ISO New England Energy-Efficiency Forecast for 2019 to 2024

ISO New England Inc.
System Planning
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Disclaimer

ISO New England (ISO) has been developing the energy-efficiency forecast at the request of stakeholders, who recognize the ongoing nature of energy-efficiency (EE) investment in the New England region. The ISO uses the energy-efficiency forecast for planning purposes only; the forecast does not affect any market activity pursuant to *Market Rule 1*, Section III.13, of the ISO's *Transmission, Markets, and Services Tariff* (ISO tariff).[1] The ISO does not endorse any assumptions or conclusions made by readers of this report, including but not limited to assumptions and conclusions on market behavior or market pricing. The ISO publishes this report for informational purposes only, and readers should not construe it as anticompetitive. As with any forecast, the users of this information must be aware of the limitations of all assumptions used to develop the forecast and make prudent decisions based on all available information and sound business judgment.

[1] *ISO New England Inc. Transmission, Markets, and Services Tariff* (ISO tariff), *Market Rule 1* (2014), http://www.iso-ne.com/regulatory/tariff/sect_3/index.html.

Acknowledgment

The ISO New England Energy-Efficiency Forecast is a collaborative effort between ISO New England and its stakeholders. The outcome of the EE forecast process is informed by the EE Forecast Working Group and its members, utility program administrators, and state regulators. We wish to thank all those who provided input to the process. The principal authors also wish to specifically acknowledge the contributions of the New England States Committee on Electricity in promoting this process and supporting the effort.

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Contents

Figures

Tables

Section 1
Executive Summary

ISO New England Inc. (ISO) is the not-for-profit corporation responsible for the reliable operation of New England's electric power system. It also administers the region's wholesale electricity markets and manages the comprehensive planning of the regional power system. In 2012, the ISO developed a process to forecast the future impacts from energy efficiency (EE) delivered by state-sponsored EE programs. This EE forecast supplements the ISO annual 10-year load forecast. This report contains the results of the most recent EE forecasting process for 2019 to 2024.

1.1 Overview

By statute, rule, and policy, the New England states have made EE a priority for the region. Each state has its own structure for planning and implementing EE programs, although all the programs generally cover the residential, commercial, and industrial sectors. In general, EE programs range from consumer incentives, such as rebates for purchasing new efficient equipment, process improvements, and energy management systems, to energy audits. Some states also have established aggressive long-term energy-efficiency goals tied to reductions in greenhouse gas emissions and global-warming solutions. In New England, lighting and mixed lighting measures normally constitute a majority of the energy and peak demand savings, and the commercial and industrial sectors provide most of the overall savings.

Compared with the rest of the nation, the New England states' EE programs rank among the most ambitious. The energy savings resulting from EE programs constitutes capacity that can be bid into the ISO-administered Forward Capacity Market (FCM). Since the inception of the FCM, the region's EE program administrators (PAs) typically have bid their EE portfolios into this market. By this mechanism, EE resources are compensated for providing capacity three years into the future the same way as traditional generating resources. Data on EE participation in the FCM provides the ISO with a solid understanding of the amount of EE available in the region in the one- to three-year timeframe.

But by all indications, state-sponsored EE programs are not static. In fact, the states communicated their general intention for long-term growth of EE programs. The purpose of the ISO's EE forecast is to estimate this longer-term (four- to 10-year) growth in EE. The ISO's long-term planning processes generally estimate system needs 10 years into the future. The goal of the EE forecast is to provide ISO system planners and regional stakeholders with information about the amount of EE anticipated to be deployed over this 10-year planning horizon.

To get assistance in developing an EE forecast, the ISO organized and chairs the Energy-Efficiency Forecast Working Group (EEFWG). This broad stakeholder group supplies and verifies data on the nature of EE programs in New England.

1.2 EE Forecast Methodology

After researching potential EE forecasting techniques and finding little or no precedents to follow, the ISO created its own forecasting methodology. At a high level, the EE forecasting methodology is based on the projected costs of energy savings (expressed in dollars per megawatt-hours; $/MWh) and projected future state-sponsored EE budgets. By projecting the amount states will authorize PAs to spend in future years and the amount of energy savings achieved per dollar spent, future energy savings can be calculated. The ISO also uses a "peak to energy" ratio to estimate how the projections of energy use (i.e., savings in energy use) (in MWh) will affect future peak demand (in megawatts; MW).

A simplified representation of the calculation for the ISO's EE forecast methodology is as follows:

1) $$MWh = [(1 - BSR) * Budget\ \$] / [\$/MWh * PCINCR]$$

Where:

- BSR is budget spend rate (%).
- Budget $ is an estimate of the dollars to be spent on EE ($).
- $/MWh is production cost.
- PCINCR is production cost increase (%).

2) $$MW = MWh * PER$$

Where:

- PER is the ratio of the peak energy demand to the annual energy use ("peak-to-energy" ratio) (MW/MWh)

1.3 Results

The EE forecast shows that the energy savings resulting from state-sponsored EE programs can be expected to cause electric energy usage to remain flat in New England as a whole, with energy use in Maine, Massachusetts, Rhode Island, and Vermont, declining by 2024 to levels below those that had been expected in the 2014 EE forecast. The EE forecast also projects that the EE savings will slow the growth in peak demand across the region.

When the EE savings are factored into the region's load forecast, energy usage is expected to barely grow at an average annual rate of 0.1% rather than the 1% in the baseline load forecast. Similarly, peak demand growth is slower, decreasing from 1.3% to 0.7% annually, when factoring in both the savings from EE measures committed through the FCM and the projected future EE measures.

The results of the final EE forecast for 2019 to 2024, as shown in Table 1-1, indicate that the region will save about 1,616 gigawatt-hours (GWh) of electric energy per year and about 9,696 GWh of energy over the forecast period.

Table 1-1
ISO New England Energy-Efficiency Forecast of Total Electric Energy Savings for the Region and Each New England State, 2019 to 2024 (GWh)

Year	ME	NH	VT	CT	RI	MA	ISO
2019	148	65	116	426	138	976	1,867
2020	141	62	111	404	128	913	1,759
2021	134	59	108	384	119	854	1,659
2022	128	57	102	364	111	799	1,560
2023	122	54	97	344	104	747	1,468
2024	117	52	95	325	96	698	1,382
Total	**791**	**349**	**628**	**2,246**	**696**	**4,986**	**9,696**
Average	**132**	**58**	**105**	**374**	**116**	**831**	**1,616**

To put these energy savings in context, in 2014, the total energy output from the region's generation sources was approximately 108,352 GWh; thus, the average annual energy savings attributable to EE was about 1.35% of total generation. The savings from EE on average over the forecast timeframe also will be slightly lower than the region's wind power production in 2014 (1,928 GWh).[2]

The results of the final EE forecast for 2019 to 2024 indicate that the region will reduce peak energy use about 212 MW per year and about 1,274 MW over the forecast period. Table 1-2 shows these results.

Table 1-2
ISO New England Energy-Efficiency Forecast of Total Savings in Peak Energy Use for the Region and Each New England State, 2019 to 2024 (MW)

Year	ME	NH	VT	CT	RI	MA	ISO
2019	15	10	15	52	22	131	246
2020	15	9	15	49	20	123	231
2021	14	9	14	47	19	115	218
2022	13	9	14	44	18	108	205
2023	13	8	13	42	17	101	193
2024	12	8	13	39	15	94	181
Total	**83**	**52**	**84**	**272**	**111**	**671**	**1,274**
Average	**14**	**9**	**14**	**45**	**19**	**112**	**212**

To put these peak demand savings in context of the New England system, the average annual reduction of peak energy demand resulting from EE was about 0.64% of the total capacity

[2] "Sources of Electricity Used in 2014" at the "Resource Mix," webpage (2015), http://www.iso-ne.com/about/what-we-do/key-stats/resource-mix.

requirement for the region in the 2014/2015 period, roughly 33,000 MW.[3] The total peak savings from EE over the 10-year forecast timeframe also will be roughly equivalent to some of the region's largest generation resources, when comparing EE peak capacity reductions and the seasonal claimed capability of generator output.[4]

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[3] The 33,000 MW is the ISO's net Installed Capacity Requirement (ICR)(i.e., the ICR minus 954 MW of Hydro-Québec's (HQ) Interconnection Capability Credits, which reflects the annual installed capacity benefits of the HQ Interconnection). *ISO New England Installed Capacity Requirement, Local Sourcing Requirements, and Maximum Capacity Limit for the 2014/15 Capability Year*, (April 2011), http://www.iso-ne.com/static-assets/documents/genrtion_resrcs/reports/nepool_oc_review/2011/icr_2014_2015_final_report.pdf.

[4] *Seasonal claimed capability* is a generator's maximum production or output during a particular season, adjusted for physical and regulatory limitations.

Section 2
Introduction

ISO New England Inc. (ISO) is the not-for-profit corporation responsible for the reliable operation of New England's electric power system. It also administers the region's wholesale electricity markets and manages the comprehensive planning of the regional power system. In 2012, at the request of stakeholders, the ISO developed a process for forecasting the impacts of energy efficiency (EE), delivered by state-sponsored EE programs, on future loads and incorporated the EE forecast into system planning studies.[5] The development of the EE forecast followed a multiyear stakeholder outreach and data-collecting effort spearheaded by the ISO.[6] This initial effort was necessary because no single source of information was available on the size and scope of the six New England states' EE programs.

This report contains the results of the most recent EE forecasting process for 2019 to 2024, for the region and each New England state.[7] The report first summarizes the rationale for developing the EE forecast and the methodology used. Appendices provide information on the milestones for the next EE forecast, as well as specific EE measure data the ISO collected. EE measures are components of a program administrator's (PA's) EE portfolio offered to customers to reduce energy usage.[8]

2.1 Background

The six New England states—Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont—have led the charge nationally for enhancing energy efficiency through the deployment of statewide ratepayer-funded programs. By statute, rule, and policy, the New England states have made EE a priority for the region. Each state has its own structure for planning and implementing EE programs, although all the programs generally cover the residential, commercial, and industrial sectors. In general, EE programs range from consumer incentives, such as rebates for purchasing new efficient equipment, process improvements, and energy management systems, to energy audits. In addition, most states have EE programs designed to assist low-income residents and "hard-to-reach" customers, as well as goals to achieve all cost-effective savings. Some states also have established aggressive long-term energy-efficiency goals tied to reductions in greenhouse gas emissions and global-warming solutions.

[5] As defined in Section I of the ISO's tariff, energy efficiency is installed measures (e.g., any combination of products, equipment, systems, services, practices, and strategies) on end-use customer facilities that reduce the total amount of electrical energy needed while delivering a comparable or improved level of end-use service. Such measures include, but are not limited to, the installation of more energy-efficient lighting, motors, refrigeration, HVAC (heating, ventilation, and air conditioning) equipment and control systems, envelope measures, operations and maintenance procedures, and industrial process equipment. See http://www.iso-ne.com/static-assets/documents/regulatory/tariff/sect_1/sect_i.pdf.

[6] Background information on the ISO's Regional Energy-Efficiency Initiative is available at http://www.iso-ne.com/static-assets/documents/committees/comm_wkgrps/inactive/reei/mtrls/reei_background.pdf.

[7] "ISO-NE Final 2015 EE Forecast for 2019–2024" (April 20, 2015), http://www.iso-ne.com/system-planning/system-forecasting/energy-efficiency-forecast. Additional background information and data that went into the creation of the EE forecast is available at http://www.iso-ne.com/eefwg.

[8] The ISO collects data on EE measures to help analyze future trends in EE policy and funding. The ISO takes no position on state policy decisions regarding the selection of measure types or the focus of EE programs.

Generally, the state public utilities commissions (PUCs) are responsible for approving EE program scope, costs, and implementation.[9] Investor-owned utilities, "efficiency" utilities, and community-choice aggregators often serve as program administrators and manage the state-sponsored EE programs.[10] States fund EE programs via several sources. The majority of funds are accrued through a system benefits charge (SBC), which appears as a line item on ratepayer bills. EE funds also are generated by other sources, such as proceeds from the Regional Greenhouse Gas Initiative (RGGI) auctions, the ISO New England Forward Capacity Market (FCM), and EE reconciliation funds established to support all cost-effective EE policies.[11]

2.2 Energy Efficiency in New England

State-sponsored EE programs have a long history in the region, with programs in Massachusetts going back over 20 years.[12] In recent years, the New England state-sponsored EE programs have grown to unprecedented levels. The New England states are nationally recognized for their EE programs.[13]

The growth in EE regionally is supported by significant changes in policy and funding. Vermont began the trend in supporting all cost-effective EE measures in 2007, earning it the top spot in the American Council for an Energy-Efficient Economy (ACEEE) scorecard for that year. In subsequent years, Rhode Island, Massachusetts, Maine, and Connecticut adopted all-cost-effective policies with funding mechanisms to match the state goals. All four states continue to rank in the top 10 nationally, with Massachusetts taking top spot for four years running. Figure 2-1 depicts the trends in EE funding for the six New England states as reported by either PAs or the states.

[9] More specific information about state EE programs is available at http://www.dsireusa.org.

[10] Most of the energy efficiency implemented in Maine and Vermont is by energy-efficiency utilities, Efficiency Maine Trust, and Efficiency Vermont, respectively.

[11] For information on RGGI, see www.rggi.org. The FCM is a locational capacity market for which the ISO projects the needs of the power system three years in advance and then holds an annual auction to purchase power resources to satisfy the future capacity needs, regionwide and in local areas. The aim of the FCM is to send appropriate price signals to attract new investment and maintain existing resources where and when they are needed, including during shortage events, thus ensuring the reliability of the New England electricity grid.

[12] Massachusetts Department of Energy Resources, *Efficiency as Our First Fuel: Strategic Investments in Massachusetts' Energy Future: the 2010 Report of the Massachusetts Energy Efficiency Advisory Council* (June 2011), http://www.mass.gov/eea/docs/doer/energy-efficiency/eeac-2010-report-ee-advisory-council.pdf.

[13] See the American Council for an Energy-Efficient Economy's annual scorecard ranking states on their EE programs. In 2014, Massachusetts was ranked first nationally for the fourth time in a row (http://aceee.org/state-policy/scorecard).

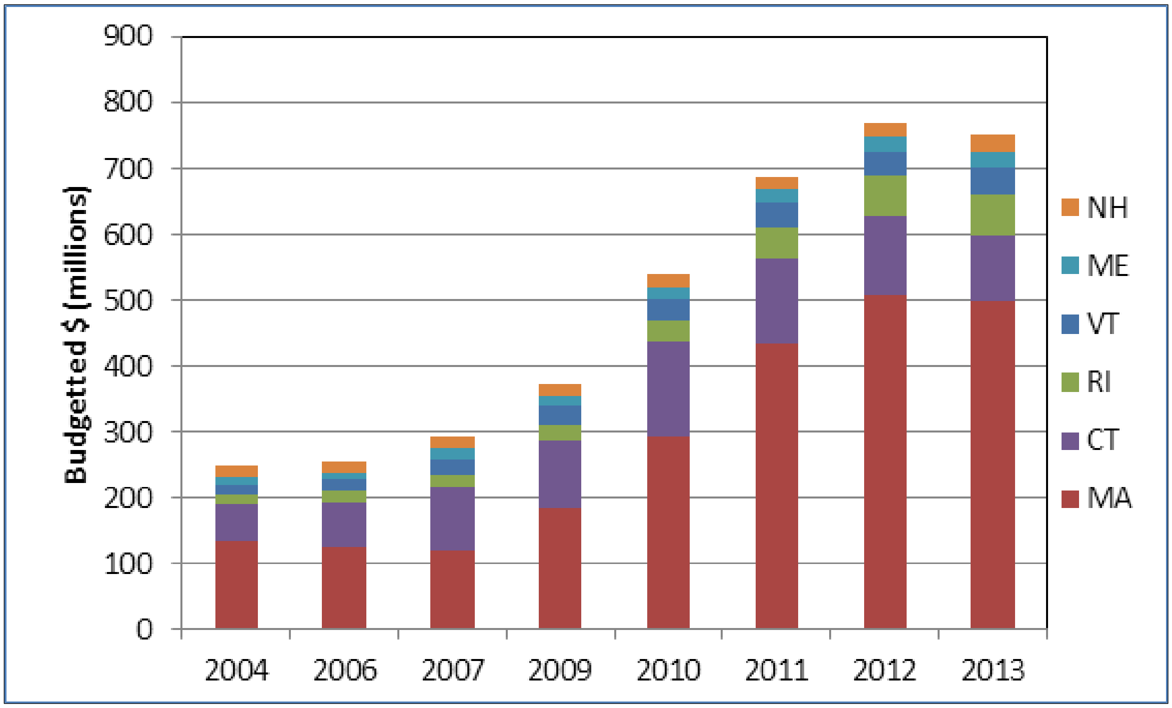

Figure 2-1: Trends in EE funding for the six New England states, 2004 to 2013.

Energy-efficiency programs not only have a long history as state policy, they also have a long history of participation in ISO New England's markets. Under the market rules governing the transition period of the Forward Capacity Market, in December 2006, the ISO began accepting and registering qualified EE projects as capacity resources. Starting in 2010 and continuing today, EE resources continue to participate in the FCM, taking significant positions in all the annual auctions for future delivery periods. As a result, the FCM provides the ISO with a comprehensive understanding and projection of the savings in energy use over the three-to-four-year FCM horizon. Figure 2-2 shows the growth of EE in the FCM.

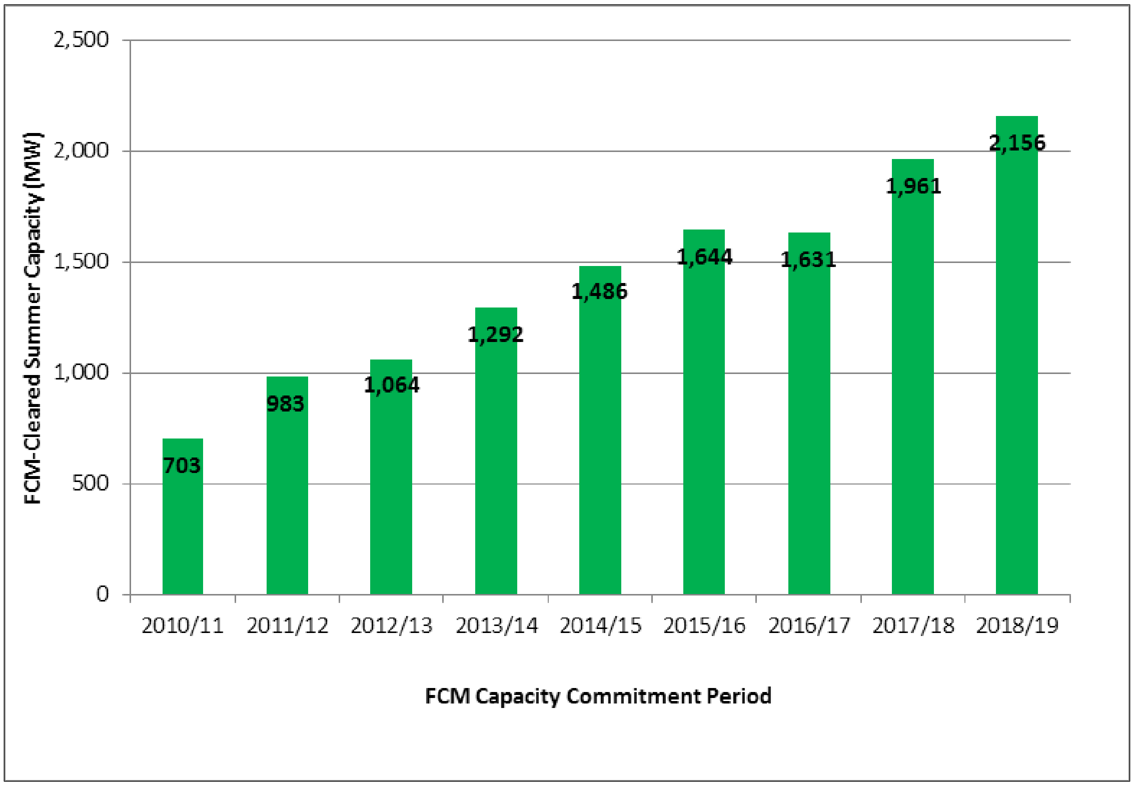

Figure 2-2: Growth of energy efficiency in the Forward Capacity Market (Capacity Supply Obligation; MW)

Notes: "MW" stands *for megawatts*.

Given the significant changes that have occurred in the New England EE programs over the past 10 years, in 2011, the ISO conducted a detailed survey of the region's EE program administrators concerning their participation in the FCM. The results of this analysis showed that essentially all the EE capacity the PAs developed was indeed participating in the FCM.[14] The ISO also determined that nonregulated entities deploying EE through performance contracts were small relative to the state-funded programs and some already in the FCM. Consequently, the projections of EE in the ISO's planning process only focus on state-sponsored EE programs.

2.3 Early Development of the Energy-Efficiency Forecast

In 2009, the ISO and the region's energy-efficiency stakeholders began an intensive, multiyear research, data-collection, and analysis process, resulting in a comprehensive assessment of historical EE spending and savings achieved in programs administered by PAs. The ISO and EE stakeholders agreed to the need for an approach to account for future EE investment and savings beyond the FCM based on empirical data and long-standing policy and legislative mandates. In 2012, the ISO began the development, with input from stakeholders, of a methodology to forecast EE savings in years beyond the FCM out to 10 years. The EE forecast would equip system planners and stakeholders with reliable information about the long-term impacts of state-sponsored EE programs.

[14] ISO New England, *Energy Efficiency Update*, PAC presentation (April 14, 2011), http://www.iso-ne.com/static-assets/documents/committees/comm_wkgrps/prtcpnts_comm/pac/mtrls/2011/apr142011/energy_efficiency.pdf.

2.4 Energy-Efficiency Forecast Working Group

In 2012, the ISO established the Energy-Efficiency Forecast Working Group (EEFWG) to provide ongoing input into the EE forecast process.[15] In addition to the ISO, this stakeholder group consists of state representatives with expertise in energy-efficiency programs, PAs, and other interested parties, who provide guidance on EE forecast assumptions, methodologies, and data inputs. Chaired by the ISO, the EEFWG meets periodically over the course of a year to assist the ISO in the development of the EE forecast. Members of the EEFWG provide data to the ISO on EE programs, ensuring that the most current and accurate information is available for the EE forecast. The ISO analyzes the data, which the EEFWG then validates. The EEFWG also reviews the draft EE forecast and provides feedback where appropriate. The EEFWG is an open stakeholder process, and new participants are welcome. A timeline of relevant EE forecast meeting and other milestones follows in Figure 2-3.

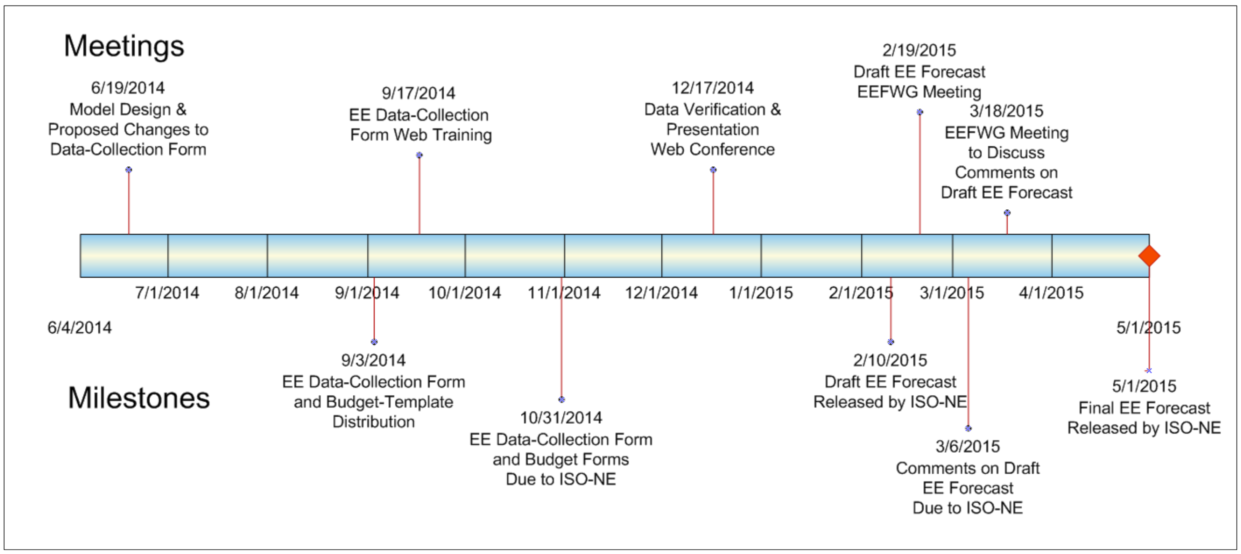

Figure 2-3: Timeline for the development of the 2015 energy-efficiency forecast.

[15] More information on the EEFWG is available at http://www.iso-ne.com/eefwg.

Section 3
Forecast Methodology

To create a quantitative, data-driven forecast of future EE, the ISO needed a forecast methodology. To determine whether such a methodology existed, ISO New England surveyed other ISOs and Regional Transmission Organizations (RTOs). The survey gathered information about whether other regions were dealing with these issues and, if so, if they had an EE forecast methodology. Results of this survey concluded that only the New York ISO (NYISO) had a basic EE forecast tool primarily based on the cost of EE measures and the state's EE budget.

Building on this basic concept, the ISO developed its own EE forecast methodology with stakeholder input. It first vetted a proof-of-concept forecast with stakeholders and then released a draft EE forecast for review on February 24, 2012.[16] This draft used budget data and production costs provided by the PAs and included a range of scenarios for addressing various levels of uncertainty for consideration by the EEFWG. After consultation with the EEFWG, a final draft was released on March 19, 2012.[17]

As a result of input provided by the EEFWG, the ISO revised the EE forecast methodology to incorporate the states' near-term approved EE budgets. The ISO bases its forecast methodology estimates of future EE budgets on projections of current EE revenue sources, including system benefits charges, revenues from RGGI auctions, the FCM, and other sources. The ISO relies on the states to provide accurate information about the sources of funding for EE programs.

This section includes the calculations for the EE forecast model and the budget model.

3.1 EE Forecast Model

The ISO's EE forecast calculates future energy reductions and peak demand savings based on three major elements:

- EE program budgets
- Production costs (expressed as dollars per megawatt-hours; $/MWh)
- A ratio of peak demand to the annual savings in energy use (MW/MWh)

3.1.1 Calculations for Future Energy Reductions

A simplified representation of the calculation for the ISO's EE forecast methodology is as follows:

[16] ISO New England, *Energy Efficiency Forecast 2015–2012,* EEFWG presentation (February 24, 2012), http://www.iso-ne.com/static-assets/documents/committees/comm_wkgrps/othr/enrgy_effncy_frcst/mtrls/ee_forecast_work_group_2_24_12_final.pdf.

[17] ISO New England, *Draft Final Energy-Efficiency Forecast* 2015–2021 (March 19, 2012), http://www.iso-ne.com/committees/comm_wkgrps/othr/enrgy_effncy_frcst/mtrls/draft_final_ee_forecast_3_16_12.pdf.

1) $$MWh = [(1 - BSR) * Budget \$] / [\$/MWh * PCINCR]$$

Where:

- BSR is budget spend rate (%).
- Budget $ is an estimate of the dollars to be spent on EE ($).
- $/MWh is production cost.
- PCINCR is production cost increase (%).

2) $$MW = MWh * PER$$

Where:

- PER is the ratio of the peak energy demand to the annual energy use ("peak-to-energy" ratio) (MW/MWh)

3.1.2 Model Uncertainty Factors

The ISO applies modest and reasonable uncertainty factors to future EE budgets to reflect the vagaries of predicting future policy trends. For example, in Massachusetts and Rhode Island, EE programs continue expanding rapidly. Also, in the 2015 program year, Connecticut's program will expand significantly in size. To reflect the uncertainty regarding whether or not these states will be able to spend the full budgeted amount for these newly expanded EE goals, the ISO discounted the budget for Massachusetts and Rhode Island by 10%. These factors are developed from actual percentage spend rates observed in prior reporting years (and reflected in Section 4.2, Table 4-3, "Program Summary of the ISO New England 2014 Energy-Efficiency Forecast"). With Connecticut's projected expansion, the ISO determined that the Connecticut utilities have significant demand for services and will spend their full budget, a factor that may be reassessed in the 2016 forecast. The ISO also adjusts the final EE forecast to account for the impacts of inflation on the program costs and assumed increases in production costs.[18] For all states, production costs were escalated by 5% each year to account for the increasing costs of energy-efficiency measures. In addition, the ISO applied a 2.5% inflation rate on all states.

A description of the regional and state-specific EE forecast model uncertainty factors and other assumptions precede the forecast data presented in Section 5.2.

3.2 Budget Model

The following equations were used to estimate the projected budgets through the forecast period. As previously noted, program administrators, state regulatory personnel, or their representatives provided certain data used in the equations. The balance of parameters originates from other ISO

[18] In future EE forecasts, a longer EE data record may allow for the refinement of the uncertainty factors.

reports, such as the Capacity, Energy, Load, and Transmission (CELT) Report and Forward Capacity Market results.[19]

3) Amount of EE dollars gained from system benefits charge:

$$\mathrm{SALES(y,r)} = \frac{\mathrm{NEL(y,r)} - \mathrm{PDR(y,r)}}{(1 + \mathrm{Loss\ Factor})} * \%\mathrm{SBC}$$

Where:

- NEL is the ISO New England annual energy forecast.
- PDR is the ISO New England FCM passive demand resource.[20]
- Loss Factor is the average transmission and distribution losses for ISO New England.
- %SBC is the percentage of sales subject to the systems benefit charge (PA/regulator).

4) Budget dollars available for EE programs from sources other than state budgets:

$$\mathrm{Budget\$(y,r)} = [\mathrm{SALES(y,r)} * \mathrm{SBC(r)}] + [\mathrm{RGGI\$(r)} * \%\mathrm{RGGI(r)}] + [\mathrm{RGGI\$(r)} * \%\mathrm{RGGI(r)}] + \mathrm{POLVAR(y,r)}$$

Where:

- SALES is the ISO New England annual electricity sales forecast.
- SBC is the system benefit charge (PA/regulator).
- RGGI$ is the annual average dollars from the historical RGGI auctions in New England.
- %RGGI is the percentage of RGGI$ to be spent on EE (PA/regulator).
- FCMMW is the level of passive demand resources in the ISO New England FCM.
- CLPR is the last ISO New England Forward Capacity Auction (FCA) clearing price.
- %FCM is the percentage of FCM dollars to be spent on EE (PA/regulator).
- POLVAR$ is the money to be spent on EE not based on SBC, RGGI, or FCM (PA/regulator).

[19] The ISO's CELT reports are available at http://www.iso-ne.com/system-planning/system-plans-studies/celt.

[20] *Passive demand resources* (PDRs) reduce electric energy consumption that generation resources would have otherwise served. Energy efficiency is a passive demand resource.

5) State budget dollars accounting for spend-rate uncertainty:

$$\text{TOTALDLR\$}(y, r) = \text{BUDGET\$}(y, r) * [100 - \text{BSR}(r)]$$

Where:

- %SPENT is the percentage of BUDGET$ that can be spent (PA data).

6) EE megawatt-hours based on cost to produce an EE megawatt-hour and available funds:

$$\text{EEMWH}(y, r) = \frac{\text{TOTDLR\$}(y,r)}{\text{PRODCOST}(r) * \text{PCINCR}(y,r)} * (1 + \text{Loss Factor})$$

Where:

- EEMWH is the annual megawatt-hours of EE.
- TOTDLR$ is the amount of dollars spent annually on EE.
- PRODCOST is the dollars spent per achieved megawatt-hour of EE (PA data).

7) Amount of EE megawatt-hours that occur on peak:

$$\text{EEMW}(y, r) = \text{EEMWH}(y, r) * \text{PEAKENER}(r)$$

Where:

- EEMW is the EE megawatts on peak.
- PEAKENER is the ratio of EE megawatts on peak to the annual EE megawatt-hours (PA data).

8) Adjustment in system benefits charge (SBCADJ) in the budget due to impacts of lower energy sales resulting from EE investment:

$$\text{SBCADJ\$}(y, r) = \sum \text{EEMWH}(y, r) * \text{SBC}(r)$$

Where:

- EEMWH EE reduces total electricity sales and SBC dollars for EE:

9) Adjustment in FCM revenues (FCMADJ) in the budget due to impacts of increased capacity payments resulting from EE investment:

$$\mathrm{FCMADJ\$}(\mathrm{y},\mathrm{r}) = \sum \mathrm{EEMW}(\mathrm{y},\mathrm{r}) * \mathrm{CLPR} * \%\mathrm{FCM}(\mathrm{y},\mathrm{r})$$

Where:

- EEMW clears the FCA and funds additional EE.

10) Total energy reductions based on budget, adjustments to the budget, production costs, and adjustments to production costs:

$$\mathrm{EEMWH}(\mathrm{y},\mathrm{r}) = \frac{\mathrm{TOTDLR\$}(\mathrm{y},\mathrm{r}) - \mathrm{SBCADJ\$}(\mathrm{y},\mathrm{r}) + \mathrm{FCMADJ\$}(\mathrm{y},\mathrm{r})}{\mathrm{PRODCOST}(\mathrm{r}) * \mathrm{PCINCR}(\mathrm{y},\mathrm{r})}$$

11) Peak demand reduction based on energy and peak-to-energy ratio:

$$\mathrm{EEMW}(\mathrm{y},\mathrm{r}) = \mathrm{EEMWH}(\mathrm{y},\mathrm{r}) * \mathrm{PEAKENER}(\mathrm{r})$$

Section 4
Data Collection

This section summarizes the process used to gather data and the data collected for the forecast years. The detailed data from state-sponsored EE programs, included in this section, were used to implement the EE forecast methodology and produce the EE forecast.

4.1 Data-Collection Process

The ISO collects data for the EE forecast by annually distributing an EE data-gathering worksheet to the PAs.[21]

Via the worksheet, the ISO receives data from all the region's PAs, who report on approximately 136 unique EE programs aimed at commercial/industrial (C&I), residential, and low-income customers.[22] For each EE program, a PA can provide information on the type of EE program, the size and cost of the program, and the actual energy saved. Of these programs, lighting measures and mixed lighting normally constitute a majority of the energy and demand savings, and the commercial and industrial sectors provide most of the overall savings.[23]

Table 4-1 is a sample of the blank EE data collection worksheet the ISO provides to the PAs each year. Table 4-2 shows the types of EE programs of the New England states for each class.

[21] EE data submitted to the ISO by the PAs is available at http://www.iso-ne.com/committees/planning/energy-efficiency-forecast.

[22] The ISO did not request data from municipal electric entities and merchant energy-efficiency providers.

[23] Mixed lighting refers to programs that include lighting and other measures, such as mechanical systems, building envelope, process improvements, and appliances. See *Energy Efficiency Forecast 2015–2020*, EEFWG presentation, slide 28 (February 24, 2012), http://www.iso-ne.com/static-assets/documents/committees/comm_wkgrps/othr/enrgy_effncy_frcst/mtrls/ee_forecast_work_group_2_24_12_final.pdf.

Table 4-1
Sample EE Data Collection Worksheet (partial data)

ID	Energy-Efficiency Data Reporting Form	Input Format	Program 1
1	Reporting period information		
1.1	Reporting period start date	MM/DD/YYYY	39814
1.2	Reporting period end date	MM/DD/YYYY	40148
1.3	Energy-efficiency program administrator	XYZ Company	XYZ Company
1.4	Program name	Program name	Energy Solutions
1.5	Program type	Program type	Lighting/appliances
1.6	Program sector	Sector name	Residential
1.7.1	Program measures/end uses 1	Measures/end uses	Lighting
1.7.1.1	Program percentage of measure/end use 1 based on kWh	%	60%
1.7.1.2	Program percentage of measure/end use 1 based on kW	%	60%
1.7.1.3	Program percentage of measure/end use 1 based on $	%	60%
1.7.2	Program measures/end uses 2	Measures/end uses	HVAC
1.7.2.1	Program percentage of measure/end use 2 based on kWh	%	20%
1.7.2.2	Program percentage of measure/end use 2 based on kW	%	20%
1.7.2.3	Program percentage of measure/end use 2 based on $	%	20%
1.7.3	Program measures/end uses 3	Measures/end uses	Appliances
1.7.3.1	Program percentage of measure/end use 3 based on kWh	%	10%
1.7.3.2	Program percentage of measure/end use 3 based on kW	%	10%
1.7.3.3	Program percentage of measure/end use 3 based on $	%	10%
1.7.4	Program measures/end uses 4	Measures/end uses	Hot water
1.7.4.1	Program percentage of measure/end use 4 based on kWh	%	10%
1.7.4.2	Program percentage of measure/end use 4 based on kW	%	10%
1.7.4.3	Program percentage of measure/end use 4 based on $	%	10%

Table 4-2
Types of Energy-Efficiency Programs of the New England States

Commercial/Industrial (C&I)	Low Income	Residential
Behavior	Behavior	Behavior
Demand response	Demand response	Demand response
Education	Education	Education
Lighting/appliances	Lighting/appliances	Lighting/appliances
Loans	Loans	Loans
Lost opportunity, small	Lost opportunity	Lost opportunity
Lost opportunity, large		
Retrofit, small	Retrofit	Retrofit
Retrofit, large		

The New England states' energy-efficiency programs include the following types of general end-use measures:[24]

- Appliances
- Building envelope
- Compressed air
- Consumer products
- Custom
- Education
- Heating
- Hot water
- Heating, ventilation, and air conditioning (HVAC)
- Lighting
- Motors/drives/variable-frequency drives
- Process improvements (equipment operation)
- Refrigeration
- Small motors

4.2 Data-Collection Results

Table 4-3 shows an overview of the 2015 energy-efficiency forecast data. Table 4-4 shows the 2015 data summary by class. Figure 4-1 to Figure 4-9 show specific results of the forecast, including the following:

[24] Cooling end-use was converted to HVAC, pursuant to PA requests that cooling was better characterized as HVAC.

- For 2013, the percentage of total costs, annual energy use, and summer peak energy use for New England's EE programs by class (C&I, low income, residential) and the ratio of peak energy demand to annual energy use for each class
- For 2009 to 2013, the totals and averages of the following statistics for New England and for each New England state:
    - Annual energy production costs
    - Ratio of summer peak demand to annual energy use
    - Percentage of the annual energy savings goal achieved
    - Percentage of the budget spent
    - Percentage of the summer peak reduction goal achieved

Table 4-3
Program Summary of the ISO New England 2015 Energy-Efficiency Forecast

State	Budget	Total Costs	Achieved Annual Energy	$/MWh	Achieved Summer Peak	$/MW	Energy Achieved	Budget Spent	Peak Achieved	Peak-to-Energy Ratio	Achieved Lifetime Energy	Lifetime $/MWh
	$1,000s	$1,000s	MWh	$	MW	$	%	%	%	MW/GWh	MWh	$
NE												
2009	357,939	352,374	933,803	377	149.8	2,352,646	83	98	94	0.160395	10,688,990	33
2010	524,416	500,979	1,371,179	365	191.5	2,616,574	103	96	95	0.139634	14,631,980	34
2011	665,087	518,865	1,575,303	329	200.4	2,588,875	90	78	75	0.127227	17,638,160	29
2012	745,761	648,848	1,723,357	377	221.4	2,930,061	98	87	86	0.128496	18,384,080	35
2013	726,651	706,010	1,822,458	387	253.1	2,789,903	108	97	105	0.138856	20,277,070	35
Avg 2011-13	712,499	624,574	1,707,039	366	225.0	2,776,194	99	88	88	0.131792	18,766,440	33
CT												
2009	102,183	73,412	222,501	330	34.1	2,150,156	60	72	63	0.153449	2,464,777	30
2010	143,544	144,938	405,043	358	49.9	2,907,363	113	101	105	0.123079	3,533,542	41
2011	129,909	119,426	381,974	313	43.1	2,769,483	93	92	87	0.112893	3,163,706	38
2012	120,177	121,826	308,428	395	40.2	3,032,727	131	101	124	0.130243	3,116,687	39
2013	97,955	121,612	271,480	448	33.3	3,648,327	139	124	130	0.122785	2,885,413	42
Avg 2011-13	116,013	120,955	320,627	377	38.9	3,111,342	114	104	109	0.121248	3,055,269	40
ME												
2009	0	13,806	55,176	250	6.5	2,127,603	662	0	472	0.117601	519,953	27
2010	0	16,846	74,180	227	7.7	2,198,392	101	0	102	0.103303	709,392	24
2011	0	22,817	152,664	150	18.3	1,248,321	117	0	100	0.119730	1,447,766	16
2012	0	23,713	143,532	165	12.5	1,904,493	101	0	114	0.086746	1,266,751	19
2013	0	24,279	141,978	171	15.1	1,604,008	0	0	0	0.106613	2,043,036	12
Avg 2011-13	0	23,603	146,058	162	15.3	1,543,830	109	0	107	0.104675	1,585,851	15
MA												
2009	183,782	192,362	424,652	453	69.9	2,751,526	81	105	99	0.164631	5,075,858	38
2010	294,315	253,086	619,638	408	91.4	2,769,183	99	86	90	0.147496	7,336,580	35
2011	432,796	283,898	777,100	365	100.6	2,823,156	86	66	67	0.129405	10,177,750	28

State	Budget	Total Costs	Achieved Annual Energy	$/MWh	Achieved Summer Peak	$/MW	Energy Achieved	Budget Spent	Peak Achieved	Peak-to-Energy Ratio	Achieved Lifetime Energy	Lifetime $/MWh
	$1,000s	$1,000s	MWh	$	MW	$	%	%	%	MW/GWh	MWh	$
2012	508,988	400,607	980,105	409	125.3	3,198,071	88	79	75	0.127808	10,724,660	37
2013	499,734	438,951	1,108,907	396	160.1	2,742,348	93	88	92	0.144344	11,921,490	37
Avg 2011-13	480,506	374,485	955,371	392	128.6	2,911,341	89	78	79	0.134639	10,941,300	34
NH												
2009	18,286	17,988	59,691	301	9.5	1,889,480	139	98	137	0.159488	750,029	24
2010	21,866	21,763	73,710	295	12.4	1,759,992	121	100	117	0.167759	894,648	24
2011	17,667	18,904	58,042	326	9.9	1,910,675	123	107	121	0.170458	673,064	28
2012	19,673	18,703	53,973	347	7.9	2,376,082	106	95	101	0.145835	666,868	28
2013	26,442	25,552	58,834	434	8.0	3,207,111	111	97	107	0.135421	764,368	33
Avg 2011-13	21,261	21,053	56,950	370	8.6	2,454,444	113	99	110	0.150614	701,433	30
RI												
2009	24,555	26,211	81,543	321	15.4	1,702,261	103	107	124	0.188828	899,331	29
2010	30,366	27,581	81,275	339	12.7	2,163,691	107	91	78	0.156838	929,242	30
2011	48,649	36,495	96,009	380	13.7	2,673,394	94	75	71	0.142185	1,076,778	34
2012	61,246	48,870	119,666	408	19.5	2,504,012	93	80	82	0.163091	1,288,325	38
2013	64,179	61,547	149,033	413	25.1	2,453,409	104	96	123	0.168327	1,602,369	38
Avg 2011-13	58,025	48,970	121,569	403	19.4	2,521,913	97	84	92	0.159727	1,322,491	37
VT												
2009	29,134	28,597	90,240	317	14.3	1,997,246	92	98	104	0.158666	979,041	29
2010	34,326	36,764	117,334	313	17.4	2,107,775	88	107	93	0.148653	1,228,575	30
2011	36,066	37,325	109,514	341	14.9	2,502,506	72	104	69	0.136192	1,099,092	34
2012	35,678	35,130	117,653	299	16.2	2,172,427	119	99	109	0.137447	1,320,789	27
2013	38,341	34,068	92,226	369	11.5	2,969,952	94	89	77	0.124379	1,060,396	32
Avg 2011-13	36,695	35,508	106,464	334	14.2	2,503,078	92	97	83	0.133243	1,160,092	31

Table 4-4
ISO New England 2015 Energy-Efficiency Forecast Data Summary by Class

Class	Budget	Total Costs	Achieved Annual Energy	$/MWh	Achieved Summer Peak	$/MW	Energy Achieved	Budget Spent	Peak Achieved	Peak-to-Energy Ratio	Total	Annual	Summer
	$1,000s	$1,000s	MWh	$	MW	$	%	%	%	MW/GWh	%	%	%
NE Total													
2009	357,939	352,374	933,803	377	149.8	2,352,646	83	98	94	0.160395	100	100	100
2010	524,416	500,979	1,371,179	365	191.5	2,616,574	103	96	95	0.139634	100	100	100
2011	665,087	518,865	1,575,303	329	200.4	2,588,875	90	78	75	0.127227	100	100	100
2012	745,761	648,848	1,723,357	377	221.4	2,930,061	98	87	86	0.128496	100	100	100
2013	726,651	706,010	1,822,458	387	253.1	2,789,904	108	97	105	0.138856	100	100	100
Mixed All Classes													
2009	850	775	0	0	0	0	0	91	0	0.000000	0	0	0
2010	1,525	960	0	0	0	0	0	63	0	0.000000	0	0	0
2011	1,048	723	0	0	0	0	0	69	0	0.000000	0	0	0
2012	1,414	3,554	0	0	0	0	0	251	0	0.000000	1	0	0
2013	2,109	7,065	75,443	94	6.9	1,031,080	2,744	335	1766	0.090824	1	4	3
Commercial & Industrial													
2009	195,507	197,161	598,047	330	108.8	1,811,537	93	101	100	0.181987	56	64	73
2010	279,904	258,853	779,162	332	122.2	2,118,321	93	93	87	0.156831	52	57	64
2011	403,028	279,046	899,762	310	133.6	2,089,173	84	69	71	0.148448	54	57	67
2012	440,940	342,779	1,058,624	324	159.9	2,143,582	92	78	85	0.151054	53	61	72
2013	414,184	350,471	1,074,326	326	157.4	2,226,825	94	85	91	0.146497	50	59	62
Low Income													
2009	42,971	41,889	35,566	1,178	3.7	11,208,450	79	98	83	0.105080	12	4	3
2010	58,986	48,410	40,448	1,197	4.0	12,020,120	70	82	75	0.099571	10	3	2
2011	65,794	55,593	47,360	1,174	3.9	14,269,340	84	85	72	0.082264	11	3	2

Class	Budget	Total Costs	Achieved Annual Energy	$/MWh	Achieved Summer Peak	$/MW	Energy Achieved	Budget Spent	Peak Achieved	Peak-to-Energy Ratio	Total	Annual	Summer
	$1,000s	$1,000s	MWh	$	MW	$	%	%	%	MW/GWh	%	%	%
2012	80,661	73,295	51,855	1,414	4.6	15,859,920	95	91	82	0.089122	11	3	2
2013	75,138	82,716	55,725	1,484	6.3	13,209,870	138	110	137	0.112367	12	3	3
Residential													
2009	118,611	112,549	300,190	375	37.2	3,025,181	69	95	79	0.123935	32	32	25
2010	184,001	192,756	551,570	350	65.2	2,954,616	128	105	117	0.118279	39	40	34
2011	195,216	183,503	628,181	292	63.0	2,914,709	101	94	85	0.100222	35	40	31
2012	222,746	229,219	612,878	374	56.9	4,027,454	111	103	90	0.092864	35	36	26
2013	235,220	265,757	616,964	431	82.6	3,218,997	124	113	131	0.133815	38	34	33

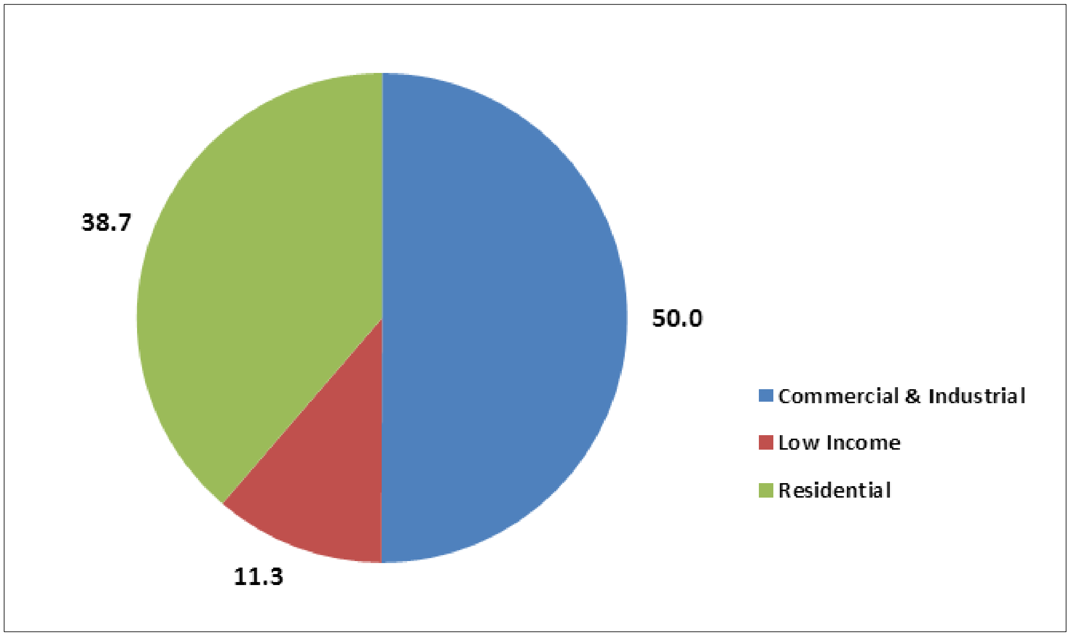

Figure 4-1: Percentage of total costs for energy-efficiency programs in New England, by class, 2013.

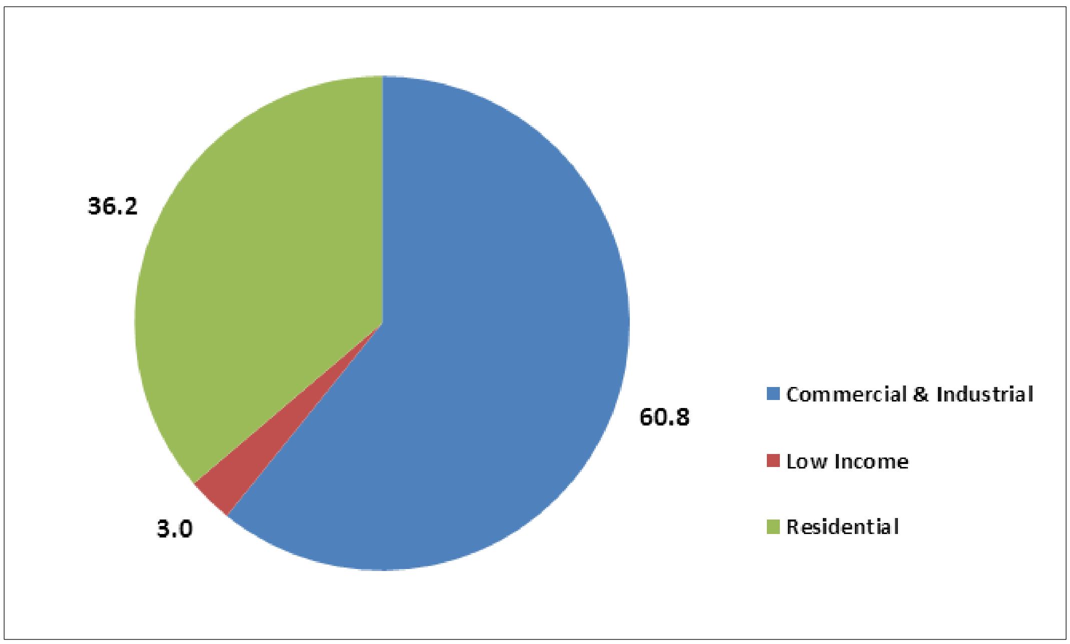

Figure 4-2: Percentage of annual energy use in New England, by class, 2013.

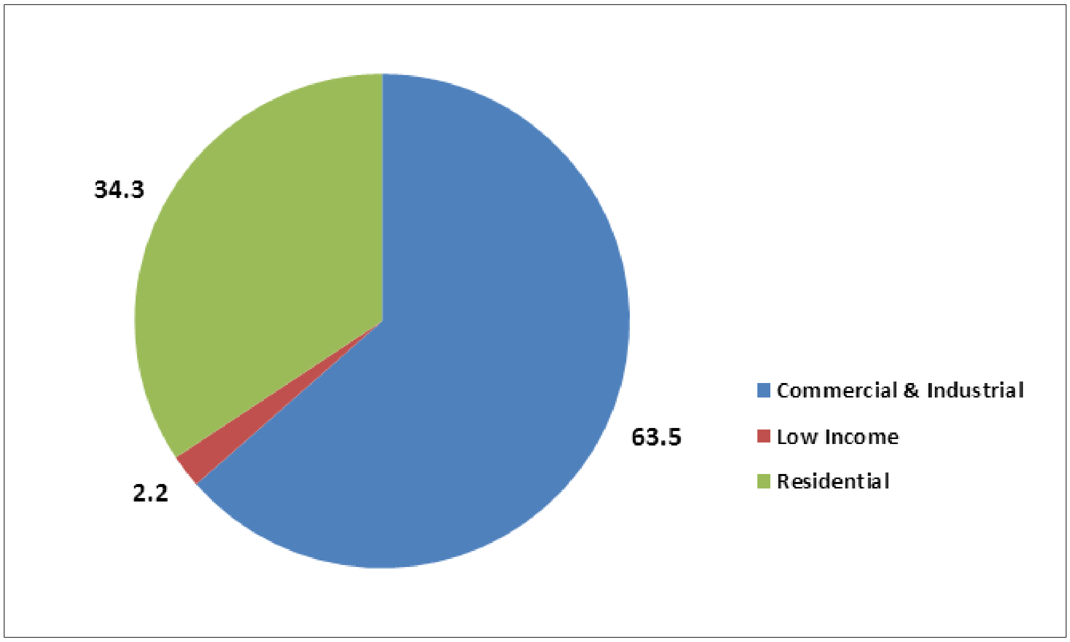

Figure 4-3: Percentage of summer peak energy use in New England, by class, 2013.

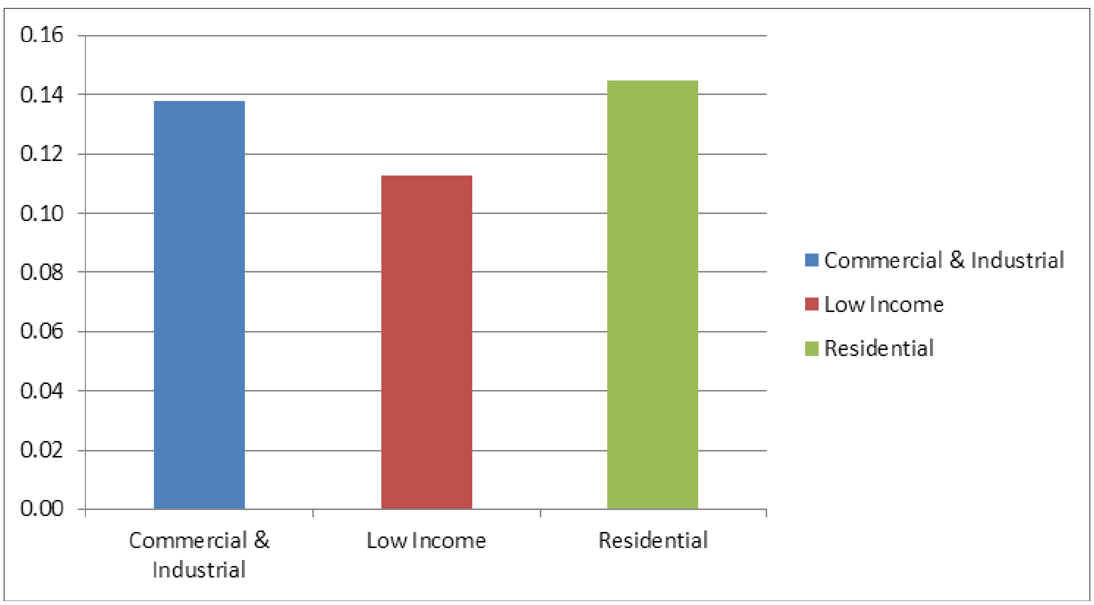

Figure 4-4: Ratio of peak energy demand to annual energy use in New England, by class, 2013.

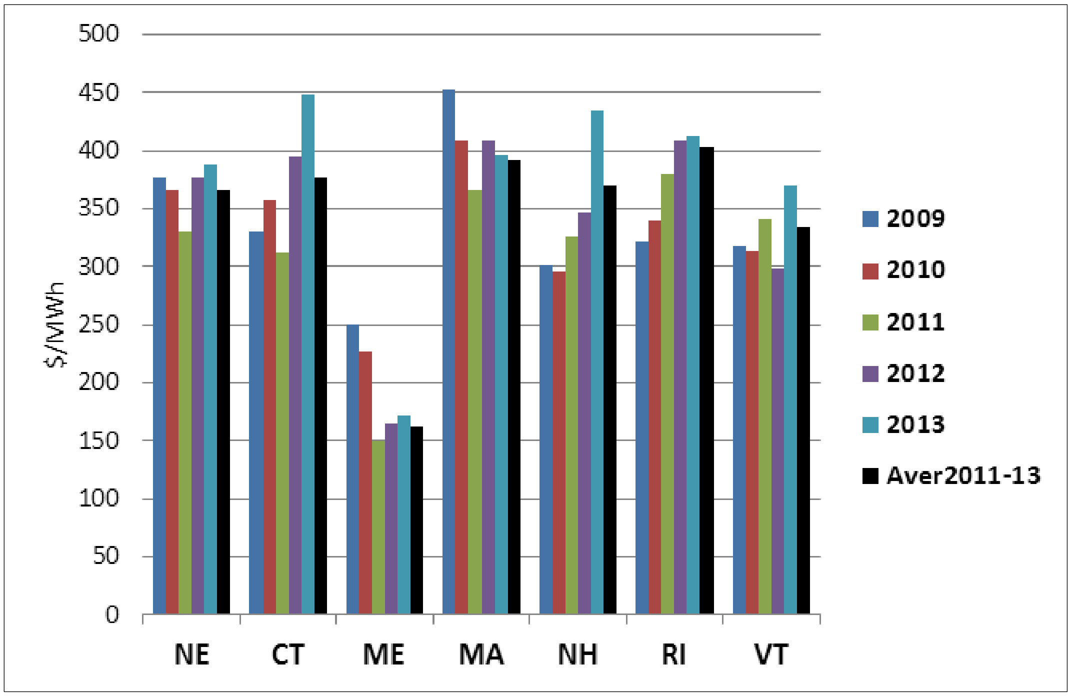

Figure 4-5: 2015 energy-efficiency forecast annual energy production costs in New England and for each New England state, totals and average for 2009 to 2013 ($/MWh).

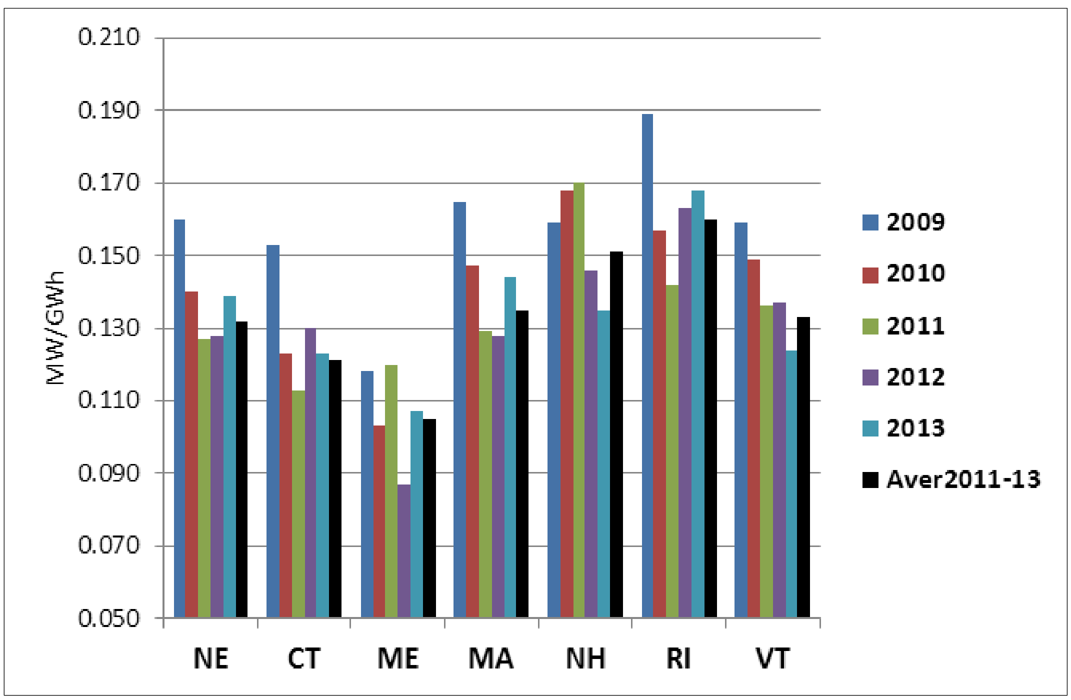

Figure 4-6: 2015 energy-efficiency forecast ratio of summer peak demand to annual energy use in New England and for each New England state, totals and average for 2009 to 2013 (MW/GWh).

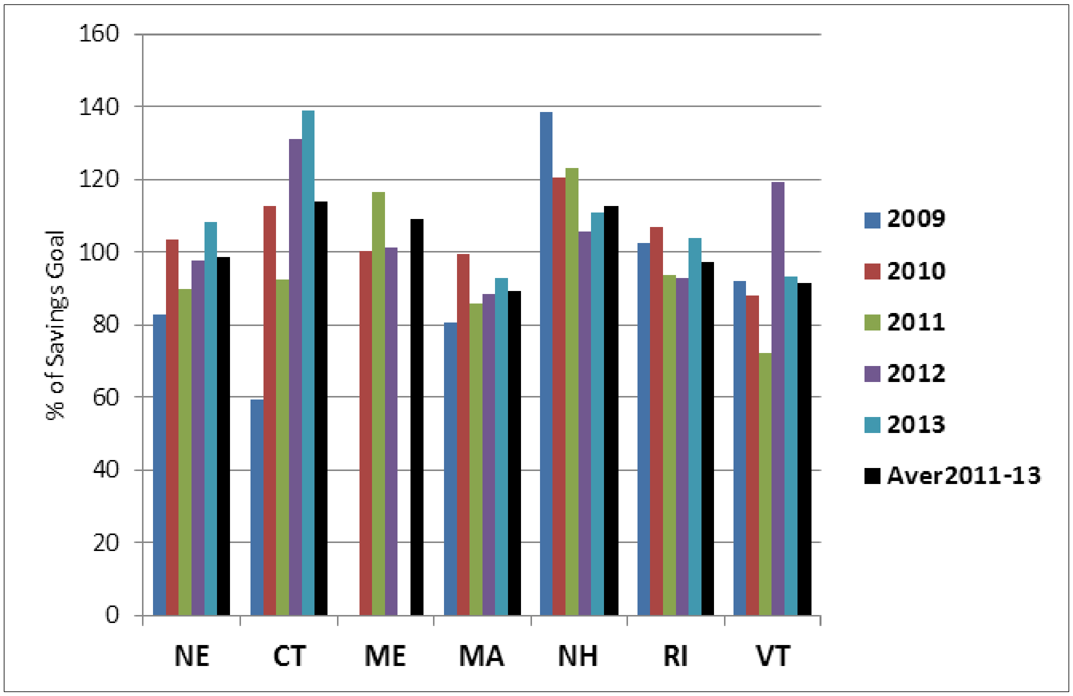

Figure 4-7: 2015 energy-efficiency forecast percentage of annual energy savings goal achieved in New England and by each New England state, totals and average for 2009 to 2013.

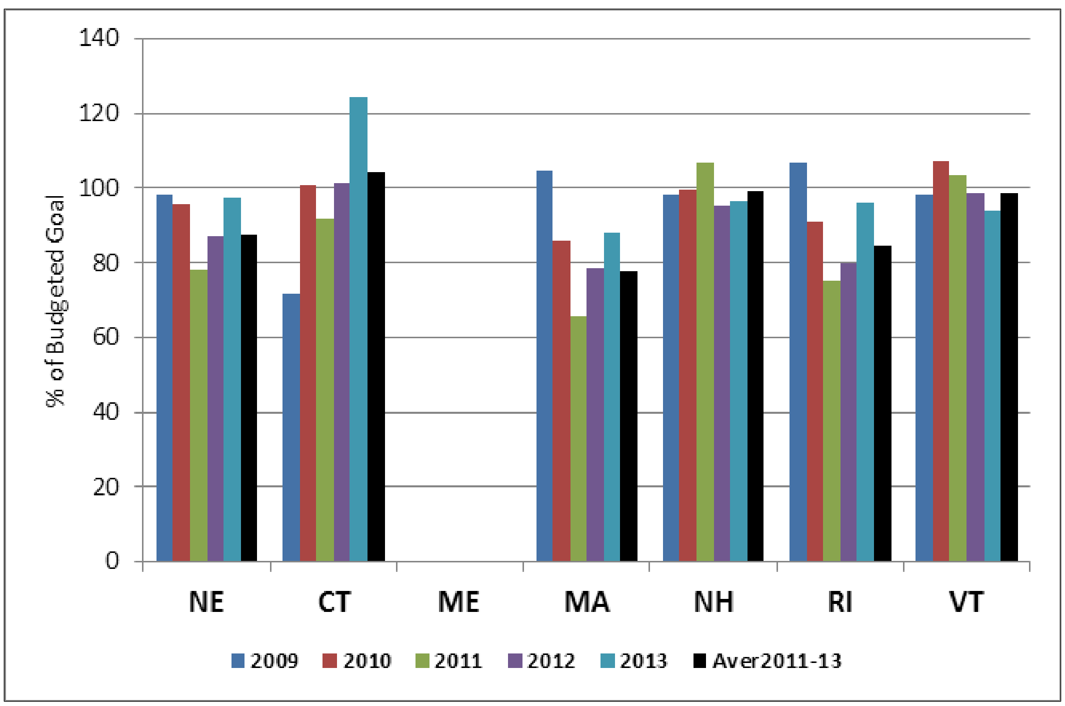

Figure 4-8: 2015 energy-efficiency forecast percentage of budget spent in New England and by each New England state, totals and average for 2009 to 2013.

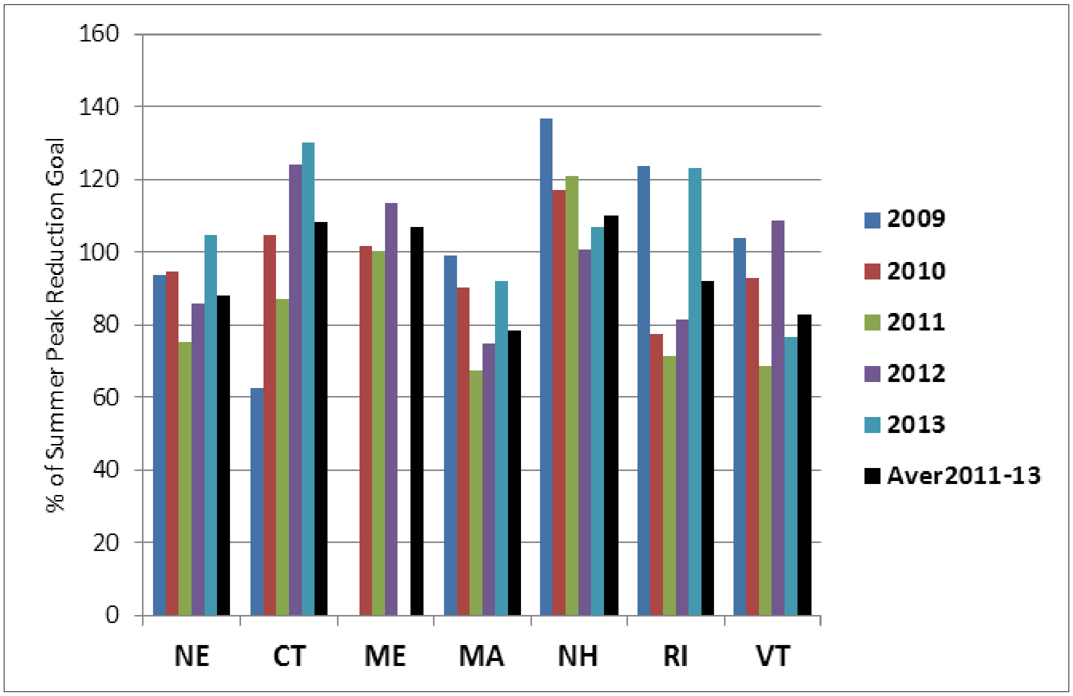

Figure 4-9: 2015 energy-efficiency forecast percentage of summer peak reduction goal achieved for New England and by each New England state, totals and average for 2009 to 2013.

4.3 EE Forecast Input Data

Table 4-5 to Table 4-10 reflect the synthesis of the data collected from the PAs, state regulatory agencies, and ISO inputs, such as forecasted energy and loads.

Table 4-5
Forecast of RGGI and FCM Dollars to Be Spent on EE Measures by Each New England State and Total for New England and 2018 to 2024 for the FCM (1,000 $)

	ME	NH	VT	CT	RI	MA	ISO
RGGI dollars ($1,000s)							
Applied to EE Annually[a]	0	2,600	0	12,000	4,300	30,000	48,900
FCM MW							
2018	181	83	119	422	198	1,153	2,156
FCM dollars ($1,000s; clearing price, $725/MWh)							
2018	20,735	9,516	13,660	48,335	22,671	132,178	247,095
FCM dollars for EE ($1,000s)							
2019	0	9,516	0	48,335	22,671	132,178	212,700
2020	0	9,516	0	48,335	22,671	132,178	212,700
2021	0	9,516	0	48,335	22,671	132,178	212,700
2022	0	9,516	0	48,335	22,671	132,178	212,700
2023	0	9,516	0	48,335	22,671	132,178	212,700
2024	0	9,516	0	48,335	22,671	132,178	212,700

(a) Anticipated annual revenue from RGGI auctions applied to EE as provided by state regulators to the ISO in their most recent data submissions.

Table 4-6
***2014 Regional System Plan* Forecast of Annual Energy Use, the Forecast Minus FCM Passive Demand Resources, and the Amount of Energy Eligible for Systems Benefits Charge, for Each New England State and Total for New England, 2019 to 2024 (GWh)[(a)]**

	ME	NH	VT	CT	RI	MA	ISO
2014 RSP energy forecast (GWh)							
2019	12,875	13,210	6,975	36,290	9,220	68,055	146,625
2020	12,945	13,335	7,025	36,585	9,280	68,665	147,835
2021	13,020	13,455	7,070	36,885	9,340	69,285	149,055
2022	13,100	13,575	7,125	37,185	9,400	69,905	150,290
2023	13,175	13,700	7,175	37,495	9,455	70,530	151,530
2024	13,240	13,815	7,225	37,795	9,510	71,120	152,705
2014 RSP energy forecast minus FCM passive demand resources (GWh)							
2019	11,840	12,797	6,151	34,442	8,445	63,481	137,156
2020	11,907	12,920	6,199	34,731	8,503	64,078	138,337
2021	11,985	13,042	6,246	35,037	8,565	64,711	139,586
2022	12,065	13,162	6,301	35,337	8,625	65,331	140,821
2023	12,140	13,287	6,351	35,647	8,680	65,956	142,061
2024	12,202	13,400	6,399	35,941	8,733	66,533	143,207
SBC eligibility	75%	100%	100%	94%	100%	86%	
SBC eligible; 2014 RSP energy forecast minus FCM passive demand resources (GWh)							
2019	8,880	12,797	6,151	32,238	8,445	54,594	123,104
2020	8,930	12,920	6,199	32,509	8,503	55,107	124,167
2021	8,989	13,042	6,246	32,795	8,565	55,652	125,288
2022	9,049	13,162	6,301	33,076	8,625	56,185	126,397
2023	9,105	13,287	6,351	33,366	8,680	56,722	127,511
2024	9,151	13,400	6,399	33,641	8,733	57,218	128,542

(a) FCA #8 results are available in the ISO's filing to FERC: *ISO New England Inc., Docket No. ER14-___-000, Forward Capacity Auction Results Filing* (February 28, 2014), http://www.iso-ne.com/static-assets/documents/regulatory/ferc/filings/2014/feb/er14_1409_000_fca8_results_filing_2_28_2014.pdf.

Table 4-7
2014 Forecast of Energy Sales (GWh) and System Benefit Charge ($) for Each New England State and the Total for New England, 2019 to 2024

	ME	NH	VT	CT	RI	MA	ISO
Sales (GWh)							
2019	8,377	12,072	5,803	30,413	7,967	51,504	116,136
2020	8,425	12,189	5,848	30,669	8,021	51,987	117,139
2021	8,480	12,303	5,892	30,938	8,080	52,502	118,196
2022	8,536	12,417	5,944	31,203	8,137	53,005	119,242
2023	8,589	12,535	5,991	31,477	8,189	53,512	120,293
2024	8,633	12,642	6,036	31,737	8,238	53,979	121,266
SBC rate ($/kwh)	0000	0018	0000	0030	0088	0025	
SBC dollars ($1,000s)							
2019	0	21,730	0	91,239	61,584	128,759	303,313
2020	0	21,940	0	92,006	60,531	129,969	304,445
2021	0	22,146	0	92,815	59,622	131,254	305,838
2022	0	22,350	0	93,610	58,788	132,512	307,259
2023	0	22,562	0	94,431	57,996	133,779	308,769
2024	0	22,755	0	95,211	57,268	134,948	310,182
Total	**0**	**133,483**	**0**	**559,312**	**355,789**	**791,221**	**1,839,806**

Table 4-8
2014 Forecast of Impacts of New Energy-Efficiency Measures on Revenue Streams in Each New England State and Total For New England, 2019 to 2024

	ME	NH	VT	CT	RI	MA	ISO
Lost SBC dollars ($1,000s)							
2019	0	113	0	1,252	1,364	2,430	5,159
2020	0	219	0	2,421	2,640	4,695	9,974
2021	0	318	0	3,511	3,834	6,806	14,469
2022	0	411	0	4,530	4,952	8,774	18,666
2023	0	497	0	5,480	5,998	10,608	22,584
2024	0	579	0	6,368	6,976	12,318	26,240
Total	**0**	**2,137**	**0**	**23,562**	**25,764**	**45,631**	**97,092**
New FCM dollars ($1,000s)							
2019	0	1,084	0	5,799	2,534	14,997	24,414
2020	0	2,100	0	11,211	4,905	28,975	47,191
2021	0	3,049	0	16,264	7,125	42,005	68,443
2022	0	3,938	0	20,980	9,203	54,150	88,271
2023	0	4,770	0	25,383	11,146	65,471	106,770
2024	0	5,549	0	29,492	12,964	76,022	124,027
Total	**0**	**20,490**	**0**	**109,129**	**47,877**	**281,620**	**459,116**

Table 4-9
2014 Forecast of Policy Dollars and Total Budgets for Each New England State and Total for New England, 2019 to 2024 ($1,000s)

Year	ME	NH	VT	CT	RI	MA	ISO
Policy dollars ($1,000s)							
2019	38,768	0	56,230	77,500	0	315,370	487,868
2020	39,737	0	57,763	77,500	0	306,002	481,002
2021	40,731	0	60,572	77,500	0	297,270	476,073
2022	41,749	0	61,497	77,500	0	289,131	469,877
2023	42,793	0	63,124	77,500	0	281,544	464,961
2024	43,863	0	66,247	77,500	0	274,473	462,083
Total	**247,641**	**0**	**365,433**	**465,000**	**0**	**1,763,790**	**2,841,864**
Total budgets ($1,000s)							
2019	34,891	34,817	56,230	233,621	80,753	556,987	997,299
2020	35,764	35,937	57,763	238,632	80,790	560,186	1,009,071
2021	36,658	36,994	60,572	243,403	80,896	563,311	1,021,833
2022	37,574	37,994	61,497	247,896	81,008	566,277	1,032,246
2023	38,513	38,951	63,124	252,169	81,104	569,128	1,042,989
2024	39,476	39,841	66,247	256,171	81,203	571,773	1,054,712
Total	**222,876**	**224,534**	**365,433**	**1,471,892**	**485,754**	**3,387,662**	**6,158,150**

Table 4-10
Production Cost Multiplier, Production Costs ($/MWh), and Ratio of Peak Energy Demand to Annual Use, 2013 to 2024

Year	ME	NH	VT	CT	RI	MA
Production cost multiplier (includes inflation)						
2013	1	1	1	1	1	1
2014	175	175	175	175	175	175
2015	175	175	175	175	175	175
2016	175	175	175	175	175	175
2017	175	175	175	175	175	175
2018	175	175	175	175	175	175
2019	175	175	175	175	175	175
2020	175	175	175	175	175	175
2021	175	175	175	175	175	175
2022	175	175	175	175	175	175
2023	175	175	175	175	175	175
2024	175	175	175	175	175	175
Production costs ($/MWh)						
2013	162	370	334	377	403	392
2014	174	398	359	405	433	421
2015	187	428	386	436	466	453
2016	201	460	415	468	501	487
2017	216	494	446	503	538	524
2018	233	531	480	541	579	563
2019	250	571	515	582	622	605
2020	269	614	554	625	669	650
2021	289	660	596	672	719	699
2022	311	709	640	723	773	752
2023	334	763	688	777	831	808
2024	359	820	740	835	893	869
Peak-to-energy ratio (MW/GWh)	**0.1047**	**0.1506**	**0.1332**	**0.1212**	**0.1597**	**0.1346**

Section 5
Results of New England’s 2014 Energy-Efficiency Forecast

The final EE forecast for 2019 to 2024 projects savings in the average, total, and peak demand for the region and each state. The results, which are based on an average annual spending rate among the six states of approximately $900 million per year, show a regional annual average energy savings of 1616 GWh. The forecast for total energy savings from 2019 to 2024 is 9,696 GWh. The states’ annual average energy savings ranges from a low of 58 GWh in New Hampshire to a high of 831 GWh in Massachusetts.

The regional average savings in peak demand is 212 MW. The forecast for total peak savings is 1,274 MW from 2019 to 2024. The states’ annual average peak savings ranges from a low of 9 MW in New Hampshire to a high of 112 MW in Massachusetts. Table 5-1 shows the results of ISO’s final EE forecast for 2019 to 2024. The sections that follow summarize the results of the regional load forecast and the state-level EE forecasts.

Table 5-1
ISO New England’s Final Energy-Efficiency Forecast for 2019 to 2024 (GWh, MW)

Forecast of Electric Energy Savings (GWh)							
Year	Sum of States	States					
		ME	NH	VT	CT	RI	MA
2019	1,867	148	65	116	426	138	976
2020	1,759	141	62	111	404	128	913
2021	1,659	134	59	108	384	119	854
2022	1,560	128	57	102	364	111	799
2023	1,468	122	54	97	344	104	747
2024	1,382	117	52	95	325	96	698
Total	9,696	791	349	628	2,246	696	4,986
Average	**1,616**	**132**	**58**	**105**	**374**	**116**	**831**

Forecast of Peak Demand Savings (MW)							
Year	Sum of States	States					
		ME	NH	VT	CT	RI	MA
2019	246	15	10	15	52	22	131
2020	231	15	9	15	49	20	123
2021	218	14	9	14	47	19	115
2022	205	13	9	14	44	18	108
2023	193	13	8	13	42	17	101
2024	181	12	8	13	39	15	94
Total	1,274	83	52	84	272	111	671
Average	**212**	**14**	**9**	**14**	**45**	**19**	**112**

5.1 Regional Load Forecast

Figure 5-1 shows the annual forecast of energy use, minus both the FCM passive resources projected for 2015 to 2018 and the results of the 2015 energy-efficiency forecast for 2019 to 2024. The figure shows essentially no long-term growth in electric energy use.

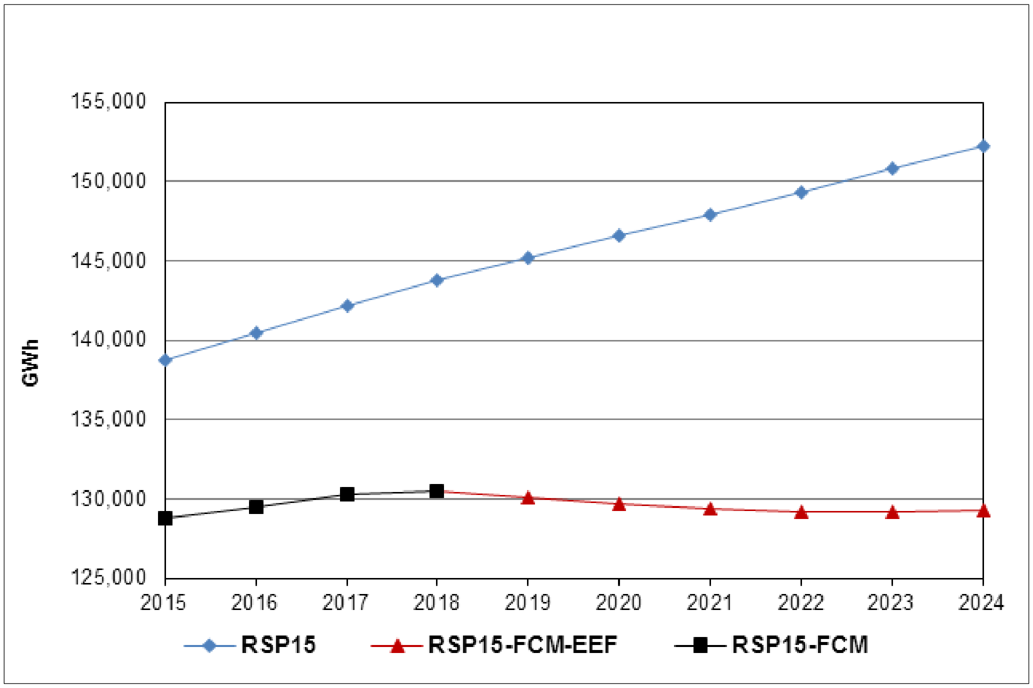

Figure 5-1: Net energy-use load forecast (diamond), net energy-use load forecast minus FCM #9 results through 2018 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2019 to 2024 (GWh).

Figure 5-2 and Figure 5-3 show the 90/10 and 50/50 summer peak forecasts, respectfully, when adjusted for both the existing FCM passive demand resources projected for 2015 to 2018 and the 2019 to 2024 energy-efficiency forecast.[25] The 90/10 summer peak forecast, when adjusted for both the existing FCM PDRs and energy-efficiency forecast, is projected to increase at a more modest rate than the net forecast.

[25] The 50/50 "reference-case" peak loads have a 50% chance of being exceeded because of weather conditions. For the reference case, the summer peak load is expected to occur at a weighted New England-wide temperature of 90.2°F, and the winter peak load is expected to occur at 7.0°F. The 90/10 peak loads have a 10% chance of being exceeded because of weather. For the 90/10 case, the summer peak is expected to occur at a temperature of 94.2°F, and the winter peak is expected to occur at a temperature of 1.6°F.

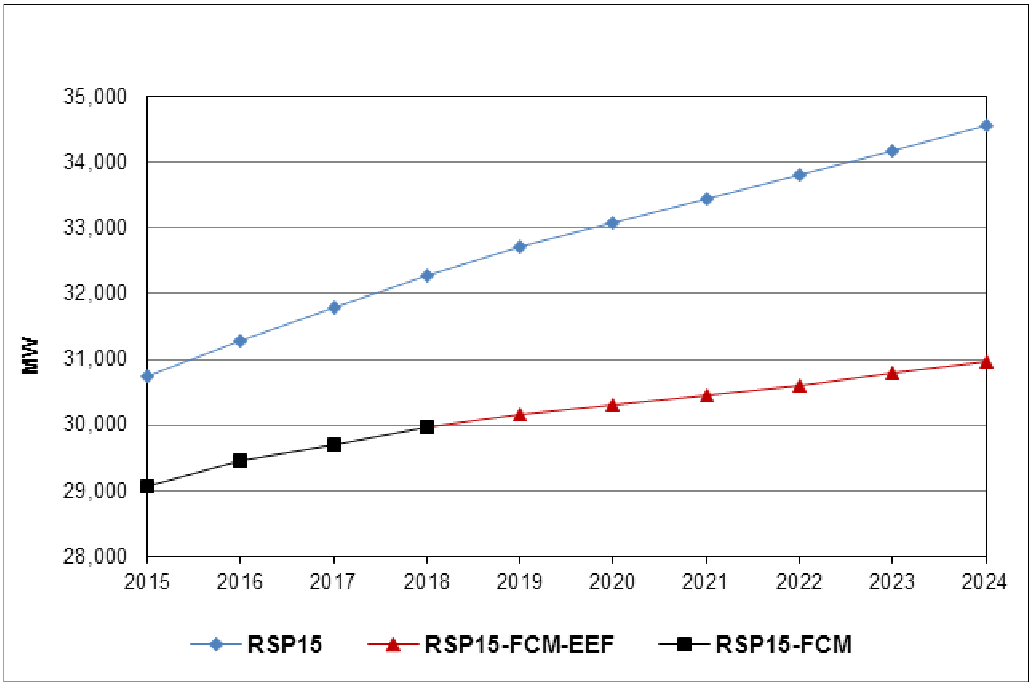

Figure 5-2: Summer peak demand forecast (90/10) (diamond), load forecast minus FCM #9 results through 2018 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2019 to 2024 (MW).

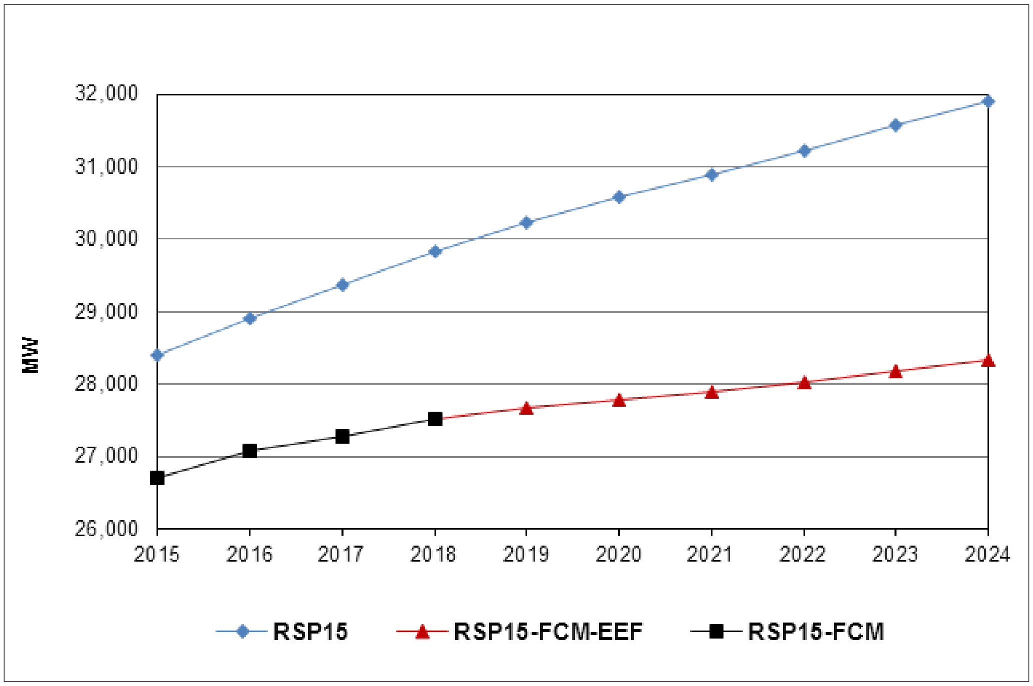

Figure 5-3: Summer peak demand forecast (50/50) (diamond), load forecast minus FCM #9 results through 2018 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2019 to 2024 (MW).

The gross compound annual growth rate (CAGR) for the ISO's summer peak demand, for 2014 through 2023, is 1.3%.[26] The gross CAGR for the ISO's electric energy use for the same period is 1%. When EE resources are subtracted from these projections, the CAGR for 2014 to 2023 is 0.7% for summer peak demand and 0.1% for energy use.

Figure 5-4 and Figure 5-5 show the 90/10 and 50/50 winter peak demand forecasts, respectfully, when adjusted for both the existing FCM passive demand resources projected for 2015 to 2018 and the 2019 to 2024 energy-efficiency forecast.[27]

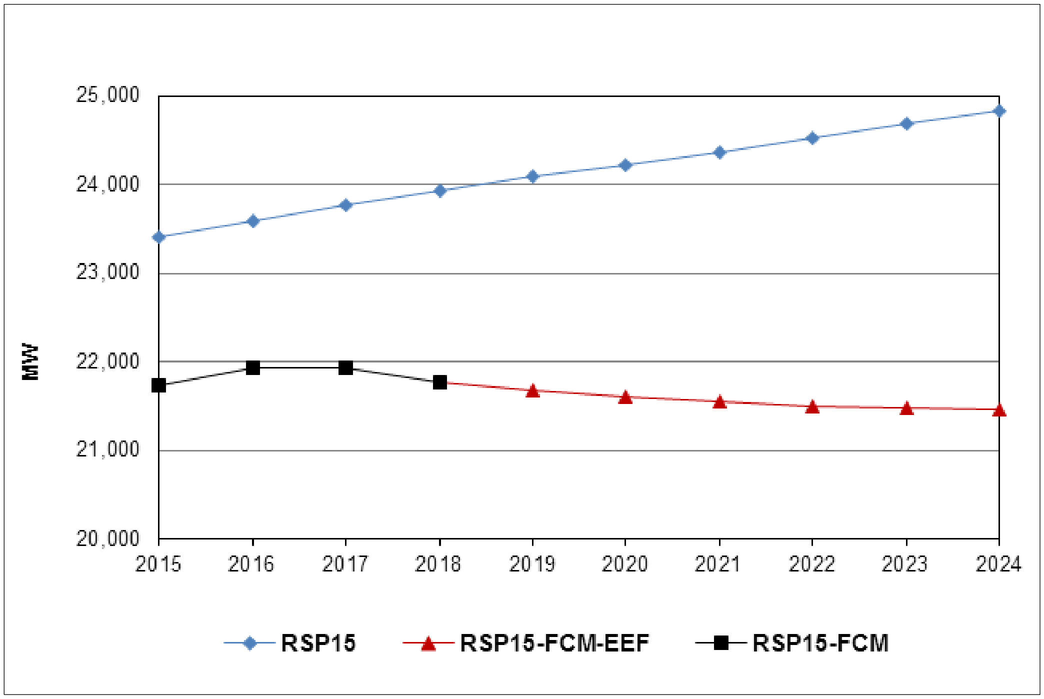

Figure 5-4: Winter peak demand forecast (90/10) (diamond), load forecast minus FCM #9 results through 2018 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2019 to 2024 (MW).

[26] The compound annual growth rate is calculated as follows:

$$\text{Percent CAGR} = \left\{ \left[\left(\frac{\text{Peak in Final Year}}{\text{Peak in Initial Year}} \right)^{\left(\frac{1}{\text{Final Year} - \text{Initial Year}} \right)} - 1 \right] \times 100 \right\}$$

ISO New England, *2014 CELT/RSP ISO-NE, State, Subarea, and Load Zone Energy and Seasonal Peak Forecast 2014-2023*, PAC presentation (April 29, 2014), http://www.iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/pac/mtrls/2014/apr292014/a7_2014_2023_state_energy_and_peak_forecast_update.pdf.

[27] Winter EE savings and reductions to the winter load forecast are based on the ratio of summer to winter FCM cleared capacity from FCA-#9 and not PA performance data as reported for the 2015 EE forecast.

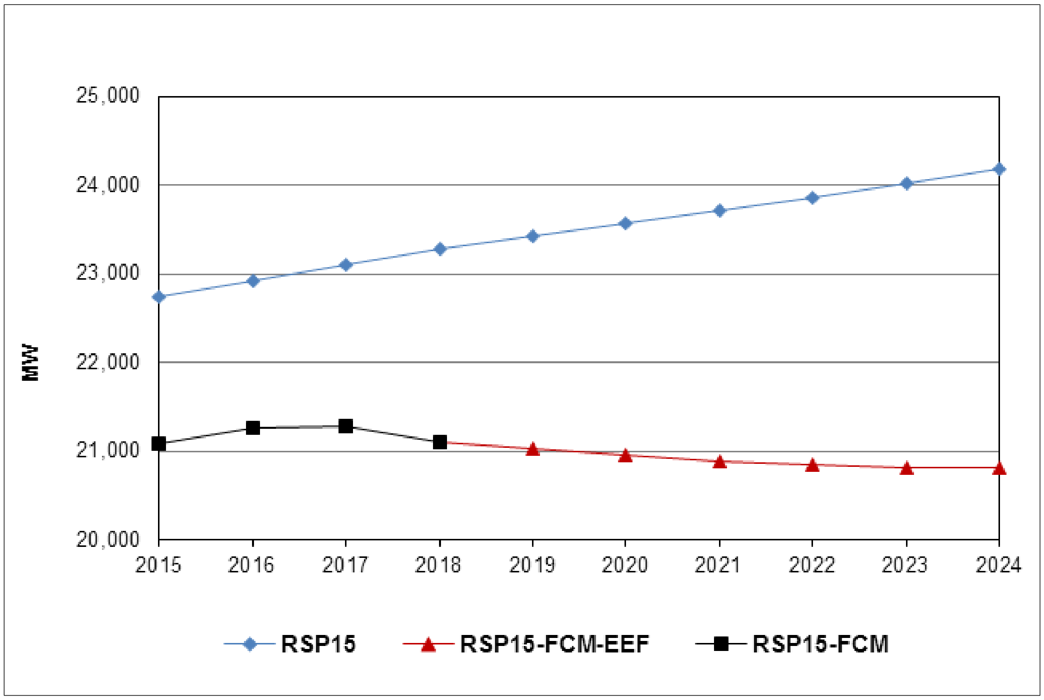

Figure 5-5: Winter peak demand forecast (50/50) (diamond), load forecast minus FCM #9 results through 2018 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2019 to 2024 (MW).

The gross CAGR for the ISO's winter peak demand, for 2015 through 2024, is 0.7%. The gross CAGR for the ISO's electric energy use for the same period is 0.7%. When EE resources are subtracted from these projections, the CAGR for 2015 to 2024 is minus 0.1% for winter peak demand and 0.0% for energy use.

5.2 State-Level EE Forecasts

The ISO developed an EE forecast for each state in New England. Given that each state funds its EE programs somewhat differently, the inputs to the forecast model for each state reflect these differences. For example, Massachusetts implemented new policies in 2011 designed to achieve all cost-effective EE. This resulted in large increases in EE budgets. The resulting influx of funds has outpaced the state's capability to use all the funds, with a spend rate of only 80% on average. The ISO addressed these unique issues in the assumptions described for each state, including the model input and the rationale for the use of the assumption. The following are the state-level assumptions that may vary across the regional model:

- **Budget basis:** planned or rate based
- **Budget uncertainty rate:** applied to rapidly changing portfolios
- **Production cost basis:** average of historical production costs
- **Production cost escalation rate:** estimated change in delivery cost due to technology and penetration rates plus inflation
- **Ratio of peak energy demand to the annual use of electric energy:** average of historical ratio

- **Additional budgetary items:** alternative revenue sources, state redirection of budget model components (e.g., SBC, RGGI, FCM, policy)

The following figures (Figure 5-6 to Figure 5-17) represent the energy-efficiency forecast for both energy use (GWh) and peak demand (MW) for each New England state. EE programs can be expected to cause electric energy usage in Vermont, Maine, and Rhode Island to decline by 2024 to levels below those that are expected in 2015.

5.2.1 Connecticut

The state-level assumptions used for Connecticut are as follows:

- Budget: based on commission-approved 2014 budget
- Budget uncertainty rate: none
- Production cost: based on average of 2011–2013 PA data
- Production cost escalation rate: 5% + 2.5% inflation
- Peak-to-energy ratio: based on average of 2011–2013 PA data
- Increased budget dollars due to an all-cost-effective policy

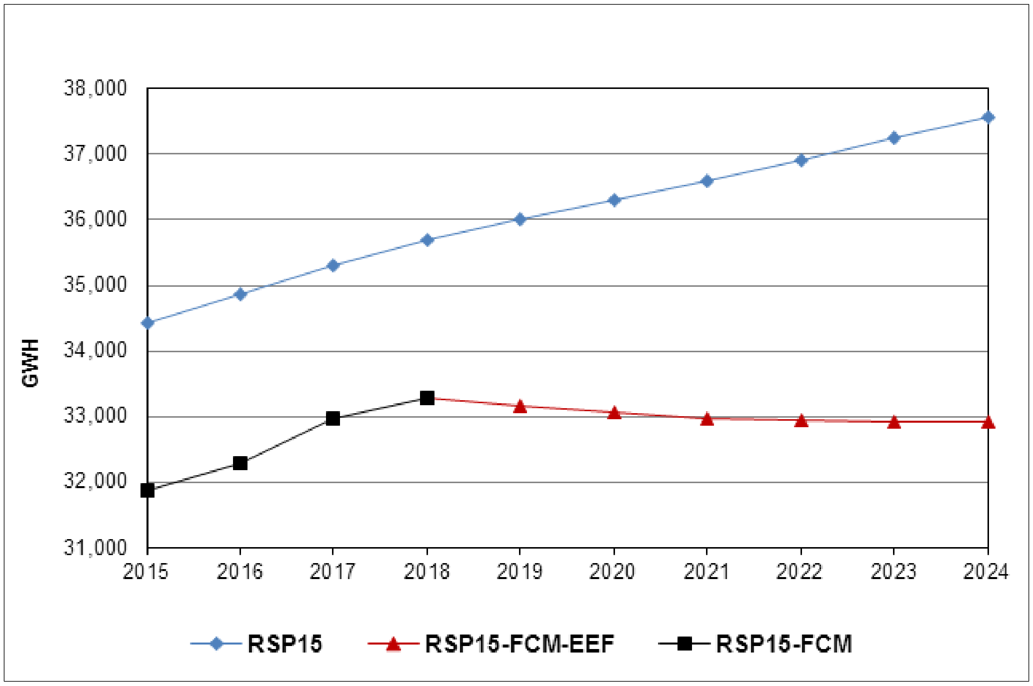

Figure 5-6: Net energy-use load forecast for Connecticut (diamond), net energy-use load forecast minus FCM #9 results through 2018 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2019 to 2024 (GWh).

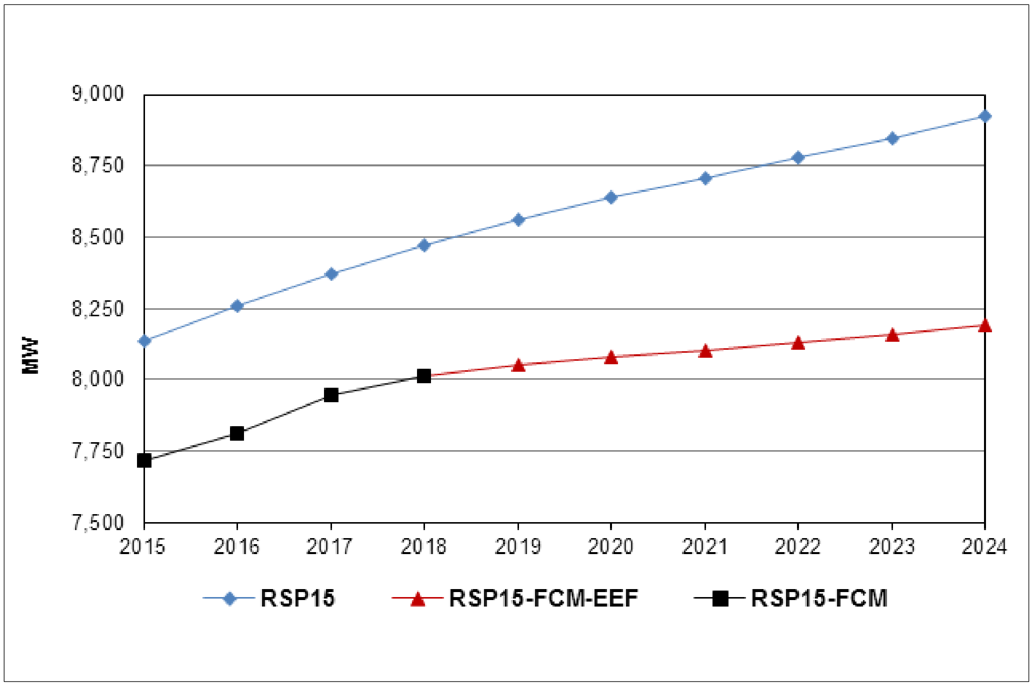

Figure 5-7: Summer peak demand forecast (90/10) for Connecticut (diamond), load forecast minus FCM #9 results through 2018 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2019 to 2024 (MW).

5.2.2 Massachusetts

The state-level assumptions used for Massachusetts are as follows**:**

- Budget: based on commission-approved 2013-15 budget
- Budget uncertainty rate: 10%
- Production cost: based on average of 2011–2013 PA data
- Production cost escalation rate: 5% + 2.5% inflation
- Peak-to-energy ratio: based on average of 2011–2013 PA data

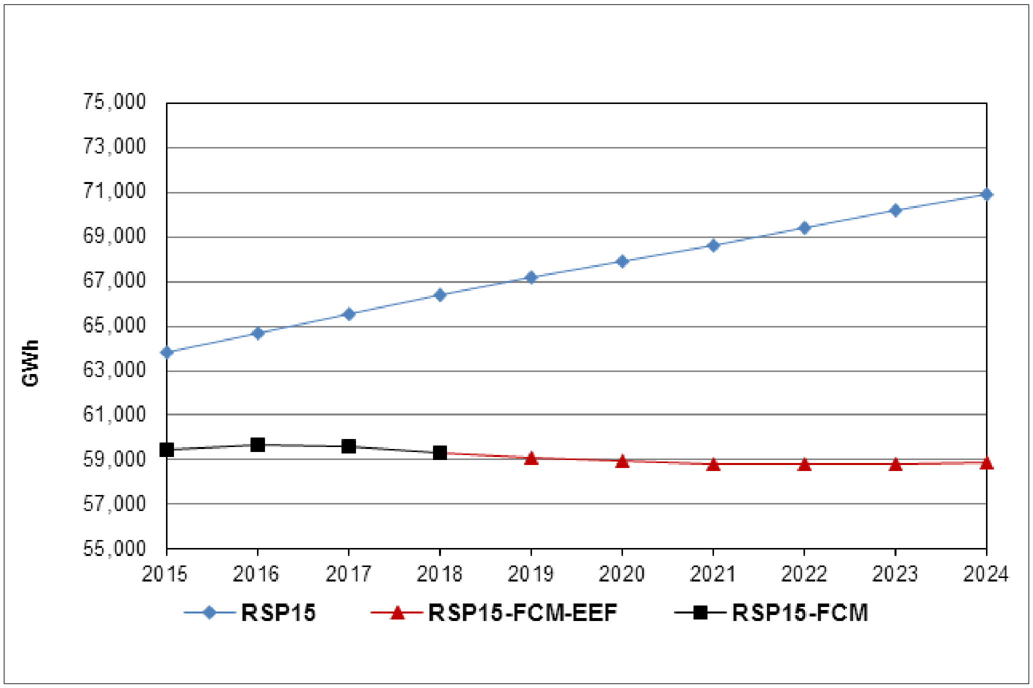

Figure 5-8: Net energy-use load forecast for Massachusetts (diamond), net energy-use load forecast minus FCM #9 results through 2018 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2019 to 2024 (GWh).

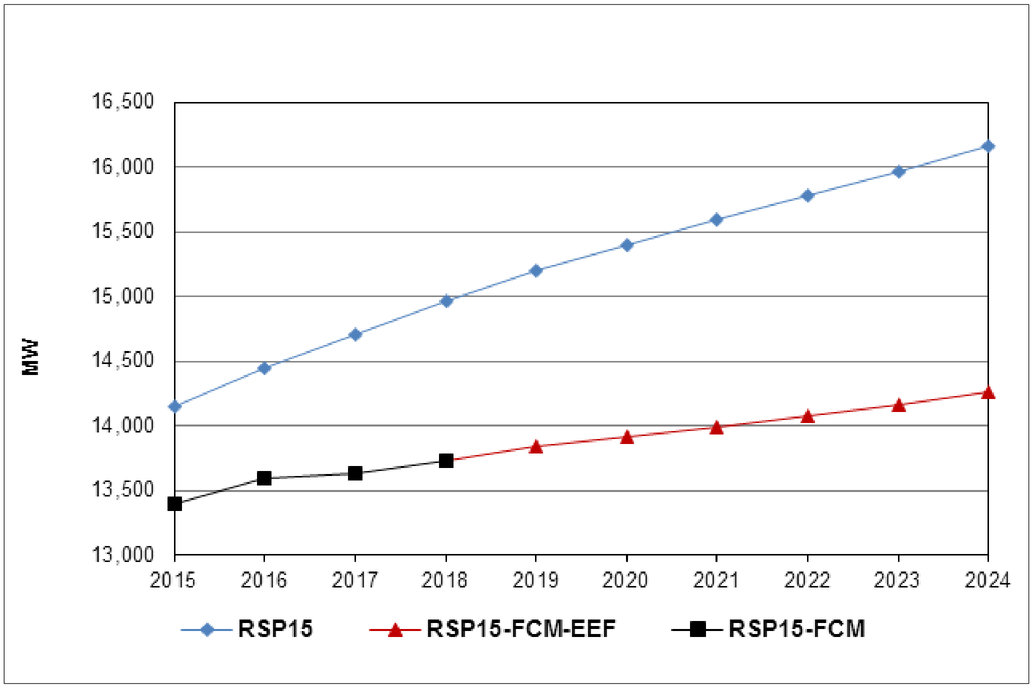

Figure 5-9: Summer peak demand forecast (90/10) for Massachusetts (diamond), load forecast minus FCM #9 results through 2018 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2019 to 2024 (MW).

5.2.3 Maine

The state-level assumptions used for Maine are as follows:

- Budget: based on commission-approved 2014–2016 budget
- Budget uncertainty rate: 10%
- Production cost: based on average of 2011–2013 PA data[28]
- Production cost escalation rate: 5% + 2.5% inflation
- Peak-to-energy ratio: based on average of 2014–2016 budget

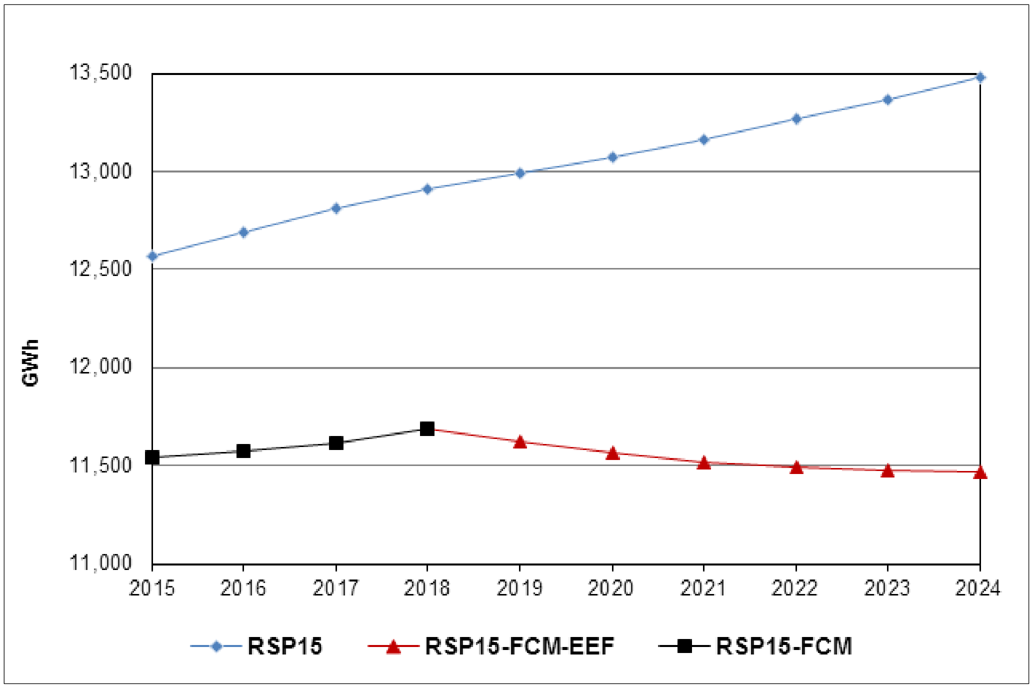

Figure 5-10: Net energy-use load forecast for Maine (diamond), net energy-use load forecast minus FCM #9 results through 2018 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2019 to 2024 (GWh).

[28] In the 2014 EE forecast for 2018 to 2023, the ISO used the 2014 to 2016 budget to establish the production cost due to proposed significant changes in funding and projected cost. Subsequent to the 2014 EE forecast, the Maine budget changed again significantly and the prior year's approach no longer seemed appropriate. As such, the 2015 EE forecast uses the same approach for Maine as is applied to all other PAs.

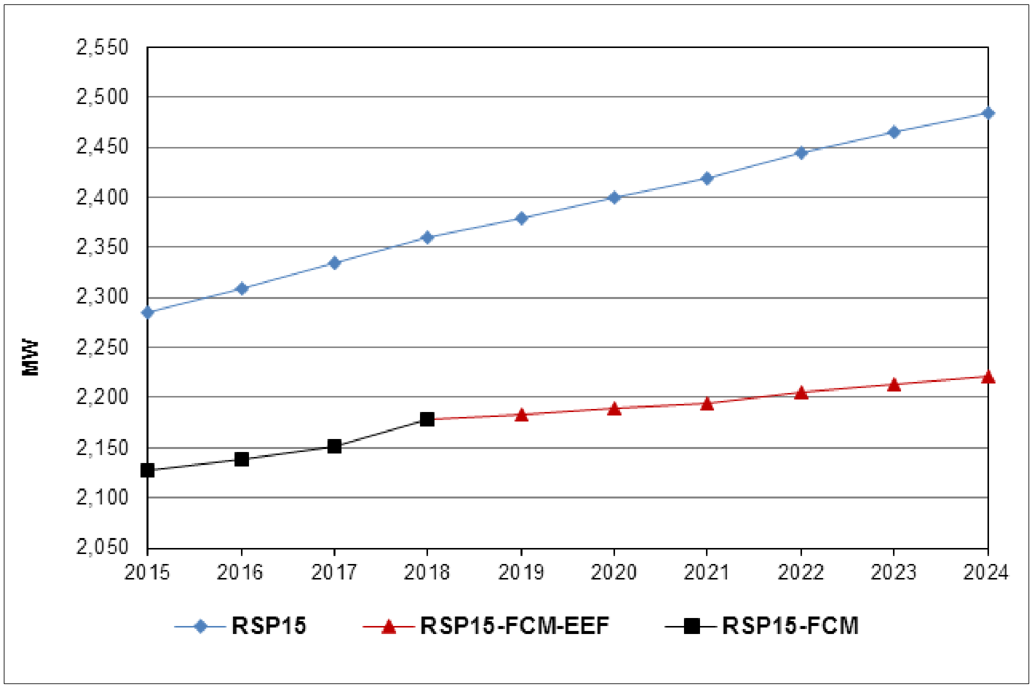

Figure 5-11: Summer peak demand forecast (90/10) for Maine (diamond), load forecast minus FCM #9 results through 2018 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2019 to 2024 (MW).

5.2.4 New Hampshire

The state-level assumptions used for New Hampshire are as follows:

- Budget: based on commission-approved 2015 to 2016 budget
- Budget uncertainty rate: none
- Production cost: based on average of 2011 to 2013 PA data
- Production cost escalation rate: 5% + 2.5% inflation
- Peak-to-energy ratio: based on average of 2011 to 2013 PA data

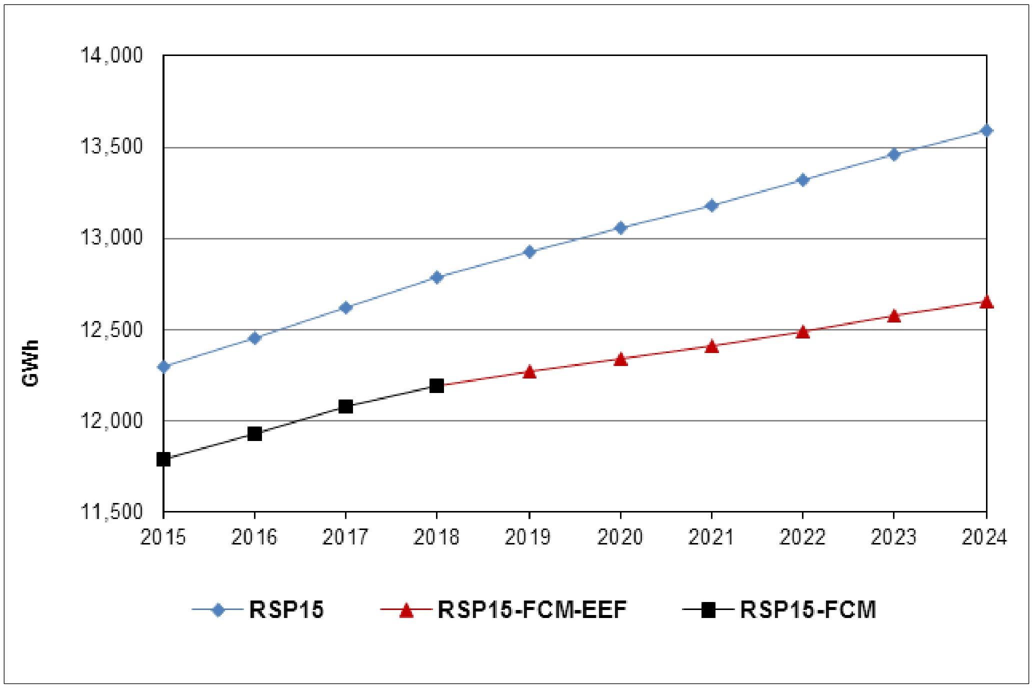

Figure 5-12: Net energy-use load forecast for New Hampshire (diamond), net energy-use load forecast minus FCM #9 results through 2018 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2019 to 2024 (GWh).

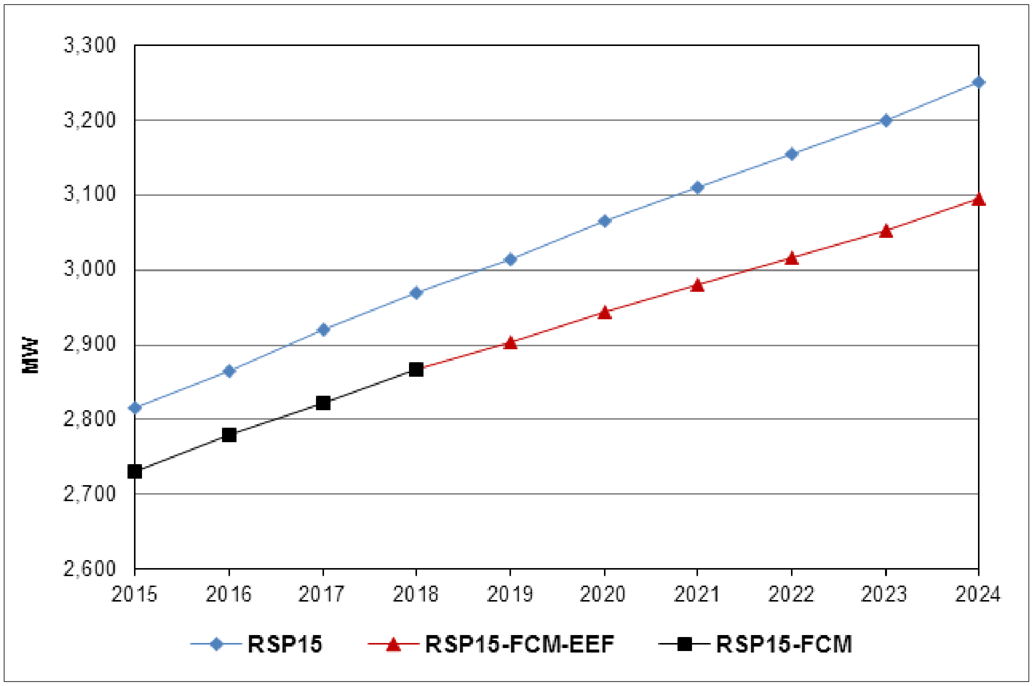

Figure 5-13: Summer peak demand forecast (90/10) for New Hampshire (diamond), load forecast minus FCM #9 results through 2018 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2019 to 2024 (MW).

5.2.5 Rhode Island

The state-level assumptions used for Rhode Island are as follows:

- Budget: based on commission-approved 2015 to 2016 budget
- Budget uncertainty rate: 10%
- Production cost: based on average of 2011 to 2013 PA data
- Production cost escalation rate: 5% + 2.5% inflation
- Peak-to-energy ratio: based on average of 2011 to 2013 PA data

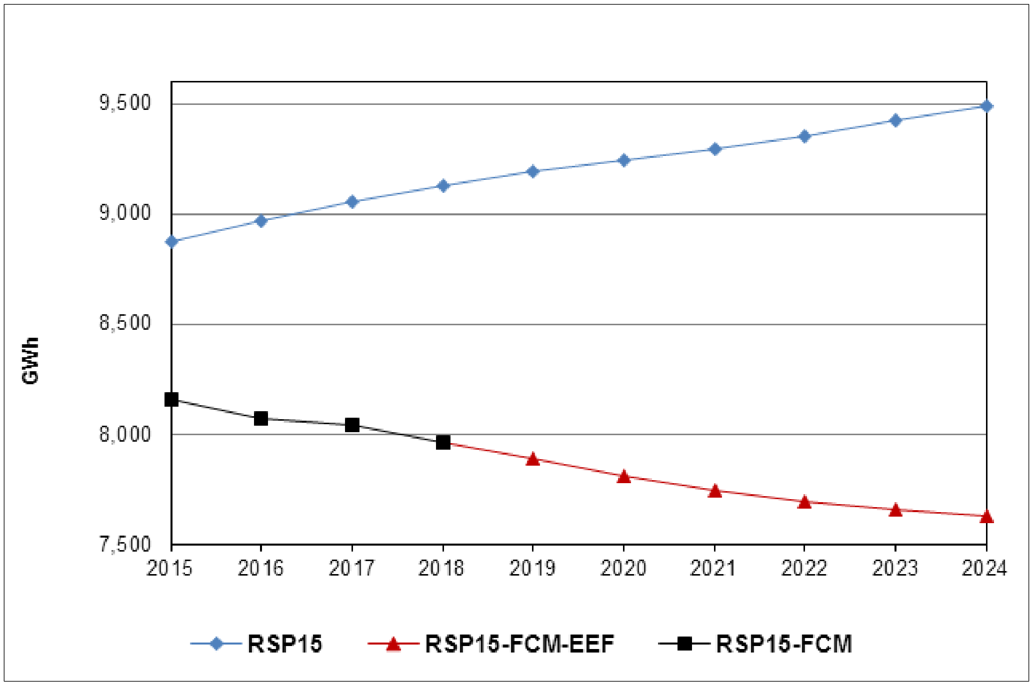

Figure 5-14: Net energy-use load forecast for Rhode Island (diamond), net energy-use load forecast minus FCM #9 results through 2018 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2019 to 2024 (GWh).

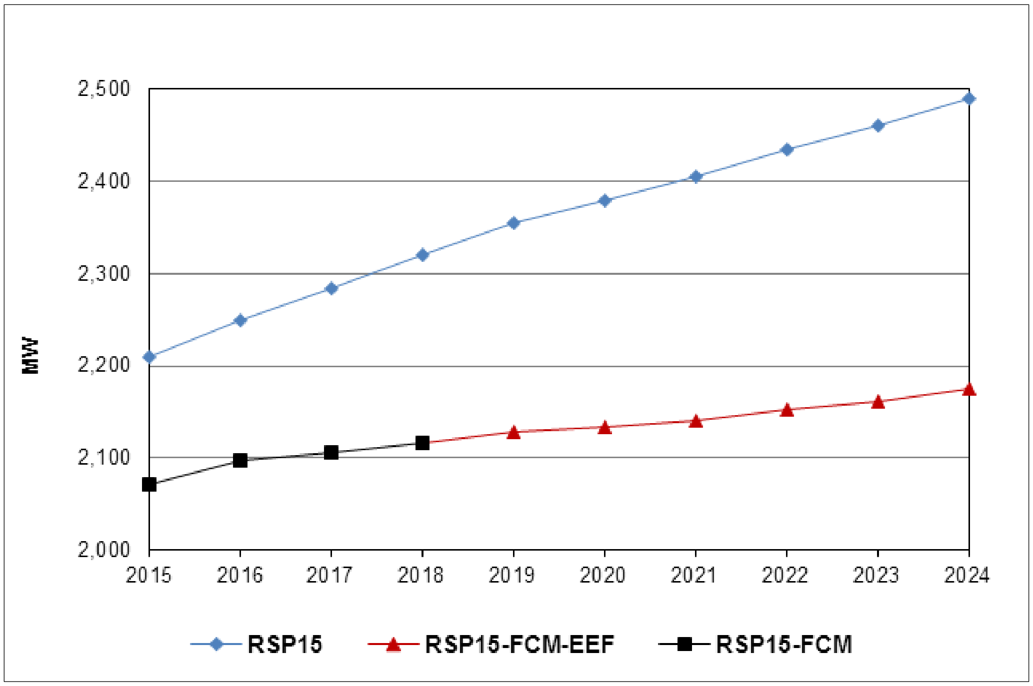

Figure 5-15: Summer peak demand forecast (90/10) for Rhode Island (diamond), load forecast minus FCM #9 results through 2018 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2019 to 2024 (MW).

5.2.6 Vermont

The state-level assumptions used for Vermont are as follows:

- Budget: based on commission-approved 2014 to 2024 budget
- Budget uncertainty rate: none
- Production cost: based on average of 2011 to 2013 PA data
- Production cost escalation rate: 5% + 2.5% inflation
- Peak-to-energy ratio: based on average of 2011 to 2013 PA data

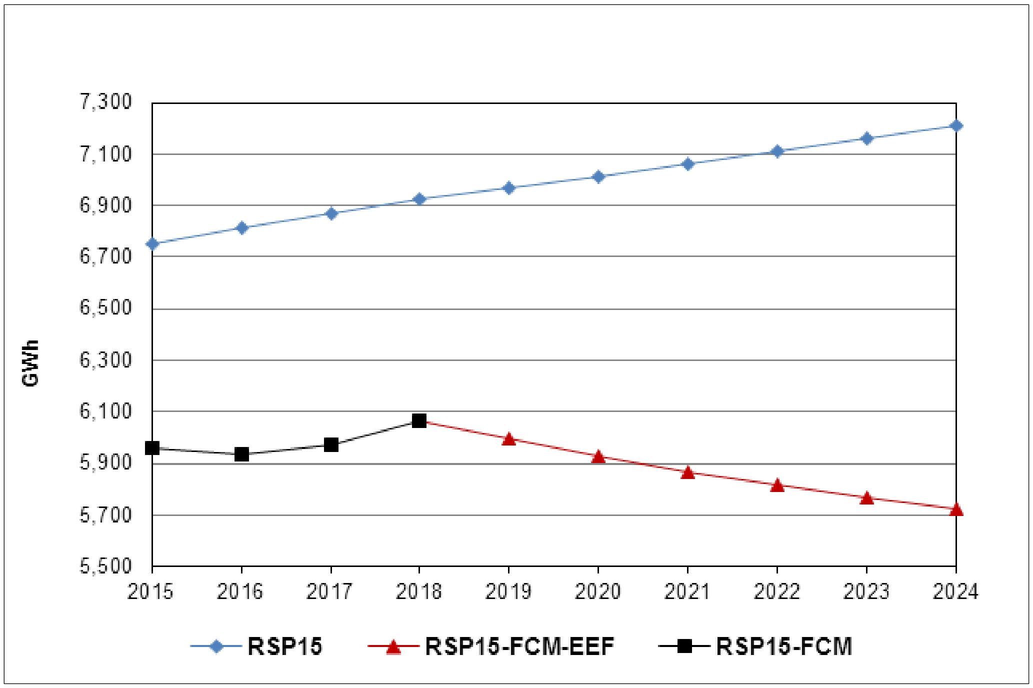

Figure 5-16: Net energy-use load forecast for Vermont (diamond), net energy-use load forecast minus FCM #9 results through 2018 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2019 to 2024 (GWh).

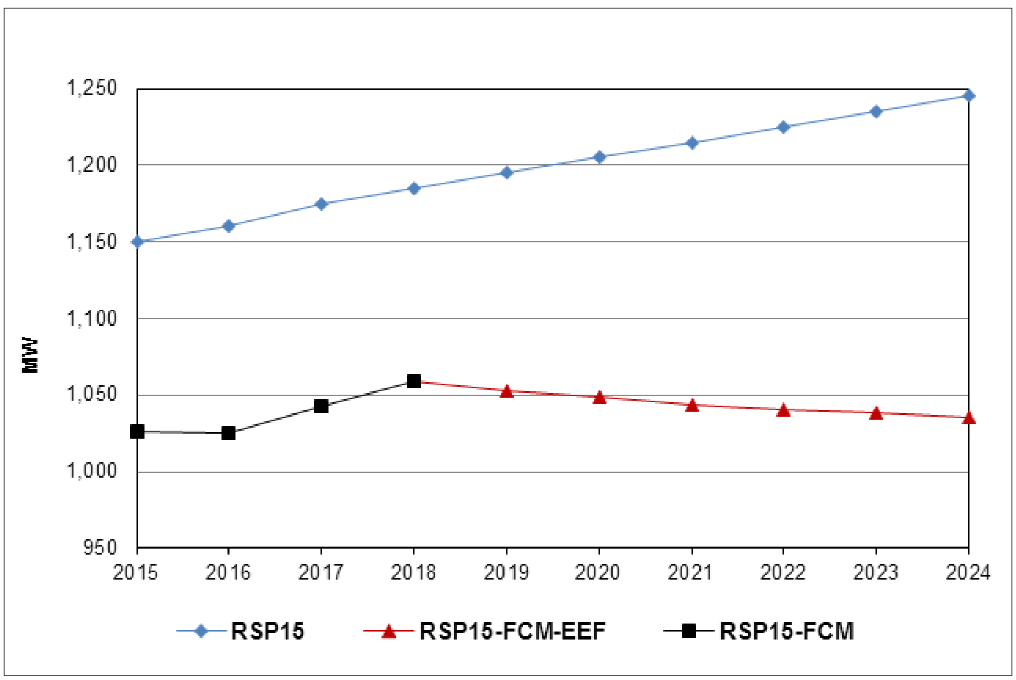

Figure 5-17: Summer peak demand forecast (90/10) for Vermont (diamond), load forecast minus FCM #8 results through 2018 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2019 to 2024 (MW).

Section 6
Appendix B: Energy-Efficiency Measure Data

Program data collected by the ISO captured the relative contributions of energy, demand, and dollars spent for each of the broad classes of measures described above. The following graphs reflect the percentage reductions for each measure type over the past three program years with the data further broken down by class. These data in aggregate provide a clear depiction of the relative contributions of the programs' energy-efficiency measures and the relationships between investment and performance.

When the data are aggregated, energy-efficiency measures in lighting continued to drive the energy savings in the region over the past three years and at lower cost relative to other types of savings. Lighting measures also delivered higher energy and demand savings relative to the dollar investment. HVAC is notably the second-greatest fraction of program cost but with markedly different values relative to demand and energy savings. Process measures, which are mostly deployed in the commercial/industrial sector, had a high ratio of demand savings relative to total program cost. Refrigeration and motors, pumps, and variable-frequency drives have similar characteristics as HVAC but resulted in less than a third of the HVAC impacts. Refer to Figure 6-1.

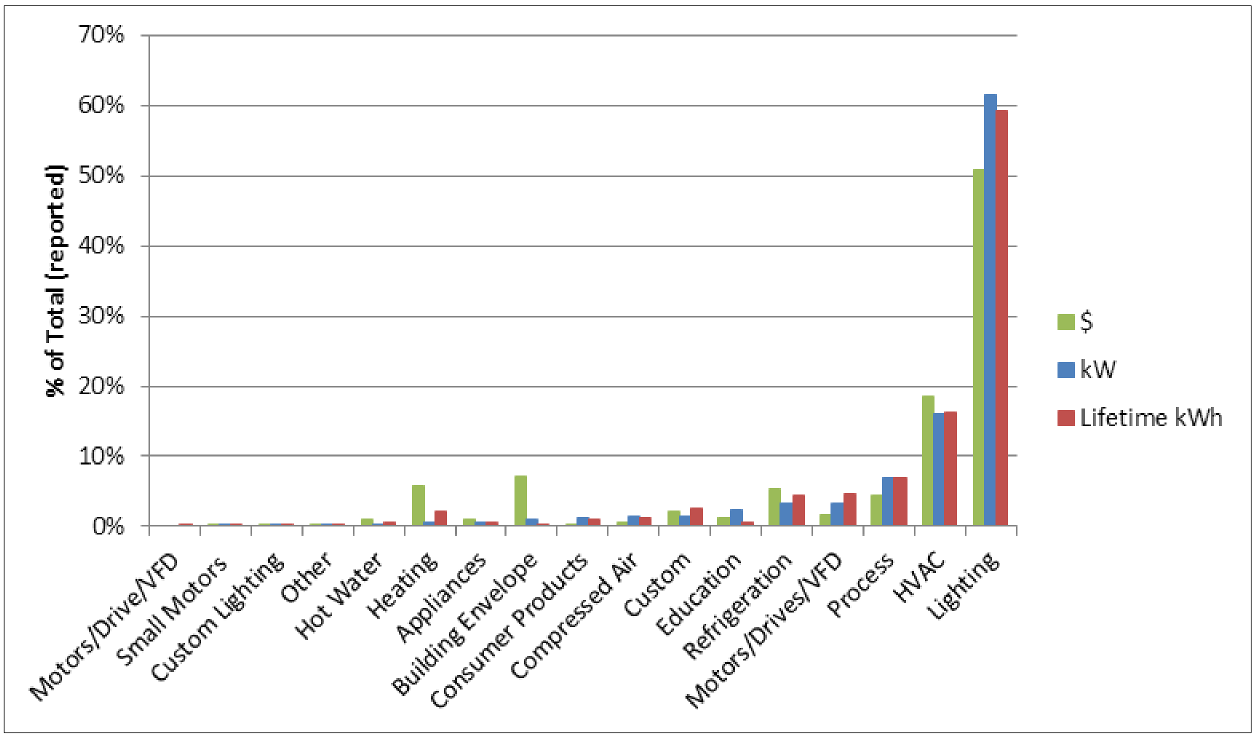

Figure 6-1: Percentage of costs ($), demand (kW), and lifetime energy reduction (kWh), for each type of energy-efficiency measure used by programs in the New England states, total for 2009 to 2013.

The energy impacts of the efficiency measures, shown by class in Figure 6-2, follow the general trends described above. Notably, 80% of the energy savings in the residential sector are from measures to make lighting more efficient, while the cost for implementation is only 50% of the residential budget. HVAC, process improvements, and motors, in this order, show the next-greatest impacts behind lighting in the commercial/industrial sector. Heating, HVAC, and hot water follow lighting in the low-income sector. While refrigeration appears to show a large savings in the low-income sector, the data appear to be disproportionately high relative to the other sectors and should be discounted. In general, the magnitude of energy savings in the low-income sector is very small relative to the residential and commercial/industrial sectors when considering the entire portfolio (3% for low-income, compared with 24% for residential and 72% for commercial/industrial).

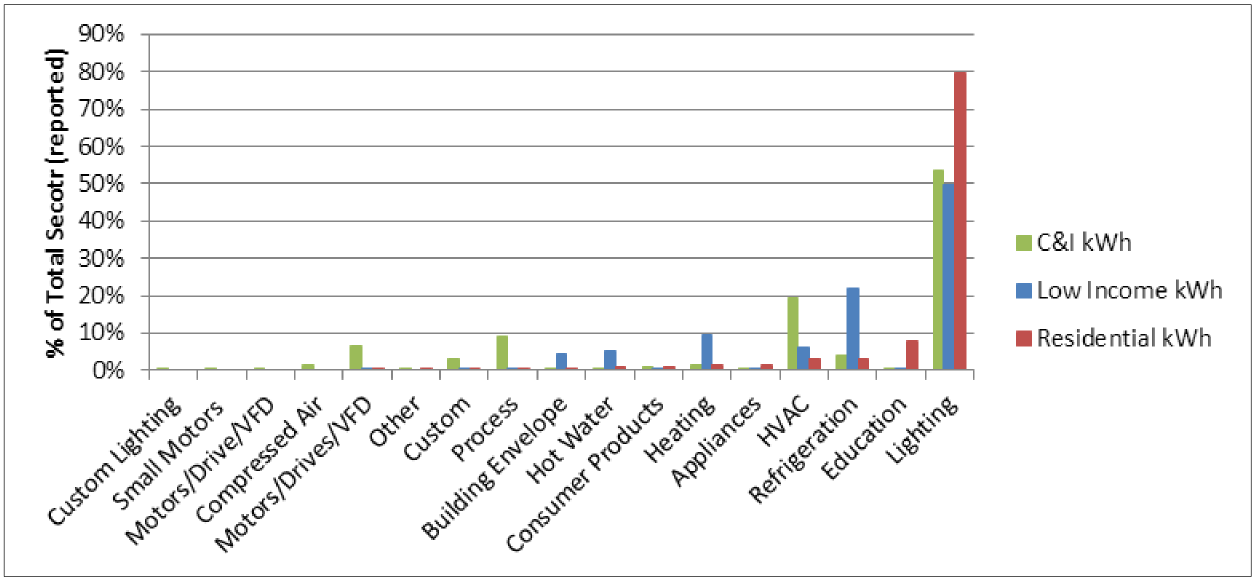

Figure 6-2: Percentage of annual energy use (kWh) in New England, by type of energy-efficiency measure and sector, total for 2009 to 2013.

As shown in Figure 6-3, the savings in demand exhibited by each of the efficiency measures had patterns similar to the savings in energy use, relative to the sector distributions. Lighting clearly dominated the demand savings in all sectors but notably is over 90% of the residential savings. Given the implementation of the federal *2007 Energy Policy Act* standards for lighting mostly implemented in 2014, the ISO assumes that the relative savings contribution of lighting may decrease in the residential sector in the near term, while HVAC, heating, and cooling may increase.[29] These technologies would be supported by the deployment of heat pumps and heat-pump water heaters. Demand savings in the commercial/industrial sector were also heavily dependent on lighting, followed by process improvements, HVAC, and education—the latter supported by building operator certification (BOC) and best-practices training on industrial technologies.

[29] *Energy Policy Act of 2005*, Pub. L. 109-58, Title XII, Subtitle B, 119 Stat. 594 (2005) (amending the *Federal Power Act* to add a new § 216).

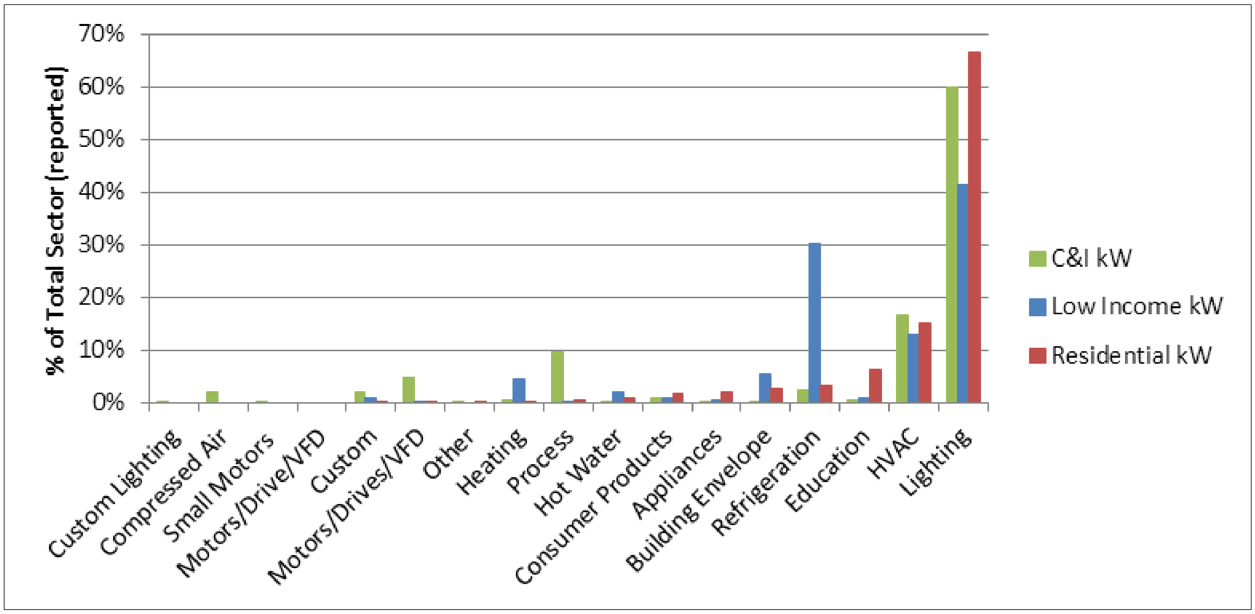

Figure 6-3: Percentage of demand (kW) in New England, by type of energy-efficiency measure and sector, total for 2009 to 2013.

The distribution of program funding across the measures also follows the general trends described above and shown in Figure 6-4. However, investments in the low-income sector appear to focus more on building envelope and heating measures than the residential and commercial/industrial sectors. Lighting clearly uses the majority of funds in all sectors. However, as previously noted, lighting's low relative cost investment, for saving both energy and demand, results in lower overall program costs. As lighting investment changes in response to lighting standards, the overall cost to deliver the portfolio will likely change, as well.

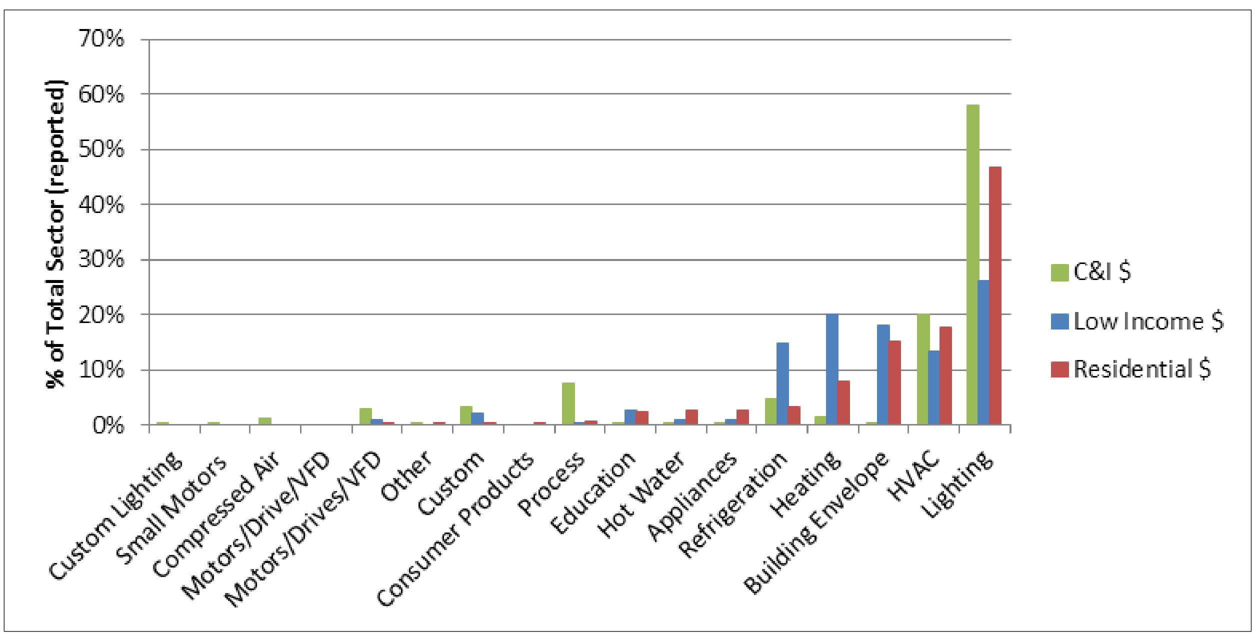

Figure 6-4: Percentage investment ($) in energy-efficiency measures in New England, by type of measure and sector, total for 2009 to 2013.

6.1 State-Level Measure Trends

The following representations (Figure 6-5 to Figure 6-10) illustrate trends in the contribution to energy savings at the state level for each type of measure. The date indicated for each state reflects the availability of the data collected for this forecast and the prior years. While the data set is not complete, the general magnitude of particular measures and the relationship from year to year are reasonable but not undisputable.

6.1.1 Connecticut

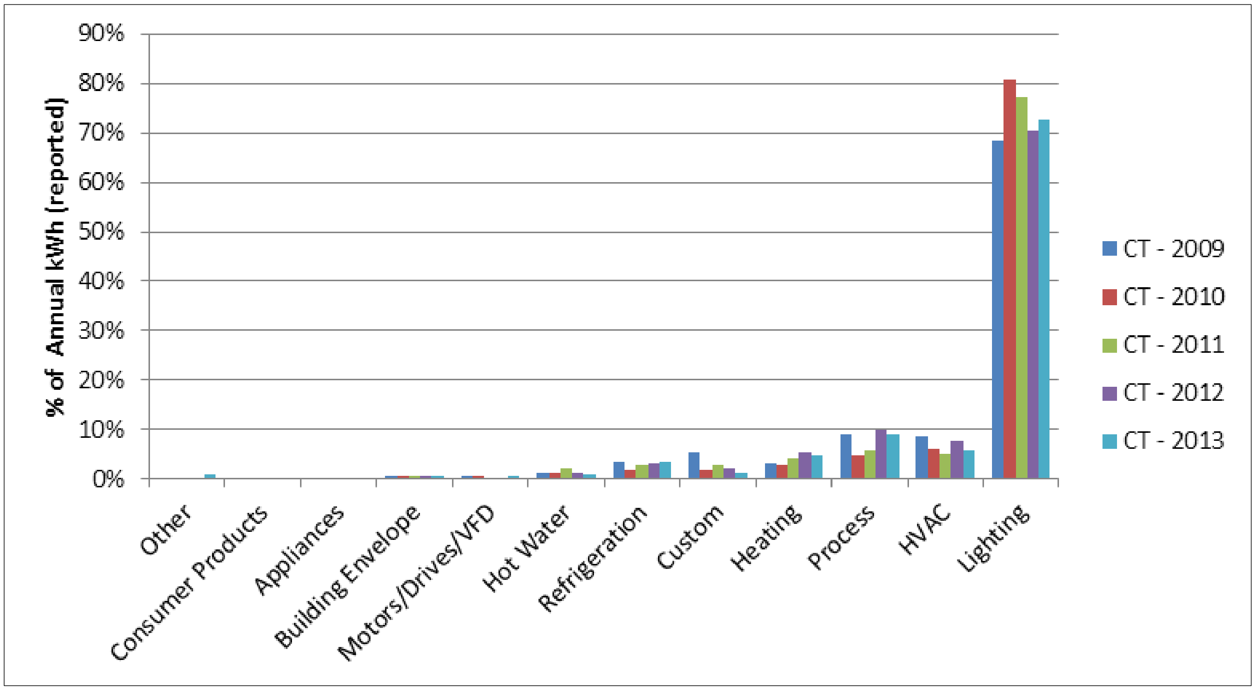

Figure 6-5: Percentage contributions to energy savings (kWh) in Connecticut by various measures, 2009 to 2013.

6.1.2 Massachusetts

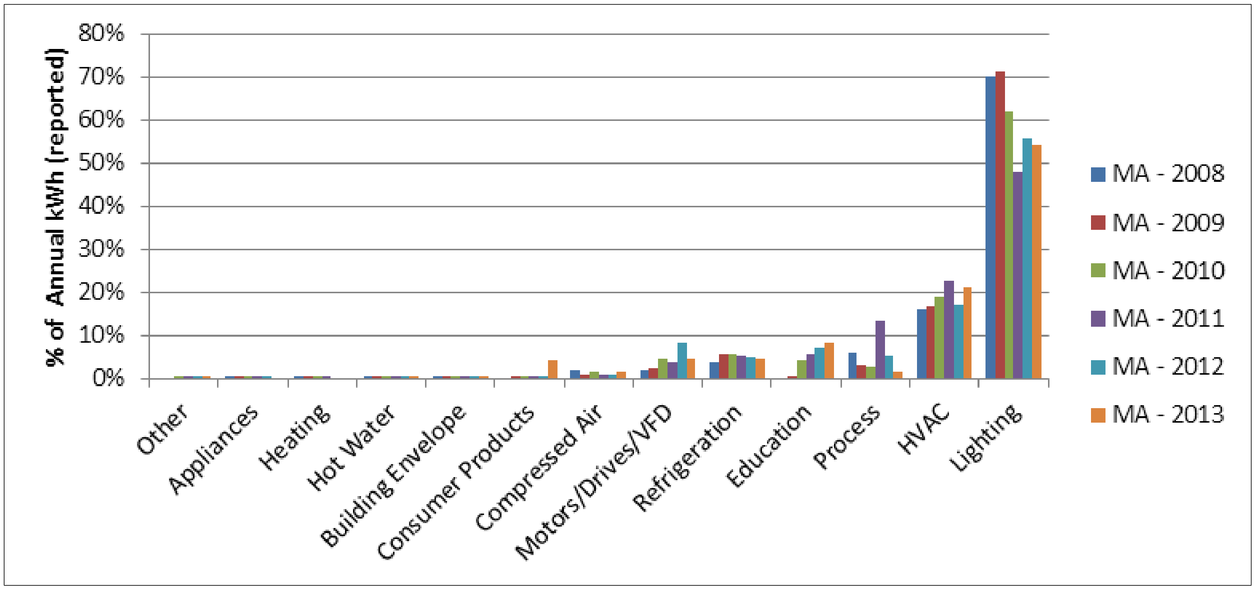

Figure 6-6: Percentage contributions to energy savings (kWh) in Massachusetts by various measures, 2008 to 2013.

6.1.3 Maine

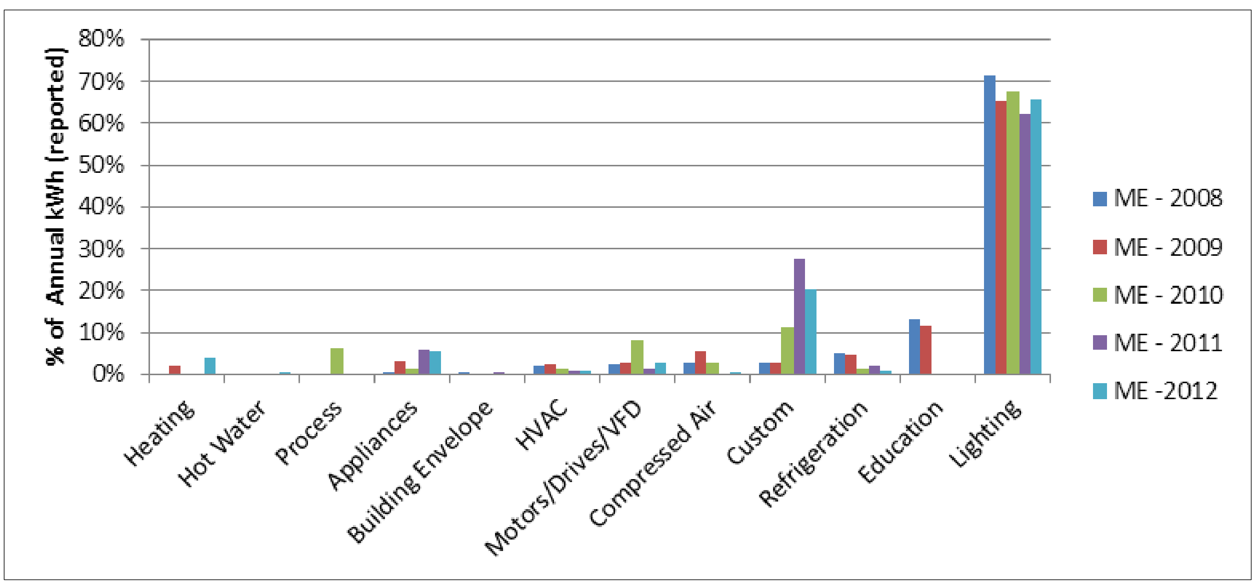

Figure 6-7: Percentage contributions to energy savings (MWh) in Maine by various measures, 2008 to 2012.

6.1.4 Rhode Island

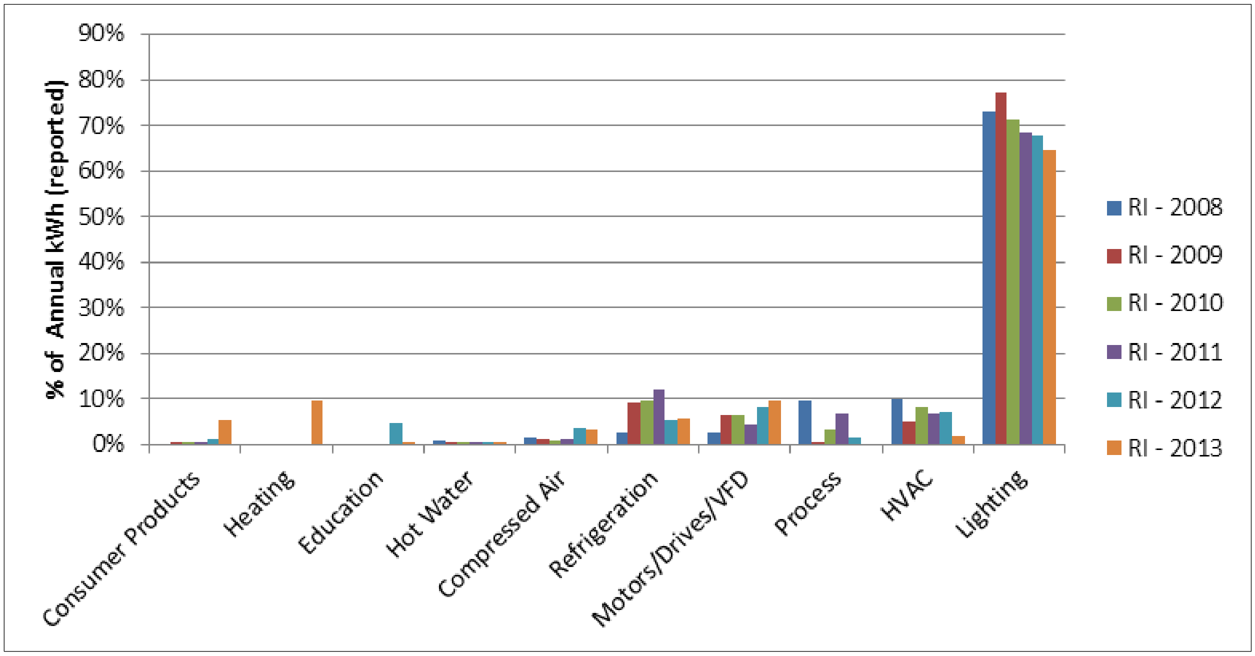

Figure 6-8: Percentage contributions to energy savings (kWh) in Rhode Island by various measures, 2008 to 2013.

6.1.5 New Hampshire

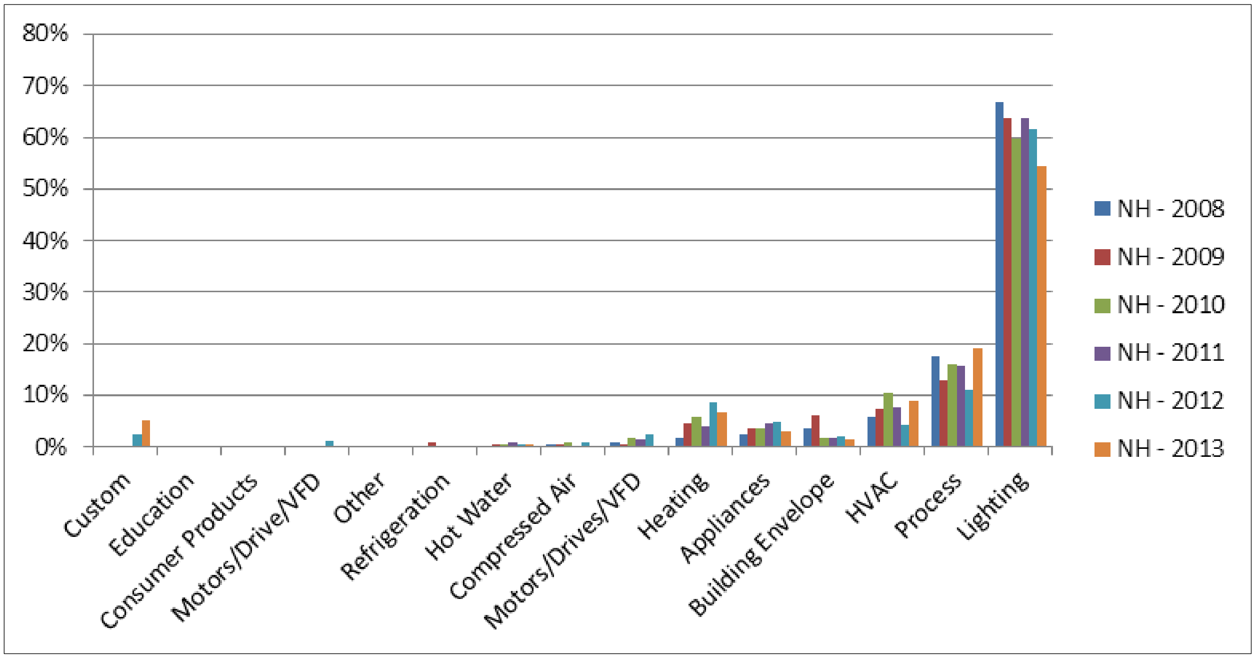

Figure 6-9: Percentage contributions to energy savings (MWh) in New Hampshire by various measures, 2008 to 2012.

6.1.6 Vermont

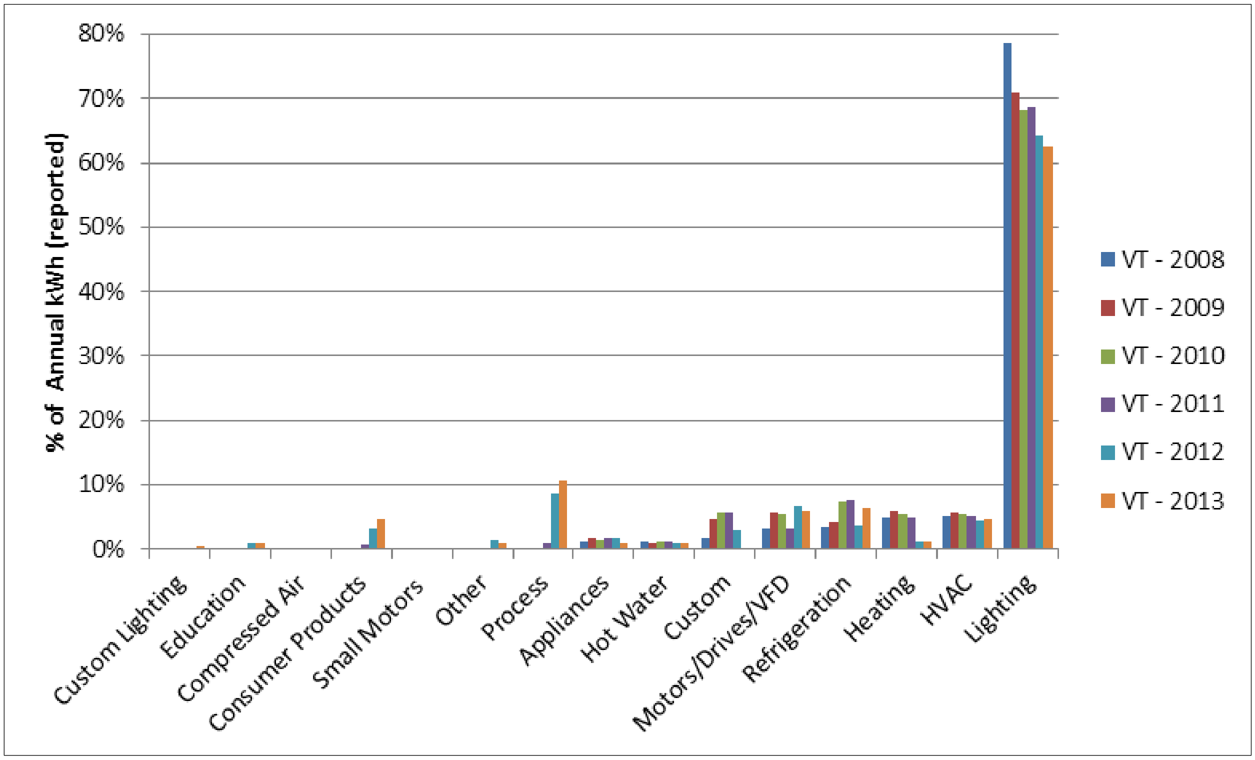

Figure 6-10: Percentage contributions to energy savings (MWh) in Vermont by various measures, 2008 to 2013.

6.2 Production Cost Savings by Energy-Efficiency Measure

Production cost data were calculated for each type of energy-efficiency measure for the latest production year, 2013. Data were available for each New England state except Rhode Island but not for all measure types. Table 6-1 and Table 6-2 illustrate the relative dollar cost of each measure per megawatt-hour and per kilowatt, respectively, and the cost differences. These values reflect total costs for program measures plus any attributable, unallocated portfolio costs divided by savings for all periods.[30] Missing values indicated in the tables reflect either missing data on the percentage of costs within a program for a particular measure (percentage dollars cost) or zero savings.

[30] Attributable unallocated portfolio costs include costs from programs that have no reported savings and are shared across programs that have savings proportional to energy or cost contribution, depending on the type of spending.

Table 6-1
Net Annualized Production Costs for 2013 Reported Energy-Efficiency Measures for Each New England State (Sum of $/MWh)

Energy-Efficiency Measure	State[a]					
	CT	ME	MA	NH	RI	VT
Appliances	784	326	-	1,328	-	780
Building envelope	3,592	-	13,208	5,225	-	-
Compressed air	-	234	144	-	-	-
Consumer products	-	-	-	-	-	238
Custom	1,310	146	-	-	-	-
Custom lighting	-	-	-	-	-	222
Education	-	-	67	-	-	1,084
HVAC	819	288	291	350	-	401
Heating	1,596	1,090	-	1,049	-	1,121
Hot water	352	1,090	517	193	-	807
Lighting	339	112	181	231	-	340
Motors/drives/VFD[b]	301	136	21	162	-	242
Other	468	-	-	151	-	634
Process	246	-	602	219	-	156
Refrigeration	413	87	238	403	-	547

(a) "-" reflects no cost estimate due to missing cost data for percentage dollars.

(b) VFD refers to variable frequency drives.

Table 6-2
Cost Based on Net Annualized Savings for 2013 Reported Energy-Efficiency Measures for Each New England State ($/kW)

Energy-Efficiency Measure	State[a]					
	CT	ME	MA	NH	RI	VT
Appliances	3,889	3,136	-	4,195	-	7,294
Building envelope	28,235	-	338,858	65,577	-	-
Compressed air	-	1,967	723	-	-	-
Consumer products	-	-	-	-	-	2,060
Custom	5,373	1,634	-	-	-	-
Custom lighting	-	-	-	-	-	1,034
Education	-	-	438	-	-	18,943
HVAC	2,541	1,703	2,488	1,120	-	2,973
Heating	142,357	5,556	-	753,368	-	24,512
Hot water	9,486	5,556	3,829	1,850	-	6,042
Lighting	3,043	1,049	1,201	1,903	-	2,518
Motors/drives/VFD	4,690	1,318	109	5,100	-	1,696
Other	5,761	-	-	-	-	12,382
Process	1,537	-	5,331	2,440	-	1,724
Refrigeration	4,548	1,087	2,240	4,154	-	6,062

(a) "-" reflects no cost estimate due to missing cost data for percentage dollars.

As shown in Table 6-1, the 2013 data available from the states, as represented in the 2015 forecast for 2019 to 2024, are not conclusive and do not illustrate any trends in the costs of energy-efficiency measures by state.[31] Rather, they illustrate the relative magnitude of the production cost differences across the different types of measures within the programs and across the states. The states that had the most complete data sets—CT, NH, and VT—tended to have the highest overall costs.

The costs based on net annualized savings, as shown in Table 6-2, exhibit wide variation across the states. Some of the notable costs indicated in this table, including those with costs in excess of $100,000/MW, are more likely artifacts of singular projects with relatively low savings compared with the overall portfolio. Refer to Table 4-4 and Table 4-10 for state-level historical production costs and EE forecast production costs, respectively, to compare overall portfolio costs and savings by state.

The lack of a complete data set and the limited trends reflected in the data prevented the ISO from drawing any conclusions. A more complete data set would support the ISO's making better comparisons and identifying trends in the measures used by the states compared with changes in cost over time.

[31] The data for prior years, not presented in this report, showed that lighting measures tended to have lower production costs, while building envelope and heating measures had the highest production costs. The *Initial Energy-Efficiency Forecast 2017–2023—Measure Data Analysis* (February 11, 2014) is available at http://www.iso-ne.com/static-assets/documents/committees/comm_wkgrps/othr/enrgy_effncy_frcst/2014mtrls/iso_ne_prelim_2014_ee_measures_2017_2023_final_2_21_14.pdf.