ISO New England
Energy-Efficiency Forecast Report
for 2018 to 2023

ISO New England Inc.
System Planning

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Disclaimer

ISO New England (ISO) has been developing the energy-efficiency forecast (EEF) 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, state regulators and other stakeholders. We wish to thank all of those people who provided input to the process. The principal authors also wish to specifically acknowledge the contributions New England States Committee on Electricity in promoting this process and supporting the effort.

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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 2018 to 2023.

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.

The ISO's first EE forecast was completed in 2012 and projected the savings in energy use and peak demand in the 2015 to 2021 timeframe. The second EE forecast covered 2016 to 2022. These forecasts were finalized in presentation materials provided to the EEFWG and other stakeholder groups, such as the Planning Advisory Committee. For the 2018 to 2023 EE forecast, the ISO also drafted this written report to provide a greater level of detail for stakeholders.[2]

1.2 EE Forecast Methodology

After researching potential EE forecasting techniques and finding little or no precedents to follow, the ISO created its own 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 knowing 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).

1.3 Results

The EE forecast shows that the 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 Vermont, Maine and Rhode Island declining by 2023 to levels below those expected in 2014. The EE forecast also projects that the impact of 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 1.0% in the baseline load forecast. Similarly, peak demand growth is also slower when the savings from EE measures committed through the FCM and projected future EE measures are factored in, decreasing from 1.3% to 0.7% annually.

The results of the final EE forecast for 2018 to 2023, as shown in Table 1-1, indicate that the region will save about 1,518 gigawatt-hours (GWh) of electric energy per year and about 9,105 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, 2018 to 2023 (GWh)

Year	ME	NH	VT	CT	RI	MA	ISO-NE
2018	142	76	125	401	141	880	1,764
2019	132	73	120	379	132	823	1,658
2020	122	69	117	358	123	769	1,560
2021	114	66	110	338	114	719	1,462
2022	106	63	106	319	106	672	1,373
2023	99	60	102	300	99	628	1,288
Total	**714**	**408**	**681**	**2,096**	**715**	**4,491**	**9,105**
Average	**119**	**68**	**113**	**349**	**119**	**749**	**1,518**

[2] If any differences exist between this written report and the final EE forecast materials contained in final presentation materials for the EEFWG, the latter shall be considered the definitive and controlling version.

To put these energy savings in context, in 2013, the total energy output from the region's generation sources amounted to about 112,040 GWh; thus, the average annual EE energy savings was about 1% of total generation. The savings from EE on average over the forecast timeframe also will be roughly equivalent to the region's wind production in 2013 (1,766 GWh).[3]

The results of the final EE forecast for 2018 to 2023 indicate that the region will reduce peak energy use about 205 MW per year and about 1,233 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, 2018 to 2023 (MW)

Year	ME	NH	VT	CT	RI	MA	ISO-NE
2018	20	12	18	49	22	118	239
2019	19	12	17	46	20	111	225
2020	17	11	17	44	19	104	211
2021	16	11	16	41	18	97	198
2022	15	10	15	39	16	90	186
2023	14	10	14	37	15	85	174
Total	**101**	**66**	**96**	**255**	**111**	**605**	**1,233**
Average	**17**	**11**	**16**	**42**	**18**	**101**	**205**

To put these peak demand savings in context of the New England System, the average annual savings of peak energy use resulting from EE was about 0.6% of the total capacity requirement for the region in 2013, roughly 32,000 MW.

[3] ISO New England, "Energy Sources in New England, 2013," webpage (2014), http://www.iso-ne.com/nwsiss/grid_mkts/enrgy_srcs/index.html.

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.[4] The development of the EE forecast followed a multiyear stakeholder outreach and data-collecting effort spearheaded by the ISO.[5] 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 2018 to 2023, for the region and each New England state.[6] 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.[7]

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.

[4] As defined in Section I of the ISO's Tariff, "Energy Efficiency is installed measures (e.g., products, equipment, systems, services, practices and/or 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 equipment and control systems, envelope measures, operations and maintenance procedures, and industrial process equipment." See http://www.iso-ne.com/regulatory/tariff/sect_1/sect_i.pdf

[5] Background information on the ISO's Regional Energy-Efficiency Initiative is available at http://www.iso-ne.com/committees/comm_wkgrps/inactive/reei/mtrls/index.html.

[6] Additional background information and data that went into the creation of the EE forecast is available at www.iso-ne.com/eefwg/2014.

[7] 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 resulting in the selection of measure type or EE program focus.

Generally, the state public utilities commissions (PUCs) are responsible for approving EE program scope, costs, and implementation.[8] Investor-owned utilities, "efficiency" utilities, and community-choice aggregators often serve as program administrators and manage the state-sponsored EE programs.[9] 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.[10]

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.[11] In recent years, the New England state-sponsored EE programs have grown to unprecedented levels.[12] 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.[14] Figure 2-1 depicts the trends in EE funding for the six New England states as reported by either PAs or the states.

[8] More specific information about state EE programs is available at http://www.dsireusa.org/index.cfm?EE=1&RE=1.

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

[10] 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, region-wide 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.

[11] 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.

[12] The ISO's *2010 Regional System Plan* (http://www.iso-ne.com/trans/rsp/2010/index.html) provides an overview of the states' legislative authority for EE programs.

[13] See the American Council for an Energy-Efficient Economy's annual scorecard ranking states on their EE programs. In 2013, Massachusetts was ranked first nationally for the third time in a row (http://aceee.org/state-policy/scorecard).

[14] ACEEE, *State Energy Efficiency Scorecard* (2006, 2008, 2009, 2010, 2011, 2012, 2013), http://www.aceee.org/state-policy/scorecard.

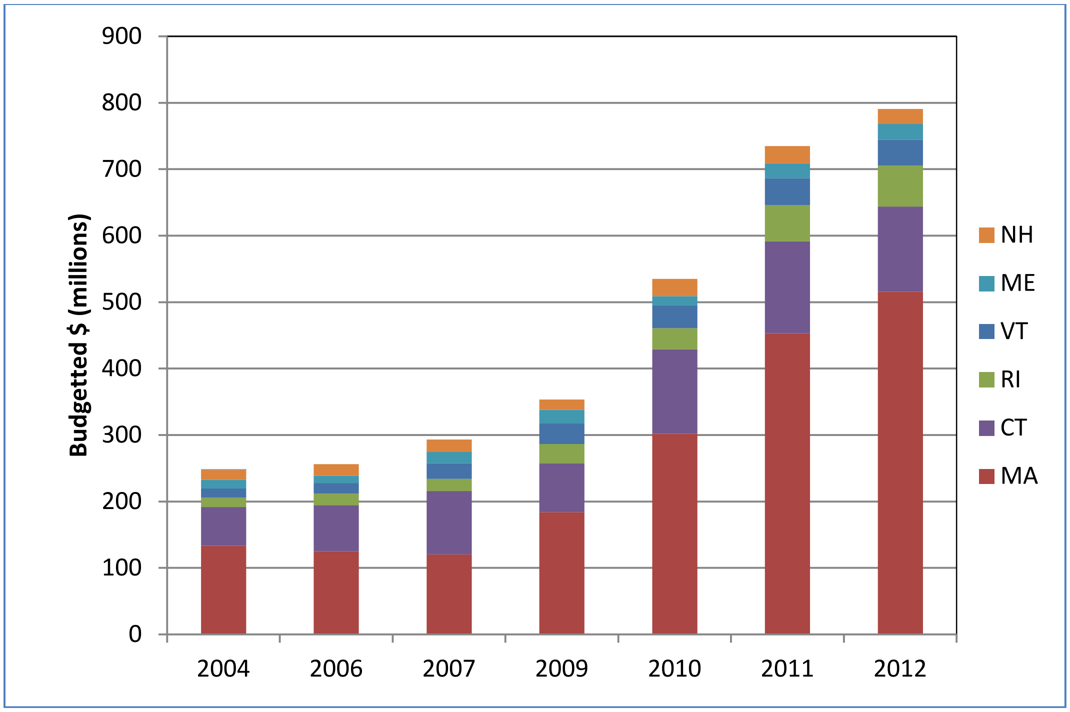


Figure 2-1: Trends in EE funding for the six New England states, 2004 to 2012.

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. These resources were paid according to measured reductions in electricity use. For example, a participant that implemented a lighting upgrade in a factory, replacing older less energy-efficient lights with more energy-efficient lighting, was paid capacity transition payments for the difference in wattage usage.[15] 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.

[15] ISO New England, *2008 Regional System Plan* (October 16, 2008), https://smd.iso-ne.com/trans/sys_studies/rsp_docs/rpts/2008/rsp08_final_101608_full_version.pdf.

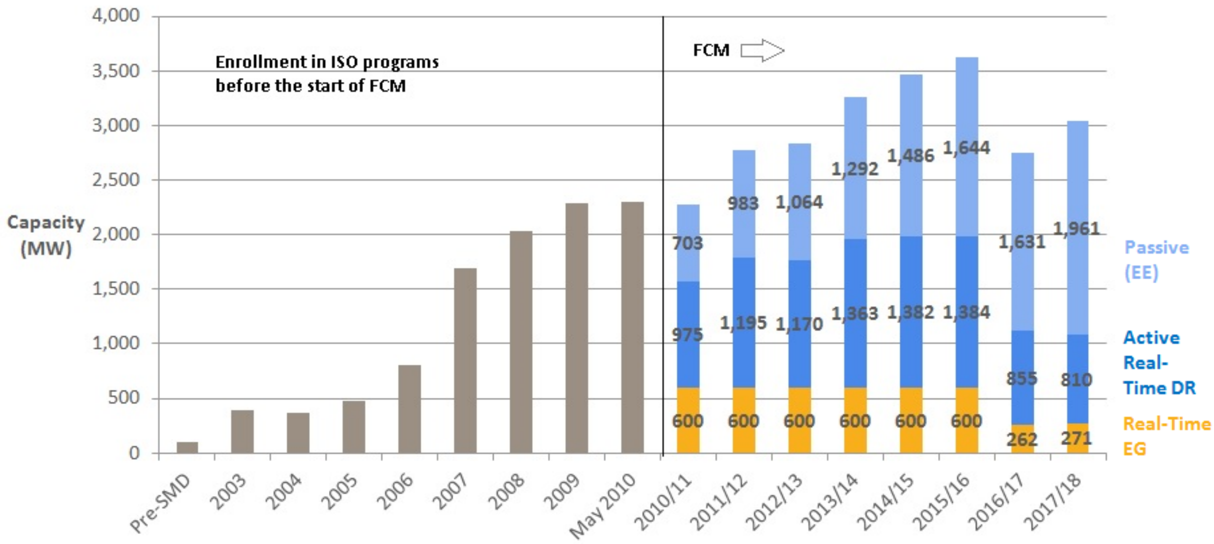


Figure 2-2: Growth of energy efficiency in the Forward Capacity Market (Capacity Supply Obligation - MW)

Notes: "MW" stands *for megawatts*. "Passive EE" refers to *passive demand resources* (PDRs), which reduce electric energy consumption that generation resources would have otherwise served. PDRs include such resources as energy efficiency and "behind-the meter" distributed generation (DG) used on site at locations that have *net metering*, which allows power customers who generate their own electricity to feed their unused electricity back into the grid. "Active Real-Time DR" refers to *active real-time demand response*, which reduces load in response to a request from the ISO for system reliability reasons or in response to a price signal. "Real-Time EG" refers to *real-time emergency generation*, which is DG the ISO calls on to operate during certain voltage-reduction or more severe actions but must limit its operation to 600 MW to comply with the generation's federal, state, or local air quality permit(s) or combination of permits, as well as the ISO's market rules. RTEG operations result in curtailing load on the grid, as the distributed energy provided by the emergency generator begins serving demand.

Given the significant changes that have occurred in the New England EE programs over the past 10 years, some New England states believed that significant EE resources that had been developed as a result of state-sponsored EE programs did not participate in the FCM and were therefore unaccounted for by the ISO.[16] To address this issue, 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.[17] While stakeholders indicted that other non-regulated entities may be engaged in deploying EE through performance contracts, these projects were small relative to the state-funded programs. Consequently, the projections of EE in the ISO's planning process only focus on state-sponsored EE programs.

2.3 Development of the Energy-Efficiency Forecast

In addition to the one-to-four-year planning timeframe of the FCM, the ISO routinely plans and forecasts energy and demand looking 10 years into the future, but grid planners had assumed constant levels of EE in the long-term planning, four to 10 years out. This resulted in the planning assumption that there would be no additional growth in EE beyond the FCM. Concerned that the presumption of constant levels of future EE, beyond the FCM horizon, would not capture the

[16] Tim Woolf, *Accounting for Energy Efficiency Programs in Regional Load Forecasts*, presentation (Massachusetts Department of Public Utilities, December 16, 2010), http://www.iso-ne.com/committees/comm_wkgrps/prtcpnts_comm/pac/mtrls/2010/dec162010/ma_dpu_pac_efficiency_forecasts.ppt.

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

anticipated growth in EE resources from year to year, stakeholders and the ISO investigated possible methods to forecast future savings in the annual and peak use of electric energy from EE programs.

Beginning in 2009, the ISO and the region's energy-efficiency stakeholders conducted an intensive, multiyear research, data-collection, and analysis process resulting in a comprehensive assessment of historical spending on EE programs by PAs.[18] The study analyzed EE programs and studied how to model incremental, future long-term EE savings for four to 10 years into the future. This deliberate and analytic effort advanced the anecdotal understanding of EE to empirical knowledge about production costs, spend rates, realization rates, and performance at the program level. The result of this effort was a fully vetted approach to accounting for future EE investment and savings and the nation's first regional (multistate) long-term forecast of energy efficiency. The current EE forecast now equips system planners and stakeholders with reliable information about the long-term impacts of state-sponsored EE programs.[19]

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.[20] 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 on EE programs to the ISO and then validate the data after the ISO has analyzed it. 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.

[18] Past Regional System Plans report on the ISO's efforts to understand the role of EE. See RSP10, Section 8.4 (October 28, 2010), http://www.iso-ne.com/trans/rsp/2010/index.html, and RSP11, Section 4 (October 21, 2011), http://www.iso-ne.com/trans/rsp/2011/index.html.

[19] "Final ISO-NE Forecast of EE 2105–2012" (April 11, 2012), http://www.iso-ne.com/committees/comm_wkgrps/othr/enrgy_effncy_frcst/index.html.

[20] More information on the EEFWG is available at www.iso-ne.com/eefwg and http://www.iso-ne.com/committees/comm_wkgrps/othr/enrgy_effncy_frcst/index.html.

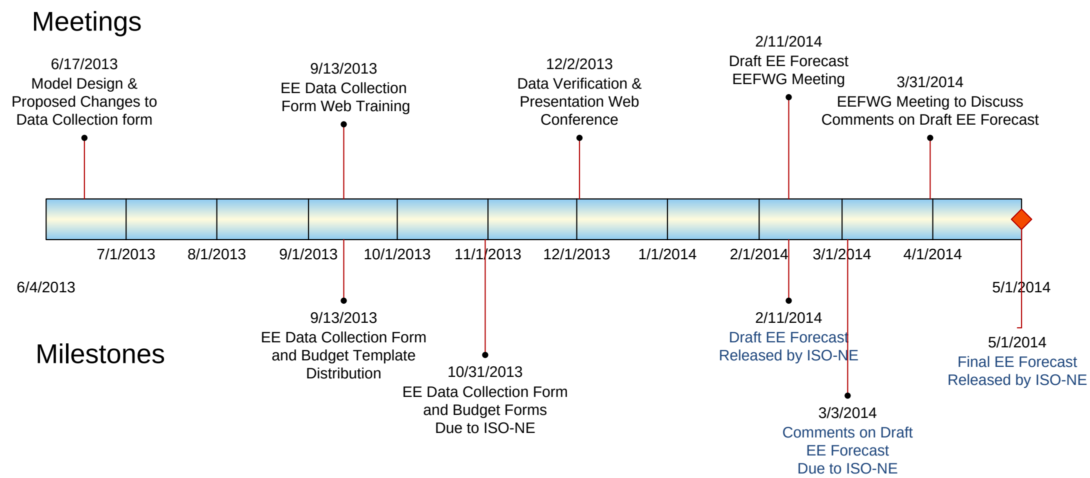


Figure 2-3: Timeline for the development of the energy-efficiency forecast.

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.[21] 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.[22]

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 EEFWG ensures that the most current and accurate information is available for the EE forecast. 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:

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

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

[22] 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.

Where:

- Budget $ is an estimate of the dollars to be spent on EE ($).
- BU is budget uncertainty (%).
- $/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 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 are expanding rapidly. To reflect the uncertainty regarding whether or not these states will be able to meet these newly expanded EE goals, the ISO discounted the budget for Massachusetts by up to 20% and the budget for Rhode Island up to 10% in each budget year. 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). 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.[23] 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 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 originate from other ISO reports, such as the Capacity, Energy, Load, and Transmission (CELT) Report and Forward Capacity Market results.[24]

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

[24] The ISO's CELT reports are available at http://www.iso-ne.com/trans/celt/report/index.html.

3) Amount of EE dollars gained from System Benefits charge:

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

Where:

- NEL is the ISO New England annual energy forecast.
- PDR is the ISO New England FCM passive demand resource.
- 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:

$$\text{Budget\$}(\text{y}, \text{r}) = \big(\text{SALES}(\text{y}, \text{r}) * \text{SBC}(\text{r})\big) + \big(\text{RGGI\$}(\text{r}) * \%\text{RGGI}(\text{r})\big) + \big(\text{FCMMW}(\text{r}) * \text{CLPR} * \%\text{FCM}(\text{r})\big) + \text{POLVAR}(\text{y}, \text{r})$$

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, orFCM (PA/regulator).

5) State budget dollars accounting for spend rate uncertainty:

$$\text{TOTALDLR\$}(\text{y}, \text{r}) = \big(\text{BUDGET\$}(\text{y}, \text{r})\big) * (100 - \text{BU}(\text{r}))$$

Where:

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

6) EE MWh based on cost to produce an EE MWh and available funds:

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

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 MWh that occur on peak:

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

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 Benefit Charge (SBCADJ) in the budget due to impacts of lower energy sales resulting from EE investment:

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

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:

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

Where:

- EEMW clears the FCA and funds additional EE.

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

11)

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

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

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

Section 4
Data Collection

After the EE forecast methodology was developed, it was populated with detailed data on state-sponsored EE programs to produce an EE forecast. This section summarizes the process used to gather data and the data collected for the forecast years.

4.1 Data-Collection Process

The ISO collects data for the EE forecast by annually distributing an EE data-gathering worksheet to the PAs.[25]

Via the worksheet, the ISO receives data from all the region's PAs, who report on approximately 130 unique EE programs aimed at commercial/industrial (C&I), residential, and low-income customers.[26] 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.[27]

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.

[25] EE data submitted to the ISO by the PAs is available at http://www.iso-ne.com/committees/comm_wkgrps/othr/enrgy_effncy_frcst/frcst/index.html.

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

[27] Mixed lighting refers to programs that include lighting and other measures, such as mechanical systems, building envelope, process improvements, and appliances.

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	Retrofit
Retrofit, small		
Retrofit, large		

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

- Appliances
- Building envelope
- Compressed air
- Consumer products
- Cooling
- 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 2014 energy-efficiency forecast data. Table 4-4 shows the 2014 data summary by class. Figure 4-1 to Figure 4-9 show specific results of the forecast, including the following:

- For 2012, 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 2012, 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 2014 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	150	2,352,612	83	98	94	0.160398	10,688,990	33
2010	524,416	500,978	1,371,179	365	191	2,616,499	103	96	95	0.139638	14,631,980	34
2011	665,087	518,865	1,575,303	329	200	2,588,875	90	78	75	0.127227	17,638,160	29
2012	745,761	648,848	1,723,357	377	223	2,912,977	98	87	86	0.129250	18,384,080	35
Avg 2010–12	645,088	556,231	1,556,613	357	205	2,708,981	96	86	85	0.131907	16,992,390	33
CT												
2009	102,183	73,411	222,500	330	34	2,150,181	60	72	63	0.153447	2,464,777	30
2010	143,543	144,938	405,042	358	50	2,907,253	113	101	105	0.123083	3,533,541	41
2011	129,909	119,426	381,974	313	43	2,769,495	93	92	87	0.112892	3,163,706	38
2012	120,176	121,826	308,428	395	40	3,032,765	131	101	124	0.130241	3,116,688	39
Avg 2010–12	131,210	128,730	365,148	353	44	2,900,482	109	98	103	0.121546	3,271,312	39
ME												
2009		13,806	55,176	250	6	2,127,537	662	0	472	0.117605	519,953	27
2010		16,846	74,180	227	8	2,198,392	101	0	102	0.103303	709,392	24
2011		22,817	152,663	149	18	1,248,348	117	0	100	0.119727	1,447,766	16
2012		23,712	143,531	165	12	1,904,462	101	0	114	0.086747	1,266,751	19
Avg 2010–12		21,125	123,458	171	13	1,650,762	107	0	105	0.103657	1,141,303	19
MA												
2009	183,782	192,362	424,652	453	70	2,751,448	81	105	99	0.164636	5,075,859	38
2010	294,315	253,086	619,638	408	91	2,769,089	99	86	90	0.147501	7,336,580	34
2011	432,796	283,898	777,100	365	101	2,823,145	86	66	67	0.129405	10,177,750	28
2012	508,987	400,607	980,105	409	127	3,165,278	88	79	75	0.129132	10,724,660	37
Avg 2010–12	412,033	312,531	792,281	394	107	2,931,156	90	76	76	0.134578	9,520,644	33
NH												
2009	18,286	17,988	59,691	301	10	1,889,281	139	98	137	0.159504	750,029	24
2010	21,866	21,763	73,710	295	12	1,759,778	121	100	117	0.167779	894,648	24
2011	17,667	18,904	58,042	326	10	1,910,830	123	107	121	0.170445	673,064	28
2012	19,673	18,703	53,973	347	8	2,376,142	106	95	101	0.145832	666,868	28
Avg 2010–12	19,735	19,790	61,909	320	10	1,970,384	117	100	113	0.162234	744,860	27
RI												
2009	24,555	26,211	81,543	321	15	1,702,327	103	107	123	0.188820	899,330	29
2010	30,366	27,581	81,275	339	13	2,163,861	107	91	78	0.156826	929,242	30
2011	48,649	36,494	96,009	380	14	2,673,198	94	75	71	0.142195	1,076,778	34

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	61,246	48,870	119,666	408	20	2,503,820	93	80	82	0.163104	1,288,325	38
Avg 2010–12	46,754	37,648	98,983	380	15	2,459,809	97	81	77	0.154625	1,098,115	34
VT												
2009	29,134	28,597	90,240	317	14	1,997,246	92	98	104	0.158666	979,041	29
2010	34,326	36,764	117,334	313	17	2,107,775	88	107	93	0.148653	1,228,575	30
2011	36,066	37,325	109,514	341	15	2,502,506	72	103	69	0.136192	1,099,092	34
2012	35,678	35,130	117,653	299	16	2,172,426	119	98	109	0.137447	1,320,789	27
Avg 2010–12	35,357	36,406	114,834	317	16	2,250,639	90	103	88	0.140865	1,216,152	30

Table 4-4
ISO New England 2014 Energy-Efficiency Forecast Data Summary by Class

Class	Budget	Total Costs	Achieved Annual Energy	Dollars per MWh	Achieved Summer Peak	Dollars per 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	150	2,352,612	83	98	94	0.160398	100.0	100.0	100.0
2010	524,416	500,978	1,371,179	365	191	2,616,499	103	96	95	0.139638	100.0	100.0	100.0
2011	665,087	518,865	1,575,303	329	202	2,571,541	90	78	76	0.128085	100.0	100.0	100.0
2012	745,761	648,848	1,723,357	377	223	2,912,976	98	87	86	0.129250	100.0	100.0	100.0
All													
2009	0	0	0	0	0	0	0	0	0	0.000000	0.0	0.0	0.0
2010	0	0	0	0	0	0	0	0	0	0.000000	0.0	0.0	0.0
2011	0	0	0	0	0	0	0	0	0	0.000000	0.0	0.0	0.0
2012	50	112	0	0	0	0	0	223	0	0.000000	0.0	0.0	0.0
Commercial & Industrial													
2009	195,207	197,046	598,047	329	109	1,810,501	93	101	100	0.181984	55.9	64.0	72.7
2010	278,504	258,538	779,162	332	122	2,115,693	93	93	86	0.156835	51.6	56.8	63.8
2011	402,418	278,911	899,762	310	135	2,067,278	84	69	72	0.149947	53.8	57.1	66.9

Class	Budget	Total Costs	Achieved Annual Energy	Dollars per MWh	Achieved Summer Peak	Dollars per MW	Energy Achieved	Budget Spent	Peak Achieved	Peak to Energy Ratio	Total	Annual	Summer
	$1,000s	$1,000s	(MWh)	$	(MW)	$	%	%	%	(MW/GWh)	%	%	%
2012	440,290	341,984	1,058,624	323	161	2,121,368	91	78	85	0.152282	52.7	61.4	72.4
Low Income													
2009	42,971	41,889	35,566	1178	4	11,206,350	79	97	83	0.105100	11.9	3.8	2.5
2010	58,986	48,410	40,447	1197	4	12,018,330	70	82	75	0.099586	9.7	2.9	2.1
2011	65,794	55,593	47,360	1174	4	14,269,340	84	84	72	0.082264	10.7	3.0	1.9
2012	80,661	72,365	50,817	1424	4	17,115,600	95	90	79	0.083201	11.2	2.9	1.9
Residential													
2009	118,161	112,287	300,190	374	37	3,017,904	69	95	79	0.123945	31.9	32.1	24.8
2010	178,501	172,895	551,570	313	65	2,650,098	128	97	117	0.118282	34.5	40.2	34.1
2011	190,491	179,676	628,181	286	63	2,853,856	101	94	85	0.100224	34.6	39.9	31.2
2012	215,070	223,473	613,916	364	57	3,899,578	111	104	90	0.093347	34.4	35.6	25.7
Undefined													
2009	1,600	1,152	0	0	0	0	0	72	0	0.000000	0.3	0.0	0.0
2010	8,425	21,136	0	0	0	0	0	251	0	0.000000	4.2	0.0	0.0
2011	6,383	4,685	0	0	0	0	0	73	0	0.000000	0.9	0.0	0.0
2012	9,690	10,915	0	0	0	0	0	113	0	0.000000	1.7	0.0	0.0

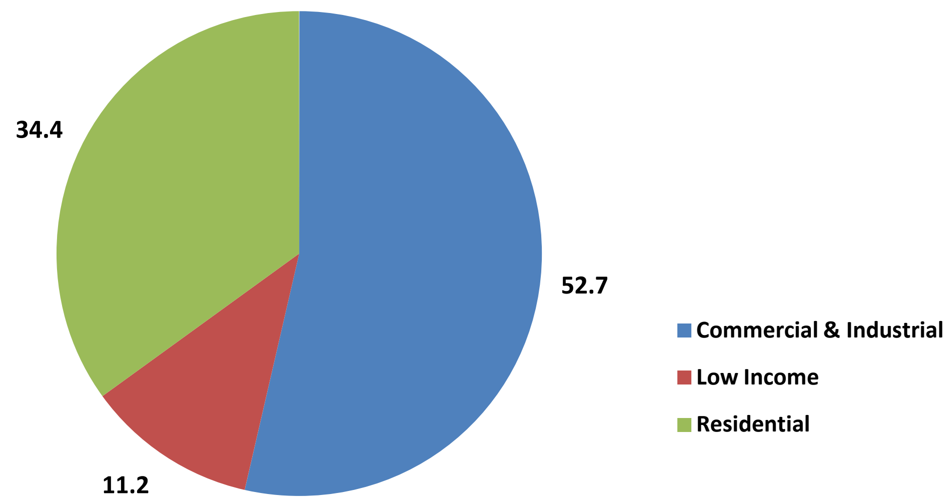


Figure 4-1: Percentage of total costs for energy-efficiency programs in New England, by class, 2012.

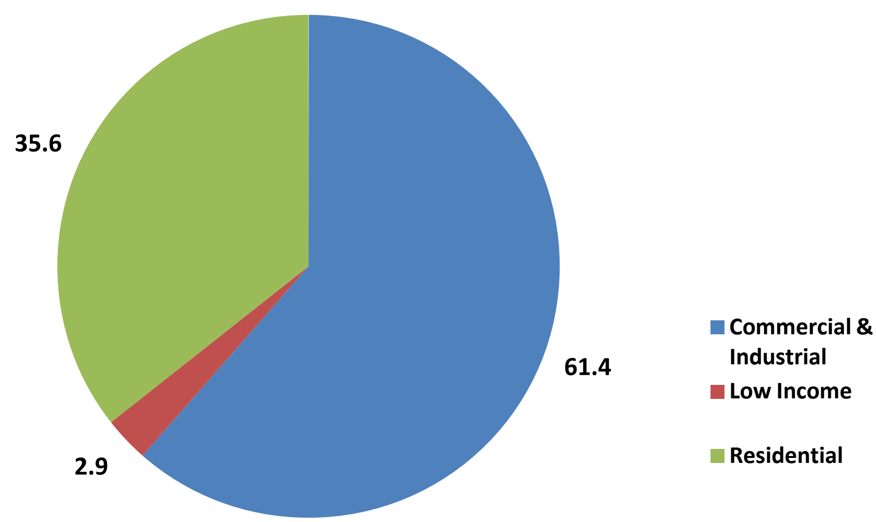


Figure 4-2: Percentage of annual energy use in New England, by class, 2012.

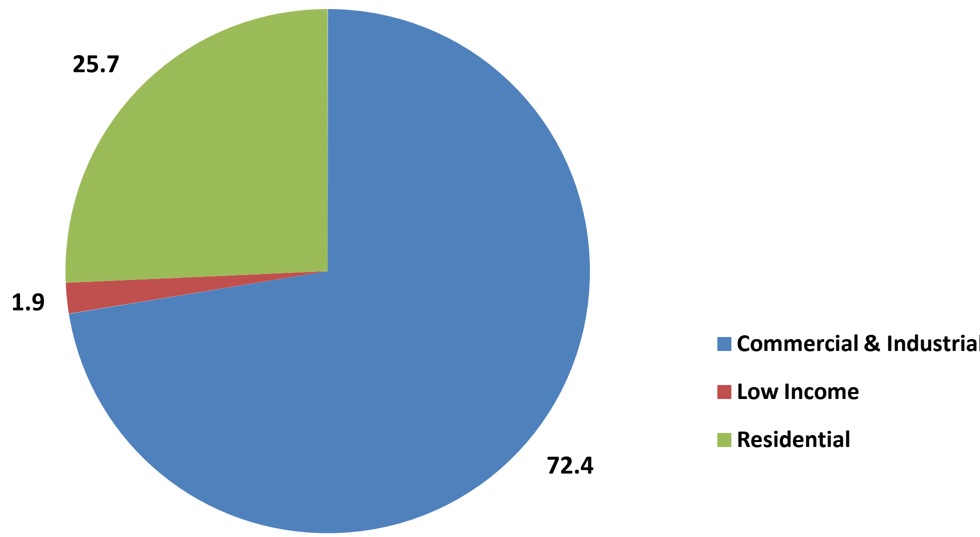


Figure 4-3; Percentage of summer peak energy use in New England, by class, 2012.

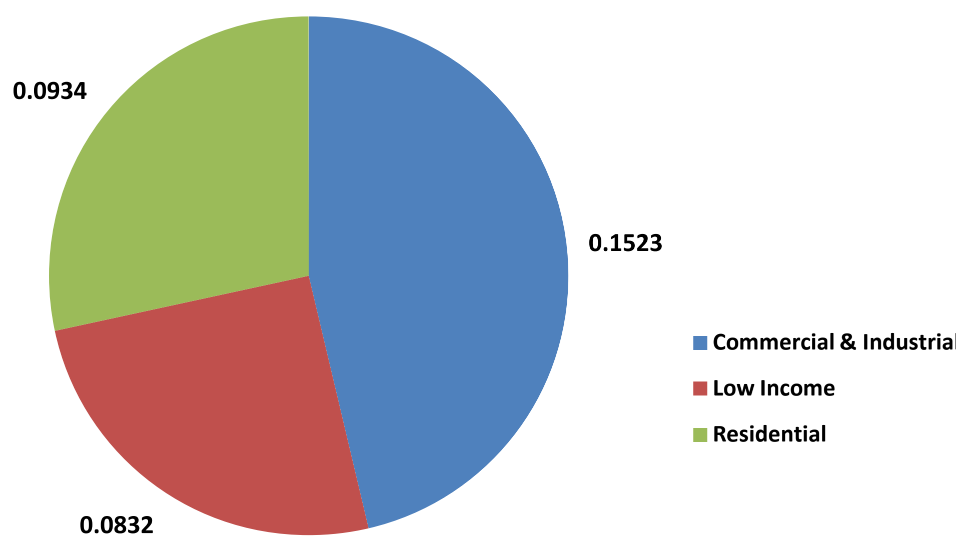


Figure 4-4: Ratio of peak energy demand to annual energy use in New England, by class, 2012.

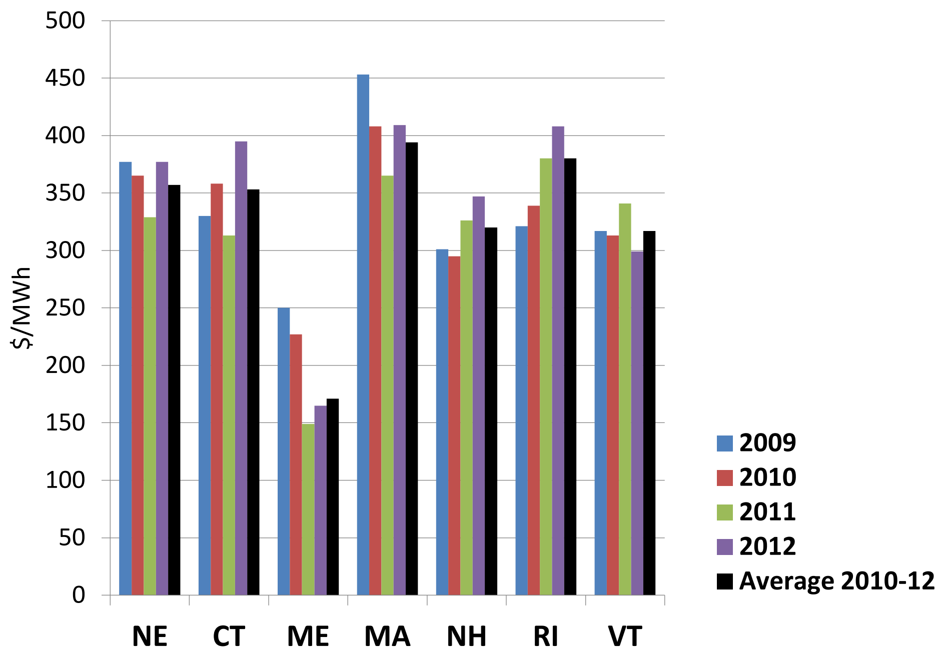


Figure 4-5: 2014 energy-efficiency forecast annual energy production costs in New England and for each New England state, totals and average for 2009 to 2012 ($/MWh).

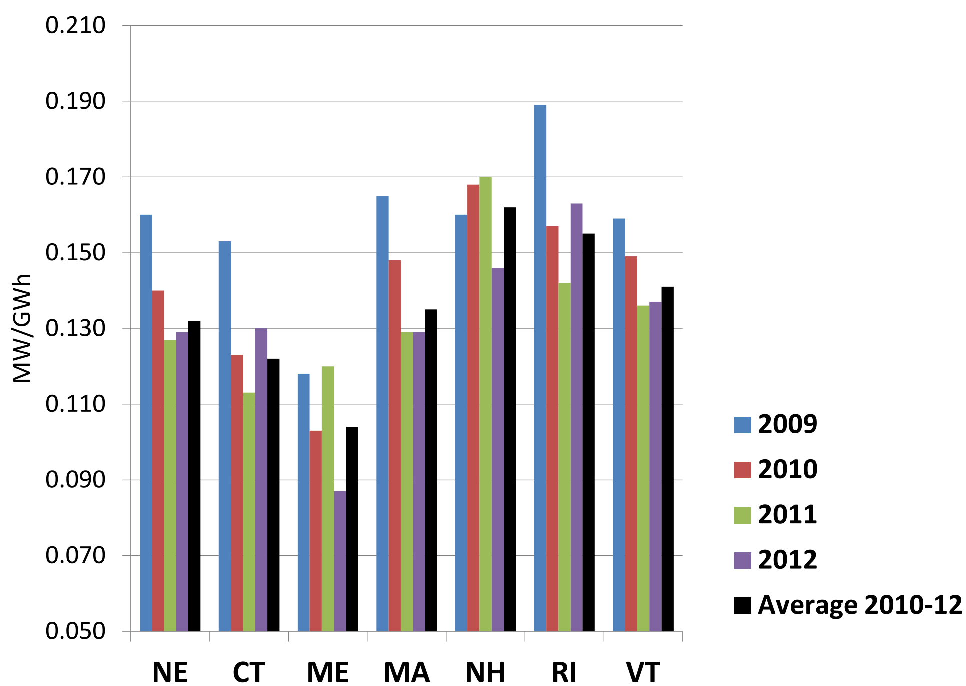


Figure 4-6: 2014 energy-efficiency forecast ratio of summer peak demand to annual energy use in new England and for each New England state, totals and average for 2009 to 2012 (MW/GWh).

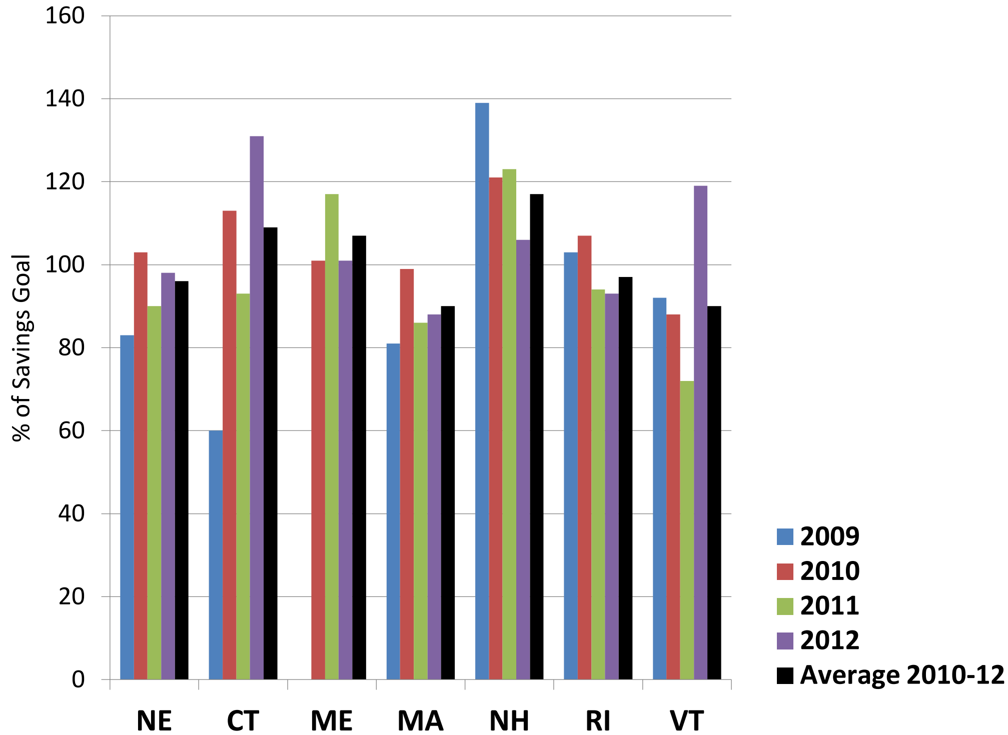


Figure 4-7: 2014 energy-efficiency forecast percentage of annual energy savings goal achieved in New England and by each New England state, totals and average for 2009 to 2012.

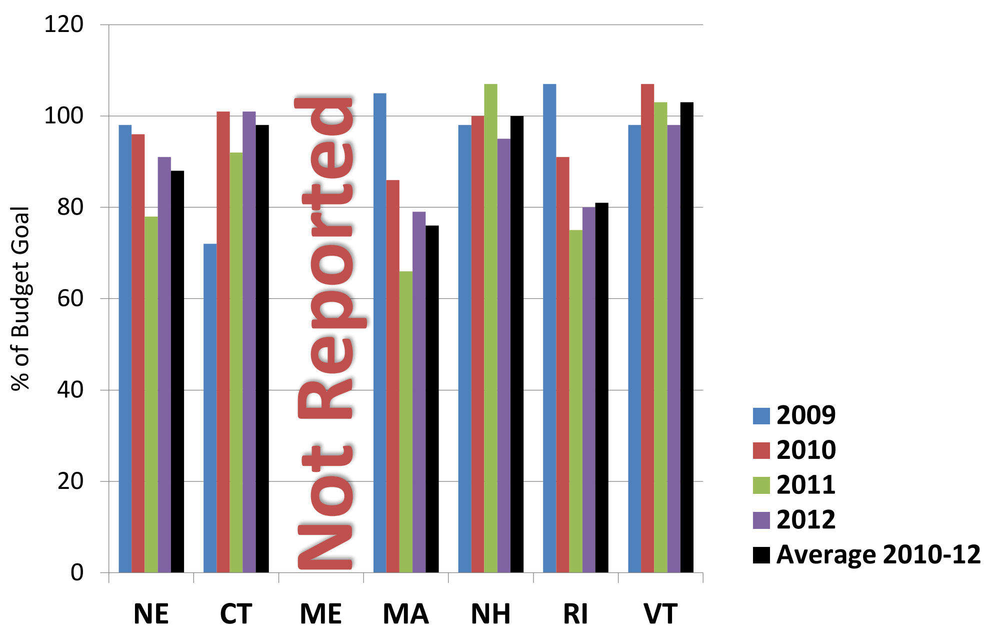


Figure 4-8: 2014 energy-efficiency forecast percentage of budget spent in New England and by each New England state, totals and average for 2009 to 2012.

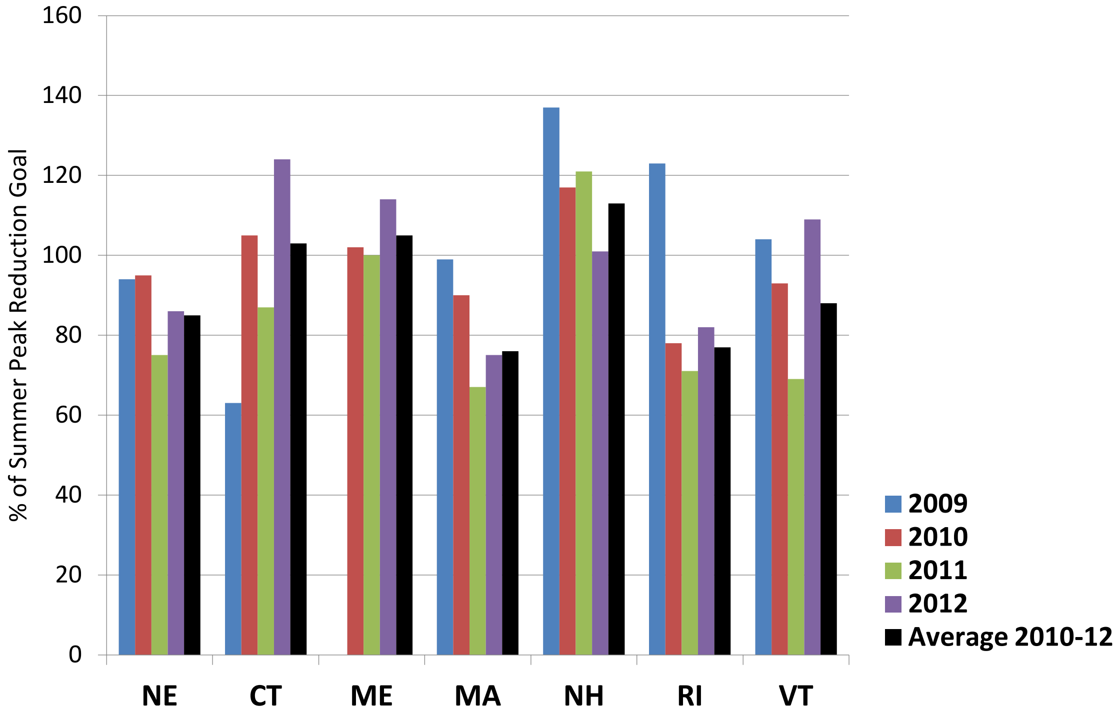


Figure 4-9: 2014 energy-efficiency forecast percentage of summer peak reduction goal achieved for New England and by each New England state, totals and average for 2009 to 2012.

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 2017 to 2023 for the FCM (1,000 $)

	ME	NH	VT	CT	RI	MA	ISO-NE
RGGI dollars ($1,000s)							
Annual[(a)]	9,070	12,112	2,210	17,646	4,984	48,062	94,084
Applied to EE	0	6,056	0	3,529	2,741	48,062	60,388
FCM MW							
2017	182	79	132	369	175	1,023	1,961
FCM dollars ($1,000s; clearing price, $7.025/MWh)							
2017	15,369	6,679	11,113	31,086	14,784	86,240	165,272
FCM dollars for EE ($1,000s)							
2018	0	6,679	0	31,086	14,784	86,240	138,789
2019	0	6,679	0	31,086	14,784	86,240	138,789
2020	0	6,679	0	31,086	14,784	86,240	138,789
2021	0	6,679	0	31,086	14,784	86,240	138,789
2022	0	6,679	0	31,086	14,784	86,240	138,789
2023	**0**	6,679	0	31,086	14,784	86,240	138,789

(a) Anticipated annual revenue from RGGI auctions, as provided by state regulators to the ISO in their most recent data submissions, 2014 or earlier.

Table 4-6
***2013 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, 2018 to 2023 (GWh)[(a)]**

	ME	NH	VT	CT	RI	MA	ISO-NE
2013 RSP energy forecast (GWh)							
2018	12,815	13,255	6,930	36,250	9,175	67,515	145,940
2019	12,895	13,370	6,980	36,545	9,255	68,220	147,265
2020	12,970	13,490	7,020	36,835	9,320	68,900	148,535
2021	13,045	13,615	7,065	37,120	9,380	69,550	149,775
2022	13,125	13,740	7,110	37,400	9,435	70,195	151,005
2023	13,195	13,865	7,160	37,690	9,495	70,840	152,245
2013 RSP energy forecast minus FCM passive demand resources (GWh)							
2018	11,780	12,842	6,106	34,402	8,400	62,941	136,471
2019	11,860	12,957	6,156	34,697	8,480	63,646	137,796
2020	11,932	13,075	6,194	34,981	8,543	64,313	139,037
2021	12,010	13,202	6,241	35,272	8,605	64,976	140,306
2022	12,090	13,327	6,286	35,552	8,660	65,621	141,536
2023	12,160	13,452	6,336	35,842	8,720	66,266	142,776
SBC eligibility	75%	100%	100%	94%	100%	86%	
SBC eligible; 2013 RSP energy forecast minus FCM passive demand resources (GWh)							
2018	8,835	12,842	6,106	32,200	8,400	54,130	122,512
2019	8,895	12,957	6,156	32,477	8,480	54,736	123,700
2020	8,949	13,075	6,194	32,743	8,543	55,309	124,812
2021	9,007	13,202	6,241	33,015	8,605	55,880	125,949
2022	9,067	13,327	6,286	33,277	8,660	56,434	127,051
2023	9,120	13,452	6,336	33,548	8,720	56,989	128,165

(a) FCA #8 results are available at http://www.iso-ne.com/regulatory/ferc/filings/2014/feb/index.htm.

Table 4-7
2013 Forecast of Energy Sales (GWh) and System Benefit Charge ($) for Each New England State and the Total for New England, 2018 to 2023

	ME	NH	VT	CT	RI	MA	ISO-NE
Sales (GWh)							
2018	8,335	12,115	5,760	30,378	7,925	51,066	115,578
2019	8,391	12,223	5,807	30,638	8,000	51,638	116,698
2020	8,442	12,335	5,843	30,889	8,059	52,178	117,747
2021	8,497	12,454	5,888	31,146	8,118	52,717	118,820
2022	8,554	12,572	5,930	31,393	8,170	53,240	119,860
2023	8,604	12,690	5,977	31,649	8,226	53,763	120,910
SBC rate ($/kwh)	0.0000	0.0018	0.0000	0.0030	0.0088	0.0025	
SBC dollars ($1,000s)							
2018	0	21,807	0	91,133	68,880	12,7664	309,483
2019	0	22,002	0	91,915	68,664	129,094	311,674
2020	0	22,204	0	92,668	68,348	130,445	313,664
2021	0	22,418	0	93,438	68,086	131,792	315,734
2022	0	22,630	0	94,180	67,811	133,100	317,720
2023	0	22,842	0	94,948	67,632	134,408	319,830
Total	**0**	**133,903**	**0**	**558,282**	**409,421**	**786,503**	**1,888,105**

Table 4-8
2013 Forecast of Impacts of New Energy-Efficiency Measures on Revenue Streams in Each New England State and Total For New England, 2018 to 2023

	ME	NH	VT	CT	RI	MA	ISO-NE
Lost SBC dollars ($1,000s)							
2018	0	133	0	1,186	1,401	2,191	4,912
2019	0	258	0	2,294	2,715	4,234	9,501
2020	0	375	0	3,329	3,946	6,138	13,787
2021	0	484	0	4,294	5,098	7,913	17,790
2022	0	587	0	5,196	6,176	9,568	21,526
2023	0	682	0	6,038	7,185	11,110	25,016
Total	**0**	**2,519**	**0**	**22,337**	**26,521**	**41,154**	**92,532**
New FCM dollars ($1,000s)							
2018	**0**	**1,014**	**0**	**4,051**	**1,854**	**9,944**	**16,862**
2019	0	1,962	0	7,833	3,592	19,215	32,602
2020	0	2,849	0	11,364	5,221	27,858	47,292
2021	0	3,680	0	14,662	6,745	35,915	61,002
2022	0	4,457	0	17,740	8,171	43,425	73,794
2023	0	5,184	0	20,615	9,506	50,426	85,732
Total	**0**	**19,146**	**0**	**76,265**	**35,089**	**186,783**	**317,284**

Table 4-9
2013 Forecast of Policy Dollars and Total Budgets for Each New England State and Total for New England, 2018 to 2023 ($1,000s)

Year	ME	NH	VT	CT	RI	MA	ISO-NE
Policy dollars ($1,000s)							
2018	52,000	0	57,548	77,500	0	360,945	547,993
2019	52,000	0	59,638	77,500	0	355,831	544,969
2020	52,000	0	62,599	77,500	0	351,063	543,162
2021	52,000	0	63,196	77,500	0	346,619	539,315
2022	52,000	0	65,430	77,500	0	342,476	537,406
2023	52,000	0	67,513	77,500	0	338,615	535,628
Total	**312,000**	**0**	**375,924**	**465,000**	**0**	**2,095,549**	**3,248,473**
Total budgets ($1,000s)							
2018	52,000	35,422	57,548	206,112	78,172	504,531	933,785
2019	52,000	36,440	59,638	209,568	78,360	507,367	943,374
2020	52,000	37,413	62,599	212,819	78,433	510,025	953,288
2021	52,000	38,348	63,196	215,920	78,533	512,572	960,570
2022	52,000	39,235	65,430	218,839	78,598	514,989	969,092
2023	52,000	40,079	67,513	221,640	78,731	517,313	977,276
Total	**312,000**	**226,937**	**375,924**	**1,284,898**	**470,827**	**3,066,797**	**5,737,385**

Table 4-10
Production Cost Multiplier, Production Costs ($/MWh), and Ratio of Peak Energy Demand to Annual Use, 2012 to 2023

Year	ME	NH	VT	CT	RI	MA
Production cost multiplier (includes inflation)						
2012	1	1	1	1	1	1
2013	1	1.075	1.075	1.075	1.075	1.075
2014	1	1.075	1.075	1.075	1.075	1.075
2015	1	1.075	1.075	1.075	1.075	1.075
2016	1	1.075	1.075	1.075	1.075	1.075
2017	1.075	1.075	1.075	1.075	1.075	1.075
2018	1.075	1.075	1.075	1.075	1.075	1.075
2019	1.075	1.075	1.075	1.075	1.075	1.075
2020	1.075	1.075	1.075	1.075	1.075	1.075
2021	1.075	1.075	1.075	1.075	1.075	1.075
2022	1.075	1.075	1.075	1.075	1.075	1.075
2023	1.075	1.075	1.075	1.075	1.075	1.075
Production costs ($/MWh)						
2012	337	320	317	353	380	394
2013	337	344	341	379	409	424
2014	337	370	366	408	439	455
2015	337	398	394	439	472	489
2016	337	427	423	471	507	526
2017	362	459	455	507	546	566
2018	389	494	489	545	586	608
2019	419	531	526	586	630	654
2020	450	571	565	630	678	703
2021	484	614	608	677	729	755
2022	520	660	653	728	783	812
2023	559	709	702	782	842	873
Peak-to-energy ratio (MW/GWh)	**0.141**	**0.1622**	**0.1409**	**0.1215**	**0.1546**	**0.1346**

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

The final EE forecast for 2018 to 2023 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 1,518 GWh. The forecast for total energy savings from 2018 to 2023 is 9,105 GWh. The states' annual average energy savings ranges from a low of 68 GWh in New Hampshire to a high of 749 GWh in Massachusetts.

The regional average savings in peak demand is 205 MW. The forecast for total peak savings is 1,233 MW from 2018 to 2023. The states' annual average peak savings ranges from a low of 11 MW in New Hampshire to a high of 101 MW in Massachusetts. Table 5-1 shows the results of ISO's final EE forecast for 2018 to 2023. 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 2018 to 2023 (GWh, MW)

Forecast of Electric Energy Savings (GWh)							
Year	Sum of States	States					
		ME	NH	VT	CT	RI	MA
2018	1,764	142	76	125	401	141	880
2019	1,658	132	73	120	379	132	823
2020	1,560	122	69	117	358	123	769
2021	1,462	114	66	110	338	114	719
2022	1,373	106	63	106	319	106	672
2023	1,288	99	60	102	300	99	628
Total	9,105	714	408	681	2,096	715	4,491
Average	**1,518**	**119**	**68**	**113**	**349**	**119**	**749**
Forecast of Peak Demand Savings (MW)							
Year	**Sum of States**	**States**					
		ME	**NH**	**VT**	**CT**	**RI**	**MA**
2018	239	20	12	18	49	22	118
2019	225	19	12	17	46	20	111
2020	211	17	11	17	44	19	104
2021	198	16	11	16	41	18	97
2022	186	15	10	15	39	16	90
2023	174	14	10	14	37	15	85
Total	1,233	101	66	96	255	111	605
Average	**205**	**17**	**11**	**16**	**42**	**18**	**101**

5.1 Regional Load Forecast

Figure 5-1 shows the annual forecast of energy use, minus both the FCM passive resources projected for 2013–2017 and the results of the 2014 energy-efficiency forecast for 2018–2023. The figure shows essentially no long-term growth in electric energy use.

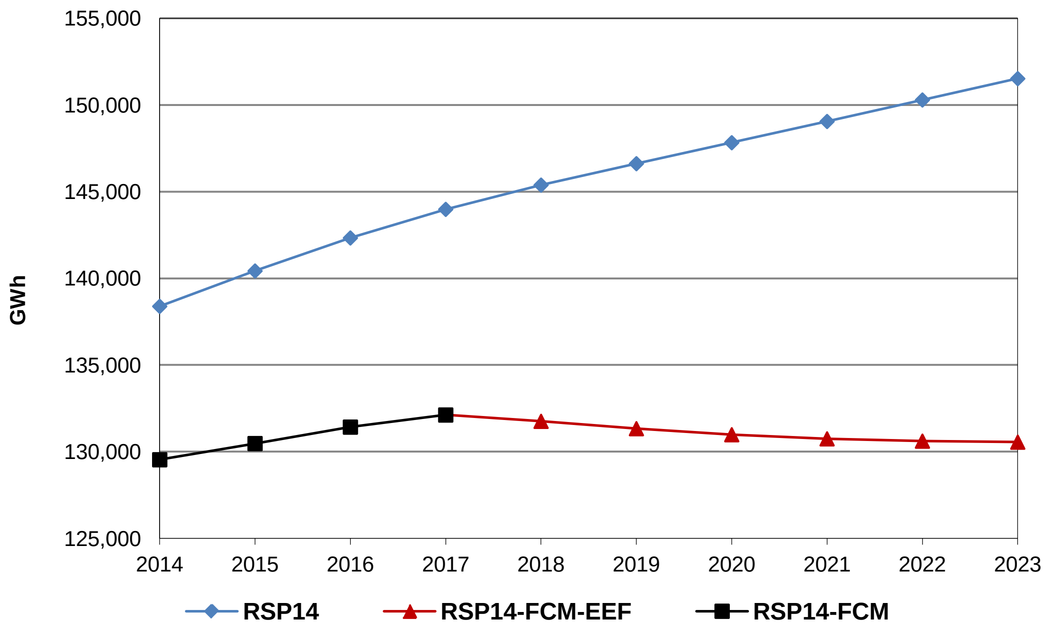


Figure 5-1: **Net energy-use load forecast (diamond), net energy-use load forecast minus FCM #8 results through 2017 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2018 to 2023 (GWh).**

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 2013 to 2017 and the 2018 to 2023 energy-efficiency forecast.[28] 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.

[28] 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.

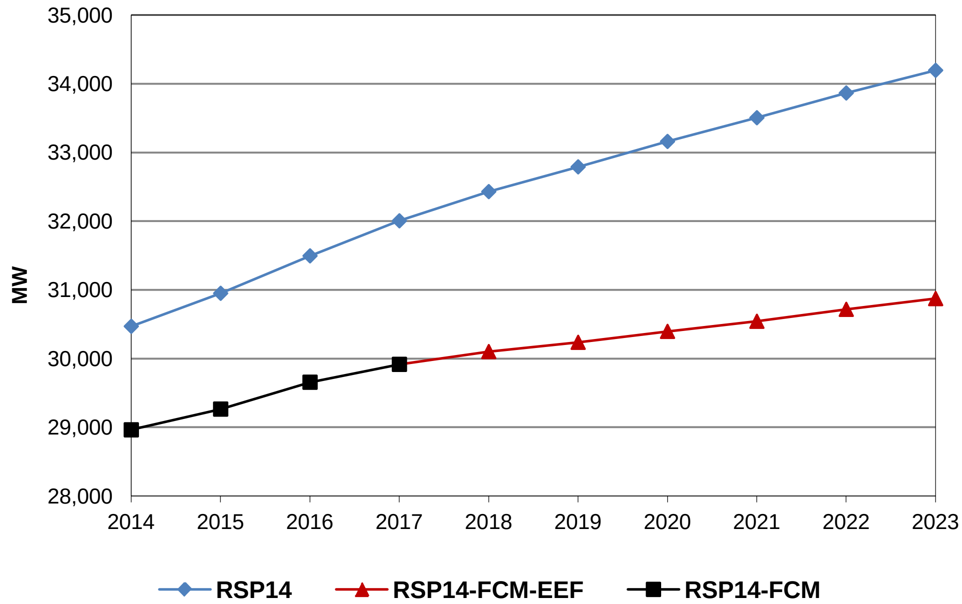


Figure 5-2: Summer peak demand forecast (90/10) (diamond), load forecast minus FCM #8 results through 2017 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2018 to 2023 (MW).

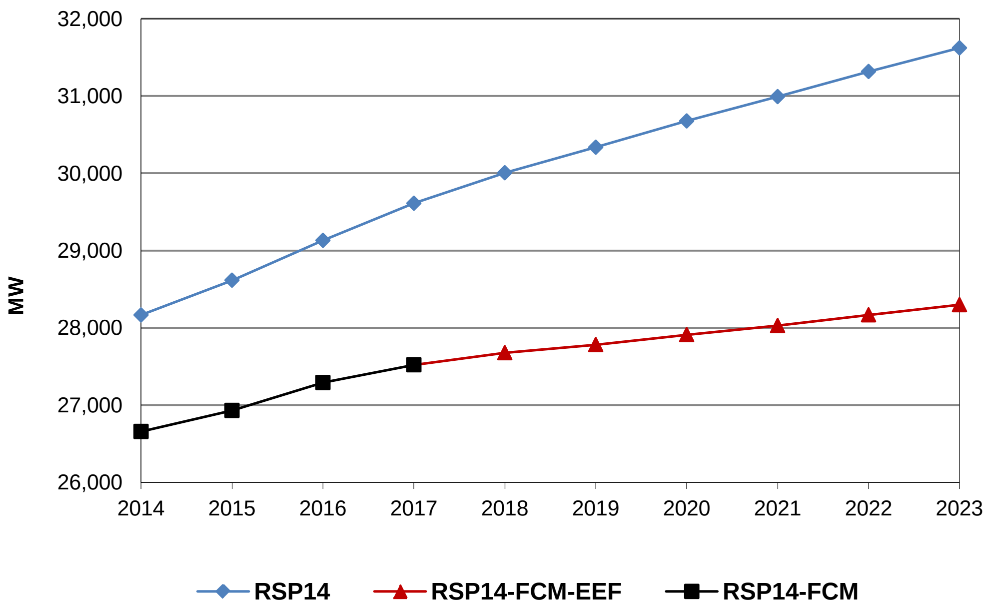


Figure 5-3: Summer peak demand forecast (50/50) (diamond), load forecast minus FCM #8 results through 2017 (square), and load forecast minus FCM

results and minus the energy-efficiency forecast (triangle) for 2018 to 2023 (MW).

The gross compound annual growth rate (CAGR) for the ISO's summer peak demand, for 2014 through 2023, is 1.3%.[29] The gross CAGR for the ISO's electric energy use for the same period is 1.0%. 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.

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 5-4 to Figure 5-15) 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 2023 to levels below those expected in 2014.

[29] 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.

5.2.1 Connecticut

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

- Budget: based on commission-approved 2013 budget
- Budget uncertainty rate: none
- Production cost: based on average of 2010–2012 PA data
- Production cost escalation rate: 5% + 2.5% inflation
- Peak-to-energy ratio: based on average of 2010–2012 PA data
- Increased budget dollars due to an all-cost-effective policy

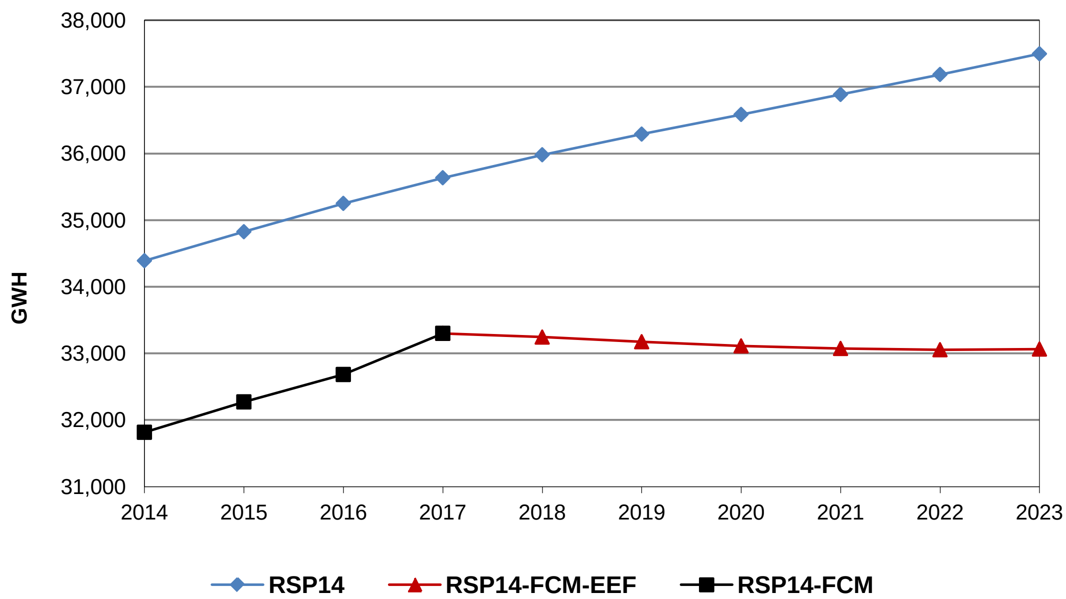


Figure 5-4: Net energy-use load forecast for Connecticut (diamond), net energy-use load forecast minus FCM #8 results through 2017 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2018 to 2023 (GWh).

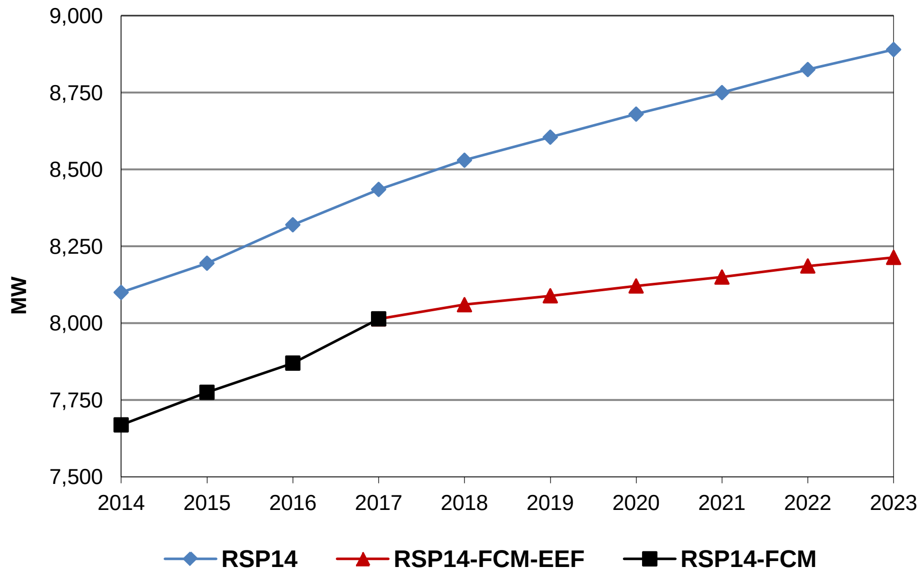


Figure 5-5: Summer peak demand forecast (90/10) for Connecticut (diamond), load forecast minus FCM #8 results through 2017 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2018 to 2023 (MW).

5.2.2 Massachusetts

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

- Budget: based on commission-approved 2013 budget
- Budget uncertainty rate: 20%
- Production cost: based on average of 2010–2012 PA data
- Production cost escalation rate: 5% + 2.5% inflation
- Peak-to-energy ratio: based on average of 2010–2012 PA data

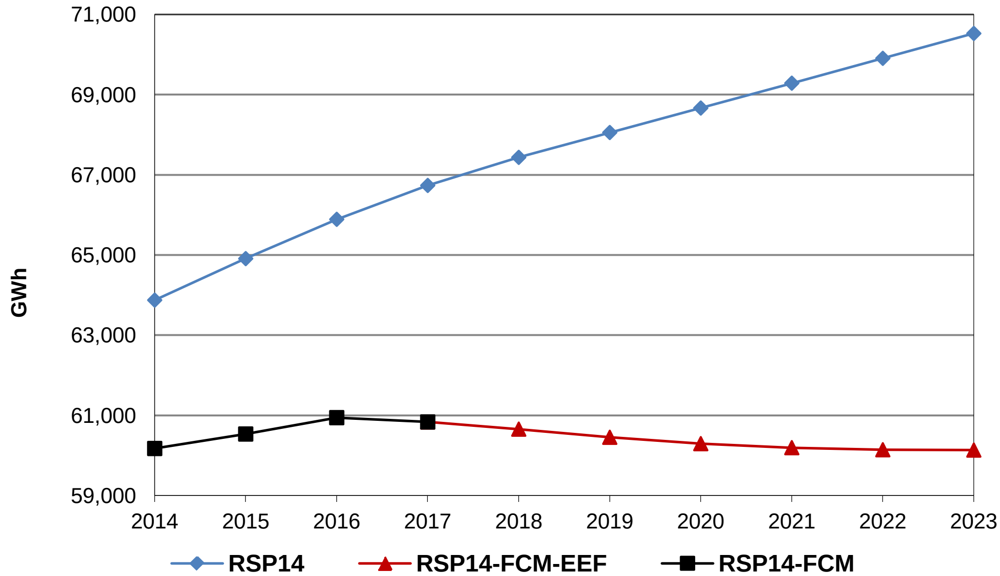


Figure 5-6: Net energy-use load forecast for Massachusetts (diamond), net energy-use load forecast minus FCM #8 results through 2017 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2018 to 2023 (GWh).

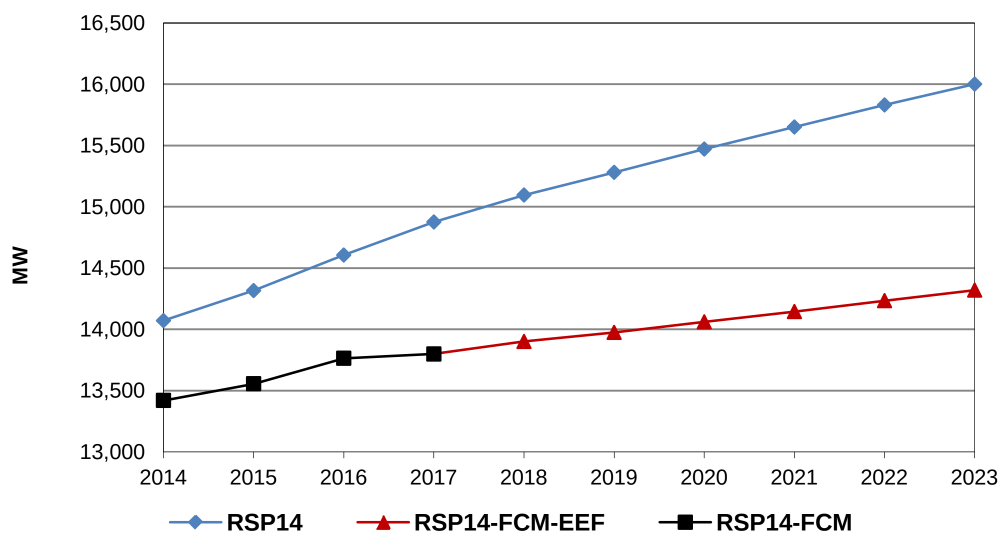


Figure 5-7: Summer peak demand forecast (90/10) for Massachusetts (diamond), load forecast minus FCM #8 results through 2017 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2018 to 2023 (MW).

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: none
- Production cost: based on average of 2014–2016 budget
- Production cost escalation rate: 5% + 2.5% inflation
- Peak-to-energy ratio: based on average of 2014–2016 budget

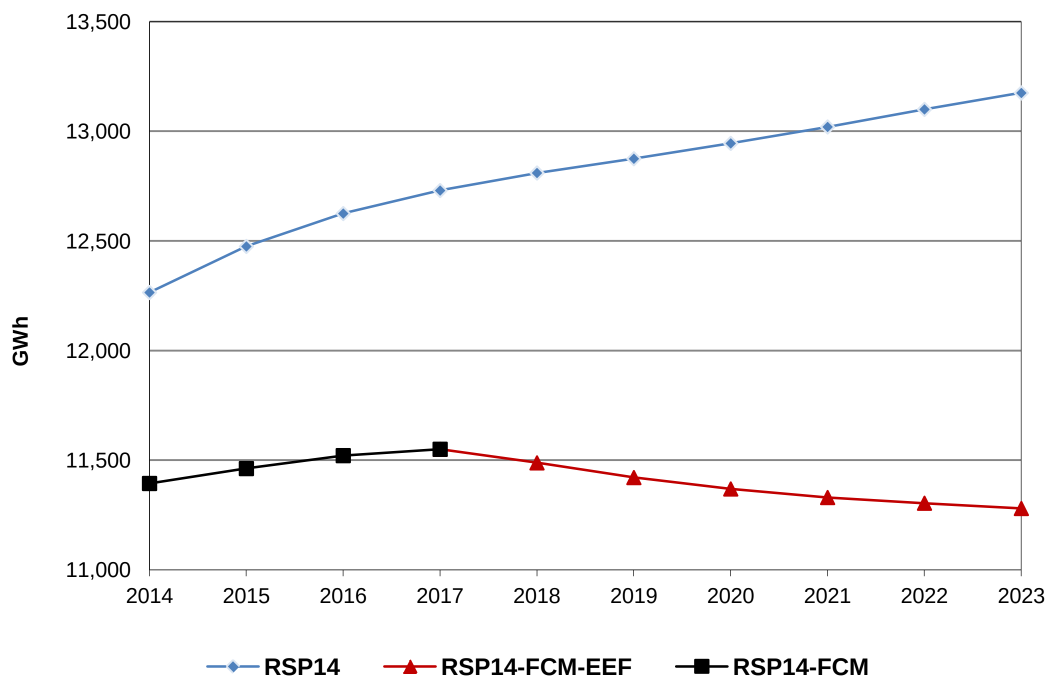


Figure 5-8: Net energy-use load forecast for Maine (diamond), net energy-use load forecast minus FCM #8 results through 2017 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2018 to 2023 (GWh).

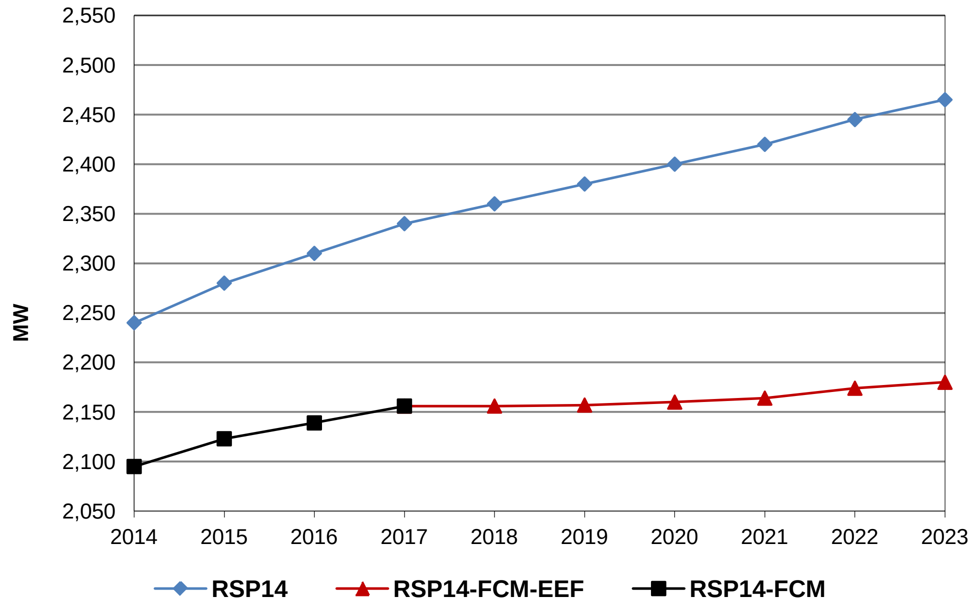


Figure 5-9: Summer peak demand forecast (90/10) for Maine (diamond), load forecast minus FCM #8 results through 2017 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2018 to 2023 (MW).

5.2.4 New Hampshire

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

- Budget: based on commission-approved 2013 budget
- Budget uncertainty rate: none
- Production cost: based on average of 2010–2012 PA data
- Production cost escalation rate: 5% + 2.5% inflation
- Peak-to-energy ratio: based on average of 2010–2012 PA data

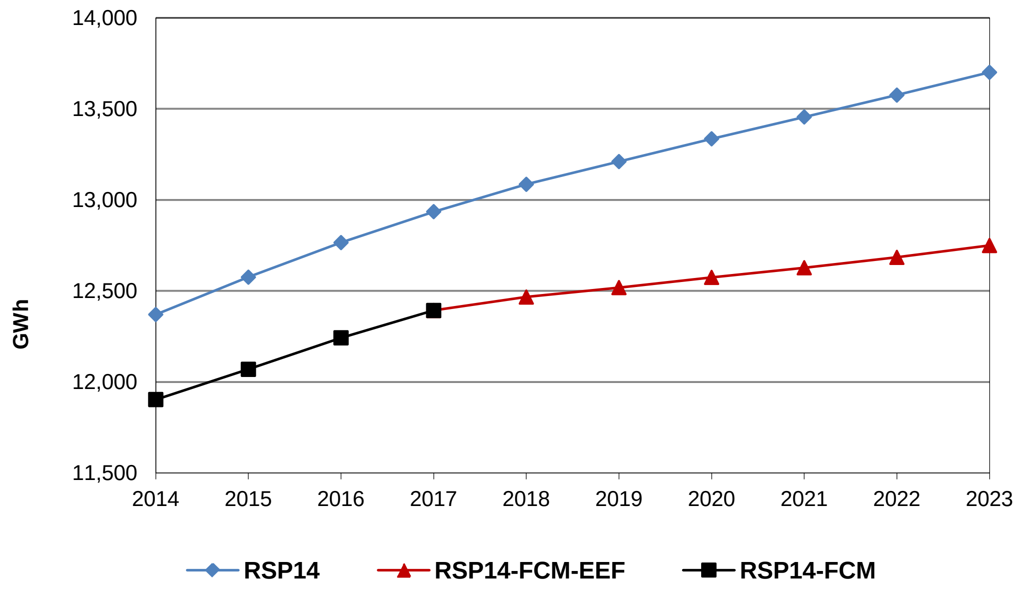


Figure 5-10: Net energy-use load forecast for New Hampshire (diamond), net energy-use load forecast minus FCM #8 results through 2017 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2018 to 2023 (GWh).

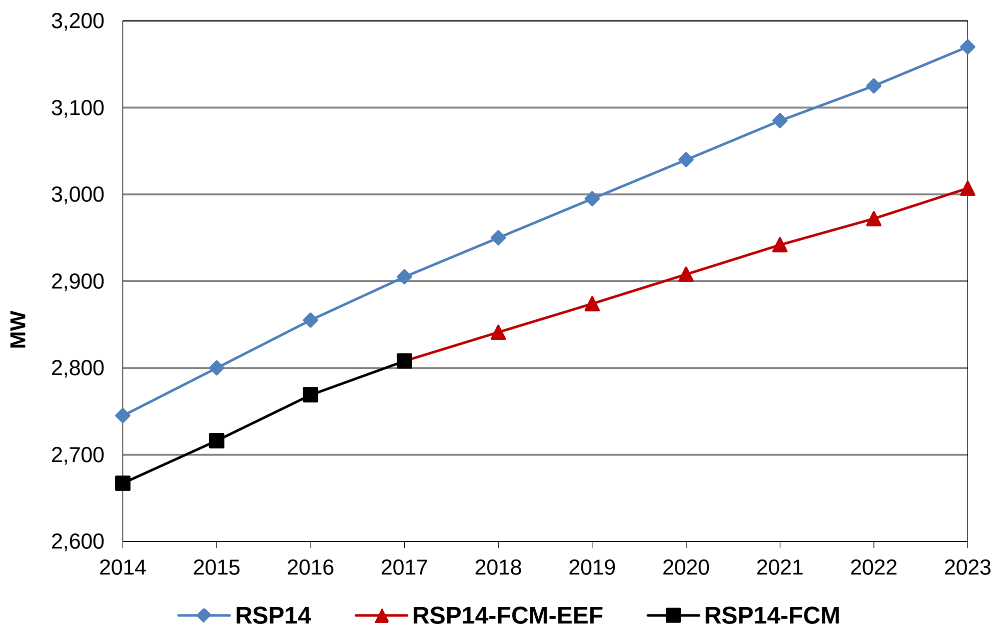


Figure 5-11: Summer peak demand forecast (90/10) for New Hampshire (diamond), load forecast minus FCM #8 results through 2017 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2018 to 2023 (MW).

5.2.5 Rhode Island

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

- Budget: based on commission-approved 2012–2014 budget
- Budget uncertainty rate: 10%
- Production cost: based on average of 2010–2012 PA data
- Production cost escalation rate: 5% + 2.5% inflation
- Peak-to-energy ratio: based on average of 2010–2012 PA data

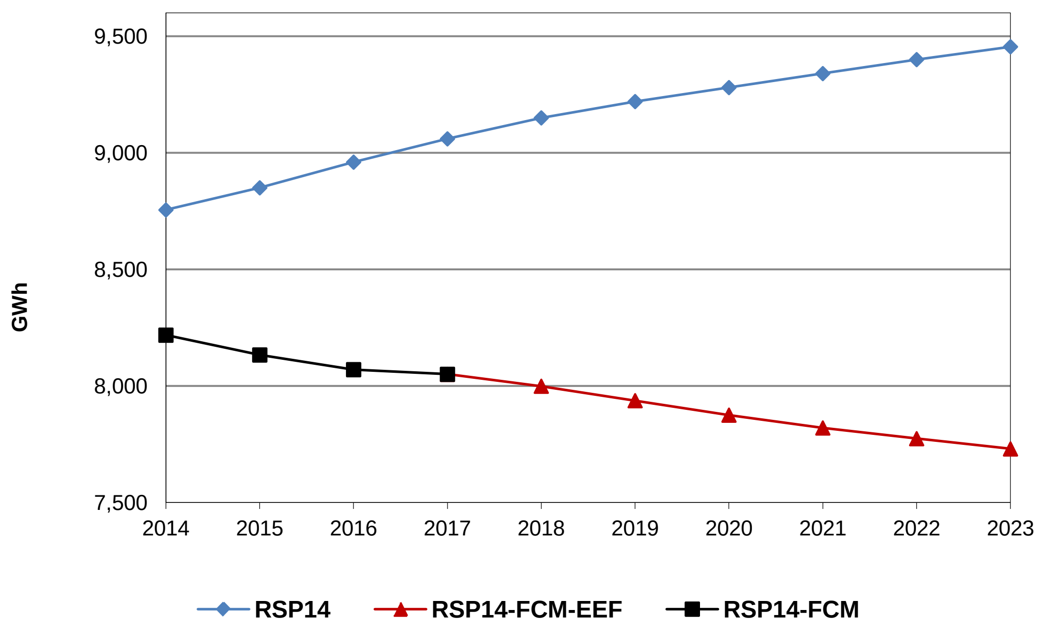


Figure 5-12: Net energy-use load forecast for Rhode Island (diamond), net energy-use load forecast minus FCM #8 results through 2017 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2018 to 2023 (GWh).

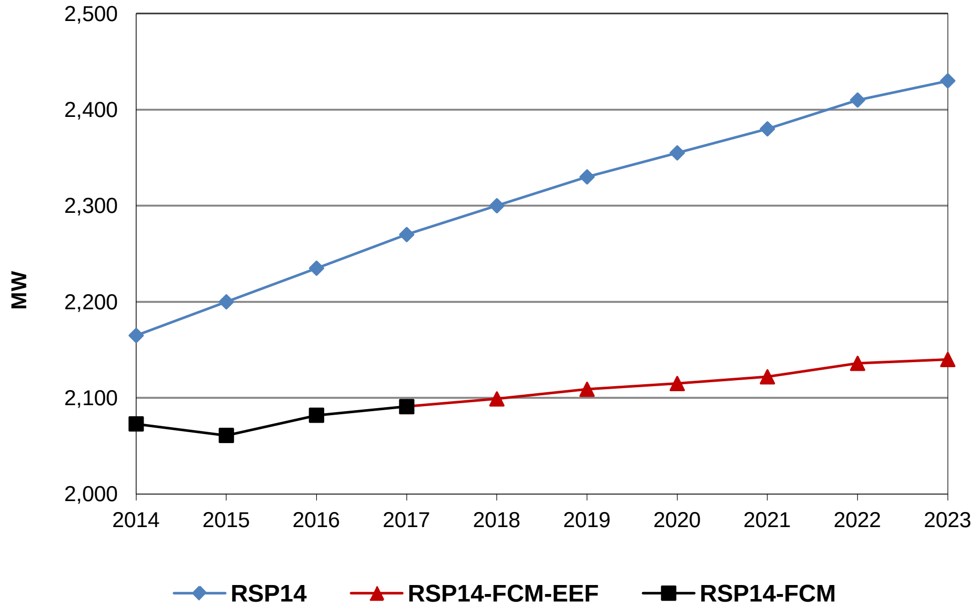


Figure 5-13: Summer peak demand forecast (90/10) for Rhode Island (diamond), load forecast minus FCM #8 results through 2017 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2018 to 2023 (MW).

5.2.6 Vermont

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

- Budget: based on commission-approved 2013–2023 budget
- Budget uncertainty rate: none
- Production cost: based on average of 2010–2012 PA data
- Production cost escalation rate: 5% + 2.5% inflation
- Peak-to-energy ratio: based on average of 2010–2012 PA data

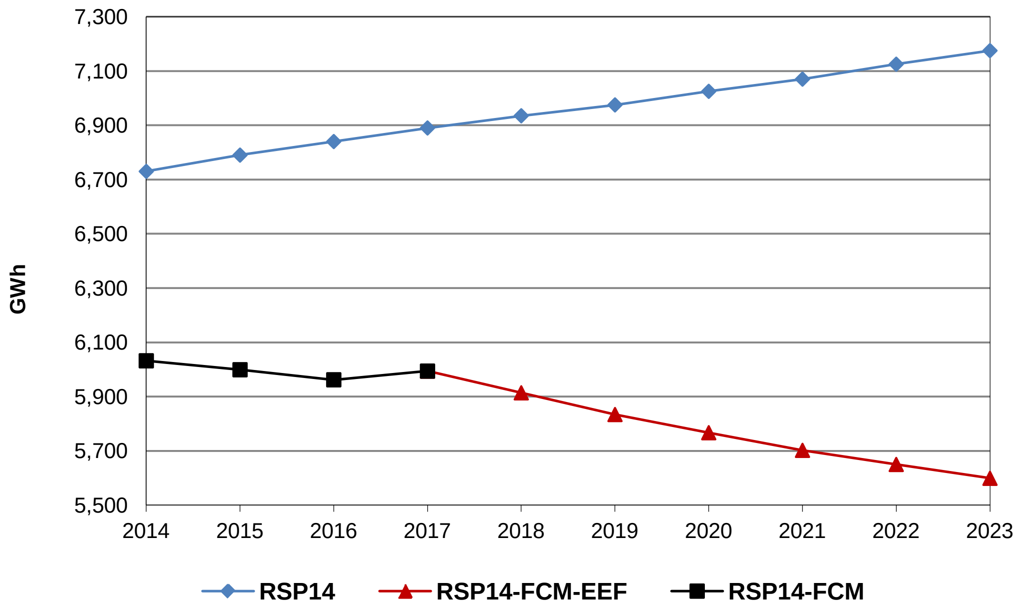


Figure 5-14: Net energy-use load forecast for Vermont (diamond), net energy-use load forecast minus FCM #8 results through 2017 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2018 to 2023 (GWh).

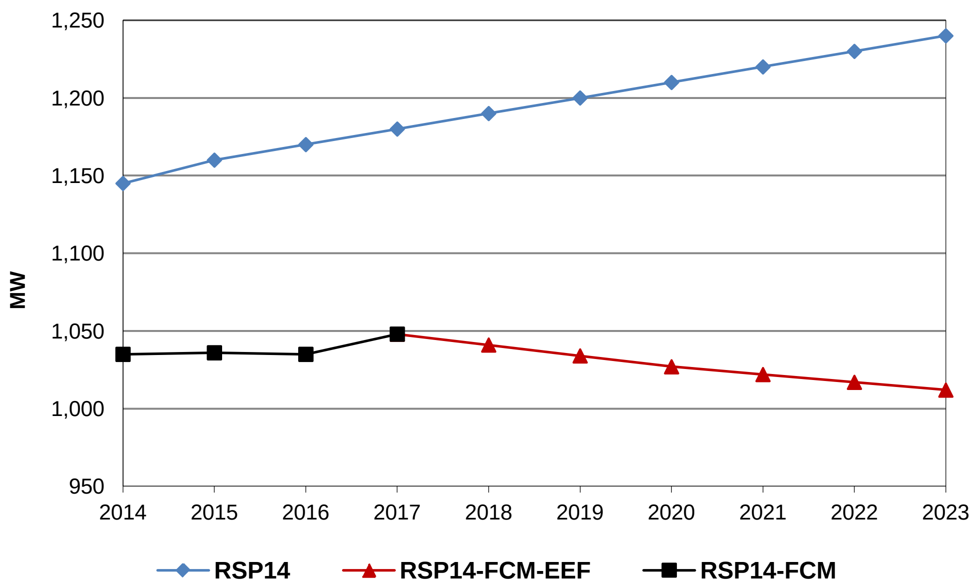
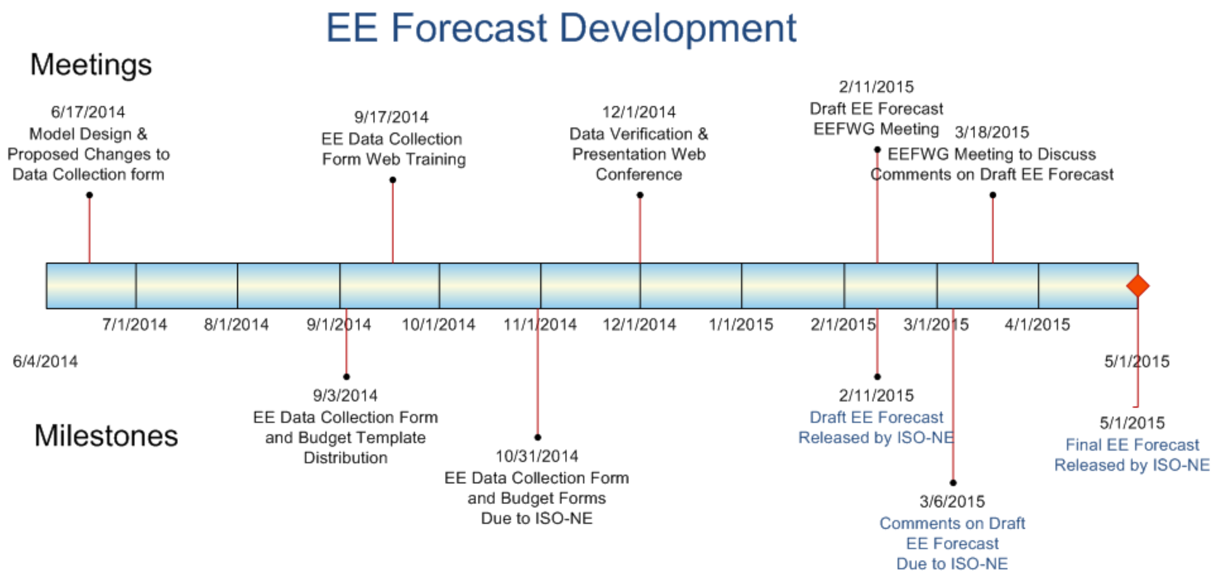


Figure 5-15: Summer peak demand forecast (90/10) for Vermont (diamond), load forecast minus FCM #8 results through 2017 (square), and load forecast minus FCM results and minus the energy-efficiency forecast (triangle) for 2018 to 2023 (MW).

Section 6
Appendix A: 2019 to 2024 Forecast Timeline



Section 7
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 value 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 7-1.

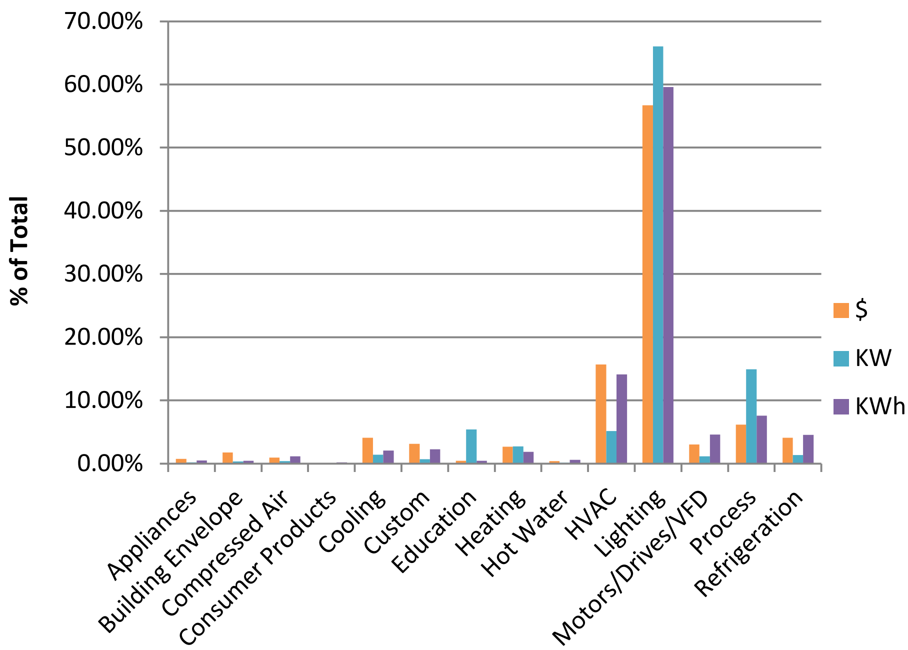


Figure 7-1: Percentage of costs ($), demand (kW), and energy use (KWh), for each type of energy-efficiency measure used by programs in the New England states, total for 2009 to 2012.

The energy impacts of the efficiency measures, shown by class in Figure 5-5, 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).

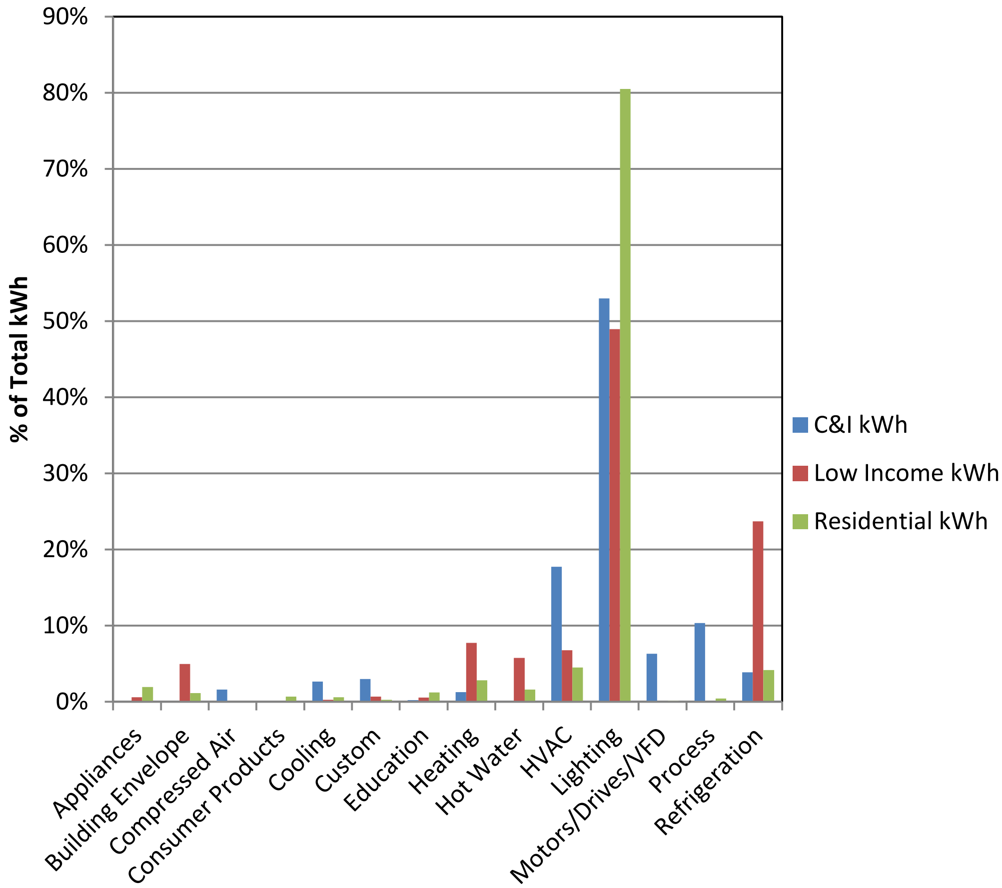


Figure 7-2: Percentage of energy use (kWh) in New England, by type of energy-efficiency measure and sector, total for 2009 to 2011.

As shown in Figure 7-3, 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.[30] These technologies would be supported by the deployment of heat pumps and heat-pump water

[30] *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).

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.

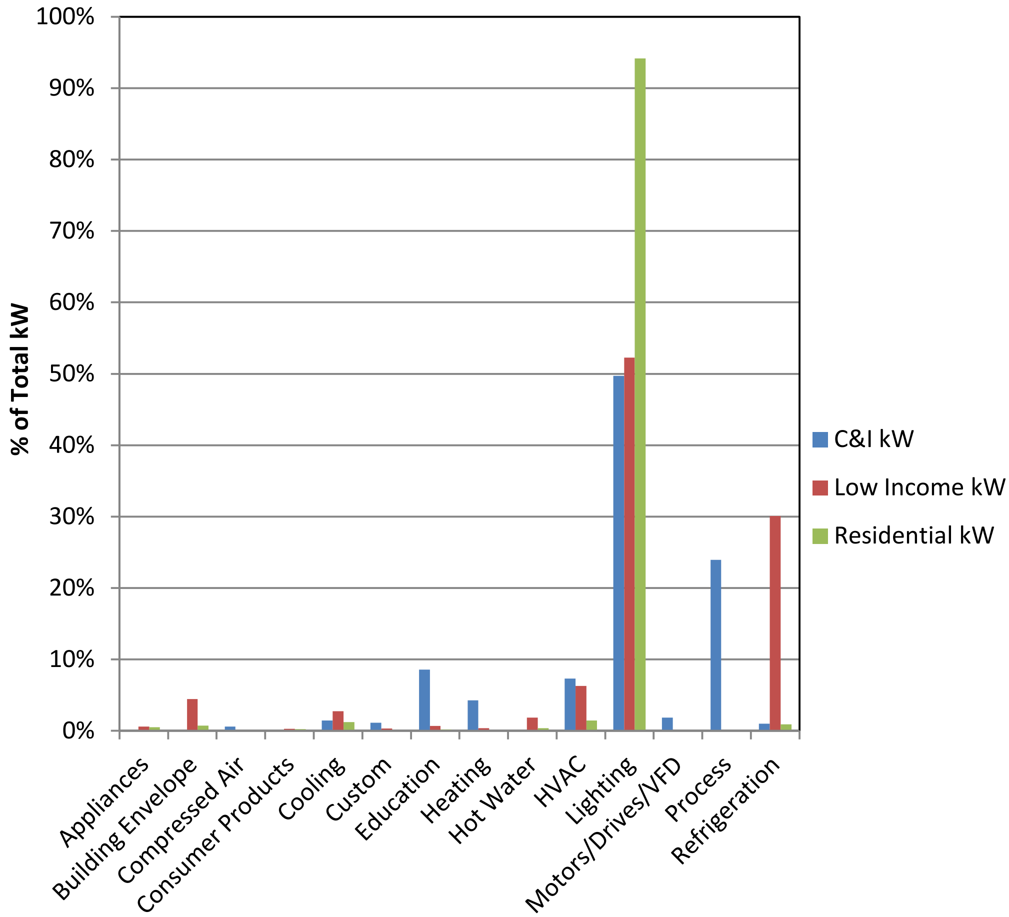


Figure 7-3: Percentage of demand (KW) in New England, by type of energy-efficiency measure and sector, total for 2009 to 2011.

The distribution of program funding across the measures also follows the general trends described above and shown in Figure 5-7. 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.

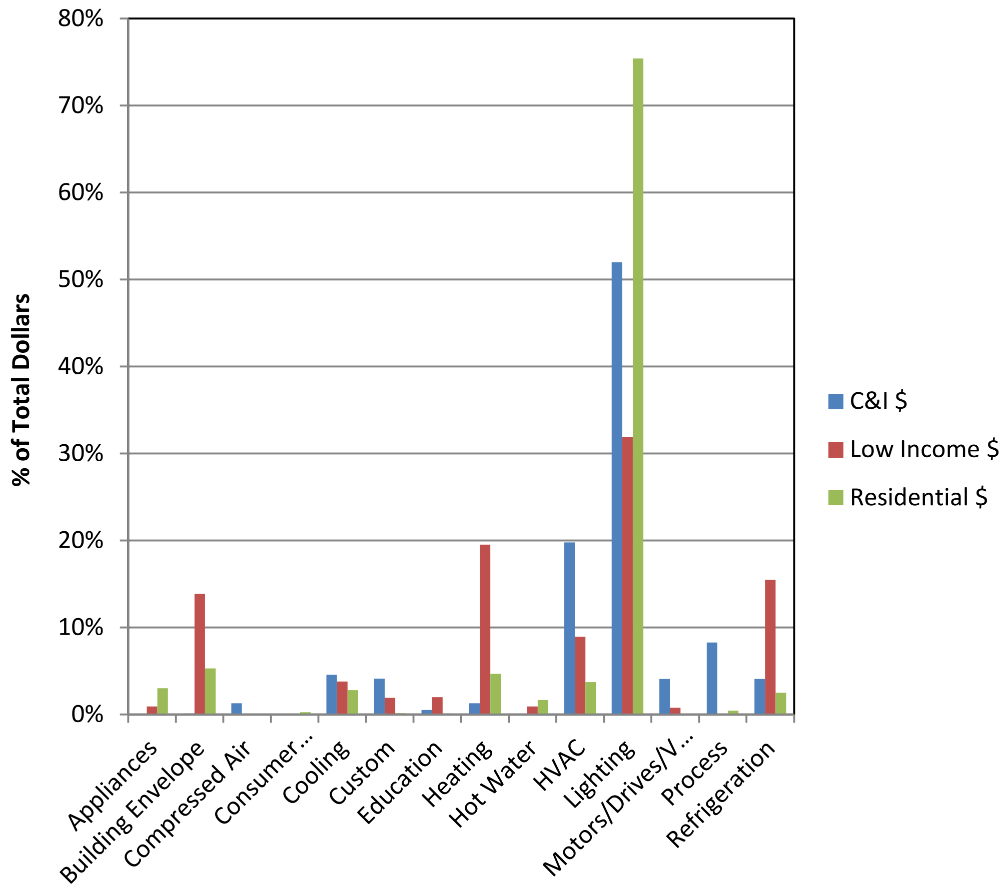


Figure 7-4: Percentage investment ($) in energy-efficiency measures in New England, by type of measure and sector, total for 2009 to 2012.

7.1 State-Level Measure Trends

The following representations (Figure 7-5 to Figure 7-11) 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 indisputable.

7.1.1 Connecticut

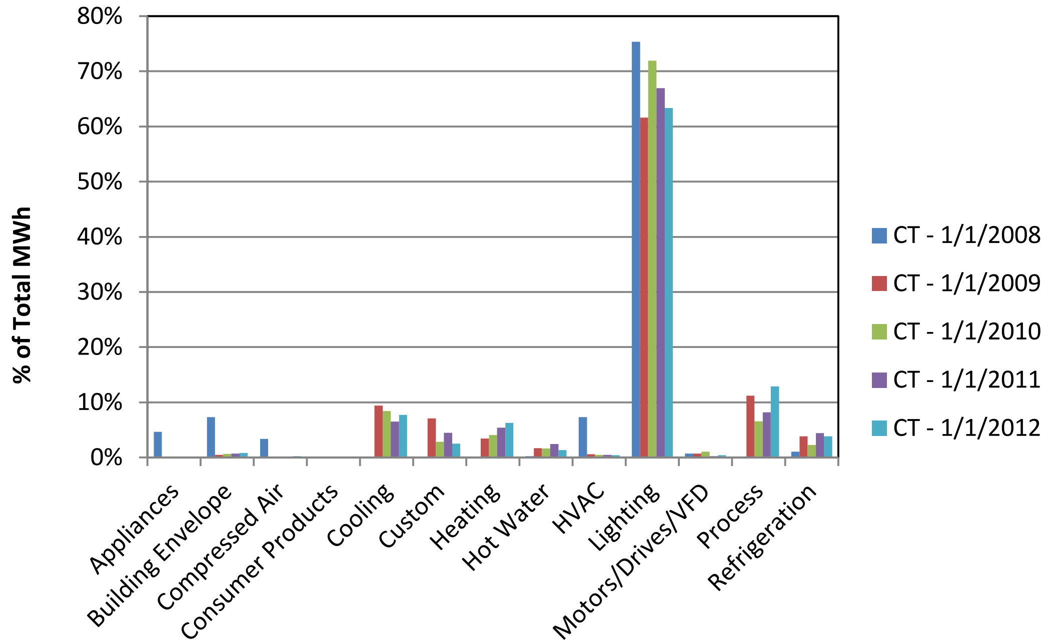


Figure 7-5: Percentage contributions to energy savings (MWh) in Connecticut by various measures, 2008 to 2012.

7.1.2 Massachusetts

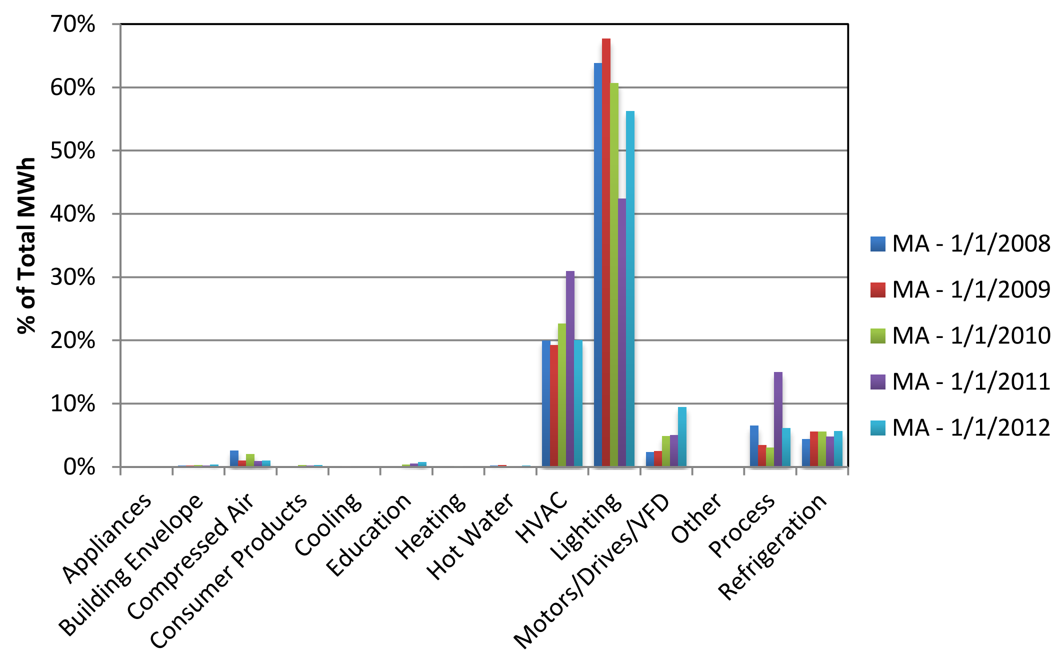


Figure 7-6: Percentage contributions to energy savings (MWh) in Massachusetts by various measures, 2008 to 2012.

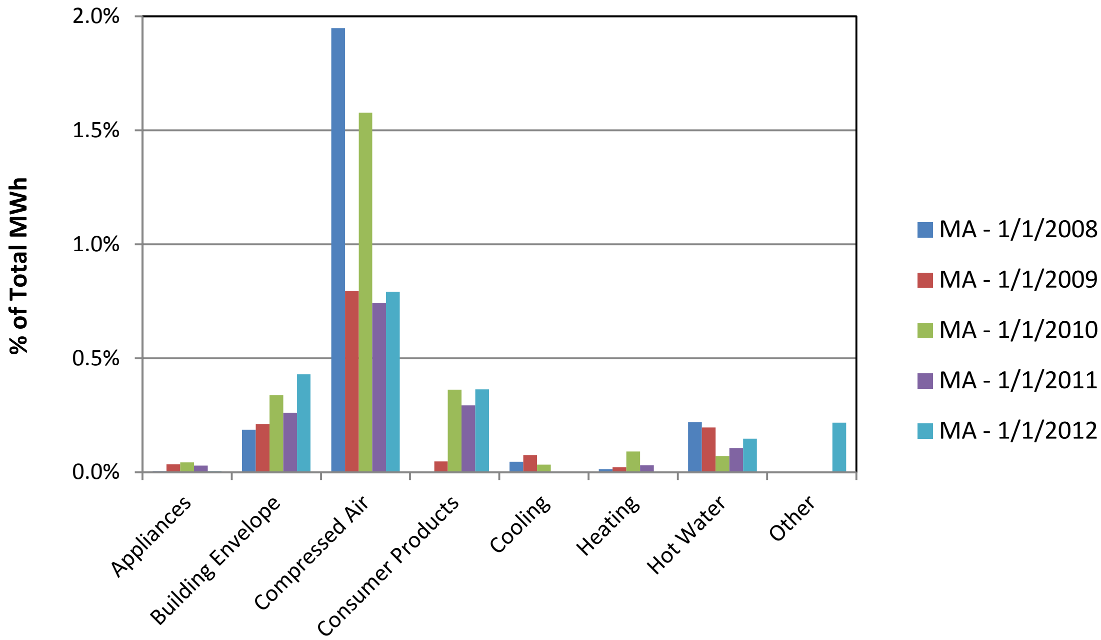


Figure 7-7: Percentage contributions to energy savings (MWh) in Massachusetts by various measures, 2008 to 2012; detail of low percentage measures.

7.1.3 Maine

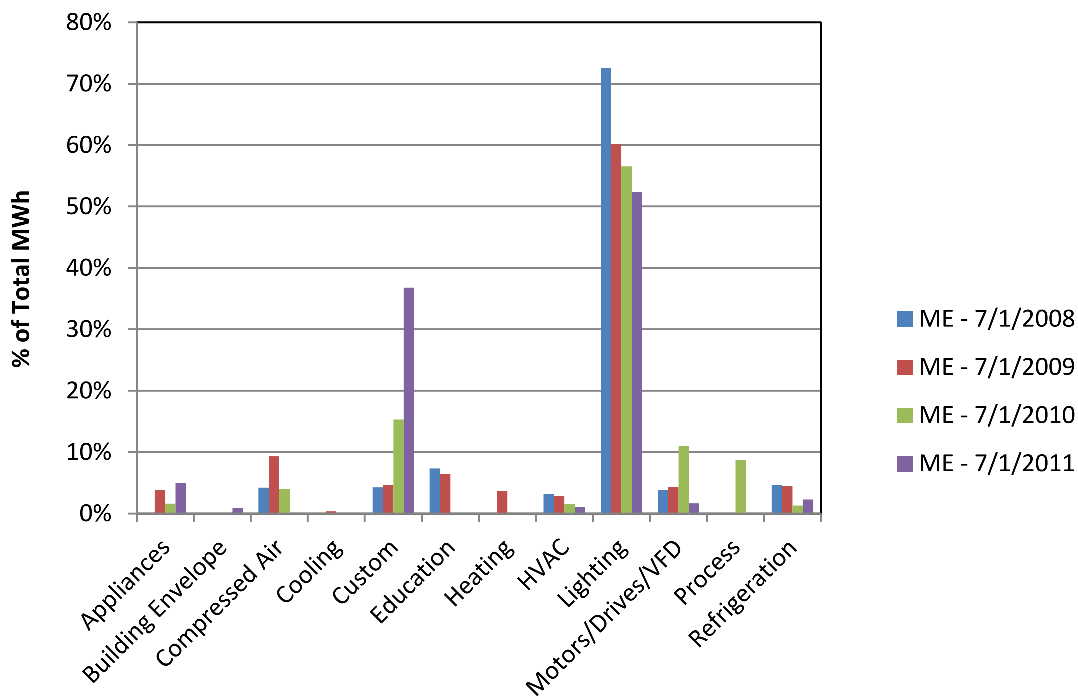


Figure 7-8: Percentage contributions to energy savings (MWh) in Maine by various measures, 2008 to 2011.

7.1.4 Rhode Island

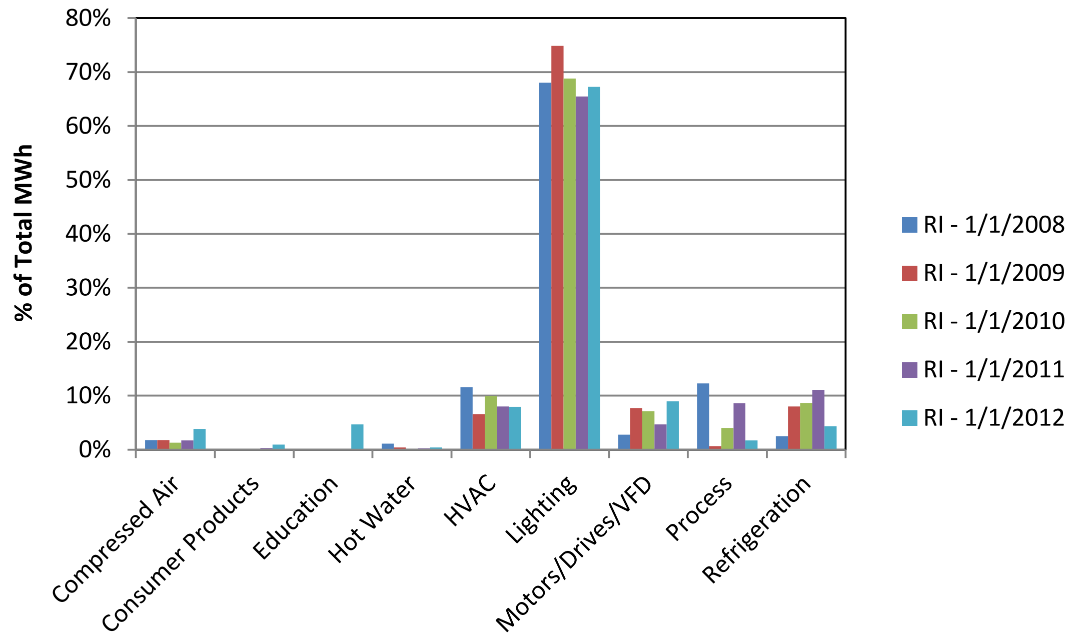


Figure 7-9: Percentage contributions to energy savings (MWh) in Rhode Island by various measures, 2008 to 2012.

7.1.5 New Hampshire

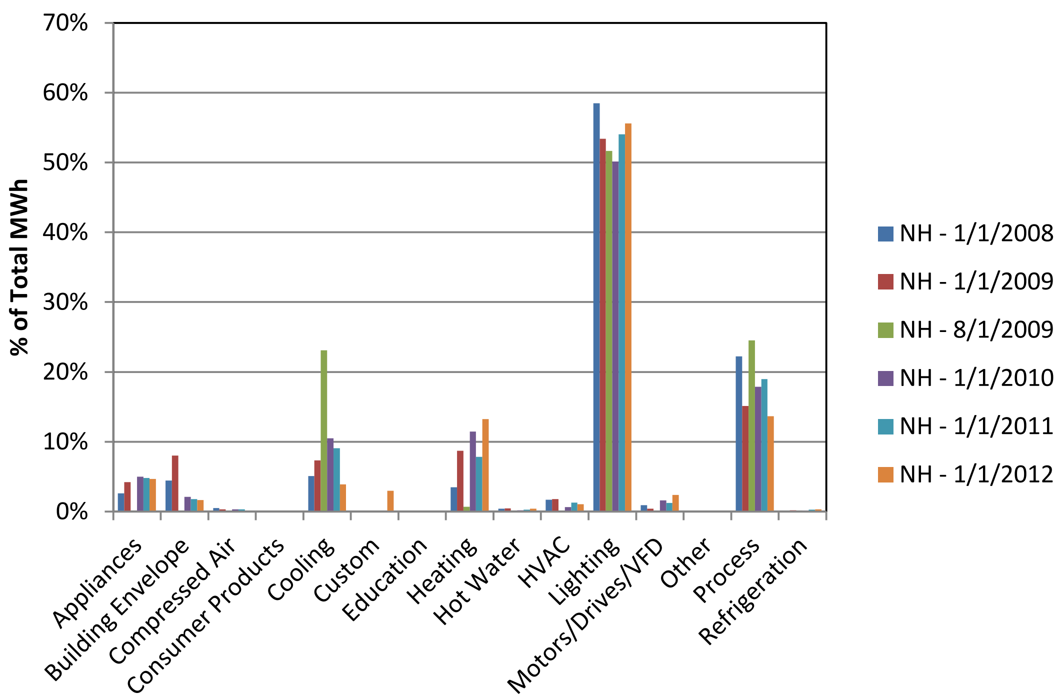


Figure 7-10: Percentage contributions to energy savings (MWh) in New Hampshire by various measures, 2008 to 2012.

7.1.6 Vermont

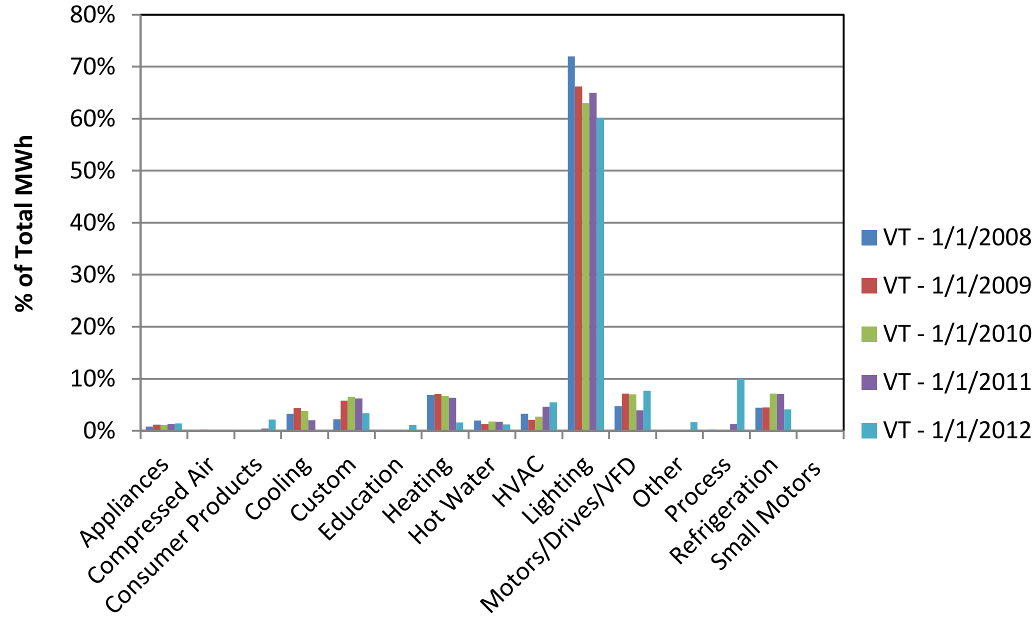


Figure 7-11: Percentage contributions to energy savings (MWh) in Vermont by various measures, 2008 to 2012.

7.2 Analysis of Production Cost Savings by Energy-Efficiency Measure

Production cost data for each type of measure were examined. Table 7-2 and Table 7-2 illustrate the relative dollar cost per megawatt-hour and megawatt, respectively. Null and "n/a" values in the tables reflect missing data on the percentage of costs within a program for a particular measure (percentage dollars cost) and zero savings, respectively, both attributable to an incomplete dataset. These values equal total costs divided by savings for all periods. Although the data are not conclusive and do not indicate specific trends in cost, they do show the relative magnitude of the cost differences across the different types of measures.

Table 7-1
Net Annualized Production Cost for Various Energy-Efficiency Measures for Each New England State (Sum of $/MWh)

Energy-EfficiencyMeasure	State[(a)]					
	CT	MA	ME	NH	RI	VT
Appliances	355	491	215	521	n/a	552
Building envelope	827	2,265	835	1,820	n/a	n/a
Compressed air	142	197	296	null	null	172
Consumer products	22	147	n/a	null	null	29
Cooling	713	434	null	273	n/a	null
Custom	601	n/a	197	null	n/a	null
Heating	572	5,467	244	333	n/a	244
Hot water	269	419	n/a	33	null	187
HVAC	449	390	182	6	null	222
Lighting	202	194	111	97	null	142
Motors/drives/VFD	191	215	144	39	null	11
Other	n/a	706	n/a	null	n/a	264
Process	315	178	152	239	null	217
Refrigeration	422	268	278	3	null	237
Small motors	n/a	n/a	n/a	n/a	n/a	487

(a) "Null" refers to no cost estimate due to missing percentage dollars cost data, and "n/a" refers to zero savings.

Table 7-2
Cost Based on Net Annualized Savings for Various Energy-Efficiency Measures for each New England State (Sum of $/MW)

Energy-Efficiency Measure	Measure Cost per MW by State[(a)] ($/MW)					
	CT	MA	ME	NH	RI	VT
Appliances	475	553	222	561	n/a	474
Building envelope	672	1,415	682	1,756	n/a	n/a
Compressed air	221	230	424	n/a	null	562
Consumer products	22	159	n/a	n/a	null	23
Cooling	312	143	null	102	n/a	n/a
Custom	885	n/a	180	n/a	n/a	null
Heating	3,037	7,375	152	1,684	n/a	365
Hot water	378	295	n/a	73	null	363
HVAC	189	339	114	493	null	761
Lighting	217	222	113	241	null	342
Motors/drives/VFD	250	230	213	1,018	null	120
Other	n/a	686	n/a	n/a	n/a	420
Process	473	175	93	240	null	273
Refrigeration	461	265	308	793	null	310
Small motors	n/a	n/a	n/a	n/a	n/a	215

(a) "Null" refers to no cost estimate due to missing percentage dollars cost data, and "n/a" refers to zero savings.

Under the grouping covering cost per annualized megawatt-hour, lighting measures clearly were the least costly universally across all states, while the building-envelope measure universally were the most costly. Massachusetts and Connecticut appear to have spent the most per megawatt-hour compared with the other states (except RI, which had no data). With respect to cost per megawatt, lighting and consumer products appear to have provided the greatest reductions in demand per dollar spent. The heating category, followed by the building-envelope category, delivered demand savings at the greatest cost. The cost per unit demand savings also exhibited wide variation across the states.