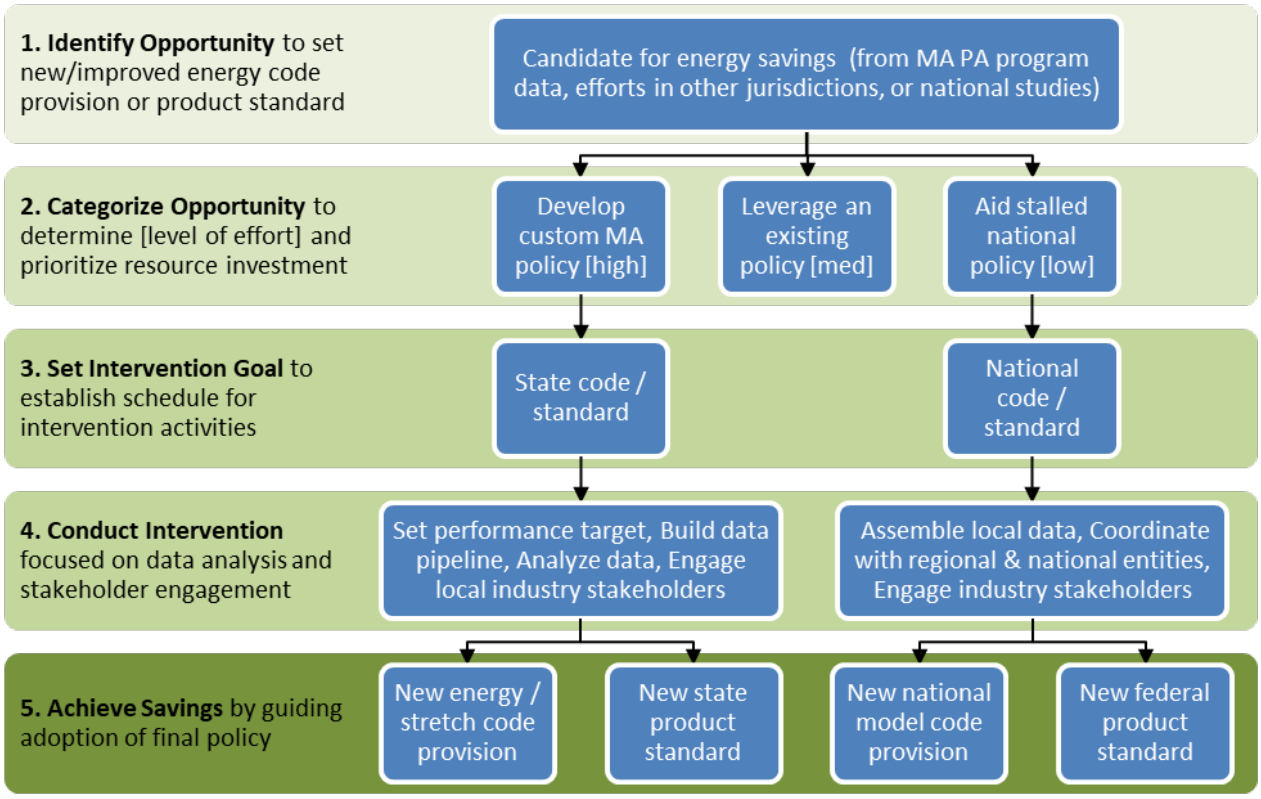
Codes & Standards

The Program Administrators will continue to focus on improving compliance with the current energy code for both new construction and renovation projects through education, technical assistance, stakeholder engagement, and resource development and delivery. The Program Administrators will also expand this effort to advance the adoption of progressively more efficient energy codes, including stretch codes, and efficiency standards for appliances and equipment.

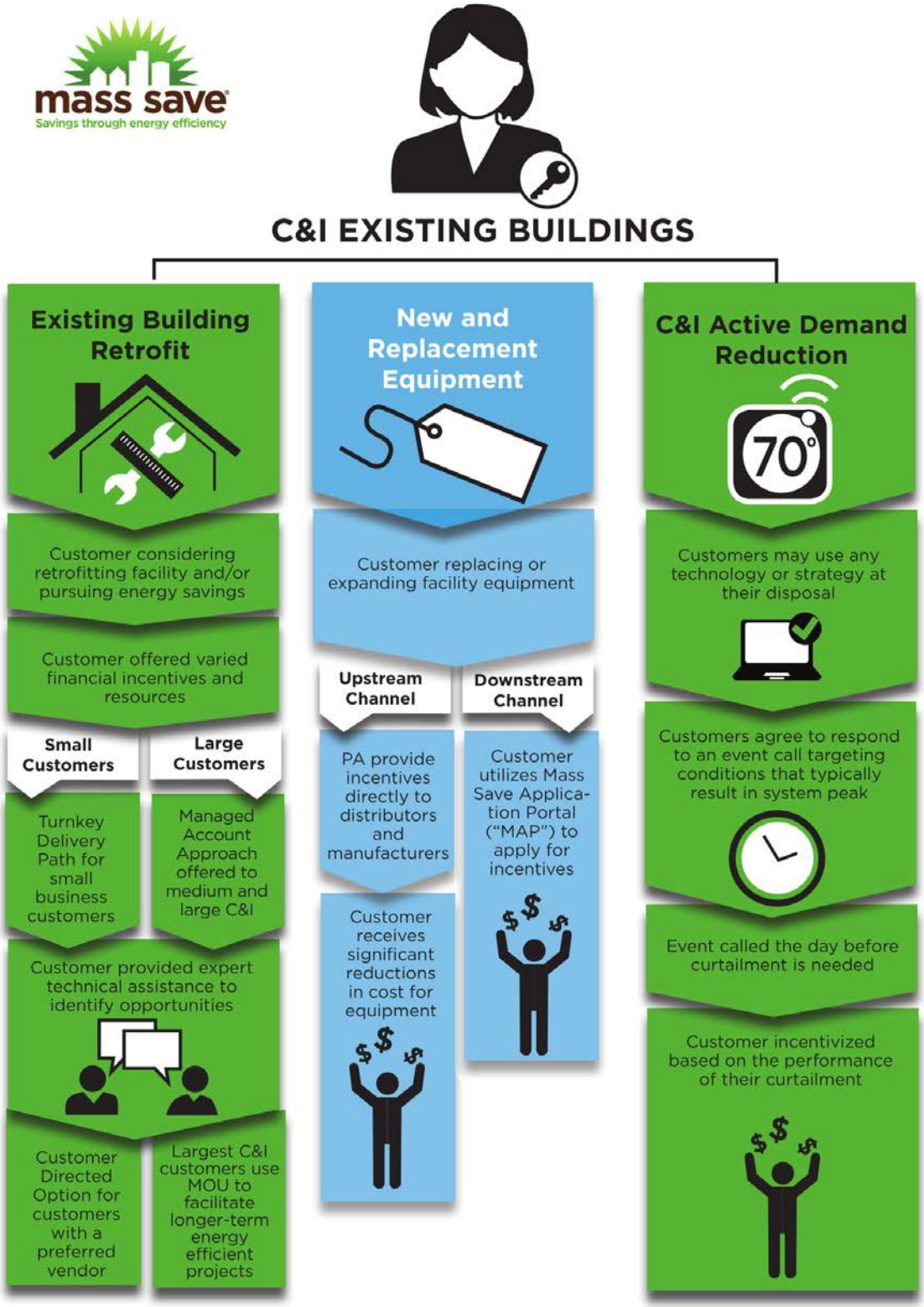
Innovation – Supporting Development of *State and National Energy Codes and Equipment Standards*

The Program Administrators will research and support the development of enhanced energy codes and product standards at the state and national levels. The Program Administrators will implement a formulaic, multi-year approach based on information collection, data analysis, and stakeholder engagement, described in the programs overview as a cross cutting effort encompassing both commercial and residential programs. Program Administrators expect to claim savings for this initiative starting in 2021 based on efforts already underway to provide technical assistance and research in order to: (1) support improvement of the efficiency of the statewide energy code during the Commonwealth's current building code update process; and (2) support the adoption of product efficiency standards during the Commonwealth's forthcoming legislative session. The expansion

of the Program Administrators' codes work to include equipment standards and to work both at the state and nation levelis a significant element of the Programs Administrators' overarching strategy to proactively move markets to ever high levels of energy efficiency and to continue to build a culture that moves the Commonwealth forward on a path of maximizing clean energy from energy efficiency.



C&I Existing Buildings Program



2. C&I Existing Building Retrofit Initiative

Overview and Objectives

The Existing Buildings Retrofit initiative is available to all non-residential customers and supports efficiency and demand-reduction opportunities for all types of commercial, industrial, institutional, and municipal buildings and operations. The initiative works with customers to pursuing energy and demand-reduction measures and strategies to optimize their operations, manage their energy and capacity expenses, and improve their workplaces.

The initiative promotes a menu of incentives and technical services to encourage building owners to replace inefficient equipment with more efficient options and to optimize systems and processes to reduce energy consumption and demand. The goal is to give customers confidence in estimates of project savings, and equipment reliability and performance to justify investments, and then to support the upgrades as simply and seamlessly as possible.

The Program Administrators have recently adopted innovations and enhancements that allow Program Administrators to offer a suite of aligned services to non-residential customers, including training for building operators, to ensure that equipment and facilities operate as designed, and that low-cost/no-cost opportunities for optimized building operations that result in energy and electrical demand savings are fully exploited.

The Program Administrators further tailor their offers and marketing to respond to the unique barriers diverse customers face. This includes providing pathways that respond to customer size, geography, the needs of particular industry segments, and specific energy end uses (e.g., lighting, HVAC, Combined Heat and Power ("CHP")). The Program Administrators are testing ways to leverage these end-use strategies alongside the segment-targeted approach discussed below within the *Tailored Approaches for Segments*. For example, Program Administrators are working with key customer partners in the franchise restaurant segment to explore the impacts, benefits and challenges to implement micro-CHP systems.

Strategic Enhancements and Major Innovations for the 2019-2021 Plan

- ✓ **Expedited Paths to HVAC Optimization including Operations & Maintenance ("O&M") Savings and Retro-Commissioning ("RCx")**
- ✓ **Expanded Advanced Systems Training**
- ✓ **Expanded Resource offer within the Industrial and Process segment-targeted approach**
- ✓ **Customized Services to Franchise Businesses**
- ✓ **Small Business Enhancements**
- ✓ **Strategic Energy Management Cohort Demonstration**

Initiative Design

The Existing Building Retrofit initiative offers prescriptive incentives for efficient electric and gas technologies, and custom incentives when a unique characteristic of the customer, site, or process requires a custom approach whereby savings estimates are calculated. All cost-effective opportunities to save gas and electric energy and demand are considered.

Prescriptive incentives are offered for measures that provide predictable energy savings, which exceed industry standard practice and result in cost-effective savings over the life of the measure, in all applications where they replace a similar technology. Incentives are available for a long list of electric and gas technologies, including lighting equipment and controls, HVAC controls, motors and variable frequency drives, spray valves, and steam traps. Prescriptive incentives often serve as the customer's initial exposure to the Program Administrators' efficiency program and may lead to more complex custom projects. Prescriptive measures have achieved predictable savings across a wide universe of applications and can therefore be offered to customers through a simplified application and approval process.

As a mature efficiency delivery approach with established and trusted customer relationships, the Existing Building Retrofit initiative is seeing an increase in the number of custom projects. Many larger customers are more sophisticated in their understanding of their facilities' energy use and the potential for additional savings. The Program Administrators have matched these elevated expectations by encouraging customers to engage in a thoughtful series of building upgrades.

To identify and quantify custom opportunities, the Program Administrators provide customers with access to expert technical assistance, using both their own technical staff, preferred engineering vendors (independent energy advisors), and subject-matter experts drawn from a pool of private-sector engineering consultants that meet the Program Administrators' criteria for expertise and experience. To move customers to action once opportunities have been identified, the Program Administrators offer various financial incentives and resources that are calibrated to match customer investment criteria and reduce barriers to adoption, while maintaining cost-effectiveness and minimizing Program Administrator costs of acquisition.

Delivery Pathways for Existing Buildings

Serving Medium and Large Customers - Managed Account Approach

The managed account approach is focused on learning the customers' unique needs and opportunities and connecting customers to the resources and offerings best suited to their circumstances. All Program Administrators offer managed account services for some sub-set of larger C&I customers. Most medium and large customers have access to Program Administrator representatives. Smaller customers have access to turnkey, upstream and downstream prescriptive pathways which offer more tailored simplified pathways targeted to provide these customers a smooth onramp to the wide variety of Program Administrator offerings.

Program Administrators have built up internal staff with direct experience or engaged vendors with expertise in the manufacturing and industrial space, commercial real estate, healthcare, hospitality, grocery and other distinct business segments. Program Administrators have continued to learn the language of their customers, improving the experience for customers while deepening our ability to work with facility managers across the spectrum of sectors and segments to identify, scope, and specify projects.

Strategic Enhancement - Expedited Paths to HVAC Optimization including Operations & Maintenance Savings and Retro-Commissioning

The Program Administrators have targeted HVAC Optimization, along with other operations-based opportunities as a key area to achieve improved savings. A pay-for-performance pathway has, historically, been used as a primary pathway for customers pursuing retro-commissioning and monitoring-based commissioning ("MBCx"). The process allows customers to hire an appropriate technical resource and then identify and implement energy efficiency measures. Once appropriate documentation is submitted, Program Administrators verify the savings and pay an incentive based on the demonstrated performance. As approaches to retro-commissioning, including monitoring-based commissioning, have evolved, and as Program Administrators have been able to identify and quantify savings from specific operations and maintenance ("O&M") interventions, Program Administrators see an opportunity to provide more tailored guidance and an expedited pathway for customers to pursue these savings.

The O&M offering will provide a simplified approach to implementing common low-cost/no-cost measures or actions with predictable savings that can be captured through a prescriptive incentive. Program Administrators are actively reviewing the property-management and equipment-tuning strategies that have been deployed through the pay-for-performance path, in MOU plans, and through broader research, to identify a package of opportunities that customers can implement quickly and easily to achieve consistent verifiable savings. By leveraging this historic data, Program Administrators can create a streamlined path that dramatically reduces documentation requirements and shortens the time it takes to reward customers with their earned incentive. This eliminates two major barriers to participation while also improving the customer experience.

For customers interested in more resource-intensive, longer-term approaches to pursuing deeper savings, including monitoring-based or continuous-commissioning platforms, Program Administrators are investigating design options that can offer more up-front technical guidance and predictable incentives to encourage customers to choose technical resources and adopt platforms that allow for monitoring or continuous commissioning. By developing more predictable incentive structures with earlier or periodic payment schedules, this offer can encourage customers to commit to these systems by giving them greater confidence that they will realize a return on their investment if they implement the identified energy saving measures.

Customers will continue to have the option to participate in the current pay-for-performance pathway. The redesign work has begun and is expected to continue into the 2019-2021 Plan cycle, with estimated implementation of the O&M prescriptive pathway and the streamlined deeper retro-commissioning offering in the first half of 2019.

Memoranda of Understanding ("MOU")

For the very largest customers, including large manufacturers, university campuses, and large healthcare systems, the Program Administrators encourage the use of multiyear MOUs to facilitate longer-term energy efficiency projects that achieve greater depth and comprehensiveness and align with customer long-term goals and vision. The MOU identifies shared goals, defines the relationship between the customer and the Program Administrators, and outlines a plan to achieve the goals. It may also specify incentive structures. These large customers have human and financial resources and management-planning horizons that allow for this more intensive shared partnership. Often there are larger complex opportunities available in these customers' facilities that offer significant energy and cost savings opportunities. The maturity of the relationships and the multiple projects completed with these larger customers over preceding plan periods means much of the savings potential from these customers facilities may already have been secured. The relationship continues to offer opportunity for pioneering the systems-based approaches and optimization that Program Administrators see as the pivot required to continue to squeeze out additional savings within a pool of ever scarcer savings.

The success of MOUs translates into savings for these large customers. In addition, the creative and innovative approach that is inherent in shared explorations and project development with these large customers provide Program Administrators with insights that can be applied to medium-sized and smaller customers in the same segments whether through the account management pathway or a tailored segment-delivery path. There can even be payoffs for businesses that use the small business pathways as new technologies are proven in the field and are added as prescriptive offerings to turnkey delivery.

Innovation - Strategic Energy Management Cohort Approach

Program Administrators conducted a comprehensive review of Strategic Energy Management ("SEM") approaches in practice in other jurisdictions. SEM was revealed to be an evolving concept with no definable set of consistent program-design elements or method of delivery. While the examined programs did produce real energy savings through a combination of O&M actions and incremental new measures, Program Administrators identified some significant drawbacks to SEM as a program offering:

- ✓ SEM is narrowly applicable to small numbers of very large customers and expensive to deliver, and the costs-per-customer do not effectively scale to other business customers.
- ✓ Evaluation data does not clearly establish that SEM succeeds in instilling a culture of continuing efficient practices when program support ends.
- ✓ Most of the program administrators deploying SEM offerings do not have long histories of engagement with their large and mid-sized customers.

The Program Administrators plan to take lessons learned from this evaluation and implement enhancements that offer opportunities to secure additional savings in the two areas

targeted by SEM offers: O&M and incremental-measure adoption. Program Administrators' O&M enhancements are described above under *Expedited Paths to Capture Operations & Maintenance Savings and Retro-Commissioning.*

The Program Administrators plan to investigate an SEM Cohort approach, where a group of customers work together to adopt a more strategic approach to energy management in their facilities. The Program Administrators' objective in studying a SEM Cohort approach is to test a whether the drawbacks identified above, i.e., inability to scale to medium and smaller customers, and failure to instill a lasting culture of efficiency among participants, can be effectively addressed.

Program Administrators are currently developing an RFP to secure a partner to support delivery of this SEM cohort approach. The SEM cohort approach is expected to conclude in Q4 of 2020, and the results will be reviewed in the context of the critical questions listed above. The design, scale, and timing of future SEM cohort approach will take place in the context of this review and in consultation with customers and other stakeholders.

Serving Small Businesses

The Program Administrators use a suite of approaches to deliver services to small businesses. In addition to the turnkey approach, the Program Administrators work through distributors at a point-of-sale where customers, or contractors doing work for customers, can essentially self-serve. Small business customers are eligible to participate in all Program Administrator retrofit and replace-on-failure offerings for specific measures, as long as the equipment meets the eligibility requirements. Small business energy savings will be advanced by targeting energy efficiency measures that are most prevalent in small business customer facilities, including energy efficient lighting systems, controls, and HVAC systems. Additionally, other energy efficiency measures including, but are not limited to, energy optimization controls and strategies, envelope measures, and other prescriptive and site-specific energy efficiency measures are available for small business customers when they have applicable opportunities.

Small Business customers are also eligible for the tailored approaches offered to specific segments. Maintaining an array of approaches allows the Program Administrators to deliver efficient solutions to the tens of thousands of smaller customers in the Commonwealth, solutions that effectively respond to the customer's unique circumstances and preferred engagement model. Program Administrators regularly review and reflect on what is working and take lessons from one delivery path and apply it to others. This broad approach using turnkey, upstream, and downstream delivery pathways serves thousands of smaller customers, well more than those served through the traditional "small business program", which remains an important delivery pathway that is constantly being improved and expanded over time. The flexibility of approaches serves customer needs efficiently.

Small businesses face significant barriers when considering and implementing energy efficiency measures. Owners often have limited time, focus, and know-how to analyze options, and are averse to even short interruptions of business operations. The small business pathway provides two statewide unified offers: a turnkey delivery model implemented by vendors subcontracted to the Program Administrators, and a Customer Directed Option ("CDO"), which

allows customers to choose their own installation vendor who meet specific criteria for technology and installation. These offers address the barriers small businesses face and maximize their uptake of comprehensive retrofit measures (lighting and controls, HVAC controls, Demand Hot Water Heating controls, weatherization, among others).

Turnkey and Customer Directed Option Pathways for Small Businesses:

Turnkey, sometimes referred to as direct install delivery, is the traditional form of energy efficiency delivery to small business customers. The approach consists of a no-cost assessment, a customer-specific proposal, installation, and recycling or post-installation cleanup for customer-selected measures. The turnkey-delivery path offers electric and gas measures (as applicable) and is intended to help customers navigate efficiency options, mostly retrofit-type measures that improve the operations of their existing buildings in a streamlined manner. The vendors working for the Program Administrators conduct thousands of these projects each year and have done so throughout the long history of this delivery pathway. The activity and savings from this pathway are recorded in the Small Business Core initiative for 2016-2018.

The turnkey small business common offer includes:

- ✓ No-cost energy assessments that can occur while the business maintains operations;
- ✓ A simple-to-understand proposal outlining key opportunities and costs for energy retrofit upgrades;
- ✓ A proposal with recommendations for efficiency measures and the opportunity for direct installation of certain measures and facilitation of professional installation for more complex measures;
- ✓ Incentives covering generally up to 70% of equipment and installation.
- ✓ Financing options and
- ✓ Quality assurance and quality control through randomized on-site project verification.

After the assessment is complete, participants choose which measures to install. The vendors install the measures then invoice the Program Administrators for the incentive amounts. Electric and gas Program Administrators conduct quality control ("QC") checks on a limited number of sites. Although the turnkey model is a statewide small business delivery method, certain service-area characteristics do require customization. Tailored approaches are therefore offered to enhance and customize specific opportunities to customer needs.

Customer Directed Option is a delivery path recently offered to customers and other trade allies not under contract to the Program Administrators to allow customers to choose the installation vendor with which they are most comfortable. This pathway has been welcomed by customers and trade allies and has grown over the past few years. The activity and savings from this pathway are recorded in the Small Business Core initiative for 2016-2018.

The Customer Directed small business common offer includes:

- ✓ A standard participation pathway for measures and incentives typically offered via turnkey vendors for all other interested trade allies;
- ✓ Common specifications of technology, installation, and quality assurance;
- ✓ Incentives (generally covering up to 70% of equipment and installation);
- ✓ Financing options
- ✓ Quality assurance and quality control through randomized on-site project verification.

Main Streets Outreach Approach Targeting Small Businesses

Very small businesses, sometimes referred to as micro-businesses, the classic "main street" businesses such as a small local bakery or hardware store are particularly challenging to reach because energy use is low while effort is generally high. It is imperative to increase the volume of projects to overcome the resource costs of labor, trucks, and other equipment needed to perform the installations. One approach that Program Administrators use is to work collaboratively with cities and towns, through the community and economic development offices, with local chambers of commerce and other local business associations to create multiple touchpoints to encourage these customers to take part in the small business turnkey pathway.

Program Administrators can, with local input, tailor the offering and provide a dedicated team of turnkey implementers. Program Administrators work to include materials that are translated into local languages and may offer special Main Street days or other approaches to meet these small customers effectively and efficiently. By leveraging community connections and tailoring to this micro business market, Program Administrators are able to ensure even the smallest of small business customers are provided a path to energy efficiency savings. The Main Street approach to marketing the turnkey delivery pathway is one of many participation pathways for very small businesses to participate in efficiency offerings.

Strategic Enhancement - Small Business

The Program Administrators conducted a comprehensive review of small business turnkey delivery programs offered by program administrators across North America. The research found two critical elements that improve savings:

- Segmentation in either program design or marketing; and
- Allowing negotiated incentives to help secure more comprehensive projects.

These elements—segmentation and negotiated incentives—are core components of the small business pathways. Program Administrators are focused on continuing to enhance these aspects of the small business turnkey pathway, adding additional tailored segment-specific packages and increasing training and direction for vendors to support comprehensive projects. Currently the restaurant and lodging segments are being targeted for customized offerings.

Based upon the past research and in-field experience, the Program Administrators continue to provide tailored and localized delivery. As discussed earlier, each territory has some demographic differences, and this can be an opportunity for shared learning in answering the unique needs of disparate parts of the state. All of the PAs are planning on increasing marketing efforts to target specific segments within their territories in coordination with their vendors and partnerships with local organizations. For example, Cape Light Compact plans to target seasonal businesses and year-round cottage industries while Liberty Utilities will focus on office spaces and residential style businesses. Berkshire Gas will increase efforts to approach non-profit, religious and municipal buildings, which fit the small business profile while Unitil will utilize partnerships with local business and community groups to increase awareness. National Grid will be revisiting sales skills training with vendors to help them find compelling ways to drive uptake of more comprehensive projects. Eversource is continuing to expand the use of Main Streets approach looking to apply it to "business parks" with multiple small businesses. All of these efforts focus on the key partners in each territory to create familiarity with the offerings and increase participation.

The variety of approaches offer a laboratory for new innovations in delivery, and these can be shared across all Program Administrators through integration into the statewide common offer. This laboratory allows for rapid testing and retooling to the next concept without major disruption to the core common statewide small business offer and pathways. Hard-to-reach customers are a focus for this next three years. For example, Columbia Gas of Massachusetts has created a strategic partnership with a regional chamber of commerce to increase visibility with an eye toward expanding outreach to and participation among Spanish speaking small businesses. Likewise, Eversource is looking to address the split incentives of the tenant-landlord relationship working with landlords, property managers and tenants to approach the market. The actions within this initiative will include: framing the value proposition to tenants around improved environment and productivity, structuring incentives that facilitate passing savings to small business tenants and making strategic engagements with landlords and property managers to bring offerings to tenants. These tests will provide some lessons to improve service as the PAs continue to best address these customers.

Innovation – Statewide Small Business Targeted Marketing and Community Partnership Strategy

At a statewide level, the Program Administrators plan to engage a marketing agency for novel, statewide small business marketing strategy and tactics. The objective will be to expand outreach strategies to target and engage a wider range of small business customers and owners of buildings occupied by small businesses. As a statewide initiative, Program Administrators are also exploring additional trainings and certifications for our turnkey vendors for improving energy audit quality. Program Administrators will continue to coordinate incentives and grants with the Massachusetts Clean Energy Center to support the uptake of comprehensive technologies like solar thermal and heat pump technologies.

The new statewide Community Partnership strategy under development, with the residential sector, will include a stronger connection to local municipal governments whose local economic development and small business connections can be a valuable connection point for

increasing awareness and participation in Program Administrator efficiency offerings. As part of the Municipal Community Partnership strategy Program Administrators are developing an additional regular connection point beyond the municipal connection targeting very small business customers ("micro-businesses") to provide a forum for Program Administrators to share updates to programs as well as simply be available to help these smaller businesses navigate the programs, and for small businesses to share their feedback with Program Administrators including specific issues in program design that may present barriers for these smaller businesses.

Tailored Approaches for Segments

Program Administrators regularly engage in market segmentation, a process of subdividing customers into segments with similar characteristics. This process allows Program Administrators to create segment-tailored marketing, mixes of prescriptive and custom measures, and package them with outreach and delivery that speaks to customer's specific business priorities.

Market segmentation is both an art and a science. Each Program Administrator uses multiple market segmentation strategies as needed in their respective service areas. For instance, Eversource has used a quartile analysis segmentation strategy for years, National Grid was early-to-market with a differentiated technical assistance offering for grocery customers, and Cape Light Compact has deep experience with the lodging market based on their unique geography.

Each Program Administrator follows multiple sub-markets, based on their service area firmographics. A Program Administrator may have as many as 50 or more sub-segments for which they track market intelligence and connect it with customer firmographic data, to provide optimized offerings to customers in their territory. Through their common management and technical committees and EM&V studies, Program Administrators have continuously shared and pooled their learning from their independent market-segmentation strategies. They have created common marketing materials for eight market segments. Program Administrators continue to share intelligence on advances in energy saving technology and systems-design approaches specific to each segment.

Data Centers 	• High energy intensity • Flat load characteristics • Custom, complex supply systems with common end-use loads • High savings potential, challenging engagement due to varied lessee contract structure within each leased area
Grocery 	• Common measures, business model (low margin), and barriers • Can benefit from provision of industry-expert technical assistance • Potential for economies of scale in marketing and delivery • Homogenous and concentrated usage
Hospital 	• Energy intensive • Sensitive to costs, non-energy related drivers heavily impact capital deployment • Scalable to other customers of varying sizes
Hospitality 	• Common measures, business model, and barriers • More gas opportunities relative to other segments
Laboratories 	• Require specialized technical expertise • High savings potential
Manufacturing 	• Typically energy intensive, though energy costs not necessarily a primary driver of cost of goods sold • Heterogeneous, requiring specialized technical expertise • Common implementation barriers, exacerbated with small and medium size manufacturing base

Municipal 	• Have unique budgeting process and require one-on-one attention from the PA • Common barriers
Multi-Family 	• Mixed customer types with differing engagement expectations and decision-making processes
Property Management 	• Common barriers • Lower participation rates

Industrial and Process

The Program Administrators have collaborated and coordinated to create a model of resource offerings that brings high value services to this subset of customers. Not only are the Program Administrators utilizing a uniform model of service, they are coordinating amongst each other in overlapping territories so as to provide a seamless customer experience, a sharing of best practices and to ensure an efficient use of program funds.

The primary challenges for industrial customers fit into a consistent set of themes, which are laid out in the chart below. For individual customers the priority or influence of the barrier or challenge may be higher or lower. In general, as customer size decreases, the challenges are amplified and savings potential per customer may be lower for similar projects. A critical insight gained from these close relationships and experience with the Massachusetts manufacturing market is understanding that information and technical documentation of opportunity and savings are rarely the primary barriers to getting manufacturing customers engaged in energy efficiency projects. The chart also offers the high-level approaches to overcoming these specific barriers that Program administrators regularly employ.

Overcoming Industrial Customer's Barriers		
Challenge	**Barriers**	**Approach to Overcome Barriers**
Customer risk, inertia, and uncertainty.	Businesses whose profitability relies on producing goods are reluctant to interrupt or change established production processes. Regardless of the true level of risk the perceived risk for such customers is very high.	Engaging customer quality control staff early, thorough customer-centric risk assessment and planning around customer production cycles can assist. Downside= even longer project completion times.
Customer focus on business growth, profitability, capital funds use	Growth and increased profitability are the overarching goals of the industrial and manufacturing customers. Depending on where energy costs sits in the operating expense stacking, potential energy savings may not be a primary focus for investment.	PA staff works with the customer over time to translate EE value to a customer's long-term business growth and as necessary works to assist capital planning, facilitating third party financing where appropriate.
	Competitive sources of project funding are a challenge when an EE project is a substantial capital outlay relative to the size (i.e., medium and small manufacturers) or health of a company.	
Limited human resources and time required for effective engagement	The need for highly technical evaluation and project development and personnel who can engage through an energy efficiency project presents considerable challenges to program participation. Customer resources are scarce for managing the implementation of energy efficiency upgrades.	Identifying customers whose resource constraints could put a project at risk and subsequently selectively deploying project management services can keep a project from getting lost.
Complexity and constructability of site-specific EE equipment	Much of the equipment used in industrial facilities is highly specialized with site-specific configuration, requiring custom, comprehensive solutions. The bench of available technical assistance vendors and installation contractors capable of functioning in that space is small relative to HVAC and lighting.	Program Administrators are working directly with vendor business partners to expand staffing, train new employees and have sought additional qualified partners.

Program Administrators offer multiple strategic pathways and targeted offerings to overcome barriers and increase the reach to the smaller-to-medium industrial base. Program Administrators respond to our customers' risk perception and need for greater certainty by making a broader business case for efficiency to our customers including providing information and support that demonstrates not only the cost savings but measurable additional benefits to product

quality, waste reduction and/or equipment reliability. This more expansive approach to engaging with our customers on efficiency upgrades provides customers with the most compelling and accurate case for participation which can greatly reduce their risk and uncertainty barriers. Similarly, Program Administrators provide investment information including return on investment and provide our customers with accessible financing that allows energy efficiency investments to compete favorably amongst our customers' capital investment priorities.

Program Administrators are doubling our efforts to provide education, training and technical assistance support, including engineering support (discussed under *Strategic Enhancement – Industrial and Process Enhanced Resource Offer* above) to alleviate our customers' project management constraints and provide streamlined engagement respectful of customer time limitations. Program Administrators are creating simplified decision paths with full supporting information to support critical customer C-suite and other decision makers' ability to engage effectively and participate in the benefits of Program Administrators energy efficiency offers. Program Administrators are investing in making available a strong bench of technical assistance vendors and installation contractors capable of functioning in the manufacturing space who can deliver site specific configurations and custom solutions.

Municipal

Cities and towns represent a key segment of the C&I market and critical partners in Program Administrator service areas. Cities and towns own and operate a wide array of buildings and infrastructure and have many unique operational aspects. The Program Administrators offer a standardized pathway for municipalities to build long-term relationships with the Program Administrators. All Program Administrators have dedicated points of contact for municipalities and maintain a "continuous engagement approach" with municipal customers and offer a mix of standard prescriptive offerings and the option for custom measure offerings.

Each Program Administrator tailors their implementation strategy to reflect and best serve their unique geographies. Each Program Administrator has dedicated vendors and/or staff to support each municipality with a customized approach, which starts with technical assistance to identify opportunities for efficiency measures and works with the municipality to determine the best path forward. The municipal vendor or staff working with municipalities is familiar with the process for DOER's Green Communities as the designation and can support municipalities in securing these designations. The designations and competitive grants require working with the Program Administrator's efficiency programs as part of the process. Similarly, the Program Administrators collaborate with the Massachusetts Clean Energy Center, which recommends working with the efficiency programs on any project as well.

The Program Administrators have also been actively involved in conversations with the Massachusetts School Building Authority, which recently issued a Project Advisory in April 2018, regarding the school's ability to get incentives for energy efficiency measures without reducing the funding from the MSBA. This clarification of third-party funding is an excellent example of collaboration between school personnel, the building community and the Program Administrators to ensure that the incentive dollars could be used to help improve the building efficiency without harm to the overall project funding.

A small Program Administrator such as Berkshire Gas utilizes a dedicated vendor resource whereas other small Program Administrators such as Cape Light Compact and Liberty Utilities have dedicated Program Managers as the "point" people for the municipalities within their territories. Similarly, Unitil has a Manager of Municipal and Community Services.

Larger Program Administrators utilize teams to accomplish the same goals. Columbia Gas of Massachusetts, Eversource, and National Grid have staff with specific geographic territories to serve as liaisons to the cities, towns, and other municipal entities to provide technical assistance and access to vendors for implementation. Eversource and National Grid also maintain lists of vendors that are pre-approved firms that municipalities can utilize under the M.G.L. Ch. 25A streamlined procurement pathways.

In additional to the Energy Efficiency personnel, many Program Administrators also have staff that work with customer affairs in areas like streetlighting, billing and distribution systems. While the Program Administrators always strive for continuous improvement in their strategic partnerships, there has been a lot of effort by each Program Administrator to understand the municipal bidding, contracting and funding process. As new grants and funding sources are made available to the municipalities, the Program Administrators will continue to work with each of these communities to get a common understanding of the needs of the communities.

Strategic Enhancement – Educational Webinar for Municipalities

Program Administrators are committed to working with Regional Planning Entities to provide a participatory webinar targeted to municipalities that walks through the Program Administrators offerings and clarifies the pathways and resources available to support municipalities working to increase their energy efficiency and participate in Program Administrator offerings.

The Program Administrators work directly with municipalities to address unique barriers and opportunities. The C&I program offerings are the foundation or starting point for most other statewide incentive programs such as the Massachusetts School Building Authority ("MSBA"), The Department of Energy Resources ("DOER"), Green Communities and MassCEC programs. Most of these programs collaborate closely with the Program Administrators to ensure offers are well aligned. Many require or strongly encourage participating municipalities to start with the Program Administrators services. As such, the Program Administrators, through dedicated staff or representatives, are adept at working with stakeholders and state agencies including the Green Communities Division of the Massachusetts Department of Energy Resources and the Massachusetts Department of Environmental Protection. The Program Administrators are also highly familiar with various grants and the funding cycles (such as Town Meeting votes) in each community, and this segmented approach aids in implementation of the projects.

Innovation – Development of Statewide Municipal Outreach Partnership

Program Administrators recognize the unique role municipalities can have in supporting community outreach and are developing a statewide Municipal and Community partnership strategy with municipal partnerships at the heart of the effort. The partnership strategy will provide

statewide opportunities to work directly with municipalities to advance the shared goal of promoting energy efficiency, particularly with harder to serve customers including small businesses.

LED Streetlight Conversion

Program Administrators work with municipalities and other owners of exterior lighting to review costs and savings for applicable streetlights for LED conversions, for both customer-owned and company-owned lighting systems. Each community requires a case-by-case approach based upon the existing lighting ownership structure, project costs, existing lighting and metering configurations and the available technology options.

Many Massachusetts communities are already reaping the many benefits of LED streetlights, having either purchased their streetlights from their electric utility and converted them or simply having them converted with the utility retaining ownership. Nearly 40% of all streetlights statewide, roughly 157,000 of the 410,000 total, have already been converted to LED mainly as a result of larger communities having purchased their streetlights and converted them prior to an LED tariff for utility-owned streetlights being approved by the Department. Since such tariffs have been put in place, mainly in the last one to two years, more and more communities have been requesting conversion of their streetlights. The Program Administrators are confident that by continuing to work closely with these communities, a considerable portion of this additional savings potential can be realized during this Plan term.

The level of municipal interest in streetlight conversion remains very high and shows no sign of abating. At any moment in time, there are roughly 10-20 communities involved in some stage of the conversion process from requesting the inventory of streetlights from their utility, deciding (on their own or with the assistance of a lighting design consultant) which fixtures to be replaced and with what wattages, reviewing the cost proposal from the utility based on their selections, gaining budgetary approval from their city or town, notifying the utility of their final choices and authorizing the conversion, materials being ordered by the utility, and scheduling of implementation. Cape Light Compact, Eversource and Unitil have successfully deployed greater than 50% LED street across their territories. National Grid has greatest remaining conversion potential. In just the National Grid territory, since the Department approved a utility-owned LED tariff at the end of 2016, 27 different communities have formally requested an inventory of their streetlights and of those, 17 have thus far authorized conversion and have been completed or are in progress.

The Program Administrators continue to actively promote streetlight conversions as part of their overall engagement with municipalities regarding energy efficiency opportunities and will continue to do so throughout the course of the 2019-2021 Three Year Plan. During the Plan Term, the Program Administrators will contact each municipality within their respective service territories that have not completed conversions of streetlights and educate the municipality about the Program Administrators' LED conversion offerings. As described earlier in this document, the Program Administrators have a multifaceted approach to serving municipalities and fully expect that the continuation of those efforts will strive to continue the conversion pace or even accelerate it over the next few years.

Multi-Family Properties

Program Administrators will continue to integrate residential and commercial implementation teams to support delivery of services to multi-unit buildings with both residential and commercial meters. The Program Administrators have made significant modifications to how they segment residential multi-unit buildings, fully described in the Residential Coordinated Delivery initiative within the Residential Programs section of this Plan. A major shift is to provide larger multi-unit buildings, such as those with 4 stories or more, or with a centralized heating system, a more customized path that builds on the Project Point of Contact ("PPC") model established during the 2016-2018 Energy Efficiency Plan via the former Multi-Family Retrofit initiative. The PPC will provide property owners an individualized path with custom incentives and savings, using a Pay for Savings incentive structure, to maximize capture of the unique opportunities of larger and mixed-use multi-unit structures, and provide a strong business proposition that makes energy efficiency upgrades an easy decision. Program Administrators will work with larger multi-unit customers who are not ready to implement a whole building upgrade but have an immediate need or desire to install a specific energy savings measure Program Administrator representative will continue to promote more comprehensive savings and work to enroll the customer in the comprehensive whole building process.

Multi-unit buildings may contain building-level systems more traditionally found in commercial facilities, and therefore a number of measures more often found in the C&I Retrofit program will also be available for upgrades in these multi-unit buildings, as appropriate, even if there is no commercial meter. This is a value of having an integrated approach and shared implementation teams working on multi-family energy efficiency implementation. Energy measure costs and savings will be allocated to the appropriate sector when both residential and commercial meters are present in a building. These measures may include:

- ✓ HVAC high-efficiency equipment upgrades and controls;
- ✓ Variable speed drives and motors;
- ✓ Chillers;
- ✓ Air compressors;
- ✓ Water heating equipment;
- ✓ Lighting and lighting controls;
- ✓ Energy-management systems; and
- ✓ Custom measures.

Property Management & Commercial Real Estate

Commercial Real Estate ("CRE") is a key segment that is prevalent in the Commercial & Industrial customer groups. The CRE customer group has varied models including building owner-occupied, landlord-lessee, and professionally managed versus owner managed. Additionally, the CRE sector dynamics are sub-regional in nature with the characteristics of Boston, for example, being different from that of outlying cities and communities of the Commonwealth. In order to facilitate improved participation in this space, the Program Administrators are continuing to support many training including Building Operator Certification ("BOC"), a nationally

recognized, competency-based training and certification program. BOC is designed to give facility staff practical skills and knowledge that they can apply to make their buildings more comfortable, energy-efficient, and environmentally friendly.

Common barriers that have limited full participation in prior plan years remain, such as, identifying and working with individual tenants (and associated decision makers) in buildings with multiple tenants, cost effectively engaging multiple, sometimes small, tenants leasing space in a single building, identifying decision makers in buildings with one property management entity and a different ownership entity, split incentives between the customer paying the bill and the entity actually using the energy, and identifying single building LLCs that may be part of larger ownership entity. Over recent plan years, the Program Administrators have undertaken several efforts to try and break through several of these barriers to drive increased participation.

CRE is generally comprised of three primary entities – the Landlord, the Property Manager and the Tenant – with varying needs, concerns and interests. Over the 2016-2018 plan years, the Program Administrators worked to refine the approach and strategic framework considering relevant business models and primary-engagement entities. Initially, Program Administrators targeted small, multi-tenant property management where metered tenants were served through small business. This initial outreach served to assist the Program Administrators in identifying opportunities and work through delivery challenges. The effort was then extended to engage more closely with property managers. Meanwhile Program Administrators worked to identify a list of CRE tenanted spaces, such as mixed retail and office space management. In those spaces, the delivered projects for metered tenants were served through small business and shared facilities were served through the C&I program, creating challenges not only from an administrative as well as customer engagement standpoint. These challenges and other barriers were identified such that in the third year of engagement the strategic framework was refined, and high potential targets were identified including property owners/managers and Class B&C property portfolios. Additionally, these entities are subject to policy pressures related to Boston Building Energy Reporting and Disclosure Ordinance ("BERDO") compliance, prompting a further need for support and engagement. Further refining of engagement strategies for the CRE segment will to help drive participation in the CRE segment.

Innovation – Customized Services to Franchise Businesses

Most casual dining and Quick Service Restaurants ("QSRs"), are independently owned. They represent a significant and growing business segment that present unique challenges and opportunities for energy efficiency program savings. In addition to the traditional obstacles to serving small restaurants (e.g., modest savings potential with high transaction costs), QSRs that are franchisees face two additional barriers: owners are averse to any changes that could compromise the customer experience or the franchise relationship, and owners are rarely on-site.

To address these issues, Program Administrators have partnered with a major national QSR franchise, headquartered and with over 1,200 QSRs within Massachusetts, to develop a more targeted strategy to support efficiency across their franchisees. The franchise owner brought franchisee representatives, corporate operations specialists, and construction and finance experts to the partnership effort. The Program Administrators brought account executives, evaluation

analysts, program engineers, and senior leadership to work with franchise owners to develop solutions. Together the group developed and piloted a package of energy management systems that included control-enabled LED lighting, refrigeration controls, and water savings devices. The combination of measures was vetted in a six-store test. The package of measures is now offered through a joint Program Administrator/Franchise owner presentation at quarterly franchisee meetings. After the first such meeting approximately one-third of these "hard to serve" small business franchisees signed on to participate in this statewide comprehensive offer, and over 80% of that initial group has completed or will soon complete whole-store projects with comprehensive measures.

Program Administrators are now engaged in discussions with several other multi-facility operators, including QSRs, convenience stores, gas stations, and mini marts to broaden this highly successful approach to franchise businesses.

Technology Focused Strategies

Energy Efficient Lighting

The Massachusetts commercial lighting market has undergone drastic changes over the last decade, with Program Administrator efforts driving rapid market transformation. The Program Administrators took on an effort to improve program delivery to all lighting customers by considering alternative program delivery models, including an upstream/midstream model whereby the incremental cost of high efficiency products was reduced to alleviate cost constraints in the customer decision making process. Program Administrators launched the upstream delivery model (described further in the New and Replacement Equipment Initiative) later in 2012 with the inclusion of high performance T8s and T5 linear fluorescent lamps. The success of these efforts solidified the upstream approach as a viable delivery model, and in subsequent years it was leveraged for a variety of other lighting products, including reflector lamps, screw-in lighting products, and decorative lamps. Today, by offering viable and diverse participation pathways for customers to participate, Program Administrators have provided robust access to energy efficiency lighting systems that offer a broad reach to all C&I customers as well as to market actors working on behalf of customers.

Over the last few years, linear LED products have also shown drastic improvements in quality and were therefore more broadly introduced. While the LED screw-in market shows very high degrees of market adoption headed toward saturation, the TLED technology has as of late shown higher degrees of adoption especially for small businesses. While TLEDs offer substantial benefit to small business customers in the form of reduced wattages, aggressive marketing of these products is somewhat shortsighted as it negates the benefit of controls technologies. Consequently, for the 2019-2021 period, Program Administrators have chosen to put less focus on the "plug and play" TLED products for small business customers in favor of the longer-term benefits of marketing linear LED fixtures where controls savings can be realized. Focusing on these products provides a considerable, incremental savings benefit to these customers. The Program Administrators will continue however to provide support for TLED products in the small business segment, recognizing there is no "one size fits all" strategy, and consistent with an effort to continue providing our customers with a menu of options to suit their energy needs.

The focus on fixtures and controls in the 2019-2021 plan speaks to a bigger issue which the Program Administrators recognize and have started to address. In the wake of increasing federal energy codes and coincident increases to baseline "standard practices," the Program Administrators recognize the need to look beyond equipment-based wattage reductions to a larger Program Administrator focus on controls savings. As previously mentioned, controls measures have shown poor evaluation results in the past and more recent evaluations have supported a broader Program Administrator belief that education needs to be a consideration when implementing controls projects to reduce light levels and achieve optimal efficiency[28]. Consequently, Program Administrators have designed a number of educational efforts with various market actors including manufacturers/distributors, lighting designers, and installers/contractors. The structure of the trainings is varied and generally tailored to the target trainee. Each training module is intended to achieve the same result: increase controls awareness, understanding, and installation practices thereby ensuring customer value creation and savings persistence. While some of these education and training efforts are standalone, others are partnered with existing program delivery mechanisms where synergies exist. For instance, training for installers and contractors will piggyback on upstream efforts to incent and install controlled LED fixtures. Understanding and leveraging the potential benefits of trainings and access to commission agents to verify proper installation of systems is expected to allow for proper implementation of these systems by market actors who work in that space and afford the opportunity for customers to properly utilize lighting control systems in their facilities.

Advanced Lighting Controls continues to be a measure that the Massachusetts Program Administrators will target and continue to prioritize for the 2019-2021 Plan. Incentives for Advanced Lighting controls are currently being offered under the equipment-based prescriptive forms, the Performance Lighting application, Sustainable Office Design Program, and the Custom application processes for Existing Buildings and New Buildings. In addition, a new comprehensive & multi-tiered training program *(described under Strategic Enhancement - Expanded Advanced Systems Training)* is also being developed to increase the knowledge and awareness of advanced lighting control systems and to ensure their successful installation and use.

Additional linear lighting products have recently been added to the Upstream Program in order to expand the Program Administrators delivery strategy. Similar to both the prescriptive and custom participation pathways, these new products offer additional incentives for products with integrated controls and for higher efficiency fixtures that are DLC Premium rated. The Program Administrators will continue to evaluate new products to add to Upstream to maintain a broad and comprehensive product selection.

The Program Administrators will continue their collaboration on the DLC Technical Committee to expand the list of product categories on the published Qualifying Products List ("QPL") as new product groups come into the market.

Additionally, the Program Administrators have expanded lighting design service support, for customers and designers/engineers, through a lighting design initiative. The Lighting Designer Initiative ("LDI") has been expanded throughout the initiatives. Currently, LDI is included and

[28] *Impact Evaluation of PY2016 Massachusetts Commercial & Industrial Small Business Initiative: Phase I*, DNV GL (2018)

referenced in both the Program Administrator prescriptive Performance Lighting and Sustainable Office Design offerings. In addition, LDI is an option as a stand-alone offering under our Engineering Services offering. For the 2019-2021 plan, the Program Administrators will continue to promote and leverage the LDI offering to assist customers and to develop higher energy-saving projects. This is one streamlined and intuitive pathway that promotes customer to use lighting design professionals engaged in the market.

The Program Administrators will continue to work proactively with customers interested in converting customer-owned and IOU-owned streetlights. A full discussion of streetlight conversions is included in the *Tailored Approaches for Segments- Municipal.*

Custom Express Tools

In addition to identifying new technologies and defining measure mixes, Program Administrators actively develop tools that allow more customized offerings to be rapidly taken up by medium and smaller customers. Program Administrators actively collaborate and engage with stakeholders to develop customized engineering calculator tools. These engineering calculators, also known as custom express tools, streamline, simplify and standardize analysis of similar energy conservation measures. These tools are developed for technologies/measures where implementation is replicated easily based on potential for rapidly penetrating various market segments. The tools are a mechanism to maximize the limited customer touch points and move quickly from initial engagement to defined measure and incentive offer. *Example*: Program Administrators collaborated with vendors and industry partners to develop a custom express calculator tool for Grocery Stores where the savings and incentive offers can be presented in a customized menu-like fashion to Grocers. The simplified, laymen friendly tool allows the Program Administrators to distill a complex set of energy efficiency measures in a simple to use, quick set of potential outcomes in language that resonates with these types of businesses. An additional example is the Roof Top Unit Optimizer product. The technology was identified as an applicable technology for small and medium customers and the developed tool resulted in simplifying data collection requirements, standardizing calculation methodology and streamlining of deliverables. Program Administrators followed up with internal and external stakeholder training to ensure smoother delivery to vendors and customers. The tool is currently being used extensively by installers (input section only) and vendors/internal Program Administrator engineers (entire tool) to calculate energy savings.

Energy Optimization of Heating for Commercial, Industrial, and Municipal Customers

C&I customers come in all shapes and sizes, from mom and pop pizza places to major manufacturers with 100,000s square feet of conditioned space. The PAs believe it is up to the customer for choice of heating, water heating, and cooling equipment and what fuel (electricity, oil, propane, or natural gas) will drive that equipment. The Program Administrators will drive awareness through existing marketing channels, education of customers, trade ally direct outreach, and trade shows in order to encourage customers to convert from inefficient electric baseboard or standard heat pumps, oil, and propane systems to cold climate heat pumps or natural gas systems. The Program Administrators will provide an incentive to encourage adoption of high efficiency equipment. Incentives will be offered for strategic electrification that reduces greenhouse gas

emissions and minimizes ratepayer costs, and witching to renewable or clean energy technologies, including wood pellet heating where cost-effective. Customers converting to natural gas will be eligible for the same incentives for high efficiency gas equipment as an existing gas customer; the incentive level will not differ depending on a customer's fuel source.

Designing the proper heating, water heating, and cooling system is paramount for reaching the highest level of comfort and efficiency. The Program Administrators plan to provide customers general information regarding the types of equipment available in the market so that they can make the best holistic decision for their businesses. And in providing this information, show the customers what savings can be achieved in CO2, MMBtus, gallons of fuel, kWhs and in dollars. Along with installed costs and incentives to buy down these costs, customers can then perform their own economic analysis (payback, life cycle cost, etc.) or utilize the Program Administrator's pro forma tool in order to determine if the investment in converting their heating system is worthwhile.

In order for this to be accomplished, each project needs to be analyzed/modelled on a custom basis, which includes hours of operation, internal heat gain, cooling needs, and information about the building envelope, (i.e. a heat load/cooling load calculation). Prescriptive offerings may be warranted in future years if patterns of usage, savings, and equipment sizing can be established. For example, small to medium restaurants have patterns based on required heat load (MMBtus) on a square footage basis. This will affect decision-making for that customer.

Combined Heat and Power

During the 2019-2021 Plan term the Program Administrators will aggressively explore more ways to increase CHP installations in Massachusetts while maintaining the high standards for project screening, qualification, and performance for which Program Administrator programs are known. The Program Administrators have developed a network of over 50 vendors, developers, and installers who want to sell CHP in the Commonwealth. Program Administrators have enhanced the education campaign for CHP technology, including providing technical assistance on determining cost effectiveness and navigating the DEP permitting process, when applicable. The success of the technology over the years has been, in part, a direct result of this network and the strategies to raise awareness and education, to provide clear and complete information regarding the process to achieve a successful CHP project and qualify for an incentive through the CHP guidebook. The lessons learned from long-served, deep engagement in delivering CHP serve is a core foundation to improving program delivery. Additionally, the Program Administrators conducted a third-party study to identify market barriers facing CHP systems and to help identify ways that these barriers can be mitigated[29]. To improve on past successes, the Program Administrators continue to look for ways to improve interconnection process management and to streamline the incentive application process.

As the Program Administrators achieve success with the typical sweet spots where significant thermal load exists, such as higher education, waste water treatment, hospitals and large industrial customers with process heat loads, opportunities to look to even smaller units have

[29] Combined Heat and Power Process Evaluation: Final Report, DNV GL (2017)

become a focus. The knowledge and lessons learned over prior plan terms, where typical "good" candidates have a year-round thermal load requirement in excess of 5,000 hours, remain as the optimal CHP candidates. Program Administrators have increasingly been targeting smaller units to a wider array of segments including restaurants, multifamily complexes, and hospitality in addition to the typical sweet spots of higher education, waste water treatment, hospitals, and large industrial customers with process heat loads. The Program Administrators are working to understand technology and performance impacts of going to the small and micro-CHP scale. Smaller units can be applicable to a wide array of segments including restaurants, multifamily complexes, and hospitality where sufficient coincident thermal load exists. While the volume of potential customers increases with this approach, the challenges and barriers shift, while the known barriers and risks - significant time and capital, as well as integration and operations risk remain. In addition, as customers move toward potential islanding, they may become ineligible for any future additional Program Administrator supported energy efficiency offers, which means it is best to undertake as much efficiency in the facility as possible to then be able to right-size the CHP and capture more efficiency.

While economics is a primary driver of most CHP installations, reliability and resiliency are increasingly moving up in terms of importance to customers as they look to invest in their campuses and facilities for years to come. The impacts of this to efficient performance is being examined, particularly where situations arise where the traditional thermal load following approach moves to electric load following, requiring additional thermal equipment, such as absorption chillers, which also increases the capital cost per delivered kWh. Enduring interruptions and outages due to storms has significantly impacted the psyche of businesses where back-up power capability is moving to the forefront of the CHP industry. As an example, the Program Administrators worked with several large hospitals to access DOER funds made funds available for CHP installations that should include Island Mode or back up capabilities. Customers received over $4,000,000 in DOER resiliency grants as a result of this combined support and awareness campaign. Moving forward Program Administrators staff will continue to provide active assistance to the customer throughout the process, further driving the success and broadening applicability of this end-use strategy. The Program Administrators focus remains on promoting and providing incentives for CHP where it provides energy-efficiency and demand reduction benefits.

Fuel cell technology, when cost-effective, is a technology that can be considered in energy efficiency projects on a case-by-case customer/situation-specific basis, where the application meets all other program requirements including project cost-effectiveness.

Customer Focused Technical Assistance and Resources

Customers have multiple pathways to receive technical support in adopting more energy efficient practices. The managed account approach, the small business pathways, and segment-specific approaches (all discussed above) all offer customers facility assessments and skilled professionals who can provide advice and help in selecting energy efficient options. Program Administrators also support specialized trainings to give customers and trade allies technical knowledge and keep energy and demand savings at the forefront of their thinking when selling related products and services to customers. This includes technical sessions with information targeted at those in charge of making the financial and facility decisions.

There are instances where customers can benefit from additional technical or engineering study beyond what is offered through the standard customer support and trainings. Program Administrators have created a system that allows customers to pursue additional engineering and technical support in a shared investment model, sometimes referred to as a cost-share, with Program Administrators. Any customer may propose a study or technical-support project via a simple-to-follow online engineering services application. The Program Administrators support a team of engineers and technical experts, both in-house and under contract, who review applications and approve a scope-of-study or technical assistance. Program Administrators will work with customer's preferred engineering consultant, with the consultant under contract with the customer. In instances where the consultant is under contract to the customer the cost-share is limited and at Program Administrators discretion. In either scenario, the customer's investment in the study helps ensure that they are committed to implementing its recommendations resulting in savings.

All customers have access to the technical assistance application process, and all applications are given a comprehensive review and support to scope and implement studies or assistance projects. It is a common practice for technical assistance vendors and account managers working with customers to identify study opportunities and work with customers to submit applications. A vendor may see a significant opportunity for custom measures but need to do a study to more clearly define the savings. The vendor can propose the study and help the customer submit the application. Program Administrator representatives working with customers may see an opportunity that needs better definition or may recognize that the customer needs help with prioritizing multiple opportunities to reach an investment decision and staged upgrade plan that works for their specific business operation and facility. In these cases, the Program Administrator representative may suggest the customer use the engineering-services pathway and support the customer's submission of an application. In all cases, the Program Administrators' objective is to actively promote technical support as a critical tool to help customers understand their energy saving opportunities and act on them.

Strategic Enhancement – Industrial and Process Enhanced Resource Offer

The Program Administrators have implemented an enhanced resource offer targeted to industrial customers providing both technical and project management services. The offer is also available to other customers with process end-use in other segments such as hospitals, laboratories with process loads. The Program Administrators provide our customers access to a suite of contracted engineering firms that specialize in industrial or process-related energy efficiency. The contracted firms also have expertise in management of efficiency projects in the manufacturing environment and can provide this additional technical knowledge and service. The Program Administrators have targeted process-end use customers as an area to potentially achieve improved portfolio savings levels.

The industrial and process resource assistance offer has been specifically designed to overcome the time barriers industrial customers have experienced with traditional technical assistance models, i.e., long investigation and report preparation cycles. Vendors are deployed strategically to expeditiously identify and analyze targeted energy conservation measures, which results in quicker turnaround and prompt implementation.

The use of vendors with the ability to provide project-management support has been instrumental in overcoming customer resourcing constraints. This is particularly critical in overcoming these constraints for medium and small manufacturers. Being smaller does increase relative costs compared to savings, because while the fixed costs of finding efficiency opportunities are the same in smaller manufacturing settings, the potential savings are less. But the efficiency of the program design has secured cost-effective savings even for small manufacturing customers.

The offer makes it easy for Program Administrators to coordinate gas and electric offerings. Contracted firms provide comprehensive technical support, including the identification and delivery of opportunities for gas and electric projects. The approach enables the coordination and back-end processing of associated costs and incentive delivery where multiple Program Administrators serve the same customer, without any interruption of service. From a customer perspective, they have one engineering-support partner who can provide tailored high-impact strategies that are responsive to their unique business priorities and constraints. During the testing of this element of the platform with larger customers, Program Administrators discovered that an extra benefit of the integrated design and delivery is increased instances of shared knowledge and savings delivery between Program Administrators.

Training

As the tools available for Program Administrators to achieve savings evolve, the Program Administrators are adjusting their programmatic offerings to help customers not only adopt integrated systems, but properly install, commission, and operate them to maximize energy and demand savings. To capture *and maintain* the savings inherent in these sophisticated new systems, the Program Administrators will need to rely to an even greater degree on the skillsets of facility managers and trade allies who provide services in the field. Trades like electrician and HVAC installer and technician will not only require enhanced entry-level skillsets, but also access to continuing training opportunities as these professions encounter an increasing range and complexity of end uses that are always changing.

The Program Administrators have been working with the industry experts to provide an annual training for the plumbers and HVAC contractors installing high efficiency furnaces, boilers, water heaters and other instant savings gas measures such as aerators and spray valves. Program Administrators will be offering training on how to properly size furnaces and boilers, including how to conduct heating and cooling load calculations, which helps contractors determine optimal heating system and duct system sizing. Program Administrators will offer sessions on how to service and set up condensing boilers because condensing boilers and furnaces have different specifications than the equipment they generally are replacing. Program Administrators are also supporting trade allies in completing the efficiency sale by offering training that helps present the efficiency and financial benefits to customers in a manner that creates a winning sales proposal that moves customers to action.

Strategic Enhancement - Expanded Advanced Systems Training

As equipment baselines and codes rise, an increasing share of energy efficiency program savings will need to be derived from a systemic approach that focuses on optimizing the specification and installation of energy efficient equipment combined with sophisticated controls and management systems that ensure that savings are maintained. Lighting will increasingly be designed and installed to be an interactive network, capable of sensing customer lighting needs, using dimming and on-off cycles and incorporating daylighting-sensor information and information about occupant activity and location. HVAC systems will similarly become "smarter," responding to customer ventilation and temperature needs in real time by combining data on outside conditions with information about the number and location of occupants. Lighting and HVAC systems will increasingly create opportunities for customers to participate in active demand reduction without compromising the functionality of their equipment or disrupting their operations.

Program Administrators plan to include two new training offers to support advanced lighting controls. The Program Administrators will implement the National Advanced Lighting Controls Training Program ("NALCTP") which trains and certifies electrical contractors and electricians in the installation, calibration, programming, commissioning, and maintenance of advanced lighting-controls systems. The Program Administrators are partnering with Massachusetts Energy Efficiency Partnership ("MAEEP") to develop and deliver a day-long seminar on Advanced Lighting Controls Systems ("ALCS"). The session targets lighting designers and specifiers, engineers, major property owners, vendors, and contractors. The training introduces attendees to the newest enhancements to Advanced Lighting Controls Systems, such as Luminaire Level Lighting Control ("LLLC") and new software.

Innovation - Experiments in Facility Operator Training

Eversource has been testing an innovative customer training program that allows for facility staff to train on the customer's operating building systems including lighting, HVAC, process, and building energy management systems. The intent is to deliver targeted and customized on-site training for customer facility staff and the vendors who supply and service their equipment and energy management systems.

The goal of the training is to ensure that these systems remain optimized. Delivery would be accomplished through: (1) an initial scoping/walk-through audit to identify and assess potential opportunities. The assessment would be conducted by a skilled Eversource contractor in cooperation with the facility operator and would yield a brief report summarizing the opportunities and a proposed plan of attack; (2) one or more on-site working sessions with the facility manager, the appropriate Eversource technical support contractors, and technicians from the firms responsible for supplying/maintaining building operating systems (EMS, HVAC, etc.). Eversource will also offer one or more follow-up visits to verify ongoing system operations and provide training and technical assistance updates for staff. It is expected that Eversource will collaborate with all Program Administrators regarding the results of the effort and explore expansion.

Financing Energy Efficiency Investments

The Program Administrators have partnered with the Massachusetts Bankers Association to make available financing for business, multi-family, and non-profit commercial customers who need capital beyond the value of the Program Administrator incentive to implement a project. Customers can elect to use project incentives to apply to the interest on the loans or use the incentives to reduce the capital needs of the project. Loans can range from $5,000 to $500,000 and can extend to 7 years. For the Program Administrators, the ability to link customers to capital where that is a barrier to project execution is an invaluable sales tool. For participating lenders, the partnership opens up a new market to attract new customers, with the assurance of receiving a market rate interest payment from the Program Administrators.

Mass Save Financing for Business has had a modest uptake, and is best viewed as a useful, but niche tool in the energy efficiency sales toolkit. Larger-sized businesses in the Commonwealth have indicated that access to outside capital financing is not a primary barrier to program participation. The Massachusetts experience is consistent with the financing experience of most other program administrators. There remains continued interest in investigating alternative and creative financing vehicles, such as the newly created commercial Property Assessed Clean Energy ("PACE") offering in the Commonwealth and options for third-party financing. These alternative financing options may have the potential to improve customer uptake of project financing and reach more customers who may not have participated in energy efficiency programs due to capital constraints. The Program Administrators will continue to review new studies and proposed mechanisms as they emerge. Program Administrators will continue to closely watch financing pilots and initiatives being conducted in other jurisdictions to determine which emerging models, if any, show promise for replication in the Commonwealth.

Innovation - Experiments in Financing Energy Efficiency

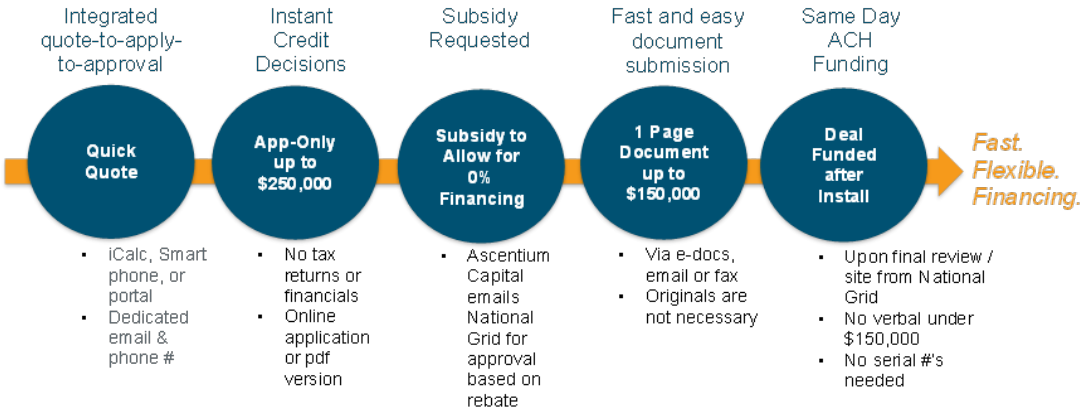
The Program Administrators experiment with different forms of financing to open greater efficiency investment options to customers. Between renewables, clean energy investments, and energy efficiency, there are multiple financial assistance paths to help customers complete projects, some older and well established like the Energy Services Company ("ESCO") performance contracting model, and others more transactional such as financing for a particular piece of equipment. Some Program Administrators use turnkey vendors who extend financing to customers and others look to incorporate available financing products in the energy marketplace.

One Program Administrator, National Grid, is experimenting with an external financing option for electric and gas customers pursuing retrofit or new or replacement equipment projects, which uses the energy efficiency incentive to buy down the interest of the loan. This new streamlined online submittal offering (the loan application is online and can be processed in two hours) is expected to provide flexible financing up to $1.5 million with terms up to 60 months. The process is intended to speed up the project decision process by using a simple online tool to

develop a quote and provide a financing proposal back in two-hours or less. The flexible financing offer is expected to support the following selling strategies for National Grid sales personnel:

- ✓ Offer the payment that provides a cash flow positive situation from day 1.
- ✓ Highlight that the energy savings will cover the cost of the measures.
- ✓ Show them how much they will save after the term is completed.
- ✓ Calculate their "Cost of Waiting" and break it down per year, month, and day.

National Grid is using this financing solution to a limited extent now and plans to expand, if successful, in the 2019-2021 term. The Program Administrators will continue to follow this effort and be regularly updated through the knowledge-sharing forum of the C&I Management Committee and assess for applicability to each individual Program Administrator on a case by case basis.



3. C&I New & Replacement Equipment Initiative

Overview and Objectives

The New and Replacement Equipment initiative encourages customers who are buying new equipment, or replacing equipment that has worn out or failed, to opt for the most efficient alternative in the market. Initial or replacement on failure equipment-purchase decisions establish energy-consumption patterns for decades and lock in operating costs for the end-user. Most major commercial equipment will continue to be used until it fails or needs to be replaced, or a retrofit project is proposed and economical. The goal of the New and Replacement Equipment initiative is to ensure that no opportunity to place the highest-efficiency equipment in service is lost.

Strategic Enhancements and Major Innovations

- ✓ **Expanding Upstream Offerings**
- ✓ **Implementation of Mass Save Application Portal ("MAP")**
- ✓ **Increased leveraging of training and workforce development to transition to an era of integration of energy efficiency strategies, smart technologies and energy using equipment.**

Initiative Design

When purchasing a new piece of equipment or replacing a failed one, customers have a choice between standard, generally code dictated, and high-efficiency options. By incentivizing purchases of high-efficiency equipment Program Administrators can make such purchases easier, by reducing the up-front costs to the customer. Program Administrators generally attempt to incentivize the incremental costs only, i.e., the price difference between the standard or code-compliant equipment and the higher-efficiency equipment, and balancing that against the incremental savings, i.e., the savings between the operation of the standard or code-compliant equipment and the high-efficiency equipment over the expected life of the equipment.

The types of equipment include gas heating and water heating equipment, electric HVAC including heat pumps, and food service equipment,

Prescriptive downstream and upstream incentives are available for a wide array of energy and demand saving equipment. Prescriptive incentives are most effective when the customer or the trade ally serving the customer can be actively engaged at the time of purchase (initial or replacement). Program Administrators are able to exert influence over customer and trade ally purchasing through account and program managers, training of trade allies, and building awareness across customers and industry regarding more efficient options.

While the prescriptive application process and upstream incentives offer customers a streamlined participation pathway for common energy efficiency measures, the custom application pathway provides customers an opportunity to put forth more complex and/or customer site specific energy efficiency measures for consideration within the programs. Typically, these energy efficiency measures require detailed energy efficiency savings analysis, measure-specific

implementation costs, and, in some instances, inputs from modelling programs. This information is required by the Program Administrators in order to determine if the proposed energy efficiency measures meet the benefit-cost screening and other pertinent program guidelines. The custom pathway allows the customer and Program Administrators the flexibility to consider new technology and advance other cost-effective energy efficiency measures and strategies not captured through the prescriptive application process. As increasingly stringent code adoption, rising standard practice, customer awareness and the success of our energy efficiency programs continues to put pressure on Program Administrators ability to claim savings for simple equipment replacement, the custom incentive process is a key tool to create integrated solutions that create new energy efficiency savings.

The addition of MAP is the type of effort that helps contractors operating independently in the market deliver energy efficient options directly to customers. MAP is designed to help customers understand what energy efficiency opportunities are available and enables customers to create and submit applications for financial incentives or services in support of energy efficiency projects in Massachusetts. This new Portal greatly simplifies the process of creating and submitting applications by combining all offers and incentives in a single, simple to use, online system.

Upstream Channel

The upstream model leverages existing distributor networks and infrastructure to influence the thousands of equipment-purchasing decisions that customers and contractors make every day. Under the upstream model, the Program Administrators provide incentives directly to distributors and manufacturers, rather than to end users, with the end users benefiting from the significant reductions in retail costs that this enables. The incentives are structured to remove the price premium between conventional and high-efficiency products at the point of purchase, thereby placing efficient products in direct competition with conventional products based on quality and efficiency alone.

For the upstream model to succeed, a special set of special circumstances are required:

- ✓ the higher-efficiency equipment must be a direct replacement for less efficient equipment;
- ✓ the equipment-purchase decision must be primarily driven by first cost, with no real reliability or performance distinctions between the products;
- ✓ the high-efficiency equipment must be stocked and available at distributors at the time the purchase decision is made; and
- ✓ there must be no, or minimal, additional or unique installation requirements that distinguish it from the product for which it is substituted.

Building on early success in the linear fluorescent market, the Program Administrators have broadened the application of this approach to additional lighting products, including LED fixtures and a variety of other LED products. The Program Administrators also now offer upstream pathways for many non-lighting measures that are amenable to the upstream approach (e.g., efficient technologies that can be substituted for less efficient options without any adaptation or

technical or performance limitation). In addition to lighting lamps and some select fixture types, upstream incentives are now available for ECM circulator pumps, natural gas water heaters, electric HVAC (including air-source and ground-source heat pumps and variable refrigerant flow) measures, and qualified natural gas and electric commercial kitchen measures.

Upstream offers fewer measures, primarily because it is limited to equipment types where the efficient alternative is a direct and comparable substitute for the standard equipment in all circumstances, without any requirement for program verification. But for the measures that are offered, market uptake is high and broad, due to minimal price and administrative barriers to customer access. Because upstream engages many customers who would otherwise not participate, it both captures additional savings and addresses equity concerns.

4. C&I Active Demand Reduction Initiative

Overview and Objectives

The electric Program Administrators will be implementing active demand reduction offerings based on the recent evaluated demonstration efforts. During the summer of 2017 and 2018, National Grid and Eversource (2018 only) deployed a C&I demand reduction demonstration. Customers with interval meters, time of use rates, and demand charges, with demand of 250 kW or higher, typically, and the ability to curtail 50 kW, were eligible for the demonstration. Under this active demand reduction approach customers agree to respond to an event call targeting conditions that typically result in system peak through curtailment service providers ("CSPs"). The customer is incentivized to respond to event calls using performance based incentives and measuring performance against a baseline in alignment with ISO New England methodology. This approach is technology agnostic and can utilize single end use control strategies or a multitude of approaches that can dramatically reduce demand when an event is called. In the demonstrations customers have used lighting with both manual and automated controls, HVAC with both manual and automated controls, process loads, scheduling changes, excess CHP capacity, and even energy storage.

Based on the success of the demonstration efforts, the Program Administrators will offer customers offerings to incentivize them to reduce demand at key points to realize customer value and system benefits mainly tied to avoided peak demand, transmission, and distribution investments. The Program Administrators can add a new service offering to the portfolio to provide value to Large C&I customers and generate claimable benefits, primarily avoided capacity, transmission, distribution, and capacity DRIPE.

The electric Program Administrators will also review the results of new demonstrations proposed by Eversource and approved by the Department in D.P.U. 16-178. In 2018 and 2019, Eversource will deploy demand reduction demonstration offerings for battery storage, thermal storage, software and controls, and active demand response, some including upfront incentives for equipment installations. These demonstrations are designed to test the ability of the projects to deliver cost-effective benefits to customers at scale. After the evaluation of the demonstrations, Eversource will submit a report to the Department with an analysis of the actual costs and benefits of each demonstration project. Each electric Program Administrator will use the results of the demonstration offerings to assist in analyzing whether a program based on the demonstration projects can be deployed cost-effectively at scale. Any new program design will be implemented at the earliest appropriate time, as determined by each PA.

Strategic Enhancements and Major Innovations for the 2019-2021 Plan

- ✓ **New Statewide Active Demand Offer for Customers**

Initiative Design

C&I Interruptible Load Curtailment

The 2016-2018 C&I Interruptible Load Curtailment demonstration projects targeting summer peak demand will serve as the basis for a new statewide C&I curtailment active demand reduction offering in 2019-2021. This offering is technology agnostic and provides an incentive for verifiable shedding of load in response to a signal or communication from the Program Administrators coinciding with system peak conditions. Customers are incentivized based on their average performance and the typical technologies or strategies used to curtail load may include:

- energy management systems,
- building management systems,
- software and controls,
- HVAC controls,
- lighting with controls (manual, networked system or integrated),
- process offsets,
- any open ADR compliant technology,
- startup sequencing, and
- other customer facility specific approaches.

Since the offering is technology-agnostic and performance-based, the Program Administrators will be able to incent the performance of customers adopting innovative and emerging demand reduction technologies, including energy storage technologies (see later section). Customers can use any technology or strategy at their disposal and earn an incentive based on their curtailment performance. In essence, the incentive equals the customers' opportunity cost – if it makes sense for a customer to shed load for the incentive price offered by the Program Administrator, then the customer will curtail.

Large C&I customers that are subject to demand charges and/or direct capacity charges (determined by Installed Capacity ("ICAP") tags) with the ability to control lighting, comfort, and/or process loads, can use this demand reduction performance offering to generate revenue by altering their operations a few times per year. The Program Administrator incentive, combined with any ISO-NE capacity supply obligation reduction and demand charge reduction, round out a compelling package for customers to adjust operations a few times per year.

The Program Administrators will also be incentivizing active demand reduction strategies during winter. The goal is to help promote winter resiliency by finding customers that can reduce electric usage during times of high winter system load. The PAs will recruit customers that participate in the summer reduction program and sign them up for a winter reduction obligation as well. These customers will receive two payments – one for summer and one for winter, based on their seasonal performance relative to an agreed upon target. The seasonal payment for winter demand response will be incentivized at a different rate than summer as nearly the entirety of claimable benefits for a resource of this type is tied to summer peak demand reduction. The

Program Administrators will test customer acceptance to respond to winter dispatch signals and continue exploring claimable values that may result from winter demand response performance.

C&I Storage Performance Approach

The C&I Storage Performance offering recognizes that Large C&I customers with demand charges, direct capacity costs, and time of use rates have a different value proposition from residential and small and medium C&I customers. Program Administrator incentives are just one of many accessible revenue streams customers and developers could use to stack for a financially viable project (ISO-NE markets revenue, ICAP tag avoidance, demand charge management). Due to the increased capital and operating costs, customer and developer risk, and lack of current clear access to or mutual exclusivity of revenue streams for energy storage technologies that the Program Administrators are proposing increased performance incentives for C&I storage performance, significantly above the proposed technology-agnostic Interruptible Curtailment performance incentives proposed above.

The Program Administrations have conducted extensive market actor outreach through:

- Multiple discussions with market actors and customers during the 2016-2018 demonstrations, and
- Eversource's demonstration projects which are investigating the best strategies for dispatching storage, customer acceptance, and cost-effectiveness.

The Program Administrators recognize that there is multiple programs and funding efforts in the State currently targeting storage (ACES, SMART, Clean Peak Standard) and believe this overall offering balances customer flexibility in using energy storage systems for multiple purposes and ensuring that ratepayer funds are used in a manner that provides substantial peak demand reductions for years to come.

Delivery Pathways for C&I Active Demand Reduction Initiative

This fully-integrated initiative uses CSPs and the Program Administrator's existing energy efficiency sales teams to assess curtailment opportunities at a facility and deliver curtailment services to enrolled customers. The Program Administrators will leverage the existing consultative sales approach employed for large customers to market to and recruit customers. CSPs will then identify specific curtailment opportunities, as well as demand charge and ICAP tag management opportunities, and present a complete curtailment proposal to the customer. The demand charge and ICAP tag management provide opportunities for direct bill savings to customers.

This fully integrated approach relies on sales delivery teams promoting efficiency and active demand offerings to customers as they assess opportunities at customer facilities. This approach of using the existing efficiency delivery apparatus is key to the growth of C&I active demand reduction. The robust relationships the Program Administrators have with the target customers (typically large electric customers with interval meters, TOU rates, and demand charges) have been critical to the demonstration success and are believed to be the source of forward progress on this new initiative.

Customers and CSPs respond to dispatch signals or criteria specified by the Program Administrators, generally using a system peak trigger. Events will be called the day before curtailment as needed. The core model remains focused on reducing demand during summer peak events typically targeting fewer than twenty hours per summer. In the case of energy storage additional hours will be sought. The goal of the offering is to call events at times of peak energy use, however daily peak calls may be able to access greater system benefits. For customers participating in ISO-NE demand response markets, ISO-NE event days will be excluded from baseline calculations. The approach is structured to avoid interfering with the ISO-NE programs or penalizing customers for participating in both programs.

For energy storage resources, or technology not impacting customer comfort or operations, there is an expectation of daily availability. The Program Administrators believe, from our interpretation of the AESC 2018 study, that there are more claimable benefits, specifically from avoided capacity and avoided capacity DRIPE from daily peak calls than just system peak benefits. It is our hypothesis that customers would opt to dispatch daily during the summer months of July and August and maximize revenue from these types of technology if their comfort or operations are not impacted. To this end the Program Administrators propose justifying the significantly increased performance-based incentive for daily dispatch devices.

D. Hard-to-Measure Efforts and Pilots

1. Hard-to-Measure Efforts

a. Statewide Marketing (Residential, Income Eligible, C&I)

i. Introduction

The budget in the Statewide Marketing hard-to-measure initiative is used to support general statewide marketing efforts and the statewide brands, including Mass Save®. Program marketing is included in program budgets.

By creating powerful, engaging and motivating education and marketing strategies, Program Administrators can increase awareness of the benefits of energy efficiency and drive increased participation in energy efficiency programs and services. Proposed marketing strategies will consider the unique motivational differences among residential and non-residential customers.

Building on the success of digital and social marketing platforms will continue to be a key focus in the 2019-2021 term. The Mass Save website has become a critical focal point in the comprehensive marketing program, providing a consolidated one stop shop for residents and businesses to learn about energy efficiency, program offerings and opportunities. MassSave.com received over 1.2 million unique visitors in 2017. MassSave.com and the strategies that drive customers to the website will continue to be refined to ensure the highest quality customer experience. Marketing will continue to leverage the strong social media presence built over the 2013-2015 and 2016-2018 terms. With over 133,000 Facebook fans (www.facebook.com/MassSavers) and nearly 24,000 Twitter followers (www.twitter.com/MassSave), PA marketing and education is able to reach an ever broadening audience. The social media platforms support effective peer to peer marketing, allowing customers to become brand ambassadors.

Reaching out to customers who have not yet participated in Mass Save branded programs remains a fundamental commitment of the Program Administrators. The Mass Save website is currently accessible in English, Spanish and Portuguese, the most common languages spoken across the Commonwealth, and may include other language tools in the future to ensure accessibility for diverse linguistic populations. The statewide Mass Save phone line offers five different language options (English, Spanish, Portuguese, Russian, and Mandarin). In 2016-2018, the Program Administrators executed specific educational outreach to reach targeted audiences including Spanish and Portuguese speakers, renters, income-eligible customers, and small business owners, and will continue to target specific audiences in 2019-2021. The Program Administrators will explore affinity marketing opportunities to expand the reach to new market segments while offering the added benefit of supporting the community beyond energy efficiency. For example, as a part of its 2017 awareness evaluation, the Program Administrators studied awareness in Latino and income eligible communities and used this data to inform tactics specifically designed to build Mass Save program awareness and drive participation in these segments. The key themes for the Statewide Marketing efforts for the 2019-2021 Plan are as follows:

- Define who and what Mass Save is and what it means to the customer.
- Increase the message that associates Mass Save with "A way to lower your energy bills" to both residential and business customers.
- Message and graphically tie in the Program Administrator brand logos with the Mass Save mark to create a strong association and clarity of message.
- Utilize the segmentation work identified by the RMC and C&IMC so Program Administrators can better and more consistently target customers.
- Create awareness and understanding of Mass Save as a trusted statewide resource for all customers' energy efficiency needs.
- Educate customers about the opportunities to save energy and motivate them to act.
- Ensure cross-promotion and broader and deeper program participation through a number of strategies including featuring all energy efficiency programs on social media, driving from Facebook and Twitter to MassSave.com blog articles, etc.

During the 2019-2021 Plan term, the Statewide Marketing Committee will continue to meet monthly and update DOER, through informal discussions, on any new developments concerning the Program Administrators' statewide marketing efforts. From a market research perspective, the Program Administrators will continue to conduct campaign studies and track campaign effectiveness in terms of driving customers to the website.

ii. Marketing Plan Overview

The ultimate goal of all educational, community outreach, and marketing efforts is to build a culture of efficiency. It is necessary for a rapidly evolving energy marketplace to be able to utilize a system of effective communication with Massachusetts residents and businesses. This system is a critical tool to support customer awareness, understanding and participation in the Program Administrators' comprehensive energy efficiency programs. Independent evaluation studies and a review of the marketing activities from 2010 to date illustrate the extraordinary growth and success of the coordinated marketing efforts among the Program Administrators and provide insights for Program Administrators to better understand where improvements can be made.

For the 2019-2021 Plan, core objectives of the Program Administrators' public education and promotion campaign include:

- Maximizing reach to ensure *all* residential and business customers are provided access to information and connection to resources.
- Providing compelling and accessible messages, which clearly describe the benefits of energy efficiency without excess jargon or overly technical language.
- Exploring and deploying targeted marketing to unique or specific communities throughout the state (including communities where English is not the primary language).
- Utilizing diverse media (e.g., internet, radio, public transit, social media, bill inserts) to disseminate consistent and clear messages.

- Ensuring that the various strategies work together to ultimately achieve deeper and broader savings.
- Ensuring that customers understand who their local Mass Save sponsor is and increasing the awareness of Program Administrators' commitment to their customers.

Through an extensive array of effective messages and an all-inclusive media strategy, the Program Administrators commit to engaging with the broadest cross section of residential and business customers with tailored, targeted, and actionable information. The careful balancing of breadth, depth, and understanding of customer motivation in the campaigns will drive value to customers and support obtaining the aggressive energy efficiency goals set forth in this Plan.

iii. Mass Save®

In 2010, the Program Administrators joined together to promote energy efficiency programs to the Commonwealth through a statewide PA brand. As sponsors of the Mass Save word service mark, the intent of the Program Administrators was to complement their individual PA brands when communicating with residential and business customers about energy efficiency programs.

The Program Administrators are the owners of the Mass Save word service mark. A trademark or service mark identifies goods and services as originating from a single source. Trademarks, in effect, represent the goodwill that a business has built up through its history of offering quality goods and services. A word mark is the most common form of trademark and simply consists of a word or group of words. The Program Administrators have rights to the word mark Mass Save, having obtained federal registration of it on August 29, 2006.

Under trademark law, the Program Administrators monitor and control the use of their marks in order to maintain them and to prevent inferior energy efficiency services from diminishing them. Throughout the past three plan periods, the Program Administrators have overseen significant monitoring efforts with respect to the Mass Save mark to identify unauthorized uses of the service mark. Legal measures have been successful to stop such unauthorized uses and thus the integrity of the mark has been protected.

iv. Marketing for 2019-2021

The Program Administrators maintain a joint statewide website, MassSave.com, which is designed to educate customers and provide access to energy efficiency program information and participation. The website provides the Program Administrators an opportunity to offer streamlined information, including the online home energy assessment and online rebate processing, which offer substantial customer experience benefits. The centrality of this website to the Program Administrators' marketing efforts demonstrates the commitment of the Program Administrators to working together for the benefit of customers throughout the Commonwealth.

In May 2017, the Program Administrators launched a refreshed, improved, modernized MassSave.com website. Upgrades included:

- Optimizing the site for mobile visitors (in addition to customers accessing the site from desktops, laptops, and tablets). Mobile traffic to MassSave.com continues to increase year-over-year; in fact, it accounted for 41% of total traffic to the site in 2017.
- Refreshing each page's content, ensuring it is customer-friendly, compelling, and succinct.
- Consolidating the number of pages on the site, enabling customers to find what they are looking for in fewer clicks.
- Leveraging lifestyle imagery and icons throughout the site, adding visual interest while maintaining a clean look-and-feel.
- Creating interactive tools, enabling customers to simply enter their 5 digit zip codes to find a custom list of participating contractors, retailers, vendors, etc. who serve their area. Tools include listings of:
    - Home Performance Contractors
    - Independent Installation Contractors
    - AC Check Contractors
    - Community Action Programs
    - Retailers for Lighting and Products
    - C&I Upstream HVAC Distributors
    - C&I Upstream Lighting Distributors
    - C&I Food Service Vendors
- Introducing personalization variables such as homepage hero images, welcome text, and program promotional content customized to residential, multi-family, and business audiences by zip code. Personalization encourages higher engagement and ultimately improved conversion rates (i.e., online rebate application completions; PDF downloads, product purchases; etc.).
- Launched homepage hero images and welcome text specific to returning visitors (distinct from what first-time visitors to the site see). Returning visitors receive custom creative based on their customer segment (residential, multi-family, or business) which encourages their further exploration of the site.
- Ensured all high-traffic program pages are accessible through easy-to-remember vanity URLs such as MassSave.com/Thermostats, MassSave.com/Eligible, MassSave.com/NewHome, MassSave.com/Business, and MassSave.com/Contractors, etc.

While the Program Administrators have recently completed these significant updates, MassSave.com will continue to be evaluated for content and usability and improvements that can be made, especially as the realignment of the residential programs is implemented. The Program Administrators' focus on total customer experience recognizes the entry of the customer through

the website as a critical component of that experience. The Program Administrators will continue to feature all the PAs' brands in conjunction with the Mass Save marks per the findings from the Massachusetts Statewide Marketing Campaign Evaluation Report and consistent with their goal to convey who and what Mass Save is. The Program Administrators will utilize multiple marketing and branding strategies to facilitate customer perception of individual PAs as trusted energy advisors, leveraging the strong awareness and trust held by existing utility brands. These efforts will support the expansion of messaging and branding strategies into the broader context of energy and environment as a whole, supporting the Administration's expanded policy objectives around strategic electrification, renewable energy and clean peak strategies.

In addition to optimizing the website, Mass Save uses consistent, succinct, effective campaign messaging: "It's easy to save energy and money with Mass Save."

The Program Administrators use marketing campaigns to increase awareness of energy efficiency and Mass Save across the Commonwealth. The Program Administrators promote the programs across many forms of media, including radio, internet banner ads, social media, smartphone and tablet ads, pre-roll video, native advertising, and print ads.

The marketing efforts include: (1) updating and optimizing the MassSave.com website; (2) posting customer-facing videos on the Mass Save website that share customers' positive experiences with home energy assessments and energy efficiency technologies; (3) leveraging of social media outlets like Facebook and Twitter to launch creative campaigns; (4) reviewing marketing materials and rebate forms across programs to ensure they leverage a consistent look and feel and follow best practices; (5) using an integrated out-of-home advertising campaign, including platforms such as commuter rail, subway, bus, and billboard ads across the state; and (6) using native advertising and infographics to the mix of promotional strategies.[30] The Program Administrators have also proposed enhanced marketing partnerships with communities, as discussed above in Section III.B ("Increased Target Marketing and Partnerships with Communities"). Because this work will cross sectors and programs, it will be funded through statewide marketing, although the partnerships will be managed primarily by the Program Administrator staff responsible for implementing the promoted programs.

The Program Administrators also execute annual and post-campaign studies, allowing the Program Administrators to benchmark and evaluate the effectiveness of their messaging and media planning and adapt the marketing strategies to take into account the results. In reviewing campaigns, Program Administrators review key findings regarding: (1) customer awareness of the Mass Save brand; (2) customer awareness of www.MassSave.com and self-reported website usage; (3) web traffic; (4) clarity and resonance of campaign messaging to residential and commercial customers; (5) self-reported exposure to Mass Save messaging; and (6) depth of knowledge about program offerings among residential and commercial customers. The most recent Mass Save Awareness Campaign showed increases in customer awareness in each of these areas and showed that customers found the messaging to be clear and resonant.

[30] Native advertising enables the Program Administrators to present educational messages seamlessly within the surrounding website environment, engaging audiences rather than disrupting the user experience. Mass Save also offers educational information on a variety of topics, in a variety of formats.

v. Maintenance of Complementary Individual Efforts

While working diligently on the statewide public education efforts, the Program Administrators will also continue individually to maintain customer awareness, satisfaction, and participation goals. Accordingly, the Program Administrators will continue outreach efforts utilizing customer representatives and account executives (who enjoy one-on-one/person-to-person relationships that are especially important in the C&I sector) and PA-specific efforts that complement and are consistent with statewide marketing and outreach efforts.

b. Statewide Database
(Residential, Income Eligible, C&I)

The budget in this category is used to support database and data review and sharing efforts, including costs associated with vendors developing and improving Mass Save Data, the Program Administrators' statewide energy efficiency database. Statewide database efforts will affect all sectors, with funds budgeted for each sector. Please see Section IV.I.5 for more information on Mass Save Data.

c. DOER Assessment
(Residential, Income Eligible, C&I)

The DOER Assessment represents an annual budget for DOER that is assessed per G.L. c. 25A, § 11H.

d. Council Consultants
(Residential, Income Eligible, C&I)

The Council consultants budget is managed by DOER and used to support the retention of expert consultants by the Council and reasonable administrative costs, in accordance with G.L. c. 25, § 22(c). The Council must annually submit to the Department a proposed budget for the "retention of expert consultants and reasonable administrative costs." G.L. c. 25, § 22(c).

e. Sponsorships & Subscriptions
(Residential, Income Eligible, C&I)

Costs included on the Sponsorships and Subscriptions hard-to-measure line items provide direct benefits to customers, but are not directly linked to specific in-the-field energy efficiency measures or services. Sponsorships and subscriptions support the energy efficiency market, encourage workforce education, attract skilled employees to Massachusetts, and promote innovation in both service delivery and the development and testing of energy efficient technologies. In accordance with the Order of the Department of Public Utilities regarding the 2019-2021 Three-Year Energy Efficiency Plan and general accepted practice, each sponsorship and subscription expense must be reasonable, prudently incurred, and provide a direct benefit to Massachusetts customers. Detailed definitions are as follows:

- **Sponsorship**: Payment by or on behalf of a Program Administrator to financially support an organization, event, or project directed by a non-PA person or group, in

order to gain participation or access to a benefit of sponsorship. The purpose of these costs may include, without limitation, sharing of regional and national best practices, transformation of energy efficiency markets, influencing manufacturers, furthering energy efficiency evaluation techniques and standards, and the ability to network (with customers, contractors, evaluators, or other experts) to learn about additional energy efficiency opportunities and ways in which to improve offered energy efficiency services. These activities all provide benefits to customers and programs generally, but do not focus on a specific initiative. Specific categories of sponsorships enumerated by the Department include:

1. Energy efficiency forums
2. Trade associations
3. National industry associations
4. Groups that target specific industry sectors
5. Universities and organizations that develop new technologies
6. Residential focused groups to educate and engage with the community

Costs reported in the hard-to-measure line items will be limited to sponsorships that are anticipated to provide benefits to customers but are not associated with a specific program or initiative. Conversely, expenses related to the above categories that directly impact programs will be included in the appropriate program budget.

- **Subscription**: Payment by or on behalf of a Program Administrator to receive or use something related to energy efficiency over a fixed period, such as a periodical, a book series, or an informational service.

Costs will be categorized in the appropriate cost category. For additional information on Sponsorships & Subscriptions, please see the policy set forth at Appendix J.

f. Residential HEAT Loan (Residential)

The Residential HEAT Loan budget includes costs to buy down the interest due on the loan and the cost to administer the loans.

The highly successful Mass Save HEAT Loan offers zero percent interest financing to help customers finance the purchase and installation of qualified energy efficiency technologies. For some customers, raising sufficient capital to pay for their upfront customer contribution is a barrier to installing energy efficiency. Financing allows these customers to borrow funds, without having to also bear the cost of the interest on the loan, in order to invest in energy efficiency. Customers may qualify for loans up to $25,000 with terms up to 7 years, depending on the Program Administrator and the loan provider.

Additionally, some pre-weatherization repair costs may be eligible for financing if the repair removes the barrier to installing insulation measures. As discussed above, the Program Administrators are expanding the list of barriers eligible for financing through the Mass Save HEAT Loan® to include the most common pre-weatherization barriers identified during the Home

Energy Assessment. Barriers include knob-and-tube wiring, combustion safety issues, mold, vermiculite and asbestos, and certain structural concerns. Additionally, the Program Administrators are increasing the allowable financing amount for mitigating pre-weatherization barriers.

As part of the new active demand reduction offering, battery storage will also be added to HEAT loan eligible equipment, if customers agree to participate in the active demand offer.

Any savings or costs associated with installing energy efficiency measures due to availability of the HEAT Loan are included in the core initiative under which the measure was installed, for example, in Residential Coordinated Delivery. HEAT Loans are generally administered by the electric Program Administrator, except for instances in which a gas Program Administrator serves a customer in a municipal light plant territory, in which case the gas Program Administrator would offer the loan. Program Administrators have worked with the Massachusetts Bankers Association to provide procedures for banks to participate in the program.

The process for applying for a HEAT Loan is described in detail on https://www.masssave.com/en/saving/residential-rebates/heat-loan-program/.

g. Workforce Development
(Residential, Income Eligible, C&I)

The Program Administrators continue to monitor and support trainings in order to contribute to building and maintaining a qualified workforce that will meet the demand for energy efficiency. Trainings provided under Workforce Development provide general skills or training that could benefit the workforce across initiatives and/or sectors, including topics such as building science, energy efficient new construction, heating and cooling technologies and techniques, and sales and marketing. Program Administrators consistently look for collaborative ways to improve the communication and delivery of trainings to address the demands of the market. This effort is ongoing within the respective management groups and best practices group, as exemplified by the Low-Income Best Practices Working Group chaired by LEAN, and the Contractor Best Practices Working Group, as well as through ongoing communication with key trade allies. In 2019-2021, all Program Administrators will be charging only external (non-employee) general training to this hard-to-measure category.

h. Research and Development ("R&D") and Demonstration
(Residential, C&I)

In the continued efforts to explore new technologies and measures, Program Administrators set forth this budget to pursue new technologies, processes, and strategies that may not immediately lead to savings. This allows the Program Administrators to be proactive, and to be leaders in innovation. Costs associated with the MTAC, as well as research and development into areas of interest, are charged to this category.

i. Residential Education (Residential)

The budget in the Residential Education hard-to-measure effort is used to support public education efforts.

The key objective of the Residential Education effort is to offer an array of K-12+ educational outreach programs and enhanced consumer education. The focus will be to create powerful, engaging, and motivating education and marketing strategies that will increase awareness of the benefits of energy efficiency and drive increased participation in Mass Save energy efficiency programs and services. The strategies developed for statewide energy efficiency education, outreach and marketing will augment the efforts already in use by several Program Administrators.

The Program Administrators' support of educators, students, and parents through program opportunities, curriculum, and materials on energy efficiency and conservation is a critical component in fostering an energy efficiency literate society. Students are the Program Administrators' future customers and staff, and instilling positive energy behaviors in them will prove to be a positive outcome for society.

Several Program Administrators collaborate with the National Energy Education Development ("NEED") Project, bringing energy efficiency curriculum and training to teachers in Massachusetts. Teachers also receive ongoing support for implementing energy efficiency programming in the classroom.

Additional efforts directed at consumers focus on educating customers on the benefits of investing in energy efficiency products and services and the multitude of energy efficiency initiatives available to them. Collaborative efforts for consumer education in the 2013-2015 and 2016-2018 plans included the Energy Savvy online energy assessment tool on the Mass Save website and kits containing "Kill A Watt" meters available through libraries. These efforts will be continued in 2019-2021.

Some Program Administrators also conduct additional direct outreach and provide additional in-school programming to schools in their service territories. These programs will continue to evolve and expand to reach more students. Many of these programs have earned local and national awards for energy education programs.

The Program Administrators plan to work with DOER, educational institutions, the statewide marketing working group, and PA education and/or marketing departments to continue to develop educational and promotional strategies. Efforts for school-aged education will focus on expanding the existing, in many cases award-winning, PA school programs. Educational outreach strategies for 2019-2021 may include:

- Provide energy efficiency related classroom presentations and activities to K-12+ schools.
- Direct educators and children to online educational resources to help educate children about energy safety and conservation.

- Aid with science fairs, teacher training workshops, and other elementary and secondary educational opportunities in collaboration with DOER, Massachusetts Department of Education, and schools throughout the Commonwealth.
- Encourage schools and informal education programs to participate in the annual NEED Project's Youth Awards Program held in April of each year, with follow-up awards program and ceremony in June in Washington, D.C.
- Partner with youth group summer camps promoting energy conservation and behavioral change.
- Partner with communities to educate and promote energy efficiency through energy fairs and community-specific outreach.
- Participate in various energy efficiency employee awareness events.
- Conduct school fundraisers promoting energy-efficient technologies.
- Offer prompt-based contests for students to showcase their energy and energy efficiency knowledge.
- Direct customers to online calculators and web tools to learn more about home energy usage and to offer energy saving recommendations, including information on available energy efficiency incentives.
- Partner with vocational high schools to promote green jobs by providing training and curriculum.

The Program Administrators will work to develop energy efficiency marketing messages aimed at residential customers, educators, students, parent/teacher organizations, and community groups. Proposed collateral will highlight the many benefits of investing in energy efficiency, savings that can be generated by individual efficiency measure upgrades, behavioral changes, and testimonials from past program participants. The Program Administrators will employ a variety of media sources for messaging, which may include bill inserts, bill messages, customer newsletters, www.masssave.com, direct mail, employee and business partnerships, newspapers, social media outlets, and educator workshops.

j. Low-Income Energy Affordability Network (Income Eligible)

LEAN works with the Program Administrators to comprehensively serve income eligible households. LEAN delivers income eligible energy programs and represents income eligible Program Administrator customers in legislative discussions and regulatory proceedings. The LEAN budget is used to pay for their administrative and personnel costs related to income eligible implementation.

k. Evaluation and Market Research (Residential, Income Eligible, C&I)

Starting in 2019-2021 the Program Administrators propose to charge all EM&V costs to a hard-to-measure line item called Evaluation and Market Research, rather than to individual

programs. This change aligns more effectively with current EM&V efforts, which apply to multiple program areas. In fact, the lessons learned from EM&V studies are often applicable to many or all of the programs. Given that EM&V costs are necessary and important, but do not directly lead to savings opportunities, they are appropriately categorized as hard-to-measure. This change will also allow reviewers to better evaluate the actual costs of implementing the program, without comingling the costs of evaluating the program. This budget category will include costs associated with the EM&V budget, potential studies, the avoided energy supply cost study ("AESC Study"), the electronic Technical Reference Manual ("eTRM"), acquisition of data sets, related labor costs, and other evaluation and market research costs. Evaluation and Market Research costs will be allocated to one or more sectors as appropriate to the activity.

2. Pilots

The Program Administrators are not proposing any new pilot programs or initiatives for the 2019-2021 Plan term.

E. PA-Specific Programming

The Program Administrators strive for consistency in program offerings with the goal that customers across the Commonwealth can take advantage of comprehensive energy efficiency services. In some instances, however, individual Program Administrators may provide additional services or unique incentive structures that are specific to their territory. These offerings may be specifically related to the unique characteristics of a service area, or may be developed based on unique conditions in that territory, such as gas constraints or reduction in expense related to very large capital improvement projects. They may also be based on the governing structure of a Program Administrator, such as the Compact, which has a distinct role as a municipal aggregator. Finally, these efforts may be run as a test case by one Program Administrator, with the idea that the programming could be rolled out across Program Administrators if proven successful and cost-effective.

The PA-specific initiatives set forth in Appendix K represent proposals of only the Program Administrator making the proposal. They do not constitute proposals that have been reviewed and agreed to by all Program Administrators, and Program Administrators may have divergent views on the materials contained therein. All Program Administrators reserve their right to comment on these proposals in the future, and the inclusion of these materials does not constitute the consent of any Program Administrator to any other Program Administrator's specific initiatives or proposals.

F. Coordination and Best Practices

1. Management Committees and Working Groups

a. Overview

Consistent with the GCA, the Program Administrators work together to jointly develop and implement the Three-Year Plan. The Program Administrators have maintained their commitment to work collaboratively on a daily basis to ensure that all eligible customers in Massachusetts

experience seamless programs, with consistent application procedures, incentives, and supportive educational and technical services. The Program Administrators consistently develop and share best practices and seek continuous improvement to provide the best possible service to their customers. The Program Administrators have developed management committees, working groups, and best practices committees to have structured channels for sharing best practices. Additionally, the PA Leads, which consists of the individuals responsible for overseeing their respective Program Administrator's energy efficiency activities, collaborate extensively to ensure that the overall strategy and vision remains consistent and in the best interests of customers. The PA Leads meet at least monthly to discuss and set statewide objectives, share challenges and opportunities, and management practices. The PA Leads provide guidance and directives, as needed, to the various management committees.

b. Residential and C&I Management Committees

The Program Administrators maintain working groups that bring together experts from every gas and electric company and energy efficiency service provider in the Commonwealth. These working groups provide for seamless program delivery across fuels and across service territories, and help maintain consistent messaging to customers, trade allies, manufacturers, market actors, and market channels. Chief among these groups is the Residential Management Committee ("RMC") and the Commercial & Industrial Management Committee ("C&IMC"), which work together and with the Council's consultants to plan and deliver programming in their respective sectors. Managing and delivering a statewide portfolio of programs is an ongoing and dynamic exercise, and the management committees are a venue for the program managers to discuss consumer dynamics and expectations, new efficiency technologies, price and baseline changes, effects of evaluation studies on the programs, and changes in the market. In addition to enhancements to existing programs and initiatives, new programs and initiatives are primarily designed by the management committees.

Each management committee works to ensure that: (a) all Program Administrators remain up-to-date on the key activities of other Program Administrators; (b) implementation activities and efforts by all Program Administrators are integrated and coordinated to the optimal extent; (c) program implementation and the Statewide Marketing Committee is coordinated; (d) evaluation and market assessment studies are reviewed and appropriate recommendations are implemented in the programs; (e) program policy and implementation issues are resolved collectively, and decisions are communicated to each PA's staff to ensure uniform application; and (f) program best practices, technology innovations, and integration and coordination efforts in other jurisdictions are reviewed and incorporated as appropriate.

The RMC, C&IMC, and Evaluation Management Committee (described below) meet altogether quarterly in Tri-Management Committee ("Tri-MC") meetings to discuss topics of interest to all management committees. The Tri-MC provides a unique forum for the Program Administrators to communicate and coordinate on topics affecting the statewide programs.

These Management Committees provide an essential function for the Program Administrators to maintain the statewide collaboration and consistent programs that are the hallmark of the nation-leading Massachusetts energy efficiency programs.

c. Low-Income Best Practices

With respect to income eligible efforts, LEAN has convened the highly effective Low-Income Best Practices Group to coordinate practices across all Program Administrators and agencies. The Low-Income Best Practices group meets regularly, and continues to offer opportunities for various stakeholders to discuss program implementation, new measures, innovative strategies, and other matters related to the Program Administrators' income eligible programs.

d. Evaluation Management Committee

The Evaluation Management Committee ("EMC"), established by the Program Administrators and the EM&V Consultant, serves as a steering committee for statewide evaluation activities and issues, providing guidance and direction to each of the evaluation research areas. The EMC works to plan, prioritize and delineate the research studies to be undertaken over the Three-Year Plan term. For more information about the EMC, please see Section H.2.

e. The Massachusetts Technology Assessment Committee

MTAC reviews new technologies that have the potential to cost-effectively save energy. MTAC is both a proactive and a reactive body, and consists of key PA technical staff. The committee addresses residential, commercial and industrial technologies, drawing on the subject matter experts from the committee, PA staff, or outside expertise as necessary. It establishes and publishes threshold technical requirements that must be met to qualify products or processes as eligible for program incentives. It documents its findings in a standardized manner and disseminates them to the PA program managers, technical staff, account managers, and outside parties such as vendors, customers, and other interested parties, as appropriate.

The MTAC is the authority for consistent program interpretation of technical matters relating to emerging technologies and provides information, documented technical interpretations, and technology assessments to the Program Administrators. The committee has developed a set of protocols for the content of their review and procedures for documenting and disseminating their conclusions and technical interpretations. These protocols are publicly available on MassSave.com.[31] The MTAC meets as needed, either as a whole committee or in ad hoc technology or issue-specific subgroups, and more regularly during the annual program review and planning period.

f. Other Committees and Working Groups

The Program Administrators convene other long-term and short-term working groups. Some are discussed below.

Statewide Marketing Committee organizes statewide marketing and media campaigns, manages www.MassSave.com, updates social media campaigns, and works to ensure that

[31] MTAC materials can be found here: https://www.masssave.com/en/learn/partners/assessing-new-efficiency-technologies/.

communications are presented in multiple channels to reach highly diverse customer bases. The Combined Heat and Power Group sets standards required for projects including efficiency levels and incentives. The Common Assumptions Group works to maintain consistent application, calculation, and presentation of savings, benefits and costs. The Demand Working Group works on initiatives related to reducing customer demand, including pilot programs, cost-effectiveness review, and statewide strategies. The Program Administrators also have groups that review tables, specific costs, codes & standards, and education efforts, among other aspects of the energy efficiency programs.

2. Community, Stakeholder, and Third-Party Engagement

The Program Administrators are continuously engaged with a variety of stakeholders. Every day the Program Administrators communicate with residential and commercial customers, program participants, contractors, service providers, equipment manufacturers and distributors, trade and professional associations, legislators and regulators, environmental and community advocates, civic leaders, business owners and organizations, media and marketers, and other interested parties. Every citizen and every business has an interest and a stake in the effectiveness of the portfolio of Massachusetts energy efficiency programs because energy costs touch and affect every person and business in the Commonwealth.

Massachusetts residents and other interested parties can voice their views through existing and established public oversight processes. The Council, which represents a broad spectrum of stakeholder interests, has facilitated additional organized venues for individual and organizational input specific to the energy efficiency programs through regular public comment periods at Council meetings, and additional sessions during the Plan development time period. All the comments and input collected from these various forums are reviewed closely by the Program Administrators.

On a continuing basis, there are a variety of other structured or semi-structured events, venues, or processes through which stakeholder input is encouraged. For example:

- **Annual open houses for trade allies.** Every year the Program Administrators host several large statewide events for the express purpose of presenting and explaining program changes and updates to the business partners the Program Administrators depend on to deliver their various programs to customers. Attendees have ample opportunity to network with each other and PA staff, and to engage in a dialog about program design and operations.
- **Best Practices Working Group.** This group is constituted of a subset of the residential contractors elected annually by their peers, as well as the Program Administrators, and the Lead Vendors. The members meet monthly to provide continuous feedback for the improvement of the program across the state. Topics discussed have ranged from refining the QA/QC process, to adopting new measures such as spray foam, to pricing and training.
- **The Proposal process.** The Program Administrators provide a structured process by which any third-party organization can propose to a management committee a program concept or proposal to supplement or enhance the Program Administrators' approved programs. The criteria and two-step process for considering a proposal is clearly

articulated. This process, while open, is rigorous and applicants must demonstrate that their concept can demonstrate and produce cost-effective and incremental energy savings beyond the work being performed by the Program Administrators.[32]

- **The Massachusetts Technology Assessment Committee process.** The clearly-articulated and open process by which MTAC reviews submitted technologies provides a level playing field. Any manufacturer or vendor of an emerging or newly-commercialized efficiency technology can make a science-based case for acceptance of their product into the Program Administrator offerings.
- **Informal Program Administrator speakers' bureau.** Program Administrator representatives are regularly called upon to represent and explain the programs to trade and civic associations. Industry associations, like the Massachusetts Restaurant Association and the Massachusetts Lodging Association, seek knowledgeable speakers to explain how the programs can work for their members and provide relevant case study examples from their industry.
- **Proactively solicit input from customer and industry experts.** The Program Administrators routinely seek input from key constituencies when they are considering program design changes or considering new product innovations. For example, a Program Administrator may need to establish that a product meets a customer's priority business need before promoting the energy saving attributes.
- **Input and advice from peer programs.** The delivery of energy efficiency programs throughout the country is largely a collaborative and congenial enterprise. PA program managers have come to know their peers in other jurisdictions around the country, and consider each other colleagues in a shared mission of improving the efficiency of homes and businesses in the United States. This means that emerging program ideas and best practices are freely shared. Massachusetts program managers test program concepts and share evaluation results and technical information with their counterparts, and receive feedback that is built into new program designs or improvements to existing ones.
- **Provide collateral materials for customer events**. Individual Program Administrators routinely offer stakeholders significant volumes of energy efficiency program collateral for distribution at local community and trade association meetings.

[32] The documents related to the proposal process are available at: https://www.masssave.com/en/learn/partners/process-for-managing-proposals/

IV. STATEWIDE BUDGETS, SAVINGS, AND BENEFITS

A. Summary of Budgets, Lifetime Savings, and Benefits

1. Introduction

The program budgets, savings, and benefits set forth in this Plan are presented on an aggregate, statewide basis. In the Energy Efficiency Data tables, each Program Administrator provides its individual recommended savings and budget levels for the three-year term commencing January 1, 2019, consistent with the statewide program designs and energy efficiency framework. Please also see Appendix C for statewide Energy Efficiency Data Tables for budgets, savings, benefits, and cost-effectiveness.

As described above, the Program Administrators have set forth some key savings metrics in this Plan designed to measure success and support their overall holistic approach to reducing energy use for customers. The key savings metrics are:

- Net lifetime MMBtus savings at site from all fuel sources (excluding MMBtus associated with combined heat and power, and active demand reduction efforts), and net lifetime MMBtus savings at source from combined heat and power. Statewide MMBtus are expressed as adjusted MMBtus to reflect the MMBtu savings from energy efficiency and combined heat and power measures.
- Demand savings (kW) for electric Program Administrators
- Net lifetime electric savings (MWh) (excluding fuel conversions and active demand reduction efforts) for electric Program Administrators
- Net lifetime gas savings (therms) for gas Program Administrators

Please see Section II.C for more details regarding the use of these core savings metrics for measuring success in 2019-2021.

Following historic aggregate savings achievements, the goals set forth in this Plan reflect the current market after years of energy efficiency programming in Massachusetts, the unique characteristics of each Program Administrator's service area, the specific needs of each Program Administrator's customers, and Massachusetts state policy goals related to energy. These programs provide benefits for customers related to avoided costs, non-energy impacts, greenhouse gas reductions, and job growth and retention.

2. Statewide Combined, Electric, and Gas Data

a. Statewide Combined Data

Statewide Adjusted Net Lifetime Savings All Fuels (MMBtu) (excluding ADR)				
	2019	2020	2021	2019-2021
Residential	32,158,316	32,792,312	34,403,212	99,353,830
Income Eligible	7,381,055	7,437,527	7,401,853	22,220,435
Commercial & Industrial	43,646,009	60,829,638	43,961,394	148,437,041
Total	**83,185,379**	**101,059,477**	**85,766,460**	**270,011,315**

Statewide Benefits ($)				
	2019	2020	2021	2019-2021
Residential	884,813,049	881,763,197	907,597,567	2,674,173,813
Income Eligible	283,432,060	284,020,835	274,937,567	842,390,461
Commercial & Industrial	1,575,982,212	1,872,018,456	1,569,714,492	5,017,715,160
Total	**2,744,227,320**	**3,037,802,488**	**2,752,249,626**	**8,534,279,434**

Statewide Budgets ($)				
	2019	2020	2021	2019-2021
Residential	408,500,959	411,349,996	413,790,981	1,233,641,935
Income Eligible	60,370,482	133,150,517	135,950,124	398,644,873
Commercial & Industrial	78,575,406	393,770,253	386,132,529	1,137,879,697
Total	**896,022,104**	**938,270,767**	**935,873,633**	**2,770,166,505**

b. Statewide Electric Data

Electric PA Net Adjusted Lifetime Savings All Fuels (MMBtu) (Excluding ADR)				
	2019	2020	2021	2019-2021
Residential	13,753,653	14,120,807	15,467,105	43,341,556
Income Eligible	2,811,973	2,823,192	2,835,801	8,470,966
Commercial & Industrial	25,078,604	41,991,446	24,927,224	91,997,274
Total	**41,644,229**	**58,935,445**	**43,230,131**	**143,809,805**

Electric PA Lifetime Electric Energy Savings (MWh) (excluding fuel conversions and ADR)				
	2019	2020	2021	2019-2021
Residential	1,902,972	1,558,942	1,215,631	4,677,544
Income Eligible	363,064	353,593	349,130	1,065,788
Commercial & Industrial	8,561,444	13,063,945	8,926,804	30,552,192
Total	**10,827,480**	**14,976,480**	**10,491,565**	**36,295,524**

Electric PA Summer Peak Demand Reductions (kW)				
	2019	2020	2021	2019-2021[33]
Residential	71,215	68,017	60,229	176,686
Income Eligible	5,540	5,646	4,079	15,265
Commercial & Industrial	199,976	262,903	275,694	502,309
Total	**276,731**	**336,566**	**340,002**	**694,259**

Electric PA Budgets ($)				
	2019	2020	2021	2019-2021
Residential	260,912,913	258,409,971	256,941,050	776,263,934
Income Eligible	2,862,029	74,974,931	77,137,716	224,148,425
Commercial & Industrial	24,177,850	337,707,550	328,991,633	970,278,542
Total	**636,528,050**	**671,092,452**	**663,070,398**	**1,970,690,901**

Statewide tables reflect aggregated proposals of the individual electric Program Administrators.

[33] Please note that active demand savings are not cumulative. The 2019-2021 total reflects the sum of passive demand reductions and 2021 active demand reductions.

c. Statewide Gas Data

Gas PA Net Lifetime Savings All Fuels (MMBtu)				
	2019	2020	2021	2019-2021
Residential	18,404,663	18,671,505	18,936,107	56,012,274
Income Eligible	4,569,082	4,614,335	4,566,052	13,749,469
Commercial & Industrial	18,567,405	18,838,192	19,034,170	56,439,767
Total	**41,541,150**	**42,124,032**	**42,536,329**	**126,201,510**

Gas PA Lifetime Gas Savings (therms)				
	2019	2020	2021	2019-2021
Residential	180,553,615	183,436,773	186,148,428	550,138,816
Income Eligible	45,024,648	45,471,340	44,951,353	135,447,341
Commercial & Industrial	185,653,635	188,361,167	190,320,667	564,335,468
Total	**411,231,897**	**417,269,281**	**421,420,448**	**1,249,921,626**

Gas PA Budgets ($)				
	2019	2020	2021	2019-2021
Residential	147,588,046	152,940,025	156,849,931	457,378,001
Income Eligible	57,508,453	58,175,586	58,812,408	174,496,448
Commercial & Industrial	54,397,556	56,062,703	57,140,896	167,601,155
Total	**259,494,054**	**267,178,315**	**272,803,235**	**799,475,604**

Statewide tables reflect aggregated proposals of the individual gas Program Administrators.

B. Common Assumptions and Electronic Technical Reference Manual

The Program Administrators continuously work together to develop and apply common assumptions. Consistent collaboration and structured review of common assumptions through the working groups, such as the Common Assumptions Working Group, allows the Program Administrators to collectively provide the best available data in the most consistent manner. The Program Administrators work together to harmonize assumptions and approaches to various cost, savings, and benefits data. Program Administrators collectively determine way the avoided costs from the AESC Studies and evaluation results are applied, including non-energy impacts. Additionally, Program Administrators have worked together to include similar data, measure IDs, and naming conventions in the screening models and eTRM.

Specific program assumptions are accounted for uniformly, and algorithms are applied in the same manner across Program Administrators, as set forth in the eTRM. The eTRM documents how the energy efficiency Program Administrators consistently, reliably, and transparently calculate savings resulting from the installation of prescriptive energy efficiency measures. The eTRM provides methods, formulas, and default assumptions for estimating energy, peak demand, and other resource impacts from energy efficiency measures. The eTRM is an excellent example of how the Program Administrators work together, share data and best practices and work to develop common assumptions that reflect state-of the-art EM&V results. The Program Administrators have transitioned the former technical reference manual into an electronic version, which is available publicly and provides additional search functions to aid users. The eTRM is available at http://www.masssavedata.com/Public/TechnicalReferenceLibrary. The Program Administrators have made improvements to the eTRM in order to provide a more user-friendly experience. Please see Appendix L for a paper copy of the technical reference manual.

Under the GCA, the Program Administrators implement common programs. Therefore, in order to be able to review participants in a consistent manner, the Program Administrators develop a set of common definitions to guide each Program Administrator's participant calculation. These definitions are designed to reflect unique participants in each program and initiative. Please see Appendix M for participant definitions used in this Plan.

C. Development of Goals

1. Introduction

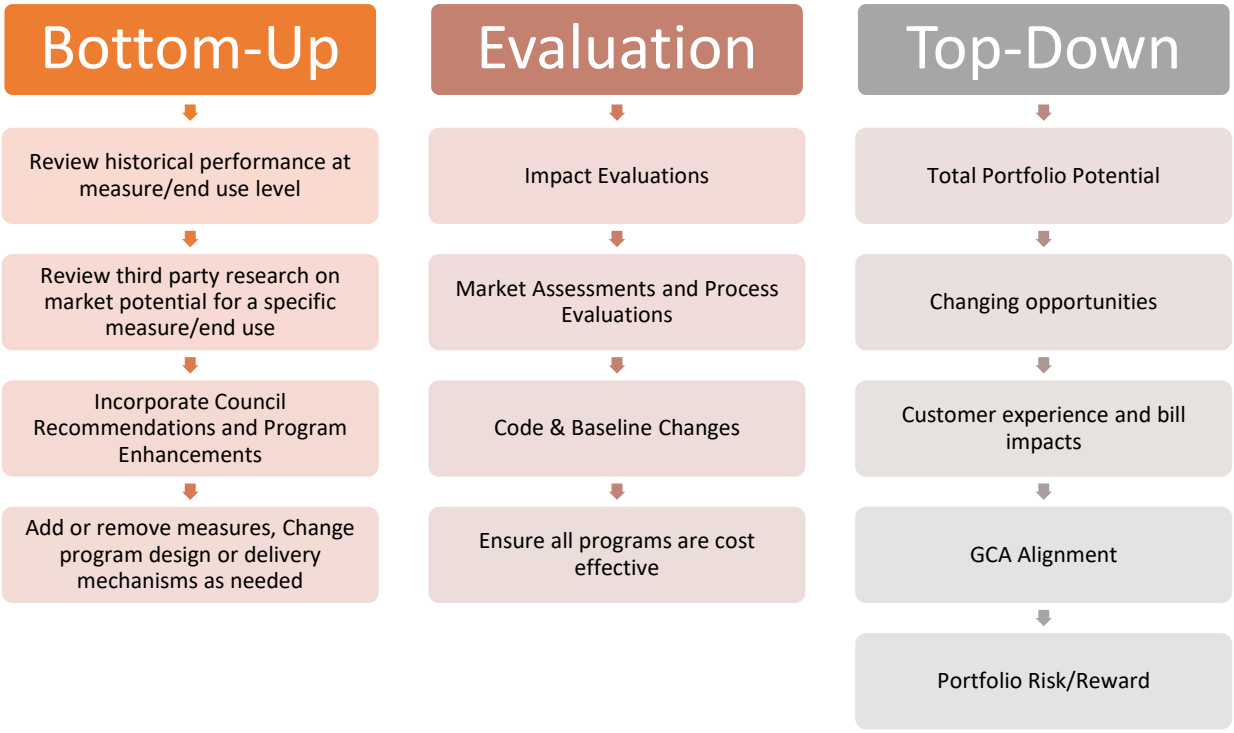
The Program Administrators engage in a highly collaborative and detailed planning process for setting savings goals and budgets. Programmatic decisions that inform savings goals and budgets are made both at the individual PA level and at the statewide level, including work by the respective management committees, which facilitate ongoing stakeholder input, continuous sharing of best practices, and consistency of offerings among the Program Administrators. While ultimately the results associated with development of a Program Administrator's plan are PA-specific and the planning process for savings varies for each program and initiative, certain common processes apply to inform the development and to facilitate regulatory review.

2. Process to Determine Goals

a. Overview

The development and determination of the proposed statewide and Program Administrator-specific savings goals involves many considerations, and there is no simple, algebraic method to develop goals to meet the requirements of the GCA. The Program Administrators' process considers many factors, including the assessment of savings opportunities in individual PA service areas (bottom-up), incorporation of recent evaluation study findings, and a collaborative consideration of statewide policy objectives that balances savings goals with the total cost of capturing energy efficiency (top-down). The bottom-up process involves determining savings by measure, including projected quantities and customer incentive amounts for every piece of energy efficient equipment, and the type of technology or program service. The top-down process looks at the portfolio as a whole, evaluating the potential for achieving savings given the mature markets

in which the programs are operating, subject to overall cost. The impact of evaluation results, including process and market assessment studies, are considered in both bottom-up and top-down planning and may drive other adjustments. The process to determine goals is appropriately fluid, flexible and iterative, incorporating information that the Program Administrators learn throughout the planning process related to program design, evaluation, market conditions, costs and other factors.



The 2019-2021 Plan accounts for many interacting considerations, including, but not limited to, bill impacts, cost-efficiency, integrated program delivery, contractor and market infrastructure, economic and environmental benefits, efforts focused on innovation, customer experience, changing market conditions, and the need to establish an "integrated" effort that can be "sustained" over time, as mandated by the GCA. G.L. c. 25, § 22(b). In assessing the level of energy efficiency savings that is possible and sustainable for this Plan, the Program Administrators considered a number of factors. These factors include: (1) quality of program implementation; (2) customer economic conditions; (3) bill impacts; (4) market conditions/seasonality for various measures; (5) lower avoided costs; (6) market barriers; (7) equity concerns; (8) the need to avoid "stops/starts" that send negative messages to the contractor community; (9) the capacity and reach of vendors and contractors; (10) the need to provide consistency over time to be able to capture time-dependent opportunities such as renovations and new construction; (11) the need to accommodate new technologies over time; and (12) input and consideration of priorities articulated by DOER and the Attorney General in Term Sheet discussions. Ensuring sustainability requires the Program Administrators to examine all of these considerations when developing their energy efficiency goals.

The planning process for the 2019-2021 period began with a focus on customers' experience with the suite of energy efficiency programs. Significant effort and expertise were dedicated to reviewing the hierarchy of residential, income eligible, and C&I programs and initiatives. As a result, the Program Administrators have refined the design of programs to better reflect how energy efficiency services are accessed from the perspective of customers. Refocusing Program Administrator efforts to enhance the customer-centric program design will help to promote flexibility in delivery models, and drive maximum achievement of energy efficiency savings and benefits.

b. Bottom-Up Planning

The bottom-up planning process includes a combination of PA-specific and statewide activities, is iterative, and is often impacted by changes to program design and delivery models. The enhanced focus on a customer-centric approach affects bottom-up planning in that the budgeting process will now be driven more strongly through multiple channels. For example, the budgeting process in the Residential Retail initiative is driven by the number of rebates expected to be delivered through mass market, while the Residential Coordinated Delivery initiative is planned based on the projected number of assessments undertaken, homes weatherized, and customers served.

The Program Administrators typically begin each planning process by examining historical data to gain insight into participation trends, savings achieved, and costs to achieve annual and lifetime savings. The Program Administrators also consider recent or pending changes in federal efficiency standards, as well as other third-party research on consumer adoption of new technology. In parallel to each Program Administrator assessing what they can achieve over the next three years, the Program Administrators collaborate to decide what changes, if any, need to be made to program offerings. For example, the Program Administrators may decide to discontinue measures that have become standard efficiency practice, or to add new measures and services in response to improved technologies or identified consumer needs, subject to consideration of cost-effectiveness. The value of energy benefits is determined through a regional AESC Study, which also guides the Program Administrators as they look to achieve all cost-effective energy efficiency opportunity. See Appendix H.

The statewide planning work is undertaken at the respective management committees and working groups, ensuring input from all stakeholders, continuous sharing of best practices, and facilitating consistency of offerings among the Program Administrators. Each Program Administrator uses this information to develop a forecast of energy efficiency that can be achieved in its unique service territory. Program Administrators also consult with their own or statewide vendors to support or augment their forecasts based on their own market intelligence. Manufacturers and contractors may also be consulted for insight into workforce capacity and technology availability and limitations.

c. Top-Down Planning

While bottom-up planning focuses on individual measures within each Program Administrator's service territory, top-down planning considers what is reasonable and achievable for the energy efficiency portfolio as a whole. This planning effort involves the examination of

impacts to the markets the programs are targeting, as well as cost implications to the Program Administrator, its participating and non-participating customers.

One of the tools that Program Administrators use in top-down planning is potential studies, which help Program Administrators to better understand the overall opportunity to achieve energy efficiency savings within their territory. Potential studies typically provide the Program Administrator with insight into three types of energy efficiency potential:

- *Technical Potential* is defined as the *complete* saturation of energy efficiency measures that are technologically feasible without consideration of cost or likely consumer acceptance.
- *Economic Potential* is a subset of *technical potential* consisting only of that technology that results in more benefits than costs over the life of the measure.
- *Achievable Potential* is a further subset of economic potential and is limited to that which is attainable given barriers faced by real-world program infrastructure and customer, market or other limitations.[34]

The Program Administrators use the results of potential studies to gain valuable insight into the achievable, cost-effective energy efficiency potential over a period of years. This information helps guide the Program Administrators to set term savings goals that consider not only what is available and cost-effective, but also how willing and able customers are to adopt energy efficiency measures. Each of the Program Administrators has performed a territory-specific potential study in advance of the 2019-2021 Plan filing in accordance with the Department's directive. 2016-2018 Three-Year Plans Order at 24-25. The results of those studies, and the lessons learned, have been shared among all Program Administrators so that each PA can learn from these studies.

The potential studies consider a wide range of factors to estimate potential savings over time, including but not limited to the size of the market, economic trends, current market penetration and saturation of specific equipment, adoption rates for efficient equipment, costs and benefits associated with efficiency upgrades, and market barriers. In addition, to the extent that evaluation results were available when the potential studies were conducted, these results were accounted for in assessing potential savings. The Program Administrators use the results of potential studies to understand the remaining achievable, cost-effective potential opportunity for savings over the next three-year period. This information helps the Program Administrators to set savings goals in the Plan that are sustainable and take into account not only what is available and cost-effective, but also how willing and able customers are to adopt energy efficiency measures.

Each of the potential studies, in addition to providing technical, economic, and achievable scenarios as described above, looks at several different scenarios of achievable potential in order to understand the sensitivity of achievable savings to inputs such as increased incentive levels and higher levels of spending on marketing and program awareness. The studies generally include statements of potential that range from looking at the "business as usual" case, up to a scenario in which the Program Administrator pays 100 percent of costs as customer incentives and

[34] Potential definitions are based on ACEEE definitions available at http://aceee.org/topics/efficiency-potential-and-market-analysis.

significantly ramps up costs associated with marketing and program awareness. The Program Administrators review these scenarios with an understanding of the need to minimize customer bill impacts, and the need to maintain sustainable energy efficiency efforts over time. The Program Administrators also take into account any changes in market conditions or other information that may impact the recommendations from the potential studies. The PA-specific potential study materials are attached at Appendix N.

d. Evaluation Results

As noted above, Program Administrators also utilize the results of third party evaluation to inform proposed goals. As part of the statewide EM&V framework, the Program Administrators collectively conduct many different types of evaluation studies, including impact evaluations, baseline studies, net-to-gross studies, market effects evaluation, non-energy impact studies, cost and measure life studies, market characterization, and process evaluations. For more information on each type of study please see Section IV.H.4.

e. Cost Drivers

A final step in energy efficiency goal setting for the three year term is to develop budgets to deliver the energy efficiency programs to the marketplace. This involves assessing the cost impact of the programs on participating and non-participating ratepayers in support of "right sizing" proposed budgets. The Program Administrators' statewide energy efficiency programs have matured significantly since the development of the first Three-Year Plan in 2009, as have the technologies that are promoted through the programs. In the 2019-2021 term, the Program Administrators face new challenges in pursuing all cost-effective energy efficiency, including more robust lighting and equipment baselines, stretch code adoption in most of the Commonwealth's towns and cities, and widespread adoption of the least expensive energy efficient technologies, driven by past and ongoing PA-led efforts, such as LED lighting. The cost of marketing, delivering and evaluating ever more sophisticated programs is also expected to increase in order to capture more complex and deeper opportunities, such as controls and demand reduction.

To address these challenges and deliver cost-effective energy efficiency programs to their customers, the Program Administrators have developed a thorough understanding of current and future cost drivers for their proposed energy efficiency programs. Because each Program Administrator is affected to a different degree by each cost driver, variations in savings goals and the cost to achieve these goals are to be expected. Customer demographics, fuel mixes, economic conditions, differences in the built environment and even contractor wages vary widely across the Commonwealth and impact each Program Administrator's service territory differently. Each Program Administrator sets its goals based on their own unique service territory.

From 2009-2011, the cost to achieve savings for electric energy efficiency programs throughout the state was trending downwards.[35] During that same period, the cost to achieve

[35] The Program Administrators note that the costs and savings of large, one-time projects can skew the historical costs to achieve savings, often making the costs appear lower than the average. Because large projects are not typical or replicable, they should not be included in the planning process to estimate budgets or savings, or when calculating costs to achieve savings, without careful analysis and appropriate adjustments. For

savings for gas programs was trending upwards. From 2012-2014, the cost to achieve savings for electric and gas energy efficiency programs throughout the state was relatively stable with a modest increase in the cost of delivering gas programs. During the 2016-2018 Plan Term there was an upward trend in cost to achieve savings from the 2013-2015 Plan Term, though thanks to cost-effective implementation practices, the increase was not as great as Program Administrators anticipated.[36] Although the number of customers to be served in 2019-2021 is expected to remain steady, the average claimable savings per participant will be lower due to naturally-occurring energy efficiency and past participation, as well as more stringent local, state and federal codes and standards. As a result, the Program Administrators anticipate that costs in 2019-2021 will increase due to a shift to a shorter-lived and more expensive measure mix. Additional details on key cost driver considerations include the following:

- **Codes and Standards** – As federal and state codes and standards become increasingly rigorous, the amount of incremental savings from installing energy efficiency measures decreases (unless the efficiency of the program measures rise as well). This decrease in savings results in a higher cost per unit of savings. The Energy Independence and Security Act ("EISA") lighting standards continue to raise the bar for program delivery, as do federal water heater standards, the highly efficient new construction practices in the Commonwealth driven both by the GCA requirement that member communities adopt stretch codes, as well as by aggressive outreach by Program Administrators, and increasing federal standards for many different kinds of equipment. While these changes still drive real savings for customers in the Commonwealth, these factors reduce the incremental energy savings the Program Administrators can capture and claim through their programs.
- **Going Deeper and Broader** – Another factor that is impacting the cost to achieve in this Plan is the planned implementation of new program delivery models, including the enhanced customer-centric approach. As certain programs begin to saturate markets, Program Administrators seek to reach more difficult to reach customers, which requires more creative, and often more expensive marketing efforts, as well as deep savings, such as Passive House. During the 2019-2021 term, the Program Administrators have restructured programs and initiatives to provide multiple points of entry for customers, regardless of the services or equipment sought, which may be more expensive than previous strategies. Some initiatives proposed for 2019-2021, such as Residential Coordinated Delivery, are designed to be more comprehensive in scope than the previous initiatives. This reflects a more seamless, comprehensive, and supportive approach to program design and delivery. Program Administrators incorporated findings of process and market evaluations to adjust programs to further penetrate markets already deeply penetrated by the Program Administrators and their programs.
- **Cost-Effectiveness Limitations** – The 2018 AESC Study projected a continued decline in wholesale natural gas prices as well as electricity and summer demand prices as a direct result of wholesale natural gas prices and energy efficiency. As a result, the energy-related

example, some Program Administrators had large CHP projects in 2011, making the cost per kWh appear to decrease in 2011 compared to previous years. When excluded, however, costs were relatively flat.

[36] "Cost to achieve" is typically discussed in terms of net savings. Net to gross factors are only updated at the beginning of a three-year term and their impact may therefore be more pronounced when looking at differences between two different Three-Year Plans.

benefits of energy efficiency programs are lower than they have been in prior terms, challenging Program Administrators to minimize costs and maximize benefits to maintain cost-effective program delivery. Some traditional measures may become non-cost-effective. The Program Administrators are pursuing new delivery options as well as new technologies to capture untapped energy efficiency potential. These efforts are not without cost, however, which puts pressure on programs in the short term. For example, new active demand reduction initiatives provide benefits to the energy system but have significant upfront and ongoing costs, and the 2018 AESC Study projects declining capacity benefits.

- **Unique Service Area Drivers** – Despite consistent program offerings, variations among Program Administrators in savings goals and costs to achieve naturally result due to each Program Administrator's unique service territory. Each Program Administrator's territory has a distinct mix of customers, markets, and vendors. Contributing to these differences are varying customer demographics, different mixes of building and business types, penetration of natural gas and delivered fuels, economic conditions, depth of community engagement, and population density. Each Program Administrator has unique commercial and residential demographics, which may result in differences in how each Program Administrator approaches program delivery. For example, the service territory of one Program Administrator may have a smaller percentage of commercial customers than the statewide average, and thus may not be able to benefit from the higher savings opportunities that tend to correspond with that customer segment. Similarly, a Program Administrator may have a higher proportion of lower-income residents, requiring greater coordination with the community and higher costs to serve. Unique characteristics of smaller territories are more apparent than in larger territories, which represent a broader array of customers and communities that make these unique characteristics less visible. Variances among Program Administrators are appropriate, consistent with sound regulatory policy, the GCA, and previous Department recognition of Program Administrator differences. In setting their goals, each Program Administrator has used their knowledge of their unique service territory, as well as inputs and insights from their independent energy efficiency Potential Study, to design programs that best meet the needs of their customers. All Program Administrators are committed to achieving all available cost-effective energy efficiency in accordance with the GCA.

f. Information Sharing

As part of the process of developing goals and budgets, following the submission of the April Draft, the Program Administrators worked with the Council's consultants to share information on the assumptions that are used for bottom-up planning. The Program Administrators also considered the multiple (and sometimes conflicting) priorities of the Council members and other stakeholders in planning for cost-effective savings opportunities in 2019-2021. For example, the Program Administrators have included a strong commitment to promoting cold climate air source heat pumps in this Plan, which offer an exciting opportunity that is supported by the Commonwealth, but which also come with additional costs. Finally, the Program Administrators worked with the DOER and the Attorney General to review aspects of the Plan, including savings and cost assumptions, and to ultimately agree to statewide goals and budgets that reflect all cost-effective energy efficiency, and take into account sustainability and bill impacts in accordance with the GCA. See Appendix F. These agreed-to goals reflect months of review and collaboration,

and take into account the unique savings opportunities and cost considerations of each individual Program Administrator.

g. Summary of Savings Goals Development

In developing the proposed savings goals, the Program Administrators undertook, individually and collectively, a detailed review of energy efficiency opportunities and costs, with a particular emphasis on customer barriers and opportunities. This analysis included a bottom-up approach to assess savings opportunities by measure and initiative, a top-down look at overall savings potential and cost to achieve savings, and careful consideration of evaluation study findings, potential studies, and market changes. Development of the 2019-2021 Plan was influenced by collaborative discussions with the Council and stakeholders to better understand key savings and cost drivers across the Commonwealth, considering sustainability of delivery efforts and bill impacts. Ultimately, the Program Administrators, the Attorney General, and DOER reached agreement on the high level statewide savings and benefit goals, as well as target budgets, for the 2019-2021 Three-Year Plan. See Appendix F.

D. Cost Categorization

1. Overview

The Program Administrators have developed consistent definitions and methods of assigning costs. The Program Administrators developed common definitions to assign budget costs across all five program implementation cost categories. With respect to salaries and overhead, each Program Administrator has developed a method to allocate these costs to appropriate cost categories. With respect to vendor costs, the Program Administrators utilize uniform practices to assign these costs based on cost causation principles.

2. Program Implementation Budget Cost Category Definitions

Program Administrators developed and refined the program implementation cost category definitions over several years. The categories below are consistent with the implementation of the 2016-2018 Plan. The statewide definitions used by all Program Administrators in this Plan are as follows.

> **Program Planning and Administration** - includes costs associated with developing program plans, including market transformation plans, R&D (excluding R&D assigned to Evaluation and Market Research), day-to-day program administration, including labor, benefits, expenses, materials, supplies, overhead costs, any regulatory costs associated with energy efficiency activities, database/data repository development and maintenance, and energy efficiency services contracted to non-affiliated companies, e.g., outside consultants used to prepare plans, screen programs, improve databases and perform legal services. This category also includes internal salaries for administrative employees/ tasks, including program managers who do not have direct sales and technical assistance contact with customers.

Marketing and Advertising - includes costs for the development and implementation of marketing strategies and costs to advertise – through television, radio, billboards, brochures, telemarketing, web-sites and mailings – regarding the existence and availability of energy efficiency programs or technologies, and to induce customers or trade allies to participate in energy efficiency programs. These costs include internal salaries for employee functions related to marketing and advertising.

Participant Incentives - includes funds paid by the reporting Program Administrator to or on behalf of customers or trade allies as rebates or in other forms. Participant incentives include costs that directly benefit customers, including permit fees, pre-weatherization expenses, repairs, and interest buy-down.

Sales, Technical Assistance & Training - includes administration, sales technical assistance and training costs to motivate: (1) customers to install energy efficiency products and services; (2) retailers to stock energy efficiency products; (3) trade professionals to offer energy efficiency services; (4) manufactures to make energy efficiency products; and (5) use of vendor services and suppliers that demonstrate benefits of energy efficiency. This category also includes costs not directly tied to savings, including residential assessments, technical assistance studies, contractor fees and performance bonuses, vendor cost of money; lead vendor fees and internal salaries for employees with direct customer sales and technical assistance contact.

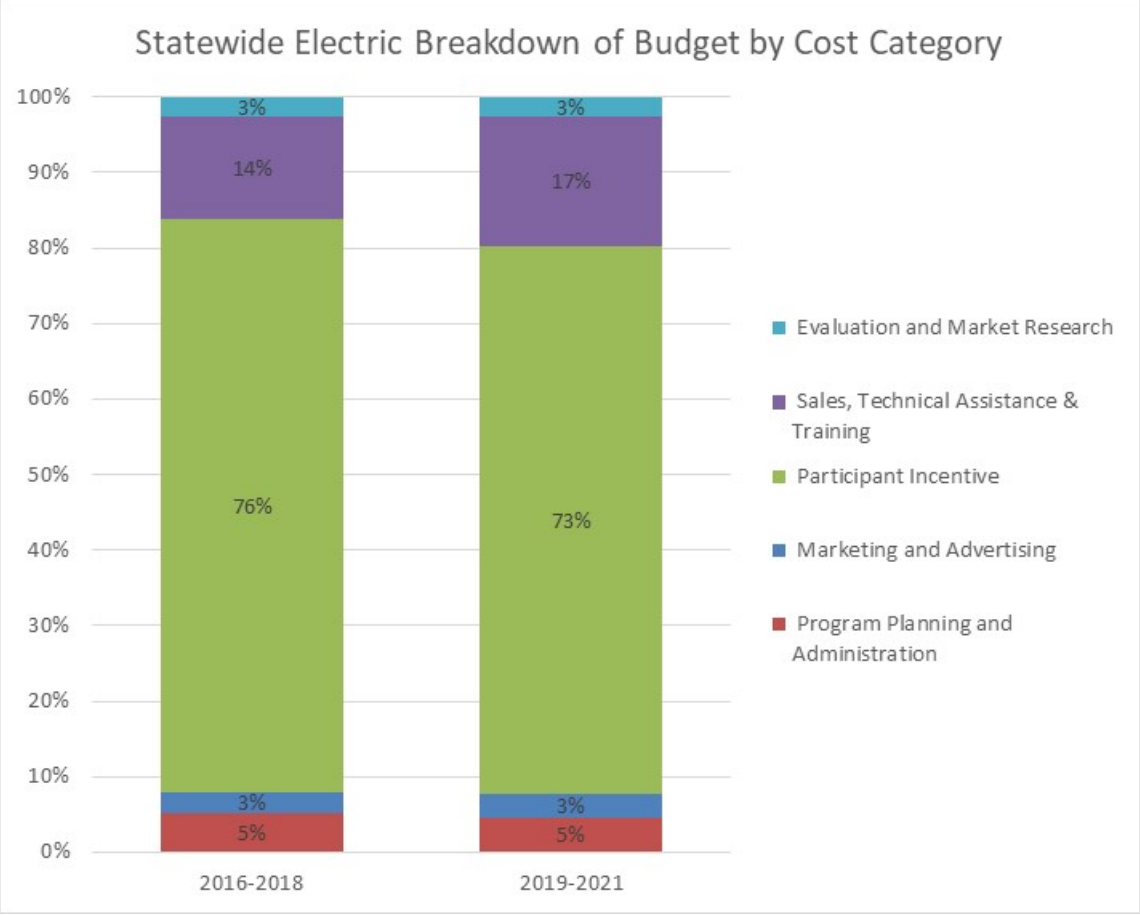
Evaluation and Market Research - includes costs associated with cost-effectiveness evaluation, market research (e.g., baseline studies, market assessments and surveys, technical potential studies), impact and process evaluation reports, tracking and reporting program inputs and outputs, funding studies, eTRM, and other costs related to evaluations and market research. This category also includes internal salaries for employee functions related to evaluating the programs.

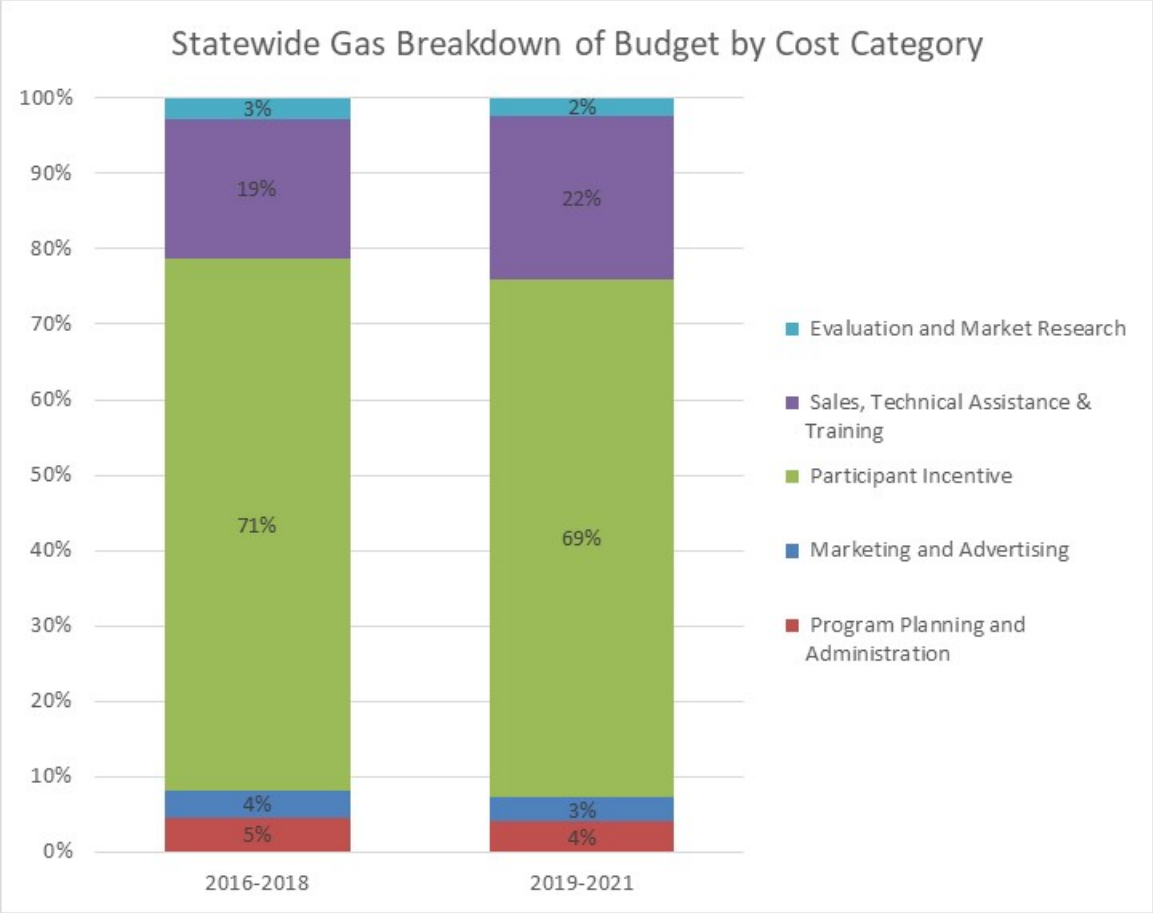
These cost categories have remained consistent since the last three-year plan, except for one cost, Potential Studies. These costs were originally classified as PP&A because they were done as part of a planning process, but were moved to the cost category of Evaluation and Market Research during 2016-2018 based on cost causation principles. While potential studies continue to be a planning tool for the Program Administrators, these studies are more appropriately categorized as market research costs and therefore charged to Evaluation and Market Research. All Program Administrators have made this change consistently.

At this time, the Program Administrators have not encountered any costs that are difficult to assign to one of the five cost categories. Costs are assigned to the relevant category within the relevant program, core initiative, or hard-to-measure program. Costs that are not appropriately assigned directly to a program are allocated among relevant programs on an appropriate basis and tracked accordingly. Costs related to Evaluation and Market Research are assigned to the hard-to-measure line item, as described in Section III.D.1.k and Section IV.H.6, below.

3. Breakdown of Program Implementation Budget by Cost Category

The majority of energy efficiency program implementation budgets are delivered directly to customers in the form of incentives that are intended to overcome the financial barrier to investment. In the 2019-2021 Plan, 73 percent of the electric and 69 percent of the gas budget is delivered directly to customers through use of participant incentives. Participant incentives help customers adopt high efficiency measures and is one of the primary drivers of historic and continuing energy savings. Approximately 17-22 percent of the Program Administrators' costs are budgeted in the Sales, Technical Assistance & Training cost category, supporting the activities of vendors, contractors and other industry professionals. These investments are driving job creation and the evolution of a green economy in the Commonwealth. Approximately 3 percent of the statewide budget is dedicated to the rigorous Evaluation and Market Research efforts. Other administrative functions, like Program Planning and Administration and Marketing and Advertising, make up approximately 7-8 percent of the statewide program budget. These percentages are in line with historical averages, demonstrating that the Program Administrators have been able to significantly grow their energy efficiency portfolios while keeping administrative costs low and maximizing the value of the programs for participating customers.





4. Salaries

Consistent with Department precedent, all Program Administrators have developed allocation methods based upon cost causation principles to assign expenses to the appropriate budget category.

For PA staff performing multiple functions, employee salaries are allocated across the appropriate budget categories based on the percentage of employee time spent on various functions within energy efficiency. Program Administrators treat salaries as follows: (1) assign salaries of staff performing a single function to the appropriate cost category in the appropriate program/sector; and (2) assign salaries of staff performing multiple functions to multiple cost categories in multiple programs/sectors, as appropriate, based on an allocation for each employee in accordance with assigned job tasks. Salaries of program managers with direct sales and technical assistance customer contact are allocated to STAT, while salaries of program managers without direct contact are allocated to PP&A.

5. Vendor Cost Categories

The Program Administrators also collaborate to use consistent vendor cost categories. The Program Administrators consistently review new costs to determine the appropriate category. Program Administrators maintain a chart, attached at Appendix O, showing vendor cost types and

the related cost category to support consistency and serve as a guide. Since the 2016-2018 Plan, the only change on this list is the Statewide Database, which was previously charged to Evaluation and Market Research to enable separate cost tracking that could not be done at that time, but is now appropriately charged to PP&A.

6. Sponsorships & Subscriptions Costs

Sponsorships and subscriptions support the energy efficiency market, encourage workforce education, attract skilled employees to Massachusetts, and promote innovation in both service delivery and the development and testing of energy efficient technologies. Consistent with Department directives, the Program Administrators developed a methodology for assigning costs related to sponsorships and subscriptions. Expenses paid to directly support a program are considered program expenses and are allocated to the appropriate programs/initiatives where benefits are expected to be realized. Sponsorship and subscription costs that are not directly linked to specific in-the-field energy efficiency measures or services are allocated the Sponsorship and Subscription hard-to-measure program. A cost may be included in program line items even if called a sponsorship or subscription because the expense is directly related to the program. Please see Sponsorships and Subscriptions Policy at Appendix J for more information.

7. Evaluation and Market Research Costs

As discussed in Section III.D.1.k, above, starting in 2019-2021 the Program Administrators propose to charge all EM&V costs to a hard-to-measure line item called Evaluation and Market Research. There will be no EM&V costs allocated to individual programs. This budget category will include costs associated the EM&V budget, potential studies, the AESC Study, the eTRM, acquisition of data sets, and other evaluation and market research costs. Evaluation and Market Research costs will be allocated to one or more sectors as appropriate to the cost.

E. Statutory Budget Requirements

1. Minimizing Administrative Cost

In accordance with the GCA, the Program Administrators seek to minimize administrative costs to the fullest extent practicable. Administrative costs, also commonly referred to as PP&A costs, include costs associated with:

- Developing program plans, including market transformation plans, R&D activities (excluding R&D assigned to Evaluation and Market Research).
- Day-to-day program administration, including labor, benefits, expenses, materials, supplies, and overhead costs.
- Any regulatory costs associated with energy efficiency activities.

- Costs for energy efficiency services contracted to non-affiliated companies such as outside consultants used to prepare plans, screen programs, improve databases, and perform legal services.
- Internal salaries for administrative employees/tasks, including program managers that do not have direct sales and technical assistance contact with customers.

For the 2019-2021 Plan, 4-5 percent of the statewide electric and gas Program Administrators' costs are assigned to Program Planning and Administration. These percentages are in line with the budget allocations approved by the Department historically, demonstrating that the Program Administrators have been able to provide direct benefits to customers and contractors and grow the energy efficiency portfolios while minimizing costs. Importantly, the majority of energy efficiency budgets are returned to customers in the form of incentives that are intended to overcome the financial barrier to investment.

The most significant factor in the Program Administrator approach to minimizing administrative costs is the statewide collaborative process, which is used by the Program Administrators to coordinate planning, the adoption of consistent programs and processes, program design, EM&V studies, statewide marketing, regulatory proceedings, and the development and sharing of all best practices. Sharing of these costs, which would otherwise be borne by each Program Administrator individually, results in economies of scale that reduce the cost for each Program Administrator. For example, joint releases of RFPs lead to minimization of administrative costs in that the cost for preparation and release of the RFP are shared by the Program Administrators. The Program Administrators also minimize administrative costs by coordinating energy efficiency program delivery, where appropriate, with other customer service activities such as customer acquisition, key account management and trade ally relationships.

Notwithstanding any appropriate coordination with other customer service departments, it is necessary and appropriate for all Program Administrators to maintain a skilled and dedicated administrative staff to ensure successful delivery of programs, compliance with the GCA, timely responses to the requests of the Council, Department, and DOER, and documentation and achievement of substantial savings. The Program Administrators seek to balance the need to minimize administrative costs to the extent prudent with the need to maximize program quality and oversight. Councilors have emphasized the need to devote sufficient administrative resources to successfully implement the aggressive programs called for in the Three-Year Plans.

While the economies of scale and other steps taken by the Program Administrators to minimize costs are effective, and administrative costs incurred by the Program Administrators are transparent, exact quantification of the minimization of administrative costs is not possible in a meaningful way. This is because the continuous scaling up and evolution of the plans make it impractical to establish a solid baseline for a comparison. When the variables are constantly (and necessarily) shifting, there is no opportunity to make a meaningful quantitative comparison. Further, a direct quantitative comparison would not be useful because it would only provide a comparison of two points in time. The mandate of the GCA is to seek administrative efficiencies, which is a continuous process that evolves along with energy efficiency planning and programming. Program needs and opportunities for administrative efficiency are always changing. The Program Administrators seek to minimize costs at all available opportunities, and not just

from one point in time to another. By collaborating, creating consistent programming, and optimizing staffing needs, the Program Administrators can minimize administrative costs to the extent practicable while providing quality energy efficiency services for customers.

Consistent with the Department's directives in the 2016-2018 Plan Order, the Program Administrators worked with a third-party vendor to study best practices for minimizing administrative costs. The Best Practices for Minimizing Program Planning and Administrative Costs (PP&A) for the Massachusetts Utilities and Energy Efficiency Services Providers report was finalized on October 25, 2018 ("PP&A Report") and is provided to the Department as Appendix P. The PP&A Report: (1) identified best practices, both in Massachusetts and nationwide, for tracking and assessing administrative costs; (2) identified potential benchmarks, metrics, and/or indicators for measuring administrative costs; and (3) provided specific recommendations, as appropriate, for reducing administrative costs.

The PP&A Report primarily focused on the PP&A cost category, and noted that the way Massachusetts tracks PP&A costs is unique from any other state's program administrators. The vendor examined cost accounting, reviewed key metrics program administrators may use to assess PP&A costs, and reviewed cost tracking practices. The PP&A Report found that Massachusetts PAs are working efficiently and thoughtfully to achieve energy efficiency objectives while seeking to minimize PP&A costs within their control to the extent possible. To continue to minimize administrative costs, the PP&A Report made the following overall recommendations: (1) Continue to Focus on Ways to Improve Consistency in Accounting Practices; (2) Formalize and Seek to Streamline Further the Reporting and Data Request Process; (3) Follow Cost Accounting Best Practices in Allocation, Tracking and Control; (4) Seek New Ways to Minimize the Regulatory / Collaboration / Facilitation/ Reporting and Ad hoc Requests Burden Without Compromising Goal Obtainment; and (5) Implement an Annual Process to Stress-Test Status Quo Processes and Spending.

The Program Administrators will use these recommendations during the 2019-2021 term to assist in efforts to continuously minimize administrative costs to the greatest extent practicable without negatively affecting program delivery. The Program Administrators will continue to regularly review costs and allocation procedures internally and through statewide Cost Review Working Group meetings and other discussions, and will examine whether there are ways to streamline reporting and updates to interested parties. Additionally, at the time of each Plan-Year and Term Report filing, the Program Administrators will review administrative costs and cost allocation procedures.

2. Allocation of Funds for Income Eligible Programs and Education

Energy efficiency funds shall be allocated to customer classes in proportion to their contributions to those funds, and, "at least 10 percent of the amount expended for electric energy efficiency programs and at least 20 percent of the amount expended for gas energy efficiency programs shall be spent on comprehensive low-income residential demand side management and education programs." G.L. c. 25, § 19(c). Based on the budget figures set forth in this Plan, for electric Program Administrators, 11.37 percent of the total budget will be allocated to the electric income eligible programs. Based on the budget figures set forth in this Plan, for gas Program

Administrators, approximately 21.83 percent of the total budget will be allocated to the gas income eligible programs.

3. Competitive Procurement

The Program Administrators utilize competitive procurement processes to engage and retain contractors and vendors to perform activities including, but not limited to assessment delivery, quality control, rebate processing, monitoring and evaluation, potential studies, and marketing. The Program Administrators are committed to continuing to utilize competitive procurement practices to the fullest extent practicable throughout the implementation of the Plan. Therefore, consistent with past practice, the Program Administrators anticipate that they will continue to issue RFPs to engage appropriate third-party vendors to provide energy efficiency services and work collaboratively to ensure that energy efficiency services have been procured in a manner that minimizes costs to ratepayers, while maximizing the associated benefits of those investments. The Program Administrators will continue to seek to expand the pool of qualified program vendors, promote the entry of new market actors into contractor and subcontractor roles, and ensure the transparency of the contractor bidding process and selection criteria used to evaluate proposals. Please see Appendix Q for a list of competitively procured vendor contracts, including the percentage and total dollar amount of competitively procured services, which the Program Administrators have executed to date in order support program efforts for the 2019-2021 term.

F. Performance Incentives

1. Summary of Relevant Precedent and Guidelines

Pursuant to the GCA, the Three-Year Plan must include a proposed mechanism designed to provide an incentive to distribution companies based on their success in meeting or exceeding certain performance goals.[37] G.L. c. 25 § B.2.v. The Department has established Guidelines outlining the principles and requirements for the design of a performance incentive mechanism. Guidelines § 3.6.2. Pursuant to the Guidelines, an incentive mechanism must: (1) be designed to encourage Program Administrators to pursue all available cost-effective energy efficiency; (2) be designed to encourage energy efficiency programs that will best achieve the Commonwealth's energy goals; (3) be based on clearly defined goals and activities that can be sufficiently monitored, quantified, and verified after the fact; (4) be available only for activities in which the Program Administrator plays a distinct and clear role in bringing about the desired outcome; (5) be as consistent as possible across all electric and gas Program Administrators; and (6) avoid any perverse incentives. Guidelines § 3.6.2. Further, the Guidelines specify that the amount of funds available for performance incentives should be kept as low as possible to minimize the costs to electricity and gas customers, while still providing appropriate incentives for the Program Administrators. Guidelines §§ 3.6.2, 3.6.3.

All Program Administrators must calculate design level incentive payments based on projections of performance for the entire three-year term, not based on annual projections.[38]

[37] The Compact, as a municipal aggregator, does not receive a performance incentive. D.P.U. 08-50-A at 51.

[38] Design level performance is defined as 100 percent of the Program Administrator's projected benefits and net benefits multiplied by the appropriate payout rate.

Guidelines § 3.6.4; D.P.U. 11-120-A, Phase II at 7-8. Both electric and gas Program Administrators collect performance incentives through the EES at the design level during the three-year term. D.P.U. 11-12-A, Phase II at 13 n.16. The Department reviews each Program Administrator's performance based on the entire three-year term of the plan and approves final performance incentives through the Term Report proceeding. See D.P.U. 11-120-A, Phase II at 13. Each Program Administrator reconciles actual and design performance incentive payments at the end of each term as part of their respective EES filings. Guidelines § 3.6.4.2.

The Department has approved performance incentive mechanisms that include savings and value components based on benefits and net benefits. See 2016-2018 Three-Year Plans Order at 67. Specifically, the Department has found that uniform statewide payout rates for the savings and value components is consistent with the goals of the GCA and Department precedent, and, because the rates do not vary by year, found that the payout rates were consistent with the D.P.U. 11-120-A, Phase II Order.

The Department requires that a proposed performance incentive mechanism must encourage Program Administrators to achieve savings where they exist to reach portfolio goals. 2016-2018 Three-Year Plans Order at 69. The Department has rejected proposals that do not comply with this principle. In 2016, the Department specifically rejected a split performance incentives proposal finding that it would not encourage Program Administrators to seek all available cost-effective savings opportunities wherever they exist, but rather may encourage Program Administrators to focus on only the sector in which performance incentives remain available. 2016-2018 Three-Year Plans Order at 69.

Also in D.P.U. 13-67, the Department determined that performance metrics (i.e., an incentive model designed to encourage Program Administrators to undertake specific actions or meet specific goals) were no longer appropriate under the GCA because the Program Administrators are obligated to undertake activities targeted by performance metrics to satisfy the mandates of the GCA. D.P.U. 13-67, at 14-15. Further, the Department found that preparing and verifying performance of these metrics would divert Program Administrator and stakeholders focus from the successful implementation of the Three-Year Plans and is inconsistent with the Department's obligation to fulfill its oversight responsibilities in an administratively efficient and effective manner. D.P.U. 13-67, at 13.

2. Proposed Performance Incentive Mechanism

a. Overview

For 2019-2021, the Program Administrators proposed an incentive mechanism that includes a Value component, a two-part Savings component with (1) an energy efficiency and passive demand component and (2) an active demand component (electric PAs only), and a unique Renter component. The Value component is based on net benefits[39]; the Savings components are based on total benefits; and the Renter component is based on renter participation. Based upon the well-developed principles and precedent described above, the performance incentive

[39] For the purpose of performance incentives, net benefits will be determined by subtracting actual program costs from benefits.

mechanism provides for common payout rates in each component applicable to the electric and gas Program Administrators, respectively with performance assessed at the portfolio level using cumulative three-year results. Each Program Administrators' total performance incentive will be the sum of the incentives for each component of the mechanism based on performance over the full term. The specifics of each component of the mechanism, including calculation of payout rates and requirements for earning performance incentives are set forth below and in Appendix R.

The Program Administrators also propose a change in the reconciliation of performance incentives in order to more timely true up design level performance incentive collections with actual performance incentive achievement.

b. Statewide Incentive Pool for 2019-2021

Statewide, the design level incentive pool is set at $114 million for electric efforts and $23 million for gas efforts.

The electric incentive pool is divided among the performance incentive components as follows:

Electric Performance Incentive Totals				
Component	Threshold	Design Level	Design Level	Cap
Value Component (Energy Efficiency, Passive Demand, and Active Demand)	75% of planned portfolio net benefits	$41.195 million	$107 million (38.5% Value and 61.5% Savings)	125% of planned portfolio net benefits
Savings Component (Energy Efficiency and Passive Demand)	75% of planned portfolio total benefits	$65.805 million		125% of planned energy efficiency and passive demand benefits
Savings Component (Active Demand)	75% of planned portfolio benefits AND 75% of planned active demand benefits	$5 million		Targeted payout capped at 125% of planned active demand benefits; Standard payout until total savings component reaches 125% of design level
Renter Component	75% of planned renter participants	$2 million		125% of design level
Total		$114 million		

The gas incentive pool is divided among the performance incentive components as follows:

Gas Performance Incentive Totals				
Component	Threshold	Design Level	Design Level	Cap
Value Component	75% of planned portfolio net benefits	$8.47 million	$22 million (38.5% Value and 61.5% Savings)	125% of planned portfolio net benefits
Savings Component	75% of planned portfolio total benefits	$13.53 million		125% of planned portfolio benefits
Renter Component	75% of planned renter participants	$1 million		125% of design level
Total		$23 million		

The amounts reflected in the above tables reflect the challenge of continuing to adopt aggressive savings goals in 2019-2021 in light of achievements to date, the remaining savings opportunities identified in each service territory, and the success the Program Administrators are cultivating as markets are transformed. In addition, the 2019-2021 Plan incorporates new technologies and less tested strategies that create increased risk, and the proposed incentive pool provides an appropriate level of incentives to undertake the additional risk. As discussed more below, the specific amounts allocated to the Active Demand Savings component and the Renter component are designed to recognize the unique challenges and costs associated with delivering active demand and serving renters.

These electric and gas incentive pools are consistent with the levels that has been supported by DOER, the Attorney General and the Program Administrators. See Appendix F. The statewide incentive pool will not change as a result of newly identified benefits or changes to avoided costs that may occur during term of this Plan.[40]

[40] The Program Administrators have agreed to conduct a study to be commenced in Q1 of 2019 to quantify any benefits associated with winter peak capacity reduction. The PAs will issue an RFP and conduct this study in collaboration with the DOER, the Attorney General and the Council consultants. Study results will be aligned with and compatible with the 2018 AESC. If new benefits are identified as a result of this study, the Program Administrators will apply those benefits to reported values. If the Program Administrators and DOER agree, the Program Administrators will seek to include such benefits in performance incentives during the Term and correspondingly revise threshold levels for the savings and value components (including the active demand savings component) to properly account for the newly identified benefits associated with the winter kW already included in the PAs' Plans, all subject to Department approval. The Program Administrators will not include these benefits for performance incentive purposes without such modifications. In all events, the statewide incentive pool level will not change.

c. Value Component

The statewide incentives for the value component of the incentive pool for both gas and electric are allocated on the basis of the dollar value of net benefits using common payout rates. The common payout rate and calculation is set forth in Appendix R and is determined consistently but separately for gas and electric by dividing the value component performance incentive pools by statewide planned portfolio net benefits. The threshold for earning performance incentives for the value component will be based on achieving 75% of planned portfolio net benefits. Performance incentives for the value component will be capped at 125% of design level.

For this Plan, the Program Administrators are proposing that for calculating the performance incentive associated with the value component, the Program Administrators will use actual spending as opposed to total resource costs, which include calculated or estimated participant costs that are not within the Program Administrators' control. Using actual spending will avoid the circular use of including performance incentive dollars in the costs used in calculating performance incentives. In addition, this approach will encourage Program Administrators to minimize actual spending.

d. Savings Component

The statewide incentives for the savings components of the incentive pool for both gas and electric are allocated on the basis of the dollar value of total benefits using common payout rates for each component. For the 2019-2021 term, the Program Administrators are proposing a modification to the electric savings component (totaling $70.805 million) used in the 2016-2018 term to incorporate a targeted active demand payout rate. The gas savings component is the same as the 2016-2018 mechanism except the payout rate is calculated using a $13.53 million statewide savings component performance incentive pool.

i. <u>Electric Savings Component</u>

For the 2019-2021 term, the electric savings component is divided into two performance pools: (1) $65.805 million that is allocated to energy efficiency and passive demand and (2) $5 million allocated for a targeted active demand reduction payout rate. While the savings component is still designed to encourage the electric Program Administrators to pursue all-cost effective energy efficiency and demand reduction wherever it may be, measured by total benefits for customers; the Council has determined that a special targeted payout rate for active demand is necessary to encourage the Program Administrators to take on new active demand activities.

As discussed above, the 2019-2021 Plan reflects a pivot to pursue demand reduction opportunities by incorporating for the first time, new statewide active demand offerings, which were previously not determined to be cost-effective. Unlike passive demand reduction, active demand reduction includes measures and strategies that primarily provide kW savings (but may increase kWh) and are dispatched over specific periods of time through automation, programming, or control. Accordingly, active demand requires increased and persistent engagement between the Program Administrators and customers participating in these offerings in order to realize benefits from these efforts. Currently, the active demand market is not as robust as the energy efficiency market, which the Program Administrators have helped cultivate and transform over several

decades. Significant upfront costs and effort is required to begin to develop a market that can successfully deliver active demand reduction benefits for customers under the programs. Based on recognition of the increased challenges and risks associated with active demand, the Council recommended that the Program Administrators incorporate a specialized incentive mechanism to provide additional incentives for successfully achieving benefits associated with active demand reduction efforts.

Based on the Council's desire for a targeted active demand component to the shareholder incentive and in recognition of the Department's clear precedent regarding performance incentive mechanisms and performance metrics, the Program Administrators' proposed savings component mechanism is carefully designed to set common payout rates based on the two performance incentive pools, ties the achievement of performance incentives to the delivery of benefits for customers, and establishes a series of thresholds to encourage the Program Administrators to pursue all cost-effective energy efficiency and demand reduction (passive and active) wherever opportunities may be, while not providing perverse incentives.

The common payout rates for the two savings components and calculations are set forth in Appendix R. The energy efficiency and passive demand savings component payout rate ("standard savings payout rate") is determined by dividing the $65.805 million portion of the statewide pool by planned total benefits from energy efficiency and passive demand. The active demand savings component payout rate is determined by dividing the $5 million allocated for a targeted active demand payout rate by planned total benefits from active demand.

The threshold for electric Program Administrators to earn performance incentives under the standard savings component is based on achieving 75% of planned portfolio total benefits from energy efficiency and demand reduction efforts (passive and active). Upon meeting the threshold, electric Program Administrators may begin to earn performance incentives for energy efficiency and passive demand reduction benefits at the standard payout rate. This threshold is designed to incentivize the Program Administrators to achieve a minimum level of portfolio benefits prior to receiving any performance incentives. Performance incentives for the energy efficiency and passive demand reduction component will be capped at 125% of the energy efficiency and passive demand reduction design level.

The threshold for electric Program Administrators to earn performance incentives at the targeted active demand savings payout rate is based on achieving the portfolio threshold described above and 75% of planned active demand benefits. This threshold requirement is intended to ensure that the Program Administrators achieve a minimum level of portfolio benefits for customers prior to receiving any performance incentives and ensures that the Program Administrators pursue a minimum level of active demand benefits in order to receive the targeted payout rate. Upon meeting these thresholds, electric Program Administrators may begin to earn performance incentives for active demand benefits at the targeted active demand reduction payout rate.[41]

[41] Achieving the threshold level for the targeted active demand payout rate does not change the payout rate for energy efficiency and passive demand benefits.

Electric Program Administrators may earn at the targeted active demand savings payout rate up to 125% of planned active demand benefits. The Program Administrators may continue to earn performance incentives for achieving additional active demand reduction benefits above the 125% targeted active demand payout rate cap at the standard payout rate. All savings component performance incentives, however, are capped at 125% of the total of the two design level savings components. The two payout rates available for active demand reduction efforts reflects the Council's intent to have a dedicated targeted active demand payout rate to encourage the Program Administrators to take on the additional costs and challenges to develop active demand offerings at scale, but not provide a perverse incentive. If the Program Administrators are able to achieve 125% of planned total benefits from active demand efforts, the assumption is that these initial challenges have been met and the enhanced payout rate is no longer required.

The caps established under the savings component mechanism protect against perverse incentives while also encouraging the Program Administrators to pursue all cost-effective demand reduction opportunities, passive or active. Active demand benefits represent approximately 3% of electric portfolio benefits. Since active demand is a new statewide offering, the Program Administrators have less experience forecasting future savings opportunities and have used their best judgment, informed by stakeholders and industry experts, to estimate the potential growth rate of active demand during the three-year term, which is projected to double between 2019 and 2021. In recognition of these facts and the principles behind the Department's precedent regarding split performance incentives, the proposed portfolio cap for active demand encourages the Program Administrators pursue all cost-effective demand reduction even if the limited pool available for an enhanced active demand payout rate has been exhausted. This ensures that the Program Administrators will not pursue a cost-effective demand reduction opportunity because a special performance incentive pool has been exhausted.

ii. Gas Savings Component

As discussed above, the gas savings component is materially the same as the 2016-2018 savings component. The statewide incentives for the gas savings component of the incentive pool are allocated on the basis of the dollar value of total benefits using common payout rates. The common payout rate and calculation is set forth in Appendix R and is determined by dividing the gas savings component performance incentive pools of $13.53 million by statewide planned portfolio total benefits. The threshold for earning performance incentives for the gas savings component will be based on achieving 75% of planned portfolio total benefits. Performance incentives for the value component will be capped at 125% of design level.

e. Renter Component

For the 2019-2021 Plan, the Council encouraged the Program Administrators to include a dedicated pool for the successful service of renters in the performance incentive mechanism. The statewide incentives for the renter component of the incentive pool for both gas ($1 million) and electric ($2 million) are allocated on the basis of projected renter participants using common payout rates. The common payout rate and calculation is set forth in Appendix R and is determined by dividing the electric and gas renter component performance incentive pools (separately but consistently) by statewide projected number of renter participants. Renter participants will include any rental dwelling unit that benefits from a measure in the Residential Coordinated Delivery,

Income-Eligible Coordinated Delivery, or C&I Existing Buildings (Residential End Use) initiatives and any rental unit that receives an energy savings package through the Residential Retail Initiative. Since the Program Administrators' programs have historically been designed to provide cost-effective savings to customers through a variety of upstream, retail, and in-home services, and regardless of ownership status, there is insufficient data on the exact participation levels of renters. To establish a goal for this metric, projected renter participant levels were developed based on the best estimate of cost-effective opportunities using historic participation levels and assumptions regarding the percent of renters in multi-family buildings. The Program Administrators worked closely with the Attorney General to determine a reasonable goal for the Renter component.

The threshold for earning performance incentives for the renter component will be based on achieving 75% of planned portfolio renter participants. Performance incentives for the renter component will be capped at 125% of design level.

As discussed above, the Department has determined that performance metric are no longer an appropriate component of the performance incentive mechanism under the Green Communities Act. Historic performance metrics have included qualitative requirements or incremental improvements/achievements above baselines. The proposed renter component of the performance incentive mechanism is not a performance metric similar to those previously considered by the Department.

First, the renter component is based on clearly defined goals that can be sufficiently monitored, quantified, and verified after the fact. Program Administrators will track the number of renter participants defined above and report the number to the Department in the Plan-Year and Term Reports.

Second, the renter component is designed similar to savings and value component, with a payout rate based on design level achievement, and an appropriate threshold and cap to encourage Program Administrators to pursue cost-effective energy efficiency opportunities wherever they exist while not providing perverse incentives.

Third, the design level for the renter component is based on projected renter participants with cost-effective energy efficiency and demand reduction opportunities. The design level is not based on achieving a desired level of participation or increase in participation that has been set regardless of consideration of cost-effective opportunities.

Fourth, the Council believes that targeted renter component is needed to encourage the PAs to pursue all cost-effective energy efficiency opportunities that they may not otherwise be incentivized to pursue by providing a small incremental incentive payment for successful service of renters. The programs implemented by the Program Administrators are designed to lower energy use of buildings regardless of ownership status. The Council, in urging the adoption of a renter based performance incentive component, recognized that renters are a hard to serve segment of the population. Renters do not have the ability to adopt major measures, such as insulation, heating systems, or measures that constitute fixtures, without landlord approval. Installing major measures for the benefit of non-owner occupied dwellings requires additional costs and effort to

achieve similar savings for owner occupied dwelling. Therefore, the Council supported dedicating a small portion of the statewide performance incentive pool (about 2%) to a dedicated renter component to provide a specific, incremental incentive to Program Administrators for undertaking the additional costs and efforts to serve renters.

Finally, the renter component is designed to provide a small incremental performance incentive as part of the overall performance mechanism. If the Program Administrators significantly overachieve the planned renter participant levels, the savings and value components still encourage the Program Administrators to pursue all cost-effective energy efficiency opportunities for renter and owner-occupied dwellings.

3. Reconciliation of Performance Incentives

Currently Program Administrators are required to collect performance incentives at the design level during the term, and reconcile actual performance incentives following approval of their Term Reports. Guidelines § 3.6.4.2. To support the goal of rate continuity, the Program Administrators propose to modify this schedule, and reconcile actual performance incentives in their EES filing following the filing of the Term Report (e.g., the 2022 peak LDAC for gas Program Administrators). This proposal will allow the Program Administrators to reconcile over- and under-recoveries of performance incentives in a timelier manner and minimize interest associated with delayed collections. The Program Administrators would continue to make any needed adjustments after the Term Report is approved.

G. Cost-Effectiveness and Benefits

1. Cost-Effectiveness

The Program Administrators have projected the expected benefits and costs associated with this statewide 2019-2021 Plan consistent with the requirements of the Guidelines and D.P.U. 08-50-A, in which the Department reaffirmed that "the Total Resource Cost test is the appropriate test for evaluation of the cost-effectiveness of ratepayer-funded energy efficiency programs." D.P.U. 08-50-A at 14. A program is cost-effective under the TRC test if the cumulative present value of its benefits is equal to or greater than the cumulative present value of its costs. Guidelines § 3.4.3.1. Under the updated GCA, for the purposes of cost-effectiveness screening, programs are aggregated by sector. G.L. c. 25, § 21(b)(3), as revised by Acts of 2018, c. 227. To conduct the TRC test, the Program Administrators have developed detailed benefit/cost screening models, and use these models to reflect assumptions relating to program costs and benefits, the discount rate, the general rate of inflation, and avoided costs.

The Program Administrators identify and quantify costs and benefits needed to calculate the cost-effectiveness of programs consistent with the TRC test. Costs included in the TRC test include all Program Administrator costs and program participant costs. Program Administrator costs include program implementation expenses, evaluation costs, proposed performance incentives, and tax liability for performance incentives. Program-participant costs include initial costs incurred by customers as a result of their participation in the program.

Benefits included in the TRC test are the value of avoided costs and non-energy impacts ("NEIs") resulting from a program over the lifetime of the measures. Benefit categories include resource benefits and NEIs (sometimes referred to as non-resource benefits). Resource benefits include avoided energy valued at different times, avoided capacity valued at peaking periods, avoided transmission, avoided distribution, and effects on energy market prices. Specifically, the Program Administrators calculate the benefits associated with positive or negative electric, natural gas, oil, propane, water savings, and capacity savings, and energy DRIPE.[42] NEIs are the values associated with the positive or negative effects attributable to energy efficiency programs apart from energy savings, such as reduced costs for operation and maintenance, longer equipment replacement cycles and productivity improvements, reductions in costs associated with reduced customer arrearages, service terminations, and reconnections, and other measureable benefits due to the installation of the energy efficiency.

The benefit/cost screening model uses this data to calculate the present value of the program benefits and costs, and then calculates ratios of these values to produce BCRs. The present value of costs and benefits is calculated over the expected duration of the useful life of the measures installed in the program.

2. Benefit Analysis Components

a. Overview

The Program Administrators developed methods to determine the appropriate manner to measure and verify the benefits associated with the energy efficiency programs. Important elements of this analysis include using the AESC Study, and assessing NEIs, market effects, and new demand reduction initiatives, each of which are described further below.

b. Avoided Energy Supply Cost Study

To develop avoided supply costs, the Program Administrators participate in the AESC Study process, which is a well-established regional and collaborative process. The AESC Study determines projections of marginal energy supply costs that will be avoided due to reductions in the use of electricity, natural gas, and other fuels, as well as avoided environmental compliance costs resulting from energy efficiency programs. The AESC study is prepared every three years for the AESC Study group, which is comprised of the Program Administrators, as well as utilities throughout New England and other interested non-utility parties. In order to inform the initial draft of the 2019-2021 Plan, which must be submitted to the Council by April 30, 2018, the 2018 AESC Study was completed on March 30, 2018.

The AESC Study provides projections of avoided costs of energy in each New England state for a hypothetical future, the "Base Case," in which no new energy efficiency programs are implemented in New England. The 2018 AESC Study provides an updated assessment of avoided electricity and natural gas costs using a model that simulates the operation of the New England

[42] Demand Reduction-Induced Price Effect ("DRIPE") is a measurement of the value of demand reductions in terms of the decrease in wholesale energy prices, resulting in lower total expenditures on electricity or natural gas across a given system.

wholesale energy and capacity markets in an iterative, integrated manner. In the 2018 AESC Study, there were several factors that changed significantly from the previous study, resulting in lower overall natural gas, electric energy, and electric capacity costs. Lower Henry Hub natural gas prices, and the resulting avoided natural gas supply costs, are driven by higher shale gas production and lower breakeven drilling and operating costs relative to the 2015 AESC Study. Estimates for avoided electric energy costs are lower than in the 2015 AESC Study due to a number of factors, such as lower overall demand for electricity, lower natural gas supply prices, lower RGGI prices, increased renewable energy generation, and a new transmission line from Canada; while avoided electric capacity costs are 44 percent lower than in the 2015 AESC Study due to recent declines in the Forward Capacity Market auction prices and a change in the capacity modeling methodology. The 2018 AESC Study estimates electric energy DRIPE benefits to be higher than those in the 2015 AESC Study, and estimates electric capacity DRIPE benefits, where the 2015 AESC Study identified no capacity DRIPE benefits, due to a change in the modeling approach for DRIPE, new commodity and capacity forecasts, and changes in the market conditions. The 2018 AESC Study also includes a new avoided transmission cost component to account for avoided costs of pooled transmission facilities ("PTF"), as well as a new benefit component to value the improved the effect of increased reserve margins resulting from energy efficiency on generation reliability. The overall avoided costs in the 2018 AESC Study are lower than those in the 2015 AESC Study and tend to decrease benefits and cost-effectiveness relative to the previous Plan Term, making goals harder to achieve. The 2018 AESC Study is available at Appendix H.

c. Non-Energy Impacts

A NEI is a benefit (positive or negative) for participants in energy efficiency beyond the energy savings gained from installing energy efficient measures. NEIs include benefits such as reduced costs for operation and maintenance associated with efficient equipment or practices, or reduced environmental and safety costs. The Department has stated that NEIs are "a well-established component of the program cost-effectiveness analyses conducted by the Program Administrators" and found that the benefits of the NEIs are quantifiable and flow to Massachusetts ratepayers. 2013-2015 Order at 61. The Department has specifically stated that non-resource benefits should be included in cost-effectiveness. Guidelines at §§ 3.4.4.1, 3.4.4.2. Consistent with Department precedent, the Program Administrators have included the benefits associated NEIs established in evaluation studies in the program cost-effectiveness calculations. For 2019-2021, the Program Administrators are including NEIs that were not filed in previous Three-Year Plans and applying pre-existing NEIs to other programs as set forth below:

- Low-income single family health- and safety-related NEIs, August 2016 (filed with 2016 Plan-Year Report, D.P.U. 17-100)
- C&I new construction NEIs, March 2016 (filed with 2013-2015 Term Report, D.P.U. 16-120 through D.P.U. 16-130)
- NEI framework, January 2018: makes recommendations related to property value/rental income NEIs with their underlying non-property value NEIs

- Market-rate multi-family NEI Phase 1, March 2018: recommends Program Administrators apply the existing low-income multi-family owner NEIs to market rate multi-family and existing C&I operations and maintenance NEIs to residential multi-family common area lighting
- NEIs for heat pumps memo, Oct 2017: reconciles and recommends existing NEI values to apply to residential heat pump measures installed in multi-family, low-income multi-family, and low-income single family
- Multifamily health- and safety-related NEIs, October 2018

d. Demand Reduction

The 2019-2021 Three-Year Plan includes new active demand reduction initiatives. Unlike passive demand reduction measures, active demand savings and benefits accrue during specified and limited time periods. Under the proposed initiatives, active demand reduction measures will be called on to perform during specified events and the claimed savings will be based on customer performance during those called events. Due to these unique characteristics of active demand reduction measures, the Program Administrators developed a methodology for appropriately accounting for costs and benefits in the TRC test.

The Program Administrators have agreed with DOER and the Attorney General to conduct a study to be commenced in Q1 of 2019 to quantify any benefits associated with winter peak capacity reduction. The PAs will issue an RFP and conduct this study in collaboration with the DOER, the Attorney General and the Council consultants. Study results will be aligned with and compatible with the 2018 AESC. If new benefits are identified as a result of this study, the Program Administrators will apply those benefits to reported values.

3. Environmental and Economic Benefits from Energy Efficiency

a. Overview

In advancing the objectives of the GCA, the energy efficiency programs also support the Commonwealth's broader policy objectives. In legislation enacted in parallel with the GCA, the Commonwealth signaled its commitment to being a worldwide leader in developing a green economy through the Global Warming Solutions Act, St. 2008, c. 298 ("GWSA") and the Green Jobs Act, St. 2008, c. 307. The GWSA calls for broad statewide reductions of greenhouse gas ("GHG") emissions in the Commonwealth, spurring innovation and promoting research and development in the area of clean energy. Enacted concurrently, the Green Jobs Act provides a robust funding source for the green technology industry, facilitating economic development and job growth in the clean energy sector. Taken together, these legislative enactments reflect the Commonwealth's commitment to climate protection and its leadership in promoting clean and renewable energy. Reductions in GHG emissions and job creation are important results of energy efficiency programs implemented pursuant to the GCA. Like past plans, the 2019-2021 Plan will continue to fulfill the requirements of the GCA and support the goals of the GWSA and Green Jobs Act, with a focus on meeting customers' energy needs through energy efficiency first and minimizing costs for the benefit of customers.

b. Environmental Benefits and Support of Carbon Reduction

i. Overview

Reduction in the use of electricity, natural gas, and other resources provides significant environmental benefits to Massachusetts and the region. These benefits include reduced air pollution, improved air quality, and beneficial impacts on water systems. Decreasing energy consumption results in less demand for energy from power plants and natural gas pipelines. Reduced plant operating time can lower the volume of emitted air pollutants and greenhouse gases.

Generating electricity or heat from non-renewable fossil fuels (e.g., coal, oil, or natural gas) results in greenhouse gas emissions. Reducing the amount of energy needed to operate Massachusetts homes and businesses through the adoption of energy efficiency improvements reduces these impacts both in Massachusetts and in neighboring states. One particularly impactful measure is the conversion of customers from old, often oil-fired, heating equipment to new, high-efficiency units, which help customers reduce energy use and costs, and can significantly reduce local pollution levels.

Water resources also benefit from energy efficiency programs. With fewer pollutants in the air and acid rain abatement, fresh water resources have less opportunity for particulate contamination or potential acidification. Additionally, some energy efficiency measures offer the co-benefit of reducing water usage and resultant wastewater treatment. For example, low flow aerators reduce the volume of water flowing from a faucet, thus lessening the energy needed to heat the smaller volume of water. Reducing water usage limits stress on reservoirs and water treatment facilities. The 2019-2021 Plan projects saving over 589 million gallons of water annually and over five billion gallons over the lifetime of installed measures. Five billion gallons of water is equivalent to the water needed to do 135 million loads of laundry for the average household.[43]

Investment in energy efficiency is recognized as an effective cost-containment and climate protection tool of the Commonwealth, which is one strategy to help the Commonwealth achieve the goals of the GWSA. While other programs, such as DOER's Alternative Portfolio Standard and MassCEC's grant programs, encourage adoption of renewable technologies, energy efficiency lowers energy consumption, which reduces emissions by avoiding the use of a unit of energy in the first place and delivers those reductions for the full lifetime of the energy efficiency measure. Further, consistent with the updated GCA, the Program Administrators will identify opportunities to lower overall energy use and greenhouse gas emissions by converting customers to alternative and renewable energy sources. By delivering on the goals in their Three-Year Plans, the Program Administrators are materially contributing to GHG emissions reductions in the Commonwealth, and each Three-Year Plan compounds the GHG emissions reductions from the one before it. Although the GWSA does not govern the Program Administrators energy efficiency efforts,[44] the

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43 Equivalency calculation based on the equivalency information available on the Department of Environmental Protection's WaterSense website, https://www.epa.gov/watersense/start-saving.

44 The GCA governs the Program Administrators' energy efficiency efforts and requires them to seek to acquire all available cost-effective energy efficiency and demand reduction resources. The specified purpose of energy efficiency under the GCA is to encourage the efficient use of energy. St. 2008, c. 169 § 11;

Program Administrators remain committed to achieving reductions in GHG emissions through implementation of their Three-Year Plans.

ii. Avoided Cost of Compliance with GWSA

As discussed above, DOER undertook a study to examine the avoided cost of compliance with the Global Warming Solutions Act. The study examined seven potential strategies for GWSA compliance that the study found are currently being deployed in the Commonwealth in the near-to medium-term under already promulgated legislation and regulations, or as part of the Massachusetts Clean Energy and Climate Plan for 2020. The strategies are: (1) onshore wind, (2) offshore wind, (3) large solar, (4) medium solar, (5) small solar, (6) clean energy imports, and (7) light-duty vehicle electrification infrastructure. The study used a counterfactual approach that presumed no incremental energy efficiency in 2018 and in all later years. The study states that the incremental avoided costs of compliance with the GWSA may be applied to any measure in the 2019-2021 three-year plan, regardless of fuel.

Under the Department's Guidelines, the Program Administrators may include certain avoided costs of complying with environmental laws and regulations as benefits under the TRC test. The avoided costs must be from reasonable foreseeable laws, regulations, or policies that will result in a cost included in electric or gas prices. See 419 Mass. 239; D.P.U. 08-50-A at 2.

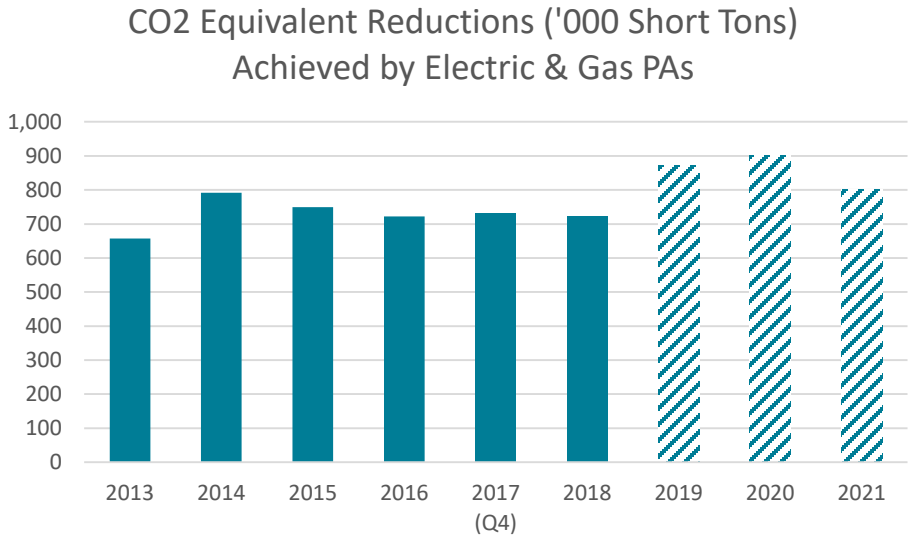
For the purpose of this Plan only, the Program Administrators have incorporated the benefits identified in the DOER study into the goals and benefit calculations set forth in this Plan. In order to understand the impact of this study, the Program Administrators have provided benefit calculations provided in the Energy Efficiency Data Tables both with and without the incremental values identified in the study. The study is provided at Appendix I.

iii. Greenhouse Gas Emissions Reductions in Plan

GHG emissions calculations are based on adjusted gross savings. Adjusted gross savings are the actual savings achieved due to the installation of energy efficiency measures, as adjusted by impact factors but without factors related to program attribution. Adjusted gross savings take into account the full energy reductions associated with the programs, including non-electric savings (such as gas and oil savings) achieved by electric Program Administrators, and non-gas savings (such as electric and oil savings) achieved by the gas Program Administrators. Adjusted gross savings do not subtract savings associated with free-ridership, which are savings that are real, but are not attributable to the Program Administrators. For the purpose of Program Administrator calculations, net savings are used to show the impact of the Program Administrator programs on the market; for the purposes of calculating GHG emissions, however, the attribution is not relevant. Calculating GHG emissions using adjusted gross savings more accurately demonstrates the contributions of energy efficiency to the Commonwealth's total GHG emission reductions.

G.L. c. 164, § 1. The GWSA does not supersede or abrogate the Department's regulatory authority or the Council's role with respect to Three-Year Plans under the GCA.

Since 2013, the Program Administrators' energy efficiency programs have resulted in significant carbon dioxide equivalents reductions, as shown in the chart below.



*CO_2e = carbon dioxide equivalents

Collectively, the programs contained in the 2019-2021 Plan are expected to provide three-year adjusted gross annual CO_2e reductions of 2,643,426 short tons. Over the three years of this Plan, these savings equate to the following:

2019-2021 Adjusted Gross Annual CO_2e Reductions Equivalents
507,375
Number of cars removed from the road through energy savings
583,398
Number of homes powered through electric savings
112,474
Number of homes heated through gas savings

Information from the table above will be available on Mass Save Data for 2019-2021. This information is currently available for 2010-2018.

For reference, as of 2010, there were 272,481 homes in Boston and 2,802,254 homes in Massachusetts. The electric and gas savings in the 2019-2021 Plan, are equivalent to the amount of energy needed to power 25 percent of the Commonwealth's homes.

The 2019-2021 Plan reports climate benefits resulting from the programs in the form of reduced emissions of nitrogen oxide, sulfur dioxide, and carbon dioxide equivalents. Information on the reductions in these emissions from energy efficiency is available in the energy efficiency data tables and on the GHG Reductions tab of Mass Save Data, the Program Administrators' energy efficiency database (http://www.masssavedata.com/Public/GHGReductions). The GHG Reductions tab allows for conversions between metric and short tons and displays conversion factors and sources.

The Program Administrators use the most current emission factors provided by DEP to convert savings to GHG emission reductions. These factors were updated for the Program Administrators in August 2018.

The Program Administrators are proud to be material actors in helping the Commonwealth achieve its GHG emission reduction goals, and to be proposing a savings goal for the 2019-2021 Plan that will support the Commonwealth's obligations under the GWSA.

c. Economic Development and Job Growth and Retention

Another positive effect of the energy efficiency programs in Massachusetts has been green job growth and retention. The MassCEC has tracked the growth of the Commonwealth's clean energy economy on an annual basis. The 2017 Clean Energy Industry Report looks at Massachusetts-wide employment of people in a broad category of "Energy Efficiency, Demand Management, and Clean Heating and Cooling."[45] MassCEC's most recent report provides the following information on employees and establishments in energy efficiency related fields.

	2015 Employees	2016 Employees	2017 Employees	2015 Establishments	2016 Establishments	2017 Establishments
Energy Efficiency, Demand Management, and Clean Heating and Cooling	**72,651**	**73,370**	**77,899**	**3,414**	**3,396**	**3,788**

In September 2018, E4TheFuture and E2 issued Energy Efficiency Jobs in America,[46] a report on energy efficiency jobs in the United States. This research, based on 2018 U.S. Energy and Employment Report (USEER) data, reported that there are 84,556 energy efficiency jobs in

45 http://www.masscec.com/2017-massachusetts-clean-energy-industry-report

46 https://e4thefuture.org/wp-content/uploads/2018/09/EE-Jobs-in-America-2018.pdf

Massachusetts. This number includes jobs related to delivery of goods and services that lower energy use by improving technologies, appliances, buildings, and energy systems. According to the study, energy efficiency jobs comprise 24 percent of all construction jobs and 47 percent of all energy sector jobs.

The Program Administrators carefully develop programs and savings goals to foster and sustain a robust energy efficiency contractor and vendor community. As the programs continue to drive market transformation, energy efficiency businesses continue to serve customers and drive deeper energy savings.

H. Evaluation, Measurement & Verification

1. EM&V Framework

Consistent with past Three-Year Plans and Department precedent, the Program Administrators propose to continue the evaluation framework that has been successfully used to promote high quality third-party EM&V efforts. It is critical that the programs be evaluated, measured, and verified in a way that provides confidence to the public at large in the results of the programs. The EM&V efforts enable the Program Administrators to report savings to the Department with full confidence. Additionally, there is a need to ensure both the reality and the perception of the independence and objectivity of EM&V activities. Accordingly, the Council will continue to have an oversight role over the EM&V activities of the Program Administrators, which will help ensure consistency, timeliness, and credibility of the results. The Council's oversight role will be accomplished through the Council's EM&V consultant ("EM&V Consultant"), a third-party expert consultant who has primary responsibility for working with the Program Administrators to plan and implement high-quality EM&V in Massachusetts.

While Program Administrators and the EM&V Consultant will continue to work diligently to reach a consensus on evaluation issues, if there are areas of difference that arise that cannot be resolved through consensus during the ongoing interactive process between the EM&V Consultant and the PA evaluation staff, authority for decision-making will reside with the EM&V Consultant and the Council.

To enable the Program Administrators to fulfill their responsibility to report program savings to the Department with full confidence, an appeals process has been established, through which the Program Administrators may bring decisions made by the EM&V Consultant or the Council for review and resolution. This process will be implemented through the formation of an evaluation appeals committee ("Appeals Committee") of the Council, whose responsibility in this area will be to hear the matter under dispute and rule so that the study may proceed in a timely way. In general, it is expected that this review process will be completed within 72 hours once an issue is elevated to the Appeals Committee. This Appeals Committee will consist of three voting members of the Council, including DOER. Consistent with general Council proceedings, the Appeals Committee will include and consult with, in both deliberations and decision-making, a representative of both the Program Administrators and the Council's consultant team, neither of whom shall have a vote in the Appeals Committee. The Appeals Committee will review the issues related to the disputed matter, hear from the PA evaluation staff and EM&V Consultant, and make a determination on the outcome of the matter. The decision will be recorded, along with a

description of the applicable issues. The participants in the appeal will sign the record of the decision, indicating their acceptance of, the representation of the issues and of the decision. In exceptional cases, where the Program Administrators perceive there to be significant risk to their ability to manage the energy efficiency programs in the near term, the Program Administrators will note their disagreement with the decision of the Appeals Committee on the record of the decision and reserve the right to immediately petition the Department on the Appeals Committee's decision. The Program Administrators shall be able to submit any such documents to the Department in conjunction with the filing of the Three-Year Plans, mid-term modifications, and term reports. The Department will be able to review the record of this decision in its review of Three-Year Plans, mid-term modifications, plan-year reports, and term reports.

To date, the EM&V Consultant and PA evaluation staff have been able to resolve all areas of differences without proceeding to the Appeals Committee. This is a testament to the professionalism, hard work and collaborative engagement of the Program Administrators and the EM&V Consultant.

The Program Administrators will maintain a statewide focus to the maximum extent possible, will review EM&V budgets with the EM&V Consultant, and will integrate electric and gas evaluation efforts to the maximum extent possible. The Program Administrators will be responsible for contracting with the independent evaluation contractors, and will work with evaluation contractors to maintain privacy of customer data.

2. Evaluation Management Committee

The Program Administrators and the EM&V Consultant established the EMC to be similar to other management committees discussed above in Section III.F.1. The EMC serves as a steering committee for statewide evaluation issues, providing guidance and direction to each of the evaluation research areas. The EMC works to plan, prioritize, and delineate the research studies to be undertaken over the Three-Year Plan term.

The Program Administrators and the EM&V Consultant have worked to consistently improve the EM&V process over time. As issues arise, the EMC has established working groups to review and address new topics, areas of concern, or disagreement. The EMC will continue to do so, in order to keep the EM&V process running transparently, efficiently, and effectively.

3. Descriptions of Research Areas

Consistent with the experience since the establishment of the GCA, the EMC worked collaboratively to develop and refine three market research areas. These research areas are organized primarily by target markets, which design is intended to help maximize the statewide effectiveness of EM&V, while presenting minimal overlap among areas. The research areas identified are as follows: Residential, C&I, and Special and Cross-Cutting. The Special and Cross-Cutting research area covers topics that do not fit cleanly into either the Residential or C&I research areas, as well as additional specialized topics in which it is particularly important to ensure consistency across research areas and markets. Examples of topics within this research are codes and standards, education and training, market effects, top-down modeling, program and portfolio marketing, customer profile report, and demand reduction.

More details regarding these research areas and specific research topics can be found in the Strategic Evaluation Plan, which is attached at Appendix S.

4. Types of Evaluation Functions

EM&V refers to the systematic collection and analysis of information to document the impacts of energy efficiency programs and improve the effectiveness of these programs. EM&V includes the following types of studies:

- *Impact evaluation* refers to the measurement of gross energy and demand (electric and natural gas) savings achieved within overall program populations. Impact evaluations may also include the study of key impact factors to estimate savings, such as in-service rates and other resource savings, including water and non-utility fuels (e.g., propane and oil).
- *Baseline studies* refer to specific research to determine baselines, such as industry-standard practice baselines. Baseline research is sometimes conducted at the same time as impact evaluation studies.
- *Net-to-gross ("NTG") studies* refer to specific research that estimates free-ridership and the various components of spillover (e.g., participant and/or non-participant spillover).
- *Market effects evaluation* refers to the measurement of the effects that programs have on the structure and functioning of their target markets.
- *NEI studies* refer to research that estimates NEIs of demand side management measures, including participant and utility benefits. These benefits include O&M, comfort, productivity, avoided arrearages, etc.
- *Cost and measure life studies* include research to determine the total and incremental costs and lifetime of demand side management measures.
- *Market characterization* refers to the systematic assessment of demand side management markets for the purpose of improving the effectiveness of programs targeting those markets.
- *Process evaluation* refers to the systematic assessment of programs for the purpose of documenting their operations and developing recommendations to improve their effectiveness and design. It may also include marketing studies to understand the effectiveness of various marketing approaches.

5. Evaluation Planning and Strategic Evaluation Plan

The EMC has sought to establish a long-term strategic view of EM&V for the 2019-2021 Plan, including developing evaluation strategy and determining priorities that the EMC expects to research during the three-year term. These priorities were developed based on the findings of current research, a multi-day Strategic Evaluation Planning Summit in December 2017, and discussions in the EMC and with Councilors and other stakeholders. The Strategic Evaluation Plan expands upon and prioritizes the important research topics that were discussed and established

at the summit and during EMC and other discussions. These details and priorities are attached at Appendix S.

6. Evaluation Budgets

The EM&V evaluation study budget for the 2019–2021 Plan is projected to be in line with historical program budget levels. Twenty percent of each sector's available evaluation budget is allocated to the Special and Cross-Cutting research area.

In 2017, EM&V evaluation study expenditures (not including potential studies and internal labor costs) totaled approximately $17.2 million ($12.8 million for electric and $4.4 million for gas). Therefore, for the three years of the 2019-2021 Plan, the Program Administrators recommend an EM&V study-specific expenditure of $51.6 million (i.e., the 2017 expenditures multiplied by three). As mentioned above, this budget does not include potential study costs or internal staffing costs.

The EM&V budget is included in the Evaluation and Market Research hard-to-measure line item, along with other evaluation and market research costs, such as potential studies, the AESC Study, the eTRM, and internal PA staffing related to EM&V. See Section III.D.1.k for more information on the hard-to-measure program.

7. Evaluation/Implementation Feedback Loop

One of the purposes of EM&V is to provide information to enhance the energy efficiency programs. The Program Administrators have developed a feedback loop to ensure that the results of evaluations are communicated to program implementers, who can then use those results to enhance and refine the programs.

The feedback loop has many steps, from the initial consideration of a study to completion. Before a study is commenced, multiple teams, including evaluation, implementation, contractors, stakeholders, and consultants, convene to identify researchable questions across the statewide portfolio. The EMC then works with contractors and consultants to create a plan based on the researchable questions. As evaluation studies are scoped and planned out, the work plan may be shared with implementation to ensure that the EMC is asking the most appropriate researchable questions to help implementation. Evaluators also provide advanced notice of evaluation activity, such as customer on-sites and staff interviews. During a study process, the implementation team is often interviewed as part of evaluation, particularly for process/market studies. Once a draft report is available, the materials are shared with implementation, consultants, evaluation, and other stakeholders to give interested parties the opportunity to review and provide feedback. Once a study is complete, final recommendations are reviewed by the RMC and C&IMC and their respective working groups, which determine whether it is appropriate to adopt and implement a recommendation. If the Program Administrators determine that it is not appropriate to adopt a recommendation, the decision and reasoning will be documented clearly. A chart describing EM&V recommendation decisions is provided to the Department as part of the Term Report filing. Final impact results are also reviewed and incorporated by the Common Assumptions Working Group.

Information on EM&V continuously flows in both directions, from the implementation teams seeking guidance from EM&V, and from the EMC seeking to research topics of importance to the programs. An EMC liaison participates in RMC and C&IMC meetings to inform the management committees of studies about to commence, seek input from implementation when it is needed, and to explain results and recommendations. Also, as discussed above, the management committees meet altogether quarterly in Tri-MC meetings to discuss various topics, including evaluations. Finally, the Program Administrators consistently communicate at meetings and informally on all aspects of the programs, and maintain the flexibility to incorporate new studies and their recommendations over time.

8. Market Effects

The Program Administrators have sought to study both direct and indirect effects of the energy efficiency programs. Market effects studies look at how the energy efficiency programs have successfully reduced market barriers and transformed markets. To quantify program impacts that have translated to market effects, first a baseline must be established, and then changes from that baseline can be determined to be program induced and included in the calculation of net savings. The Program Administrators are in the process of considering the type and manner of studying market effects in 2019-2021 and will work with the Council and the EM&V Consultant on potential proposals during the Term.

9. Evaluation Studies Completed in Advance of the 2019-2021 Plan

In advance of the 2019-2021 Plan, the Program Administrators completed 37 new studies, in addition to other studies previously filed in previous Plan-Year Reports. These new studies include a wide range of evaluation topics in the residential, low-income, C&I, and cross-sector evaluation areas. A summary of each of these studies is included in Appendix T and the full set of studies are provided in Appendix U.

All currently completed studies are available on the Council's website at: http://ma-eeac.org/studies/.

I. Reporting

1. Overview

The Program Administrators provide transparent reporting on their energy efficiency activities in multiple presentations, and reports. Providing regular communications allows the public and stakeholders to receive up-to-date information regarding energy efficiency investments and savings directly from the Program Administrators. Program Administrators provide formal reporting required by the GCA and the Department, including the three-year plan, Plan-Year Reports, Term Reports, EES filings, and Quarterly Reports to the Council. Additionally, the Program Administrators provide monthly data dashboards to the Council, present regularly on various topics of interest to the Council, and maintain a detailed energy efficiency database, Mass Save Data (http://www.masssavedata.com).

2. Quarterly Report

At the end of each quarter, the Program Administrators provide a detailed report on the implementation, expenditures, savings, and benefits regarding activities during that quarter. The Quarterly Reports include a narrative component with information on energy efficiency activities in each sector, as well as a working spreadsheet. Data is provided by individual Program Administrator and aggregated statewide reflecting costs, participants, savings, benefits, and greenhouse gas emissions reductions. This data is reported on a cumulative basis throughout year (e.g., the Q3 report includes the most up-to-date values from the start of the program year through the end of Q3), as well as cumulatively over the three year term. All data is also available on Mass Save Data.

For 2019-2021, the Program Administrators have agreed to include the following additional information bi-annually in quarterly reports:

- Active demand participation by approach (including without limitation, storage, residential direct load control, and C&I curtailment), by sector, and by season
- Number of heat pump installations, including specifying the number of heat pumps related to fuel switching
- Number of approved applicants within the moderate income offering
- Number of approved applicants within the moderate income offering that result in weatherization jobs
- Number of participants (excluding upstream and behavior) by zip code broken out by: (a) residential sector initiatives subtracting moderate income offering participants; (b) moderate income offering; and (c) low income initiatives
- Small business savings, budgets, and participation across all C&I initiatives
- Streetlight conversions

Annually, the Program Administrators will provide an update in the quarterly reports on the new Passive House offer. The Program Administrators will also report in quarterly reports on up to six (6) additional key performance indicators (not including any specified above) as mutually agreed upon by the PAs and by the Council, and as can be reported without material associated costs.

3. Plan-Year Report

As discussed above, the Program Administrators annually file a Plan-Year Report in order for the Department to fulfill its obligation to review the effectiveness of the programs pursuant to G.L. c. 25, § 21(d)(2). The reports document fully evaluated implementation results for each program year that are than incorporated as part of each Program Administrator's Term Report. The Plan-Year Reports include updated data tables comparing planned, preliminary, and evaluated results. Each Program Administrator provides detailed explanations of variances in budget, lifetime savings, total benefits, and total resource benefits. These reports include information on

cost-effectiveness. In the event of a non-cost-effective program, a Program Administrator must provide a detailed explanation of the reasons why the program is not cost-effective, and how the Program Administrator expects to proceed with the program (e.g., modify program implementation, modify program budget, terminate the program, etc.) and why this course of action is appropriate. The Plan-Year Report is filed following the first two program years of a term.

4. Term Report

At the conclusion of the term, the Program Administrators file a Term Report with the Department documenting performance over the entirety of the term. The Term Report contains similar data and variance explanations to the Plan-Year Report, along with other information to demonstrate compliance with the approved plan and statutory requirements. The Department reviews each Program Administrator's Term Report in a publicly noticed adjudicatory proceeding. At the conclusion of the proceeding, the Department provides final approval of program expenditures, performance incentives, and LBR, if any. As discussed above, the Program Administrators propose that the Department allow the reconciliation of performance incentives in the next EES filing after the submission of the Term Report to support the goal of rate continuity. See Section IV.F.4, above.

5. Database

The Program Administrators developed and maintain a publicly accessible statewide energy efficiency database, Mass Save Data, which is available at http://www.MassSaveData.com. Mass Save Data is an online statewide database that improves public and stakeholder access to the extensive data already reported by Program Administrators, as well as provides additional information and presentations of data. It provides a single, reliable and timely data source for currently reported data on an individual Program Administrator and statewide basis that can be accessed at any time. Mass Save Data enables users to export data to Excel or PDF formats for further analysis and queries. The Program Administrators designed Mass Save Data to export data easily for those stakeholders like the Council and DOER who prepare data-driven reports on energy efficiency and, at the same time, to display data in a user-friendly, understandable manner for those users who prefer charts and graphs. Mass Save Data has been implemented in a manner that is cost efficient and protects customer privacy. The platform has been materially expanded over the last two program terms and provides accessible, meaningful information to customers, municipalities, and stakeholders over time.

Mass Save Data provides quantitative data similar to that provided in the Program Administrators' public reports, including information related to participants, expenditures, annual and lifetime savings, electric capacity savings, and benefits. The database includes data at the sector, program, initiative, and measure levels. In addition to the Program-Administrators specific data, Mass Save Data also provides savings, usage, and incentives data on the geographic tab at the county, town, and zip code level. This data allows municipalities to see the effects of energy efficiency in their town and other areas. Following a request from several municipalities, the Program Administrators are now providing usage data by town by individual month on an annual basis. Program Administrators have updated Mass Save Data and provided new information and views based on input from members of the Council and other stakeholders. Mass Save Data tabs

and sections include overview sections such as time series, performance overview, monthly reporting, and sales and savings; detailed data such as performance details, cost to deliver, home energy services, HEAT Loan, GHG reductions, and measure details; and geographic information including savings, usage and incentives by county, town, and zip code. There are also reference materials such as a glossary and the link to the eTRM.

Mass Save Data appropriately protects customer privacy and reduces the need for expensive data security measures because the website is populated with aggregated rather than customer-specific energy efficiency data.[47] Protecting customer data is a core database concern of the Department, Program Administrators and stakeholders. Safeguarding the confidentiality of sensitive customer-specific account data is both a legal obligation and an important corporate responsibility for the Program Administrators.[48]

The Program Administrators update Mass Save Data with various data sets monthly, quarterly, and annually.

[47] In Massachusetts, the Program Administrators strictly control access to sensitive customer-specific account information like customer names, account numbers, rate class, location, usage, and demand data. Customer consent is necessary to permit third-party access to sensitive customer-specific account information outside the conduct of regulated Program Administrator business. Disclosure of customer information to a third-party without customer authorization would violate corporate privacy policies and expose a Program Administrator to liability under the Massachusetts Right to Privacy Act, M.G.L. c. 214, § 1B or Chapter 93A, and potentially other statutes.

[48] The Program Administrators have each adopted strict corporate privacy policies and safeguards to protect sensitive customer-specific account information. These corporate privacy policies explicitly state that customers' personal information will be safeguarded and only disclosed for a regulated Program Administrator business purpose.

V. COST RECOVERY, FUNDING SOURCES, AND BILL IMPACTS

A. Cost Recovery

Cost recovery is a critical element of the three-year plans. Cost recovery associated with the implementation of energy efficiency programs includes the recovery of a performance incentive,[49] and, for those Program Administrators without a Department-approved decoupling mechanism, the replacement of revenues that support system operating costs. For the Program Administrators to pursue the aggressive goals set forth in this Plan, it is essential that the Department provide a full and fair opportunity for the Program Administrators to be made economically whole for aggressively pursuing sales-reducing energy efficiency and demand reduction efforts and to earn a reasonable return on this investment based upon their performance and achievement. Although Department approval of the proposed Plan should ensure cost-recovery of reasonable Plan-related costs, performance incentives, and LBR, if applicable, the details related to individual Program Administrator cost-recovery mechanisms will be addressed in separate Department proceedings.

Pursuant to the GCA, after reviewing a Program Administrator's proposed Plan, the Department must approve a fully reconciling funding mechanisms, in addition to other statutorily specified sources, if it determines that the Plan ensures that the Program Administrator has identified and will capture all energy efficiency and demand reduction resources that are cost-effective or less expensive than supply. G.L. c. 25, §§ 19, 21(d)(2).

B. Funding Sources

1. Introduction

The Program Administrators seek to leverage available funding sources and financing initiatives to increase the benefits of Three-Year Plans and minimize customer bill impacts. For electric Program Administrators, the GCA identifies four specific funding sources for energy efficiency programs: (1) revenues collected from ratepayers through the SBC; (2) proceeds from the Program Administrators' participation in the FCM; (3) proceeds from cap and trade pollution control programs, including but not limited to the RGGI; and (4) other funding as approved by the Department, including revenues to be recovered from ratepayers through a fully reconciling funding mechanism (i.e., an EES). G.L. c. 25, §§ 19(a); 21(b)(2)(vii). Consistent with the Department's Guidelines, the Program Administrators allocate SBC, FCM, and RGGI revenues to each customer sector in proportion to the kWh consumption of each class.[50] In approving other funding for electric Program Administrators, the Department must consider: (1) the availability of other private or public funds; (2) whether past programs have lowered the cost of electricity to customers; and (3) the effect of any rate increases on customers. G.L. c. 25, § 19(a). The Department has determined that a bill impact analysis with a short-term perspective that isolates the effect of a proposed change in the energy efficiency surcharge ("EES") is appropriate because

[49] For a discussion of performance incentives, please see supra Section IV.F.

[50] The income eligible sector is allocated at least ten percent of the funds for electric energy efficiency programs and 20 percent of the funds for gas energy efficiency programs pursuant to G.L. c. 25, § 19(c).

it provides an accurate and understandable assessment of the impact that customers will experience on their bills. 2013-2015 Three-Year Plans Order at 122; D.P.U. 08-50-D at 11-12.

For gas Program Administrators, the GCA does not identify multiple funding sources for energy efficiency programs and instead requires the gas Program Administrators to include a fully reconciling funding mechanism to collect energy efficiency program costs from customers (i.e., EES). G.L. c. 25, § 21(b)(2)(vii); see also G.L. c. 25, § 21(d)(2). In approving funding for gas Program Administrators, the Department considers the effect of any rate increases on customers. Guidelines § 3.2.2.2.

Below is a description of each funding source currently available to the Program Administrators.

2. Non-EES Revenues

a. System Benefit Charge (electric only)

The SBC is calculated consistent with G.L. c. 25, § 19(a) which states: "The [D]epartment shall require a mandatory charge of 2.5 mills per kilowatt-hour for all customers, except those served by a municipal lighting plant, to fund energy efficiency programs including, but not limited to, demand side management programs." Specifically, each electric Program Administrator calculates projected SBC revenues as the product of the statutorily mandated SBC of $0.0025 per kWh and projected sales for the applicable year.

b. Forward Capacity Market Proceeds (electric only)

Pursuant to G.L. c. 25, § 19(a), the Three-Year Plans of electric Program Administrators shall be funded in part by "amounts generated by the distribution companies and municipal aggregators under the Forward Capacity Market program administered by ISO-NE, as defined in section 1 of chapter 164." Specifically, each Program Administrator calculates projected FCM revenues as the product of the clearing prices of the FCM in the applicable year and the energy efficiency capacity that is designated by ISO-NE as an FCM capacity resource for the year. The Program Administrators propose to apply all net proceeds from the FCM to energy efficiency programs.

To minimize ratepayer funding for energy efficiency efforts, each electric Program Administrator seeks to maximize FCM revenues for its customers. FCM bidding strategies are designed to strike an appropriate balance between maximizing revenues through participation in the FCM and avoiding the risks associated with FCM penalties for failure to deliver their capacity-supply obligations. In addition, demand reduction resources must participate in the energy market if the resource has a capacity supply obligation in the FCM, which adds potential for additional revenues but carries the risk of penalties. Each Program Administrator employs its own individual strategy in bidding future capacity into the FCM. For more information on Program Administrator bidding strategy see each electric PA's testimony.

The Department has recognized the challenges Program Administrators face in projecting with precision over the term of a Three-Year Plan the level of planned energy efficiency resources

that will be installed before and during each FCM commitment period. 2013-2015 Order at 119. One of these challenges is driven by the timing of the FCM auction cycles, which are conducted three years ahead and begin with a "show-of-interest" submission almost four years before the capacity-commitment period.[51] Another is that there are financial penalties for failing to deliver on FCM supply obligations. However, each Program Administrator takes all reasonable steps to maximize FCM revenues during the term.

In developing a bid, each Program Administrator uses the best information available at the time. Each Program Administrator considers historic achieved annual peak period MW reductions from their energy efficiency programs, as well as ongoing studies and evaluations that may affect future savings potential. Given the difficulty in estimating the actual energy efficiency savings that will be eligible to participate in the FCM and the potential penalties, Program Administrators typically do not bid into future FCM commitment periods the total amount of energy efficiency savings they expect to achieve. In making conservative FCM bids, the Program Administrators avoid overpromising and thereby compromising future system reliability. In addition, the reconciling nature of the EES ensures that customers are made whole if Program Administrator FCM revenue projections are overly conservative and the Program Administrators ultimately collect additional FCM revenues.

c. Regional Greenhouse Gas Initiative Proceeds (electric only)

Pursuant to G.L. c. 25, § 19(a), the Three-Year Plans of electric Program Administrators shall be funded in part by "not less than 80 per cent of amounts generated by the carbon dioxide allowance trading mechanism established under the Regional Greenhouse Gas Initiative Memorandum of Understanding, as defined in subsection (a) of section 22 of chapter 21A, and the NOx Allowance Trading Program." As described further below, the electric Program Administrators typically calculate projected RGGI revenues by multiplying projected RGGI clearing prices by a projection of allowances sales in each RGGI auction, with 80 percent of the revenues allocated to electric efficiency programs. RGGI allowances prices are derived from the AESC Study. The electric Program Administrators consulted with DOER to forecast RGGI proceeds for the 2019-2021 Plan. The forecasted RGGI funds are reflected in the Energy Efficiency Data Tables (see Appendix C).

3. EES Revenues[52]

The EES is a fully reconciling funding mechanism that the Department approves for funding the Three-Year Plans. G.L. c. 25, § 21(d)(2). On an annual basis, each Program Administrator submits an updated EES for Department review, based on: (1) the Program Administrator's most recent projections of budgets, revenues for non-EES funding sources (for electric Program Administrators), and sales for the current year; and (2) a reconciliation of any under- or over-recovery of costs from the previous year. 2016-2018 Three-Year Plans Order

[51] The next forward capacity auction, in February 2019, will be for capacity delivery in July 2022.

[52] The Program Administrators collect funds related to RCS through their EESs. 220 C.M.R. § 7.00 et seq. The Department reviews the reconciliation of any over and under collections of RCS funds in the LDAC filings for the gas Program Administrators and in the Energy Efficiency Reconciliation Factor ("EERF") tariff filings for the electric Program Administrators.

at 114.[53] Electric Program Administrators collect the EES through EERF tariffs. Guidelines §§ 2(9), 3.2.1.6. For gas Program Administrators, the EES is collected through the LDAC tariff in accordance with established Department practice. Guidelines §§ 2(9), 3.2.2. The EERF and LDAC filings of the Program Administrators are separate proceedings from the Three-Year Plan proceeding and are implemented on schedules that vary among the Program Administrators.[54]

4. Carryover Information

In determining its EES, an electric Program Administrator takes into account carry over funds. Pursuant to the Guidelines § 3.2.1.6.1, if the funding for a customer sector from SBC, FCM, RGGI, and other non-EES sources exceeds the customer sector's budget, the electric Program Administrator must carry over any excess funding to the customer sector's budget for the subsequent year in order. For 2019-2021, the electric Program Administrators do not have any carry over funds. Each Program Administrator may have an over- or under-collection from their respective EES. These estimated over- and under-recoveries are reflected in the electric PA-specific funding tables in each PA-specific Exh. 4.

5. Outside Funding Levels

The 2019-2021 Plan does not contain outside funding assumptions at this time given the absence of material viable funding sources. The Program Administrators, as well as Councilors and government agencies, all actively continue to seek new sources of outside funding. The Program Administrators' approach in this regard reflects lessons learned over the course of prior Three-Year Plans. There continues to be a low likelihood that a major new federal "cap and trade" program will be implemented in the foreseeable future as had been anticipated when the 2010-2012 Plans were initially developed and approved by the Council.

As part of the Program Administrators' holistic, integrated approach, the Program Administrators will seek to educate customers about other funding offered through other government programs. One example of this is a DOER grant designed to assist moderate income customers with pre-weatherization barriers. Another example is funding designed to promote conversion to and adoption of renewable technologies, as defined by DOER. MassCEC has historically offered generous incentives, in addition to the incentives offered under the Plan, for

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53 In D.P.U. 17-05-B, the Department approved a single energy efficiency charges tariff for the newly consolidated NSTAR Electric Company d/b/a Eversource Energy (in which the former Western Massachusetts Electric Company was consolidated with the former NSTAR Electric Company as of January 1, 2018). See also D.P.U. 17-05, at 44. (2017). Accordingly, for the 2019-2021 plan term, Eversource will be collecting its energy efficiency costs through class-specific energy efficiency recovery factors applicable to its entire Massachusetts service territory.

54 With the exception of the Compact, EERF filings are made coincident with each electric Program Administrators'' residential basic service rate change, creating a lag between energy efficiency program spending and collection. The Compact's rates are effective January 1 of each year, consistent with the 2013-2015 Order at 125, n.106. The gas Program Administrators' LDAC filings are approved for effect November 1st each year. Due to the timing of these filings, the budget and revenue projections are based on the twelve month period starting on the effective date of each EES, rather than on a calendar year. Therefore, projected expenditures and revenues included in the respective EERF and LDAC filings will differ from the amounts included in the Plan.

air source heat pumps, ground source heat pumps, wood heating, and solar hot water. In addition, MassCEC and DOER have partnered to develop the HeatSmart Mass Residential program designed to encourage customers to use clean heating and cooling technologies. DOER's Alternative Portfolio Standard for Renewable Thermal offers an opportunity for customers to obtain revenue for installing eligible solar thermal, air source heat pumps, and ground source heat pumps based on the size of the unit installed. While the objectives of these programs differ from the goals of the energy efficiency programs, customers may leverage the multiple funding sources to reduce the customer contribution cost, removing barriers to adoption of measures that provide both energy efficiency benefits and advance other state policies, including meeting the requirements of the GWSA.

C. **Bill Impacts**

Consistent with directives of the GCA and the goal of the 2019-2021 Plan to provide for the acquisition of all available energy efficiency and demand reduction resources that are cost-effective or less expensive than supply, the Program Administrators have sought to develop a statewide energy efficiency plan that acquires these resources with the lowest reasonable customer contribution. G.L. c. 25, § 21(b). The Department has determined that a bill impact analysis with a short-term perspective that isolates the effect of a proposed change in the EES is appropriate because it provides an accurate and understandable assessment of the impact that customers will experience on their bills. 2013-2015 Three-Year Plans Order at 122; D.P.U. 08-50-D at 11-12.

The Department requires the Program Administrators to submit traditional bill impacts for non-participants under the following scenarios:

1. the current (e.g., 2018) EES to the proposed EES for the first year of the three-year plan (e.g., 2019);
2. the EES from the first year of the three-year plan (e.g., 2019) to the proposed EES for the second year of the three-year plan (e.g., 2020);
3. the EES from the second year of the three-year plan (e.g., 2020) to the proposed EES for the third year of the three-year plan (e.g., 2021);
4. the current EES (e.g., 2018) to the proposed EES for the third year of the three-year plan (e.g., 2021).

D.P.U. 08-50-D at 12. The Department also directed the Program Administrators to submit bill impacts for participants, "where consumption is reduced for three levels of savings – low, medium, and high – and [to] provide a description of how these savings levels were determined." Id. The Department later clarified the bill impact requirements for non-participants by providing a spreadsheet to the Program Administrators, directing them to use average monthly usage levels under the first and fourth scenarios listed above.

Accordingly, to calculate bill impacts for participants, the Program Administrators will populate the Department's spreadsheet (with peak and off-peak rates on separate sheets), using the average monthly kWh and/or therm usage for non-participants for each rate class, and the percentages set forth in the table below. To best approximate low, medium and high annual savings consistent with the Department's directive in D.P.U. 08-50-D, the Program Administrators

collaborated on appropriate assumptions for residential, income eligible and C&I programs to develop statewide percentages that best approximate savings for those types of participants. The Program Administrators determined that the percentages in the table below will provide directional information on the bill impacts that a residential, income eligible or C&I participant may experience.

The Program Administrators determined that there is no low, medium and high savings scenario for income eligible participants. These participants typically receive a comprehensive "whole house" energy efficiency approach, meaning potential measures are installed in most cases (the work that can be done is done). Similarly, the Program Administrators determined that there is no low, medium and high savings scenario for residential and income eligible gas non-heating participants and street lighting. Accordingly, the Program Administrators determined that the percentages in the table below best approximate savings for those types of participants.

	Low	**Medium**	**High**
Residential- Electric:	2%	10%	30%
Residential- Gas:	2%	15%	30%
Residential Gas Non-Heating:	2%		
Income Eligible Gas Non-Heating:	2%		
Income Eligible:	25%		
Street Lighting:	10%		
C&I- Electric:	1%	10%	20%
C&I- Gas:	1%	10%	20%

Each PA has provided traditional bill impacts for all rate classes in each individual PA's filing. Please see PA-specific Exh. 6 for bill impacts.

It is important to emphasize that actual rate and bill impacts for customers associated with the 2019-2021 Plan will vary based upon a multiplicity of factors, such as the cost of service in a particular Program Administrator's service territory, the customer's actual individual usage, the level and quality of measure installation, and the availability of public or private funds other than those collected through the SBC for application towards energy efficiency expenditures, such as proceeds realized from the FCM or from cap-and-trade programs (e.g., RGGI). Finally, bill and rate impacts will vary from the bill and rate impacts included in each Program Administrator's EES filings, which are done on a different time schedule from this filing, and include up-to-date over- and under-collections.

VI. APPENDICES

Appendices

A. **Glossary**

GLOSSARY OF TERMS AND ABBREVIATIONS	
2010-2012 Orders	Orders issued by the Department on January 28, 2010 for the 2010-2012 Plans in dockets D.P.U. 09-116 through D.P.U. 09-120 and D.P.U. 09-121 through D.P.U. 09-128
2010-2012 Plans	2010-2012 Electric Three-Year Energy Efficiency Plan, D.P.U. 09-116 through D.P.U. 09-120; 2010-2012 Gas Three-Year Energy Efficiency Plan, D.P.U. 09-121 through D.P.U. 09-128
2013-2015 Order	Order issued by the Department on January 31, 2013 for the 2013-2015 Plans in dockets D.P.U. 12-100 through 12-111
2013-2015 Plan	2013-2015 Three-Year Energy Efficiency Plan, D.P.U. 12-100 through D.P.U. 12-111
2015 AESC Study	Avoided Energy Supply Costs in New England: 2015 Report
2016-2018 Order	Order issued by the Department on January 28, 2016 for the 2016-2018 Plans in dockets D.P.U. 15-160 through D.P.U. 15-169
2016-2018 Plan	2016-2018 Three-Year Energy Efficiency Plan
2018 AESC Study	Avoided Energy Supply Components in New England: 2018 Report (March 30, 2018, amended October 24, 2018)
2019-2021 Plan	2019-2021 Three-Year Energy Efficiency Plan
ACEEE	American Council for an Energy-Efficient Economy
Act Relative to Competitively Priced Electricity in the Commonwealth	Chapter 209 of the Acts of 2012. Signed into law on August 23, 2012.
AESC	Avoided Energy Supply Costs
AFUE	Annual Fuel Utilization Efficiency
AG	Office of the Attorney General of Massachusetts
ALCS	Advanced Lighting Controls Systems
API	Application programming interface
Appeals Committee	Evaluation appeals committee of the Council
Attorney General	Office of the Attorney General
BCR	Benefit/Cost Ratio
BERDO	Boston Building Energy Reporting and Disclosure Ordinance
BOC	Building Operator Certification
C&I	Commercial and Industrial
C&IMC	Commercial and Industrial Management Committee
CAP	Community Action Program
CDO	Customer Directed Option
CHP	Combined Heat and Power
Consultants	Consultants employed by the Energy Efficiency Advisory Council
Council	Energy Efficiency Advisory Council

CPHC	Certified Passive House Consultant
CPHT-E, CPHT-MBS	Certified Passive House Tradesperson
CRE	Commercial Real Estate
CSP	Curtailment Service Provider
DD	Design Development
Department	Massachusetts Department of Public Utilities
DEP	Massachusetts Department of Environmental Protection
DHCD	Massachusetts Department of Housing and Community Development
DOE	Department of Energy
DOER	Massachusetts Department of Energy Resources
DPU	Massachusetts Department of Public Utilities
D.P.U. 08-50	Energy Efficiency Guidelines, D.P.U. 08-50 (2008)
D.P.U. 08-50-B Guidelines	Energy efficiency guidelines established in D.P.U. 08-50-B (2009)
D.P.U. 11-120 Guidelines	Energy efficiency guidelines established in D.P.U. 11-120-A, Phase II (2013)
D.T.E. 98-100 Guidelines	Energy efficiency guidelines established in Investigation to Establish Methods and Procedures to Evaluate and Approve Energy Efficiency Programs, D.T.E. 98-100 (2000)
DRIPE	Demand Reduction Induced Price Effect
DSM	Demand-Side Management
ECM	Electronically Commutated Motor
EEAC	Energy Efficiency Advisory Council
EERF	Energy Efficiency Reconciliation Factor
EES	Energy Efficiency Surcharge
EISA	Energy Independence and Security Act
Energy Act of 2012	Act Relative to Competitively Priced Electricity in the Commonwealth
EMC	Evaluation Management Committee
EMS	Energy Management System
EM&V	Evaluation, Measurement and Verification
EM&V Consultant	A third-party expert consultant who has primary responsibility for working with the PAs to plan and implement high-quality EM&V in Massachusetts.
ENERGY STAR®	Brand name for the voluntary energy efficiency labeling initiative sponsored by the U.S. Environmental Protection Agency and Department of Energy.
EPA	U.S. Environmental Protection Agency
ESCO	Energy Services Company
eTRM	Electronic Technical Resource Manual

EUI	Energy use intensity
FCM	Forward Capacity Market
Free Riders	Customers who participate in an energy efficiency program but would have installed the same measure(s) on their own if the program had not been available.
Free-Ridership Rate	The percent of savings attributable to Free Riders.
FTE	Full-Time Employee
GCA	Green Communities Act
GHG	Greenhouse Gas
Green Communities Act	An Act Relative to Green Communities, Chapter 169 of the Acts of 2008. Signed into law on July 2, 2008.
Guidelines	Department's D.P.U. 11-120 Guidelines
GWSA	Global Warming Solutions Act, St. 2008, c. 298
HEARTWAP	Heating Emergency Assistance Retrofit Task Weatherization Assistance program
HER	Home Energy Report
HERS	Home Energy Rating System
HES	Former initiative Home Energy Services
HPC	Home Performance Contractor
HRV	Heat-Recovery Ventilator Equipment
HVAC	Heating, Ventilation, and Air Conditioning
ICAP	Installed Capacity
IIC	Independent Installation Contractor
Impact Factor	Generic term for persistence, realization rates, in-service rates, non-coincident connected demand factors, etc., developed during the evaluation of energy efficiency programs and used to calculate net savings.
ISO-NE	Independent System Operator – New England
JMC	Former name for the High-Performance Housing Working Group – Joint Management Committee of PA and non-PA parties that manages the Residential and Low-Income New Construction Core Initiatives –
LBR	Lost Base Revenue (for PAs not operating under decoupled rate structure, these costs account for revenues not collected by the PA's distribution business as a result of the energy efficiency undertaken during the program year)
LDAF	Local Distribution Adjustment Factor
LDAC	Local Distribution Adjustment Clause
LDI	Lighting Design Initiative
LEAN	The Low-Income Energy Affordability Network
LED	Light-Emitting Diode

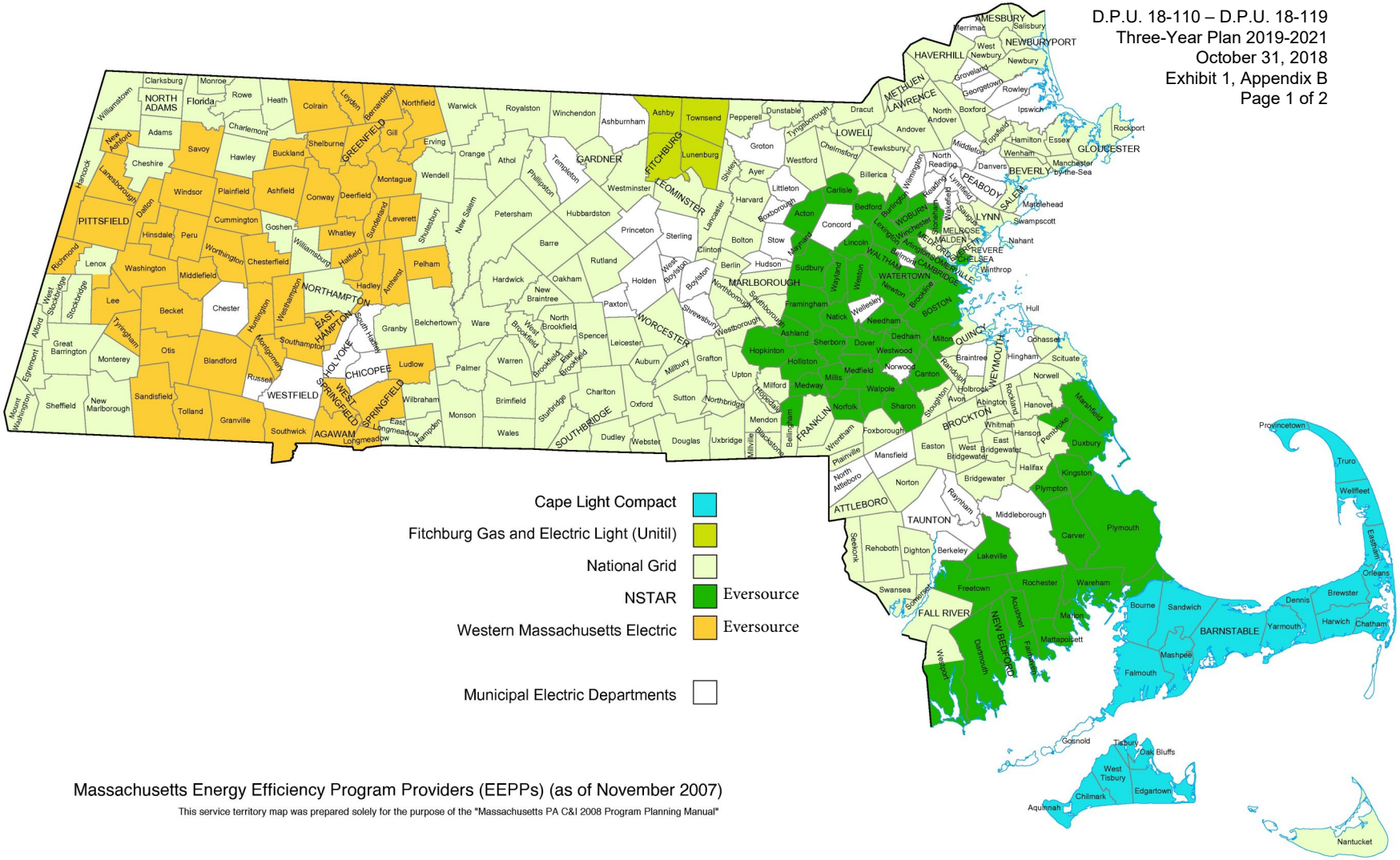
Lifetime	The expected length of time, in years, that an installed measure will be in service and producing savings.
LIHEAP	Low-Income Home Energy Assistance
LLLC	Luminaire Level Lighting Control
M&V	Measurement and Verification
MAEEP	Massachusetts Energy Efficiency Partnership
MAP	Mass Save Application Portal
MassCEC	Massachusetts Clean Energy Center
MBCx	Monitoring Based Commissioning
Measure	Specific technology or practice that produces energy and/or demand savings for which the PA provides financial incentives.
Mid-Term Modification	Modification to approved Three-Year Plan during term of Plan.
MMBTU	Millions of British Thermal Units
MMI	Multifamily Market Integrator
MOU	Memorandum of Understanding
MSBA	Massachusetts School Building Authority
MSD	Mass Save Data
MTAC	Massachusetts Technical Assessment Committee
MTM	Mid-Term Modification
NALCTP	National Advanced Lighting Controls Training Program
NEED	National Energy Education Development
Net to Gross Ratio or NTGR	A factor representing net program savings divided by gross program savings that is applied to gross program impacts to convert them into net program load impacts.
NEI	Non-Energy Impacts
Network	Low-Income Weatherization and Fuel Assistance Program Network
NTG	Net-to-Gross
O&M	Operations and Maintenance
PA	Program Administrator
PACE	Property Assessed Clean Energy
Participant Cost	The total cost of a project or measure less the customer incentive.
Partnership Strategy	Statewide municipal and community partnership strategy
Performance Incentive	Compensation for a utility's successful execution of the energy efficiency programs during the program year as determined by Massachusetts Department of Public Utilities.
PHI	Passive House Institute
PHIUS	Passive House Institute US
PI	Performance Incentive

Plan	Three-Year Energy Efficiency Plan
PP&A	Program Planning and Administration
PP&A Report	Best Practices for Minimizing Program Planning and Administrative Costs (PP&A) for the Massachusetts Utilities and Energy Efficiency Services Providers dated October 24, 2018
PPC	Project Point of Contact
Program Administrators	Utilities and municipal aggregators that are certified to offer energy efficiency programs.
PTF	Pooled Transmission Facilities
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
QPL	Qualifying Products List
QSRs	Quick Service Restaurants
R&D	Research and Development
RCD	Residential Coordinated Delivery
RCS	Residential Conservation Service, established in An Act Establishing The Massachusetts Residential Conservation Service, Chapter 465 of the Acts of 1980, July 11, 1980.
RCx	Retrocommissioning
RFP	Request For Proposal
RGGI	Regional Greenhouse Gas Initiative
RMC	Residential Management Committee
SBC	System Benefit Charge
SD	Schematic Design
SEM	Strategic Energy Management
STAT	Sales, Technical Assistance & Training
Spillover	Additional energy efficient equipment installed by customers that was influenced by the PA's sponsored program, but without direct financial or technical assistance from the program. Spillover is separated into Participant and Non-participant factors. Non-participating customers may be influenced by product availability, publicity, education and other factors that are affected by the program.
Spillover Rate	Estimate of energy savings attributable to spillover effects expressed as a percent of savings installed by participants through an energy efficiency program.
Standard Savings Payout Rate	The energy efficiency and passive demand savings component payout rate for performance incentives.
TA	Technical Assistance
T&D	Transmission and Distribution

Term	Three-year term of the energy efficiency plan
Three-Year Plan	Energy Efficiency Investment Plans required by the GCA every three years.
TRC	Total Resource Cost
Tri-MC	Tri-Management Committee
TRM	Technical Resource Manual
WAP	Weatherization Assistance Program

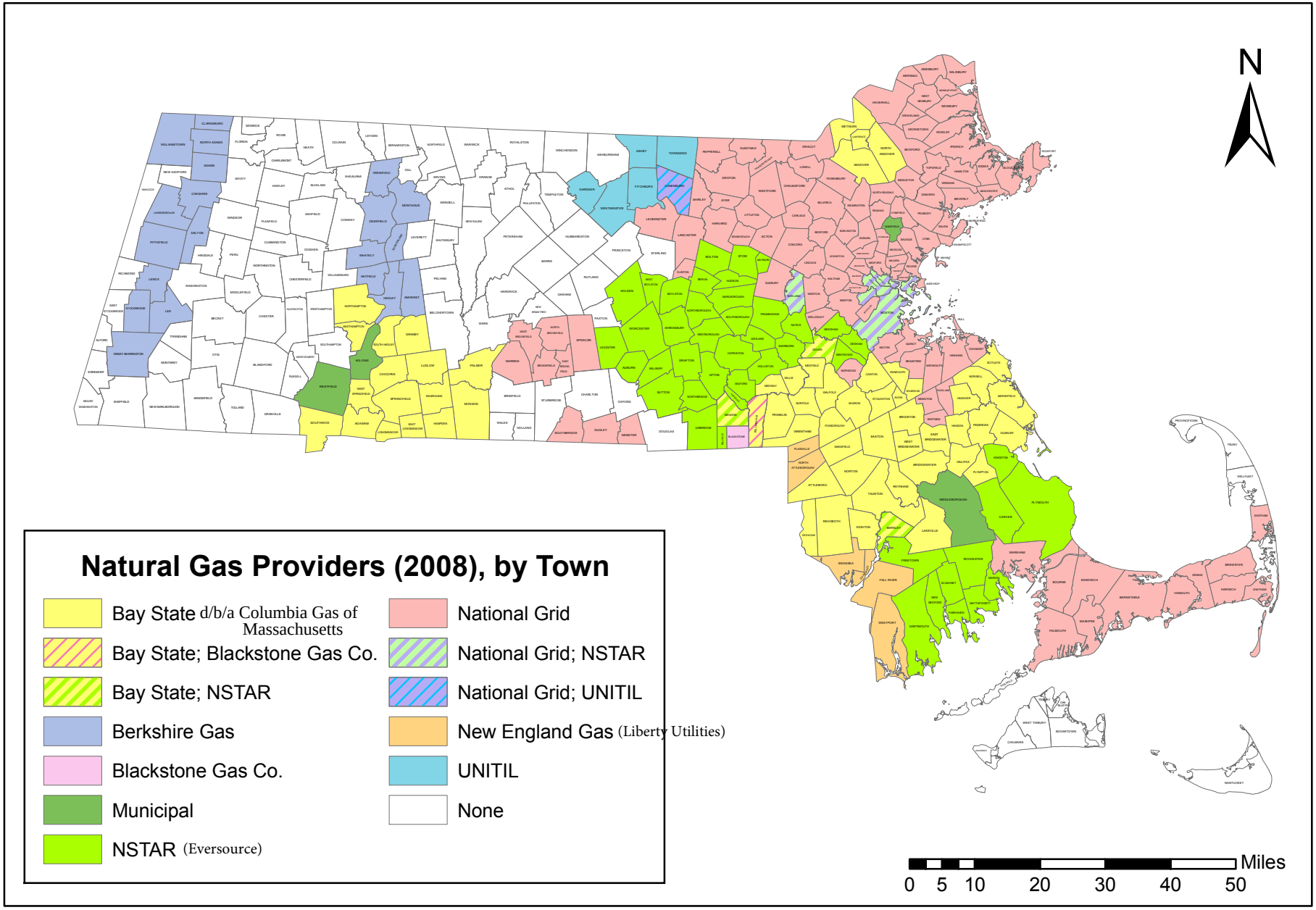
Appendices

B. **Maps of Service Areas**



Massachusetts Energy Efficiency Program Providers (EEPPs) (as of November 2007)

This service territory map was prepared solely for the purpose of the "Massachusetts PA C&I 2008 Program Planning Manual"


N
Natural Gas Providers (2008), by Town
Bay State d/b/a Columbia Gas of Massachusetts
Bay State; Blackstone Gas Co.
Bay State; NSTAR
Berkshire Gas
Blackstone Gas Co.
Municipal
NSTAR (Eversource)
National Grid
National Grid; NSTAR
National Grid; UNITIL
New England Gas (Liberty Utilities)
UNITIL
None
Miles
0 5 10 20 30 40 50

Appendices

C. **Statewide Energy Efficiency Data Tables**

Energy Efficiency Data Tables

Overview

Statewide Electric
October 31, 2018

DATA OVERVIEW

The following data tables provide a summary of the Program Administrator's benefits, costs, savings, and cost-effectiveness for 2016 through 2021. The 2016 through 2018 planned values are consistent with each Program Administrator's 2016-2018 Three-Year Plan. The 2016 and 2017 evaluated values are consistent with each Program Administrator's 2016 and 2017 Plan-Year Reports. The 2018 year-to-date data represents the most up-to-date estimated actual values available through August 2018. The 2019-2021 planned values are consistent with each Program Administrator's 2019-2021 Three-Year Plan.

SUPPORTING INFORMATION

The data included in these tables is based on other supporting models. The primary supporting models used by the Program Administrators are the Benefit-Cost Screening model, each Program Administrator's EES calculation support documents, and the Performance Incentive model. These exhibits should be referenced when looking for more detailed analyses, such as measure level detail and EES calculations. High-level summaries for each of these models are provided below, along with information on plan details that are not summarized in the following plan tables.

Benefit-Cost Screening Models

The Benefit-Cost Screening model provides measure level savings and benefits. This model uses the avoided cost values from the 2018 Avoided Energy Supply Cost study prepared by Synapse Energy Economics.

EES Calculations

Each Program Administrator's Energy Efficiency Surcharge analysis provides supporting information on the EES rates proposed for effect in 2019-2021, including how the rates are calculated for each customer sector, and how revenue is collected from each customer sector.

Performance Incentive Model

The Performance Incentive model filed as part of the Joint Statewide Three-Year Plan provides support for the performance incentive dollars proposed for collection by the Program Administrator. Note that performance incentives are not applicable to the Cape Light Compact.

EM&V Activities

The Evaluation, Monitoring & Verification Section of the Joint Statewide Three-Year Plan describes in detail the EM&V activities planned for 2019-2021.

Other Funding

For the electric Program Administrators, "Other Funding" are those funds, private or public utility administered or otherwise, that may be available for energy efficiency or demand resources and do not include SBC Funds, FCM Revenue, or RGGI Proceeds. The electric Program Administrators assume no other funding sources for 2019-2021.

2019-2021 Plan Data Tables

Template Version: October 25, 2018

PA-Specific Information

PA FILING

Distribution Company	Electric
Program Administrator	Statewide Electric
Date of Filing/Draft	October 31, 2018

PLAN FILINGS

Reporting Period	Filing Date	DPU Docket #
2016 Planned	December 21, 2015	D.P.U. 15-166
2016 Evaluated	May 1, 2017	D.P.U. 17-100
2017 Planned	December 21, 2015	D.P.U. 15-166
2017 Evaluated	June 8, 2018	D.P.U. 18-51
2018 Planned	December 21, 2015	D.P.U. 15-166
2018 YTD	August 2018	
2019 Planned	October 31, 2018	
2020 Planned	October 31, 2018	
2021 Planned	October 31, 2018	

RATES FOR ADJUSTMENTS

2017 Nominal Discount Rate	2.54%	
2018 Nominal Discount Rate	2.54%	
2020 Nominal Discount Rate	2.33%	
2021 Nominal Discount Rate	2.33%	
Effective Tax Rate	27.32%	PA-specific
MWh to MMBTU conversion	3.412	(1 MWh = 3.412 MMBTU)

PLAN YEARS

Previous Plan Year 1	2016
Previous Plan Year 2	2017
Previous Plan Year 3	2018
Current Plan Year 1	2019
Current Plan Year 2	2020
Current Plan Year 3	2021

GHG EMISSIONS REDUCTION FACTORS (Short Tons)

GHG per:	NOX	SO2	CO2
Electricity (MWh)	0.00016	0.00004	0.49400
Gas (Therm)			0.00585
Oil (MMBTU)			0.08069
Propane (MMBTU)			0.06959
Source:	File named "3-year plan EFs 8-9-		

IV.B. Electric PA Funding Sources

1. Summary Table

Statewide Electric
October 31, 2018

2019 Total Electric Funding Sources							2019 Funding as a Percent of Total Electric Funding Sources					
Sector	**SBC**	**FCM**	**RGGI**	**Carryover**	**EERF**	**Total**	**SBC**	**FCM**	**RGGI**	**Carryover**	**EERF**	**Total**
A - Residential	34,937,137	39,050,124	6,458,921	(33,540,909)	224,562,989	271,468,263	13%	14%	2%	-12%	83%	100%
B - Income Eligible	4,558,026	5,066,305	842,654	(4,183,393)	68,716,405	74,999,996	6%	7%	1%	-6%	92%	100%
C - Commercial & Industrial	69,014,438	77,556,532	12,758,882	(42,702,078)	212,606,622	329,234,397	21%	24%	4%	-13%	65%	100%
Grand Total	**108,509,601**	**121,672,961**	**20,060,457**	**(80,426,380)**	**505,886,016**	**675,702,656**	**16%**	**18%**	**3%**	**-12%**	**75%**	**100%**

2019 Total Electric Funding Sources							2019 Funding as a Percent of Total Electric Funding Sources					
Sector	**SBC**	**FCM**	**RGGI**	**Carryover**	**EERF**	**Total**	**SBC**	**FCM**	**RGGI**	**Carryover**	**EERF**	**Total**
A - Residential	34,573,820	32,061,082	6,343,620	-	194,493,971	267,472,492	13%	12%	2%	0%	73%	100%
B - Income Eligible	4,508,240	4,187,303	827,174	-	68,283,262	77,805,979	6%	5%	1%	0%	88%	100%
C - Commercial & Industrial	67,862,970	63,822,327	12,451,527	-	224,594,799	368,731,623	18%	17%	3%	0%	61%	100%
Grand Total	**106,945,030**	**100,070,712**	**19,622,321**	**-**	**487,372,032**	**714,010,094**	**15%**	**14%**	**3%**	**0%**	**68%**	**100%**

2019 Total Electric Funding Sources							2019 Funding as a Percent of Total Electric Funding Sources					
Sector	**SBC**	**FCM**	**RGGI**	**Carryover**	**EERF**	**Total**	**SBC**	**FCM**	**RGGI**	**Carryover**	**EERF**	**Total**
A - Residential	34,238,926	28,755,989	6,575,097	-	196,966,112	266,536,125	13%	11%	2%	0%	74%	100%
B - Income Eligible	4,459,165	3,763,392	856,319	-	70,647,915	79,726,790	6%	5%	1%	0%	89%	100%
C - Commercial & Industrial	66,773,931	56,387,387	12,822,981	-	218,747,115	354,731,413	19%	16%	4%	0%	62%	100%
Grand Total	**105,472,021**	**88,906,768**	**20,254,397**	**-**	**486,361,142**	**700,994,328**	**15%**	**13%**	**3%**	**0%**	**69%**	**100%**

2019 Total Electric Funding Sources							2019 Funding as a Percent of Total Electric Funding Sources					
Sector	**SBC**	**FCM**	**RGGI**	**Carryover**	**EERF**	**Total**	**SBC**	**FCM**	**RGGI**	**Carryover**	**EERF**	**Total**
A - Residential	103,749,883	99,867,195	19,377,638	(33,540,909)	616,023,073	805,476,880	13%	12%	2%	-4%	76%	100%
B - Income Eligible	13,525,430	13,016,999	2,526,147	(4,183,393)	207,647,581	232,532,765	6%	6%	1%	-2%	89%	100%
C - Commercial & Industrial	203,651,338	197,766,246	38,033,390	(42,702,078)	655,948,536	1,052,697,433	19%	19%	4%	-4%	62%	100%
Grand Total	**320,926,652**	**310,650,441**	**59,937,175**	**(80,426,380)**	**1,479,619,190**	**2,090,707,078**	**15%**	**15%**	**3%**	**-4%**	**71%**	**100%**

Notes:
For supporting information on SBC collections, see Table IV.B.3.1.
For supporting information on FCM revenue, see Table IV.B.3.2.
For supporting information on RGGI proceeds, see Table IV.B.3.3.
For supporting information on other funding see, Additional Sources of Information.
For supporting information on estimated carryover, see Table IV.B.3.5.
For supporting information on the EERF, see Table IV.B.3.6.
Funding sources for each year are represented in nominal dollars (2019$, 2020$, 2021$).

IV.B. Electric PA Funding Sources

3.1. System Benefit Charge Funds

Statewide Electric

October 31, 2018

2019 System Benefit Charge Collections				
Sector	Sales (kWh)	SBC Charge ($/kWh)	Collections	
			($)	(% of Total)
A - Residential	13,974,854,707	0.0025	34,937,137	32.2%
B - Income Eligible	1,823,210,331	0.0025	4,558,026	4.2%
C - Commercial & Industrial	27,605,775,357	0.0025	69,014,438	63.6%
Grand Total	**43,403,840,395**		**108,509,601**	**100%**

2020 System Benefit Charge Collections				
Sector	Sales (kWh)	SBC Charge ($/kWh)	Collections	
			($)	(% of Total)
A - Residential	13,829,528,078	0.0025	34,573,820	32.3%
B - Income Eligible	1,803,296,032	0.0025	4,508,240	4.2%
C - Commercial & Industrial	27,145,187,809	0.0025	67,862,970	63.5%
Grand Total	**42,778,011,919**		**106,945,030**	**100%**

2021 System Benefit Charge Collections				
Sector	Sales (kWh)	SBC Charge ($/kWh)	Collections	
			($)	(% of Total)
A - Residential	13,695,570,480	0.0025	34,238,926	32.5%
B - Income Eligible	1,783,665,814	0.0025	4,459,165	4.2%
C - Commercial & Industrial	26,709,572,224	0.0025	66,773,931	63.3%
Grand Total	**42,188,808,518**		**105,472,021**	**100%**

2019-2021 System Benefit Charge Collections				
Sector	Sales (kWh)	SBC Charge ($/kWh)	Collections	
			($)	(% of Total)
A - Residential	41,499,953,265	0.0025	103,749,883	32.3%
B - Income Eligible	5,410,172,178	0.0025	13,525,430	4.2%
C - Commercial & Industrial	81,460,535,391	0.0025	203,651,338	63.5%
Grand Total	**128,370,660,833**		**320,926,652**	**100%**

Notes:

Collections are the sales multiplied by the SBC charge.

Consistent with the Department's Energy Efficiency Guidelines § 3.2.1.2, electric Program Administrators allocate revenue from the System Benefits Charge to the residential, low-income, and commercial and industrial customer sectors in proportion to the sector's kilowatt-hour consumption.

IV.B. Electric PA Funding Sources

3.2. Forward Capacity Market Proceeds

Statewide Electric

October 31, 2018

2019 Forward Capacity Market Revenue							
Program Administrator	Jan 2019 - May 2019			June 2019 - Dec 2019			Total Revenue ($)
	Savings (kW)	Price ($)	Revenue ($)	Savings (kW)	Price ($)	Revenue ($)	
National Grid	596,987	n/a	28,687,478	524,974	n/a	25,833,971	54,521,448
Eversource	661,924		29,906,157	634,157		31,365,213	61,271,370
CLC	45,948		3,063,099	39,604		1,948,913	5,012,012
Unitil	8,310	n/a	396,844	9,578	n/a	471,287	868,131
							-
							-
							-
							-
Grand Total	**1,313,169**	**n/a**	**62,053,578**	**1,208,313**	**n/a**	**59,619,383**	**121,672,961**

2020 Forward Capacity Market Revenue							
Program Administrator	Jan 2020 - May 2020			June 2020 - Dec 2020			Total Revenue ($)
	Savings (kW)	Price ($)	Revenue ($)	Savings (kW)	Price ($)	Revenue ($)	
National Grid	646,045	n/a	20,571,579	672,331	n/a	24,929,361	45,500,940
Eversource	634,157		22,403,723	730,369		28,278,755	50,682,478
CLC	39,604		1,392,081	48,805		1,809,641	3,201,722
Unitil	9,680	n/a	340,219	9,314	n/a	345,354	685,573
							-
							-
							-
							-
Grand Total	**1,329,486**	**n/a**	**44,707,602**	**1,460,819**	**n/a**	**55,363,111**	**100,070,713**

2021 Forward Capacity Market Revenue							
Program Administrator	Jan 2021 - May 2021			June 2021 - Dec 2021			Total Revenue ($)
	Savings (kW)	Price ($)	Revenue ($)	Savings (kW)	Price ($)	Revenue ($)	
National Grid	672,331	n/a	17,806,687	755,517	n/a	24,491,595	42,298,281
Eversource	730,369		20,199,111	698,211		22,942,936	43,142,047
CLC	48,805		1,292,600	50,257		1,629,181	2,921,782
Unitil	9,314	n/a	246,681	9,192	n/a	297,977	544,658
							-
							-
							-
							-
Grand Total	**1,460,819**	**n/a**	**39,545,079**	**1,513,177**	**n/a**	**49,361,689**	**88,906,768**

Notes:

Revenue is allocated across customer sector based on percentage allocation of kWh sales. See Table IV.B.3.1.

Each Program Administrator completes this table according to how their FCM resources have cleared in each auction.

IV.B. Electric PA Funding Sources

3.3. RGGI Proceeds

Statewide Electric

October 31, 2018

RGGI Forecast by Calendar Year				
Calendar Year	Allowances	Clearing Price	PA Allocation	PA Proceeds
2018	9,709,728	$ 4.08	55%	$ 21,775,279
2019	8,539,575	$ 4.00	55%	$ 18,787,065
2020	8,664,089	$ 4.00	55%	$ 19,060,996
2021	9,005,661	$ 4.00	55%	$ 19,812,454

Notes:

The Allowances, Clearing Price, and PA Allocation information in the above table was provided to the Massachusetts Program Administrators by the Massachusetts Department of Energy Resources. For more information on RGGI Auctions, refer to https://www.rggi.org/auctions/about-auctions.

DOER allocates 80 percent of RGGI proceeds to energy efficiency activities. DOER first allocates proceeds to certain activities, such as its administration of RGGI, and the remaining proceeds are allocated to the Program Administrators.

The 2018 clearing price is an average of actual and forecasted clearing prices.

RGGI Forecast by Auction								
Auction	Auction Date	Revenue Year	Allowances	Clearing Price	PA Allocation	PA Proceeds	PA-Specific Allocation	PA-Specific Proceeds
42	Dec-18	2019	2,427,432	$ 4.00	55%	$ 5,340,350	100.0%	$ 5,497,802
43	Mar-19	2019	2,134,894	$ 4.00	55%	$ 4,696,766	100.0%	$ 4,854,218
44	Jun-19	2019	2,134,894	$ 4.00	55%	$ 4,696,766	100.0%	$ 4,854,218
45	Sep-19	2019	2,134,894	$ 4.00	55%	$ 4,696,766	100.0%	$ 4,854,218
46	Dec-19	2020	2,134,894	$ 4.00	55%	$ 4,696,766	100.0%	$ 4,854,218
47	Mar-20	2020	2,166,022	$ 4.00	55%	$ 4,765,249	100.0%	$ 4,922,701
48	Jun-20	2020	2,166,022	$ 4.00	55%	$ 4,765,249	100.0%	$ 4,922,701
49	Sep-20	2020	2,166,022	$ 4.00	55%	$ 4,765,249	100.0%	$ 4,922,701
50	Dec-20	2021	2,166,022	$ 4.00	55%	$ 4,765,249	100.0%	$ 4,922,701
51	Mar-21	2021	2,251,415	$ 4.00	55%	$ 4,953,114	100.0%	$ 5,110,565
52	Jun-21	2021	2,251,415	$ 4.00	55%	$ 4,953,114	100.0%	$ 5,110,565
53	Sep-21	2021	2,251,415	$ 4.00	55%	$ 4,953,114	100.0%	$ 5,110,565

Notes:

PA-Specific Allocation is based on each Program Administrator's percent of statewide sales.

RGGI Forecast by Revenue Year		
Revenue Year	PA Proceeds	PA-Specific Proceeds
2019	$ 19,430,649	$ 20,060,457
2020	$ 18,992,513	$ 19,622,321
2021	$ 19,624,590	$ 20,254,397
2019-2021	**$ 58,047,752**	**$ 59,937,175**

Notes:

There is an approximately three- to five-month lag between the completion of an auction and receipt of proceeds from that auction by the Program Administrators. The Program Administrators have accounted for this time lag in the table above to better reflect calendar-year energy efficiency revenue.

Program Administrator Allocation of RGGI Proceeds to Customer Sectors								
Sector	2019		2020		2021		2019-2021	
	RGGI Funds	% of Total RGGI Funds	RGGI Funds	% of Total RGGI Funds	RGGI Funds	% of Total RGGI Funds	RGGI Funds	% of Total RGGI Funds
A - Residential	$6,458,921	32.2%	$6,343,620	32.3%	$6,575,097	32.5%	$19,377,638	32.3%
B - Income Eligible	$842,654	4.2%	$827,174	4.2%	$856,319	4.2%	$2,526,147	4.2%
C - Commercial & Industrial	$12,758,882	63.6%	$12,451,527	63.5%	$12,822,981	63.3%	$38,033,390	63.5%
Grand Total	**$20,060,457**	**100.0%**	**$19,622,321**	**100.0%**	**$20,254,397**	**100.0%**	**$59,937,175**	**100.0%**

Notes:

RGGI Proceeds are allocated to each customer sector based on the sector's percentage of kWh sales. See Table IV.B.3.1.

IV.B. Program Administrator Funding Sources

3.5. Carryover

Statewide Electric

October 31, 2018

Estimated 2018 Carryover into 2019								
Sector	2016-2018 Planned		2016-2018 Actual		2016-2018 Beginning Balance (Carryover from 2015)	2018 Ending Balance w/o Interest (Carryover from 2018)	Interest on Carryover	Total 2018 Carryover into 2019
	Funding	Budget	Revenue	Expenditures				
A - Residential	896,112,233	846,597,258	907,601,932	823,623,943	(118,289,250)	(34,916,735)	1,375,826	(33,540,909)
B - Income Eligible	212,895,343	208,399,217	232,974,531	203,177,435	(33,718,199)	(4,310,615)	127,222	(4,183,393)
C - Commercial & Industrial	1,022,538,254	905,806,668	947,197,883	990,650,122	(1,463,152)	(44,252,447)	1,550,369	(42,702,078)
Grand Total	**2,131,545,831**	**1,960,803,143**	**2,087,774,346**	**2,017,451,500**	**(153,470,601)**	**(83,479,796)**	**3,053,417**	**(80,426,380)**

Notes:

In 2018 funding from the SBC, FCM, and RGGI does not exceed the budget. As such, the Program Administrator does not have excess funding to carryover to the subsequent year as defined in Energy Efficiency Guideline § 3.2.1.6.1.

The above table provides an estimate of the over- or under-collection for the EERF from the 2016-2018 Three-Year Plan. The Program Administrator's actual 2016-2018 carryover for collection in 2019 will be presented in its Energy Efficiency Reconciliation Factor filing.

A positive carryover value indicates an over-collection while a negative carryover value indicates an under-collection.

IV.B. Electric PA Funding Sources

3.6. EERF

Statewide Electric

October 31, 2018

2019 Energy Efficiency Reconciliation Factor Funds							
Sector	**Total Budget**	**Sales (kWh)**	**SBC + FCM + RGGI + Carryover**	**Interest**	**EERF Funding Required**	**Low-Income Subsidization**	**EERF Funding Collected**
A - Residential	270,002,328	13,974,854,707	46,905,273	118,223	223,215,278	27,083,367	250,298,645
B - Income Eligible	74,897,838	1,823,210,331	6,283,591	(12,944)	68,601,303	3,533,394	3,533,394
C - Commercial & Industrial	327,757,209	27,605,775,357	116,627,775	34,346	211,163,781	37,984,541	249,148,322
Grand Total	**672,657,376**	**43,403,840,395**	**169,816,639**	**139,626**	**502,980,362**	**68,601,303**	**502,980,362**

2020 Energy Efficiency Reconciliation Factor Funds							
Sector	**Total Budget**	**Sales (kWh)**	**SBC + FCM + RGGI + Carryover**	**Interest**	**EERF Funding Required**	**Low-Income Subsidization**	**EERF Funding Collected**
A - Residential	267,399,292	13,829,528,078	72,978,521	73,201	194,493,971	26,959,452	221,453,423
B - Income Eligible	77,783,103	1,803,296,032	9,522,717	22,875	68,283,262	3,515,367	3,515,367
C - Commercial & Industrial	368,686,301	27,145,187,809	144,136,824	45,323	224,594,799	37,808,442	262,403,241
Grand Total	**713,868,695**	**42,778,011,919**	**226,638,062**	**141,399**	**487,372,032**	**68,283,262**	**487,372,032**

2021 Energy Efficiency Reconciliation Factor Funds							
Sector	**Total Budget**	**Sales (kWh)**	**SBC + FCM + RGGI + Carryover**	**Interest**	**EERF Funding Required**	**Low-Income Subsidization**	**EERF Funding Collected**
A - Residential	266,458,259	13,695,570,480	69,570,013	77,866	196,966,112	27,896,957	224,863,069
B - Income Eligible	79,696,956	1,783,665,814	9,078,875	29,834	70,647,915	3,633,207	3,633,207
C - Commercial & Industrial	354,683,977	26,709,572,224	135,984,298	47,436	218,747,115	39,117,750	257,864,865
Grand Total	**700,839,192**	**42,188,808,518**	**214,633,187**	**155,136**	**486,361,142**	**70,647,915**	**486,361,142**

2019-2021 Energy Efficiency Reconciliation Factor Funds							
Sector	**Total Budget**	**Sales (kWh)**	**SBC + FCM + RGGI + Carryover**	**Interest**	**EERF Funding Required**	**Low-Income Subsidization**	**EERF Funding Collected**
A - Residential	803,859,879	41,499,953,265	189,453,808	269,290	614,675,361	81,939,625	696,614,987
B - Income Eligible	232,377,897	5,410,172,178	24,885,184	39,766	207,532,479	10,682,120	10,682,120
C - Commercial & Industrial	1,051,127,487	81,460,535,391	396,748,897	127,104	654,505,695	114,910,734	769,416,429
Grand Total	**2,087,365,263**	**128,370,660,833**	**611,087,888**	**436,160**	**1,476,713,535**	**207,532,479**	**1,476,713,535**

Notes:

For supporting information on the Total Program Administrator Budget, which includes Performance Incentives, see Table IV.C.1.3.

For supporting information on the EERF calculation, including low income subsidization. refer to the Program Administrator's EERF exhibit.

All electric Program Administrators except for the Cape Light Compact have a revenue decoupling mechanism in place and do not estimate LBR. LBR is not applicable to the Cape Light

IV.C. Program Administrator Budgets

1. Summary Table

Statewide Electric
October 31, 2018

2019 Program Administrator Budget										
Program	Program Costs						Performance Incentive	Total Program Administrator Budget	Program Cost per Participant	Resource Benefit per Program Cost
	Program Planning and Administration	Marketing and Advertising	Participant Incentive	Sales, Technical Assistance & Training	Evaluation and Market Research	Total Program Costs				
A - Residential	**11,516,101**	**14,228,055**	**175,172,793**	**52,243,959**	**7,752,006**	**260,912,913**	**9,089,415**	**270,002,328**	**46**	**2.00**
A1 - Residential New Buildings	783,256	248,600	13,680,814	1,604,622	-	16,317,292	721,078	17,038,370	1,366	2.72
A1a - Residential New Homes & Renovations	783,256	248,600	13,680,814	1,604,622	-	16,317,292	721,078	17,038,370	1,366	2.72
A2 - Residential Existing Buildings	8,325,224	11,092,373	139,475,411	46,739,362	-	205,632,370	8,368,337	214,000,707	36	2.32
A2a - Residential Coordinated Delivery	3,571,444	2,494,671	67,409,260	13,893,854	-	87,369,229	4,382,823	91,752,052	1,742	2.78
A2b - Residential Conservation Services (RCS)	861,914	1,740,733	-	15,881,305	-	18,483,952	-	18,483,952		-
A2c - Residential Retail	3,310,559	6,742,934	70,455,623	6,171,186	-	86,680,302	3,481,850	90,162,152	21	2.37
A2d - Residential Behavior	288,067	38,440	787,500	9,386,337	-	10,500,344	395,024	10,895,368	7	2.33
A2e - Residential Active Demand Reduction	293,240	75,594	823,028	1,406,680	-	2,598,542	108,640	2,707,182	260	1.47
A3 - Residential Hard-to-Measure	2,407,621	2,887,082	22,016,568	3,899,975	7,752,006	38,963,251	-	38,963,251		
A3a - Residential Statewide Marketing	-	1,665,753	-	-	-	1,665,753	-	1,665,753		
A3b - Residential Statewide Database	86,290	-	-	-	-	86,290	-	86,290		
A3c - Residential DOER Assessment	1,531,842	-	-	-	-	1,531,842	-	1,531,842		
A3d - Residential Sponsorships & Subscriptions	25,500	10,000	-	164,993	15,000	215,493	-	215,493		
A3e - Residential Workforce Development	157,468	-	-	90,590	-	248,058	-	248,058		
A3f - Residential Evaluation and Market Research	-	719,185	-	-	4,671,625	5,390,810	-	5,390,810		
A3g - Residential EEAC Consultants	340,235	3,758	-	24,058	1,241	369,292	-	369,292		
A3h - Residential R&D and Demonstration	109,889	-	134,426	672,674	-	916,989	-	916,989		
A3i - Residential HEAT Loan	85,280	95,289	10,783,252	954,480	3,064,140	14,982,440	-	14,982,440		
A3j - Residential Education	71,117	393,097	11,098,890	1,993,179	-	13,556,284	-	13,556,284		
B - Income Eligible	**3,503,539**	**1,034,530**	**52,564,430**	**13,084,750**	**1,848,529**	**72,035,779**	**2,862,059**	**74,897,838**	**2,609**	**1.34**
B1 - Income Eligible Existing Buildings	2,696,834	721,052	52,564,430	13,025,409	-	69,007,725	2,862,059	71,869,785	2,499	1.39
B1a - Income Eligible Coordinated Delivery	2,696,635	720,997	52,564,430	13,020,348	-	69,002,410	2,862,059	71,864,470	2,499	1.39
B1b - Income Eligible Active Demand Reduction	200	54	-	5,061	-	5,315	-	5,315		-
B2 - Income Eligible Hard-to-Measure	806,705	313,479	-	59,341	1,848,529	3,028,053	-	3,028,053		
B2a - Income Eligible Statewide Marketing	-	312,410	-	-	-	312,410	-	312,410		
B2b - Income Eligible Statewide Database	20,025	-	-	-	-	20,025	-	20,025		
B2c - Income Eligible DOER Assessment	410,250	-	-	-	-	410,250	-	410,250		
B2d - Income Eligible Sponsorships & Subscriptions	333	-	-	12,500	-	12,833	-	12,833		
B2e - Income Eligible Workforce Development	150,000	-	-	40,000	-	190,000	-	190,000		
B2f - Income Eligible Evaluation and Market Research	-	-	-	-	1,848,176	1,848,176	-	1,848,176		
B2g - Income Eligible Energy Affordability Network	226,097	1,069	-	6,841	353	234,360	-	234,360		
C - Commercial & Industrial	**14,078,851**	**4,600,328**	**236,497,361**	**41,839,483**	**6,563,335**	**303,579,359**	**24,177,850**	**327,757,209**	**14,692**	**3.75**
C1 - C&I New Buildings	913,476	651,489	14,065,987	5,502,163	-	21,133,115	1,748,207	22,881,322	24,525	4.42
C1a - C&I New Buildings & Major Renovations	913,476	651,489	14,065,987	5,502,163	-	21,133,115	1,748,207	22,881,322	24,525	4.42
C2 - C&I Existing Buildings	10,999,646	3,058,716	222,393,874	35,434,657	-	271,886,894	22,429,643	294,316,537	13,731	3.85
C2a - C&I Existing Building Retrofit	8,463,542	2,644,506	178,102,824	26,305,814	-	215,516,686	15,850,445	231,367,131	31,111	3.35
C2b - C&I New & Replacement Equipment	2,173,920	336,135	37,728,578	7,795,720	-	48,034,353	5,344,664	53,379,016	3,835	5.97
C2c - C&I Active Demand Reduction	362,185	78,075	6,562,472	1,333,123	-	8,335,855	1,234,535	9,570,390	23,954	4.53
C3 - C&I Hard-to-Measure	2,165,729	890,122	37,500	902,663	6,563,335	10,559,350	-	10,559,350		
C3a - C&I Statewide Marketing	-	861,253	-	-	-	861,253	-	861,253		
C3b - C&I Statewide Database	45,438	-	-	-	-	45,438	-	45,438		
C3c - C&I DOER Assessment	1,684,529	-	-	-	-	1,684,529	-	1,684,529		
C3d - C&I Sponsorships & Subscriptions	100,335	15,000	-	114,820	30,000	260,155	-	260,155		
C3e - C&I Workforce Development	-	5,000	-	332,354	2,805,266	3,142,620	-	3,142,620		
C3f - C&I Evaluation and Market Research	1,099	5,000	-	78,716	3,726,792	3,811,607	-	3,811,607		
C3g - C&I EEAC Consultants	135,666	3,869	-	24,772	1,278	165,586	-	165,586		
C3h - C&I R&D and Demonstration	198,661	-	37,500	352,000	-	588,161	-	588,161		
Grand Total	**29,098,491**	**19,862,913**	**464,234,585**	**107,168,192**	**16,163,870**	**636,528,050**	**36,129,325**	**672,657,376**	**112**	**2.76**

IV.C. Program Administrator Budgets

1. Summary Table

Statewide Electric
October 31, 2018

2020 Program Administrator Budget										
Program	Program Costs						Performance Incentive	Total Program Administrator Budget	Program Cost per Participant	Resource Benefit per Program Cost
	Program Planning and Administration	Marketing and Advertising	Participant Incentive	Sales, Technical Assistance & Training	Evaluation and Market Research	Total Program Costs				
A - Residential	**11,385,803**	**14,475,629**	**170,929,959**	**53,769,837**	**7,848,743**	**258,409,971**	**8,989,321**	**267,399,292**	**55**	**2.01**
A1 - Residential New Buildings	768,552	267,756	13,912,393	1,657,378	-	16,606,079	754,125	17,360,205	1,353	2.72
A1a - Residential New Homes & Renovations	768,552	267,756	13,912,393	1,657,378	-	16,606,079	754,125	17,360,205	1,353	2.72
A2 - Residential Existing Buildings	8,135,068	11,298,098	132,950,850	48,140,683	-	200,524,700	8,235,196	208,759,895	43	2.37
A2a - Residential Coordinated Delivery	3,565,698	2,539,736	67,420,020	14,352,695	-	87,878,150	4,370,949	92,249,099	2,286	2.83
A2b - Residential Conservation Services (RCS)	892,283	1,767,845	-	16,274,925	-	18,935,052	-	18,935,052		-
A2c - Residential Retail	2,942,093	6,839,927	60,298,539	6,015,995	-	76,096,554	3,283,203	79,379,757	24	2.45
A2d - Residential Behavior	304,191	37,146	665,000	9,431,237	-	10,437,574	400,690	10,838,263	7	2.37
A2e - Residential Active Demand Reduction	430,804	113,445	4,567,291	2,065,831	-	7,177,370	180,353	7,357,723	523	2.13
A3 - Residential Hard-to-Measure	2,482,182	2,909,775	24,066,716	3,971,775	7,848,743	41,279,192	-	41,279,192		
A3a - Residential Statewide Marketing	-	1,638,320	-	-	-	1,638,320	-	1,638,320		
A3b - Residential Statewide Database	89,805	-	-	-	-	89,805	-	89,805		
A3c - Residential DOER Assessment	1,548,752	-	-	-	-	1,548,752	-	1,548,752		
A3d - Residential Sponsorships & Subscriptions	30,500	15,000	-	164,993	20,000	230,493	-	230,493		
A3e - Residential Workforce Development	157,468	-	-	95,590	-	253,058	-	253,058		
A3f - Residential Evaluation and Market Research	-	740,761	-	-	4,748,323	5,489,084	-	5,489,084		
A3g - Residential EEAC Consultants	354,493	3,737	-	23,924	1,234	383,388	-	383,388		
A3h - Residential R&D and Demonstration	115,076	-	124,817	697,855	-	937,748	-	937,748		
A3i - Residential HEAT Loan	114,528	108,861	12,843,009	996,233	3,079,185	17,141,816	-	17,141,816		
A3j - Residential Education	71,561	403,097	11,098,890	1,993,179	-	13,566,728	-	13,566,728		
B - Income Eligible	**3,528,827**	**1,109,408**	**54,720,046**	**13,719,964**	**1,896,686**	**74,974,931**	**2,808,172**	**77,783,103**	**2,698**	**1.34**
B1 - Income Eligible Existing Buildings	2,686,317	778,829	54,720,046	13,655,194	-	71,840,386	2,808,172	74,648,559	2,586	1.40
B1a - Income Eligible Coordinated Delivery	2,655,241	769,229	53,970,046	13,492,398	-	70,886,915	2,808,172	73,695,087	2,558	1.38
B1b - Income Eligible Active Demand Reduction	31,076	9,600	750,000	162,796	-	953,472	-	953,472	12,713	2.27
B2 - Income Eligible Hard-to-Measure	842,510	330,579	-	64,770	1,896,686	3,134,545	-	3,134,545		
B2a - Income Eligible Statewide Marketing	-	329,443	-	-	-	329,443	-	329,443		
B2b - Income Eligible Statewide Database	25,953	-	-	-	-	25,953	-	25,953		
B2c - Income Eligible DOER Assessment	429,056	-	-	-	-	429,056	-	429,056		
B2d - Income Eligible Sponsorships & Subscriptions	333	-	-	12,500	-	12,833	-	12,833		
B2e - Income Eligible Workforce Development	150,000	-	-	45,000	-	195,000	-	195,000		
B2f - Income Eligible Evaluation and Market Research	-	-	-	-	1,896,311	1,896,311	-	1,896,311		
B2g - Income Eligible Energy Affordability Network	237,168	1,136	-	7,270	375	245,948	-	245,948		
C - Commercial & Industrial	**15,057,587**	**4,579,020**	**266,927,350**	**44,467,990**	**6,675,603**	**337,707,550**	**30,978,750**	**368,686,301**	**20,890**	**4.43**
C1 - C&I New Buildings	852,658	589,132	12,811,747	5,644,644	-	19,898,181	1,703,206	21,601,387	28,177	4.37
C1a - C&I New Buildings & Major Renovations	852,658	589,132	12,811,747	5,644,644	-	19,898,181	1,703,206	21,601,387	28,177	4.37
C2 - C&I Existing Buildings	11,951,858	3,088,223	254,061,103	37,843,359	-	306,944,543	29,275,544	336,220,087	19,854	4.59
C2a - C&I Existing Building Retrofit	9,324,944	2,657,964	204,629,653	27,652,240	-	244,264,802	22,534,464	266,799,266	44,548	4.48
C2b - C&I New & Replacement Equipment	2,079,073	336,049	37,524,386	8,458,922	-	48,398,430	4,871,774	53,270,204	5,078	5.32
C2c - C&I Active Demand Reduction	547,840	94,211	11,907,063	1,732,197	-	14,281,311	1,869,306	16,150,617	32,093	3.91
C3 - C&I Hard-to-Measure	2,253,071	901,665	54,500	979,987	6,675,603	10,864,827	-	10,864,827		
C3a - C&I Statewide Marketing	-	872,581	-	-	-	872,581	-	872,581		
C3b - C&I Statewide Database	50,996	-	-	-	-	50,996	-	50,996		
C3c - C&I DOER Assessment	1,752,431	-	-	-	-	1,752,431	-	1,752,431		
C3d - C&I Sponsorships & Subscriptions	105,335	20,000	-	109,820	35,000	270,155	-	270,155		
C3e - C&I Workforce Development	-	5,000	-	342,354	2,793,619	3,140,974	-	3,140,974		
C3f - C&I Evaluation and Market Research	1,138	-	17,000	134,665	3,845,635	3,998,438	-	3,998,438		
C3g - C&I EEAC Consultants	144,510	4,084	-	26,148	1,349	176,091	-	176,091		
C3h - C&I R&D and Demonstration	198,661	-	37,500	367,000	-	603,161	-	603,161		
Grand Total	**29,972,217**	**20,164,057**	**492,577,355**	**111,957,791**	**16,421,033**	**671,092,452**	**42,776,243**	**713,868,695**	**141**	**3.15**

IV.C. Program Administrator Budgets

1. Summary Table

Statewide Electric
October 31, 2018

2021 Program Administrator Budget										
Program	Program Costs						Performance Incentive	Total Program Administrator Budget	Program Cost per Participant	Resource Benefit per Program Cost
	Program Planning and Administration	Marketing and Advertising	Participant Incentive	Sales, Technical Assistance & Training	Evaluation and Market Research	Total Program Costs				
A - Residential	**11,905,834**	**14,829,368**	**167,392,914**	**54,355,919**	**8,457,014**	**256,941,050**	**9,517,210**	**266,458,259**	**70**	**2.13**
A1 - Residential New Buildings	809,316	269,381	14,153,548	1,687,260	-	16,919,505	771,194	17,690,699	1,348	2.67
A1a - Residential New Homes & Renovations	809,316	269,381	14,153,548	1,687,260	-	16,919,505	771,194	17,690,699	1,348	2.67
A2 - Residential Existing Buildings	8,516,331	11,619,734	128,295,610	48,622,787	-	197,054,462	8,746,016	205,800,477	54	2.54
A2a - Residential Coordinated Delivery	3,819,651	2,652,029	69,181,432	14,630,735	-	90,283,847	4,617,505	94,901,352	2,326	2.96
A2b - Residential Conservation Services (RCS)	915,897	1,847,318	-	16,072,558	-	18,835,773	-	18,835,773		-
A2c - Residential Retail	2,907,477	6,937,640	52,698,350	6,035,288	-	68,578,755	3,460,185	72,038,940	31	2.76
A2d - Residential Behavior	361,759	50,256	612,500	9,430,041	-	10,454,556	413,602	10,868,158	7	2.39
A2e - Residential Active Demand Reduction	511,547	132,490	5,803,327	2,454,166	-	8,901,531	254,724	9,156,255	524	2.19
A3 - Residential Hard-to-Measure	2,580,186	2,940,253	24,943,757	4,045,872	8,457,014	42,967,083	-	42,967,083		
A3a - Residential Statewide Marketing	-	1,621,157	-	-	-	1,621,157	-	1,621,157		
A3b - Residential Statewide Database	88,854	-	-	-	-	88,854	-	88,854		
A3c - Residential DOER Assessment	1,575,575	-	-	-	-	1,575,575	-	1,575,575		
A3d - Residential Sponsorships & Subscriptions	30,500	15,000	-	164,993	20,000	230,493	-	230,493		
A3e - Residential Workforce Development	157,468	-	-	100,590	-	258,058	-	258,058		
A3f - Residential Evaluation and Market Research	-	762,984	-	-	4,794,121	5,557,105	-	5,557,105		
A3g - Residential EEAC Consultants	374,775	3,767	-	24,115	1,244	403,901	-	403,901		
A3h - Residential R&D and Demonstration	125,269	-	125,322	723,044	-	973,635	-	973,635		
A3i - Residential HEAT Loan	150,721	124,249	13,719,545	1,039,951	3,641,649	18,676,115	-	18,676,115		
A3j - Residential Education	77,023	413,097	11,098,890	1,993,179	-	13,582,190	-	13,582,190		
B - Income Eligible	**3,699,501**	**1,186,136**	**55,763,401**	**14,384,177**	**2,104,500**	**77,137,716**	**2,559,240**	**79,696,956**	**2,765**	**1.25**
B1 - Income Eligible Existing Buildings	2,825,465	837,430	55,763,401	14,313,806	-	73,740,102	2,559,240	76,299,342	2,643	1.31
B1a - Income Eligible Coordinated Delivery	2,783,109	824,363	54,763,401	14,099,544	-	72,470,417	2,559,240	75,029,657	2,607	1.29
B1b - Income Eligible Active Demand Reduction	42,356	13,068	1,000,000	214,262	-	1,269,685	-	1,269,685	12,697	2.28
B2 - Income Eligible Hard-to-Measure	874,037	348,706	-	70,371	2,104,500	3,397,614	-	3,397,614		
B2a - Income Eligible Statewide Marketing	-	347,476	-	-	-	347,476	-	347,476		
B2b - Income Eligible Statewide Database	26,919	-	-	-	-	26,919	-	26,919		
B2c - Income Eligible DOER Assessment	458,116	-	-	-	-	458,116	-	458,116		
B2d - Income Eligible Sponsorships & Subscriptions	333	-	-	12,500	-	12,833	-	12,833		
B2e - Income Eligible Workforce Development	150,000	-	-	50,000	-	200,000	-	200,000		
B2f - Income Eligible Evaluation and Market Research	-	-	-	-	2,104,094	2,104,094	-	2,104,094		
B2g - Income Eligible Energy Affordability Network	238,670	1,229	-	7,871	406	248,176	-	248,176		
C - Commercial & Industrial	**15,300,530**	**4,721,720**	**256,117,557**	**45,374,876**	**7,476,950**	**328,991,633**	**25,692,345**	**354,683,977**	**21,323**	**3.45**
C1 - C&I New Buildings	967,410	652,791	12,937,318	5,777,614	-	20,335,133	1,801,200	22,136,333	28,880	4.42
C1a - C&I New Buildings & Major Renovations	967,410	652,791	12,937,318	5,777,614	-	20,335,133	1,801,200	22,136,333	28,880	4.42
C2 - C&I Existing Buildings	12,008,248	3,156,026	243,142,739	38,633,630	-	296,940,643	23,891,145	320,831,787	20,166	3.52
C2a - C&I Existing Building Retrofit	8,988,719	2,700,522	187,027,059	27,816,685	-	226,532,985	16,660,225	243,193,210	50,224	3.22
C2b - C&I New & Replacement Equipment	2,168,535	355,916	37,840,057	8,775,450	-	49,139,958	4,571,619	53,711,577	5,059	4.86
C2c - C&I Active Demand Reduction	850,994	99,588	18,275,623	2,041,495	-	21,267,700	2,659,301	23,927,001	42,535	3.58
C3 - C&I Hard-to-Measure	2,324,872	912,903	37,500	963,631	7,476,950	11,715,857	-	11,715,857		
C3a - C&I Statewide Marketing	-	872,674	-	-	-	872,674	-	872,674		
C3b - C&I Statewide Database	50,981	-	-	-	-	50,981	-	50,981		
C3c - C&I DOER Assessment	1,728,782	-	-	-	-	1,728,782	-	1,728,782		
C3d - C&I Sponsorships & Subscriptions	110,335	20,000	-	94,820	35,000	260,155	-	260,155		
C3e - C&I Workforce Development	97,530	-	-	324,000	3,458,474	3,880,004	-	3,880,004		
C3f - C&I Evaluation and Market Research	1,178	11,000	-	107,381	3,982,080	4,101,639	-	4,101,639		
C3g - C&I EEAC Consultants	132,404	9,229	-	55,430	1,397	198,461	-	198,461		
C3h - C&I R&D and Demonstration	203,661	-	37,500	382,000	-	623,161	-	623,161		
Grand Total	**30,905,865**	**20,737,224**	**479,273,872**	**114,114,972**	**18,038,464**	**663,070,398**	**37,768,794**	**700,839,192**	**179**	**2.68**

IV.C. Program Administrator Budgets

1. Summary Table

Statewide Electric
October 31, 2018

2019-2021 Program Administrator Budget										
Program	Program Costs						Performance Incentive	Total Program Administrator Budget	Program Cost per Participant	Resource Benefit per Program Cost
	Program Planning and Administration	Marketing and Advertising	Participant Incentive	Sales, Technical Assistance & Training	Evaluation and Market Research	Total Program Costs				
A - Residential	**34,807,738**	**43,533,052**	**513,495,666**	**160,369,715**	**24,057,763**	**776,263,934**	**27,595,946**	**803,859,879**	**55**	**2.05**
A1 - Residential New Buildings	2,361,125	785,737	41,746,755	4,949,260	-	49,842,877	2,246,397	52,089,274	1,356	2.70
A1a - Residential New Homes & Renovations	2,361,125	785,737	41,746,755	4,949,260	-	49,842,877	2,246,397	52,089,274	1,356	2.70
A2 - Residential Existing Buildings	24,976,623	34,010,205	400,721,871	143,502,832	-	603,211,531	25,349,548	628,561,079	43	2.41
A2a - Residential Coordinated Delivery	10,956,794	7,686,437	204,010,712	42,877,284	-	265,531,226	13,371,277	278,902,503	2,084	2.86
A2b - Residential Conservation Services (RCS)	2,670,093	5,355,896	-	48,228,788	-	56,254,778	-	56,254,778		-
A2c - Residential Retail	9,160,129	20,520,501	183,452,512	18,222,469	-	231,355,611	10,225,238	241,580,850	24	2.51
A2d - Residential Behavior	954,016	125,842	2,065,000	28,247,615	-	31,392,473	1,209,316	32,601,789	7	2.36
A2e - Residential Active Demand Reduction	1,235,591	321,529	11,193,647	5,926,676	-	18,677,443	543,717	19,221,160	459	2.07
A3 - Residential Hard-to-Measure	7,469,989	8,737,111	71,027,041	11,917,622	24,057,763	123,209,526	-	123,209,526		
A3a - Residential Statewide Marketing	-	4,925,230	-	-	-	4,925,230	-	4,925,230		
A3b - Residential Statewide Database	264,949	-	-	-	-	264,949	-	264,949		
A3c - Residential DOER Assessment	4,656,169	-	-	-	-	4,656,169	-	4,656,169		
A3d - Residential Sponsorships & Subscriptions	86,500	40,000	-	494,979	55,000	676,479	-	676,479		
A3e - Residential Workforce Development	472,404	-	-	286,769	-	759,174	-	759,174		
A3f - Residential Evaluation and Market Research	-	2,222,930	-	-	14,214,069	16,436,999	-	16,436,999		
A3g - Residential EEAC Consultants	1,069,503	11,261	-	72,098	3,720	1,156,581	-	1,156,581		
A3h - Residential R&D and Demonstration	350,234	-	384,565	2,093,574	-	2,828,372	-	2,828,372		
A3i - Residential HEAT Loan	350,529	328,399	37,345,806	2,990,664	9,784,974	50,800,371	-	50,800,371		
A3j - Residential Education	219,702	1,209,291	33,296,670	5,979,538	-	40,705,201	-	40,705,201		
B - Income Eligible	**10,731,867**	**3,330,075**	**163,047,878**	**41,188,891**	**5,849,715**	**224,148,425**	**8,229,471**	**232,377,897**	**2,691**	**1.31**
B1 - Income Eligible Existing Buildings	8,208,616	2,337,311	163,047,878	40,994,409	-	214,588,214	8,229,471	222,817,685	2,576	1.36
B1a - Income Eligible Coordinated Delivery	8,134,984	2,314,589	161,297,878	40,612,291	-	212,359,742	8,229,471	220,589,213	2,555	1.35
B1b - Income Eligible Active Demand Reduction	73,632	22,722	1,750,000	382,118	-	2,228,472	-	2,228,472	12,734	2.27
B2 - Income Eligible Hard-to-Measure	2,523,251	992,763	-	194,483	5,849,715	9,560,212	-	9,560,212		
B2a - Income Eligible Statewide Marketing	-	989,330	-	-	-	989,330	-	989,330		
B2b - Income Eligible Statewide Database	72,897	-	-	-	-	72,897	-	72,897		
B2c - Income Eligible DOER Assessment	1,297,422	-	-	-	-	1,297,422	-	1,297,422		
B2d - Income Eligible Sponsorships & Subscriptions	998	-	-	37,500	-	38,498	-	38,498		
B2e - Income Eligible Workforce Development	450,000	-	-	135,000	-	585,000	-	585,000		
B2f - Income Eligible Evaluation and Market Research	-	-	-	-	5,848,581	5,848,581	-	5,848,581		
B2g - Income Eligible Energy Affordability Network	701,934	3,433	-	21,983	1,134	728,484	-	728,484		
C - Commercial & Industrial	**44,436,968**	**13,901,068**	**759,542,268**	**131,682,349**	**20,715,889**	**970,278,542**	**80,848,945**	**1,051,127,487**	**18,567**	**3.88**
C1 - C&I New Buildings	2,733,544	1,893,412	39,815,052	16,924,421	-	61,366,429	5,252,613	66,619,042	27,010	4.40
C1a - C&I New Buildings & Major Renovations	2,733,544	1,893,412	39,815,052	16,924,421	-	61,366,429	5,252,613	66,619,042	27,010	4.40
C2 - C&I Existing Buildings	34,959,752	9,302,966	719,597,716	111,911,645	-	875,772,079	75,596,332	951,368,411	17,521	4.00
C2a - C&I Existing Building Retrofit	26,777,205	8,002,992	569,759,537	81,774,739	-	686,314,473	55,045,134	741,359,606	40,560	3.71
C2b - C&I New & Replacement Equipment	6,421,528	1,028,100	113,093,021	25,030,091	-	145,572,740	14,788,057	160,360,797	4,582	5.38
C2c - C&I Active Demand Reduction	1,761,019	271,874	36,745,158	5,106,815	-	43,884,866	5,763,141	49,648,007	33,940	3.87
C3 - C&I Hard-to-Measure	6,743,672	2,704,690	129,500	2,846,282	20,715,889	33,140,034	-	33,140,034		
C3a - C&I Statewide Marketing	-	2,606,508	-	-	-	2,606,508	-	2,606,508		
C3b - C&I Statewide Database	147,415	-	-	-	-	147,415	-	147,415		
C3c - C&I DOER Assessment	5,165,743	-	-	-	-	5,165,743	-	5,165,743		
C3d - C&I Sponsorships & Subscriptions	316,005	55,000	-	319,461	100,000	790,466	-	790,466		
C3e - C&I Workforce Development	97,530	10,000	-	998,708	9,057,359	10,163,597	-	10,163,597		
C3f - C&I Evaluation and Market Research	3,415	16,000	17,000	320,762	11,554,506	11,911,684	-	11,911,684		
C3g - C&I EEAC Consultants	412,580	17,182	-	106,351	4,024	540,137	-	540,137		
C3h - C&I R&D and Demonstration	600,984	-	112,500	1,101,000	-	1,814,484	-	1,814,484		
Grand Total	**89,976,573**	**60,764,195**	**1,436,085,812**	**333,240,955**	**50,623,367**	**1,970,690,901**	**116,674,362**	**2,087,365,263**	**139**	**2.87**

Notes:

Budgets for each year are represented in nominal dollars (2019$, 2020$, 2021$).

Refer to common definitions for allocation of costs.

IV.C. Program Administrator Budgets

2.2 PA Budget Comparison Table - Three Year Plan vs. Previous Years

Statewide Electric
October 31, 2018

2016-2021 Residential Program Administrator Budget

PA Budget Categories	Program Administrator Budget ($)									Budget Categories as a Percent of Total Program Administrator Budget (%)								
	2016		2017		2018		2019	2020	2021	2016		2017		2018		2019	2020	2021
	Planned	Evaluated	Planned	Evaluated	Planned	YTD	Planned	Planned	Planned	Planned	Evaluated	Planned	Evaluated	Planned	YTD	Planned	Planned	Planned
Program Planning and Administration	10,789,200	7,835,128	10,833,896	8,746,420	10,948,815	3,489,323	11,516,101	11,385,803	11,905,834	4%	3%	4%	4%	4%	5%	4%	4%	4%
Marketing and Advertising	12,264,480	10,767,507	12,977,740	11,778,669	13,102,062	3,744,097	14,228,055	14,475,629	14,829,368	4%	5%	5%	5%	5%	5%	5%	5%	6%
Participant Incentive	190,688,330	158,382,029	196,745,198	168,943,503	199,569,420	55,634,741	175,172,793	170,929,959	167,392,914	69%	70%	69%	70%	69%	74%	65%	64%	63%
Sales, Technical Assistance & Training	41,545,325	33,359,353	43,061,823	33,526,442	45,046,608	10,782,991	52,243,959	53,769,837	54,355,919	15%	15%	15%	14%	16%	14%	19%	20%	20%
Evaluation and Market Research	6,745,060	5,532,220	6,774,529	7,493,296	6,711,865	2,024,975	7,752,006	7,848,743	8,457,014	2%	2%	2%	3%	2%	3%	3%	3%	3%
Performance Incentive	13,120,336	11,112,850	12,963,021	12,134,725	12,709,549	-	9,089,415	8,989,321	9,517,210	5%	5%	5%	5%	4%	0%	3%	3%	4%
Total Program Administrator Budget	**275,152,732**	**226,989,087**	**283,356,208**	**242,623,055**	**288,088,318**	**75,676,127**	**270,002,328**	**267,399,292**	**266,458,259**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

2016-2021 Income Eligible Program Administrator Budget

PA Budget Categories	Program Administrator Budget ($)									Budget Categories as a Percent of Total Program Administrator Budget (%)								
	2016		2017		2018		2019	2020	2021	2016		2017		2018		2019	2020	2021
	Planned	Evaluated	Planned	Evaluated	Planned	YTD	Planned	Planned	Planned	Planned	Evaluated	Planned	Evaluated	Planned	YTD	Planned	Planned	Planned
Program Planning and Administration	3,528,776	2,391,553	3,515,222	2,536,187	3,514,694	852,919	3,503,539	3,528,827	3,699,501	5%	4%	5%	4%	5%	5%	5%	5%	5%
Marketing and Advertising	953,229	641,013	965,054	667,875	972,671	259,995	1,034,530	1,109,408	1,186,136	1%	1%	1%	1%	1%	2%	1%	1%	1%
Participant Incentive	49,198,860	45,001,059	49,753,295	49,275,446	49,377,835	12,843,596	52,564,430	54,720,046	55,763,401	71%	74%	71%	74%	71%	76%	70%	70%	70%
Sales, Technical Assistance & Training	11,999,654	9,806,405	11,945,558	10,427,970	12,117,299	2,544,810	13,084,750	13,719,964	14,384,177	17%	16%	17%	16%	17%	15%	17%	18%	18%
Evaluation and Market Research	1,955,517	1,045,225	1,919,803	1,669,569	1,856,285	396,987	1,848,529	1,896,686	2,104,500	3%	2%	3%	3%	3%	2%	2%	2%	3%
Performance Incentive	1,564,948	1,689,595	1,595,000	1,895,493	1,665,518	-	2,862,059	2,808,172	2,559,240	2%	3%	2%	3%	2%	0%	4%	4%	3%
Total Program Administrator Budget	**69,200,984**	**60,574,850**	**69,693,932**	**66,472,540**	**69,504,302**	**16,898,306**	**74,897,838**	**77,783,103**	**79,696,956**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

2016-2021 Commercial & Industrial Program Administrator Budget

PA Budget Categories	Program Administrator Budget ($)									Budget Categories as a Percent of Total Program Administrator Budget (%)								
	2016		2017		2018		2019	2020	2021	2016		2017		2018		2019	2020	2021
	Planned	Evaluated	Planned	Evaluated	Planned	YTD	Planned	Planned	Planned	Planned	Evaluated	Planned	Evaluated	Planned	YTD	Planned	Planned	Planned
Program Planning and Administration	19,784,761	14,774,275	20,771,978	16,251,714	20,233,786	3,516,885	14,078,851	15,057,587	15,300,530	7%	5%	7%	6%	6%	8%	4%	4%	4%
Marketing and Advertising	4,400,414	3,387,158	4,380,128	4,047,717	4,444,934	1,601,364	4,600,328	4,579,020	4,721,720	2%	1%	1%	2%	1%	3%	1%	1%	1%
Participant Incentive	198,962,063	216,570,100	210,400,371	189,060,868	221,729,002	29,857,630	236,497,361	266,927,350	256,117,557	69%	75%	70%	73%	70%	65%	72%	72%	72%
Sales, Technical Assistance & Training	38,295,056	25,083,316	39,353,331	23,905,055	40,250,095	9,862,976	41,839,483	44,467,990	45,374,876	13%	9%	13%	9%	13%	21%	13%	12%	13%
Evaluation and Market Research	7,982,002	4,343,955	7,840,002	6,323,135	8,010,865	1,299,442	6,563,335	6,675,603	7,476,950	3%	2%	3%	2%	3%	3%	2%	2%	2%
Performance Incentive	18,238,781	24,962,262	19,476,581	20,728,488	21,252,520	-	24,177,850	30,978,750	25,692,345	6%	9%	6%	8%	7%	0%	7%	8%	7%
Total Program Administrator Budget	**287,663,075**	**289,121,065**	**302,222,391**	**260,316,976**	**315,921,201**	**46,138,297**	**327,757,209**	**368,686,301**	**354,683,977**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

2016-2021 Total Program Administrator Budget

PA Budget Categories	Program Administrator Budget ($)									Budget Categories as a Percent of Total Program Administrator Budget (%)								
	2016		2017		2018		2019	2020	2021	2016		2017		2018		2019	2020	2021
	Planned	Evaluated	Planned	Evaluated	Planned	YTD	Planned	Planned	Planned	Planned	Evaluated	Planned	Evaluated	Planned	YTD	Planned	Planned	Planned
Program Planning and Administration	34,102,737	25,000,956	35,121,096	27,534,322	34,697,295	7,859,128	29,098,491	29,972,217	30,905,865	5%	4%	5%	5%	5%	6%	4%	4%	4%
Marketing and Advertising	17,618,123	14,795,678	18,322,922	16,494,260	18,519,668	5,605,455	19,862,913	20,164,057	20,737,224	3%	3%	3%	3%	3%	4%	3%	3%	3%
Participant Incentive	438,849,253	419,953,188	456,898,864	407,279,816	470,676,256	98,335,967	464,234,585	492,577,355	479,273,872	69%	73%	70%	72%	70%	71%	69%	69%	68%
Sales, Technical Assistance & Training	91,840,034	68,249,075	94,360,712	67,859,467	97,414,002	23,190,777	107,168,192	111,957,791	114,114,972	15%	12%	14%	12%	14%	17%	16%	16%	16%
Evaluation and Market Research	16,682,579	10,921,399	16,534,334	15,486,000	16,579,015	3,721,403	16,163,870	16,421,033	18,038,464	3%	2%	3%	3%	2%	3%	2%	2%	3%
Performance Incentive	32,924,065	37,764,707	34,034,603	34,758,706	35,627,586	-	36,129,325	42,776,243	37,768,794	5%	7%	5%	6%	5%	0%	5%	6%	5%
Total Program Administrator Budget	**632,016,791**	**576,685,003**	**655,272,531**	**569,412,571**	**673,513,821**	**138,712,731**	**672,657,376**	**713,868,695**	**700,839,192**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Notes:

2016-2018 planned values are from the Program Administrator's 2016-2018 Three-Year Plan, D.P.U. 15-166, in nominal dollars (2016$, 2017$, 2018$).

2016 evaluated values are from the Program Administrator's 2016 Plan Year Report, D.P.U. 17-100, in 2016$.

2017 evaluated values are from the Program Administrator's 2017 Plan Year Report, D.P.U. 18-51, in 2017$.

2018 YTD values are estimated actual cost through August 2018, in 2018$.

For supporting information on the 2019-2021 values, see Table IV.C.1. Budgets for each year are represented in nominal dollars (2019$, 2020$, 2021$).

The Program Administrators have better aligned cost allocations across Program Administrators for this Three-Year Plan, consistent with the Department's directives in the 2016-2018 Three-Year Plan Order (January 31, 2016). As a result, historical budget categories may not be directly comparable for each Program Administrator.

IV.C. Program Administrator Budgets

3. Program Planning and Administration

Statewide Electric

October 31, 2018

Program Planning and Administration Expenditures							
Year	Internal Costs	External Costs					Total Program Planning and Administration
	Labor, benefits, employee expenses, materials, and overhead	Legal Services	Assessments	Other Vendor Services	Hard to Measure Sponsorships & Subscriptions	Total External Costs	
2019	$ 14,422,315	$ 1,220,136	$ 3,839,912	$ 9,247,336	$ 265,251	$ 14,572,635	$ 28,994,949
2020	$ 14,737,795	$ 1,215,635	$ 4,711,533	$ 8,889,429	$ 279,424	$ 15,096,021	$ 29,833,816
2021	$ 15,291,452	$ 1,209,706	$ 4,846,928	$ 9,081,011	$ 288,721	$ 15,426,366	$ 30,717,817
Grand Total	**$ 44,451,561**	**$ 3,645,477**	**$ 13,398,373**	**$ 27,217,776**	**$ 833,396**	**$ 45,095,021**	**$ 89,546,582**

Notes:

• Assessments include costs associated with the Department of Energy Resource (DOER), Residential Conservation Services (RCS), Energy Efficiency Advisory Council (EEAC) Consultants, and the Low-Income Energy Affordability Network (LEAN). Note that the electric Program Administrators do not budget for the EEAC Consultant fees as these costs are paid by the DOER using RGGI proceeds.

• Other Vendor Services include costs associated with third-party consultants that assist with program planning and administration.

• The data included in the Hard to Measure Sponsorship and Subscriptions column is consistent with the hard-to-measure Sponsorships & Subscriptions lines in the Budget table.

• This table is included pursuant to Department directives (D.P.U. 15-160 through D.P.U. 15-169, at 42).

IV.D. Cost-Effectiveness

1. Summary Table

Statewide Electric
October 31, 2018

2019 Total Resource Cost Test (2019$)										
Program	With GWSA Benefits			Without GWSA Benefits			Costs			
	Benefit-Cost Ratio	Net Benefits	Total TRC Test Benefits	Benefit-Cost Ratio	Net Benefits	Total TRC Test Benefits	Total Program Costs	Performance Incentive	Participant Costs	Total TRC Test Costs
A - Residential	**1.80**	**255,958,926**	**574,652,448**	**1.62**	**196,148,138**	**514,841,660**	**260,912,913**	**9,089,415**	**48,691,193**	**318,693,522**
A1 - Residential New Buildings	1.40	13,872,088	48,409,478	1.29	10,177,193	44,714,583	16,317,292	721,078	17,499,020	34,537,390
A1a - Residential New Homes & Renovations	1.40	13,872,088	48,409,478	1.29	10,177,193	44,714,583	16,317,292	721,078	17,499,020	34,537,390
A2 - Residential Existing Buildings	2.15	281,050,089	526,242,970	1.92	224,934,197	470,127,077	205,632,370	8,368,337	31,192,174	245,192,880
A2a - Residential Coordinated Delivery	2.44	163,481,896	276,815,863	2.22	137,986,453	251,320,420	87,369,229	4,382,823	21,581,915	113,333,967
A2b - Residential Conservation Services (RCS)	0.00	(18,483,952)	-	0.00	(18,483,952)	-	18,483,952	-	-	18,483,952
A2c - Residential Retail	2.22	121,321,706	221,094,117	1.95	95,278,647	195,051,058	86,680,302	3,481,850	9,610,258	99,772,411
A2d - Residential Behavior	2.25	13,617,135	24,512,503	1.83	9,038,294	19,933,662	10,500,344	395,024	-	10,895,368
A2e - Residential Active Demand Reduction	1.41	1,113,304	3,820,486	1.41	1,114,755	3,821,938	2,598,542	108,640	-	2,707,182
A3 - Residential Hard-to-Measure	0.00	(38,963,251)	-	0.00	(38,963,251)	-	38,963,251	-	-	38,963,251
B - Income Eligible	**2.30**	**97,340,878**	**172,238,856**	**2.15**	**86,289,703**	**161,187,681**	**72,035,779**	**2,862,059**	**140**	**74,897,978**
B1 - Income Eligible Existing Buildings	2.40	100,368,932	172,238,856	2.24	89,317,757	161,187,681	69,007,725	2,862,059	140	71,869,925
B1a - Income Eligible Coordinated Delivery	2.40	100,374,247	172,238,856	2.24	89,323,072	161,187,681	69,002,410	2,862,059	140	71,864,610
B1b - Income Eligible Active Demand Reduction	0.00	(5,315)	-	0.00	(5,315)	-	5,315	-	-	5,315
B2 - Income Eligible Hard-to-Measure	0.00	(3,028,053)	-	0.00	(3,028,053)	-	3,028,053	-	-	3,028,053
C - Commercial & Industrial	**2.61**	**821,725,381**	**1,331,746,023**	**2.31**	**669,884,696**	**1,179,905,338**	**303,579,359**	**24,177,850**	**182,263,433**	**510,020,642**
C1 - C&I New Buildings	3.58	69,787,822	96,872,508	3.09	56,718,038	83,802,724	21,133,115	1,748,207	4,203,364	27,084,686
C1a - C&I New Buildings & Major Renovations	3.58	69,787,822	96,872,508	3.09	56,718,038	83,802,724	21,133,115	1,748,207	4,203,364	27,084,686
C2 - C&I Existing Buildings	2.61	762,496,908	1,234,873,515	2.32	623,726,008	1,096,102,614	271,886,894	22,429,643	178,060,069	472,376,606
C2a - C&I Existing Building Retrofit	2.43	535,529,285	908,823,706	2.16	432,966,852	806,261,273	215,516,686	15,850,445	141,927,290	373,294,421
C2b - C&I New & Replacement Equipment	3.22	198,816,969	288,328,764	2.82	162,603,786	252,115,582	48,034,353	5,344,664	36,132,779	89,511,795
C2c - C&I Active Demand Reduction	3.94	28,150,655	37,721,045	3.94	28,155,369	37,725,759	8,335,855	1,234,535	-	9,570,390
C3 - C&I Hard-to-Measure	0.00	(10,559,350)	-	0.00	(10,559,350)	-	10,559,350	-	-	10,559,350
Grand Total	**2.30**	**1,175,025,185**	**2,078,637,327**	**2.05**	**952,322,538**	**1,855,934,680**	**636,528,050**	**36,129,325**	**230,954,766**	**903,612,142**

IV.D. Cost-Effectiveness

1. Summary Table

Statewide Electric
October 31, 2018

2020 Total Resource Cost Test (2019$)										
Program	With GWSA Benefits			Without GWSA Benefits			Costs			
	Benefit-Cost Ratio	Net Benefits	Total TRC Test Benefits	Benefit-Cost Ratio	Net Benefits	Total TRC Test Benefits	Total Program Costs	Performance Incentive	Participant Costs	Total TRC Test Costs
A - Residential	**1.81**	**256,394,679**	**571,169,738**	**1.66**	**207,619,296**	**522,394,356**	**252,526,112**	**8,784,639**	**53,464,308**	**314,775,060**
A1 - Residential New Buildings	1.45	15,245,819	49,270,075	1.35	11,790,366	45,814,622	16,227,968	736,954	17,059,334	34,024,256
A1a - Residential New Homes & Renovations	1.45	15,245,819	49,270,075	1.35	11,790,366	45,814,622	16,227,968	736,954	17,059,334	34,024,256
A2 - Residential Existing Buildings	2.17	281,488,146	521,899,663	1.98	236,168,217	476,579,734	195,958,858	8,047,685	36,404,974	240,411,517
A2a - Residential Coordinated Delivery	2.43	166,419,901	282,528,989	2.24	144,427,693	260,536,782	85,877,211	4,271,425	25,960,453	116,109,088
A2b - Residential Conservation Services (RCS)	0.00	(18,503,911)	-	0.00	(18,503,911)	-	18,503,911	-	-	18,503,911
A2c - Residential Retail	2.27	111,356,360	199,373,204	2.04	91,402,693	179,419,537	74,363,876	3,208,447	10,444,522	88,016,844
A2d - Residential Behavior	2.33	14,096,388	24,687,870	2.01	10,708,654	21,300,136	10,199,916	391,566	-	10,591,482
A2e - Residential Active Demand Reduction	2.13	8,119,408	15,309,600	2.13	8,133,088	15,323,279	7,013,945	176,247	-	7,190,192
A3 - Residential Hard-to-Measure	0.00	(40,339,286)	-	0.00	(40,339,286)	-	40,339,286	-	-	40,339,286
B - Income Eligible	**2.27**	**96,497,094**	**172,509,254**	**2.14**	**86,491,482**	**162,503,642**	**73,267,792**	**2,744,231**	**137**	**76,012,160**
B1 - Income Eligible Existing Buildings	2.36	99,560,267	172,509,254	2.23	89,554,655	162,503,642	70,204,619	2,744,231	137	72,948,987
B1a - Income Eligible Coordinated Delivery	2.37	98,325,730	170,342,956	2.23	88,317,433	160,334,659	69,272,857	2,744,231	137	72,017,226
B1b - Income Eligible Active Demand Reduction	2.32	1,234,537	2,166,298	2.33	1,237,221	2,168,983	931,762	-	-	931,762
B2 - Income Eligible Hard-to-Measure	0.00	(3,063,173)	-	0.00	(3,063,173)	-	3,063,173	-	-	3,063,173
C - Commercial & Industrial	**2.96**	**1,078,549,034**	**1,627,486,389**	**2.65**	**903,161,592**	**1,452,098,947**	**330,018,128**	**30,273,380**	**188,645,846**	**548,937,355**
C1 - C&I New Buildings	3.68	66,988,352	92,008,990	3.22	55,604,618	80,625,255	19,445,110	1,664,425	3,911,102	25,020,637
C1a - C&I New Buildings & Major Renovations	3.68	66,988,352	92,008,990	3.22	55,604,618	80,625,255	19,445,110	1,664,425	3,911,102	25,020,637
C2 - C&I Existing Buildings	2.99	1,022,178,122	1,535,477,399	2.67	858,174,415	1,371,473,692	299,955,578	28,608,955	184,734,744	513,299,277
C2a - C&I Existing Building Retrofit	2.87	795,256,790	1,221,391,945	2.55	661,657,911	1,087,793,066	238,703,021	22,021,366	165,410,768	426,135,155
C2b - C&I New & Replacement Equipment	3.62	186,853,046	258,234,292	3.19	156,436,174	227,817,421	47,296,423	4,760,846	19,323,976	71,381,246
C2c - C&I Active Demand Reduction	3.54	40,068,286	55,851,161	3.54	40,080,330	55,863,205	13,956,133	1,826,743	-	15,782,876
C3 - C&I Hard-to-Measure	0.00	(10,617,441)	-	0.00	(10,617,441)	-	10,617,441	-	-	10,617,441
Grand Total	**2.52**	**1,431,440,807**	**2,371,165,381**	**2.27**	**1,197,272,370**	**2,136,996,944**	**655,812,032**	**41,802,251**	**242,110,292**	**939,724,574**

IV.D. Cost-Effectiveness

1. Summary Table

Statewide Electric
October 31, 2018

2021 Total Resource Cost Test (2019$)										
Program	With GWSA Benefits			Without GWSA Benefits			Costs			
	Benefit-Cost Ratio	Net Benefits	Total TRC Test Benefits	Benefit-Cost Ratio	Net Benefits	Total TRC Test Benefits	Total Program Costs	Performance Incentive	Participant Costs	Total TRC Test Costs
A - Residential	**1.83**	**269,398,080**	**592,881,426**	**1.70**	**225,692,238**	**549,175,584**	**245,373,437**	**9,088,740**	**69,021,169**	**323,483,346**
A1 - Residential New Buildings	1.47	15,909,562	49,449,072	1.38	12,668,382	46,207,892	16,157,781	736,474	16,645,255	33,539,510
A1a - Residential New Homes & Renovations	1.47	15,909,562	49,449,072	1.38	12,668,382	46,207,892	16,157,781	736,474	16,645,255	33,539,510
A2 - Residential Existing Buildings	2.18	294,521,201	543,432,354	2.02	254,056,539	502,967,692	188,182,973	8,352,266	52,375,915	248,911,153
A2a - Residential Coordinated Delivery	2.50	180,750,296	301,419,412	2.32	159,256,955	279,926,071	86,219,224	4,409,622	30,040,270	120,669,116
A2b - Residential Conservation Services (RCS)	0.00	(17,987,777)	-	0.00	(17,987,777)	-	17,987,777	-	-	17,987,777
A2c - Residential Retail	2.17	106,407,091	197,538,447	2.00	90,817,204	181,948,560	65,491,305	3,304,406	22,335,645	91,131,356
A2d - Residential Behavior	2.41	14,596,830	24,975,698	2.08	11,198,538	21,577,406	9,983,887	394,981	-	10,378,868
A2e - Residential Active Demand Reduction	2.23	10,754,761	19,498,797	2.23	10,771,619	19,515,655	8,500,779	243,256	-	8,744,036
A3 - Residential Hard-to-Measure	0.00	(41,032,684)	-	0.00	(41,032,684)	-	41,032,684	-	-	41,032,684
B - Income Eligible	**2.14**	**86,865,710**	**162,974,803**	**2.02**	**77,363,024**	**153,472,117**	**73,664,938**	**2,444,022**	**134**	**76,109,093**
B1 - Income Eligible Existing Buildings	2.24	90,110,361	162,974,803	2.11	80,607,675	153,472,117	70,420,286	2,444,022	134	72,864,442
B1a - Income Eligible Coordinated Delivery	2.23	88,433,421	160,085,339	2.10	78,927,284	150,579,202	69,207,763	2,444,022	134	71,651,918
B1b - Income Eligible Active Demand Reduction	2.38	1,676,940	2,889,464	2.39	1,680,392	2,892,915	1,212,524	-	-	1,212,524
B2 - Income Eligible Hard-to-Measure	0.00	(3,244,651)	-	0.00	(3,244,651)	-	3,244,651	-	-	3,244,651
C - Commercial & Industrial	**2.47**	**789,306,667**	**1,325,004,803**	**2.23**	**657,631,168**	**1,193,329,305**	**314,180,267**	**24,535,662**	**196,982,207**	**535,698,136**
C1 - C&I New Buildings	3.80	70,107,469	95,112,487	3.35	58,852,629	83,857,646	19,419,635	1,720,109	3,865,273	25,005,017
C1a - C&I New Buildings & Major Renovations	3.80	70,107,469	95,112,487	3.35	58,852,629	83,857,646	19,419,635	1,720,109	3,865,273	25,005,017
C2 - C&I Existing Buildings	2.46	730,387,601	1,229,892,316	2.22	609,966,943	1,109,471,659	283,572,228	22,815,554	193,116,933	499,504,715
C2a - C&I Existing Building Retrofit	2.28	513,050,748	914,867,868	2.05	420,004,413	821,821,533	216,334,358	15,910,173	169,572,588	401,817,119
C2b - C&I New & Replacement Equipment	3.19	164,093,080	238,930,880	2.83	136,699,822	211,537,622	46,927,652	4,365,803	23,544,346	74,837,801
C2c - C&I Active Demand Reduction	3.33	53,243,773	76,093,568	3.33	53,262,708	76,112,504	20,310,218	2,539,578	-	22,849,795
C3 - C&I Hard-to-Measure	0.00	(11,188,403)	-	0.00	(11,188,403)	-	11,188,403	-	-	11,188,403
Grand Total	**2.22**	**1,145,570,456**	**2,080,861,032**	**2.03**	**960,686,430**	**1,895,977,005**	**633,218,642**	**36,068,424**	**266,003,510**	**935,290,575**

IV.D. Cost-Effectiveness

1. Summary Table

Statewide Electric
October 31, 2018

2019-2021 Total Resource Cost Test (2019$)										
Program	With GWSA Benefits			Without GWSA Benefits			Costs			
	Benefit-Cost Ratio	Net Benefits	Total TRC Test Benefits	Benefit-Cost Ratio	Net Benefits	Total TRC Test Benefits	Total Program Costs	Performance Incentive	Participant Costs	Total TRC Test Costs
A - Residential	**1.82**	**781,751,685**	**1,738,703,612**	**1.66**	**629,459,672**	**1,586,411,600**	**758,812,462**	**26,962,794**	**171,176,671**	**956,951,927**
A1 - Residential New Buildings	1.44	45,027,469	147,128,626	1.34	34,635,940	136,737,096	48,703,040	2,194,507	51,203,609	102,101,156
A1a - Residential New Homes & Renovations	1.44	45,027,469	147,128,626	1.34	34,635,940	136,737,096	48,703,040	2,194,507	51,203,609	102,101,156
A2 - Residential Existing Buildings	2.17	857,059,436	1,591,574,986	1.97	715,158,953	1,449,674,503	589,774,201	24,768,287	119,973,062	734,515,550
A2a - Residential Coordinated Delivery	2.46	510,652,093	860,764,264	2.26	441,671,102	791,783,273	259,465,664	13,063,870	77,582,638	350,112,172
A2b - Residential Conservation Services (RCS)	0.00	(54,975,641)	-	0.00	(54,975,641)	-	54,975,641	-	-	54,975,641
A2c - Residential Retail	2.22	339,085,158	618,005,768	1.99	277,498,544	556,419,154	226,535,484	9,994,702	42,390,425	278,920,610
A2d - Residential Behavior	2.33	42,310,352	74,176,070	1.97	30,945,486	62,811,204	30,684,146	1,181,572	-	31,865,718
A2e - Residential Active Demand Reduction	2.07	19,987,474	38,628,884	2.07	20,019,462	38,660,872	18,113,267	528,143	-	18,641,410
A3 - Residential Hard-to-Measure	0.00	(120,335,221)	-	0.00	(120,335,221)	-	120,335,221	-	-	120,335,221
B - Income Eligible	**2.24**	**280,703,682**	**507,722,913**	**2.10**	**250,144,209**	**477,163,440**	**218,968,508**	**8,050,313**	**411**	**227,019,231**
B1 - Income Eligible Existing Buildings	2.33	290,039,560	507,722,913	2.19	259,480,087	477,163,440	209,632,630	8,050,313	411	217,683,353
B1a - Income Eligible Coordinated Delivery	2.33	287,133,398	502,667,151	2.19	256,567,789	472,101,542	207,483,030	8,050,313	411	215,533,753
B1b - Income Eligible Active Demand Reduction	2.35	2,906,162	5,055,762	2.35	2,912,298	5,061,898	2,149,600	-	-	2,149,600
B2 - Income Eligible Hard-to-Measure	0.00	(9,335,878)	-	0.00	(9,335,878)	-	9,335,878	-	-	9,335,878
C - Commercial & Industrial	**2.69**	**2,689,581,081**	**4,284,237,214**	**2.40**	**2,230,677,456**	**3,825,333,590**	**947,777,754**	**78,986,893**	**567,891,486**	**1,594,656,133**
C1 - C&I New Buildings	3.68	206,883,644	283,993,985	3.22	171,175,284	248,285,625	59,997,860	5,132,741	11,979,739	77,110,341
C1a - C&I New Buildings & Major Renovations	3.68	206,883,644	283,993,985	3.22	171,175,284	248,285,625	59,997,860	5,132,741	11,979,739	77,110,341
C2 - C&I Existing Buildings	2.69	2,515,062,631	4,000,243,229	2.41	2,091,867,366	3,577,047,965	855,414,700	73,854,152	555,911,747	1,485,180,599
C2a - C&I Existing Building Retrofit	2.53	1,843,836,823	3,045,083,519	2.26	1,514,629,176	2,715,875,872	670,554,066	53,781,984	476,910,646	1,201,246,696
C2b - C&I New & Replacement Equipment	3.33	549,763,095	785,493,937	2.93	455,739,782	691,470,624	142,258,429	14,471,313	79,001,101	235,730,842
C2c - C&I Active Demand Reduction	3.52	121,462,713	169,665,774	3.52	121,498,407	169,701,468	42,602,206	5,600,855	-	48,203,061
C3 - C&I Hard-to-Measure	0.00	(32,365,194)	-	0.00	(32,365,194)	-	32,365,194	-	-	32,365,194
Grand Total	**2.35**	**3,752,036,448**	**6,530,663,740**	**2.12**	**3,110,281,338**	**5,888,908,629**	**1,925,558,724**	**114,000,000**	**739,068,568**	**2,778,627,292**

Notes:

The Benefit-Cost Ratio is the Total TRC Test Benefits divided by the Total TRC Test Costs.

The Net Benefits are the Total TRC Test Benefits minus the Total TRC Test Costs.

For supporting information on the Total TRC Test Benefits, see Table IV.D.3.1.i.

For supporting information on the Total Program Costs, see Table IV.C.1.

For supporting information on the Performance Incentive, refer to the Performance Incentive Model.

The Total TRC Costs are the sum of the Total Program Costs, Performance Incentives, and Participant Costs.

IV.D Cost-Effectiveness

2.3 Cost Comparison Table - Three-Year Plan vs. Previous Years

Statewide Electric

October 31, 2018

2016-2021 TRC Costs												
TRC Costs Categories	TRC Costs						TRC Cost Categories as a Percent of Total TRC Costs (%)					
	2016 Evaluated	2017 Evaluated	2018 Planned	2019 Planned	2020 Planned	2021 Planned	2016 Evaluated	2017 Evaluated	2018 Planned	2019 Planned	2020 Planned	2021 Planned
A - Residential												
PA Budget	226,989,087	236,613,083	273,992,719	270,002,328	261,310,751	254,462,177	69%	70%	81%	85%	83%	79%
Participant Cost	101,375,953	101,662,087	63,688,813	48,691,193	53,464,308	69,021,169	31%	30%	19%	15%	17%	21%
Residential Total TRC Costs	328,710,792	338,275,169	339,809,613	318,693,522	314,775,060	323,483,346	100%	100%	100%	100%	100%	100%
B - Income Eligible												
PA Budget	60,574,850	64,825,960	66,103,592	74,897,838	76,012,023	76,108,959	100%	100%	99%	100%	100%	100%
Participant Cost	(8)	-	-	140	137	134	0%	0%	0%	0%	0%	0%
Low-Income Total TRC Costs	60,654,261	64,825,960	66,731,637	74,897,978	76,012,160	76,109,093	100%	100%	100%	100%	100%	100%
C - Commercial & Industrial												
PA Budget	289,121,065	253,868,711	300,463,793	327,757,209	360,291,509	338,715,930	65%	61%	65%	64%	66%	63%
Participant Cost	156,736,922	161,982,218	158,603,759	182,263,433	188,645,846	196,982,207	35%	39%	34%	36%	34%	37%
C&I Total TRC Costs	447,126,000	415,850,928	461,256,463	510,020,642	548,937,355	535,698,136	100%	100%	100%	100%	100%	100%
Grand Total												
PA Budget	576,685,003	555,307,754	640,560,104	672,657,376	697,614,283	669,287,066	69%	68%	74%	74%	74%	72%
Participant Cost	258,112,867	263,644,304	222,292,572	230,954,766	242,110,292	266,003,510	31%	32%	26%	26%	26%	28%
Grand Total TRC Costs	836,491,052	818,952,058	867,797,714	903,612,142	939,724,574	935,290,575	100%	100%	100%	100%	100%	100%

Notes:

2016 values are from the Program Administrator's 2016 Plan Year Report D.P.U. 17-100, in 2016$.
2017 values are from the Program Administrator's 2017 Plan Year Report D.P.U. 18-51, in 2016$.
2018 values are from the Program Administrator's 2016-2018 Three-Year Plan, D.P.U. 15-166, in 2016$.
For supporting information on the 2019-2021 values, see Table IV.D.1. The 2019-2021 values are in 2019$.

IV.D Cost-Effectiveness

3.1.i. Benefits Summary Table

Statewide Electric

October 31, 2018

2019 Benefits

Program	Electric									
	Capacity						Electric Energy			
	Summer Generation	Capacity DRIPE	Transmission	Distribution	Reliability	Total Capacity	Electric Energy	Electric Energy DRIPE	Electric Energy GWSA	Total Electric Energy
A - Residential	**21,673,821**	**4,841,555**	**28,706,431**	**44,808,485**	**668,924**	**100,699,214**	**112,064,824**	**46,822,456**	**42,581,557**	**201,468,837**
A1 - Residential New Buildings	2,675,721	16,050	2,955,666	5,313,848	30,384	10,991,670	9,157,638	2,118,045	2,565,002	13,840,686
A1a - Residential New Homes & Renovations	2,675,721	16,050	2,955,666	5,313,848	30,384	10,991,670	9,157,638	2,118,045	2,565,002	13,840,686
A2 - Residential Existing Buildings	18,998,099	4,825,505	25,750,765	39,494,636	638,540	89,707,544	102,907,185	44,704,411	40,016,555	187,628,151
A2a - Residential Coordinated Delivery	4,699,491	317,643	5,712,047	9,353,024	102,265	20,184,470	27,423,130	10,020,328	9,676,513	47,119,969
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	12,400,178	510,251	17,374,888	26,159,945	338,928	56,784,190	67,763,453	31,987,608	25,917,976	125,669,038
A2d - Residential Behavior	1,734,279	2,631,474	1,775,663	2,700,558	77,644	8,919,618	7,718,416	2,695,991	4,423,516	14,837,924
A2e - Residential Active Demand Reduction	164,151	1,366,137	888,167	1,281,109	119,703	3,819,267	2,187	483	(1,450)	1,220
B - Income Eligible	**4,464,650**	**130,574**	**5,343,783**	**7,646,983**	**74,955**	**17,660,944**	**21,840,362**	**6,467,484**	**7,168,316**	**35,476,163**
B1 - Income Eligible Existing Buildings	4,464,650	130,574	5,343,783	7,646,983	74,955	17,660,944	21,840,362	6,467,484	7,168,316	35,476,163
B1a - Income Eligible Coordinated Delivery	4,464,650	130,574	5,343,783	7,646,983	74,955	17,660,944	21,840,362	6,467,484	7,168,316	35,476,163
B1b - Income Eligible Active Demand Reduction	-	-	-	-	-	-	-	-	-	-
C - Commercial & Industrial	**93,908,019**	**14,225,922**	**123,263,595**	**192,745,803**	**3,024,119**	**427,167,458**	**507,956,482**	**155,986,794**	**171,223,972**	**835,167,247**
C1 - C&I New Buildings	7,225,800	70,574	8,458,076	15,200,205	106,145	31,060,800	45,932,157	11,786,365	14,646,714	72,365,237
C1a - C&I New Buildings & Major Renovations	7,225,800	70,574	8,458,076	15,200,205	106,145	31,060,800	45,932,157	11,786,365	14,646,714	72,365,237
C2 - C&I Existing Buildings	86,682,219	14,155,348	114,805,518	177,545,598	2,917,975	396,106,659	462,024,325	144,200,428	156,577,257	762,802,011
C2a - C&I Existing Building Retrofit	59,405,253	2,577,423	72,391,558	111,295,324	1,055,796	246,725,353	354,156,166	109,358,923	119,668,776	583,183,864
C2b - C&I New & Replacement Equipment	26,041,026	1,514,775	32,178,548	51,429,802	500,325	111,664,476	107,860,893	34,839,842	36,913,196	179,613,931
C2c - C&I Active Demand Reduction	1,235,940	10,063,151	10,235,412	14,820,472	1,361,854	37,716,829	7,266	1,664	(4,715)	4,215
Grand Total	**120,046,490**	**19,198,051**	**157,313,808**	**245,201,270**	**3,767,999**	**545,527,616**	**641,861,668**	**209,276,734**	**220,973,845**	**1,072,112,248**

2020 Benefits

Program	Electric									
	Capacity						Electric Energy			
	Summer Generation	Capacity DRIPE	Transmission	Distribution	Reliability	Total Capacity	Electric Energy	Electric Energy DRIPE	Electric Energy GWSA	Total Electric Energy
A - Residential	**20,115,463**	**10,934,058**	**26,731,268**	**43,719,959**	**729,316**	**102,230,062**	**88,114,183**	**33,534,913**	**28,242,817**	**149,891,914**
A1 - Residential New Buildings	2,731,056	13,966	3,000,390	5,374,843	29,929	11,150,183	9,568,988	2,040,872	2,387,475	13,997,335
A1a - Residential New Homes & Renovations	2,731,056	13,966	3,000,390	5,374,843	29,929	11,150,183	9,568,988	2,040,872	2,387,475	13,997,335
A2 - Residential Existing Buildings	17,384,408	10,920,092	23,730,878	38,345,116	699,386	91,079,880	78,545,195	31,494,041	25,855,342	135,894,579
A2a - Residential Coordinated Delivery	5,409,797	1,066,246	6,306,664	11,419,044	88,634	24,290,385	22,405,494	6,522,224	6,414,859	35,342,577
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	9,005,620	514,583	13,096,465	19,680,516	252,430	42,549,614	47,255,880	22,121,367	16,175,746	85,552,994
A2d - Residential Behavior	1,348,722	2,771,376	1,870,067	2,900,449	81,772	8,972,386	8,835,708	2,842,779	3,278,417	14,956,903
A2e - Residential Active Demand Reduction	1,620,269	6,567,887	2,457,682	4,345,107	276,550	15,267,495	48,113	7,671	(13,679)	42,106
B - Income Eligible	**5,137,227**	**1,257,038**	**5,963,899**	**9,042,562**	**98,083**	**21,498,808**	**21,422,207**	**5,863,983**	**6,235,950**	**33,522,140**
B1 - Income Eligible Existing Buildings	5,137,227	1,257,038	5,963,899	9,042,562	98,083	21,498,808	21,422,207	5,863,983	6,235,950	33,522,140
B1a - Income Eligible Coordinated Delivery	4,827,113	272,300	5,693,846	8,473,726	74,306	19,341,291	21,412,294	5,862,429	6,238,634	33,513,358
B1b - Income Eligible Active Demand Reduction	310,113	984,737	270,053	568,836	23,777	2,157,516	9,913	1,554	(2,685)	8,782
C - Commercial & Industrial	**137,001,155**	**19,868,939**	**173,341,506**	**303,720,605**	**3,975,349**	**637,907,555**	**802,430,181**	**206,783,038**	**232,562,068**	**1,241,775,287**
C1 - C&I New Buildings	6,617,195	79,629	7,736,575	14,669,161	98,563	29,201,125	43,512,766	10,977,652	12,616,471	67,106,889
C1a - C&I New Buildings & Major Renovations	6,617,195	79,629	7,736,575	14,669,161	98,563	29,201,125	43,512,766	10,977,652	12,616,471	67,106,889
C2 - C&I Existing Buildings	130,383,959	19,789,310	165,604,931	289,051,444	3,876,786	608,706,430	758,917,415	195,805,386	219,945,596	1,174,668,398
C2a - C&I Existing Building Retrofit	104,935,036	2,545,725	122,377,359	220,581,204	1,543,267	451,982,591	658,845,497	163,350,613	188,542,689	1,010,738,799
C2b - C&I New & Replacement Equipment	23,424,386	1,681,471	29,061,347	46,287,193	450,302	100,904,699	100,034,565	32,448,060	31,414,951	163,897,577
C2c - C&I Active Demand Reduction	2,024,537	15,562,114	14,166,224	22,183,047	1,883,216	55,819,140	37,354	6,713	(12,044)	32,021
Grand Total	**162,253,845**	**32,060,035**	**206,036,673**	**356,483,126**	**4,802,748**	**761,636,425**	**911,966,571**	**246,181,934**	**267,040,835**	**1,425,189,341**

IV.D Cost-Effectiveness

3.1.i. Benefits Summary Table

Statewide Electric
October 31, 2018

2021 Benefits

Program	Electric									
	Capacity						Electric Energy			
	Summer Generation	Capacity DRIPE	Transmission	Distribution	Reliability	Total Capacity	Electric Energy	Electric Energy DRIPE	Electric Energy GWSA	Total Electric Energy
A - Residential	**18,887,234**	**12,312,955**	**23,644,851**	**40,569,020**	**691,227**	**96,105,287**	**57,788,115**	**19,649,057**	**17,091,527**	**94,528,701**
A1 - Residential New Buildings	2,795,616	17,382	2,969,388	5,307,151	28,300	11,117,837	9,625,290	1,803,734	2,205,949	13,634,974
A1a - Residential New Homes & Renovations	2,795,616	17,382	2,969,388	5,307,151	28,300	11,117,837	9,625,290	1,803,734	2,205,949	13,634,974
A2 - Residential Existing Buildings	16,091,618	12,295,573	20,675,463	35,261,869	662,927	84,987,451	48,162,825	17,845,323	14,885,578	80,893,727
A2a - Residential Coordinated Delivery	6,926,672	672,709	7,666,689	14,521,022	89,910	29,877,002	21,617,125	5,692,364	5,616,115	32,925,604
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	6,053,764	414,830	8,096,676	12,501,444	144,105	27,210,817	17,016,041	9,196,667	5,993,976	32,206,685
A2d - Residential Behavior	1,065,867	2,698,873	1,821,142	2,796,355	79,633	8,461,870	9,461,486	2,946,571	3,292,346	15,700,403
A2e - Residential Active Demand Reduction	2,045,316	8,509,162	3,090,956	5,443,048	349,280	19,437,762	68,173	9,720	(16,859)	61,035
B - Income Eligible	**3,682,082**	**1,523,979**	**4,112,519**	**7,509,757**	**80,440**	**16,908,777**	**21,244,258**	**5,506,914**	**5,795,440**	**32,546,611**
B1 - Income Eligible Existing Buildings	3,682,082	1,523,979	4,112,519	7,509,757	80,440	16,908,777	21,244,258	5,506,914	5,795,440	32,546,611
B1a - Income Eligible Coordinated Delivery	3,268,597	210,996	3,752,448	6,751,309	48,738	14,032,089	21,230,103	5,504,842	5,798,891	32,533,836
B1b - Income Eligible Active Demand Reduction	413,485	1,312,983	360,071	758,447	31,703	2,876,688	14,155	2,072	(3,451)	12,775
C - Commercial & Industrial	**96,956,973**	**25,195,761**	**130,003,770**	**211,753,975**	**4,119,065**	**468,029,544**	**538,135,638**	**161,345,918**	**158,510,877**	**857,992,433**
C1 - C&I New Buildings	7,145,102	69,049	8,125,241	15,166,055	102,225	30,607,673	45,530,193	11,209,897	12,478,300	69,218,390
C1a - C&I New Buildings & Major Renovations	7,145,102	69,049	8,125,241	15,166,055	102,225	30,607,673	45,530,193	11,209,897	12,478,300	69,218,390
C2 - C&I Existing Buildings	89,811,871	25,126,711	121,878,530	196,587,921	4,016,840	437,421,871	492,605,445	150,136,021	146,032,577	788,774,043
C2a - C&I Existing Building Retrofit	65,077,646	2,611,853	76,397,265	123,317,470	1,081,487	268,485,721	398,599,697	119,753,710	117,782,814	636,136,220
C2b - C&I New & Replacement Equipment	22,073,528	1,658,329	26,583,716	42,189,250	414,473	92,919,294	93,920,806	30,371,606	28,268,699	152,561,110
C2c - C&I Active Demand Reduction	2,660,697	20,856,529	18,897,548	31,081,202	2,520,880	76,016,856	84,943	10,705	(18,936)	76,712
Grand Total	**119,526,288**	**39,032,695**	**157,761,140**	**259,832,752**	**4,890,732**	**581,043,609**	**617,168,010**	**186,501,889**	**181,397,844**	**985,067,745**

2019-2021 Benefits

Program	Electric									
	Capacity						Electric Energy			
	Summer Generation	Capacity DRIPE	Transmission	Distribution	Reliability	Total Capacity	Electric Energy	Electric Energy DRIPE	Electric Energy GWSA	Total Electric Energy
A - Residential	**60,676,518**	**28,088,568**	**79,082,550**	**129,097,463**	**2,089,467**	**299,034,564**	**257,967,121**	**100,006,426**	**87,915,902**	**445,889,453**
A1 - Residential New Buildings	8,202,393	47,398	8,925,444	15,995,842	88,613	33,259,689	28,351,916	5,962,651	7,158,426	41,472,995
A1a - Residential New Homes & Renovations	8,202,393	47,398	8,925,444	15,995,842	88,613	33,259,689	28,351,916	5,962,651	7,158,426	41,472,995
A2 - Residential Existing Buildings	52,474,125	28,041,170	70,157,106	113,101,622	2,000,853	265,774,875	229,615,205	94,043,775	80,757,476	404,416,458
A2a - Residential Coordinated Delivery	17,035,960	2,056,597	19,685,400	35,293,091	280,809	74,351,857	71,445,749	22,234,917	21,707,487	115,388,151
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	27,459,562	1,439,664	38,568,029	58,341,905	735,463	126,544,621	132,035,374	63,305,643	48,087,699	243,428,717
A2d - Residential Behavior	4,148,867	8,101,723	5,466,872	8,397,362	239,048	26,353,874	26,015,610	8,485,342	10,994,279	45,495,230
A2e - Residential Active Demand Reduction	3,829,736	16,443,185	6,436,805	11,069,265	745,533	38,524,523	118,472	17,874	(31,988)	104,360
B - Income Eligible	**13,283,959**	**2,911,590**	**15,420,201**	**24,199,301**	**253,479**	**56,068,529**	**64,506,827**	**17,838,381**	**19,199,705**	**101,544,914**
B1 - Income Eligible Existing Buildings	13,283,959	2,911,590	15,420,201	24,199,301	253,479	56,068,529	64,506,827	17,838,381	19,199,705	101,544,914
B1a - Income Eligible Coordinated Delivery	12,560,361	613,870	14,790,077	22,872,018	197,999	51,034,324	64,482,759	17,834,756	19,205,841	101,523,356
B1b - Income Eligible Active Demand Reduction	723,598	2,297,720	630,124	1,327,283	55,480	5,034,205	24,068	3,625	(6,136)	21,557
C - Commercial & Industrial	**327,866,147**	**59,290,622**	**426,608,871**	**708,220,383**	**11,118,533**	**1,533,104,557**	**1,848,522,301**	**524,115,750**	**562,296,916**	**2,934,934,967**
C1 - C&I New Buildings	20,988,098	219,252	24,319,892	45,035,421	306,933	90,869,598	134,975,116	33,973,914	39,741,486	208,690,516
C1a - C&I New Buildings & Major Renovations	20,988,098	219,252	24,319,892	45,035,421	306,933	90,869,598	134,975,116	33,973,914	39,741,486	208,690,516
C2 - C&I Existing Buildings	306,878,049	59,071,370	402,288,979	663,184,963	10,811,600	1,442,234,959	1,713,547,185	490,141,835	522,555,431	2,726,244,451
C2a - C&I Existing Building Retrofit	229,417,935	7,735,001	271,166,182	455,193,998	3,680,550	967,193,665	1,411,601,359	392,463,246	425,994,278	2,230,058,884
C2b - C&I New & Replacement Equipment	71,538,940	4,854,574	87,823,612	139,906,245	1,365,100	305,488,469	301,816,263	97,659,508	96,596,847	496,072,618
C2c - C&I Active Demand Reduction	5,921,174	46,481,795	43,299,185	68,084,720	5,765,950	169,552,825	129,563	19,081	(35,694)	112,949
Grand Total	**401,826,623**	**90,290,781**	**521,111,622**	**861,517,148**	**13,461,478**	**1,888,207,650**	**2,170,996,249**	**641,960,557**	**669,412,523**	**3,482,369,333**

IV.D Cost-Effectiveness

3.1.i. Benefits Summary Table

Statewide Electric

October 31, 2018

Program	2019 Benefits										
	Natural Gas				Oil				Propane Benefits		
	Natural Gas	Natural Gas DRIPE	Natural Gas GWSA	Total Natural Gas	Oil	Oil DRIPE	Oil GWSA	Total Oil	Propane	Propane GWSA	Total Propane Benefits
A - Residential	**(3,635,635)**	**(2,656,250)**	**(1,472,871)**	**(7,764,757)**	**149,036,232**	**427,322**	**15,385,787**	**164,849,342**	**51,482,661**	**3,316,316**	**54,798,978**
A1 - Residential New Buildings	7,624	764	1,922	10,309	395,057	1,214	38,534	434,805	17,983,018	1,089,437	19,072,456
A1a - Residential New Homes & Renovations	7,624	764	1,922	10,309	395,057	1,214	38,534	434,805	17,983,018	1,089,437	19,072,456
A2 - Residential Existing Buildings	(3,643,259)	(2,657,013)	(1,474,793)	(7,775,066)	148,641,175	426,108	15,347,253	164,414,536	33,499,643	2,226,879	35,726,522
A2a - Residential Coordinated Delivery	4,803,167	526,865	902,299	6,232,330	130,887,955	376,112	13,774,434	145,038,501	16,769,383	1,142,197	17,911,580
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	(8,446,426)	(3,183,878)	(2,377,092)	(14,007,396)	17,297,910	48,978	1,441,539	18,788,428	16,586,952	1,060,636	17,647,587
A2d - Residential Behavior	-	-	-	-	455,310	1,018	131,279	587,608	143,308	24,046	167,354
A2e - Residential Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-
B - Income Eligible	**436,253**	**69,236**	**98,472**	**603,959**	**32,745,037**	**93,896**	**3,494,916**	**36,333,850**	**4,341,705**	**289,471**	**4,631,176**
B1 - Income Eligible Existing Buildings	436,253	69,236	98,472	603,959	32,745,037	93,896	3,494,916	36,333,850	4,341,705	289,471	4,631,176
B1a - Income Eligible Coordinated Delivery	436,253	69,236	98,472	603,959	32,745,037	93,896	3,494,916	36,333,850	4,341,705	289,471	4,631,176
B1b - Income Eligible Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-
C - Commercial & Industrial	**(66,939,242)**	**(10,115,493)**	**(15,073,365)**	**(92,128,102)**	**(26,447,098)**	**(62,330)**	**(4,310,730)**	**(30,820,159)**	**8,895**	**810**	**9,705**
C1 - C&I New Buildings	(4,543,179)	(723,348)	(1,054,663)	(6,321,189)	(3,257,605)	(8,165)	(522,267)	(3,788,037)	-	-	-
C1a - C&I New Buildings & Major Renovations	(4,543,179)	(723,348)	(1,054,663)	(6,321,189)	(3,257,605)	(8,165)	(522,267)	(3,788,037)	-	-	-
C2 - C&I Existing Buildings	(62,396,063)	(9,392,145)	(14,018,703)	(85,806,912)	(23,189,493)	(54,166)	(3,788,463)	(27,032,122)	8,895	810	9,705
C2a - C&I Existing Building Retrofit	(61,688,641)	(9,218,921)	(13,831,889)	(84,739,452)	(20,089,587)	(46,819)	(3,275,263)	(23,411,670)	8,895	810	9,705
C2b - C&I New & Replacement Equipment	(707,422)	(173,224)	(186,813)	(1,067,460)	(3,099,906)	(7,347)	(513,199)	(3,620,452)	-	-	-
C2c - C&I Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-
Grand Total	**(70,138,625)**	**(12,702,507)**	**(16,447,765)**	**(99,288,899)**	**155,334,172**	**458,888**	**14,569,973**	**170,363,033**	**55,833,260**	**3,606,597**	**59,439,858**

Program	2020 Benefits										
	Natural Gas				Oil				Propane Benefits		
	Natural Gas	Natural Gas DRIPE	Natural Gas GWSA	Total Natural Gas	Oil	Oil DRIPE	Oil GWSA	Total Oil	Propane	Propane GWSA	Total Propane Benefits
A - Residential	**(813,167)**	**(1,451,996)**	**(555,199)**	**(2,820,361)**	**177,556,245**	**521,518**	**17,109,051**	**195,186,814**	**65,241,190**	**3,978,714**	**69,219,905**
A1 - Residential New Buildings	7,757	642	1,792	10,190	403,631	1,269	36,169	441,069	18,463,137	1,030,017	19,493,154
A1a - Residential New Homes & Renovations	7,757	642	1,792	10,190	403,631	1,269	36,169	441,069	18,463,137	1,030,017	19,493,154
A2 - Residential Existing Buildings	(820,924)	(1,452,638)	(556,991)	(2,830,551)	177,152,614	520,249	17,072,881	194,745,744	46,778,053	2,948,697	49,726,752
A2a - Residential Coordinated Delivery	4,830,963	436,742	839,863	6,107,569	139,760,773	414,870	13,386,109	153,561,752	21,532,183	1,351,378	22,883,560
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	(5,651,887)	(1,889,380)	(1,396,853)	(8,938,120)	36,895,874	104,299	3,594,378	40,594,551	25,093,655	1,580,396	26,674,052
A2d - Residential Behavior	-	-	-	-	495,967	1,080	92,394	589,441	152,216	16,924	169,140
A2e - Residential Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-
B - Income Eligible	**443,312**	**57,892**	**91,572**	**592,775**	**34,570,669**	**101,961**	**3,384,614**	**38,057,242**	**4,759,359**	**293,477**	**5,052,836**
B1 - Income Eligible Existing Buildings	443,312	57,892	91,572	592,775	34,570,669	101,961	3,384,614	38,057,242	4,759,359	293,477	5,052,836
B1a - Income Eligible Coordinated Delivery	443,312	57,892	91,572	592,775	34,570,669	101,961	3,384,614	38,057,242	4,759,359	293,477	5,052,836
B1b - Income Eligible Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-
C - Commercial & Industrial	**(246,394,981)**	**(27,129,546)**	**(49,349,925)**	**(322,874,452)**	**(54,308,621)**	**(67,739)**	**(7,825,445)**	**(62,201,807)**	**9,218**	**744**	**9,962**
C1 - C&I New Buildings	(1,174,426)	(178,141)	(259,570)	(1,612,136)	(6,833,268)	(8,648)	(973,167)	(7,815,084)	-	-	-
C1a - C&I New Buildings & Major Renovations	(1,174,426)	(178,141)	(259,570)	(1,612,136)	(6,833,268)	(8,648)	(973,167)	(7,815,084)	-	-	-
C2 - C&I Existing Buildings	(245,220,555)	(26,951,405)	(49,090,355)	(321,262,316)	(47,475,353)	(59,091)	(6,852,278)	(54,386,723)	9,218	744	9,962
C2a - C&I Existing Building Retrofit	(244,587,165)	(26,823,389)	(48,939,292)	(320,349,847)	(41,697,116)	(52,163)	(6,005,262)	(47,754,541)	9,218	744	9,962
C2b - C&I New & Replacement Equipment	(633,390)	(128,016)	(151,063)	(912,468)	(5,778,237)	(6,927)	(847,017)	(6,632,182)	-	-	-
C2c - C&I Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-
Grand Total	**(246,764,837)**	**(28,523,651)**	**(49,813,552)**	**(325,102,038)**	**157,818,292**	**555,740**	**12,668,220**	**171,042,249**	**70,009,767**	**4,272,936**	**74,282,704**

IV.D Cost-Effectiveness

3.1.i. Benefits Summary Table

Statewide Electric

October 31, 2018

Program	2021 Benefits										
	Natural Gas				Oil				Propane Benefits		
	Natural Gas	Natural Gas DRIPE	Natural Gas GWSA	Total Natural Gas	Oil	Oil DRIPE	Oil GWSA	Total Oil	Propane	Propane GWSA	Total Propane Benefits
A - Residential	**2,711,996**	**(309,054)**	**293,463**	**2,696,405**	**223,622,514**	**671,075**	**20,677,529**	**244,971,117**	**95,510,088**	**5,643,320**	**101,153,408**
A1 - Residential New Buildings	7,842	505	1,724	10,071	411,334	1,325	34,787	447,445	18,943,727	998,721	19,942,448
A1a - Residential New Homes & Renovations	7,842	505	1,724	10,071	411,334	1,325	34,787	447,445	18,943,727	998,721	19,942,448
A2 - Residential Existing Buildings	2,704,154	(309,560)	291,740	2,686,334	223,211,180	669,750	20,642,742	244,523,671	76,566,361	4,644,600	81,210,960
A2a - Residential Coordinated Delivery	4,851,739	338,996	804,037	5,994,772	150,056,868	459,428	13,506,457	164,022,752	26,330,469	1,566,731	27,897,200
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	(2,147,585)	(648,555)	(512,298)	(3,308,438)	72,611,754	209,211	7,046,741	79,867,706	50,072,083	3,061,467	53,133,550
A2d - Residential Behavior	-	-	-	-	542,559	1,111	89,544	633,214	163,809	16,402	180,210
A2e - Residential Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-
B - Income Eligible	**447,820**	**45,103**	**88,131**	**581,054**	**35,962,610**	**109,252**	**3,321,641**	**39,393,504**	**5,084,776**	**297,474**	**5,382,251**
B1 - Income Eligible Existing Buildings	447,820	45,103	88,131	581,054	35,962,610	109,252	3,321,641	39,393,504	5,084,776	297,474	5,382,251
B1a - Income Eligible Coordinated Delivery	447,820	45,103	88,131	581,054	35,962,610	109,252	3,321,641	39,393,504	5,084,776	297,474	5,382,251
B1b - Income Eligible Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-
C - Commercial & Industrial	**(99,440,805)**	**(9,104,973)**	**(19,330,113)**	**(127,875,890)**	**(55,880,957)**	**(73,583)**	**(7,505,983)**	**(63,460,524)**	**9,494**	**718**	**10,212**
C1 - C&I New Buildings	(1,222,048)	(140,472)	(255,960)	(1,618,479)	(7,344,747)	(9,793)	(967,500)	(8,322,041)	-	-	-
C1a - C&I New Buildings & Major Renovations	(1,222,048)	(140,472)	(255,960)	(1,618,479)	(7,344,747)	(9,793)	(967,500)	(8,322,041)	-	-	-
C2 - C&I Existing Buildings	(98,218,757)	(8,964,501)	(19,074,154)	(126,257,411)	(48,536,209)	(63,790)	(6,538,483)	(55,138,483)	9,494	718	10,212
C2a - C&I Existing Building Retrofit	(97,643,625)	(8,876,263)	(18,943,918)	(125,463,807)	(43,095,523)	(57,307)	(5,793,279)	(48,946,110)	9,494	718	10,212
C2b - C&I New & Replacement Equipment	(575,131)	(88,238)	(130,235)	(793,605)	(5,440,686)	(6,482)	(745,204)	(6,192,373)	-	-	-
C2c - C&I Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-
Grand Total	**(96,280,988)**	**(9,368,924)**	**(18,948,519)**	**(124,598,431)**	**203,704,168**	**706,744**	**16,493,187**	**220,904,097**	**100,604,357**	**5,941,513**	**106,545,871**

Program	2019-2021 Benefits										
	Natural Gas				Oil				Propane Benefits		
	Natural Gas	Natural Gas DRIPE	Natural Gas GWSA	Total Natural Gas	Oil	Oil DRIPE	Oil GWSA	Total Oil	Propane	Propane GWSA	Total Propane Benefits
A - Residential	**(1,736,806)**	**(4,417,301)**	**(1,734,607)**	**(7,888,712)**	**550,214,991**	**1,619,915**	**53,172,367**	**605,007,272**	**212,233,938**	**12,938,351**	**225,172,291**
A1 - Residential New Buildings	23,223	1,910	5,437	30,570	1,210,022	3,808	109,491	1,323,320	55,389,881	3,118,175	58,508,057
A1a - Residential New Homes & Renovations	23,223	1,910	5,437	30,570	1,210,022	3,808	109,491	1,323,320	55,389,881	3,118,175	58,508,057
A2 - Residential Existing Buildings	(1,760,029)	(4,419,211)	(1,740,044)	(7,919,283)	549,004,969	1,616,107	53,062,876	603,683,952	156,844,057	9,820,176	166,664,234
A2a - Residential Coordinated Delivery	14,485,869	1,302,603	2,546,199	18,334,671	420,705,596	1,250,410	40,667,001	462,623,005	64,632,034	4,060,306	68,692,340
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	(16,245,897)	(5,721,814)	(4,286,243)	(26,253,954)	126,805,537	362,488	12,082,658	139,250,684	91,752,691	5,702,498	97,455,189
A2d - Residential Behavior	-	-	-	-	1,493,836	3,209	313,217	1,810,263	459,332	57,372	516,704
A2e - Residential Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-
B - Income Eligible	**1,327,384**	**172,230**	**278,175**	**1,777,788**	**103,278,316**	**305,109**	**10,201,171**	**113,784,596**	**14,185,840**	**880,422**	**15,066,262**
B1 - Income Eligible Existing Buildings	1,327,384	172,230	278,175	1,777,788	103,278,316	305,109	10,201,171	113,784,596	14,185,840	880,422	15,066,262
B1a - Income Eligible Coordinated Delivery	1,327,384	172,230	278,175	1,777,788	103,278,316	305,109	10,201,171	113,784,596	14,185,840	880,422	15,066,262
B1b - Income Eligible Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-
C - Commercial & Industrial	**(412,775,029)**	**(46,350,011)**	**(83,753,404)**	**(542,878,444)**	**(136,636,676)**	**(203,652)**	**(19,642,158)**	**(156,482,490)**	**27,607**	**2,272**	**29,879**
C1 - C&I New Buildings	(6,939,653)	(1,041,961)	(1,570,192)	(9,551,805)	(17,435,621)	(26,607)	(2,462,934)	(19,925,162)	-	-	-
C1a - C&I New Buildings & Major Renovations	(6,939,653)	(1,041,961)	(1,570,192)	(9,551,805)	(17,435,621)	(26,607)	(2,462,934)	(19,925,162)	-	-	-
C2 - C&I Existing Buildings	(405,835,375)	(45,308,050)	(82,183,212)	(533,326,639)	(119,201,055)	(177,046)	(17,179,225)	(136,557,328)	27,607	2,272	29,879
C2a - C&I Existing Building Retrofit	(403,919,432)	(44,918,573)	(81,715,100)	(530,553,106)	(104,882,226)	(156,289)	(15,073,804)	(120,112,321)	27,607	2,272	29,879
C2b - C&I New & Replacement Equipment	(1,915,943)	(389,477)	(468,112)	(2,773,533)	(14,318,829)	(20,757)	(2,105,421)	(16,445,007)	-	-	-
C2c - C&I Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-
Grand Total	**(413,184,450)**	**(50,595,082)**	**(85,209,835)**	**(548,989,368)**	**516,856,632**	**1,721,372**	**43,731,380**	**562,309,378**	**226,447,385**	**13,821,045**	**240,268,433**

IV.D Cost-Effectiveness

3.1.i. Benefits Summary Table

Statewide Electric

October 31, 2018

	2019 Benefits							
Program	Wood	Water	Total Resource Benefits	Total GWSA Benefits	Non-Energy Impacts	Total TRC Test Benefits	Total TRC Test Benefits w/o GWSA	Total Resource Benefits per Participant
A - Residential	**-**	**6,814,165**	**520,865,777**	**59,810,789**	**53,786,669**	**574,652,448**	**514,841,660**	**92**
A1 - Residential New Buildings	-	-	44,349,925	3,694,895	4,059,553	48,409,478	44,714,583	3,713
A1a - Residential New Homes & Renovations	-	-	44,349,925	3,694,895	4,059,553	48,409,478	44,714,583	3,713
A2 - Residential Existing Buildings	-	6,814,165	476,515,852	56,115,893	49,727,116	526,242,970	470,127,077	84
A2a - Residential Coordinated Delivery	-	6,612,655	243,099,505	25,495,443	33,716,357	276,815,863	251,320,420	4,848
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	
A2c - Residential Retail	-	201,510	205,083,358	26,043,060	16,010,759	221,094,117	195,051,058	49
A2d - Residential Behavior	-	-	24,512,503	4,578,841	-	24,512,503	19,933,662	17
A2e - Residential Active Demand Reduction	-	-	3,820,486	(1,450)	-	3,820,486	3,821,938	382
B - Income Eligible	**-**	**1,500,960**	**96,207,052**	**11,051,175**	**76,031,805**	**172,238,856**	**161,187,681**	**3,484**
B1 - Income Eligible Existing Buildings	-	1,500,960	96,207,052	11,051,175	76,031,805	172,238,856	161,187,681	3,484
B1a - Income Eligible Coordinated Delivery	-	1,500,960	96,207,052	11,051,175	76,031,805	172,238,856	161,187,681	3,484
B1b - Income Eligible Active Demand Reduction	-	-	-	-	-	-	-	
C - Commercial & Industrial	**-**	**121,712**	**1,139,517,861**	**151,840,686**	**192,228,161**	**1,331,746,023**	**1,179,905,338**	**55,149**
C1 - C&I New Buildings	-	456	93,317,266	13,069,784	3,555,242	96,872,508	83,802,724	108,294
C1a - C&I New Buildings & Major Renovations	-	456	93,317,266	13,069,784	3,555,242	96,872,508	83,802,724	108,294
C2 - C&I Existing Buildings	-	121,256	1,046,200,595	138,770,901	188,672,919	1,234,873,515	1,096,102,614	52,836
C2a - C&I Existing Building Retrofit	-	32,735	721,800,535	102,562,432	187,023,170	908,823,706	806,261,273	104,197
C2b - C&I New & Replacement Equipment	-	88,521	286,679,016	36,213,184	1,649,749	288,328,764	252,115,582	22,888
C2c - C&I Active Demand Reduction	-	-	37,721,045	(4,715)	-	37,721,045	37,725,759	108,394
Grand Total	**-**	**8,436,837**	**1,756,590,690**	**222,702,649**	**322,046,635**	**2,078,637,327**	**1,855,934,680**	**308**

	2020 Benefits							
Program	Wood	Water	Total Resource Benefits	Total GWSA Benefits	Non-Energy Impacts	Total TRC Test Benefits	Total TRC Test Benefits w/o GWSA	Total Resource Benefits per Participant
A - Residential	**-**	**6,793,207**	**520,501,539**	**48,775,384**	**50,668,198**	**571,169,738**	**522,394,356**	**111**
A1 - Residential New Buildings	-	-	45,091,931	3,455,453	4,178,143	49,270,075	45,814,622	3,675
A1a - Residential New Homes & Renovations	-	-	45,091,931	3,455,453	4,178,143	49,270,075	45,814,622	3,675
A2 - Residential Existing Buildings	-	6,793,207	475,409,608	45,319,930	46,490,055	521,899,663	476,579,734	101
A2a - Residential Coordinated Delivery	-	6,571,549	248,757,391	21,992,209	33,771,598	282,528,989	260,536,782	6,470
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	
A2c - Residential Retail	-	221,658	186,654,747	19,953,666	12,718,457	199,373,204	179,419,537	58
A2d - Residential Behavior	-	-	24,687,870	3,387,735	-	24,687,870	21,300,136	18
A2e - Residential Active Demand Reduction	-	-	15,309,600	(13,679)	-	15,309,600	15,323,279	1,115
B - Income Eligible	**-**	**1,500,960**	**100,224,761**	**10,005,613**	**72,284,493**	**172,509,254**	**162,503,642**	**3,607**
B1 - Income Eligible Existing Buildings	-	1,500,960	100,224,761	10,005,613	72,284,493	172,509,254	162,503,642	3,607
B1a - Income Eligible Coordinated Delivery	-	1,500,960	98,058,463	10,008,297	72,284,493	170,342,956	160,334,659	3,539
B1b - Income Eligible Active Demand Reduction	-	-	2,166,298	(2,685)	-	2,166,298	2,168,983	28,884
C - Commercial & Industrial	**-**	**123,317**	**1,494,739,862**	**175,387,442**	**132,746,526**	**1,627,486,389**	**1,452,098,947**	**92,462**
C1 - C&I New Buildings	-	684	86,881,477	11,383,735	5,127,512	92,008,990	80,625,255	123,030
C1a - C&I New Buildings & Major Renovations	-	684	86,881,477	11,383,735	5,127,512	92,008,990	80,625,255	123,030
C2 - C&I Existing Buildings	-	122,633	1,407,858,385	164,003,707	127,619,014	1,535,477,399	1,371,473,692	91,065
C2a - C&I Existing Building Retrofit	-	32,986	1,094,659,950	133,598,879	126,731,995	1,221,391,945	1,087,793,066	199,642
C2b - C&I New & Replacement Equipment	-	89,647	257,347,273	30,416,872	887,020	258,234,292	227,817,421	26,999
C2c - C&I Active Demand Reduction	-	-	55,851,161	(12,044)	-	55,851,161	55,863,205	125,508
Grand Total	**-**	**8,417,484**	**2,115,466,162**	**234,168,438**	**255,699,217**	**2,371,165,381**	**2,136,996,944**	**446**

IV.D Cost-Effectiveness

3.1.i. Benefits Summary Table

Statewide Electric

October 31, 2018

	2021 Benefits							
Program	**Wood**	**Water**	**Total Resource Benefits**	**Total GWSA Benefits**	**Non-Energy Impacts**	**Total TRC Test Benefits**	**Total TRC Test Benefits w/o GWSA**	**Total Resource Benefits per Participant**
A - Residential	**-**	**6,754,744**	**546,209,663**	**43,705,840**	**46,671,762**	**592,881,426**	**549,175,584**	**149**
A1 - Residential New Buildings	-	-	45,152,774	3,241,180	4,296,298	49,449,072	46,207,892	3,597
A1a - Residential New Homes & Renovations	-	-	45,152,774	3,241,180	4,296,298	49,449,072	46,207,892	3,597
A2 - Residential Existing Buildings	-	6,754,744	501,056,889	40,464,660	42,375,464	543,432,354	502,967,692	137
A2a - Residential Coordinated Delivery	-	6,533,411	267,250,740	21,493,341	34,168,671	301,419,412	279,926,071	6,886
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	
A2c - Residential Retail	-	221,333	189,331,654	15,589,886	8,206,794	197,538,447	181,948,560	86
A2d - Residential Behavior	-	-	24,975,698	3,398,292	-	24,975,698	21,577,406	18
A2e - Residential Active Demand Reduction	-	-	19,498,797	(16,859)	-	19,498,797	19,515,655	1,147
B - Income Eligible	**-**	**1,500,960**	**96,313,155**	**9,502,686**	**66,661,648**	**162,974,803**	**153,472,117**	**3,452**
B1 - Income Eligible Existing Buildings	-	1,500,960	96,313,155	9,502,686	66,661,648	162,974,803	153,472,117	3,452
B1a - Income Eligible Coordinated Delivery	-	1,500,960	93,423,692	9,506,137	66,661,648	160,085,339	150,579,202	3,361
B1b - Income Eligible Active Demand Reduction	-	-	2,889,464	(3,451)	-	2,889,464	2,892,915	28,895
C - Commercial & Industrial	**-**	**125,696**	**1,134,821,469**	**131,675,499**	**190,183,334**	**1,325,004,803**	**1,193,329,305**	**73,552**
C1 - C&I New Buildings	-	684	89,886,227	11,254,841	5,226,260	95,112,487	83,857,646	127,655
C1a - C&I New Buildings & Major Renovations	-	684	89,886,227	11,254,841	5,226,260	95,112,487	83,857,646	127,655
C2 - C&I Existing Buildings	-	125,011	1,044,935,243	120,420,658	184,957,073	1,229,892,316	1,109,471,659	70,965
C2a - C&I Existing Building Retrofit	-	34,238	730,256,476	93,046,335	184,611,392	914,867,868	821,821,533	161,902
C2b - C&I New & Replacement Equipment	-	90,773	238,585,199	27,393,259	345,681	238,930,880	211,537,622	24,561
C2c - C&I Active Demand Reduction	-	-	76,093,568	(18,936)	-	76,093,568	76,112,504	152,187
Grand Total	**-**	**8,381,400**	**1,777,344,288**	**184,884,025**	**303,516,743**	**2,080,861,032**	**1,895,977,005**	**480**

	2019-2021 Benefits							
Program	**Wood**	**Water**	**Total Resource Benefits**	**Total GWSA Benefits**	**Non-Energy Impacts**	**Total TRC Test Benefits**	**Total TRC Test Benefits w/o GWSA**	**Total Resource Benefits per Participant**
A - Residential	**-**	**20,362,116**	**1,587,576,979**	**152,292,012**	**151,126,630**	**1,738,703,612**	**1,586,411,600**	**113**
A1 - Residential New Buildings	-	-	134,594,630	10,391,529	12,533,994	147,128,626	136,737,096	3,660
A1a - Residential New Homes & Renovations	-	-	134,594,630	10,391,529	12,533,994	147,128,626	136,737,096	3,660
A2 - Residential Existing Buildings	-	20,362,116	1,452,982,349	141,900,483	138,592,636	1,591,574,986	1,449,674,503	104
A2a - Residential Coordinated Delivery	-	19,717,615	759,107,637	68,980,992	101,656,626	860,764,264	791,783,273	5,959
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	
A2c - Residential Retail	-	644,501	581,069,758	61,586,612	36,936,010	618,005,768	556,419,154	61
A2d - Residential Behavior	-	-	74,176,070	11,364,867	-	74,176,070	62,811,204	18
A2e - Residential Active Demand Reduction	-	-	38,628,884	(31,988)	-	38,628,884	38,660,872	949
B - Income Eligible	**-**	**4,502,879**	**292,744,969**	**30,559,473**	**214,977,945**	**507,722,913**	**477,163,440**	**3,514**
B1 - Income Eligible Existing Buildings	-	4,502,879	292,744,969	30,559,473	214,977,945	507,722,913	477,163,440	3,514
B1a - Income Eligible Coordinated Delivery	-	4,502,879	287,689,206	30,565,609	214,977,945	502,667,151	472,101,542	3,461
B1b - Income Eligible Active Demand Reduction	-	-	5,055,762	(6,136)	-	5,055,762	5,061,898	28,890
C - Commercial & Industrial	**-**	**370,726**	**3,769,079,192**	**458,903,627**	**515,158,020**	**4,284,237,214**	**3,825,333,590**	**72,125**
C1 - C&I New Buildings	-	1,825	270,084,970	35,708,360	13,909,014	283,993,985	248,285,625	118,874
C1a - C&I New Buildings & Major Renovations	-	1,825	270,084,970	35,708,360	13,909,014	283,993,985	248,285,625	118,874
C2 - C&I Existing Buildings	-	368,900	3,498,994,222	423,195,267	501,249,006	4,000,243,229	3,577,047,965	70,001
C2a - C&I Existing Building Retrofit	-	99,960	2,546,716,961	329,207,647	498,366,557	3,045,083,519	2,715,875,872	150,508
C2b - C&I New & Replacement Equipment	-	268,941	782,611,488	94,023,314	2,882,449	785,493,937	691,470,624	24,633
C2c - C&I Active Demand Reduction	-	-	169,665,774	(35,694)	-	169,665,774	169,701,468	131,219
Grand Total	**-**	**25,235,721**	**5,649,401,140**	**641,755,112**	**881,262,595**	**6,530,663,740**	**5,888,908,629**	**399**

IV.D Cost-Effectiveness

3.1.iii. Benefits Comparison Table - Three Year Plan vs. Previous Years

Statewide Electric
October 31, 2018

2016-2021 Benefits								
Sector	Electric Benefits							
	Capacity					Electric Energy		
	Summer Generation	Transmission	Distribution	Capacity DRIPE	Total Capacity Benefits	Electric Energy	Electric Energy DRIPE	Total Electric Energy Benefits
A - Residential	**346,832,257**	**200,042,900**	**242,949,821**	**39,599,487**	**831,513,930**	**1,220,534,589**	**251,632,791**	**1,560,083,285**
2016 Evaluated	74,306,044	37,136,402	33,938,533	3,583,240	148,964,219	289,455,956	79,675,893	369,131,849
2017 Evaluated	106,786,501	44,847,652	44,642,257	4,172,864	200,449,273	343,664,932	54,210,822	397,875,754
2018 Planned	105,063,195	38,976,296	35,271,568	3,754,815	183,065,874	329,446,579	17,739,650	347,186,229
2019 Planned	21,673,821	28,706,431	44,808,485	4,841,555	100,699,214	112,064,824	46,822,456	201,468,837
2020 Planned	20,115,463	26,731,268	43,719,959	10,934,058	102,230,062	88,114,183	33,534,913	149,891,914
2021 Planned	18,887,234	23,644,851	40,569,020	12,312,955	96,105,287	57,788,115	19,649,057	94,528,701
B - Income Eligible	**34,941,453**	**23,315,612**	**32,648,192**	**3,653,127**	**94,811,862**	**148,844,133**	**28,248,954**	**196,292,792**
2016 Evaluated	6,369,405	2,576,096	2,746,136	243,097	11,934,734	26,029,012	5,533,381	31,562,394
2017 Evaluated	7,099,155	2,409,325	3,000,890	214,206	12,723,576	32,041,082	3,430,818	35,471,900
2018 Planned	8,188,935	2,909,989	2,701,865	284,234	14,085,023	26,267,212	1,446,373	27,713,585
2019 Planned	4,464,650	5,343,783	7,646,983	130,574	17,660,944	21,840,362	6,467,484	35,476,163
2020 Planned	5,137,227	5,963,899	9,042,562	1,257,038	21,498,808	21,422,207	5,863,983	33,522,140
2021 Planned	3,682,082	4,112,519	7,509,757	1,523,979	16,908,777	21,244,258	5,506,914	32,546,611
C - Commercial & Industrial	**1,004,540,421**	**668,577,740**	**997,918,804**	**80,059,455**	**2,762,214,954**	**4,094,643,904**	**733,021,625**	**5,389,962,445**
2016 Evaluated	225,593,671	87,214,454	111,090,468	7,181,403	431,079,997	743,250,454	119,304,614	862,555,068
2017 Evaluated	216,663,209	72,693,596	85,977,676	6,441,669	381,776,150	725,414,061	57,304,987	782,719,047
2018 Planned	234,417,395	82,060,819	92,630,276	7,145,760	416,254,250	777,457,088	32,296,275	809,753,363
2019 Planned	93,908,019	123,263,595	192,745,803	14,225,922	427,167,458	507,956,482	155,986,794	835,167,247
2020 Planned	137,001,155	173,341,506	303,720,605	19,868,939	637,907,555	802,430,181	206,783,038	1,241,775,287
2021 Planned	96,956,973	130,003,770	211,753,975	25,195,761	468,029,544	538,135,638	161,345,918	857,992,433
Grand Total	**1,386,314,132**	**891,936,252**	**1,273,516,817**	**123,312,069**	**3,688,540,746**	**5,464,022,626**	**1,012,903,369**	**7,146,338,522**
2016 Evaluated	306,269,120	126,926,953	147,775,138	11,007,740	591,978,950	1,058,735,423	204,513,888	1,263,249,311
2017 Evaluated	330,548,865	119,950,573	133,620,822	10,828,739	594,948,999	1,101,120,074	114,946,626	1,216,066,701
2018 Planned	347,669,525	123,947,105	130,603,710	11,184,809	613,405,148	1,133,170,879	51,482,298	1,184,653,177
2019 Planned	120,046,490	157,313,808	245,201,270	19,198,051	545,527,616	641,861,668	209,276,734	1,072,112,248
2020 Planned	162,253,845	206,036,673	356,483,126	32,060,035	761,636,425	911,966,571	246,181,934	1,425,189,341
2021 Planned	119,526,288	157,761,140	259,832,752	39,032,695	581,043,609	617,168,010	186,501,889	985,067,745

IV.D Cost-Effectiveness

3.1.iii. Benefits Comparison Table - Three Year Plan vs. Previous Years

Statewide Electric
October 31, 2018

2016-2021 Benefits, Percent of Total TRC Test Benefits								
Sector	Electric Benefits							
	Capacity					Electric Energy		
	Summer Generation	Transmission	Distribution	Capacity DRIPE	Total Capacity Benefits	Electric Energy	Electric Energy DRIPE	Total Electric Energy Benefits
A - Residential	**8.7%**	**5.0%**	**6.1%**	**1.0%**	**20.9%**	**30.7%**	**6.3%**	**39.2%**
2016 Evaluated	10.5%	5.3%	4.8%	0.5%	21.1%	40.9%	11.3%	52.2%
2017 Evaluated	14.0%	5.9%	5.9%	0.5%	26.3%	45.1%	7.1%	52.2%
2018 Planned	13.6%	5.1%	4.6%	0.5%	23.8%	42.7%	2.3%	45.0%
2019 Planned	3.8%	5.0%	7.8%	0.8%	17.5%	19.5%	8.1%	35.1%
2020 Planned	3.5%	4.7%	7.7%	1.9%	17.9%	15.4%	5.9%	26.2%
2021 Planned	3.2%	4.0%	6.8%	2.1%	16.2%	9.7%	3.3%	15.9%
B - Income Eligible	**4.0%**	**2.7%**	**3.8%**	**0.4%**	**11.0%**	**17.2%**	**3.3%**	**22.7%**
2016 Evaluated	5.5%	2.2%	2.4%	0.2%	10.3%	22.5%	4.8%	27.3%
2017 Evaluated	5.7%	1.9%	2.4%	0.2%	10.2%	25.7%	2.7%	28.4%
2018 Planned	7.0%	2.5%	2.3%	0.2%	12.1%	22.6%	1.2%	23.8%
2019 Planned	2.6%	3.1%	4.4%	0.1%	10.3%	12.7%	3.8%	20.6%
2020 Planned	3.0%	3.5%	5.2%	0.7%	12.5%	12.4%	3.4%	19.4%
2021 Planned	2.3%	2.5%	4.6%	0.9%	10.4%	13.0%	3.4%	20.0%
C - Commercial & Industrial	**12.4%**	**8.3%**	**12.3%**	**1.0%**	**34.1%**	**50.6%**	**9.1%**	**66.6%**
2016 Evaluated	16.2%	6.3%	8.0%	0.5%	30.9%	53.3%	8.6%	61.9%
2017 Evaluated	18.3%	6.1%	7.3%	0.5%	32.3%	61.4%	4.8%	66.2%
2018 Planned	19.1%	6.7%	7.5%	0.6%	33.9%	63.3%	2.6%	65.9%
2019 Planned	7.1%	9.3%	14.5%	1.1%	32.1%	38.1%	11.7%	62.7%
2020 Planned	8.4%	10.7%	18.7%	1.2%	39.2%	49.3%	12.7%	76.3%
2021 Planned	7.3%	9.8%	16.0%	1.9%	35.3%	40.6%	12.2%	64.8%
Grand Total	**10.7%**	**6.9%**	**9.8%**	**1.0%**	**28.5%**	**42.3%**	**7.8%**	**55.3%**
2016 Evaluated	13.8%	5.7%	6.7%	0.5%	26.7%	47.8%	9.2%	57.0%
2017 Evaluated	16.0%	5.8%	6.5%	0.5%	28.7%	53.2%	5.6%	58.8%
2018 Planned	16.4%	5.9%	6.2%	0.5%	29.0%	53.6%	2.4%	56.0%
2019 Planned	5.8%	7.6%	11.8%	0.9%	26.2%	30.9%	10.1%	51.6%
2020 Planned	6.8%	8.7%	15.0%	1.4%	32.1%	38.5%	10.4%	60.1%
2021 Planned	5.7%	7.6%	12.5%	1.9%	27.9%	29.7%	9.0%	47.3%

Notes:

2016 values are from the Program Administrator's 2016 Plan Year Report D.P.U. 17-100, in 2016$.

2017 values are from the Program Administrator's 2017 Plan Year Report D.P.U. 18-51, in 2016$.

2018 values are from the Program Administrator's 2016-2018 Three-Year Plan, D.P.U. 15-166, in 2016$.

For supporting information on the 2019-2021 values, see Table IV.D.3.1.i. The 2019-2021 values are in 2019$.

IV.D Cost-Effectiveness

3.1.iii. Benefits Comparison

Statewide Electric
October 31, 2018

Sector	2016-2021 Benefits								
	Natural Gas Benefits			Deliverable Fuel Benefits		Other Benefits	Total Energy Benefits	Non-Energy Impacts	Total TRC Test Benefits
	Natural Gas	Natural Gas DRIPE	Total Gas Benefits	Oil	Propane	Water			
A - Residential	**(75,939,669)**	**(16,563,043)**	**(94,237,318)**	**908,977,337**	**261,151,139**	**36,553,497**	**3,571,772,499**	**407,271,184**	**3,979,043,687**
2016 Evaluated	(23,466,292)	(6,648,784)	(30,115,076)	103,888,786	20,866,065	4,898,011	617,633,853	89,395,523	707,029,377
2017 Evaluated	(24,249,634)	(3,817,877)	(28,067,511)	90,506,658	14,651,854	4,845,055	680,261,084	82,270,545	762,531,629
2018 Planned	(26,486,938)	(1,679,081)	(28,166,019)	164,366,902	13,399,282	6,448,315	686,300,584	84,478,486	770,779,069
2019 Planned	(3,635,635)	(2,656,250)	(7,764,757)	149,036,232	51,482,661	6,814,165	520,865,777	53,786,669	574,652,448
2020 Planned	(813,167)	(1,451,996)	(2,820,361)	177,556,245	65,241,190	6,793,207	520,501,539	50,668,198	571,169,738
2021 Planned	2,711,996	(309,054)	2,696,405	223,622,514	95,510,088	6,754,744	546,209,663	46,671,762	592,881,426
B - Income Eligible	**1,636,905**	**199,539**	**2,114,617**	**195,747,291**	**18,887,638**	**5,654,442**	**524,895,345**	**339,519,076**	**864,414,421**
2016 Evaluated	627	168	795	25,563,581	1,784,332	266,787	71,112,623	44,415,380	115,528,003
2017 Evaluated	307,158	26,983	334,141	25,281,474	1,596,286	447,517	75,854,894	48,928,764	124,783,657
2018 Planned	1,735	158	1,893	41,623,919	1,321,180	437,259	85,182,860	31,196,988	116,379,848
2019 Planned	436,253	69,236	603,959	32,745,037	4,341,705	1,500,960	96,207,052	76,031,805	172,238,856
2020 Planned	443,312	57,892	592,775	34,570,669	4,759,359	1,500,960	100,224,761	72,284,493	172,509,254
2021 Planned	447,820	45,103	581,054	35,962,610	5,084,776	1,500,960	96,313,155	66,661,648	162,974,803
C - Commercial & Industrial	**(691,242,187)**	**(67,604,243)**	**(842,599,833)**	**(227,624,422)**	**2,228,403**	**(13,924)**	**7,064,324,077**	**1,024,483,725**	**8,088,807,804**
2016 Evaluated	(53,837,818)	(7,451,654)	(61,289,473)	(40,867,126)	30,836	200,094	1,191,709,397	201,695,732	1,393,405,129
2017 Evaluated	(106,759,981)	(7,572,730)	(114,332,711)	(26,253,240)	842,281	(1,088,875)	1,023,662,652	158,748,107	1,182,410,759
2018 Planned	(117,869,359)	(6,229,847)	(124,099,206)	(23,867,381)	1,327,678	504,132	1,079,872,837	148,881,865	1,228,754,702
2019 Planned	(66,939,242)	(10,115,493)	(92,128,102)	(26,447,098)	8,895	121,712	1,139,517,861	192,228,161	1,331,746,023
2020 Planned	(246,394,981)	(27,129,546)	(322,874,452)	(54,308,621)	9,218	123,317	1,494,739,862	132,746,526	1,627,486,389
2021 Planned	(99,440,805)	(9,104,973)	(127,875,890)	(55,880,957)	9,494	125,696	1,134,821,469	190,183,334	1,325,004,803
Grand Total	**(765,544,952)**	**(83,967,746)**	**(934,722,534)**	**877,100,206**	**282,267,180**	**42,194,016**	**11,160,991,922**	**1,771,273,985**	**12,932,265,913**
2016 Evaluated	(77,303,484)	(14,100,269)	(91,403,753)	88,585,241	22,681,233	5,364,891	1,880,455,873	335,506,635	2,215,962,508
2017 Evaluated	(130,702,457)	(11,363,624)	(142,066,081)	89,534,892	17,090,421	4,203,697	1,779,778,629	289,947,416	2,069,726,045
2018 Planned	(144,354,561)	(7,908,771)	(152,263,331)	182,123,440	16,048,141	7,389,706	1,851,356,280	264,557,339	2,115,913,619
2019 Planned	(70,138,625)	(12,702,507)	(99,288,899)	155,334,172	55,833,260	8,436,837	1,756,590,690	322,046,635	2,078,637,327
2020 Planned	(246,764,837)	(28,523,651)	(325,102,038)	157,818,292	70,009,767	8,417,484	2,115,466,162	255,699,217	2,371,165,381
2021 Planned	(96,280,988)	(9,368,924)	(124,598,431)	203,704,168	100,604,357	8,381,400	1,777,344,288	303,516,743	2,080,861,032

IV.D Cost-Effectiveness

3.1.iii. Benefits Comparison

Statewide Electric
October 31, 2018

Sector	2016-2021 Benefits, Percent of Total TRC Test Benefits								
	Natural Gas Benefits			Deliverable Fuel Benefits		Other Benefits	Total Energy Benefits	Non-Energy Impacts	Total TRC Test Benefits
	Natural Gas	Natural Gas DRIPE	Total Gas Benefits	Oil	Propane	Water			
A - Residential	**-1.9%**	**-0.4%**	**-2.4%**	**22.8%**	**6.6%**	**0.9%**	**89.8%**	**10.2%**	**100%**
2016 Evaluated	-3.3%	-0.9%	-4.3%	14.7%	3.0%	0.7%	87.4%	12.6%	100%
2017 Evaluated	-3.2%	-0.5%	-3.7%	11.9%	1.9%	0.6%	89.2%	10.8%	100%
2018 Planned	-3.4%	-0.2%	-3.7%	21.3%	1.7%	0.8%	89.0%	11.0%	100%
2019 Planned	-0.6%	-0.5%	-1.4%	25.9%	9.0%	1.2%	90.6%	9.4%	100%
2020 Planned	-0.1%	-0.3%	-0.5%	31.1%	11.4%	1.2%	91.1%	8.9%	100%
2021 Planned	0.5%	-0.1%	0.5%	37.7%	16.1%	1.1%	92.1%	7.9%	100%
B - Income Eligible	**0.2%**	**0.0%**	**0.2%**	**22.6%**	**2.2%**	**0.7%**	**60.7%**	**39.3%**	**100%**
2016 Evaluated	0.0%	0.0%	0.0%	22.1%	1.5%	0.2%	61.6%	38.4%	100%
2017 Evaluated	0.2%	0.0%	0.3%	20.3%	1.3%	0.4%	60.8%	39.2%	100%
2018 Planned	0.0%	0.0%	0.0%	35.8%	1.1%	0.4%	73.2%	26.8%	100%
2019 Planned	0.3%	0.0%	0.4%	19.0%	2.5%	0.9%	55.9%	44.1%	100%
2020 Planned	0.3%	0.0%	0.3%	20.0%	2.8%	0.9%	58.1%	41.9%	100%
2021 Planned	0.3%	0.0%	0.4%	22.1%	3.1%	0.9%	59.1%	40.9%	100%
C - Commercial & Industrial	**-8.5%**	**-0.8%**	**-10.4%**	**-2.8%**	**0.0%**	**0.0%**	**87.3%**	**12.7%**	**100%**
2016 Evaluated	-3.9%	-0.5%	-4.4%	-2.9%	0.0%	0.0%	85.5%	14.5%	100%
2017 Evaluated	-9.0%	-0.6%	-9.7%	-2.2%	0.1%	-0.1%	86.6%	13.4%	100%
2018 Planned	-9.6%	-0.5%	-10.1%	-1.9%	0.1%	0.0%	87.9%	12.1%	100%
2019 Planned	-5.0%	-0.8%	-6.9%	-2.0%	0.0%	0.0%	85.6%	14.4%	100%
2020 Planned	-15.1%	-1.7%	-19.8%	-3.3%	0.0%	0.0%	91.8%	8.2%	100%
2021 Planned	-7.5%	-0.7%	-9.7%	-4.2%	0.0%	0.0%	85.6%	14.4%	100%
Grand Total	**-5.9%**	**-0.6%**	**-7.2%**	**6.8%**	**2.2%**	**0.3%**	**86.3%**	**13.7%**	**100%**
2016 Evaluated	-3.5%	-0.6%	-4.1%	4.0%	1.0%	0.2%	84.9%	15.1%	100%
2017 Evaluated	-6.3%	-0.5%	-6.9%	4.3%	0.8%	0.2%	86.0%	14.0%	100%
2018 Planned	-6.8%	-0.4%	-7.2%	8.6%	0.8%	0.3%	87.5%	12.5%	100%
2019 Planned	-3.4%	-0.6%	-4.8%	7.5%	2.7%	0.4%	84.5%	15.5%	100%
2020 Planned	-10.4%	-1.2%	-13.7%	6.7%	3.0%	0.4%	89.2%	10.8%	100%
2021 Planned	-4.6%	-0.5%	-6.0%	9.8%	4.8%	0.4%	85.4%	14.6%	100%

Notes:

2016 values are from the Program Admini

2017 values are from the Program Admini

2018 values are from the Program Admini

For supporting information on the 2019-2

IV.D. Cost-Effectiveness

3.2.i. Savings Summary Table

Statewide Electric
October 31, 2018

2019 Net Savings									
Program	# of Participants	Electric						Natural Gas (Therms)	
		Annual Capacity (kW)		Electric Energy (MWh)		Electric Energy (MMBTU)			
		Summer	Winter	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
A - Residential	**5,657,928**	**61,918**	**81,874**	**408,926**	**1,811,873**	**1,395,257**	**6,182,111**	**(1,509,004)**	**(4,254,247)**
A1 - Residential New Buildings	11,946	2,101	2,013	11,204	144,253	38,227	492,192	643	9,640
A1a - Residential New Homes & Renovations	11,946	2,101	2,013	11,204	144,253	38,227	492,192	643	9,640
A2 - Residential Existing Buildings	5,645,982	59,816	79,861	397,722	1,667,619	1,357,030	5,689,919	(1,509,646)	(4,263,887)
A2a - Residential Coordinated Delivery	50,142	11,083	16,854	83,959	434,764	286,469	1,483,415	247,732	5,258,529
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	4,168,748	30,145	34,679	182,237	1,101,329	621,792	3,757,735	(1,757,378)	(9,522,416)
A2d - Residential Behavior	1,417,100	18,588	28,327	131,526	131,526	448,769	448,769	-	-
A2e - Residential Active Demand Reduction	9,992	-	-	-	-	-	-	-	-
B - Income Eligible	**27,615**	**5,540**	**6,317**	**36,315**	**354,956**	**123,906**	**1,211,107**	**36,002**	**484,168**
B1 - Income Eligible Existing Buildings	27,615	5,540	6,317	36,315	354,956	123,906	1,211,107	36,002	484,168
B1a - Income Eligible Coordinated Delivery	27,615	5,540	6,317	36,315	354,956	123,906	1,211,107	36,002	484,168
B1b - Income Eligible Active Demand Reduction	-	-	-	-	-	-	-	-	-
C - Commercial & Industrial	**20,662**	**96,378**	**85,657**	**687,008**	**8,561,444**	**2,616,725**	**34,563,728**	**(4,753,824)**	**(80,284,606)**
C1 - C&I New Buildings	862	5,845	4,696	49,604	784,958	200,354	3,207,045	(340,187)	(5,444,550)
C1a - C&I New Buildings & Major Renovations	862	5,845	4,696	49,604	784,958	200,354	3,207,045	(340,187)	(5,444,550)
C2 - C&I Existing Buildings	19,801	90,533	80,961	637,404	7,776,486	2,416,371	31,356,683	(4,413,637)	(74,840,056)
C2a - C&I Existing Building Retrofit	6,927	60,842	60,780	481,822	5,963,392	1,885,527	25,170,409	(4,327,924)	(73,986,423)
C2b - C&I New & Replacement Equipment	12,526	29,691	20,180	155,581	1,813,093	530,844	6,186,274	(85,713)	(853,633)
C2c - C&I Active Demand Reduction	348	-	-	-	-	-	-	-	-
Grand Total	**5,706,205**	**163,836**	**173,847**	**1,132,249**	**10,728,272**	**4,135,888**	**41,956,946**	**(6,226,827)**	**(84,054,684)**

2020 Net Savings									
Program	# of Participants	Electric						Natural Gas (Therms)	
		Annual Capacity (kW)		Electric Energy (MWh)		Electric Energy (MMBTU)			
		Summer	Winter	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
A - Residential	**4,699,662**	**54,540**	**72,050**	**345,129**	**1,384,478**	**1,177,790**	**4,725,918**	**(985,023)**	**(925,330)**
A1 - Residential New Buildings	12,270	2,019	1,922	10,639	147,344	36,300	502,737	643	9,640
A1a - Residential New Homes & Renovations	12,270	2,019	1,922	10,639	147,344	36,300	502,737	643	9,640
A2 - Residential Existing Buildings	4,687,392	52,521	70,127	334,490	1,237,135	1,141,491	4,223,181	(985,666)	(934,970)
A2a - Residential Coordinated Delivery	38,448	9,167	13,593	64,183	344,546	218,993	1,175,591	245,835	5,230,794
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	3,232,119	22,528	25,429	131,680	754,509	449,293	2,574,385	(1,231,501)	(6,165,764)
A2d - Residential Behavior	1,403,100	19,576	29,854	138,688	138,688	473,204	473,204	-	-
A2e - Residential Active Demand Reduction	13,725	1,250	1,250	(61)	(609)	-	-	-	-
B - Income Eligible	**27,785**	**5,646**	**6,417**	**33,520**	**341,962**	**114,416**	**1,167,254**	**36,002**	**484,168**
B1 - Income Eligible Existing Buildings	27,785	5,646	6,417	33,520	341,962	114,416	1,167,254	36,002	484,168
B1a - Income Eligible Coordinated Delivery	27,710	5,357	6,128	33,534	342,103	114,416	1,167,254	36,002	484,168
B1b - Income Eligible Active Demand Reduction	75	289	289	(14)	(141)	-	-	-	-
C - Commercial & Industrial	**16,166**	**120,042**	**97,940**	**912,397**	**13,063,882**	**4,511,617**	**72,536,234**	**(15,204,993)**	**(290,957,793)**
C1 - C&I New Buildings	706	5,435	4,096	45,985	725,572	156,903	2,475,650	(100,992)	(1,387,932)
C1a - C&I New Buildings & Major Renovations	706	5,435	4,096	45,985	725,572	156,903	2,475,650	(100,992)	(1,387,932)
C2 - C&I Existing Buildings	15,460	114,607	93,843	866,411	12,338,310	4,354,714	70,060,584	(15,104,001)	(289,569,861)
C2a - C&I Existing Building Retrofit	5,483	87,509	75,219	723,738	10,676,289	3,867,881	64,389,551	(15,030,144)	(288,824,039)
C2b - C&I New & Replacement Equipment	9,532	26,906	18,432	142,682	1,662,084	486,834	5,671,033	(73,856)	(745,822)
C2c - C&I Active Demand Reduction	445	192	192	(9)	(63)	-	-	-	-
Grand Total	**4,743,613**	**180,227**	**176,406**	**1,291,046**	**14,790,322**	**5,803,824**	**78,429,406**	**(16,154,015)**	**(291,398,955)**

IV.D. Cost-Effectiveness

3.2.i. Savings Summary Table

Statewide Electric
October 31, 2018

2021 Net Savings									
Program	# of Participants	Electric						Natural Gas (Therms)	
		Annual Capacity (kW)		Electric Energy (MWh)		Electric Energy (MMBTU)			
		Summer	Winter	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
A - Residential	**3,658,588**	**42,950**	**56,405**	**265,620**	**882,430**	**906,548**	**3,013,407**	**(326,486)**	**2,928,612**
A1 - Residential New Buildings	12,554	1,918	1,808	9,952	145,087	33,955	495,035	643	9,640
A1a - Residential New Homes & Renovations	12,554	1,918	1,808	9,952	145,087	33,955	495,035	643	9,640
A2 - Residential Existing Buildings	3,646,034	41,032	54,598	255,668	737,343	872,593	2,518,372	(327,129)	2,918,971
A2a - Residential Coordinated Delivery	38,809	7,718	11,096	48,321	328,257	164,870	1,120,012	244,554	5,214,700
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	2,193,123	12,711	12,900	63,670	266,083	217,239	907,877	(571,682)	(2,295,728)
A2d - Residential Behavior	1,397,100	19,064	29,063	143,753	143,753	490,484	490,484	-	-
A2e - Residential Active Demand Reduction	17,002	1,539	1,539	(75)	(750)	-	-	-	-
B - Income Eligible	**27,900**	**4,079**	**9,536**	**30,481**	**335,201**	**104,067**	**1,144,347**	**36,002**	**484,168**
B1 - Income Eligible Existing Buildings	27,900	4,079	9,536	30,481	335,201	104,067	1,144,347	36,002	484,168
B1a - Income Eligible Coordinated Delivery	27,800	3,694	9,151	30,500	335,388	104,067	1,144,347	36,002	484,168
B1b - Income Eligible Active Demand Reduction	100	385	385	(19)	(187)	-	-	-	-
C - Commercial & Industrial	**15,429**	**93,501**	**83,306**	**710,075**	**8,926,741**	**2,800,517**	**38,004,688**	**(6,576,668)**	**(116,347,119)**
C1 - C&I New Buildings	704	5,630	3,938	46,982	748,070	160,304	2,552,416	(102,518)	(1,427,542)
C1a - C&I New Buildings & Major Renovations	704	5,630	3,938	46,982	748,070	160,304	2,552,416	(102,518)	(1,427,542)
C2 - C&I Existing Buildings	14,725	87,872	79,368	663,094	8,178,671	2,640,214	35,452,273	(6,474,149)	(114,919,576)
C2a - C&I Existing Building Retrofit	4,510	63,065	62,212	530,565	6,624,423	2,187,993	30,148,962	(6,408,937)	(114,252,839)
C2b - C&I New & Replacement Equipment	9,714	24,614	16,963	132,538	1,554,311	452,221	5,303,310	(65,212)	(666,737)
C2c - C&I Active Demand Reduction	500	192	192	(9)	(63)	-	-	-	-
Grand Total	**3,701,916**	**140,530**	**149,247**	**1,006,176**	**10,144,371**	**3,811,132**	**42,162,442**	**(6,867,152)**	**(112,934,339)**

2019-2021 Net Savings									
Program	# of Participants	Electric						Natural Gas (Therms)	
		Annual Capacity (kW)		Electric Energy (MWh)		Electric Energy (MMBTU)			
		Summer	Winter	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
A - Residential	**14,016,177**	**159,407**	**210,328**	**1,019,675**	**4,078,780**	**3,479,595**	**13,921,436**	**(2,820,513)**	**(2,250,964)**
A1 - Residential New Buildings	36,770	6,038	5,743	31,794	436,684	108,482	1,489,964	1,928	28,921
A1a - Residential New Homes & Renovations	36,770	6,038	5,743	31,794	436,684	108,482	1,489,964	1,928	28,921
A2 - Residential Existing Buildings	13,979,407	153,369	204,585	987,881	3,642,097	3,371,113	12,431,472	(2,822,441)	(2,279,885)
A2a - Residential Coordinated Delivery	127,399	27,968	41,543	196,463	1,107,566	670,332	3,779,018	738,120	15,704,023
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	9,593,989	65,384	73,009	377,586	2,121,921	1,288,324	7,239,997	(3,560,561)	(17,983,908)
A2d - Residential Behavior	4,217,300	57,228	87,244	413,968	413,968	1,412,457	1,412,457	-	-
A2e - Residential Active Demand Reduction	40,719	2,789	2,789	(136)	(1,359)	-	-	-	-
B - Income Eligible	**83,300**	**15,265**	**22,269**	**100,316**	**1,032,118**	**342,389**	**3,522,708**	**108,005**	**1,452,504**
B1 - Income Eligible Existing Buildings	83,300	15,265	22,269	100,316	1,032,118	342,389	3,522,708	108,005	1,452,504
B1a - Income Eligible Coordinated Delivery	83,125	14,591	21,595	100,348	1,032,446	342,389	3,522,708	108,005	1,452,504
B1b - Income Eligible Active Demand Reduction	175	673	673	(33)	(328)	-	-	-	-
C - Commercial & Industrial	**52,257**	**309,921**	**266,903**	**2,309,480**	**30,552,066**	**9,928,860**	**145,104,650**	**(26,535,485)**	**(487,589,518)**
C1 - C&I New Buildings	2,272	16,910	12,731	142,571	2,258,600	517,561	8,235,110	(543,698)	(8,260,024)
C1a - C&I New Buildings & Major Renovations	2,272	16,910	12,731	142,571	2,258,600	517,561	8,235,110	(543,698)	(8,260,024)
C2 - C&I Existing Buildings	49,985	293,011	254,172	2,166,908	28,293,466	9,411,299	136,869,540	(25,991,787)	(479,329,494)
C2a - C&I Existing Building Retrofit	16,921	211,416	198,212	1,736,125	23,264,104	7,941,400	119,708,923	(25,767,006)	(477,063,301)
C2b - C&I New & Replacement Equipment	31,771	81,211	55,576	430,802	5,029,488	1,469,899	17,160,617	(224,782)	(2,266,192)
C2c - C&I Active Demand Reduction	1,293	385	385	(19)	(126)	-	-	-	-
Grand Total	**14,151,735**	**484,592**	**499,500**	**3,429,471**	**35,662,965**	**13,750,845**	**162,548,795**	**(29,247,994)**	**(488,387,978)**

IV.D. Cost-Effectiveness

3.2.i. Savings Summary Table

Statewide Electric
October 31, 2018

2019 Net Savings

Program	Deliverable Fuels				Other				Total Savings		Electric Energy, no Fuel Switching or ADR (MWh)	
	Oil (MMBTU)		Propane (MMBTU)		Wood (MMBTU)		Water (Gallons)		MMBTU			
	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
A - Residential	**299,370**	**6,396,755**	**70,611**	**1,600,212**	**-**	**-**	**58,759,348**	**417,409,154**	**1,614,338**	**13,753,653**	**414,278**	**1,902,972**
A1 - Residential New Buildings	726	16,831	23,475	554,934	-	-	-	-	62,493	1,064,922	11,204	144,253
A1a - Residential New Homes & Renovations	726	16,831	23,475	554,934	-	-	-	-	62,493	1,064,922	11,204	144,253
A2 - Residential Existing Buildings	298,644	6,379,924	47,136	1,045,277	-	-	58,759,348	417,409,154	1,551,845	12,688,731	403,074	1,758,719
A2a - Residential Coordinated Delivery	295,276	5,657,294	29,454	527,099	-	-	56,997,302	405,074,839	635,973	8,193,661	84,531	444,105
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	(24,187)	695,075	11,836	512,332	-	-	1,762,045	12,334,315	433,703	4,012,900	187,017	1,183,087
A2d - Residential Behavior	27,555	27,555	5,846	5,846	-	-	-	-	482,169	482,169	131,526	131,526
A2e - Residential Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-	-
B - Income Eligible	**72,187**	**1,416,480**	**7,042**	**135,969**	**-**	**-**	**9,436,848**	**92,594,171**	**206,736**	**2,811,973**	**36,855**	**363,064**
B1 - Income Eligible Existing Buildings	72,187	1,416,480	7,042	135,969	-	-	9,436,848	92,594,171	206,736	2,811,973	36,855	363,064
B1a - Income Eligible Coordinated Delivery	72,187	1,416,480	7,042	135,969	-	-	9,436,848	92,594,171	206,736	2,811,973	36,855	363,064
B1b - Income Eligible Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-	-
C - Commercial & Industrial	**(127,389)**	**(1,456,960)**	**35**	**296**	**-**	**-**	**638,660**	**7,559,982**	**2,013,988**	**25,078,604**	**687,008**	**8,561,444**
C1 - C&I New Buildings	(15,034)	(178,549)	-	-	-	-	3,499	27,994	151,301	2,484,041	49,604	784,958
C1a - C&I New Buildings & Major Renovations	(15,034)	(178,549)	-	-	-	-	3,499	27,994	151,301	2,484,041	49,604	784,958
C2 - C&I Existing Buildings	(112,356)	(1,278,411)	35	296	-	-	635,161	7,531,988	1,862,687	22,594,563	637,404	7,776,486
C2a - C&I Existing Building Retrofit	(96,310)	(1,106,593)	35	296	-	-	246,943	2,010,116	1,356,459	16,665,470	481,822	5,963,392
C2b - C&I New & Replacement Equipment	(16,046)	(171,818)	-	-	-	-	388,218	5,521,872	506,227	5,929,093	155,581	1,813,093
C2c - C&I Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total	**244,168**	**6,356,275**	**77,688**	**1,736,476**	**-**	**-**	**68,834,856**	**517,563,307**	**3,835,062**	**41,644,229**	**1,138,140**	**10,827,480**

2020 Net Savings

Program	Deliverable Fuels				Other				Total Savings		Electric Energy, no Fuel Switching or ADR (MWh)	
	Oil (MMBTU)		Propane (MMBTU)		Wood (MMBTU)		Water (Gallons)		MMBTU			
	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
A - Residential	**377,214**	**7,486,744**	**98,824**	**2,000,678**	**-**	**-**	**58,549,095**	**416,136,014**	**1,555,326**	**14,120,807**	**355,278**	**1,558,942**
A1 - Residential New Buildings	727	16,848	23,658	559,456	-	-	-	-	60,748	1,080,005	10,639	147,344
A1a - Residential New Homes & Renovations	727	16,848	23,658	559,456	-	-	-	-	60,748	1,080,005	10,639	147,344
A2 - Residential Existing Buildings	376,488	7,469,896	75,166	1,441,223	-	-	58,549,095	416,136,014	1,494,577	13,040,802	344,639	1,411,598
A2a - Residential Coordinated Delivery	304,393	5,897,120	37,168	663,373	-	-	56,610,874	402,568,471	585,137	8,259,164	66,034	376,337
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	44,540	1,545,221	32,152	772,004	-	-	1,938,221	13,567,543	402,835	4,275,033	139,917	896,572
A2d - Residential Behavior	27,555	27,555	5,846	5,846	-	-	-	-	506,605	506,605	138,688	138,688
A2e - Residential Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-	-
B - Income Eligible	**75,114**	**1,461,291**	**7,726**	**146,230**	**-**	**-**	**9,436,848**	**92,594,171**	**200,857**	**2,823,192**	**34,299**	**353,593**
B1 - Income Eligible Existing Buildings	75,114	1,461,291	7,726	146,230	-	-	9,436,848	92,594,171	200,857	2,823,192	34,299	353,593
B1a - Income Eligible Coordinated Delivery	75,114	1,461,291	7,726	146,230	-	-	9,436,848	92,594,171	200,857	2,823,192	34,299	353,593
B1b - Income Eligible Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-	-
C - Commercial & Industrial	**(126,951)**	**(1,449,304)**	**35**	**296**	**-**	**-**	**649,834**	**7,658,659**	**2,864,202**	**41,991,446**	**912,406**	**13,063,945**
C1 - C&I New Buildings	(15,208)	(179,093)	-	-	-	-	5,249	41,991	131,596	2,157,764	45,985	725,572
C1a - C&I New Buildings & Major Renovations	(15,208)	(179,093)	-	-	-	-	5,249	41,991	131,596	2,157,764	45,985	725,572
C2 - C&I Existing Buildings	(111,744)	(1,270,212)	35	296	-	-	644,585	7,616,668	2,732,605	39,833,682	866,421	12,338,373
C2a - C&I Existing Building Retrofit	(97,286)	(1,116,970)	35	296	-	-	248,867	2,025,509	2,267,615	34,390,473	723,738	10,676,289
C2b - C&I New & Replacement Equipment	(14,457)	(153,241)	-	-	-	-	395,718	5,591,159	464,991	5,443,209	142,682	1,662,084
C2c - C&I Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total	**325,378**	**7,498,730**	**106,585**	**2,147,205**	**-**	**-**	**68,635,777**	**516,388,844**	**4,620,385**	**58,935,445**	**1,301,984**	**14,976,480**

IV.D. Cost-Effectiveness

3.2.i. Savings Summary Table

Statewide Electric
October 31, 2018

2021 Net Savings												
Program	Deliverable Fuels				Other				Total Savings		Electric Energy, no Fuel Switching or ADR (MWh)	
	Oil (MMBTU)		Propane (MMBTU)		Wood (MMBTU)		Water (Gallons)		MMBTU			
	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
A - Residential	**500,539**	**9,272,419**	**156,397**	**2,888,418**	**-**	**-**	**58,183,601**	**413,792,260**	**1,530,834**	**15,467,105**	**284,851**	**1,215,631**
A1 - Residential New Buildings	727	16,869	23,874	564,787	-	-	-	-	58,621	1,077,655	9,952	145,087
A1a - Residential New Homes & Renovations	727	16,869	23,874	564,787	-	-	-	-	58,621	1,077,655	9,952	145,087
A2 - Residential Existing Buildings	499,811	9,255,550	132,522	2,323,630	-	-	58,183,601	413,792,260	1,472,213	14,389,450	274,899	1,070,544
A2a - Residential Coordinated Delivery	316,713	6,203,562	44,663	796,747	-	-	56,248,222	400,244,608	550,700	8,641,791	51,353	380,895
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	155,544	3,024,434	82,014	1,521,037	-	-	1,935,379	13,547,652	397,629	5,223,775	79,793	545,896
A2d - Residential Behavior	27,555	27,555	5,846	5,846	-	-	-	-	523,884	523,884	143,753	143,753
A2e - Residential Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-	-
B - Income Eligible	**76,943**	**1,489,517**	**8,204**	**153,521**	**-**	**-**	**9,436,848**	**92,594,171**	**192,813**	**2,835,801**	**31,417**	**349,130**
B1 - Income Eligible Existing Buildings	76,943	1,489,517	8,204	153,521	-	-	9,436,848	92,594,171	192,813	2,835,801	31,417	349,130
B1a - Income Eligible Coordinated Delivery	76,943	1,489,517	8,204	153,521	-	-	9,436,848	92,594,171	192,813	2,835,801	31,417	349,130
B1b - Income Eligible Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-	-
C - Commercial & Industrial	**(126,570)**	**(1,443,048)**	**35**	**296**	**-**	**-**	**666,939**	**7,804,781**	**2,016,315**	**24,927,224**	**710,085**	**8,926,804**
C1 - C&I New Buildings	(15,480)	(186,374)	-	-	-	-	5,249	41,991	134,572	2,223,288	46,982	748,070
C1a - C&I New Buildings & Major Renovations	(15,480)	(186,374)	-	-	-	-	5,249	41,991	134,572	2,223,288	46,982	748,070
C2 - C&I Existing Buildings	(111,090)	(1,256,675)	35	296	-	-	661,690	7,762,791	1,881,743	22,703,936	663,103	8,178,734
C2a - C&I Existing Building Retrofit	(97,927)	(1,117,115)	35	296	-	-	258,472	2,102,345	1,449,207	17,606,859	530,565	6,624,423
C2b - C&I New & Replacement Equipment	(13,163)	(139,559)	-	-	-	-	403,218	5,660,446	432,536	5,097,077	132,538	1,554,311
C2c - C&I Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total	**450,911**	**9,318,888**	**164,635**	**3,042,235**	**-**	**-**	**68,287,388**	**514,191,213**	**3,739,963**	**43,230,131**	**1,026,352**	**10,491,565**

2019-2021 Net Savings												
Program	Deliverable Fuels				Other				Total Savings		Electric Energy, no Fuel Switching or ADR (MWh)	
	Oil (MMBTU)		Propane (MMBTU)		Wood (MMBTU)		Water (Gallons)		MMBTU			
	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
A - Residential	**1,177,123**	**23,155,918**	**325,831**	**6,489,308**	**-**	**-**	**175,492,044**	**1,247,337,429**	**4,700,498**	**43,341,566**	**1,054,406**	**4,677,544**
A1 - Residential New Buildings	2,180	50,548	71,007	1,679,178	-	-	-	-	181,862	3,222,582	31,794	436,684
A1a - Residential New Homes & Renovations	2,180	50,548	71,007	1,679,178	-	-	-	-	181,862	3,222,582	31,794	436,684
A2 - Residential Existing Buildings	1,174,943	23,105,370	254,824	4,810,130	-	-	175,492,044	1,247,337,429	4,518,636	40,118,984	1,022,612	4,240,861
A2a - Residential Coordinated Delivery	916,382	17,757,977	111,285	1,987,219	-	-	169,856,398	1,207,887,918	1,771,811	25,094,616	201,918	1,201,338
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	175,897	5,264,730	126,001	2,805,373	-	-	5,635,646	39,449,510	1,234,167	13,511,709	406,727	2,625,555
A2d - Residential Behavior	82,664	82,664	17,538	17,538	-	-	-	-	1,512,659	1,512,659	413,968	413,968
A2e - Residential Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-	-
B - Income Eligible	**224,244**	**4,367,288**	**22,972**	**435,720**	**-**	**-**	**28,310,544**	**277,782,513**	**600,406**	**8,470,966**	**102,571**	**1,065,788**
B1 - Income Eligible Existing Buildings	224,244	4,367,288	22,972	435,720	-	-	28,310,544	277,782,513	600,406	8,470,966	102,571	1,065,788
B1a - Income Eligible Coordinated Delivery	224,244	4,367,288	22,972	435,720	-	-	28,310,544	277,782,513	600,406	8,470,966	102,571	1,065,788
B1b - Income Eligible Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-	-
C - Commercial & Industrial	**(380,910)**	**(4,349,313)**	**104**	**888**	**-**	**-**	**1,955,433**	**23,023,422**	**6,894,505**	**91,997,274**	**2,309,499**	**30,552,192**
C1 - C&I New Buildings	(45,721)	(544,016)	-	-	-	-	13,997	111,975	417,470	6,865,093	142,571	2,258,600
C1a - C&I New Buildings & Major Renovations	(45,721)	(544,016)	-	-	-	-	13,997	111,975	417,470	6,865,093	142,571	2,258,600
C2 - C&I Existing Buildings	(335,189)	(3,805,297)	104	888	-	-	1,941,436	22,911,447	6,477,035	85,132,182	2,166,927	28,293,593
C2a - C&I Existing Building Retrofit	(291,523)	(3,340,679)	104	888	-	-	754,281	6,137,969	5,073,281	68,662,802	1,736,125	23,264,104
C2b - C&I New & Replacement Equipment	(43,666)	(464,619)	-	-	-	-	1,187,155	16,773,477	1,403,754	16,469,379	430,802	5,029,488
C2c - C&I Active Demand Reduction	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total	**1,020,457**	**23,173,893**	**348,908**	**6,925,916**	**-**	**-**	**205,758,021**	**1,548,143,364**	**12,195,409**	**143,809,805**	**3,466,476**	**36,295,524**

IV.D. Cost-Effectiveness

3.2.i. Savings Summary Table, Active Demand Reduction Measures

Statewide Electric
October 31, 2018

2019 Net Savings

Program	# of Participants	Electric						Total Savings	
		Annual Capacity (kW)		Electric Energy (MWh)		Electric Energy (MMBTU)		MMBTU	
		Summer	Winter	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
A - Residential	**12,532**	**9,297**	**992**	**(45)**	**(45)**	**(154)**	**(154)**	**(8)**	**(8)**
A2 - Residential Existing Buildings	12,532	9,297	992	(45)	(45)	(154)	(154)	(8)	(8)
A2e - Residential Active Demand Reduction	12,532	9,297	992	(45)	(45)	(154)	(154)	(8)	(8)
B - Income Eligible	-	-	-	-	-	-	-	-	-
B1 - Income Eligible Existing Buildings	-	-	-	-	-	-	-	-	-
B1b - Income Eligible Active Demand Reduction	-	-	-	-	-	-	-	-	-
C - Commercial & Industrial	**658**	**103,598**	**15,410**	**(147)**	**(147)**	**(500)**	**(500)**	**(81)**	**(81)**
C2 - C&I Existing Buildings	658	103,598	15,410	(147)	(147)	(500)	(500)	(81)	(81)
C2c - C&I Active Demand Reduction	658	103,598	15,410	(147)	(147)	(500)	(500)	(81)	(81)
Grand Total	**13,190**	**112,895**	**16,402**	**(192)**	**(192)**	**(654)**	**(654)**	**(88)**	**(88)**

2020 Net Savings

Program	# of Participants	Electric						Total Savings	
		Annual Capacity (kW)		Electric Energy (MWh)		Electric Energy (MMBTU)		MMBTU	
		Summer	Winter	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
A - Residential	**17,205**	**13,477**	**1,962**	**(90)**	**(90)**	**(308)**	**(308)**	**(23)**	**(23)**
A2 - Residential Existing Buildings	17,205	13,477	1,962	(90)	(90)	(308)	(308)	(23)	(23)
A2e - Residential Active Demand Reduction	17,205	13,477	1,962	(90)	(90)	(308)	(308)	(23)	(23)
B - Income Eligible	-	-	-	-	-	-	-	-	-
B1 - Income Eligible Existing Buildings	-	-	-	-	-	-	-	-	-
B1b - Income Eligible Active Demand Reduction	-	-	-	-	-	-	-	-	-
C - Commercial & Industrial	**868**	**142,861**	**32,010**	**(479)**	**(479)**	**(1,636)**	**(1,636)**	**(813)**	**(813)**
C2 - C&I Existing Buildings	868	142,861	32,010	(479)	(479)	(1,636)	(1,636)	(813)	(813)
C2c - C&I Active Demand Reduction	868	142,861	32,010	(479)	(479)	(1,636)	(1,636)	(813)	(813)
Grand Total	**18,073**	**156,338**	**33,972**	**(570)**	**(570)**	**(1,944)**	**(1,944)**	**(836)**	**(836)**

2021 Net Savings

Program	# of Participants	Electric						Total Savings	
		Annual Capacity (kW)		Electric Energy (MWh)		Electric Energy (MMBTU)		MMBTU	
		Summer	Winter	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
A - Residential	**21,264**	**17,279**	**3,006**	**(139)**	**(139)**	**(475)**	**(475)**	**(38)**	**(38)**
A2 - Residential Existing Buildings	21,264	17,279	3,006	(139)	(139)	(475)	(475)	(38)	(38)
A2e - Residential Active Demand Reduction	21,264	17,279	3,006	(139)	(139)	(475)	(475)	(38)	(38)
B - Income Eligible	-	-	-	-	-	-	-	-	-
B1 - Income Eligible Existing Buildings	-	-	-	-	-	-	-	-	-
B1b - Income Eligible Active Demand Reduction	-	-	-	-	-	-	-	-	-
C - Commercial & Industrial	**1,023**	**192,388**	**44,530**	**(812)**	**(812)**	**(2,771)**	**(2,771)**	**(1,626)**	**(1,626)**
C2 - C&I Existing Buildings	1,023	192,388	44,530	(812)	(812)	(2,771)	(2,771)	(1,626)	(1,626)
C2c - C&I Active Demand Reduction	1,023	192,388	44,530	(812)	(812)	(2,771)	(2,771)	(1,626)	(1,626)
Grand Total	**22,287**	**209,667**	**47,536**	**(951)**	**(951)**	**(3,246)**	**(3,246)**	**(1,664)**	**(1,664)**

Notes:

The above tables reflect only demand response measures in the active demand reduction core initiatives. These savings cannot be summed across years, so are shown here for each individual year.

The active demand reduction core initiatives include other, non-demand response measures such as storage that are included in the previous savings table.

IV.D. Cost-Effectiveness

3.2.ii. Savings Comparison Table - Three Year Plan vs. Previous Years

Statewide Electric

October 31, 2018

2016-2021 Net Savings																		
Sector	# of Participants	Electric						Natural Gas		Deliverable Fuels				Other		Total Savings	
		Annual Capacity (kW)		Electric Energy (MWh)		Electric Energy (MMBTU)		(Therms)		Oil (MMBTU)		Propane (MMBTU)		Water (Gallons)		MMBTU	
		Summer	Winter	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
A - Residential	**25,674,961**	**465,545**	**505,541**	**2,663,054**	**14,987,073**	**10,485,199**	**60,546,772**	**(15,667,216)**	**(93,347,331)**	**1,533,475**	**39,845,159**	**354,579**	**9,012,429**	**376,335,018**	**2,768,211,235**	**10,806,532**	**100,069,626**
2016 Evaluated	3,740,270	104,417	101,453	666,479	3,952,940	2,273,490	13,484,225	(4,877,156)	(29,675,632)	1,737	4,845,000	38,038	1,094,051	64,829,064	459,262,157	1,825,550	16,455,713
2017 Evaluated	4,470,489	115,626	113,964	447,840	2,802,740	2,576,455	16,149,845	(4,841,542)	(30,158,053)	32,085	4,181,561	(19,639)	744,480	61,475,038	454,831,101	2,104,747	18,060,081
2018 Planned	3,448,024	86,096	79,796	529,059	4,152,613	2,155,658	16,991,266	(3,128,005)	(31,262,681)	322,530	7,662,679	10,349	684,590	74,538,873	606,780,547	2,175,737	22,212,267
2019 Planned	5,657,928	61,918	81,874	408,926	1,811,873	1,395,257	6,182,111	(1,509,004)	(4,254,247)	299,370	6,396,755	70,611	1,600,212	58,759,348	417,409,154	1,614,338	13,753,653
2020 Planned	4,699,662	54,540	72,050	345,129	1,384,478	1,177,790	4,725,918	(985,023)	(925,330)	377,214	7,486,744	98,824	2,000,678	58,549,095	416,136,014	1,555,326	14,120,807
2021 Planned	3,658,588	42,950	56,405	265,620	882,430	906,548	3,013,407	(326,486)	2,928,612	500,539	9,272,419	156,397	2,888,418	58,183,601	413,792,260	1,530,834	15,467,105
B - Income Eligible	**183,070**	**40,667**	**45,772**	**200,692**	**1,963,734**	**782,296**	**7,486,625**	**137,177**	**1,824,623**	**442,353**	**8,779,972**	**35,310**	**681,226**	**45,790,855**	**385,590,355**	**1,273,676**	**17,130,285**
2016 Evaluated	30,895	6,242	8,082	41,134	352,426	140,303	1,202,092	119	833	61,649	1,246,180	4,600	94,219	4,442,269	24,939,677	206,564	2,542,574
2017 Evaluated	36,726	12,587	7,345	21,041	234,385	146,972	1,424,487	28,736	369,066	59,736	1,208,338	4,197	83,114	6,347,930	41,946,503	213,778	2,752,846
2018 Planned	32,149	6,573	8,076	38,201	344,804	152,631	1,337,339	317	2,220	96,723	1,958,166	3,542	68,173	6,690,112	40,921,662	252,928	3,363,900
2019 Planned	27,615	5,540	6,317	36,315	354,956	123,906	1,211,107	36,002	484,168	72,187	1,416,480	7,042	135,969	9,436,848	92,594,171	206,736	2,811,973
2020 Planned	27,785	5,646	6,417	33,520	341,962	114,416	1,167,254	36,002	484,168	75,114	1,461,291	7,726	146,230	9,436,848	92,594,171	200,857	2,823,192
2021 Planned	27,900	4,079	9,536	30,481	335,201	104,067	1,144,347	36,002	484,168	76,943	1,489,517	8,204	153,521	9,436,848	92,594,171	192,813	2,835,801
C - Commercial & Industrial	**127,619**	**646,825**	**590,975**	**4,279,450**	**54,145,772**	**20,813,078**	**264,970,567**	**(45,965,454)**	**(834,556,777)**	**(943,976)**	**(9,395,751)**	**9,876**	**116,346**	**(579,113)**	**(94,736,283)**	**15,282,433**	**172,235,484**
2016 Evaluated	27,243	129,764	120,883	850,423	9,868,348	3,304,247	35,513,812	(4,643,432)	(69,315,389)	(268,967)	(2,326,610)	141	1,665	3,012,483	31,156,888	2,571,078	26,257,328
2017 Evaluated	23,018	99,304	94,526	311,599	3,994,776	2,753,122	33,400,186	(6,558,572)	(132,155,541)	(117,917)	(1,422,296)	4,226	44,641	(14,071,323)	(257,993,341)	1,983,573	18,806,977
2018 Planned	25,102	107,836	108,663	807,949	9,730,582	4,826,849	50,951,918	(8,227,964)	(145,496,329)	(176,181)	(1,297,532)	5,405	69,152	8,524,294	109,076,748	3,833,276	35,173,905
2019 Planned	20,662	96,378	85,657	687,008	8,561,444	2,616,725	34,563,728	(4,753,824)	(80,284,606)	(127,389)	(1,456,960)	35	296	638,660	7,559,982	2,013,988	25,078,604
2020 Planned	16,166	120,042	97,940	912,397	13,063,882	4,511,617	72,536,234	(15,204,993)	(290,957,793)	(126,951)	(1,449,304)	35	296	649,834	7,658,659	2,864,202	41,991,446
2021 Planned	15,429	93,501	83,306	710,075	8,926,741	2,800,517	38,004,688	(6,576,668)	(116,347,119)	(126,570)	(1,443,048)	35	296	666,939	7,804,781	2,016,315	24,927,224
Grand Total	**25,985,651**	**1,153,037**	**1,142,287**	**7,143,195**	**71,096,580**	**32,080,572**	**333,003,964**	**(61,495,492)**	**(926,079,484)**	**1,031,852**	**39,229,380**	**399,765**	**9,810,001**	**421,546,760**	**3,059,065,307**	**27,362,641**	**289,435,396**
2016 Evaluated	3,798,408	240,422	230,418	1,558,036	14,173,714	5,718,040	50,200,129	(9,520,469)	(98,990,189)	(205,580)	3,764,570	42,779	1,189,934	72,283,816	515,358,722	4,603,192	45,255,614
2017 Evaluated	4,530,233	227,517	215,834	780,479	7,031,901	5,476,550	50,974,518	(11,371,378)	(161,944,528)	(26,096)	3,967,603	(11,217)	872,236	53,751,645	238,784,263	4,302,099	39,619,904
2018 Planned	3,505,275	200,505	196,535	1,375,209	14,228,000	7,135,138	69,280,522	(11,355,652)	(176,756,790)	243,072	8,323,314	19,295	821,915	89,753,279	756,778,957	6,261,940	60,750,072
2019 Planned	5,706,205	163,836	173,847	1,132,249	10,728,272	4,135,888	41,956,946	(6,226,827)	(84,054,684)	244,168	6,356,275	77,688	1,736,476	68,834,856	517,563,307	3,835,062	41,644,229
2020 Planned	4,743,613	180,227	176,406	1,291,046	14,790,322	5,803,824	78,429,406	(16,154,015)	(291,398,955)	325,378	7,498,730	106,585	2,147,205	68,635,777	516,388,844	4,620,385	58,935,445
2021 Planned	3,701,916	140,530	149,247	1,006,176	10,144,371	3,811,132	42,162,442	(6,867,152)	(112,934,339)	450,911	9,318,888	164,635	3,042,235	68,287,388	514,191,213	3,739,963	43,230,131

Notes:

2016 values are from the Program Administrator's 2016 Plan Year Report D.P.U. 17-100.

2017 values are from the Program Administrator's 2017 Plan Year Report D.P.U. 18-51.

2018 values are from the Program Administrator's 2016-2018 Three-Year Plan, D.P.U. 15-166.

For supporting information on the 2019-2021 values, see Table IV.D.3.2.i.

The Progam Administrators have developed new participant definitions through the common assumptions working group for this Three-Year Plan. Historical participant numbers may not be comparable.

IV.D. Cost-Effectiveness

3.3.iii. T&D Avoided Costs Comparison Table - Three Year Plan vs. Previous Years

Statewide Electric

October 31, 2018

National Grid Avoided Cost Factors ($/kW)		
Plan Term	**Distribution**	**Transmission**
2016 - 2018	$82.57	$10.52
2019 - 2021	$102.48	$94.00

Eversource Avoided Cost Factors ($/kW)		
Plan Term	**Distribution**	**Transmission**
2016 - 2018 NSTAR	$122.34	$36.53
2016 - 2018 WMECO	$56.02	$0.00
2019 - 2021 Eversource	$198.00	$94.00

CLC Avoided Cost Factors ($/kW)		
Plan Term	**Distribution**	**Transmission**
2016 - 2018	$122.34	$36.53
2019 - 2021	$198.00	$94.00

Unitil Avoided Cost Factors ($/kW)		
Plan Term	**Distribution**	**Transmission**
2016 - 2018	$182.58	-
2019 - 2021	$222.56	$94.00

Notes:

2016 values are from the Program Administrator's 2016 Plan Year Report D.P.U. 17-100, in 2016$.
2017 values are from the Program Administrator's 2017 Plan Year Report D.P.U. 18-51, in 2016$.
2018 values are from the Program Administrator's 2016-2018 Three-Year Plan, D.P.U. 15-166, in 2016$.

IV.H. Performance Incentive

1. Summary Table

Statewide Electric
October 31, 2018

2019 Performance Incentives					
Sector	Total Program Costs	Pre-Tax		After-Tax	
		Performance Incentives	% of Program Costs	Performance Incentives	% of Program Costs
A - Residential	260,912,913	9,089,415	3%	6,606,187	3%
B - Income Eligible	72,035,779	2,862,059	4%	2,080,145	3%
C - Commercial & Industrial	303,579,359	24,177,850	8%	17,572,462	6%
Grand Total	**636,528,050**	**36,129,325**	**6%**	**26,258,794**	**4%**

2020 Performance Incentives					
Sector	Total Program Costs	Pre-Tax		After-Tax	
		Performance Incentives	% of Program Costs	Performance Incentives	% of Program Costs
A - Residential	258,409,971	8,989,321	3%	6,533,438	3%
B - Income Eligible	74,974,931	2,808,172	4%	2,040,979	3%
C - Commercial & Industrial	337,707,550	30,978,750	9%	22,515,356	7%
Grand Total	**671,092,452**	**42,776,243**	**6%**	**31,089,773**	**5%**

2021 Performance Incentives					
Sector	Total Program Costs	Pre-Tax		After-Tax	
		Performance Incentives	% of Program Costs	Performance Incentives	% of Program Costs
A - Residential	256,941,050	9,517,210	4%	6,917,108	3%
B - Income Eligible	77,137,716	2,559,240	3%	1,860,056	2%
C - Commercial & Industrial	328,991,633	25,692,345	8%	18,673,196	6%
Grand Total	**663,070,398**	**37,768,794**	**6%**	**27,450,359**	**4%**

2019-2021 Performance Incentives					
Sector	Total Program Costs	Pre-Tax		After-Tax	
		Performance Incentives	% of Program Costs	Performance Incentives	% of Program Costs
A - Residential	776,263,934	27,595,946	4%	20,056,733	3%
B - Income Eligible	224,148,425	8,229,471	4%	5,981,180	3%
C - Commercial & Industrial	970,278,542	80,848,945	8%	58,761,013	6%
Grand Total	**1,970,690,901**	**116,674,362**	**6%**	**84,798,926**	**4%**

Notes:
Performance Incentives for each year are represented in nominal dollars (2019$, 2020$, 2021$).
For supporting information on the Performance Incentive, refer to the Performance Incentive Model.
Performance Incentives are not applicable to the Cape Light Compact.

V.B. Allocation of Funds

1. Low-Income Minimum

Statewide Electric
October 31, 2018

2019 Sector Cost Allocation		
Sector	Program Budget	
	($)	(% of Total)
A - Residential	260,912,913	41.0%
B - Income Eligible	72,035,779	11.32%
C - Commercial & Industrial	303,579,359	47.7%
Grand Total	**636,528,050**	**100%**

2020 Sector Cost Allocation		
Sector	Program Budget	
	($)	(% of Total)
A - Residential	258,409,971	38.5%
B - Income Eligible	74,974,931	11.17%
C - Commercial & Industrial	337,707,550	50.3%
Grand Total	**671,092,452**	**100%**

2021 Sector Cost Allocation		
Sector	Program Budget	
	($)	(% of Total)
A - Residential	256,941,050	38.8%
B - Income Eligible	77,137,716	11.63%
C - Commercial & Industrial	328,991,633	49.6%
Grand Total	**663,070,398**	**100%**

2019-2021 Sector Cost Allocation		
Sector	Program Budget	
	($)	(% of Total)
A - Residential	776,263,934	39.4%
B - Income Eligible	224,148,425	11.37%
C - Commercial & Industrial	970,278,542	49.2%
Grand Total	**1,970,690,901**	**100%**

Notes:
General Laws c. 25, § 19(c) requires that at least 10 percent of the amount expended for electric energy efficiency programs and at least 20 percent of the amount expended for gas energy efficiency programs be spent on low-income programs.

V.D. Outsourced/Competitively Procured Services

1. Summary Table

Statewide Electric

October 31, 2018

2019-2021 Competitively Procured Services										
Sector	Competitively Procured Services Costs ($)					Competitively Procured Services Costs as a Percent of Total Sector Costs (%)				
	Total Cost of Services	In-House Activities	Outsourced Activities			Total Cost of Services	In-House Activities	Outsourced Activities		
			Total Outsourced	Competitively Procured	Non-Competitively Procured			Total Outsourced	Competitively Procured	Non-Competitively Procured
2019	**169,513,815**	**38,531,618**	**130,982,198**	**108,113,178**	**22,869,020**	**100%**	**23%**	**77%**	**64%**	**13%**
A - Residential	84,518,000	9,774,394	74,743,606	69,767,560	4,976,046	100%	12%	88%	83%	6%
B - Income Eligible	19,052,005	2,171,123	16,880,883	4,158,158	12,722,724	100%	11%	89%	22%	67%
C - Commercial & Industrial	65,943,810	26,586,101	39,357,709	34,187,459	5,170,250	100%	40%	60%	52%	8%
2020	**176,098,061**	**40,138,189**	**135,959,872**	**112,942,705**	**23,017,167**	**100%**	**23%**	**77%**	**64%**	**13%**
A - Residential	86,305,396	9,724,553	76,580,843	71,625,527	4,955,316	100%	11%	89%	83%	6%
B - Income Eligible	19,864,481	2,227,681	17,636,800	4,941,571	12,695,229	100%	11%	89%	25%	64%
C - Commercial & Industrial	69,928,183	28,185,955	41,742,229	36,375,608	5,366,621	100%	40%	60%	52%	8%
2021	**181,225,753**	**41,911,188**	**139,314,566**	**115,659,605**	**23,654,961**	**100%**	**23%**	**77%**	**64%**	**13%**
A - Residential	88,298,393	10,274,042	78,024,352	72,964,977	5,059,374	100%	12%	88%	83%	6%
B - Income Eligible	20,973,257	2,360,005	18,613,252	5,647,881	12,965,371	100%	11%	89%	27%	62%
C - Commercial & Industrial	71,954,103	29,277,141	42,676,962	37,046,746	5,630,216	100%	41%	59%	51%	8%
Grand Total	**526,837,630**	**120,580,995**	**406,256,635**	**336,715,487**	**69,541,148**	**100%**	**23%**	**77%**	**64%**	**13%**
A - Residential	259,121,790	29,772,989	229,348,801	214,358,064	14,990,737	100%	11%	89%	83%	6%
B - Income Eligible	59,889,744	6,758,809	53,130,934	14,747,610	38,383,324	100%	11%	89%	25%	64%
C - Commercial & Industrial	207,826,097	84,049,196	123,776,900	107,609,813	16,167,087	100%	40%	60%	52%	8%

Notes:

General Laws c. 25, § 19(b) requires the Department to ensure that energy efficiency programs use competitive procurement processes to the fullest extent practicable.

Costs for the Competitively Procured Services analysis include Program Planning and Administration; Marketing and Advertising; Sales, Technical Assistance & Training; and Evaluation and Market Research.

Costs for each year in 2016-2018 are represented in nominal dollars (2016$, 2017$, 2018$).

V.D. Outsourced/Competitively Procured Services

3. Comparison Table - Three Year Plan vs. Previous Years

Statewide Electric

October 31, 2018

2016-2021 Competitively Procured Services										
Sector	Competitively Procured Services Costs ($)					Competitively Procured Services Costs as a Percent of Total Sector Costs (%)				
	Total Cost of Services	In-House Activities	Outsourced Activities			Total Cost of Services	In-House Activities	Outsourced Activities		
			Total Outsourced	Competitively Procured	Non-Competitively Procured			Total Outsourced	Competitively Procured	Non-Competitively Procured
A - Residential	**448,170,850**	**58,499,793**	**389,671,057**	**368,224,171**	**21,446,886**	**100%**	**13%**	**87%**	**82%**	**5%**
2016	71,344,067	9,263,484	62,080,583	59,958,001	2,122,582	100%	13%	87%	84%	3%
2017	73,647,988	9,558,901	64,089,086	61,939,685	2,149,401	100%	13%	87%	84%	3%
2018	44,057,005	9,904,418	34,152,587	31,968,420	2,184,167	100%	22%	78%	73%	5%
2019	84,518,000	9,774,394	74,743,606	69,767,560	4,976,046	100%	12%	88%	83%	6%
2020	86,305,396	9,724,553	76,580,843	71,625,527	4,955,316	100%	11%	89%	83%	6%
2021	88,298,393	10,274,042	78,024,352	72,964,977	5,059,374	100%	12%	88%	83%	6%
B - Income Eligible	**115,133,506**	**12,910,828**	**102,222,677**	**28,198,260**	**74,024,418**	**100%**	**11%**	**89%**	**24%**	**64%**
2016	18,437,175	2,009,676	16,427,499	4,462,571	11,964,928	100%	11%	89%	24%	65%
2017	18,345,637	2,051,530	16,294,107	4,485,688	11,808,419	100%	11%	89%	24%	64%
2018	18,460,950	2,090,813	16,370,138	4,502,391	11,867,747	100%	11%	89%	24%	64%
2019	19,052,005	2,171,123	16,880,883	4,158,158	12,722,724	100%	11%	89%	22%	67%
2020	19,864,481	2,227,681	17,636,800	4,941,571	12,695,229	100%	11%	89%	25%	64%
2021	20,973,257	2,360,005	18,613,252	5,647,881	12,965,371	100%	11%	89%	27%	62%
C - Commercial & Industrial	**423,573,447**	**157,886,539**	**265,686,908**	**225,565,028**	**40,121,880**	**100%**	**37%**	**63%**	**53%**	**9%**
2016	70,462,231	23,906,773	46,555,458	38,738,427	7,817,031	100%	34%	66%	55%	11%
2017	72,345,439	24,536,728	47,808,711	39,869,547	7,939,164	100%	34%	66%	55%	11%
2018	72,939,680	25,393,841	47,545,839	39,347,242	8,198,597	100%	35%	65%	54%	11%
2019	65,943,810	26,586,101	39,357,709	34,187,459	5,170,250	100%	40%	60%	52%	8%
2020	69,928,183	28,185,955	41,742,229	36,375,608	5,366,621	100%	40%	60%	52%	8%
2021	71,954,103	29,277,141	42,676,962	37,046,746	5,630,216	100%	41%	59%	51%	8%
Grand Total	**986,877,802**	**229,297,160**	**757,580,642**	**621,987,459**	**135,593,183**	**100%**	**23%**	**77%**	**63%**	**14%**
2016	160,243,473	35,179,934	125,063,539	103,158,999	21,904,540	100%	22%	78%	64%	14%
2017	164,339,064	36,147,160	128,191,904	106,294,920	21,896,984	100%	22%	78%	65%	13%
2018	135,457,636	37,389,072	98,068,564	75,818,053	22,250,511	100%	28%	72%	56%	16%
2019	169,513,815	38,531,618	130,982,198	108,113,178	22,869,020	100%	23%	77%	64%	13%
2020	176,098,061	40,138,189	135,959,872	112,942,705	23,017,167	100%	23%	77%	64%	13%
2021	181,225,753	41,911,188	139,314,566	115,659,605	23,654,961	100%	23%	77%	64%	13%

Notes:

General Laws c. 25, § 19(b) requires the Department to ensure that energy efficiency programs use competitive procurement processes to the fullest extent practicable.

Costs for the Competitively Procured Services analysis include Program Planning and Administration; Marketing and Advertising; Sales, Technical Assistance & Training; and Evaluation and Market Research.

The 2016-2018 costs are from the Program Administrator's 2016-2018 Three-Year Plan, D.P.U. 15-166, in nominal dollars (2016$, 2017$, 2018$).

For supporting information on the 2019-2021 values, see Table V.D.1. Costs for each year are represented in nominal dollars (2019$, 2020$, 2021$).

VII. Appendix

B.2. Summary of Activities

Statewide Electric
October 31, 2018

2019-2021 Summary								
Sector	Net Annual Savings							
	Summer Capacity (kW)	Electric Energy (MWh)	Natural Gas (Therms)	Oil (MMBTU)	Propane (MMBTU)	Wood (MMBTU)	Water (Gallons)	Total Savings (MMBTU)
2019	**163,836**	**1,132,249**	**(6,226,827)**	**244,168**	**77,688**	**-**	**68,834,856**	**3,835,062**
A - Residential	61,918	408,926	(1,509,004)	299,370	70,611	-	58,759,348	1,614,338
B - Income Eligible	5,540	36,315	36,002	72,187	7,042	-	9,436,848	206,736
C - Commercial & Industrial	96,378	687,008	(4,753,824)	(127,389)	35	-	638,660	2,013,988
2020	**180,227**	**1,291,046**	**(16,154,015)**	**325,378**	**106,585**	**-**	**68,635,777**	**4,620,385**
A - Residential	54,540	345,129	(985,023)	377,214	98,824	-	58,549,095	1,555,326
B - Income Eligible	5,646	33,520	36,002	75,114	7,726	-	9,436,848	200,857
C - Commercial & Industrial	120,042	912,397	(15,204,993)	(126,951)	35	-	649,834	2,864,202
2021	**140,530**	**1,006,176**	**(6,867,152)**	**450,911**	**164,635**	**-**	**68,287,388**	**3,739,963**
A - Residential	42,950	265,620	(326,486)	500,539	156,397	-	58,183,601	1,530,834
B - Income Eligible	4,079	30,481	36,002	76,943	8,204	-	9,436,848	192,813
C - Commercial & Industrial	93,501	710,075	(6,576,668)	(126,570)	35	-	666,939	2,016,315
Grand Total	**484,592**	**3,429,471**	**(29,247,994)**	**1,020,457**	**348,908**	**-**	**205,758,021**	**12,195,409**
A - Residential	159,407	1,019,675	(2,820,513)	1,177,123	325,831	-	175,492,044	4,700,498
B - Income Eligible	15,265	100,316	108,005	224,244	22,972	-	28,310,544	600,406
C - Commercial & Industrial	309,921	2,309,480	(26,535,485)	(380,910)	104	-	1,955,433	6,894,505

2019-2021 Summary									
Sector	TRC Benefits (2019$)						TRC Costs (2019$)		
	Capacity	Electric Energy	Natural Gas	Deliverable Fuels & Other	Non-Energy Impacts	Total Benefits	PA Budget	Participant Costs	Total TRC Test Costs
2019	**545,527,616**	**1,072,112,248**	**(99,288,899)**	**238,239,727**	**322,046,635**	**2,078,637,327**	**672,657,376**	**230,954,766**	**903,612,142**
A - Residential	100,699,214	201,468,837	(7,764,757)	226,462,484	53,786,669	574,652,448	270,002,328	48,691,193	318,693,522
B - Income Eligible	17,660,944	35,476,163	603,959	42,465,985	76,031,805	172,238,856	74,897,838	140	74,897,978
C - Commercial & Industrial	427,167,458	835,167,247	(92,128,102)	(30,688,742)	192,228,161	1,331,746,023	327,757,209	182,263,433	510,020,642
2020	**761,636,425**	**1,425,189,341**	**(325,102,038)**	**253,742,437**	**255,699,217**	**2,371,165,381**	**697,614,283**	**242,110,292**	**939,724,574**
A - Residential	102,230,062	149,891,914	(2,820,361)	271,199,925	50,668,198	571,169,738	261,310,751	53,464,308	314,775,060
B - Income Eligible	21,498,808	33,522,140	592,775	44,611,039	72,284,493	172,509,254	76,012,023	137	76,012,160
C - Commercial & Industrial	637,907,555	1,241,775,287	(322,874,452)	(62,068,527)	132,746,526	1,627,486,389	360,291,509	188,645,846	548,937,355
2021	**581,043,609**	**985,067,745**	**(124,598,431)**	**335,831,367**	**303,516,743**	**2,080,861,032**	**669,287,066**	**266,003,510**	**935,290,575**
A - Residential	96,105,287	94,528,701	2,696,405	352,879,270	46,671,762	592,881,426	254,462,177	69,021,169	323,483,346
B - Income Eligible	16,908,777	32,546,611	581,054	46,276,713	66,661,648	162,974,803	76,108,959	134	76,109,093
C - Commercial & Industrial	468,029,544	857,992,433	(127,875,890)	(63,324,616)	190,183,334	1,325,004,803	338,715,930	196,982,207	535,698,136
Grand Total	**1,888,207,650**	**3,482,369,333**	**(548,989,368)**	**827,813,532**	**881,262,595**	**6,530,663,740**	**2,039,558,724**	**739,068,568**	**2,778,627,292**
A - Residential	299,034,564	445,889,453	(7,888,712)	850,541,679	151,126,630	1,738,703,612	785,775,256	171,176,671	956,951,927
B - Income Eligible	56,068,529	101,544,914	1,777,788	133,353,738	214,977,945	507,722,913	227,018,820	411	227,019,231
C - Commercial & Industrial	1,533,104,557	2,934,934,967	(542,878,444)	(156,081,885)	515,158,020	4,284,237,214	1,026,764,648	567,891,486	1,594,656,133

VII. Appendix

B.2. Summary of Activities

Statewide Electric
October 31, 2018

2019-2021 Summary											
Sector	TRC Cost-Effectiveness		Cost of Saved Energy (PA Budget per annual savings unit)				Participants	Avg Measure Life (yrs.)	Annual Emissions Reductions (Short Tons)		
	B/C Ratio	Net Benefits	Summer Capacity ($/kW)	Electric Energy ($/MWh)	Natural Gas Costs ($/Therm)	Total Savings ($/MMBTU)			NOX	SO2	CO2
2019	**2.30**	**1,175,025,185**	**4,106**	**594**	**(108)**	**175**	**5,706,205**	**11**	**243.47**	**62.83**	**684,472**
A - Residential	1.80	255,958,926	4,361	660	(179)	167	5,657,928	9	111.55	28.79	323,292
B - Income Eligible	2.30	97,340,878	13,519	2,062	2,080	362	27,615	14	5.97	1.54	24,465
C - Commercial & Industrial	2.61	821,725,381	3,401	477	(69)	163	20,662	12	125.95	32.50	336,715
2020	**2.52**	**1,431,440,807**	**3,871**	**540**	**(43)**	**151**	**4,743,613**	**13**	**268.93**	**69.40**	**710,977**
A - Residential	1.81	256,394,679	4,791	757	(265)	168	4,699,662	9	95.92	24.75	292,271
B - Income Eligible	2.27	96,497,094	13,464	2,268	2,111	378	27,785	14	5.51	1.42	23,368
C - Commercial & Industrial	2.96	1,078,549,034	3,001	395	(24)	126	16,166	15	167.50	43.23	395,338
2021	**2.22**	**1,145,570,456**	**4,763**	**665**	**(97)**	**179**	**3,701,916**	**12**	**206.79**	**53.37**	**609,343**
A - Residential	1.83	269,398,080	5,925	958	(779)	166	3,658,588	10	68.60	17.70	240,428
B - Income Eligible	2.14	86,865,710	18,661	2,497	2,114	395	27,900	15	5.01	1.29	22,048
C - Commercial & Industrial	2.47	789,306,667	3,623	477	(52)	168	15,429	12	133.18	34.37	346,867
Grand Total	**2.35**	**3,752,036,448**	**4,209**	**595**	**(70)**	**167**	**14,151,735**	**12**	**719.19**	**185.60**	**2,004,792**
A - Residential	1.82	781,751,685	5,026	792	(408)	167	14,016,177	9	276.08	71.25	855,991
B - Income Eligible	2.24	280,703,682	15,214	2,276	2,102	378	83,300	14	16.49	4.26	69,881
C - Commercial & Industrial	2.68	2,689,581,081	3,342	450	(48)	152	52,257	13	426.63	110.10	1,078,920

Notes:
GHG reductions are provided for information purposes only. They are not included in the TRC test.

VII. Appendix

GHG reductions are provided for information purposes only. They are not included in the TRC test.

Statewide Electric

October 31, 2018

2019 Greenhouse Gas Reductions							
Sector	Adjusted Gross Annual Savings				Annual Emissions Reductions (Short Tons)		
	Electric Energy (MWh)	Natural Gas (Therm)	Oil (MMBTU)	Propane (MMBTU)	NOX	SO2	CO2
A - Residential	678,653	(4,180,493)	125,188	34,368	111.55	28.79	323,292
B - Income Eligible	36,315	36,002	72,187	7,042	5.97	1.54	24,465
C - Commercial & Industrial	766,271	(5,170,047)	(143,510)	32	125.95	32.50	336,715
Grand Total	**1,481,239**	**(9,314,539)**	**53,865**	**41,442**	**243.47**	**62.83**	**684,472**

2020 Greenhouse Gas Reductions							
Sector	Adjusted Gross Annual Savings				Annual Emissions Reductions (Short Tons)		
	Electric Energy (MWh)	Natural Gas (Therm)	Oil (MMBTU)	Propane (MMBTU)	NOX	SO2	CO2
A - Residential	583,586	(3,293,390)	227,811	69,885	95.92	24.75	292,271
B - Income Eligible	33,520	36,002	75,114	7,726	5.51	1.42	23,368
C - Commercial & Industrial	1,019,059	(16,492,889)	(143,707)	32	167.50	43.23	395,338
Grand Total	**1,636,165**	**(19,750,277)**	**159,218**	**77,643**	**268.93**	**69.40**	**710,977**

2021 Greenhouse Gas Reductions							
Sector	Adjusted Gross Annual Savings				Annual Emissions Reductions (Short Tons)		
	Electric Energy (MWh)	Natural Gas (Therm)	Oil (MMBTU)	Propane (MMBTU)	NOX	SO2	CO2
A - Residential	417,370	(1,655,590)	417,003	147,770	68.60	17.70	240,428
B - Income Eligible	30,481	36,002	76,943	8,204	5.01	1.29	22,048
C - Commercial & Industrial	810,232	(7,135,905)	(144,308)	32	133.18	34.37	346,867
Grand Total	**1,258,082**	**(8,755,494)**	**349,637**	**156,006**	**206.79**	**53.37**	**609,343**

2019-2021 Greenhouse Gas Reductions							
Sector	Adjusted Gross Annual Savings				Annual Emissions Reductions (Short Tons)		
	Electric Energy (MWh)	Natural Gas (Therm)	Oil (MMBTU)	Propane (MMBTU)	NOX	SO2	CO2
A - Residential	1,679,608	(9,129,473)	770,002	252,023	276.08	71.25	855,991
B - Income Eligible	100,316	108,005	224,244	22,972	16.49	4.26	69,881
C - Commercial & Industrial	2,595,562	(28,798,841)	(431,525)	96	426.63	110.10	1,078,920
Grand Total	**4,375,486**	**(37,820,310)**	**562,721**	**275,091**	**719.19**	**185.60**	**2,004,792**

Notes:

The Program Administrators have worked with DEP to properly capture the full impact of energy efficiency measures on GHG emissions. These reductions are calculated using factors prepared by DEP, which are based on adjusted gross annual electric energy, natural gas, oil, and propane savings. For projected emissions reductions in future years for the electric sector, Program Administrators are using values that are consistent with the values used in the Massachusetts Clean Energy and Climate Plan for 2020, as provided by DEP.

Energy Efficiency Data Tables

Overview

Statewide Gas
October 31, 2018

DATA OVERVIEW

The following data tables provide a summary of the Program Administrator's benefits, costs, savings, and cost-effectiveness for 2016 through 2021. The 2016 through 2018 planned values are consistent with each Program Administrator's 2016-2018 Three-Year Plan. The 2016 and 2017 evaluated values are consistent with each Program Administrator's 2016 and 2017 Plan-Year Reports. The 2018 year-to-date data represents the most up-to-date estimated actual values available through August 2018. The 2019-2021 planned values are consistent with each Program Administrator's 2019-2021 Three-Year Plan.

SUPPORTING INFORMATION

The data included in these tables is based on other supporting models. The primary supporting models used by the Program Administrators are the Benefit-Cost Screening model, each Program Administrator's EES calculation support documents, and the Performance Incentive model. These exhibits should be referenced when looking for more detailed analyses, such as measure level detail and EES calculations. High-level summaries for each of these models are provided below, along with information on plan details that are not summarized in the following plan tables.

Benefit-Cost Screening Models

The Benefit-Cost Screening model provides measure level savings and benefits. This model uses the avoided cost values from the 2018 Avoided Energy Supply Cost study prepared by Synapse Energy Economics.

EES Calculations

Each Program Administrator's Energy Efficiency Surcharge analysis provides supporting information on the EES rates proposed for effect in 2019-2021, including how the rates are calculated for each customer sector, and how revenue is collected from each customer sector.

Performance Incentive Model

The Performance Incentive model filed as part of the Joint Statewide Three-Year Plan provides support for the performance incentive dollars proposed for collection by the Program Administrator. Note that performance incentives are not applicable to the Cape Light Compact.

EM&V Activities

The Evaluation, Monitoring & Verification Section of the Joint Statewide Three-Year Plan describes in detail the EM&V activities planned for 2019-2021.

Other Funding

For the electric Program Administrators, "Other Funding" are those funds, private or public utility administered or otherwise, that may be available for energy efficiency or demand resources and do not include SBC Funds, FCM Revenue, or RGGI Proceeds. The electric Program Administrators assume no other funding sources for 2019-2021.

2019-2021 Plan Data Tables

Template Version: October 25, 2018

PA-Specific Information

PA FILING

Distribution Company	Electric
Program Administrator	Statewide Gas
Date of Filing/Draft	October 31, 2018

PLAN FILINGS

Reporting Period	Filing Date	DPU Docket #
2016 Planned	December 21, 2015	D.P.U. 15-166
2016 Evaluated	May 1, 2017	D.P.U. 17-100
2017 Planned	December 21, 2015	D.P.U. 15-166
2017 Evaluated	June 8, 2018	D.P.U. 18-51
2018 Planned	December 21, 2015	D.P.U. 15-166
2018 YTD	August 2018	
2019 Planned	October 31, 2018	D.P.U. 18-116
2020 Planned	October 31, 2018	D.P.U. 18-116
2021 Planned	October 31, 2018	D.P.U. 18-116

RATES FOR ADJUSTMENTS

2017 Nominal Discount Rate	2.54%	
2018 Nominal Discount Rate	2.54%	
2020 Nominal Discount Rate	2.33%	
2021 Nominal Discount Rate	2.33%	
Effective Tax Rate	27.32%	PA-specific
MWh to MMBTU conversion	3.412	(1 MWh = 3.412 MMBTU)

PLAN YEARS

Previous Plan Year 1	2016
Previous Plan Year 2	2017
Previous Plan Year 3	2018
Current Plan Year 1	2019
Current Plan Year 2	2020
Current Plan Year 3	2021

GHG EMISSIONS REDUCTION FACTORS (Short Tons)

GHG per:	NOX	SO2	CO2
Electricity (MWh)	0.00016	0.00004	0.49400
Gas (Therm)			0.00585
Oil (MMBTU)			0.08069
Propane (MMBTU)			0.06959
Source:	File named "3-year plan EFs 8-9-		

IV.B. Gas PA Funding Sources

1. Summary Table

Statewide Gas

October 31, 2018

2019 Gas Ratepayer Funds				
Sector	**Total Program Costs**	**Performance Incentives**	**Lost Base Revenues**	**Total Ratepayer Funds**
A - Residential	147,588,046	3,451,754		151,039,800
B - Income Eligible	57,508,453	1,225,210		58,733,662
C - Commercial & Industrial	54,397,556	2,964,553		57,362,109
Grand Total	**259,494,054**	**7,641,517**		**267,135,572**

2020 Gas Ratepayer Funds				
Sector	**Total Program Costs**	**Performance Incentives**	**Lost Base Revenues**	**Total Ratepayer Funds**
A - Residential	152,940,025	3,524,957		156,464,982
B - Income Eligible	58,175,586	1,262,904		59,438,491
C - Commercial & Industrial	56,062,703	3,035,014		59,097,718
Grand Total	**267,178,315**	**7,822,875**		**275,001,190**

2021 Gas Ratepayer Funds				
Sector	**Total Program Costs**	**Performance Incentives**	**Lost Base Revenues**	**Total Ratepayer Funds**
A - Residential	156,849,931	3,664,227		160,514,157
B - Income Eligible	58,812,408	1,303,296		60,115,705
C - Commercial & Industrial	57,140,896	3,109,855		60,250,751
Grand Total	**272,803,235**	**8,077,378**		**280,880,613**

2019-2021 Gas Ratepayer Funds				
Sector	**Total Program Costs**	**Performance Incentives**	**Lost Base Revenues**	**Total Ratepayer Funds**
A - Residential	457,378,001	10,640,938		468,018,939
B - Income Eligible	174,496,448	3,791,410		178,287,858
C - Commercial & Industrial	167,601,155	9,109,422		176,710,578
Grand Total	**799,475,604**	**23,541,770**		**823,017,374**

Notes:

Ratepayer funds for each year are represented in nominal dollars (2019$, 2020$, 2021$).

Berkshire Gas is the only gas Program Administrator that will collect Lost Base Revenue (LBR) during the Three-Year Plan term. All other gas Program Administrators have a revenue decoupling mechanism in place and do not estimate LBR.

IV.C. Program Administrator Budgets

1. Summary Table

Statewide Gas
October 31, 2018

2019 Program Administrator Budget										
Program	Program Costs						Performance Incentive	Total Program Administrator Budget	Program Cost per Participant	Resource Benefit per Program Cost
	Program Planning and Administration	Marketing and Advertising	Participant Incentive	Sales, Technical Assistance & Training	Evaluation and Market Research	Total Program Costs				
A - Residential	**5,647,705**	**5,441,265**	**101,194,976**	**32,145,723**	**3,158,376**	**147,588,046**	**3,451,754**	**151,039,800**	**195**	**1.63**
A1 - Residential New Buildings	380,676	88,047	10,295,163	1,084,619	-	11,848,505	505,070	12,353,575	1,700	2.64
A1a - Residential New Homes & Renovations	380,676	88,047	10,295,163	1,084,619	-	11,848,505	505,070	12,353,575	1,700	2.64
A2 - Residential Existing Buildings	4,052,631	3,821,991	89,632,334	30,535,059	-	128,042,016	2,946,685	130,988,701	171	1.64
A2a - Residential Coordinated Delivery	2,092,938	1,467,098	59,822,188	9,285,250	-	72,667,474	2,083,272	74,750,746	1,195	2.00
A2b - Residential Conservation Services (RCS)	800,260	1,026,566	-	15,661,126	-	17,487,952	-	17,487,952		-
A2c - Residential Retail	969,265	1,298,980	29,810,147	1,548,208	-	33,626,600	759,290	34,385,890	723	1.61
A2d - Residential Behavior	190,168	29,347	-	4,040,475	-	4,259,990	104,123	4,364,113	7	2.39
A3 - Residential Hard-to-Measure	1,214,397	1,531,227	1,267,480	526,045	3,158,376	7,697,524	-	7,697,524		
A3a - Residential Statewide Marketing	1,169	1,303,184	-	-	-	1,304,353	-	1,304,353		
A3b - Residential Statewide Database	61,258	-	-	-	-	61,258	-	61,258		
A3c - Residential DOER Assessment	738,647	-	-	-	-	738,647	-	738,647		
A3d - Residential Sponsorships & Subscriptions	54,796	11,999	-	687	5,000	72,481	-	72,481		
A3e - Residential Workforce Development	-	-	-	243,520	-	243,520	-	243,520		
A3f - Residential Evaluation and Market Research	-	-	-	-	3,153,376	3,153,376	-	3,153,376		
A3g - Residential EEAC Consultants	326,051	-	-	-	-	326,051	-	326,051		
A3h - Residential R&D and Demonstration	25,143	-	-	121,822	-	146,965	-	146,965		
A3i - Residential HEAT Loan	7,333	53,118	1,267,480	141,967	-	1,469,897	-	1,469,897		
A3j - Residential Education	-	162,926	-	18,050	-	180,976	-	180,976		
B - Income Eligible	**2,267,045**	**927,893**	**43,530,217**	**9,502,105**	**1,281,192**	**57,508,453**	**1,225,210**	**58,733,662**	**3,257**	**1.02**
B1 - Income Eligible Existing Buildings	1,727,621	726,221	43,530,217	9,473,025	-	55,457,083	1,225,210	56,682,293	3,140	1.06
B1a - Income Eligible Coordinated Delivery	1,727,621	726,221	43,530,217	9,473,025	-	55,457,083	1,225,210	56,682,293	3,140	1.06
B2 - Income Eligible Hard-to-Measure	539,425	201,672	-	29,081	1,281,192	2,051,369	-	2,051,369		
B2a - Income Eligible Statewide Marketing	1,253	199,444	-	-	-	200,697	-	200,697		
B2b - Income Eligible Statewide Database	18,887	-	-	-	-	18,887	-	18,887		
B2c - Income Eligible DOER Assessment	288,544	-	-	-	-	288,544	-	288,544		
B2d - Income Eligible Sponsorships & Subscriptions	19,191	2,228	-	273	-	21,691	-	21,691		
B2e - Income Eligible Workforce Development	-	-	-	28,808	-	28,808	-	28,808		
B2f - Income Eligible Evaluation and Market Research	-	-	-	-	1,281,192	1,281,192	-	1,281,192		
B2g - Income Eligible Energy Affordability Network	211,550	-	-	-	-	211,550	-	211,550		
C - Commercial & Industrial	**2,687,319**	**2,694,317**	**33,998,678**	**12,707,500**	**2,309,741**	**54,397,556**	**2,964,553**	**57,362,109**	**7,402**	**4.17**
C1 - C&I New Buildings	356,597	521,993	6,195,342	1,748,216	-	8,822,148	606,091	9,428,239	13,089	5.39
C1a - C&I New Buildings & Major Renovations	356,597	521,993	6,195,342	1,748,216	-	8,822,148	606,091	9,428,239	13,089	5.39
C2 - C&I Existing Buildings	1,827,206	1,885,179	27,803,336	10,536,910	-	42,052,631	2,358,462	44,411,093	6,300	4.26
C2a - C&I Existing Building Retrofit	1,252,008	1,475,214	19,692,864	7,129,048	-	29,549,133	1,717,693	31,266,826	7,078	4.25
C2b - C&I New & Replacement Equipment	575,198	409,965	8,110,472	3,407,862	-	12,503,497	640,769	13,144,267	5,000	4.28
C3 - C&I Hard-to-Measure	503,516	287,146	-	422,375	2,309,741	3,522,778	-	3,522,778		
C3a - C&I Statewide Marketing	2,650	278,678	-	-	-	281,328	-	281,328		
C3b - C&I Statewide Database	13,824	-	-	-	-	13,824	-	13,824		
C3c - C&I DOER Assessment	341,665	-	-	-	-	341,665	-	341,665		
C3d - C&I Sponsorships & Subscriptions	30,809	8,468	-	188	5,000	44,465	-	44,465		
C3e - C&I Workforce Development	-	-	-	133,690	-	133,690	-	133,690		
C3f - C&I Evaluation and Market Research	-	-	-	-	2,304,741	2,304,741	-	2,304,741		
C3g - C&I EEAC Consultants	78,996	-	-	-	-	78,996	-	78,996		
C3h - C&I R&D and Demonstration	35,572	-	-	288,496	-	324,068	-	324,068		
Grand Total	**10,602,070**	**9,063,475**	**178,723,872**	**54,355,329**	**6,749,309**	**259,494,054**	**7,641,517**	**267,135,572**	**332**	**2.03**

IV.C. Program Administrator Budgets

1. Summary Table

Statewide Gas
October 31, 2018

2020 Program Administrator Budget										
Program	Program Costs						Performance Incentive	Total Program Administrator Budget	Program Cost per Participant	Resource Benefit per Program Cost
	Program Planning and Administration	Marketing and Advertising	Participant Incentive	Sales, Technical Assistance & Training	Evaluation and Market Research	Total Program Costs				
A - Residential	**5,882,480**	**5,553,653**	**103,626,121**	**34,480,705**	**3,397,066**	**152,940,025**	**3,524,957**	**156,464,982**	**204**	**1.57**
A1 - Residential New Buildings	387,633	89,158	10,461,360	950,236	-	11,888,387	520,615	12,409,001	1,674	2.62
A1a - Residential New Homes & Renovations	387,633	89,158	10,461,360	950,236	-	11,888,387	520,615	12,409,001	1,674	2.62
A2 - Residential Existing Buildings	4,235,726	3,921,128	91,887,282	32,968,715	-	133,012,851	3,004,342	136,017,193	179	1.57
A2a - Residential Coordinated Delivery	2,180,182	1,517,976	63,293,058	9,622,797	-	76,614,013	2,152,096	78,766,109	1,222	1.91
A2b - Residential Conservation Services (RCS)	866,882	1,071,933	-	17,191,406	-	19,130,221	-	19,130,221		-
A2c - Residential Retail	964,078	1,288,703	28,594,224	1,530,738	-	32,377,743	737,981	33,115,723	703	1.60
A2d - Residential Behavior	224,584	42,517	-	4,623,773	-	4,890,874	114,265	5,005,139	8	2.26
A3 - Residential Hard-to-Measure	1,259,122	1,543,366	1,277,480	561,754	3,397,066	8,038,787	-	8,038,787		
A3a - Residential Statewide Marketing	1,169	1,305,110	-	-	-	1,306,279	-	1,306,279		
A3b - Residential Statewide Database	61,309	-	-	-	-	61,309	-	61,309		
A3c - Residential DOER Assessment	770,406	-	-	-	-	770,406	-	770,406		
A3d - Residential Sponsorships & Subscriptions	61,245	12,184	-	707	5,000	79,136	-	79,136		
A3e - Residential Workforce Development	-	-	-	253,879	-	253,879	-	253,879		
A3f - Residential Evaluation and Market Research	-	-	-	-	3,392,066	3,392,066	-	3,392,066		
A3g - Residential EEAC Consultants	332,740	-	-	-	-	332,740	-	332,740		
A3h - Residential R&D and Demonstration	25,344	-	-	145,748	-	171,093	-	171,093		
A3i - Residential HEAT Loan	6,908	58,261	1,277,480	142,673	-	1,485,322	-	1,485,322		
A3j - Residential Education	-	167,812	-	18,746	-	186,559	-	186,559		
B - Income Eligible	**2,307,648**	**949,086**	**43,836,113**	**9,726,317**	**1,356,422**	**58,175,586**	**1,262,904**	**59,438,491**	**2,584**	**1.01**
B1 - Income Eligible Existing Buildings	1,759,516	747,224	43,836,113	9,692,167	-	56,035,021	1,262,904	57,297,925	2,489	1.05
B1a - Income Eligible Coordinated Delivery	1,759,516	747,224	43,836,113	9,692,167	-	56,035,021	1,262,904	57,297,925	2,489	1.05
B2 - Income Eligible Hard-to-Measure	548,132	201,862	-	34,150	1,356,422	2,140,566	-	2,140,566		
B2a - Income Eligible Statewide Marketing	1,263	199,580	-	-	-	200,843	-	200,843		
B2b - Income Eligible Statewide Database	18,869	-	-	-	-	18,869	-	18,869		
B2c - Income Eligible DOER Assessment	295,136	-	-	-	-	295,136	-	295,136		
B2d - Income Eligible Sponsorships & Subscriptions	19,831	2,282	-	281	-	22,395	-	22,395		
B2e - Income Eligible Workforce Development	-	-	-	33,868	-	33,868	-	33,868		
B2f - Income Eligible Evaluation and Market Research	-	-	-	-	1,356,422	1,356,422	-	1,356,422		
B2g - Income Eligible Energy Affordability Network	213,032	-	-	-	-	213,032	-	213,032		
C - Commercial & Industrial	**2,777,059**	**2,842,190**	**34,782,432**	**13,245,474**	**2,415,548**	**56,062,703**	**3,035,014**	**59,097,718**	**7,506**	**4.04**
C1 - C&I New Buildings	369,535	528,086	6,280,575	1,793,587	-	8,971,783	621,844	9,593,627	13,411	5.29
C1a - C&I New Buildings & Major Renovations	369,535	528,086	6,280,575	1,793,587	-	8,971,783	621,844	9,593,627	13,411	5.29
C2 - C&I Existing Buildings	1,860,771	2,023,480	28,501,856	11,010,360	-	43,396,467	2,413,170	45,809,637	6,382	4.12
C2a - C&I Existing Building Retrofit	1,292,972	1,593,197	20,248,989	7,585,644	-	30,720,803	1,768,751	32,489,554	7,277	4.11
C2b - C&I New & Replacement Equipment	567,799	430,282	8,252,867	3,424,716	-	12,675,664	644,419	13,320,083	4,917	4.16
C3 - C&I Hard-to-Measure	546,753	290,624	-	441,527	2,415,548	3,694,453	-	3,694,453		
C3a - C&I Statewide Marketing	2,471	277,130	-	-	-	279,601	-	279,601		
C3b - C&I Statewide Database	13,791	-	-	-	-	13,791	-	13,791		
C3c - C&I DOER Assessment	354,644	-	-	-	-	354,644	-	354,644		
C3d - C&I Sponsorships & Subscriptions	35,862	13,495	-	194	10,000	59,550	-	59,550		
C3e - C&I Workforce Development	-	-	-	143,883	-	143,883	-	143,883		
C3f - C&I Evaluation and Market Research	-	-	-	-	2,405,548	2,405,548	-	2,405,548		
C3g - C&I EEAC Consultants	84,199	-	-	-	-	84,199	-	84,199		
C3h - C&I R&D and Demonstration	55,786	-	-	297,451	-	353,237	-	353,237		
Grand Total	**10,967,188**	**9,344,929**	**182,244,666**	**57,452,496**	**7,169,036**	**267,178,315**	**7,822,875**	**275,001,190**	**342**	**1.97**

IV.C. Program Administrator Budgets

1. Summary Table

Statewide Gas
October 31, 2018

2021 Program Administrator Budget										
Program	Program Costs						Performance Incentive	Total Program Administrator Budget	Program Cost per Participant	Resource Benefit per Program Cost
	Program Planning and Administration	Marketing and Advertising	Participant Incentive	Sales, Technical Assistance & Training	Evaluation and Market Research	Total Program Costs				
A - Residential	**6,081,783**	**5,689,573**	**106,455,258**	**35,110,042**	**3,513,274**	**156,849,931**	**3,664,227**	**160,514,157**	**208**	**1.55**
A1 - Residential New Buildings	396,264	91,551	10,622,238	979,391	-	12,089,444	540,462	12,629,907	1,672	2.59
A1a - Residential New Homes & Renovations	396,264	91,551	10,622,238	979,391	-	12,089,444	540,462	12,629,907	1,672	2.59
A2 - Residential Existing Buildings	4,374,543	4,033,802	94,545,540	33,560,952	-	136,514,836	3,123,764	139,638,601	183	1.55
A2a - Residential Coordinated Delivery	2,306,595	1,550,381	65,439,061	9,915,595	-	79,211,633	2,218,948	81,430,581	1,263	1.86
A2b - Residential Conservation Services (RCS)	898,511	1,108,169	-	17,418,059	-	19,424,739	-	19,424,739		-
A2c - Residential Retail	994,624	1,331,083	29,106,479	1,564,870	-	32,997,056	770,750	33,767,806	701	1.59
A2d - Residential Behavior	174,812	44,169	-	4,662,428	-	4,881,409	134,066	5,015,475	8	2.51
A3 - Residential Hard-to-Measure	1,310,976	1,564,221	1,287,480	569,700	3,513,274	8,245,650	-	8,245,650		
A3a - Residential Statewide Marketing	1,172	1,310,551	-	-	-	1,311,724	-	1,311,724		
A3b - Residential Statewide Database	66,275	-	-	-	-	66,275	-	66,275		
A3c - Residential DOER Assessment	799,445	-	-	-	-	799,445	-	799,445		
A3d - Residential Sponsorships & Subscriptions	67,254	17,329	-	729	5,000	90,312	-	90,312		
A3e - Residential Workforce Development	-	-	-	264,129	-	264,129	-	264,129		
A3f - Residential Evaluation and Market Research	56,498	-	-	-	2,901,012	2,957,510	-	2,957,510		
A3g - Residential EEAC Consultants	282,453	-	-	-	607,262	889,715	-	889,715		
A3h - Residential R&D and Demonstration	30,554	-	-	142,266	-	172,820	-	172,820		
A3i - Residential HEAT Loan	7,325	63,495	1,287,480	143,425	-	1,501,724	-	1,501,724		
A3j - Residential Education	-	172,845	-	19,151	-	191,997	-	191,997		
B - Income Eligible	**2,371,742**	**982,944**	**44,243,187**	**9,807,972**	**1,406,563**	**58,812,408**	**1,303,296**	**60,115,705**	**4,515**	**0.98**
B1 - Income Eligible Existing Buildings	1,815,800	771,112	44,243,187	9,768,719	-	56,598,818	1,303,296	57,902,114	4,345	1.02
B1a - Income Eligible Coordinated Delivery	1,815,800	771,112	44,243,187	9,768,719	-	56,598,818	1,303,296	57,902,114	4,345	1.02
B2 - Income Eligible Hard-to-Measure	555,942	211,833	-	39,253	1,406,563	2,213,591	-	2,213,591		
B2a - Income Eligible Statewide Marketing	1,274	209,494	-	-	-	210,768	-	210,768		
B2b - Income Eligible Statewide Database	23,840	-	-	-	-	23,840	-	23,840		
B2c - Income Eligible DOER Assessment	309,339	-	-	-	-	309,339	-	309,339		
B2d - Income Eligible Sponsorships & Subscriptions	20,389	2,339	-	290	-	23,018	-	23,018		
B2e - Income Eligible Workforce Development	-	-	-	38,963	-	38,963	-	38,963		
B2f - Income Eligible Evaluation and Market Research	-	-	-	-	1,406,563	1,406,563	-	1,406,563		
B2g - Income Eligible Energy Affordability Network	201,100	-	-	-	-	201,100	-	201,100		
C - Commercial & Industrial	**2,901,354**	**2,906,465**	**35,418,188**	**13,487,011**	**2,427,879**	**57,140,896**	**3,109,855**	**60,250,751**	**7,592**	**3.96**
C1 - C&I New Buildings	406,024	545,293	6,417,143	1,863,976	-	9,232,436	640,734	9,873,170	13,739	5.18
C1a - C&I New Buildings & Major Renovations	406,024	545,293	6,417,143	1,863,976	-	9,232,436	640,734	9,873,170	13,739	5.18
C2 - C&I Existing Buildings	1,918,477	2,055,659	29,001,045	11,334,326	-	44,309,508	2,469,121	46,778,629	6,464	4.03
C2a - C&I Existing Building Retrofit	1,339,359	1,611,752	20,668,159	7,835,002	-	31,454,271	1,808,756	33,263,027	7,435	4.00
C2b - C&I New & Replacement Equipment	579,119	443,907	8,332,886	3,499,324	-	12,855,236	660,365	13,515,601	4,899	4.10
C3 - C&I Hard-to-Measure	576,853	305,512	-	288,708	2,427,879	3,598,952	-	3,598,952		
C3a - C&I Statewide Marketing	2,422	286,946	-	-	-	289,369	-	289,369		
C3b - C&I Statewide Database	18,844	-	-	-	-	18,844	-	18,844		
C3c - C&I DOER Assessment	374,179	-	-	-	-	374,179	-	374,179		
C3d - C&I Sponsorships & Subscriptions	41,406	18,566	-	200	10,000	70,172	-	70,172		
C3e - C&I Workforce Development	-	-	-	139,080	-	139,080	-	139,080		
C3f - C&I Evaluation and Market Research	-	-	-	-	2,417,879	2,417,879	-	2,417,879		
C3g - C&I EEAC Consultants	89,923	-	-	-	-	89,923	-	89,923		
C3h - C&I R&D and Demonstration	50,079	-	-	149,429	-	199,508	-	199,508		
Grand Total	**11,354,879**	**9,578,982**	**186,116,633**	**58,405,025**	**7,347,716**	**272,803,235**	**8,077,378**	**280,880,613**	**353**	**1.93**

IV.C. Program Administrator Budgets

1. Summary Table

Statewide Gas
October 31, 2018

2019-2021 Program Administrator Budget										
Program	Program Costs						Performance Incentive	Total Program Administrator Budget	Program Cost per Participant	Resource Benefit per Program Cost
	Program Planning and Administration	Marketing and Advertising	Participant Incentive	Sales, Technical Assistance & Training	Evaluation and Market Research	Total Program Costs				
A - Residential	**17,611,969**	**16,684,492**	**311,276,356**	**101,736,470**	**10,068,715**	**457,378,001**	**10,640,938**	**468,018,939**	**202**	**1.59**
A1 - Residential New Buildings	1,164,574	268,757	31,378,761	3,014,245	-	35,826,336	1,566,147	37,392,483	1,682	2.62
A1a - Residential New Homes & Renovations	1,164,574	268,757	31,378,761	3,014,245	-	35,826,336	1,566,147	37,392,483	1,682	2.62
A2 - Residential Existing Buildings	12,662,900	11,776,921	276,065,156	97,064,726	-	397,569,703	9,074,791	406,644,494	178	1.59
A2a - Residential Coordinated Delivery	6,579,715	4,535,456	188,554,307	28,823,643	-	228,493,121	6,454,315	234,947,436	1,227	1.92
A2b - Residential Conservation Services (RCS)	2,565,653	3,206,668	-	50,270,591	-	56,042,912	-	56,042,912		-
A2c - Residential Retail	2,927,967	3,918,766	87,510,850	4,643,816	-	99,001,398	2,268,021	101,269,419	709	1.60
A2d - Residential Behavior	589,565	116,032	-	13,326,676	-	14,032,273	352,455	14,384,728	7	2.39
A3 - Residential Hard-to-Measure	3,784,496	4,638,814	3,832,439	1,657,499	10,068,715	23,981,962	-	23,981,962		
A3a - Residential Statewide Marketing	3,511	3,918,845	-	-	-	3,922,356	-	3,922,356		
A3b - Residential Statewide Database	188,842	-	-	-	-	188,842	-	188,842		
A3c - Residential DOER Assessment	2,308,498	-	-	-	-	2,308,498	-	2,308,498		
A3d - Residential Sponsorships & Subscriptions	183,295	41,511	-	2,123	15,000	241,929	-	241,929		
A3e - Residential Workforce Development	-	-	-	761,527	-	761,527	-	761,527		
A3f - Residential Evaluation and Market Research	56,498	-	-	-	9,446,453	9,502,952	-	9,502,952		
A3g - Residential EEAC Consultants	941,244	-	-	-	607,262	1,548,506	-	1,548,506		
A3h - Residential R&D and Demonstration	81,041	-	-	409,836	-	490,877	-	490,877		
A3i - Residential HEAT Loan	21,566	174,874	3,832,439	428,065	-	4,456,943	-	4,456,943		
A3j - Residential Education	-	503,584	-	55,948	-	559,532	-	559,532		
B - Income Eligible	**6,946,435**	**2,859,924**	**131,609,517**	**29,036,394**	**4,044,177**	**174,496,448**	**3,791,410**	**178,287,858**	**3,280**	**1.01**
B1 - Income Eligible Existing Buildings	5,302,937	2,244,557	131,609,517	28,933,911	-	168,090,922	3,791,410	171,882,332	3,160	1.04
B1a - Income Eligible Coordinated Delivery	5,302,937	2,244,557	131,609,517	28,933,911	-	168,090,922	3,791,410	171,882,332	3,160	1.04
B2 - Income Eligible Hard-to-Measure	1,643,498	615,367	-	102,483	4,044,177	6,405,526	-	6,405,526		
B2a - Income Eligible Statewide Marketing	3,790	608,518	-	-	-	612,308	-	612,308		
B2b - Income Eligible Statewide Database	61,596	-	-	-	-	61,596	-	61,596		
B2c - Income Eligible DOER Assessment	893,019	-	-	-	-	893,019	-	893,019		
B2d - Income Eligible Sponsorships & Subscriptions	59,411	6,849	-	844	-	67,105	-	67,105		
B2e - Income Eligible Workforce Development	-	-	-	101,639	-	101,639	-	101,639		
B2f - Income Eligible Evaluation and Market Research	-	-	-	-	4,044,177	4,044,177	-	4,044,177		
B2g - Income Eligible Energy Affordability Network	625,682	-	-	-	-	625,682	-	625,682		
C - Commercial & Industrial	**8,365,732**	**8,442,972**	**104,199,298**	**39,439,985**	**7,153,168**	**167,601,155**	**9,109,422**	**176,710,578**	**7,501**	**4.05**
C1 - C&I New Buildings	1,132,156	1,595,371	18,893,060	5,405,779	-	27,026,367	1,868,669	28,895,036	13,413	5.28
C1a - C&I New Buildings & Major Renovations	1,132,156	1,595,371	18,893,060	5,405,779	-	27,026,367	1,868,669	28,895,036	13,413	5.28
C2 - C&I Existing Buildings	5,606,454	5,964,318	85,306,238	32,881,596	-	129,758,606	7,240,753	136,999,359	6,383	4.13
C2a - C&I Existing Building Retrofit	3,884,339	4,680,164	60,610,012	22,549,694	-	91,724,208	5,295,199	97,019,407	7,264	4.12
C2b - C&I New & Replacement Equipment	1,722,116	1,284,154	24,696,226	10,331,902	-	38,034,398	1,945,554	39,979,951	4,938	4.18
C3 - C&I Hard-to-Measure	1,627,122	883,282	-	1,152,611	7,153,168	10,816,183	-	10,816,183		
C3a - C&I Statewide Marketing	7,543	842,754	-	-	-	850,297	-	850,297		
C3b - C&I Statewide Database	46,459	-	-	-	-	46,459	-	46,459		
C3c - C&I DOER Assessment	1,070,488	-	-	-	-	1,070,488	-	1,070,488		
C3d - C&I Sponsorships & Subscriptions	108,077	40,528	-	581	25,000	174,187	-	174,187		
C3e - C&I Workforce Development	-	-	-	416,653	-	416,653	-	416,653		
C3f - C&I Evaluation and Market Research	-	-	-	-	7,128,168	7,128,168	-	7,128,168		
C3g - C&I EEAC Consultants	253,119	-	-	-	-	253,119	-	253,119		
C3h - C&I R&D and Demonstration	141,437	-	-	735,377	-	876,813	-	876,813		
Grand Total	**32,924,136**	**27,987,387**	**547,085,171**	**170,212,849**	**21,266,060**	**799,475,604**	**23,541,770**	**823,017,374**	**342**	**1.98**

Notes:

Budgets for each year are represented in nominal dollars (2019$, 2020$, 2021$).

Refer to common definitions for allocation of costs.

IV.C. Program Administrator Budgets

2.2 PA Budget Comparison Table - Three Year Plan vs. Previous Years

Statewide Gas
October 31, 2018

2016-2021 Residential Program Administrator Budget

PA Budget Categories	Program Administrator Budget ($)									Budget Categories as a Percent of Total Program Administrator Budget (%)								
	2016		2017		2018		2019	2020	2021	2016		2017		2018		2019	2020	2021
	Planned	Evaluated	Planned	Evaluated	Planned	YTD	Planned	Planned	Planned	Planned	Evaluated	Planned	Evaluated	Planned	YTD	Planned	Planned	Planned
Program Planning and Administration	5,102,111	4,441,207	5,019,505	4,315,759	5,220,910	3,270,358	5,647,705	5,882,480	6,081,783	4%	4%	4%	4%	4%	4%	4%	4%	4%
Marketing and Advertising	4,400,641	3,691,354	4,747,788	4,444,462	4,778,215	2,680,897	5,441,265	5,553,653	5,689,573	3%	3%	4%	4%	3%	3%	4%	4%	4%
Participant Incentive	91,733,398	86,878,406	94,041,570	82,445,884	96,861,532	55,896,222	101,194,976	103,626,121	106,455,258	70%	71%	70%	70%	70%	72%	67%	66%	66%
Sales, Technical Assistance & Training	23,279,077	21,818,305	23,834,983	21,007,716	24,669,972	13,745,355	32,145,723	34,480,705	35,110,042	18%	18%	18%	18%	18%	18%	21%	22%	22%
Evaluation and Market Research	3,926,871	1,857,070	3,955,049	3,182,107	3,985,958	1,513,683	3,158,376	3,397,066	3,513,274	3%	2%	3%	3%	3%	2%	2%	2%	2%
Performance Incentive	3,122,907	3,299,268	3,193,213	3,149,236	3,377,846	-	3,451,754	3,524,957	3,664,227	2%	3%	2%	3%	2%	0%	2%	2%	2%
Total Program Administrator Budget	**131,565,005**	**121,985,611**	**134,792,109**	**118,545,166**	**138,894,434**	**77,106,515**	**151,039,800**	**156,464,982**	**160,514,157**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

2016-2021 Income Eligible Program Administrator Budget

PA Budget Categories	Program Administrator Budget ($)									Budget Categories as a Percent of Total Program Administrator Budget (%)								
	2016		2017		2018		2019	2020	2021	2016		2017		2018		2019	2020	2021
	Planned	Evaluated	Planned	Evaluated	Planned	YTD	Planned	Planned	Planned	Planned	Evaluated	Planned	Evaluated	Planned	YTD	Planned	Planned	Planned
Program Planning and Administration	2,320,814	1,681,218	2,291,318	1,737,494	2,362,031	1,172,375	2,267,045	2,307,648	2,371,742	5%	4%	5%	4%	5%	5%	4%	4%	4%
Marketing and Advertising	830,646	784,987	852,462	819,984	875,124	475,320	927,893	949,086	982,944	2%	2%	2%	2%	2%	2%	2%	2%	2%
Participant Incentive	32,447,649	29,936,600	32,836,670	34,938,137	33,286,684	19,625,146	43,530,217	43,836,113	44,243,187	71%	75%	72%	75%	71%	76%	74%	74%	74%
Sales, Technical Assistance & Training	7,530,517	6,284,292	7,593,967	7,190,627	7,738,339	4,092,763	9,502,105	9,726,317	9,807,972	17%	16%	17%	15%	17%	16%	16%	16%	16%
Evaluation and Market Research	1,488,293	493,420	1,475,866	998,260	1,470,492	540,618	1,281,192	1,356,422	1,406,563	3%	1%	3%	2%	3%	2%	2%	2%	2%
Performance Incentive	823,351	924,390	848,598	1,124,513	883,225	-	1,225,210	1,262,904	1,303,296	2%	2%	2%	2%	2%	0%	2%	2%	2%
Total Program Administrator Budget	**45,441,269**	**40,104,907**	**45,898,881**	**46,809,016**	**46,615,895**	**25,906,222**	**58,733,662**	**59,438,491**	**60,115,705**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

2016-2021 Commercial & Industrial Program Administrator Budget

PA Budget Categories	Program Administrator Budget ($)									Budget Categories as a Percent of Total Program Administrator Budget (%)								
	2016		2017		2018		2019	2020	2021	2016		2017		2018		2019	2020	2021
	Planned	Evaluated	Planned	Evaluated	Planned	YTD	Planned	Planned	Planned	Planned	Evaluated	Planned	Evaluated	Planned	YTD	Planned	Planned	Planned
Program Planning and Administration	3,489,268	2,716,012	3,502,434	3,169,481	3,551,115	2,096,965	2,687,319	2,777,059	2,901,354	8%	6%	7%	7%	7%	9%	5%	5%	5%
Marketing and Advertising	2,265,011	2,016,088	2,280,714	2,612,626	2,320,907	1,561,945	2,694,317	2,842,190	2,906,465	5%	4%	5%	6%	5%	7%	5%	5%	5%
Participant Incentive	28,687,144	27,898,129	29,487,561	25,064,678	30,728,625	12,418,129	33,998,678	34,782,432	35,418,188	62%	61%	63%	55%	63%	53%	59%	59%	59%
Sales, Technical Assistance & Training	7,937,029	9,630,390	8,044,722	11,015,816	8,233,452	6,225,064	12,707,500	13,245,474	13,487,011	17%	21%	17%	24%	17%	26%	22%	22%	22%
Evaluation and Market Research	1,770,536	1,597,300	1,783,037	1,784,457	1,812,030	1,335,370	2,309,741	2,415,548	2,427,879	4%	3%	4%	4%	4%	6%	4%	4%	4%
Performance Incentive	2,022,734	1,963,403	2,059,102	1,992,694	2,132,998	-	2,964,553	3,035,014	3,109,855	4%	4%	4%	4%	4%	0%	5%	5%	5%
Total Program Administrator Budget	**46,171,722**	**45,821,322**	**47,157,571**	**45,639,752**	**48,779,128**	**23,637,472**	**57,362,109**	**59,097,718**	**60,250,751**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

2016-2021 Total Program Administrator Budget

PA Budget Categories	Program Administrator Budget ($)									Budget Categories as a Percent of Total Program Administrator Budget (%)								
	2016		2017		2018		2019	2020	2021	2016		2017		2018		2019	2020	2021
	Planned	Evaluated	Planned	Evaluated	Planned	YTD	Planned	Planned	Planned	Planned	Evaluated	Planned	Evaluated	Planned	YTD	Planned	Planned	Planned
Program Planning and Administration	10,912,193	8,838,438	10,813,257	9,222,734	11,134,056	6,539,697	10,602,070	10,967,188	11,354,879	5%	4%	5%	4%	5%	5%	4%	4%	4%
Marketing and Advertising	7,496,297	6,492,429	7,880,963	7,877,073	7,974,246	4,718,162	9,063,475	9,344,929	9,578,982	3%	3%	3%	4%	3%	4%	3%	3%	3%
Participant Incentive	152,868,191	144,713,135	156,365,802	142,448,700	160,876,842	87,939,497	178,723,872	182,244,666	186,116,633	68%	70%	69%	68%	69%	69%	67%	66%	66%
Sales, Technical Assistance & Training	38,746,623	37,732,987	39,473,673	39,214,159	40,641,763	24,063,182	54,355,329	57,452,496	58,405,025	17%	18%	17%	19%	17%	19%	20%	21%	21%
Evaluation and Market Research	7,185,700	3,947,791	7,213,953	5,964,824	7,268,481	3,389,671	6,749,309	7,169,036	7,347,716	3%	2%	3%	3%	3%	3%	3%	3%	3%
Performance Incentive	5,968,991	6,187,061	6,100,913	6,266,443	6,394,069	-	7,641,517	7,822,875	8,077,378	3%	3%	3%	3%	3%	0%	3%	3%	3%
Total Program Administrator Budget	**223,177,996**	**207,911,840**	**227,848,561**	**210,993,933**	**234,289,457**	**126,650,209**	**267,135,572**	**275,001,190**	**280,880,613**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Notes:

2016-2018 planned values are from the Program Administrator's 2016-2018 Three-Year Plan, D.P.U. 15-166, in nominal dollars (2016$, 2017$, 2018$).

2016 evaluated values are from the Program Administrator's 2016 Plan Year Report, D.P.U. 17-100, in 2016$.

2017 evaluated values are from the Program Administrator's 2017 Plan Year Report, D.P.U. 18-51, in 2017$.

2018 YTD values are estimated actual cost through August 2018, in 2018$.

For supporting information on the 2019-2021 values, see Table IV.C.1. Budgets for each year are represented in nominal dollars (2019$, 2020$, 2021$).

The Program Administrators have better aligned cost allocations across Program Administrators for this Three-Year Plan, consistent with the Department's directives in the 2016-2018 Three-Year Plan Order (January 31, 2016). As a result, historical budget categories may not be directly comparable for each Program Administrator.

IV.C. Program Administrator Budgets

3. Program Planning and Administration

Statewide Gas

October 31, 2018

Program Planning and Administration Expenditures							
Year	Internal Costs	External Costs					Total Program Planning and Administration
	Labor, benefits, employee expenses, materials, and overhead	Legal Services	Assessments	Other Vendor Services	Hard to Measure Sponsorships & Subscriptions	Total External Costs	
2019	$ 4,856,893	$ 562,450	$ 985,492	$ 4,090,148	$ 104,795	$ 5,742,885	$ 10,599,778
2020	$ 5,253,398	$ 553,305	$ 1,033,235	$ 4,008,020	$ 116,938	$ 5,711,498	$ 10,964,896
2021	$ 5,396,403	$ 585,516	$ 1,073,044	$ 4,168,574	$ 129,049	$ 5,956,184	$ 11,352,587
Grand Total	**$ 15,506,694**	**$ 1,701,271**	**$ 3,091,771**	**$ 12,266,742**	**$ 350,783**	**$ 17,410,567**	**$ 32,917,261**

Notes:

• Assessments include costs associated with the Department of Energy Resource (DOER), Residential Conservation Services (RCS), Energy Efficiency Advisory Council (EEAC) Consultants, and the Low-Income Energy Affordability Network (LEAN). Note that the electric Program Administrators do not budget for the EEAC Consultant fees as these costs are paid by the DOER using RGGI proceeds.

• Other Vendor Services include costs associated with third-party consultants that assist with program planning and administration.

• The data included in the Hard to Measure Sponsorship and Subscriptions column is consistent with the hard-to-measure Sponsorships & Subscriptions lines in the Budget table.

• This table is included pursuant to Department directives (D.P.U. 15-160 through D.P.U. 15-169, at 42).

IV.D. Cost-Effectiveness

1. Summary Table

Statewide Gas
October 31, 2018

2019 Total Resource Cost Test (2019$)										
Program	With GWSA Benefits			Without GWSA Benefits			Costs			
	Benefit-Cost Ratio	Net Benefits	Total TRC Test Benefits	Benefit-Cost Ratio	Net Benefits	Total TRC Test Benefits	Total Program Costs	Performance Incentive	Participant Costs	Total TRC Test Costs
A - Residential	**1.47**	**99,848,456**	**310,160,601**	**1.31**	**64,802,376**	**275,114,521**	**147,588,046**	**3,451,754**	**59,272,344**	**210,312,144**
A1 - Residential New Buildings	1.66	18,014,144	45,167,901	1.50	13,472,927	40,626,684	11,848,505	505,070	14,800,182	27,153,757
A1a - Residential New Homes & Renovations	1.66	18,014,144	45,167,901	1.50	13,472,927	40,626,684	11,848,505	505,070	14,800,182	27,153,757
A2 - Residential Existing Buildings	1.51	89,531,837	264,992,700	1.34	59,026,974	234,487,837	128,042,016	2,946,685	44,472,162	175,460,863
A2a - Residential Coordinated Delivery	1.83	83,748,351	184,402,104	1.64	63,997,331	164,651,083	72,667,474	2,083,272	25,903,007	100,653,753
A2b - Residential Conservation Services (RCS)	0.00	(17,487,952)	-	0.00	(17,487,952)	-	17,487,952	-	-	17,487,952
A2c - Residential Retail	1.33	17,437,312	70,392,357	1.17	9,047,502	62,002,547	33,626,600	759,290	18,569,155	52,955,045
A2d - Residential Behavior	2.34	5,834,124	10,198,238	1.80	3,470,093	7,834,206	4,259,990	104,123	-	4,364,113
A3 - Residential Hard-to-Measure	0.00	(7,697,524)	-	0.00	(7,697,524)	-	7,697,524	-	-	7,697,524
B - Income Eligible	**1.89**	**52,448,233**	**111,193,203**	**1.75**	**44,072,254**	**102,817,225**	**57,508,453**	**1,225,210**	**11,309**	**58,744,971**
B1 - Income Eligible Existing Buildings	1.96	54,499,602	111,193,203	1.81	46,123,623	102,817,225	55,457,083	1,225,210	11,309	56,693,601
B1a - Income Eligible Coordinated Delivery	1.96	54,499,602	111,193,203	1.81	46,123,623	102,817,225	55,457,083	1,225,210	11,309	56,693,601
B2 - Income Eligible Hard-to-Measure	0.00	(2,051,369)	-	0.00	(2,051,369)	-	2,051,369	-	-	2,051,369
C - Commercial & Industrial	**3.10**	**165,466,659**	**244,236,189**	**2.63**	**128,403,370**	**207,172,900**	**54,397,556**	**2,964,553**	**21,407,421**	**78,769,530**
C1 - C&I New Buildings	4.07	37,059,942	49,145,834	3.40	28,950,579	41,036,472	8,822,148	606,091	2,657,654	12,085,893
C1a - C&I New Buildings & Major Renovations	4.07	37,059,942	49,145,834	3.40	28,950,579	41,036,472	8,822,148	606,091	2,657,654	12,085,893
C2 - C&I Existing Buildings	3.09	131,929,495	195,090,355	2.63	102,975,568	166,136,428	42,052,631	2,358,462	18,749,767	63,160,860
C2a - C&I Existing Building Retrofit	3.15	96,546,316	141,542,855	2.72	77,453,507	122,450,046	29,549,133	1,717,693	13,729,714	44,996,540
C2b - C&I New & Replacement Equipment	2.95	35,383,179	53,547,500	2.41	25,522,061	43,686,382	12,503,497	640,769	5,020,054	18,164,320
C3 - C&I Hard-to-Measure	0.00	(3,522,778)	-	0.00	(3,522,778)	-	3,522,778	-	-	3,522,778
Grand Total	**1.91**	**317,763,348**	**665,589,993**	**1.68**	**237,278,000**	**585,104,645**	**259,494,054**	**7,641,517**	**80,691,074**	**347,826,645**

IV.D. Cost-Effectiveness

1. Summary Table

Statewide Gas
October 31, 2018

2020 Total Resource Cost Test (2019$)										
Program	With GWSA Benefits			Without GWSA Benefits			Costs			
	Benefit-Cost Ratio	Net Benefits	Total TRC Test Benefits	Benefit-Cost Ratio	Net Benefits	Total TRC Test Benefits	Total Program Costs	Performance Incentive	Participant Costs	Total TRC Test Costs
A - Residential	**1.46**	**98,483,405**	**310,593,459**	**1.31**	**65,980,186**	**278,090,240**	**149,457,661**	**3,444,695**	**59,207,697**	**212,110,054**
A1 - Residential New Buildings	1.71	18,829,443	45,480,835	1.55	14,547,867	41,199,259	11,617,695	508,761	14,524,937	26,651,392
A1a - Residential New Homes & Renovations	1.71	18,829,443	45,480,835	1.55	14,547,867	41,199,259	11,617,695	508,761	14,524,937	26,651,392
A2 - Residential Existing Buildings	1.49	87,509,710	265,112,624	1.33	59,288,067	236,890,981	129,984,219	2,935,935	44,682,761	177,602,914
A2a - Residential Coordinated Delivery	1.80	83,245,754	187,258,399	1.62	64,420,009	168,432,654	74,869,553	2,103,094	27,039,999	104,012,645
A2b - Residential Conservation Services (RCS)	0.00	(18,694,636)	-	0.00	(18,694,636)	-	18,694,636	-	-	18,694,636
A2c - Residential Retail	1.34	16,809,322	66,813,780	1.18	9,204,596	59,209,054	31,640,518	721,177	17,642,762	50,004,458
A2d - Residential Behavior	2.26	6,149,270	11,040,445	1.89	4,358,098	9,249,273	4,779,511	111,664	-	4,891,175
A3 - Residential Hard-to-Measure	0.00	(7,855,748)	-	0.00	(7,855,748)	-	7,855,748	-	-	7,855,748
B - Income Eligible	**1.92**	**53,415,428**	**111,511,581**	**1.78**	**45,505,693**	**103,601,846**	**56,850,959**	**1,234,149**	**11,045**	**58,096,153**
B1 - Income Eligible Existing Buildings	1.99	55,507,254	111,511,581	1.85	47,597,520	103,601,846	54,759,133	1,234,149	11,045	56,004,327
B1a - Income Eligible Coordinated Delivery	1.99	55,507,254	111,511,581	1.85	47,597,520	103,601,846	54,759,133	1,234,149	11,045	56,004,327
B2 - Income Eligible Hard-to-Measure	0.00	(2,091,826)	-	0.00	(2,091,826)	-	2,091,826	-	-	2,091,826
C - Commercial & Industrial	**3.09**	**165,345,186**	**244,532,067**	**2.65**	**130,381,903**	**209,568,784**	**54,786,185**	**2,965,909**	**21,434,787**	**79,186,881**
C1 - C&I New Buildings	4.11	37,273,262	49,248,462	3.47	29,588,461	41,563,661	8,767,500	607,685	2,600,014	11,975,200
C1a - C&I New Buildings & Major Renovations	4.11	37,273,262	49,248,462	3.47	29,588,461	41,563,661	8,767,500	607,685	2,600,014	11,975,200
C2 - C&I Existing Buildings	3.07	131,682,256	195,283,605	2.64	104,403,774	168,005,123	42,408,352	2,358,224	18,834,773	63,601,349
C2a - C&I Existing Building Retrofit	3.13	96,987,337	142,599,810	2.73	78,881,028	124,493,502	30,021,307	1,728,477	13,862,689	45,612,473
C2b - C&I New & Replacement Equipment	2.93	34,694,919	52,683,795	2.42	25,522,746	43,511,622	12,387,046	629,746	4,972,084	17,988,876
C3 - C&I Hard-to-Measure	0.00	(3,610,332)	-	0.00	(3,610,332)	-	3,610,332	-	-	3,610,332
Grand Total	**1.91**	**317,244,019**	**666,637,107**	**1.69**	**241,867,782**	**591,260,870**	**261,094,806**	**7,644,752**	**80,653,530**	**349,393,088**

IV.D. Cost-Effectiveness

1. Summary Table

Statewide Gas
October 31, 2018

2021 Total Resource Cost Test (2019$)										
Program	With GWSA Benefits			Without GWSA Benefits			Costs			
	Benefit-Cost Ratio	Net Benefits	Total TRC Test Benefits	Benefit-Cost Ratio	Net Benefits	Total TRC Test Benefits	Total Program Costs	Performance Incentive	Participant Costs	Total TRC Test Costs
A - Residential	**1.48**	**102,126,070**	**314,716,141**	**1.32**	**68,133,802**	**280,723,873**	**149,788,469**	**3,499,262**	**59,302,341**	**212,590,072**
A1 - Residential New Buildings	1.75	19,633,185	45,960,227	1.58	15,249,467	41,576,509	11,545,171	516,131	14,265,740	26,327,042
A1a - Residential New Homes & Renovations	1.75	19,633,185	45,960,227	1.58	15,249,467	41,576,509	11,545,171	516,131	14,265,740	26,327,042
A2 - Residential Existing Buildings	1.51	90,367,311	268,755,914	1.34	60,758,761	239,147,365	130,368,871	2,983,131	45,036,601	178,388,603
A2a - Residential Coordinated Delivery	1.79	83,467,563	188,688,266	1.61	64,133,624	169,354,327	75,645,486	2,119,050	27,456,167	105,220,703
A2b - Residential Conservation Services (RCS)	0.00	(18,550,227)	-	0.00	(18,550,227)	-	18,550,227	-	-	18,550,227
A2c - Residential Retail	1.36	17,982,662	67,810,658	1.20	9,985,246	59,813,243	31,511,512	736,050	17,580,434	49,827,997
A2d - Residential Behavior	2.56	7,467,314	12,256,990	2.08	5,190,119	9,979,795	4,661,645	128,031	-	4,789,676
A3 - Residential Hard-to-Measure	0.00	(7,874,427)	-	0.00	(7,874,427)	-	7,874,427	-	-	7,874,427
B - Income Eligible	**1.95**	**54,542,698**	**111,962,764**	**1.81**	**46,563,239**	**103,983,305**	**56,164,645**	**1,244,621**	**10,799**	**57,420,065**
B1 - Income Eligible Existing Buildings	2.02	56,656,632	111,962,764	1.88	48,677,173	103,983,305	54,050,711	1,244,621	10,799	55,306,132
B1a - Income Eligible Coordinated Delivery	2.02	56,656,632	111,962,764	1.88	48,677,173	103,983,305	54,050,711	1,244,621	10,799	55,306,132
B2 - Income Eligible Hard-to-Measure	0.00	(2,113,934)	-	0.00	(2,113,934)	-	2,113,934	-	-	2,113,934
C - Commercial & Industrial	**3.10**	**165,887,460**	**244,709,689**	**2.65**	**130,188,946**	**209,011,175**	**54,568,385**	**2,969,848**	**21,283,997**	**78,822,230**
C1 - C&I New Buildings	4.12	37,533,057	49,574,797	3.46	29,622,013	41,663,754	8,816,787	611,888	2,613,066	12,041,741
C1a - C&I New Buildings & Major Renovations	4.12	37,533,057	49,574,797	3.46	29,622,013	41,663,754	8,816,787	611,888	2,613,066	12,041,741
C2 - C&I Existing Buildings	3.08	131,791,328	195,134,892	2.64	104,003,858	167,347,422	42,314,672	2,357,960	18,670,932	63,343,563
C2a - C&I Existing Building Retrofit	3.13	96,932,989	142,457,406	2.72	78,463,152	123,987,569	30,038,185	1,727,325	13,758,908	45,524,417
C2b - C&I New & Replacement Equipment	2.96	34,858,339	52,677,485	2.43	25,540,706	43,359,853	12,276,487	630,635	4,912,024	17,819,146
C3 - C&I Hard-to-Measure	0.00	(3,436,926)	-	0.00	(3,436,926)	-	3,436,926	-	-	3,436,926
Grand Total	**1.92**	**322,556,228**	**671,388,594**	**1.70**	**244,885,987**	**593,718,353**	**260,521,499**	**7,713,730**	**80,597,137**	**348,832,367**

IV.D. Cost-Effectiveness

1. Summary Table

Statewide Gas
October 31, 2018

2019-2021 Total Resource Cost Test (2019$)										
Program	With GWSA Benefits			Without GWSA Benefits			Costs			
	Benefit-Cost Ratio	Net Benefits	Total TRC Test Benefits	Benefit-Cost Ratio	Net Benefits	Total TRC Test Benefits	Total Program Costs	Performance Incentive	Participant Costs	Total TRC Test Costs
A - Residential	**1.47**	**300,457,931**	**935,470,201**	**1.31**	**198,916,364**	**833,928,634**	**446,834,176**	**10,395,711**	**177,782,383**	**635,012,270**
A1 - Residential New Buildings	1.70	56,476,773	136,608,963	1.54	43,270,261	123,402,452	35,011,371	1,529,961	43,590,859	80,132,190
A1a - Residential New Homes & Renovations	1.70	56,476,773	136,608,963	1.54	43,270,261	123,402,452	35,011,371	1,529,961	43,590,859	80,132,190
A2 - Residential Existing Buildings	1.50	267,408,857	798,861,237	1.34	179,073,802	710,526,182	388,395,106	8,865,750	134,191,524	531,452,380
A2a - Residential Coordinated Delivery	1.81	250,461,668	560,348,769	1.62	192,550,963	502,438,064	223,182,513	6,305,415	80,399,172	309,887,101
A2b - Residential Conservation Services (RCS)	0.00	(54,732,815)	-	0.00	(54,732,815)	-	54,732,815	-	-	54,732,815
A2c - Residential Retail	1.34	52,229,296	205,016,796	1.18	28,237,344	181,024,844	96,778,630	2,216,518	53,792,352	152,787,500
A2d - Residential Behavior	2.38	19,450,709	33,495,673	1.93	13,018,310	27,063,275	13,701,147	343,817	-	14,044,964
A3 - Residential Hard-to-Measure	0.00	(23,427,700)	-	0.00	(23,427,700)	-	23,427,700	-	-	23,427,700
B - Income Eligible	**1.92**	**160,406,359**	**334,667,548**	**1.78**	**136,141,187**	**310,402,376**	**170,524,057**	**3,703,979**	**33,153**	**174,261,189**
B1 - Income Eligible Existing Buildings	1.99	166,663,488	334,667,548	1.85	142,398,316	310,402,376	164,266,927	3,703,979	33,153	168,004,060
B1a - Income Eligible Coordinated Delivery	1.99	166,663,488	334,667,548	1.85	142,398,316	310,402,376	164,266,927	3,703,979	33,153	168,004,060
B2 - Income Eligible Hard-to-Measure	0.00	(6,257,129)	-	0.00	(6,257,129)	-	6,257,129	-	-	6,257,129
C - Commercial & Industrial	**3.10**	**496,699,305**	**733,477,946**	**2.64**	**388,974,218**	**625,752,859**	**163,752,126**	**8,900,310**	**64,126,205**	**236,778,641**
C1 - C&I New Buildings	4.10	111,866,261	147,969,094	3.44	88,161,053	124,263,886	26,406,435	1,825,664	7,870,733	36,102,833
C1a - C&I New Buildings & Major Renovations	4.10	111,866,261	147,969,094	3.44	88,161,053	124,263,886	26,406,435	1,825,664	7,870,733	36,102,833
C2 - C&I Existing Buildings	3.08	395,403,080	585,508,852	2.64	311,383,200	501,488,973	126,775,655	7,074,645	56,255,472	190,105,773
C2a - C&I Existing Building Retrofit	3.13	290,466,642	426,600,072	2.72	234,797,687	370,931,117	89,608,625	5,173,495	41,351,310	136,133,430
C2b - C&I New & Replacement Equipment	2.94	104,936,437	158,908,780	2.42	76,585,513	130,557,856	37,167,030	1,901,151	14,904,162	53,972,343
C3 - C&I Hard-to-Measure	0.00	(10,570,035)	-	0.00	(10,570,035)	-	10,570,035	-	-	10,570,035
Grand Total	**1.92**	**957,563,595**	**2,003,615,695**	**1.69**	**724,031,769**	**1,770,083,869**	**781,110,359**	**23,000,000**	**241,941,741**	**############**

Notes:

The Benefit-Cost Ratio is the Total TRC Test Benefits divided by the Total TRC Test Costs.

The Net Benefits are the Total TRC Test Benefits minus the Total TRC Test Costs.

For supporting information on the Total TRC Test Benefits, see Table IV.D.3.1.i.

For supporting information on the Total Program Costs, see Table IV.C.1.

For supporting information on the Performance Incentive, refer to the Performance Incentive Model.

The Total TRC Costs are the sum of the Total Program Costs, Performance Incentives, and Participant Costs.

IV.D Cost-Effectiveness

2.3 Cost Comparison Table - Three-Year Plan vs. Previous Years

Statewide Gas

October 31, 2018

2016-2021 TRC Costs												
TRC Costs Categories	TRC Costs						TRC Cost Categories as a Percent of Total TRC Costs (%)					
	2016 Evaluated	2017 Evaluated	2018 Planned	2019 Planned	2020 Planned	2021 Planned	2016 Evaluated	2017 Evaluated	2018 Planned	2019 Planned	2020 Planned	2021 Planned
A - Residential												
PA Budget	121,985,611	115,608,705	132,098,600	151,039,800	152,902,357	153,287,731	66%	66%	70%	72%	72%	72%
Participant Cost	61,591,133	58,828,402	57,147,737	59,272,344	59,207,697	59,302,341	34%	34%	30%	28%	28%	28%
Residential Total TRC Costs	183,576,745	174,437,106	189,728,888	210,312,144	212,110,054	212,590,072	100%	100%	100%	100%	100%	100%
B - Income Eligible												
PA Budget	40,104,907	45,649,518	44,335,070	58,733,662	58,085,108	57,409,266	100%	100%	100%	100%	100%	100%
Participant Cost	20,765	341	-	11,309	11,045	10,799	0%	0%	0%	0%	0%	0%
Low-Income Total TRC Costs	40,125,672	45,649,859	44,515,041	58,744,971	58,096,153	57,420,065	100%	100%	100%	100%	100%	100%
C - Commercial & Industrial												
PA Budget	45,821,322	44,509,217	46,392,460	57,362,109	57,752,094	57,538,233	74%	76%	71%	73%	73%	73%
Participant Cost	16,220,136	14,039,211	18,564,244	21,407,421	21,434,787	21,283,997	26%	24%	29%	27%	27%	27%
C&I Total TRC Costs	62,041,458	58,548,428	65,099,191	78,769,530	79,186,881	78,822,230	100%	100%	100%	100%	100%	100%
Grand Total												
PA Budget	207,911,840	205,767,440	222,826,131	267,135,572	268,739,558	268,235,229	73%	74%	74%	77%	77%	77%
Participant Cost	77,832,034	72,867,954	75,711,981	80,691,074	80,653,530	80,597,137	27%	26%	25%	23%	23%	23%
Grand Total TRC Costs	285,743,875	278,635,394	299,343,120	347,826,645	349,393,088	348,832,367	100%	100%	100%	100%	100%	100%

Notes:

2016 values are from the Program Administrator's 2016 Plan Year Report D.P.U. 17-100, in 2016$.
2017 values are from the Program Administrator's 2017 Plan Year Report D.P.U. 18-51, in 2016$.
2018 values are from the Program Administrator's 2016-2018 Three-Year Plan, D.P.U. 15-166, in 2016$.
For supporting information on the 2019-2021 values, see Table IV.D.1. The 2019-2021 values are in 2019$.

IV.D Cost-Effectiveness

3.1.i. Benefits Summary Table

Statewide Gas

October 31, 2018

2019 Benefits

Program	Electric									
	Capacity						Electric Energy			
	Summer Generation	Capacity DRIPE	Transmission	Distribution	Reliability	Total Capacity	Electric Energy	Electric Energy DRIPE	Electric Energy GWSA	Total Electric Energy
A - Residential	**2,042,950**	**10,525**	**2,561,581**	**4,158,208**	**139,948**	**8,913,212**	**6,364,953**	**1,499,203**	**1,751,522**	**9,615,679**
A1 - Residential New Buildings	245,374	52	272,605	442,519	12,312	972,862	718,155	133,994	176,285	1,028,434
A1a - Residential New Homes & Renovations	245,374	52	272,605	442,519	12,312	972,862	718,155	133,994	176,285	1,028,434
A2 - Residential Existing Buildings	1,797,576	10,473	2,288,976	3,715,690	127,636	7,940,350	5,646,798	1,365,209	1,575,236	8,587,244
A2a - Residential Coordinated Delivery	1,493,707	5,192	1,860,702	3,020,473	97,941	6,478,015	4,886,010	1,160,605	1,337,126	7,383,741
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	303,868	5,281	428,274	695,217	29,695	1,462,335	760,788	204,604	238,110	1,203,504
A2d - Residential Behavior	-	-	-	-	-	-	-	-	-	-
B - Income Eligible	**811,078**	**29**	**919,915**	**1,493,296**	**45,296**	**3,269,614**	**1,125,681**	**222,034**	**303,595**	**1,651,308**
B1 - Income Eligible Existing Buildings	811,078	29	919,915	1,493,296	45,296	3,269,614	1,125,681	222,034	303,595	1,651,308
B1a - Income Eligible Coordinated Delivery	811,078	29	919,915	1,493,296	45,296	3,269,614	1,125,681	222,034	303,595	1,651,308
C - Commercial & Industrial	**19,164**	**242**	**25,181**	**40,875**	**1,593**	**87,056**	**33,676**	**8,423**	**10,192**	**52,292**
C1 - C&I New Buildings	-	-	-	-	-	-	-	-	-	-
C1a - C&I New Buildings & Major Renovations	-	-	-	-	-	-	-	-	-	-
C2 - C&I Existing Buildings	19,164	242	25,181	40,875	1,593	87,056	33,676	8,423	10,192	52,292
C2a - C&I Existing Building Retrofit	15,315	242	20,380	33,082	1,316	70,337	21,441	5,906	6,788	34,136
C2b - C&I New & Replacement Equipment	3,849	-	4,801	7,793	277	16,719	12,235	2,518	3,404	18,157
Grand Total	**2,873,192**	**10,796**	**3,506,677**	**5,692,379**	**186,838**	**12,269,882**	**7,524,310**	**1,729,660**	**2,065,309**	**11,319,279**

2020 Benefits

Program	Electric									
	Capacity						Electric Energy			
	Summer Generation	Capacity DRIPE	Transmission	Distribution	Reliability	Total Capacity	Electric Energy	Electric Energy DRIPE	Electric Energy GWSA	Total Electric Energy
A - Residential	**2,260,268**	**10,172**	**2,514,743**	**4,082,177**	**133,045**	**9,000,405**	**6,102,034**	**1,237,110**	**1,462,345**	**8,801,489**
A1 - Residential New Buildings	267,824	52	277,642	450,696	12,502	1,008,716	744,339	134,647	166,196	1,045,184
A1a - Residential New Homes & Renovations	267,824	52	277,642	450,696	12,502	1,008,716	744,339	134,647	166,196	1,045,184
A2 - Residential Existing Buildings	1,992,444	10,120	2,237,101	3,631,481	120,543	7,991,689	5,357,695	1,102,463	1,296,148	7,756,306
A2a - Residential Coordinated Delivery	1,654,274	4,858	1,808,924	2,936,423	90,827	6,495,306	4,668,407	913,627	1,093,619	6,675,652
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	338,170	5,261	428,177	695,058	29,716	1,496,384	689,288	188,835	202,530	1,080,653
A2d - Residential Behavior	-	-	-	-	-	-	-	-	-	-
B - Income Eligible	**882,117**	**28**	**929,080**	**1,508,174**	**45,607**	**3,365,008**	**1,167,940**	**223,325**	**286,453**	**1,677,718**
B1 - Income Eligible Existing Buildings	882,117	28	929,080	1,508,174	45,607	3,365,008	1,167,940	223,325	286,453	1,677,718
B1a - Income Eligible Coordinated Delivery	882,117	28	929,080	1,508,174	45,607	3,365,008	1,167,940	223,325	286,453	1,677,718
C - Commercial & Industrial	**21,397**	**246**	**25,551**	**41,476**	**1,618**	**90,289**	**34,792**	**8,563**	**9,676**	**53,030**
C1 - C&I New Buildings	-	-	-	-	-	-	-	-	-	-
C1a - C&I New Buildings & Major Renovations	-	-	-	-	-	-	-	-	-	-
C2 - C&I Existing Buildings	21,397	246	25,551	41,476	1,618	90,289	34,792	8,563	9,676	53,030
C2a - C&I Existing Building Retrofit	17,090	246	20,630	33,489	1,334	72,789	22,061	5,983	6,414	34,457
C2b - C&I New & Replacement Equipment	4,308	-	4,921	7,988	284	17,499	12,731	2,580	3,262	18,572
Grand Total	**3,163,783**	**10,446**	**3,469,375**	**5,631,827**	**180,269**	**12,455,702**	**7,304,767**	**1,468,998**	**1,758,474**	**10,532,237**

IV.D Cost-Effectiveness

3.1.i. Benefits Summary Table

Statewide Gas

October 31, 2018

2021 Benefits										
Program	Electric									
	Capacity						Electric Energy			
	Summer Generation	Capacity DRIPE	Transmission	Distribution	Reliability	Total Capacity	Electric Energy	Electric Energy DRIPE	Electric Energy GWSA	Total Electric Energy
A - Residential	**2,423,639**	**9,475**	**2,464,094**	**3,999,959**	**127,746**	**9,024,911**	**6,077,264**	**1,158,911**	**1,358,168**	**8,594,342**
A1 - Residential New Buildings	289,150	52	276,445	448,754	12,154	1,026,555	740,722	120,984	152,872	1,014,577
A1a - Residential New Homes & Renovations	289,150	52	276,445	448,754	12,154	1,026,555	740,722	120,984	152,872	1,014,577
A2 - Residential Existing Buildings	2,134,489	9,422	2,187,649	3,551,206	115,592	7,998,357	5,336,542	1,037,926	1,205,296	7,579,765
A2a - Residential Coordinated Delivery	1,753,446	4,063	1,752,646	2,845,066	85,381	6,440,601	4,635,745	846,961	1,008,544	6,491,249
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	381,042	5,360	435,003	706,139	30,212	1,557,756	700,797	190,966	196,753	1,088,516
A2d - Residential Behavior	-	-	-	-	-	-	-	-	-	-
B - Income Eligible	**991,204**	**28**	**974,786**	**1,582,368**	**47,860**	**3,596,246**	**1,263,607**	**235,497**	**290,333**	**1,789,437**
B1 - Income Eligible Existing Buildings	991,204	28	974,786	1,582,368	47,860	3,596,246	1,263,607	235,497	290,333	1,789,437
B1a - Income Eligible Coordinated Delivery	991,204	28	974,786	1,582,368	47,860	3,596,246	1,263,607	235,497	290,333	1,789,437
C - Commercial & Industrial	**23,633**	**247**	**25,738**	**41,779**	**1,629**	**93,027**	**35,812**	**8,675**	**9,430**	**53,917**
C1 - C&I New Buildings	-	-	-	-	-	-	-	-	-	-
C1a - C&I New Buildings & Major Renovations	-	-	-	-	-	-	-	-	-	-
C2 - C&I Existing Buildings	23,633	247	25,738	41,779	1,629	93,027	35,812	8,675	9,430	53,917
C2a - C&I Existing Building Retrofit	18,872	247	20,730	33,650	1,340	74,840	22,611	6,032	6,218	34,862
C2b - C&I New & Replacement Equipment	4,762	-	5,008	8,130	289	18,187	13,201	2,643	3,212	19,055
Grand Total	**3,438,476**	**9,750**	**3,464,618**	**5,624,107**	**177,236**	**12,714,185**	**7,376,683**	**1,403,083**	**1,657,932**	**10,437,696**

2019-2021 Benefits										
Program	Electric									
	Capacity						Electric Energy			
	Summer Generation	Capacity DRIPE	Transmission	Distribution	Reliability	Total Capacity	Electric Energy	Electric Energy DRIPE	Electric Energy GWSA	Total Electric Energy
A - Residential	**6,726,857**	**30,172**	**7,540,418**	**12,240,344**	**400,739**	**26,938,528**	**18,544,251**	**3,895,224**	**4,572,035**	**27,011,510**
A1 - Residential New Buildings	802,348	157	826,692	1,341,968	36,968	3,008,133	2,203,216	389,626	495,353	3,088,195
A1a - Residential New Homes & Renovations	802,348	157	826,692	1,341,968	36,968	3,008,133	2,203,216	389,626	495,353	3,088,195
A2 - Residential Existing Buildings	5,924,509	30,015	6,713,726	10,898,376	363,771	23,930,395	16,341,035	3,505,598	4,076,681	23,923,315
A2a - Residential Coordinated Delivery	4,901,428	14,113	5,422,272	8,801,962	274,148	19,413,921	14,190,162	2,921,193	3,439,289	20,550,643
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	1,023,081	15,902	1,291,455	2,096,415	89,623	4,516,474	2,150,873	584,405	637,393	3,372,672
A2d - Residential Behavior	-	-	-	-	-	-	-	-	-	-
B - Income Eligible	**2,684,399**	**85**	**2,823,781**	**4,583,838**	**138,763**	**10,230,869**	**3,557,228**	**680,855**	**880,381**	**5,118,464**
B1 - Income Eligible Existing Buildings	2,684,399	85	2,823,781	4,583,838	138,763	10,230,869	3,557,228	680,855	880,381	5,118,464
B1a - Income Eligible Coordinated Delivery	2,684,399	85	2,823,781	4,583,838	138,763	10,230,869	3,557,228	680,855	880,381	5,118,464
C - Commercial & Industrial	**64,195**	**736**	**76,470**	**124,131**	**4,840**	**270,372**	**104,280**	**25,661**	**29,299**	**159,239**
C1 - C&I New Buildings	-	-	-	-	-	-	-	-	-	-
C1a - C&I New Buildings & Major Renovations	-	-	-	-	-	-	-	-	-	-
C2 - C&I Existing Buildings	64,195	736	76,470	124,131	4,840	270,372	104,280	25,661	29,299	159,239
C2a - C&I Existing Building Retrofit	51,277	736	61,740	100,220	3,991	217,966	66,113	17,921	19,420	103,455
C2b - C&I New & Replacement Equipment	12,918	-	14,731	23,910	850	52,406	38,167	7,741	9,878	55,784
Grand Total	**9,475,451**	**30,992**	**10,440,669**	**16,948,313**	**544,343**	**37,439,769**	**22,205,759**	**4,601,740**	**5,481,715**	**32,289,212**

IV.D Cost-Effectiveness

3.1.i. Benefits Summary Table

Statewide Gas

October 31, 2018

Program	2019 Benefits			
	Natural Gas			
	Natural Gas	Natural Gas DRIPE	Natural Gas GWSA	Total Natural Gas
A - Residential	**162,173,038**	**20,641,946**	**33,294,555**	**216,109,540**
A1 - Residential New Buildings	22,703,660	2,171,947	4,364,931	29,240,537
A1a - Residential New Homes & Renovations	22,703,660	2,171,947	4,364,931	29,240,537
A2 - Residential Existing Buildings	139,469,378	18,469,999	28,929,624	186,869,002
A2a - Residential Coordinated Delivery	96,186,649	10,883,519	18,413,894	125,484,062
A2b - Residential Conservation Services (RCS)	-	-	-	-
A2c - Residential Retail	37,946,616	5,088,386	8,151,699	51,186,702
A2d - Residential Behavior	5,336,113	2,498,093	2,364,031	10,198,238
B - Income Eligible	**40,686,118**	**4,693,427**	**8,072,385**	**53,451,931**
B1 - Income Eligible Existing Buildings	40,686,118	4,693,427	8,072,385	53,451,931
B1a - Income Eligible Coordinated Delivery	40,686,118	4,693,427	8,072,385	53,451,931
C - Commercial & Industrial	**147,830,483**	**25,057,743**	**37,053,097**	**209,941,325**
C1 - C&I New Buildings	34,795,764	4,453,405	8,109,362	47,358,532
C1a - C&I New Buildings & Major Renovations	34,795,764	4,453,405	8,109,362	47,358,532
C2 - C&I Existing Buildings	113,034,720	20,604,339	28,943,735	162,582,793
C2a - C&I Existing Building Retrofit	74,901,224	15,513,129	19,086,021	109,500,373
C2b - C&I New & Replacement Equipment	38,133,496	5,091,210	9,857,714	53,082,420
Grand Total	**350,689,639**	**50,393,116**	**78,420,037**	**479,502,795**

Program	2020 Benefits			
	Natural Gas			
	Natural Gas	Natural Gas DRIPE	Natural Gas GWSA	Total Natural Gas
A - Residential	**167,137,421**	**18,235,296**	**31,040,872**	**216,413,591**
A1 - Residential New Buildings	23,193,037	1,835,044	4,115,379	29,143,461
A1a - Residential New Homes & Renovations	23,193,037	1,835,044	4,115,379	29,143,461
A2 - Residential Existing Buildings	143,944,384	16,400,252	26,925,493	187,270,131
A2a - Residential Coordinated Delivery	100,325,064	9,322,430	17,732,125	127,379,620
A2b - Residential Conservation Services (RCS)	-	-	-	-
A2c - Residential Retail	37,343,259	4,104,610	7,402,197	48,850,066
A2d - Residential Behavior	6,276,060	2,973,213	1,791,171	11,040,445
B - Income Eligible	**41,584,055**	**3,956,931**	**7,623,282**	**53,164,269**
B1 - Income Eligible Existing Buildings	41,584,055	3,956,931	7,623,282	53,164,269
B1a - Income Eligible Coordinated Delivery	41,584,055	3,956,931	7,623,282	53,164,269
C - Commercial & Industrial	**152,994,759**	**21,312,645**	**34,953,606**	**209,261,012**
C1 - C&I New Buildings	35,850,191	3,784,230	7,684,801	47,319,224
C1a - C&I New Buildings & Major Renovations	35,850,191	3,784,230	7,684,801	47,319,224
C2 - C&I Existing Buildings	117,144,568	17,528,414	27,268,805	161,941,788
C2a - C&I Existing Building Retrofit	78,363,312	13,269,926	18,099,895	109,733,133
C2b - C&I New & Replacement Equipment	38,781,256	4,258,488	9,168,910	52,208,655
Grand Total	**361,716,236**	**43,504,872**	**73,617,760**	**478,838,873**

IV.D Cost-Effectiveness

3.1.i. Benefits Summary Table

Statewide Gas

October 31, 2018

Program	2021 Benefits			
	Natural Gas			
	Natural Gas	Natural Gas DRIPE	Natural Gas GWSA	Total Natural Gas
A - Residential	**171,643,381**	**15,060,064**	**32,634,100**	**219,337,546**
A1 - Residential New Buildings	23,601,940	1,449,870	4,230,846	29,282,658
A1a - Residential New Homes & Renovations	23,601,940	1,449,870	4,230,846	29,282,658
A2 - Residential Existing Buildings	148,041,441	13,610,194	28,403,253	190,054,888
A2a - Residential Coordinated Delivery	102,569,259	7,344,919	18,325,395	128,239,573
A2b - Residential Conservation Services (RCS)	-	-	-	-
A2c - Residential Retail	38,492,185	3,265,477	7,800,663	49,558,325
A2d - Residential Behavior	6,979,997	2,999,798	2,277,196	12,256,990
B - Income Eligible	**41,435,302**	**3,050,023**	**7,689,126**	**52,174,451**
B1 - Income Eligible Existing Buildings	41,435,302	3,050,023	7,689,126	52,174,451
B1a - Income Eligible Coordinated Delivery	41,435,302	3,050,023	7,689,126	52,174,451
C - Commercial & Industrial	**156,418,027**	**16,801,281**	**35,689,084**	**208,908,390**
C1 - C&I New Buildings	36,739,309	2,996,096	7,911,044	47,646,448
C1a - C&I New Buildings & Major Renovations	36,739,309	2,996,096	7,911,044	47,646,448
C2 - C&I Existing Buildings	119,678,718	13,805,185	27,778,040	161,261,942
C2a - C&I Existing Building Retrofit	80,180,419	10,452,645	18,463,620	109,096,683
C2b - C&I New & Replacement Equipment	39,498,299	3,352,539	9,314,420	52,165,259
Grand Total	**369,496,710**	**34,911,367**	**76,012,309**	**480,420,387**

Program	2019-2021 Benefits			
	Natural Gas			
	Natural Gas	Natural Gas DRIPE	Natural Gas GWSA	Total Natural Gas
A - Residential	**500,953,840**	**53,937,305**	**96,969,527**	**651,860,677**
A1 - Residential New Buildings	69,498,637	5,456,860	12,711,156	87,666,656
A1a - Residential New Homes & Renovations	69,498,637	5,456,860	12,711,156	87,666,656
A2 - Residential Existing Buildings	431,455,203	48,480,445	84,258,371	564,194,021
A2a - Residential Coordinated Delivery	299,080,972	27,550,868	54,471,414	381,103,256
A2b - Residential Conservation Services (RCS)	-	-	-	-
A2c - Residential Retail	113,782,061	12,458,473	23,354,558	149,595,092
A2d - Residential Behavior	18,592,170	8,471,104	6,432,398	33,495,673
B - Income Eligible	**123,705,475**	**11,700,381**	**23,384,792**	**158,790,650**
B1 - Income Eligible Existing Buildings	123,705,475	11,700,381	23,384,792	158,790,650
B1a - Income Eligible Coordinated Delivery	123,705,475	11,700,381	23,384,792	158,790,650
C - Commercial & Industrial	**457,243,270**	**63,171,668**	**107,695,787**	**628,110,727**
C1 - C&I New Buildings	107,385,263	11,233,731	23,705,207	142,324,204
C1a - C&I New Buildings & Major Renovations	107,385,263	11,233,731	23,705,207	142,324,204
C2 - C&I Existing Buildings	349,858,006	51,937,938	83,990,580	485,786,523
C2a - C&I Existing Building Retrofit	233,444,955	39,235,700	55,649,535	328,330,189
C2b - C&I New & Replacement Equipment	116,413,052	12,702,238	28,341,045	157,456,335
Grand Total	**1,081,902,585**	**128,809,355**	**228,050,106**	**1,438,762,054**

IV.D Cost-Effectiveness

3.1.i. Benefits Summary Table

Statewide Gas
October 31, 2018

	2019 Benefits						
Program	Water	Total Resource Benefits	Total GWSA Benefits	Non-Energy Impacts	Total TRC Test Benefits	Total TRC Test Benefits w/o GWSA	Total Energy Benefits per Participant
A - Residential	**6,323,291**	**240,961,721**	**35,046,077**	**69,198,879**	**310,160,601**	**275,114,521**	**319**
A1 - Residential New Buildings	-	31,241,835	4,541,216	13,926,066	45,167,901	40,626,684	4,482
A1a - Residential New Homes & Renovations	-	31,241,835	4,541,216	13,926,066	45,167,901	40,626,684	4,482
A2 - Residential Existing Buildings	6,323,291	209,719,886	30,504,861	55,272,812	264,992,700	234,487,837	280
A2a - Residential Coordinated Delivery	6,008,603	145,354,421	19,751,020	39,047,683	184,402,104	164,651,083	2,390
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	
A2c - Residential Retail	314,688	54,167,227	8,389,809	16,225,129	70,392,357	62,002,547	1,165
A2d - Residential Behavior	-	10,198,238	2,364,031	-	10,198,238	7,834,206	16
B - Income Eligible	**473,879**	**58,846,732**	**8,375,980**	**52,346,473**	**111,193,203**	**102,817,225**	**3,332**
B1 - Income Eligible Existing Buildings	473,879	58,846,732	8,375,980	52,346,473	111,193,203	102,817,225	3,332
B1a - Income Eligible Coordinated Delivery	473,879	58,846,732	8,375,980	52,346,473	111,193,203	102,817,225	3,332
C - Commercial & Industrial	**16,618,611**	**226,699,283**	**37,063,290**	**17,536,907**	**244,236,189**	**207,172,900**	**30,846**
C1 - C&I New Buildings	150,130	47,508,662	8,109,362	1,637,172	49,145,834	41,036,472	70,488
C1a - C&I New Buildings & Major Renovations	150,130	47,508,662	8,109,362	1,637,172	49,145,834	41,036,472	70,488
C2 - C&I Existing Buildings	16,468,481	179,190,621	28,953,927	15,899,734	195,090,355	166,136,428	26,844
C2a - C&I Existing Building Retrofit	16,038,276	125,643,121	19,092,809	15,899,734	141,542,855	122,450,046	30,096
C2b - C&I New & Replacement Equipment	430,205	53,547,500	9,861,118	-	53,547,500	43,686,382	21,413
Grand Total	**23,415,781**	**526,507,735**	**80,485,346**	**139,082,258**	**665,589,993**	**585,104,645**	**674**

	2020 Benefits						
Program	Water	Total Resource Benefits	Total GWSA Benefits	Non-Energy Impacts	Total TRC Test Benefits	Total TRC Test Benefits w/o GWSA	Total Energy Benefits per Participant
A - Residential	**6,437,259**	**240,652,744**	**32,503,217**	**69,940,713**	**310,593,459**	**278,090,240**	**320**
A1 - Residential New Buildings	-	31,197,359	4,281,575	14,283,475	45,480,835	41,199,259	4,394
A1a - Residential New Homes & Renovations	-	31,197,359	4,281,575	14,283,475	45,480,835	41,199,259	4,394
A2 - Residential Existing Buildings	6,437,259	209,455,385	28,221,642	55,657,238	265,112,624	236,890,981	282
A2a - Residential Coordinated Delivery	6,107,460	146,658,038	18,825,744	40,600,360	187,258,399	168,432,654	2,338
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	
A2c - Residential Retail	329,800	51,756,902	7,604,726	15,056,878	66,813,780	59,209,054	1,124
A2d - Residential Behavior	-	11,040,445	1,791,171	-	11,040,445	9,249,273	17
B - Income Eligible	**761,840**	**58,968,835**	**7,909,735**	**52,542,746**	**111,511,581**	**103,601,846**	**2,619**
B1 - Income Eligible Existing Buildings	761,840	58,968,835	7,909,735	52,542,746	111,511,581	103,601,846	2,619
B1a - Income Eligible Coordinated Delivery	761,840	58,968,835	7,909,735	52,542,746	111,511,581	103,601,846	2,619
C - Commercial & Industrial	**16,905,807**	**226,310,139**	**34,963,282**	**18,221,928**	**244,532,067**	**209,568,784**	**30,301**
C1 - C&I New Buildings	175,040	47,494,264	7,684,801	1,754,198	49,248,462	41,563,661	70,993
C1a - C&I New Buildings & Major Renovations	175,040	47,494,264	7,684,801	1,754,198	49,248,462	41,563,661	70,993
C2 - C&I Existing Buildings	16,730,767	178,815,875	27,278,481	16,467,730	195,283,605	168,005,123	26,298
C2a - C&I Existing Building Retrofit	16,291,699	126,132,080	18,106,309	16,467,730	142,599,810	124,493,502	29,877
C2b - C&I New & Replacement Equipment	439,068	52,683,795	9,172,172	-	52,683,795	43,511,622	20,436
Grand Total	**24,104,906**	**525,931,718**	**75,376,234**	**140,705,387**	**666,637,107**	**591,260,870**	**674**

IV.D Cost-Effectiveness

3.1.i. Benefits Summary Table

Statewide Gas

October 31, 2018

	2021 Benefits						
Program	**Water**	**Total Resource Benefits**	**Total GWSA Benefits**	**Non-Energy Impacts**	**Total TRC Test Benefits**	**Total TRC Test Benefits w/o GWSA**	**Total Energy Benefits per Participant**
A - Residential	**6,439,826**	**243,396,626**	**33,992,268**	**71,319,515**	**314,716,141**	**280,723,873**	**323**
A1 - Residential New Buildings	-	31,323,790	4,383,718	14,636,437	45,960,227	41,576,509	4,332
A1a - Residential New Homes & Renovations	-	31,323,790	4,383,718	14,636,437	45,960,227	41,576,509	4,332
A2 - Residential Existing Buildings	6,439,826	212,072,837	29,608,550	56,683,078	268,755,914	239,147,365	285
A2a - Residential Coordinated Delivery	6,110,077	147,281,501	19,333,939	41,406,765	188,688,266	169,354,327	2,349
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	
A2c - Residential Retail	329,749	52,534,345	7,997,415	15,276,313	67,810,658	59,813,243	1,116
A2d - Residential Behavior	-	12,256,990	2,277,196	-	12,256,990	9,979,795	19
B - Income Eligible	**194,578**	**57,754,713**	**7,979,459**	**54,208,051**	**111,962,764**	**103,983,305**	**4,434**
B1 - Income Eligible Existing Buildings	194,578	57,754,713	7,979,459	54,208,051	111,962,764	103,983,305	4,434
B1a - Income Eligible Coordinated Delivery	194,578	57,754,713	7,979,459	54,208,051	111,962,764	103,983,305	4,434
C - Commercial & Industrial	**17,155,656**	**226,210,990**	**35,698,514**	**18,498,699**	**244,709,689**	**209,011,175**	**30,054**
C1 - C&I New Buildings	175,040	47,821,488	7,911,044	1,753,310	49,574,797	41,663,754	71,163
C1a - C&I New Buildings & Major Renovations	175,040	47,821,488	7,911,044	1,753,310	49,574,797	41,663,754	71,163
C2 - C&I Existing Buildings	16,980,616	178,389,502	27,787,470	16,745,389	195,134,892	167,347,422	26,024
C2a - C&I Existing Building Retrofit	16,505,633	125,712,017	18,469,838	16,745,389	142,457,406	123,987,569	29,714
C2b - C&I New & Replacement Equipment	474,984	52,677,485	9,317,633	-	52,677,485	43,359,853	20,075
Grand Total	**23,790,060**	**527,362,330**	**77,670,241**	**144,026,265**	**671,388,594**	**593,718,353**	**682**

	2019-2021 Benefits						
Program	**Water**	**Total Resource Benefits**	**Total GWSA Benefits**	**Non-Energy Impacts**	**Total TRC Test Benefits**	**Total TRC Test Benefits w/o GWSA**	**Total Energy Benefits per Participant**
A - Residential	**19,200,376**	**725,011,091**	**101,541,562**	**210,459,107**	**935,470,201**	**833,928,634**	**321**
A1 - Residential New Buildings	-	93,762,984	13,206,510	42,845,979	136,608,963	123,402,452	4,402
A1a - Residential New Homes & Renovations	-	93,762,984	13,206,510	42,845,979	136,608,963	123,402,452	4,402
A2 - Residential Existing Buildings	19,200,376	631,248,107	88,335,052	167,613,128	798,861,237	710,526,182	282
A2a - Residential Coordinated Delivery	18,226,139	439,293,960	57,910,703	121,054,808	560,348,769	502,438,064	2,359
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	
A2c - Residential Retail	974,236	158,458,474	23,991,951	46,558,320	205,016,796	181,024,844	1,135
A2d - Residential Behavior	-	33,495,673	6,432,398	-	33,495,673	27,063,275	18
B - Income Eligible	**1,430,296**	**175,570,280**	**24,265,173**	**159,097,270**	**334,667,548**	**310,402,376**	**3,300**
B1 - Income Eligible Existing Buildings	1,430,296	175,570,280	24,265,173	159,097,270	334,667,548	310,402,376	3,300
B1a - Income Eligible Coordinated Delivery	1,430,296	175,570,280	24,265,173	159,097,270	334,667,548	310,402,376	3,300
C - Commercial & Industrial	**50,680,075**	**679,220,412**	**107,725,086**	**54,257,534**	**733,477,946**	**625,752,859**	**30,397**
C1 - C&I New Buildings	500,210	142,824,414	23,705,207	5,144,680	147,969,094	124,263,886	70,881
C1a - C&I New Buildings & Major Renovations	500,210	142,824,414	23,705,207	5,144,680	147,969,094	124,263,886	70,881
C2 - C&I Existing Buildings	50,179,865	536,395,998	84,019,878	49,112,854	585,508,852	501,488,973	26,385
C2a - C&I Existing Building Retrofit	48,835,608	377,487,218	55,668,955	49,112,854	426,600,072	370,931,117	29,895
C2b - C&I New & Replacement Equipment	1,344,257	158,908,780	28,350,923	-	158,908,780	130,557,856	20,630
Grand Total	**71,310,747**	**1,579,801,783**	**233,531,821**	**423,813,911**	**2,003,615,695**	**1,770,083,869**	**677**

IV.D Cost-Effectiveness

3.1.iii. Benefits Comparison Table - Three Year Plan vs. Previous Years

Statewide Gas
October 31, 2018

2016-2021 Benefits								
Sector	Electric Benefits							
	Capacity					Electric Energy		
	Summer Generation	Transmission	Distribution	Capacity DRIPE	Total Capacity Benefits	Electric Energy	Electric Energy DRIPE	Total Electric Energy Benefits
A - Residential	**70,073,650**	**31,385,351**	**29,648,970**	**3,759,869**	**135,268,577**	**62,249,020**	**6,667,717**	**73,488,772**
2016 Evaluated	19,227,446	7,750,898	5,759,337	1,436,606	34,174,287	13,175,061	1,158,100	14,333,161
2017 Evaluated	23,416,927	8,744,121	5,476,289	962,389	38,599,727	15,549,696	1,194,019	16,743,715
2018 Planned	20,702,420	7,349,914	6,172,999	1,330,701	35,556,034	14,980,012	420,374	15,400,386
2019 Planned	2,042,950	2,561,581	4,158,208	10,525	8,913,212	6,364,953	1,499,203	9,615,679
2020 Planned	2,260,268	2,514,743	4,082,177	10,172	9,000,405	6,102,034	1,237,110	8,801,489
2021 Planned	2,423,639	2,464,094	3,999,959	9,475	9,024,911	6,077,264	1,158,911	8,594,342
B - Income Eligible	**8,511,873**	**5,205,635**	**5,958,505**	**410,080**	**20,224,861**	**6,996,504**	**863,593**	**8,740,477**
2016 Evaluated	1,655,759	760,198	385,691	151,177	2,952,825	988,176	86,395	1,074,571
2017 Evaluated	1,912,711	700,940	456,896	79,040	3,149,586	1,110,537	58,593	1,169,130
2018 Planned	2,259,004	920,717	532,080	179,779	3,891,580	1,340,563	37,750	1,378,312
2019 Planned	811,078	919,915	1,493,296	29	3,269,614	1,125,681	222,034	1,651,308
2020 Planned	882,117	929,080	1,508,174	28	3,365,008	1,167,940	223,325	1,677,718
2021 Planned	991,204	974,786	1,582,368	28	3,596,246	1,263,607	235,497	1,789,437
C - Commercial & Industrial	**88,093**	**79,897**	**139,009**	**736**	**312,575**	**130,088**	**27,333**	**186,719**
2016 Evaluated	-	-	-	-	-	1,940	196	2,136
2017 Evaluated	23,898	3,426	14,879	-	42,203	18,790	1,298	20,088
2018 Planned	-	-	-	-	-	5,079	177	5,255
2019 Planned	19,164	25,181	40,875	242	87,056	33,676	8,423	52,292
2020 Planned	21,397	25,551	41,476	246	90,289	34,792	8,563	53,030
2021 Planned	23,633	25,738	41,779	247	93,027	35,812	8,675	53,917
Grand Total	**78,673,616**	**36,670,884**	**35,746,485**	**4,170,685**	**155,806,013**	**69,375,613**	**7,558,642**	**82,415,968**
2016 Evaluated	20,883,205	8,511,096	6,145,028	1,587,784	37,127,112	14,165,177	1,244,692	15,409,868
2017 Evaluated	25,353,537	9,448,487	5,948,064	1,041,429	41,791,517	16,679,023	1,253,910	17,932,933
2018 Planned	22,961,424	8,270,631	6,705,079	1,510,480	39,447,615	16,325,654	458,300	16,783,954
2019 Planned	2,873,192	3,506,677	5,692,379	10,796	12,269,882	7,524,310	1,729,660	11,319,279
2020 Planned	3,163,783	3,469,375	5,631,827	10,446	12,455,702	7,304,767	1,468,998	10,532,237
2021 Planned	3,438,476	3,464,618	5,624,107	9,750	12,714,185	7,376,683	1,403,083	10,437,696

IV.D Cost-Effectiveness

3.1.iii. Benefits Comparison Table - Three Year Plan vs. Previous Years

Statewide Gas
October 31, 2018

2016-2021 Benefits, Percent of Total TRC Test Benefits								
Sector	Electric Benefits							
	Capacity					Electric Energy		
	Summer Generation	Transmission	Distribution	Capacity DRIPE	Total Capacity Benefits	Electric Energy	Electric Energy DRIPE	Total Electric Energy Benefits
A - Residential	**3.8%**	**1.7%**	**1.6%**	**0.2%**	**7.3%**	**3.4%**	**0.4%**	**4.0%**
2016 Evaluated	6.2%	2.5%	1.9%	0.5%	11.0%	4.2%	0.4%	4.6%
2017 Evaluated	8.2%	3.1%	1.9%	0.3%	13.6%	5.5%	0.4%	5.9%
2018 Planned	6.6%	2.4%	2.0%	0.4%	11.4%	4.8%	0.1%	4.9%
2019 Planned	0.7%	0.8%	1.3%	0.0%	2.9%	2.1%	0.5%	3.1%
2020 Planned	0.7%	0.8%	1.3%	0.0%	2.9%	2.0%	0.4%	2.8%
2021 Planned	0.8%	0.8%	1.3%	0.0%	2.9%	1.9%	0.4%	2.7%
B - Income Eligible	**1.4%**	**0.9%**	**1.0%**	**0.1%**	**3.4%**	**1.2%**	**0.1%**	**1.5%**
2016 Evaluated	2.0%	0.9%	0.5%	0.2%	3.5%	1.2%	0.1%	1.3%
2017 Evaluated	2.0%	0.7%	0.5%	0.1%	3.3%	1.2%	0.1%	1.2%
2018 Planned	2.9%	1.2%	0.7%	0.2%	5.0%	1.7%	0.0%	1.8%
2019 Planned	0.7%	0.8%	1.3%	0.0%	2.9%	1.0%	0.2%	1.5%
2020 Planned	0.8%	0.8%	1.4%	0.0%	3.0%	1.0%	0.2%	1.5%
2021 Planned	0.9%	0.9%	1.4%	0.0%	3.2%	1.1%	0.2%	1.6%
C - Commercial & Industrial	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
2016 Evaluated	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2017 Evaluated	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2018 Planned	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2019 Planned	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2020 Planned	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2021 Planned	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Grand Total	**2.2%**	**1.0%**	**1.0%**	**0.1%**	**4.3%**	**1.9%**	**0.2%**	**2.3%**
2016 Evaluated	3.7%	1.5%	1.1%	0.3%	6.7%	2.5%	0.2%	2.8%
2017 Evaluated	4.7%	1.8%	1.1%	0.2%	7.8%	3.1%	0.2%	3.3%
2018 Planned	4.1%	1.5%	1.2%	0.3%	7.1%	2.9%	0.1%	3.0%
2019 Planned	0.4%	0.5%	0.9%	0.0%	1.8%	1.1%	0.3%	1.7%
2020 Planned	0.5%	0.5%	0.8%	0.0%	1.9%	1.1%	0.2%	1.6%
2021 Planned	0.5%	0.5%	0.8%	0.0%	1.9%	1.1%	0.2%	1.6%

Notes:

2016 values are from the Program Administrator's 2016 Plan Year Report D.P.U. 17-100, in 2016$.

2017 values are from the Program Administrator's 2017 Plan Year Report D.P.U. 18-51, in 2016$.

2018 values are from the Program Administrator's 2016-2018 Three-Year Plan, D.P.U. 15-166, in 2016$.

For supporting information on the 2019-2021 values, see Table IV.D.3.1.i. The 2019-2021 values are in 2019$.

IV.D Cost-Effectiveness

3.1.iii. Benefits Comparison

Statewide Gas

October 31, 2018

Sector	2016-2021 Benefits						
	Natural Gas Benefits			Other Benefits	Total Energy Benefits	Non-Energy Impacts	Total TRC Test Benefits
	Natural Gas	Natural Gas DRIPE	Total Gas Benefits	Water			
A - Residential	**966,664,311**	**92,299,121**	**1,155,932,963**	**30,960,660**	**1,395,650,972**	**446,937,780**	**1,842,588,755**
2016 Evaluated	148,344,285	18,311,611	166,655,896	4,430,325	219,593,670	91,574,119	311,167,789
2017 Evaluated	152,272,818	11,962,046	164,234,863	4,110,753	223,689,058	60,663,399	284,352,457
2018 Planned	165,093,368	8,088,159	173,181,527	3,219,206	227,357,154	84,241,155	311,598,308
2019 Planned	162,173,038	20,641,946	216,109,540	6,323,291	240,961,721	69,198,879	310,160,601
2020 Planned	167,137,421	18,235,296	216,413,591	6,437,259	240,652,744	69,940,713	310,593,459
2021 Planned	171,643,381	15,060,064	219,337,546	6,439,826	243,396,626	71,319,515	314,716,141
B - Income Eligible	**228,447,819**	**18,737,223**	**270,569,836**	**2,269,073**	**301,804,247**	**290,871,770**	**592,676,016**
2016 Evaluated	31,750,159	3,151,000	34,901,158	177,707	39,106,262	44,404,136	83,510,398
2017 Evaluated	36,866,148	2,323,552	39,189,701	188,402	43,696,819	52,232,169	95,928,989
2018 Planned	36,126,037	1,562,289	37,688,326	472,668	43,430,887	35,138,195	78,569,081
2019 Planned	40,686,118	4,693,427	53,451,931	473,879	58,846,732	52,346,473	111,193,203
2020 Planned	41,584,055	3,956,931	53,164,269	761,840	58,968,835	52,542,746	111,511,581
2021 Planned	41,435,302	3,050,023	52,174,451	194,578	57,754,713	54,208,051	111,962,764
C - Commercial & Industrial	**808,780,814**	**99,446,062**	**1,015,922,665**	**74,564,182**	**1,090,986,141**	**129,567,403**	**1,220,553,543**
2016 Evaluated	111,496,512	17,342,686	128,839,198	11,172,426	140,013,760	23,340,655	163,354,416
2017 Evaluated	113,102,488	11,003,641	124,106,129	10,205,791	134,374,211	23,826,453	158,200,664
2018 Planned	126,938,545	7,928,066	134,866,611	2,505,890	137,377,757	28,142,761	165,520,517
2019 Planned	147,830,483	25,057,743	209,941,325	16,618,611	226,699,283	17,536,907	244,236,189
2020 Planned	152,994,759	21,312,645	209,261,012	16,905,807	226,310,139	18,221,928	244,532,067
2021 Planned	156,418,027	16,801,281	208,908,390	17,155,656	226,210,990	18,498,699	244,709,689
Grand Total	**2,003,892,943**	**210,482,406**	**2,442,425,463**	**107,793,916**	**2,788,441,360**	**867,376,952**	**3,655,818,314**
2016 Evaluated	291,590,955	38,805,297	330,396,253	15,780,459	398,713,692	159,318,910	558,032,602
2017 Evaluated	302,241,454	25,289,239	327,530,693	14,504,946	401,760,089	136,722,021	538,482,110
2018 Planned	328,157,950	17,578,515	345,736,464	6,197,764	408,165,797	147,522,110	555,687,907
2019 Planned	350,689,639	50,393,116	479,502,795	23,415,781	526,507,735	139,082,258	665,589,993
2020 Planned	361,716,236	43,504,872	478,838,873	24,104,906	525,931,718	140,705,387	666,637,107
2021 Planned	369,496,710	34,911,367	480,420,387	23,790,060	527,362,330	144,026,265	671,388,594

IV.D Cost-Effectiveness

3.1.iii. Benefits Comparison

Statewide Gas

October 31, 2018

Sector	2016-2021 Benefits, Percent of Total TRC Test Benefits						
	Natural Gas Benefits			Other Benefits	Total Energy Benefits	Non-Energy Impacts	Total TRC Test Benefits
	Natural Gas	Natural Gas DRIPE	Total Gas Benefits	Water			
A - Residential	**52.5%**	**5.0%**	**62.7%**	**1.7%**	**75.7%**	**24.3%**	**100%**
2016 Evaluated	47.7%	5.9%	53.6%	1.4%	70.6%	29.4%	100%
2017 Evaluated	53.6%	4.2%	57.8%	1.4%	78.7%	21.3%	100%
2018 Planned	53.0%	2.6%	55.6%	1.0%	73.0%	27.0%	100%
2019 Planned	52.3%	6.7%	69.7%	2.0%	77.7%	22.3%	100%
2020 Planned	53.8%	5.9%	69.7%	2.1%	77.5%	22.5%	100%
2021 Planned	54.5%	4.8%	69.7%	2.0%	77.3%	22.7%	100%
B - Income Eligible	**38.5%**	**3.2%**	**45.7%**	**0.4%**	**50.9%**	**49.1%**	**100%**
2016 Evaluated	38.0%	3.8%	41.8%	0.2%	46.8%	53.2%	100%
2017 Evaluated	38.4%	2.4%	40.9%	0.2%	45.6%	54.4%	100%
2018 Planned	46.0%	2.0%	48.0%	0.6%	55.3%	44.7%	100%
2019 Planned	36.6%	4.2%	48.1%	0.4%	52.9%	47.1%	100%
2020 Planned	37.3%	3.5%	47.7%	0.7%	52.9%	47.1%	100%
2021 Planned	37.0%	2.7%	46.6%	0.2%	51.6%	48.4%	100%
C - Commercial & Industrial	**66.3%**	**8.1%**	**83.2%**	**6.1%**	**89.4%**	**10.6%**	**100%**
2016 Evaluated	68.3%	10.6%	78.9%	6.8%	85.7%	14.3%	100%
2017 Evaluated	71.5%	7.0%	78.4%	6.5%	84.9%	15.1%	100%
2018 Planned	76.7%	4.8%	81.5%	1.5%	83.0%	17.0%	100%
2019 Planned	60.5%	10.3%	86.0%	6.8%	92.8%	7.2%	100%
2020 Planned	62.6%	8.7%	85.6%	6.9%	92.5%	7.5%	100%
2021 Planned	63.9%	6.9%	85.4%	7.0%	92.4%	7.6%	100%
Grand Total	**54.8%**	**5.8%**	**66.8%**	**2.9%**	**76.3%**	**23.7%**	**100%**
2016 Evaluated	52.3%	7.0%	59.2%	2.8%	71.4%	28.6%	100%
2017 Evaluated	56.1%	4.7%	60.8%	2.7%	74.6%	25.4%	100%
2018 Planned	59.1%	3.2%	62.2%	1.1%	73.5%	26.5%	100%
2019 Planned	52.7%	7.6%	72.0%	3.5%	79.1%	20.9%	100%
2020 Planned	54.3%	6.5%	71.8%	3.6%	78.9%	21.1%	100%
2021 Planned	55.0%	5.2%	71.6%	3.5%	78.5%	21.5%	100%

Notes:

2016 values are from the Program Admini

2017 values are from the Program Admini

2018 values are from the Program Admini

For supporting information on the 2019-2

IV.D. Cost-Effectiveness

3.2.i. Savings Summary Table

Statewide Gas
October 31, 2018

2019 Net Savings

Program	# of Participants	Electric						Natural Gas	
		Annual Capacity (kW)		Electric Energy (MWh)		Electric Energy (MMBTU)		(Therms)	
		Summer	Winter	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
A - Residential	**756,039**	**1,994**	**1,646**	**9,673**	**102,374**	**33,002**	**349,301**	**15,797,811**	**180,553,615**
A1 - Residential New Buildings	6,970	148	114	660	11,302	2,251	38,563	1,177,798	25,616,960
A1a - Residential New Homes & Renovations	6,970	148	114	660	11,302	2,251	38,563	1,177,798	25,616,960
A2 - Residential Existing Buildings	749,069	1,846	1,532	9,013	91,072	30,751	310,738	14,620,013	154,936,655
A2a - Residential Coordinated Delivery	60,828	1,534	1,413	8,105	77,971	27,654	266,036	5,226,324	105,626,578
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	46,500	311	119	908	13,101	3,097	44,701	2,565,697	42,482,085
A2d - Residential Behavior	641,741	-	-	-	-	-	-	6,827,992	6,827,992
B - Income Eligible	**17,659**	**476**	**23**	**933**	**19,525**	**3,181**	**66,617**	**2,296,352**	**45,024,648**
B1 - Income Eligible Existing Buildings	17,659	476	23	933	19,525	3,181	66,617	2,296,352	45,024,648
B1a - Income Eligible Coordinated Delivery	17,659	476	23	933	19,525	3,181	66,617	2,296,352	45,024,648
C - Commercial & Industrial	**7,349**	**16**	**2**	**36**	**598**	**123**	**2,042**	**13,455,076**	**185,653,635**
C1 - C&I New Buildings	674	-	-	-	-	-	-	2,401,441	43,706,511
C1a - C&I New Buildings & Major Renovations	674	-	-	-	-	-	-	2,401,441	43,706,511
C2 - C&I Existing Buildings	6,675	16	2	36	598	123	2,042	11,053,635	141,947,123
C2a - C&I Existing Building Retrofit	4,175	14	-	25	396	85	1,352	7,762,286	91,519,320
C2b - C&I New & Replacement Equipment	2,501	3	2	11	202	38	690	3,291,348	50,427,803
Grand Total	**781,047**	**2,486**	**1,671**	**10,642**	**122,497**	**36,306**	**417,960**	**31,549,238**	**411,231,897**

2020 Net Savings

Program	# of Participants	Electric						Natural Gas	
		Annual Capacity (kW)		Electric Energy (MWh)		Electric Energy (MMBTU)		(Therms)	
		Summer	Winter	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
A - Residential	**750,892**	**1,825**	**1,356**	**8,321**	**96,080**	**28,391**	**327,828**	**16,382,843**	**183,436,773**
A1 - Residential New Buildings	7,100	150	113	660	11,466	2,254	39,122	1,180,518	25,836,560
A1a - Residential New Homes & Renovations	7,100	150	113	660	11,466	2,254	39,122	1,180,518	25,836,560
A2 - Residential Existing Buildings	743,792	1,675	1,244	7,661	84,614	26,137	288,706	15,202,325	157,600,214
A2a - Residential Coordinated Delivery	62,715	1,363	1,146	6,828	72,663	23,295	247,929	5,357,646	108,918,955
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	46,056	312	98	833	11,951	2,842	40,776	2,493,959	41,330,540
A2d - Residential Behavior	635,021	-	-	-	-	-	-	7,350,719	7,350,719
B - Income Eligible	**22,513**	**478**	**23**	**937**	**19,696**	**3,199**	**67,201**	**2,321,535**	**45,471,340**
B1 - Income Eligible Existing Buildings	22,513	478	23	937	19,696	3,199	67,201	2,321,535	45,471,340
B1a - Income Eligible Coordinated Delivery	22,513	478	23	937	19,696	3,199	67,201	2,321,535	45,471,340
C - Commercial & Industrial	**7,469**	**17**	**2**	**37**	**608**	**125**	**2,075**	**13,634,255**	**188,361,167**
C1 - C&I New Buildings	669	-	-	-	-	-	-	2,433,643	44,305,901
C1a - C&I New Buildings & Major Renovations	669	-	-	-	-	-	-	2,433,643	44,305,901
C2 - C&I Existing Buildings	6,800	17	2	37	608	125	2,075	11,200,612	144,055,266
C2a - C&I Existing Building Retrofit	4,222	14	-	26	401	86	1,368	7,913,247	93,762,783
C2b - C&I New & Replacement Equipment	2,578	3	2	11	207	39	707	3,287,365	50,292,482
Grand Total	**780,874**	**2,320**	**1,381**	**9,295**	**116,384**	**31,715**	**397,104**	**32,338,633**	**417,269,281**

IV.D. Cost-Effectiveness

3.2.i. Savings Summary Table

Statewide Gas

October 31, 2018

2021 Net Savings									
Program	# of Participants	Electric						Natural Gas (Therms)	
		Annual Capacity (kW)		Electric Energy (MWh)		Electric Energy (MMBTU)			
		Summer	Winter	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
A - Residential	**752,447**	**1,634**	**1,099**	**7,101**	**94,157**	**24,231**	**321,264**	**16,503,880**	**186,148,428**
A1 - Residential New Buildings	7,231	143	99	602	11,172	2,055	38,119	1,183,332	26,057,663
A1a - Residential New Homes & Renovations	7,231	143	99	602	11,172	2,055	38,119	1,183,332	26,057,663
A2 - Residential Existing Buildings	745,216	1,491	1,000	6,499	82,985	22,176	283,145	15,320,547	160,090,765
A2a - Residential Coordinated Delivery	62,695	1,174	903	5,657	70,924	19,303	241,993	5,413,859	110,535,685
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	47,053	317	97	842	12,061	2,873	41,152	2,545,728	42,194,120
A2d - Residential Behavior	635,468	-	-	-	-	-	-	7,360,960	7,360,960
B - Income Eligible	**13,026**	**502**	**24**	**988**	**20,785**	**3,372**	**70,917**	**2,287,504**	**44,951,353**
B1 - Income Eligible Existing Buildings	13,026	502	24	988	20,785	3,372	70,917	2,287,504	44,951,353
B1a - Income Eligible Coordinated Delivery	13,026	502	24	988	20,785	3,372	70,917	2,287,504	44,951,353
C - Commercial & Industrial	**7,527**	**17**	**2**	**37**	**616**	**127**	**2,103**	**13,780,861**	**190,320,667**
C1 - C&I New Buildings	672	-	-	-	-	-	-	2,471,972	44,989,094
C1a - C&I New Buildings & Major Renovations	672	-	-	-	-	-	-	2,471,972	44,989,094
C2 - C&I Existing Buildings	6,855	17	2	37	616	127	2,103	11,308,889	145,331,572
C2a - C&I Existing Building Retrofit	4,231	14	-	26	404	87	1,379	7,993,427	94,700,407
C2b - C&I New & Replacement Equipment	2,624	3	2	12	212	40	724	3,315,462	50,631,165
Grand Total	**773,000**	**2,153**	**1,125**	**8,127**	**115,558**	**27,731**	**394,284**	**32,572,245**	**421,420,448**

2019-2021 Net Savings									
Program	# of Participants	Electric						Natural Gas (Therms)	
		Annual Capacity (kW)		Electric Energy (MWh)		Electric Energy (MMBTU)			
		Summer	Winter	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
A - Residential	**2,259,378**	**5,452**	**4,102**	**25,094**	**292,611**	**85,624**	**998,393**	**48,684,533**	**550,138,816**
A1 - Residential New Buildings	21,301	441	326	1,922	33,940	6,559	115,805	3,541,649	77,511,183
A1a - Residential New Homes & Renovations	21,301	441	326	1,922	33,940	6,559	115,805	3,541,649	77,511,183
A2 - Residential Existing Buildings	2,238,077	5,011	3,776	23,173	258,671	79,065	882,588	45,142,885	472,627,633
A2a - Residential Coordinated Delivery	186,238	4,071	3,461	20,590	221,558	70,253	755,959	15,997,829	325,081,219
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-	-	-	-
A2c - Residential Retail	139,609	940	314	2,582	37,113	8,812	126,630	7,605,385	126,006,744
A2d - Residential Behavior	1,912,230	-	-	-	-	-	-	21,539,671	21,539,671
B - Income Eligible	**53,198**	**1,456**	**70**	**2,858**	**60,006**	**9,752**	**204,735**	**6,905,391**	**135,447,341**
B1 - Income Eligible Existing Buildings	53,198	1,456	70	2,858	60,006	9,752	204,735	6,905,391	135,447,341
B1a - Income Eligible Coordinated Delivery	53,198	1,456	70	2,858	60,006	9,752	204,735	6,905,391	135,447,341
C - Commercial & Industrial	**22,345**	**50**	**5**	**111**	**1,822**	**376**	**6,220**	**40,870,191**	**564,335,468**
C1 - C&I New Buildings	2,015	-	-	-	-	-	-	7,307,056	133,001,507
C1a - C&I New Buildings & Major Renovations	2,015	-	-	-	-	-	-	7,307,056	133,001,507
C2 - C&I Existing Buildings	20,330	50	5	111	1,822	376	6,220	33,563,135	431,333,962
C2a - C&I Existing Building Retrofit	12,627	42	-	77	1,201	257	4,098	23,668,960	279,982,511
C2b - C&I New & Replacement Equipment	7,703	8	5	34	621	118	2,121	9,894,175	151,351,451
Grand Total	**2,334,921**	**6,958**	**4,177**	**28,064**	**354,439**	**95,752**	**1,209,348**	**96,460,116**	**1,249,921,626**

IV.D. Cost-Effectiveness

3.2.i. Savings Summary Table

Statewide Gas
October 31, 2018

2019 Net Savings						
Program	Other Water (Gallons)		Total Savings MMBTU		Electric Energy, no Fuel Switching or ADR (MWh)	
	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
A - Residential	**55,292,139**	**387,044,970**	**1,612,783**	**18,404,663**	**9,673**	**102,374**
A1 - Residential New Buildings	-	-	120,030	2,600,259	660	11,302
A1a - Residential New Homes & Renovations	-	-	120,030	2,600,259	660	11,302
A2 - Residential Existing Buildings	55,292,139	387,044,970	1,492,753	15,804,403	9,013	91,072
A2a - Residential Coordinated Delivery	52,540,444	367,783,112	550,286	10,828,694	8,105	77,971
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-
A2c - Residential Retail	2,751,694	19,261,858	259,667	4,292,910	908	13,101
A2d - Residential Behavior	-	-	682,799	682,799	-	-
B - Income Eligible	**4,143,693**	**29,005,851**	**232,816**	**4,569,082**	**933**	**19,525**
B1 - Income Eligible Existing Buildings	4,143,693	29,005,851	232,816	4,569,082	933	19,525
B1a - Income Eligible Coordinated Delivery	4,143,693	29,005,851	232,816	4,569,082	933	19,525
C - Commercial & Industrial	**104,272,420**	**1,023,932,805**	**1,345,631**	**18,567,405**	**36**	**598**
C1 - C&I New Buildings	774,555	9,294,658	240,144	4,370,651	-	-
C1a - C&I New Buildings & Major Renovations	774,555	9,294,658	240,144	4,370,651	-	-
C2 - C&I Existing Buildings	103,497,865	1,014,638,148	1,105,487	14,196,754	36	598
C2a - C&I Existing Building Retrofit	101,278,347	988,003,931	776,313	9,153,284	25	396
C2b - C&I New & Replacement Equipment	2,219,518	26,634,217	329,173	5,043,470	11	202
Grand Total	**163,708,251**	**1,439,983,626**	**3,191,230**	**41,541,150**	**10,642**	**122,497**

2020 Net Savings						
Program	Other Water (Gallons)		Total Savings MMBTU		Electric Energy, no Fuel Switching or ADR (MWh)	
	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
A - Residential	**56,288,701**	**394,020,907**	**1,666,675**	**18,671,505**	**8,321**	**96,080**
A1 - Residential New Buildings	-	-	120,305	2,622,778	660	11,466
A1a - Residential New Homes & Renovations	-	-	120,305	2,622,778	660	11,466
A2 - Residential Existing Buildings	56,288,701	394,020,907	1,546,370	16,048,727	7,661	84,614
A2a - Residential Coordinated Delivery	53,404,864	373,834,048	559,060	11,139,825	6,828	72,663
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-
A2c - Residential Retail	2,883,837	20,186,859	252,238	4,173,830	833	11,951
A2d - Residential Behavior	-	-	735,072	735,072	-	-
B - Income Eligible	**6,661,681**	**46,631,767**	**235,352**	**4,614,335**	**937**	**19,696**
B1 - Income Eligible Existing Buildings	6,661,681	46,631,767	235,352	4,614,335	937	19,696
B1a - Income Eligible Coordinated Delivery	6,661,681	46,631,767	235,352	4,614,335	937	19,696
C - Commercial & Industrial	**106,036,013**	**1,041,637,322**	**1,363,551**	**18,838,192**	**37**	**608**
C1 - C&I New Buildings	903,068	10,836,821	243,364	4,430,590	-	-
C1a - C&I New Buildings & Major Renovations	903,068	10,836,821	243,364	4,430,590	-	-
C2 - C&I Existing Buildings	105,132,944	1,030,800,501	1,120,187	14,407,602	37	608
C2a - C&I Existing Building Retrofit	102,867,699	1,003,617,556	791,411	9,377,646	26	401
C2b - C&I New & Replacement Equipment	2,265,245	27,182,945	328,776	5,029,955	11	207
Grand Total	**168,986,395**	**1,482,289,996**	**3,265,578**	**42,124,032**	**9,295**	**116,384**

IV.D. Cost-Effectiveness

3.2.i. Savings Summary Table

Statewide Gas
October 31, 2018

Program	2021 Net Savings					
	Other Water (Gallons)		Total Savings MMBTU		Electric Energy, no Fuel Switching or ADR (MWh)	
	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
A - Residential	**56,311,145**	**394,178,013**	**1,674,619**	**18,936,107**	**7,101**	**94,157**
A1 - Residential New Buildings	-	-	120,388	2,643,886	602	11,172
A1a - Residential New Homes & Renovations	-	-	120,388	2,643,886	602	11,172
A2 - Residential Existing Buildings	56,311,145	394,178,013	1,554,231	16,292,221	6,499	82,985
A2a - Residential Coordinated Delivery	53,427,748	373,994,238	560,689	11,295,561	5,657	70,924
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-
A2c - Residential Retail	2,883,397	20,183,775	257,446	4,260,564	842	12,061
A2d - Residential Behavior	-	-	736,096	736,096	-	-
B - Income Eligible	**1,701,430**	**11,910,010**	**232,123**	**4,566,052**	**988**	**20,785**
B1 - Income Eligible Existing Buildings	1,701,430	11,910,010	232,123	4,566,052	988	20,785
B1a - Income Eligible Coordinated Delivery	1,701,430	11,910,010	232,123	4,566,052	988	20,785
C - Commercial & Industrial	**107,618,703**	**1,057,031,280**	**1,378,213**	**19,034,170**	**37**	**616**
C1 - C&I New Buildings	903,068	10,836,821	247,197	4,498,909	-	-
C1a - C&I New Buildings & Major Renovations	903,068	10,836,821	247,197	4,498,909	-	-
C2 - C&I Existing Buildings	106,715,635	1,046,194,459	1,131,016	14,535,260	37	616
C2a - C&I Existing Building Retrofit	104,265,094	1,016,787,962	799,429	9,471,419	26	404
C2b - C&I New & Replacement Equipment	2,450,541	29,406,497	331,587	5,063,841	12	212
Grand Total	**165,631,278**	**1,463,119,303**	**3,284,955**	**42,536,329**	**8,127**	**115,558**

Program	2019-2021 Net Savings					
	Other Water (Gallons)		Total Savings MMBTU		Electric Energy, no Fuel Switching or ADR (MWh)	
	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
A - Residential	**167,891,984**	**1,175,243,890**	**4,954,078**	**56,012,274**	**25,094**	**292,611**
A1 - Residential New Buildings	-	-	360,724	7,866,923	1,922	33,940
A1a - Residential New Homes & Renovations	-	-	360,724	7,866,923	1,922	33,940
A2 - Residential Existing Buildings	167,891,984	1,175,243,890	4,593,354	48,145,351	23,173	258,671
A2a - Residential Coordinated Delivery	159,373,056	1,115,611,398	1,670,036	33,264,080	20,590	221,558
A2b - Residential Conservation Services (RCS)	-	-	-	-	-	-
A2c - Residential Retail	8,518,929	59,632,492	769,351	12,727,304	2,582	37,113
A2d - Residential Behavior	-	-	2,153,967	2,153,967	-	-
B - Income Eligible	**12,506,804**	**87,547,628**	**700,291**	**13,749,469**	**2,858**	**60,006**
B1 - Income Eligible Existing Buildings	12,506,804	87,547,628	700,291	13,749,469	2,858	60,006
B1a - Income Eligible Coordinated Delivery	12,506,804	87,547,628	700,291	13,749,469	2,858	60,006
C - Commercial & Industrial	**317,927,136**	**3,122,601,407**	**4,087,395**	**56,439,767**	**111**	**1,822**
C1 - C&I New Buildings	2,580,692	30,968,299	730,706	13,300,151	-	-
C1a - C&I New Buildings & Major Renovations	2,580,692	30,968,299	730,706	13,300,151	-	-
C2 - C&I Existing Buildings	315,346,444	3,091,633,108	3,356,689	43,139,616	111	1,822
C2a - C&I Existing Building Retrofit	308,411,140	3,008,409,448	2,367,153	28,002,350	77	1,201
C2b - C&I New & Replacement Equipment	6,935,304	83,223,659	989,536	15,137,267	34	621
Grand Total	**498,325,924**	**4,385,392,925**	**9,741,763**	**126,201,510**	**28,064**	**354,439**

IV.D. Cost-Effectiveness

3.2.ii. Savings Comparison Table - Three Year Plan vs. Previous Years

Statewide Gas
October 31, 2018

2016-2021 Net Savings													
Sector	# of Participants	Electric						Natural Gas		Other		Total Savings	
		Annual Capacity (kW)		Electric Energy (MWh)		Electric Energy (MMBTU)		(Therms)		Water (Gallons)		MMBTU	
		Summer	Winter	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime	Annual	Lifetime
A - Residential	**4,095,450**	**23,342**	**12,805**	**56,434**	**789,600**	**126,282**	**1,732,040**	**93,919,560**	**1,093,334,642**	**326,306,369**	**2,284,144,586**	**9,518,238**	**111,065,504**
2016 Evaluated	569,534	5,750	2,122	8,027	150,161	11,500	232,786	14,702,874	176,381,980	59,324,499	415,271,494	1,481,787	17,870,984
2017 Evaluated	602,940	8,037	2,809	14,503	185,598	16,946	250,031	15,011,117	178,099,862	55,094,599	385,662,190	1,518,058	18,060,017
2018 Planned	663,599	4,103	3,772	8,809	161,230	12,212	250,830	15,521,036	188,713,984	43,995,287	307,967,012	1,564,315	19,122,228
2019 Planned	756,039	1,994	1,646	9,673	102,374	33,002	349,301	15,797,811	180,553,615	55,292,139	387,044,970	1,612,783	18,404,663
2020 Planned	750,892	1,825	1,356	8,321	96,080	28,391	327,828	16,382,843	183,436,773	56,288,701	394,020,907	1,666,675	18,671,505
2021 Planned	752,447	1,634	1,099	7,101	94,157	24,231	321,264	16,503,880	186,148,428	56,311,145	394,178,013	1,674,619	18,936,107
B - Income Eligible	**93,327**	**2,915**	**1,070**	**4,872**	**99,895**	**12,397**	**256,818**	**12,992,845**	**256,947,536**	**23,738,531**	**166,169,719**	**1,311,682**	**25,951,572**
2016 Evaluated	11,970	491	241	596	11,836	752	14,852	1,886,414	37,544,405	2,379,579	16,657,053	189,393	3,769,293
2017 Evaluated	13,404	546	264	656	12,960	840	16,430	2,124,809	42,756,282	2,522,802	17,659,614	213,321	4,292,059
2018 Planned	14,755	422	496	761	15,092	1,053	20,801	2,076,231	41,199,508	6,329,346	44,305,424	208,677	4,140,752
2019 Planned	17,659	476	23	933	19,525	3,181	66,617	2,296,352	45,024,648	4,143,693	29,005,851	232,816	4,569,082
2020 Planned	22,513	478	23	937	19,696	3,199	67,201	2,321,535	45,471,340	6,661,681	46,631,767	235,352	4,614,335
2021 Planned	13,026	502	24	988	20,785	3,372	70,917	2,287,504	44,951,353	1,701,430	11,910,010	232,123	4,566,052
C - Commercial & Industrial	**39,320**	**60**	**9**	**131**	**2,144**	**445**	**7,319**	**73,721,815**	**1,027,076,149**	**654,389,829**	**5,400,999,654**	**7,372,627**	**102,714,934**
2016 Evaluated	5,105	-	0	1	24	4	81	10,759,513	150,126,515	155,622,760	1,053,879,537	1,075,956	15,012,732
2017 Evaluated	4,946	10	3	16	239	54	815	10,478,990	150,432,038	151,897,182	965,219,785	1,047,953	15,044,019
2018 Planned	6,924	-	0	3	59	11	203	11,613,120	162,182,128	28,942,751	259,298,925	1,161,323	16,218,416
2019 Planned	7,349	16	2	36	598	123	2,042	13,455,076	185,653,635	104,272,420	1,023,932,805	1,345,631	18,567,405
2020 Planned	7,469	17	2	37	608	125	2,075	13,634,255	188,361,167	106,036,013	1,041,637,322	1,363,551	18,838,192
2021 Planned	7,527	17	2	37	616	127	2,103	13,780,861	190,320,667	107,618,703	1,057,031,280	1,378,213	19,034,170
Grand Total	**4,228,097**	**26,317**	**13,884**	**61,437**	**891,639**	**139,124**	**1,996,177**	**180,634,220**	**2,377,358,328**	**1,004,434,730**	**7,851,313,959**	**18,202,546**	**239,732,010**
2016 Evaluated	586,609	6,240	2,363	8,624	162,021	12,256	247,719	27,348,800	364,052,900	217,326,838	1,485,808,084	2,747,136	36,653,009
2017 Evaluated	621,290	8,593	3,076	15,175	198,797	17,840	267,277	27,614,917	371,288,182	209,514,583	1,368,541,589	2,779,332	37,396,095
2018 Planned	685,278	4,525	4,269	9,574	176,382	13,277	271,834	29,210,387	392,095,620	79,267,384	611,571,361	2,934,315	39,481,396
2019 Planned	781,047	2,486	1,671	10,642	122,497	36,306	417,960	31,549,238	411,231,897	163,708,251	1,439,983,626	3,191,230	41,541,150
2020 Planned	780,874	2,320	1,381	9,295	116,384	31,715	397,104	32,338,633	417,269,281	168,986,395	1,482,289,996	3,265,578	42,124,032
2021 Planned	773,000	2,153	1,125	8,127	115,558	27,731	394,284	32,572,245	421,420,448	165,631,278	1,463,119,303	3,284,955	42,536,329

Notes:

2016 values are from the Program Administrator's 2016 Plan Year Report D.P.U. 17-100.

2017 values are from the Program Administrator's 2017 Plan Year Report D.P.U. 18-51.

2018 values are from the Program Administrator's 2016-2018 Three-Year Plan, D.P.U. 15-166.

For supporting information on the 2019-2021 values, see Table IV.D.3.2.i.

The Progam Administrators have developed new participant definitions through the common assumptions working group for this Three-Year Plan. Historical participant numbers may not be comparable.

IV.H. Performance Incentive

1. Summary Table

Statewide Gas

October 31, 2018

2019 Performance Incentives					
Sector	Total Program Costs	Pre-Tax		After-Tax	
		Performance Incentives	% of Program Costs	Performance Incentives	% of Program Costs
A - Residential	147,588,046	3,451,754	2%	2,508,735	2%
B - Income Eligible	57,508,453	1,225,210	2%	890,482	2%
C - Commercial & Industrial	54,397,556	2,964,553	5%	2,154,637	4%
Grand Total	**259,494,054**	**7,641,517**	**3%**	**5,553,855**	**2%**

2020 Performance Incentives					
Sector	Total Program Costs	Pre-Tax		After-Tax	
		Performance Incentives	% of Program Costs	Performance Incentives	% of Program Costs
A - Residential	152,940,025	3,524,957	2%	2,561,938	2%
B - Income Eligible	58,175,586	1,262,904	2%	917,879	2%
C - Commercial & Industrial	56,062,703	3,035,014	5%	2,205,848	4%
Grand Total	**267,178,315**	**7,822,875**	**3%**	**5,685,666**	**2%**

2021 Performance Incentives					
Sector	Total Program Costs	Pre-Tax		After-Tax	
		Performance Incentives	% of Program Costs	Performance Incentives	% of Program Costs
A - Residential	156,849,931	3,664,227	2%	2,663,160	2%
B - Income Eligible	58,812,408	1,303,296	2%	947,236	2%
C - Commercial & Industrial	57,140,896	3,109,855	5%	2,260,243	4%
Grand Total	**272,803,235**	**8,077,378**	**3%**	**5,870,638**	**2%**

2019-2021 Performance Incentives					
Sector	Total Program Costs	Pre-Tax		After-Tax	
		Performance Incentives	% of Program Costs	Performance Incentives	% of Program Costs
A - Residential	457,378,001	10,640,938	2%	7,733,834	2%
B - Income Eligible	174,496,448	3,791,410	2%	2,755,597	2%
C - Commercial & Industrial	167,601,155	9,109,422	5%	6,620,728	4%
Grand Total	**799,475,604**	**23,541,770**	**3%**	**17,110,159**	**2%**

Notes:

Performance Incentives for each year are represented in nominal dollars (2019$, 2020$, 2021$).

For supporting information on the Performance Incentive, refer to the Performance Incentive Model.

Performance Incentives are not applicable to the Cape Light Compact.

V.B. Allocation of Funds

1. Low-Income Minimum

Statewide Gas
October 31, 2018

2019 Sector Cost Allocation		
Sector	Program Budget	
	($)	(% of Total)
A - Residential	147,588,046	56.9%
B - Income Eligible	57,508,453	22.16%
C - Commercial & Industrial	54,397,556	21.0%
Grand Total	**259,494,054**	**100%**

2020 Sector Cost Allocation		
Sector	Program Budget	
	($)	(% of Total)
A - Residential	152,940,025	57.2%
B - Income Eligible	58,175,586	21.77%
C - Commercial & Industrial	56,062,703	21.0%
Grand Total	**267,178,315**	**100%**

2021 Sector Cost Allocation		
Sector	Program Budget	
	($)	(% of Total)
A - Residential	156,849,931	57.5%
B - Income Eligible	58,812,408	21.56%
C - Commercial & Industrial	57,140,896	20.9%
Grand Total	**272,803,235**	**100%**

2019-2021 Sector Cost Allocation		
Sector	Program Budget	
	($)	(% of Total)
A - Residential	457,378,001	57.2%
B - Income Eligible	174,496,448	21.83%
C - Commercial & Industrial	167,601,155	21.0%
Grand Total	**799,475,604**	**100%**

Notes:
General Laws c. 25, § 19(c) requires that at least 10 percent of the amount expended for electric energy efficiency programs and at least 20 percent of the amount expended for gas energy efficiency programs be spent on low-income programs.

V.D. Outsourced/Competitively Procured Services

1. Summary Table

Statewide Gas

October 31, 2018

2019-2021 Competitively Procured Services										
Sector	Competitively Procured Services Costs ($)					Competitively Procured Services Costs as a Percent of Total Sector Costs (%)				
	Total Cost of Services	In-House Activities	Outsourced Activities			Total Cost of Services	In-House Activities	Outsourced Activities		
			Total Outsourced	Competitively Procured	Non-Competitively Procured			Total Outsourced	Competitively Procured	Non-Competitively Procured
2019	**79,760,001**	**12,074,245**	**67,685,756**	**50,206,680**	**17,479,076**	**100%**	**15%**	**85%**	**63%**	**22%**
A - Residential	45,859,605	3,786,207	42,073,397	38,585,432	3,487,965	100%	8%	92%	84%	8%
B - Income Eligible	13,744,423	1,440,600	12,303,823	2,069,942	10,233,881	100%	10%	90%	15%	74%
C - Commercial & Industrial	20,155,973	6,847,438	13,308,535	9,551,306	3,757,229	100%	34%	66%	47%	19%
2020	**83,960,833**	**12,759,608**	**71,201,225**	**53,277,072**	**17,924,153**	**100%**	**15%**	**85%**	**63%**	**21%**
A - Residential	48,762,276	4,081,422	44,680,855	41,167,496	3,513,359	100%	8%	92%	84%	7%
B - Income Eligible	14,115,229	1,521,801	12,593,428	2,135,717	10,457,711	100%	11%	89%	15%	74%
C - Commercial & Industrial	21,083,327	7,156,385	13,926,943	9,973,859	3,953,084	100%	34%	66%	47%	19%
2021	**85,683,396**	**13,487,120**	**72,196,276**	**54,125,500**	**18,070,775**	**100%**	**16%**	**84%**	**63%**	**21%**
A - Residential	49,833,977	4,451,903	45,382,075	41,878,246	3,503,829	100%	9%	91%	84%	7%
B - Income Eligible	14,344,108	1,565,339	12,778,770	2,139,807	10,638,962	100%	11%	89%	15%	74%
C - Commercial & Industrial	21,505,310	7,469,879	14,035,431	10,107,448	3,927,984	100%	35%	65%	47%	18%
Grand Total	**249,404,229**	**38,320,973**	**211,083,256**	**157,609,252**	**53,474,004**	**100%**	**15%**	**85%**	**63%**	**21%**
A - Residential	144,455,858	12,319,532	132,136,326	121,631,174	10,505,153	100%	9%	91%	84%	7%
B - Income Eligible	42,203,760	4,527,740	37,676,021	6,345,466	31,330,554	100%	11%	89%	15%	74%
C - Commercial & Industrial	62,744,611	21,473,701	41,270,909	29,632,612	11,638,297	100%	34%	66%	47%	19%

Notes:

General Laws c. 25, § 19(b) requires the Department to ensure that energy efficiency programs use competitive procurement processes to the fullest extent practicable.

Costs for the Competitively Procured Services analysis include Program Planning and Administration; Marketing and Advertising; Sales, Technical Assistance & Training; and Evaluation and Market Research.

Costs for each year in 2016-2018 are represented in nominal dollars (2016$, 2017$, 2018$).

V.D. Outsourced/Competitively Procured Services

3. Comparison Table - Three Year Plan vs. Previous Years

Statewide Gas

October 31, 2018

2016-2021 Competitively Procured Services										
Sector	Competitively Procured Services Costs ($)					Competitively Procured Services Costs as a Percent of Total Sector Costs (%)				
	Total Cost of Services	In-House Activities	Outsourced Activities			Total Cost of Services	In-House Activities	Outsourced Activities		
			Total Outsourced	Competitively Procured	Non-Competitively Procured			Total Outsourced	Competitively Procured	Non-Competitively Procured
A - Residential	**257,352,116**	**24,186,173**	**233,165,943**	**218,325,758**	**14,840,185**	**100%**	**9%**	**91%**	**85%**	**6%**
2016	36,698,324	3,803,626	32,894,699	31,482,079	1,412,620	100%	10%	90%	86%	4%
2017	37,550,096	3,922,183	33,627,913	32,184,140	1,443,774	100%	10%	90%	86%	4%
2018	38,647,838	4,140,833	34,507,005	33,028,366	1,478,639	100%	11%	89%	85%	4%
2019	45,859,605	3,786,207	42,073,397	38,585,432	3,487,965	100%	8%	92%	84%	8%
2020	48,762,276	4,081,422	44,680,855	41,167,496	3,513,359	100%	8%	92%	84%	7%
2021	49,833,977	4,451,903	45,382,075	41,878,246	3,503,829	100%	9%	91%	84%	7%
B - Income Eligible	**78,999,505**	**8,959,626**	**70,039,879**	**13,819,721**	**56,220,157**	**100%**	**11%**	**89%**	**17%**	**71%**
2016	12,158,894	1,425,169	10,733,725	2,500,258	8,233,467	100%	12%	88%	21%	68%
2017	12,202,238	1,463,083	10,739,155	2,490,830	8,248,325	100%	12%	88%	20%	68%
2018	12,434,613	1,543,635	10,890,977	2,483,167	8,407,811	100%	12%	88%	20%	68%
2019	13,744,423	1,440,600	12,303,823	2,069,942	10,233,881	100%	10%	90%	15%	74%
2020	14,115,229	1,521,801	12,593,428	2,135,717	10,457,711	100%	11%	89%	15%	74%
2021	14,344,108	1,565,339	12,778,770	2,139,807	10,638,962	100%	11%	89%	15%	74%
C - Commercial & Industrial	**109,800,190**	**38,799,473**	**71,000,717**	**53,093,504**	**17,907,214**	**100%**	**35%**	**65%**	**48%**	**16%**
2016	15,484,857	5,562,622	9,922,235	7,845,531	2,076,704	100%	36%	64%	51%	13%
2017	15,632,000	5,709,154	9,922,846	7,835,524	2,087,322	100%	37%	63%	50%	13%
2018	15,938,722	6,053,996	9,884,727	7,779,837	2,104,890	100%	38%	62%	49%	13%
2019	20,155,973	6,847,438	13,308,535	9,551,306	3,757,229	100%	34%	66%	47%	19%
2020	21,083,327	7,156,385	13,926,943	9,973,859	3,953,084	100%	34%	66%	47%	19%
2021	21,505,310	7,469,879	14,035,431	10,107,448	3,927,984	100%	35%	65%	47%	18%
Grand Total	**446,151,811**	**71,945,272**	**374,206,539**	**285,238,983**	**88,967,556**	**100%**	**16%**	**84%**	**64%**	**20%**
2016	64,342,075	10,791,416	53,550,659	41,827,868	11,722,791	100%	17%	83%	65%	18%
2017	65,384,334	11,094,420	54,289,915	42,510,493	11,779,421	100%	17%	83%	65%	18%
2018	67,021,173	11,738,464	55,282,709	43,291,369	11,991,340	100%	18%	82%	65%	18%
2019	79,760,001	12,074,245	67,685,756	50,206,680	17,479,076	100%	15%	85%	63%	22%
2020	83,960,833	12,759,608	71,201,225	53,277,072	17,924,153	100%	15%	85%	63%	21%
2021	85,683,396	13,487,120	72,196,276	54,125,500	18,070,775	100%	16%	84%	63%	21%

Notes:

General Laws c. 25, § 19(b) requires the Department to ensure that energy efficiency programs use competitive procurement processes to the fullest extent practicable.

Costs for the Competitively Procured Services analysis include Program Planning and Administration; Marketing and Advertising; Sales, Technical Assistance & Training; and Evaluation and Market Research.

The 2016-2018 costs are from the Program Administrator's 2016-2018 Three-Year Plan, D.P.U. 15-166, in nominal dollars (2016$, 2017$, 2018$).

For supporting information on the 2019-2021 values, see Table V.D.1. Costs for each year are represented in nominal dollars (2019$, 2020$, 2021$).

VII. Appendix

B.2. Summary of Activities

Statewide Gas

October 31, 2018

2019-2021 Summary								
Sector	Net Annual Savings							
	Summer Capacity (kW)	Electric Energy (MWh)	Natural Gas (Therms)	Oil (MMBTU)	Propane (MMBTU)	Wood (MMBTU)	Water (Gallons)	Total Savings (MMBTU)
2019	**2,486**	**10,642**	**31,549,238**			**-**	**163,708,251**	**3,191,230**
A - Residential	1,994	9,673	15,797,811			-	55,292,139	1,612,783
B - Income Eligible	476	933	2,296,352			-	4,143,693	232,816
C - Commercial & Industrial	16	36	13,455,076			-	104,272,420	1,345,631
2020	**2,320**	**9,295**	**32,338,633**			**-**	**168,986,395**	**3,265,578**
A - Residential	1,825	8,321	16,382,843			-	56,288,701	1,666,675
B - Income Eligible	478	937	2,321,535			-	6,661,681	235,352
C - Commercial & Industrial	17	37	13,634,255			-	106,036,013	1,363,551
2021	**2,153**	**8,127**	**32,572,245**			**-**	**165,631,278**	**3,284,955**
A - Residential	1,634	7,101	16,503,880			-	56,311,145	1,674,619
B - Income Eligible	502	988	2,287,504			-	1,701,430	232,123
C - Commercial & Industrial	17	37	13,780,861			-	107,618,703	1,378,213
Grand Total	**6,958**	**28,064**	**96,460,116**			**-**	**498,325,924**	**9,741,763**
A - Residential	5,452	25,094	48,684,533	-	-	-	167,891,984	4,954,078
B - Income Eligible	1,456	2,858	6,905,391	-	-	-	12,506,804	700,291
C - Commercial & Industrial	50	111	40,870,191	-	-	-	317,927,136	4,087,395

2019-2021 Summary									
Sector	TRC Benefits (2019$)						TRC Costs (2019$)		
	Capacity	Electric Energy	Natural Gas	Deliverable Fuels & Other	Non-Energy Impacts	Total Benefits	PA Budget	Participant Costs	Total TRC Test Costs
2019	**12,269,882**	**11,319,279**	**479,502,795**	**23,415,781**	**139,082,258**	**665,589,993**	**267,135,572**	**80,691,074**	**347,826,645**
A - Residential	8,913,212	9,615,679	216,109,540	6,323,291	69,198,879	310,160,601	151,039,800	59,272,344	210,312,144
B - Income Eligible	3,269,614	1,651,308	53,451,931	473,879	52,346,473	111,193,203	58,733,662	11,309	58,744,971
C - Commercial & Industrial	87,056	52,292	209,941,325	16,618,611	17,536,907	244,236,189	57,362,109	21,407,421	78,769,530
2020	**12,455,702**	**10,532,237**	**478,838,873**	**24,104,906**	**140,705,387**	**666,637,107**	**268,739,558**	**80,653,530**	**349,393,088**
A - Residential	9,000,405	8,801,489	216,413,591	6,437,259	69,940,713	310,593,459	152,902,357	59,207,697	212,110,054
B - Income Eligible	3,365,008	1,677,718	53,164,269	761,840	52,542,746	111,511,581	58,085,108	11,045	58,096,153
C - Commercial & Industrial	90,289	53,030	209,261,012	16,905,807	18,221,928	244,532,067	57,752,094	21,434,787	79,186,881
2021	**12,714,185**	**10,437,696**	**480,420,387**	**23,790,060**	**144,026,265**	**671,388,594**	**268,235,229**	**80,597,137**	**348,832,367**
A - Residential	9,024,911	8,594,342	219,337,546	6,439,826	71,319,515	314,716,141	153,287,731	59,302,341	212,590,072
B - Income Eligible	3,596,246	1,789,437	52,174,451	194,578	54,208,051	111,962,764	57,409,266	10,799	57,420,065
C - Commercial & Industrial	93,027	53,917	208,908,390	17,155,656	18,498,699	244,709,689	57,538,233	21,283,997	78,822,230
Grand Total	**37,439,769**	**32,289,212**	**1,438,762,054**	**71,310,747**	**423,813,911**	**2,003,615,695**	**804,110,359**	**241,941,741**	**1,046,052,100**
A - Residential	26,938,528	27,011,510	651,860,677	19,200,376	210,459,107	935,470,201	457,229,887	177,782,383	635,012,270
B - Income Eligible	10,230,869	5,118,464	158,790,650	1,430,296	159,097,270	334,667,548	174,228,036	33,153	174,261,189
C - Commercial & Industrial	270,372	159,239	628,110,727	50,680,075	54,257,534	733,477,946	172,652,436	64,126,205	236,778,641

VII. Appendix

B.2. Summary of Activities

Statewide Gas
October 31, 2018

2019-2021 Summary											
Sector	TRC Cost-Effectiveness		Cost of Saved Energy (PA Budget per annual savings unit)				Participants	Avg Measure Life (yrs.)	Annual Emissions Reductions (Short Tons)		
	B/C Ratio	Net Benefits	Summer Capacity ($/kW)	Electric Energy ($/MWh)	Natural Gas Costs ($/Therm)	Total Savings ($/MMBTU)			NOX	SO2	CO2
2019	**1.91**	**317,763,348**	**107,460**	**25,102**	**8.5**	**83.7**	**781,047**	**13**	**1.90**	**0.49**	**209,809**
A - Residential	1.47	99,848,456	75,753	15,615	9.6	93.7	756,039	11	1.74	0.45	96,716
B - Income Eligible	1.89	52,448,233	123,468	62,968	25.6	252.3	17,659	20	0.15	0.04	13,894
C - Commercial & Industrial	3.10	165,466,659	3,505,062	1,576,420	4.3	42.6	7,349	14	0.01	0.00	99,199
2020	**1.91**	**317,244,019**	**115,860**	**28,913**	**8.3**	**82.3**	**780,874**	**13**	**1.70**	**0.44**	**213,806**
A - Residential	1.46	98,483,405	83,800	18,376	9.3	91.7	750,892	11	1.54	0.40	99,311
B - Income Eligible	1.92	53,415,428	121,443	61,980	25.0	246.8	22,513	20	0.15	0.04	14,044
C - Commercial & Industrial	3.09	165,345,186	3,475,187	1,561,239	4.2	42.4	7,469	14	0.01	0.00	100,451
2021	**1.92**	**322,556,228**	**124,605**	**33,006**	**8.2**	**81.7**	**773,000**	**13**	**1.57**	**0.41**	**215,019**
A - Residential	1.48	102,126,070	93,830	21,587	9.3	91.5	752,447	11	1.40	0.36	99,504
B - Income Eligible	1.95	54,542,698	114,301	58,086	25.1	247.3	13,026	20	0.16	0.04	13,870
C - Commercial & Industrial	3.10	165,887,460	3,436,612	1,535,290	4.2	41.7	7,527	14	0.01	0.00	101,645
Grand Total	**1.92**	**957,563,595**	**115,564**	**28,653**	**8.3**	**82.5**	**2,334,921**	**13**	**5.17**	**1.33**	**638,634**
A - Residential	1.47	300,457,931	84,461	18,526	9.4	92.3	2,259,378	11	4.68	1.21	295,530
B - Income Eligible	1.92	160,406,359	119,737	61,011	25.2	248.8	53,198	20	0.47	0.12	41,809
C - Commercial & Industrial	3.10	496,699,305	3,472,287	1,557,650	4.2	42.2	22,345	14	0.02	0.00	301,296

Notes:
GHG reductions are provided for information purposes only. They are not included in the TRC test.

VII. Appendix

GHG reductions are provided for information purposes only. They are not included in the TRC test.

Statewide Gas

October 31, 2018

2019 Greenhouse Gas Reductions							
Sector	Adjusted Gross Annual Savings				Annual Emissions Reductions (Short Tons)		
	Electric Energy (MWh)	Natural Gas (Therm)	Oil (MMBTU)	Propane (MMBTU)	NOX	SO2	CO2
A - Residential	10,562	15,640,657			1.74	0.45	96,716
B - Income Eligible	933	2,296,352			0.15	0.04	13,894
C - Commercial & Industrial	36	16,954,110			0.01	0.00	99,199
Grand Total	**11,531**	**34,891,119**			**1.90**	**0.49**	**209,809**

2020 Greenhouse Gas Reductions							
Sector	Adjusted Gross Annual Savings				Annual Emissions Reductions (Short Tons)		
	Electric Energy (MWh)	Natural Gas (Therm)	Oil (MMBTU)	Propane (MMBTU)	NOX	SO2	CO2
A - Residential	9,391	16,183,168			1.54	0.40	99,311
B - Income Eligible	937	2,321,535			0.15	0.04	14,044
C - Commercial & Industrial	36	17,168,093			0.01	0.00	100,451
Grand Total	**10,365**	**35,672,797**			**1.70**	**0.44**	**213,806**

2021 Greenhouse Gas Reductions							
Sector	Adjusted Gross Annual Savings				Annual Emissions Reductions (Short Tons)		
	Electric Energy (MWh)	Natural Gas (Therm)	Oil (MMBTU)	Propane (MMBTU)	NOX	SO2	CO2
A - Residential	8,527	16,289,083			1.40	0.36	99,504
B - Income Eligible	988	2,287,504			0.16	0.04	13,870
C - Commercial & Industrial	37	17,372,105			0.01	0.00	101,645
Grand Total	**9,553**	**35,948,693**			**1.57**	**0.41**	**215,019**

2019-2021 Greenhouse Gas Reductions							
Sector	Adjusted Gross Annual Savings				Annual Emissions Reductions (Short Tons)		
	Electric Energy (MWh)	Natural Gas (Therm)	Oil (MMBTU)	Propane (MMBTU)	NOX	SO2	CO2
A - Residential	28,481	48,112,909			4.68	1.21	295,530
B - Income Eligible	2,858	6,905,391			0.47	0.12	41,809
C - Commercial & Industrial	109	51,494,309			0.02	0.00	301,296
Grand Total	**31,448**	**106,512,609**			**5.17**	**1.33**	**638,634**

Notes:

The Program Administrators have worked with DEP to properly capture the full impact of energy efficiency measures on GHG emissions. These reductions are calculated using factors prepared by DEP, which are based on adjusted gross annual electric energy, natural gas, oil, and propane savings. For projected emissions reductions in future years for the electric sector, Program Administrators are using values that are consistent with the values used in the Massachusetts Clean Energy and Climate Plan for 2020, as provided by DEP.

Appendices

D. **Council's Resolution of February 28, 2018**

EEAC Resolution Concerning Its Priorities for the Development, Implementation, and Evaluation of the 2019-2021 Three-Year Energy Efficiency Plan

February 28, 2018

Introduction

Under the Green Communities Act ("GCA"), the Energy Efficiency Advisory Council ("EEAC" or "Council") is charged with reviewing the Massachusetts Program Administrators' ("PAs") energy efficiency investment plans and budgets, which are prepared in coordination with the EEAC. The Council looks forward to continuing its collaboration with the PAs and interested stakeholders as the PAs develop a fourth robust, innovative, and cost-effective electric and natural gas statewide Plan.

This resolution articulates the EEAC's priorities for the upcoming 2019-2021 Plan, which were gathered and refined over the course of six collaborative planning workshops conducted by the Council between September 26, 2017 and January 30, 2018. Detailed briefing documents on priority topics were circulated before each workshop. During the workshops, Councilors engaged in discussion, with input from the PAs and Council Consultants, in order to develop the list of informed recommendations that is attached to this resolution..

In addition to the Council's own input at the workshops, the stakeholder perspectives received during the upcoming public listening sessions will be an important consideration in developing the 2019-2021 Plan.

Priorities

The EEAC affirms the PAs' obligation to acquire "all available energy efficiency and demand reduction resources that are cost effective or less expensive than supply," as stipulated in the GCA. In striving to meet this statutory requirement, the EEAC is requesting a 2019-2021 Plan that builds on prior Plans' achievements, notwithstanding the expected decline in claimable electric savings from residential lighting initiatives. It is the Council's strong sense that, in order to meet the requirements of the GCA, the PAs must approach the development of the 2019-2021 Plan with a willingness to implement innovative new energy efficiency and demand reduction measures and strategies, particularly in the residential, multi-family, and low-income electric sectors.

It is the Council's sense that energy efficiency investments planned under the GCA should reflect the Commonwealth's long-term greenhouse gas reduction requirements as established in the Global Warming Solutions Act ("GWSA"). This will require prioritizing from among cost-effective energy efficiency and demand reduction resources those measures and strategies that lead to greater lifetime emissions reductions. To this end, the Council wants in the plan strategic electrification of space heating and water heating equipment and other innovative approaches for achieving GWSA-supportive emissions reductions via the programs' resource acquisition framework.

The Council will prioritize continuous improvement in lifetime savings, benefits, and customer experience, in order to ensure delivery of cost-effective programs that:

1. Increase participation by, and savings from, hard-to-reach and underserved populations and geographies, including moderate income, renters, small business, and non-profits.
2. Include goals specific to active demand management and integrate the delivery of active demand management offerings within the EE programs in the 2019-2021 Plan.

3. Promote & incentivize fuel switching strategies, in all sectors, that support the Commonwealth's long term greenhouse gas reduction requirements, as established under the Global Warming Solutions Act.
4. Provide a new, integrated residential program design that maintains strong savings and benefits for all residential homeowner and rental initiatives by:
    a. Increasing customer capture,
    b. Providing new methods for realizing savings,
    c. Expanding HVAC, behavioral, financing, and upstream offerings, and
    d. Increasing conversion rates for HVAC and weatherization measures.
5. Increase program savings in the C&I sector from HVAC, process, lighting, and CHP measures.
6. Actively promote zero energy ready buildings (ZEBs) & Passivehouse for new construction and major renovations in all sectors.
7. Establish a multi-family framework that better integrates residential and commercial offerings and is cost-effective.
8. Review low-income programs for potential improvements in participation and achievement of savings, and seek additional savings & cost-efficiency opportunities, to ensure continued success.
9. Modernize data management across all PAs and sectors, enhance accessibility to and usefulness of the data to the public, and leverage additional data sources to accomplish items 1-8 above.

Recommendations

The EEAC's initial recommendations regarding priority elements of the 2019-2021 Plan are listed below. These are the result of a collaborative and deliberative process during which the Council took care to focus its attention at a strategic level, allowing the PAs the flexibility to discern the most appropriate tactics for realizing the recommendations.

The Council appreciates that the cost-effectiveness and budgeting implications of each of these recommendations, individually and in total, will be carefully considered by the PAs. The Council looks forward to continued collaboration with the PAs, and to reviewing the draft 2019-2021 Plan and the PAs' written response to these recommendations.

Cross-Sector Recommendations

Active Demand Management

Include goals specific to active demand management and integrate the delivery of active demand management offerings within the EE programs in the 2019-2021 Plan.

- Move beyond the current demand demonstrations and scale up ADM activities fully in the 2019- 2021 Plan, including claiming demand savings and quantifying impacts.
- Integrate the delivery of ADM offerings with energy efficiency program delivery.
- Develop a goal for ADM that is separate and distinct from goals for traditional EE/passive demand reduction. Plan, track, and report the capabilities, performance, and costs of active demand management separately and in a manner that will enable development of and tracking towards the active demand management goal.

Commercial and Industrial Sector Recommendations

Combined Heat and Power

The electric PAs should set a clear and increasing target to grow CHP savings by:

- Utilizing EM&V and Council feedback to streamline participation, test alternative outreach models (e.g. circuit riders with an emphasis on small/medium customers), and increase collaboration with CHP vendors.
- Addressing potential for CHP in New Construction and small CHP systems
- Continuing to explore and seek to deploy resiliency (e.g. islanding) and ownership innovations (e.g. third party or other)

C&I Process Savings

The PAs should continue to increase process savings goals (electric and gas), in addition to other end use savings from industrial customers by:

- Increasing technical assistance and support to overcome barriers and increase savings
- Demonstrating that the PAs are sharing best practices and developing statewide initiatives on common end uses
- Providing additional energy consumption data to customers, including incentives for EMIS and benchmarking of different processes

Data-Driven Customer Acquisition and Engagement Strategies; and Big Data

The PAs should create a framework and incentives to increase the presence and use of market-driven data acquisition including software, granular energy usage measurement, and monitoring based commissioning services, including adjustments to the M&V framework to facilitate this activity.

Small Business

The PAs should increase savings in the Small Business Initiative (SBI) by:

- Unifying a SBI delivery model statewide (including statewide PA-led marketing)
- Promoting uptake of comprehensive measures

- Expanding outreach strategies and committed resources to target and engage a wider range of small business customers and owners of buildings occupied by small businesses
- Establishing a statewide small business and non-profit ambassador position that can act as an ombudsman for customers

New Construction

The PAs should seek opportunities and increase resources to drive continuous improvement and effective feedback loops in the new construction and major renovation market so that a higher percentage of buildings are served and low-energy use/low-GHG buildings are measured, recognized, promoted, and emulated in the market. Specifically, actively promote zero energy ready buildings (ZEBs) & Passivehouse for new construction and major renovations. Also pay particular attention to the commercial real estate sub-sector including new construction, major renovations, and tenant fit-outs.

Lighting & Controls

The PAs should maximize C&I lighting savings by emphasizing the linear lighting market and incentivizing active demand management-enabled controls. The PAs should increase the percent of lighting opportunities used as lead generation for non-lighting projects. Methods to consider include:

- Increasing participation in lighting initiatives (including upstream) by expanding marketing, outreach and technical support to customers, contractors, and trade associations
- A new offering, including education and training, to increase the penetration and successful use of advanced lighting controls
- Expanding lighting design service support for customers and designers/engineers, through a lighting design initiative.
- Converting all company owned streetlights to LEDs by the end of the next three-year plan including strategies that incentivize use of controls to capture greater energy savings.

HVAC & Controls

The PAs should increase HVAC savings and build market capacity for future HVAC savings growth. The PAs should work toward HVAC market transformation to make right-sized energy efficient HVAC systems the norm, and take a system optimization approach for existing and new systems in order to build a long-term upward savings trajectory for the next two three-year-plans. The PAs should:

- Conduct a market baseline study that includes recommendations to increase HVAC savings in the 2022-2024 three-year plan, and lays the groundwork for potential future efforts to assess market effects.
- Promote optimized building automation systems, including retro-commissioning and persistent commissioning of existing systems and rigorous design review and commissioning of new control systems.
- Address known market barriers to upfront investment in the engineering services necessary for system optimization through innovative program offerings. Incentivize performance verification and ongoing system tuning.
- Substantially increase ongoing education and training programs for building operators.

Fuel Switching

The Council recommends that the 2019-2021 Plan include fuel switching strategies that are consistent with and support the Global Warming Solutions Act. These include opportunities to strategically electrify energy use, and to switch from inefficient equipment to more efficient fuel and/or equipment, where cost-effective. A customer should be able to choose energy efficiency services regardless of current fuel, as long as the equipment or upgrade is to efficient equipment and is cost-effective.

Municipal

PAs should seek opportunities and increase dedicated resources to align relevant programs with municipal processes, timelines and financing streams, and to enhance savings and participation.

Residential Sector Recommendations

Heating and Cooling Equipment

- Emphasize an integrated, systems-based approach to HVAC equipment promotion and installation, particularly for heat pumps and condensing boilers
- Streamline the customer experience and ensure seamless and comprehensive delivery of all measures
- Ensure service providers are broadly knowledgeable and compensated appropriately, and/or prescreen customer projects to match them with service providers with appropriate expertise
- Expand HVAC efforts by providing new active demand management and fuel switching measures along with the appropriate education of the consumer
- Expand water heating and HVAC upstream offerings, leveraging best practices and lessons learned from the C&I sector
- Enhance connections between HVAC, weatherization, and other whole-house offerings, enabling customers to engage in more holistic improvements in a single transaction or over time
- Weatherization should remain a high priority and focal point

Serving Hard to Reach and Underserved Populations and Geographies

Increase participation and savings for hard to reach populations by:

- Implementing a stakeholder engagement process to reassess program design and improve participation in renter and moderate income customer initiatives
- Identifying underserved demographic groups, developing new segmented approaches to serve them, identifying best marketing and sales approaches to reach them, and adequately funding and incentivizing these approaches
- Increasing outreach and partnerships with community based organizations and social networks, municipalities, employers, and other organizations
- Applying lessons learned from low income programs
- Using data more effectively to better target customers – specifically geo-targeting and identification of areas with linguistic barriers
- Developing new delivery models to increase participation rate of households between 60 and 80 percent median income

- Implement methods to increase access to and use of financing across all customer segments

Behavior Programs

Broaden current behavioral program strategies to include cost-efficient new approaches for customers of all Massachusetts PAs – for example, using a statewide procurement and integrating customer data for better customization

New Construction

- Offer specific low energy path(s) such as net zero energy ready and Passivehouse (multi-family) to better align with the stretch code and to drive construction of low energy buildings and market transformation
- Integrate active demand management measures that promote load shifting opportunities of solar photovoltaics, electric vehicles and chargers, and storage
- Explore opportunities to capture additional savings via major renovations

Integrated Residential Program Design

Increase participation levels and maintain strong program savings and benefits achievements for all residential homeowner and rental initiatives by providing a new integrated residential program design that:

1. **Increases customer capture**
    - Segment, target, prioritize, and customize marketing and offers to customers by leveraging remotely accessible data, third-party sources, and real-time site data
    - Increase the points of entry into the Mass Save program for customers during home improvement, financing, and other transactions, linked to incentives that meet a wider range of customer needs
    - Cultivate, diversify, and expand market channel and community partnerships to inform, recruit, and enroll customers in the program
2. **Provides new methods of realizing savings**
    - Promote cost-effective new fuel switching measures that are consistent with and support the Global Warming Solutions Act
    - Integrate new active demand management measures (e.g. EV charging) and storage into EE programs, in addition to achieving passive demand reductions through efficiency
    - Co-deliver and coordinate electric vehicles/charging, distributed energy resources, and other related services with EE programs, while ensuring primacy of energy efficiency measures
3. **Increases conversion rates for existing measures** (especially weatherization, heating and cooling)
    - Develop new audit approaches, including data-driven remote options
    - Provide an easier path and reduce barriers for customers – require fewer steps, automate and expedite the approval processes, and improve access to financing
    - Improve feedback loop and increase targeted reengagement to close on recommendations
    - Cultivate and expand trusted, long-term relationships with customers
    - Offer greater customization to customers using single measure, comprehensive, incremental, and performance-based options
    - Support sales training and recognition for individuals who are in contact with the customer.

Multi-Family Program

- Establish a multi-family retrofit program framework that seamlessly integrates residential and commercial metered savings opportunities into whole building solutions, and increases uptake of whole building measures
- Enable program tracking and energy benchmarking by building/facility to support improved customer service and provide customizable levels of service appropriate to varying customer and building types including incremental paths to whole building improvements
- Identify and present options to address market and regulatory barriers to serving multifamily properties, including a blended benefit cost ratio for multifamily core initiative
- Leverage key points in the building life cycle including refinancing
- Reexamine a pay for performance program for market rate multifamily

Low-Income Sector Recommendations

- Identify and support new and enhanced electric and gas measures and innovative strategies
- Review program model strategies to achieve additional cost efficiencies
- Identify and implement continuous improvement opportunities and document in the 2019-2021 Plan
- Assess whether there are gaps in participation and take steps to deliver equivalent and proportional services across the Commonwealth, if necessary
- Develop and demonstrate alternative measure packages and service delivery models to serve a wider and diverse range of customer needs and interests
- Ensure communication between the market rate and Low-Income Programs to identify and coordinate program innovations when applicable
- Increase outreach and partnerships with community based organizations and social networks, municipalities, employers, and other organizations

Appendices

E. **Council's Resolution of July 31, 2018**

Massachusetts Energy Efficiency Advisory Council

Resolution Regarding the April 30th Draft of the 2019-2021 Three-Year Energy Efficiency Plan

July 31, 2018

1. Introduction

Under the Green Communities Act ("GCA"), the Energy Efficiency Advisory Council ("EEAC" or "Council") is charged with reviewing the Massachusetts Program Administrators' ("PAs") draft Statewide Electric and Gas Energy Efficiency Plan ("the Draft Plan"), submitted to the EEAC on April 30, 2018. Having reviewed the Draft Plan, the EEAC, by this Resolution, provides the following comments on the Draft Plan to the Department of Public Utilities ("the Department") and the PAs.[1] The EEAC recognizes and commends the PAs on their past energy efficiency achievements, particularly in the electric sector, made during the first two years of the current 2016-2018 Plan. The Council looks forward to building on that success by leveraging the parties' collective experiences and shared commitment to design and deliver programs to achieve all available, cost-effective energy efficiency and demand management savings, for both electricity and natural gas, consistent with the GCA goals. In its February 28, 2018 Resolution, the EEAC stated its firm assessment that program innovation was needed and outlined the Council's priorities on which it expected the 2019-2021 programs to deliver. Unfortunately, while the Draft Plan mentions these priorities, the lack of program details and analytical support provided in the Draft Plan renders the Draft Plan largely non-responsive to these priorities and call for innovation.

Recognizing the PAs' ongoing commitment to energy efficiency, the Council looks forward to continuing collaboration and exchange of information among the PAs, the EEAC and its Consultants[2], and interested stakeholders throughout the summer and fall. It is the EEAC's expectation that the PAs will work with the EEAC and its Consultants to refine and improve the Draft Plan, through timely interim updates that respond to this Resolution. The Council expects to receive a much improved and stronger Revised Plan from the PAs no later than September 14th, leading to filing a Final Plan with the Department in October. In this spirit of collaboration, the Council provides the following comments on the Draft Plan in its role in shaping a 2019-2021 Final Plan that merits the concurrence and support of the EEAC.

2. Savings Goals and Program Costs

The EEAC's initial priority in evaluating the Draft Plan is to consider the level of targeted, cost-effective lifetime energy savings and related benefits achieved by the programs. The Draft Plan does not build on the programs' prior savings and benefits achieved and does not meet the GCA's mandate to acquire all available cost-effective energy efficiency and demand management resources. The PAs' proposed efficiency savings goals for gas and electric in the Draft Plan are too low and well below both the level of current achieved savings and analyzed energy efficiency potential. Consistent with the GCA, the PAs must also seek to acquire all cost-effective innovations in managing energy demand, especially at times of system peak load conditions and times when clean energy sources are constrained.

[1] Only voting members of the EEAC may vote to approve this Resolution, therefore this Resolution does not necessarily represent the individual views of all parties who have participated in the 2019-2021 Draft Plan development.
[2] "Consultant" here refers to the consultant team led by Optimal Energy, Inc., acting on behalf of the EEAC, pursuant RFR-ENE-2016-019, as amended March, 2018.

The EEAC, informed by its Consultants, supports savings goals substantially higher than those proposed in the Draft Plan, in line with the March 15th Consultants' Assessment of Potential presentation. The EEAC Consultants recommended targeting average annual electric savings goals of 3.15% of retail sales and approximately 11,500 gigawatt hours (GWh) of lifetime savings. For gas, the Consultants recommended average annual gas savings of 1.65% of retail sales and approximately 565 million therms of lifetime savings are achievable. The EEAC also supports the active electric demand savings goals in line with those recommended by the Consultants at the April 25th EEAC meeting: namely, 4.6% of total peak demand, or 437 MW by 2021, including not less than 75 MW of peak load reduction stemming from behind-the-meter energy storage.

The EEAC sees many indications that the PAs can pursue and achieve additional energy savings and benefits, beyond those reflected in the Draft Plan. Among the more significant indications of higher achievable savings are:

- The historical PA achievements, including the evaluated level of savings in 2017 (for electric: annual savings as a percentage of retail sales of 3.18%, and 14,419,888 MWh of lifetime savings; and for gas: annual savings as a percentage of retail sales of 1.20%, and 371,288,182 therms of lifetime gas savings)
- The historical PA achievements of 213 MW of summer capacity savings in 2017 from energy efficiency programs alone;
- The EEAC Consultants' March 10th Assessment of Potential for achievable energy efficiency savings (3.15% of annual sales for electric and 1.65% for gas);
- The EEAC Consultants' April 25th Assessment of Potential for active electric demand management including storage (electric demand savings of 4.6% of total peak demand, or 437 MW by 2021, including at least 75 MW of peak load reduction stemming from behind-the-meter energy storage)
- The energy efficiency savings goals needed to align with the Massachusetts Clean Energy and Climate Plan for 2020 and longer term GWSA targets for 2030;
- Individual PA potential studies showing portfolio electric savings as high as 3.63% of retail sales and portfolio gas savings as high as 2.95% of retail sales; and
- The benefit/cost ratios for the programs in the PAs' Draft Plan (2.03 electric and 1.72 for gas).

The EEAC recognizes the significance of the electric energy efficiency programs' serving oil and propane consumers in a fuel-neutral manner and supports the PAs' proposal to utilize MMBtus as a common measurement of achievement for the electric programs. However, the EEAC will continue to rely on, and expects the PAs to report lifetime and annual electric, oil, and propane savings in parallel to MMBTUs for the electric PAs. The EEAC will also continue to rely on the PA reporting quarterly on all fuel metrics provided in the D.P.U. 08-50 Tables along with reductions in annual and lifetime greenhouse gas emissions. The EEAC will continue to rely on lifetime and annual Therms saved as the measurement of achievement for the gas programs, and the EEAC does not see a need for considering MMBtus as a measurement of achievement for the gas programs because the gas PAs, unlike the electric PAs, do not serve oil or propane customers.

Given the marked differences in achievable savings goals and program costs between the Council's Consultants and the Draft Plan, it is apparent that some of the planning assumptions made by the PAs in the Draft Plan differ from those assumptions made by the EEAC Consultants in their March 15th recommendation. The EEAC appreciates the collaborative effort that the PAs and Consultants have expended in recent weeks exploring the main assumptions that account for these differences and expects that the "key drivers" process will conclude in August, with results presented at the August EEAC

Meeting. The EEAC anticipates that these results will include detailed information from the Consultants and PAs on each of the identified Key Drivers, differences in initial assumptions, updates to planning assumptions, and the impact of those updates on 2019-2021 forecasted energy savings and program costs.

The EEAC notes that, in 2017, the PAs achieved electric savings substantially above plan year goals while spending close to budgeted costs. The PAs' hard work in overcoming sector level challenges to achieve these nation-leading levels of savings is noteworthy and appreciated. 2017 also saw achieved gas savings near plan year goals while 2017 spending by the PAs came in significantly below budgeted costs. The 2019-2021 Three-year plan will mark a decade of gas efficiency programs under an all cost-effective mandate in Massachusetts. The Council reasonably expects to see these mature programs deliver increasing savings in line with the assessment of potential and historical costs to achieve.The Council looks forward to a Revised and Final Plan that builds on the Draft Plan to maximize allocation of funding for programs that directly benefit ratepayers including participant incentives, outreach, education, and technical assistance.

Notwithstanding the potential for assumptions to change through the "key drivers" process, the PAs' most recent results indicate that the steep increase in proposed program costs to achieve in the Draft Plan are not merited. The Council requires a more detailed understanding of the PAs' planning assumptions including detailed and reasonable justification of costs to achieve savings. This justification should include factual support linked to program redesign, participation levels, specific baseline changes, new initiatives, deeper savings, or incorporation of the EEAC's recommendations.

The EEAC expects that the Revised Plan will provide significantly higher savings goals at similar or lower costs to achieve, while clearly demonstrating that the PAs seek to acquire all available cost-effective energy efficiency consistent with the GCA. Natural gas constraints in recent winters have resulted in significant cost impacts to electric and gas ratepayers, and underscore the need for the Revised Plan to achieve greater and better targeted energy savings across both the electric and gas programs. The EEAC expects the PAs to consider additional cost-effective measures that directly address winter peaks, including comprehensive streetlight and other outdoor lighting retrofits and winter gas demand management. The EEAC requires that the Revised Draft provide more specificity and back-up data for the proposed goals in general, and, more specifically, a complete and updated cost-benefit screening tool data from each PA. The updated cost-benefit screening tools should include updated 2018 Avoided Energy Supply Costs (AESC) values, including forthcoming Massachusetts-specific Avoided Cost of Compliance with GWSA[3].

3. Priorities, Comments, and Recommendations

The following section contains the Council's detailed review and feedback on the responsiveness of the Draft Plan to the Council's February Resolution. The Council appreciates the PAs' recognition of certain Council priorities, but the Draft Plan does not sufficiently address any of the recommendations. Therefore, all the Council's priorities and recommendations in its February Resolution remain a present concern, and the Council thus reiterates its priorities below. The Council expects that the Revised Plan will provide significantly more detail, in terms of narrative, supporting data, and assumptions, which demonstrate how the PAs propose to address each of the Council priorities and recommendations throughout 2019-2021. The Council proposes below Key Indicators for each recommendation and expects the Revised Plan to specifically describe how the PAs will address and monitor each one.

[3] The Council expects results from the Avoided Cost of Compliance with GWSA study as a supplement to the 2018 New England AESC study in August.

a. Underserved Populations and Geographies

Priority:

Increase participation by, and savings from, hard-to-reach and underserved populations and geographies, including moderate income, renters, small business, and non-profits.

Council Assessment of Draft Plan

Ensuring that customers have equitable access to energy efficiency programs has been a consistent priority of the Council. Based on data available, efforts to target and increase services to moderate income customers, renters, and small businesses in the 2016-2018 plan period have been generally ineffective. The Council is especially disappointed with participation in the PAs' moderate income initiative. Although the Draft Plan expresses a commitment to reaching underserved customers it lacks detail on how this will be accomplished. In the residential sector, this commitment is supported by broadly stated strategies to increase simplicity, ease of participation, and access, along with using data-driven approaches to reach customers. For C&I customers, the PAs highlight improving small business savings and experience by expanding segmentation and negotiated incentives into the small business category. There is also discussion about expanding the Main Streets approach pioneered by Eversource and the customer directed option pioneered by National Grid to the other PAs. While these strategies appear promising, there are insufficient details in the Draft Plan narrative and supporting data for the EEAC to assess whether these planned enhancements or expansions will lead to increased participation and savings. The Council expects further details and specific commitments in the Revised Plan. The Council would also like to see concrete opportunities for municipalities and non-profits (or organizations representing non-profits) to partner directly with PAs to advance the shared goal of promoting energy efficiency and reaching underserved populations and geographies.

Key indicators associated with priority

- # of participants for specific customer groups
  - 60-80% State Median Income (SMI)
  - Renters
  - Non-English speakers
  - Small businesses
- Ratios of participation, incentive spending and lifetime MMBtu/household savings for specific customer groups vs. market rate participants
- Participants per capita by zip code by sector
- Number of partnerships on energy efficiency campaigns with the municipal seal of approval

b. Active Demand Management

Priority:

Include goals specific to active demand management and integrate the delivery of active demand management offerings within the EE programs in the 2019-2021 Plan.

Council Assessment of Draft Plan:

The EEAC continues to support the development and implementation of effective active demand management (ADM) program offerings, including behind-the-meter energy storage (battery and thermal storage), in 2019-2021. The Draft Plan included a residential direct load control ADM offering targeting customers with connected efficiency equipment (starting with Wi-Fi thermostats), and a large commercial, technology-agnostic, performance-based, load curtailment offering, both of which were proposed

statewide. While these two statewide offerings are useful first steps, the amount of ADM proposed in the Draft Plan is too low. The EEAC Consultants' April 25th Assessment of Potential for active demand management estimated potential demand savings equivalent to 4.6% of total peak demand, or 437 MW by 2021, including at least 75 MW of peak load reductions from behind-the-meter storage, based on the results from two PA demand potential studies, which the Consultants extrapolated to all PAs. The amount of ADM proposed in the Draft Plan is less than 30% of the ADM potential estimated by the EEAC Consultants. The Draft Plan includes significant variation in the volume and scope of ADM across the PAs, with some PAs proposing very low levels. Only one PA (Cape Light Compact) proposed behind-the-meter energy storage in the Draft Plan. In addition, both the Residential and C&I proposed ADM offerings were based on summer electricity peak demand only, leaving opportunities to manage electric and gas winter demand un-addressed. The EEAC does not consider its original recommendation satisfied by the Draft Plan and therefore re-emphasizes its recommendation.

The Revised Plan should include: (1) much higher target levels of peak load ADM, including where cost-effective an upfront rebate program for behind-the-meter storage, as part of every PA's offerings; (2) ADM that addresses opportunities to manage both summer and winter demand; (3) MW savings goals specific to ADM; and (4) programs addressing winter gas demand management. Further, the Revised Plan should include a clear description of how the promotion and delivery of all proposed ADM peak load reduction offerings are fully integrated with the EE program delivery. The EEAC expects the PAs to work with DOER and other stakeholders to ensure coordination across the ADM programs proposed in the Revised Plan with other Massachusetts programs, such as Solar Massachusetts Renewable Target (SMART).

Key indicators associated with priority

- ADM MW in summer, and ADM MW in winter, with sub-categories for battery storage and thermal storage
- Conversion rate (% of all outreach offers that have enrolled)
- Penetration (e.g., % of customers with wifi thermostats who have enrolled)
- Performance by technology or service (% of enrollments that have performed)

c. Fuel Switching

Priority:

Promote & incentivize fuel switching strategies, in all sectors, that support the Commonwealth's long term greenhouse gas reduction requirements, as established under the Global Warming Solutions Act.

Council Assessment of Draft Plan

The Council supports fuel switching strategies that are consistent with and support the greenhouse gas reduction goals of the Global Warming Solutions Act. These include opportunities for electric PAs to strategically electrify energy use by converting oil and propane customers to high efficiency air source heat pumps. The 2019-2021 Plan suggests that the PAs will provide an "energy optimization" approach to program delivery, which is intended to be a more holistic and integrated approach, to help customers make informed decisions to decrease overall energy use. The proposed approach is fuel-neutral and should enable customers to access efficiency services, regardless of current fuel, as long as the customer is upgrading to efficient, cost-effective equipment. However, the Draft Plan and associated Benefit-Cost Ratio (BCR) models do not specify how savings from fuel switching will be counted and incentivized. The Council seeks to ensure alignment of energy efficiency investments and savings goals with the GWSA and needs additional information on the PAs' approach to fuel switching. This should

include calculations for savings from fuel switching, broken down by fuel, and a detailed description of how the PAs' will convert customers from oil and propane to support beneficial electrification and all-electric new construction. The Council expects the PAs to work with the EEAC Consultants on issues related to evaluation, measurement, and verification of fuel switching savings and benefits in advance of the Revised Plan.

Key indicators associated with priority

- Number of heat pump and heat pump water heater installations by initial heating fuel type, sector, and market segment

d. Integrated Residential Program Design

Priority:

Provide a new, integrated residential program design that maintains strong savings and benefits for all residential homeowner and rental initiatives by:

- *Increasing customer capture,*
- *Providing new methods for realizing savings,*
- *Expanding HVAC, behavioral, financing, and upstream offerings, and*
- *Increasing conversion rates for HVAC and weatherization measures.*

Council Assessment of Draft Plan

Given declining claimable electricity savings from residential lighting initiatives and other market developments, the Council continues to support a comprehensive redesign for the residential retrofit and retail programs. The PAs' Draft Plan presents a new program reporting structure with single family (Home Energy Services or HES) and multi-family retrofit offers, previously addressed in two separate initiatives, combined into a single new Residential Coordinated Delivery Initiative. However, the PAs' Draft Plan does not provide sufficient detail regarding how, nor a timeline showing when, this updated retrofit program design will be implemented. Further, BCR model inputs and calculations are similar to that offered in 2016-2018 rather than reflecting an updated approach to delivery of the residential programs. The Council will need additional program design details, a timeline for implementation, and updated BCR model inputs with higher residential savings goals before it is able to consider a favorable recommendation regarding the new residential program. Given the contemplated reduction in emphasis on audits, the PAs should also provide specific details regarding plans to continue to achieve savings and participation from weatherization and major measures including training for public-facing professionals.

Key indicators associated with priority

- Number of Home Energy Assessments planned and Conversion rate for recommended-to-installed weatherization and major measures (separately for single and multi-family)
- Total MMBtu savings per household
- Number of contractor trainings planned and number of people to be trained on new initiative and offerings

e. C&I Sector Savings Measures

Priority:

Increase program savings in the C&I sector from HVAC, process, lighting, and CHP measures.

Council Assessment of Draft Plan

The Draft Plan's proposed savings in the C&I sector are too low and do not meet the GCA mandate of "all cost-effective energy efficiency." The EEAC believes there is still significant opportunity in C&I lighting (including controls), HVAC, and process end uses, based on evidence in: the PA potential studies; the MA onsite study; and the Consultant Assessment of Potential. However, the Draft Plan savings are flat or declining from current achieved levels for those end uses rather than a year over year increase, as recommended by the EEAC and the Consultant Assessment of Potential. The EEAC calls for an increase in program savings targets in the C&I sector from HVAC, process, and lighting measures in the Revised Plan. Since submission of the Draft Plan, the PAs have worked with the Consultants to confirm the details of the CHP projections in the Draft Plan. The Council is pleased with the progress of discussions related to CHP and looks forward to seeing a Revised Plan that reflects an increase to CHP projections for 2019-2021, including additional savings estimates for a known, large CHP project..The Revised Plan should also include more detail on the Commercial Real Estate (CRE) offering, including a description of how all recommendations from the 2015 CRE Working Group report will be rolled out statewide in 2019-2021 to expand to more geographies and CRE business types. The Council also expects further detail and specific commitments in the Revised Plan regarding proposed C&I Market Segmentation, specifically regarding program offerings that address challenges currently faced by the municipal market segment.

Key indicators associated with priority

- Savings from lighting and HVAC controls by PA
- Process savings statewide
- CHP savings and project information in line with current reporting practices
- Savings and participation rates broken out by customer consumption size bin, in line with the C&I Customer Profile

- Square Footage projected to be served, number of individual customers, and energy savings projections by PA for the CRE-specific offering

f. Zero Energy Ready Buildings and Passive House

Priority:

Actively promote zero energy ready buildings (ZEBs) & Passive House for new construction and major renovations in all sectors.

Council Assessment of Draft Plan:

In the Draft Plan, the PAs state support for construction of Zero Energy Ready Buildings (ZEBs) and Passive House-compliant buildings through the delivery of targeted education/trainings, technical support and incentives for both commercial and residential customers. The Council is pleased to see the support for these building types expressed in the Draft Plan. The Council requests additional detail to understand how the PAs' planned efforts will translate into spending and savings, what volume of production is expected, and whether the general strategies presented will yield significant results. The Council requests more specificity in how ZEBs and Passive House will be supported beyond education and trainings.

Key indicators associated with priority

- # and % of planned new construction projects built to ZEB or Passive House standards
- # of trainings planned and # of people to be trained in ZEB construction and Passive House construction techniques

- Average % of building energy savings compared to baseline from New Construction programs

g. Integrated Multi-Family Framework

Priority:

Establish a multi-family framework that better integrates residential and commercial offerings and is cost-effective.

Council Assessment of Draft Plan:

The PAs have provided fully integrated residential and C&I services to the multi-family high rise new construction and low income multi-family market segments for some time. However, integrating retrofit multi-family services for the market rate program has been more challenging. Although the PAs have made incremental improvements to the program in recent years, several factors within the residential sector have prompted the PAs to combine the Multi-family Retrofit and HES Initiatives into a combined Residential Coordinated Delivery Initiative. The Draft Plan indicates that smaller multi-family buildings will receive HES-style services while larger multi-unit buildings will follow a more customized path. While this general approach seems promising, the Council has unanswered questions regarding planned participation levels (in all relevant initiatives), how the general strategies will be specifically implemented and represent full residential and C&I integration, and what savings and costs are expected from multi-family energy efficiency projects. The Council specifically expects the PAs to separately track and report single family and multi-family buildings and multi-family dwelling units served within all initiatives serving both building types (Residential, C&I and Low Income; new and existing buildings).

Key indicators associated with priority

- Close rates (for example, audits to projects)
- Savings and number of participants broken out by residential and multi-family C&I

h. Low Income Programs

Priority:

Review low-income programs for potential improvements in participation and achievement of savings, and seek additional savings & cost-efficiency opportunities, to ensure continued success.

Council Assessment of Draft Plan

The Draft Plan states that the low-income program approach will preserve existing implementation and marketing strategies. Recruiting low-income participants through a partnership with the federal Low-Income Home Energy Assistance Program (LIHEAP) has been effective and the Council supports this continued approach. There are additional opportunities available to recruit participants that the PAs, in coordination with LEAN, should include in their Revised Plan. Further, the Draft Plan does not propose any new electric or gas savings measures, despite indications that Low-income Energy Affordability Network (LEAN) has been actively exploring them. The Draft Plan also does not include participation numbers, nor identify any specific ideas that could reduce the cost to deliver the program. The EEAC expects to see a Revised Plan with low-income programs that actively seek improvements in recruitment, participation and achievement of savings, and that makes a clear commitment to incorporating additional cost-effective savings measures and cost efficiency opportunities such as strategic electrification with cold-climate heat pumps.

Key indicators associated with priority

- Total savings and average total cost and savings per participant household
- # of participants by referral source
- # of participating households receiving each measure
- # of heat pump conversion projects from oil and propane
- # of customers on the low-income rate who have not participated

i. Data Management

Priority:

Modernize data management across all PAs and sectors, enhance accessibility to and usefulness of the data to the public, and leverage additional data sources to accomplish items a-h above.

Council Assessment of Draft Plan:

The delivery of the Mass Save programs would significantly benefit from the adoption of a common data platform across PAs, capable of tracking and motivating customer progress in energy efficiency measures over time and enabling two-way online engagement with customers. The PAs have already adopted a customer segmentation approach to serve large and mid-sized C&I customers. The EEAC believes that it will become increasingly imperative to understand and target specific customer needs in the residential and small business sectors, particularly in light of the expected draw-down in claimable electricity savings from screw-in lighting over 2019-2021. In order to better understand and target customers, PAs should coordinate around a common platform to seamlessly share this data among PAs where customers are served by more than one PA.

This need for better coordinated and more comprehensive customer data management is separate from, but intrinsically related to, the EEAC's desire for improved tracking and reporting of the results of Mass Save ratepayer investments. As noted by the Council in its resolution on the 2016-2018 Plan, the need for, and benefits from, improved tracking and reporting have yet to be satisfactorily resolved by the Mass Save Data website, and a common and modern data platform should be designed to save significant time and costs in tracking and reporting across the program administrators.

Prior to full implementation of a common data platform, the statewide databases constructed by EM&V after the completion of each program year form the best available resource for understanding participation trends. It is therefore critical that EM&V databases be constructed as quickly as possible. The Revised Plan should include a detailed description and timeline for how the PAs will coordinate and implement a common data management platform for customer engagement and comprehensive tracking and reporting of Mass Save investments and results.

j. Performance Incentives

The EEAC continues to support the concept and use of performance incentive payments to the PAs to encourage and reward the achievement of ambitious energy and demand savings goals. Performance incentives for the 2019-2021 Plan were not addressed by the Council during the EEAC workshops, and therefore the EEAC did not include a recommendation on performance incentives in its February, 2018 resolution. The PAs' Draft Plan proposed placeholder performance incentives based on the current performance incentive level and design. The EEAC expects to discuss the need for changes in performance incentive design and the incentive mechanism this summer, and may consider revisions to both the level of incentive payments and the design of the performance incentive mechanism, which it would expect the PAs to address in the Revised Plan.

The EEAC Consultants have suggested that an additional component be added to the performance incentive mechanism for 2019-2021, in addition to the two components in the current mechanism ("savings" based on benefits, and "value" based on net benefits). The additional component would be focused on specific, quantifiable key performance indicators. Performance incentive categories will be discussed prior to the Revised Plan.

Appendices

F. **Agreement of October 19, 2019 on Certain Terms between Attorney General, DOER, and Program Administrators**

Final Version – October 19, 2018

2019-2021 ENERGY EFFICIENCY PLAN TERM SHEET

CORE 2019-2021 PRINCIPLES

- **Energy efficiency is a cornerstone of the Commonwealth's long term energy policy**. The 2019-2021 Plan ("Plan") reflects this key role and builds upon the high level of success of the Mass Save® program and pivots to more fully embrace demand savings and fuel switching to clean energy resources consistent with the Green Communities Act, G.L. c. 25, §21, as most recently updated by "An Act to Advance Clean Energy" enacted on August 9th, 2018. The net savings included in this term sheet take into account improvements to standard practice that have been driven by the PAs' past energy efficiency programs, evolving codes and standards, and recent Evaluation, Measurement, and Verification ("EM&V") results.
- This effort will yield an estimated $8.561 billion in benefits to customers, and **GHG reductions** of 2,759,500 million short tons of CO_2e.
- The Plan will embrace a broader energy system view by providing new tools to help all customers reduce system costs by **reducing energy and lowering demand at peak periods**. The Plan has a focus on peak demand reductions in both summer and winter that can help minimize total system costs and the use of inefficient and constrained generation sources.
- The Plan will target savings to support the Commonwealth's **winter reliability** efforts and drive down winter electric demand by 500 MW. The PAs will introduce new active demand offerings targeting winter demand.
- The Plan introduces an overarching "**Energy Optimization**" philosophy across all sectors, which includes providing customers with fuel neutral educational materials and assistance on all options for heating and cooling. This philosophy means that the Plan will provide a more holistic and integrated approach to helping customers address their energy use and associated costs based on their individual needs and goals, while aligning with the broader state clean energy policy and greenhouse gas emissions goals for 2020 and beyond. In some instances, for example, this may mean helping customers utilize energy more efficiently and reduce greenhouse gas emissions by increasing electric usage through the adoption of state-of-the-art **air source heat pumps**.
- The PAs will offer enhanced strategies and community outreach efforts to increase participation and savings from **renters, moderate income customers, and non-English speaking customers**.

Final Version – October 19, 2018

2019-2021 GOALS SUMMARY

Statewide Summary

	2019-2021
Net Lifetime MMBTUs	**261,931,735**
CO2e Reductions	**2,759,578**
Benefits ($M)	**$ 8,560.8**
Budget ($M)	**$ 2,794.5**

Statewide Electric Summary

	2019-2021
Net Annual MWh (No FS)	**3,461,294**
Net Lifetime MWh (No FS)	**35,672,978**
Net Annual Site MMBTUs (EE other than CHP)	10,892,732
Net Annual Source MMBTUs from CHP	1,107,268
Total Adjusted Annual MMBTU	**12,000,000**
Net Lifetime Site MMBTUs (EE other than CHP)	120,396,475
Net Lifetime Source MMBTUs from CHP	22,071,692
Total Adjusted Lifetime MMBTU	**142,468,167**
Summer MW (including Active)	**665**
Winter MW (including Active)	**500**
CO2e Reductions	**2,137,288**
Benefits ($M)	**$ 6,560.8**
Budget ($M)	**$ 1,995.0**
Performance Incentive ($M)	**$ 114.0**

Statewide Gas Summary

	2019-2021
Net Annual Therm	**95,886,212**
Net Lifetime Therm	**1,192,251,177**
Net Lifetime MMBTUs	**119,463,568**
CO2e Reductions (Tons)	**622,290**
Benefits ($M)	**$ 2,000.0**
Budget ($M)	**$ 799.5**
Performance Incentive ($M) (Design Level)	**$ 23.0**

Final Version – October 19, 2018

CORE TERMS

The Program Administrators, the Department of Energy Resources, and the Office of the Attorney General (together, the "Parties"), each will support 2019-2021 energy efficiency statewide savings goals of 2.70% of retail sales for electric Program Administrators ("PAs") and 1.25% of retail sales for gas PAs, along with MW savings, MMBtu savings, budgets, benefits (inclusive of avoided costs of GWSA compliance), and performance incentives as set forth in Attachment A.[1]

The summary information in Attachment A is provided at a three-year, rolled up level. The Program Administrators will provide updated sets of PA-specific and statewide rolled-up energy efficiency data tables and benefit-cost models in the final 2019-2021 Plan that are consistent with, and derived from, this Term Sheet.

This Term Sheet outlines three-year savings, budget, and other terms that have been negotiated, with supporting details to be provided in the Plan.[2] This framework is designed with an expectation of a detailed review of the full Three-Year Plan, but all Parties support each of the overall terms set forth herein.

SAVINGS/BUDGETS/BENEFITS

Electric PA Savings Goals[3]:

- 2.7% of sales statewide for electric PAs (2019-2021 average)
- Net annual MWh of 3,461,000, and net lifetime MWh of 35,600,000 (excluding fuel switching and active demand)
- Lifetime MMBtu savings (excluding active demand) of 120.4 site MMBtu from energy efficiency other than CHP and 22.1 source MMBtu from CHP, totaling at least 142.5 million adjusted lifetime MMBtu savings (excluding active demand)
- Active demand of 200 MW summer and 50 MW winter[4]
- Total demand of 665 MW summer and 500 MW winter
- See Attachment A for other data points

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1 As a public entity, the Cape Light Compact JPE is not eligible for performance incentives.

2 The annual net electric MWh (excluding active demand and fuel switching) divided by the statewide electric sales forecast is 2.7%. The annual net gas therms (excluding fuel switching) divided by the statewide gas sales forecast is 1.25%. As the programs evolve, the Parties believe that percent of sales should eventually be replaced as a core metric.

3 Primary electric goals are expressed in lifetime MWh and adjusted lifetime MMBtus to reflect the full system benefits of the electric Program Administrators' energy efficiency efforts, inclusive of all fuel savings. Annual MWh values are provided for informational and continuity purposes, and will continue to be reported.

4 The PAs will report on active and passive demand savings, and break down savings by demand approaches (including without limitation, residential storage, C&I storage, residential direct load control, and C&I curtailment) bi-annually in the quarterly reports.

Gas PA Savings Goals[5]:

- 1.25% of sales statewide for gas PAs (2019-2021 average).
- Net annual therms of 95,886,000, and net lifetime therms of 1,192,000,000.
- Lifetime MMBtu savings of at least 119.4 million MMBtus.
- See Attachment A for other data points.

Budgets: $1.995 billion for the three-year term for electric PAs and $799.5 million for gas PAs. Final budgets will depend on final program measure mixes to be provided in detailed data tables by the PAs.

Benefits: $6.561 billion or more for electric PAs and $2 billion or more for gas PAs. Final benefits will depend on final program measure mixes.

PERFORMANCE INCENTIVES

The Parties have agreed to a statewide performance incentive mechanism that includes portfolio savings and value components, with an additional specific active demand savings component designed to encourage the PAs to pursue active demand benefits. The mechanism also includes a unique renter component designed to provide additional incentives for service of renters. The amounts allocated to each of the components are set forth in the tables below.

Electric Performance Incentive Totals		
Value Component (Energy Efficiency, Passive Demand, and Active Demand)	$41.195 million	$107 million (38.5% Value and 61.5% Savings)
Savings Component (Energy Efficiency and Passive Demand)	$65.805 million	
Savings Component (Active Demand)	$5 million	
Renter Component	$2 million	
Total	$114 million	

- The base electric performance incentive mechanism will include a value component (net benefits) and a savings component (total benefits).
    - The value component pool is 38.5% of the $107 million pool (or $41.195 million).
        - The value component payout rate will be PI $ per planned portfolio net benefits.
        - The threshold for earning performance incentives for the value component will be based on achieving 75% of planned portfolio net benefits.

[5] Primary gas goals are expressed in lifetime MMBtus and therms. Annual therm values are provided for informational and continuity purposes, and will continue to be reported. Oil savings from any oil-to-gas heating conversions are not included in MMBtu and benefits calculations.

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- Performance incentives for the value component will be capped at 125% of design level.

o The savings component is divided into two performance pools: (1) 61.5% of the $107 million pool (or $65.805 million) that is allocated to energy efficiency and passive demand and (2) the $5 million pool for active demand reduction.

- The energy efficiency and passive demand savings component payout rate will be established based on PI $ per planned total benefits from energy efficiency and passive demand.
- The threshold for earning performance incentives for the energy efficiency and passive demand savings component will be based on achieving 75% of planned portfolio benefits.
- Performance incentives for energy efficiency and passive demand reduction efforts will be capped at 125% of design level for energy efficiency and passive demand reduction.
- The active demand savings component will consist of two payout rates. The initial payout rate will be established based on PI $ per planned total benefits from active demand using the $5 million pool allocated to the active demand savings component. The PAs will earn at this payout rate for active demand benefits after threshold level, described in the bullet below, is achieved, and up to 125% of planned active demand benefits. Subject to the portfolio cap discussed in the last bullet, for any incremental active demand reduction benefits achieved above the 125% level, performance incentives will be earned at the energy efficiency and passive demand payout rate described above.
- The threshold for earning performance incentives for the active demand reduction savings component will be based on (1) achieving 75% of planned portfolio benefits, and (2) achieving 75% of planned active demand benefits. Subject to the portfolio cap described in the following bullet, performance incentives for active demand reduction will not be capped.[6]
- In all events, total performance incentives for the savings component (energy efficiency and passive demand, and active demand) will be capped at 125% of the portfolio design level for the savings components (i.e., $65.805 + $5 million).

[6] The Program Administrators agree to conduct a study to be commenced in Q1 of 2019 to quantify any benefits associated with winter peak capacity reduction. The PAs will issue an RFP and conduct this study in collaboration with the DOER, the Attorney General and the Council consultants. Study results will be aligned with and compatible with the 2018 AESC. If new benefits are identified as a result of this study, the Program Administrators will apply those benefits to reported values. If the Program Administrators and DOER agree, the Program Administrators will seek to include such benefits in performance incentives during the Term and correspondingly revise threshold levels for the savings and value components (including the active demand savings component) to properly account for the newly identified benefits associated with the winter kW already included in the PAs' Plans, all subject to Department approval. The Program Administrators will not include these benefits for performance incentive purposes without such modifications.

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- An additional performance incentive pool of $2 million for a unique incentive for successfully serving renters, as mutually agreed to by the Parties, will be implemented in 2019-2021.

Gas Performance Incentive Totals		
Value Component	$8.47 million	$22 million (38.5% Value and 61.5% Savings)
Savings Component	$13.53 million	
Renter Component	$1 million	
Total	$23 million	

- The base gas performance incentive mechanism will include a value component (net benefits) and savings component (total benefits).
    - The value component pool is $8.47 million.
        - The value component payout rate will be PI $ per planned portfolio net benefits.
        - The threshold for earning performance incentives for the value component will be based on achieving 75% of planned portfolio net benefits.
        - Performance incentives for the value component will be capped at 125% of design level.
    - The savings component pool is $13.53 million.
        - The savings component payout rate will be PI $ per planned portfolio total benefits.
        - The threshold for earning performance incentives for the savings component will be based on achieving 75% of planned portfolio total benefits.
        - Performance incentives for the value component will be capped at 125% of design level.
- An additional performance incentive pool of $1 million for a unique incentive for successfully serving renters, as mutually agreed to by the Parties, will be implemented in 2019-2021.

OTHER PA COMMITMENTS

The Program Administrators agree to the following commitments to be included in the 2019-2021 Plan filed with the Department.

- **Demand Savings Efforts**. The Plan will provide new active demand reduction efforts, including a technology agnostic active demand offering that allows market actors to participate in order to encourage innovation. The Plan will provide incentives for energy storage to deliver peak reductions to spur the emerging market and deliver benefits to customers and the Commonwealth. The PAs will report bi-annually in quarterly reports

on active demand reduction participation by approach (including without limitation, storage, residential direct load control, and C&I curtailment), sector and season.

- **Scorecard Integration**. The Program Administrators will implement residential scorecards as part of the in-home audit in coordination with DOER. The budgets and design for this innovative new effort to be undertaken in accordance with the RCS State Plan section 2.B.1. issued by DOER in September 2018 pursuant to the Residential Conservation Services statute (G.L. c. 164, App. §§ 2-1 to 2-10) have not yet been developed, and will be collaboratively worked on by the PAs and DOER. The target date for the roll-out of this scorecard effort is July 2019.

- **Energy Optimization**. The Program Administrators' Energy Optimization approach provides for fuel neutral education and assistance on all options and incentives, including for higher efficiency heating and cooling equipment. Incentives will be offered for strategic electrification that reduces greenhouse gases and minimizes ratepayer costs, and switching to renewable or clean energy technologies, including wood pellet heating where cost-effective. Customers converting to natural gas will be eligible for the same incentives for high efficiency gas equipment as an existing gas customer; the incentive level will not differ depending on a customer's fuel source.

- **Air Source Heat Pumps**. The PAs will target the following number of cold climate air source heat pump installations (total 2019-2021):

    - 37,993 customers (Residential)
    - 6,082 customers (Low Income)
    - 17,980 units (C&I)[7]

  The PAs will report bi-annually in the quarterly reports on the number of heat pump installations, including specifying the number of heat pumps related to fuel switching.

- **Integrated Residential Program Design**. During the 2019-2021 Plan term, the Program Administrators will present annually to the EEAC on the status of the roll-out of the residential program design enhancements set forth in the Plan. In September 2019, the Program Administrators will present to the EEAC on new enhancements planned for 2020 and 2021.

- **Special Focus on Renters, Moderate Income, Non-English Speaking, and Small Business Customers**.
    - The Program Administrators will conduct tailored evaluations in 2019 that address participation levels and potential unaddressed barriers for (a) businesses (small, medium and large) and (b) residential customers by income levels and by non-English speaking populations (utilizing proxy methods that do not rely on specific income or demographic information from Mass Save® participants). The Program Administrators will leverage the existing EM&V framework, and present full results of the studies to the EEAC.

[7] The C&I target does not include air source heat pumps for C&I customers that are fuel switching. The PAs, however, will include these installations in the quarterly reports to the Council.

- The PAs will continue to work in collaboration with the Low-Income Energy Affordability Network ("LEAN") to serve low-income customers, and will offer enhanced strategies and community outreach efforts targeting increased participation and savings from **renters, moderate income customers, and non-English speaking customers**. Highlights of new efforts are:
    - The PAs will provide no-cost weatherization for moderate income customers and, to assist renters, 90% incentives for insulation for landlords of all low-rise buildings (three stories and under) who are willing to complete all recommended insulation and air sealing.
    - The PAs will proactively engage with municipalities and communities with historically low participation rates through a partnership model that will provide marketing materials, trainings, and networking check-ins to share program updates and outreach best practices.
    - The PAs will review the customer journey for non-English speakers by July 31, 2019. The PAs will optimize this journey by providing more consistent language services via the Mass Save® phone line and in follow-up communications for those customers who communicated that English is not a primary language. The PAs will also offer additional translated program materials in the most commonly spoken languages across Massachusetts. Enhancements described in the 2019-2021 plan will be implemented by September 2019.
- The PAs will add the following data bi-annually to their quarterly reports:
    - Number of approved applicants within the moderate income initiative
        - Number of approved applicants that result in weatherization jobs
    - Number of participants (excluding upstream and behavior) by zip code broken out by: (a) residential sector initiatives subtracting moderate income offering participants; (b) moderate income offering; and (c) low income initiatives.
    - Small business savings, budgets, and participation across all C&I initiatives.
- The PAs will present annually on the results of Customer Profile Studies, including findings of program participant characteristics from those studies.

- **<u>New Passive House Offering</u>:** The PAs will implement a new Passive House offering in 2019-2021 through both training efforts and new incentive offerings. These offerings will include incentives to mitigate soft costs to help provide financial certainty early in projects, including an early modeling subsidy, design team incentives, design charrette incentives, and a certification subsidy. Additionally, the PAs will provide a performance incentive calculated on a $/kWh and $/therm incentive for savings. The PAs are actively working on improving the incentives for infiltration for High Rise buildings to better quantify performance savings. The PAs and DOER are committed to changing the process by which savings are claimed to be a more whole building performance based approach for the

Passive House offer. The PAs and DOER will work expeditiously with EM&V to pursue this change using Passive House certification modeling tools to quantify savings. The PAs will provide an annual update in the quarterly reports and will have launched the Passive House incentives no later than July 1, 2019.

- **Street Lighting**. The PAs will continue to support all municipalities that would like to explore and convert customer- and utility-owned streetlights. All utilities now have LED streetlight tariffs approved through recent rate cases. During the term, the PAs will contact each municipality within their respective service territories that have not completed conversions of streetlights and educate the municipality about the PAs' LED conversion offerings. The PAs will provide incentives and expertise to assist Municipalities to take the steps necessary to convert customer-owned and utility-owned streetlights. The PAs will report bi-annually in quarterly reports on streetlight conversions.

- **Key Performance Indicators**. The PAs will report in quarterly reports on up to six (6) additional key performance indicators (not including any specified in this term sheet) as mutually agreed upon by the PAs and by the Energy Efficiency Advisory Council and as can be reported without material associated costs.

NOTES

- **Confirmation**. All savings and budget figures are subject to confirmation and quality control checks as the PAs develop detailed tables consistent with this Term Sheet. Final PA-specific savings and budget numbers may be slightly higher or lower than these values, but all within a reasonable, non-material bandwidth that does not reduce the overall statewide savings target or increase overall statewide budget.
- **Aggressive Goals**. The PAs have utilized an integrated, statewide approach to commit to the increased aggressive statewide savings levels set forth in this term sheet at costs that reflect the increased challenges of achieving savings. The individual PA savings levels and costs set forth in Attachment A are appropriate for the 2019-2021 Plan. Savings goals assume consistent treatment for co-generation facility-related savings as in the past. Consistent with other measures, this includes that new projects installed after the end-of-life of an existing project are given full credit for all cost-effective project savings.
- **Effect of Future Legislation or Regulations**. The PAs may be required to offer new approaches in the future based upon new legislation. In the event that material impacts occur from a new or potential municipal aggregator program (including the City of Lowell), new regulations or guidelines, or any other new legislation issued prior to or during the three-year plan term, any affected PA shall have the opportunity to make appropriate adjustments to its costs and savings goals (and related performance incentives) based upon the nature of the impacts, subject to the Council review under G.L. c. 25, § 21(c) and the approval of the Department of Public Utilities.

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Attachment A

2019-2021

Energy Efficiency Plan

Electric Statewide at 2.70%

Gas at 1.25%

Statewide Totals

	2019-2021
Net Lifetime MMBTUs	**261,931,735**
CO2e Reductions	**2,759,578**
Benefits ($M)	**$ 8,560.8**
Budget ($M)	**$ 2,794.5**

Electric

	2019-2021
Net Annual MWh (No FS)	**3,461,294**
Net Lifetime MWh (No FS)	**35,672,978**
Net Lifetime Site MMBTUs (EE other than CHP)	120,396,475
Net Lifetime Source MMBTUs from CHP	22,071,692
Total Adjusted MMBTU	**142,468,167**
Summer MW (including Active)	**665**
Winter MW (including Active)	**500**
Total MW CHP	**47**
CO2e Reductions	**2,137,288**
Benefits ($M)	**$ 6,560.8**
Budget ($M)	**$ 1,995.0**
Performance Incentive ($M)	**$ 114.0**

Gas

	2019-2021
Net Annual Therm	**95,886,212**
Net Lifetime Therm	**1,192,251,177**
Net Lifetime MMBTUs	**119,463,568**
CO2e Reductions	**622,290**
Benefits ($M)	**$ 2,000.0**
Budget ($M)	**$ 799.5**
Performance Incentive ($M)	**$ 23.0**

2019-2021

Energy Efficiency Plan **National Grid**

Electric at 2.71%

Gas at 1.29%

Statewide Totals

	2019-2021
Net Lifetime MMBTUs	**118,541,412**
CO2e Reductions	**1,377,264**
Benefits ($M)	**$ 3,861.9**
Budget ($M)	**$ 1,341.4**

Electric

	2019-2021
Net Annual MWh (No FS)	**1,564,141**
Net Lifetime MWh (No FS)	**14,189,897**
Net Lifetime Site MMBTUs (EE other than CHP)	
Net Lifetime Source MMBTUs from CHP	
Total Adjusted MMBTU	**58,085,635**
Summer MW (including Active)	**338**
Winter MW (including Active)	**273**
Total MW CHP	**5**
CO2e Reductions	**1,029,715**
Benefits ($M)	**$ 2,839**
Budget ($M)	**$ 910.0**
Performance Incentive ($M)	

Gas

	2019-2021
Net Annual Therm	**51,209,461**
Net Lifetime Therm	**604,557,775**
Net Lifetime MMBTUs	**60,455,777**
CO2e Reductions	**347,549**
Benefits ($M)	**$ 1,022.9**
Budget ($M)	**$ 431.4**
Performance Incentive ($M)	

2019-2021

Energy Efficiency Plan

Eversource

Electric at 2.76%

Gas at 1.34%

Statewide Totals

	2019-2021
Net Lifetime MMBTUs	**103,247,000**
CO2e Reductions	**1,201,458**
Benefits ($M)	**$ 3,694.9**
Budget ($M)	**$ 1,085.6**

Electric

	2019-2021
Net Annual MWh (No FS)	**1,752,744**
Net Lifetime MWh (No FS)	**20,366,014**
Net Lifetime Site MMBTUs (EE other than CHP)	
Net Lifetime Source MMBTUs from CHP	
Total Adjusted MMBTU	**75,194,479**
Summer MW (Including Active)	**321**
Winter MW (Including Active)	**234**
Total MW CHP (Included in Above)	**42**
CO2e Reductions	**1,053,982**
Benefits ($M)	**$ 3,268**
Budget ($M)	**$ 907.0**
Performance Incentive ($M)	

Gas

	2019-2021
Net Annual Therm	**21,886,851**
Net Lifetime Therm	**278,775,253**
Net Lifetime MMBTUs	**28,052,521**
CO2e Reductions	**147,476**
Benefits ($M)	**$ 426.9**
Budget ($M)	**$ 178.6**
Performance Incentive ($M)	

2019-2021
Energy Efficiency Plan **CMA**

Gas at 1.28%

Statewide Totals

	2019-2021
Net Lifetime MMBTUs	**28,809,779**
CO2e Reductions	**102,634**
Benefits ($M)	**$ 474.6**
Budget ($M)	**$ 155.3**

Electric

	2019-2021
Net Annual MWh (No FS)	
Net Lifetime MWh (No FS)	
Net Lifetime Site MMBTUs (EE other than CHP)	
Net Lifetime Source MMBTUs from CHP	
Total Adjusted MMBTU	
Summer MW (Including Active)	
Winter MW	
Total MW CHP	
CO2e Reductions	
Benefits ($M)	
Budget ($M)	
Performance Incentive ($M)	

Gas

	2019-2021
Net Annual Therm	**20,064,501**
Net Lifetime Therm	**285,130,333**
Net Lifetime MMBTUs	**28,809,779**
CO2e Reductions	**102,634**
Benefits ($M)	**$ 474.6**
Budget ($M)	**$ 155.3**
Performance Incentive ($M)	

2019-2021

Energy Efficiency Plan **CLC**

Electric at 2.14%

Statewide Totals

	2019-2021
Net Lifetime MMBTUs	**8,830,699**
CO2e Reductions	**93,433**
Benefits ($M)	**$ 430.5**
Budget ($M)	**$ 160.9**

Electric

	2019-2021
Net Annual MWh (No FS)	**125,000**
Net Lifetime MWh (No FS)	**1,167,499**
Net Lifetime Site MMBTUs (EE other than CHP)	9,476,426
Net Lifetime Source MMBTUs from CHP	-
Total Adjusted MMBTU	**8,830,699**
Summer MW (Including Active)	**29**
Winter MW (including Active)	**28**
Total MW CHP	**-**
CO2e Reductions	**93,433**
Benefits ($M)	**$ 430.5**
Budget ($M)	**$ 160.9**
Performance Incentive ($M)	

Gas

	2019-2021
Net Annual Therm	
Net Lifetime Therm	
Net Lifetime MMBTUs	
CO2e Reductions	
Benefits ($M)	
Budget ($M)	
Performance Incentive ($M)	

2019-2021

Energy Efficiency Plan

Unitil

Electric at 1.47%

Gas at 0.78%

Statewide Totals

	2019-2021
Net Lifetime MMBTUs	**1,860,916**
CO2e Reductions	**17,214**
Benefits ($M)	**$ 66.8**
Budget ($M)	**$ 24.4**

Electric

	2019-2021
Net Annual MWh (No FS)	**19,232**
Net Lifetime MWh (No FS)	**193,027**
Net Lifetime Site MMBTUs (EE other than CHP)	992,469
Net Lifetime Source MMBTUs from CHP	
Total Adjusted MMBTU	**992,469**
Summer MW (Including Active)	**0.6**
Winter MW	**0.3**
Total MW CHP	0.4
CO2e Reductions	**13,190**
Benefits ($M)	**$ 52.0**
Budget ($M)	**$ 17.1**
Performance Incentive ($M)	

Gas

	2019-2021
Net Annual Therm	**600,003**
Net Lifetime Therm	**8,588,306**
Net Lifetime MMBTUs	**868,447**
CO2e Reductions	**4,024**
Benefits ($M)	**$ 14.8**
Budget ($M)	**$ 7.3**
Performance Incentive ($M)	

2019-2021
Energy Efficiency Plan **Liberty**

Gas at 0.58%

Statewide Totals

	2019-2021
Net Lifetime MMBTUs	**1,679,940**
CO2e Reductions	**7,068**
Benefits ($M)	**$ 30.6**
Budget ($M)	**$ 14.1**

Electric

	2019-2021
Net Annual MWh (No FS)	
Net Lifetime MWh (No FS)	
Net Lifetime Site MMBTUs (EE other than CHP)	
Net Lifetime Source MMBTUs from CHP	
Total Adjusted MMBTU	
Summer MW (Including Active)	
Winter MW	
Total MW CHP	
CO2e Reductions	
Benefits ($M)	
Budget ($M)	
Performance Incentive ($M)	

Gas

	2019-2021
Net Annual Therm	**1,173,359**
Net Lifetime Therm	**16,631,717**
Net Lifetime MMBTUs	**1,679,940**
CO2e Reductions	**7,068**
Benefits ($M)	**$ 30.6**
Budget ($M)	**$ 14.1**
Performance Incentive ($M)	

2019-2021
Energy Efficiency Plan **Berkshire**

Gas at 0.65%

Statewide Totals

	2019-2021
Net Lifetime MMBTUs	**1,795,609**
CO2e Reductions	**9,899**
Benefits ($M)	**$ 30.6**
Budget ($M)	**$ 12.8**

Electric

	2019-2021
Net Annual MWh (No FS)	
Net Lifetime MWh (No FS)	
Net Lifetime Site MMBTUs (EE other than CHP)	
Net Lifetime Source MMBTUs from CHP	
Total Adjusted MMBTU	
Summer MW (Including Active)	
Winter MW	
Total MW CHP	
CO2e Reductions	
Benefits ($M)	
Budget ($M)	
Performance Incentive ($M)	

Gas

	2019-2021
Net Annual Therm	**1,508,514**
Net Lifetime Therm	**17,781,744**
Net Lifetime MMBTUs	**1,795,609**
CO2e Reductions	**9,899**
Benefits ($M)	**$ 30.6**
Budget ($M)	**$ 12.8**
Performance Incentive ($M)	

Appendices

G. **Council's Resolution of October 30, 2018**

Massachusetts Energy Efficiency Advisory Council
Resolution Regarding the 2019-2021 Massachusetts Joint Statewide Three-Year Electric and Gas Energy Efficiency Investment Plans

October 30, 2018

BE IT RESOLVED THAT

Pursuant to G.L. c. 25, § 21, the Energy Efficiency Advisory Council ("Council" or "EEAC") presents the following comments to the Department of Public Utilities ("DPU") regarding the 2019-2021 Massachusetts Joint Statewide Three-Year Electric and Gas Energy Efficiency Investment Plans. The Green Communities Act, as set forth in G.L. c. 25, § 21, directs the Council to review the draft 2019-2021 Massachusetts Joint Statewide Three-Year Electric and Gas Energy Efficiency Investment Plans ("Statewide Plans") submitted to the Council on April 30th by the Program Administrators (PAs). The PAs are then directed to incorporate any changes or revisions to reflect the input of the Council into their submittal of the Statewide Plans to the DPU on or before October 31st. The detailed contents of the plan that the Council must review are set forth in G.L. c. 25, § 21(b)(2).

In developing its input on the 2019-2021 Statewide Plans, the Council undertook a comprehensive engagement process, starting with six collaborative planning workshops between September 26, 2017 and January 30, 2018 that featured research materials, and extensive and in-depth discussion between Councilors, PAs and the EEAC Consultants. Additionally, the Council held eight public listening sessions in municipalities across the Commonwealth (Pittsfield, Springfield, Worcester, Lowell, Salem, Fall River, Mashpee and Boston). Finally, in addition to dedicating time at every Council meeting for public comment, the Council held a special meeting in June 2018 exclusively to receive public comment. The workshops and public comments informed the Council's February 28th, 2018 resolution that set forth Council priorities and recommendations for the Statewide Plans[1].

The PAs submitted a draft of the Statewide Plans to the Council on April 30, 2018. Some of the recommendations from the Council were touched on in the April plans but the consensus of the Council was that the Plans were largely non-responsive to the Council priorities, savings goal levels proposed were too low, program details were missing, and the projected cost per unit of savings was too high. These efforts informed the July 31st, 2018 EEAC resolution to the Program Administrators[2]. The PAs then submitted revised draft plans on September 14th, 2018. On October 22nd, 2018, the PAs submitted updated data tables and a memo of program enhancements that reflect changes to the September 14th Draft Plans. The Council offers its comments based on the following records (collectively the "October 22nd Drafts") with the expectation that the PAs will file final Statewide Plans with DPU on October 31st, 2018 that are fully consistent with the content of these materials.

1. Draft joint statewide plans dated September 14th, 2018;
2. Term Sheet dated October 19th, 2018;
3. Revised data tables dated October 22nd, 2018; and
4. Memo of Program Enhancements from PAs dated October 22nd, 2018.[3]

Overall Plan Comments

The Council appreciates the significant efforts the PAs have invested in the development of the October 22nd Draft Plans to address the priorities of the Council and stakeholders. We recognize and appreciate the significant contributions of PA staff, Council consultants, Councilors, the Low-Income Energy

[1] Briefing documents, presentations, and meeting summaries from the workshops are available at www.ma-eeac.org
[2] Available at http://ma-eeac.org/plans-updates/
[3] Available at: http://ma-eeac.org/plans-updates/

Affordability Network ("LEAN"), and stakeholders in preparing these energy efficiency plans. The development of the 2019-2021 Statewide Plans reflects significant collaboration across PAs and among members of the Council, DOER, and the AGO. These comments of the Council are based on its review of the October 22nd Draft:

- The Council has reviewed and approves the October 22nd Draft of the 2019 – 2021 Statewide Plan, as the savings levels represent record levels of gas energy efficiency savings and continue Massachusetts on a path to achieving all cost effective energy efficiency as required by the Green Communities Act ("GCA").[4]
- The October 22nd Draft sets a path forward to pivot Massachusetts' nation-leading energy efficiency programs to focus on (1) reducing energy usage during times of summer and winter peak demand, and (2) promoting fuel switching from oil and propane to clean energy sources such as cold climate air source heat pumps, as authorized by "An Act to Advance Clean Energy" enacted on August 9, 2018. The Council further recognizes that the Act to Advance Clean Energy was enacted late in the planning process, leaving limited time to incorporate additional changes authorized by this legislation. The Council urges the PAs to continue efforts to introduce new approaches and clean energy sources into the energy efficiency programs.
- The October 22nd Draft sets electric savings levels of 2.7% of annual sales (35.6 million lifetime MWH) and natural gas savings levels of 1.25% of annual sales (1.192 million lifetime therms). The 2019-2021 Statewide Plans, as represented by the October 22nd Draft, will provide 8.6% higher benefits than the 2016-2018 Plan. These goal levels represent significant increases from the April draft plan, while reducing the cost to achieve and minimizing budget increases – statewide lifetime electric MWH goals increased 23%, and MMBtu goals increased 22%, and statewide lifetime gas goals increased 16%.
- The Council confirms that the October 22nd Draft[5] includes ambitious energy savings goals, sensible program budgets, and substantial benefits to Massachusetts consumers as required by the GCA. The programs and strategies in the Statewide Plan represent a significant opportunity to maximize benefits for the Commonwealth over the next three years.
- The Council recognizes the importance of pivoting the electric energy efficiency programs under an Act to Advance Clean Energy to a broader energy system view and supports the commitment in the October 22nd Draft to target summer and winter peak energy reduction and the PAs' commitment to energy optimization with a focus on fuel switching to cold climate air source heat pumps and other clean energy sources.
- The Council expects the Individual PA Plans will remain fully consistent with the October 22nd Draft of the Statewide Plan.
- While the current statewide savings, budgets, and benefits proposed in the October 22nd Draft are appropriate, there exists significant variation in savings levels, cost to achieve, and plan details among individual PAs. The Council urges the PAs to continue their joint planning and best practices efforts, with the goal of achieving programmatic consistency and equivalency while fostering creativity and providing equitable service for customers across the Commonwealth.
- The Council recognizes that performance incentives are an integral part of the planning and implementation of the energy efficiency programs. We accept, consistent with the DPU's Energy Efficiency Guidelines at Section 3.6, the performance incentives set forth in the October 22nd Draft,

[4] This approval is provided there are not unexpected or contrary data or details in later PA submissions. In approving this resolution, the Council also acknowledges the right of the DOER, the Attorney General, and any other member of the Council to participate in the proceedings before the DPU.
[5] http://ma-eeac.org/plans-updates/

including the two new performance incentive components (savings component for active demand benefits and renter target).

- The Council, Council consultants, and PAs will continue to work collaboratively throughout the three-year roll-out of the Individual Plans, as directed by the GCA, through continued quarterly reports and specific updates in regular meetings that focus on topics to be determined by the Council. We expect the PAs to consistently engage with the Council consultants to analyze new lessons learned, develop adjustments, and put them into practice.

Council Priorities

The October 22nd Draft provides additional detail and PA attention to Council recommendations from the July 31st resolution, and addresses many specific recommendations. We appreciate that these elements are reflected in the plan. The Council provides comments below on each of its key 2019-2021 priorities:

1. **Underserved Populations and Geographies: Increase participation by, and savings from, hard-to-reach and underserved populations and geographies, including moderate income, renters, small business, and non-profits.**

The Council's first priority in the development of the 2019-2021 Statewide Plan has been to increase participation by, and savings from, hard-to-reach and underserved populations and geographies, including moderate income, renters, English as a second language speakers, small businesses, and non-profits.

- While renter, moderate income, and non-English speaking populations are hard to precisely define or identify with existing Mass Save metrics, the Council commends the addition of a renter metric in the PA performance incentive. In addition to targeting renters, this metric is also the best available proxy indicator of these and other underserved populations and a sign of a renewed commitment to deliver the benefits of the Mass Save program to all customers.
- The Council is supportive of EM&V studies committed to in the Term Sheet and requests that the PAs fully engage the EM&V consultants in this process.
- The Council commends the PAs' commitment to develop and launch a statewide municipal and community partnership strategy. The Council expects the PAs to proactively engage and formally partner with municipalities and communities with historically low participation rates along with non-profits in the development and implementation of this strategy and provide a range of support to improve access to, and savings from, residents, small business, non-profits, and municipal facilities, among others.
- The Council supports the commitment to zip code level participation reporting made in the Term Sheet as a step forward in tracking, collecting, and reporting data to help the Council assess the geographic equity of these programs, and expects the reporting to cover each sector, subject to the privacy standards required by the Department of Public Utilities.
- The Council expects a targeted effort to support the installation of high efficiency equipment, including air source heat pumps, and weatherization measures in homes and businesses impacted by the September 2018 Columbia Gas incidents in the Merrimack Valley.

2. **Active Demand Management: Include goals specific to active demand management and integrate the delivery of active demand management offerings within the EE programs in the 2019-2021 Plan.**

The Council strongly supports the development and implementation of new active demand management program offerings, including behind-the-meter energy storage in 2019-2021.

- The Council is pleased to see active demand management programs that include wi-fi thermostats, energy storage, and C&I load curtailment.
- The Council supports the inclusion of a winter active demand management goal and a study to assess the benefits of winter demand reduction.
- The Council expects these Active Demand Management offerings to complement and coordinate with other state policies and incentive programs including, but not limited to, SMART and Clean Peak Standard.
- The Council supports $5 million of the PAs' performance incentives specifically dedicated to achieving active demand management goals.

3. Fuel Switching: Promote & incentivize fuel switching strategies, in all sectors, that support the Commonwealth's long term greenhouse gas reduction requirements, as established under the Global Warming Solutions Act.

As a way to continue to align statewide energy efficiency policy with the Commonwealth's Global Warming Solutions Act ("GWSA") goals, the Council strongly supports the fuel switching strategies of the electric PAs that are consistent with the an Act to Advance Clean Energy and the GWSA. The Council supports the PAs plan to provide an "energy optimization" approach to program delivery, which is fuel-neutral, and supports a shift to include a primary MMBtu metric to reflect the importance of this pivot. Achieving fuel-neutrality will require enhanced marketing, outreach, contractor training and incentives for residential customers to understand newer options such as converting to high efficiency, cold climate air source heat pumps. The Council expects to coordinate with the PAs during implementation of the Statewide Plan to explore market expansion of heat pump offerings in the residential retrofit and new construction initiatives, and looks forward to working with the PAs to ensure there is a commensurate fuel switching commitment to serve commercial customers.

4. Integrated Residential Program Design: Provide a new, integrated residential program design that maintains strong savings and benefits for all residential homeowner and rental initiatives by: increasing customer capture, providing new methods for realizing savings, expanding HVAC, behavioral, financing, and upstream offerings, and increasing conversion rates for HVAC and weatherization measures.

Given the predicted declining claimable electricity savings from residential lighting initiatives and other market developments that have been apparent for the past few years, the Council continues to see a need for a comprehensive redesign for the residential retrofit and retail programs to continue to obtain all cost-effective energy efficiency, as highlighted in its February and July resolutions. Positive improvements in the October 22nd Drafts include combining single and multi-family programs into a single new Residential Coordinated Delivery Initiative, as well as the residential sector enhancements to program delivery. The Council looks forward to regular updates in the quarterly reports from the PAs on the rollout status of the new program enhancements, including a report to the Council on the results of the enhancements demonstrated and tested in 2019, and any adjustments or revisions to be

implemented in 2020 and 2021, and levels of additional resources dedicated toward these enhancements in 2019-2021. The Council supports significant increases in technical and sales training for call center staff and contractors and would like to see regular updates regarding this in the quarterly reports.

The Council expects residential program design to be a major focus of the PAs over the next three years. The Council requires a commitment by the PAs to work with the EEAC and its Consultants in 2019 to assess potential residential program design updates or delivery model changes to increase participation and savings. In September 2019, the Program Administrators will provide and present to the EEAC results of the assessment and planned enhancements or changes for 2020 and 2021, including any impacts to participation, costs, and savings.

5. **C&I Sector Savings Measures: Increase program savings in the C&I sector from HVAC, process, lighting, and CHP measures.**

The Council is supportive of the October 22nd Draft's increased focus in 2019-2021 on achieving additional savings opportunities in the Commercial & Industrial (C&I) sector. The Council supports the increases in planned CHP, HVAC, and process savings. The Council continues to believe there are additional C&I lighting opportunities and looks forward to working with the PAs to track progress over the next three years. The Council is concerned about historical over-budgeting in the C&I sector. Given the increase in the C&I budget in the October 22nd Draft compared to prior three year plans, the Council would like to see a greater commitment to obtaining all cost effective savings in the C&I sector.

6. **Zero Energy Ready Buildings and Passive House: Actively promote zero energy ready buildings (ZEBs) & Passive House for new construction and major renovations in all sectors.**

The Council is supportive of the October 22nd Draft's new Passive House offering that provides new, increased performance-based incentives for Passive House construction. The PAs commitment to actively working on re-defining the performance-based incentive for Passive House New Construction developers addresses the subject of many public comments received by the Council.

7. **Integrated Multi-family Framework: Establish a multi-family framework that better integrates residential and commercial offerings and is cost- effective.**

The Council supports a new integrated multi-family framework and looks forward to assessing results by maintaining distinct multi-family reporting to the Council.

8. **Low Income Programs: Review low-income programs for potential improvements in participation and achievement of savings, and seek additional savings & cost-efficiency opportunities, to ensure continued success.**

The low income programs are testing out new measures and approaches including wi-fi thermostats, cold-climate air source heat pumps for fuel switching, active demand management, and coordinated

service delivery with the market rate program for 1-4 unit mixed use buildings. The Council is pleased that the PAs and the Low-Income Energy Affordability Network will evaluate the use of U.S. Department of Energy approved electronic audit tools to improve the low-income audit and data collection process. The Council looks forward to continuing to work with the PAs and LEAN during plan implementation to assess opportunities to improve low income participation channels.

9. Data Management: Modernize data management across all PAs and sectors, enhance accessibility to and usefulness of the data to the public, and leverage additional data sources to accomplish items 1-8 above.

The Council supports the new reporting commitments in the Term Sheet and looks forward to developing Key Performance Indicators for tracking of Council priorities and Plan progress. The Council expects the PAs to work towards more comprehensive data collection and management, while ensuring customer privacy and security, during implementation of the 2019-2021 Statewide Plan.

Council Decision on Draft Plan

Based on its review described above, the Energy Efficiency Advisory Council respectfully requests the Department of Public Utilities approve the 2019-2021 Massachusetts Joint Statewide Three-Year Electric and Gas Energy Efficiency Investment Plans and the individual plans of the Program Administrators, to the degree that the individual plans are fully consistent with the Statewide Plan and to the Degree that the final filed plans are fully consistent with information available to the Council at this time.[6] We further request that the DPU embrace and reflect the comments above, including a commitment by the Program Administrators to work with the Council and its Consultants to assess residential program design changes for implementation in 2020 and 2021.

[6] Since the Council has not had an opportunity to review the Benefit-Cost Models or Technical Resource Manual, the Council reserves its rights to complete a review of these documents and provide comments to the DPU as appropriate.

Appendices

H. **Avoided Energy Supply Components in New England: 2018 Report**

Please see separate binder for Exhibit 1, Appendix H

Appendices

I. **DOER Study on Avoided Cost of Compliance with GWSA**

Analysis of the Avoided Costs of Compliance of the Massachusetts Global Warming Solutions Act

Supplement to 2018 AESC Study

Prepared for Massachusetts Department of Energy Resources and Massachusetts Department of Environmental Protection

August 22, 2018

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EXECUTIVE SUMMARY

This document supplements the 2018 Avoided Energy Supply Component (AESC) Study (2018 AESC). Specifically, this document provides estimates of the incremental avoided compliance costs with the Massachusetts Global Warming Solutions Act (GWSA)[I], beyond those already included in the main 2018 AESC study.[2]

Avoided compliance costs from this study are intended to be added to the avoided costs for energy, capacity, and other values determined in the 2018 AESC. The combined costs provide total avoided costs for demand-side measures installed by Massachusetts energy efficiency program administrators.

This supplemental study was commissioned by Massachusetts Department of Energy Resources (DOER). It includes input from the GWSA Study Group, which includes Massachusetts Department of Environmental Protection (MassDEP), consultants to the Massachusetts Energy Efficiency Advisory Council (EEAC), and members of the Massachusetts energy efficiency program administrators. The GWSA Study Group helped to develop and review methodological approaches, compliance strategies, and other issues related to the development of the avoided cost of GWSA compliance.

This supplemental analysis finds that the incremental 15-year levelized avoided cost of GWSA compliance is 2.09 cents per kWh, expressed in 2018 dollars.[3] This represents an 18 percent increase over the 11.69 cents per kWh avoided cost as currently calculated on Table ES-1 of the 2018 AESC study.

Table 1. Illustration of avoided retail summer on-peak electricity cost components, AESC 2018 and GWSA Supplement (2018 cents/kWh, 15-year levelized values from 2018 through 2032)

Total avoided costs in 2018 AESC Study Table ES-1	16.05	(a)
"CO_2 non-embedded" component (not used in MA)	4.36	(b)
Total avoided costs, less "CO_2 non-embedded" component[4]	11.69	(c) = (a) – (b)
Estimated incremental avoided cost of GWSA compliance	2.09	(d)
Total avoided cost with incremental avoided GWSA compliance cost	13.78	(e) = (c) + (d)
Percent difference	18%	(f) = (e)/(c) - 1

Because the Massachusetts energy efficiency program administrators do not use 2018 in their three-year energy efficiency plan for 2019 through 2021, we also calculate the 15-year levelized cost for 2019 through 2033. Under this timeframe, the 15-year levelized avoided cost of GWSA compliance is 1.79

[I] Chapter 298 of the Acts of 2008.

[2] See http://www.synapse-energy.com/sites/default/files/AESC-2018-17-080-June-Release.pdf.

[3] This cost is inclusive of an adjustment for distribution losses (8 percent), consistent with the non-embedded environmental cost methodology applied in the 2018 AESC study in Table ES-1.

[4] Includes embedded Massachusetts regulations 310 CMR 7.70, 7.74, and 7.75 (see page 5 for details).

cents per kWh. This is a 16 percent increase over the avoided cost in the 2018 AESC Study, were it calculated on a 15-year levelized basis between 2019 and 2033 (see Table 2).

Table 2. Illustration of avoided retail summer on-peak electricity cost components, AESC 2018 and GWSA Supplement (2018 cents/kWh, 15-year levelized values from 2019 through 2033)

Total avoided costs in 2018 AESC Study	15.53	(a)
"CO_2 non-embedded" component (not used in MA)	4.31	(b)
Total avoided costs, less "CO_2 non-embedded" component[5]	11.22	(c) = (a) – (b)
Estimated incremental avoided cost of GWSA compliance	1.79	(d)
Total avoided cost with incremental avoided GWSA compliance cost	13.01	(e) = (c) + (d)
Percent difference	16%	(f) = (e)/(c) - 1

We calculated the avoided cost of GWSA compliance using a weighted average of anticipated costs and greenhouse gas (GHG) emission reduction potential for seven strategies. All seven strategies are currently being deployed by the Commonwealth of Massachusetts (Commonwealth) in the near to medium term under already promulgated legislation and regulations, or as part of the *Massachusetts Clean Energy and Climate Plan for 2020 (CECP)* in order to comply with the GWSA.[6] These strategies include: (1) onshore wind, (2) offshore wind, (3) large solar, (4) medium solar, (5) small solar, (6) clean energy imports, and (7) light-duty vehicle electrification infrastructure.

In the counterfactual AESC case that presumes no incremental energy efficiency in 2018 and all later years, the Commonwealth would not achieve the GWSA limit for 2020 and later years without implementing additional non-efficiency strategies. While the Commonwealth does not develop two CECPs (one with and one without energy efficiency), for this analysis, we have assumed that the counter-factual AESC case of no incremental energy efficiency would rely on an expansion of the above-listed electric-related strategies already in the CECP.

As a result, these incremental avoided costs of GWSA compliance may be applied to any measure in the 2019–2021 three-year plan for energy efficiency. Said another way, any measure in the 2019–2021 three-year plan for energy efficiency (which may include but is not limited to LEDs, heat pumps, insulation, weatherization, energy efficiency appliances, demand response, storage, etc.) will reduce GHG emissions and avoid the cost of GWSA compliance. This may improve the cost-effectiveness of measures in each program administrator's three-year energy efficiency plan.

Because the "main" AESC case represents a theoretical future in which no new energy efficiency measures are put into place, the 2018 AESC Study and results from this Supplement should not be used to infer information about actual future market conditions, energy prices, or resource builds in New England. Furthermore, actual prices in the future will be different than the long-term prices calculated in

[5] Includes embedded Massachusetts regulations 310 CMR 7.70, 7.74, and 7.75 (see page 5 for details).

[6] See https://www.mass.gov/files/documents/2017/12/06/Clean%20Energy%20and%20Climate%20Plan%20for%202020.pdf.

this study as actual future prices will be subject to short-term variations in energy markets that are unknowable at this point in time.

The following sections provide detailed findings and a description of the methodology used to derive an avoided cost of compliance with GWSA.

1. BACKGROUND

The Global Warming Solutions Act (GWSA) requires the Commonwealth to reduce greenhouse gas (GHG) emissions by 25 percent in 2020, relative to 1990 levels, and by at least 80 percent in 2050, relative to 1990 levels.[7] GWSA tasks state agencies with developing regulations that require reporting of GHG emissions by different sources in the Commonwealth, establishing target emission reductions that must be achieved by 2020, and developing a plan for achieving these targets. To this end, Massachusetts agencies published a *Massachusetts Clean Energy and Climate Plan for 2020* in 2010 and an updated version in 2015. These two documents outline the measures or strategies that the Commonwealth is using to achieve the emissions reduction requirements.[8]

In May 2016, the Massachusetts Supreme Judicial Court ruled in *Kain et al.* that the Commonwealth must also promulgate regulations establishing declining annual emissions limits for sources or categories of sources that emit GHGs, enabling the state to comply with the 2020 limit set by the Secretary of Energy and Environmental Affairs.[9] In response to this decision, MassDEP and EEA issued a set of regulations that would result in compliance with the 2020 emissions limit.[10] As noted in the 2018 AESC Study report, three specific regulations—one pre-*Kain* regulation (310 CMR 7.70) and two post-*Kain* regulations (310 CMR 7.74 and 310 CMR 7.75) as discussed further on page 6—were modeled in the current 2018 AESC Study. Therefore, the costs associated with complying with these regulations are already included in the 2018 AESC avoided energy costs.

However, the 2018 AESC Study does not necessarily represent a future in which compliance with the GWSA emissions reduction requirement is achieved. The 2018 AESC Study models a future in which no energy efficiency is installed in 2018 through 2050. This hypothetical "but-for" case is then used to estimate the costs avoidable by any unit of energy efficiency (or other demand-side measure). Because electric generating resources that emit GHGs are commonly on the margin in New England, the 2018 AESC Study—with its lack of new energy efficiency—represents a future in which emissions in Massachusetts and the rest of New England are higher than they would be in a future that does account for the impact of incremental energy efficiency.

For this reason, the avoided cost of complying with the GWSA is not fully accounted for in the 2018 AESC Study.[11] To estimate the avoided cost of compliance under the AESC counter-factual, this supplement assumes that in the absence of energy efficiency, the Commonwealth would pursue an expansion of the strategies outlined in the CECP.

[7] See https://www.mass.gov/service-details/global-warming-solutions-act-background.

[8] All the measures or strategies in the CECP have GHG benefits. Some may also achieve additional goals such as public health, economic development, or avoiding costs of capacity, transmission, and distribution.

[9] See http://masscases.com/cases/sjc/474/474mass278.html.

[10] See https://www.mass.gov/guides/reducing-ghg-emissions-under-section-3d-of-the-global-warming-solutions-act.

[11] Note the calculation of the avoided cost of GWSA is not the primary focus of the AESC study. The objective of the AESC study is to calculate a wide range of categories of avoided costs of demand-side measures for the different New England states. Historically, analyses on state-specific avoided costs have been conducted separately from the main AESC study.

2. METHODOLOGY

This section describes the general methodology used to calculate a non-embedded avoided cost of GWSA compliance. Unless otherwise noted, all dollar terms in this analysis are in 2018 dollars.

2.1. Calculating the Avoided Cost of GWSA Compliance

The approach used to calculate preliminary findings involves assembling costs and emission-reducing potentials for seven compliance strategies: onshore wind, offshore wind, large solar, medium solar, small solar, clean energy imports, and light-duty vehicle electrification infrastructure (see Table 3). While this set of strategies may not include all possible strategies eventually employed to reduce GHG emissions, it is our understanding that it represents the strategies that are most likely to produce sizeable GHG emission reductions through the study period.[12]

Six of the seven strategies listed in Table 3 are electric-sector technologies and are calculated first in $-per-MWh terms and MWh potentials. The expected cost of energy (per the 2018 AESC Study) is then subtracted from these $-per-MWh terms to estimate the incremental avoided cost of employing a particular strategy, as opposed to an "all-in" cost.[13] Using a set of seasonal- and temporal-specific emissions rates calculated in the EnCompass electric-sector dispatch model from the 2018 AESC Study, the incremental costs and incremental potentials are then converted into $-per-short-ton and short-ton values. Because the light-duty vehicle electrification strategy involves switching from fossil fuels to electricity for light-duty vehicles, it increases load on the grid rather than generating electricity.[14] Therefore, the avoided cost of compliance for this strategy is not directly calculated from a $/MWh cost and GWh potential. Instead, it is converted natively into $-per-short-ton and short tons.

All incremental avoided costs are averaged and weighted using each strategy's potential for emission reductions separately for 2018, 2019, 2020, and 2030 (see an example of this calculation in Equation 1).[15] Incremental avoided GWSA costs between 2020 and 2030 are interpolated, with the implied

[12] Again, note that this list specifically does not include energy efficiency or other demand-side measures. This analysis focuses on strategies that could be done in place of demand-side measures. Demand-side measures (as they are installed) would avoid or reduce the cost of compliance, i.e., the deployment of these strategies.

[13] This step is performed for all strategies except light-duty vehicle electrification infrastructure, which is unaffected by energy prices.

[14] As such, the electric sector will be involved to a significant extent in implementing this strategy.

[15] Although 2018 and 2019 do not have specific emissions reductions requirements, energy efficiency measures installed in these years and which persist through 2020 and later years are able to contribute to future-year emissions reductions and avoid some portion of the cost of GWSA compliance. The load forecast in the 2018 AESC Study is created by using ISO New England's gross load projections from CELT 2017, which accounts for a future without new energy efficiency beginning in 2018. Note that avoided costs for 2018 are not used by the energy efficiency program administrators in their development of the 2019–2021 three-year plan for energy efficiency, but are calculated as part of this analysis for consistency with the main 2018 AESC Study. See Appendix A for additional detail on calculations for avoided costs in 2018 and 2019.

increase in costs extrapolated through 2031 and all later years.[16] Our analysis indicates that the incremental weighted average avoided costs for 2020 and 2030 are $41 per short ton and $28 per short ton, respectively (see Table 3 and Table 4).[17]

This methodology results in a single potential avoided cost for each of the analyzed years. This weighted average approach means that no single strategy dominates the calculated compliance value. This is important for two reasons: first, the costs and potentials for each of these values are inherently uncertain. While they represent our best estimate as of August 2018, it is possible that these values may increase or decrease as technologies improve, materials and labor costs change, or as other, different technologies become available.

Second, this approach considers that many different strategies are likely and reasonably foreseeable to be employed to meet the state's emission reduction requirements. Each of the seven strategies is already present in Massachusetts today. Further, each strategy is being employed in the near to medium term under already promulgated legislation and regulations, or as part of the *Massachusetts Clean Energy and Climate Plan for 2020* (CECP).[18] For example, onshore wind, offshore wind, and solar installations are eligible to fulfill Massachusetts' Renewable Portfolio Standard (RPS) requirements, and clean energy imports are regulated under Section 83D of Chapter 169 of the Acts of 2008, as amended by the 2016 Energy Diversity Act ("83D").[19]

The 2018 AESC Study already accounts for three strategies or regulations currently in place that steer Massachusetts towards GWSA compliance: (1) 310 CMR 7.70 *Massachusetts CO_2 Budget Trading Program* (also known as Regional Greenhouse Gas Initiative or RGGI); (2) 310 CMR 7.74 *Reducing CO_2 Emissions from Electricity Generating Facilities* (cap on CO_2 emissions from power generators inside Massachusetts); and (3) 310 CMR 7.75 *Clean Energy Standard* (CES) for Massachusetts load-serving entities. These electric-sector regulations (and other regulations that address emissions from other parts of the economy) were designed to yield 2020 GHG emissions at or below the specified annual requirement. In the counterfactual AESC case that presumes no incremental energy efficiency for 2018, 2019, 2020, and all later years through 2050, non-efficiency measures would be needed to replace the emissions reductions from energy efficiency in order to still achieve GWSA-required 2020, 2030, 2040, and 2050 GHG emissions limits. To evaluate the incremental portion of GWSA avoided costs, these

[16] This is similar to the methodology applied in other parts of the 2018 AESC Study. For example, avoided energy costs are calculated for 2018 through 2035, then extrapolated at a specified rate of change for 2036 to 2050. Importantly, because avoided costs in these later years are discounted heavily in the 30-year levelization (and not used at all in the 10- and 15-year levelizations), avoided costs after 2030 have less of an impact on the levelized value than do avoided costs in the nearer term.

[17] Note that the 2018 AESC Study calculates a total environmental avoided cost for CO_2 abatement of $100 per short ton. Avoided costs in this supplemental analysis generally decline over time as the different strategies become less expensive relative to the energy prices modeled in the 2018 AESC study.

[18] See the following section describing the costs and potentials for each strategy for additional information on specific existing and proposed legislation and regulations associated with each strategy.

[19] Requests for proposals for both 83C and 83D were defined in Chapter 188 of the Acts of 2016 "An Act to Promote Energy Diversity," available at https://malegislature.gov/Laws/SessionLaws/Acts/2016/Chapter188. For more information, see https://macleanenergy.com/83d/ https://macleanenergy.com/83c/.

already modeled GWSA avoided costs must be removed from the total avoided cost of GWSA compliance. Because these avoided costs are embedded in the modeled avoided energy cost in the 2018 AESC Study, removing the already modeled avoided energy cost from the total "all-in cost" of compliance functionally removes this double-counting of the already modeled avoided GWSA costs.[20]

The resulting 15-year levelized avoided cost (over 2018–2032) is about $41 per short ton, or $19 per MWh, as shown in Table 5.[21] Over 2019–2033, the resulting 15-year levelized avoided cost is about $35 per short ton, or $17 per MWh. See Appendix B. Avoided GWSA Compliance Costs for 10- and 30-year levelized avoided costs.

[20] Note that the 2018 AESC Study is different. It instead calculates a $100/ton non-embedded avoided cost of environmental compliance, which is based on the incremental cost to install carbon capture and sequestration technology on existing emitting facilities. In the 2018 AESC Study, the already modeled avoided cost of compliance with environmental regulations —e.g., 310 CMR 7.70 (RGGI), 310 CMR 7.74, and 310 CMR 7.75—are subtracted from the $100/ton value to determine the incremental avoided cost of reducing CO_2 emissions in a future with no additional energy efficiency.

[21] Note that in some years, a strategy's potential is estimated to be 0 GWh. This occurs in situations where more energy is assumed to be deployed from this strategy in the existing 2018 AESC Study, in the specified year. This occurs as a result of the 2018 AESC Study being a hypothetical future with no energy efficiency; in this future, energy prices are higher, and total MWh requirements under RPS policies are higher, changing the economic potential of various resources. Also note that in certain years, the estimated "all-in" cost for a particular strategy is less than the projected avoided energy price; in these years, we assume a "floor" price of $0 per MWh.

Table 3. Calculating the avoided cost of GWSA compliance in 2020

	All-In Costs	Incremental Costs		Incremental Potential		Notes
	2018 $/MWh	*2018 $/MWh*	*2018 $/short ton*	*GWh*	*million short tons*	
	a	*b*	*c*	*d*	*e*	*f*
Onshore wind	$68	$30	$64	0	0.0	
Offshore wind	-	-	-	-	-	*Assumed none in 2020*
Large solar	$40	$3	$5	6,013	2.9	*Utility*
Medium solar	$82	$44	$93	1,632	0.8	*Commercial*
Small solar	$105	$68	$142	1,348	0.6	*Residential*
Clean Energy Imports	-	-	-	-	-	*Assumed none in 2020*
Light-duty vehicle electrification	-	-	$0	-	0.1	*Public charging infrastructure costs only*
2020 Weighted Avg Avoided Cost	-	-	**$41**	-	-	

Notes: The weighted average avoided cost is calculated by calculating the average of $-per-ton values in column "c" using the weights in column "e". Potentials are incremental to the quantity of the strategy that is already modeled within the main 2018 AESC study. This $-per-ton value is then converted into an incremental $-per-MWh value (see Table 5) using the summer on-peak emission rate identified in Table 150 of the 2018 AESC Study (June 1 release). This note applies to this table, as well as Table 4.

Table 4. Calculating the avoided cost of GWSA compliance in 2030

	All-In Costs	Incremental Costs		Incremental Potential		Notes
	2018 $/MWh	*2018 $/MWh*	*2018 $/short ton*	*GWh*	*million short tons*	
	a	*b*	*c*	*d*	*e*	*f*
Onshore wind	$69	$18	$38	2,279	1.1	
Offshore wind	$66	$16	$33	79,845	38.0	
Large solar	$35	$0	$0	8,883	4.2	*Utility*
Medium solar	$58	$8	$17	2,143	1.0	*Commercial*
Small solar	$73	$23	$48	1,788	0.9	*Residential*
Clean Energy Imports	$60	$10	$20	58,100	27.7	
Light-duty vehicle electrification	-	-	$151	-	1.2	*Public charging infrastructure costs only*
2030 Weighted Avg Avoided Cost	-	-	**$28**	-	-	

Equation 1. Example of calculating the weighted average avoided cost

$A = \frac{\sum_{i=1}^{n} w_i c_i}{\sum_{i=1}^{n} w_i}$, where A is the weighted average avoided cost for 2030, w is the weight (measured in million short tons), and c is the cost (measured in 2018 $/short ton)

$$A = \frac{(\$38)(1.1)+(\$33)(38)+(\$0)(4.2)+(\$17)(1.0)+(\$48)(0.9)+(\$20)(27.7)+(\$151)(1.2)}{1.1+38+4.2+1.0+0.9+27.7+1.2}$$

$$A = \$28 \text{ / short ton}$$

Table 5. Incremental avoided cost of GWSA compliance

Year	Incremental Avoided MA GWSA Cost (2018 $/ton) *a*	Incremental Avoided MA GWSA Cost (2018$/MWh) *b=a*emissions rate*
2018	$104.77	$49.87
2019	$58.24	$27.72
2020	$40.99	$19.51
2021	$39.72	$18.91
2022	$38.46	$18.31
2023	$37.19	$17.70
2024	$35.93	$17.10
2025	$34.67	$16.50
2026	$33.40	$15.90
2027	$32.14	$15.30
2028	$30.88	$14.70
2029	$29.61	$14.10
2030	$28.35	$13.49
2031	$27.08	$12.89
2032	$25.82	$12.29
2033	$24.69	$11.75
15-Year Levelized Avoided Cost (2018-2032)	**$40.61**	**$19.33**
15-Year Levelized Avoided Cost (2019-2033)	**$34.89**	**$16.61**

Note: Real discount rate of 1.34 percent. Values are converted from $-per-short-ton to $-per-MWh using the summer on-peak emissions rate identified in Table 150 of the 2018 AESC Study (June 1 Release). Avoided costs in this table have not been adjusted for distribution losses (assumed to be 8 percent).

These avoided costs may then be calculated in terms of $-per-MMBtu for non-electric fuels. Table 6 converts the 15-year levelized avoided cost values from column (a) in Table 5 into $-per-MMBtu values using the CO_2 emissions rates developed in the 2018 AESC Study. Compared to the avoided costs calculated in the 2018 AESC Study, these represent a 15 percent increase in the avoided cost of

residential distillate fuel oil and a 36 percent increase in the avoided cost of residential natural gas.[22] See Appendix B for additional detail on non-electric avoided fuel costs.

Table 6. Incremental avoided costs of GWSA compliance for non-electric fuels

Fuel	Sector	Incremental avoided GWSA compliance cost 2018–2032 (2018 $ per MMBtu)	Incremental avoided GWSA compliance cost 2019–2033 (2018 $ per MMBtu)
Natural Gas	Residential	$2.38	$2.04
	Commercial	$2.38	$2.04
	Industrial	$2.38	$2.04
Distillate fuel oil	Residential	$3.27	$2.81
	Commercial	$3.27	$2.81
	Industrial	$3.27	$2.81
B5 Biofuel	All	$3.11	$2.67
B20 Biofuel	All	$2.62	$2.25
Kerosene	All	$3.23	$2.77
LPG	All	$2.82	$2.43
RFO	All	$3.51	$3.02
Wood	All	zero	zero
Wood & Waste	All	zero	zero

Notes: CO_2 emissions rates for wood and wood & waste are assumed to be zero (see 2018 AESC Study, June 1 Release, Table 149), resulting in a non-embedded CO_2 avoided cost of zero. As in the 2018 AESC Study, as the emission rates of non-electric fuels do not vary by time of day or season, there is only one set of annual compliance avoided cost values.

2.2. Costs and Potentials of Compliance Strategies

For each of the seven strategies (onshore and offshore wind, large [utility] solar, medium [commercial] solar, small [residential] solar, light-duty vehicle electrification, and clean energy imports), Synapse has conducted a literature review assessing the likely unit cost (in 2018 $/MWh or $/short ton) and emissions-reducing potential of each of the compliance strategies.[23] This section describes the specific approaches and sources used to calculate these values for each strategy. Note that some strategies

[22] See 2018 AESC Study, June 1 release, Table 117 and Table 130. Comparisons are shown relative to residential avoided costs only for the sake of simplicity. Natural gas percent changes are calculated using an example value of "All" residential natural gas avoided costs with some avoidable retail margin in Southern New England. Distillate fuel oil (DFO) percent changes are calculated using an example value of residential DFO avoided costs.

[23] Note that Synapse originally evaluated an eighth strategy: electrification of commuter rail equipment. However, because recent documentation from the MBTA's Focus 40 project (see https://static1.squarespace.com/static/57757a3cff7c50f318d8aae0/t/5b5f2ebef950b7feeb9eaf9a/1532964586865/FOCUS40_PRINT_DRAFT_07-30-2018.pdf) does not cite commuter rail electrification as an action it is pursuing before 2040, it was not included in this analysis. Note that the MBTA is launching a separate commuter rail study, which may eventually yield specific information about commuter rail electrification plans and costs (see https://www.mbta.com/news/2017-06-15/mbta-launching-study-future-needs-commuter-rail and https://www.mbta.com/projects/commuter-rail-vision).

(onshore and offshore wind; large, medium, and small solar) feature similar methodologies or sources, resulting in those strategies being discussed in combination below. This section also includes discussion of existing and proposed legislation and regulation linked with each strategy.

Wind (Onshore and Offshore)

Both onshore and offshore wind are eligible resources under the Massachusetts Class I RPS and the CES.[24] In addition to the Class I RPS and CES, both onshore and offshore wind are eligible resources under the Section 83D Clean Energy request for proposals. Offshore wind is the sole resource identified under the Section 83C Clean Energy request for proposals. In addition, both onshore and offshore wind were identified as strategies for meeting compliance with the Massachusetts GWSA in the 2015 update to the *Massachusetts Clean Energy and Climate Plan for 2020*.[25] For these reasons, deployment of onshore wind and offshore wind is assumed to be a reasonably foreseeable strategy for reducing GHG emissions in a future lacking incremental energy efficiency in 2018 and later years.

Much of the wind energy literature cites the U.S. Department of Energy's 2015 *Wind Vision* report, which analyzed future scenarios of onshore and offshore wind energy development through 2050.[26] However, authors of the *Wind Vision* report did not directly assess the economic potential of wind energy. Instead, they developed future plausible scenarios grounded in wind energy growth projections from the U.S. Energy Information Administration's Annual Energy Outlook and expanded with several sensitivities for future fuel costs and wind costs. As a result, Synapse relied on alternate resources that directly calculate the economic potential of wind energy in the northeastern United States. Synapse used different approaches to calculate the potential economic onshore and offshore wind energy resources, described in detail below.

Onshore wind energy potentials for 2018, 2019, 2020, and 2030 were calculated using results from NREL's 2017 Annual Technology Baseline (ATB) Cost and Performance Summary.[27] The annual generation values for the northeastern states reported in the NREL study were reduced by the onshore wind energy quantities already present in the 2018 AESC Study for each year analyzed, yielding an annual incremental amount of potential generation of 1 TWh in 2018, 0 TWh in 2019, 0 TWh in 2020,

[24] See 225 CMR 14.00 (RPS) and 310 CMR 7.75 (CES)

[25] See www.mass.gov/eea/docs/eea/energy/cecp-for-2020.pdf.

[26] U.S. Department of Energy. Wind Vision: A New Era for Wind Power in the United States. March 2015. See https://openei.org/apps/wv_viewer/# for data visualization and download.

[27] See https://atb.nrel.gov/electricity/2017/summary.html and https://openei.org/apps/reeds/ for more detail. Economic potential data from the 2018 version of this study is not yet available. Economic potentials were aggregated from the 2017 study based on the scenarios that featured onshore wind costs most analogous to the "Mid" case modeled in the 2018 version of this study (available at https://atb.nrel.gov/electricity/2018/summary.html).

and 2.3 TWh in 2030.[28] Translating this to reduced CO_2 emissions using the 2018 AESC summer on-peak emissions rate yields an incremental reduction of 1.1 million short tons of CO_2 in 2030.[29]

For onshore wind, Synapse included potential generation data from all six New England states. Any wind energy generation in the region can be utilized as part of the MA Class I RPS, therefore the total wind energy potential in those six states is included in this analysis—less the amount already modeled in the 2018 AESC Study as part of Massachusetts' RPS and renewable policies in other states.

Onshore wind energy costs for 2018 were adopted using NREL's latest 2018 ATB Cost and Performance Summary. This approach yields all-in costs for onshore wind between $65 and $68 per MWh and $38 and $70 per short ton of CO_2 (see Table 7).[30]

Synapse estimated offshore wind energy generation potential using data derived from NREL's study "An Assessment of the Economic Potential of Offshore Wind in the United States from 2015 to 2030."[31] The original data was screened to only include offshore areas between 12–50 nautical miles offshore in Massachusetts and Rhode Island where it is possible to install fixed turbines.[32] These additional filters, after subtracting the quantity of offshore wind energy already modeled in the 2018 AESC Study, yield an offshore potential of about 80 TWh in 2030. Synapse did not calculate potentials for 2018 through 2020 because we assumed large-scale offshore wind deployment in Massachusetts would not be achievable until the early 2020s. Translating this to reduced CO_2 emissions using the AESC summer on-peak emissions rate yields an incremental reduction of 38 million short tons of CO_2.

Offshore energy costs were derived from the MA DOER 83C filing to the Department of Public Utilities, which states the levelized long-term generation cost of the offshore wind energy projects is 6.5 cents

[28] The 2018 AESC Study models a total of 5.9 TWh of onshore wind in 2020 (for example), versus the total economic potential of 4.9 TWh cited in the 2017 NREL ATB study. The 2018 AESC Study features a higher quantity of potential generation in this year due to a variety of reasons, including likely differences in assumptions relating to technology costs and differences in terms of market prices for energy (i.e., the 2018 AESC Study features higher-than-otherwise-expected avoided energy costs since it models a future without incremental energy efficiency). This same logic was applied to 2019.

[29] During the summer on-peak period, this value is approximately 952 lbs per MWh (see 2018 AESC Study, June 1 Release, Table 150). Note that this value does not vary substantially throughout the year.

[30] These cost ranges reflect the changing costs of wind technology based on technological improvements and the phase-out of the production tax credit (PTC), as well as the changing price of energy as calculated in the 2018 AESC Study.

[31] See https://www.nrel.gov/docs/fy15osti/64503.pdf. This data source was chosen as it is a recent analysis that contains a particularly high level of resolution on wind deployment in New England.

[32] The range of 12–50 nautical miles offshore was determined to be the economic region by Sustainable Energy Advantage (SEA. Northeast Offshore Wind Regional Market Characterization. 2017). Available at https://www.cesa.org/assets/Uploads/Northeast-Offshore-Wind-Regional-Market-Characterization.pdf). While offshore wind resources throughout New England are theoretically eligible to receive credit under the Massachusetts Class I RPS and CES, this analysis focuses on the regions currently associated with offshore wind energy leases: Massachusetts and Rhode Island. This report also deems floating turbines to not yet be a commercial technology; therefore, this assessment further filtered the economic regions to only include areas where fixed turbines can be installed. Note that this "filtering" methodology was used instead of relying on a previous study's analysis of economic potential because of the rapid changes taking place in the likely costs of offshore wind installed in New England.

per kWh in 2017 dollars.[33] This equates to $66 per MWh in 2018 dollars in 2030 (see Table 7). Subtracting the estimated cost of energy and converting this value into units of dollars-per-short-ton yields an offshore wind cost of approximately $33 per short ton of CO_2 in 2030.

Table 7. Onshore and offshore wind energy costs and potentials

Year	Onshore Wind		Offshore Wind	
	All-In Cost (2018 $/MWh)	*Incremental Potential (TWh)*	*All-In Cost (2018 $/MWh)*	*Incremental Potential (TWh)*
2018	$65	1.0	-	-
2019	$65	0.0	-	-
2020	$68	0.0	-	-
⋮				
2030	$69	2.3	$66	79.8

Note: Only offshore zones in Massachusetts and Rhode Island are considered economic in this study due to the location of offshore wind energy leases.

Solar (Large, Medium, and Small)

This analysis includes large, medium, and small solar categories across all six New England states. For the purposes of this analysis, we define "large" solar as being utility-scale, "medium" solar as being distributed solar at commercial and industrial sites, and "small" solar as being distributed solar at residential sites. As with wind energy, any solar energy generation in the region can be utilized as part of the Massachusetts Class 1 RPS, therefore solar from all six states was included. All solar resources are eligible resources under both Massachusetts' Class I RPS and CES. Solar was also identified as an eligible resource under the Section 83D Clean Energy request for proposals. In addition, specific types of solar programs are eligible under other programs promulgated by the Commonwealth, including the Class I solar carve-out, and the Solar Massachusetts Renewable Target (SMART) Program.[34] Solar resources were also identified as a strategy for meeting compliance with the Massachusetts GWSA in the 2015 update to the *Massachusetts Clean Energy and Climate Plan for 2020*. For these reasons, deployment of large, medium, and small solar is assumed to be a reasonably foreseeable strategy for reducing GHG emissions in a future without incremental energy efficiency in 2018 and later years.

[33] See https://macleanenergy.files.wordpress.com/2018/08/doer-83c-filing-letter-dpu-18-76-18-77-18-78august-1-2018.pdf. Note that this cost assumes that the proposed projects under 83C will be eligible for the federal tax credit, which is phasing out. We did not consider the impact of this tax credit phase-out, or the impacts of any potential cost improvements for offshore wind.

[34] See https://www.mass.gov/service-details/development-of-the-solar-massachusetts-renewable-target-smart-program.

Synapse first calculated the economic potential for all three sizes of solar. As with onshore wind, we relied on NREL's 2017 ATB Cost and Performance Summary.[35] To estimate distributed solar independently for both the residential and commercial sectors, we relied on NREL's 2016 study "Rooftop Solar Photovoltaic Technical Potential in the United States."[36] This study provides technical potential for all three categories of solar. We calculated the relationship between the technical and economic potential of distributed and utility solar in the two NREL studies and applied this ratio to the technical potential for both commercial and residential solar. We then subtracted the quantity of solar capacity already estimated to be in place in each analyzed year in the 2018 AESC Study from the total economic potential values to determine "residual" values for solar potential.[37] This results in the potential generation described in Table 8. When converted into avoided emissions, these resources are estimated to together incrementally avoid 6.1 million short tons in 2030.

We next calculated the levelized cost of solar resources. NREL's 2018 ATB Cost and Performance Summary provides national levelized costs of energy (LCOE) for large, medium, and small solar resources in 2030.[38] In 2018, 2019, 2020, and 2030, we estimate a range of "all-in" LCOEs from $35 to $115 per MWh; when these costs are converted to dollar-per-short-ton values, and the 2018 cost of energy is subtracted, they yield a range of $0 to $175 per short ton of CO_2 (see Table 8).[39]

[35] See https://atb.nrel.gov/electricity/2017/summary.html and https://openei.org/apps/reeds/ for more detail. Economic potential data from the 2018 version of this study is not yet available. Economic potentials were aggregated from the 2017 study based on the scenarios that featured large, medium, and small solar costs most analogous to the "Mid" case modeled in the 2018 version of this study (available at https://atb.nrel.gov/electricity/2018/summary.html).

[36] Available at https://www.nrel.gov/docs/fy16osti/65298.pdf.

[37] Note that ISO New England also conducts a solar forecast, the most recent of which is the "2018 PV Forecast" (available at https://www.iso-ne.com/static-assets/documents/2018/03/a03-2018-pv-forecast.pdf). Note that the quantities of solar projected by ISO New England's solar forecast are smaller than the solar resources already modeled in the existing 2018 AESC study and therefore are not used in this analysis.

[38] Available at https://atb.nrel.gov/electricity/2018/summary.html. NREL's ATB study provides levelized costs for a selected number of regions around the United States. While New England is not one such region, we applied the cost values associated with Chicago given that it has the most comparable capacity factors to New England. Note that we also reviewed other studies, such as Lazard's Levelized Cost of Energy Analysis – Version 11.0 (available at https://www.lazard.com/media/450337/lazard-levelized-cost-of-energy-version-110.pdf); this study and others were used by NREL in its ATB analysis to develop a projection of future costs, making it most appropriate to rely on the NREL ATB study.

[39] These costs reflect technological improvements, as well as the phase-out of the investment tax credit (ITC) and the changing price of energy as calculated in the 2018 AESC Study. In 2030, the expected cost of large solar is below the avoided cost of energy modeled in the 2018 AESC Study. As a result, we assume that the incremental cost of pursuing this specific measure is capped at $0 per MWh, and $0 per short ton.

Table 8. Estimated solar energy costs and potentials

Year	Large Solar		Medium Solar		Small Solar	
	All-In Cost (2018 $/MWh)	*Incremental Potential (TWh)*	*All-In Cost (2018 $/MWh)*	*Incremental Potential (TWh)*	*All-In Cost (2018 $/MWh)*	*Incremental Potential (TWh)*
2018	$42	1.1	$86	1.2	$114	1.7
2019	$43	5.6	$86	1.3	$115	1.1
2020	$40	6.0	$82	1.6	$105	1.3
⋮						
2030	$35	8.9	$58	2.1	$73	1.8

Clean Energy Imports

Clean Energy Imports (defined in this document as energy purchased from large hydroelectric facilities via newly built transmission lines) are an eligible resource under Massachusetts' CES. Clean Energy Imports were also identified as an eligible resource under the Section 83D Clean Energy request for proposals, and as a strategy for meeting compliance with the Massachusetts GWSA in the 2015 update to the *Massachusetts Clean Energy and Climate Plan for 2020*. For these reasons, deployment of Clean Energy Imports is assumed to be a reasonably foreseeable strategy for reducing GHG emissions in a future lacking incremental energy efficiency in 2018 and later years.

In this analysis, the cost associated with Clean Energy Imports comes directly from the Massachusetts DOER 83D filing to the Department of Public Utilities, which states the levelized long-term generation cost of the New England Clean Energy Connect (NECEC) project is 5.9 cents per kWh in 2017 dollars.[40] This equates to $60 per MWh in 2018 dollars.

To estimate energy potential for Clean Energy Imports, we first relied on the annual Clean Energy Import generation modeled in the 2018 AESC Study (8.3 TWh). This value is assumed to represent the potential added generation from a single transmission line carrying clean energy imports from Canada.[41] We assume that the maximum possible annual incremental generation from Clean Energy Imports is limited to one transmission line per year.[42] Given that 2023 is the first full year Clean Energy Imports are assumed to be operational (Table 9), we calculated the maximum generation potential in 2030 by multiplying the transmission line potential (8.3 TWh) by eight years (2023 to 2030). That value was then reduced by the Clean Energy Imports generation modeled in the 2018 AESC Study, yielding a potential of 58.1 TWh in 2030, or an avoided potential of 27.7 million short tons. Because the first Clean Energy

[40] See https://macleanenergy.files.wordpress.com/2018/07/doer-83d-filing-letter-dpu-18-64-18-65-18-66july-23-2018.pdf.

[41] The majority of the 2018 AESC Study was completed before the winning proposal under 83D was announced. The project ultimately selected under 83D, the New England Clean Energy Connect (NECEC), is proposed to provide 9.55 TWh of energy to Massachusetts beginning in 2023.

[42] Note that this analysis does not make any assumptions as to the siting or feasibility of any particular CEI project.

Imports line will not be producing electricity until 2023, we do not model any potentials or costs for 2020.

Table 9. Clean Energy Import timeline and potential annual generation in years 2023 to 2030

Clean Energy Import name	Online date	Year fully energized	Generation (TWh)
83D Modeled in AESC 2018	31 Dec 2022	2023	8.3
CEI A	31 Dec 2023	2024	8.3
CEI B	31 Dec 2024	2025	8.3
CEI C	31 Dec 2025	2026	8.3
CEI D	31 Dec 2026	2027	8.3
CEI E	31 Dec 2027	2028	8.3
CEI F	31 Dec 2028	2029	8.3
CEI G	31 Dec 2029	2030	8.3
Total CEI in 2030 (TWh)			**66.4**
Incremental CEI in 2030, relative to AESC 2018 (TWh)			**58.1**
Cost of CEI in 2030 (2018 $/MWh)			**$60**

Light-Duty Vehicle Electrification

Light-duty vehicle electrification is identified as a strategy for meeting compliance with the Massachusetts GWSA in the 2015 update to the *Massachusetts Clean Energy and Climate Plan for 2020*. Massachusetts is also a signatory to the zero-emission vehicle memorandum of understanding (i.e., the "ZEV MOU"), a document signed by nine states that commits these states to having at least 3.3 million electric vehicles (EV) operating on their roadways by 2025.[43] When this 3.3 million vehicle number is apportioned using vehicle stock or vehicle miles traveled values, it results in approximately 300,000 EVs for Massachusetts in 2025.[44] In addition, as of August 2018, one Massachusetts electric distribution company (EDC) has already received approval from the Massachusetts Department of Public Utilities to install charging infrastructure to incent the adoption of EVs. The approval creates a precedent wherein electric ratepayers pay for the cost of building publicly sited EV charging infrastructure.[45] For these reasons, deployment of light-duty vehicle electrification infrastructure is assumed to be a reasonably

[43] See https://www.mass.gov/news/massachusetts-joins-nine-state-coalition-in-releasing-new-zero-emission-vehicle-action-plan.

[44] Note that because Massachusetts follows California's emission standards under Section 177 of the Clean Air Act, the Commonwealth is projected to have 160,000 EVs on the road in 2025 (this is in line with the California Air Resources Board's (CARB) 2017 report *California's Advanced Clean Cars Midterm Review*, available at https://www.arb.ca.gov/msprog/acc/mtr/acc_mtr_finalreport_full.pdf). The main scenario modeled in the 2018 AESC Study did not model any incremental EVs in place in Massachusetts or other states.

[45] See D.P.U. 12-95, D.P.U. 13-182, D.P.U. 17-05, and D.P.U. 17-13.

foreseeable strategy for reducing GHG emissions in a future lacking incremental energy efficiency in 2018 and later years.

This analysis assumes a potential for emissions reductions in Massachusetts linked to its ZEV MOU commitment (300,000 EVs by 2025). Synapse used an in-house EV adoption model to project how many EVs would be on the road in Massachusetts in 2030, given the interim target of 300,000 EVs by 2025. The EV model uses a Bass Diffusion growth curve and projects that approximately 1.2 million EVs will be on the road by 2030.[46] Additional outputs taken from this model include: annual wholesale electricity usage by EVs, avoided gasoline emissions, and annual EV sales.

For this analysis, Synapse considered only the cost of installing publicly sited, non-residential EV supply equipment (EVSE), or charging stations, to reach the potential EV penetration in 2030.[47] This analysis includes equipment and installation costs associated with Level 1 chargers, Level 2 chargers, and Direct Current Fast Chargers (DCFC).[48] NREL's January 2017 study "Infrastructure for Plug-In Electric Vehicles: A Case Study of Massachusetts" estimates the number of charging plugs—Level 1 (L1), Level 2 (L2), and DCFC—required for Massachusetts to reach its 2025 EV goal (see Table 10).[49]

[46] For this analysis, EVs include battery electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV). The model assumes that 40 percent of EVs on the road are BEV and 60 percent are PHEVs, based on 2017 sales data from the Auto Alliance. For original EV sales data see: https://autoalliance.org/energy-environment/advanced-technology-vehicle-sales-dashboard/ . This model also assumes that 50 percent of light-duty vehicles in Massachusetts are cars, with the rest being light trucks, based on 2016 fleet composition data. Massachusetts fleet composition data comes from the Federal Highway Administration's Highway Statistics: https://www.fhwa.dot.gov/policyinformation/statistics.cfm. Finally, the model assumes that 50 percent of the vehicle miles traveled by PHEVs is run on electricity, based on the central scenario of the NREL study "National Plug-In Electric Vehicle Infrastructure Analysis" (September 2017).

[47] The cost of publicly sited, non-residential EVSE is the cost component most likely to be addressed through state-level policymaking or utility incentives, and therefore borne by ratepayers. This is in line with programs like Eversource's "Make Ready" program (described above) wherein MA D.P.U. has approved that electric ratepayers may bear the cost of installing publicly sited electric vehicle charging infrastructure. As a result, the cost of the electric vehicles and home chargers were not included in this analysis. This analysis also does not make any assumptions regarding the economics of EVs relative to conventional vehicles in 2030, which may vary a great deal depending on the assumptions used for upfront cost, fuel savings, and maintenance savings.

[48] Only non-residential (workplace and public) EV charging stations were considered in this analysis. Generally speaking, workplace chargers are those which are accessible to employees of the company where the charger is sited, whereas public charging stations are available to any EV driver. Level 1 (L1) chargers provide electricity at 1 kW; these chargers may require 8–15 hours for a full charge. Level 2 (L2) chargers provide faster electricity than L1 chargers, at about 6 kW; a full charge may require 3–8 hours. Direct current fast chargers (DCFC) provide electricity at 50 kW and require 20 minutes to an hour for a full charge.

[49] See https://www.nrel.gov/docs/fy17osti/67436.pdf.

Table 10. Number of plugs required to meet the Massachusetts goal of 300,000 EVs on the road by 2025, by charger type

Charger Type	Plugs Required for 2025 EV Goal				
	Low Estimate Total Plugs	*High Estimate Total Plugs*	*Average Total Plugs*	*Average Plugs per 1,000 EV*	*Average Total Plugs*
Work L1	33,700	40,800	37,250	124	148,985
Public L1	1,000	2,400	1,700	6	6,799
Work L2	3,700	4,500	4,100	14	16,398
Public L2	3,700	40,700	22,200	74	88,791
DCFC	220	1,600	910	3	3,640
Total	**42,320**	**90,000**	**66,160**	**221**	**264,613**

Source: NREL. Infrastructure for Plug-In Electric Vehicles: A Case Study of Massachusetts. January 2017.

The ratio of plugs per EV was applied to the projected number of EVs on the road in 2030 from the EV model to calculate the total number of plugs required in 2030. That value was then converted from plugs to charging stations, as stations commonly have multiple plugs.[50] Using EVSE equipment and installation costs from the Department of Energy's 2015 report "Costs Associated with Non-Residential Electric Vehicle Supply Equipment" (see Table 11), we calculated a total EVSE cost for 2030.[51]

Table 11. Equipment and installation costs associated with each type of EV charging station

Charger Type	Equipment Costs			Installation Costs		
	Low 2011 $	*High 2011 $*	*Average 2011 $*	*Low 2011 $*	*High 2011 $*	*Average 2011 $*
Level 1	$300	$1,500	**$900**	$0	$3,000	$1,500
Level 2	$400	$6,500	**$3,450**	$600	$12,700	$6,650
DCFC	$10,000	$40,000	**$25,000**	$4,000	$51,000	$27,500
Total	**$10,700**	**$48,000**	**$29,350**	**$4,600**	**$66,700**	**$35,650**

Source: U.S. DOE. Costs Associated with Non-Residential Electric Vehicle Supply Equipment. November 2015.

Because the EVSE costs associated with the 2030 EV goal will be spent incrementally between 2018 and 2030, the total cost was spread over the period of 2018 through 2030, scaled to the number of EV sales

[50] We assume an average of one plug per station for L1, two plugs per station for L2 (per requirements of MassDEP's MassEVIP [Electric Vehicle Incentive Program] grant application for Fleets, available at https://www.mass.gov/files/documents/2017/11/08/massevipap_6.pdf), and four plugs per station for DCFC (NREL Sept. 2017, available at https://www.nrel.gov/docs/fy17osti/69031.pdf).

[51] These costs are for single-plug charging stations, but they were applied for all chargers due to a lack of data on how cost scales with additional ports. See https://www.afdc.energy.gov/uploads/publication/evse_cost_report_2015.pdf for more information.

estimated for each year. Furthermore, because EVSE funds have already been committed via the Volkswagen Settlement Funds[52] and the Eversource Make-Ready Program[53] and are therefore not paid by ratepayers (VW) or are unavoidable (Eversource), those annual investments were subtracted from 2019 to 2022, yielding the net annual EVSE cost needed to achieve the Massachusetts EV goal in those years. The incremental 2030 costs were used to calculate the all-in costs for EVs in 2030. In 2020, the estimated incremental cost of EVSE deployment is $0 million. In 2030, the estimated incremental cost of EVSE deployment is $185 million (see Table 12). Note that reliance on public EVSE decreases as vehicle range improves, meaning that cost estimates may be lower if electric vehicle technological advancements continue.

Synapse calculated emissions impacts by taking the avoided gasoline emissions from the EV model and subtracting the additional emissions from grid electricity usage by EVs. Additional emissions were calculated for each year by multiplying the annual EV grid electricity usage (TWh) from the EV model by the 2018 AESC average summer electricity emissions rate. This yields a potential of 1.2 million short tons of avoided CO_2 emissions in 2030, implying a cost per short ton of $151 (see Table 12).

Table 12. Incremental costs and avoided emissions from electrification of light-duty vehicles in 2020 and 2030

		2018	2019	2020	2030
Total Incremental EVSE Expenditures	*2018 $ million*	$6	$9	$12	$185
VW Settlement Investment	*2018 $ million*	$0	-$5	-$3	$0
Eversource Makeready Investment	*2018 $ million*	$0	$0	-$9	$0
Net Incremental EVSE Expenditures	*2018 $ million*	$6	$4	$0	$185
Net Avoided Emissions	*million short tons*	0.05	0.06	0.08	1.22
Incremental EVSE Cost	*2018 $ million / short ton*	$117	$55	$0	$151

Note: In 2020, the net incremental EVSE expenditures is $0 million because the Volkswagen Funds and the Eversource Make-Ready program together fulfill the required EVSE investment for that year. The same is true for 2021 and 2022 (not shown).

[52] Massachusetts plans to spend $5 million (of the $11.25 million available for EVSE) in 2019, the first year of the program. We assume that remaining available funds are spent equally in the two subsequent years (2020 and 2021). See https://www.mass.gov/files/documents/2018/07/19/vw-draftbmp_0.pdf for more information.

[53] Eversource is committing $45 million from 2020 through 2022 for "make-ready" electric vehicle charging infrastructure, which includes all prep and site work for everything up to, but not including, the charging station (i.e., the Eversource program covers the installation portion of total EVSE costs, but not the equipment costs). In 2022, 100 percent of the required EVSE investment for that year is fulfilled by Eversource Make Ready program; the implicit assumption is that Eversource's three-year investment front-loads make-ready infrastructure, allowing investments in later years to be directed more towards the accompanying charging stations. See https://www.eversource.com/content/docs/default-source/investors/d-p-u-17-05-final-order-(revenue-requirement)-11-30-17.pdf for more information.

APPENDIX A. AVOIDED COST OF GWSA COMPLIANCE DETAIL

This section provides additional detail on the derivation of avoided costs for 2018 and 2019 in Table 13 and Table 14. The detail in these tables correspond to the detail presented for 2020 and 2030 (see Table 3 and Table 4).

Table 13. Calculating the avoided cost of GWSA compliance in 2018

	All-In Costs	Incremental Costs		Incremental Potential		Notes
	2018 $/MWh	*2018 $/MWh*	*2018 $/short ton*	*GWh*	*million short tons*	
	a	*b*	*c*	*d*	*e*	*f*
Onshore wind	$65	$33	$69	1,011	0.5	
Offshore wind	-	-	-	-	-	*Assumed none in 2018*
Large solar	$42	$10	$21	1,128	0.5	*Utility*
Medium solar	$86	$54	$114	1,152	0.5	*Commercial*
Small solar	$114	$82	$172	1,738	0.8	*Residential*
Clean Energy Imports	-	-	-	-	-	*Assumed none in 2018*
Light-duty vehicle electrification	-	-	$117	-	0.1	*Public charging infrastructure costs only*
2018 Weighted Avg Avoided Cost	-	-	**$105**	-	-	

Notes: The weighted average avoided cost is calculated by calculating the average of $-per-ton values in column "c" using the weights in column "e". Potentials are incremental to the quantity of the strategy that is already modeled within the main 2018 AESC study. This $-per-ton value is then converted into an incremental $-per-MWh value (see Table 5) using the summer on-peak emission rate identified in Table 150 of the 2018 AESC Study (June 1 release). This note applies to this table, as well as Table 14.

Table 14. Calculating the avoided cost of GWSA compliance in 2019

	All-In Costs	Incremental Costs		Incremental Potential		Notes
	2018 $/MWh	*2018 $/MWh*	*2018 $/short ton*	*GWh*	*million short tons*	
	a	*b*	*c*	*d*	*e*	*f*
Onshore wind	$65	$33	$70	0	0.0	
Offshore wind	-	-	-	-	-	*Assumed none in 2019*
Large solar	$43	$11	$23	5,614	2.7	*Utility*
Medium solar	$86	$55	$115	1,303	0.6	*Commercial*
Small solar	$115	$83	$175	1,073	0.5	*Residential*
Clean Energy Imports	-	-	-	-	-	*Assumed none in 2019*
Light-duty vehicle electrification	-	-	$55	-	0.1	*Public charging infrastructure costs only*
2019 Weighted Avg Avoided Cost	**-**	**-**	**$58**	**-**	**-**	

APPENDIX B. AVOIDED GWSA COMPLIANCE COSTS

The following tables contain detailed annual information on the avoided costs of Massachusetts GWSA compliance. Table 15 provides information on avoided costs for electric measures in a similar format to Appendix B of the 2018 AESC Study. Table 16 provides information for avoided costs for non-electric measures in a similar format to Table 130 of the 2018 AESC Study.

Table 15. Massachusetts GWSA avoided cost of compliance for electric measures

	Wholesale Incremental GWSA Cost of Compliance				Retail Incremental GWSA Cost of Compliance[1]			
	Winter Peak	Winter Off-Peak	Summer Peak	Summer Off-Peak	Winter Peak	Winter Off-Peak	Summer Peak	Summer Off-Peak
Units:	$/kWh	$/kWh	$/kWh	$/kWh	$/kWh	$/kWh	$/kWh	$/kWh
Period:	i	ii	iii	iv	v = i*(1+DL)	vi = ii*(1+DL)	vii = iii*(1+DL)	viii = iv*(1+DL)
2018	0.0512	0.0523	0.0499	0.0502	0.0553	0.0565	0.0539	0.0543
2019	0.0285	0.0291	0.0277	0.0279	0.0308	0.0314	0.0299	0.0302
2020	0.0200	0.0205	0.0195	0.0197	0.0216	0.0221	0.0211	0.0212
2021	0.0194	0.0198	0.0189	0.0190	0.0210	0.0214	0.0204	0.0206
2022	0.0188	0.0192	0.0183	0.0184	0.0203	0.0207	0.0198	0.0199
2023	0.0182	0.0186	0.0177	0.0178	0.0196	0.0201	0.0191	0.0193
2024	0.0176	0.0179	0.0171	0.0172	0.0190	0.0194	0.0185	0.0186
2025	0.0170	0.0173	0.0165	0.0166	0.0183	0.0187	0.0178	0.0180
2026	0.0163	0.0167	0.0159	0.0160	0.0176	0.0180	0.0172	0.0173
2027	0.0157	0.0161	0.0153	0.0154	0.0170	0.0173	0.0165	0.0166
2028	0.0151	0.0154	0.0147	0.0148	0.0163	0.0167	0.0159	0.0160
2029	0.0145	0.0148	0.0141	0.0142	0.0156	0.0160	0.0152	0.0153
2030	0.0139	0.0142	0.0135	0.0136	0.0150	0.0153	0.0146	0.0147
2031	0.0132	0.0135	0.0129	0.0130	0.0143	0.0146	0.0139	0.0140
2032	0.0126	0.0129	0.0123	0.0124	0.0136	0.0139	0.0133	0.0134
2033	0.0121	0.0123	0.0118	0.0118	0.0130	0.0133	0.0127	0.0128
2034	0.0115	0.0118	0.0112	0.0113	0.0125	0.0127	0.0121	0.0122
2035	0.0110	0.0113	0.0107	0.0108	0.0119	0.0122	0.0116	0.0117
2036	0.0106	0.0108	0.0103	0.0104	0.0114	0.0116	0.0111	0.0112
2037	0.0101	0.0103	0.0098	0.0099	0.0109	0.0111	0.0106	0.0107
2038	0.0097	0.0099	0.0094	0.0095	0.0104	0.0107	0.0102	0.0102
2039	0.0092	0.0094	0.0090	0.0091	0.0100	0.0102	0.0097	0.0098
2040	0.0088	0.0090	0.0086	0.0087	0.0095	0.0097	0.0093	0.0094
2041	0.0084	0.0086	0.0082	0.0083	0.0091	0.0093	0.0089	0.0089
2042	0.0081	0.0082	0.0079	0.0079	0.0087	0.0089	0.0085	0.0086
2043	0.0077	0.0079	0.0075	0.0076	0.0083	0.0085	0.0081	0.0082
2044	0.0074	0.0075	0.0072	0.0072	0.0080	0.0081	0.0078	0.0078
2045	0.0071	0.0072	0.0069	0.0069	0.0076	0.0078	0.0074	0.0075
2046	0.0068	0.0069	0.0066	0.0066	0.0073	0.0074	0.0071	0.0072
2047	0.0065	0.0066	0.0063	0.0063	0.0070	0.0071	0.0068	0.0068
2048	0.0062	0.0063	0.0060	0.0061	0.0067	0.0068	0.0065	0.0065
2049	0.0059	0.0060	0.0057	0.0058	0.0064	0.0065	0.0062	0.0063
2050	0.0056	0.0058	0.0055	0.0055	0.0061	0.0062	0.0059	0.0060
Levelized Costs								
10 years (2018-2027)	0.0226	0.0230	0.0220	0.0221	0.0244	0.0249	0.0237	0.0239
15 years (2018-2032)	0.0199	0.0203	0.0193	0.0195	0.0214	0.0219	0.0209	0.0210
30 years (2018-2047)	0.0150	0.0153	0.0146	0.0147	0.0162	0.0166	0.0158	0.0159
Levelized Costs								
10 years (2019-2028)	0.0188	0.0192	0.0183	0.0184	0.0203	0.0207	0.0197	0.0199
15 years (2019-2033)	0.0171	0.0174	0.0166	0.0167	0.0184	0.0188	0.0179	0.0181
30 years (2019-2048)	0.0133	0.0136	0.0129	0.0130	0.0144	0.0147	0.0140	0.0141

*Notes: All avoided costs are in 2018 Dollars. ISO New England periods are: Summer is June through September; winter is all other months. Peak hours are Monday through Friday 7 AM–11 PM; Off-Peak Hours are all other hours. Avoided retail cost of GWSA compliance = (wholesale avoided cost) * (1 + Distribution Losses), e.g., v = i * (1 + 8.0%).*

Table 16. Avoided costs of Massachusetts GWSA compliance for natural gas, petroleum fuels, and other fuels by sector

Year	Natural Gas			Fuel Oils							Other Fuels				
				Residential	Commercial			Industrial			Residential				Industrial
	Residential	Commercial	Industrial	Distillate Fuel Oil	Distillate Fuel Oil	Residual Fuel Oil	Weighted Average	Distillate Fuel Oil	Residual Fuel Oil	Weighted Average	Cord Wood	Pellets	Kerosene	Propane	Kerosene
	$/MMBtu	*$/MMBtu*	*$/MMBtu*	*$/MMBtu*	*$/MMBtu*	*$/MMBtu*	*$/MMBtu*	*$/MMBtu*	*$/MMBtu*	*$/MMBtu*	*$/MMBtu*	*$/MMBtu*	*$/MMBtu*	*$/MMBtu*	*$/MMBtu*
2018	$6.13	$6.13	$6.13	$8.43	$8.43	$9.06	$8.45	$8.43	$9.06	$8.48	$0.00	$0.00	$8.33	$7.28	$8.33
2019	$3.41	$3.41	$3.41	$4.69	$4.69	$5.04	$4.70	$4.69	$5.04	$4.72	$0.00	$0.00	$4.63	$4.05	$4.63
2020	$2.40	$2.40	$2.40	$3.30	$3.30	$3.55	$3.31	$3.30	$3.55	$3.32	$0.00	$0.00	$3.26	$2.85	$3.26
2021	$2.32	$2.32	$2.32	$3.20	$3.20	$3.44	$3.21	$3.20	$3.44	$3.22	$0.00	$0.00	$3.16	$2.76	$3.16
2022	$2.25	$2.25	$2.25	$3.10	$3.10	$3.33	$3.10	$3.10	$3.33	$3.11	$0.00	$0.00	$3.06	$2.67	$3.06
2023	$2.18	$2.18	$2.18	$2.99	$2.99	$3.22	$3.00	$2.99	$3.22	$3.01	$0.00	$0.00	$2.96	$2.59	$2.96
2024	$2.10	$2.10	$2.10	$2.89	$2.89	$3.11	$2.90	$2.89	$3.11	$2.91	$0.00	$0.00	$2.86	$2.50	$2.86
2025	$2.03	$2.03	$2.03	$2.79	$2.79	$3.00	$2.80	$2.79	$3.00	$2.81	$0.00	$0.00	$2.76	$2.41	$2.76
2026	$1.95	$1.95	$1.95	$2.69	$2.69	$2.89	$2.70	$2.69	$2.89	$2.70	$0.00	$0.00	$2.66	$2.32	$2.66
2027	$1.88	$1.88	$1.88	$2.59	$2.59	$2.78	$2.59	$2.59	$2.78	$2.60	$0.00	$0.00	$2.56	$2.23	$2.56
2028	$1.81	$1.81	$1.81	$2.49	$2.49	$2.67	$2.49	$2.49	$2.67	$2.50	$0.00	$0.00	$2.45	$2.15	$2.45
2029	$1.73	$1.73	$1.73	$2.38	$2.38	$2.56	$2.39	$2.38	$2.56	$2.40	$0.00	$0.00	$2.35	$2.06	$2.35
2030	$1.66	$1.66	$1.66	$2.28	$2.28	$2.45	$2.29	$2.28	$2.45	$2.30	$0.00	$0.00	$2.25	$1.97	$2.25
2031	$1.58	$1.58	$1.58	$2.18	$2.18	$2.34	$2.19	$2.18	$2.34	$2.19	$0.00	$0.00	$2.15	$1.88	$2.15
2032	$1.51	$1.51	$1.51	$2.08	$2.08	$2.23	$2.08	$2.08	$2.23	$2.09	$0.00	$0.00	$2.05	$1.79	$2.05
2033	$1.44	$1.44	$1.44	$1.99	$1.99	$2.14	$1.99	$1.99	$2.14	$2.00	$0.00	$0.00	$1.96	$1.72	$1.96
2034	$1.38	$1.38	$1.38	$1.90	$1.90	$2.04	$1.91	$1.90	$2.04	$1.91	$0.00	$0.00	$1.88	$1.64	$1.88
2035	$1.32	$1.32	$1.32	$1.82	$1.82	$1.95	$1.82	$1.82	$1.95	$1.83	$0.00	$0.00	$1.80	$1.57	$1.80
2036	$1.26	$1.26	$1.26	$1.74	$1.74	$1.87	$1.74	$1.74	$1.87	$1.75	$0.00	$0.00	$1.72	$1.50	$1.72
2037	$1.21	$1.21	$1.21	$1.66	$1.66	$1.79	$1.67	$1.66	$1.79	$1.67	$0.00	$0.00	$1.64	$1.44	$1.64
2038	$1.16	$1.16	$1.16	$1.59	$1.59	$1.71	$1.59	$1.59	$1.71	$1.60	$0.00	$0.00	$1.57	$1.37	$1.57
2039	$1.10	$1.10	$1.10	$1.52	$1.52	$1.63	$1.52	$1.52	$1.63	$1.53	$0.00	$0.00	$1.50	$1.31	$1.50
2040	$1.06	$1.06	$1.06	$1.45	$1.45	$1.56	$1.46	$1.45	$1.56	$1.46	$0.00	$0.00	$1.44	$1.25	$1.44
2041	$1.01	$1.01	$1.01	$1.39	$1.39	$1.49	$1.39	$1.39	$1.49	$1.40	$0.00	$0.00	$1.37	$1.20	$1.37
2042	$0.97	$0.97	$0.97	$1.33	$1.33	$1.43	$1.33	$1.33	$1.43	$1.34	$0.00	$0.00	$1.31	$1.15	$1.31
2043	$0.92	$0.92	$0.92	$1.27	$1.27	$1.37	$1.27	$1.27	$1.37	$1.28	$0.00	$0.00	$1.26	$1.10	$1.26
2044	$0.88	$0.88	$0.88	$1.22	$1.22	$1.31	$1.22	$1.22	$1.31	$1.22	$0.00	$0.00	$1.20	$1.05	$1.20
2045	$0.84	$0.84	$0.84	$1.16	$1.16	$1.25	$1.17	$1.16	$1.25	$1.17	$0.00	$0.00	$1.15	$1.00	$1.15
2046	$0.81	$0.81	$0.81	$1.11	$1.11	$1.19	$1.11	$1.11	$1.19	$1.12	$0.00	$0.00	$1.10	$0.96	$1.10
2047	$0.77	$0.77	$0.77	$1.06	$1.06	$1.14	$1.07	$1.06	$1.14	$1.07	$0.00	$0.00	$1.05	$0.92	$1.05
2048	$0.74	$0.74	$0.74	$1.02	$1.02	$1.09	$1.02	$1.02	$1.09	$1.02	$0.00	$0.00	$1.00	$0.88	$1.00
2049	$0.71	$0.71	$0.71	$0.97	$0.97	$1.04	$0.97	$0.97	$1.04	$0.98	$0.00	$0.00	$0.96	$0.84	$0.96
2050	$0.68	$0.68	$0.68	$0.93	$0.93	$1.00	$0.93	$0.93	$1.00	$0.94	$0.00	$0.00	$0.92	$0.80	$0.92
Levelized Costs															
10 years (2018-2027)	$2.70	$2.70	$2.70	$3.71	$3.71	$3.99	$3.72	$3.71	$3.99	$3.74	$0.00	$0.00	$3.67	$3.21	$3.67
15 years (2018-2032)	$2.38	$2.38	$2.38	$3.27	$3.27	$3.51	$3.28	$3.27	$3.51	$3.29	$0.00	$0.00	$3.23	$2.82	$3.23
30 years (2018-2047)	$1.80	$1.80	$1.80	$2.47	$2.47	$2.66	$2.48	$2.47	$2.66	$2.49	$0.00	$0.00	$2.44	$2.13	$2.44
Levelized Costs															
10 years (2019-2028)	$2.25	$2.25	$2.25	$3.09	$3.09	$3.32	$3.10	$3.09	$3.32	$3.11	$0.00	$0.00	$3.05	$2.67	$3.05
15 years (2019-2033)	$2.04	$2.04	$2.04	$2.81	$2.81	$3.02	$2.82	$2.81	$3.02	$2.83	$0.00	$0.00	$2.77	$2.43	$2.77
30 years (2019-2048)	$1.59	$1.59	$1.59	$2.19	$2.19	$2.35	$2.19	$2.19	$2.35	$2.20	$0.00	$0.00	$2.16	$1.89	$2.16

Notes: All avoided costs are in 2018 dollars per MMBtu. Emission rates for wood products are assumed to be zero.

Appendices

J. **Sponsorships & Subscriptions Policy**

POLICY ON SPONSORSHIPS & SUBSCRIPTIONS

A. Hard-to Measure "Sponsorships and Subscriptions"

Sponsorships and subscriptions are undertaken by the PAs in order to support the goals of the Green Communities Act ("GCA") and acquire all available cost-effective energy efficiency. Costs included on the Sponsorships and Subscriptions hard-to-measure line items provide direct benefits to customers, but are not directly linked to specific in-the-field energy efficiency measures or services. Sponsorships and subscriptions support the energy efficiency market, encourage workforce education, attract skilled employees to Massachusetts, and promote innovation in both service delivery and the development and testing of energy efficient technologies. In accordance with the Order of the Department of Public Utilities regarding the 2016-2018 Three-Year Energy Efficiency Plan and general accepted practice, each sponsorship and subscription expense must be reasonable, prudently incurred, and provide a direct benefit to Massachusetts customers. Detailed definitions are as follows:

- **Sponsorship**: Payment by or on behalf of a PA to financially support an organization, event, or project directed by a non-PA person or group, in order to gain participation or access to a benefit of sponsorship. The purpose of these costs may include, without limitation, sharing of regional and national best practices, transformation of energy efficiency markets, influencing manufacturers, furthering energy efficiency evaluation techniques and standards, and the ability to network (with customers, contractors, evaluators, or other experts) to learn about additional energy efficiency opportunities and ways in which to improve offered energy efficiency services. These activities all provide benefits to customers and programs generally, but do not focus on a specific initiative. Specific categories of sponsorships enumerated by the Department include:

    1. Energy efficiency forums
    2. Trade associations
    3. National industry associations
    4. Groups that target specific industry sectors
    5. Universities and organizations that develop new technologies
    6. Residential focused groups to educate and engage with the community

    Costs reported in the hard-to-measure line items will be limited to sponsorships that are anticipated to provide benefits to customers but are not associated with a specific program or initiative. Conversely, expenses related to the above categories that directly impact programs will be included in the appropriate program budget (see Section B, below).

- **Subscription**: Payment by or on behalf of a PA to receive or use something related to energy efficiency over a fixed period of time, such as a periodical, a book series, or an informational service.

Costs will be categorized in the appropriate cost category.

Examples and Cost Categorization

1. Membership Dues for Consortium for Energy Efficiency ("CEE") - allows the PAs to provide guidance to manufacturers who make equipment that can be used to increase efficiency or options in the programs, and gives the PAs early insight into new technologies coming to market.
   – *Line item*: Sponsorships & Subscriptions hard-to-measure for each sector
   – *Cost Category*: PP&A
   (Note that other charges from CEE specifically related to programs may be included as program costs; see Section B, below)

2. Membership in Ally Program of American Council for an Energy-Efficient Economy ("ACEEE") - allows PAs to bring awareness to the programs generally and advance Massachusetts' goals throughout the national energy efficiency community. Allies gain access to a national center of expertise as well as unique opportunities to help contribute to and shape the nation's energy efficiency research and program agenda. Allies also learn from networks of peers and other experts about the latest trends and issues in energy efficiency. Additionally, Allies receive industry-leading information on energy efficiency markets, technology, and policy. Participation in ACEEE's Ally program allows the PAs to share in the expertise of ACEEE and other Ally members on energy efficiency technologies and opportunities that can influence the programs of the future and help PAs improve program delivery.
   – *Line item*: Sponsorships & Subscriptions hard-to-measure for each sector
   – *Cost Category*: PP&A

3. Sponsorship of International Energy Program Evaluation Conference ("IEPEC") – allows the PAs to participate in the annual professional conference, which is held for energy program implementers, evaluators of those programs, local, state, national and international representatives, and academic researchers involved in evaluation. The conference provides a forum for the presentation, critique and discussion of objective evaluations of energy programs, and promotes the documentation of unbiased, peer-reviewed evaluations that establish the basis for accurate information and provide credible evidence of program success or failure. In addition, the PAs gain access to information on current issues, market assessments, emerging technologies, and alternatives to traditional centralized supply-side options, as well as educational workshops on relevant topics, including information on evaluation methodologies, vendors, and strategies to continuously improve evaluation of the PAs' programs. In addition, support of IEPEC provides the PAs with the opportunity to learn about new program efforts and how those innovative approaches are working in other areas. This helps the PAs to effectively deliver energy efficiency solutions to customers.
   – *Line item: Sponsorships & Subscriptions hard-to-measure for each sector*
   – *Cost Category: Evaluation and Market Research*

B. Program Expenses (NOT Hard-to-Measure "Sponsorships and Subscriptions")

Expenses paid to directly support a program are program expenses and will be included in and allocated to the appropriate programs/core initiatives where benefits are expected to be realized. *A cost may be included in program line items even if called a sponsorship or subscription because the expense is directly related to the program.* These expenses include:

- **Data Purchase**: Payments made to receive data on a one-time or recurring basis will be included in the programs to which the data relates.

- **Memberships / Employee Training**: Membership fees (group or individual) where the fee is not used to sponsor a conference or event, but rather as a cost-efficient way to obtain multiple individual employee memberships, receive tickets to conferences for learning opportunities for employees, advertise energy efficiency programs to customers/contractors, provide direct access to member lists, and advertise energy efficiency job positions. Employee conference and training attendance enhances employee skills and teaches the employee about new technologies and strategies, helping the employee in his or her job/role and improving the programs. The conference/training must provide an energy efficiency related benefit and the PA should determine if the value of the employee's attendance justifies the costs.

- **Goods or Services**: Expenditures made to pay for a good or service, such as a product table at an event (without otherwise sponsoring the event or organization).

Costs will be categorized in the appropriate cost category.

Examples and Cost Categorization

1. Sponsorship of an HVAC conference where a PA presents on Heating & Cooling energy efficiency in order to market the Mass Save program.
   - *Line item*: Residential Heating & Cooling program core initiatives
   - *Cost Category*: Marketing and Advertising

2. Subscription to or sponsorship of an organization that shares or disseminates data that the PAs use for planning or evaluation.
   - *Line item*: Each affected program/core initiative
   - *Cost Category*: PP&A for planning data or Evaluation and Market Research for evaluation data

3. Sponsorship of a community event at which a PA promotes Mass Save through brochures, banners, and tabling to potential customers.
   - *Line item*: All relevant programs/core initiatives
   - *Cost Category*: Marketing and Advertising

4. Sponsorship of the Design Lights Consortium, which directly impacts the lighting products the PAs offer in C&I programs as well as lighting design practices for C&I customers and program design and implementation.
   - *Line item*: C&I Upstream Lighting and C&I Retrofit core initiatives
   - *Cost Category*: Sales, Technical Assistance & Training

4. Group Membership in Association of Energy Services Professionals, with which the PA gains "points," and uses these points to assign individual memberships to staff members, allowing staff to improve their skills and learn innovate ideas and best practices to improve program delivery and achieve energy savings.
   - *Line item*: All relevant programs/core initiatives
   - *Cost Category*: PP&A

Documentation of Expenditures Included in Program Costs

In 2016-2018, the PAs will contemporaneously document the benefits to customers of expenditures that are or were previously included in the Sponsorships & Subscriptions hard-to-measure line item in 2013-2015, including any sponsorship or membership payment that is made to directly affect programs and is included in program line items. PAs do not intend to provide a detailed explanation of benefits (or contemporaneously document the benefits) associated with costs that were never included in the Sponsorships & Subscriptions line items, including (1) payments solely for goods and services (e.g., tabling), (2) the purchasing of data, (3) conference fees paid for directly by employees, and (4) costs included in other line items (e.g., Residential Education (in-school programs), Workforce Development (third-party trainings)). The PAs will provide detailed information about all costs in the Term Report in accordance with the Term Report template.

C. Lobbying or Engagement in Legislative Activity

For each sponsorship and subscription expenditure, the PA will determine whether the sponsored organization is a registered lobbyist or engages in legislative activity[1]. For all sponsored organizations, whether registered as a lobbyist or not, PAs will seek to obtain a written statement prior to providing monetary support covenanting in substance as follows:

[The Organization] understands that the Massachusetts energy efficiency Program Administrators cannot and do not support lobbying activities by organizations sponsored by the Program Administrators. [The Organization] covenants and agrees that funds provided by [Company] as an energy efficiency or demand savings sponsorship or subscription will not be used for lobbying or other legislative activities.

In the event a PA determines that sponsorship of an organization that is involved in lobbying activities has a direct benefit to Massachusetts customers, the PA will document the benefits and provide evidence of how the funds at issue are used by the sponsored organization. Consistent

[1] In 2016 – 2018, this information will also be obtained for commitments that were included as "Sponsorships and Subscriptions" in 2013-2015 even if the costs are now being directed to specific programs or core initiatives.

with the Department's directives in the 2016-2018 Three-Year Plan Order, the organization must also provide documentation that (1) details the structure and function of the sponsored organization; (2) identifies the percentage of resources devoted to lobbying and legislative activities; and (3) provides the method used to derive the percentage.

PAs expect to sponsor organizations that lobby or advocate for more stringent codes and standards. The PAs will document all spending as noted above, but will work under the presumption that more stringent codes and standards provide a direct benefit to customers.

D. Annual Review Process

Prior to filing the Plan-Year Report or Term Report, each PA will review all sponsorship and subscription spending incurred during the prior program year (including, in 2016-2018, those expenses directly affecting programs and categorized in program line items that were previously included as Sponsorships & Subscriptions hard-to-measure costs in 2013-2015) to determine whether the events or organizations sponsored in the prior year realized the expected benefits (noting that some benefits may take more than a year to accrue, and that many benefits are not quantifiable). Each PA will document actual benefits realized, and verify that each expense was reasonable, prudently incurred, and was intended to provide a direct benefit to customers.

E. Process to Determine Whether to Enter into a Sponsorship or Subscription; Contemporaneous Documentation

Step 1. **Identify** sponsorship or subscription opportunity – may come from staff or vendor.

Step 2. Identify and document the **purpose** of the organization or event to assess whether it is **directly related to energy efficiency**.

Step 3. Identify and document in detail the expected **direct energy efficiency-related benefit to Massachusetts customers** of the expense, which may include: enhanced energy efficiency program delivery, marketing and education opportunities, reaching key industry sectors, sharing of best practices, access to manufacturers, contractors, and/or data and evaluation materials, assisting the PA in achieving savings or satisfying an energy efficiency related statutory mandate, or other benefits. For sponsorships that are being renewed, identify the benefits that were achieved in prior years and their impact on the decision to renew the sponsorship.

Step 4. Assess whether the associated sponsorship costs are **reasonable and prudent** in relation to the expected benefits; determine if the opportunity is the best and most cost-efficient means by which the PA can achieve the expected benefits.

Step 5. Determine whether or not the organization is a registered lobbyist or otherwise **engages in lobbying** (note that an organization can be engaged in lobbying even if it is not required to be a formally registered lobbyist). For organizations that do engage in lobbying, additional scrutiny should be used to determine that the sponsorship funds will not be spent for lobbying purposes. If it is determined that the sponsorship is prudent, ensure that the organization seeking sponsorship signs a statement that organization will not use PA funds for lobbying purposes and gather evidence that: (1) details the structure and function of the sponsored organization (e.g., organization

chart, mission statement); (2) identifies the percentage of resources devoted to lobbying and legislative activities; and (3) provides the method used to derive the percentage.

Step 6. Determine and document how the expenditure will be allocated between a PA's **gas and electric operations** (when applicable), based on the benefits to be realized by each fuel type's customers.

Step 7. Determine and document the **appropriate line item and cost category**, including: whether the expense (1) is a hard-to-measure Sponsorship or Subscription; or (2) directly affects a program, and if so, determine which programs and how the expense will be allocated among the impacted core initiatives. Determine and document the appropriate budget category (PP&A, Marketing, STAT, or Evaluation and Market Research). When appropriate, coordinate with other PAs for consistency.

Step 8. Obtain sign-off from the designated PA staff approving the sponsorship or subscription.

Step 9. Obtain documentation from a manager (or equivalent) of the organization stating that it **will not use PA funds for lobbying purposes**. For organizations that engage in lobbying, ensure that the PA has received all information listed in Step 5.

Step 10. Confirm that all **logos and marketing** materials used in relation to the sponsorship for which the PA will seek cost recovery from energy efficiency are designed to support and promote energy efficiency programs.

Step 11. **Pay invoice** per standard PA procedure.

Step 12. **Review** all costs following completion of sponsored event or program and determine whether and how the expected benefits were realized. Determine whether the PA would sponsor or participate in the organization or event again in the future.

Appendices

K. **PA-Specific Programming**

Cape Light Compact Program Enhancements

Introduction

In addition to the statewide plan, which is always the core of the Compact's approved Three Year Plans, the Compact provides for specific cost-effective program enhancements that have been identified to better meet the needs and demands of its unique customer base.

In developing the drafts of the 2019-2021 Three Year Plan, the Compact staff have identified proposed enhancements and modifications that are the result of the Compact's administration of its 2016-2018 Three Year Plan, direction from the Compact's Governing Board and stakeholder input, which included twelve stakeholder meetings over a four-month period.

The Compact's proposed enhancements were presented to the Compact's Governing Board at several meetings throughout the preparation of the 2019-2021 Three Year Plan. The Governing Board conducted its final review of the Compact's proposed plan enhancements, savings goals, and budgets at its October 10, 2018 Governing Board meeting and voted to approve the proposed plan.

The following sections provide a summary of the enhancements to programs proposed for the 2019-2021 Three Year Plan term.

Residential and Income Eligible Program Enhancements

Residential Coordinated Delivery

For the 2019-2021 term, the Compact proposes to continue to provide 100% incentive without a program cap for qualified weatherization measures to all electric customers that are either 1) year-round renters who are responsible for paying the electric bill; 2) customers whose income is within 61-80% of state median income; or 3) customers whose operations are managed by municipalities or other government entities. The Compact also proposes to continue to provide 75% incentive without a program cap for qualified weatherization measures for all electric customers that are market rate customers.

As background, during the 2013-2015 plan term, the Compact identified cost-effective enhancements designed to assist customers with identified barriers such as split incentives and difficulty with co-payments. The Compact offered 100% incentives, up to the program cap of $4,000, for qualified insulation incentives for year-round renters who paid their electric bill, customers whose income was within 61-80% of state median income, and customers whose operations were managed by municipalities or other government entities. The Compact also raised the insulation cap to $4,000 for market rate electric customers, after determining the average insulation recommendation surpassed the previous cap of $2,000. These changes allowed customers to make improvements within one year rather than over several years. The

Compact continued this offer through the 2016-2018 term and then, along with all the Program Administrators, supplemented it by removing the insulation incentive cap beginning in mid-2017 through the end of 2018.

Residential Electrification Offering

In response to the recent amendments to the Green Communities Act (the "GCA"), the Compact has developed its Cape and Vineyard Electrification Offering ("CVEO"). The CVEO is designed to serve oil, propane or electric resistance heat customers with the following cost-effective tiered services:

- Installation of cold climate air source heat pumps
- Installation of solar photovoltaic ("PV") system
- Installation of battery storage for active demand response

The CVEO is designed to serve 700 participants over the course of the three-year term. The proposed breakdown includes:

- 175 residential low-income customers residing in deed restricted low income residence
- 175 residential moderate income (61-80% AMI) customers
- 175 residential extended moderate income (81-120% AMI) customers
- 175 residential customers

The CVEO will include a 100% incentive for low-income participants, and a combination of a sliding scale incentive and utilization of the HEAT Loan for all remaining co-pays.

The GCA supports the installation of cold climate air source heat pumps as part of its mandate for strategic electrification. Similarly, the GCA also supports the installation of PV systems paired with battery storage as a means for the Program Administrators to address peak demand and greenhouse gas reductions.

The goal of the CVEO is to test this three-pronged approach as a means to achieve the goals of the GCA and to reduce peak demand. Cape Cod and Martha's Vineyard have been identified by the local distribution company as constrained areas with seasonal spikes. The Compact is well positioned to implement the CVEO as its service territory has some of the highest incidence of electric heat, and both Martha's Vineyard and the Outer Cape do not have natural gas pipeline/service availability. The CVEO is designed to yield valuable information for other Program Administrators, the Department of Public Utilities, and other stakeholders, as well as to inform with "real-time" information and data any technical sessions and/or future program designs relating to these three areas.

Commercial & Industrial ("C&I") Program Enhancements

C&I New Buildings

The Compact proposes to continue its approved 2016-2018 Plan enhancements to its new construction and major renovation program to include cost-effective thermal measures designed to save oil, propane and other unregulated fuels.

C&I Existing Buildings

The Compact proposes to continue to offer its municipal customers specialized incentives that cover up to 100% of cost-effective measure costs as part of this program.

The Compact also plans to continue two special incentive options first adopted in 2013 to assist small business customers further in overcoming barriers to participation: a 95% incentive option for qualifying small business tenants; and for other small businesses, the zero-interest financing option.

The Compact is also looking to continue several enhancements in its 2019-2021 Plan to its C&I Existing Buildings Program, each designed to further reduce barriers to participation for key customer segments.

First, the Compact proposes to continue enhancements to its commercial and industrial retrofit program to include all cost-effective thermal measures designed to save oil, propane, and other unregulated fuels.

Second, the Compact modeled its small business effort after the HES program and will include a BEA (Business Energy Audit) and a core offering of deemed savings measures, many of which can be installed in the first visit, some at 100% incentive coverage. For its small business customers, the Compact continues to offer higher incentives for standard direct install measures (up to 100% rather than up to 70% as offered in the Statewide Plan).

Finally, the Compact will continue offering 100% incentive for all cost-effective measures non-profit corporations on Cape Cod and Martha's Vineyard that meet qualifying criteria.

Residential and C&I Program Enhancements

Demand Management – Energy Storage

As part of its 2019-2021 Three Year Plan, the Compact proposes to offer battery storage to reduce peak demand in its service territory. Due to its high penetration of residential and small commercial solar on Cape Cod and Martha's Vineyard, the Compact will initially focus on installing batteries in homes and small businesses that have distributed energy resources installed behind the meter.

The Compact's program will be informed by other Program Administrator's demand management efforts, especially Unitil Electric's 2016-2018 Demand Response Offering. The Compact hopes to learn from Unitil's marketing experiences; what marketing efforts successfully enrolled and educated customers and what marketing efforts were not so successful. Also, the Compact will incorporate any lessons Unitil learned relative to the procurement of small scale battery storage (e.g., request for proposal and contract terms and conditions).

Eversource PA-Specific Materials

A. Income-Eligible Coordinated Delivery

Pilgrim Fund

The Pilgrim Fund was established in 1990 in the context of a settlement agreement resolving litigation associated with replacement power costs incurred by Commonwealth Electric Company ("ComElectric") in connection with an outage at Boston Edison Company's ("Boston Edison") Pilgrim Nuclear Power Station. Under the settlement, Boston Edison paid ComElectric funds to be applied for Demand Side Management ("DSM") programs which would be specified by the Attorney General and filed with the Department of Public Utilities ("Department") for approval. A further settlement in 1991 allocated one half of the funds to DSM activities, with the balance designated for specification by the Attorney General. A third settlement addressing the use of these funds was approved by the Department in 1996. The settlement funds have been used to support various DSM and energy efficiency programs between 1996 and the present.

Pursuant to settlements among Commonwealth Electric Co., the Attorney General, and LEAN (D.P.U. 91-80, Phase 2-A (1992), D.PU. 95-95 (1996)), creating a fund for, inter alia, low-income energy efficiency (the Pilgrim Fund), the Eversource low-income program will be additionally funded, subject to Department approval, by approximately $275,000 (plus applicable interest) for the purpose of removing barriers to weatherization in low-income homes and multi-family housing in the former Commonwealth and Cambridge territories that remain unfunded by the Three-Year Plan.

In keeping with the original intent of the settlement that created the Pilgrim Fund, the remaining settling parties propose that the remaining funds be used to supplement energy efficient services by funding necessary health and safety repairs within the Income-Eligible Coordinated Delivery Initiative. Eversource and the Low-Income Energy Affordability Network ("LEAN") believe this is a great opportunity to mitigate the barriers and expenses associated with repairs that typically prohibit the installation of energy efficiency upgrades. The barriers include such major needs for remediation as knob & tube wiring, substandard roofs, faulty windows, and other physical obstacles to weatherization. It is estimated that 35-40 homes will be served by the Fund at an average cost per home of $7000-$8000.

Expending the fund balance on such repairs will allow for more energy efficiency services to be implemented and more energy savings to be achieved within the income-eligible population of Eversource's former ComElectric service territory. Eversource plans to work collaboratively with the Attorney General and LEAN to pursue this great opportunity and it is thus anticipated that the Fund will be depleted within the Three-Year Plan of 2019-2021.

B. Active Demand Reduction

EV Load Management

The Electric Vehicle ("EV") load management effort is focused on shifting EV charging away from peak hours. This effort is analogous to demand response focused on residential and commercial charging load management. This effort does not provide any incentives for electric

vehicles or electric vehicle chargers. The incentives provided through this effort will be used to shift when EVs charge. The Company intends for this effort to evolve, accommodating current types of equipment deployed in its service territory and attracting customers that are considering upgrading or purchasing new charging equipment.

The incentives for enrollment and payment to the customer will be based on the operation of the load control approach, with two control approaches: (1) "throttling", which involves lowering the charging capacity; or (2) "restricting/scheduling" charging during specific time periods specified by the program. Either of the control approaches may be implemented based on a fixed schedule or via notification, similar to demand response events which would be limited to program design hours. Customers will be paid an incentive to allow the Company's vendor to either throttle EV charging during specific hours per month (which might vary in the summer cooling season or winter heating season, as applicable), and/or set a defined schedule for when the car charges, with the possibility of a guaranteed minimum state of charge and established preferred time. The preferred approach for the scheduled option would be to restrict charging during peak hours. Customers will have the option to opt out for reduced incentive compensation.

For residential charging applications, the Company will work with its vendors to determine the needs of each EV owner to try and accommodate their specific charging needs. The defined schedule (including critical hours when charging should not occur) could be different in the summer cooling months compared to the winter heating season. The EV load management effort will be able to integrate with a control system as an end node and will be OpenADR compliant, meaning that it will be possible to manage EV charging through a centralized control system using open communication protocols.

The EV Load management effort recognizes that there are multiple technical interfaces for charging, including Level I and Level II chargers[1]. The effort could include incentivizing customers using Level I and II chargers, depending upon the number of customers with each type of device willing to participate. However, the expectation is customers with higher functioning Level II chargers will be the primary participants, with the possible opportunity to retrofit Level I chargers with "smart" devices to expand the number of individual sites. The Company is also exploring the possibility of working with EV car manufacturers to manage EV charging directly through the vehicle's onboard telematics.

This effort is unique from anything else the Company is currently doing in regards to EVs. This effort does not contain any of the components outlined in D.P.U. 12-95 such as planning studies, technical evaluations of vehicle to home or vehicle to grid capabilities or deploying charging infrastructure (DC fast Chargers or Level II chargers). Similarly, this effort does not overlap with the Company's deployment of its "Make Ready" EV infrastructure program approved in D.P.U. 17-05 as there is no physical improvements or infrastructure proposed as part of this demand reduction effort. The sole purpose of this effort is to mitigate peak demand by controlling an EV's charge through an existing charger or through the car's onboard telematics.

[1] Level I chargers generally refer to using a 120 volt (V) alternating-current (AC) plug with a kW charge rate of up to 2 kW and can be plugged into a household outlet. Level II chargers typically are around 240V and 40 amps, with a charge rate of up to 19 kW but more commonly around 6-7 kW. Level II charges require specialized equipment.

C. Residential Education

Eversource Specific

In addition to the statewide education plan, Eversource provides an array of programs for their Residential and School Education Program. Eversource recognizes the need to educate our future customers with positive energy behaviors. As such, Eversource strives to meet the needs of educators to teach our children positive energy behaviors, energy education and green job opportunities.

Eversource offers in class programs for Grades K-8. These programs teach students to be more aware of their energy usage and to develop positive energy-saving habits that help conserve natural resources. Many of these programs have won national and regional awards for their creativeness and effectiveness. All programs are science-based learning and align with the Massachusetts State Frameworks.

Eversource is introducing a new program for high school students in 2018. The program will develop the next generation of creative problem solvers by offering teachers and students the tools they need to design a sustainable future. Using a comprehensive LEED Prep curriculum, Eversource will promote sustainability and green building education to develop a workforce development program for secondary students. This program will help narrow the green skills gap in Massachusetts. These secondary students will be prepared to sit for the LEED GA Exam.

The Eversource Challenge is a prompt-based student contest for Grades K-12 to showcase their knowledge on saving energy, energy efficient technologies and sustainability. The contest includes challenges ranging from poster making for first graders to developing an energy efficiency plan for high school students. First, second and third place prizes are awarded for each grade level.

"Kids Green Their School Program" developed and administered by "e" inc., targets inner-city, hard to reach schools in Metro-Boston to educate children, youth and caregivers about energy conservation and sustainability through standards-based science curriculum and hands-on activities. This market usually lacks resources to promote science, technology, engineering and math (STEM) education and sustainability to its students. The program provides an in-depth sustainability program with two simple goals:

1) Teach children in schools some of the science underpinning an important environmental resource (in this case: energy) that the school wants to conserve so the children gain an understanding of how it is produced and what challenges are associated with it in our world;

2) Involve the children and the system in some clear doable conservation tasks. To achieve these goals, students participate in a series of hands-on experiments and games to fully understand each concept. The program encourages positive energy behavior and teaches the skills needed to make a difference that can lead to a sustainable future. The program also encourages students to minimize the school's energy footprint and bring home the lessons learned to lower their household energy footprint In addition, the program encourages students to participate in energy efficiency programs offered by Program Administrators.

The Change a Light, Change the World fundraiser offers schools and non-profits a chance to sell energy efficient products while earning much needed funds for their schools. This program has been very successful with schools using the funds to upgrade their facilities.

Teacher workshops are offered statewide through all Program Administrators. Eversource goes beyond the state workshops and offers additional workshops for teachers working in the Eversource electric service territory. These workshops offer curriculum and resources to teachers so they can develop and teach lesson plans focusing on Energy Efficiency to their students.

2019-2021 Energy Efficiency Plan

National Grid Specific Elements

National Grid is committed to acquiring cost-effective energy efficiency and demand reduction resources for the benefit of our customers. The Company fully supports the programs as outlined in the 2019-2021 Massachusetts Joint Statewide Three-Year Electric and Gas Energy Efficiency Plan and plans to supplement those efforts with the following offers:

Communities Initiative

Since National Grid originally deployed the Communities Initiative in 2013, the Company has partnered with 24 municipalities, working with municipal officials and volunteers to increase engagement and participation in our residential energy efficiency initiatives. The Company plans to build on this successful history in the 2019-2021 Term.

National Grid's Communities Initiative will serve as an enhancement to the statewide municipal and community engagement partnership strategy outlined in the 2019-2021 Massachusetts Joint Statewide Three-Year Electric and Gas Energy Efficiency Plan. National Grid's Communities Initiative is designed to accommodate the special circumstances of any community, regardless of demographic or socioeconomic characteristics.

Municipalities are encouraged to apply for the program. They are selected using a number of criteria including the strength of proposed marketing tactics and community ties, historical participation levels in the community (i.e. is this a municipality that could benefit from increased participation rates?), and characteristics that suggest community-based marketing may be particularly valuable in a given municipality.

Each municipality is given participation and savings goals based upon past residential participation levels in that specific community, creating a level playing field while incentivizing municipalities to drive incremental engagement. Representatives from the municipalities, including staff and volunteers, are trained in current offers and in best practices for outreach and education. Regular check-in calls between National Grid and partnering municipalities allow for the sharing of successful outreach tactics and provide a sense of competition. The most successful municipalities draw on their own knowledge of their communities and available resources.

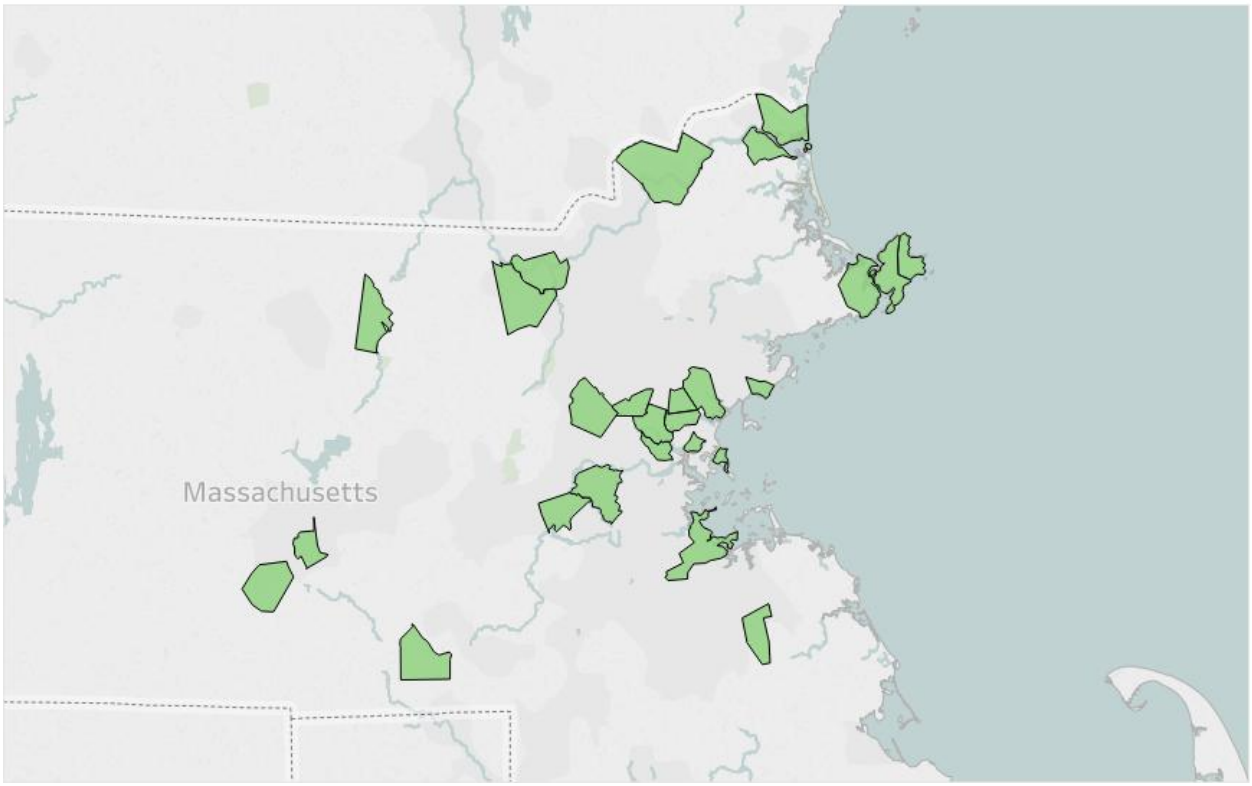
Participating municipalities are provided with up-front funding to cover marketing costs. Participation numbers are communicated to municipalities monthly, so they can track progress towards their goals. Additional compensation is granted based on audits performed and additional measures completed, such as insulation and heating systems. The approach specifically rewards municipalities for increasing the volume of not just home energy assessments, but also measure installations, such as weatherization and heating systems.

For the 2019-2021 Term, participating municipalities will also be encouraged to establish partnerships with local community groups, reaching residents that may be less accessible through traditional channels. While this has already been done informally by past partner municipalities, the Company will begin supporting these efforts more formally with trainings, best practices and information sharing, and progress reports for these community groups. The Company's focus will be on working with municipalities, but, to the extent that the Company

identifies areas targeted for outreach within municipalities that lack the resources to participate in the Communities Initiative, the Company will consider working with and providing participation incentives directly to community groups.

In communities that demonstrate an interest, the Company may consider working with the municipality to address commercial and municipal consumption, and exploring possible opportunities for local workforce development efforts.

National Grid Communities Initiative Participants



Previous Participants			
Auburn	Lowell	Newton	Shirley
Chelmsford	Malden	Quincy	Somerville
Chelsea	Medford	Rockland	Swampscott
Gloucester	Melrose	Rockport	Wellesley
Haverhill	Mendon	Salisbury	Winchester
Lexington	Newburyport	Saugus	Winthrop

Electric Vehicle Active Demand Reduction

Electric vehicles are a cornerstone of Massachusetts' strategy to reach Global Warming Solutions Act carbon reduction goals, and the number of these vehicles in the state increases every year. However, as with any strategic electrification, transitioning from fossil-fuel powered

vehicles to electric vehicles increases the burden on the electric grid. Targeting electric vehicles for active demand reduction can help to reduce that burden.

National Grid will begin offering an active demand reduction incentive for customers with electric vehicles to pause or shift charging during system peak periods in the summer of 2019. Similar to the other demand reduction initiatives included in this Plan, this offer will be based on a bring-your-own-device model. Much like the approach used for communicating thermostats, this means customers with eligible technology will have the opportunity to enroll in the active demand offering. Incentives are based on performance during peak demand events and will not be used to incentivize the purchase of electric vehicles or charging stations. The same event calling process will be employed in this offer as for measures in the Residential active demand reduction initiative.

National Grid will reach out to customers through vehicle manufacturers, specifically targeting customers who charge during peak periods in the summer and winter months. Based on initial discussions with manufacturers, it is anticipated that there will be fewer than 300 participants in the 2019-2021 Term. Once customers have agreed to participate, during peak events manufacturers will automatically change vehicle settings to begin charging after the peak event ends. Customers can override this for immediate charging needs but will be removed from the program if they regularly opt out of participation.

National Grid anticipates that this offer will have an impact on system peak demand and may contribute to winter reliability, while strongly supporting the Commonwealth's greenhouse gas reduction goals.

Online Solar Marketplace

In addition to being a trusted resource for energy efficiency, customers also recognize National Grid as a resource for photovoltaic ("PV") system information. This represents an opportunity to leverage the interests of customers participating in the Company's residential energy efficiency programs to encourage the installation of PV systems.

National Grid will offer an online solar marketplace for customers pursuing residential energy efficiency upgrades who also want to assess the solar potential of their homes and refine financial estimates by pursuing quotes from multiple installers. The online solar marketplace will be presented to interested customers through relevant web-based channels, during in-home Home Energy Assessments ("HEA"s), and on other printed and electronic collateral. The goal of the on-line solar marketplace will be to provide comprehensive energy information and education to customers engaged in making energy decisions for their home.

Web-based channels and other printed and electronic collateral will address common customer concerns related to the installation of PV systems and will guide customers to the on-line solar marketplace. For in-home HEAs, National Grid will provide online solar marketplace information in the customer's HEA report and train Energy Specialists to refer interested customers to the platform, as appropriate. The online solar marketplace will include information about community solar for renters and other customers who do not have the opportunity to install PV systems on their own homes.

Appendices

L. **Technical Reference Manual**

Please see separate binder for Exhibit 1, Appendix L

Appendices

M. **Participant Definitions**

Participant Definitions for 2019-2021

PROGRAM/CORE INITIATIVE	PARTICIPANT DEFINITION
A - Residential	
A1 - Residential New Buildings	
A1a - Residential New Homes & Renovations	Dwelling unit with any measure
A2 - Residential Existing Buildings	
A2a - Residential Coordinated Delivery	Dwelling unit with any measure
A2b - Residential Conservation Services (RCS)	[no participants; not a separate initiative]
A2c - Residential Retail	Unique account number when available, assumption for upstream (1 measure per participant, except for lighting, per the chart below)
A2d - Residential Behavior & Demand Management	Unique account number
A3 - Residential Hard-to-Measure	
B - Income Eligible	
B1 - Income Eligible Existing Buildings	
B1a - Income Eligible Coordinated Delivery	Dwelling unit with any measure
B2 - Income Eligible Hard-to-Measure	
C - Commercial & Industrial	
C1 - C&I New Buildings	
C1a - C&I New Buildings & Major Renovations	Unique account number or equivalent
C2 - C&I Existing Buildings	
C2a - C&I Existing Building Retrofit	Unique account number
C2b - C&I New & Replacement Equipment	Unique account number
C2c - C&I Demand Management	Unique account number
C3 - C&I Hard-to-Measure	
Residential Upstream Lighting	**Widget per Participant**
LED Fixture	1
LED Bulb	4
LED Bulb (Specialty)	3
LED Bulb (Hard to Reach)	2
LED Bulb (School Fundraiser)	4
LED Reflectors	3
Food Pantries LEDs	2
Linear LEDs	2

Appendices

N. **Studies of Remaining Potential**

Please see separate binder for Exhibit 1, Appendix N

Appendices

O. **Vendor Cost Categories**

Program Administrator Vendor Cost Categories

Row Number	Cost Type	Elec/Gas/Both	Cost Category
1	Statewide Database/Mass Save Data	B	PP&A
2	Builder and Equipment Incentives	B	Incentive
3	Heating System Rebates	B	Incentive
4	Lighting/ISMs	B	Incentive
5	Permits	B	Incentive
6	Pre-weatherization Incentive	B	Incentive
7	Rater Inspection Fees	B	Incentive
8	Rebates/ Incentives (customer)	B	Incentive
9	Refrigerator Costs within Low-Income	E	Incentive
10	Repairs within the Low-Income Initiatives	B	Incentive
11	Total Interest Subsidy	B	Incentive
12	Weatherization Costs	B	Incentive
13	Marketing and Advertising Support	B	Marketing
14	Cost Effectiveness Screening	B	PP&A
15	EEAC Consultants/Regulatory Assessments/LEAN	B	PP&A
16	Legal Services	B	PP&A
17	Planning Support	B	PP&A
18	Tracking System Maintenance	B	PP&A
19	Account Management	B	STAT
20	Audit Fees	B	STAT
21	Call Center Activities	B	STAT
22	Circuit Rider Activities	B	STAT
23	Postage Associated with Rebate Processing	B	STAT
24	Processing Fee	B	STAT
25	Program Administration Fees	B	STAT
26	Quality Assurance and Control activities	B	STAT
27	Reporting	B	STAT
28	Technical Assistance Studies	B	STAT
29	Technical Support for Contractors	B	STAT
30	Travel	B	STAT
31	Contractor Fees	B	STAT (contractor services/fees); Incentive (measure costs/labor)
32	Training	B	STAT (Workforce Development)

Appendices

P. **Administrative Cost Study**

NAVIGANT

Best Practices for Minimizing Program Planning and Administrative Costs (PP&A) for the Massachusetts Utilities and Energy Efficiency Services Providers

Prepared for:

The Massachusetts Utilities and Energy Efficiency Services Providers:

The Berkshire Gas Company
Cape Light Compact
Columbia Gas (NiSource)
Eversource Energy (Electric & Gas)
Liberty Utilities
National Grid (Electric & Gas)
Unitil / Fitchburg Gas & Electric

October 25, 2018

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NAVIGANT

Best Practices for Minimizing Program Planning and Administrative Costs

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NAVIGANT

Best Practices for Minimizing Program Planning and Administrative Costs

1 Introduction

Massachusetts Energy Efficiency Program Administrators (PAs) deliver nation-leading[1] energy efficiency programs under the Mass Save brand. When measured as a percent of total retail sales, the quantity of energy savings procured annually in Massachusetts has been the highest in the United States in recent years. This success is, in large part, attributable to a combination of supportive policy and a unique program delivery structure. Unlike most other jurisdictions, energy efficiency programs in Massachusetts are delivered by a consortium of program administrators in a statewide collaborative of all electric and natural gas utilities and energy efficiency service providers across the Commonwealth, under a single coordinated portfolio design. This statewide collaborative faces a high level of regulatory and stakeholder oversight and requires constant communication and cooperation among the MA Program Administrators. Based on Navigant's engagement in this project, we believe the coordination and collegial engagement among the individual PAs is exemplary and a key factor for the success of the Massachusetts energy efficiency programs.

As part of the Green Communities Act of 2008, the Massachusetts Department of Public Utilities (DPU) is charged with ensuring that Energy Efficiency Program Administrators minimize administrative costs "to the fullest extent practicable".[2] After reviewing the Program Administrators 2016 - 2018 Three Year Plan, the DPU found that "Program Administrators have appropriately balanced the requirement to minimize [Program Planning & Administration (PP&A) costs with the need to maximize program quality and oversight." However, the DPU suggested there may be additional opportunities for the Program Administrators to minimize administrative costs. The DPU, therefore, directed PAs to study best practices for tracking, assessing and minimizing PP&A costs.[3]

Navigant worked closely with all seven Program Administrators and the PA-designated working group to fulfill this directive by:

1. Identifying best practices, both in Massachusetts and nationwide, for tracking and assessing administrative costs
2. Identifying potential benchmarks, metrics, and/or indicators for measuring administrative costs
3. Providing specific recommendations, as appropriate, for reducing administrative costs, without jeopardizing the PAs industry leading energy efficiency programs.

The fundamental requirements of the Green Communities Act require that PAs commit to extensive coordination and stakeholder outreach when developing and implementing tri-annual energy efficiency plans. This includes robust opportunities for public input from groups such as the Massachusetts Department of Energy Resources (DOER), the Energy Efficiency Advisory Council (EEAC) members and their consultants, and other stakeholders. The requirement that PAs offer coordinated programs, by necessity, leads to extensive PP&A investments. Nevertheless, PAs must continually work with stakeholders to identify opportunities to reduce PP&A costs while also maximizing energy efficiency benefits.

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[1] According to, e.g. the American Council for and Energy-Efficient Economy (ACEEE) *State Energy Efficiency Scorecard, 2017*, where Massachusetts is ranked #1.

[2] G.L. c. 25, § 19(b)

[3] D.P.U. 15-160 through D.P.U. 15-169

Navigant's scope of work included qualitative review of PA accounting practices, limited quantitative review of PP&A expenditures and tracking processes, interviews with the MA Program Administrators and with four different non-MA peer program administrators active across the U.S. This report summarizes Navigant's findings on industry best practices for tracking, assessing and controlling (minimizing) administrative costs. This study was limited to qualitative assessment of PP&A accounting methods and did not include an evaluation of actual individual PA PP&A spending or benchmarking of PP&A costs across different MA Program Administrators. Additionally, our scope was limited primarily to considerations of costs that the PAs have direct control over, as opposed to "assessed" costs which the PAs pay per direction from state agencies (e.g. DPU or DOER, etc.).

1.1 Defining Administrative Costs

The DPU's Guidelines identify five categories of program implementation costs:

1. Program planning and administration (PP&A),
2. Marketing and advertising,
3. Participant incentives,
4. Sales, technical assistance and training, and
5. Evaluation and market research

This report is primarily focused on the PP&A cost category, which includes the following:

> *"Program Planning and Administration include costs associated with developing program plans, including market transformation plans, research and development (R&D) (excluding R&D assigned to Evaluation and Market Research), and day-to-day program administration, including labor, benefits, expenses, materials, supplies, and overhead costs, and any regulatory costs associated with energy efficiency activities. Also includes costs for energy efficiency services contracted to non-affiliated companies such as outside consultants used to prepare plans, screen programs, improve databases, and perform legal services. Includes internal salaries for administrative employees/tasks, including program managers that do not have direct sales and technical assistance contact with customers."*

This project presents a unique challenge, as the way Massachusetts tracks PP&A costs is unique from any other state's program administrators and therefore required the development of a new approach to this type of analysis. Our project objectives were not to simply review and benchmark all "non-incentive" costs, since the Massachusetts cost categories are more delineated. As such, our study objectives are more nuanced and qualitative in their findings and recommendations. Additionally, since PP&A costs are incurred from almost any element of program administration, some of our findings and recommendations address overall operations.

2 Study Approach

The objective of this study was to identify best practices for tracking, assessing, measuring, and controlling PP&A costs without negatively impacting the Program Administrators' ability to deliver nation-leading energy efficiency programs. The following section summarizes Navigant's approach to meeting the study objectives.

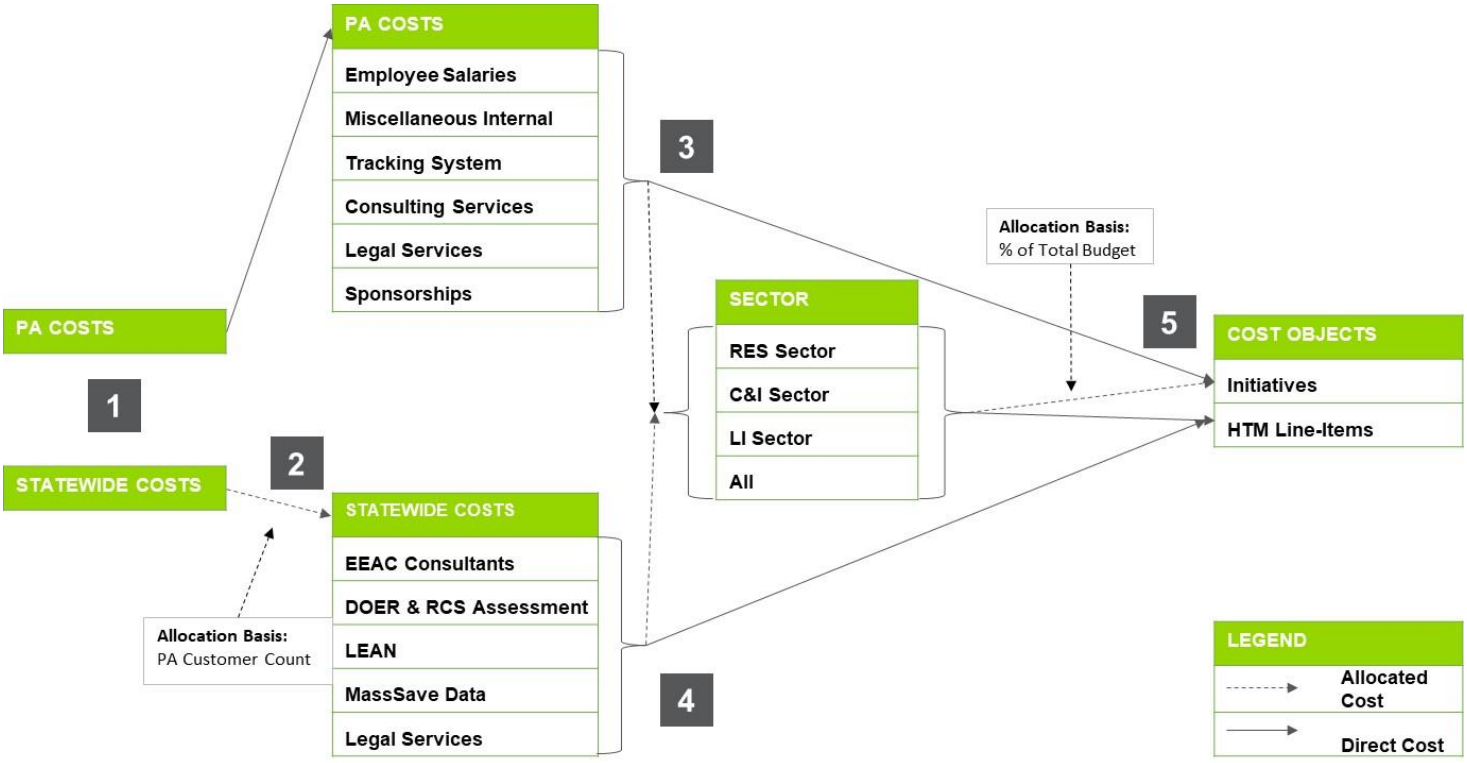
2.1 *PP&A Cost Accounting Review*

Navigant reviewed 2016-2017 information on PP&A costs from each Program Administrator to clearly understand the current accounting methods used to budget and track PP&A costs. Where possible, Navigant conducted an even further in-depth review of actual cost data, to trace the calculations used to pool and allocate PP&A costs across initiatives. This review was limited to a qualitative review of accounting processes, rather than a detailed quantitative benchmarking or comparative analysis of individual PA PP&A spending. The purpose of this review was to develop an understanding of current accounting methods, to compare against best practices, and to identify possible inefficiencies. Our review was further used to inform follow-up interviews conducted with each PA. Navigant completed the following tasks as part of the PP&A cost accounting review:

1. Reviewed data collected from each PA on the list of PP&A cost types and methods for budgeting, accounting, and reporting
2. Compared PP&A cost types and accounting methods to identify similarities and differences across PAs
3. Conducted interviews to clarify details and further understand practices of the Massachusetts PAs that contribute to PP&A spending
4. Summarized common PP&A accounting methods and assumptions

Figure 1 below is an illustrative schematic of the general process by which Program Administrators account for PP&A costs. This schematic was informed by a review of each PA's data submission. The granularity of submission varied by PA, and as a result, the following analysis is more reflective of PA submissions that were highly detailed.

Figure 1. Current PP&A Cost Allocation Methodology



Step 1 – Cost are identified as either PA-specific or statewide costs.

Step 2 – Statewide costs are allocated to PAs based on customer count by fuel type.

Step 3 – PA costs are allocated to portfolio or sector-level cost pools or directly to initiatives, where possible.

Step 4 – Statewide costs are allocated to portfolio or sector-level cost pools or directly to initiatives where possible.

Step 5 – Costs are allocated to initiatives based on the initiative's portion of the total sector or portfolio budget.

2.2 *Best Practice Research into Program Planning and Administrative Costs (PP&A)*

Navigant conducted interviews with MA portfolio managers to further understand their practices for tracking and assessing PP&A costs, key metrics they use to compare and assess PP&A costs, and efforts undertaken to minimize controllable PP&A costs. Navigant also conducted in-depth qualitative research of PP&A costs for four program administrators outside MA to identify similarities, differences, and best practice

considerations for PP&A cost tracking and management. The peer group was selected to include PAs with similar profiles (e.g. portfolio size, maturity, etc.) to the Massachusetts PAs. The research team conducted a detailed review of each PA's annual reports to better understand the regulatory requirements, portfolio structure and implementation approach. An additional consideration in the selection of external program administrators was the level of collaboration required in the respective jurisdictions, given the extensive coordination required of Massachusetts PAs. However, there are few other program administrators with a comparable regulatory and market environment to those in MA. Interviews with the non-Massachusetts PAs were conducted based on anonymity, as such, we cannot release the specific names of the non-Massachusetts PAs we interviewed.

3 Administrative Cost Accounting Best Practices

The Massachusetts PAs and peer utilities interviewed by Navigant had similar strategies for managing PP&A costs, representing some key best practices in administrative cost accounting. However, Navigant determined through research and interviews that some external PAs and non-demand-side management (DSM) organizations (e.g. government entities) employ further valuable approaches in the areas of administrative cost accounting, which could be of use to the Massachusetts PAs. Specifically, these best practices involve increased measurement and analysis to better understand, allocate and control costs, as well as target-setting to reduce costs where possible. Table 1 presents a summary of these administrative cost accounting best practices, which are described in further detail in this section.

Table 1. Administrative Cost Accounting Best Practices

Topic Area	Best Practice
Budgeting / Planning	**Update Budget Allocation Methodology Regularly** The methodology used to allocate PP&A costs should be updated regularly to reflect most closely the actual source areas for which the costs are incurred. Ideally, allocation rates/assumptions should be based on actual performance, program design/delivery changes and other factors.
	Set Annual Cost Targets Set administrative cost targets (and/or cost reduction targets), and track progress towards targets.
Allocating / Assessing	**Allocate Indirect Costs to Programs/Initiatives** Ensure that all indirect costs are absorbed by programs/initiatives.
	Allocate to Programs/Initiatives Proportionally Administrative costs should be allocated equitably, in proportion to the programs/initiatives that consume them.
Tracking	**Monthly Variance Tracking and Reconciliation** Track variances between actual and budgeted costs and reconcile where applicable.
	Invoice Review Sampling Quality control and validate a sample of invoices each month to ensure alignment with internal systems and to mitigate risk of fraud or inappropriate accounting.
Control	**Dedicated controller** Designate an internal controller within the energy efficiency division to oversee effective administrative cost accounting and tracking, and be another independent internal source focused on cost control.
	Variance Thresholds Set monthly or quarterly thresholds on administrative cost variance that trigger formal budget modification or course corrections.
	Manage to Target Ensure organization is focused on achieving administrative cost targets through reviews, meetings, etc.
Metrics	**Monitor YoY Metrics** Monitor administrative spending using metrics that allow for monitoring year-over-year (YoY) performance.

The following sections discuss each topic area in more detail and compare methods used among the Massachusetts PAs and non-Massachusetts program administrators profiled for this study.

3.1 Budgeting and Planning

The budgeting and planning of costs is a key step in PP&A cost accounting that varies across PAs. At a high level, it is best practice to set budgets that vary as little as possible from actuals. To do this, budgets and cost allocation methodology must be updated regularly to reflect current conditions. Targets for administrative cost reduction can be built into budgets to regularly improve cost effectiveness.

Table 2. Budgeting and Planning Best Practices

Topic Area	Best Practice	Mass. PAs	Utility 1 (Dual Fuel PA)	Utility 2 (Dual Fuel PA)	Utility 3 (Electric PA)	Utility 4 (Dual Fuel PA)
Budgeting / Planning	Update Budget Allocation Methodology Regularly	✔	✔	✔	✔	
	Set Annual Administrative Cost Reduction Targets		✔	✔		✔

Update Budget Allocation Methodology Regularly

Typically, administrative costs are not directly allocable to specific initiatives. Therefore, these costs should be allocated across initiatives as equitably as possible based on a predetermined methodology. The Massachusetts PAs allocate costs based on budgets, assigning the same percentage of an allocated cost to an initiative as the percentage of the sector or portfolio budget (as appropriate) planned for that initiative. An allocation methodology should be updated regularly to remain reflective of the current operating environment, subject to any limitations or requirements as directed by regulators that might be prescriptive in application. For example, a utility might have an allocation methodology based on assigning administrative costs based on total spending by program, or by savings by program. Navigant determined that it is best practice to maintain consistency in methodology as much as possible to allow for multi-year comparisons, with changes in methodology to be implemented at the start of a new program cycle. Ideally, however, flexibility should be built in to allow for adjustment of the methodology in the interim if a significant event has occurred.

It takes a significant amount of resources to update an administrative cost allocation methodology, which includes extensive analysis and documentation that support the allocation of each administrative cost. PAs must determine how often this methodology should be updated while considering both the cost to update the methodology and the risk of operating with an outdated allocation.

In Massachusetts, statewide administrative costs are allocated to PAs based on customer counts (by fuel). PA-specific administrative costs that cannot be allocated directly to initiatives are distributed across initiatives based on budget.

Set Annual Administrative Cost (Reduction) Targets

It is best practice to set administrative cost targets (and/or cost reduction targets), and track progress towards targets. For example, one non-Massachusetts PA sets a target of administrative cost as a percentage of total portfolio costs and strives to maintain this target month over month. The Massachusetts PAs do not currently do this. One external utility Navigant interviewed set a target of reducing administrative costs each year by 2%, to manage inflationary increases in costs through "operational excellence" (six sigma) initiatives. PAs can also benchmark administrative costs against other PAs / utilities to help develop these cost reduction targets. This benchmarking is currently done by some Massachusetts and external PAs. Without a purposeful and focused effort to reduce administrative costs, significant savings are not likely to materialize. Opportunities to seek out these cost reductions can occur from numerous opportunities such as standardization of routine and recurring activities, retention of high-performing staff, purposeful and structured questioning of where and how to achieve administrative efficiencies, all without compromising program results. Additionally, efforts by all stakeholders engaged with the PAs, (e.g. DOER, EEAC councilors, consultants etc.) can take efforts as well to reduce PA costs by ensuring supplemental data requests, which require additional PA effort to assemble and present, are truly high value and necessary, and review their own spending and prioritization of tasks and contracts, which ultimately can influence PP&A costs.

Summary

- Budgeting is the first step in administrative cost accounting and there are corresponding best practices that the Massachusetts PAs can strive towards. Navigant found that an indirect cost allocation methodology should be updated regularly, at prescribed intervals, to remain relevant.

- Administrative cost reduction targets are an effective method of maintaining or lowering costs year over year. The Massachusetts PAs do not set annual cost reduction targets, while many PAs that Navigant interviewed do. The PAs should consider setting targets that seek to reduce costs, while remaining cognizant of the varied operating environments that the PAs operate in, as well as being clear what PP&A costs are within control of the PAs versus allocations and directives to expense certain costs (e.g. DOER assessments).

Further discussion on metrics that can be used to set targets to reduce costs can be found in Section 3.4.

3.2 Allocation and Assessment

Administrative costs apply to multiple activities carried out by an organization. In the energy efficiency context, administrative costs should be allocated to the programs/initiatives that incur them. Organizations can design their administrative cost allocation framework to be as simple or complex as they choose, however this is a decision often driven by the data and resources available.

Table 3. Allocation and Assessment Best Practices

Topic Area	Best Practice	Mass. PAs	Utility 1 (Dual Fuel PA)	Utility 2 (Dual Fuel PA)	Utility 3 (Electric PA)	Utility 4 (Dual Fuel PA)
Allocating/ Assessing	Allocate Indirect Costs to Programs/Initiatives	✔	✔	✔	✔	✔
	Allocate to Programs/Initiatives Proportionally	✔	✔	✔	✔	✔

Allocate Indirect Costs to Programs/Initiatives

A key principle of cost accounting is that costs should be attributed to the activities that benefit from them to the extent possible. Allocation methodologies affect how administrative costs are distributed and absorbed across initiatives, but do not necessarily affect how much is spent or whether costs are minimized.

Choosing the right allocation method is vital to transparently tracking costs and in providing insight into areas of potential cost reduction. Simply put, effectively identifying areas to reduce administrative costs depends on the ability to clearly understand what programs and efforts those costs are currently supporting.

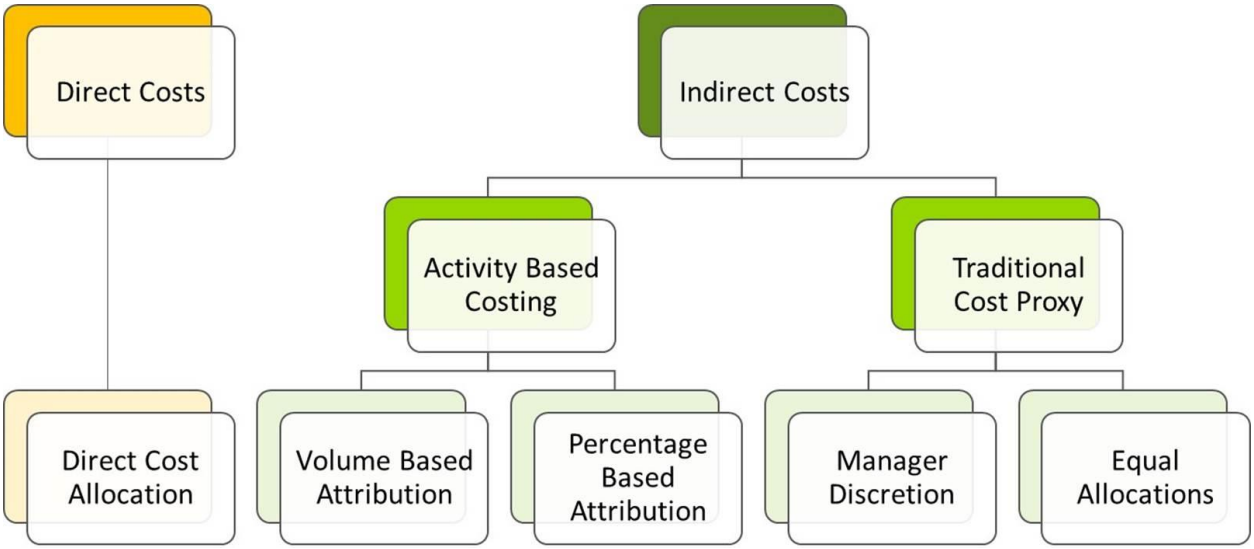
Administrative costs incurred by an organization are typically grouped into two major categories, direct and indirect costs. Direct costs can be linked directly to a specific initiative, while indirect costs (also known as overhead costs) can be more abstract. Indirect costs are defined below per the U.S. Department of Labor:[4]

> *Indirect costs mean those costs incurred for a common or joint purpose benefitting more than one cost objective, and not readily assignable to the cost objectives specifically benefitted, without effort disproportionate to the results achieved. To facilitate equitable distribution of indirect expenses to the cost objectives served, it may be necessary to establish a number of pools of indirect costs. Indirect cost pools should be distributed to benefitted cost objectives on bases that will produce an equitable result in consideration of relative benefits derived.*

Figure 2 below illustrates the basic methods of cost allocation for both direct and indirect costs.

[4] U.S. Department of Labor Office of Cost Determination - A Guide for Indirect Cost Rate Determination (August 2017)

Figure 2. Methods of Cost Allocation



Source: Navigant

Allocate to Programs/Initiatives Proportionally

Indirect costs should be allocated ideally in proportion to the initiatives that consume them. Unfortunately, it is not always possible to determine this proportionality. Through a review of general and PA-specific administrative cost accounting practices, Navigant observed two main methods of allocating administrative costs:

1. **Activity-Based Cost Allocation**

   Activity-based cost (ABC) allocation quantitatively ties administrative costs to activities by measuring and tracking the output of supported activities. Linkages between costs and activities must be drawn to effectively carry out ABC allocation. Navigant identified two key types of ABC allocation:

   a. **Volume Based Attribution**: Costs are allocated based on a countable metric. For example, employee fringe benefits can be allocated to initiatives based on the number of hours the employee worked on each initiative.

   b. **Percentage Based Attribution**: Costs are allocated across initiatives based on a proportion. For example, indirect costs can be linked to initiatives based on the percentage of total budget that is assigned to the initiative.

   There are pros and cons to ABC allocation:

   - **Pros**: ABC allocation better reflects each initiative's actual use of administrative costs, which could help identify areas for reduction.
   - **Cons**: ABC allocation can be difficult and tedious to administer as it requires tracking time by activity or a cost study. Often it is determined ABC allocation requires more effort than it is worth. Also, it is possible that activities will be inaccurately linked to cost, negating all benefit of this methodology.

2. Traditional Cost Allocation

Traditional cost allocation methods assign costs to initiatives based on predetermined factors or rules of thumb. While it is best practice to link costs to initiatives quantitatively, there are certain instances where this is not viable or makes logical sense. Alternatively, there are instances where the benefits of ABC do not justify the expense of measuring and tracking activity output. In these cases, traditional cost allocation methods are preferred. These include:

a. **Manager Discretion**: Costs are allocated to initiatives based on the insight of the management team. For example, managers note most meetings are spent discussing C&I initiatives, therefore meeting expenses are primarily allocated to these initiatives.

b. **Equal Allocations**: Costs are allocated equally between all initiatives. For example, if an IT system is used for two initiatives, costs are allocated equally between the two, regardless of the volume of use.

There are pros and cons to traditional cost allocation:

- **Pros**: Traditional cost allocation is much easier to administer and does not require resources to track activities or adjust spending.
- **Cons**: Traditional cost allocation does not accurately reflect each initiative's actual use of resources. This method allows for subjectivity to impact cost allocation, which could pose risks for the PA.

Regardless of the allocation methodology used, each PA would benefit from developing and implementing an overhead cost allocation plan. An overhead allocation plan clearly describes what administrative costs will be allocated, and the methodology behind the allocation. The plan should include examples of the allocation in practice, lists of key responsible and accountable parties within the firm, as well as a schedule for the update and review of the allocation methodology. Many of the best practices discussed in this document are entrenched in an overhead cost allocation plan. Ultimately, an outsider to the PA should be able to clearly understand the cost allocation methodology after reading the plan.

Summary:

All Massachusetts PAs are required use the same budget cost categories. Through both interviews and a review of PA data, Navigant determined that Pas use the same allocation methodology (by budget), but do not use the same allocation rates, given differences in each PA's initiative budgets.

In general, Massachusetts PAs employ a mix of traditional and activity-based cost allocation methodologies to spread administrative costs across initiatives. For example, some indirect administrative costs are assigned to initiatives based on the initiative's percentage of total budget. Conversely, some PAs split some administrative costs 50:50 between sectors/initiatives (e.g. splitting of sponsorship funding 50:50 between Residential and C&I line items, after which the costs are assigned to the programs based on budget spend), regardless of the true amount of cost attributable to each sector/initiative.

Some external PAs also demonstrated a similar mix of traditional and activity-based cost allocation as the Massachusetts PAs. Through interviews, Navigant was able to determine that at least one PA has been pushed by intervenors to use ABC allocation as much as possible. It was noted that to reduce administrative costs, one must understand the drivers of these costs through measurement and tracking. A PA can use the results of this measurement and tracking to more effectively allocate costs based on activities.

3.3 Tracking and Control

Administrative costs should be tracked to provide insight into exactly where and when costs are being incurred. Effective tracking facilitates better management of administrative costs, which can help PAs lower costs and mitigate risk. The table below provides a comparison of best practice activities across our study group of non- Massachusetts PAs to the Massachusetts PAs, which highlight that the Massachusetts PAs are doing well at tracking and controlling costs.

Table 4. Tracking and Control Best Practices

Topic Area	Best Practice	Mass. PAs	Utility 1 (Dual Fuel PA)	Utility 2 (Dual Fuel PA)	Utility 3 (Electric PA)	Utility 4 (Dual Fuel PA)
Tracking	1. Track Variance Monthly	✓	✓	✓	✓	✓
	2. Invoice Review Sampling	✓	✓	✓	✓	✓
	3. Monthly Reconciliation	✓	✓	✓	✓	✓
Control	4. Dedicated Controller	✓	✓			✓
	5. Variance Thresholds	✓	✓	✓		✓
	6. Manage to Target	✓	✓	✓	✓	✓

Best Practices for Minimizing PP&A Costs among Massachusetts and Non-Massachusetts Program Administrators

Track Variance Monthly

The variance between budgeted and actual administrative cost spending can provide insight into how well a program administrator is managing costs. It is best practice among program administrators to track this variance at regular intervals to adjust activities as soon as possible. Variance should be tracked by a dedicated member of the energy efficiency team, e.g. a controller, which is another best practice discussed in this section. All external program administrators interviewed by Navigant tracked variances monthly. If possible, variances should be tracked at the smallest level of granularity possible (e.g. initiative level).

Invoice Review Sampling

Navigant interviewed multiple program administrators that perform random audits on invoices to ensure they reconcile with budgeted administration costs and figures within IT systems. These audits provide insight into how much risk the program administrator is exposed to and can mitigate variances. This activity can be done as part of monthly variance tracking and carried out by a dedicated controller.

Monthly Reconciliation

The cost allocation approach should allow for reconciliation between budgets and actual spending as well as reconciliation of spending between periods. This can provide insight into actual administrative cost spending and offer an opportunity for these costs to be managed more effectively and potentially minimized.

Dedicated Controller
Some program administrators employ a dedicated controller to conduct monthly variance reconciliation, invoice sampling/audits and other tasks to ensure administrative costs are accurately tracked and managed. It is noted that it may be beneficial to rotate this controller regularly (i.e. 2 – 3 years) to allow for fresh eyes into administrative cost assessment. A dedicated controller may not be necessary for all program administrators, especially those that are relatively small.

Variance Thresholds
Some program administrators set minimum variance thresholds (e.g. 2% variance between budget and actual). This allows the program administrator to determine precisely which activities exceed thresholds and rapidly manage spending to adjust, and ultimately ensures that actual administrative spending aligns as closely as possible to budgets.

Manage to Target
Navigant interviewed program administrators that set targets for administrative costs by program and internally review progress towards targets to ensure each group is on track. This provides an incentive for program managers to reduce annual and monthly variance as much as possible. Ideally, this activity allows the program administrators to limit unnecessary activities to manage to target. However, it is important to manage cost reduction reasonably so that the same quality of administration and delivery is maintained.

Summary:
All Massachusetts PAs interviewed exhibited the tracking and control best practices described above. These best practices provide the PA greater insight into how administrative costs are trending, and the PAs can use this information to control or minimize costs where possible. Depending on the PA, the party responsible for carrying out these tasks varied; larger PAs may utilize a dedicated controller, and smaller PAs may utilize rotational accountants or other schemes. It is vital to ensure that specific individuals are responsible for key tasks related to tracking of administrative costs, and that the information gained from these tasks is utilized in an effective manner.

3.4 Metrics for Measuring Administrative Costs

Administrative costs can be benchmarked (either internally or externally) through year over year (YoY) metrics. Metrics can be used to set cost thresholds and/or cost reduction targets.

Table 5. Administrative Cost Metrics

Topic Area	Best Practice	Mass. PAs	Utility 1 (Dual Fuel PA)	Utility 2 (Dual Fuel PA)	Utility 3 (Electric PA)	Utility 4 (Dual Fuel PA)
Metrics	Monitor YoY Metrics		✔	✔	✔	✔

Monitor Year over Year (YoY) Metrics:
The Massachusetts PAs are not currently held to specific administrative cost targets based on YoY metrics. However, all Massachusetts PAs track and report PP&A spending to both the DPU and EEAC in various

regulatory reports, such as quarterly reports to the EEAC, and Plan-Year Reports and Term Reports to the DPU. Some conventional YoY metrics that are, in some instances, tracked by Massachusetts PAs are listed below. All graphical examples included limited PA data and should be considered illustrative examples:

1. **PP&A Costs vs. Energy Savings ($/MWh) (PAs with Electricity Savings Only)**:
   One metric is to track PP&A costs per MWh saved. This metric is easy to track, and PAs could use it to gauge their performance on an annual basis. PAs could highlight more explicitly the percentage changes in costs that are within their control (or not) when reporting to the DPU, including how costs are changing over time and key cost drivers. This value may be different for different PAs, and there are many factors that could influence this discrepancy, both within or outside of the PA control, and some investigation could be made into mitigating the impact on administrative costs.

2. **PP&A Spending as a Proportion of Total Spend (% PP&A) (PAs with Electricity Savings Only)**:
   PP&A spending as a proportion of total spend is another metric. This metric could be used to track PA performance YoY, as well as set a target goal for PP&A cost reduction - e.g., maintain a PP&A % of less than or equal to X% per PA. PAs could look at this figure over time to show trends and highlight outlier years for further investigation.

3. **Variance Between Planned and Actual PP&A Costs (%) (PAs with Electricity Savings Only)**:
   Variance between planned and actual PP&A costs is another metric. This metric could be monitored yearly to gauge PA budgeting performance. Spending less than budget on PP&A is a positive indicator for cost management, but it also could indicate that the PA has inaccurate budgeting. A target could be set at + or - X% variance, so PAs can strive to set budgets that are more reflective of real-world conditions. To achieve this, PAs will have to employ many of the best practices discussed in previous sections related to allocating, tracking and controlling administrative costs.

These metrics can provide insight into a PA's administrative cost management performance but may not be entirely valid for setting cost targets. This is due to the wide array of differences between Massachusetts PAs. In addition to these traditional metrics, Navigant has identified several volume/activity-based metrics that may be feasible alternatives to the metrics discussed above:

1. **Composite Metrics**: These include conventional metrics that have been modified to more equitably represent individual PAs. E.g. $/kWh/customers

2. **PP&A Spend per Participant Served**: Measures the administrative cost per energy efficiency customer of the PA.

3. **PP&A Spend per Full-Time Employee (FTE):** Measures the administrative cost per FTE within the energy efficiency group.

Summary

There is no single representative metric that can be used to benchmark administrative cost performance across all PAs equitably. Additionally, we do not believe a single metric can be established and used across all PAs given the difference in their customer base. However, it is necessary that PAs devote time to determine the most effective metrics individually to track cost year over year, and prioritize ways to find PP&A efficiencies, including reviewing and analyzing factors and key elements that may have contributed

to changes in PP&A costs. This will allow the PAs to monitor trends and develop a strategy for potentially reducing administrative costs, to the extent feasible, without compromising quality and results.

4 Conclusions and Recommendations

Navigant found that Massachusetts PAs are working efficiently and thoughtfully to achieve energy efficiency objectives while seeking to minimize PP&A costs within their control to the extent possible. With this said, we believe the pursuit of trying to achieve unprecedented energy efficiency goals, while also seeking to minimize total costs (PP&A and other costs) should be a constant priority across all aspects of the Program Administrators' portfolios. Broadly speaking, our initial observations are that cost reduction (PP&A and other categories), is not a topic of routine discussion within the Massachusetts energy efficiency stakeholder community. Beyond the confines specifically of PP&A, Navigant recommends the PAs (and all stakeholders), embrace an ethic of continued energy efficiency program exceptionalism by collectively finding new ways (through innovations in program design, delivery, marketing, and new business partnerships with unregulated businesses) to reduce the cost of acquiring energy efficiency savings.

Recommendations

Specific to the objectives of this report, we offer the following recommendations, targeted primarily to the PP&A cost category.

1. **Continue to Focus on Ways to Improve Consistency in Accounting Practices:**

   There are seven PAs in Massachusetts delivering energy efficiency programs and incurring PP&A administrative costs. Although there are key areas where principles have been developed to maintain accounting consistencies across PAs (e.g., all PAs use the same PP&A cost categories and allocation methodology). However, Navigant determined that, while the PAs all allocate costs based on budgets, they do not use the same allocation rates due to initiative budget differences. It is important to ensure that accounting practices are as consistent as possible across PAs to allow for year over year comparative assessments as needed. Continued attention by the PAs to ensure consistency in accounting, as appropriate, should be an on-going prioritization.

2. **Formalize and Seek to Streamline Further the Reporting and Data Request Process:**

   In interviews, PAs repeatedly mentioned that the process of responding to data requests from stakeholders and/or oversight bodies (DOER, EEAC members, Council Consultants, etc.) requires significant PP&A time. Navigant recommends developing a more formalized communication plan which sets out clear guidelines on when and what information will be provided to stakeholders via an established data request process and limited timeline. Moreover, there should be explicit guidance that stakeholders (and their consultants) should first maximize the use of information already available in the public domain before requesting additional new information, special presentations, or custom analyses. Ensuring that data requests are high value, and worthy of PP&A cost to attend to the request, should be a priority for all stakeholders. With this said, it is vital that any new formalized structure does not overly impinge on Massachusetts stakeholders' right to information.

3. **Follow Cost Accounting Best Practices in Allocation, Tracking and Control:**

   The Massachusetts PAs follow many best practices related to accounting and assessing of administrative costs. However, the PAs can adopt even more strategies to ensure PP&A costs are accounted for as accurately as possible. These include setting clear and transparent administrative cost allocation methodologies that are rigorously documented in an allocation plan. In addition,

these costs can be tracked to allow for allocation on an activity-basis. Targets for cost reduction can be set using trackable metrics that are aligned across PAs. Finally, depending on the PA, a specific individual in the energy efficiency department can be responsible for ensuring these processes are carried out and the PA is managing costs towards targets. A dedicated controller may not be necessary or cost-effective for all PAs, especially those that are relatively small.

4. **Seek New Ways to Minimize the Regulatory / Collaboration / Facilitation/ Reporting and Ad hoc Requests Burden Without Compromising Goal Obtainment:**

   Massachusetts is the national leader in energy efficiency, and the systems and processes established to date can rightfully be celebrated as contributing factors to the success of the Massachusetts energy efficiency programs. The combination of progressive policies, with strong regulatory and political support for achieving energy efficiency goals are key factors of the success. Additionally, it is likely that the current stakeholder and regulatory review process (e.g. EEAC process, DOER review, etc.) is also a key factor for goal obtainment. With this said, all of the regulatory, collaboration, reporting, and ad hoc data requests from the multitude of stakeholder parties directly impacts PP&A costs. Undoubtedly, we would expect most of these requests and requirements to be valid and necessary to enable a coordinated delivery structure and a fair review process that is a direct contributor to the Massachusetts success to date. However, to the extent all parties (regulators, stakeholders, DOER etc.) appreciate the PP&A costs that are incurred to respond to reporting and ad hoc requests, then it may be possible to find ways to streamline further the reporting and advisory update processes. Finding ways to balance what is essential and valuable in reporting and attentive responses to requests, from excessive and/or non-critical reports and/or requests, is a fine line that is open to broad interpretation of value. Simply raising awareness to all parties, that every data request, every meeting, every committee, every point of contact incurs additional PP&A costs, could by itself, lead to some streamlined and more strategic engagement with the PAs.

5. **Implement an Annual Process to Stress-Test Status Quo Processes and Spending:** Over time, structures, committees, meetings, are put in place that may continue to take up staff time and resources long after they have ceased to be useful. Stress testing these structures will help determine if they are still necessary, or if they should be scaled back or eliminated. At least annually, PAs and their stakeholders should consider reviewing a select list of status quo approaches and processes to assess if a more cost-effective approach is viable. The idea is to stress test the need and validity of standing committees, reports, briefing and update processes, to re-confirm the on-going value and function of the activities (or firms under contract), to gauge if innovations, modifications, or timing and frequency of past status quo activities could be revised, with a gain in efficiency in operations, without compromising quality and results. A process could be initiated to systematically review where and how to stress-test various components of PP&A costs, and beyond. Not all categories of PP&A costs should or need to be reviewed and tested every year, but a prioritization and schedule could be created to build time into the collective management effort, to challenge status quo processes, and assess if opportunities exist to generate PP&A cost savings, through purposeful changes, while being sensitive to not impacting the overall spirit and intent of the Mass Save objectives. This could include a review across all the major operations of the Massachusetts energy efficiency programs, which all impact PP&A costs, including but not limited to:

   a. **Seek out efficiencies in program design development and review**. PAs (and other parties) should consider outside the box changes to established processes in the pursuit of innovation and quality, while achieving cost reductions. For example, PAs could

consider supporting a change to the Green Communities Act to change from a three-year planning process to a four-year planning horizon, as an extension of the plan duration may result in overall reductions in PP&A plan development costs.

b. **Continue to seek out efficiencies in program implementation.** Finding ways to achieve nation leading energy efficiency goals in the most cost-effective way possible, is a standing objective for all PAs. This can include a review of the efficiency in operations and staffing levels within each PA, as well as roles and functions of all third-party design and implementation firms. Additionally, this includes challenging established practices and procedures, across all aspects of the portfolio design, management, delivery and evaluation, to see where cost-efficiencies can be gained (leading to potential PP&A cost reductions, or overall cost reductions), without significantly compromising results. Continuing the current process of seeking out ways to find greater efficiencies, while balancing continuation of program results, in a sustainable way is important, and can lead to PP&A or overall cost reductions per unit of energy saved. Increasingly, we recommend the PAs explore pilot partnerships with entrepreneurial third parties, not under contract to the PA, but whose business model includes achieving energy efficiency savings, to find ways to sync up activities for mutual benefit, at overall lower customer cost for efficiency savings goal obtainment (Galvin et. al 2018).[5]

c. **Review role and function of PA representation on standing or ad hoc committees**. For example, how can oversight responsibilities be shared further across the PAs, such that not all PAs need to be present or directly represented on each committee or meeting topic. Explore and experiment with various approaches to find the right balance of engagement and oversight, depending on the topic. One such example could be establishing a common contract across PAs to streamline procurement or testing out levels of delegation for various committees and working groups, to find balance in levels of engagement ranging from: responsible, accountable, consented, or informed (RACI)[6] depending on the topic and threshold of significance (programmatic and/or financial). While it may be appropriate for certain groups to function without a representative from each PA, it is important to note that each PA territory is unique, and in many instances it is necessary and appropriate for each PA to have representation on a committee.

d. **Review of role and functions for all third parties incurring PP&A costs.** A systematic review of all third-party PP&A contracts should occur on a regular basis to re-confirm on-going quality, value, and necessity. The review should identify current activities that could be considered essential, versus, elements that could be managed by PAs directly, and/or, through a lower cost third-party resource, without compromising on quality and effectiveness. Navigant suggests this review of the role and function of third parties incurring PP&A costs should address those contracts that are directly issued by PAs and for those expenses from third parties that are assigned to the PAs from DOER or other entities. In some instances, it might be found to be more cost-effective overall, to increase spending with third parties, if this results in overall reductions in total PP&A expenditures, with a superior service, function, consistency and results.

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[5] See for example the innovative partnership announced between National Grid-NY and Metrus Energy: https://www.metrusenergy.com/metrusandnationalgrid

[6] See https://en.wikipedia.org/wiki/Responsibility_assignment_matrix

e. **Seek efficiencies in the EEAC review process.** Advisory oversight, awareness, and consent of stakeholders is valid and important. However, finding a balance such that the advisory and stakeholder input process does not become overly burdensome (and expensive) is a valid goal, of which, all parties concerned with PP&A cost efficiency, should concur. Implementing an annual process to identify ways to streamline the EEAC process, without compromising essential elements should be prioritized as a shared responsibility.

Conclusion

Every aspect of the Massachusetts Program Administrators' energy efficiency ecosystem (people and technology) requires some element of PP&A attention, and as such, costs are incurred. Establishing a systematic process to annually review select elements of the status quo could be implemented not only for the purview of specific PP&A costs, but more broadly, across all PA initiatives. Efficiency across all operations, without compromising quality and goal obtainment, should be a priority for all stakeholders, and requires focused attention and prioritization to identify, test, and implement changes. This requires enthusiastic support, not only from PAs, but from all key stakeholders who jointly all influence costs. The energy efficiency industry is changing, with the arrival of new technologies, new and competitive third-party delivery strategies, and an increased focus on assessing the temporal and geographic value of energy efficiency savings. As part of addressing how to reduce PP&A costs, a broader question should be asked: How can Massachusetts PAs continue to innovate, achieve greater levels of energy efficiency, and do so at lower costs, both from a PP&A perspective or more broadly? With an eye on overall goal obtainment, it may be completely appropriate to expect an increase in PP&A costs, if the programmatic design for achieving energy efficiency savings changes, resulting in acquiring savings and achieving multiple goals for appropriate overall costs. These are challenges that go well beyond the scope of this study, but is critical, and should be prioritized by both the Massachusetts PAs and all key stakeholders.

5 References

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b. "The Allocation Game: Managing Cost Before Money is Spent". Ernst & Young LLP. White Paper, July 2017

c. Indirect Cost Allocation. Government Finance Officers Association. http://www.gfoe.org/print/1739

d. Energy Trust 2014 Management Review – Final Report. Corragio Group, September 2014

e. Administrative Costs Review: Enbridge Gas Distribution and Union Gas Limited. Dunsky Energy Consulting, September 2017

f. Cost Allocation. The Municipal Research and Services Center (MRSC). http://mrsc.org/getdoc/d2e9b27e-815e-4fb1-bcca-22a02a609e0f/Cost-Allocation.aspx

g. A Guide for Indirect Cost Rate Determination. U.S. Department of Labor Office of Cost Determination, August 2017.

Appendices

Q. **List of Competitively Procured Vendors**

The table below lists statewide and PA-specific contracts that have already been competitively procured for 2019-2021. In addition to this list, several other contracts are out for bid, or in other intermediate stages of competitive procurement.

Vendor Name	Initiative/Topic	Statewide or PA-specific	Term	Option to Extend	Conditions for Renewal
Abode Energy Management	Residential Coordinated Delivery	National Grid - Electric	12/31/2022	N	
Abode Energy Management	Residential Coordinated Delivery	National Grid - Gas	12/31/2022	N	
Abode Energy Management	Residential Coordinated Delivery - piggyback	Eversource - Electric	11/30/2019	N	
Aclara	Behavior	Berkshire Gas	5/30/2019	N	
Action for Boston Community Development (ABCD)	Residential Coordinated Delivery - Income Verification	Statewide except for Cape Light Compact	3/30/2020	N	
Advanced Microgrid Solutions	C&I Demand Demos	Eversource - Electric	12/31/2019	N	
AECOM	C&I Existing Buildings	Eversource - Electric	3/31/2021	Y	Mutual Agreement
AECOM	C&I Existing Buildings - Turnkey	Unitil - Gas	12/31/2019	Y	Mutual Agreement
AECOM	C&I Existing Buildings - Turnkey	Unitil - Electric	12/31/2019	Y	Mutual Agreement
Andelman and Lelek Engineering	C&I Engineering	Eversource - Electric	6/1/2020	Y	Mutual Agreement
Andelman and Lelek Engineering	C&I Engineering	Eversource - Gas	6/1/2020	Y	Mutual Agreement
APEX Analytics	Evaluation Consulting Support	Eversource - Electric	12/31/2019	N	
APEX Analytics	Evaluation Consulting Support	Eversource - Gas	12/31/2019	N	
Applied Energy Engineering & Commissioning	C&I Engineering	Eversource - Electric	6/1/2020	Y	Mutual Agreement
Applied Energy Engineering & Commissioning	C&I Engineering	Eversource - Gas	6/1/2020	Y	Mutual Agreement
Applied Energy Group	Data Systems	Liberty	5/15/2019	Y	Mutual Agreement
ARCA Recycling Inc	Appliance Recycling	Statewide-Electric	12/31/2020	N	Some PAs have not yet amended their contracts

Vendor Name	Initiative/Topic	Statewide or PA-specific	Term	Option to Extend	Conditions for Renewal
Artis Energy	C&I Demand Demos	Eversource - Electric	12/31/2019	N	
Autogrid	C&I Demand Demos	Eversource - Electric	6/1/2019	N	
Banks II Quan Associates dba B2Q	C&I Engineering	Eversource - Electric	6/1/2020	Y	Mutual Agreement
Banks II Quan Associates dba B2Q	C&I Engineering	Eversource - Gas	6/1/2020	Y	Mutual Agreement
Boyko Engineering, Inc.	C&I Engineering	Eversource - Electric	6/1/2020	Y	Mutual Agreement
Boyko Engineering, Inc.	C&I Engineering	Eversource - Gas	6/1/2020	Y	Mutual Agreement
Building IQ	Demand Response Software & Controls	Eversource - Electric	12/31/2019	Y	
C3 Inc.	Customer Engagement Platform	Eversource - Electric	2/2/2021	Y	
C3 Inc.	Customer Engagement Platform	Eversource - Gas	2/2/2021	Y	
Cadeo Group	Large C&I Evaluation	Statewide	3/31/2022	N	Some PAs have not yet executed contracts
Cascade Energy	Continuous Energy Improvement Demonstration initiative	National Grid - Electric	12/31/2021	N	
Cascade Energy	Continuous Energy Improvement Demonstration initiative	National Grid - Gas	12/31/2021	N	
Center for EcoTechnology	Residential Coordinated Delivery and C&I Existing Buildings	Berkshire Gas	12/31/2019	N	
Center for EcoTechnology	Residential Coordinated Delivery - piggyback	Eversource - Electric	12/31/2019	N	
CET	Pre-Post Inspections	National Grid - Electric	6/30/2019	N	
CET	Pre-Post Inspections	National Grid - Gas	6/30/2019	N	
CLEAResult	Residential Coordinated Delivery - Multi-Family	Eversource - Electric	12/31/2019	N	
CLEAResult	Residential Coordinated Delivery - Multi-Family	Eversource - Gas	12/31/2019	N	
CLEAResult	Residential Coordinated Delivery - Single Family	Eversource - Electric	6/30/2019	N	
CLEAResult	Residential Coordinated Delivery - Single Family	Eversource - Gas	6/30/2019	N	

Vendor Name	Initiative/Topic	Statewide or PA-specific	Term	Option to Extend	Conditions for Renewal
CLEAResult	Residential Coordinated Delivery - 1-4 units	National Grid - Electric	12/31/2022	N	
CLEAResult	Residential Coordinated Delivery - 1-4 units	National Grid - Gas	12/31/2022	N	
CLEAResult	Residential Coordinated Delivery - Multi-Family	National Grid - Electric	6/30/2019	Y	Mutual Agreement
CLEAResult	Residential Coordinated Delivery - Multi-Family	National Grid - Gas	6/30/2019	Y	Mutual Agreement
CLEAResult	Nantucket NWA Pilot	National Grid - Electric	1/31/2019	N	
CLEAResult	MA Residential and Commercial Multifamily Retrofit	National Grid Electric	6/30/2019	N	
CLEAResult	Nantucket NWA Pilot	National Grid - Gas	1/31/2019	N	
CLEAResult	MA Residential and Commercial Multifamily Retrofit	National Grid - Gas	6/30/2019	N	
CMC Energy Services	QA/QC Services	Statewide	10/31/2019	Y	Mutual Agreement
Coastal Lighting	Pre-Post Inspections	National Grid - Electric	7/31/2019	Y	Mutual Agreement
Coastal Lighting	Pre-Post Inspections	National Grid - Gas	7/31/2019	Y	Mutual Agreement
Commonwealth Electrical Technologies	C&I Existing Buildings	Eversource - Electric	3/31/2021	Y	Mutual Agreement
Complete Recycling Solutions	Lamp Recycling	Eversource - Electric	1/31/2019	N	
Complete Recycling Solutions	Lamp Recycling	National Grid - Electric	12/31/2019	Y	Mutual Agreement
Compressor Energy Services	C&I Engineering	Eversource - Electric	6/1/2020	Y	Mutual Agreement
Compressor Energy Services	C&I Engineering	Eversource - Gas	6/1/2020	Y	Mutual Agreement
Crow Insight	Evaluation Consulting Support	Eversource - Electric	12/31/2019	N	
Crow Insight	Evaluation Consulting Support	Eversource - Gas	12/31/2019	N	
Customertimes	MAP Global Administrator	Statewide except CMA	4/19/2020	Y	Mutual Agreement
DMI	C&I Engineering	National Grid - Electric	1/31/2019	N	
DMI	C&I Engineering	National Grid - Gas	1/31/2019	N	

Vendor Name	Initiative/Topic	Statewide or PA-specific	Term	Option to Extend	Conditions for Renewal
DNV-GL	Residential Data Management Contract	Statewide	6/30/2020	N	Some PAs have not yet amended their contracts
DNV-GL	C&I Data Management Contract	Statewide	6/30/2020	N	Some PAs have not yet amended their contracts
DNV-GL	Large C&I Evaluation Research Services Program	Statewide	3/31/2022	N	Some PAs have not yet executed contracts
Earthlight Technologies, LLC	C&I Existing Buildings	Eversource - Electric	3/31/2021	Y	Mutual Agreement
Energy & Resource Solutions	Special & Cross Cutting Evaluation	Statewide - Electric	6/30/2020	N	
Energy & Resource Solutions	C&I Engineering	Eversource - Electric	6/1/2020	Y	Mutual Agreement
Energy & Resource Solutions	C&I Engineering	Eversource - Gas	6/1/2020	Y	Mutual Agreement
Energy Efficient Investments	C&I Existing Buildings	Eversource - Electric	3/31/2021	Y	Mutual Agreement
Energy Federation, Inc.	Rebate fulfillment for Residential Coordinated Delivery	Statewide	6/30/2019	N	Some PAs have not yet amended their contracts
Energy Federation, Inc.	Rebate fulfillment for ECM Circulator Pumps	Statewide - Electric	3/31/2019	N	Some PAs have not yet amended their contracts
Energy Federation, Inc.	Rebate fulfillment for electric HVAC	Statewide - Electric	6/30/2019	N	Some PAs have not yet amended their contracts

Vendor Name	Initiative/Topic	Statewide or PA-specific	Term	Option to Extend	Conditions for Renewal
Energy Federation, Inc.	Rebate fulfillment for Retail Products	Statewide	3/31/2019	Y	Mutual Agreement. Some PAs have not yet amended their contracts.
Energy Federation, Inc.	HEAT Loans	Statewide	3/31/2019	N	Some PAs have not yet amended their contracts
Energy Resources (previously JK Energy)	C&I Existing Buildings	Eversource - Electric	3/31/2021	Y	Mutual Agreement
Energy Solutions	C&I Upstream HVAC and Heat Pump	Statewide - Electric	4/1/2019	N	
Energy Solutions	Upstream Food Service	Statewide except CMA	3/31/2019	N	
Energy Solutions	Upstream Gas	Statewide - Gas	3/31/2019	N	
Energy Source	C&I Existing Buildings	Eversource - Electric	3/31/2021	Y	Mutual Agreement
Energy Source	C&I Existing Buildings - Turnkey	National Grid - Electric	12/31/2019	Y	Mutual Agreement
Energy Source	C&I Existing Buildings - Turnkey	National Grid - Gas	12/31/2019	Y	Mutual Agreement
Energy Source	C&I Existing Buildings - Turnkey	Unitil - Gas	12/31/2019	Y	Mutual Agreement
Energy Source	C&I Existing Buildings - Turnkey	Unitil - Electric	12/31/2019	Y	Mutual Agreement
energyOrbit dba CRMOrbit	MAP	Statewide except CMA	12/31/2021	N	
EnerNOC	C&I Demand Demos	Eversource - Electric	12/31/2019	N	
ENGIE Services U.S.	C&I Existing Buildings	Eversource - Electric	3/31/2021	Y	Mutual Agreement
enviENERGY Studio, LLC	C&I Engineering	Eversource - Electric	6/1/2020	Y	Mutual Agreement
enviENERGY Studio, LLC	C&I Engineering	Eversource - Gas	6/1/2020	Y	Mutual Agreement
Environmental Health & Engineering, Inc.	C&I Engineering	Eversource - Electric	6/1/2020	Y	Mutual Agreement
Environmental Health & Engineering, Inc.	C&I Engineering	Eversource - Gas	6/1/2020	Y	Mutual Agreement

Vendor Name	Initiative/Topic	Statewide or PA-specific	Term	Option to Extend	Conditions for Renewal
Environmental Integrity	Lamp Recycling	Eversource - Electric	1/31/2019	N	
Environmental Systems Corporation	C&I Existing Buildings	Eversource - Electric	3/31/2021	Y	Mutual Agreement
Fairbanks Energy Services, Inc.	C&I Existing Buildings	Eversource - Electric	3/31/2021	Y	Mutual Agreement
Fairbanks Energy Services, Inc.	Lamp Recycling	National Grid - Gas	12/31/2019	Y	Mutual Agreement
GDS Associates, Inc.	Engineering Services	Berkshire Gas	2/28/2019	Y	Mutual Agreement
GDS Associates, Inc.	C&I Engineering	Unitil - Gas	12/31/2019	Y	Mutual Agreement
GDS Associates, Inc.	C&I Engineering	Unitil - Electric	12/31/2019	Y	Mutual Agreement
Genbright	C&I Demand Demos	Eversource - Electric	12/31/2019	N	
Guardian Energy Management Solutions, LLC	C&I Existing Buildings	Eversource - Electric	3/31/2021	Y	Mutual Agreement
Horizon Energy	C&I Existing Buildings	Eversource - Electric	3/31/2021	Y	Mutual Agreement
Ice Energy	C&I Demand Demos	Eversource - Electric	12/31/2019	N	
ICF International	C&I New Buildings and Major Renovation	Statewide	6/30/2020	N	
ICF International	Residential New Buildings	Statewide	6/30/2020	N	
ICO Energy and Engineering, Inc.	C&I Engineering	Eversource - Electric	6/1/2020	Y	Mutual Agreement
ICO Energy and Engineering, Inc.	C&I Engineering	Eversource - Gas	6/1/2020	Y	Mutual Agreement
ILLUME Advising, LLC	Special & Cross Cutting Evaluation	Statewide	6/30/2020	N	
INDUSTRIAL ECONOMICS, INC.	Evaluation Consulting Support	Eversource - Electric	12/31/2019	N	
INDUSTRIAL ECONOMICS, INC.	Evaluation Consulting Support	Eversource - Gas	12/31/2019	N	
Itron	C&I Demand Demos	Eversource - Electric	12/31/2019	N	
KSV	Statewide Marketing	Statewide	12/31/2019	N	
kW Engineering	C&I Engineering	Eversource - Electric	6/1/2020	Y	Mutual Agreement
kW Engineering	C&I Engineering	Eversource - Gas	6/1/2020	Y	Mutual Agreement

Vendor Name	Initiative/Topic	Statewide or PA-specific	Term	Option to Extend	Conditions for Renewal
Leftfield	On-Site Facility Operator Training Program	Eversource - Electric	4/1/2019	N	
Leftfield	On-Site Facility Operator Training Program	Eversource - Gas	4/1/2019	N	
Leidos Engineering	C&I Engineering	Eversource - Electric	6/1/2020	Y	Mutual Agreement
Leidos Engineering	C&I Engineering	Eversource - Gas	6/1/2020	Y	Mutual Agreement
Leidos Engineering	C&I Engineering	Unitil - Gas	12/31/2019	Y	Mutual Agreement
Leidos Engineering	C&I Engineering	Unitil - Electric	12/31/2019	Y	Mutual Agreement
Lexicon Energy Consulting	Evaluation Consulting Support	Eversource - Electric	12/31/2019	N	
Lexicon Energy Consulting	Evaluation Consulting Support	Eversource - Gas	12/31/2019	N	
Lockheed Martin	Outreach for Gas Networks Resi/Comms	National Grid - Gas	12/31/2019	Y	Mutual Agreement
Loureiro Engineering Associates	C&I Engineering	Eversource - Electric	6/1/2020	Y	Mutual Agreement
Loureiro Engineering Associates	C&I Engineering	Eversource - Gas	6/1/2020	Y	Mutual Agreement
National Resource Management	Refrigeration Turnkey	Eversource - Electric	11/13/2020	N	
National Resource Management	C&I Existing Buildings - Turnkey	Unitil - Gas	12/31/2019	Y	Mutual Agreement
National Resource Management	C&I Existing Buildings - Turnkey	Unitil - Electric	12/31/2019	Y	Mutual Agreement
National Theatre for Children	Residential Education	Eversource - Electric	6/30/2019	N	
Navigant Consulting	Residential Retrofit and HVAC Evaluation	Statewide	6/30/2019	N	
Navigant Consulting	Special & Cross Cutting Evaluation	Statewide - Electric	6/30/2020	N	
Nest	Thermostat Seasonal Savings	National Grid - Electric	6/30/2021	Y	Mutual Agreement
NMR Group	Lighting & Products Evaluation	Statewide - Electric	6/30/2019	N	
NMR Group	Special & Cross Cutting Evaluation	Statewide	6/30/2020	N	
NMR Group	Residential New Construction Evaluation	Statewide	6/30/2019	N	

Vendor Name	Initiative/Topic	Statewide or PA-specific	Term	Option to Extend	Conditions for Renewal
NMR Group	Large C&I Evaluation	Statewide	3/31/2022	N	Some PAs have not yet executed contracts
Northern Energy Services	C&I Existing Buildings - Turnkey	National Grid - Electric	12/31/2019	Y	Mutual Agreement
Northern Energy Services	C&I Existing Buildings - Turnkey	National Grid - Gas	12/31/2019	Y	Mutual Agreement
Northern Energy Services	QA/QC Services	National Grid - Electric	3/31/2019	Y	Mutual Agreement
Northern Energy Services	QA/QC Services	National Grid - Gas	3/31/2019	Y	Mutual Agreement
Opinion Dynamics Corporation	Special & Cross Cutting Evaluation	Statewide	6/30/2020	N	
Oracle	Residential Behavior	Unitil - Gas	12/31/2021	Y	DPU Approval
Oracle	Residential Behavior	Unitil - Electric	12/31/2021	Y	DPU Approval
Oracle	Residential Behavior	National Grid - Electric	12/31/2021	N	
Oracle	Residential Behavior	National Grid - Gas	12/31/2021	N	
Performance Systems Development	Codes and Standards	Statewide	3/31/2021	N	
Prism Energy Services	C&I Existing Buildings	Eversource - Electric	3/31/2021	Y	Mutual Agreement
Rethinking Power Management	On-Site Facility Operator Training Program	Eversource - Electric	4/1/2019	N	
Rethinking Power Management	On-Site Facility Operator Training Program	Eversource - Gas	4/1/2019	N	
RetroCool	C&I Demand Demos	Eversource - Electric	12/31/2019	N	
Revision Energy	Active Demand Response	Unitil - Electric	12/31/2020	Y	Mutual Agreement
RISE Engineering	Residential Coordinated Delivery	Unitil - Gas	12/31/2019	Y	Mutual Agreement
RISE Engineering	Residential Coordinated Delivery	Unitil - Electric	12/31/2019	Y	Mutual Agreement
RISE Engineering	C&I Existing Buildings	Unitil - Gas	12/31/2019	Y	Mutual Agreement
RISE Engineering	C&I Existing Buildings	Unitil - Electric	12/31/2019	Y	Mutual Agreement
RISE Engineering	C&I Existing Buildings	Eversource - Electric	3/31/2021	Y	Mutual Agreement

Vendor Name	Initiative/Topic	Statewide or PA-specific	Term	Option to Extend	Conditions for Renewal
RISE Engineering	Residential Coordinated Delivery - piggyback	Eversource - Electric	6/30/2019	Y	Mutual Agreement
RISE Engineering	Residential Coordinated Delivery - piggyback	Eversource - Electric	12/31/2019	Y	Mutual Agreement
RISE Engineering	Residential Coordinated Delivery - piggyback	Liberty	6/30/2019	N	
RISE Engineering	C&I Engineering	Eversource - Electric	6/1/2020	Y	Mutual Agreement
RISE Engineering	Residential Coordinated Delivery - Multi-Family	Liberty	12/31/2019	Y	Mutual Agreement
RISE Engineering	Residential Coordinated Delivery - 1-4 units	Liberty	6/30/2019	Y	Mutual Agreement
RISE Engineering	C&I Existing Buildings - Turnkey	Liberty	6/30/2019	Y	Mutual Agreement
RISE Engineering	C&I Existing Buildings	Liberty	6/30/2019	Y	Mutual Agreement
RISE Engineering	C&I Existing Buildings - Multi-Family	Liberty	12/31/2019	Y	Mutual Agreement
RISE Engineering	Residential Coordinated Delivery - 1-4 units	Columbia Gas	5/31/2019	Y	Mutual Agreement
RISE Engineering	C&I Engineering	Eversource - Gas	6/1/2020	Y	Mutual Agreement
RISE Engineering	Multi-Family Standard Income Residential & Commercial	National Grid - Electric	6/30/2019	Y	Mutual Agreement
RISE Engineering	Multi-Family Standard Income Residential & Commercial	National Grid - Gas	6/30/2019	Y	Mutual Agreement
Sarracco Mechanical Services	C&I Existing Buildings	Eversource - Electric	3/31/2021	Y	Mutual Agreement
Second Law Engineers, Inc. dba DMI	C&I Engineering	Eversource - Electric	6/1/2020	Y	Mutual Agreement
Second Law Engineers, Inc. dba DMI	C&I Engineering	Eversource - Gas	6/1/2020	Y	Mutual Agreement
Seventhwave	Procurement Demonstration Program	Eversource and National Grid	12/31/2021	N	
STEM Inc.	C&I Demand Demos	Eversource - Electric	12/31/2019	N	
The Green Engineer, Inc.	C&I Engineering	Eversource - Electric	6/1/2020	Y	Mutual Agreement
The Green Engineer, Inc.	C&I Engineering	Eversource - Gas	6/1/2020	Y	Mutual Agreement
TNZ Energy Consulting, Inc.	C&I Engineering	Eversource - Electric	6/1/2020	Y	Mutual Agreement

Vendor Name	Initiative/Topic	Statewide or PA-specific	Term	Option to Extend	Conditions for Renewal
TNZ Energy Consulting, Inc.	C&I Engineering	Eversource - Gas	6/1/2020	Y	Mutual Agreement
Veolia	Lamp Recycling	Eversource - Electric	1/31/2019	N	
Warren Energy Engineering	Evaluation Consulting Support	Eversource - Electric	12/31/2019	N	
Warren Energy Engineering	Evaluation Consulting Support	Eversource - Gas	12/31/2019	N	
Winkler Energy Consulting LLC	Evaluation Consulting Support	Eversource - Electric	12/31/2019	N	
Winkler Energy Consulting LLC	Evaluation Consulting Support	Eversource - Gas	12/31/2019	N	
World Energy Efficiency Services, LLC	C&I Existing Buildings	Eversource - Electric	3/31/2021	Y	Mutual Agreement

The table below shows the percentage and total dollar amount of competitively procured services that have already been procured for the 2019-2021 term for each PA. For contracts that include customer rebate/incentive dollars (which typically account for a significant portion of contracts), PAs have only included the non-incentive portion of the contract, based on historical spending or other planning values. PAs note that these values are planned estimates of a planned budget; actual expenditures will be available at the time of the Term Report.

Program Administrator	**Dollar Amount Already Competitively Procured**	**% of Planned Competitive Procurement Already Procured**
Berkshire Gas	$ 888,123.00	30%
Cape Light Compact	$ 1,281,484.67	4%
Columbia Gas	$ 3,823,124.79	14%
Eversource Electric	$ 82,023,215.94	49%
Eversource Gas	$ 22,109,726.18	46%
Liberty	$ 538,673.00	20%
National Grid Electric	$ 83,413,241.05	55%
National Grid Gas	$ 51,689,836.83	58%
Unitil Electric	$ 457,000.00	20%
Unitil Gas	$ 293,000.00	22%

Appendices

R. **Performance Incentive Models**

A. Performance Incentives (PI) Calculation

The 2019-2021 Statewide electric PI pool includes a traditional portfolio value component and energy efficiency/passive demand savings component, referred to as the base pool (totaling $107 million); an additional component for active demand reduction savings ($5M pool); and a component for services to renters ($2M).

1	Statewide Electric 2019 - 2021 Total Design Level PI	$	114,000,000	
2	Statewide Electric 2019-2021 Design Level Base Pool	$	107,000,000	Base Pool
	STANDARD SAVINGS COMPONENT - EE & PASSIVE DEMAND			
3	Statewide Electric EE & Passive Demand Benefits, excluding CLC	$	5,892,620,914	
4	Percent of Electric Base Pool Allocated to Savings Component		61.5%	Percentage of Base Pool of $107 million
5	Electric PI Allocated to Savings Component	$	65,805,000	Line 2 * Line 4
6	Electric Standard Savings Payout Rate	$	0.0112	**Line 5 / Line 3**
	TARGETED SAVINGS COMPONENT - ACTIVE DEMAND REDUCTION (ADR)			
7	Statewide Electric Active Demand Reduction Benefits, excluding CLC	$	172,002,454	
8	Electric PI Allocated to Savings Component - Active Demand Reduction	$	5,000,000	
9	Electric Active Demand Reduction Targeted Payout Rate	$	0.0291	**Line 8 / Line 7**
10	**Statewide Electric Performance Incentives Allocated to Standard Savings Component**	**$**	**65,805,000**	**Line 3 * Line 6**
11	**Statewide Electric Performance Incentives Allocated to Targeted ADR Savings Component**	**$**	**5,000,000**	**Line 8**
12	**Total Statewide Electric Performance Incentives Allocated to Savings Component**	**$**	**70,805,000**	**Line 10 + Line 11**
	VALUE COMPONENT - TOTAL PORTFOLIO			
13	Statewide Electric Portfolio Program Costs (2019$), excluding CLC	$	1,766,664,733	
14	Statewide Electric EE Net Benefits (Benefits - Program Costs) (2019$), excluding CLC	$	4,297,958,636	(Line 3 + Line 7) - Line 13
15	Percent of Electric Pool Allocated to Value Component		38.5%	Percentage of Base Pool of $107 million
16	Electric PI Allocated to Value Component	$	41,195,000	Line 2 * Line 15
17	Electric Standard Value Payout Rate	$	0.0096	**Line 16 / Line 14**
18	**Statewide Electric Performance Incentives Allocated to Portfolio Value Component**	**$**	**41,195,000**	**Line 14 * Line 17**
	RENTER COMPONENT			
19	Total Electric Renters Served		100,000	
20	Electric PI Allocated to Renter Component	$	2,000,000	
21	Electric PI Per Renter Served	$	20.00	Line 20 / Line 19
22	Statewide Electric 2019-2021 Design Level Standard Savings & Portfolio Value Component	$	107,000,000	Line 10 + Line 18
23	Statewide Electric 2019-2021 Design Level Active Demand Reduction Savings Component	$	5,000,000	Line 8
24	Renter Metric Component	$	2,000,000	Line 20
25	**Statewide Electric 2019 - 2021 Design Level Performance Incentives**	**$**	**114,000,000**	**Line 1**

All numbers in 2019 dollars.

Eversource Electric

	PA Performance Incentives (PI) Calculation		2019 - 2021	Comment
	SAVINGS COMPONENT - EE & PASSIVE DEMAND			
1	Electric Standard Savings Payout Rate	$	0.0112	From Statewide PI Model
2	Eversource Electric EE & Passive Demand Benefits	$	3,133,337,783	
3	Eversource Electric PI Allocated to Savings Component	$	34,991,101	
	SAVINGS COMPONENT - ACTIVE DEMAND REDUCTION			
4	Electric Active Demand Reduction Payout Rate	$	0.0291	From Statewide PI Model
5	Eversource Electric Active Demand Reduction Benefits	$	75,950,593	
6	Eversource Electric PI Allocated to Savings Component - Active Demand Reduction	$	2,207,835	
7	**Total Eversource Electric Performance Incentives Allocated to Savings Component**	**$**	**37,198,935**	
	VALUE COMPONENT - TOTAL PORTFOLIO			
8	Electric Value Payout Rate	$	0.0096	From Statewide PI Model
9	Eversource Electric Portfolio Program Costs (2019$)	$	895,988,563	
10	Eversource Electric Net Benefits (Benefits - Program Costs) (2019$)	$	2,313,299,813	
11	**Eversource Electric Performance Incentives Allocated to Portfolio Value Component**	**$**	**22,172,476**	
	RENTER COMPONENT			
12	Total Eversource Electric Renters Served		46,909.0	Allocated based on PAs' share of statewide customers
13	Electric PI Per Renter Served	$	20.00	From Statewide PI Model
14	**Eversource Electric PI Allocated to Renter Component**	**$**	**938,180**	
15	**Total Eversource Electric 2019 - 2021 Design Level Performance Incentives**	**$**	**60,309,592**	

National Grid Electric

	PA Performance Incentives (PI) Calculation		2019 - 2021	Comment
	SAVINGS COMPONENT - EE & PASSIVE DEMAND			
1	Electric Standard Savings Payout Rate	$	0.0112	From Statewide PI Model
2	National Grid Electric EE & Passive Demand Benefits	$	2,706,950,597	
3	National Grid Electric PI Allocated to Savings Component	$	30,229,483	
	SAVINGS COMPONENT - ACTIVE DEMAND REDUCTION			
4	Electric Active Demand Reduction Payout Rate	$	0.0291	From Statewide PI Model
5	National Grid Electric Active Demand Reduction Benefits	$	95,121,132	
6	National Grid Electric PI Allocated to Savings Component - Active Demand Reduction	$	2,765,110	
7	**Total National Grid Electric Performance Incentives Allocated to Savings Component**	**$**	**32,994,593**	
	VALUE COMPONENT - TOTAL PORTFOLIO			
8	Electric Value Payout Rate	$	0.0096	From Statewide PI Model
9	National Grid Electric Portfolio Program Costs (2019$)	$	853,985,681	
10	National Grid Electric Net Benefits (Benefits - Program Costs) (2019$)	$	1,948,086,048	
11	**National Grid Electric Performance Incentives Allocated to Portfolio Value Component**	**$**	**18,671,982**	
	RENTER COMPONENT			
12	Total National Grid Electric Renters Served		51,954.0	Allocated based on PAs' share of statewide customers
13	Electric PI Per Renter Served	$	20.00	From Statewide PI Model
14	**National Grid Electric PI Allocated to Renter Component**	**$**	**1,039,080**	
15	**Total National Grid Electric 2019 - 2021 Design Level Performance Incentives**	**$**	**52,705,654**	

Unitil Electric

	PA Performance Incentives (PI) Calculation - 2019$s		2019 - 2021	Comment
	SAVINGS COMPONENT - EE & PASSIVE DEMAND			
1	Electric Standard Savings Payout Rate	$	0.0112	From Statewide PI Model
2	Unitil Electric EE & Passive Demand Benefits	$	52,332,533	
3	Unitil Electric PI Allocated to Savings Component	$	584,416	
	SAVINGS COMPONENT - ACTIVE DEMAND REDUCTION			
4	Electric Active Demand Reduction Payout Rate	$	0.0291	From Statewide PI Model
5	Unitil Electric Active Demand Reduction Benefits	$	930,729	
6	Unitil Electric PI Allocated to Savings Component - Active Demand Reduction	$	27,056	
7	**Total Unitil Electric Performance Incentives Allocated to Savings Component**	**$**	**611,472**	
	VALUE COMPONENT - TOTAL PORTFOLIO			
8	Electric Value Payout Rate	$	0.0096	From Statewide PI Model
9	Unitil Electric Portfolio Program Costs (2019$)	$	16,690,489	
10	Unitil Electric Net Benefits (Benefits - Program Costs) (2019$)	$	36,572,774	
11	**Unitil Electric Performance Incentives Allocated to Portfolio Value Component**	**$**	**350,542**	
	RENTER COMPONENT			
12	Total Unitil Electric Renters Served		1,137.0	Allocated based on PAs' share of statewide customers
13	Electric PI Per Renter Served	$	20.00	From Statewide PI Model
14	**Unitil Electric PI Allocated to Renter Component**	**$**	**22,740**	
15	**Total Unitil Electric 2019 - 2021 Design Level Performance Incentives**	**$**	**984,754**	

	A. Performance Incentives (PI) Calculation		**2019 - 2021**	**Comment**
1	Statewide Gas 2019 - 2021 Total Design Level PI	$	23,000,000	Statewide gas PI pool, inclusive of traditional portfolio savings & value components ($22M) and an additional renter metric pool ($1M)
2	Statewide Gas 2019-2021 Design Level Base Pool	$	22,000,000	
	SAVINGS COMPONENT			
3	Statewide Gas Total Benefits	$	2,003,615,694	
4	Percent of Gas Base Pool Allocated to Savings Component		61.5%	Percentage of base pool of $22M
5	Gas PI Allocated to Savings Component	$	13,530,000	Line 2 * Line 4
6	Gas Standard Savings Payout Rate		0.0068	**Line 5 / Line 3**
7	**Statewide Gas Performance Incentives Allocated to Standard Savings Component**	**$**	**13,530,000**	
	VALUE COMPONENT			
8	Statewide Gas Portfolio Program Costs (2019$)	$	781,110,358	
9	Statewide Gas Net Benefits (Benefits - Program Costs) (2019$)	$	1,222,505,336	Line 3 - Line 8
10	Percent of Gas Pool Allocated to Value Component		38.5%	Percentage of base pool of $22M
11	Gas PI Allocated to Value Component	$	8,470,000	Line 2 * Line 10
12	Gas Value Payout Rate		0.0069	**Line 11 / Line 9**
13	**Statewide Gas Performance Incentives Allocated to Portfolio Value Component**	**$**	**8,470,000**	
	RENTER COMPONENT			
14	Total Gas Renters Served		48,000	
15	Gas PI Allocated to Renter Component	$	1,000,000	
16	Gas PI Per Renter Served	$	20.83	Line 15 / Line 14
17	Statewide Gas 2019-2021 Design Level Savings Component	$	13,530,000	Line 7
18	Statewide Gas 2019-2021 Design Level Value Component	$	8,470,000	Line 3
19	Statewide Gas 2019-20221 Metric Component	$	1,000,000	Line 15
20	**Statewide Gas 2019 - 2021 Design Level Performance Incentives**	**$**	**23,000,000**	**Line 1**

Berkshire Gas

	PA Performance Incentives (PI) Calculation		2019 - 2021	Comment
	SAVINGS COMPONENT			
1	Berkshire Gas Total Benefits	$	30,679,069	
3	Gas Standard Savings Payout Rate		0.0068	From Statewide PI Model
4	**Berkshire Gas Performance Incentives Allocated to Standard Savings Component**	**$**	**207,169**	
	VALUE COMPONENT			
8	Berkshire Gas Portfolio Program Costs (2019$)	$	12,482,563	
9	Berkshire Gas Net Benefits (Benefits - Program Costs) (2019$)	$	18,196,506	
12	Gas Value Payout Rate		0.0069	From Statewide PI Model
13	**Berkshire Gas Performance Incentives Allocated to Portfolio Value Component**	**$**	**126,073**	
	RENTER COMPONENT			
14	Berkshire Gas Renters Served		1,122	
16	Gas PI Per Renter Served	$	20.83	From Statewide PI Model
15	Berkshire Gas PI Allocated to Renter Component	$	23,375	
17	Berkshire Gas 2019-2021 Design Level Savings Component	$	207,169	
18	Berkshire Gas 2019-2021 Design Level Value Component	$	126,073	
19	Berkshire Gas 2019-20221 Metric Component	$	23,375	
20	**Berkshire Gas 2019 - 2021 Design Level Performance Incentives**	**$**	**356,617**	

CMA Gas

	PA Performance Incentives (PI) Calculation		2019 - 2021	Comment
	SAVINGS COMPONENT			
1	CMA Gas Total Benefits	$	480,950,396	
3	Gas Standard Savings Payout Rate		0.0068	From Statewide PI Model
4	**CMA Gas Performance Incentives Allocated to Standard Savings Component**	**$**	**3,247,758**	
	VALUE COMPONENT			
8	CMA Gas Portfolio Program Costs (2019$)	$	156,124,180	
9	CMA Gas Net Benefits (Benefits - Program Costs) (2019$)	$	324,826,216	
12	Gas Value Payout Rate		0.0069	From Statewide PI Model
13	**CMA Gas Performance Incentives Allocated to Portfolio Value Component**	**$**	**2,250,524**	
	RENTER COMPONENT			
14	CMA Gas Renters Served		9,312	
16	Gas PI Per Renter Served	$	20.83	From Statewide PI Model
15	CMA Gas PI Allocated to Renter Component	$	194,000	
17	CMA Gas 2019-2021 Design Level Savings Component	$	3,247,758	
18	CMA Gas 2019-2021 Design Level Value Component	$	2,250,524	
19	CMA Gas 2019-20221 Metric Component	$	194,000	
20	**CMA Gas 2019 - 2021 Design Level Performance Incentives**	**$**	**5,692,282**	

Eversource Gas

	PA Performance Incentives (PI) Calculation		2019 - 2021	Comment
	SAVINGS COMPONENT			
1	Eversource Gas Total Benefits	$	429,463,184	
3	Gas Standard Savings Payout Rate		0.0068	From Statewide PI Model
4	**Eversource Gas Performance Incentives Allocated to Standard Savings Component**	**$**	**2,900,076**	
	VALUE COMPONENT			
8	Eversource Gas Portfolio Program Costs (2019$)	$	172,033,359	
9	Eversource Gas Net Benefits (Benefits - Program Costs) (2019$)	$	257,429,825	
12	Gas Value Payout Rate		0.0069	From Statewide PI Model
13	**Eversource Gas Performance Incentives Allocated to Portfolio Value Component**	**$**	**1,783,576**	
	RENTER COMPONENT			
14	Eversource Gas Renters Served		8,400	
16	Gas PI Per Renter Served	$	20.83	From Statewide PI Model
15	Eversource Gas PI Allocated to Renter Component	$	175,000	
17	Eversource Gas 2019-2021 Design Level Savings Component	$	2,900,076	
18	Eversource Gas 2019-2021 Design Level Value Component	$	1,783,576	
19	Eversource Gas 2019-20221 Metric Component	$	175,000	
20	**Eversource Gas 2019 - 2021 Design Level Performance Incentives**	**$**	**4,858,651**	

Liberty Gas

	PA Performance Incentives (PI) Calculation		2019 - 2021	Comment
	SAVINGS COMPONENT			
1	Liberty Gas Total Benefits	$	30,525,041	
3	Gas Standard Savings Payout Rate		0.0068	From Statewide PI Model
4	**Liberty Gas Performance Incentives Allocated to Standard Savings Component**	**$**	**206,129**	
	VALUE COMPONENT			
8	Liberty Gas Portfolio Program Costs (2019$)	$	13,605,510	
9	Liberty Gas Net Benefits (Benefits - Program Costs) (2019$)	$	16,919,531	
12	Gas Value Payout Rate		0.0069	From Statewide PI Model
13	**Liberty Gas Performance Incentives Allocated to Portfolio Value Component**	**$**	**117,225**	
	RENTER COMPONENT			
14	Liberty Gas Renters Served		1,659	
16	Gas PI Per Renter Served	$	20.83	From Statewide PI Model
15	Liberty Gas PI Allocated to Renter Component	$	34,563	
17	Liberty Gas 2019-2021 Design Level Savings Component	$	206,129	
18	Liberty Gas 2019-2021 Design Level Value Component	$	117,225	
19	Liberty Gas 2019-20221 Metric Component	$	34,563	
20	**Liberty Gas 2019 - 2021 Design Level Performance Incentives**	**$**	**357,917**	

National Grid Gas

	PA Performance Incentives (PI) Calculation		2019 - 2021	Comment
	SAVINGS COMPONENT			
1	National Grid Gas Total Benefits	$	1,017,231,960	
3	Gas Standard Savings Payout Rate		0.0068	From Statewide PI Model
4	**National Grid Gas Performance Incentives Allocated to Standard Savings Component**	**$**	**6,869,156**	
	VALUE COMPONENT			
8	National Grid Gas Portfolio Program Costs (2019$)	$	419,734,911	
9	National Grid Gas Net Benefits (Benefits - Program Costs) (2019$)	$	597,497,049	
12	Gas Value Payout Rate		0.0069	From Statewide PI Model
13	**National Grid Gas Performance Incentives Allocated to Portfolio Value Component**	**$**	**4,139,696**	
	RENTER COMPONENT			
14	National Grid Gas Renters Served		27,045	
16	Gas PI Per Renter Served	$	20.83	From Statewide PI Model
15	National Grid Gas PI Allocated to Renter Component	$	563,438	
17	National Grid Gas 2019-2021 Design Level Savings Component	$	6,869,156	
18	National Grid Gas 2019-2021 Design Level Value Component	$	4,139,696	
19	National Grid Gas 2019-20221 Metric Component	$	563,438	
20	**National Grid Gas 2019 - 2021 Design Level Performance Incentives**	**$**	**11,572,289**	

Unitil Gas

	PA Performance Incentives (PI) Calculation - 2019$s		2019 - 2021	Comment
	SAVINGS COMPONENT			
1	Unitil Gas Total Benefits	$	14,766,043	
3	Gas Standard Savings Payout Rate		0.0068	From Statewide PI Model
4	**Unitil Gas Performance Incentives Allocated to Standard Savings Component**	**$**	**99,712**	
	VALUE COMPONENT			
8	Unitil Gas Portfolio Program Costs (2019$)	$	7,129,835	
9	Unitil Gas Net Benefits (Benefits - Program Costs) (2019$)	$	7,636,208	
12	Gas Value Payout Rate		0.0069	From Statewide PI Model
13	**Unitil Gas Performance Incentives Allocated to Portfolio Value Component**	**$**	**52,907**	
	RENTER COMPONENT			
14	Unitil Gas Renters Served		462	
16	Gas PI Per Renter Served	$	20.83	From Statewide PI Model
15	Unitil Gas PI Allocated to Renter Component	$	9,625	
17	Unitil Gas 2019-2021 Design Level Savings Component	$	99,712	
18	Unitil Gas 2019-2021 Design Level Value Component	$	52,907	
19	Unitil Gas 2019-20221 Metric Component	$	9,625	
20	**Unitil Gas 2019 - 2021 Design Level Performance Incentives**	**$**	**162,244**	

Appendices

S. **Strategic Evaluation Plan**

mass save
Savings through energy efficiency

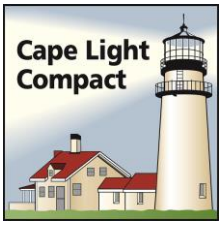
2019 - 2021

Massachusetts Statewide Energy Efficiency Strategic Evaluation Plan

nationalgrid

EVERSOURCE

Columbia Gas of Massachusetts
A NiSource Company



berkshire gas
A UIL HOLDINGS COMPANY

Liberty Utilities

Unitil

BLACKSTONE GAS COMPANY

October 2018

Table of Contents

1. BACKGROUND OF EM&V

1.1 INTRODUCTION

Evaluation, Measurement and Verification (EM&V) has been an integral component of the efficiency programs in Massachusetts since their inception. The robust EM&V framework has led to verifiable energy efficiency savings and benefits and has supported continuous improvement in the delivery of cost-effective programs. Over time, the EM&V process has become more rigorous and strategic and has incorporated a long-term evaluation planning approach. Recently, substantial EM&V research has been conducted by the program administrators (PAs). From 2013 to 2017, the PAs completed 174[1] EM&V studies at a total cost of $78.9 million[2].

The EM&V studies are managed by the Evaluation Management Committee (EMC). The EMC is a collaborative group of PAs and the Energy Efficiency Advisory Council (EEAC or "Council") EM&V consultants. The statewide process for planning energy efficiency activities for 2019 to 2021 represents a good opportunity for the EMC to reaffirm its priorities and commit to continuing improvements in its evaluation approaches. To that end, this 2019–2021 Strategic Evaluation Plan (SEP) lays out the EMC's strategy for EM&V activities from 2019 to 2021, including priorities for research and policies to guide decision making and approaches to EM&V.

This strategic exercise is particularly important given the maturation of programs and rapid changes in markets (e.g., lighting and HVAC). Demand side management (DSM[3]) programs in the 2019–2021 SEP are expected to experience substantial changes in terms of the types and depth of programs that will be delivered, such as moving upstream, demand response (DR), and energy optimization. The EMC needs to be agile and responsive to program needs as they adjust to changing conditions, and do so in a way that is efficient, reasonable, and valuable. Toward that end, recent experience has uncovered some aspects of the policies and processes of EM&V in Massachusetts that the EMC plans to refine for the next three-year period, as discussed in the sections below.

By improving planning and processes, the EMC will have the ability to carry out and manage well-developed, transparent, and rigorous EM&V studies that are useful, practical, and appropriate to DSM programs. These improvements include considerations on how to select new evaluation studies that will provide the most value to programs and ratepayers, as well as changes in policy that will give increased flexibility and confidence to verify savings and make continuous program improvements in a practical, sustainable way.

1.2 EM&V STUDIES

EM&V refers to the systematic collection and analysis of information to document the impacts of DSM programs and recommend improvements in program design and delivery. In Massachusetts, EM&V is divided into three major research areas: Residential; Commercial and Industrial (C&I); and Special and Cross-Cutting (SCC). These research areas are discussed

[1] Source: Completed studies from 2012–2016 annual reports and 2016–2018 SEP.

[2] Source: Mass Save Data from 2013 to 2016 for both electric and gas EM&V. Includes evaluation staff salaries, which account for approximately 10% to 20% of the total.

[3] This document generalizes future efforts to include energy efficiency and demand response.

in Sections 5, 6, and 7 below. EM&V includes the following types of studies, which are often conducted in coordination with each other:

- **Impact evaluation** refers to the measurement of gross energy and demand (electric and natural gas) savings achieved within overall program populations. Impact evaluations may also include the study of key impact factors to estimate savings, such as in-service rates and other resource savings, including water and non-utility fuels (e.g., propane and oil).
- **Baseline studies** refer to specific research to determine baselines, such as industry-standard practice baselines. Baseline research is sometimes conducted at the same time as impact evaluation studies.
- **Net-to-gross (NTG) studies** refer to specific research that quantifies program influence by estimating free-ridership and the various components of spillover (e.g., participant and/or non-participant spillover).
- **Market effects evaluation** refers to the measurement of the effects that programs or measures have on the structure and functioning of their target markets (e.g., changing product availability and pricing).
- **Non-energy impact (NEI) studies** refer to research that estimates NEIs of DSM measures, including participant and utility benefits. These benefits include operations and maintenance (O&M), comfort, productivity, avoided arrearages, etc.
- **Cost and measure life studies** include research to determine the total and incremental costs and lifetime of DSM measures.
- **Market characterization** refers to the systematic assessment of product and service markets for the purpose of improving the design and effectiveness of programs targeting those markets.
- **Process evaluation** refers to the systematic assessment of programs for the purpose of documenting their operations and developing recommendations to improve their effectiveness and design. It may also include marketing studies to understand the effectiveness of various marketing approaches.

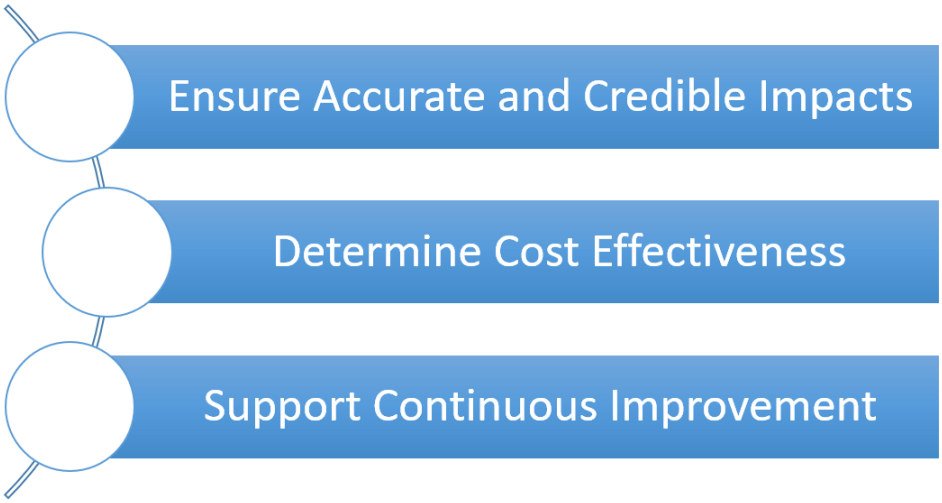
1.3 PURPOSES OF EM&V

Fundamentally, EM&V is used to meet regulatory commitments to the Department of Public Utilities (DPU) and the ISO New England (ISO), as well as providing ratepayers and stakeholders confidence that programs are effective and that estimates of claimed savings are credible. The EMC will continue the evaluation framework that has successfully resulted in high-quality, independent EM&V efforts. It is critical that the programs are evaluated, measured, and verified in a way that provides confidence to stakeholders, including the DPU, the ISO, the EEAC, the public, and internal PAs' departments[4].

The key purposes of EM&V are to ensure accurate and credible impacts, determine cost effectiveness, and support continuous program improvement, as shown in Figure 1 below. These purposes are interactive and are all equally important.

[4] Such as load forecasting, planning, program implementation.

Figure 1: EM&V Purposes



1.3.1 ENSURE ACCURATE AND CREDIBLE IMPACTS

EM&V ensures that program impacts reported to stakeholders are credible and sufficiently accurate for decision-making. Program impacts include gross resource savings, NTG factors, measure lives, and NEIs. These impacts are credible to stakeholders when the results are fact-based and reproducible and when the information is communicated in an understandable, transparent way that identifies actionable steps and key sources of uncertainty and limitations.

The primary studies that support this purpose are impact, NTG, market effects, NEI, and baseline studies (see Section 1.2). Yet, EM&V research is interactive and other studies also support this purpose, as shown in Table 1 below.

1.3.2 DETERMINE COST EFFECTIVENESS

The determination of cost effectiveness is important for ensuring that the programs are an effective use of ratepayer funds. EM&V calculates the costs associated with DSM programs by researching total and incremental measure costs. Using the credible impacts described above, ratepayer-funded programs are determined to be cost effective if their benefits are greater than their costs (or the ratio of benefits to costs is greater than 1). The primary EM&V studies that support this purpose are cost studies, as well as the impact studies listed above.

1.3.3 SUPPORT CONTINUOUS IMPROVEMENT

EM&V identifies strengths, limitations, and areas for program improvement to ensure that programs are valuable for ratepayers and other stakeholders. These studies help identify if programs are well-designed, well-run, and beneficial to customers. This type of research is focused on the future and how programs can improve to better serve customers, adjust to changing conditions, and achieve program goals. The primary research types for this purpose are process evaluation and market characterization studies, although many other types of research inform continuous improvement, as shown below.

Table 1: EM&V Purposes and Studies

Studies/Purposes	Ensure Accurate, Credible Impacts	Determine Cost Effectiveness	Support Continuous Improvement
Impact Evaluation	☑	☑	✓
NTG Studies	☑	☑	☑
Baseline Studies	☑	✓	✓
Market Effects Evaluation	☑	☑	✓
NEI Studies	☑	☑	✓
Cost Studies		☑	✓
Measure Life Studies	☑	☑	
Market Characterization	✓		☑
Process Evaluation		✓	☑
Legend: Primary Purpose ☑, Secondary Purpose ✓			

1.4 PRINCIPLES OF EM&V

EM&V must meet the purposes described above and uphold the principles of being valuable, high quality, reasonable, and cost efficient. These principles do not have a hierarchy; each principle is equally important and therefore a balance is required to maintain them concurrently. For example, if EM&V raises the expectation of accuracy too high, it can impose unnecessary time and cost burdens on vendors and customers and can result in program barriers, which prevents meaningful projects from moving forward. Similarly, if EM&V research is overly focused on cost efficiency, it could lead to studies of insufficient quality that are not valuable to stakeholders.

1.4.1 VALUABLE

EM&V provides value to all stakeholders, maintaining a key focus on benefits to ratepayers and program implementation. In order to provide value:

- EM&V is communicated effectively, which means the research is transparent, understandable, timely, and actionable.
- EM&V focuses on key evidence regarding programs and markets and is inclusive of future needs, recognizing that understanding the past is a way to make improvements for the future.
- EM&V is relevant to the underlying program or measure and consistent with the tracking and reporting approaches of the PAs, whenever possible.

1.4.2 HIGH QUALITY

EM&V is executed with independence and high quality throughout all aspects of its planning, implementing, and reporting. It adheres to standard methods for conducting EM&V of energy efficiency programs, including leveraging resources like the

Uniform Methods Project and International Performance Measurement and Verification Protocols, where relevant. It also adheres to the ISO's requirements for measuring and verifying reductions in demand, particularly for statistical precision and accuracy, as well as specifications for measurement of equipment. Where existing methods are not sufficient, development of new EM&V approaches may be considered as long as the other principles are upheld. EM&V methods are clearly documented and defined, which supports consistency (across state, sectors, and programs), reduces evaluation time, and mitigates risk of differences between evaluation and program implementation assumptions.

1.4.3 REASONABLE

EM&V meets its purposes (credible impacts, etc.) in a way that is reasonable and sufficient for decision-making needs. The effort and rigor of studies vary to account for issues such as amount of savings relative to the portfolio, level of uncertainty, participant population sizes, data security, and intended usage of results. Approaches are structured to deliver accurate results but avoid introducing false precision (i.e., numerical data that imply better precision than is justified by the research). EM&V is as simple and understandable as possible, being sensitive to unnecessarily increasing complexity in methodology, especially when such complexity (or additional studies) will not add meaningful improvements to accuracy. Generally, EM&V tries to minimize burden (e.g., telephone surveys and site visits) on customers, including financial burden, time, and effort. The number of studies is manageable for the EMC, and the resulting findings and recommendations are actionable and manageable for program implementation staff.

1.4.4 COST EFFICIENT

As with other DSM activities, EM&V must be cost efficient for the ratepayers, ensuring that evaluation resources are spent effectively. This condition means that the effort of EM&V is justified by the value of the information it produces and that, as studies increase in cost, their associated value also rises.

1.5 EM&V FRAMEWORK

Consistent with past three-year plans and the Council's September 8, 2009 EM&V Resolution, the PAs propose to continue the evaluation framework that has successfully allowed the EMC to engage in high-quality third-party EM&V efforts. The Council and the PAs find that it is critical that the programs be evaluated, measured, and verified in a way that provides confidence to the public at large that the savings are real and in a way that enables the PAs to report those savings to the DPU with full confidence. Additionally, the Council stated that there is a need to ensure both the reality and the perception of the independence and objectivity of EM&V activities, as well as a need to help ensure consistency, timeliness, and credibility of the results. Accordingly, the Council will continue to have an oversight role over the EM&V activities of the PAs to ensure the objectivity and independence of those activities (and the perception of such) and to help ensure consistency, timeliness, and credibility. The Council's oversight role will be accomplished through the Council's EM&V consultants ("EM&V Consultants"), a team of third-party expert consultants that has primary responsibility for working with the PAs to plan and implement high-quality EM&V activities in Massachusetts.

The PAs will maintain a statewide focus to the maximum extent possible, will review EM&V budgets with the EM&V Consultants, and will integrate electric and gas evaluation efforts to the maximum extent possible. The PAs will be the main mechanism for contracting with the independent evaluation contractors and will work with evaluation contractors to maintain privacy of customer data.

1.5.1 EVALUATION MANAGEMENT COMMITTEE (EMC)

The PAs and the EM&V Consultants established the EMC to be similar to other management committees. The EMC serves as a steering committee for statewide evaluation issues, providing guidance and direction to each of the evaluation research areas. The EMC works to plan, prioritize, and delineate the research studies to be undertaken over the three-year plan period.

The PAs and the EM&V Consultants have worked to consistently improve the EM&V process over time. As issues arise, the EMC has established working groups to review and address new topics, areas of concern, or disagreement. For example, in 2017 the EMC realized that DR evaluations were being completed by individual PAs, along with EM&V Consultants, and only final results were shared with the full EMC. In response to that issue, the EMC formed an EM&V DR subcommittee that includes a member of each electric PA and members of the EM&V Consultant team. This group has helped ensure that the EMC is up to speed on all issues. The EMC will continue to establish appropriate working groups to address issues as they arise and keep the EM&V process running smoothly.

1.5.2 APPEALS PROCESS

The PAs and the EM&V Consultants will continue to work diligently to reach a consensus on evaluation issues. Areas of difference may arise, however, that cannot be resolved through consensus during the ongoing interactive process between the EM&V Consultants and the PA evaluation staff. In this instance, authority for decision-making will reside with the EM&V Consultants and the Council.

An appeals process has been established to enable the PAs to fulfill their responsibility of reporting program savings to the DPU with full confidence. Under the appeals process, the PAs may bring decisions made by the EM&V Consultants or the Council to an Appeals Committee for review and resolution. The Council forms the Appeals Committee, whose responsibility is to hear the matter under dispute and rule so that the study may proceed in a timely way. In general, it is expected that this review process will be completed within 72 hours once an issue is elevated to the Appeals Committee. The Appeals Committee will consist of three voting members of the Council, including the Department of Energy Resources (DOER). Consistent with general Council proceedings, the Appeals Committee will include and consult with, in both deliberations and decision-making, a representative of both the PAs and the Council's consultant team, neither of whom shall have a vote in the standing committee. The Appeals Committee will review the issues related to the disputed matter, hear from the PA evaluation staff and EM&V Consultants, and make a determination on the outcome of the matter. The decision will be recorded, along with a description of the applicable issues. The participants in the appeal will sign the record of the decision, indicating their acceptance and the representation of the issues and the decision. In exceptional cases, where the PAs perceive there to be significant risk to their ability to manage the energy efficiency programs in the near term, the PAs will note their disagreement with the decision of the Appeals Committee on the record of the decision and reserve the right to immediately petition the DPU on the Appeals Committee's decision. The PAs shall be able to submit any such documents to the DPU in conjunction with the filing of the three-year plans, mid-term modifications, and term reports. The DPU will be able to review the record of this decision in its review of three-year plans, mid-term modifications, plan-year reports, and term reports.

As discussed below, the EMC has been a key component to keeping communication channels open. To date, all major disagreements have been resolved through a data-driven consensus process. It is a testament to the hard work and collaborative engagement of the PAs and the EM&V Consultants that the appeals process has not been invoked to date.

2. EM&V SUMMIT AND KEY STRATEGIC ISSUES

2.1 EM&V SUMMIT OVERVIEW AND FINDINGS

To encourage early participation in the evaluation planning process, the PAs hosted a Strategic Evaluation Planning Summit (Summit) in December 2017. The Summit provided a forum for the EMC, DOER, the Residential Management Committee (RMC), C&I Management Committee (C&IMC), evaluation contractor teams, and EM&V Consultants to identify emerging evaluation topics and activities. The following list represents key issues discussed during the Summit:

- It is important to maintain the **collaborative environment** of the EM&V framework.
- Improved **communication and collaboration between evaluation and implementation** is needed, such as presenting evaluation results in a timely manner and providing more Quick Hit (or "fast track") studies to inform program design.
- Improved **prioritization of studies** would be valuable, such as creating a prioritization framework and having a champion for each study.
- **Reporting improvements** are needed, including clearer definitions, templates for recommendations, and justification for why the recommendation is needed.
- **Baselines** need to be credible, and additional policy and discussion are needed on industry-standard baselines.
- Important **new technologies and emerging issues** should be considered**,** such as DR, electric vehicles, load shapes, and energy optimization.
- Research and savings claims of **market effects** should be facilitated by including development of program theories, as well as determination of market effects data acquisition and research needs early in the program life cycle.
- The approach to **NTG coordination** should remain flexible. Typically, the SCC research area should serve as an advisor for all NTG studies, but studies are led by the research area (i.e., residential, C&I) contract groups, particularly when the NTG is combined with impact and/or process evaluation. However, complex studies or studies trying new methods are typically completed by the SCC team.

The following sections provide additional insights into key strategic topics. Additionally, the near-term priorities listed in Sections 5.3, 6.3, and 7.3 below were generated through collaborative discussions at the Summit and subsequent discussions with stakeholders. In order to maintain alignment with the three-year planning cycles, it is anticipated that Summits will continue to be held prior to the beginning of each three-year cycle in order to support subsequent planning activities.

2.2 MARKET EFFECTS

The PAs currently implement a number of measures through upstream delivery paths and are considering adding to these offerings in the next program cycle. While these offerings aren't specifically identified as market transformation programs, all of them have been designed with the goal of impacting availability, pricing, awareness, promotion, and ultimately sales of energy efficiency equipment, which are typically considered market transformation indicators. The PAs have also offered incentives/rebates through downstream strategies for measures where there is potential that the programs helped move standard practice to higher levels of efficient equipment.

The EMC plans to take a more proactive, deliberate, and structured effort to measure market effects and market transformation. The EMC will continue to discuss the research framework and potential approaches with the independent evaluators and other stakeholders. In particular, the EMC is aware that market effects research must be guided by a program theory and the research should begin early in the lifecycle of the measure or program, and there must be sufficient data and evidence to support market effects claims. In addition, the use of Delphi panels to synthesize data and

construct the counterfactual has proven helpful for prior market effects studies and will be considered for future studies. The EMC will continue to have a productive dialogue to make it possible for programs to measure and claim savings where they have in fact influenced markets.

2.3 BASELINES

Massachusetts has recognized that baselines (i.e., the condition that would have existed absent the installed measure) may differ from relevant state/national codes or standards and therefore has moved towards an Industry Standard Practice (ISP) baseline approach. This is particularly important for electricity savings, which must be consistent with the requirements of the ISO for the bidding of demand reductions into the Forward Capacity Market. The ISO requires that baseline for efficiency projects be defined by the applicable efficiency code or standard. Where there is no code or standard, or if the ISP is more stringent than the relevant code or standard, the ISP is used as the baseline.[5]

To help clarify the procedures for estimating and applying the proper baseline, Massachusetts has recently commissioned a number of evaluation projects, including a study to help define a baseline framework (C&I Project 64) and a study examining the relationship of baseline and NTG (C&I Project 73C). Massachusetts has also commissioned a number of recent ISP studies for residential and commercial lighting, commercial boilers, infrared heaters, and air compressors.

As part of the 2019–2021 program cycle, the EMC expects to continue to conduct ISP studies on selected measure types. The EMC will consider criteria such as whether a measure is unique or a commodity measure, the existence of an intermediate efficiency level (i.e., between a code/standard and the program efficiency level), and evidence of non-code or standard practices in determining which measures merit study in the ISP framework. In addition, the EMC may apply criteria similar to those used in the prioritization framework (see Section3.3). The EMC will also try to integrate baseline and NTG research together, in order to mitigate the potential for double counting any shifts in the market or free-ridership effects that may be reflected in both baseline and NTG research, and in order to understand the influence of PA programs on changing standard practices. This integration effort may be conducted through a modeled partial net approach, which would explicitly incorporate baseline and NTG together rather than applying both separately.

2.4 LIGHTING RESEARCH CHANGES

From 2016 to 2018, the EMC conducted a comprehensive research agenda for the lighting market, including approximately 20 studies over the three-year period. These studies included on-site saturation studies, supplier interviews, sales data analysis, market adoption model development, shelf stocking, lighting decision making, market scans, and NTG analysis. The goal of these studies was to gather as much intelligence about the lighting market as possible to help inform the 2019–2021 plans. Yet, it was also envisioned that the research would be front-loaded early in the planning cycle. Therefore, significant research was conducted in 2016, with a reduction in effort in both 2017 and 2018.

Based on the draft 2019–2021 Energy Efficiency (EE) Plan, the EMC has decided to further reduce the effort spent on lighting research for the 2019–2021 period due to expected significant transformation of the lighting market resulting from

[5] ISO-NE recently revised its *Manual M-MVDR, Measurement and Verification of On-Peak Demand Resources and Seasonal Peak Demand Resources*, whereby effective October 4, 2018, the baseline has been standardized between early replacement and replace on failure measures to be standard practice only if there is no applicable state code or federal energy efficiency standard (i.e., not whichever is most stringent). The EMC will investigate how best to address this change during the next term.

the rapid market adoption of light emitting diodes (LEDs), as well as the likelihood of federal standards. Yet, the EMC will continue to conduct some research on the lighting market (see Sections 5.3.3 and 6.3.3**Error! Reference source not found.** f or more on planned research in the residential and C&I research areas), including sales data analysis, as well as less frequent on-site saturation studies and supplier interviews.

2.5 EMERGING ISSUES

A number of research areas could rise to importance as part of the 2019–2021 EE Plan but, at the time of this SEP, are still under development. Potential areas include:

- **Energy Optimization**. The PAs will include energy optimization (i.e., the expansion of cost-effective measure options across multiple fuels, including delivered fuels to electricity or gas, in order to reduce overall home energy use and costs) in the 2019–2021 EE Plan, which may require changes to evaluation practices.
- **Standards Advocacy**. The PAs may initiate an effort to promote higher standards for selected products.
- **Demand Response (DR)**. DR programs may be a more prominent component of program offerings in 2019–2021 term.

The EMC will monitor these areas as they develop and modify updates to this SEP as more information becomes available.

3. PLANNING FOR EVALUATION

3.1 PLANNING PRINCIPLES

Collaboratively, the EMC considers multiple factors in planning EM&V studies, which collectively are utilized to assess potential evaluation activities, identify priorities, and determine the appropriate timing of all evaluation efforts. These factors are consistent with the EM&V principles described in Section 1.4 (i.e., valuable, high quality, reasonable, cost efficient) and are used in the prioritization framework described in Section 3.3. Factors considered by the EMC include:

- **Importance**. The EMC will allocate evaluation resources to research questions that have a significant impact on DSM investments or that directly inform significant policy questions and stakeholder interests. Key indicators of this include:
    - Magnitude of savings (energy and demand)
    - Expected/potential future savings trend
    - Implementation requests
    - Regulatory requirement/political sensitivity
- **History**. The EMC will leverage existing research before investing in additional research, including previous evaluation research conducted in Massachusetts and relevant research from other jurisdictions. Key factors include the age of the most recent study and the stability of evaluation results over time.
- **Uncertainty**. The EMC will allocate evaluation resources to research questions with the greatest uncertainty. Uncertainty may be due to shifts in markets, technologies, or baselines; program implementation changes; or uncertainty in impact factors.

In addition to the factors described above, there are three additional considerations when establishing the evaluation research portfolio. These include:

- **Balance**. The EMC undertakes a mix of studies each year, in terms of the evaluation study types (e.g., impact, process, NTG, market effects), fuel types, and programsto be evaluated.
- **Flexibility**. Unanticipated, but not yet known or identified, evaluation efforts may arise over time. To ensure that these issues may be addressed, the PAs will allocate sufficient resources for unplanned ad hoc evaluation efforts, including Quick Hit studies. The EMC develops evaluation plans with flexibility to add evaluation activities (such as pilot evaluations or assessments of the effectiveness of mid-year program design changes) without compromising the timing and quality of concurrent evaluation work.
- **Differences**. The EMC recognizes that there can be legitimate reasons for variations in findings of statewide studies within small vs. large PAs, gas vs. electric PAs, or within definable economic/demographic areas of the state. When appropriate, evaluation research activities may be implemented in a manner that ensures consideration, identification, and documentation of any such legitimate differences.

In Massachusetts, EM&V is divided into three major research areas: Residential, C&I, and SCC. Planning strategies used in each of these areas are discussed below.

3.1.1 RESIDENTIAL

For residential efforts, the specific strategy for planning impact evaluations is dependent on three things: the size of each core initiative or end-use; when each core initiative or end-use was last evaluated; and whether or not the program has undergone recent and significant changes. Particularly large programs or major end-uses within programs may be evaluated on a more frequent basis to ensure the largest contributors to savings in the statewide portfolio are accurate. In addition, the PAs and EM&V Consultants may consider evaluating smaller programs, even if the program represents only a small portion of the portfolio savings. Finally, if a program undergoes significant changes or is newly developed, the EMC may consider completing an evaluation to understand how well the program is performing and identify any issues with the delivery as early as possible.

3.1.2 COMMERCIAL AND INDUSTRIAL (C&I)

Historically, the strategy for planning impact evaluations in the C&I sector has largely mirrored that of Residential. However, during the 2016–2018 period, the EMC coordinated on development of a revised impact framework, the goal of which was to ultimately shift impact evaluation planning to a more frequent and/or rolling approach. In doing so, the EMC anticipates feedback from these evaluations to be timelier due to smaller sample sizes and associated ease of execution, while also being of greater benefit to stakeholders such as the PA implementers. Outside of the impact evaluation space, it is the EMC's intent to test a more systematic approach to study planning, which may include adoption of a screening tool and/or process to vet ideas prior to studies moving forward, consistent with the prioritization framework in Section 3.3 below. It is anticipated that this approach will produce a study list that will provide the most value for all stakeholders.

3.1.3 SPECIAL AND CROSS-CUTTING (SCC)

For each SCC topic area, specific planning strategies may vary. Work in this area may cross multiple topics to identify overarching market trends and consumer behavior. When determining whether the EMC should evaluate a specific subject, some of the factors considered include, but are not limited to, the following:

- Ensuring that process and impact evaluations are performed as appropriate based on the defined goals of each delivery model.

- Quantifying market effects where necessary data are available for programs identified as being likely to induce measurable market effects.
- Providing program planning, implementation, and evaluation staff with the market information they need to maximize market effects from program activities.
- Continuing to re-examine the most-appropriate approach for estimating NTG, researching what is driving differences in NTG ratios by end-use and over time, and repeating NTG studies as needed.

Some additional SCC work is typically developed on a short turnaround, ad hoc basis. This work may include literature reviews or surveys of programs in other jurisdictions and other smaller scale work designed to inform implementation efforts or program strategy. Another priority of this research area is to retain the flexibility to respond to new efforts in the field to provide appropriate and timely evaluation support.

3.2 STAGES OF EVALUATION

The stages through which a project moves from being an initial concept to being completed are shown in Table 2 below.

Table 2: Stages of Evaluation

Stage	Document Under Review	Description
Stage One: Conceptual Framework	1-Page Summary	Document provides conceptual framework for the project, including a very high-level budget and timing, as well as the objective or goal.
Stage Two: Preliminary (High-Level) Work Plan	2- to 3-Page Summary	Work plan provides strategies to meet objective, including more detail on the potential research design, level of effort (number of surveys, site visits), and budget/timing. This step is used only for projects where there were major issues or concerns with the Stage One plan.
Stage Three: Detailed Work Plan	3- to 25-Page Work Plan	Work plan provides detailed sampling and analysis plans, specific staffing needs, and milestone deliverables.
Stage Four: In Progress	Status Report	Status reports are prepared consistently with the work plan; there may be detailed planning occurring simultaneously with execution on early tasks.
Stage Five: Reporting	Draft Report	Reporting includes the period from draft report through final report and any review/communications/meetings in between; also includes paperwork for submittal.
Stage Six: Complete	Final Report	Report is finalized and either filed or ready to be filed with the DPU.

There are multiple planning stages since there is a need for projects to proceed incrementally from concept to preliminary work plan to detailed work plan. By proceeding incrementally, the PAs and EM&V Consultants are not only able to better manage the stakeholder review process but effectively stage studies across the three research areas.

The methods by which stakeholders are engaged can vary based on the stage of evaluation. The PAs have hosted strategic evaluation planning meetings to encourage participation in the early stage of the evaluation planning process and solicit input from a wide variety of program stakeholders. Additionally, there is active engagement with both program

implementers and policymakers to identify additional key research needs and to further refine project recommendations developed at the strategic evaluation planning meetings.

Much of the stakeholder engagement happens through the RMC and C&IMC and associated subcommittees. For projects in Stage One, one-page summaries are developed and shared with the management committees. Progress on projects in Stages Two, Three, and Four (preliminary and detailed work plans and in progress) is also provided to the management committees. For projects in Stage Five, draft reports are shared with the management committees.

Input from non-utility stakeholders represented on the Council generally flows through the EM&V Consultants. A representative from the EMC attends RMC and C&IMC meetings as frequently as possible in order to facilitate coordination and solicit feedback from the various management councils and working groups.

3.3 PRIORITIZATION FRAMEWORK

In order to ensure the most important ideas become studies, the EMC has developed a study prioritization tool and process to enable the prioritization of studies within a plan term and/or plan year. The tool combines quantitative and qualitative factors to develop an overall score for each study concept. Based upon these scores and subsequent deliberation amongst the working groups and EMC, collective decisions are made regarding which studies will move ahead.

This process was used in the development of this SEP and the resulting prioritized studies are included in the planned research sections for each research area (Sections 5.3.3, 6.3.3, and 7.3.3). This planned research reflects new studies to begin in the first year or two of the term (2019 to 2020) and is not intended as an exhaustive representation of research studies to be undertaken throughout the entirety of the three-year term. To ensure flexibility and adaptive management in the planning process, the prioritization framework also will be used within the plan period as new studies are proposed. This will allow the evaluation studies to best reflect changes in programs, markets, codes/standards, and policies that occur during the term and cannot be predicted at this time.

3.3.1 BACKGROUND

The study prioritization process was developed by the EMC in order to apply a higher degree of rigor and transparency to the process of deciding which evaluation studies will be undertaken under the statewide evaluation framework. Previously, the EMC and research area subgroups considered ideas for studies as they were suggested on an ad hoc basis by various stakeholders. The 2016–2018 SEP established principles regarding the priority of potential evaluation research, but these principles were not integrated into a scoring tool. The study prioritization process described below addresses this challenge by laying out the indicators, scoring, and process to be followed when considering study concepts brought forward during the three-year planning process, as well as ideas that arise during a term.

3.3.2 OVERVIEW OF THE STUDY PRIORITIZATION TOOL

Each proposed study is described, characterized, and rated on key value factors such as savings, uncertainty, and priorities in the study prioritization tool (Tool). To develop the Tool, the PAs adapted the Massachusetts Commercial and Industrial Gross Impact Evaluation Framework[6], which uses a spreadsheet-based scoring and prioritization tool that was reviewed and

[6] DNV GL, Massachusetts Program Administrators and Energy Efficiency Advisory Council, May 2017.

tested by stakeholders. In developing the Tool, the PAs adjusted this framework to account for all sectors and types of studies.

Primary elements of the framework include basic study information, key indicators, scoring, and indicator weights, as described below. Please refer to Appendix D for a complete list of key indicators and weights.

Basic Study Information. Each study is described with basic information such as study name, study type, research area, sector, fuel type, underlying program and initiative, technology type, brief description, and study champion (i.e. someone who is supportive of the study).

Key Indicators. Each study is rated on key indicators of relevance, uncertainty, and priorities. These factors include:

- Magnitude of savings (energy and demand)
- Age of most recent study
- Expected/potential future savings trend
- Market/technology/baseline Shifts
- Program implementation changes
- Uncertainty of impact factors
- Regulatory requirement/political sensitivity
- Implementation requests

Scoring Definition. Studies are scored individually on a 1 to 5 basis, with a score of 5 indicating the highest need for additional research. Guidance is provided on each key indicator to support consistency among users. To account for nuances of fuels and study types, "Not Applicable" (NA) is allowed at the Study Champion's and research area team's discretion.

Indicator Weights. The score for each indicator is weighted to calculate aggregated study scores, which are ranked overall and by fuel type and research area. There are three weighting schemes, which apply to different study types and have different priorities:

- Weight 1 is used for the following study types: baseline, impact, cost (incremental or total depending on the baseline), market effects, measure life, NEIs, and NTG. Weight 1 is also used for combination studies if a market characterization or process component is integrated into the study. This weighting scheme places highest priority on magnitude of energy savings, expected/potential future savings, and market/technology/baseline shifts.
- Weight 2 is used for market characterization and process studies. This weighting scheme places highest priority on program implementation changes, market/technology/baseline shifts, and expected/potential future savings.
- Weight 3 is used for DR studies. This weighting scheme places highest priority on magnitude of demand savings, expected/potential future savings, and market/technology/baseline shifts.

The PAs will update the Tool and its components on an as-needed basis to remain relevant with current policy priorities.

3.3.3 THE STUDY PRIORITIZATION PROCESS

The following section describes the process by which study concepts are be prioritized.

1. The concept for a study is proposed by a Study Concept Originator (Originator). An Originator may be a PA evaluator, an EM&V Consultant, an evaluation vendor, program implementation staff or consultant, DOER, or EEAC. Alternatively, the study concept may be generated by reviewing the Tool. The Tool may be populated with

quantitative program and measure data by the PAs or EM&V contractors on behalf of PAs. A review of the data in the Tool may bring to light certain programs, initiatives, or measures that are higher priority for evaluation.

2. In order to move the concept forward for consideration, it must have a Study Champion. If the Originator is not a PA evaluator or EM&V Consultant, then the Originator hands off the concept to a PA evaluator or EM&V Consultant who is supportive of the research and who takes on the role of Study Champion.
3. The responsibilities of the Study Champion are to populate and rate the study concept in the Tool[7], submit the Tool to the relevant working group[8] for consideration, discuss the concept with the working group and/or EMC (see Steps 4 and 5), and communicate back to the Originator as needed.
4. After receiving the Tool populated with the study concept information and ratings, the relevant working group discuss the concept and decide whether to accept, decline, or table the concept.[9,10] The group may also adjust the ratings and note any key comments. If considering multiple concepts at one time, the working group may choose to prioritize the concepts based upon their relative ratings, rankings, and other criteria, such as maintaining balance between fuels and study types, likely evaluation approaches and associated costs and timelines, and other salient factors. In contrast, if considering one study concept at a time, the score for the concept can be benchmarked against scores from previously considered study concepts.
5. The EMC considers the study concepts that are sent by the working groups based upon their ratings and rankings in the Tool as well as other criteria, such as maintaining balance between sectors, fuels, and study types; likely evaluation approaches and associated budgets and timelines; and other salient factors. The decision whether or not to move forward is made by building consensus through discussion.
6. The Research Area Lead informs the relevant evaluation vendor(s) that the study concept has been approved and request that a Stage One plan be developed.

3.4 AVAILABLE BUDGET

The EM&V budget available to the research areas for the 2019–2021 EE Plan is projected to be in line with historical program budget levels. Twenty percent of each sector's available evaluation budget is allocated to the SCC research area.

In 2017, EM&V evaluation study expenditures (not including potential studies and internal labor costs) totaled approximately $17.2 million ($12.8 million for electric and $4.4 million for gas). Therefore, for the three years of the 2019–2021 EE Plan, the EMC recommends an EM&V study-specific expenditure of $51.6 million (i.e., three times the 2017 expenditures), which includes $38.4 million for electric and $13.2 million for gas. As mentioned above, this budget does not include costs for potential studies or internal staffing costs.

3.5 ASSIGNED STAFF

[7] If a study idea is proposed as a Quick Hit study, the prioritization step may be skipped if there is consensus among the working group that the study should be pursued. If there is not a clear consensus, then the study idea should go through the rating process.

[8] The working group should include the topic area lead, PA evaluation representatives, and EM&V Consultants relevant to the proposed study.

[9] Studies expected to require a budget less than $500,000 may be decided upon by the working group rather than being forwarded to the EMC.

[10] In the case of studies that are required for regulatory purposes, the working group and EMC will assign the study as an automatic "Pass" and note the regulatory requirement in the Tool.

Across the PAs, there are approximately 20 full-time equivalent employees assigned to Massachusetts evaluations, with approximately 30 PA employees actively engaged in study oversight. The PAs currently contract with several external evaluation experts to supplement staff. External evaluation experts are employed in addition to the evaluation contractors that are responsible for completing the evaluations in each research area.

3.6 QUICK HIT APPROVAL APPROACH

In addition to the standard staged process of decision making, the EMC also has a Quick Hit (or "fast track") approach to evaluation study review and approval. This approach is used to produce answers to important researchable questions in an expedited manner, and thus provide more timely feedback to program managers and implementation staff. These evaluations are intended to be smaller in scope and therefore can generally be completed more quickly than a standard evaluation.

The following provides a set of parameters that define Quick Hit evaluations. If these parameters cannot be met, the Quick Hit study would revert back to following the staged-study process described above. This list is intended to serve as guidance rather than an exhaustive checklist where every criterion must be met (i.e., studies that generally meet these parameters can qualify).

- **Scope**. Quick Hit evaluations need a very specific, targeted scope with one or two clearly articulated research questions. The study could potentially focus on scoping/reconnaissance studies for larger projects. Quick Hit studies are not suitable for complex or integrated evaluations.
- **Planning**. The planning of Quick Hit studies is limited to improve timeliness of the research. Specifically, the Study Champion proposes the study concept and date by which the information is needed to the working group (e.g., the residential, C&I, or SCC working groups) for approval. If the working group approves, the study skips Stage One and Stage Two and moves directly into an abridged Stage Three (without going through the prioritization framework and Tool described in Section 3.3). The abridged Stage Three succinctly captures the goal of the research, the research methodology, the timeline, and the budget. The Research Area Lead is then responsible for approving the Stage Three plan and may leverage the working group as they see fit. If consensus to proceed with the study is not reached in the working group, however, then the study should go through the prioritization framework to determine whether or not to proceed to Stage Three.
- **Budget**. Quick Hit studies have comparatively smaller budgets as compared to standard evaluations (i.e., $100,000 or less). The Research Area Lead will define an appropriate budget maximum so that the work can be completed but small enough to dissuade scope creep.
- **Timeline**. The timeline is an abridged timeline that all stakeholders agree to maintain. The aim is to complete Quick Hit studies within six months or less of kick-off. This includes a hard stop on the date for the final report (e.g., study lead to ensure any comments from others arrive on time).
- **Staffing and Project Management**. The project should be staffed with a highly experienced lead contractor that can work autonomously and is familiar with the topics and data involved with answering the researchable question. The contractor should have a strong project manager to ensure no scope creep. The project should avoid use of junior staff that need supervision and could potentially slow down the process and add cost.
- **Reporting and Recommendations**. Output is in memo format to both distinguish from full-fledged studies and spend less time on formalizing a report. The output of the study is flexible and informal so long as the specific research questions are answered. Outcomes may include suggestions, considerations, or limited recommendations. Scoping studies may make recommendations regarding future work.
- **Stakeholder Updates and Comment Processes**. Stakeholders (i.e., research area working group and the EMC), will be updated of the approved Stage Three workplan and project status during the study process. The comment

process will be streamlined to expedite the review process and timely delivery of the research (e.g., only one round of comments). The PA statewide evaluation study lead will send out reminders regarding comment deadlines.

3.7 INTEGRATION OF RESEARCH

To support the principles of reasonableness and cost efficiency, the EMC recommends that, during EM&V planning, staff explicitly consider how and when to integrate similar research components into a single study (e.g., impact, process, NTG, and market characterization on one program). Combining relevant studies can have the following benefits:

- **Increased value and understanding**. Combining topics into a single study can increase stakeholder understanding of the topic, providing both the "what" and the "why" of the research concurrently. There is value to both evaluators and program implementation teams in knowing specifically how program operations **and** delivery can be improved to increase program savings or address deficiencies or poor impact results. It also results in a more comprehensive, but succinct and actionable, set of conclusions and recommendations.
- **Increased study efficiency**. Combining studies can reduce duplication of effort and customer fatigue, as contacts with participants can be integrated. Contact integration can reduce evaluation costs and is an improvement for customers. It also provides a comprehensive, single snapshot of a particular program, rather than disparate snapshots taken at different times.
- **Reduced number of studies**. Combining studies may be more efficient for evaluation staff management as it reduces the number of study documents requiring review, data requests, contracting efforts, etc.

The EMC recognizes that combining studies could lead to longer study durations and increase study complexity, especially if unrelated tasks are melded into a single study. Additionally, there may be a need for timing to be different among studies (e.g., process evaluations may need to be conducted earlier in the program lifecycle than impact studies). In general, however, combining studies will result in overall lower costs, increased program understanding, more actionable recommendations, and reduced customer burden.

3.8 COLLABORATION WITH IMPLEMENTATION DURING EM&V PLANNING

Coordination between evaluation and implementation during early stage research development is important to ensure that all stakeholders have the opportunity to provide feedback for evaluation project identification and scoping. While coordination with implementation typically occurs in the EM&V planning stages, the approach historically lacked standardization, such as who from implementation provides feedback and when they provide it. EMC evaluators agree that coordination on research planning should be done in a more uniform way to ensure solicitation for feedback is consistent. To that end, the EMC has taken the following steps toward a more formal process:

- Inclusion of a field in Stage One Plans (see Section 3.2) which ensures that research ideas are provided to implementation subcommittees (i.e., RMC and C&IMC) for review and comment.
- At least one EMC evaluator is assigned to each implementation management committee to attend meetings, provide feedback and present and/or discuss planned research with these groups.
- EMC and PA evaluators will invite implementers to EMC and other evaluation meetings to discuss planned research activities and solicit ideas for additional research needs.

Further refinements and improvements to proposed processes will be made throughout the 2019–2021 EE Plan.

3.9 EM&V EARLY INVOLVEMENT

Understanding customer decision-making processes is critical to determining the baseline and often requires evaluators to make assumptions and to rely on customers' memory and verbal reporting, leading to issues with the confidence and accuracy of savings estimation. In addition, pre-treatment conditions are a critical component of many early replacement or retrofit measure impact assessments, and evaluators often struggle with developing savings based upon high-rigor data collected ex-post.

In order to address these evaluation challenges, the PAs are exploring methods for involving EM&V in program processes in earlier stages. Ex-ante evaluation for C&I custom projects (i.e., evaluation prior to project completion) can help address these challenges, plus offer a number of other benefits, by:

- Reducing downstream uncertainty in site-specific realization rates via early discussion between implementer and evaluator on baseline characterization
- Inspecting pre-retrofit conditions and characteristics that might not be accessible or recalled post-installation
- Educating the implementer about evaluation methods and savings considerations
- Reviewing the EM&V plan and making suggestions to gather desired data (for projects with implementer EM&V)
- Obtaining timely insights to customer motivations and decision making for NTG gross assessment

Custom projects, therefore, will increasingly have the option to be brought in as part of an ex-ante review, particularly for projects with significant savings and/or complex baselines. At the time of this SEP, this process is being piloted and the exact details of this process are still being developed, but the PAs expect that the exact steps and details of the ex-ante review will be more clearly documented prior to 2019. These details include:

- Establishing a method for selecting projects for ex-ante review
- Expediting the review process so as not to cause delays with implementation, as well as to minimize customer burden
- Determining which aspects of the ex-ante review process are binding during the ex-post evaluation process, and which are not
- Developing a method for ex-post evaluation to properly sample and weight projects that received ex-ante review, so as not to bias the final realization rates

4. REPORTING POLICIES

4.1 REPORTING GUIDELINES

As discussed in Section 1.4, EM&V must uphold the principles of being valuable, high quality, reasonable, and cost efficient. These principles must therefore be fundamentally evident in the work products of EM&V, namely the work plans, reports, and other written documentation that the EMC and its evaluation vendors produce during the planning, execution, and reporting of their research activities. EM&V reports should be transparent, concise, understandable, and actionable. EMC will work with evaluation consultants to establish specific guidelines for report length and format in order to meet these goals.

4.2 RECOMMENDATIONS GUIDELINES

Evaluation studies produce several types of results that are used to help estimate savings, suggest program improvements, and identify potential future research. Often these results are reported as three types: recommendations for PAs, policy recommendations, and considerations.

- Recommendations for PAs should serve one of three functions: 1) to clearly describe actionable steps that can be taken to improve programs based on strong evidence from the evaluation findings; 2) to update quantitative parameters used to estimate program savings; or 3) to improve program evaluability (e.g., by improving program tracking). Recommendations for PAs are high priority, actionable, and have the potential to have a large impact. Recommendations for PAs are used where there is some certainty that the recommended action will address the findings revealed in the report.
- Policy recommendations may be included in the evaluation report in a separate section; the EMC will not track status of their implementation. Policy recommendations should be addressed to the policy makers with the relevant authority for acting on the recommendation.
- Considerations should be used to document possible actions that could be taken to improve programs in cases where study findings are not as robust or do not clearly point to the needed course of action. Considerations often include multiple options for how to respond to report findings or lay out options for a longer-term plan of action than described in the recommendations. In addition, considerations may be used if more information is needed to develop a clear recommendation.

Historically there have not been guidelines for how and when evaluation contractors should develop recommendations. This lack of guidance has led in some cases to a large number of recommendations, some of which were not clear or actionable. The EMC therefore has defined expectations and guidelines for recommendations to ensure they service the functions described above and to clarify the difference between a recommendation and a consideration.

The EMC suggests that evaluation contractors use the following guidelines when developing recommendations.

- Recommendations should be based on strong factual evidence from the evaluation study report. Ideally, recommendations will draw from multiple sources of data when available. If a single source of data is the basis for a recommendation, it should be high-quality data. When crafting the recommendation, the evaluators should point to the specific finding(s) from which the recommendation stems. Not all findings in the report need to have a recommendation.
- Recommendations should be specific and actionable. Each recommendation should be clear about what problem it is seeking to solve or the parameter it will update. Recommendations focused on program improvement should also specify who should take what action to address what finding. If the suggested action is to keep the status quo, this decision should be categorized as a conclusion.
- Recommendations should have consequences. To the extent possible, each recommendation should specifically articulate what desired outcome would be achieved by acting on the recommendation, such as increasing program participation; increasing per-unit savings; or addressing a prominent program or Benefit Cost Ratio (BCR) gap, inconsistency, or discrepancy. The recommendation might also articulate what is at stake by not acting on the recommendation, such as a low realization rate, loss of customer participation, or a health/safety risk.
- Recommendations should be short and to the point. Recommendations should appear in the executive summary and should explicitly link the recommendation with the relevant study finding(s) or conclusion(s).

When an evaluation report produces an impact factor or other numerical value that is intended to be incorporated into the Technical Reference Library and/or BCR model, these values will be clearly summarized in the executive summary, and a recommendation describing the new values should be included in the list of recommendations.

These guidelines are intended to lead to recommendations that PAs can effectively implement to achieve meaningful program improvements. To the extent that potential recommendations do not meet these criteria, evaluators should consider alternative approaches to reporting the information. For example, evaluators may continue to use considerations in the report for potential actions that do not rise to the level of a recommendation, or in cases when it is not clear what course of action would best address a finding. Considerations should also be used to identify areas of potential future research, unless there is a gap in essential knowledge that must be addressed to improve the program or update a quantitative parameter, in which case undertaking the research could be considered a recommendation. Considerations will be presented to implementers alongside the recommendations but will not be tracked in the evaluation tracking spreadsheet.

In addition to developing sound recommendations, evaluation contractors will work with PA evaluation staff to communicate recommendations to program implementers before the evaluation report is finalized. This interaction will allow evaluation contractors to get feedback on the feasibility of implementing the recommendations and allow implementers to understand and ask questions about what the evaluators recommend. If an evaluation does not directly impact program implementers (e.g., it is an evaluation focused on evaluation methodologies), this step may be skipped.

The EMC currently works with the RMC and C&IMC to ensure that implementation of each recommendation is considered and will continue to do so. EMC will continue to track the status of all recommendations, specifically whether they have been implemented (and if not, why not), and will file this information with the Term Year Report. As is current practice, the EMC will ensure that an individual is assigned to track the status of each recommendation and follow up until it is clear whether the recommendation will be implemented (or if not, why not). The EMC will continue to review the status of recommendations under consideration on a quarterly basis at the Tri-Management Committee so that representatives from evaluation and implementation can jointly resolve the status of recommendations as needed.

4.3 REPORTING COLLABORATION WITH IMPLEMENTATION

While the avenues for communication described above for EM&V planning (see Section 3.8) will also be utilized for reporting (i.e., evaluators sharing results at RMC and C&IMC and inviting implementers to join evaluation meetings), evaluation recognizes that communication of results rests largely on individual PA preferences. Consequently, having standardized reporting venues alone may not be sufficient or timely enough for effectively communicating evaluation results, particularly if they are important and have significant impact on program savings and delivery. In addition, there are energy efficiency stakeholders, such as implementation vendors, who are involved in program execution and consequently need to be considered in the reporting phase but whose involvement in the planning phase is less crucial. For these reasons, EMC recognizes the need to provide additional pathways for communication during the reporting phase which include:

- Recurring or one-off, PA-specific meetings between evaluation and implementation to discuss research results and program implications
- Webinars presenting results and research implications to various parties who are not involved in research planning, which could include stakeholders such as the DPU and third-party implementation and/or engineering vendors

Further refinements and improvements to proposed processes will be made throughout the 2019–2021 EE Plan.

5. RESIDENTIAL RESEARCH AREA

5.1 SCOPE OF RESEARCH AREA

The Residential research area consists of four separate topic areas: Residential Retrofit and HVAC, Residential Retail Products, Residential New Construction, and Residential Behavior. The residential evaluation research area includes the following initiatives:

- Residential New Homes and Renovations
- Residential Coordinated Delivery
- Residential Retail
- Residential Behavior and Demand Management
- Income-Eligible Coordinated Delivery

The work in this research area is currently led by Navigant Consulting (Retrofit, HVAC, and Behavior) and the NMR Group, Inc. (Retail Products and New Construction). The Navigant evaluation contractor team also includes Cadeo and ILLUME Advising. The NMR Group, Inc. evaluation contractor team also includes DNV GL and Dorothy Conant.

The evaluation teams were selected through a competitively procured joint Request for Proposal (RFP) process conducted in the fall of 2015. The current Navigant and NMR teams have been awarded the contract through June 2019. Each research area and study has an assigned PA staff member and EM&V Consultant covering it.

This research area is currently led by a National Grid employee (i.e., the Research Area Lead).

5.2 RESEARCH COMPLETED DURING 2016–2018 PLAN

From 2016 to 2018, the PAs and EM&V Consultants supported over 50 residential evaluation studies in four major study types: impact evaluations, process evaluations, NTG evaluations, and market characterization (see below). In the residential sector, many evaluations include components of each of the four study types, as indicated below. These studies seek to quantify program impacts and provide focused, actionable recommendations to improve the performance and efficiency of residential programs.

1. Impact Evaluations

Impact evaluations provide an independent assessment of the energy savings achieved by a specific population of energy efficiency measures and provide recommendations focused on improving the program and the accuracy of its savings estimates. Eighteen residential impact evaluations were completed from 2016 to 2018[11] or are currently on-going (see list below). This work includes assessments of incremental costs, baselines, and impact factors such as realization rates, in-service rates, and hours of use.

1. Ductless Mini-Split Impact
2. Heat Pump Water Heater Impact
3. Home Energy Services (HES) Impact
4. Multifamily Lighting Impact (*includes NTG component*)
5. Mini-Split Heat Pump Incremental Cost
6. HVAC and Water Heating Incremental Cost
7. Single Family Code Compliance Baseline (*includes market characterization component*)
8. Massachusetts Multifamily High-Rise Baseline (*includes market characterization component*)

[11] Completed studies can be found at http://ma-eeac.org/studies/.

9. RNC/Code Compliant Support Initiative (CCSI) Attribution (*includes NTG component*)
10. Massachusetts RNC Incremental Cost
11. Lighting Hours of Use
12. Lighting Interactive Effects
13. Lighting Incremental Cost
14. Smart Power Strip Metering
15. Smart Power Strip Literature Review & Customer Survey (*includes process and NTG components*)
16. Assessment of Combined Behavior and Wi-Fi Thermostat Program (*includes process component*)
17. Appliance Recycling Impact Update[12]
18. Load Shape Model Update[13]

2. Process Evaluations

Process evaluations analyze information on a program's operations and, based on that analysis, identify practical approaches to improve the program in relation to program goals. Nine residential process evaluations were undertaken from 2016 to 2018 (see list below). This work included an expansion of a 2014 High Efficiency Heating Equipment Impact Evaluation to examine reasons why condensing boilers were not condensing and also studies that focused on HES and Low-Income programs and code compliance training.

1. Low-Income Program Process (*single and multifamily*)
2. Mini-Split Heat Pump Survey – Follow Up
3. Heating and Cooling Contractor Survey
4. Condensing Boiler Loss and Savings Potential
5. Condensing Heating Equipment Barriers
6. Multifamily Program Research (*includes impact component*)
7. HES Process Evaluation
8. CCSI Residential Training
9. Understanding the Role of Weather on Air Conditioning Use Behavior and DR Program Participation

3. NTG Evaluations

NTG evaluations estimate energy savings that are specifically attributable to the program under study. Six residential NTG evaluations were undertaken in this research area in the last term. Other NTG evaluations were conducted for residential programs under the SCC research area.

1. Early Retirement HVAC NTG – Heating and Cooling equipment
2. General Products Consumer NTG
3. Sales Data LED NTG Modeling – Lighting
4. Consensus NTG Study – Lighting
5. HES LED NTG Assessment

[12] As of August 1, 2018, not complete but expected to be so by October 1, 2018.

[13] As of August 1, 2018, not complete but expected to be so by October 1, 2018.

6. Products NTG Consensus[14]

4. Market Characterization

Market characterizations assess changes in market conditions for energy efficiency products and provide information to help PAs influence those markets to increase energy savings. Twenty-two residential market characterizations were undertaken in the last contract period, as follows.

1. Moderate Income Market Characterization
2. Heat Loan Analysis
3. Wi-Fi Thermostat Technology and Literature Review
4. Census of Multifamily Properties
5. HVAC Contractors Interviews *(includes process component)*
6. Residential Baseline Study *(includes impact component)*
7. Residential Single-Family Building Department Document Review
8. Stretch Code Market Effects Study
9. Single-Family Stretch Code Update Compliance and Potential
10. Massachusetts Mini-Baseline Study
11. Lighting Shelf Stocking
12. Lighting Supplier Interviews *(includes process and NTG components)*
13. Lighting Market Scans
14. Lighting On-Sites and Consumer Surveys *(includes process and NTG components)*
15. Lighting Sales Data Analysis
16. Lighting Logic and Market Model *(includes process component)*
17. Lighting Decision Making
18. Lighting Web Scraping *(includes impact component)*
19. Lighting Distribution Model
20. Lighting Market Adoption Models *(includes impact component)*
21. What's Next for Products
22. Census of Massachusetts Multifamily and Condo Properties[15]

5.3 NEAR-TERM PRIORITIES

In the residential research area, near-term priorities include multiple strategic considerations, as well as completing in-progress studies and beginning new research.

5.3.1 STRATEGIC PRIORITIES

Strategic priorities for the residential research area are listed below. Some of these are included in the in-progress studies and planned research in subsequent sections.

[14] As of August 1, 2018, not complete but expected to be so by October 1, 2018.

[15] As of August 1, 2018, not complete but expected to be so by October 1, 2018.

- Revisiting past impact evaluations to determine appropriate impact factors to apply to the new initiatives until impact evaluation on the new initiatives can be completed. Due to the new structure of the residential initiatives, there will need to be some focus on developing gross savings estimates and impact factors based on the updated design (e.g., single-family detached vs. high-rise multifamily vs. low-rise residential buildings, direct install vs. retail). Full impact evaluations will be a longer-term priority as new residential initiatives will need to operate for some time before undergoing evaluation, specific studies will be flagged where deeper evaluations are needed. An ongoing quick hit study will develop savings and impact factors for use in the 2019–2021 planning estimates.
- Conducting process evaluations of the new initiatives to measure if the objectives of the new program design are being achieved and provide recommendations to improve the program design and performance (see Planned Research and Stage One plans for more information).
- Developing a better understanding of the characteristics of non-participants and what would motivate them to participate. This should be a broad view of non-participants and could include housing type, geography, income level, etc. It could also include a look at which messages, means of communication, and incentives might resonate with these customers (see Planned Research and Stage One plans for more information).
- Understanding how evaluation can help with upcoming lighting transitions, determination of sunset years, differences between upstream and downstream lighting programs, and opportunities for lighting controls (see Planned Research and Stage One plans for more information).
- Understanding where product baselines may be needed and maximizing the opportunities in the current baseline study (see Planned Research regrading mini-split heat pumps and Longer-Term Priorities).
- Considering programs where market effects could and should be tracked, starting early in the lifecycle process. Residential research area will continue to work with the program staff to define program theories/logic models and identify where data can be collected.
- Considering new construction evaluation needs, including net-zero energy building practices, baseline measurement, multifamily, and renovation opportunities (see Planned Research and Stage One plans for more information).
- Increasing consistency with the C&I research area in terms of approach to baselines, where relevant. The residential research area will define where additional consistency is needed and then develop a plan for how to move forward in the 2019–2021 term (see Planned Research in the SCC research area for more information).
- Continuing to develop estimates of demand savings, including the timing of the savings (i.e., load shapes).
- Energy optimization may become additionally important, and the residential research area will continue to watch this issue and create a plan for research or research policies to address it.

5.3.2 IN-PROGRESS RESEARCH

The residential research area has 10 studies in progress, many of which are expected to continue beyond the final plan filing and, in some cases, into 2019. These studies include:

1. Massachusetts RNC Home Automation Demonstration
2. Renovation/Addition Market Characterization
3. Lighting Market Scan
4. Lighting On-Sites
5. Lighting Sales Data
6. Smart Thermostat Impact Study
7. Energy Optimization

8. Program Design Evaluation and Research Support
9. Residential Baseline Study Phase 3: Panel Study
10. Assessment of Combined Behavior and Wi-Fi Thermostat Program: Phase 1

5.3.3 PLANNED RESEARCH

Based on the process described in Section 3.3.3, the residential research area team developed a list of study ideas, rated the study ideas, and decided on which studies would proceed to Stage One Plans. The team decided to recommend the following nine studies to begin in early 2019 (see Appendix A for full Stage One plans).

- **RNC Passive House Design Assessment**. The overall goal of this study is to verify savings methodologies being used for passive house design projects. While there are existing energy modeling platforms, both in the form of existing implementation tools and tools specific to passive design, these may require adjustments or adaptations to reflect the specifics of program design, climate, and materials in Massachusetts.
- **Low-Rise Measure Review**. This research will determine the appropriate gross and net savings for measures installed in low-rise multifamily homes through the Residential Coordinated Delivery (RCD) initiative. These gross and net savings may already exist (i.e., the PAs can readily apply current single family or multifamily estimates) or require additional calculation, likely by adjusting one or more impact factors (e.g., hours of use, installation rates, baseline conditions) associating the existing estimates to more accurately reflect low-rise building installations.
- **Non-Participant Research**. The objective of this study is to better understand the residential customers that, to date, have not participated in Massachusetts Mass Save programs with the end goal of informing strategies to reach and engage these nonparticipants. The study will use multiple and potentially non-traditional research approaches to more deeply understand barriers to participation as well as identify segments where these barriers are most prevalent. Segments may include the traditional harder-to-serve markets of interest (e.g., low income, moderate income, renters); however, the study will broadly assess the market with an eye to identifying characteristics of customers who have not participated.
- **Mini-Split Heat Pump Process and Market Optimization Study**. The goal of this study is to conduct a comprehensive review of Mini-Split Heat Pump (MSHP) measures by examining how residents use this technology, customer satisfaction, and (if applicable) assessing if the PAs are meeting objectives for energy optimization opportunities with MSHP installations. The focus is primarily on multifamily program participants, including both low income and market rate customers. The study can be expanded as desired to update previous MSHP studies for single family program participants.
- **New Initiative Process Evaluations and Research**. To support the PAs' continued improvement efforts, as well as provide program design and implementation guidance, the evaluation will conduct process evaluations of and/or provide evaluation or research support for these new initiatives. The activities can take a variety of forms, ranging from quick-hit research addressing targeted process questions to comprehensive, full-program process evaluations, assessing the efficacy of the program as a whole, across all market actors and programmatic elements. Further, these activities may take place across the lifecycle of the 2019–2021 program offerings, starting with early research and evaluation services, possibly leveraging the real-time survey approach discussed below.
- **Lighting Sales Data Analysis**. The study will analyze data purchased from the Consortium for Residential Energy Efficiency Data's (CREED's) LightTracker Initiative and describe bulb sales, market shares, and prices for LEDs, compact fluorescent lamps (CFLs), halogens, and incandescents. Evaluators will compare data for Massachusetts to those for other program areas, non-program areas, and the nation. The study will report results broken down by various categories, dependent on data availability and program evaluation needs.

- **Residential Real-Time Participant Surveys**. The overall goal is to provide program administrators with actionable feedback on program processes on a timely basis to enable continuous improvement. The fast feedback survey approach collects valuable information on participant satisfaction, areas for improvement, and free-ridership in close to real time, which helps to avoid recall issues and increase survey response rates relative to less frequent evaluation surveys.
- **Workforce Retention and Recruitment for Residential Programs**. The objective of this study is to ensure workforce retention and recruitment for Massachusetts Residential Energy Efficiency programs are sufficient given the expected program design and scale changes for the 2019–2021 planning period. With the upcoming changes to program implementation and potential expansion to the weatherization workforce, the PAs would like to identify areas that could be impacted and potentially adjusted due to the higher demands of the program. Such areas to review include the current trainings offered to the workforce and if these will meet the expected demand or if additional trainings are required.
- **Decision-Maker Targeting Study**. This research will determine how the PAs can more effectively identify, market to, and engage landlords and property managers, as well as any other harder-to-reach decision-makers, in the PAs' suite of residential energy efficiency initiatives. The research will also identify the drivers of participation for these decision-makers and the delivery design structure, measure mix, and incentive levels that will result in greater participation in the PAs' initiatives.

5.4 LONGER-TERM PRIORITIES

In addition to the near-term priorities listed above, the residential research area has the following longer-term priorities. These are expected to become relevant during the 2019–2021 EE Plan, but do not require a Stage One plan at this time.

- **Connected Lighting**. Determine whether there is a future for connected lighting programs.
- **Creation and Use of Aggregate Multifamily Accounts.** Establish whole building aggregate account totals for all of the multifamily properties identified in the Census study.
- **Characterization of EE/DR Storage Ability**. Assess the electricity-equivalent capacity of various "thermal batteries" using smart controls to load shift using smart thermostats and smart water heaters.
- **New Construction**. Determine the value of energy efficiency on the sale of homes as well as the value of labeling.
- **Thermostats**. Based on findings of 2018 thermostat study, evaluate (if necessary) the variation in demand and energy savings by manufacturer.
- **RCD Initiative**. Determine the effectiveness of new customer intake and online assessment/triage process.
- **Appliance Recycling**. If appliance recycling programs continue, review (if necessary) the database and update savings and other inputs.
- **Behavior**. Determine the drivers of behavior savings (e.g., what actions are taken or measures installed) and how behavior programs interact with rebate/traditional programs.
- **Insulation and Air Sealing**. Assess impact of potential program design changes.
- **Exploration of Opportunities**. Explore potential new measures and/or services to offer, including emerging technologies (ensuring no overlap with the Tech Demo group), electric vehicles, and new delivery mechanisms. Where relevant, priorities will be noted if they vary by electric and gas measures.
- **Maximization of Residential Baseline Study and Residential Profile Studies**. Determine what information can be gained and applied to update the current savings values using the residential baseline study. Determine how residential profile study can be utilized to improve evaluation or programs in the future.
- **Residential Retail Initiative**. Determine which equipment types are best suited for midstream delivery model and how to mitigate free-ridership. Ensure that customer information is accurately collected.

- **RNC Home Automation**. Conduct an impact analysis of savings from full deployment of home automation offering.
- **QA/QC**. Understand the purposes, activities and costs of QA/QC to see if a) additional improvements should be made, b) improvements can be leveraged for evaluation purposes, and c) additional research is needed.

6. C&I RESEARCH AREA

6.1 SCOPE OF RESEARCH AREA

This research area consists of four separate topic areas: Impact, Process, NTG, and Market Characterization. The C&I evaluation research area includes the following initiatives:

- C&I New Buildings and Major Renovations
- C&I Existing Buildings Retrofit
- C&I New and Replacement Equipment
- Active Demand[16]

The evaluation teams were selected through a competitively procured joint RFP process conducted in early 2018. The bid process and contract negotiations were completed in July 2018, and the new contract will run through 2021. Three contractor teams were selected and assigned to research areas as follows:

- Impact / NTG Evaluation - DNV GL Team (ERS, NMR, DMI, Dunsky)
- Market Assessment Evaluation - DNV GL Team (ERS, NMR, EMI, Dunsky) & Cadeo Team (Navigant)
- Process Evaluation - NMR Team (EMI, Dunsky)

Each research area and study have an assigned PA staff member and EM&V Consultant covering them.

This research area is currently led by an Eversource employee.

6.2 RESEARCH COMPLETED DURING 2016–2018 PLAN

Since 2016, the EMC has supported approximately 30 C&I evaluation studies in four major research areas: impact evaluations, process evaluations, NTG evaluations, and market characterizations (see below).

1. Impact Evaluations

Impact evaluations provide an independent assessment of the energy savings achieved by a specific population of energy efficiency measures and provide recommendations focused on improving the program and the accuracy of its savings estimates. Ten impact evaluations were recently completed (see list below). This work includes assessments of operating characteristics, including, but not limited to, baselines, hours of use, and in-service rates. These inputs are generally captured and/or reported as realization rates. While all of the studies below pertain to impact work, not all produced impact factors. For instance, some of these were scoped for purposes of policy development related to impact work.

[16] Active Demand evaluation studies are included in the SCC research area.

1. Impact Evaluation of 2013 Prescriptive Gas Installations (Steam Traps and Programmable Thermostats)
2. Custom Process Impact Evaluation
3. Impact Evaluation of Upstream Lighting Initiative
4. Prescriptive/Custom Gas Steam Trap Measure Phase II Evaluation
5. Refinements of Gross Impact Evaluation Framework
6. Articulating Baseline Policy and Practice
7. Custom Comprehensive Design Approach Gas and Electric Evaluation[17]
8. Small Business Impact Evaluation
9. Prescriptive C&I Loadshape of Savings Study
10. Impact Evaluation of Custom Gas Installations[18]

2. Process Evaluations

Process evaluations analyze information on a program's operations and, on the basis of that analysis, identify practical approaches to improve that program in relation to program goals. Two C&I process evaluations were undertaken and completed in the last contract period (see list below). While work in this segment was relatively scarce during 2016–2018, it was somewhat intentional as stakeholders worked through considerations of a more standardized approach to process evaluation planning.

1. Process Evaluation of Upstream HVAC Initiative
2. Combined Heat and Power (CHP) Process Evaluation

3. NTG Evaluations

NTG evaluations estimate energy savings that are specifically attributable to the program under study. Although some NTG evaluations were conducted for C&I programs under the SCC research area, two C&I NTG evaluations were undertaken and completed in this research area in the last term.

1. Drivers of NTG
2. Upstream LED NTG Analysis

4. Market Characterization

Market characterizations assess changes in market conditions for energy efficiency products and provide information to help PAs influence those markets to increase energy savings. Thirteen C&I market characterizations were undertaken and completed in the last contract period (see list below).

1. Existing Buildings Market Characterization: C&I Customer On-Site Assessments
2. Phase II: Gas Boiler Market Characterization
3. Existing Buildings Market Characterization: Market Share and Sales Trend Study
4. 2015 PA Differences Evaluation
5. 2016 PA Differences Evaluation

[17] As of August 1, 2018, not complete but expected to be complete by October 1, 2018.

[18] As of August 1, 2018, not complete but expected to be complete by October 1, 2018.

6. Upstream HVAC Distributor Data Collection
7. Assessment of the Share of Incentivized High Efficiency Equipment
8. Enhanced Customer-Level Database Capabilities Evaluation
9. 2011–2016 C&I Mid-Sized Customer Needs Assessment
10. C&I Code Compliance Follow-Up Study
11. 2016 C&I Customer Profile Study and Associated Deep Dives (Advanced Lighting, HVAC)
12. LED Market Monitor Study
13. C&I Injection Molding Machine Market Assessment Baseline Study

6.3 NEAR-TERM PRIORITIES

In the C&I research area, near-term priorities include multiple strategic considerations, as well as completing in-progress studies and beginning new research.

6.3.1 STRATEGIC PRIORITIES

The following represent strategic priorities for the C&I research area. Some of these priorities may be addressed in the in-progress studies and planned research in subsequent sections.

- Systematic approach to study planning, including the use of screening tool and process to vet ideas prior to studies moving forward, consistent with the prioritization framework in Section 3.3.
- Consideration of specific market sectors with rapidly shifting baselines warranting further research, as well as sectors that stakeholders need to understand better (see Planned Research and Stage One plans for more information).
- For baseline analyses, determination of when and for how long ISPs should be applied, key factors triggering ISP/baseline research, defining what constitutes unique vs. non-unique measures, and increasing coordination between evaluation and other stakeholders on ISP/baseline research and implementation in program assumptions. Establishing standardized approach to how baselines are incorporated into realization rates and other impact factors (e.g., NTG) with consideration of issues such as sampling, baselines, and changes over time.
- Further examination and vetting of measure lives for program offerings (see Planned Research and Stage One plans for more information).
- Improved coordination on all evaluation activities and results with external stakeholders.
- Establishing process/policy guidelines for rolling evaluation (see Planned Research and Stage One plans for more information).
- Continued investigation of successful methods to evaluate HVAC control savings (see In-Progress Research).
- Impact evaluation of CHP with special consideration of the effects CHP has on underlying customer usage and any subsequent electric efficiency measures installed.
- Process evaluation to develop a more performance-based approach for evaluating C&I new construction, with whole building energy use intensity (or similar) as a metric and basis for incentives, and with consideration for a framework to yield and claim market effects in the future.

6.3.2 IN-PROGRESS RESEARCH

The C&I research area has nine studies in progress, many of which are expected to continue beyond the final plan filing and, in some cases, into 2019. These studies include:

1. Baseline Transition Planning
2. Impact Framework Transition
3. C&I Lighting Inventory
4. Process Evaluation of C&I Upstream Lighting Initiative
5. Upstream Water Heater Deemed Savings Impact Evaluation
6. Impact Evaluation of Custom Electric Installations
7. Lighting & Controls Market Effects Study
8. Lighting Hours of Use Meta-Study
9. Method Development of Controls Measures

6.3.3 PLANNED RESEARCH

Based on the process described in Section 3.3.3the C&I research area team developed a list of study ideas, rated the study ideas, and decided on which studies would proceed to Stage One Plans. The team decided to recommend the following 12 study ideas for near term research (see Appendix B for full C&I Stage One plans).

- **Rolling Impact Studies.** Updated realization rates with consideration of ISP recommendations and other program changes. Expected in 2019, 2020 and 2021. These studies include:
    - **Impact Evaluation of 2018/2019 Upstream Lighting.** The objective of this impact evaluation is to provide verification or re-estimation of electric energy and summer/winter peak demand savings estimates for a sample of upstream lighting projects through site-specific inspection, monitoring, and analysis. The results of this study will be used to determine the impact savings factors that will be applied to upstream lighting purchases in 2018. Savings factors of interest in 2018 include the installation rate and possibly the delta watts.
    - **Impact Evaluation of 2017 Custom Gas Installations.** The objective of this impact evaluation is to provide verification or re-estimation of natural gas energy savings estimates for a sample of custom gas projects through site-specific inspection, monitoring, and analysis. The results of this study will be used to determine the final realization rates for custom gas energy efficiency offerings installed in 2019. Realization rates will be separately determined for Columbia Gas, National Grid, and Eversource, as well as at the statewide level.
    - **Impact Evaluation of 2017 Custom Electric Installations.** The objective of this impact evaluation is to provide verification or re-estimation of electric energy and summer/winter peak demand savings estimates for a sample of custom electric projects through site-specific inspection, monitoring, and analysis. The results of this study will be used to determine the final realization rates for custom electric energy efficiency offerings installed in 2019. Realization rates will be separately determined for National Grid and Eversource, as well as at the statewide level.
    - **Impact Evaluation of 2017 Small Business Electric Installations.** The objective of this impact evaluation is to provide verification or re-estimation of electric energy and summer/winter peak demand savings estimates for a sample of small business non-lighting electric projects through site-specific inspection, monitoring, and analysis. The results of this study will be used to determine the final realization rates for small business, non-lighting electric energy efficiency offerings installed in 2019. Results will be determined at the overall statewide level.
- **Incremental Costs.** Measure installation costs are incorporated in benefit-cost tests used to screen measures and programs. The evaluation team will investigate and identify alternate approaches to account for cost associated with dual-baseline energy efficiency measures which may be easier to implement consistently in C&I. As a second part of this scope, the DNV GL team will research select measures to determine full installed

or incremental costs as appropriate.

- **C&I Measure Life Study.** The purpose of this study is to provide the EMC with up-to-date evidence that can inform Estimated Useful Lives (EULs) and Remaining Useful Lives (RULs) for key C&I energy efficiency measures. This study will build upon the work already completed by Project 73, Track D: Measure Life Methods and will include both primary and secondary research.
- **Evaluation Participation Improvement.** The goal of this study is to provide strategies on how to improve the participation of C&I customers in evaluation studies.
- **Evaluation of Integrated Lighting Controls.** The goal of this study is to characterize the current state and trajectory of the market for integrated lighting controls, from both supply and customer perspectives. This is a nascent technology with potential savings in the near term. Results from this study will support program design, establish a market baseline, contribute to gross savings baseline specifications, and indicate current free-ridership rates.
- **Impact Evaluation of Prescriptive Installations.** The objective of this impact evaluation is to provide verification or re-estimation of electric energy and demand and/or natural gas savings estimates for a subset of Prescriptive projects through site-specific inspection, monitoring, and analysis. The results of this study will be used to determine new deemed savings values and/or savings parameters for selected Prescriptive energy efficiency offerings installed in 2017. Evaluation results will be determined at the statewide level.
- **Ongoing Updates to LED Market Adoption Model.** This effort will provide updates to the C&I LED adoption model using available data on the rapidly changing C&I lighting market. Beyond incorporating updated market information, the evaluation team will also add additional model functionality and increase the diversity of lighting technologies included in the model.
- **C&I Baseline Saturation Study. On-site Inventory Assessment.** The C&I baseline study update will compile a detailed inventory of electric and gas measures. The study will assess the baseline efficiency for measures, identify the penetration of energy efficiency measures within customer business types, and analyze trends in sales data. The study will identify the measures and business types that offer the greatest opportunities to capture efficiency improvements.
- **Ongoing C&I Industry Standard Practice Research & Repository.** The primary objective of this study includes: a) Repository upkeep, which includes a formal roll-out of the Baseline Repository with educational outreach to potential stakeholders, incorporation of new data, and further refinement of procedures, and b) ISP research for measures prioritized in the initial populating of the Baseline Repository. The scope of work of the Repository is to determine if secondary ISP research exists for the candidate. After the secondary research is completed, measures will be prioritized for ISP research. This scope of work is intended to conduct the research for select prioritized measures.

6.4 LONGER-TERM PRIORITIES

In addition to the near-term priorities listed above, the C&I research area has the following longer-term priorities. These priorities are expected to become relevant during the 2019–2021 Plan but do not require a Stage One plan at this time.

- **Non-Capital Measure Research.** Determination of savings for non-capital measures and how should they be evaluated.
- **Market Regression.** Determination of whether markets have regressed after PAs pull out of a market.
- **NRNC Market Baseline Study.** Assessment of current baseline conditions in the Non-Residential New Construction (NRNC) market.

- **HVAC Market Characterization.** Determination of how PAs better engage with this market to achieve savings in small and large HVAC opportunities.
- **M&V 2.0.** Consideration of where M&V 2.0 concepts would be applicable, benefits/limitations, etc.
- **Demand response (DR).** Although demand response currently resides in SCC, demand studies may become more important in the future and require C&I research area effort.
- **Future Savings Opportunities.** Investigation of potential sources of future program savings due to factors such as new product offerings, gaps in program strategy, or generally low market penetration.
- **Customer Understanding.** Additional understanding of customer characteristics, customer barriers, customer decision making, and customer engagement to improve program execution and the customer experience.
- **Upstream Measures.** Additional understanding of the importance of upstream measures for the 2019–2021 EE Plan and assurance that EM&V methodologies and data collection protocols are defined.

7. SPECIAL AND CROSS-CUTTING (SCC) RESEARCH AREA

7.1 SCOPE OF RESEARCH AREA

The SCC research area covers topics that do not fit cleanly into either the Residential or C&I research areas, as well as additional specialized topics in which it is particularly important to ensure consistency across research areas and markets. Topics within this research area include, but are not limited to:

- Codes and Standards
- Community Mobilization Initiatives, Education, and Training
- Market Effects
- Top-Down Modeling
- Net-to-Gross (NTG)
- Non-Energy Impacts (NEIs)
- Program and Portfolio Marketing
- Customer Profile Report
- Demand Response (DR)
- Additional Work

For each cross-cutting topic area, specific planning strategies may vary. A brief overview of the current strategy for each topic area follows.

- **Codes and Standards.** The Code Compliance Support Initiative (CCSI) evaluation seeks to measure net savings attributable to the CCSI for improving code compliance in Massachusetts through various avenues over the long term, and also to gather supporting evidence for those savings. Evaluation activities include implementing immediate surveys after each classroom training and reporting the findings at the end of the contract period, implementing follow-up interviews with training attendees, examining building code compliance documents, and estimating the number of Massachusetts code officials who have attended different types of trainings as a share of the population.
- **Community Mobilization Initiatives, Education, and Training.** For these topic areas, process and impact evaluations are performed as appropriate based on the defined goals of each delivery model and the planning principles discussed above. Each new in-field effort is reviewed to determine whether a specific evaluation of the

effort should occur. Evaluation efforts focus on new or changing delivery models rather than established models, but all efforts are periodically reviewed.

- **Market Effects.** Market effects studies seek to measure long-term structural changes in a market that are caused by energy efficiency programs and lead to increased adoption of energy efficient products, services, or practices. Examples of market effects include increased availability of efficient technologies produced by manufacturers and/or sold through retail channels, reduced prices for efficient models, and increased market share of efficient equipment. Market effects are closely related to spillover but may go beyond what is typically counted as spillover as part of NTG studies. Evaluation efforts will focus on quantifying market effects for selected PA programs/initiatives that are expected to influence a target market. Specific activities may include market characterization and baseline studies, assistance in documenting program theory and identifying market effects indicators, gathering and analyzing market share data, cross sectional analysis, historical tracing or other theory-based evaluation, and structured expert judgment.
- **Top-Down Modeling.** Top-down modeling techniques use an econometric approach to estimate program impacts across all energy efficiency programs in a given geographical region or service territory. Top-down approaches use regression models to measure changes in energy consumption over time that are attributable to programmatic interventions by the PAs. In theory, top-down methods are capable of capturing the full portfolio-level effect, including free-ridership, spillover, market effects, and snapback across multiple programs. By nature, top-down methods cannot measure savings due to individual programs and are intended to complement, but not replace, traditional bottom-up evaluation methods which quantify savings for specific programs, initiatives, and energy efficiency measures. To date, evaluators in Massachusetts have explored top-down approaches but initial findings were very imprecise. PAs will track data that could be used for top-down methods in the future and will reconsider whether top-down analysis would add valuable insight to bottom-up evaluation during the 2019–2021 term.
- **Net-to-Gross (NTG).** NTG studies estimate the share of savings that are attributable to a program, accounting for free-riders and spillover. Free-riders refers to program participants who receive program incentives but who would have adopted the energy efficient product or service even without the program intervention. Spillover refers to the energy savings that occurs because of the influence of an energy efficiency program, but without direct financial or technical assistance from the program. NTG studies often rely on self-report methods, where evaluators survey program participants, non-participants, and/or market actors, to understand the influence of the program on their decisions regarding energy efficiency. Going forward, this topic area will continue to develop updated NTG research as needed, with attention to improving and simplifying NTG methods where possible. In addition, this research will consider complex customer decisions (e.g., early retirement of equipment and fuel optimization), interactions with ISP baselines, and integration with market effects research. It will re-examine the most appropriate approaches for estimating NTG under different circumstances and with different types of customers/program models. This research will be used not only to ensure that net savings claimed are appropriate, but also to provide feedback to program implementation teams about how to adapt program design to minimize free-ridership and maximize spillover.
- **Non-Energy Impacts (NEIs).** NEIs include effects beyond energy savings that are attributable to energy efficiency programs. Examples of NEIs include reduced labor or non-labor O&M costs and improved occupant health and safety. The goal of NEI studies is to provide guidance to the EMC by quantifying participant NEIs associated with various measures through residential programs. Similar to NTG, initial work in the NEI area focused on developing methods for quantifying NEIs attributable to the PA programs. Current research in this area continues to quantify appropriate NEIs for the Multifamily and Low-Income programs. This topic area also examines additional NEIs that may be appropriate to either study for the first time or further update and/or refine.
- **Program and Portfolio Marketing.** Currently, this area focuses on determining the effectiveness of each statewide marketing campaign. Each year, a post-survey has been completed to measure the impact of the campaign in

raising brand and program awareness. Additional work will measure brand effectiveness, as well as support marketing efforts with specific smaller scale evaluations as necessary.

- **Customer Profile Report.** The Customer Profile Report serves as the vehicle to aggregate and summarize the account- and project-level details contained in the PAs' evaluation database. The Customer Profile report allows the PAs to evaluate how their standardized data compares to other PAs' standardized data and to data for the state as a whole. The C&I Customer Profile report has been completed on an annual basis since 2012, and the Residential Custom Profile study has been completed on an annual basis since 2015. Each year presents an analysis of Massachusetts PAs' billing and tracking data, which allows the EMC to accurately quantify and report on trends and time series evolution in the Massachusetts landscape. The reports also develop narratives about these trends and their implications for a variety of stakeholder interests and help to formulate testable hypotheses for future process, market, and impact assessment studies.
- **Demand Response (DR)**. DR is a relatively new area of focus for the PAs and, while it is within the statewide EM&V framework, current programming efforts are focused mainly on individual PA demonstrations, so each of the studies to date have been mainly PA-specific. EM&V efforts are focused on supporting program development and working with the DR EM&V subcommittee to ensure that findings are shared. In the next program cycle, it is possible there will be more statewide programs, in which case EM&V efforts will more likely resemble current statewide energy efficiency efforts. The PAs continue to explore new demonstration offerings to determine if DR should be implemented on a statewide scale, as a full program, or as an element within a program. These demonstration projects are being deployed to assess new technologies and strategies, with PAs using the evaluation findings to improve upon their existing program offerings. The current approach of focusing on broad "umbrella" programs creates the opportunity to refine efforts quickly based on the lessons learned during the demonstration project.
- **Additional Work.** Work in SCC may cross multiple topics to identify overarching market trends and consumer behavior. Some additional cross-cutting work is typically developed on a short turnaround, ad hoc basis. This work may include literature reviews or surveys of programs in other jurisdictions and other smaller -scale work designed to inform implementation efforts or program strategy.

Top-down modeling, market effects, NTG, and Codes and Standards topic areas are all interrelated. In theory, the top-down evaluation area describes the net effect of all the PA programs and efforts on changes in total energy consumption. However, the underlying drivers of these net savings are better understood by using other methods to estimate net savings. These methods include participant NTG surveys, estimation of market effects, and estimation of savings attributable to codes and standards support. Taken together, these four topic areas identify program-driven savings in programs and markets in areas that overlap and provide different explanations for the net savings.

In addition to the topics and strategies discussed above, another priority of this research area is to retain the flexibility to respond to new efforts in the field to provide appropriate and timely evaluation support.

Currently, SCC research is served by six different EM&V contracting teams. The evaluation teams were selected through a competitively procured joint RFP process conducted in 2016. The term for this contract will end mid-2020. The research areas and contracting teams are outlined below.

- NTG, Market Effects, Top-Down Modeling, Codes and Standards, and NEIs
    - Prime Contractor: NMR Group, Inc
    - Subcontractor: DNV GL, Tetra Tech, Three[3], The Cadmus Group, EcoMetric, and RMS
- Education, Training, and Community Mobilization Initiatives
    - Prime Contractor: Opinion Dynamics
- Program and Portfolio Marketing

  - Prime Contractor: ILLUME Advising, LLC
  - Subcontractor: Diddio and Grounded Research
- Demand Reduction and Mitigation Strategy – Residential and Small C&I
  - Prime Contractor: Navigant Consulting
- Demand Reduction and Mitigation Strategy – C&I
  - Prime Contractor: Energy and Resource Solutions, Inc.
  - Subcontractor: DNV GL

A representative of Cape Light Compact JPE is currently the statewide research area manager.

7.2 RESEARCH COMPLETED DURING 2016–2018 PLAN

Since 2016, the following 18 studies have been supported in the areas of top-down, market effects, NTG, and Codes and Standards.

1. Top-Down Modeling Extended Methods Review
2. NTG Methodology Research
3. CCSI Evaluation of Classroom Trainings
4. CCSI Commercial Code Compliance Documentation Assessment
5. C&I New Construction CCSI Attribution
6. RNC CCSI Attribution
7. Stretch Code Market Effects Study
8. Results of Spring 2016 HVAC Manufacturer Panel Maintenance and Pilot Data
9. Lighting Distribution Modeling
10. Community -Based Program Design Effectiveness
11. Education Kits Program Deemed Savings Review Results
12. C&I Upstream HVAC Heat Pump Program NTG and Market Effects Study (includes market effects components)
13. Summary of Findings from Winter 2017 HVAC Manufacturer Panel Interviews
14. Status and Directions for Top -Down Work
15. 2017 Seasonal Savings Evaluation
16. Process evaluation of Education Kits Program
17. Non-Residential New Construction Market Effects
18. C&I NTG Surveys

Of the five NEI studies below, four have been completed while the Low-Income Multifamily Health and Safety NEI study is still in progress.

1. Low-Income Single-Family Health- and Safety-Related NEI
2. NEI Framework
3. Low-Income Multi-Family Health and Safety NEI
4. Market-Rate Multifamily NEI – Phase 1
5. NEI Reference Table

The Program and Portfolio Marketing area has completed several research activities to evaluate the statewide marketing of energy efficiency programs since 2016. The primary evaluation activity was a series of tracking surveys with residential and commercial customers. The surveys measured customer awareness, knowledge, and associations with the Mass Save brand

and the effectiveness of marketing activities. In 2017, the Massachusetts energy efficiency PAs implemented the seventh year of a statewide marketing campaign, under the trademark of Mass Save®. During this planning period, two studies have been completed.

1. 2016 Massachusetts Statewide Marketing Campaign: Post Campaign Report
2. 2017 Massachusetts Statewide Marketing Campaign: Post Campaign Report

The following three Customer Profile studies below have been completed.

1. 2015 C&I Customer Profile
2. 2016 C&I Customer Profile
3. 2013–2015 Residential Customer Profile

Three DR studies have been completed from 2016 to 2018.

1. Evaluation Report for Cape Light Compacts 2016 DR Demonstration Offering
2. 2016 National Grid Residential Wi-Fi Thermostat DR Evaluation
3. 2017 National Grid Residential Wi-Fi Thermostat DR Evaluation

7.3 NEAR-TERM PRIORITIES

In the SCC research area, near-term priorities include multiple strategic considerations, as well as completing in-progress studies and beginning new research.

7.3.1 STRATEGIC PRIORITIES

The following represent strategic priorities for the SCC research areas. Some of these are included in the in-progress studies and planned research in subsequent sections.

Non-Energy Impacts (NEIs). The EMC is working toward understanding how to best communicate and market NEIs. For the upcoming term the SCC research area will research NEIs when and where appropriate. The EMC will continue to assess the existing gaps in NEI research and NEIs resulting from changes to programs and measures, and how those measures interact with program participants' costs and revenues.

Program and Portfolio Marketing. The EMC plans to continue efforts assessing Mass Save brand awareness and whether the awareness has changed due to campaign changes and whether it impacts program participation.

- The 2019 study will help in understanding the success indicators for Mass Save energy efficiency marketing efforts as well as how the customers view Mass Save and who sponsors it, customers' perception of the redesigned website, and recommendations on how marketing can motivate customers to participate in Mass Save programs (see Planned Research and Stage One plan for more information).

NTG and Market Effects. The SCC research area will continue to develop updated NTG research as needed, with attention to improving and simplifying NTG methods where possible. This may include developing NTG methods that go beyond self-report surveys, as well as NTG methods that consider the long-term effects of programs that have repeated interactions over time and PAs that build long-term relationships with customers. In addition, this research will include identifying issues

and factors to consider in assessing attribution and estimating NTG in cases of Energy Optimization to help evaluators and PAs prepare for a possible policy change that would allow PAs to claim savings from Energy Optimization.

The SCC research area will continue to focus on market effects from the perspective of understanding the areas that need quantification, and, more broadly, how program efforts influence the adoption of new technologies both inside and outside the program. The EMC will collaborate with implementation to define market theories and logic models early in program lifecycle and work to ensure EM&V data is collected during program implementation. Implementation and strategy staff are increasingly looking at which markets they should purposefully try to change and which should be addressed through a standard-rebate-offer type of approach. To support this effort, evaluation will prepare a document for C&I Implementation to clarify how we will gather baseline data, measure prospective market effects, and lay the groundwork for claiming savings from market effects.

Other specific priorities include:

- Understanding how to use findings from NTG and market effects studies for program planning and design.
- Understanding how baseline levels of efficiency of energy-using equipment affect NTG and market effects, how non-energy efficiency market trends affect baselines, and whether upstream impacts should be measured comprehensively.
- Assessing the degree to which more consistent methodologies should be developed for self-reported residential NTG and algorithms/methods specific to Massachusetts. In an effort to do this we will identify the range of program delivery approaches and situations that methods should cover and identify situations to address, such as early replacement and real-time data collection. (see Planned Research and Stage One plan for more information).

Codes and Standards. The following represents the SCC priorities in codes and standards:

- Evaluate PA influence in advancing state and/or federal standards for high -efficiency equipment, and develop a savings attribution model.
- Determine program viability and evaluability.
- Determine opportunity for Regional Collaboration Effort to spread the cost.
- Determine potential for education opportunities via baseline studies for awareness and changes.

Customer Profile Studies

The PAs are committed to continuing with the Residential and C&I Customer Profile Studies. In an effort to have the most current data available, the evaluation team will continue to work towards accelerating completion of these studies.

In addition, over time, program implementers have turned increasingly to integrated-programming efforts that are not specific to either customer sector. Examples include community-based programs, umbrella marketing, and integrating behavioral aspects into existing programs. The SCC research area has been the focal point for evaluation of these efforts. The PAs anticipate leveraging research in the SCC area to help increase program effectiveness and meet aggressive savings goals.

7.3.2 IN-PROGRESS RESEARCH

The SCC research area has four studies in progress, some of which are expected to continue beyond the final plan filing and, in some cases, into 2019. These studies include:

1. Initial Considerations for Attribution/NTG Estimation for Energy Optimization
2. Process Assessment for the Cross-Cutting Code Compliance Support Initiative Evaluation

3. Residential HVAC Market Share Estimates
4. Immediate Surveys for the CCSI Evaluation 2018

7.3.3 PLANNED RESEARCH

Based on the process described in Section 3.2 the SCC research area team developed a list of study ideas, rated the study ideas and decided on which studies would proceed to Stage One Plans. The team decided to recommend the following five studies to begin in early 2019 (see Appendix C for full Stage One plans).

- **Continuation of CCSI Immediate Surveys & Follow-Up Interviews.** This research will: a) continue to document the effects of CCSI trainings and other efforts for use in the attribution process for residential and commercial code compliance savings; and b) help PAs ensure that the training reaches as wide an audience as is appropriate and is as effective as possible by continuing to assess the new implementer's training efforts. The follow-up studies may utilize a survey-based approach rather using in-depth interviews.
- **C&I NEI Estimation Study.** This research will provide the EMC with an up-to-date, comprehensive set of NEI values associated with the C&I energy efficiency programs. The results of the study will be used in regulatory cost-benefit analysis and program sales and marketing. This Phase 1 Scoping study will identify and prioritize the set of C&I measures, initiatives, and corresponding NEIs that require updates or lack NEIs. It will also identify the most appropriate and cost-effective set of research techniques for developing NEI estimates for the prioritized NEIs and identify data that are currently available for updating these NEIs. Finally, it will develop a research plan for completing the Phase 2 NEI research.
- **Mass Save Brand Awareness and Engagement Study**. The goal of this study is to continue assessing Mass Save brand awareness and whether that awareness has changed due to campaign changes. This study will identify metrics for the marketing campaign's success based on movement from awareness of the brand, to the knowledge of Mass Save programs, to actively participating in those programs. The study will also explore customers' understanding of Mass Save sponsorship, their satisfaction with the redesigned website, and gain their perspective on how programs and Mass Save marketing can help increase awareness of both the Mass Save brand overall as well as specific programs offered by Mass Save.
- **Residential New Construction Compliance/Baseline Study.** The goals of this research are to update the User Defined Reference Home for the RNC program, calculate code compliance rates for stretch code and non-stretch code municipalities, and to develop key inputs and background information for a future RNC/CCSI NTG study.
- **Consistent Methodologies for Self-Reported Residential NTG.** Assess prospects for developing consistent methodologies for self-reported residential NTG for Massachusetts. Clearly identify the range of residential program delivery approaches and situations that such methodologies should cover, and identify special situations to address, such as early replacement and real-time data collection. Develop consistent methodologies for the program types and delivery methods for which the initial results indicate that consistency is feasible, while respecting differences that suggest a need for methodological diversity.

7.4 LONGER-TERM PRIORITIES

In addition to the near-term priorities listed above, the SCC research area has the following longer-term priorities. These are expected to become relevant during the 2019–2021 EE Plan but do not require a Stage One plan at this time.

- **Support for Codes and Standards.** Conduct research to develop the evaluation framework for the standards support initiative or research that is dictated by the evaluation framework to begin to estimate savings for the CCSI.

- **Market Effects.** Understand the principles to identify what areas need quantification and, more broadly, how program efforts influence the adoption of new technologies both inside and outside the program. Once it's clear which programs are likely to generate measurable changes in markets under the new plan, consider studying market effects for other types of equipment besides HVAC and lighting.
- **Grid Modernization.** Determine the impact of not having Advanced Metering Infrastructure (AMI) meters for Distributed Energy Resources (DER) development and DR efforts.
- **NEIs.**
    - Quantify additional market-rate multifamily and moderate income NEIs
    - Identify energy optimization measures
    - Determine how to best communicate and market NEIs
- **New Construction.** Understand changes in new construction market, including the opportunity to understand program influence on low-energy buildings.
- **Demand Response (DR).** Conduct research supporting new DR programs and policy frameworks.
- **Time-Based Carbon Impacts of Energy Efficiency.** If relevant, establish a framework for calculating carbon impacts based on how savings impacts lined up with dispatched resources in ISO-NE and long-term impact on generation mix.
- **NTG.** Conduct NTG research on energy optimization, solar panels and renewable rates, and ductless mini-split heat pumps as supplemental heat.
- **TMY3 Replacement.** If TMY3 doesn't apply, determine what should be used for normalization.

A. RESIDENTIAL STAGE ONE PLANS

A.1 RESIDENTIAL NEW CONSTRUCTION PASSIVE DESIGN ASSESSMENT

Study Name: **Residential New Construction Passive Design Assessment**

Study Champion: **Chris Chan, Eversource**

Research Area: **Residential New Construction**

Type of Study: **Impact**

Study Lead: **Zack Tyler, NMR**

Applicable Fuel(s): **Electric and Gas**

Underlying Program/Initiative: **Residential New Homes and Renovations Initiative**

Background:

As stated in the draft Mass Save 2019–2021 Three-Year Energy Efficiency Plan,[19] initial construction and renovations offer the greatest opportunity to promote the highest-efficiency energy systems and maximize the performance of a building's shell. During construction or renovation, key shell components such as exterior walls, foundation walls, and roofs can be upgraded to achieve high efficiency levels. The passive design approach offers high efficiency design that results in buildings that use little or no energy and include additional resiliency benefits. In addition to a focus on super-efficient shell or building envelope design, and optimized energy systems, the passive design approach also manages solar gain to take advantage of the sun's energy for heating and to minimize overheating in the cooling season. As part of the 2019–2021 program cycle, the PAs plan to support passive design new construction through a combination of targeted trainings, technical support, and incentives.

The PAs are currently leveraging projects completed through the residential new construction (RNC) initiative that used passive design techniques to garner lessons learned that can be used to help broaden the understanding of passive design in Massachusetts. As stated in the draft Mass Save 2019–2021 Three-Year Energy Efficiency Plan, passive design techniques have been shown to be best applied to larger facilities, the PAs will focus efforts on multi-unit and mixed-use new construction projects. This will require the RNC team to work closely with the commercial team's new construction programs.

Overall Study Goal:

The overall goal of this study is to verify savings methodologies being used for passive design projects. While there are existing energy modeling platforms, both in the form of existing implementation tools and tools specific to passive design,[20] these may require adjustments or adaptations to reflect the specifics of program design, climate, and materials in Massachusetts.

Value of Study:

Since passive design will be a central focus of Mass Save new construction programs, it is important to have a firm understanding of how savings from passive design can be quantified and claimed. In addition, building a base of knowledge from current and former projects will help the PAs grow the program throughout the next three-year cycle. Lessons learned from both within and outside of Massachusetts should help program implementers as they move forward with this important new program focus.

High-Level Description of Approach/Methodology:

Phase 1: Review Existing Projects, Assess Model Capabilities, and Assess Savings

To assess savings from these projects, evaluators will compare energy models of baseline projects and passive design participant projects to assess the overall impacts of program participation. We recommend this approach, as passive design is a whole building efficiency approach and savings from passive-designed homes should be evaluated in a similar manner. Evaluators will develop baseline prototype models (based on the UDRH in place for the low-rise and high-rise programs, respectively) to calculate baseline energy consumption for typical new construction projects. Evaluators will then develop

[19] http://ma-eeac.org/wordpress/wp-content/uploads/2019-2021-Three-Year-Energy-Efficiency-Plan-April-2018.pdf

[20] http://www.phius.org/software-resources/wufi-passive-and-other-modeling-tools/wufi-passive-3-0; http://passivehouse.com/04_phpp/04_phpp.htm

passive design models, either in the form of prototypes that represent average passive design participant projects or by modeling individual participant projects, to calculate the energy consumption associated with passive design participant projects. The difference between these models will represent the savings associated with passive design participant projects. Evaluators should work with the PAs and program implementers to determine what modeling tools are currently being used to measure savings from passive design projects. Part of this evaluation will include an assessment of whether or not the current tools are appropriate for capturing the savings from passive design projects. Evaluators may find a need to model baseline projects in typical new construction software packages while passive design participant projects may need to be modeled in passive design software packages. Through this process, evaluators will be able to identify and explore the impact of different techniques and different efficiency levels (e.g. infiltration, thermal bridging, mass walls, etc.) to explore their relative importance in passive design. The results of the evaluation modeling effort should be compared to any current savings methodologies to assess whether current practices need to be adjusted.

Phase 2: Conduct In-Depth Interviews with Market Actors

As an optional second study phase, evaluators would conduct in-depth interviews with program administrators and builders who have experience with passive design techniques. These in-depth interviews would be designed to gain an understanding of opportunities that could be exploited and barriers or pitfalls that could be avoided as the program develops. In-depth interview participants would include Mass Save program participants that used passive design techniques as well as industry experts from outside of Massachusetts. Insights from these in-depth interviews will provide actionable recommendations for topics to be included in training, as well as advice for technical support resources, and incentive structures that will help achieve program goals. Evaluators should work with the PAs and the EEAC to determine whether or not to pursue phase two research at the time phase one research begins.

Research questions include the following:

- What savings methodologies work for passive projects? (Phase 1)
- If and how savings methodologies need to be adjusted for Massachusetts? (Phase 1)
- What are the common barriers or pitfalls associated with passive design? (Phase 2)
- What lessons can Massachusetts learn from others who have implemented passive design? (Phase 2)
- How can incentives be structured to best promote passive design techniques? (Phase 2)
- What training topics will be most important for passive design training? (Phase 2)
- What types of technical support resources will be needed to support program participants? (Phase 2)

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget:

The table below presents the budget range for the tasks, with the range reflecting possible variations in the level and depth of analysis.

Phase 1: Review Existing Projects, Assess Model Capabilities, and Assess Savings	$50,000 - $125,000
Phase 2: Conduct In-Depth Interviews with Market Actors (Optional)	$25,000 - $50,000
Total Budget Range	**$75,000 - $175,000**

Timeline:

TBD

A.2 LOW-RISE MEASURE REVIEW

Study Name: **Low-Rise Measure Review**

Study Champion: **Gail Azulay, CLC**

Research Area: **Retrofit/HVAC Research Area**

Type of Study: **Impact Evaluation**

Study Lead: **TBD**

Applicable Fuel(s): **All Fuel Types**

Underlying Program/Initiative: Residential Coordinated Delivery (RCD)

Overall Study Goal:

Determine the appropriate gross and net savings for measures installed in low-rise homes through the RCD initiative. These gross and net savings may already exist (i.e., the PA's can readily apply current single family or multifamily estimates) or require additional calculation, likely by adjusting one or more impact factors (e.g., hours of use, installation rates, baseline conditions) associating the existing estimates to more accurately reflect low-rise installations.

Value of Study:

As the PAs reshape their delivery of residential offerings, it is critical they develop gross and net savings values that are specific to the customer and building-types served. Proactively developing low-rise-specific savings mitigates the risk that the PAs incorrectly leverage existing single family or multifamily impact factors that are not relevant for low-rise customers, which could result in evaluated savings differing meaningfully from planned savings.

High-Level Description of Approach/Methodology:

The review process begins with a list of all the measures the PAs anticipate installing in low-rise homes as part of RCD. Using this list, the evaluation team will—on a measure-by-measure basis—review information regarding the existing single family and multifamily gross and net savings for the same measure and determine whether one of those values is also appropriate for low-rise installations. Specifically, the evaluation team will assess whether the individual impact factors (again, hours of use, installation rates, baseline conditions) are similar or different between single family, multifamily and low-rise buildings or customers. It's important to note that differences can be driven by the nature of the building types (i.e., different building science result in different gross savings) or the customers that typically live in these building types (i.e., fewer occupants in non-single-family homes could mean lower usage for a given measure). It's equally possible that net-to-gross rates could differ between customers residing in building types for similar reasons. Consequently, the evaluation team will utilize a team of both engineers and market experts to complete this review. As scoped for this Stage One study, the team will rely exclusively on existing data (the MA TRM, audit data for each building type, Census data, previous MA or NE-specific evaluations). However, as part of this study, the evaluation team may identify future low-rise-specific primary research that would further improve/valid gross or net saving estimates for a particular measure or set of measures.

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: $50-75,000

Timeline: 2019-2021 Implementation Planning Cycle

A.3 NON-PARTICIPANT RESEARCH

Study Name: **Non-participant Research**

Study Champion: **Bob Wirtshafter, EEAC Consultant**

Research Area: **Retrofit/HVAC Research Area**

Type of Study: **Market Characterization and Process Evaluation**

Study Lead: **TBD**

Applicable Fuel(s): **All Fuel Types**

Underlying Program/Initiative: All

Overall Study Goal:

The objective of this study is to better understand the residential customers that, to date, have not participated in Massachusetts Mass Save programs with the end goal of informing strategies to reach and engage these nonparticipants. The study will use multiple and potentially non-traditional research approaches to more deeply understand barriers to participation (including market, demographic, psychographic, and programmatic barriers) as well as identify segments where these barriers are most prevalent. Segments may include the traditional harder-to-serve markets of interest (e.g., low income, moderate income, renters); however, the study will broadly assess the market with an eye to identifying

characteristics of customers who have not participated (e.g., psychographic segments based on a range of factors including demographics, attitudes, understanding, and awareness).

Value of Study:

The PAs and their evaluation teams have completed a number of research activities to investigate the residential market. These activities include the Residential Baseline Study (RES 1), Moderate Income Market Characterization Study (RES 40), the Massachusetts Cross-cutting Statewide Marketing Study (SWM-01) and the Residential Customer Profile Study completed by DNV GL. However, these studies did not intend to understand the nonparticipating market specifically. This study will:

- Start with a preliminary objective of identifying defining characteristics of nonparticipants, using various in-depth research techniques to identify those characteristics
- Use quantitative surveys to statistically measure population-related issues, such as barriers, and provide comparative analysis between participants (considering participant-specific stratifications such as one-time/repeat participants) and nonparticipants to isolate common characteristics for these groups
- As an optional task, complete a nonresponse study to determine if there is systematic bias in survey responders that may correlate to participation (e.g., lack of affinity with the utility or subject of energy efficiency)
- Isolate and visualize select results geographically

The results of this research will inform implementation and marketing strategies, highlighting any differences and needs for key populations of interest, by focusing on gathering data from nonparticipants and using participant data as an informative comparison group. Further, if completed early, this study could serve as a baseline to measure progress in key metrics (e.g., participation, barriers). This outcome would be particularly useful for identifying whether program changes planned for the next cycle are effective in reaching segments of interest.

High-Level Description of Approach/Methodology:

Task 1. Project kick-off, prioritization, and planning: Studies of this nature could go a number of directions, and risks attempting to address too many research topics in a single effort. The first task is to establish research priorities. The evaluation team will first "crowd source" all PAs and EEAC consultants through a very brief online survey. The results of this survey will then be summarized and used to efficiently facilitate a group discussion to a) prioritize the research needs and b) discuss which needs are best addressed through quantitative surveys versus in-depth qualitative research. It will also be important to use this task to identify any key segments of interest, including definitions of those segments. Finally, the kick-off meeting will be used to identify studies or resources the evaluation team could leverage to avoid redundancy with prior research. The evaluation team will then complete a Stage Three plan, specifying the final research objectives and activities to address those objectives.

Task 2. In-depth qualitative research: At this point, the evaluation team takes the position that we truly do not know all the barriers, issues, and characteristics of nonparticipants. While there has been extensive research on traditional barriers and groups, and there clearly is an interest in income constrained, renter, and multi-unit customers, this research intends to more broadly understand the nonparticipant market, which includes but is not exclusive to these groups. Quantitative surveys will not necessarily provide the initial insight needed to "see" these groups. Further, it may be the case that the quantitative surveys are not the most accurate means to assessing nonparticipation, especially if nonparticipants are less likely to respond.

Therefore, we will use exploratory, qualitative research which is invaluable for digging deeper into more subjective and nuanced issues related to customers' needs and barriers. The specific research activities will be defined based on the first task, but the team envisions using qualitative techniques that include, but are not limited to, the following:

- **Interviews or panel discussions with community and special interest organizations:** Community and special interest organizations have vision into their constituents' needs that are not apparent from the outside. Further, they can be a powerful referral source for Mass Save. Qualitative research with these groups, whether it be through interviews or a panel discussion, could provide insight into their customers' daily needs and perspectives. It would be important to think strategically with the PAs about who to target and speak with, but we envision including groups that could be influential individuals' decisions and/or be strong references for the programs. This information would then inform future segment-focused research. The information gathered in Task 1 will serve as a starting point to identify organizations of interest.
- **Focus groups:** We will employ focus groups with nonparticipants to gain insight into their needs, attitudes, and barriers for participating, currently and in the future. We could use the community/special interest organizations to target respondents as well as target nonparticipating customers from the population. We would need a sufficiently large number of focus groups to get meaningful insight, especially if we're targeting specific segments (e.g., 12-15 groups).
- **Intercept interviews:** It may be valuable to speak with customers when they are in a space where these issues are relevant for them, such home shows, when shopping for equipment, etc.
- **Other research:** The team could also consider in-home interviews, in-depth interviews (video or non-video enabled), and research with other market actors (e.g., contractors).

The qualitative research will result in a list of commonalities present among nonparticipants which can be used to define target groups and inform the quantitative survey, discussed next. Further, these research efforts could support the PA's desire to more successfully identify and engage harder-to-reach Residential Coordinated Delivery (RCD) decision-makers, including multi-unit decision makers (as documented in the separate Decision-Maker Targeting Study Stage One plan). Program stakeholders have reported, and the evaluation team experienced, difficulty reaching these types of customers/decision makers through traditional implementation and evaluation outreach methods. It's likely the evaluation team's exploration of alternative methods, as described above, will yield insight into alternative methods to recruiting these types of customers for RCD.

Task 3. Customer surveys: The primary objective of the survey will be to speak with nonparticipants to understand their awareness, barriers to participation, and attitudes (at minimum) with the end goal of characterizing this group and creating nonparticipant profiles through a psychographic segmentation analysis (described in Task 4 below). While the study will target and set survey targets for nonparticipants, we recommend surveying participants as well, focusing on select questions to provide comparative analysis. We recommend a sampling strategy to ensure PA and statewide representation and considering oversampling and/or targeting select groups or areas of interest to ensure representation within those groups. If feasible, the sample should include indicators of past participation (as far back as possible) to use to further pre-stratify customers using objective data (vs. self-report). Finally, if there is concern that survey non-responders are less likely to participate or have systematic differences, it may be worth conducting a separate nonresponse study to test that hypothesis and determining if there are any systematic biases that affect the team's ability to accurately characterize nonparticipants.

Task 4. Psychographic segmentation analysis: Using the quantitative survey results, the team will create nonparticipating customer segments or profiles using latent class analysis. To complete this analysis for nonparticipants sufficiently would require sufficient sample (1,000 to 1,200 nonparticipant surveys).

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: $300,000-$465,000 (variable by sample sizes and activities to be included)

Timeline: 2019-2021 Implementation Planning Cycle

A.4 MINI-SPLIT HEAT PUMP PROCESS AND MARKET OPTIMIZATION STUDY

Study Name: **Mini-Split Heat Pump Process and Market Optimization Study**

Study Champion: **Beth Delahajj, National Grid**

Research Area: **Retrofit/HVAC Research Area**

Type of Study: **Process and Impact**

Study Lead: **TBD**

Applicable Fuel(s): **All Fuel Types**

Underlying program/Initiative: All

Overall Study Goal:

The goal of this study is to conduct a comprehensive review of Mini-Split Heat Pump (MSHP) measures by examining how residents use this technology, customer satisfaction, and assessing if the PAs are meeting objectives for energy optimization opportunities with MSHP installations. The focus is primarily on multifamily program participants, including both low income and market rate customers. The study can be expanded as desired to update previous MSHP studies for single family program participants.

Research Questions:

- How do residents interact with and react to MSHP units?
- What is the level of satisfaction with MSHP units, in the presence and in the absence of a backup heating system?
- What changes in resident behavior and heating/cooling usage are associated with MSHP?

Value of Study:

The PAs have expressed interest in conducting a process evaluation and characterizing MSHP measures for the multifamily application type. Prior studies (such as the RES29 DMSHP Survey) have examined how single-family participants select and use ductless mini-split heat pump systems. The process evaluation in this study will complement prior studies, by examining how multifamily program participants use MSHP units and quantifying the heating run times of participants' MSHP units. The Study will also provide guidance on energy optimization, with a focus on whether customers are using MSHP units for heating while reducing using from the previous/existing heating source.

High-Level Description of Approach/Methodology:

<u>In-Depth Interviews</u>

The evaluation team will conduct in-depth interviews with key stakeholders including PA staff members responsible for residential retrofit programs and low-income retrofit programs. These interviews will help the evaluation team to understand the various applications types for MSHP units in the multifamily sector, the "typical" displacement of existing heating equipment and cooling opportunities in the multifamily building stock (e.g., MSHP replacing existing equipment or is cooling an improvement recognized with the MSHP). The evaluation team will also gather information around the current PA objectives for energy optimization opportunities and assess if additional opportunities are required or if the current objectives being met.

Surveys of Program Participants/Primary Research

Using information gathered from in-depth interviews, the evaluation team will design and conduct two separate surveys: (1) an occupant survey of households that have taken part in MSHP programs, and (2) a survey of owners and managers of low-income and market rate rental housing that have participated in MSHP programs. These surveys will focus on resident and landlord interaction and satisfaction with MSHP units, displacement of existing heating equipment, prior and existing cooling usage and heating/cooling run times for new MSHP units. The survey team will also coordinate with the special and cross-cutting team to incorporate survey questions that will help assess the non-energy impacts (NEIs) of MSHP installations which will be assessed in a separate study.

Estimate Savings for MSHP Units in Multifamily

The evaluation team will look at a variety of methods to validate the savings from tools that the vendor is using and agree on the most appropriate evaluation approach. The savings will focus on the multifamily application but could expand to single-family if desired.

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: $150,000 – $300,000 (may vary based on the impact evaluation approach)

Timeline: 2019-2021 Implementation Planning Cycle

A.5 NEW INITIATIVE PROCESS EVALUATIONS AND RESEARCH

Study Name: **New Initiative Process Evaluations and Research**

Study Champion: **Tracy Redmond-Dyke, Eversource**

Research Area: **Retrofit/HVAC Research Area**

Type of Study: **Process Evaluation**

Study Lead: **TBD**

Applicable Fuel(s): **All Fuel Types**

Underlying program/Initiative: All

Overall Study Goal:

The Massachusetts Program Administrators (PAs) recently completed and submitted their draft implementation plan for the 2019 – 2021 program cycle. In response to market conditions, baseline changes, and research and evaluation findings, the PAs incorporated design changes in some of their residential programs, with the Home Energy Services (HES) being the most extensively redesigned in terms of processes and implementation strategies. Further, the PAs continue to explore approaches to best reach and serve all customers.

To support the PAs' continued improvement efforts, and provide program design and implementation guidance, the evaluation team will conduct process evaluations of and/or provide evaluation or research support for these new initiatives. The activities can take a variety of forms, ranging from quick-hit research addressing targeted process questions to comprehensive, full-program process evaluations, assessing the efficacy of the program as a whole across all market actors and programmatic elements. Further, these activities may take place across the lifecycle of the 2019 – 2021 program offerings, starting with early research and evaluation services. For example, early process evaluation research could provide insight into how PA customers and other market actors will likely respond to the redesigned programs. As another example, the studies could, early on, document program theory, specifying how the new program design intends to address known objectives and barriers and/or establish and visualize customer journeys.

Our team will coordinate, as necessary, with the PAs' Lighting & Appliance and Cross-Cutting research area evaluation contractors as our team anticipates that some research may be relevant to multiple research areas (e.g., research around advanced power strips, which are both delivered to customers during home energy assessments and sold upstream through participating retailers). In these instances, our team will work closely with these contractors to ensure a) the appropriate evaluation staff are involved in the research, and b) that the research yields information that benefits all the affected initiatives/research areas.

Value of Study:

In addition to assessing traditional process-related issues (e.g., insights into program processes and market response) the process evaluations and research will provide the data needed to understand whether the redesigned program is generating the desired outcomes. The evaluation team will coordinate with the PAs' implementation and evaluation teams to provide these insights at various stages in the programs' cycles, including early in the cycle (to aid in launch), the middle of the cycle (to facilitate course correction), and end of the cycle (to retrospectively document results and inform redesign opportunities). The exact research questions are unknown at this point but will assess process issues and questions that the PAs' implementation and evaluation teams are grappling with as they arise.

High-Level Description of Approach/Methodology:

This Stage One research plan is intentionally open-ended. Programs designs are not yet final, and research needs are not established or refined. Additionally, to ensure the greatest value, it is important that the evaluation team is sufficiently nimble to meet research needs. Activities within these process evaluation endeavors may include, but are not limited to:

- Host kick-off meetings and conduct planning to determine critical research objectives, activities, and timelines
- Develop, or critically review existing, logic models to document program design against program theory.
- Develop customer journey maps documenting customers' points of entry, pain and satisfaction points, and movement through the program
- Conduct exploratory research on customer or market actor response to program design and marketing changes. Examples include:
    - Focus groups with market actors (e.g., contractors, Energy Specialists, and Home Performance Contractors.
    - Interviews with market actors solicit feedback on the program design elements and experiences.

    - Usability testing or response to programming or Mass Save elements (e.g., marketing and outreach messaging)
- Conduct quick hit surveys (e.g., no more than 10-minute survey administered by web, mail, and/or telephone) on a specific topic of interest.
- Survey program participants regarding their experiences, satisfaction, motivators, and demographics
- Survey nonparticipants on awareness, prior participation, needs, and barriers, among other issues (any broad nonparticipant study completed outside of this research could be leveraged for this research)
- Conduct literature reviews or interviews with program administrators from other states to follow national trends and identify program design strategies
- Mine program and tracking data
- Assess value of and progress against key performance indicators

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: TBD

Timeline: 2019-2021 Implementation Planning Cycle

A.6 LIGHTING SALES DATA ANALYSIS

Study Name: **Lighting Sales Data Analysis**

Study Champion: **TBD**

Research Area: **Residential Lighting and Products**

Type of Study: **Market Assessment**

Study Lead: **TBD**

Prioritization: **TBD**

Applicable Fuel(s): **Electric**

Underlying program/Initiative: **Residential Retail Initiative (lighting specific)**

Overall Study Goal:

The study will analyze data purchased from the Consortium for Residential Energy Efficiency Data (CREED)'s LightTracker Initiative and describe bulb sales, market shares, and prices for light emitting diodes (LEDs), compact fluorescent lamps (CFLs), halogens, and incandescent. The LightTracker data describes market-level sales and program activity for most states in the nation. Evaluators will compare data for Massachusetts to those for other program areas, non-program areas, and the nation. The study will report results broken down by various categories, dependent on data availability and program evaluation needs. Likely categories including bulb shape, lumens bins, and ENERGY STAR qualification. The study will also track quarterly national shipments of bulbs as reported by the Association of Electric Equipment and Medical Imaging Manufactures (NEMA). The LightTracker data lag by a year, so the 2019 study will analyze 2018 sales data.

Research questions include the following:

- What are the short- and long-term trends in light bulb shipments, sales, and market share in Massachusetts?

- How do these trends in Massachusetts compare with other program states, non-program states, and the nation?
- What is the bulb price of LEDs compared to other bulb types, in Massachusetts and non-program states?

Value of Study:

For 20 years, the Residential Lighting Core Initiative (the retail lighting program) and its predecessors have yielded substantial, low-cost electric savings to the ratepayers of Massachusetts. The retail lighting program has also historically accounted for much of the Residential Portfolio electric savings. For example, the 2016 Mass Save Data Dashboard reports that the retail lighting program (the Dashboard references Residential Lighting, under Residential Products) claimed 55% of the Residential Portfolio net annual electric savings and 59% of the net lifetime electricity savings, but accounted for only 24% of the Residential Portfolio program incentives. (These percentages apply only to the retail lighting program and do not include lighting from the various direct install programs, which further boosts total Residential Portfolio savings due to lighting, as reported here.) This will soon change. Not only do the PAs anticipate that annual Residential Portfolio savings in 2019 will be one-half of what they were in 2016, they also expect that the entire Residential Retail Core Initiative, which will include the retail lighting program, will account for 43% of annual and 54% of lifetime Residential Portfolio savings, less than the retail lighting program alone in 2016.).

The broader residential lighting market is driving the Massachusetts program changes. Rapid adoption of LEDs, anticipated increases in federal lighting standards, and likely expansion of the bulbs covered by the standards indicate that the residential lighting market is nearing transformation. But it is not quite there yet. This effort provides a low-cost way to track the progress of the lighting market in Massachusetts and the nation, as well as differentiating the progress between areas with and without lighting programs. The sales data will contribute to the body of knowledge regarding the continued importance of retail lighting program activity in the rapidly transforming market place and inform decisions about program strategy decisions in response to the market progress.

High-Level Description of Approach/Methodology:

This project includes three tasks:

- Task 1: Data purchase from and coordination with CREED
- Task 2: Data analysis
- Task 3: Reporting

Budget:

The table below presents the budget range for the tasks, with the range reflecting possible variations in the level and depth of analysis. Note that CREED estimates that the LightTracker data will cost approximately $80,000, with the additional $5,000 for coordination.

Task 1: Data purchase and Coordination	$85,000
Task 2: Data Analysis	$15,000 to $25,000
Task 34: Reporting	$25,000 to $35,000
Total Budget Range	**$125,000 -- $145,000**

Timeline:

CREED Data Delivery	June

Analysis and Reporting	July to September
Reporting	September to November

A.7 RESIDENTIAL REAL-TIME PARTICIPANT SURVEYS

Study Name: **Residential Real-Time Participant Surveys**

Study Champion: **Kimberly Crossman, National Grid**

Research Area: **Retrofit/HVAC Research Area**

Type of Study: **Net-to-gross and Process**

Study Lead: **TBD**

Applicable Fuel(s): **All Fuel Types**

Underlying program/Initiative: All

Overall Study Goal:

The overall goal is to provide program administrators with actionable feedback on program processes on a timely basis to enable continuous improvement. The fast feedback survey approach collects valuable information on participant satisfaction, areas for improvement, and free-ridership in close to real time, which helps to avoid recall issues and increase survey response rates relative to less frequent process evaluation surveys.

Research questions include:

- How satisfied are participants with their overall program experience, as well as individual aspects of program participation (e.g., eligibility requirements, application process, wait time to receive rebate, customer service, etc.)?
- What can program administrators do to improve customer experience in these programs?
- What are the free-ridership estimates for these programs?

Value of Study:

The primary value of fast feedback surveys is the ability to adjust program implementation processes that are veering off track before it's too late to make improvements. Response rates are typically higher for fast feedback surveys because the program is more salient and top-of-mind for participants. Furthermore, by combining multiple utilities and programs into a single streamlined survey process, there are economies of scale for fielding and analyzing survey results. This survey approach is more cost-effective and produces better quality data on a more useful timeline than typical year-end process evaluation surveys. Ideally by surveying customers within 6 weeks of their program participation, respondents are more likely to remember relevant details that help make their feedback actionable to the program implementation staff, but this can prove difficult to implement. The evaluation team will work with the PAs to implement the most feasible real-time survey to increase the value of feedback to program implementers.

High-Level Description of Approach/Methodology:

The approach requires a substantial amount of upfront work but is very quick to implement on a monthly basis after the initial lift. The team will work with program administrators to develop a concise, streamlined online survey instrument that uses skip logic to customize questions for each utility and program combination and shall look to administer the survey through a web survey platform. The team will need to work with program administrators to develop a program tracking data transfer process through which the PAs send program tracking data more frequently (preferably on a monthly, every other month or quarterly basis). The survey team will upload the data into a secure environment and then aggregate and transform the program tracking data for each program into a single sample frame for the month's survey. The final step (completed monthly) will be uploading the sample frame into the web platform which will be constructed to send invitations and reminders to take the survey automatically.

The survey team shall provide program administrators and implementation staff with a real-time summary of survey results by month and program year-to-date via a web-based survey results dashboard. Once a month, the survey team will send the program administrators a survey disposition report summarizing response rates by utility and program as well as a raw dataset (anonymized to remove personally identifiable information). The team will also provide periodic deliverables (memos or presentations, depending on the PAs' preferences) summarizing key findings and insights from the survey results on a quarterly basis or more frequently if needed.

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: $50,000 - $100,000 (variable by sample sizes and activities to be included)

Timeline: 2019-2021 Implementation Planning Cycle

A.8 WORKFORCE RETENTION AND RECRUITMENT FOR RESIDENTIAL PROGRAMS

Study Name: **Workforce Retention and Recruitment for Residential Programs**

Study Champion: **Tracy Dyke Redmond, Eversource**

Research Area: **Retrofit/HVAC Research Area**

Type of Study: **Measure Characterization and Process**

Study Lead: **TBD**

Applicable Fuel(s): **Electric / Gas**

Underlying program/Initiative: All

Overall Study Goal:

The objective of this study is to ensure workforce retention and recruitment for MA Residential Energy Efficiency programs is sufficient given the expected program design and scale changes for the 2019-2021 planning period. With the upcoming changes to program implementation and potential expansion to the weatherization workforce, the PAs would like to

identify areas that could be impacted and potentially adjusted due to the higher demands of the program. Such areas to review include the current trainings offered to the workforce and if these will meet the expected demand or if additional trainings are required. The PAs could also use this as an opportunity to research effective ways for recruitment into the program and where to find the best candidates.

The study will investigate the following research questions:

- How do the PAs ensure there is a trained, qualified workforce ready to implement the programs at the scale envisioned for the next three-year plan?
- What, if any, additional training is needed to ensure a sufficient pipeline of workers are available?
- Are any changes needed to recruitment to ensure the best candidates are hired and retained for all field services offered as part of program offerings?

Value of Study:

This study will take a deeper dive into the magnitude of the impact for program implementation changes in the 2019-2021 planning cycle and determine if adjustments are necessary. This will help to ensure if the scale increases as expected, trained and qualified field technicians are available to meet the additional demand.

High-Level Description of Approach/Methodology:

1. Characterize the "current state" of MA Residential Energy Efficiency programs workforce recruitment and retention offerings. The following activities can be considered:
    a. Interview implementation staff across PAs to assess perspectives on current workforce recruitment and retention to identify any gaps in existing processes or areas that could be impacted with the higher scale of projects.
    b. Review of MA Residential Energy Efficiency program documentation including the Income Eligible Program Process Evaluation report and the Home Energy Services Process and Impact Evaluation reports, as well as any other document on the cost-effectiveness of Residential Energy Efficiency programs for the 2016-2018 plan period.
2. Investigate factors that will help improve MA Residential Energy Efficiency program offerings. The following activities can be considered:
    a. Interview third-party contractors who have been involved with MA Residential Energy Efficiency programs, investigating their views for workforce recruitment and retention for the current/future programs. Aim to interview a range of contractors (i.e. involvement in different programs, serving different PAs/geographic areas).
    b. Interview 1-2 workforce development experts (e.g. vocational school staff) to ascertain guidance and recommendations specific to MA PAs workforce recruitment and retention relating to meeting a higher demand, including how to establish a recruitment structure that aligns with the current/future field services conducted as part of MA Residential Energy Efficiency program offerings.

Findings from this study will inform potential changes to workforce trainings and benefits associated with MA Residential Energy Efficiency programs for the 2019-2021 plan period.

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: $50-75,000 (may vary based on the defined boundaries of "workforce")

Timeline: 2019-2021 Implementation Planning Cycle

A.9 DECISION-MAKER TARGETING STUDY

Study Name: **Decision-Maker Targeting Study**

Study Champion: **Kimberly Crossman, National Grid**

Research Area: **Retrofit/HVAC Research Area**

Type of Study: **Process Evaluation**

Study Lead: **TBD**

Applicable Fuel(s): **All Fuel Types**

Underlying program/Initiative: All

Overall Study Goal:

First, to determine how the PAs can more effectively identify, market to, and engage landlords and property managers, as well as any other harder-to-reach decision-makers, in the PAs' suite of residential energy efficiency initiatives. Second, identify the drivers of participation for these decision-makers and the delivery design structure, measure mix, and incentive levels that will result in greater participation in the PAs' initiatives.

Value of Study:

Recent evaluations and three-year planning efforts have underscored the importance of reaching these decision-makers and encouraging their participation in Residential Coordinated Delivery (RCD), Residential Retail Initiative, or the Income Eligible program (as appropriate). Program stakeholders have reported, and the evaluation team experienced, difficulty reaching landlords and/or property managers, particularly for small and mid-sized (less than 20 total units) properties. As these initiatives mature and aggressive savings targets continue, it will become increasingly important for the PAs to successfully tap into these customer segments and their associated savings potential. Doing so will require effectively engaging landlords and/or property managers as they typically make the ultimate decision about whether to act on the PAs more substantive efficiency recommendations.

High-Level Description of Approach/Methodology:

The team will conduct a small number of targeted interviews with RCD, Retail, and Income Eligible project managers to understand how they currently characterize, identify, market to, and engage these decision makers. Through these interviews, the team will work with the PAs to segment and characterize primary types of harder-to-reach decision makers. This segmentation exercise may result in: landlords of single-family detached homes, landlords of multi-unit single family homes (2-4 units), landlords/property managers of small multifamily buildings (5-10 units), and so on.

These interviews will also enable the evaluation team to recruit and develop a discussion guide for a series of focus groups. The exact number, location(s), and composition (i.e., the types of hard-to-reach customers that participate) of the focus groups will be determined through future Stage Three planning efforts. Independent of these logistical details, the overall goal of the focus groups will be to better understand how to market to and encourage participation in RCD. The evaluation team will summarize the findings of the focus groups and offer recommendations for marketing and program design for each identified customer type.

In addition to the focus groups, the team will identify, procure, and review alternative data sources that may inform the PAs' marketing and outreach efforts to these customers. Based on this review, the team will specifically assess whether any of the identified data sources can facilitate systematic identification of potential hard-to-reach RCD participants.

The activities tentatively proposed as part of this research could also support the PA's desire to better understand and connect with residential non-participants more generally (as documented in the separate Non-participant Research Stage One plan). The PAs and evaluation team should, when transitioning from a Stage One to a Stage Two or Three evaluation plan, coordinate the timing and scopes of both studies or even consider combining them into a single, more comprehensive scope of work.

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: $75,000-125,000

Timeline: 2019-2021 Implementation Planning Cycle

B. C&I STAGE ONE PLANS

B.1 IMPACT EVALUATION OF 2017 CUSTOM ELECTRIC INSTALLATIONS

Study Name: **Impact Evaluation of 2017 Custom Electric Installations**

Study Champion: **Whitney Brougher**

Research Area: **C&I Impact/NTG**

Type of Study: **Impact**

Study Lead: **To Be Determined**

Applicable Fuel(s): Electric

Underlying program/Initiative: All C&I Programs/Initiatives

Overall Study Goal:

The objective of this impact evaluation is to provide verification or re-estimation of electric energy and summer/winter peak demand savings estimates for a sample of custom electric projects through site-specific inspection, monitoring, and analysis. The results of this study will be used to determine the final realization rates for custom electric energy efficiency offerings installed in 2019. Realization rates will be separately determined for National Grid and Eversource, as well as at the statewide level. The evaluation sample for this study will be designed in consideration of the 90% confidence level for energy savings and the 80% confidence level for demand savings.

Value of Study:

This study will combine the results from the current PY2016 custom electric impact evaluation with the sample results of this PY2017 impact evaluation to produce a realization rate that will be applied to custom electric offerings installed in 2019. This study will require 2017 program tracking data from the PAs by August 2018 for sampling purposes. Data collection will take place between late 2018 and mid-2019 to capture the appropriate season for each sampled project with a summary report delivered in Q4 of 2019. In addition to producing new custom electric realization rates, the study will provide findings and recommendations for implementation to consider in its offerings.

High-Level Description of Approach/Methodology:

1. **Develop Sample Design**

   The sample design will employ a multiyear staging approach as introduced in the Impact Evaluation Framework.[21] Traditionally, custom electric measures have been evaluated at the end-use level every 3-5 years. There is currently an impact evaluation being completed on the 2016 program year, which includes all electric measures (except CDA). By implementing an ongoing multiyear staged evaluation of custom electric, this program offering will be evaluated on an annual basis. Staged evaluation involves the annual gathering of data after with an independent sampling conducted for that interval. The independent samples from multiple intervals can be combined using propagation of error methods. In this specific study, the independent samples from the current 2016 program year will be combined with the independent sample from the upcoming 2017 program year.

   The goal of the study is to design a sample to estimate realization rates for electric energy savings and summer/winter peak demand savings. The target for annual energy savings will be set at the traditional ±10% at 90% confidence at the statewide level when sample results from three consecutive years of evaluation are combined (±10% at 80% confidence for peak demand savings). Beginning with the fourth year of staged evaluation, the pooling of results will drop the oldest year (PY2016) and pool the most recent three years of results. Given this framework, the PY2017 impact evaluation will require approximately one-third the number of sample points that would be needed to meet the sampling targets in a single year, non-staged impact evaluation.

[21] DNV GL. Massachusetts Commercial and Industrial Gross Impact Evaluation Framework prepared for the Massachusetts Program administrators and Energy Efficiency Advisory Council. May 19, 2017

2. Develop Site Measurement and Evaluation Plans

DNV GL will develop site specific measurement, verification and analysis (MVA) plans for each sampled site. The plans outline on-site methods, strategies, monitoring equipment placement, calibration and analysis issues. The PAs and EEAC will provide comments and edits to clarify and improve the plans prior to them being finalized.

3. Data Gathering and Analysis

Data collection will include physical inspection and inventory, interview with facility personnel, observation of site operating conditions and equipment, short-term metering of usage and EMS trends. At each site, evaluators will perform a facility walk-through that focuses on verifying the post-retrofit or installed conditions of each energy conservation measure (ECM). On-site evaluation procedures and site analysis will be presented in a site report for each sampled site. DNV GL will apply the model-assisted stratified ratio estimation methodology to aggregate the site results and expand to the study population and other segments of interest.

4. Report Writing and Follow-up

DNV GL will produce an interim desk review memo, which summarizes the results of the desk review process. DNV GL will also provide the PAs with a written summary report containing the evaluation results and key findings following this round of custom impact evaluation.

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: $750,000 - $1,000,000

Timeline: Q3 2018 – Q4 2019

B.2 IMPACT EVALUATION OF 2017 CUSTOM GAS INSTALLATIONS

Study Name: **Impact Evaluation of 2017 Custom Gas Installations**

Study Champion: **Tony Larson, National Grid**

Research Area: **C&I Impact/NTG**

Type of Study: **Impact**

Study Lead: **To Be Determined**

Applicable Fuel(s): **Gas**

Underlying program/Initiative: **All C&I Programs/Initiatives**

Overall Study Goal:

The objective of this impact evaluation is to provide verification or re-estimation of natural gas energy savings estimates for a sample of custom gas projects through site-specific inspection, monitoring, and analysis. The results of this study will be used to determine the final realization rates for custom gas energy efficiency offerings installed in 2019. Realization rates will be separately determined for Columbia Gas, National Grid and Eversource, as well as at the statewide level. The evaluation sample for this study will be designed in consideration of the 80% confidence level for therms savings.

Value of Study:

This study will combine the results from the current PY2016 custom gas impact evaluation with the sample results of this PY2017 impact evaluation to produce a realization rate that will be applied to custom gas offerings installed in 2019. This study will require 2017 program tracking data from the PAs by August 2018 for sampling purposes. Data collection will take place between late 2018 and early 2019 to capture the winter season with a summary report delivered in Q2 of 2019. In addition to producing a new custom gas realization rate, the study will provide findings and recommendations for implementation to consider in its offerings.

High-Level Description of Approach/Methodology:

1. **Develop Sample Design**

   The sample design will employ a multiyear staging approach as introduced in the Impact Evaluation Framework.[22] Traditionally, custom gas measures have been evaluated as a whole program once every 2-3 years. There is currently an impact evaluation being completed on the 2016 program year. By implementing an ongoing multiyear staged evaluation of custom gas, this program offering will be evaluated on an annual basis. Staged evaluation involves the annual gathering of data after with an independent sampling conducted for that interval. The independent samples from multiple intervals can be combined using propagation of error methods. In this specific study, the independent samples from the current 2016 program year will be combined with the independent sample from the upcoming 2017 program year.

   The goal of the study is to design a sample to estimate realization rates for natural gas therm savings. The target for annual therm savings will be set at the traditional ±10% at 80% confidence at the statewide level when sample results from three consecutive years of evaluation are combined. Beginning with the fourth year of staged evaluation, the pooling of results will drop the oldest year (PY2016) and pool the most recent three years of results. Given this framework, the PY2017 impact evaluation will require approximately one-third the number of sample points that would be needed to meet the sampling targets in a single year, non-staged impact evaluation.

2. **Develop Site Measurement and Evaluation Plans**

   DNV GL will develop site specific measurement, verification and analysis (MVA) plans for each sampled site. The plans outline on-site methods, strategies, monitoring equipment placement, calibration and analysis issues. The PAs and EEAC will provide comments and edits to clarify and improve the plans prior to them being finalized.

[22] DNV GL. Massachusetts Commercial and Industrial Gross Impact Evaluation Framework prepared for the Massachusetts Program administrators and Energy Efficiency Advisory Council. May 19, 2017

3. Data Gathering and Analysis

Data collection will include physical inspection and inventory, interview with facility personnel, observation of site operating conditions and equipment, short-term metering of usage and EMS trends. At each site, evaluators will perform a facility walk-through that focuses on verifying the post-retrofit or installed conditions of each energy conservation measure (ECM). On-site evaluation procedures and site analysis will be presented in a site report for each sampled site. DNV GL will apply the model-assisted stratified ratio estimation methodology to aggregate the site results and expand to the study population and other segments of interest.

4. Report Writing and Follow-up

DNV GL will produce an interim desk review memo, which summarizes the results of the desk review process. DNV GL will also provide the PAs with a written summary report containing the evaluation results and key findings following this round of custom impact evaluation.

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: $500,000

Timeline: Q3 2018 – Q2 2019

B.3 IMPACT EVALUATION OF 2018/2019 UPSTREAM LIGHTING

Study Name: **Impact Evaluation of 2018/2019 Upstream Lighting**

Study Champion: **Erik Mellen**

Research Area: **C&I Impact/NTG**

Type of Study: **Impact**

Study Lead: **To Be Determined**

Applicable Fuel(s): **Electric**

Underlying program/Initiative: **All C&I Programs/Initiatives**

Overall Study Goal:

The objective of this impact evaluation is to provide verification or re-estimation of electric energy and summer/winter peak demand savings estimates for a sample of upstream lighting projects through site-specific inspection, monitoring, and analysis. The results of this study will be used to determine the impact savings factors that will be applied to upstream lighting purchases in 2018. Savings factors of interest in 2018 include the installation rate and possibly the delta watts. The evaluation sample for this study will be designed in consideration of the 90% confidence level for energy savings and the 80% confidence level for demand savings.

Value of Study:

This study will continue the investigation of installation rates on a proposed quarterly basis. This is in response to recent findings from the previous completed impact evaluation that showed lower installation rates for several product types being offered by the program and significant changes implemented by the program to improve this issue. This study will require program tracking data from the PAs and/or the program vendor on a quarterly basis for review sampling purposes. Data collection will take place in quarterly intervals beginning in October 2018. In addition to producing updated product level installation rates, the study will provide findings related to the ongoing third-party QC efforts being done. DNV GL may also investigate delta watts as part of the data collection activities, if requested.

High-Level Description of Approach/Methodology:

1. **Develop Sample Design**

   The sample design will employ a quarterly staged approach as introduced in the Impact Evaluation Framework.[23] There is currently an installation rate update study being conducted by the DNV GL team. By implementing an ongoing quarterly staged evaluation of upstream lighting purchases, we can track how installation rates have changed in response to the program changes. Staged evaluation involves the quarterly gathering of data with an independent sampling conducted for that interval. The independent samples from multiple intervals can be combined using propagation of error methods.

   The goal of the study is to design a sample to estimate savings factors (installation rate) for electric energy savings and summer/winter peak demand savings. The target for annual energy savings will be set at the traditional ±10% at 90% confidence at the statewide level when sample results from four consecutive quarters of evaluation are combined (±10% at 80% confidence for peak demand savings). Given this framework, the PY2018/19 impact evaluation will require approximately one-quarter of the number of sample points that would be needed to meet the sampling targets in a single, non-staged impact evaluation.

2. **Review Third Party QC Data**

   DNV GL will continue to review and analyze the PAs' third-party QC data. The third-party QC vendor provides post-purchase inspection on approximately 10% of all facilities that purchased lamps. Their effort also focuses on installation of purchased lamps. The ongoing review of QC data along with the results from this impact evaluation will help the PAs better understand the reasons for lamps that are not being found or not being installed.

3. **Data Gathering and Analysis**

   Data collection will include physical inspection and inventory, interview with facility personnel, and observation of site operating conditions and equipment. At each site, evaluators will perform a facility walk-through that focuses on verifying the post-retrofit or installed conditions of each upstream lighting purchase. On-site evaluation procedures and site analysis will be presented in a spreadsheet for each sampled site. DNV GL will apply the model-assisted stratified ratio estimation methodology to aggregate the site results and expand to the study

[23] DNV GL. Massachusetts Commercial and Industrial Gross Impact Evaluation Framework prepared for the Massachusetts Program administrators and Energy Efficiency Advisory Council. May 19, 2017

population and other segments of interest.

4. **Report Writing and Follow-up**

   DNV GL will produce quarterly results memos following each phase of data collection. DNV GL will also provide the PAs with a written summary report containing the evaluation results and key findings following the completion of four consecutive quarters of impact evaluation.

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: $450,000 - $600,000 ($150,000 - $200,000 per quarter for 3 additional quarters)

Timeline: Q3 2018 – Q2 2019

B.4 IMPACT EVALUATION OF 2017 SMALL BUSINESS ELECTRIC INSTALLATIONS

Study Name: **Impact Evaluation of 2017 Small Business Electric Installations**

Study Champion: **Gail Azulay**

Research Area: **C&I Impact/NTG**

Type of Study: **Impact**

Study Lead: **To Be Determined**

Applicable Fuel(s): **Electric**

Underlying program/Initiative: **All C&I Programs/Initiatives**

Overall Study Goal:

The objective of this impact evaluation is to provide verification or re-estimation of electric energy and summer/winter peak demand savings estimates for a sample of small business non-lighting electric projects through site-specific inspection, monitoring, and analysis. The results of this study will be used to determine the final realization rates for small business, non-lighting electric energy efficiency offerings installed in 2019. Results will be determined at the overall statewide level. The evaluation sample for this study will be designed in consideration of the 90% confidence level for energy savings and the 80% confidence level for demand savings.

Value of Study:

This PY2017 study will focus on the non-lighting portion of small business since a full small business lighting impact evaluation was just completed in 2018. This study will require 2017 program tracking data from the PAs by August 2018 for sampling purposes. Data collection will take place between late 2018 and mid-2019 to capture the appropriate season for each sampled project with a summary report delivered in Q4 of 2019. In addition to producing new small business non-

lighting savings results, the study will provide findings and recommendations for implementation to consider in its small business program offerings.

High-Level Description of Approach/Methodology:

1. **Develop Sample Design**

   The goal of the study is to design a sample to estimate realization rates for small business, non-lighting electric energy savings and summer/winter peak demand savings. The target for annual energy savings will be set at the traditional ±10% at 90% confidence at the statewide level (±10% at 80% confidence for peak demand savings).

   Beginning in 2019, the small business sample design will combine both lighting and non-lighting and employ a multiyear staging approach as introduced in the Impact Evaluation Framework.[24] By implementing an ongoing multiyear staged evaluation of small business electric, this program offering will be evaluated on an annual basis. Staged evaluation involves the annual gathering of data after with an independent sampling conducted for that interval. The independent samples from multiple intervals can be combined using propagation of error methods. In the new framework, the target for annual energy savings will be set at the traditional ±10% at 90% confidence at the statewide level when sample results from three consecutive years of evaluation are combined (±10% at 80% confidence for peak demand savings). Beginning with the fourth year of staged evaluation, the pooling of results will drop the oldest year and pool the most recent three years of results.

2. **Develop Site Measurement and Evaluation Plans**

   DNV GL will develop measure specific measurement, verification and analysis (MVA) plans for each type of measure. The plans outline on-site methods, strategies, monitoring equipment placement, calibration and analysis issues. The PAs and EEAC will provide comments and edits to clarify and improve the plans prior to them being finalized.

3. **Data Gathering and Analysis**

   Data collection will include physical inspection and inventory, interview with facility personnel, observation of site operating conditions and equipment, short-term metering of usage and EMS trends. At each site, evaluators will perform a facility walk-through that focuses on verifying the post-retrofit or installed conditions of each energy conservation measure (ECM). On-site evaluation procedures and site analysis will be presented in a site report for each sampled site. DNV GL will apply the model-assisted stratified ratio estimation methodology to aggregate the site results and expand to the study population and other segments of interest.

4. **Report Writing and Follow-up**

   DNV GL will provide the PAs with a written summary report containing the evaluation results and key findings

[24] DNV GL. Massachusetts Commercial and Industrial Gross Impact Evaluation Framework prepared for the Massachusetts Program administrators and Energy Efficiency Advisory Council. May 19, 2017

following this round of small business non-lighting impact evaluation.

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: $500,000 - $750,000

Timeline: Q3 2018 – Q4 2019

B.5 EVALUATION OF INTEGRATED LIGHTING CONTROLS

Study Name: **Evaluation of Integrated Lighting Controls**

Study Champion: **Joe Bocanegra, National Grid**

Research Area: **C&I Impact/NTG**

Type of Study: **Various**

Study Lead: **To Be Determined**

Applicable Fuel(s): **Electric**

Underlying program/Initiative: **All C&I Programs/Initiatives**

Overall Study Goal:

The goal of this study is to characterize the current state and trajectory of the market for integrated lighting controls (ILC), from both supply and customer perspectives. This is a nascent technology with potential savings in the near term. Customer and supplier value is high but there are currently few manufacturers, and awareness and knowledge are limited on both the supply and customer sides. As a result, the potential for missed opportunity during construction or major renovations is high, and there's currently a valuable role for a program to play. As opportunities for savings from screw-in LEDs decline, ILCs may offer a large opportunity for programs. The largest manufacturer of ILC is based in Boston, making the technology particularly worthy of attention by Massachusetts programs.

Results from this study will support program design, establish a market baseline, contribute to gross savings baseline specifications, as well as indicating current free-ridership rates.

Questions to be addressed in the study include:

- Overall, what is the status and trajectory of the market for integrated lighting controls?
- What are the capabilities of the current technologies and what are anticipated improvements?
- What is the current market penetration of the technology by business and lighting type?
- How are these technologies being deployed?
- How are customers responding to the technology—what is their level of awareness, how are they using the technology?
- What are the current and projected market capabilities—supply level and trajectories
    - What is the level of manufacturing activity?
    - What is the state of distributor and contractor awareness, knowledge, and stocking?
- What are barriers to adoption?

Value of Study:

This study will help support program design in a currently nascent market with the potential for near-term savings. The study will provide insights on current adoption and awareness levels, on how the technology is being deployed and operated—including whether customers are using controls correctly---, on trade ally and customer experiences, and on barriers to adoption. The study will also establish a baseline against which market effects can later be measured.

The study will build on past and concurrent work, including:

> Project 22: Retrofit Lighting Controls Measures (P22): This 2013 study included a literature review, a tracking database review, a review of Massachusetts evaluation reports, and interviews with program managers.
>
> Project 58: Impact Evaluation of Upstream Lighting Programs (P58): This study conducted dozens of site visits with participating end users and identified opportunities for lighting controls for various LED technologies.
>
> Project 78: Upstream LED NTG (P78): In 2017 this project completed an onsite participant saturation study which included questions about lighting controls. It is also adding questions about lighting controls to a pending end user CATI survey.
>
> Project 81: Process Evaluation of C&I Upstream Lighting Initiative and Site Visits (P81) This study is launching quarterly onsite visits for participants in the Initiative. It is also about to launch in-depth interviews with nonparticipating lighting contractors and distributor which will include questions about lighting control awareness, use, and barriers to adoption.

Unlike these studies in which ILC is only one of many lighting technologies being studied, the proposed study will collect specific detailed information on these technologies. Also, the Evaluation team has not conducted interviews with lighting manufacturers concerning lighting controls for over 5 years. There are likely additional topics that could be addressed with them in brief.

High-Level Description of Approach/Methodology:

1. **Literature review on the technology capabilities and on market penetration other states.**
   We will review existing literature on the technology and the state of the market. Initial sources, which include additional references, are as follows:
   - Technology and market review & additional resources

     https://newbuildings.org/sites/default/files/LLLC_ZNE_TAG.pdf
   - Utility program:
     https://pse.com/savingsandenergycenter/forbusinesses/lighting/pages/business-lighting-program.aspx
   - Technology overview cut sheet:
     https://nwlightingnetwork.com/news/technology-corner-luminaire-level-lighting-controls/
   - Profile of products:
     https://nwlightingnetwork.com/app/uploads/2015/10/Luminaire-Level-Lighting-Controls_Rev.102015.pdf
2. **Review tracking data**
   We will review the available program tracking data to determine the prevalence of integrated lighting controls in the programs. Integrated controls are not directly identifiable in the data via measure codes. We will need to screen controls projects and review a sample of these individually.
3. **Conduct supply side interviews**
   We will interview manufacturers and compile information concerning lighting controls being collected by P81 from nonparticipating lighting distributors and contractors.

4. **Conduct interviews with recent purchasers**
   We will interview recent purchasers identified from tracking data to explore their motivation to install the technology, their satisfaction with it, how it's being used, and program influence.
5. **Supplemental data collection on concurrent studies**
   We will add one or two questions on this technology to the following field efforts that are launching shortly:
   - P78 Phase 1 general population customer screener surveys and Phase 2 onsite visits
   - P81 Quarterly onsite visits and nonparticipating lighting distributors/contractors.

   If necessary due to timing, these supplemental questions may be added to later surveys or visits under each study even if they're not ready to be included at the time of the data collection launch.

6. **Reporting**

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: To Be Determined

Timeline: Q4 2018 – Q2 2019

B.6 C&I MEASURE LIFE STUDY

Study Name: **C&I Measure Life Study**

Study Champion: **Tony Larson**

Research Area: **C&I Impact/NTG**

Type of Study: **Measure Life**

Study Lead: **To Be Determined**

Applicable Fuel(s): **Electric/ Gas**

Underlying program/Initiative: All C&I Programs/Initiatives

Overall Study Goal:

The purpose of this study is to provide the Massachusetts Program Administrators (PAs) and the Massachusetts Energy Efficiency Advisory Council (EEAC) with up-to-date evidence that can inform Estimated Useful Lives (EULs) and Remaining Useful Lives (RULs) for key C&I energy efficiency measures. This study will build upon the work already completed by Project 73, Track D: Measure Life Methods (P73 Track D) and will include both primary and secondary research.

Value of Study:

The recent P73 Track D study provided some useful deliverables including:

1) *Measure life methods literature review:* A findings memorandum covering current methodologies for estimating EULs and RULs. This memo not only summarized the current EUL/RUL methods but also described their strengths and limitations.
2) *Technical Reference Manual (TRM) benchmarking matrix:* This benchmarking matrix summarized the current measure life estimates for a few key measures which the PAs had identified including LEDs, roof-top unit (RTU) air conditioners, packaged terminal air conditioners (PTACs), variable frequency drives (VFDs), and boilers. The summary matrix summarized the EULs/RULs for these measures from over 40 different TRMs.
3) *A new analysis method for deriving measure lives from currently-installed equipment:* The P73 Track D team developed an innovative methodology for estimating measure lives based on information on the age mix of currently-installed equipment from manufacturer nameplates. This analysis used information on the age of installed unitary HVAC equipment from Project 41: The Massachusetts C&I Market Characterization On-Site Assessments and Market Share and Sales Trends Study (P41) as well as the Upstream HVAC Process Evaluation (P55).

However, the P73 Track D also identified some opportunities for useful follow-up research. This new C&I measure life study would supplement this P73 Track D research in the following areas:

1. Expanding the range of measures covered by the TRM benchmarking matrix
2. Enhancing the scope and rigor of the P73 Track D's methodology for deriving measure life estimates from installed equipment.
3. Interviewing lighting manufacturers about measure life methods
4. Devising methods to capture the age of replaced equipment from installation contractors and equipment recyclers.

The subsequent section describes these research activities.

High-Level Description of Approach/Methodology:

1. **Expanding the range of measures covered by the TRM benchmarking matrix**
   Due to budgetary and time constraints, P73 Track D's benchmarking matrix only covered six key measures (see list above), This research activity would expand this TRM benchmarking matrix to a dozen new measures.
2. **Enhancing the scope and rigor of the P73 Track D's methodology for deriving measure life estimates from installed equipment**
   Due to budget limitations, the P73 Track D only estimated EULs for unitary cooling equipment. However, there are also manufacturer nameplate data in the P41/P55 database for other key measures such as boilers, furnaces, water heaters, and chillers. So, this research activity would expand this analysis to other measures not covered by the P73 Track D study. The P73 D analysis also identified opportunities to improve the reliability of its EUL estimates. For example, about a third of the equipment in the P41/P55 database lacked manufacturer dates. This research activity would bound the age of this equipment with missing nameplates by incorporating information on building age from both the P41/P55 database and tax information from the C&I customer profiling work.
3. **Interviewing lighting manufacturers about measure life methods**
   The P73 Track D study did add a few questions about measure life methods to a 2017 interview guide for lighting manufacturers participating in the Massachusetts residential upstream lighting program. However, because these interview questions were part of a much longer interview guide being administered and funded by the Massachusetts residential evaluation team, the interviewers were unable to explore these measure life questions in much depth. In addition, the manufacturers sometimes identified alternative contacts for measure life information which the P73 Track D team was unable to follow up on due to time and budget limitations. This new study would interview representatives of 12 leading lighting manufacturers with a focus on a full and rich exploration of their methods for estimating the measure lives of their products. It would also target on manufacturer representatives who the previous lighting manufacturer interviews had identified as experts in this area.
4. **Devising methods to capture the age of replaced equipment from installation contractors and equipment recyclers**

All the PAs have installation contractors in their trade ally network which replace HVAC and lighting equipment on a routine basis. Some PAs like Eversource also use contractors to recycle replaced lighting equipment. The evaluation team would explore the feasibility of developing a "nameplate bounty" system which would compensate these installation contractors and recyclers for sending in photos (e.g. of the manufacture nameplates) of the equipment they replace. This would provide useful empirical information on the age mix of equipment being replaced. It could also provide useful information – such as the energy efficiency of the replaced equipment – that would be useful for other evaluation projects.

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: $150,000

Timeline: Q4 2018 – Q1 2019

B.7 INCREMENTAL COST EVALUATION STUDY

Study Name: **Incremental Cost Evaluation Study**

Study Champion: **Erik Mellen**

Research Area: **C&I Impact/NTG**

Type of Study: **Baseline, Impact, Net-to-gross**

Study Lead: **To Be Determined**

Applicable Fuel(s): **Electric/Gas**

Underlying program/Initiative: All C&I Programs/Initiatives

Overall Study Goal:

Measure installation cost are incorporated to benefit-cost tests used to screen measures and programs. Estimates of cost include two components: equipment cost and labor cost. Currently, the PAs use the following approach to account for the cost:

- Retrofit measure: the benefit cost test includes the full installed cost of the proposed EE equipment and labor
- Lost opportunity measure: the benefit cost test includes the incremental equipment cost differential between EE and baseline equipment/scenario
- Dual baseline measures: The PAs have an approach used in the residential sector for accounting for the cost of dual-baseline measures, however, it may be difficult to implement in CI because of the variety of products.

The evaluation team will investigate and identify alternate approaches to account for cost associated with dual-baseline EE measures which may be easier to implement consistently in CI. As a second part of this scope, the DNV GL team will research select measures to determine full installed or incremental costs as appropriate.

Value of Study:

Accurate measure costs are required to determine an accurate benefit cost ratio. This study will improve BCR reporting in two ways. First, it will lead to a formulation for dual-baseline costs which is appropriately accurate and that can be readily incorporated into the BC modeling tool used to report savings. Secondly, measure costs will be updated for select measures using multiple reference sources.

High-Level Description of Approach/Methodology:

1. **Work Plan Development**

   DNV GL team will work with the PAs and EEAC Consultants to develop a work plan and project schedule.

2. **Dual-baseline Cost Methods**

   The DNV GL Team will conduct on-line research to determine methods how dual-baseline costs are calculated in other jurisdictions and in the MA residential programs. DNV GL will present a straw person method that is appropriately accurate and works within the current BCR framework and a revised dual baseline framework. The results of the research will be incorporated into a memo for review and comment by the stakeholders. The DNV GL Team will facilitate a workshop with stakeholders to review the straw person recommendation and to reach a consensus on methodology.

3. **Primary Measure Cost Research**

   The DNVGL team will conduct cost research on four specific upstream measures.[25] The research will utilize four sources of information a) invoices from a sample of project files b) on-line research of product pricing c) use of a standardized pricing resource like RS Means and d) calls to three product distributors. The methods, findings, and results will be documented in a memo.

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: ~$75,000+

Timeline: Q3 2018 - Q1 2019

B.8 IMPROVING CUSTOMER PARTICIPATION IN EVALUATION STUDIES

Study Name: **Improving Customer Participation in Evaluation Studies**

Study Champion: **Joe Bocanegra, National Grid**

Research Area: **C&I Process**

Type of Study: **Process**

Study Lead: **To Be Determined**

Applicable Fuel(s): **All**

[25] Note that the specific measures selected will have an impact on cost with some measures (e.g. lighting) driving costs upwards from the current budget estimate.

Underlying program/Initiative: All C&I Programs/Initiatives

Overall Study Goal:

The goal of this study is to provide strategies on how to improve the participation of C&I customers in evaluation studies. The below research questions outline the key objectives:

- Why do customers choose to or choose not to participate in program evaluation studies?
- What strategies have worked or could work to overcome obstacles and boost participation?
- How do these obstacles and strategies vary across customers of different sizes or sectors, as well as the type of study?

Value of Study:

Some evaluation studies have encountered challenges in recruiting customers to participate which leads to higher recruitment costs and may yield samples that are not fully representative of the population. These studies typically involve research tasks such as in-depth interviews, telephone surveys, or onsite visits. By identifying strategies to improve customer participation in evaluations, this study should lead to both reduced evaluation costs as well as more robust evaluation results.

High-Level Description of Approach/Methodology:

We propose to complete a literature review of prior studies conducted on evaluation response rates in order to understand why customers elsewhere choose not to participate and identify best practices for improving response rates undertaken by other program administrators. Our second task will involve the analysis of any available data from Massachusetts C&I surveys regarding why customers refuse to complete the survey itself or to volunteer for subsequent onsite visits. If this data has not already been collected in prior surveys, we will work with project managers to incorporate a few simple questions into ongoing studies. Lastly, we will conduct about 30 in-depth telephone interviews with a variety of groups, including customers who have recently refused to participate as well as those who have recently agreed to participate in an evaluation study. In addition, we will interview PA account managers who have assisted in encouraging customers to participate as well as other evaluators in Massachusetts and elsewhere. The goal of these interviews will be to explore customer objections and understand which strategies have or could persuade them to participate. The overall report will integrate the findings from each task in order to identify strategies for improving participation in future evaluation studies.

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: $75,000 to $125,000

Timeline: Q4 2018 – Q1 2019

B.9 IMPACT EVALUATION OF PRESCRIPTIVE INSTALLATIONS

Study Name: Impact Evaluation of Prescriptive Installations

Study Champion: Whitney Brougher / Tony Larson

Research Area: C&I Impact/NTG

Type of Study: **Impact**

Study Lead: **To Be Determined**

Applicable Fuel(s): **Electric and Gas**

Underlying program/Initiative: **All C&I Programs/Initiatives**

Overall Study Goal:

The objective of this impact evaluation is to provide verification or re-estimation of electric energy and demand and/or natural gas savings estimates for a subset of Prescriptive projects through site-specific inspection, monitoring, and analysis. The results of this study will be used to determine new deemed savings values and/or savings parameters for selected Prescriptive energy efficiency offerings installed in 2017. Evaluation results will be determined at the statewide level. The evaluation sample for this study will be designed in consideration of the 90% confidence level for energy (kWh) and the 80% confidence level for coincident peak summer and winter demand (kW) or natural gas therms savings.

Value of Study:

This study will produce results for one or more prescriptive offerings that will be applied to projects installed in 2019. This study will require 2017 program tracking data from the PAs by August 2018 for data review and sampling purposes. Data collection will take place between late 2018 and mid 2019 to capture the appropriate season for each sampled project with a summary report delivered in Q4 of 2019. In addition to producing new deemed savings, baseline adjustments, or other savings factors, the study will provide findings and recommendations for implementation to consider in its offerings.

High-Level Description of Approach/Methodology:

1. **Program Tracking Data Review**
   The DNV GL team will review all 2017 prescriptive program tracking data and produce a summary of savings, both electric and gas, by end-use. This summary will be shared with the PAs and EEAC to determine if any prescriptive offerings have been or will be moved to an upstream delivery model, or if any other significant program changes have occurred. Following this investigation, a stakeholder meeting will be established to determine which prescriptive offerings should be evaluated in 2018/2019.
2. **Develop Sample Design**

   The goal of the study is to design a sample to provide new statewide deemed savings values and/or savings parameters for selected end-uses. For electric measures the primary variable of interest for the sample design is annual kWh savings, the PAs are also interested in coincident peak summer and winter kW because it is used in the ISO-NE Forward Capacity Market (FCM). The target for annual kWh will be set at the traditional ±10% at 90% confidence, while the target for summer and winter kW will be set at ±10% precision at 80% confidence during the design. For gas measures the sample design will be based on achieving ±10% precision at 80% confidence for annual therms savings.
3. **Develop Site Measurement and Evaluation Plans**

   DNV GL will develop end-use specific measurement, verification and analysis (MVA) plans for each selected measure type. The plans outline on-site methods, strategies, monitoring equipment placement, calibration and analysis issues. The PAs and EEAC will provide comments and edits to clarify and improve the plans prior to them being finalized.
4. **Data Gathering and Analysis**

Data collection will include physical inspection and inventory, interview with facility personnel, observation of site operating conditions and equipment, short-term metering of usage and EMS trends. At each site, evaluators will perform a facility walk-through that focuses on verifying the post-retrofit or installed conditions of each energy conservation measure (ECM). DNV GL will apply the model-assisted stratified ratio estimation methodology to aggregate the site results and expand to the study population and other segments of interest.

5. **Report Writing and Follow-up**

   DNV GL will provide the PAs with a written report containing the evaluation results and key findings.

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: TBD (Dependent on end-uses to be evaluated)

Timeline: Q3 2018 – Q4 2019

B.10 ONGOING UPDATES TO LED MARKET ADOPTION MODEL

Study Name: **Ongoing Updates to LED Market Adoption Model**

Study Champion: **Joe Bocanegra, National Grid**

Research Area: **C&I Impact/NTG**

Type of Study: **Baseline, Net-to-Gross**

Study Lead: **To Be Determined**

Applicable Fuel(s): **Electric**

Underlying program/Initiative: All Programs/Initiatives

Overall Study Goal:

This effort will provide updates to the C&I LED adoption model using available data on the rapidly changing C&I lighting market. Beyond incorporating updated market information, the evaluation team will also add additional model functionality and increase the diversity of lighting technologies included in the model.

Value of Study:

The initial LED market model developed under Project 75 formed the framework for forecasting future market conditions such as market share, net savings, and saturation with and without program influence. These forecasts can be used to inform program planning and evaluation efforts including baseline and net-to-gross research. Refreshing the model with more recent data points will increase the validity and further refine the model forecasts helping to better address nuances in the market. Expanding the functionality of the model will more accurately characterize actual market trends. As the PAs

seek to achieve high savings from C&I lighting in the next three-year plan, updating the market model as noted will help the PAs understand remaining opportunities and anticipate how program changes could impact future savings.

High-Level Description of Approach/Methodology:

1. **Work Plan Development**
   As part of the work plan process, the DNV GL team will hold a working group meeting with the PAs and EEAC to discuss which updates to the model should be prioritized. Prior to this meeting, DNV GL will review internal and external research and then develop a list of potential input and functionality updates. The team will describe how these updates and changes will impact the model and any additional data needs required for the update. At the working group meeting, DNV GL and the PAs and EEAC will decide what updates to pursue in this scope of work. DNV GL will then develop a work plan describing those updates.

2. **Model Input Data Updates**
   Under this task, DNV GL will update key model parameters, as determined during the working group meeting. These updates could include incorporating recent Massachusetts or other market research such as:
   - LED and non-LED prices and labor costs to refine the benefit-cost ratio estimates for related equipment.
   - Wattage and efficacy forecasts to improve the consumption and savings calculations
   - Measure lifetime retrofit rates (the annual percent of operating lamps expected to be replaced early), and application-specific hours of use to improve stock turnover forecasts in replace on failure and retrofit events
   - Incentive levels to improve the estimates of the benefit-cost ratio of program-eligible equipment
   - Program marketing budgets which influence the level of program awareness amongst eligible participants
   - Saturation and market share data to re-calibrate and check model baseline assumptions and technology adoption curves

3. **Model Functionality Updates**
   Under this task, DNV GL will expand the model's functionality, as determined during the working group meeting. These updates could include:
   - Adding additional lighting technologies or applications such as fixtures, controls, and high/low bay lighting
   - Updating the model to be based on lumens/square foot to better address lamp to fixture replacements or lamp quality
   - Include multiple program or no-program scenarios
   - Considering price elasticity and consumer choice in the adoption curve approach
   - Hosting the results dashboard on DNV GL's Veracity platform allowing for easier access and exploration for additional market insights

4. **Future Update Planning:**
   Revisit work completed under this scope of work and anticipated future market research to plan for future improvements.

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: $60,000-$150,000 (varies based on updates determined in working group)

Timeline: To Be Determined

B.11 C&I BASELINE SATURATION STUDY – ON-SITE INVENTORY ASSESSMENT

Study Name: **C&I Baseline Saturation Study – On-site Inventory Assessment**

Study Champion: **Gail Azulay, Cape Light Compact**

Research Area: **C&I Impact/NTG**

Type of Study: **Baseline**

Study Lead: **To Be Determined**

Applicable Fuel(s): **Electric/Gas**

Underlying program/Initiative: **All C&I Programs/Initiatives**

Overall Study Goal:

The C&I baseline study update will compile a detailed inventory of electric and gas measures. The study will assess the baseline efficiency for measures, identify the penetration of energy efficiency measures within customer business types and analyze trends in sales data. The study will identify the measures and business types that offer the greatest opportunities to capture efficiency improvements.

Value of Study:

The C&I Baseline Saturation study will build on the prior baseline study (conducted in 2014/15) to provide a clear understanding of the composition of electric and gas measures and sales trends for end-use equipment in the existing C&I building market in Massachusetts. The results of this study will help shape the programs and initiatives offered by the PAs.

High-Level Description of Approach/Methodology:

The study will be designed to build upon the data collection instruments and analysis framework developed for Massachusetts C&I Market Characterization On-site Assessment. The study will include the following tasks:

1. **Work Plan**
   Develop a detailed work plan including framework for the sample design, a description of analysis plan and a detailed outline of report and results dashboard.

2. **On-site Data Collection**
   a. **Sample Design**
   This study will construct a stratified sample design based upon electric and gas usage, business type and business size (square footage) from the PAs billing records and tracking data. The sample design will leverage the electric and gas account matching analysis completed under the Massachusetts Data Management Contract to develop a sample frame that incorporates gas usage as well as electric usage.

   b. **Develop Data Collection Instrument**
   Modify the on-site data collection instrument used in 2016 study to reflect the specific mix of end-use equipment and other information identified in the study's work plan.

   c. **Customer Recruitment and On-site Data Collection**
   Recruit customers for on-site visits and conduct the site visits.

3. **Delphi Panel**

   We will conduct a Delphi panel or series of panels, if warranted, to provide additional insight and information about the saturation of high efficiency equipment across market segments. The panels will be comprised of industry stakeholders which may include C&I customers, engineers and contractors and/or building managers.
4. **Data Analysis**
   Conduct the analysis of on-site data and results of Delphi panel(s) results and develop a results dashboard. To facilitate a deeper understanding of the results we will link the data to an accessible PowerBI dashboard that will enable users to select specific business types, sizes and/or usage levels and view the corresponding results.
5. **Reporting**
   We will provide a draft and final report as described in the work plan.

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: $2,000,000 - $5,000,000 depending upon the number of on-sites

Timeline: To Be Determined

B.12 ONGOING C&I INDUSTRY STANDARD PRACTICE RESEARCH & REPOSITORY

Study Name: **Ongoing C&I Industry Standard Practice Research & Repository**

Study Champion: **Whitney Brougher**

Research Area: **C&I Impact/NTG**

Type of Study: **Baseline, Impact, Net-to-gross**

Study Lead: **To Be Determined**

Applicable Fuel(s): **Electric/Gas**

Underlying program/Initiative: All C&I Programs/Initiatives

Overall Study Goal:

The primary objective of this study is two-fold:

- Repository upkeep, which includes a formal roll-out of the Baseline Repository with educational outreach to potential stakeholders, incorporation of new data, and further refinement of procedures.
- Conduct ISP research for measures prioritized in the initial populating of the Baseline Repository

The scope of work of the Repository is to determine if secondary ISP research exists for the candidate. After the secondary research is completed, measures will be prioritized for ISP research. This scope of work is intended to conduct the research for select prioritized measures

Value of Study:

The Massachusetts Baseline Framework established ISP baselines for lost opportunity measures with the exception of those cases where a measure is unique. The Repository team will have initially populated the Repository. This project will update the baseline with new data from P79/P80, refine select protocols, and reach out, as directed by PAs, to stakeholder groups to ensure that they are aware of the Repository and understand how to use it and what the implications are when it is not used. Research will be conducted for four high priority measures identified in the initial population of the Repository.

High-Level Description of Approach/Methodology:

1. **Work Plan Development**

   DNV GL will work with the PAs and EEAC Consultants to develop a work plan and project schedule.

2. **Repository Upkeep**

   The Repository Team will have established the Baseline Repository and populated with measures present in the current Mass Save lists and nominated from the P79 and P80 impact evaluations. Additional work remains to update the Repository with new information and refine protocols. The work includes:

   - Update measures introduced by P79/80 with the proxy ISP baseline that was used in the ex post evaluation.
   - Refine select protocols, which may include: criteria for establishing 'reasonable' baselines when ISP research is not available nor likely warranted in ex post evaluation, interpretation of baseline status
   - Establish an annual repository update schedule
   - Socialize the findings through three (3) webinars and (1) onsite presentation.

   The DNV GL team will draft a straw person document which will outline protocols and procedures for the ISP events listed above. After a period of review and comment, the DNV GL team will finalize the document. The DNV GL Team will offer to present the findings to stakeholders, as identified by PAs, to propagate the correct usage of the Repository.

3. **ISP Research**

   The Repository team is in the process of reviewing the availability of ISP research for the initial set of measures. At the conclusion of this research, measures for which there is no existing ISP will be prioritized for high or low rigor research based on the uncertainty of the baseline and the magnitude of the contribution to program savings. The scope of this work will be to conduct:

   - High rigor ISP research for one measure
   - Low rigor ISP research for three measures

   At the conclusion of the research, the methods, results, and findings will be documented in four memos, one for each measure.

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: $50K - $100K

Timeline: Q3 2018 – Q1 2019

C. SCC STAGE ONE PLANS

C.1 CONTINUATION OF CCSI IMMEDIATE SURVEYS AND ON-LINE FOLLOW-UP SURVEYS

Study Name: **Continuation of CCSI Immediate Surveys and On-line Follow-up Surveys**

Study Champion: **Joseph Bocanegra**

Research Area: **Special & Cross-cutting (Codes & Standards)**

Type of Study: **Process**

Study Lead: **TBD**

Applicable Fuel(s): **Electric and Gas**

Underlying program/Initiative: Code Compliance Support Initiative (CCSI)

Overall Study Goal:

The objective of immediate surveys is to (1) continue to document the effects of the CCSI trainings and other efforts for use in the attribution process for residential and commercial code compliance savings, and (2) to help PAs ensure that the training reaches is wide an audience as is appropriate and is as effective as possible by continuing to assess the new implementer's training efforts.

Value of Study:

The audience for this study is evaluation and implementation staff of Massachusetts Program Administrators (PAs), the PAs' implementation contractors, and the Massachusetts Energy Efficiency Advisory Council (EEAC). The surveys that trainees will take immediately following the training provide rapid feedback on the quality of the trainings, usefulness of various parts of the trainings, and identify differences from previous years that could point to improvements that are needed or were achieved. The follow-up surveys assess the degree to which information learned at the trainings affected building practices and code enforcement. Findings from both the immediate and follow-up surveys are expected to be factored into assessing attribution of savings from code compliance to the CCSI in 2020 or 2021.

High-Level Description of Approach/Methodology:

Task 1: Develop Immediate and Follow-up Survey Instruments

NMR (residential) and Cadmus (commercial) will develop follow-up on-line survey instruments based on the in-depth interview guides used in 2017. We will meet with the PAs and EEAC to ensure that the follow-up guides cover issues the PAs and EEAC wish to address and omit any questions that do not provide valuable feedback. We will modify the immediate survey instruments currently in use to cover the areas included in future trainings and any other pertinent issues.

Task 2: Data Gathering and Analysis

The evaluation team expects the implementer's instructors to provide trainees with the immediate survey paper forms to be filled out and collected at the end of each classroom training, following the current practice. The instructors will inform trainees to expect a follow-up survey, with incentive, at a future date, and encourage them to respond to it.

For the follow-up survey, the team proposes to field on-line surveys instead of the previous approach of in-depth interviews. The purpose of this change is to increase the completed sample size, and thus the generalizability of results. The

evaluation team will email links for the on-line follow-up surveys to trainees approximately six months after they attended a training, with a gift card upon completion as an incentive. The team will contact respondents through email and telephone, as needed, until a sufficient number of surveys is completed. Our goal is to have completed surveys from at least 60% of unique attendees.

Task 3: Reporting

The evaluation team will provide the PAs and EEAC with two written reports summarizing the findings from the follow-up surveys (one for residential trainings, one for commercial trainings). We will also provide memos summarizing the findings from the immediate surveys at the end of every four trainings, or at different intervals if desired by the PAs and EEAC. The memos will include data collected by the implementer through registrations and questions posed during the trainings. The budget assumes four immediate survey memos (two residential and two commercial).

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: Approximately $160,000 to $200,000

Timeline: January 2019 through December 2019

C.2 C&I NEI ESTIMATION STUDY

Study Name: **C&I NEI Estimation Study**

Study Champion: **Chris Chan**

Research Area: **Special & Cross-cutting (NEIs)**

Type of Study: **NEI**

Study Lead: **TBD**

Applicable Fuel(s): **Electric/Gas**

Underlying Program/Initiative: **Non-residential Retrofit and Non-residential New Construction**

Overall Study Goal:

This Stage One work plan addresses Phase 1 of a two-phase study to provide the PAs with an up-to-date, comprehensive set of NEI values associated with the Massachusetts Program Administrators (PA) Commercial and Industrial (C&I) energy efficiency (EE) programs. The results of the study will be used in regulatory cost-benefit analysis and program sales and marketing. The Phase 1 Scoping study will address the following research objectives:

- Identify the set of C&I measures, initiatives, and corresponding NEIs that require updates or lack NEIs. Prioritize these NEIs.
- Identify the most appropriate and cost-effective set of research techniques for developing NEI estimates for the prioritized NEIs and identify data that are currently available for updating these NEIs.
- Develop a research plan for completing the Phase 2 NEI research.

Value of Study:

This study will develop a plan for estimating NEIs that can be attributed to the C&I Retrofit and New Construction programs and replace on failure measures. It will establish a research agenda that assesses the existing gaps in NEI research and NEIs resulting from changes to programs and measures, and how those measures interact with program participants' costs and revenues.

High-Level Description of Approach/Methodology:

Task 1. Identify gaps in NEI research that include missing (zero), outdated, or new NEIs for the PAs' existing (2018) and proposed (2019-2020) C&I programs, initiatives, and measures

This research task will review the PAs existing and planned C&I portfolio to isolate those programs, initiatives, and measures for which there are no NEI values, or the existing NEI values are outdated.

Task 2. Identify the best practices for updating or filling the gaps in the NEIs RESEARCH

Both the 2012 interview-based study and the 2014 engineering-based studies developed innovative techniques for computing NEIs based on primary and secondary research. Some of the gaps identified through Task 1 may only require updates to existing parameters from these studies. For example, the retrofit study found that O&M cost savings represented roughly 80% of reported NEIs, but this may have been a function of the target respondent (e.g. facility manager or engineer), who may not know about other potential NEIs, such as revenue changes. The 2014 new construction

study used engineering analysis to estimate O&M cost savings, but that study was limited to true new construction, and excluded replace-on-failure and upstream measures. Through our on-going research in Ohio and Michigan, DNV GL has mapped the life-cycle costs of most lighting technologies and a wide range of other technologies in new construction and retrofit applications to estimate NEIs associated with O&M cost savings. Adapting these estimates to the existing stock of Massachusetts programs and measures may require an adjustment to the NEI value, provided the measures are consistent across the studies. This task will assess the range of approaches available for estimating NEIs identified in Task 1 and identify the recommended best practices.

TASK 3. Prioritize filling the gap in the NEIs research

This task will prioritize NEIs that warrant further research in Phase 2 based upon the expected cost to undertake the NEI research and expected range of NEI values (based on existing research). As an optional activity, this task may include interviews with stakeholders (PA staff, DOER, and others) to identify those program, initiatives, measures, and customer segments that stakeholders may prioritize for reasons other than benefit-cost ratios (e.g. policy reasons, customer satisfaction, etc.).

Task 4. Develop a research plan for completing the Phase 2 NEI research

This task will develop a detailed plan for filling gaps in NEI research using the identified best practices.

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: $30,000-$50,000 depending upon whether the Evaluation Team chooses to conduct stakeholder interviews.

Timeline: Q1 2019 – Q3 2019 - depending upon whether the team choses the interview option.

C.3 MASS SAVE BRAND AWARENESS AND ENGAGEMENT STUDY

Study Name: **Mass Save Brand Awareness and Engagement Study**

Study Champion: **Gail Azulay**

Research Area: **Massachusetts Cross-Cutting**

Type of Study: **Process: Marketing assessment**

Study Lead: **TBD**

Applicable Fuel(s): **Electric/ Gas/Oil/Propane**

Underlying program/Initiative: **All**

Overall Study Goal:

The goal of this study is to continue assessing Mass Save brand awareness and whether that awareness has changed due to campaign changes. This study will identify metrics for the marketing campaign's success based on movement from awareness of the brand, to the knowledge of Mass Save programs, to actively participating in those programs. The study will also explore customers' understanding of Mass Save sponsorship, their satisfaction with the redesigned website, and gain their perspective on how programs and Mass Save marketing can help increase awareness of both the Mass Save brand overall as well as specific programs offered by Mass Save.

Value of Study:

This study will continue to track key metrics longitudinally. Since the marketing team uses these metrics to plan their subsequent campaign, we will continue conducting an awareness survey. However, we will shift the study scope and methods to begin tracking where customers are in a continuum from Mass Save brand and specific program awareness, to intention to make a behavior change to actual behavior change – participation in Mass Save programs. Using the Theory of Planned Behavior as a framework, and working with MA PAs and stakeholders, we will create a set of metrics to track the effectiveness of Mass Save – now an established brand. At the end of the study, PAs will have a set of updated marketing assessment metrics, a deeper understanding of how customers view Mass Save and who sponsors it, customers' perception of the redesigned website, and recommendations on how marketing can motivate customers to participate in Mass Save programs.

The evaluation team will work with the PAs and implementation team to identify which metrics are critical for longitudinal comparison, and which can be altered to mitigate any potential risks.

High-Level Description of Approach/Methodology:

Marketing and behavior change literature review and stakeholder workshop. The evaluation team will review behavior change and marketing literature to collate a series of preliminary metrics that track customers' journey from awareness to a target behavior – program participation. The team will then conduct a stakeholder workshop to isolate the key metrics most useful for tracking Mass Save's ability to change customer behavior. We will use the metrics to design a customer survey guide and an in-depth interview guide.

In-depth online customer interviews. To gain an in-depth understanding of how customers perceive the Mass Save brand, who sponsors it, and whether it motivates them to participate in programs, we will conduct a small set of online, video-enabled interviews with residential and commercial customers. Video-enabled interviews will allow us to display marketing material and the Mass Save website, which will provide a qualitative assessment of the long-term marketing campaign.

Awareness survey. We will survey MA residential and commercial customers but reduce the sample sizes of the survey to be more cost-efficient. Further, the survey will shift from focusing predominantly on awareness to how that awareness can induce behavior change.

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: **$**150,000-$300,000

Timeline: 2019

C.4 RESIDENTIAL NEW CONSTRUCTION COMPLIANCE/BASELINE STUDY

Study Name: **Residential New Construction Compliance/Baseline Study**

Study Champion: **Scott Dimetrosky**

Research Area: **Special & Cross-cutting (Codes & Standards)**

Type of Study: **Baseline and Code Compliance**

Study Lead: **TBD**

Applicable Fuel(s): **Electric/ Gas/Oil/Propane**

Underlying program/Initiative:

Residential New Construction (RNC) and the Code Compliance Support Initiative (CCSI)

Overall Study Goal:

The goals of this work are as follows:

1. To update the User Defined Reference Home (UDRH) for the RNC program.
2. To calculate code compliance rates for stretch code and non-stretch code municipalities.
3. To develop key inputs and background information for a future RNC/CCSI net-to-gross (NTG) study.

Value of Study:

The Massachusetts RNC program UDRH was last updated as part of the 2015/16 Single-Family Code Compliance/Baseline Study.[26] It is important that the PAs update the UDRH periodically as the RNC market is frequently changing, in part due to code requirements being updated on a three-year cycle in Massachusetts. In addition to updating the RNC program UDRH, this study will assess compliance levels with the new stretch code and base code (2015 IECC) requirements that went into effect on January 1, 2017. These results will be used to ensure that the RNC program is accurately calculating gross savings for program participants. They will also be used to update the net-to-gross (NTG) ratio for the RNC and CCSI programs for the 2022-2024 program period as part of a future study.

High-Level Description of Approach/Methodology:

The evaluation team will conduct on-site inspections with 100 new single-family homes as part of this study. The evaluation team will split the sample equally between stretch code municipalities and non-stretch code municipalities to measure the impact of new code requirements on new construction building practices. Each on-site inspection will include a full Home Energy Rating System (HERS) assessment, which includes a detailed energy model for each home inspected.

The energy models will be used to calculate code compliance rates using the Massachusetts Residential Evaluation Contractor (MA-REC) compliance methodology. This approach calibrates code compliance to energy consumption by using simulated energy consumption results.

[26] http://ma-eeac.org/wordpress/wp-content/uploads/Single-Family-Code-Compliance-Baseline-Study-Volume-5-2.pdf

After completing on-site inspections and data cleaning, the team will develop new specifications for the RNC UDRH.

Alternative Lower Cost Option

The evaluation team could conduct a series of building department visits in lieu of on-site inspections. Stretch code municipalities, in particular, should have detailed HERS rating information for each new home that would specify many of the efficiency values typically collected during the on-site inspections. Non-stretch code municipalities may have this information, but likely not as frequently, since HERS ratings are not required. This approach would not provide the level of detail or confidence that the on-site inspections would, but the team could develop estimated baselines and compliance figures using this approach. The team would need to build energy models based on the building department documentation in order to calculate compliance and have energy models available for a future NTG study.

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget: Onsites: Approximately $250,000 to $350,000
Alternative Lower Cost Option (Building Department Visits): Approximately $75,000 to $125,000

Timeline: January 2019 through December 2019

C.5 CONSISTENT METHODOLOGIES FOR SELF-REPORTED RESIDENTIAL NTG

Study Name: **Consistent Methodologies for Self-Reported Residential NTG**

Study Champion: **Tabitha Vigliotti**

Research Area: **Special & Cross-cutting (NTG/Market Effects)**

Type of Study: **Net-to-gross**

Study Lead: **TBD**

Applicable Fuel(s): **Electric/ Gas/Oil/Propane**

Underlying program/Initiative: **All residential initiatives**

Overall Study Goal:

Assess prospects for developing consistent methodologies for self-reported (SR) residential net-to-gross (NTG) for Massachusetts. Clearly identify the range of residential program delivery approaches and situations that such methodologies should cover, and identify special situations to address, such as early replacement and real-time data collection. Develop consistent methodologies for the program types and delivery methods for which the initial results indicate that consistency is feasible, while respecting differences that suggest a need for methodological diversity.

Value of Study:

Assessing NTG ratios using participant self-reports is a common practice for residential program evaluations in Massachusetts. Unlike the guidance for C&I free-ridership and spillover measurement,[27] Massachusetts NTG guidance for residential programs[28] does not specify the self-reported (SR) algorithms for measuring free-ridership, participant spillover, or non-participant spillover. The recent Massachusetts report *Net-To-Gross Methodology Research*[29] recommended expanding the residential guidance to include specific questions and algorithms for different program types. This study will fulfill this recommendation. Further, the study will identify potential areas of cross-study overlap – such as potential spillover being counted as savings from another program – and mitigate those risks.

High-Level Description of Approach/Methodology:

Task 1: Establish advisory group. Convene a group of NTG experts to inform the work from its inception. The primary role of this group, and of the PAs and EEAC, is to provide insight to the team to ensure they focus on the highest priority issues within the limited budget and timeframe of this study.

Task 2: **Plan and conduct literature review.** Informed by the program plans, and with input from PA stakeholders and the NTG experts group, develop listings of different residential program delivery channels and types of participation situations, and issues that should be considered (for example, the range of different groups that would qualify to self-report (SR) NTG and how to handle different levels of decision-makers, such as tenants versus landlords; NTG measurement for replace-on-failure versus early replacement; and the implications to SR NTG of collecting data over time, closer to program participation, rather than just towards the end of a cycle). With input from the NTG experts and PA stakeholders, identify jurisdictions that warrant research into SR NTG, and possible sources such as specific TRMs and exemplary NTG evaluations. Conduct a literature review to identify and compile relevant SR NTG approaches and algorithms from these jurisdictions, including leveraging Massachusetts.

Task 3: Determine categories or types of programs for which to develop SR NTG methodologies. Summarize the results of the literature review in a memo for the experts group. This memo should identify the best ideas from the literature review, noting how other jurisdictions address the issues previously identified as needing consideration. It should also offer a preliminary assessment of the categories or types of programs for which it should currently be feasible to develop consistent SR NTG measurement methodologies, with justification for the assessment. Using the information presented in the memo, lead the NTG experts group in a prioritization process to develop final recommendations for the PAs of the categories or types of programs on which to focus development of consistent measurement methodologies, and over what time frame.

Task 4: Develop methodologies and SR NTG algorithms for selected categories or types of programs, addressing issues previously identified. Taking into account each of the categories or types of programs and the different groups that would be expected to self-report their NTG, develop a SR NTG method or methods, including high-level outlines of an algorithm or

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[27] Tetra Tech; KEMA; NMR Group, Inc. (2011). *Cross-Cutting (C&I) Free-Ridership and Spillover*

Methodology Study Final Report. Massachusetts Program Administrators.

[28] NMR Group, Inc. and Tetra Tech (2011). *Cross-Cutting Net to Gross Methodology Study for Residential Programs –Suggested Approaches.* Final report prepared for the Massachusetts Program Administrators.

[29] Tetra Tech (2017). *Net-to-Gross Methodology Research—TXC08.* Prepared for the Program Administrators of Massachusetts.

algorithms, with enough flexibility to address differences in program types, gross baseline issues, delivery methods, and respondent types, and that could be applied closer to participation/real-time. The method(s) and algorithm(s) should address energy optimization to the extent this is identified as needed in the outcome of the study "Initial Guidance for Attribution/NTG in Conjunction with Energy Optimization" planned to start in 2018. Take into consideration the issues identified previously, such as the early replacement/replace-on-failure algorithm. As the team develops these methods, periodically check in with the NTG experts group to obtain guidance and preliminary input on the methods and algorithms.

Task 5: Refine the methodologies and algorithms and deliver final product. Present the draft methods and algorithms to the NTG experts group and obtain feedback to refine the method(s), algorithm(s), and recommendations. Then present the refined draft methods and algorithms to PA stakeholders for input. Deliver a final report to PA stakeholders based on their feedback and any additional feedback from the NTG experts group.

Implementation Review:

This plan has been reviewed by implementation and comments have been incorporated.

Budget:	$80,000 to $120,000
Timeline:	January 2019 through November 2019

D. PRIORITIZATION FRAMEWORK

Indicator	Type	Definition	Scoring Definition: Scale of 1-5	Weight Type		
				1*	2*	3*
Magnitude of Savings (kWh, Therms, or MMBtu-Oil)**	Relevance (Quantitative)	Percent of sector savings (lifetime kWh, Therms and/or MMBtu***) for most recent year from Mass Save data. Include interactive savings if they are material.	1: <1% of sector 2: 1%–<3% 3: 3%–<5% 4: 5%–<10% 5: =>10%	10	5	0
Magnitude of Savings (kW-S)	Relevance (Quantitative)	Percent of annual sector savings (kW) for most recent year from Mass Save data.	1: <1% of sector 2: 1–-<3% 3: 3%–<5% 4: 5%–<10% 5: =>10%	6	3	10
Age of Most Recent Study	Relevance (Quantitative)	Age of most recent study (same program/same type), based on the year the study was finalized.	1: 2018 2: 2017 3: 2016 4: 2015 or before 5: No prior study	7	4	7
Expected/ Potential Future Savings Trend	Relevance (Qualitative)	Expected change in percent of sector savings for study period.	*Score from 1 to 5 with following guideposts:* 1: Sharply declining 3: Similar to current levels 5: Sharply increasing	9	7	9
Market/ Technology/ Baseline Shifts	Uncertainty	Expected or recent market, technology, baseline or methodology changes that would lead to need for new research.	*Score from 1 to 5 with following guideposts:* 1: No market/technology changes 3: Some changes 5: Substantial changes	9	9	9
Program Implementation Changes	Uncertainty	Recent or anticipated changes in program implementation that lead to need for new research (e.g. new program or new delivery mechanism)	*Score from 1 to 5 with following guideposts:* 1: No program changes 3: Some program changes 5: Substantial program changes, or new program	5	10	5
Impact Factors Uncertainty	Uncertainty	Concerns about uncertainty in impact factors that lead to need for new research (e.g., adjusted gross savings, deemed savings, realization rates, NEIs)	*Score from 1 to 5 with following guideposts:* 1: Very Low uncertainty (very high confidence) in current value 3: Some uncertainty 5: High uncertainty or no existing value	7	5	7
Regulatory Requirement/ Political Sensitivity	Priority	Regulatory or political needs for conducting a study	1: No requirement/sensitivity 3: Medium priority requirement/ sensitivity 5: High priority requirement/sensitivity	6	6	6
Implementation Requests	Priority	Requests from implementation team or other internal organizational need	1: No request 3: Medium priority request 5: High priority request	6	6	6

*Weight 1 used for the following studies types: baseline, impact, cost, market effects, measure life, NEIs, and NTG. It is also used for combination studies if a market characterization or process component is integrated into the study. Weight 2 used for market characterization and process. Weight 3 used for DR studies.

**If both gas and electric, then maximum rating is used for savings magnitude. Oil studies are rated with electric studies, therefore magnitude of savings (% of sector MMBtu) is input in electric column. User may combine both electric and oil into MMBtu if relevant.

*** Scoring will be updated and reassessed as needed, in particular for changes to savings metrics for 2019–2021.

Appendices

T. **Evaluation Study Summaries**

EVALUATION STUDY SUMMARIES

Table of Contents

Study 1: Products Net-to-Gross Report

Type of Study: Net-to-Gross Evaluation

Evaluation Conducted by: NMR Group

Date Evaluation Completed: 10/5/2018

Study Objective and Summary of Results:

The objective of this study was to develop and set prospective net-to-gross ratios (NTGRs) for a variety of products included in the 2019 to 2021 program plan.

The table below presents the prospective NTGRs for the products researched by NMR for RLPNC 18-4.

Recommended Prospective NTGRs

	2019	2020	2021
Recommended Product NTGRs for Program Planning			
Freezers	60%	58%	56%
Room Air Cleaners	71%	68%	65%
Clothes Dryers	57%	54%	51%
Dehumidifiers	61%	58%	55%
Room Air Conditioners	63%	63%	63%
Pool Pumps	95%	93%	91%
Tier 1 Advanced Power Strips*	100%	100%	100%
Tier 2 Advanced Power Strips – Infrared**	100%	100%	100%
Tier 2 Advanced Power Strips – Infrared & Occupancy Sensor**	100%	100%	100%
Temperature Sensing Showerheads	97%	97%	97%
Refrigerators***	N/A	N/A	N/A
Clothes Washers***	N/A	N/A	N/A
Dishwashers***	N/A	N/A	N/A

*The Tier 1 APS NTG values apply to both the Retail and Home Energy Services Initiatives.

**While multiple technological differences exist between the two Tier 2 APS technologies, for the sake of simplicity we use infrared (IR) and infrared-Occupancy Sensing (IR-OS) as the defining terminology to distinguish between strip types throughout this report. The evaluation team chose the terminology because the presence of an occupancy sensor is a clear technological difference and to remain consistent with previous literature (for example, see: "Energy Savings of Tier 2 Advanced Power Strips in Residential AV Systems," *Prepared for Pacific Gas and Electric by AESC, Inc.* (Feb 2016).

***As refrigerators, clothes washers, and dishwashers are not included in the 2019-2021 plan, the consensus panel deferred conversation on these products.

Core Initiatives to which the Results of the Study Apply:

- Residential Retail (Electric & Gas)
- Residential Coordinated Delivery (Electric Only)

Evaluation Recommendations:

No formal recommendations were made in this evaluation.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

N/A (no formal recommendations were made in this evaluation)

How the Study Affects Program Results and Its Significance:

The results of this study are being used to inform program design and planning. Specifically, this study provided prospective estimates for NTGRs for a wide variety of consumer products.

Overview of Study Method:

NTGRs were developed through a consensus process where a panel of experts, including: the Program Administrators, the Energy Efficiency Advisory Council consultants, and NMR reviewed historical NTGR estimates, including self-reported (primary research conducted with participants in Massachusetts and primary research conducted in other jurisdictions), and ENERGY STAR® market share data to help inform prospective estimates.

After reviewing materials, the consensus panel members developed their own predictions of NTGRs for 2019 to 2021. During a webinar in June 2018, the panel met to discuss predictions and worked together to agree on prospective NTGRs for products included in the 2019-2021 plan. The group loosely followed a set of guidelines in determining the ultimate prospective NTG values to be applied, as follows:

- Utilize values from primary research conducted in Massachusetts (when available) as a starting point
- Utilize national ENERGY STAR market share data (1 – ES Market Share) = NTG as a starting point when primary research conducted in Massachusetts was not available[1]
- Compare the NTG values implied by the market share approach to the NTG values gleaned from the literature review, when primary research conducted in Massachusetts was not available

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 1.

[1] The EPA provides ENERGY STAR Market Share data, which they receive from partner manufacturers.

Study 2: LED Net-to-Gross Consensus Panel Report

Type of Study: Net-to-Gross Evaluation

Evaluation Conducted by: NMR Group

Date Evaluation Completed: 6/30/2018

Study Objective and Summary of Results:

The study relied on a consensus-building process to develop prospective net-to-gross (NTGRs) for the Residential Retail Initiative for 2019 to 2021 for the following LED types:

- Standard (medium screw base, meant to reflect A-line bulbs)
- Reflector/floods
- Specialty (focused on globe and candelabra bulbs)
- LED fixtures, based on the NTGR of the most similar bulb type

The consensus process yielded recommended NTGRs for 2019 to 2021 for LED bulbs. The table below provides these results:

	2019	2020	2021
Recommended Upstream Bulb NTGRs for Program Planning			
Standard	35%	30%	25%
Reflector	45%	40%	35%
Specialty	45%	40%	35%
Recommended Upstream Fixture NTGRs for Program Planning			
General service fixtures	35%	30%	25%
Reflector fixtures & downlight kits	45%	40%	35%
Specialty fixtures (lumens < 310 or >3300)	45%	40%	35%

Core Initiatives to which the Results of the Study Apply:

- Residential Retail (Electric Only)

Evaluation Recommendations:

Recommendation 1: The study recommended that the PAs use the prospective NTGRs in the table above for program planning.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs plan to adopt the recommendations.

How the Study Affects Program Results and Its Significance:

The PAs will apply the recommended NTGRs in planning for the 2019 and 2021 cycle. These prospective values will remain in place through the 2019 – 2021 cycle.

Overview of Study Method:

The study used information from other evaluations to develop NTGRs for 2016 and 2017; one method also predicted NTGRs for 2018, 2020, and 2022. A complete list of approaches used to estimate NTGRs are contained in the full report.

The consensus process comprised six steps:

- Step 1 Confirmation of Methods to Inform Process: The first step was to confirm the studies and methods that will feed into the consensus-building process.
- Step 2 Identification and Recruitment of Experts: The PAs, EEAC consultants, and evaluators discussed whether EEAC and PA planners, PA implementers, and implementation contractors should be involved in the consensus process. They decided that planners should not be involved in the process, and that implementers could provide estimates of market share with and without the program, but should not be directly involved in the NTGR consensus process.
- Step 3 Compilation of Study Results: The Evaluation contractor compiled a memo summarizing all NTGRs developed from the agreed upon methods. The consensus panelists reviewed the memo, calculations, and results. The panel met to discuss the strengths and weaknesses of the various approaches and suggested items for the Evaluation contractor to examine more closely.
- Step 4 Solicitation of Initial Responses: The Evaluation contractor explored suggested items in more depth, performed additional quality control on NTGRs, and finalized the NTGRs. The Evaluation contractor prepared a revised memo and spreadsheet summarizing the NTGRs and distributed these to the panel. Panelists reviewed the methods and results again, submitted their own assessment of strengths and weaknesses, and rated which approach they found to be the strongest and weakest. They then gave their own predictions of NTGRs for various LED bulb styles for 2019, 2020, and 2021.
- Step 5 Setting Consensus Recommended NTGRs: The Evaluation contractor compiled the panelists' final assessments of strengths and weaknesses, as well as the individual NTGR predictions and reasons behind them from Step 4, into a webinar presentation for the second consensus panel meeting, held in February 2018. Having reviewed the methods and thought about the approaches, the panel engaged in a conversation about the evaluated results and individual predictions of NTGR and the future of the market. They reached consensus regarding the recommended NTGRs for standard, reflector, and specialty LEDs for 2019 to 2021. They also suggested a strategy for assigning NTGRs to fixtures.
- Step 6 Reporting: The Evaluation contractor prepared the final report.

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 2.

Study 3: Advanced Power Strip Metering Study

Type of Study: Impact Evaluation

Evaluation Conducted by: NMR Group

Date Evaluation Completed: 10/5/2018

Study Objective and Summary of Results:

The objectives of this study were to investigate three impact factors for Advanced Power Strips (APS):

- Baseline Energy Use
- Energy Reduction Potential (ERP)
- Realization Rate (savings reduction due to improperly setup APS)

Importantly, this study was designed as a metering study and not as an impact evaluation, therefore, it is necessary to combine results with in-service rate and short-term retention to calculate adjusted gross savings. The table below presents the updated metered impact factors for baseline energy use and ERP. The realization rate was 92% for all technologies.

Updated Metered Impact Factors

Baseline Usage	
HEC	**471 kWh**
PC	**399 kWh**
Combined (HEC and PC)	**4449 kWh**
Energy Reduction Potential (ERP)	
Tier 1 – HEC	**26%**
Tier 1 – PC	**24%**
Tier 1 – Combined (Weighted Average HEC and PC)	**226%**
Tier 2 – IR	**48%**
Tier 2 – IR-OS	**28%**
Tier 2 – All	**37%**
Demand Savings	
Tier 1 – HEC	**12W**
Tier 1 – PC	**6W**
Tier 1 – Combined	**9W**
Tier 2 – IR	**324W**
Tier 2 – IR-OS	**114W**
Tier 2 – All	**18W**

Core Initiatives to which the Results of the Study Apply:

- Residential Retail (Electric Only)
- Residential Coordinated Delivery (Electric Only)

Evaluation Recommendations:

No formal recommendations were made in this evaluation.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

N/A (no formal recommendations were made in this evaluation)

How the Study Affects Program Results and Its Significance:

The results of this study are being used to inform program design and planning. Specifically, this study provided impact factors (baseline use, energy reduction potential, and realization rate) for APS.

Overview of Study Method:

The study relied on in-home metering of end-use energy consumption. In total, the study metered 133 sites, including 65 control sites and 68 treatment sites. Metering occurred over approximately nine months for both control and treatment sites, with treatment sites switching midway from having no APS unit installed (pre-period) to having an APS unit installed (post-period).

Through our analysis of the energy usage at these treated sites, along with a control group that did not receive APS units, we produced estimates for baseline usage, ERP, and estimated annual energy savings (i.e., delta kilowatt hours, kWh).

For realization rate, NMR examined the setup of 26 pre-existing Tier 1 APS units that had been self-installed by customers participating in the RES 1 Baseline Study. While NMR did not include these sites in the baseline energy use analysis, the existing APS units provided an opportunity to observe whether customers were correctly configuring APS devices. This is important because improperly setup devices are likely to lead to lower than expected energy savings. Based on this sample of 26 Tier 1 APS units, we calculated a realization rate to correct for lost savings due to non-optimal set-ups. We calculated this realization rate as 92%. While this value was derived based on a sample of Tier 1 APS units, lacking similar data on Tier 2 units, the PAs and EEAC consultants agreed to apply it to Tier 1 and Tier 2 units, regardless of technology.

Application of Results: Retroactively and Prospectively

A copy of the complete study can be found in Appendix U, Study 3.

Study 4: Products Impact Evaluation of In-Service and Short-Term Retention Rates Study - Revision

Type of Study: Impact Evaluation

Evaluation Conducted by: NMR Group

Date Evaluation Completed: 10/5/2018

Study Objective and Summary of Results:

The objectives of the study included establishing current estimates of in-service rates (ISRs) and short-term retention rates (on average 14.5 months for products respondents and within a year for direct install respondents) for products currently offered through the Retail Consumer Products and Residential Home Energy Services Initiatives. Process research questions focused on product installation experiences, satisfaction with product performance, and likelihood of recommending the product. The table below provides the evaluated ISR and short-term retention rates derived as part of the study.

Updated Metered Impact Factors

Product Name	MA Primary Research				Literature Range
	Sample Size	ISR	Short-term Retention	Combined	
Low to Moderate Price Measures					
Leave behind Tier 1 APS	252	81%	94%	76%	42% - 86%
Online Tier 1 APS	359	89%	97%	86%	80%
Online Tier 2 APS IR+OS	60	83%	94%	78%	80% - 87%
Online Tier 2 APS IR	280	81%	87%	70%	
Online Tier 2 APS All	340	82%	91%	75%	
Dehumidifiers	137	99%	97%	96%	94%
Room Air Cleaners	126	100%	97%	97%	100%
Temperature Sensitive Showerheads, Adapters	178	86%	91%	78%	N/A
High Price Measures					
Dryers*	128	98%	99%	97%	N/A

* Note that two dyers had never been installed and one was removed. While we do not have further details on the two never installed, the respondent who removed one plans to reinstall it in the future.

Core Initiatives to which the Results of the Study Apply:

- Residential Retail (Electric Only)
- Residential Coordinated Delivery (Electric Only)

Evaluation Recommendations:

The following recommendations were made by the evaluators conducting this study.

> **Recommendation 1:** The PAs should use the combined Massachusetts ISR/short-term retention rates listed in the table above for the 2017 Annual Report, the 2018 Annual Report, updates to the TRM, and program planning for 2019 to 2021 for all evaluated products. Rationale: The evaluated results are based on recent participants and strong sample sizes. Ideally, the PAs and EEAC would update these rates during the 2019 to 2021 program cycle.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs plan to adopt the recommendations.

How the Study Affects Program Results and Its Significance:

The results of this study are being used to inform program savings, design, and planning. Specifically, this study provided ISR and short-term retention rates for a variety of consumer products.

Overview of Study Method:

This study included web-based surveys of two different populations of program participants: (1) those who purchased products via the Mass Save® Website or using a mail-in (or online-submitted) rebate between January 2016 and June 2017, and (2) those who received Tier 1 APS through a direct install program from January to October 2017 (the program did not distribute Tier 2 APS). NMR recruited respondents for the studies using an advance letter sent to randomly selected participants in both programs, providing them with a unique login for the survey and a pre-paid $5 incentive. The survey achieved response rates ranging from 38% to 51% for consumer products and 25% for direct install. NMR additionally conducted literature reviews of products and APS programs to ascertain recent estimates of ISRs in other jurisdictions.

Application of Results: Retroactively and Prospectively

A copy of the complete study can be found in Appendix U, Study 4.

Study 5: Massachusetts Residential New Construction Incremental Cost

Type of Study: Market Characterization or Assessment Evaluation

Evaluation Conducted by: NMR Group

Date Evaluation Completed: 7/26/2018

Study Objective and Summary of Results:

The purpose of this study was to document the incremental costs associated with participating in the Massachusetts Residential New Construction (RNC) Low-Rise Path and Multifamily High-Rise (MFHR) programs for the Program Administrators (PAs) and Energy Efficiency Advisory Council (EEAC) consultants. Specifically, this study identified the incremental costs associated with moving from baseline new construction practices to common practices identified in program participant housing units. The report addresses incremental costs for single-family detached homes, single-family attached homes, low-rise[2] multifamily housing units, and high-rise[3] multifamily buildings.

The study provides the following key findings:

- The incremental cost associated with participating in the low-rise path program is $2.00 per square foot across all housing types. Single-family detached homes, the most common type of participating housing unit (68% of program participants), have incremental costs ranging from $1.90 per square foot for the starting participation efficiency range level to $3.19 per square foot for the highest participating efficiency range level.
- The overall incremental cost associated with participating in the MFHR is $2.09 per square foot for all project types. Building participant projects have incremental costs ranging from $2.05 per square foot for mid-rise buildings with all electric mechanical equipment to $2.53 per square foot for mid-rise gut rehab projects. Projects participating in the "in-unit only" path have the lowest incremental cost ($0.32 per square foot).
- Recruiting contractors to estimate building costs can be extremely difficult, primarily due to time constraints and sensitivity to releasing price information.
- It came to the attention of the evaluation team that there have been issues regarding the allocation of incremental costs across electric and gas PAs in the past.

Core Initiatives to which the Results of the Study Apply:

- Residential New Homes & Renovations (Electric & Gas)

Evaluation Recommendations:

The following recommendations were made by the evaluators conducting this study.

Recommendation 1: The evaluation team recommends that the PAs allocate incremental costs based on the relative proportion of incentives provided for both the low-rise and MFHR programs. For example, if the electric PAs pay 40% of the incentives for all low-rise housing

[2] Buildings with three stories or less.

[3] Buildings with four or more stories.

units (overall incremental cost of $2.00 per square foot) and the gas PAs pay 60% of the incentives, then the electric PAs would account for an incremental cost of $0.80 per square foot and the gas PAs would account for $1.20 per square foot.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs are considering all recommendations for adoption at this time. The PAs have not formally adopted or rejected any recommendations that require changes to program design and operations.

How the Study Affects Program Results and Its Significance:

Incremental costs have increased for both the low-rise and MFHR programs since the previous study that was completed in 2013. Increased incremental costs will impact the PAs cost effectiveness calculations for these programs. These results could also be used by program implementers to inform builders about the typical costs associated with program participation.

Overview of Study Method:

This study leveraged program and non-program data collected from recent baseline studies to determine the typical efficiencies of program and non-program buildings. These data were summarized and provided to contractors active in the RNC market. Contractors were asked to provide cost estimates for both program and non-program homes for a variety of measures in the low-rise and MFHR new construction markets.

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 5.

Study 6: Shelf Stocking Study

Type of Study: Market Characterization or Assessment Evaluation

Evaluation Conducted by: NMR Group

Date Evaluation Completed: 7/6/2018

Study Objective and Summary of Results:

The objectives of this study were to assess the following indicators at participating Massachusetts retailers:

- The amount of shelf area dedicated to LEDs, CFLs, halogens, and incandescent lamps in Massachusetts
- The amount of shelf area dedicated to linear LEDs and linear fluorescent lamps
- The pricing, number of lamps per package, and shelf locations of LED, CFL, halogen, and incandescent lamps in Massachusetts
- The differences in pricing and availability of LED ENERGY STAR vs. Non-ENERGY STAR products in Massachusetts
- The current stock of lamps to determine coverage by the Energy and Independence Security Act of 2007 Phase I and Phase II

Summary of Results:

Overall Assessment: When compared to 2016 data, the current data show an increase in the shelf share of LEDs and a decrease in the average unit price of LEDs – especially for ENERGY STAR.

Select Key Findings:

- Based on a comparison of 2016 and 2017 shelf area, it appears that CFL and halogen lamps are being squeezed out by LEDs and incandescents; however, the remaining incandescent lamps are predominantly low-wattage and frequently exempt from EISA.
- The relative mix of lamp shapes offered on store shelves is fairly consistent from year to year.
- Examining results by retail channel reveals interesting stocking patterns. Efficient lamp shelf share stagnated or only increased slightly across all channels in 2017; however, this trend is due to significant increases in LED shelf share in most channels offset by declining CFL shelf share.
- The average unit price of LED lamps in Massachusetts, including program incentives, decreased by $3.56 between 2016 and 2017; this is the most dramatic shift in price observed for all lamp technologies.
- The average unit price of incandescent and halogen lamps also decreased in this period, but only by $0.16 and $0.30, respectively.
- LED lamps were displayed in a greater variety of locations throughout the store than other lamp technologies, including in glass display cases, at the register, and on special racks. The average unit price of LED lamps found at the register or in a wing stack is very low –

under two dollars – representing some of the lowest average prices among any lamp type or display location.

- Since EISA Phase II stands to close loopholes present in Phase I, it is not surprising that a larger proportion of lamps on shelves are covered under these standards. Almost nine out of ten incandescent lamps are exempt according to Phase I, whereas a little over one-half are exempt under Phase II.
- Looking at results by retail channel, it appears that Phase II will have a large impact on Hardware stores' inventories. Almost nine out of ten lamps sold in Hardware stores were exempt according to Phase I standards, whereas less than one-half of lamps sold in Hardware stores were exempt according to Phase II.

Core Initiatives to which the Results of the Study Apply:

- Residential Retail (Electric Only)

Evaluation Recommendations:

No formal recommendations were made in this evaluation.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

N/A (no formal recommendations were made in this evaluation)

How the Study Affects Program Results and Its Significance:

The results of this study are being used to inform program design and planning. Shelf stocking and pricing are essential to helping to understand the future of the residential lighting market and continued support by the Program Administrators.

Overview of Study Method:

Lockheed Martin (program implementer) completed site visits at participating stores between October and November of 2017 and delivered data to NMR in January 2018. NMR calculated shelf share for each lamp technology and channel in the same manner as defined in the previous report (RLPNC16-6). To understand the market for linear LEDs (TLEDs), linear lamps were added to the in-store data collection protocols in 2017; these lamps were not included in past efforts. Shelf area and pricing for linear lamps are presented separately from screw-base lamps. EISA Phase I and Phase II coverage, exemptions, and compliance were determined according to the flow chart diagrams seen in Appendix B in the report.

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 6.

Study 7: Home Energy Assessment LED Net-to-Gross Consensus

Type of Study: Net-to-Gross Evaluation

Evaluation Conducted by: NMR Group

Date Evaluation Completed: 7/23/2018

Study Objective and Summary of Results:

The objective of this study was to develop and set prospective net-to-gross ratios (NTGRs) and effective useful lives (EULs) for LEDs installed as part of Home Energy Assessments (HEA) during the 2019 to 2021 program period.

The table below presents the prospective NTGRs and EULs for LEDs installed as part of HEA.

Table 1: Prospective HEA LED NTGR and Effective Useful Lives

Program Year	Effective Useful Life	Upstream Program Ends			
		Dec. 31, 2021 (Base)	Dec. 31, 2018	Dec. 31, 2019	Dec. 31, 2020
2019	3	88%	88%		
2020	2	80%	83%	82%	
2021	2	66%	74%	72%	69%

Core Initiatives to which the Results of the Study Apply:

- Residential Coordinated Delivery (Electric Only)

Evaluation Recommendations:

No formal recommendations were made in this evaluation.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

N/A (no formal recommendations were made in this evaluation)

How the Study Affects Program Results and Its Significance:

The results of this study are being used to inform program design and planning. Specifically, this study provided prospective estimates for NTGRs and EULs for LEDs installed as part of HEA.

Overview of Study Method:

To support the Program Administrators (PAs) and Energy Efficiency Advisory Council (EEAC) consultants in defining prospective NTGRs, NMR compiled data on the number of efficient lamps installed as part of HEA based on program records, as well as historical lighting market trends for single-family non-low-income households based on saturation data collected as part of nearly annual lighting on-site visits. Data from these various sources were combined into an Excel-based tool that was provided to the PAs and EEAC consultants to help arrive at consensus for three key inputs which drive prospective NTGR values. These three inputs were:

- **Market Movement.** Market movement is the average incremental number of efficient lamps installed per home per year (above what was previously installed), leading to a decrease of inefficient lamp saturation on a year-to-year basis. Market movement is a combination of naturally occurring market adoption (NOMAD) and upstream program influence.
- **Escalation** of Market Movement. The degree to which market movement is expected to change over time.
- **Market Movement Attributable to Upstream**. The amount of market movement attributable to the upstream program. Note: market movement attributable to the upstream program should not be confused with HEA or Upstream program net-to-gross (NTG). NTG is the proportion of program units that could only occur due to a program (would not be done without a specific program). Market movement includes market movement due to a variety of factors including the upstream program.

The PAs and EEAC consultants entered estimates into the Excel Tool (embedded within this document) and arrived at consensus via email and phone conversations. While the PAs and EEAC consultants did not ultimately agree on the reasons and rationales behind the final values, they were able to agree on a set of values that enabled the calculation of the NTGRs and EULs presented above. Ultimately, the PAs and EEAC consultants agreed on the following values for the input variables:

Input	**2018**	**2019**	**2020**	**2021**
Market Movement	3.0	3.5	4.0	4.6
Escalation	n/a	1.15	1.15	1.15
Market Movement Attributable to Upstream	n/a	31%	26%	21%

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 7.

Study 8: Cross-Sector Sale HOU Update

Type of Study: Impact Evaluation

Evaluation Conducted by: NMR Group

Date Evaluation Completed: 8/2/2018

Study Objective and Summary of Results:

The objective of this study was to update the hours-of-use (HOU) estimates for the portion of lamps sold through the Retail Products Initiative that ultimately are used in commercial settings. The study provided estimates for three LED categories:

LED Bulb Category	Previous Annual HOU	Updated Annual HOU	Percent of 2017 Retail Products Initiative Sales	Sales Weighted HOU
A-line	3,091	2,400	76%	1,824
Specialty	3,091	2,400	6%	144
Reflector	3,091	3,281	18%	591
Overall				2,559

Core Initiatives to which the Results of the Study Apply:

- Residential Retail (Electric Only)

Evaluation Recommendations:

No formal recommendations were made in this evaluation.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

N/A (no formal recommendations were made in this evaluation)

How the Study Affects Program Results and Its Significance:

The results of this study are being used to inform program design and planning. Specifically, this study provided estimated HOU values for cross-sector sales as part of the Retail Products Initiative.

Overview of Study Method:

Recently, the PAs updated commercial lighting HOU estimates as part of the P58 Impact Evaluation of PY2015 Massachusetts Commercial and Industrial Upstream Lighting Initiative. This impact evaluation included HOU estimates for a variety of product types, including screw-based LEDs like those sold as part of the Retail Products Initiative. NMR used the estimates from P58 Study to update the HOU for Retail Products Initiative cross-sector sales.

Application of Results: Retroactively and Prospectively

A copy of the complete study can be found in Appendix U, Study 8.

Study 9: Appliance Recycling Report

Type of Study: Impact Evaluation

Evaluation Conducted by: NMR Group

Date Evaluation Completed: 9/26/2018

Study Objective and Summary of Results:

The last impact study performed on the refrigerator and freezer recycling program was completed in June 2011. A literature review suggested that the Program Administrators may need to update the Technical Reference Manual (TRM) to reflect the changing characteristics of recycled appliances. The objectives of this study were:

1. Identify the current characteristics of refrigerators and freezers being recycled through the program and compare them to those identified in the 2011 study
2. Update estimates of unit energy consumption (UEC), partial use (how often recycled units were plugged in, which serves as the realization rate), and net-to-gross ratios (NTG)
3. Calculate per-unit gross savings, adjusted gross savings, and net energy savings based on UEC, realization rates, and free ridership rates.
4. Explore the role of the incentive and ease of disposal on customer participation
5. Examine possible alternative outcomes for units in the absence of the program
6. Describe participants' experiences with the program

Key findings in this study include:

- Refrigerator Gross Energy Savings: The gross energy savings for refrigerators recycled in 2017 was 1,019 kWh (equivalent to the UEC). Refrigerators recycled in 2017 are larger (16.8 cubic feet in 2011 vs. 19.15 in 2017), more likely to have side-by-side door configurations (12% in 2011 and 19% in 2017), and more likely to be used as primary units (22% in 2011 vs. 48% in 2017) than those recycled in 2011. These factors serve to counteract the overall increases in the efficiency of younger units (26.6 years in 2011 and 18.2 in 2017). Therefore, using regression models suggested in the Uniform Methods Protocol (UMP), units recycled in 2011 used 1,179 kWh per year compared to 1,019 in 2017.
- Refrigerator Realization Rates and Net-to-gross Ratio: Because participants used many of the recycled refrigerators only part of the year, a participant survey estimated a realization rate of 88% (equivalent to the part-use factor). The same survey found a NTG of 44%, based on the stated alternative outcomes for refrigerators if the participant had not recycled the unit through the program.
- Freezer Gross Energy Savings: The gross energy savings for freezers recycled in 2017 was 718 kWh (equivalent to the UEC). Freezers recycled in 2017 were smaller (17.3 cubic feet in 2011 vs. 15.3 in 2017) and younger (22% in 2011 vs. 48% in 2017) than those recycled in 2011. These two factors drove down the UEC for refrigerators between 2011 and 2017. Therefore, using regression models suggested in the Uniform Methods Protocol (UMP), units recycled in 2011 used 1,021 kWh per year compared to 718 in 2017.

- Freezer Realization Rates and Net-to-gross Ratio: Because participants used many of the recycled freezers only part of the year, a participant survey estimated a realization rate of 68% (equivalent to the part-use factor). The same survey found a NTG of 56%, based on the stated alternative outcomes for freezers if the participant had not recycled the unit through the program.
- Most participants (about three-quarters for both appliances) had not tried to get rid of the unit prior to participation: This finding raises questions about how successful participants may have been at disposing of their refrigerators and freezers in the alternative manners used to estimate NTG.
- Participants seemed willing to pay for appliance removal but had mixed feelings about their ability to remove the bulky items on their own: About one-half of respondents for both appliances seemed willing to pay between $1 and $50 to have their appliances removed. These amounts align with the fees charged by many municipal programs but fall below those charged by haulers. Three out of five refrigerator recyclers believed they would have been able to remove the appliance on their own, but only 45% of freezer recyclers believed they could move the unit on their own.
- Participants 55 years or older not only compose the majority of participants but also exhibit higher free ridership (51% for over 54 years vs. 39% for younger): The factors underlying the higher free-ridership for older respondents include the greater age of units recycled and their willingness to pay someone to have it removed from the home. These results are inclusive of both appliances.
- Participant satisfaction with the program is high: Ninety-seven percent of respondents said they were satisfied with the program.
- Ease of recycling, environmental benefits, and the incentive serve as the top three reasons for taking part in the program. Other drivers include reducing energy costs, not wanting to pay for removed, not needing the unit anymore, purchase of a new unit (especially for refrigerators), and the unit not working well.

Core Initiatives to which the Results of the Study Apply:

- Residential Retail (Electric Only)

Evaluation Recommendations:

The Study recommended that the PAs adopt the savings estimates and inputs summarized in the table below:

Appliance	**Per Unit Gross Savings**	**Per Unit Realization Rate**	**Per Unit Adjusted Gross Savings**	**Net-to-Gross Ratio**
	Energy (kWh)		**Energy (kWh)**	
Refrigerators	1,019	88%	897	44%
Freezers	718	68%	488	56%

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs plan to adopt the recommendations.

How the Study Affects Program Results and Its Significance:

Should the PAs adopt the consideration, per-unit savings for both refrigerators and freezers would decrease compared to current TRM assumptions.

Overview of Study Method:

NMR used information contained in the 2017 Appliance Recycling Program Tracking Database and a participant survey of 365 participants to update gross energy savings estimates, realization rates, and the NTG ratio for refrigerators and freezers recycled through the program.

Application of Results: Retroactively and Prospectively

A copy of the complete study can be found in Appendix U, Study 9.

Study 10: Baseline Load Shape Study - Comprehensive Report

Type of Study: Market Characterization or Assessment Evaluation

Evaluation Conducted by: Navigant Consulting

Date Evaluation Completed: 7/27/2018

Study Objective and Summary of Results:

The primary goal of the baseline study is to collect saturation, penetration, and usage behavior data for all major electric and gas appliances, mechanical equipment, and electronics in Massachusetts homes. These data will support energy and peak demand savings calculations for program evaluation and design and will provide additional insight into the savings potential in the existing residential buildings market. The secondary goal of this study is to support other research that the PAs are undertaking by providing comprehensive data for the sampled customers. These other research efforts include energy efficiency potential studies and market effects research, among others.

This report is intended to answer the primary research question stated in the study's Stage 3 Plan: "How and when are people using the electric equipment in their homes?" Key findings are based on metered data that was collected between May 2017 and April 2018.

The study provides the following key findings:

- Across all homes in Massachusetts, central AC and room AC are by far the largest contributors to peak demand. Collectively, cooling makes up about half of total residential ISO-NE peak demand. Central AC loads averaged 1.7 kW during ISO-NE peak and room AC loads averaged 0.6 kW. Saturation of central cooling increased from 29% of households in 2008 to 45% in 2017, while room AC saturation is dropping (64% in 2008 down to 48% in 2017). The central cooling saturation increase is being driven primarily by increases in the prevalence of individual household ducted central AC and ductless heat pumps.
- Across the remaining end uses, individual homes have a wide variety of significant end use loads during peak times. Electric clothes dryers are common (53% of homes), but they have large variability in use compared to other end uses. The bottom half of energy consumers who use dryers did not use their dryers at all during peak times, while the top 25% of users have an average peak of greater than 0.3 kW. Dehumidifiers are relatively common (36% of homes). More than 25% of dehumidifiers were not in use at all during peak times, but the top 25% have a mean peak of greater than 0.4 kW. Electric water heaters are uncommon (14% of homes), but they have a mean of 0.2 kW during ISO-NE peak and the top 25% of users have a mean of 0.5 kW. Pool pumps are rare (6% of homes), but they have a mean ISO-NE peak demand of 0.6 kW.
- Heat pump water heaters appear to use about half as much electricity as domestic water heaters. Electric water heating load will become more important in the long run as more people switch from oil or propane heat sources to electricity.
- Lighting is the end use with the largest contribution to total winter consumption and winter peak.

- Electric resistance heat has a flat hourly load shape on peak days. Electric resistance heating consumption is highly variable. The top 25% of households with electric resistance heat presently consume approximately 10 times as much as the median.
- Electric water heaters offer the largest non-HVAC, non-lighting opportunity for winter peak demand savings.

Core Initiatives to which the Results of the Study Apply:

- All Residential Initiatives (Electric Only)

Evaluation Recommendations:

No formal recommendations were made in this evaluation.

Considerations

1. Central AC should be the focus of efforts to reduce summer peak demand, but ductless heat pumps and room AC are also important to a comprehensive program offering. Because peak usage is driven as much by Energy Efficiency Ratio (EER) as by Seasonal Energy Efficiency Ratio (SEER), the PAs should consider including EER requirements in addition to SEER requirements to steer customers toward AC and HP offerings with higher peak demand savings. Massachusetts has significant opportunities for early central AC and HP retirement. Over 40% of central systems in Massachusetts have an EER of 9 or lower. These low efficiency systems will generally be 12-25 years old during the 2019-2021 program period. Early retirement of these systems could save approximately 0.7 kW of peak demand per system replaced with a new code-minimum efficiency system, in addition to significant energy savings.
2. PAs should consider targeting homes with dehumidifiers, clothes dryers, and pool pumps for additional peak demand savings with low impacts on occupant comfort. Dehumidifiers (13% of all homes), clothes dryers (10% of homes), and pool pumps (5% of homes) all have opportunities for relatively easy peak savings of at least 0.2 kW without negatively affecting overall equipment performance or comfort.
3. Energy efficiency program offerings should push heat pump water heaters for both energy and demand savings. Demand response offerings for heat pump water heaters will not have large effects during the summer or winter but may be worth targeting if higher peak users could be identified or influenced through behavior-based messaging.
4. Further improvements in installed lighting efficiency and controls—either induced by programs or the overall market—will cause significant reductions in peak loads. There are still significant opportunities for programs to cost-effectively reduce energy and peak consumption by inducing the early retirement of incandescent lamps and installing lighting controls. Particularly where individuals are waiting for infrequently used lamps to burn out before replacing them, there are significant lifetime savings available when replacing them early. Similarly, networked/connected LEDs offer additional energy and load shifting potential.
5. It may be difficult to generate winter electric HVAC peak demand or energy savings with program interventions. Targeting high users would help increase savings by a large

amount. A bill-based electric resistance heating targeting algorithm could be developed and tested using this data.

6. If the PAs are looking for opportunities to reduce winter peak demand, they should consider electric water heater demand response opportunities.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

N/A (no formal recommendations were made in this evaluation)

How the Study Affects Program Results and Its Significance:

The PAs are reviewing considerations from this comprehensive report and will appropriately incorporate the results into all residential initiatives.

Overview of Study Method:

This study employed the following data collection methods:

- General saturation survey with detailed follow-up questions for specific end uses (n=6,901)
- Whole-home saturation and characterization verification and true-up (n=356)
- Comprehensive power metering of all relevant end uses (n=300)
- Targeted power metering of specific end uses (n=56)

Application of Results: Retroactively and Prospectively

A copy of the complete study can be found in Appendix U, Study 10.

Study 11: Water Heating, Boiler, and Furnace Cost Study

Type of Study: Market Characterization or Assessment Evaluation

Evaluation Conducted by: Navigant Consulting

Date Evaluation Completed: 9/21/2018

Study Objective and Summary of Results:

The purpose of this study was to evaluate the energy-efficiency-related costs of single family home installations of water heater, boiler, and furnace products currently rebated through the Residential Heating and Cooling program.

The study provides the following key findings:

- The study produced a table showing the total installed costs of different types of heating products, including furnaces, boilers, combination boilers, and water heaters. This table presented the total installed costs of each product type at the baseline efficiency level and at rebate-eligible efficiency levels.
- The webscraping of retail product prices found that the least expensive combination boilers (at the representative size of 120 MBH input) are rated at 95% AFUE. Additionally, one of the survey respondents indicated that combination boiler products rated at 95% AFUE often have lower wholesale prices than combination boilers rated between 87% and 94% AFUE.
- The evaluation team identified several 80-gallon electric water heater models on the market that meet the definition of residential electric storage water heaters, but do not meet the federal minimum standards for residential electric storage water heaters. These non-compliant models use electric resistance heating elements, which are less efficient than the heat pump technology that the program has been considering as the baseline technology for water heaters above 55 gallons capacity. Until and unless the U.S. Department of Energy enforces the federal minimum standards, these non-compliant models are available for residential customers to purchase and install.

Core Initiatives to which the Results of the Study Apply:

- Residential Coordinated Delivery (Electric & Gas)
- Residential Retail (Electric & Gas)

Evaluation Recommendations:

No formal recommendations were made in this evaluation.

Considerations

1. The PAs should consider discontinuing the lower rebate level of 90% AFUE for combination boilers and continue incentivizing the adoption of higher-efficiency 95% AFUE models that appear to be a less expensive option for customers.
2. The PAs may consider pursuing additional survey efforts to understand how prevalent installations of 80-gallon electric water heater models are in Massachusetts. If the high-

volume electric resistance models are found to be prevalent, the PAs should consider reassessing the baseline for the large electric storage water heater product class.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

N/A (no formal recommendations were made in this evaluation)

How the Study Affects Program Results and Its Significance:

The findings of this study help inform an update of the Residential Heating and Cooling Program's rebate offerings. They help the program to make informed decisions about the efficiency levels at which rebates are offered, and the rebate amounts that are offered.

Overview of Study Method:

This study relies on three main data sources: 1) a survey of HVAC contractors and plumbers in Massachusetts, 2) retail prices gathered by webscraping, and 3) program rebate invoices for water heater product classes. This study combines data from these three sources to construct cost-efficiency curves that describe the total installed cost of water heater, boiler, and furnace products across the available range of efficiency levels for each product type.

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 11.

Study 12: Low-Rise Measure Review

Type of Study: Impact Evaluation

Evaluation Conducted by: Navigant Consulting

Cadeo Group

Date Evaluation Completed: 8/1/2018

Study Objective and Summary of Results:

The primary objective of the study to support the PA's ongoing planning process by determining the appropriate gross and net savings for the set of measures that the PAs plan to install in low-rise residential buildings through the redesigned Residential Coordinated Delivery (RCD) initiative. The evaluation team documented its fuel- and measure-specific recommendations in an EXCEL workbook.

Core Initiatives to which the Results of the Study Apply:

- Residential Coordinated Delivery (Electric & Gas)
- Income Eligible Coordinated Delivery (Electric & Gas)

Evaluation Recommendations:

The following recommendations were made by the evaluators conducting this study.

> **Recommendation 1:** The evaluation team recommends using the identified gross and net savings as planning estimates for the low-rise home in RCD. The team recommends revisiting these estimates as part through a formal evaluation of the low-rise component of RCD after the component matures.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs plan to adopt the recommendations.

How the Study Affects Program Results and Its Significance:

The study identified gross and net savings for planning estimates for the low-rise home in RCD. These estimates will help support the 2019-2021 Strategic Evaluation Plan.

Overview of Study Method:

To develop its recommendations, the evaluation team reviewed the existing set of gross and net savings for single family and multifamily customers and selected the most appropriate existing estimate (i.e., the single family value, the multifamily value, or an average) to leverage for low-rise customers based on basic building science principles (for gross savings) and evaluation experience (for gross and net savings).

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 12.

Study 13: Home Energy Services Impact Evaluation

Type of Study: Impact Evaluation

Evaluation Conducted by: Navigant Consulting

Cadeo Group

Date Evaluation Completed: 8/29/2018

Study Objective and Summary of Results:

This HES Impact Evaluation was designed to estimate the gross per-unit energy savings associated with the HES measures offered in 2015 and 2016. In total, the team evaluated 29 measures across four fuel types (natural gas, electric, heating oil, and propane); nine of which were not part of the previous evaluation (completed in 2012).

The evaluation also yielded realization rates, for insulation and air sealing, that the PAs will use to adjust the ex-ante gross savings produced by each HES Lead Vendor's (LV) proprietary energy modeling software.

The scope of this evaluation did not include LED lighting or smart strips—both common HES measures—since both measures were being evaluated through a different, concurrent, evaluation effort.

The study provides the following key findings:

Weatherization

- The evaluation team's billing analysis determined that HES participants who weatherized their natural gas heated homes (i.e., installed air sealing and/or insulation) saved, on average and statewide, 130 therms per year. This result is somewhat lower than the statewide findings from the previous evaluation in 2012. The PAs should use the realization rates shown below to adjust their LV-estimated weatherization savings.

- Realization Rates by LV:
  - CLEAResult (estimated savings = 169 and evaluated savings = 127) – 75%
  - RISE (estimated savings = 265 and evaluated savings = 179) – 68%
  - CET (estimated savings = 182 and evaluated savings = 152) – 83%
  - Statewide (estimated savings = 178 and evaluated savings = 130) – 73%

Thermostats

- Programmable and Wi-Fi thermostats are estimated to have save 3.6% and 6%, respectively, of HES participants' annual heating consumption.

Furnaces and Boilers

- Due to an increase in heating loads, relative to the previous evaluation, savings increased for furnaces (while the opposite is true for boilers).

Refrigerators

- The savings associated with refrigerator replacement is greater than the previous evaluation (1,001 kWh/year, compared to 661 kWh/year)

Core Initiatives to which the Results of the Study Apply:

- Residential Coordinated Delivery (Electric & Gas)

Evaluation Recommendations:

The following recommendations were made by the evaluators conducting this study.

Recommendation 1: Use the ex post results determined through this evaluation as ex ante savings for future program years. The results of this impact evaluation reflect the most recent and relevant set of gross savings values for the measures installed through HES. While the PAs will likely continue to evolve how they serve their residential customers programmatically, these savings represent the best estimates of future measure-specific savings for single-family family customers in Massachusetts. The evaluation team therefore recommends the PAs use the results included in this evaluation as part of ongoing three-year planning efforts. This includes the LV- and weatherization-specific realization rates contained in this report.

Recommendation 2: Investigate programmable and wi-fi thermostats further. The evaluation team's thermostat-related recommendation consists of two parts. First, the current design of HES allows Energy Specialists and HPCs to leave uninstalled thermostats with participants. If future iterations of HES continue this practice, the evaluation team recommends that PAs estimate a thermostat installation rate as part of the next evaluation. Second, this evaluation—as well as the previous impact evaluation—relied on a literature review to estimate savings for thermostats. Literature reviews offer insight into possible savings generated by programmable and wi-fi thermostats but are not specific to Massachusetts and the customers who participate in HES. Given the increasing importance of thermostats as an energy efficiency and demand response measure, the team recommends the PAs conduct primary research to more definitely understand the impact of these important residential measures in their region.

Considerations

1. Future evaluations should more closely explore the disparity between LV-generated ex ante savings and evaluator ex post savings for weatherization measures. Similar to the previous HES impact evaluation, the evaluation team found ex post savings for weatherization (i.e., air sealing and insulation) in natural gas-heated homes that were lower (~25–30% less) than the savings estimated by HES LVs. Given the consistent disparity between these estimates, future evaluators should seek to understand the drivers of this disparity in greater detail. Specifically, the assessment should elucidate differences by LV, heating fuel type (e.g., natural gas vs. propane heated homes), and climate zone, as well as consider actions that might bring weatherization ex ante and ex post values into closer alignment.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs plan to adopt the recommendations.

How the Study Affects Program Results and Its Significance:

Applying the quantitative recommendations of this study will lower weatherization savings but improve the alignment of the reported savings with the savings estimated by LVs.

Overview of Study Method:

Consistent with the previous impact evaluation, the evaluation team relied on three complementary evaluation methodologies: billing analysis, engineering algorithms, and building simulation. The team used engineering algorithms to evaluate most measures, while the billing analysis was limited to air sealing and insulation. The evaluation team only reported ex post savings via billing analysis if the results were better than ±20% precision at the 90% confidence all level.

Application of Results: Retroactively and Prospectively

A copy of the complete study can be found in Appendix U, Study 13.

Study 14: Heating and Cooling Early Retirement Net-to-Gross

Type of Study: Net-to-Gross Evaluation

Evaluation Conducted by: Navigant Consulting

Illume Advising

Date Evaluation Completed: 8/1/2018

Study Objective and Summary of Results:

The primary goal of this research was to inform the 2019-2021 planning cycle with NTG estimates for the Early Retirement offerings. While not a primary objective, the research also elicited process-related data and participants' subjective assessment of equipment condition and remaining useful life.

Below are the overall net-to-gross results by measure and fuel type.

Table 1. Net-to-Gross Results: Non-Electric (n=433)

Gas, Propane, and Oil-Fueled Measures	Completed Surveys	Preliminary NTG Results	Measure Level Relative Precision at 90% Confidence	Combined NTG Results	Overall Relative Precision at 90% Confidence
Furnace	150	86.6%	8.3%	88.2 %	4.6%
Hot water boiler (owner-occupied)	147	88.8%	7.7%		
Hot water boiler (non-owner-occupied)	44	89.5%	12.6%		
Steam boiler	92	86.9%	10.1%		

Source: Participant survey, net-to-gross battery

Table 2. Net-to-Gross Results: Electric (n=95)

Electric Measures	Completed Surveys	Preliminary NTG Results	Measure Level Relative Precision at 90% Confidence	Combined NTG Results	Overall Relative Precision at 90% Confidence
Central air conditioner	76	88.1%	10.9%	84.5%	11.3%
Central heat pump	13	75.2%	38.2%		

(SEER >= 16, HSPF >= 8.5)					
Central heat pump (SEER >= 18, HSPF >= 9.6)	6	78.3%	54.8%		

Source: Participant survey, net-to-gross battery NTG results were slightly lower for electric measures overall, and specifically for heat pumps (although it should be noted the sample size for heat pumps was small and precision low). Overall, these findings indicate the program is highly effective at encouraging customers to replace their old but working HVAC equipment before it fails.

The study provides the following key findings:

- Overall, NTG for the Early Retirement HVAC program is high. Across measures, the evaluation team found that the Early Retirement HVAC program is highly influential in customer decision-making to replace old but functioning equipment before it fails. Overall, NTG was 88% for non-electric measures and 85% for electric measures.
- Participants reported that both HVAC contractors and energy specialists who provide Home Energy Assessments are influential in their decision to participate in the program. In general, participants reported that both their contractor and their experience with the Home Energy Assessment influenced their decision to participate in the program. Participant survey results indicate that contractors may be somewhat more involved than energy specialists in the actual specification and recommendation of specific equipment to install, but also commonly indicated that Home Energy Assessments are trusted sources of information for their decision, and may be where customers learn about other offerings, such as the HEAT loan.
- A key motivation for customers to participate in the program is a desire to eliminate the risk of equipment failing at an inopportune time. The anxiety at the thought of their HVAC system failing at a bad time—such as in the middle of a cold winter—emerged as a key message that resonated with participants. In open-ended responses describing program influence, participants sometimes mentioned hearing this message from their HVAC contractors as a means of encouraging them to take advantage of the Early Retirement HVAC program. Contractors and energy specialists both mentioned this message as an effective motivator to participation.
- The various components of the Early Retirement HVAC program, including Mass Save marketing and HEAT loan offerings, all appear to be working well together to influence program participation. Both contractors and Home Energy Assessments appear to be educating and influencing customers to replace their equipment early through the program. However, when asked to describe the influence of the program, participants frequently reported complex decision-making processes that included multiple points of contact and several services. For some customers, the HEAT loan was a key influence to replace their equipment early. However, it does not appear that one factor is especially influential; rather, the combination of offerings of the Early Retirement HVAC program appears to be working together well to influence customer decision-making.
- Contractors report that some customers replace HVAC systems before failure outside of the program, most frequently because customers do not want to wait for a Home Energy

Assessment. While the evaluation team did not quantify nonparticipant spillover, the evaluation team did explore whether contractors report customers replacing their HVAC equipment before failure outside the program, and, if so, why this occurs. Most frequently, contractors reported that installations occurring outside the program happen because customers do not want to wait for a Home Energy Assessment. However, it is unclear if that is because their equipment is closer to failing (and therefore actually ineligible for the program) or because customers simply do not want to wait for an assessment.

- Based on customer self-report of equipment age and condition, the evaluation team estimates that 37% of equipment rebated through the Early Retirement program should actually be categorized as replace-on-failure. The Early Retirement program seeks to incentivize the replacement of old, inefficient equipment that is still functioning well. The MA TRM[4] assumes a remaining useful life for the old replaced equipment to be between 6 to 10 years. Using an algorithm adapted from the 2012 HVAC evaluation report[5], the evaluation team categorized participants into two "replacement types:" early replacement (ER), or replace-on-failure (ROF). Participants who fell into the ROF category indicated that their old equipment was in poor working condition, needed many repairs, and/or would not have continued working much longer. This information impacts the gross savings that the program claims for the Early Retirement program.

Core Initiatives to which the Results of the Study Apply:

- Residential Coordinated Delivery (Electric & Gas)
- Residential Retail (Electric & Gas)

Evaluation Recommendations:

The following recommendations were made by the evaluators conducting this study.

Recommendation 1: Continue to promote the program benefit of eliminating the risk of equipment failure, in marketing and messaging through contractors and Home Energy Assessments.

Recommendation 2: Continue to encourage both contractors and energy specialists to promote the HEAT loan offering to eligible customers, as this appears to be a key decision-making influence for some customers.

Recommendation 3: Consider exploring the prevalence of nonparticipating customers replacing their HVAC equipment early in more detail in future research to better understand the extent to which waiting for a Home Energy Assessment is limiting participation as well as the existence of spillover.

Recommendation 4: Incorporate the results from the replacement type analysis into future program planning and gross savings estimations.

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4 http://ma-eeac.org/wordpress/wp-content/uploads/2016-2018-Plan-1.pdf

5 http://ma-eeac.org/wordpress/wp-content/uploads/2012-Residential-Heating-Water-Heating-and-Cooling-Equipment-Evaluation_Net-to-Gross-Market-Effects-and-Equipment-Replacement-Timing-Volume-I-June-2013.pdf

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs are considering all recommendations for adoption at this time. The PAs have not formally adopted or rejected any recommendations that require changes to program design and operations.

How the Study Affects Program Results and Its Significance:

The evaluation team found high overall NTG results for the Early Retirement HVAC program which will improve overall program estimates.

Overview of Study Method:

Following the established work plan, the evaluation team fielded three primary research efforts:

1. Participant survey
2. Contractor survey
3. Lead vendor/home performance contractor energy specialist survey

The evaluation team used participant survey results to develop equipment replacement type, free ridership, NTG estimates. The contractor and LV/HPC surveys provided context and process findings, but do not directly impact the NTG value. As agreed with the PAs and EEAC in planning stages, NTG results encompass free ridership only; the NTG ratio does not include spillover.

Application of Results: Retroactively and Prospectively

A copy of the complete study can be found in Appendix U, Study 14.

Study 15: HEAT Loan Assessment

Type of Study: Market Characterization or Assessment Evaluation

Evaluation Conducted by: Navigant Consulting

Cadeo Group

Date Evaluation Completed: 8/1/2018

Study Objective and Summary of Results:

The study determined the percentage of customers who received a Home Energy Assessment (HEA) and were authorized by a lead vendor (LV) to seek a HEAT loan that completed the process and secured a HEAT loan to finance energy efficiency measures. For those that start the process but do not take out the loan—referred to as authorized customers for this study—the team investigated what barriers prevented these customers from taking out the loan, what opportunities exist to overcome these barriers, and whether these customers still install recommended measures without the HEAT loan. In addition to these specific questions, the evaluation team also sought to better understand customers' overall experience going through the HEAT loan authorization and lender application process to identify what aspects of the current process are working, as well as any potential process improvements.

The study found that more than 80,000 customers had an HEA in 2017. Of these customers, approximately 6,600 (8%) worked with their LV to become authorized to seek a HEAT loan. Most of these customers (approximately 75%) completed the process and received a HEAT loan. There are four main, equally prevalent and often interrelated, reasons why 25% of these customers did not subsequently take out a HEAT loan:

1. Declined by a Lender: Due to income, existing debt, and/or low credit scores, some customers failed to meet participating lender's criteria. The PAs should explore the possibility of offering separate financing options tailored for lower income or lower credit customers (e.g., National Grid is working with Capital Good Fund, which specializes in financing options for higher risk customers).
2. Cost Too High: Despite the 0% interest rate, some customers remain uncomfortable with the total cost of and/or taking on the debt associated with the improvements. For these cost-sensitive customers, PAs should focus their messaging on lifecycle cost and how the customer's monthly energy savings will help offset their loan payments.
3. Other Financial Priorities: Some customers simply have other, non-efficiency related financial priorities. From a program perspective, this is the most difficult group to reach. One potential strategy is to focus on non-energy benefits of the recommended measures, giving the customer another value proposition if the energy benefits are not enough to encourage participation.
4. Timing Was Not Right: For some authorized customers, the timing to go to a lender is not right for several possible reasons, including the assumption that the lending process will be long and/or complicated. The PAs should clearly communicate that most customers were able to receive the loan on the same day from a lender, which could mitigate the perceived timing barrier.

Just over half of authorized customers still installed at least one of the recommended energy efficiency measures despite not utilizing the HEAT loan, using personal savings, credit cards, or a home equity line of credit. However, a meaningful subset of these customers reported that they installed less efficient equipment and/or fewer measures than they would have with the HEAT loan.

Heating systems are by far the most common measure installed by all customers in the study. Consequently, HVAC contractors present an important opportunity for driving participation. Addressing potential disincentives for HVAC contractors to recommend the HEAT loan (e.g., fear of losing the customer to a program contractor if the customer completes the required step of getting a HEA) could result in even more customers using the HEAT loan to install increasingly efficient HVAC equipment and explore other energy savings opportunities within their home.

While PAs and LVs expressed concern about the time and effort required to complete the LV authorization process, most customers indicated that the process was smooth and clear. However, almost a quarter of customers reported needing to apply multiple times or needing to resubmit missing or incorrect documentation. Resubmittal did not affect the rate at which customers completed the process but did negatively impact their satisfaction with the overall HEAT loan experience.

Core Initiatives to which the Results of the Study Apply:

- Residential Coordinated Delivery (Electric & Gas)

Evaluation Recommendations:

No formal recommendations were made in this evaluation.

<u>Considerations</u>

1. Combat Disincentives for HVAC Contractors to Promote the Loan: Eversource is testing a pathway for approved HVAC contactors to offer the HEAT loan, and other rebates for heating systems upfront, and then have the customer complete the HEA afterward. This alleviates time pressure for customers and PA concerns regarding contractors not wanting to promote the HEAT loan and HES. It also aligns how the PAs handle heating and cooling equipment. Expanding the contractor-driven mechanical system first/HEA second delivery model to also include heating measures could drive increased participation in HES as well as uptake of higher efficiency heating equipment through increased access to favorable financing. If the trial goes well, the PAs should consider adopting the model statewide.
2. Develop Alternative Financing Pathways for Lower Credit Customers: For example, National Grid recently began working with Capital Good Fund to explore alternative loan options for customers with difficulty obtaining credit from traditional lenders. This kind of alternative pathway for lower credit customers—whether in collaboration with Capital Good Fund or another partner—could drive greater installation of energy efficient measures, especially for the harder-to-reach customers who the PAs have increasingly targeted through their initiatives. It would, however, increase the total interest rate buy-down costs associated with the HEAT loan.
3. Adjust Energy Specialist Pitch to Ease Customer Concerns about Cost: Energy Specialists should always explain the lifecycle cost of and payback periods associated with

recommended measure to all HES customers. This framing is critical for focusing conversation with the customer on how the measure will generate energy and cost savings over time rather than its upfront cost. Fiscally conservative customers may respond particularly well to this type of messaging and be more amenable to installing recommended measures.

4. Proactively Explain Typical Timeline: Customers who decided not to get the loan because the timing is not right have already received an HEA and have been authorized by a PA. The last step of the process is to work with a lender. Failing to complete the process while citing timing constraints could indicate some customer perception that the lending process will be arduous and time consuming. Making sure customers understand that the average lending process is quick could reconcile this disconnect between customer perception and the actual timing.
5. Expand Program Delivery to Accommodate Emergency Replacements: Some customers looking to replace equipment quickly or in the event of failure at a critical time (e.g., failed heating system in winter) may choose not to schedule an HEA—a requirement to be eligible for the HEAT loan—because they would rather complete the work immediately than wait for the assessment and loan process. HVAC contractors can be influencers for these types of customers; restructuring the HEAT loan process to better accommodate for emergency replacements could help drive participation.
6. Modify Authorization Expiration Process: The PAs have a 60-day expiration policy, which requires about 25% of customers to resubmit and become frustrated with the process. Adding means by which customers can easily request a modest extension could reduce resubmittals and associated dissatisfaction. Another potential option is to add flexibility to the contractor bid price to allow the lender to provide financing for moderate price increases without forcing customer reauthorization.
7. Take Steps to Keep Customers Informed of Application Problems: Interviewed customers that had to submit authorization paperwork multiple times expressed frustration at the level of communication regarding their applications. Increasing the specificity of required information can alleviate some customer resubmission problems upfront. Similarly, customer satisfaction can be increased by clearly communicating any problems with the application that occurred during processing in a timely manner. Finally, providing a specific point of contact for application problems can help customers feel less confused or frustrated if a problem does arise.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

N/A (no formal recommendations were made in this evaluation)

How the Study Affects Program Results and Its Significance:

The study has no quantitative recommendations or findings from the research conducted but did explore the barriers that prevent some customers from completing the process, and whether those customers install recommended measures regardless.

Overview of Study Method:

The evaluation team conducted interviews to better understand the strengths, barriers, and opportunities related to the current delivery of the HEAT loan. Among the interviewees were

several PA program managers (PMs), the two LVs that authorize customers to pursue the HEAT loan from a participating lender, and the vendor that processes reimbursements for those lenders (EFI). Given the targeted scope for the study, the evaluation team interviewed HEAT loan PMs from only two PAs—National Grid and Eversource—and did not directly contact representatives from any of the participating lending institutions. However, the team did interview the consultant that onboards and interacts with participating lenders, who offered some—albeit indirect—perspective regarding lenders.

Application of Results: Retroactively and Prospectively

A copy of the complete study can be found in Appendix U, Study 15.

Study 16: Multi-Family Program Impact and Net-to-Gross Evaluation – Updated

Type of Study: Impact Evaluation

Net-to-Gross Evaluation

Evaluation Conducted by: Navigant Consulting

Illume Advising

Date Evaluation Completed: 8/14/2018

Study Objective and Summary of Results:

The purpose of this study was to improve the accuracy of the reported savings for the Massachusetts Multi-Family Retrofit Program (MMRP). The evaluation included an impact evaluation of lighting measures and program wide Net-to-Gross (NTG) research. The focus on lighting measures for impact evaluation activities reflects lighting's high contribution to overall program savings.

The detailed goals of this study include developing:

- Updated hours of use (HOU) realization rate for common area lighting measures
- Updated in-service rates (ISRs) for both common area and in-unit lighting measures
- Measure category-level NTG ratios for both common areas and in-unit measures
- Assessment of progress made suggested improvement strategies outlined in the Multi-Family Program Improvement Strategies report (Res 42) dated March 28, 2017
- Assessment of updated vendor project reporting and quality assurance procedures

The primary goal of the research completed through this study was to inform savings reporting for the 2017 and 2018 program years and inform the subsequent 2019-2021 planning cycle.

The study provides the following key findings:

- The vendor-reported common area lighting HOU had no correlation with the logged HOU. The high variance leads to low precision on the HOU realization rate. The evaluation team found an interior lighting HOU realization rate of 0.91 with a confidence/precision of 90/30 and an exterior HOU realization rate of 0.98 (confidence/precision is not reported for exterior lighting).
- The evaluation team found ISRs of 1.0 for common areas with a confidence/precision of 90/9 and 0.88 for in-unit areas with a confidence/precision of 90/13.
- The evaluation team found a free ridership ratio of 0.21 with a confidence/precision of 90/15 and a provisional spillover ratio of 0.30 with a confidence/precision of 90/32, resulting in a program-level NTG ratio of 1.09 with a confidence/precision of 90/14.
- In general, the quality assurance/quality control (QA/QC) processes had improved for the MMRP since the implementation of the RES 42 suggested improvement strategies which included providing site-specific locations for lighting installations. However, the quality of paperwork used by the implementation vendors to track measure installation still varies tremendously.

- During the lead vendor interviews, two of the three implementation vendors reported issues with QA/QC inspections occurring while the installation was in progress, before all measures had been installed. The PAs indicate that *in process* QA/QC visits are important to review existing conditions. However, it seems that there is confusion as to what type of visit is supposed to occur and what data is meant to be collected in each instance.
- Almost half of renters surveyed for the NTG research, all of whom live in 2017 MMRP participating buildings, did not know that their building had participated in the program.

Core Initiatives to which the Results of the Study Apply:

- Residential Coordinated Delivery (Electric & Gas)
- C&I Existing Building Retrofit (Electric & Gas)

Evaluation Recommendations:

The following recommendations were made by the evaluators conducting this study.

Recommendation 1: Due to the low precision caused by the high variance between vendor-reported common area HOU and the logged HOU, the evaluation team recommends using a deemed HOU. Therefore, to update the 2017 MMRP common area lighting savings, Eversource should replace its currently used space-by-space deemed HOU values with the updated space-by space deemed HOU results from this study:

- Interior, Circulation: 8,307 hrs/yr, 23 hrs/day
- Interior, Other: 4,115 hrs/yr, 11 hrs/day
- Exterior: 4,689 hrs/yr, 13 hrs/day
- Parking Garage: 8,760 hrs/day, 24 hrs/day

Recommendation 2: To update the 2017 MMRP common area lighting savings, all PAs other than Eversource should apply the found realization rates of 0.91 for interior lighting and 0.98 for exterior lighting to the common area HOU.

Recommendation 3: For all future program years (2018 and beyond), all PAs should use the space-by-space deemed HOU values identified in Recommendation 1. When the deemed HOU values are applied they should be accompanied by an HOU realization rate of 1.0.

Recommendation 4: The PAs should apply the found lighting ISRs (1.0 for common areas and 0.88 for in-unit) retrospectively to 2017 program savings and prospectively to future program savings and planning.

Recommendation 5: The PAs should apply the program-level NTG ratio of 1.09 prospectively to future program savings and planning. The NTG ratio should be applied to gross electric and fuel savings from all measures in the MMRP.

Recommendation 6: The PAs should work with the implementation and QA/QC vendors to identify the correct flag in the project database to ensure clarity around whether QA/QC visits can both occur when a project is in process and after completion. In addition, the PAs should work with the implementation and QA/QC vendors to clarify what data should be collected at each type of site visit.

Considerations

1. The PAs should consider continuing to implement the suggested improvement strategies from the RES 42 study, specifically those that focus on improving data clarity between the implementation and QA/QC vendors.
2. The PAs should consider encouraging a greater level of consistency in the implementation vendors' documentation. This could even go as far as recommending a standard template for all implementation vendors to use. This would increase data clarity and consistency across the PAs.
3. The PAs should consider facilitating improved outreach from implementation vendors to building residents to continue to increase program awareness. In addition, the PAs should consider opportunities to address the MMRP offering directly to renters, so that they become more active participants in the program.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs plan to adopt and/or are considering some of the recommendations, as described below.

The PAs have adopted recommendations 1-5 and are considering adoption of recommendation 6.

How the Study Affects Program Results and Its Significance:

Applying the quantitative recommendations of this study will increase the MMRP savings for 2017 and the savings projections for 2018 and beyond. The lighting impact savings will replace the temporary realization rate of 60% that is currently applied across the MMRP programs and was the result of a negotiation between the PAs and EEAC following the 2016 *National Grid Multi-Family Program Gas and Electric Impact Study.* A NTG ratio that is greater than 1 will increase the net savings for the MMRP. In addition, the qualitative program findings specifically around the QA/QC processes will help to encourage more accurate program savings in the future.

Overview of Study Method:

The lighting impact evaluation objectives were addressed through database analysis, project engineering file reviews, and site visits. The evaluation team completed site visits at a total of 23 facilities, which included reviewing 147 common area measures across 15 facilities and 201 in-unit measures installed in 201 units across 14 facilities (six facilities included both common area and in-unit measures).

The evaluation team conducted NTG research through surveys targeted at MMRP participating and nonparticipating renters, condominium owners, and property managers/owners. A total of 1,396 individuals responded to the NTG survey; following a series of screening questions, 189 of these responses were determined eligible to comment on MMRP free ridership. The survey respondents identified 560 non-incentivized, program-influenced actions; after screening, 170 actions were included in the spillover analysis.

Application of Results: Retroactively and Prospectively

A copy of the complete study can be found in Appendix U, Study 16.

Study 17: Wi-Fi Thermostat Impact Evaluation – Secondary Research Study

Type of Study: Impact Evaluation

Evaluation Conducted by: Navigant Consulting

Illume Advising

Date Evaluation Completed: 9/21/2018

Study Objective and Summary of Results:

The purpose of this study was to perform a comprehensive secondary literature review of Wi-Fi thermostat savings. The study relied on existing research performed for other jurisdictions around the country, and summarized savings by year, thermostat type, fuel type and other key considerations. The study was intended to provide recommended savings values for interim use based on these secondary findings. This review also takes into consideration additional thermostat savings which may be achieved through Seasonal Savings algorithms or direct install/audit-based delivery channels.

The study provides the following key findings:

- Wi-Fi and smart thermostat savings vary dramatically based on jurisdiction, climate zone, technology, program distribution channel and other considerations. This finding is illustrated in Table 3, which shows the minimum and maximum values for the 49 studies included in this literature review. Most studies report findings for one or two of these categories, but not for all, further complicating findings. For example, many studies will report savings in total annual kWh but not as a percent of use. For example, in Table 3, the minimum value for Therms savings is negative, but the minimum value for percent savings is zero, because studies reported one or the other value, but not both. The finding of widely varying savings for Wi-Fi thermostats aligns with previous research in Massachusetts, specifically findings from the 2017 RES 17 study.

Table 3. Savings Value Summary Table

Study Value	Annual Electric Savings (kWh)	Annual Gas Savings (Therms)	Annual Electric Savings (%)	Annual Gas Savings (%)
Minimum Value	0	-24	0.0%	0.0%
Maximum Value	841	69	6.0%	9.3%

Core Initiatives to which the Results of the Study Apply:

- Residential Coordinated Delivery (Electric & Gas)
- Residential Retail (Electric & Gas)

Evaluation Recommendations:

The following recommendations were made by the evaluators conducting this study.

> **Recommendation 1:** The evaluators recommend annual savings values of 31 Therms for combustion heating, 97 kWh for electric heating, and 64 kWh for Central Air Conditioning for use until primary research and analysis findings are complete. These values should be applied for future planning.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs plan to adopt the recommendations.

How the Study Affects Program Results and Its Significance:

Applying the qualitative recommendations of this study will lower previous gas and electric savings estimates.

Overview of Study Method:

Our team began this secondary literature review with findings presented in the RES 17 study prepared for the PAs in 2017, which summarized a large number of the secondary literature Wi-Fi and smart thermostat study findings up to that point in time. The evaluators conducted additional research to update those findings to include additional studies, both prior to 2017 and through mid-2018.

In total, this study summarizes 49 thermostat studies, including both studies in the RES 17 report and new studies. Evaluators re-reviewed the studies cited in RES17 to ensure accurate representation of findings and add additional secondary findings included in some studies.

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 17.

Study 18: Ductless Mini-Split Heat Pump Cost Study – Updated

Type of Study: Market Characterization or Assessment Evaluation

Evaluation Conducted by: Navigant Consulting

Date Evaluation Completed: 9/19/2018

Study Objective and Summary of Results:

The goal of this study was to evaluate the energy-efficiency related total and incremental costs of single family home installations of DMSHP systems currently rebated through the Residential Heating and Cooling program.

Navigant developed the Ductless Mini-Split Heat Pump Cost Study to answer the following questions:

- What are the consumer costs of purchasing and installing residential DMSHP systems in single family homes in both the retrofit and lost opportunity scenarios, and what proportion of these costs go towards equipment and labor?
- What is the relationship between cost and efficiency for DMSHP systems?
- What are the total costs and incremental costs associated with installing DMSHP systems at different efficiency levels with different configurations (i.e., single-head vs. multi-head)? Do these total and incremental costs determined from research align with the actual costs reported on invoices in collected PA program data?

The study provides the following key findings:

- For a given capacity level, the cost changes associated with increasing efficiency are due entirely to changes in the cost of equipment (i.e., the installation costs do not vary with efficiency). At smaller system capacities of 24 kBtu/h and less, the incremental cost of high-efficiency systems exceeds the rebate amounts offered for those systems. However, at larger system capacities of 30 and 36 kBtu/h, the rebate amount exceeds the incremental cost of efficiency for regular (non-cold-climate) systems.
- About 25% of the DMSHP rebate records in the period January 1, 2016 through July 31, 2017 were for systems within the capacity range of 9.5-13.5 kBtu/h rated below 28 SEER and 14 HSPF. There are systems in this capacity range on the market that are rated at or above 28 SEER and 14 HSPF, and these systems present a savings opportunity.
- At larger DMSHP system capacities, such as sizes of 30 kBtu/h + 3 zones and 36 kBtu/h + 4 zones, there is little or no incremental cost to increase efficiency from the base case of 15 SEER / 8.2 HSPF to a regular (non-cold-climate) system at the lower rebate threshold of 18 SEER / 10 HSPF. On the other hand, at these sizes there are significant incremental costs for qualified *cold-climate* systems at the lower rebate threshold of 18 SEER / 10 HSPF.
- The majority of DMSHP systems rebated in 2016-2017 used wall-mounted indoor units. As such, wall-mounted units were the focus of this cost study. However, midway through this study, the evaluation team received anecdotal evidence that an increasing proportion of DMSHP installations in Massachusetts are using ducted indoor units. The evaluation

team expects that ducted indoor units may offer comparable savings to non-ducted indoor units, but that ducted units could incur greater total installed costs due to the different equipment costs and the tradeoff between installing refrigerant lines versus installing ductwork.

Core Initiatives to which the Results of the Study Apply:

- Residential Coordinated Delivery (Electric Only)
- Residential Retail (Electric Only)

Evaluation Recommendations:

No formal recommendations were made in this evaluation.

Considerations

1. To motivate the adoption of smaller capacity systems at very high-efficiencies, the PAs should consider adding a premium rebate level at 28 SEER and 14 HSPF.
2. At larger capacities (>30 kBtu/h) the current rebate structure incentivizes the installation of non-cold-climate systems that have little or no incremental cost above the base case. Cold-climate systems should provide additional savings at all capacity levels for a small additional cost, so the PAs should consider limiting the rebate eligibility for DMSHP systems to systems that are cold-climate qualified. This limitation may be implemented by requiring ccASHP qualification or by providing specific efficiency requirements at low outdoor temperatures.
3. Since ducted DMSHP systems may comprise an increasing portion of DMSHP rebate claims, the PAs should consider an add-on task to evaluate how equipment and installation costs of ducted systems compare to the non-ducted systems examined in the current study.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

N/A (no formal recommendations were made in this evaluation)

How the Study Affects Program Results and Its Significance:

The findings of this study help inform an update of the Residential Heating and Cooling Program's rebate offerings. They help the program to make informed decisions about the efficiency levels at which rebates are offered, and the rebate amounts that are offered.

Overview of Study Method:

This study relies on three main data sources: 1) a survey of HVAC contractors in Massachusetts, 2) retail prices gathered by webscraping, and 3) a sample of scanned invoices for system installations that were rebated through the program. This study combines data from these three sources to construct cost-efficiency curves that describe the total installed cost of DMSHP systems across a range of different system sizes and efficiency levels.

The evaluation team first defined the representative product sizes that are typically installed in the PAs' service areas. The team then gathered cost data by surveying contractors and webscraping retail prices and merged the data from these two sources to construct cost-efficiency curves.

Finally, the team reviewed a sample of program invoices to confirm that the constructed cost-efficiency curves fall in the ranges of costs reported on program invoices.

Application of Results: Retroactively and Prospectively

A copy of the complete study can be found in Appendix U, Study 18.

Study 19: Cost Study of Heat Pump Installations for Dual Fuel Operation

Type of Study: Cost Study

Evaluation Conducted by: Navigant Consulting

Date Evaluation Completed: 9/21/2018

Study Objective and Summary of Results:

The primary goal of the study was to provide the PAs with an understanding of the total installed costs and cost categories (i.e., equipment, labor, supplies, and other costs) associated with early replacements and new installations of residential central A/C and heat pump (HP) products. The 2015 Cool Smart Incremental Cost Study evaluated the equipment costs of residential A/C and HP products. However, the PAs had not recently evaluated the total installation cost of installing these products in the PAs' service areas. This study summarizes the evaluation team's findings from a review of customer invoices that were submitted with rebate applications for residential A/C and HP installations.

The study provides the following key findings:

Table 4. Installed Cost per Ton for A/C and HP Installations from Program Invoice Review

Product Class and Installation Scenario	Total Installed Cost per Ton					
	New Installation			Replacement		
	25 %tile	Average	75 %tile	25 %tile	Average	75 %tile
A/C	$3,495	$4,156	$4,940	$2,838	$4,074	$5,150
HP 16 SEER	$3,676	$5,121	$6,705	$3,948	$4,685	$5,253
HP 18 SEER	$4,566	$5,259	$6,400	$3,999	$5,033	$5,766

Core Initiatives to which the Results of the Study Apply:

- Residential Coordinated Delivery (Electric & Gas)
- Residential Retail (Electric & Gas)

Evaluation Recommendations:

The following recommendations were made by the evaluators conducting this study.

> **Recommendation 1:** The evaluation team recommends using the identified installed costs as planning estimates in the RES 21 (Energy Optimization Study) model.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs plan to adopt and/or are considering some of the recommendations, as described below.

The average installed replacement cost per ton for both 16 SEER and 18 SEER heat pumps were incorporated into the Res 21 (Energy Optimization Study) model.

How the Study Affects Program Results and Its Significance:

The cost results from this study will be used by the Energy Optimization program to evaluate measures that would install heat pumps in homes that are currently heated by fossil fuel furnaces or boilers and that may or may not have central A/C.

Overview of Study Method:

In this study, the team developed a sample frame of 200 total rebate records, including 100 rebate records each for A/C and HP product types. The team selected these sample frames to proportionally represent the number of rebates in different geographic regions in the PAs' service areas. The team received scanned invoice images for each of the records in the sample frame. For each record, the team verified that the record contains useful information such that the record (1) is legible, (2) is a record that the team requested, and (3) contains itemized cost information for an A/C or HP installation. For each record with useful information, the team recorded the total installed cost for the installation; the cooling capacity in tons; and, if available, the itemized costs for equipment, labor, supplies, and other costs. For records that included installation costs for more than one A/C or HP installation, the team split the record into multiple records to provide a data point for each A/C or HP installation. For each record with useful information, the team divided the total installation cost by the cooling capacity (in tons) to calculate the installation cost per ton.

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 19.

Study 20: Energy Optimization Study

Type of Study: Impact Evaluation

Evaluation Conducted by: Navigant Consulting

Date Evaluation Completed: 10/9/2018

Study Objective and Summary of Results:

The purpose of this study was to develop a spreadsheet model that characterizes and estimates the savings, costs, and emissions reductions for various heating, cooling, and water heating measures that involve the full or partial displacement of existing oil or propane equipment with gas or electric equipment. The results of this model are being used to inform and prioritize the PAs' plans for deploying these measures under a new and evolving "energy optimization" philosophy or offering under their Residential Coordinated Delivery initiative for program years 2019 through 2021. The spreadsheet tool models the consumption, savings, costs, and emissions reductions of these energy optimization measures under three main scenarios: (1) full/early replacement, (2) partial displacement, and (3) replace on failure.

The study provides the following key findings:

- All the measures considered in this study result in annual energy cost savings for the customer.
- The early replacement measures with the highest annual energy cost savings were the measures involving the replacement of propane and oil boilers with gas-fired combination boilers.
- All the measures considered in this study result in reduced CO_2 emissions. The CO_2 emissions reductions are comparable for the early replacement scenario (with measure savings ranging from 0.32 to 6.40 tons CO_2/year) and the replace-on-failure scenario (ranging from 0.22 to 6.96 tons CO_2/year).
- Suggestions to improve its accuracy and/or expand its applicability include additional analysis to better inform and refine the model inputs related to home heating, cooling, and water heating loads; installation costs for higher capacity central heat pumps; ancillary costs for ductwork, existing equipment removal and disposal, new gas service lines, electrical system upgrades, and dual system integration; the relationship between heat pump cooling and heating capacity; and heat pump performance as a function of temperature.

Core Initiatives to which the Results of the Study Apply:

- Residential Coordinated Delivery (Electric & Gas)

Evaluation Recommendations:

No formal recommendations were made in this evaluation.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

N/A (no formal recommendations were made in this evaluation)

How the Study Affects Program Results and Its Significance:

This study produced a spreadsheet tool that the PAs are using to assess the potential costs and savings for various energy optimization scenarios and measures based on user-defined inputs and operating assumptions, such as equipment capacity and switchover temperature energy and fuel prices, and home cooling, heating, and water heating load. It will help inform the PAs' decision on which measures to include in its 2019-2021 Three-Year Plan and their associated savings and costs.

Overview of Study Method:

Each measure considered in the analysis is defined by a baseline equipment type and a replacement equipment type. The costs and savings associated with energy efficiency measures are the incremental costs and reduced consumption of a more efficient technology relative to a baseline technology. This analysis considered three replacement scenarios: (1) a Full/Early Replacement (ER) scenario where high-efficiency electric or gas equipment is installed to replace less efficient oil or propane equipment prior to the failure of the existing equipment; (2) a Partial Displacement (PD) scenario where high-efficiency electric heat pump equipment is installed to operate alongside and complement existing oil- or propane-fired heating equipment; and (3) a Replace-on-Failure (ROF) scenario where an existing piece of less-efficient oil or propane equipment has failed and is replaced by a more efficient piece of electric or gas equipment.

The incremental costs in this study were developed using results from recent evaluation studies, including the Water Heating, Boiler, and Furnace Cost Study (RES19), the Air Conditioner and Heat Pump Cost Study (RES23), and the Ductless Mini-Split Heat Pump Cost Study (RES28). The energy consumption estimates in this study were developed using a mix of engineering calculations, impact evaluation results, and (for heat pump measures) an outdoor temperature-based analysis of residential heating consumption. The evaluation team also estimated the carbon emission savings associated with each measure considered in this study using heat rate information provided by the EIA, and the typical carbon emissions associated with electricity generation in New England from ISO New England.

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 20.

Study 21: Understanding the Role of Weather in Air Conditioning Use Behavior and Demand Response Program Participation

Type of Study: Market Characterization or Assessment Evaluation

Evaluation Conducted by: Navigant Consulting

Illume Advising

Date Evaluation Completed: 10/2/2018

Study Objective and Summary of Results:

The purpose of this study was to investigate and understand the role of weather, including but not limited to heat and humidity, on people's use of their air conditioners (AC) through interaction with their thermostats, and their propensity to opt out of demand response (DR) programs. Because the study is focused on cooling and AC use, it does not consider heating behavior in relation to weather.

The study provides the following key findings:

- People use their AC units and thermostats in countless ways, defying any easy categorization -- as a result we find it more useful to identify specific behaviors and plan effective communication and intervention for users with these behaviors.
- The largest driver of people using their AC systems for the first time during a cooling season is the temperature -- generally high humidity conditions have already occurred long before people turn on their AC, but first AC turn-on coincides very well with high heat.
- When it comes to AC use throughout the season, humidity plays a large role--not only does humidity by itself make people more likely to turn on their AC on a given day, but humidity combined with high heat has more influence than either factor in isolation.
- DR program participants react to both heat and humidity when opting out of events, but event parameters such as duration or day-of-week can play as large a role in the opt-out decision as weather.
- Because the weather during the summer of 2017 (our study period) was relatively mild, we cannot generalize our findings to how people might behave under extreme weather conditions.

Core Initiatives to which the Results of the Study Apply:

- Residential Coordinated Delivery (Electric Only)
- Residential Retail (Electric Only)

Evaluation Recommendations:

No formal recommendations were made in this evaluation.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

N/A (no formal recommendations were made in this evaluation)

How the Study Affects Program Results and Its Significance:

The findings of this study allow the PAs to consider weather's effects on AC use and DR program opt-out behavior in the optimal design and delivery of these programs. The study showed it is of little value to message to static "AC User Types" to try to modify their behavior, because a nearly infinite array of types exists. Rather, PAs can identify specific AC use behaviors related to the weather such as consistently setting very low cooling setpoints, fiddling with settings often, using the hold setting excessively, etc. and craft messaging targeting these behaviors to reduce energy use and result in more efficient AC use by customers. Similarly, on the DR side, the study's results suggest the PAs must balance savings lost to weather-related opt-outs with higher savings generated by holding events on hotter days likely to have higher use. To determine the optimal balance, the study results provide numerous considerations for the PAs to improve program performance and design, such as encouraging people to get out of their homes on hot days, or consider gamification strategies to get participants to persist longer in an event under adverse weather conditions.

Overview of Study Method:

The study of weather and AC use leveraged data for households in the Worcester MA region, and utilized AMI data for approximately 15,000 homes, thermostat telemetry data for over 100 homes that would later be part of the Smart Energy Solutions (SES) Pilot (but before program intervention began) and overlapping data for 54 homes with complete cooling season thermostat telemetry and AMI data. Regression analysis and exploratory data analysis were used to illustrate AC use behavior in response to weather and provide considerations for encouraging more energy efficient use of AC systems under different weather conditions. The study also deployed in-depth interviews with participants and DR service providers, to better understand opt-out behavior and its relation to weather. The weather and DR opt-out behavior study leveraged thermostat telemetry data from National Grid Smart Thermostat DR participants. The study used both regression analysis and qualitative interview results to inform findings and provide considerations for optimizing program savings, taking weather into consideration.

Application of Results: Retroactively and Prospectively

A copy of the complete study can be found in Appendix U, Study 21.

Study 22: Impact Evaluation of PY2016 Massachusetts Commercial & Industrial Small Business Initiative: Phase I

Type of Study: Impact Evaluation

Evaluation Conducted by: DNV GL

Energy and Resource Solutions

Date Evaluation Completed: 6/7/2018

Study Objective and Summary of Results:

The purpose of this study was to quantify the electric energy savings and demand reduction of lighting measures incentivized by the Massachusetts C&I Small Business (SB) Initiative (hereafter referred to as "the Initiative"). This enables the PAs to assess whether the Initiative is achieving the expected savings and to identify any recommendations for improvement. Evaluated savings are quantified through on-site inspection, monitoring, and analysis of lighting measures within a sample of custom and prescriptive electric SB projects. This study is the first of two phases in the SB impact evaluation plan; Phase I addresses lighting measures, which represent 90% of the total program-reported kWh savings in 2016.

Additional evaluation objectives include:

- Research on how each PA processes custom measures within the SB Initiative.
- Assessment of lighting quality and potential lost opportunities.
- Assessment of potential lost opportunities from lighting control measures, including motion-based occupancy sensors and daylight dimming controls.
- Estimation of the potential impact of early replacement dual baseline methods on program savings, as a dual baseline paradigm is expected to be implemented in 2019.

The study provides the following key findings:

- Evaluators determined that lighting measures in the Small Business Initiative achieved approximately 95% of the reported electric energy savings. Demand savings results varied, with lower evaluated savings than reported for summer kW but higher evaluated savings for winter kW.
- For some projects, insufficient tracking data led evaluators to attribute savings differences to a lack of documentation.
- Evaluators found differences between the vendors' assumed preexisting fixture wattage and those recommended by the 2013-15 Massachusetts TRM.[6] Overall, evaluators found higher preexisting fixture wattages, leading to additional savings classified as technology adjustments.
- In some cases, interactive HVAC impacts were not claimed in spaces determined by the evaluators as mechanically cooled, resulting in HVAC discrepancies.

[6] Appendix A Table 56 of the MA TRM contains rated fixture wattage recommendations for a variety of fixture types and sizes. http://ma-eeac.org/wordpress/wp-content/uploads/TRM_PLAN_2013-15.pdf

- Some facility types, such as restaurants and meeting halls, featured lower-than-expected operation than anticipated by the implementation vendors.

Core Initiatives to which the Results of the Study Apply:

- C&I Existing Building Retrofit (Electric Only)

Evaluation Recommendations:

The following recommendations were made by the evaluators conducting this study.

Recommendation 1: For retrospective application of evaluation results to PY2018, we recommend that the PAs apply the RRs in the table below to reported gross kWh and peak kW savings to fully incorporate the findings from this study.

Savings Parameter	Formula Term	Retrospective Recommended Value	Relative Precision at Specified Confidence Interval
Gross Energy (kWh) Retrospective RR	$RR_{r,kWh}$	95.1%	±4.7% (90% confidence)
Gross Summer Peak Demand Retrospective RR	$RR_{r,skW}$	90.6%	±2.5% (80% confidence)
Gross Winter Peak Demand Retrospective RR	$RR_{r,wkW}$	102.8%	±11.8% (80% confidence)

Recommendation 2: Acknowledging that the PAs' tracking protocols and preferences might vary, the evaluation team has identified two options for the PAs to prospectively apply evaluation results. The two mutually-exclusive options are detailed in the next two tables. These factors should be prospectively applied to lamp and/or ballast replacement measures only, not controls.

Wholesale Approach:

The wholesale option involves the application of prospective RRs directly to tracking gross savings, not to the reported gross savings, as the prospective RRs in the table below incorporate the HVAC interactive effects factors as well as any non-HVAC adjustments determined through evaluation. The equations below illustrate the application of prospective wholesale factors to tracking gross savings.

$$Evaluated\ Gross\ kWh\ Savings = Tracking\ Gross\ kWh\ Savings \times RR_{p,kWh}$$

$$Evaluated\ Gross\ kW\ Savings_{Summer} = Tracking\ Gross\ kW\ Savings_{Summer} \times RR_{p,skW}$$

$$Evaluated\ Gross\ kW\ Savings_{Winter} = Tracking\ Gross\ kW\ Savings_{Winter} \times RR_{p,wkW}$$

Savings Parameter	Formula Term	Prospective Recommended Value
Gross Energy (kWh) Prospective RR	$RR_{p,kWh}$	100.9%
Gross Summer Peak Demand Prospective RR	$RR_{p,skW}$	92.7%
Gross Winter Peak Demand Prospective RR	$RR_{p,wkW}$	102.4%

PA tracking databases and benefit-cost calculator templates appear to accommodate such prospective RR factors. These values should replace the 102%, 100%, and 100% small C&I lighting measure RRs for kWh, summer peak kW, and winter peak kW, respectively, previously recommended to the Initiative.

Individual Factor Approach:

As an alternative to the above method, we recommend that the PAs replace individual factors within their tracking systems factors with evaluated factors, as illustrated in the following fixture savings formulas:

$$Evaluated\ Gross\ kWh\ Savings = Conn.kW\ Savings_{Tracking} \times RR_{Conn\ kW} \times HOU_{Tracking} \times RR_{HOU} \times HVAC\ Interactivity_{kWh}$$

$$Evaluated\ Gross\ Peak\ kW\ Savings_{Summer} = Conn.kW\ Savings_{Tracking} \times RR_{Conn\ kW} \times CF_{Summer} \times HVAC\ Interactivity_{skW}$$

$$Evaluated\ Gross\ Peak\ kW\ Savings_{Winter} = Conn.kW\ Savings_{Tracking} \times RR_{Conn\ kW} \times CF_{Winter} \times HVAC\ Interactivity_{wkW}$$

where,

$Conn.kW\ Savings_{Tracking}$ = Connected kW savings claimed by implementer

$HOU_{Tracking}$ = Hours of use (HOU) claimed by implementer

Savings Factor	Formula Term	Prospective Recommended Value	Relative Precision at Specified Confidence Interval
Connected kW RR	$RR_{Conn\ kW}$	97.2%	±1.4% (80% confidence)
HOU RR	RR_{HOU}	98.4%	±3.9% (90% confidence)
kWh HVAC Interactive Factor	$HVAC\ Interactivity_{kWh}$	102.4%	±6.3% (90% confidence)
Summer CF	CF_{Summer}	57.0%	±14.1% (80% confidence)

Savings Factor	Formula Term	Prospective Recommended Value	Relative Precision at Specified Confidence Interval
Winter CF	CF_{Winter}	57.9%	±8.3% (80% confidence)
Summer kW HVAC Interactive Factor	$HVAC\ Interactivity_{skW}$	108.4%	±1.7% (80% confidence)
Winter kW HVAC Interactive Factor	$HVAC\ Interactivity_{wkW}$	99.4%	±0.8% (80% confidence)

Using the individual factor approach, evaluation results would be reflected within all tracking savings estimates and would not require wholesale application of prospective RRs.

Recommendation 3: Regarding lighting controls, the evaluation team recommends that the results from the prior lighting controls-specific study (2014) are continued to be applied by the PAs. This study's population (PY2016) featured only 1% kWh savings contribution from lighting controls, and the evaluation sample design subsequently did not segment specifically for lighting controls; rather, overall statewide results were determined for SB lighting measures altogether. Therefore, we do not recommend application of any results from this evaluation study to controls measures moving forward.

Recommendation 4: The PAs should work with vendors to standardize how savings from tube LEDs (TLEDs), in particular "plug and play" TLED retrofits of fluorescent fixtures, are classified and tracked. As TLEDs were emerging when the 2013-15 MA TRM was completed, its standard fixture wattage table does not address TLEDs; therefore, evaluators found variation among vendors in how TLED fixture wattage was estimated. Many such TLED projects were classified as "custom" simply because no appropriate measure code was available in prescriptive templates. Evaluators often found differences between the vendor's fixture wattage assumption and that determined from DesignLights Consortium (DLC) reference and/or independent review of the manufacturer's specification sheets, particularly for "plug and play" TLED retrofits that reuse the preexisting fluorescent ballasts. Evaluators found that approximately 20% of TLED installations in the PY2016 sample were "plug and play," with the remainder of TLEDs classified as a whole-fixture replacement (new lamps and ballast). The PAs should provide more comprehensive guidance to vendors on when to classify fixtures as prescriptive or custom, how to estimate custom fixture wattages appropriately (e.g., through DLC reference), and which supporting documentation should be included in the application.

Recommendation 5: In 2019, Massachusetts will transition to a dual baseline approach for calculating lifetime savings. This study estimated the impacts of such a transition to dual baseline lifetime savings but referenced a placeholder out year factor of 60%. The P75 LED Market study will provide more accurate and granular data on the anticipated C&I LED market as compared with existing technologies. Additionally, the P73D study may provide more Massachusetts-specific research on remaining useful life (RUL) for C&I lighting systems. This information should be paired with the granular, fixture-level evaluation data available from this study to refine the lifetime savings impact.

Recommendation 5: As this study represents only Phase I of the Small Business Initiative impact evaluation, we recommend that Phase II is executed as soon as possible. This study examined performance of only lighting measures (fixtures and controls), but as the penetration of LEDs grows rapidly, the Initiative must look to non-lighting technologies to diversify their measure offerings and compensate for more limited lighting fixture savings in future program years. Phase II should include an assessment of potential non-lighting opportunities among major measure categories such as refrigeration, HVAC, envelope, and DHW.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs are considering all recommendations for adoption at this time. The PAs have not formally adopted or rejected any recommendations that require changes to program design and operations.

How the Study Affects Program Results and Its Significance:

The study findings decreases the electric savings estimated for program year 2018. Future 2019 and beyond projects should apply one of the two prospective application approaches, which includes HVAC interactive effects, which will improve tracking savings estimates.

Overview of Study Method:

The evaluation team's approach and methodology was consistent with the procedures and protocols developed during the previous round of SB impact evaluation last conducted of the 2010-2011 program years (PY2010-11). This study required onsite visits and metering of lighting hours-of-operation ("HOU") for a randomly selected sample of 105 customer facilities that participated in the Initiative in PY2016. In addition to onsite metering, our team investigated baseline issues, collected a comprehensive inventory of lighting and HVAC characteristics, and gathered additional information related to the objectives identified in Section 1.1. A high-level synopsis of the evaluation approach is as follows:

Sample design. Our team investigated Initiative changes since the PY2010-11 evaluation and determined the customer sample frame to develop a sample design that meets the desired statistical precision targets for key savings parameters such as energy and peak demand savings, as well as other factors such as peak coincidence factors and HVAC interactive effects.

Data collection and analysis. Data collection for this impact evaluation included a physical inspection and inventory of installed products, interviews with facility personnel, observation of site operating conditions and equipment, characterization of HVAC systems, and short-term metering of lighting HOU.

Lighting quality and controls potential. The evaluation team assessed lighting quality by measuring light levels, color rendering index and correlated color temperature reviews, lighting power densities (LPDs), and an assessment of light quality in terms of light levels, light uniformity, and color rendering index. Additionally, to estimate potential savings from missed opportunities related to lighting controls, evaluators identified and characterized manually-controlled fixtures that would be appropriate candidates for automatic lighting control

Application of Results: Retroactively and Prospectively

A copy of the complete study can be found in Appendix U, Study 22.

Study 23: LED Market Monitor Study - Lighting Market Model Summary Memo

Type of Study: Market Characterization or Assessment Evaluation

Evaluation Conducted by: DNV GL

Energy and Resource Solutions

Date Evaluation Completed: 3/29/2018

Study Objective and Summary of Results:

The primary objective of the LED Lighting Market Monitor Study is to provide the Massachusetts PAs and EEAC consultants with current information and data on the LED commercial and industrial (C&I) lighting market in Massachusetts. As part of this overarching objective, the P75 research team conducted two core research activities. For the first activity, the research team compiled a bibliographic database containing sources on lighting research (with a primary focus on C&I lighting). Following this activity, the team produced topic-level summaries on four lighting market indicators: saturation, market share, pricing, and availability. A market model was then developed for purposes of long-term forecasting.

Key findings from the lighting topic-level summaries include:

Saturation

- Linear lighting accounts for 74% of total interior sockets in Massachusetts. In 2015, 3% of linear applications used tubular LEDs (TLEDs), while 78% used T8s.
- According to the U.S. Department of Energy's (DOE's) "Energy Savings Forecast of Solid-State Lighting," saturation of LED lighting technology is forecast to grow 218% between 2015 and 2020. In the U.S., Linear fixtures, A-lines, and directional lighting are expected to grow the most during this time period. LED saturation will continue to increase through 2035 but at a decreasing rate.

Market share

- According to distributors in Massachusetts, LED sales accounted for 34% of total lighting equipment sales in 2013 in Massachusetts. Linear fluorescents comprised 33% of total sales, and CFLs accounted for 13% of total sales.
- According to the U.S. Department of Energy's (DOE's) "Energy Savings Forecast of Solid-State Lighting," market share for LED lighting technologies is forecast to increase rapidly in the U.S. to nearly 100% in screw-based lighting applications and up to 90% in some linear lighting applications by 2030.

Pricing

- The U.S. DOE projects that the steepest declines in prices for most LED lamp and luminaire types in the U.S. will occur between 2015 and 2020.
- A-lines, large downlights and track lighting, decoratives, and some linear LED lamp types are forecast to decline in price by 70% or more in the U.S. between 2015 and 2020.

Availability

- The DesignLights Consortium (DLC) database of commercial LED lamps and fixtures shows that outdoor area and roadway LED lamp products comprise roughly one-third of all LED model numbers listed in the database as of October 2017. Troffer LED products comprise 20% of the model numbers listed and linear and high bay LED products each comprise 15% of the model numbers listed in the database.
- The U.S. Department of Energy's Lighting Facts database shows exponential growth in the number of LED products listed in the database over time. There were approximately 4,300 products listed in the database in 2013 and more than 42,000 products listed in the database in 2016. The number of linear LED products listed in the database grew by a factor of nearly 100 between 2013 and 2016.

The research team then developed an LED market model. The main objectives of the model were to:

- Develop a detailed first year inventory of the installed stock of lighting equipment in Massachusetts C&I facilities, including the number of lamps installed by building type, lighting application, and equipment technology. This first-year inventory reflects conditions in the population of Massachusetts C&I facilities as of 2015.
- Develop algorithms for forecasting annual changes in the installed stock through 2026.
- Estimate annual energy use for the actual or forecasted installed inventory by building type, lighting application group, and equipment technology for the 2015-2026 period.

Core Initiatives to which the Results of the Study Apply:

- C&I New Buildings & Major Renovations (Electric Only)
- C&I Existing Building Retrofit (Electric Only)
- C&I New & Replacement Equipment (Electric Only)

Evaluation Recommendations:

No formal recommendations were made in this evaluation.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

N/A (no formal recommendations were made in this evaluation)

How the Study Affects Program Results and Its Significance:

This study has relevance for program planning and implementation. The LED market model developed for this study forecasts installed stock, savings, and consumption from 2016-2026. These forecasts can be used to update baseline assumptions for C&I lighting.

Overview of Study Method:

The first core activity of this study involved a literature review. Relevant sources on lighting research were then compiled into a bibliographic database.

For the second core activity, the research team developed an LED market model using a traditional stock adjustment modeling approach to forecast the size and composition of the stock of C&I

lighting and the energy consumption associated with that stock. The model includes 13 unique building types, 5 major interior and exterior lighting applications, and 14 specific equipment types. Using the model, the team was able to develop a detailed first year inventory of the installed stock of lighting equipment in Massachusetts C&I facilities, including the number of lamps installed by building type, lighting application, and equipment technology. This first-year inventory reflects conditions in the population of Massachusetts C&I facilities as of 2015. The team also developed algorithms for forecasting annual changes in the installed stock through 2026, and estimated annual energy use for the actual or forecasted installed inventory by building type, lighting application group, and equipment technology for the 2015-2026 period.

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 23.

Study 24: TWGA CI Portfolio Modelling Findings and Conclusions Memo

Type of Study: Impact Evaluation

Evaluation Conducted by: Energy and Resource Solutions

DNV GL

Date Evaluation Completed: 4/1/2018

Study Objective and Summary of Results:

The purpose of this study was to analyze the potential impact on savings of complying with three new evaluation practices outlined in the Baseline Framework. Prior to the Baseline Framework, these practices were present, but not systematically implemented in the evaluation and reporting of C&I portfolio savings. The three practices considered are:

1) Use of an industry standard practice baseline for lost opportunity measures,
2) Use of preponderance of evidence (POE) to establish the application type (lost opportunity or retrofit) of the measure,
3) Use of dual baselines to calculate retrofit measure lifetime savings.

The study provides the following key findings:

- Implementation of the new baseline practices are likely to reduce electricity and natural gas savings. The following table summarizes the estimated impact in the most likely scenario by systematic application of the three new practices. The table shows the estimated percent change in 2016 portfolio savings estimates if it were evaluated using today's Baseline Framework.

Savings Component	CI Electric Portfolio	Natural Gas Portfolio
Net lifetime savings (MWh)	-11%	-13%
Net annual savings	-3%	-11%
Net summer savings (MW)	-3%	NA
Average measure BCR	+61%	+11%

- Most of the 2016 retrofit lighting measures already incorporated some level of dual baseline treatment via adjustments to measure lives which mitigated the impact of a more formal dual baseline practice.
- ISP changes were already reflected in some 2016 measures. For example, the 2016 natural gas portfolio already included the ISP effects from a recent boiler market study. The result of that study reduced boiler planned measure savings by about 50%, but that effect was already included in 2016 evaluated savings.
- The first two practice (ISP and POE) effects were estimated using recent impact evaluations that incorporated the new practices. The analysis showed that while changes in baseline can have a significant impact on a single site, the frequency of the change is relatively small and therefore, the program level impact is moderated.

- Change to measure BCR are approximate. Dual baseline BCRs tend to increase, even with decreased lifetime savings, because the costs associated with the second baseline are deducted from the TRC. The ISP and POE practice generally have reduced BCRs because savings is reduced while TRCs remain the same.

Core Initiatives to which the Results of the Study Apply:

- C&I New Buildings & Major Renovations (Electric & Gas)
- C&I Existing Building Retrofit (Electric & Gas)
- C&I New & Replacement Equipment (Electric & Gas)

Evaluation Recommendations:

No formal recommendations were made in this evaluation.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

N/A (no formal recommendations were made in this evaluation)

How the Study Affects Program Results and Its Significance:

The purpose of the analysis was to forecast the effects of the new baseline practices on the CI portfolio savings for purposes of PA energy efficiency planning. The results were not intended to directly affect program savings, and should be interpreted as estimates of baseline practice impacts rather than actual impacts on future results.

Overview of Study Method:

The study simulated the effect of the new baseline practices by adjusting factors in the actual Benefit Cost model (BC model) spreadsheets the PAs used to report 2016 results. Changes in either annual gross savings or measure life propagate through the model affecting annual and lifetime energy savings, demand, net lifetime savings, other fuels, net lifetime savings benefits, and measure costs.

The adjustments to the BC model were derived primarily from analysis of the savings impact of ISP changes in previous evaluations and the results of recent market studies and ISP research. Other assumptions in the BC model, such as the line loss, attribution, net-to-gross, and avoided costs, were left unchanged.

Application of Results: Retroactively and Prospectively

Not applicable.

A copy of the complete study can be found in Appendix U, Study 24.

Study 25: Baseline Transition Planning Net-to-Gross Revisions Final Report

Type of Study: Impact Evaluation

Evaluation Conducted by: DNV GL

NMR Group

Date Evaluation Completed: 8/31/2018

Study Objective and Summary of Results:

The purpose of P73 Track C is to establish net-to-gross ratio (NTGR) methodology that accounts for industry standard practice (ISP) and customer-specific baselines.

The study provides the following key findings:

- There is potential for overlap between free ridership calculations and ISP baselines.
- Review of the questions in the current free ridership survey found that, as currently phrased, the intermediate efficiency questions would be expected to lead to overstated or understated NTGR depending on whether the baseline is code/minimum efficiency or an intermediate efficiency between code and program efficiency.
- Any disconnects or overlaps between NTGR and ISP research are magnified if NTGRs are frozen while baselines are not.
- Both NTGR and ISP research are complex, and the interaction between the two is even more so.
- Program participants are generally able to report on the alternative technologies they would have installed instead of what they installed if the alternatives are specifically enumerated.
- The "Simple" method of calculating the efficiency portion of free ridership produced consistently lower free ridership estimates than the "Classic" method, but the difference was small (less than 2%).

Core Initiatives to which the Results of the Study Apply:

- All C&I Initiatives (Electric & Gas)

Evaluation Recommendations:

The following recommendations were made by the evaluators conducting this study.

Recommendation 1: Use the "classic" method for NTGRs along with market ISP baselines for the measures examined (LED fixtures, condensing boilers, air compressors).

Recommendation 2: Ask the intermediate efficiency free ridership question only where it is applicable.

Recommendation 3: Improve the generic intermediate efficiency question to clearly distinguish between minimum required efficiency and what is most typical or commonly installed efficiency. Change the wording to ask what efficiency level would have been installed if not the high-efficiency technology. Phrase survey questions differently for baselines set at minimum efficiency vs. those with ISP baselines.

Recommendation 3: For selected high importance, intermediate baseline measures, ask which measure-specific, alternative technologies would have been adopted if not the measure that was adopted through the program. Also, continue to collect responses to the simple free ridership question.

Recommendation 4: For complex or combination measures, use the Integrated Gross-Net method.

Recommendation 5: Review the applicability of the timing component of the current NTGR method in relation to the dual baseline methods defined in the Baseline Framework and developed in Baseline Transition Planning Track A.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs are considering all recommendations for adoption at this time. The PAs have not formally adopted or rejected any recommendations that require changes to program design and operations.

How the Study Affects Program Results and Its Significance:

The study does not directly affect program results because of the recommendation to not change the NTGR methods for the few measures with ISP baselines going into the next three year plan. Longer term, the study makes recommendations that will help program managers and evaluators select the most appropriate NTG methods, which could have a direct effect (upwards or downwards) on program net savings.

Overview of Study Method:

The study included a conceptual review of the ways ISP and NTGR research interact. It reanalyzed the 2016 NTG survey results using a specific alternative NTGR method for three specific measures with ISP baselines. The study also analyzed the results of several additional conceptual/qualitative questions added to the 2016 NTG survey to determine how participants interpreted generally-worded intermediate efficiency questions and how well they could answer questions that presented specific intermediate efficiency levels.

Application of Results: Retroactively and Prospectively

A copy of the complete study can be found in Appendix U, Study 25.

Study 26: Expected Useful Life (EUL) Estimation for Air-Conditioning Equipment From Current Age Distribution – Results to Date

Type of Study: Impact Evaluation

Evaluation Conducted by: DNV GL

Date Evaluation Completed: 7/17/2018

Study Objective and Summary of Results:

The purpose of this study, which was part of the larger Project 73: Track D Measure Life Method study (P73 Track D), was to explore the viability of determining the measure life for unitary HVAC equipment using existing market research data. This main data source was Project 41: The Massachusetts C&I Market Characterization On-Site Assessments and Market Share and Sales Trends Study (P41). The data had been enhanced by Project 55: The Upstream HVAC Process Evaluation (P55), which had developed manufacturer nameplate research methods that further improved the usefulness of the P41 information.

The study produced an average Expected Useful Life (EUL) estimate for all the unitary HVAC equipment of 7.4 years. The EULs vary by equipment type, as Table 5 shows. This table presents the unweighted EUL estimates, which the study determined had the best fit with the actual site data.

Table 5: EUL Estimates for Unitary HVAC Equipment

Technology	Total AC units in field sample	Total sites with AC unit in sample	Q1	Median (EUL)	Mean	Q3	90% Confidence	
							F-Test Lower	F-Test Upper
All AC types	10,197	618	3.4	7.4	9.8	13.6	0	17.5
Split system AC condensing unit	1,702	316	3.8	7.8	9.9	13.8	0	9.4
Split system heat pump	398	57	1.4	14.8	166.4	96.1	0	25.3
Package RTU AC	2,150	369	4.1	8.1	9.9	13.7	2.4	15.3
Package system heat pump	248	26	5.5	6.5	6.5	7.6	0	32.4

Mini split AC	702	196	4.7	7.8	8.6	11.6	0.4	29.6
Packaged terminal AC (PTAC)	4,271	53	2.2	7.2	14.5	18.7	3.8	23.7
Mini split heat pump	726	45	6.1	23	53.7	65.6	0.9	38.6

Core Initiatives to which the Results of the Study Apply:

- C&I New & Replacement Equipment (Electric Only)
- C&I New Buildings & Major Renovations (Electric & Gas)

Evaluation Recommendations:

The following recommendations were made by the evaluators conducting this study.

> **Recommendation 1:** Use the information from this analysis to reduce the EUL estimates for commercial unitary HVAC equipment from the current 15 years in the Massachusetts Technical Reference Manual (TRM) to 12 years.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs plan to adopt the recommendations.

How the Study Affects Program Results and Its Significance:

The study provides evidence for reducing the EULs for commercial unitary HVAC equipment in the Massachusetts TRM from 15 to 12 years.

Overview of Study Method: Using the data from the Massachusetts P41 data described above, the study made the following key assumptions:

- That the age of an AC unit at failure/removal follows a Weibull distribution, with parameters that are constant over installation years, but may vary by AC unit type. That is, the *survival time* distribution has a Weibull structure. The Weibull is a general family of distributions, defined by a shape parameter and a scale parameter. The family includes exponential decay or constant percent "dying" in each year, corresponding to a shape parameter of 1.
- That the installation year was one year after the manufacture year of each AC unit
- That for each type of AC, the number of units installed in Massachusetts each year has been proportional to the total number of AC units installed nationally, based on national AC shipment data from the Air-Conditioning, Heating & Refrigeration Institute (AHRI).

Using these assumptions, the study determined, for any set of Weibull parameters, the expected age distribution of units in place at the time of the P41 data collection "snapshot." It started with the number of units originally installed each year, based on historical data. For any assumed survival time distribution, the number of units originally installed *y* years prior to the field work date (based on the historical installation data), combined with the probability of surviving for *y*

years (from the assumed survival time distribution), told the evaluators the number of units from the installation year that would be expected to be in place at the time of the P41 site visits. The study's estimation approach then found Weibull parameters that minimized the least-squares difference between the observed proportions in each age bin and the expected proportions, based on the Weibull survival time distribution and the relative installation rates. Once the best-fit Weibull was determined, the evaluators took the median of that distribution as the EUL; that is, the expected age by which half of the units will have been removed.

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 26.

Study 27: Massachusetts C&I Upstream Lighting Net-to-Gross Study

Type of Study: Net-to-Gross Evaluation

Evaluation Conducted by: DNV GL

NMR Group

Date Evaluation Completed: 7/31/2018

Study Objective and Summary of Results:

The purpose of this study was to support a reanalysis of NTG for LED products supported be the C&I Upstream Lighting Initiative for use in the 2019-2021 three-year plan.

The study provides the following key findings:

This study presents the final, agreed-upon NTG rates for the 2019-2021 plan, supported by customer survey research and a NTG consensus group.

Table 6. Summary of Prospective 2019-2021 NTG Results

Prospective NTG	2019	2020	2021
Screw-based	0.73	0.63	0.53
Linear	0.80	0.73	0.66

Core Initiatives to which the Results of the Study Apply:

- C&I New & Replacement Equipment (Electric Only)

Evaluation Recommendations:

The following recommendations were made by the evaluators conducting this study.

> **Recommendation 1:** Ensure program records include account numbers going forward and assess effectiveness of this requirement.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs are considering all recommendations for adoption at this time. The PAs have not formally adopted or rejected any recommendations that require changes to program design and operations.

How the Study Affects Program Results and Its Significance:

The results of this study will be applied to savings from the C&I Upstream Lighting Initiative for the 2019-2021 period. The NTG values from this study are lower than the NTG values used in the 2016-2018 study.

Overview of Study Method:

The methodology used for this study follows the NTG approach used in other Massachusetts studies, including the 2015 LED Spillover Analysis study which developed LED NTG estimates that informed the 2016-2018 three-year plan. This approach utilized customer self-report information from computer assisted telephone interviews (CATI) with 216 program participants.

The surveys gathered information on program influence to determine free-ridership and participant spillover for screw-based and linear LED technologies purchased through the Upstream Initiative in 2016. This study also conducted 50 on-site lighting inventories and compared those results with program tracking data from 2013-2017 to develop estimates of out-of-program savings. This approach results in less uncertainty than using customer-reported out-of-program savings to estimate spillover. The recommended NTG ratio from this study includes spillover estimates that have been adjusted using out-of-program savings data from the on-site inventories.

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 27.

Study 28: MA C&I Upstream Lighting In-Service Rate (ISR) Analysis Summary

Type of Study: Impact Evaluation

Evaluation Conducted by: DNV GL

Energy and Resource Solutions

Date Evaluation Completed: 9/21/2018

Study Objective and Summary of Results:

The purpose of this study was to calculate in-service rate alternatives from the prior impact evaluation[7] for use by the PAs in the 2019-2021 Three Year Plan. DNV GL conducted this analysis following the most recent (PY2015) impact evaluation, since the electric Program Administrators (PAs) have recently (2016-2018) been making improvements to the Initiative.

The study provides the following key findings:

- The final, agreed upon, result (76%) to be used by the PAs in their three-year planning represents an increase from the overall PY2015 in-service rate (65%).
- The distribution of QC sites by measure category makes it difficult to use current QC results along with some adjustment to represent the population. The PAs could consider potential changes to QC site selection (i.e., stratify by measure category in addition to size). Also, the PAs could consider requiring the QC contractor to visit sites from each distributor monthly, which is the protocol mentioned in Initiative's Distributor Handbook.

Core Initiatives to which the Results of the Study Apply:

- C&I New & Replacement Equipment (Electric Only)

Evaluation Recommendations:

The following recommendations were made by the evaluators conducting this study.

Recommendation 1: Use the revised lighting in-service rate of 76.2% and savings factors presented in the ISR analysis summary memo (Tables 1 - 7) for 2019-2021 Three Year Planning.

Recommendation 2: Build upon the initial July 2018 site visits with "rolling" data collection.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs plan to adopt the recommendations.

How the Study Affects Program Results and Its Significance:

The study increases the overall in-service rate from 65% to 76%.

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7 DNV GL. *Impact Evaluation of PY2015 Massachusetts Commercial and Industrial Upstream Lighting Initiative (P58)* Final Report. Massachusetts Program Administrators and Energy Efficiency Advisory Council, 2017. PY2015 site visits had an overall in-service rate of 65 percent for all measure categories.

Overview of Study Method:

The ISR analysis reviewed both QC contractor[8] inspection data and evaluation on-site data[9]. In June and July 2018, DNV GL completed 23[10] site visits to 2018 Q1 Initiative participants as part of this effort, these site visits included visits to 6 sites also visited by the QC contractor. Evaluation's site visits completed in 2018 consisted of a verification of installed equipment and a discussion with facility personnel regarding the location of all lamps recorded as sales in the tracking data (i.e., purchased through the MA C&I Upstream Lighting Initiative), Initiative lamps were then classified into the classifications included in the below table. DNV GL compiled the data gathered from the on-sites into spreadsheets for analysis and then calculated an in-service rate for each LED product category grouping and an overall value to be used in consensus group discussion. The group reviewed the in-service rates calculated as part of this ISR analysis and agreed upon a result for use in three-year planning.

Table 1. Site visit lamp classifications and impact on in-service rate

Site visit class name	Description	Impact on in-service rate
Installed	Visually inspected and confirmed as installed	Savings
In-storage, planning to install	Visually inspected and confirmed as planning to install [Site auditor to ask for install by date[11]]	Partial savings, assume 15 percent are installed[12]
In-storage, not planning to install for various reasons	Visually inspected and confirmed as not planning to install [Site auditor to record all reasons for not planning to install]	Zero savings
Missing, contractors using the discounted lamps for other sites or purposes	Confirmed contractors used the discounted lamps for other sites or purposes [Site auditor to try to visit those additional sites and classify the lamps]	Savings or zero savings[13]

8 The contractor retained by the electric PAs to perform inspections of incentivized products as part of the Quality Assurance (QA) and Quality Control (QC) plan.

9 The DNV GL team conducted site visits from July 2016 to May 2017 visiting PY2015 participants as part of the PY2015 impact evaluation; and in June and July 2018 visited 2018 Q1 Initiative participants as part of this ISR analysis.

10 The number of cases was constrained by time, a target of 25 sites was planned in order to have results ready in time for the 2019-2021 Three-Year Plan.

11 Site auditor to indicate in notes whether they believe contractors or customers are ordering more equipment than necessary (i.e., does what's in storage far exceed what needs to be replaced, etc.).

12 The same storage-to-socket adjustment used in the prior evaluation was applied.

13 To the extent possible the site auditor will visually verify lamps sent to alternative locations; if the lamps are not locatable then the impact on in-service rate will be zero savings.

Site visit class name	Description	Impact on in-service rate
Missing, customer or project changes	Confirmed with customer that there were project changes not reflected in Initiative tracking data	Zero savings
Missing, for various reasons	Reason for missing lamps did not fit in other classifications [Site auditor to record all known reasons]	Zero savings
Defective product	Site contact indicates that the product was defective [Site auditor to probe for details]	Zero savings
Broken	Site contact states that lamp broke either during installation or another time [Site auditor to probe for details]	Zero savings
Returned or corrected	Negative sales entry in tracking data indicates a return or correction or site contact states that they've returned the lamps to the initiative [Site auditor to ask for any documentation relating to the return and check against tracking data]	Savings or zero savings[14]
Planning to return	Site contact states that they're planning to return Initiative products [Site auditor to probe for details]	Zero savings

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 28.

[14] If the lamps are reported as returned but not reflected in the tracking data, then the impact on in-service rate will be zero savings. If the lamps are reflected as a negative entry in the tracking data then this will not have a negative impact on in-service rate (the denominator for savings is smaller).

Study 29: CLC and NGRID Education Kits Program Evaluation

Type of Study: Process Evaluation

Evaluation Conducted by: Opinion Dynamics

Date Evaluation Completed: 9/7/2018

Study Objective and Summary of Results:

The purpose of this report was to provide process-related findings for the Cape Light Compact (CLC) and National Grid (NGRID) Be Energy Efficiency Smart (BEES) Program. The study focused particularly on strategies for improving in-service rates (ISRs) and take-home kit survey response rates, survey design improvements, and additional measures that could added to the program.

The report provides the following key findings:

- Based on interviews with teachers and program staff, two key barriers to increasing survey responses were identified: 1) kits being ordered too close to the end of the year to collect and submit surveys; 2) teachers lacking time to submit survey results (specific to NGRID); and 3) language barriers.
- Based on interviews with teachers and program implementers, three key barriers were determined to negatively impact the ISR: 1) lack of parent awareness of kit distribution; 2) physical barriers to measure installation, such as rental status of residents; and 3) language barriers.
- As part of the kit contents assessment, we also explored possible additions to the kits. Opportunities to enhance the kits content were limited to door sweeps and shower timers. Those two measures are relatively easy to self-install and not costly. Other measures that our research and investigation identified do not result in energy savings directly but rather contribute to enhanced savings for main measures (e.g., improved operation of the water heater) or lead to spillover-like behaviors.

Core Initiatives to which the Results of the Study Apply:

- Residential Retail (Electric & Gas)

Evaluation Recommendations:

The following recommendations were made by the evaluators conducting this study.

Recommendation 1: To ensure that ISRs pass regulatory scrutiny and are accepted in the state, PAs should incorporate collecting feedback from parents as part of the program implementation process. That can be best done through parent reply cards distributed with the kits. These reply cards could either collect the desired data or ask parent to volunteer for a follow-up phone survey with the evaluation team.

Recommendation 2: Kits should be distributed by early May to allow time for students to install items and upload survey responses before the end of the school year.

Recommendation 3: The take home kit survey should be revised. The evaluators provided a revised instrument to the MA PAs. As of the writing of this report, the MA PAs have adopted the recommendations.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs plan to adopt the recommendations.

How the Study Affected Program Results and Its Significance:

The study identified a range of improvements that will contribute to high quality data collection, program design and delivery, potentially improving the evaluability of this program in the future.

Overview of Study Method:

Opinion Dynamics completed the following range of research and analytical activities:

- Review of program materials;
- Analysis of the implementer-collected survey data;
- Literature review;
- Program staff and implementer interviews; and
- Teacher Interviews.

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 29.

Study 30: Massachusetts Residential HVAC Net-to-Gross and Market Effects Study

Type of Study: Net-to-Gross Evaluation

Evaluation Conducted by: NMR Group

Tetra Tech

Date Evaluation Completed: 7/27/2018

Study Objective and Summary of Results:

The purpose of this study was to estimate and recommend net-to-gross ratios (NTGRs) for selected heating, cooling, and water heating measures that will receive Mass Save Standard rebates in 2019-2021. Another purpose was to measure market effects indictors for evidence of progress toward market transformation that may be attributed to the program, and to set baselines for comparison with future measurements.

The study provides the following key findings:

- The recommended NTGRs for 2019-2021 standard rebates for ductless mini-split heat pumps is 0.77; for gas hot water boilers is 0.79, and for gas condensing combination boilers is 0.79. These all represent increases from the current TRM values, which were last measured in 2012.
- The recommended NTGRs for 2019-2021 standard rebates for heat pump water heaters is 0.83; for central air conditioning is 0.67; for central heat pumps is 0.60; and for gas furnaces is 0.76. These all represent decreases from the current TRM values.
- There is anecdotal evidence that to some degree, the program has affected HVAC equipment stocking practices as intended.
- There is anecdotal evidence that the programs played a modest role in effecting changes in the prices that contractors pay for high-efficiency versus standard-efficiency HVAC equipment.
- Customer demand for high-efficiency HVAC equipment has increased and contractors attribute much of this change to the programs.
- The programs have substantial indirect influence on contractor recommendations, which appear to be the strongest driver in the selection of qualifying equipment outside the program.

Core Initiatives to which the Results of the Study Apply:

- Residential Retail (Electric & Gas)

Evaluation Recommendations:

The following recommendations were made by the evaluators conducting this study.

Recommendation 1: Use the following NTGRs for equipment incented with "Standard" rebates into the 2019-2021: ductless mini-split heat pump (0.77), heat pump water heater (0.83), central air conditioner (0.67), central heat pump (0.60), gas furnace (0.76), and gas hot water and condensing combination boilers (0.79).

Recommendation 2: Measure the same market indicators in future studies of the programs' residential HVAC activities, and compare the results to track progress over time.

Recommendation 3: The programs should continue to target both customers and contractors. While the market effects results show that customer demand for high-efficiency equipment has increased over the last three years, and participant survey results indicate that contractors' recommendations have considerable influence on the models of equipment customers choose to install, customers are important drivers of decision making for certain equipment types.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs are considering all recommendations for adoption at this time. The PAs have not formally adopted or rejected any recommendations that require changes to program design and operations.

How the Study Affects Program Results and Its Significance:

This study will not immediately affect savings because net-to-gross studies are applied prospectively pursuant to D.P.U. 11-120. This study will be applied to the 2019-2021 three-year plan.

Overview of Study Method:

The team conducted in-depth interviews with program staff and mixed-mode (web and telephone) surveys with 346 customers and 166 contractors. The team refined the NTGRs developed through this research via a NTG Consensus Group (i.e., a group of PA, EEAC, and consulting team representatives who come to a consensus on retrospective and prospective NTGRs).

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 30.

Study 31: Massachusetts Commercial and Industrial Upstream HVAC/Heat Pump and Hot Water NTG and Market Effects Indicator Study

Type of Study: Net-to-Gross Evaluation

Evaluation Conducted by: DNV GL

NMR Group

Date Evaluation Completed: 9/5/2018

Study Objective and Summary of Results:

The primary purpose of this study was to measure the retrospective (2016) and estimate the prospective (2019-2021) net-to-gross (NTG) ratios and market effects indicators for selected equipment types supported by the Upstream HVAC/Heat Pump (HP) Initiative and the Upstream Water Heater Initiative. The study addresses five types of HVAC/HP and gas-fired water heating equipment, which PA staff selected in collaboration with the evaluation team:

- Ductless mini-split heat pumps
- Electric water-source heat pumps
- Air-cooled unitary/split central air conditioning (>5 tons)
- Gas-fired storage water heaters between 76,000 and 300,000 BTU/hour
- Gas-fired tankless water heaters between 180,000 and 199,900 BTU/hour

The study provides the following key findings:

- The recommended statewide NTG ratios for 2019-2021 for each equipment type, shown below.

Equipment Type	2019	2020	2021
HVAC (electric)			
Air-cooled unitary and split CAC and HP system (>5 tons)	55%	54%	53%
Ductless mini-split heat pump (based on removing the lower efficiency tier from the Initiative)	51%	49%	47%
Electric water-source heat pump	50%	49%	48%
Water heating (gas)			
Gas-fired storage water heaters and indirect water heaters	31%	30%	29%
Volume water heaters (based on removing the lower efficiency tier and offering multiple tiers)	60%	59%	58%
Gas-fired tankless water heaters	60%	59%	58%

Core Initiatives to which the Results of the Study Apply:

- C&I New & Replacement Equipment (Electric & Gas)

Evaluation Recommendations:

The following recommendations were made by the evaluators conducting this study.

> **Recommendation 1:** Adopt the 2019-2021 prospective NTG ratios developed as part of this study, contingent on actual changes made to the initiatives**.**

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs plan to adopt the recommendations.

The PAs will use the Prospective NTG ratios from this study for the 2019-2021 Three-Year Plan. They will also make changes to the Initiative agreed upon during the process of developing the NTG ratios.

How the Study Affects Program Results and Its Significance:

The NTG ratios and associated findings from this study provide evidence that the Initiative was not inducing savings as expected and could benefit from a program review. This research suggested that while the Initiative did modify distributor behavior by motivating distributors to stock and upsell high-efficiency equipment more than they had before, these changes may not have had much impact on the surveyed buyers' decision-making.

As a result of these findings, the PAs have adopted NTG ratios for the 2019-2021 Three-Year Plan that are lower than those used in the 2016-2018 Three-Year Plan. The PAs will also be adjusting the efficiency requirements for some of the evaluated equipment to address the initial low NTG scores. This was agreed upon during discussions with PA staff and during the NTG Consensus Process.

Overview of Study Method:

The study relied on in-depth interviews with program staff and participating distributors, surveys with participating buyers, and a Consensus Group process to converge on recommended NTG ratios for each equipment type.

The table below presents the three research approaches used in this study to establish program attribution for the retrospective and prospective periods.

Approach	Task	NTGR	Research Questions
Distributor Self-Reported	Distributor interviews (n=28)	Retrospective	• In the absence of the Initiative, the 2016 sales of high-efficiency equipment would have been about the same, lower, or higher? • If lower, by what percentage?
		Prospective	• Under a scenario where the Initiative continues, estimate the percentage of the company's total units sold in MA in 2018 that will be high efficiency? • Under a scenario where the Initiative ends in 2017, estimate the percentage of the company's total units sold in 2018 that will be high efficiency?
Causal Pathways of Influence	Distributor interviews (n=28) Buyer surveys (n=35)	Retrospective	• Has the Initiative increased the stocking of energy-efficient equipment? • Has the Initiative increased distributors' efforts to promote high-efficiency equipment and what impact do these promotions have on the end users' final purchase decision? • How much of the incentive is passed to end users? Does the incentive amount influence end users' final purchase decision?
Consensus Group	Consensus group meeting to agree on NTGR	Retrospective and Prospective	• Given recent and planned changes to the Initiatives, what NTGRs are appropriate for the 2019-2021 period?

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 31.

Study 32: Non-Residential Code Compliance Support Initiative Attribution and Net Savings Assessment

Type of Study: Net-to-Gross Evaluation

Evaluation Conducted by: NMR Group

The Cadmus Group

Date Evaluation Completed: 7/26/2018

Study Objective and Summary of Results:

The purpose of this study was to estimate the savings attributable to the non-residential portion of the Code Compliance Support Initiative (CCSI) for the 2019-2021 program period.

This study used a Delphi panel approach to estimate savings attributable to the CCSI from code compliance enhancement efforts. The evaluation team asked a panel of experts to provide estimates of code compliance over the 2018-2021 period under two scenarios: (1) with the CCSI continuing training and outreach in the future at a similar level to historical efforts and (2) with the CCSI never having been implemented. The team used Delphi panelists' estimates to develop attribution scores and project net savings for 2019-2021.

Using the program attribution values, the team calculated program net savings with the following equation:

$$Program\ Net\ Savings_{year} = Program\ Attribution_{year} \times Gross\ Technical\ Potential_{year}$$

The team calculated gross technical potential (GTP) savings from two main inputs: (1) baseline technical potential estimated with modeled results from the 2017 DNV GL code compliance study[15] (i.e., the savings associated with bringing non-compliant measures up to prescriptive code levels) and (2) projected growth in the commercial new construction sector. The calculation for GTP is simply a formula that multiplies technical potential by projected commercial new construction growth for 2019-2021.

The study provides the following key findings:

- The CCSI is the primary statewide resource for training and support related to commercial building energy codes. We found that few other organizations provide direct training or support, and not to the same extent as the CCSI. Many of the Delphi panelists also acknowledged the role and impact of the CCSI program in enhancing building code officials' knowledge and understanding of code requirements. Since several of the trainings hosted by regional code official associations were delivered in partnership with CCSI, it is unlikely that these building code official trainings would have occurred without the CCSI program.
- Although the CCSI is the primary statewide resource for code support, it is worth noting that only slightly more than one-third of code officials took the 2012 IECC and 2015 IECC commercial energy code trainings (35% and 37%, respectively). The market penetration of

[15] The New Buildings institute (NBI) modeled results from the 2017 Massachusetts Energy Code Compliance and Baseline Study for IECC 2012 (P70).

the training for other occupations, such as design professionals, is not known. Many code officials and building professionals manage to stay abreast of code changes as a matter of standard professional practice. This does not undercut the value of the CCSI, but it does place its relative impact within a larger context.

- The CCSI is, in part, responsible for increased non-residential code compliance rates in Massachusetts. In their rationale for their compliance estimates with and without the CCSI, a majority of the Delphi panelists, drawing on the evaluation results from the CCSI trainings and their own experience, acknowledged that the program helps keep code officials and building professionals aware of code requirements, and that the CCSI thereby helps preserve high levels of code compliance. Results from the CCSI training evaluations indicate that the CCSI has had a positive effect on code officials and building professionals. Training attendees reported in follow-up surveys and interviews that the CCSI trainings were likely to affect their building practices or had already affected them.
- The GTP savings assessment relies on several assumptions that could be improved by future research and coordination. The assumptions are necessary due to limited information for some of the key factors. For example, the evaluation team had limited information on the mechanical system types and compliance paths used in commercial new construction projects. The team could more accurately project savings if more detailed baseline data or survey data were available for review.
- The savings calculator only accounts for new construction projects and does not address potential savings associated with compliance enhancement in renovation projects that trigger code requirements.

Core Initiatives to which the Results of the Study Apply:

- C&I New Buildings & Major Renovations (Electric Only)

Evaluation Recommendations:

The following recommendations were made by the evaluators conducting this study.

Recommendation 1: Maintain the CCSI program and use evaluation and compliance study results to target opportunities for improvement to maximize the impact and related savings from the program. For example, the NBI modeling results document GTP savings at the measure level, which could be used to develop targeted training modules for measures displaying the highest savings potential.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs are considering all recommendations for adoption at this time. The PAs have not formally adopted or rejected any recommendations that require changes to program design and operations.

How the Study Affects Program Results and Its Significance:

This study provides forecasted net savings results for the PAs to apply to the CCSI. These results only apply to the commercial portion of the CCSI, as the residential component of savings is embedded in the Residential New Construction net-to-gross value.

Overview of Study Method:

The evaluation team undertook the following research tasks to meet the study objectives:

- Conducted a two-round Delphi panel survey where panelists estimated what compliance would be in the absence of the CCSI.
- Reviewed and aggregated gross technical potential savings estimates associated with increasing prescriptive code compliance to 100%.
- Calculated the portion of gross technical potential savings achieved by the PAs based on the Delphi panel results.
- Applied the portion of gross technical potential savings achieved by the PAs to the overall gross technical potential savings to calculate net savings attributable to the PAs.

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 32.

Study 33: Residential New Construction and CCSI Attribution Assessment

Type of Study: Net-to-Gross Evaluation

Evaluation Conducted by: NMR Group

Date Evaluation Completed: 8/24/2018

Study Objective and Summary of Results:

The purpose of this study was to forecast net-to-gross (NTG) ratios for the low-rise Residential New Construction (RNC) program and the residential portion of the Code Compliance Support Initiative (CCSI) for the 2019-2021 program period.

This study used a Delphi panel approach to estimate the effect of the programs on single-family new construction building practices. The methodology for calculating net savings and developing NTG ratios is consistent with the 2014 *Residential New Construction Net Impacts Study*.[16] Depending on the municipality, new homes in Massachusetts must comply with either the base International Energy Conservation Code (IECC) requirements or the stretch code requirements. This study considered the effect of the programs on four separate samples:

- RNC program homes in stretch code municipalities
- Non-program homes in stretch code municipalities
- RNC program homes in non-stretch code municipalities
- Non-program homes in non-stretch code municipalities

The study provides the following key findings:

- The NTG ratios for the low-rise RNC program and the residential portion of the CCSI range from 0.96 in 2019 to 1.10 in 2021. The Delphi panelists indicated that the program has had a substantial impact on the building practices in the single-family new construction market, and they expect that the programs will continue to have a similar impact on this market in the future. Many factors influence the final prospective NTG ratios. Stretch code homes have lower prospective NTG ratios than non-stretch code homes, primarily due to the high RNC program penetration rate in stretch code municipalities (70% in 2015), and panelists expect that trend to continue. High program penetration rates led to lower non-participant spillover in stretch code municipalities.
- The baseline conditions used to calculate gross savings strongly affect the calculated NTG ratio. The 2015 RNC program used a User Defined Reference Home (UDRH) based on the 2011 single-family baseline study results.[17] This baseline was likely out of date, resulting in overstated gross savings for the 2015 RNC program. The 2015-16 baseline study[18] showed a large improvement in the market baseline between 2011 and 2015, providing

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16 http://ma-eeac.org/wordpress/wp-content/uploads/Residential-New-Construction-Net-Impacts-Report-1-27-14.pdf.

17 http://ma-eeac.org/wordpress/wp-content/uploads/Massachusetts-2011-Baseline-Study-of-Single-Family-Residential-New-Contruction-Final-Report.pdf

18 http://ma-eeac.org/wordpress/wp-content/uploads/Single-Family-Code-Compliance-Baseline-Study-Volume-2.pdf

evidence for the 2011 baseline being out of date for the 2015 RNC program. The Delphi panelists' counterfactual responses reflected their knowledge of the baseline transformations that had taken place between 2011 and 2015, resulting in lower net savings and yielding a lower NTG ratio than would have been the case had the 2015 RNC program used an updated baseline. Therefore, the net savings that were calculated as part of the retrospective analysis were substantially lower than the gross savings. As a result, the NTG ratio was 0.88. Had the 2015 RNC program used a more current (and thus more efficient) baseline, the gross savings would have been lower and the net savings would have been closer to the gross savings, resulting in a higher NTG ratio.

- Delphi panelists indicated that the programs have had the largest impact on duct leakage, air infiltration, and insulation installation quality. These measures displayed the largest changes when comparing the as-built efficiency values and the counterfactual efficiency values estimated by the Delphi panelists. Panelists typically indicated that the programs have a larger impact on program homes than non-program homes and the impact of these programs is similar in stretch code and non-stretch code municipalities.

Core Initiatives to which the Results of the Study Apply:

- Residential New Homes & Renovations (Electric & Gas)
- Other (specify below) (Electric & Gas)

The residential portion of CCSI

Evaluation Recommendations:

The following recommendations were made by the evaluators conducting this study.

Recommendation 1: After consulting with the PAs and EEAC, the evaluation team recommends that the PAs use the prospective 2019 NTG ratio of 0.96 for the duration of the 2019-2021 program period. The prospective analysis assumes a shifting baseline over time and reduced gross savings opportunities. The PAs are already planning to revisit the baseline conditions for the RNC market during the 2019-2021 program period, and that research will ensure that the assumption of increased baseline efficiency that was used in this study is generally consistent with the ongoing gross savings calculated by the RNC program.

Recommendation 2: The PAs should apply the prospective 2019 NTG ratio to the gross savings for all RNC participant housing units for the 2019-2021 program period. This study did not specifically look at multifamily housing units. In the absence of measured results, we recommend the prospective 2019 NTG ratio be applied to both single-family and multifamily housing units moving forward. The prospective gross and net savings presented in this report were used to calculate prospective NTG ratios and should not be used moving forward. Instead, the prospective 2019 NTG ratio should be applied to ongoing gross savings that are calculated by the RNC program.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs are considering all recommendations for adoption at this time. The PAs have not formally adopted or rejected any recommendations that require changes to program design and operations.

How the Study Affects Program Results and Its Significance:

This study will result in a net-to-gross value for the RNC program that is lower than the previous value that was calculated in 2014. In addition, the net-to-gross value developed as part of this study will be used to calculate any savings attributable to the residential portion of the CCSI. The net-to-gross will be applied to the gross savings developed through the RNC program and the resulting savings will represent the total net savings attributable to both the RNC program and the residential portion of the CCSI.

Overview of Study Method:

The evaluation team undertook the following research tasks to meet the study objectives:

- Convened a two-round Delphi panel survey effort, where panelists estimated what measure-level efficiencies would be in the absence of the RNC and CCSI programs.
- Conducted a modeling effort to calculate the difference in energy consumption from program and non-program homes as they were constructed (the *as-built* scenario) and as panelists suggested they would appear in the absence of the programs (the *counterfactual* scenario).[19]
- Completed an analysis of as-built and counterfactual energy consumption for stretch code and non-stretch code homes to calculate retrospective net savings estimates and NTG estimates.
- Developed an internal forecast of key parameters that are likely to influence the impact of the programs in 2019-2021.
- Conducted a third-round Delphi panel survey where panelists reviewed the forecast assumptions and suggested changes. These results were applied to the retrospective findings to develop prospective NTG ratios for 2019-2021.

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 33.

[19] The modeling effort leveraged REM/Rate data from 2015 RNC program year and the 2015/16 Single-Family New Construction Code Compliance/Baseline Study.

Study 34: Massachusetts Sponsors' Commercial and Industrial Programs Free-ridership and Spillover Study

Type of Study: Impact Evaluation

Evaluation Conducted by: Tetra Tech

DNV GL

Date Evaluation Completed: 8/14/2018

Study Objective and Summary of Results:

The primary objective of the 2016 free-ridership and spillover study was to assist the Massachusetts Sponsors in quantifying the net impacts of their downstream commercial and industrial electric and natural gas energy-efficiency programs, and to provide prospective net-to-gross (NTG) estimates to use for 2019-2021 program planning. These programs include both Custom and Prescriptive programs for new construction, end of useful life, and retrofit projects.

The study provides the following key findings:

- The study produced free-ridership, participant spillover and non-participant spillover rates for each PA by program and end use.
- The statewide 2016 NTG ratio for electric was 92.2% and for gas was 84.0%.
- The recommended statewide electric NTG ratios for 2019-2021 ranged from 90.2% - 94.1% for custom projects, and from 66.4% - 93.5% for prescriptive projects, depending on initiative type.
- The recommended statewide gas NTG ratios for 2019-2021 ranged from 79.3% - 87.9% for custom projects, and from 79.3% - 83.3% for prescriptive projects, depending on initiative type.

Core Initiatives to which the Results of the Study Apply:

- C&I New Buildings & Major Renovations (Electric & Gas)
- C&I Existing Building Retrofit (Electric & Gas)

Evaluation Recommendations:

The following recommendations were made by the evaluators conducting this study.

Recommendation 1: Incorporate the NTG rates recommended in the final report into the next three-year plan.

Recommendation 2: Develop a consistent and systematic approach across NTG studies to handle cases with very high gross savings that heavily influence the calculated NTG values from the study year, but are not necessarily indicative of future typical values for the program. Such cases arise occasionally in these studies.

Recommendation 3: Ensure contact information for the decision maker is recorded in the tracking system and available for evaluators.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs plan to adopt and/or are considering some of the recommendations, as described below.

> The PAs have adopted Recommendation 1, to incorporate the recommended NTG rates into the three-year plan and are considering the remaining recommendations.

How the Study Affects Program Results and Its Significance:

This study will not immediately affect savings because net-to-gross studies are applied prospectively pursuant to D.P.U. 11-120. This study will be applied to the 2019-2021 three-year plan.

Overview of Study Method:

The methodology used for this study follows the standardized methodology developed in 2010 and 2011 for the Massachusetts PAs for use in situations where end-users can report on program impacts via self-report methods.[20] The study also included interviews with design professionals and equipment vendors involved in the 2016 installations. Overall, surveys were completed with 1,973 participating customers and 239 participating vendors.

Historically, the sample and results were reported at the program level. For the 2016 study, both the electric and natural gas C&I downstream programs were aggregated into initiatives based on their market event. For filing purposes, the EEAC, evaluation team, and Sponsors agreed that as a rule, NTG values must meet the following thresholds: at least 90% confidence/25% relative precision, or at least 90% confidence/10% absolute precision. In situations where neither of these criteria were met, or where there were fewer than 11 completed surveys, a higher level of aggregation was applied. The final report contains numbers to be used for filing purposes.

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 34.

[20] "Cross-Cutting C&I Free-Ridership and Spillover Methodology Study Final Report", prepared for the Massachusetts Program Administrators by Tetra Tech, KEMA, and NMR, May 20, 2011.

Study 35: Initial Considerations for Attribution/Net-to-Gross Estimation for Energy Optimization

Type of Study: Net-to-Gross Evaluation

Evaluation Conducted by: NMR Group

Tetra Tech

DNV GL

Date Evaluation Completed: 9/20/2018

Study Objective and Summary of Results:

The purpose of this study was to develop initial considerations for assessing attribution and estimating net-to-gross ratios (NTGRs) for energy optimization should the policy change to allow PAs to claim savings from energy optimization.

The study provides the following key findings:

- The study was unable to find NTGRs measured for conversions from delivered fuels. While Vermont publishes equipment-specific NTGRs for conversions from delivered fuels, these NTGRs were negotiated, not measured.
- The study developed an approach to estimating attribution and NTG for energy optimization for PAs to consider. The approach could be used now as a framework for developing negotiated NTGRs for 2019-2021 and applying them appropriately to gross savings in this period. In the future, the approach could be used as a framework for developing prospective NTGRs for 2022-2024 that are informed by observed 2019-2021 conversion rates and other empirical data, and for applying them to gross savings for those years.
- The approach involves measuring six separate types of gross savings based on the following three customer decisions or outcomes and applying a specific NTGR to each type: 1) the decision to convert fuels, whether partially or fully (fuel conversion), 2) the outcome of adding cooling or heating where previously there was none, or reducing cooling load (service change), and 3) the decision to install higher-efficiency equipment in association with the fuel conversion (high-efficiency).

Core Initiatives to which the Results of the Study Apply:

- Residential Coordinated Delivery (Electric & Gas)

Evaluation Recommendations:

No formal recommendations were made in this evaluation.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

N/A (no formal recommendations were made in this evaluation)

How the Study Affects Program Results and Its Significance:

If policy changes to allow PAs to claim savings from energy optimization, it will be important to understand the extent to which programs should take credit for driving customers' decisions to change fuels with resulting reductions in net MMBTU usage, and how taking credit for energy optimization would affect the framework for understanding and measuring attribution and gross impacts. This research is designed to help the PAs and EEAC prepare for a possible policy change that would allow PAs to claim savings from energy optimization.

Overview of Study Method:

The evaluation team conducted a literature review of publicly available reports, evaluations, and other resources to identify and document attribution and NTG approaches relevant to energy optimization and fuel conversion programs outside of Massachusetts. The team supplemented this with follow-up interviews of selected program administrators and evaluation study authors. The team found little detailed information on topics related to program attribution and NTG assessment in the literature. Drawing on the available information, the team developed possible conceptual approaches to measuring attribution and NTG for consideration by the PAs.

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 35.

Study 36: Low-income Multifamily Health- and Safety-Related NEIs Study – Preliminary Findings Report

Type of Study: Impact Evaluation

Evaluation Conducted by: NMR Group

Three Cubed

Date Evaluation Completed: 10/13/2018

Study Objective and Summary of Results:

The purpose of this study is to evaluate the health- and safety-related NEIs attributable to improvements in the energy efficiency (EE) of income-eligible multifamily buildings funded by the PAs of the Commonwealth of Massachusetts (MA). The study complements past MA research that estimated NEIs attributable to weatherizing low-income single-family (LISF) homes. This research is funded by the MA energy efficiency Program Administrators (PA) and The JPB Foundation. The study is slated for completion in 2020. In 2018 the study team delivered preliminary results based on a partial data set. The preliminary results and are meant only to inform the PAs in planning for 2019-2021. In early 2019, the study team will deliver a follow-up report based on additional survey data collected outside of MA.

The preliminary report and analysis focused on monetizing thirteen "core" NEIs:

1. Asthma
2. Thermal stress - hot
3. Thermal stress - cold
4. Food assistance
5. Trips and falls (inside)
6. Carbon monoxide (CO) poisoning
7. Low-birth weight infants
8. Missed days of work
9. Prescription medications
10. Short-term high interest loans
11. Home productivity
12. Reduced fire risk
13. Work productivity

The core NEIs were previously monetized by the LISF study and/or the national evaluations of the U.S. Department of Energy's Weatherization Assistance Program (WAP). This study adds reduced trips and falls, based on the hypothesis that improved lighting and some health and safety measures could have an observable, monetizable impact on reduced injuries related to trips and falls inside the home.

In addition to monetized NEIs, the preliminary results provided key findings pertaining to improved indicators of health and other household factors, including the following:

- Reduction in asthma flares requiring medical treatment;
- Reduction in thermal stress;
- Reduction in missed days of work;
- Improvements in rest and sleep;
- Reduction in the needs for food assistance;
- Improvements in ability to pay for prescriptions; and
- Reductions in households trading off paying utility bills and buying food.

The preliminary monetization of the core NEIs suggests that there are considerable health and household-related LIMF NEIs that can be attributed to weatherization. Overall, the preliminary results support the hypotheses that (1) improving the energy efficiency of LIMF buildings results in positive monetary valuation of NEIs, and (2) both NEIs and NEI values are different for residents of MF housing than for residents of SF homes

Core Initiatives to which the Results of the Study Apply:

- Income-Eligible Coordinated Delivery (Electric & Gas)

Evaluation Recommendations:

The following recommendations were made by the evaluators conducting this study.

- **Recommendation 1:** The study team recommends that the PAs adopt the monetized NEI values from the study in their cost benefit models on an interim basis, until the final Phase 1 analysis is completed in March 2019.
- **Recommendation 2: T**he study team recommends that the Short-Term High-Interest Loan LIMF NEI not be counted, though it could be considered if a different cost test were used in the future
- **Recommendation 3:** The study team recommends that they and the PAs initiate a dialogue about pursuing monetization of another dozen NEI candidates for inclusion in the final analysis.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

The PAs are considering all recommendations for adoption at this time. The PAs have not formally adopted or rejected any recommendations that require changes to program design and operations.

How the Study Affects Program Results and Its Significance:

This study provides the PAs with NEI values for their LIMF retrofit programs. So far the preliminary findings have resulted in an increase of $71 in annual health and safety-related NEIs per weatherized home, from $19 to $90; in increased comfort and home productivity NEI of $12, from $101 to $113; and in a new NEI for improved safety (due to reduced fire risks) of $6.49.

In addition, the study has provided preliminary NEI values for CO monitors and smoke detectors, should the PAs include these measures in LIMF projects. The preliminary report estimated an

additional one-time health benefit (reduced CO poisonings) of $183 per weatherized home with a CO monitor installed and a reduced fire risk NEI of $0.76 for each home with a smoke detector installed.

Overview of Study Method:

NMR Group, Inc. and Three3 (the study team) followed a classic quasi-experimental research design. The sample consists of existing MF buildings with five or more units in MA and in other cold climate states in the Northeast and Midwest. These buildings fell into one of three research groups: Comparison with Treatment (CwT) (i.e., already weatherized buildings); Treatment (T) (i.e., buildings that have not been weatherized, but will be); and Control (C) (i.e., buildings that will not be weatherized during the data collection period). To be eligible for this study, CwT and T buildings needed to have installed – or be scheduled to install – a comprehensive set of weatherization measures (i.e., air sealing, insulation, and/or heating/cooling equipment).

The primary data collection instrument, a Resident Survey (RS), asked households a series of questions about health, well-being, affordability, dwelling quality, and household characteristics. In-field staff equipped with digital data collection tools distributed survey packets in the buildings, interviewed building managers, and documented building characteristics and systems conditions that can provide insights into NEIs. The team also solicited participating agencies to provide documentation on weatherization measures installed in the CwT and T groups.

The research efforts, which are still underway, are yielding three sets of data: (1) RS results, (2) building characteristics and conditions observed on site by in-field staff, and (3) weatherization measures installed in participating CwT and T buildings. The installed measures data inform NEI estimates and allow the team s to correlate specific NEIs with specific measures or combinations of measures installed.

The team distributed the RS to MA residents between January 2018 and June 2018 as part of the first phase (Phase I) of the study. Phase I survey distribution continued in other states through September 2018. In Summer/Fall of 2019, approximately one-year after the Phase I survey period, the team will commence Phase II. This will involve re-contacting T and C group respondents and asking them to complete a follow-up RS. By this time the T group will have been weatherized, providing the opportunity to compare survey findings both pre- and post-weatherization from the same household (matched pairs analysis) to estimate changes in health attributable to weatherization.

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 36.

Study 37: NEI Reference Table Memo

Type of Study: Impact Evaluation

Evaluation Conducted by: NMR Group

DNV GL

Date Evaluation Completed: 8/28/2018

Study Objective and Summary of Results:

The overall objective of this study is to provide the PAs with needed guidance and clarification on the correct application of NEIs at the measure-level and across individual initiatives in their benefit cost models. The study provides fully checked, updated and documented NEI tables for PAs' 2019-21 electric and gas benefit cost plan models.

The study provides the following key findings:

- An updated NEI lookup table. The table includes the data fields listed below:
  - The original NEI value from the PAs' 2019-21 plan models.
  - The confirmed NEI value from the NEI source document.
  - A flag indicating if the original and confirmed values disagree.
  - For NEIs estimated at the measure category or with ambiguity around which individual measures are included (e.g. C&I HVAC Prescriptive/Custom), identification of the measure(s) to which the NEI applies.
  - Columns indicating (1) the source document, (2) the page number of the NEI value, and (3) a link to an electronic copy of the source document when available.
  - Explanatory notes, as necessary.

Core Initiatives to which the Results of the Study Apply:

- All Residential Initiatives (Electric & Gas)
- All Income Eligible Initiatives (Electric & Gas)
- All C&I Initiatives (Electric & Gas)

Evaluation Recommendations:

No formal recommendations were made in this evaluation.

Explain Whether or Not the PAs Decided to Adopt the Recommendations from the Study:

N/A (no formal recommendations were made in this evaluation)

How the Study Affects Program Results and Its Significance:

This study will provide the PAs with needed guidance and clarification on the correct application of NEIs at the measure-level and across individual initiatives in their benefit cost models.

Overview of Study Method:

The team reviewed the NEI lookup tables in the PAs' 2019-21 plan model and compiled the corresponding confirmed NEI value from the NEI source document. The team indicated with the NEI values did not match and provided guidance for using the confirmed NEI values from the source NEI documents.

Application of Results: Prospectively

A copy of the complete study can be found in Appendix U, Study 37.

Appendices

U. **Evaluation Studies**

Please see separate binders for Exhibit 1, Appendix U