nationalgrid

Rhode Island
Technical Reference Manual

For Estimating Savings from Energy Efficiency Measures

2015 Program Year

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Acknowledgements

This document is the fourth edition of the Rhode Island Technical Reference Manual (“TRM”). It was produced by Sean Murphy.

Introduction

This *Rhode Island Technical Reference Manual* ("TRM") documents for regulatory agencies, customers, and other stakeholders the methodologies and assumptions used by National Grid to estimate the savings, including reductions in energy and demand consumption and other resource and non-energy impacts, attributable to its electric and gas energy efficiency programs. This reference manual provides methods, formulas and default assumptions for estimating energy, peak demand and other resource and non-energy impacts from efficiency measures.

Within this TRM, efficiency measures are organized by the sector for which the measure is eligible and by the primary energy source associated with the measure. The two sectors are Residential and Commercial & Industrial ("C&I"). The primary energy sources addressed in this TRM are electricity and natural gas.

Each measure is presented in its own section as a "measure characterization." The measure characterizations provide mathematical equations for determining savings (algorithms), as well as default assumptions and sources, where applicable. In addition, any descriptions of calculation methods or baselines are provided as appropriate. The parameters for calculating savings are listed in the same order for each measure.

Algorithms are provided for estimating annual energy and peak demand impacts for primary and secondary energy sources if appropriate. In addition, algorithms or calculated results may be provided for other non-energy impacts (such as water savings or operation and maintenance cost savings). Assumptions are based on Rhode Island data where available. Where Rhode Island-specific data is not available, assumptions may be based on: 1) manufacturer and industry data, 2) a combination of the best available data from jurisdictions in the same region, or 3) engineering judgment to develop credible and realistic factors.

The TRM will be reviewed and updated annually to reflect changes in technology, baselines and evaluation results.

The TRM in the Context of Energy Efficiency Programs

Overview

The purpose of this section is to show how the TRM fits into the process of administering energy efficiency programs in Rhode Island. This section explains how the TRM is connected to the following efforts:

- Planning,
- Annual reporting,
- Updates to PA tracking systems,
- Evolution of program and measure cost effectiveness analysis tools,
- Evaluation, Measurement and Verification ("EM&V"),
- Quality control.

Planning and Reporting

National Grid is submitting this fourth version of the RI TRM (the 2015 TRM) to the stakeholders along with its Energy Efficiency Program Plan ("EE Program Plan") for 2015.

The RI TRM provides regulators and stakeholders with documentation of the assumptions and algorithms that National Grid will use in planning and reporting its energy savings for 2015. It can also be used to support qualification in ISO-New England Forward Capacity Market Auctions. However, due to the nature of planning, not all planning assumptions – such as those for Commercial and Industrial programs – are documented in this TRM. For these areas, the algorithms used to calculate planned savings are presented.

Updates to Program Administrator Tracking Systems

National Grid maintains a tracking system that contains the energy efficiency data that it uses to meet its annual reporting to the RI PUC. The current design of the tracking system influences the types of assumptions and algorithms that appear in this TRM. The current algorithms leverage inputs that National Grid collects.

Evolution of Program and Measure Cost Effectiveness Analysis Tools

The program and measure cost effectiveness analysis tools are Microsoft® Excel® workbooks used by National Grid to ensure that the measures and programs that they implement meet the cost effectiveness requirements defined by the Rhode Island PUC in Dockets 3931 and 4202. National Grid also uses the output from the cost effectiveness analysis tools to develop the input (data, tables, and graphs) for its EE Program Plans and Year-End Reports. National Grid envisions aligning the measure names and the categorization of measures in the TRM with the measure names and categorization of measures in the cost effectiveness analysis tools either directly, or through the use of a translation tool.

Evaluation, Measurement and Verification

Evaluation, Measurement and Verification ("EM&V") ensures that the programs are evaluated, measured, and verified in a way that provides confidence to the public at large that the savings are real and in a way that enables National Grid to report those savings to the EERMC and RI PUC with full confidence.

The 2015 Rhode Island TRM will be updated with any updates to assumptions and algorithms due EM&V results from the time when it and the 2015 EE Program Plan are submitted.

A secondary goal of creating a TRM is to identify areas where savings calculations can be improved. The TRM will inform future EM&V planning as a means to make these improvements.

For its Rhode Island programs, National Grid may use evaluation results from other jurisdictions. For some of these, Rhode Island contributed sites and/or budgets. For others, the application of results from other jurisdictions is considered based on how similar the programs, delivery, and markets are to those in Rhode Island.

Quality Control

Regulators and stakeholders can use the TRM to confirm that savings inputs and calculations are reasonable and reliable. However, the TRM cannot be used by regulators and stakeholders to replicate the Company's reported savings. The TRM does not provide regulators and stakeholders with data inputs at a level that is detailed enough to enable replication of the savings reported by PAs. These calculations occur within tracking systems, within separate Excel workbooks, and within cost effectiveness analysis tools. However, in the event that regulators and stakeholders request that PAs provide tracking system details, the reproduction of reported data will be possible using the TRM.

TRM Update Process

Overview

This section describes the process for updating the TRM. The update process is synchronized with the filing of EE Program Plans.

Updates to the TRM can include:

- additions of new measures,
- updates to existing TRM measures due to:
    - changes in baseline equipment or practices, affecting measure savings
    - changes in efficient equipment or practices, affecting measure savings
    - changes to deemed savings due the revised assumptions for algorithm parameter values (e.g., due to new market research or evaluation studies)
    - other similar types of changes,
- updates to impact factors (e.g., due to new impact evaluation studies),
- discontinuance of existing TRM measures, and
- updates to the glossary and other background material included in the TRM.

Each TRM is associated with a specific program year, which corresponds to the calendar year. The TRM for each program year is updated over time as needed to both plan for future program savings and to report actual savings.

Key Stakeholders and Responsibilities

Key stakeholders and their responsibilities for the TRM updates are detailed in the following table.

Stakeholder	**Responsibilities**
National Grid	▪ Identify and perform needed updates to the TRM ▪ Provide TRM to interested stakeholders
Rhode Island EERMC and Division of Public Utilities and Carriers	▪ In 2012, the EERMC commissioned the Natural Gas Opportunities Report ▪ Review; suggest modifications; and accept TRM ▪ Assure coordination with National Grid submissions of program plans and reported savings
Jointly	▪ Administrative coordination of TRM activities, including: o Assure collaboration and consensus regarding TRM updates o Assure updates are compiled and incorporated into the TRM o Coordinate with related program activities (e.g., evaluation and program reporting processes)

TRM Update Cycle

The description below indicates the main milestones of the TRM update cycle over a period of two years. The identifier "program year" or "PY" is used to show that this cycle will be repeated every year. For example, for the 2016 Program Year, compilation of updates will begin after the 2015 TRM is completed in October 2014, and will continue through September 2015, for submission in November 2015.

September PY-2 to September PY-1: The PY TRM will be updated as needed based on evaluation studies and any other updates.

After the PY-1 TRM has been filed, there may be updates to the TRM. The most common updates to the TRM will result from new evaluation studies. Results of evaluation studies will be integrated into the next version of the TRM as the studies are completed. Other updates may include the results of group discussions to adopt latest research or the addition or removal of energy efficiency measures

November (PY-1) prior to program year: The PY TRM is filed with National Grid's PY EE program plan

The PY TRM is submitted to the PUC jointly with National Grid's EE program plan. With regard to the program plans, the TRM is considered a "planning document" in that it provides the documentation for how the PAs *plan* to count savings for that program year. The TRM is not intended to fully document how the PAs develop their plan estimates for savings.

January PY: National Grid begins to track savings based on the PY TRM

Beginning in January PY, the PAs will track savings for the PY based on the PY TRM.

Measure Characterization Structure

This section describes the common entries or inputs that make up each measure characterization. A formatted template follows the descriptions of each section of the measure characterization.

Source citations: The source of each assumption or default parameter value should be properly referenced in a footnote.

Measure Name

A single device or behavior may be analyzed as a range of measures depending on a variety of factors which largely translate to where it is and who is using it. Such factors include hours of use, location, and baseline (equipment replaced or behavior modified). For example, the same screw-in compact fluorescent lamp will produce different savings if installed in an emergency room waiting area than if installed in a bedside lamp.

Version Date

This section will include the date that the measure is effective, which corresponds to the Program Year.

Measure Category Overview

This section will include a plain text description of the efficient and baseline technology and the benefit(s) of its installation, as well as subfields of supporting information including:

- **Description:** Description of the energy efficiency measure, its benefits, and applications.
- **Baseline Efficiency Case:** Description of the assumed equipment/operation efficiency in the absence of program intervention. Multiple baselines will be provided as needed, e.g., for different markets. Baselines may refer to reference tables or may be presented as a table for more complex measures)
- **High Efficiency Case:** Description of the assumed or calculated equipment/operation efficiency from which the energy and demand savings are determined. The high efficiency case may be based on specific details of the measure installation, minimum requirements for inclusion in the program, or an energy efficiency case based on historical participation. It may refer to tables within the measure characterization or in the appendices or efficiency standards set by organizations such as ENERGY STAR® or the Consortium for Energy Efficiency
- **Sector:** Indicates whether measure is Residential, Income Eligible or Commercial and Industrial
- **End-Use:** Indicates whether measure is Lighting, HVAC, Hot Water, Products, Food Service, Compressed Air, Motors/Drives, Refrigeration, Behavior, or Custom
- **Market (Lost Opportunity):** Indicates if measure is in a Lost Opportunity Program (Yes or No)
- **Market (Retrofit):** Indicates if measure is in a Retrofit Program (Yes or No)
- **Electric Energy Impact:** Indicates if measure has electric energy impacts (Yes or No)

- **Gas Energy Impact:** Indicates if measure has gas energy impacts (Yes or No)
- **Oil Energy Impact:** Indicates if measure has oil energy impacts (Yes or No)
- **Non-Energy Impact:** Indicates if measure has non-energy impacts (Yes or No)
- **Water Resource Impact:** Indicates if a measure has water resource impacts (Yes or No)

Savings

This section includes various information on the measure savings and how they are determined.

- **Summary Average Gross Savings per Unit by Program:** This table summarizes the resource savings (kWh, kW, MMBtu) of all efficiency offerings within a measure category via a weighted average of their savings. This is only for illustrating savings and does not correspond to how savings are tracked
    - **Program:** This describes the programs in which the measures are offered. Some measures are offered in multiple program

Sector and Program name mapping will be as follows:

Sector	Full Program Name
Residential – Electric	EnergyStar® Homes
	EnergyStar® HVAC
	EnergyWise
	EnergyWise Multifamily
	EnergyStar® Lighting
	Home Energy Reports
	EnergyStar® Products
Income Eligible – Electric	Single Family Appliance Management
	Income Eligible Multifamily
Commercial & Industrial – Electric	Commercial New Construction
	Commercial Retrofit
	Direct Install
Residential – Gas	EnergyStar® Heating System
	EnergyWise
	EnergyWise Multifamily
	Home Energy Reports
	Residential New Construction
Income Eligible – Gas	Single Family Appliance Management
	Income Eligible Multifamily
Commercial & Industrial – Gas	Commercial New Construction
	Commercial Retrofit
	Direct Install
	Commercial & Industrial Multifamily

- **Algorithm Type:** This section describes which of four methods of savings calculation applies to a measure
  - Deemed: The same savings are allocated to every unit of a measure
  - Engineering Algorithm with Deemed Inputs: Measure savings are calculated with an engineering formula, the inputs of which are constant for all units of a measure.
  - Engineering Algorithm with Site Specific Inputs: Measure savings are calculated with an engineering formula, the inputs of which depend on data from the installation site.
  - Custom: Each unit of a measure receives a unique savings calculation that depends on site specific data.
- **Units:** This section describes what is installed or affected by an efficiency measure (eg. a boiler or a participant). It defines the quantity counted for savings.
- **Algorithm:** This section will describe the method for calculating the primary energy savings in appropriate units, i.e., kWh for electric energy savings or MMBtu for natural gas energy savings. The savings algorithm will be provided in a form similar to the following

$$\Delta kWh = \Delta kW \times Hours$$

Similarly, the method for calculating electric demand savings will be provided in a form similar to the following:

$$\Delta kW = (Watts_{BASE} - Watts_{EE})/1000$$

Below the savings algorithms, a table contains the definitions (and, in some cases, default values) of each input in the equation(s). The inputs for a particular measure may vary and will be reflected as such in this table (see example below).

ΔkWh	=	gross annual kWh savings from the measure
ΔkW	=	gross connected kW savings from the measure
Hours	=	average hours of use per year
$Watts_{BASE}$	=	baseline connected kW
$Watts_{EE}$	=	energy efficient connected kW

- **Hours**: The operating hours for equipment that is either on or off, or equivalent full load hours for technologies that operate at partial loads, or reduced hours for controls. Reference tables will be used as needed to avoid repetitive entries.
- **Measure Gross Savings per Unit:** This table summarizes the unit resource impacts of each efficiency offering within a measure category (e.g., the savings for boilers of different efficiencies and ratings in the Boiler measure category). The source for each value is referenced.

- **Non-Energy Impacts:** This refers the reader to tables in the Appendix that describe non-energy impacts associated with a given efficiency measure. If the measure has no NEIs, the entry is "N/A."
- **Evaluation Approach:** This section is for future use. It will describe the evaluation approach applied to calculate the savings in accordance with ISO-New England Forward Capacity Market definitions.

Impact Factors for Calculating Adjusted Gross Savings:

This section includes a table of impact factor values for adjusting gross savings and calculating lifetime savings. Sources are referenced. Impact factors (free ridership, spillover and/or net-to-gross ratio) for calculating net savings from adjusted gross savings are in Appendix B.

- **Measure Life:** Measure Life includes equipment life and the effects of measure persistence. Equipment life is the number of years that a measure is installed and will operate until failure. Measure persistence takes into account business turnover, early retirement of installed equipment, and other reasons measures might be removed or discontinued.

Other impact factors are defined in the next section.

Impact Factors for Calculating Adjusted Gross and Net Savings

National Grid uses the algorithms in the Measure Characterization sections to calculate the gross savings for energy efficiency measures. Impact factors are then applied to make various adjustments to the gross savings estimate to account for the performance of individual measures or energy efficiency programs as a whole in achieving energy reductions as assessed through evaluation studies. Impacts factors address both the technical performance of energy efficiency measures and programs, accounting for the measured energy and demand reductions realized compared to the gross estimated reductions, as well as the programs' effect on the market for energy efficient products and services.

This section describes the types of impact factors used to make such adjustments, and how those impacts are applied to gross savings estimates. Definitions of the impact factors and other terms are also provided in the Glossary (Appendix F).

Types of Impact Factors

The impact factors used to adjust savings fall into one of two categories:

Impact factors used to adjust gross savings:

- In-Service Rate ("ISR")
- Savings Persistence Factor ("SPF")
- Realization Rate ("RR")
- Summer and Winter Peak Demand Coincidence Factors ("CF").

Impact factors used to calculate net savings:

- Free-Ridership ("FR") and Spillover ("SO") Rates
- Net-to-Gross Ratios ("NTG").

The **in-service rate** is the actual portion of efficient units that are installed. For example, efficient lamps may have an in-service rate less than 1.00 since some lamps are purchased as replacement units and are not immediately installed. The ISR is 1.00 for most measures.

The **savings persistence factor** is the portion of first-year energy or demand savings expected to persist over the life of the energy efficiency measure. The SPF is developed by conducting surveys of installed equipment several years after installation to determine the actual operational capability of the equipment. The SPF is 1.00 for most measures.

In contrast to savings persistence, *measure persistence* takes into account business turnover, early retirement of installed equipment, and other reasons the installed equipment might be removed or discontinued. Measure persistence is generally incorporated as part of the measure life, and therefore is not included as a separate impact factor.

The **realization rate** is used to adjust the gross savings (as calculated by the savings algorithms) based on impact evaluation studies. The realization rate is equal to the ratio of measure savings developed from an impact evaluation to the estimated measure savings derived from the savings algorithms. The realization rate does not include the effects of any other impact factors. Depending on the impact evaluation study, there may be separate realization rates for energy (kWh), peak demand (kW), or fossil fuel energy (MMBtu).

A **coincidence factor** adjusts the connected load kW savings derived from the savings algorithm. A coincidence factor represents the fraction of the connected load reduction expected to occur at the same time as a particular system peak period. The coincidence factor includes both coincidence and diversity factors combined into one number, thus there is no need for a separate diversity factor in this TRM.

Coincidence factors are provided for the on-peak period as defined by the ISO New England for the Forward Capacity Market ("FCM"), and are calculated consistently with the FCM methodology. Electric demand reduction during the ISO New England peak periods is defined as follows:

- Summer On-Peak: average demand reduction from 1:00-5:00 PM on non-holiday weekdays in June July, and August
- Winter On-Peak: average demand reduction from 5:00-7:00 PM on non-holiday weekdays in December and January

The values described as Coincidence Factors in the TRM are not always consistent with the strict definition of a Coincidence Factor (CF). It would be more accurate to define the Coincidence Factor as "the value that is multiplied by the Gross kW value to calculate the average kW reduction coincident with the on-peak periods." A coincidence factor of 1.00 may be used because the coincidence is already included in the estimate of Gross kW; this is often the case when the "Max kW Reduction" is not calculated and instead the "Gross kW" is estimated using the annual kWh reduction estimate and a loadshape model.

A **free-rider** is a customer who participates in an energy efficiency program (and gets an incentive) but who would have installed some or all of the same measure(s) on their own, with no change in timing of the installation, if the program had not been available. The **free-ridership rate** is the percentage of savings attributable to participants who would have installed the measures in the absence of program intervention.

The **spillover rate** is the percentage of savings attributable to a measure or program, but additional to the gross (tracked) savings of a program. Spillover includes the effects of 1) participants in the program who install additional energy efficient measures outside of the program as a result of participating in the program, and 2) non-participants who install or influence the installation of energy efficient measures as a result of being aware of the program. These two components are the **participant spillover** (SO_P) and **non-participant spillover** (SO_{NP}).

The **net savings** value is the final value of savings that is attributable to a measure or program. Net savings differs from gross savings because it includes the effects of the free-ridership and/or spillover rates.

The **net-to-gross** ratio is the ratio of net savings to the gross savings adjusted by any impact factors (i.e., the "adjusted" gross savings). Depending on the evaluation study, the NTG ratio may be determined from the free-ridership and spillover rates, if available, or it may be a distinct value with no separate specification of FR and SO values.

Standard Net–to–Gross Formulas

The TRM measure entries provide algorithms or methodologies for calculating the gross energy and demand savings for each category of efficiency measures. The following standard formulas show how the impact factors are applied to calculate the net savings. These are the calculations used by National Grid to track and report gross and net savings for its energy efficiency programs in Rhode Island.

- **Calculation of Net Annual Electric Energy Savings**

  $net\_kWh = gross\_kWh \times SPF \times ISR \text{ x } RR_E \times NTG$

- **Calculation of Net Summer Electric Peak Demand Coincident kW Savings**

  $net\_kW_{SP} = gross\_kW \times SPF \times ISR \times RR_{SP} \times CF_{SP} \times NTG$

- **Calculation of Net Winter Electric Peak Demand Coincident kW Savings**

  $net\_kW_{WP} = gross\_kW \times SPF \times ISR \times RR_{WP} \times CF_{WP} \times NTG$

- **Calculation of Net Annual Natural Gas Energy Savings**

  $net\_MMbtu = gross\_MMBtu \times SPF \times ISR \times RR_E \times NTG$

Where:

Gross_kWh	=	Gross Annual kWh Savings
net_kWh	=	Net Annual kWh Savings
$Gross\_kW_{SP}$	=	Gross Connected kW Savings (summer peak)
$Gross\_kW_{WP}$	=	Gross Connected kW Savings (winter peak)
net_kW_{SP}	=	Adjusted Gross Connected kW Savings (winter peak)
net_kW_{WP}	=	Net Coincident kW Savings (winter peak)
Gross_MMBtu	=	Gross Annual MMBtu Savings
net_MMBtu	=	Net Annual MMBtu Savings
SPF	=	Savings Persistence Factor
ISR	=	In-Service Rate
CF_{SP}	=	Peak Coincidence Factor (summer peak)
CF_{WP}	=	Peak Coincidence Factor (winter peak)
RR_E	=	Realization Rate for electric energy (kWh)
RR_{SP}	=	Realization Rate for summer peak kW
RR_{WP}	=	Realization Rate for winter peak kW

NTG	=	Net-to-Gross Ratio
FR	=	Free-Ridership Factor
SO_P	=	Participant Spillover Factor
SO_{NP}	=	Non-Participant Spillover Factor

Depending on the evaluation study methodology:

- NTG is equal to (1 – FR + SO_P + SO_{NP}), or
- NTG is a single value with no distinction of FR, SO_P, SO_{NP}, and/or other factors that cannot be reliably isolated.

Measure Characterizations

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Residential Electric Efficiency Measures

Behavior - Basic Educational Measures

Version Date: PY 2015

Description

Installation of basic educational measures during an audit to help customers become more aware of energy efficiency.

Baseline Efficiency

The baseline efficiency case assumes no measures installed.

High Efficiency

The high efficiency case includes basic educational measures such as CFLs, low flow showerheads, pooland air conditioner timers, torchieres, and programmable thermostats.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	Behavior	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Completed audit.

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Baseload	Single Family Appliance	138 (122)	0.038 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Baseload	Single Family Appliance Management	5 (N31)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.35 (135)	1 (135)

Sources

122 The Cadmus Group (2009). Impact Evaluation of the 2007 Appliance Management Program and Low Income Weatherization Program. Prepared for National Grid.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

N31 National Grid assumption based on regional PA working groups.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Behavior - Home Energy Reports

Version Date: PY 2015

Description

A Home Energy report sent to electric customers that displays home energy consumption in comparison with peers and prompts energy conserving behavior.

Baseline Efficiency

A control group of homes that does not receive Home Energy Reports

High Efficiency

A home that receives Home Energy Reports.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	Behavior	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Customer receiving energy reports

Algorithm:

Program impacts are estimated by the program implementer using a linear fixed effects regression (LFER) analysis. The analysis is described in Illume and Navigant Consulting (2014). Rhode Island Behavioral Program and Pilots Impact and Process Evaluation

Gross Summer kW = ΔkW_sp_custom
Gross Winter kW = ΔkW_wp_custom

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Opt-Out electric	Home Energy Reports	Calc (N45)	Calc (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Opt-out dual fuel	Home Energy Reports	Calc (N45)	Calc (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Opt-Out electric	Home Energy Reports	1 (94)	1.00 (N31)	1.00 (N42)	0.93 (63)	0 (N35)	1 (N35)	0.73 (135)	1 (135)
Opt-out dual fuel	Home Energy Reports	1 (94)	1.00 (N31)	1.00 (N42)	1.08 (63)	0 (N35)	1 (N35)	0.73 (135)	1 (135)

Sources

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

63 Illume and Navigant Consulting (2014). Rhode Island Behavioral Program and Pilots Impact and Process Evaluation

94 Opinion Dynamics with Navigant Consulting (2012). Massachusetts Three Year Cross-Cutting Behavioral Program Evaluation Integrated Report July 2012. Prepared for Massachusetts Energy Efficiency Advisory Council & Behavioral Research Team

N31 National Grid assumption based on regional PA working groups.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N42 Savings persistence is 100% since measure life is 1 year.

N45 supplied by vendor

Hot Water - DHW Measures

Version Date: PY 2015

Description

DHW measures include high-efficiency low-flow showerheads and faucet aerators save water and water heating energy.

Baseline Efficiency

The baseline efficiency case is the existing domestic hot water equipment.

High Efficiency

The high efficiency case is the installation of high-efficiency domestic hot water equipment such as low-flow showerheads and faucet aerators.

		Electric Energy Impact:	No
Sector:	Residential	**Gas Energy Impact:**	Yes
End Use:	Hot Water	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	Yes
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed DHW efficiency measure.

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW
Gross MMBtu_Gas = Qty × ΔMMBtu_Gas
Gross MMBtu_Oil = Qty × ΔMMBtu_Oil
Gross MMBtu_Propane = Qty × ΔMMBtu_Propane

Where:
Qty = Total number of units.
ΔkWh = Average annual kWh reduction per unit.
ΔkW = Average kW reduction per unit.
ΔMMBtu_Gas = Average annual natural gas reduction per unit.
ΔMMBtu_Oil = Average annual oil reduction per unit
ΔMMBtu_Propane = Average annual propane reduction per unit

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
DHWater Measure (electric)	Single Family Appliance	134 (122)	0.017 (135)	0 (N/A)	0 (N/A)	0 (N/A)	4028 (89)
DHWater Measure (oil)	Single Family Appliance	0 (N/A)	0 (N/A)	0 (N/A)	0.7 (131)	0 (N/A)	4028 (89)
DHWater Measure (gas & other)	Single Family Appliance	0 (N/A)	0 (N/A)	0.9 (131)	0 (N/A)	0 (N/A)	4028 (89)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
DHWater Measure (electric)	Single Family Appliance Management	7 (N31)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (135)	0.94 (135)
DHWater Measure (oil)	Single Family Appliance Management	7 (N31)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0 (135)	0 (135)
DHWater Measure (gas & other)	Single Family Appliance Management	7 (N31)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0 (135)	0 (135)

Sources

122 The Cadmus Group (2009). Impact Evaluation of the 2007 Appliance Management Program and Low Income Weatherization Program. Prepared for National Grid.

131 The Cadmus Group (2014). Impact Evaluation: Rhode Island Income Eligible Services, Volume II. Prepared for National Grid.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

N31 National Grid assumption based on regional PA working groups.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Hot Water - EW DHW Measures

Version Date: PY 2015

Description

DHW measures including high-efficiency low-flow showerheads and faucet aerators save water and water heating energy.

Baseline Efficiency

The baseline efficiency case is the existing domestic hot water equipment.

High Efficiency

The high efficiency case is the installation of high-efficiency domestic hot water equipment such as low-flow showerheads and faucet aerators.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	Hot Water	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	Yes
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed DHW efficiency measure.

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
EW SF DHW - Elec	EnergyWise	109 (133)	0.016 (135)	0 (N/A)	0 (N/A)	0 (N/A)	4028 (89)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
EW SF DHW - Elec	EnergyWise	7 (N31)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (135)	0.94 (135)

Sources

133 The Cadmus Group, Inc (2012). Rhode Island EnergyWise Single Family Impact Evaluation.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

N31 National Grid assumption based on regional PA working groups.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Hot Water - Faucet Aerators

Version Date: PY 2015

Description

Installation of a faucet aerator with a flow rate of 1.5 GPM or less on an existing faucet with high flow in a commercial setting with service water heated by natural gas.

Baseline Efficiency

The baseline efficiency case is a 2.2 GPM faucet.

High Efficiency

The high efficiency case is a faucet with 1.5 GPM or less aerator installed.

Sector:	Residential
End Use:	Hot Water
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	Yes
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed faucet aerator.

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW

Where:
Qty = Total number of units.
ΔkWh = Deemed average annual kWh reduction per unit.
ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
EW LI Aerator (electric)	Income Eligible MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	Calc (N45)
EW Aerator (Elec Ht)	EnergyWise MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	Calc (N45)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
EW LI Aerator (electric)	Income Eligible MultiFamily	7 (N31)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.58 (135)	1 (135)
EW Aerator (Elec Ht)	EnergyWise MultiFamily	7 (N31)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.58 (135)	1 (135)

Sources

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

14 Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.

N31 National Grid assumption based on regional PA working groups.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N40 Realization rates are 100% since savings estimates are based on evaluation results.

N43 Savings persistence is assumed to be 100%.

Hot Water - Heat Pump Water Heaters

Version Date: PY 2015

Description

Installation of a heat pump water heater (HPWH) instead of an electric resistance water heater.

Baseline Efficiency

The baseline efficiency case is a new, standard efficiency electric resistance hot water heater.

High Efficiency

The high efficiency case is a high efficiency heat pump water heater.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	Hot Water	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed heat pump water heater.

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW

Where:
Qty = Total number of units.
ΔkWh = Deemed average annual kWh reduction per unit.
ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
EW SF HPWH 50 gallon	EnergyWise	1775 (133)	0.37 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
HPWH 50 gallon (electric)	EnergyStar® HVAC	1775 (113)	0.37 (113)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
EW SF HPWH 50 gallon	EnergyWise	10 (N8)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.47 (135)	1 (135)
HPWH 50 gallon (electric)	EnergyStar® HVAC	10 (N8)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.47 (113)	1 (113)

Sources

113 Steven Winter Associates, Inc (2012). Heat Pump Water Heaters Evaluation of Field Installed Performance. Sponsored by National Grid and NSTAR.

122 The Cadmus Group (2009). Impact Evaluation of the 2007 Appliance Management Program and Low Income Weatherization Program. Prepared for National Grid.

133 The Cadmus Group, Inc (2012). Rhode Island EnergyWise Single Family Impact Evaluation.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

N30 Massachusetts Common Assumption

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

N8 Based on warranty of equipment

Hot Water - Low-Flow Showerheads

Version Date: PY 2015

Description

Installation of a low flow showerhead with a flow rate of 1.5 GPM or less.

Baseline Efficiency

The baseline efficiency case is a showerhead with a flow of 2.5 gpm. For home audit applications, the baseline is the existing showerhead.

High Efficiency

The high efficiency is a low-flow showerhead with a flow of 1.5 gpm or less.

Sector:	Residential
End Use:	Hot Water
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	Yes
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed low-flow showerhead

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Showerheads	Residential New Construction	129 (127)	0.022 (135)	0 (N/A)	0 (N/A)	0 (N/A)	3696 (89)
EW LI Showerheads (Elec Ht)	Income Eligible MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW Showerhead (electric)	EnergyWise MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	Calc (N45)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Showerheads	Residential New Construction	7 (N30)	1.00 (N26)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.58 (135)	1 (135)
EW LI Showerheads (Elec Ht)	Income Eligible MultiFamily	12 (3)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.11 (135)	0.22 (135)
EW Showerhead (electric)	EnergyWise MultiFamily	7 (129)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.58 (135)	1 (135)

Sources

127 The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for the Massachusetts Program Administrators.

129 The Cadmus Group (2012). Rhode Island EnergyWise Single Family Impact Evaluation. Prepared for National Grid

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

14 Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.

3 2013-2015 MA Lighting Worksheet

N26 In-service rates are set to 100% based on the assumption that all purchased units are installed.

N30 Massachusetts Common Assumption

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N40 Realization rates are 100% since savings estimates are based on evaluation results.

N43 Savings persistence is assumed to be 100%.

Hot Water - Low-Flow Showerheads With Controls

Version Date: PY 2015

Description

A showerhead with a control that limits flow once water is heated.

Baseline Efficiency

The baseline case is a showerhead with a flow of 2.5 gallons per minute, or for the case of the adaper, a low flow showerhead with flow of 1.5 gpm or less.

High Efficiency

The high efficiency is a low-flow showerhead with a control that limits flow once the water is heated.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	Hot Water	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	Yes
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit:

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW

Where:
Qty = Total number of units.
ΔkWh = Deemed average annual kWh reduction per unit.
ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Low Flow Showerhead Control - Adapter	EnergyStar® Products	32.5 (142)	0.013 (99)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Low Flow Showerhead Control	EnergyStar® Products	150.2 (142)	0.052 (99)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Low Flow Showerhead Control - Adapter	EnergyStar® Products	7 (N30)	1.00 (N4)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	1 (N/A)	0.58 (N/A)
Low Flow Showerhead Control	EnergyStar® Products	7 (N30)	1.00 (N4)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	1 (N/A)	0.94 (N/A)

Sources

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

142 Verifying Thermostatic Valve Showerhead Savings.xls

99 PGE Low Flow Showerhead and Thermostatic Restriction Valve

N30 Massachusetts Common Assumption

N31 National Grid assumption based on regional PA working groups.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Hot Water - Waterbed Replacement

Version Date: PY 2015

Description

Replacement of waterbed mattress with a standard mattress.

Baseline Efficiency

The baseline efficiency case is an existing waterbed mattress.

High Efficiency

The high efficiency case is a new standard mattress.

Sector:	Residential
End Use:	Hot Water
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Replacement of existing waterbed mattress with new standard mattress.

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW

Where:
Qty = Total number of units.
ΔkWh = Deemed average annual kWh reduction per unit.
ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Waterbed mattress replacement	Single Family Appliance	872 (122)	0.109 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Waterbed mattress replacement	Single Family Appliance Management	10 (62)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.75 (135)	1 (135)

Sources

122 The Cadmus Group (2009). Impact Evaluation of the 2007 Appliance Management Program and Low Income Weatherization Program. Prepared for National Grid.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

62 http://www.serta.com/best-mattress-FAQs-mattresses-Serta-Number--1-Best-Selling-Mattress.html

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Air Source Heat Pump Systems

Version Date: PY 2015

Description

The purchase and installation of high efficiency residential heat pump system rather than a standard HVAC system, or to replace an existing inefficient HVAC system.

Baseline Efficiency

The baseline efficiency case is a residential heat pump with EER = 11.85, SEER = 14 and HSPF = 8.2. Forearly replacement installations, the baseline is a 10-12 year old HVAC unit with SEER = 10, EER = 8.5and HSPF = 7.0.

High Efficiency

The high efficiency case is an ENERGY STAR® qualified air-source heat pump.

Sector:	Residential
End Use:	HVAC
Market (Lost Opportunity):	Yes
Market (Retrofit):	No

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with deemed inputs

Unit: Installed high-efficiecny air-source heat pump system for heating.

Algorithm:

Gross kWh = Tons × 12 × [(1/SEER_base - 1/SEER_ee) × Hours_C + (1/HSPF_base - 1/HSPF_ee) × Hours_H]

Gross kW = Tons × 12 × max[(1/SEER_base - 1/SEER_ee),(1/HSPF_base - 1/HSPF_ee)]

Where:

Tons = Deemed average equipment cooling capacity: 3 tons **6**

SEER_base = Seasonal Energy Efficiency Ratio of baseline equipment.

SEER_ee = Seasonal Energy Efficiency Ratio of new equipment.

Hours_C = Deemed average equivalent full load cooling hours

HSPF_base = Heating efficiency of baseline equipment.

HSPF_ee = Heating efficiency of new equipment.

Hours_H = Deemed average equivalent full load heating hours

12 = Conversion factor: 12 kBtu/hr per ton.

Hours

Equivalent full load hours are 1200 hours/year for heating and 360 hours/year for cooling

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
CS HP SEER =>14.5, EER =>12, HSPF 8.5	EnergyStar® HVAC	32 (102)	0.038 (102)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
CS HP SEER => 16, EER 13, HSPF 8.5	EnergyStar® HVAC	302 (102)	0.269 (102)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
CS HP Seer => 15, EER 12.5, HSPF 8.5	EnergyStar® HVAC	248 (102)	0.158 (102)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
CS HP SEER 15.0, EER 12.5, HSPF 8.2	EnergyStar® HVAC	62 (102)	0.158 (102)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
CS HP SEER =>14.5, EER =>12, HSPF 8.5	EnergyStar® HVAC	18 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.23 (130)	0.53 (130)
CS HP SEER => 16, EER 13, HSPF 8.5	EnergyStar® HVAC	18 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.23 (130)	0.53 (130)
CS HP Seer => 15, EER 12.5, HSPF 8.5	EnergyStar® HVAC	18 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.23 (130)	0.53 (130)
CS HP SEER 15.0, EER 12.5, HSPF 8.2	EnergyStar® HVAC	18 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.23 (130)	0.53 (130)

Sources

102 RI Heat Pump Calculations 2015.xls

130 The Cadmus Group (2013). 2012 Residential Heating, Water Heating, and Cooling Equipment Evaluation: Net-to-Gross, Market Effects, and Equipment Replacement Timing.

55 GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.

6 ADM Associated, Inc. (2009). Residential Central AC Regional Evaluation. Prepared for NSTAR, National Grid, Connecticut Light & Power and United Illuminating.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Central AC

Version Date: PY 2015

Description

The purchase and installation of high efficiency central air-conditioning (CAC) unit rather than a standard CAC system, and/or to replace an existing inefficient CAC system.

Baseline Efficiency

The baseline efficiency case is a blend of code-compliant central air-conditioning system with SEER = 13 andEER = 11. For early replacement installations, the baseline is a 10-12 year old HVAC unit with SEER =10 and EER = 8.5.

High Efficiency

The high efficiency case is an ENERGY STAR® qualified Central AC system.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with deemed inputs

Unit: Installed high-efficiency central AC system for cooling.

Algorithm:

Gross kWh = Tons × 12 × [(1/SEER_base - 1/SEER_ee) × Hours_C
Gross kW = Tons × 12 × [(1/SEER_base - 1/SEER_ee)

Where:

Tons = Deemed average equipment cooling capacity: 3 tons **6**
SEER_base = Seasonal Energy Efficiency Ratio of baseline equipment.
SEER_ee = Seasonal Energy Efficiency Ratio of new equipment.
Hours_C = Deemed average equivalent full load cooling hours
12 = Conversion factor: 12 kBtu/hr per ton.

Hours

The equivalent full load cooling hours are 360 hours/year.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
CS AC SEER =>14.5, EER =>12, NEW Estar -	EnergyStar® HVAC	145.6 (130)	0.409 (130)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
CoolSmart AC SEER 16.0 => (Equip) -	EnergyStar® HVAC	229.4 (130)	0.64 (130)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
CoolSmart AC SEER 15.0 => (Equip) -	EnergyStar® HVAC	175.4 (130)	0.529 (130)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
CS AC SEER =>14.5, EER =>12, NEW Estar - regardless of sizing	EnergyStar® HVAC	17 (130)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.25 (130)	0 (130)
CoolSmart AC SEER 16.0 => (Equip) - EER>=13.0	EnergyStar® HVAC	16 (130)	1.00 (N4)	1.00 (N43)	1 (N30)	1 (N30)	1 (N30)	0.25 (130)	0 (130)
CoolSmart AC SEER 15.0 => (Equip) - EER>=12.5	EnergyStar® HVAC	15 (130)	1.00 (N4)	1.00 (N43)	1 (N30)	1 (N30)	1 (N30)	0.25 (130)	0 (130)

Sources

130 The Cadmus Group (2013). 2012 Residential Heating, Water Heating, and Cooling Equipment Evaluation: Net-to-Gross, Market Effects, and Equipment Replacement Timing.

6 ADM Associated, Inc. (2009). Residential Central AC Regional Evaluation. Prepared for NSTAR, National Grid, Connecticut Light & Power and United Illuminating.

N30 Massachusetts Common Assumption

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Central AC Digital Check-up/Tune–up

Version Date: PY 2015

Description

Tune-up of an existing central AC system.

Baseline Efficiency

The baseline efficiency case is a standard central air-conditioning system that does not operate according to manufacturer specifications.

High Efficiency

The high efficiency case is the same baseline system but which operates according to manufacturer specifications.

Sector:	Residential
End Use:	HVAC
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with deemed inputs

Unit: Completed tune-up of existing AC system

Algorithm:

Gross kWh = Tons × 12 × 1/SEER × Hours_C × %SAVE
Gross kW = Tons × 12 × 1/EER × %SAVE

Where:

Tons = Deemed average equipment cooling capacity: 3 tons	**6**
SEER = Seasonal Energy Efficiency Ratio of existing equipment	
EER = Peak efficiency of existing equipment	
Hours_C = Deemed average equivalent full load cooling hours	
%SAVE = Average percent demand reduction: 5.0%	**National Grid assumption based on regional PA workin groups.**
12 = Conversion factor: 12 kBtu/hr per ton.	

Hours

The equivalent full load cooling hours are 360 hours/year.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
CoolSmart AC Digital Check-up/Tune-up	EnergyStar® HVAC	64.8 (6)	0.212 (6)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
CoolSmart AC Digital Check-up/Tune-up	EnergyStar® HVAC	5 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.25 (N30)	0 (N30)

Sources

55 GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.

6 ADM Associated, Inc. (2009). Residential Central AC Regional Evaluation. Prepared for NSTAR, National Grid, Connecticut Light & Power and United Illuminating.

N30 Massachusetts Common Assumption

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Central AC Quality Installation Verification (QIV)

Version Date: PY 2015

Description

The verification of proper charge and airflow during installation of new Central AC system.

Baseline Efficiency

The baseline efficiency case is a cooling system with SEER = 14.5 and EER = 12 not installed according to manufacturer specifications.

High Efficiency

The high efficiency case is the same cooling system installed according to manufacturer specifications.

Sector:	Residential
End Use:	HVAC
Market (Lost Opportunity):	Yes
Market (Retrofit):	No

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with deemed inputs

Unit: Completed QIV on new AC system

Algorithm:

Gross kWh = Tons × 12 × 1/SEER × Hours_C × %SAVE
Gross kW = Tons × 12 × 1/EER × %SAVE

Where:

Tons = Deemed average equipment cooling capacity: 3 tons **6**
SEER = Seasonal Energy Efficiency Ratio of existing equipment
EER = Peak efficiency of existing equipment
Hours_C = Deemed average equivalent full load cooling hours
%SAVE = Average percent demand reduction: 5.0% **National Grid assumption based on regional PA workin groups.**

12 = Conversion factor: 12 kBtu/hr per ton.

Hours

The equivalent full load cooling hours are 360 hours/year.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
CoolSmart AC QIV NES	EnergyStar® HVAC	49.8 (6)	0.164 (6)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
CoolSmart AC QIV ES	EnergyStar® HVAC	45 (6)	0.15 (6)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
CoolSmart AC QIV NES	EnergyStar® HVAC	18 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.26 (6)	0 (6)
CoolSmart AC QIV ES	EnergyStar® HVAC	18 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.26 (6)	0 (6)

Sources

55 GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.

6 ADM Associated, Inc. (2009). Residential Central AC Regional Evaluation. Prepared for NSTAR, National Grid, Connecticut Light & Power and United Illuminating.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Deep Energy Retrofit

Version Date: PY 2015

Description

Deep energy retrofit projects for residential new construction include the installation of a new roof, siding, and or the refinishing of a basement.

Baseline Efficiency

The baseline case is the performance of the house before participation in the program.

High Efficiency

The efficient case is the post-retrofit performance of a house participating the program.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	Yes
Market (Lost Opportunity):	Yes	**Propane Impact:**	Yes
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Completed deep energy retrofit project.

Algorithm:

The Deep Energy Retrofit program uses project-specific information to estimate energy and demand impacts from DER measure installations. The project savings are calculated by the program implementer and provided to National Grid.

Gross Summer kW = ΔkW_sp_custom
Gross Winter kW = ΔkW_wp_custom

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Deep Energy Retrofit Basements - Air Flow	Residential New Construction	Calc (N45)	Calc (N45)	0.02 (117)	0 (N/A)	0 (N/A)	0 (N/A)
Deep Energy Retrofit Walls - Air Flow	Residential New Construction	Calc (N45)	Calc (N45)	0.02 (117)	0 (N/A)	0 (N/A)	0 (N/A)
Deep Energy Retrofit Roofs - Air Flow	Residential New Construction	Calc (N45)	Calc (N45)	0.02 (117)	0 (N/A)	0 (N/A)	0 (N/A)
Deep Energy Retrofit Basements	Residential New Construction	1.5 (117)	Calc (N45)	0.02 (117)	calc (N45)	calc (N45)	0 (N/A)
Deep Energy Retrofit Walls	Residential New Construction	2.9 (117)	Calc (N45)	0.03 (117)	calc (N45)	calc (N45)	0 (N/A)
Deep Energy Retrofit Roofs	Residential New Construction	2.3 (117)	Calc (N45)	0.02 (117)	calc (N45)	calc (N45)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Deep Energy Retrofit Basements - Air Flow Reduction	Residential New Construction	25 (N20)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (N15)	1 (N15)
Deep Energy Retrofit Walls - Air Flow Reduction	Residential New Construction	25 (N20)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (N15)	1 (N15)
Deep Energy Retrofit Roofs - Air Flow Reduction	Residential New Construction	25 (N20)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (N15)	1 (N15)
Deep Energy Retrofit Basements	Residential New Construction	25 (N20)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (N15)	1 (N15)
Deep Energy Retrofit Walls	Residential New Construction	25 (N20)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (N15)	1 (N15)
Deep Energy Retrofit Roofs	Residential New Construction	25 (N20)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (N15)	1 (N15)

Sources

117 Synapse (2012). A Preliminary Analysis of Energy Impacts from Partial Deep Energy Retrofit Projects in National Grid's Jurisdiction. Prepared for National Grid.

N15 Coincidence factors are custom calculated based on project-specific detail.

N20 Common measure life for insulation measures.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

N45 supplied by vendor

HVAC - Down Size ½ Ton

Version Date: PY 2015

Description

Reduction in system size consistent with manual J calculations.

Baseline Efficiency

The baseline efficiency case is a system that is not sized in accordance with a manual J calculation.

High Efficiency

The high efficiency case is a system that is sized in accordance with a manual J calculation.

Sector:	Residential
End Use:	HVAC
Market (Lost Opportunity):	Yes
Market (Retrofit):	No

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	Yes

Algorithm Type: Deemed

Unit: Completed job (assume downsize 1/2 ton).

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW

Where:
Qty = Total number of units.
ΔkWh = Deemed average annual kWh reduction per unit.
ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Down Size 1/2 ton	EnergyStar® HVAC	203 (103)	0.3 (103)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Down Size 1/2 ton	EnergyStar® HVAC	18 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.26 (6)	0 (6)

Sources

103 RLW Analytics (2002). Market Research for the Rhode Island, Massachusetts, and Connecticut Residential HVAC Market. Prepared for National Grid, Northeast Utilities, NSTAR, Fitchburg Gas and Electric Light Company and United Illuminating;

55 GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.

6 ADM Associated, Inc. (2009). Residential Central AC Regional Evaluation. Prepared for NSTAR, National Grid, Connecticut Light & Power and United Illuminating.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Duct Sealing

Version Date: PY 2015

Description

A 66% reduction in duct leakage from 15% to 5% of supplied CFM.

Baseline Efficiency

The baseline efficiency case is assumes a 15% leakage.

High Efficiency

The high efficiency case is a system with duct leakage reduced by 66% to 5% leakage.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Complete duct sealing job for existing HVAC system

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW

Where:
Qty = Total number of units.
ΔkWh = Deemed average annual kWh reduction per unit.
ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Duct Sealing - 100 CFM redcution in leaks 15%	EnergyStar® HVAC	212 (103)	0.3 (103)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Duct Sealing - 100 CFM redcution in leaks 15% of flow to 5%	EnergyStar® HVAC	18 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.26 (6)	0 (6)

Sources

103 RLW Analytics (2002). Market Research for the Rhode Island, Massachusetts, and Connecticut Residential HVAC Market. Prepared for National Grid, Northeast Utilities, NSTAR, Fitchburg Gas and Electric Light Company and United Illuminating;

55 GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.

6 ADM Associated, Inc. (2009). Residential Central AC Regional Evaluation. Prepared for NSTAR, National Grid, Connecticut Light & Power and United Illuminating.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Ductless MiniSplits

Version Date: PY 2015

Description

The installation of a more efficient ENERGY STAR® rated Ductless MiniSplit system.

Baseline Efficiency

The baseline efficiency case is a non- ENERGY STAR® rated ductless mini split heat pump with SEER 14, EER 8.5 and HSPF 8.2.

High Efficiency

The high efficiency case is a high-efficiency Ductless Mini Split System.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with deemed inputs

Unit: Installed high-efficiency ductless minisplit system.

Algorithm:

Gross kWh = ΔkWh_ASHP + ΔkWh_DuctSealing
Gross kW = ΔkW_ASHP + ΔkW_DuctSealing

Where:

ΔkWh_ASHP = Gross annual energy savings from equivalent ASHP unit.

ΔkWh_DuctSealing = Gross annual energy savings from Duct Sealing.

ΔkW_ASHP = Gross demand savings from equivalent ASHP unit.

ΔkW_DuctSealing = Gross demand savings from Duct Sealing.

Hours

Equivalent full load hours are 1200 hours/year for heating and 360 hours/year for cooling

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
MiniSplit HP SEER 23, EER 13, HSPF 10.6	EnergyStar® HVAC	648 (102)	0.611 (102)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
MiniSplit HP SEER 20, EER 13, HSPF 10	EnergyStar® HVAC	511 (102)	0.611 (102)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
MiniSplit HP SEER 19, EER 12.8, HSPF 10.0	EnergyStar® HVAC	497 (102)	0.565 (102)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
MiniSplit HP SEER 19, EER 12.5, HSPF 10.0	EnergyStar® HVAC	497 (102)	0.593 (102)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
MiniSplit HP SEER 16, EER 12 , HSPF 8.2	EnergyStar® HVAC	48 (102)	0.515 (102)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
MiniSplit HP SEER 23, EER 13, HSPF 10.6	EnergyStar® HVAC	18 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.25 (6)	0.5 (6)
MiniSplit HP SEER 20, EER 13, HSPF 10	EnergyStar® HVAC	18 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.25 (6)	0.5 (6)
MiniSplit HP SEER 19, EER 12.8, HSPF 10.0	EnergyStar® HVAC	18 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.25 (6)	0.5 (6)
MiniSplit HP SEER 19, EER 12.5, HSPF 10.0	EnergyStar® HVAC	18 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.25 (6)	0.5 (6)
MiniSplit HP SEER 16, EER 12 , HSPF 8.2	EnergyStar® HVAC	18 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.25 (6)	0.5 (6)

Sources

102 RI Heat Pump Calculations 2015.xls

55 GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.

6 ADM Associated, Inc. (2009). Residential Central AC Regional Evaluation. Prepared for NSTAR, National Grid, Connecticut Light & Power and United Illuminating.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Early Replacement of Central AC or Heat Pump Unit

Version Date: PY 2015

Description

Early replacement of a Central Air Conditioning or Heat Pump Unit. This measure accounts for the additional savings achieved for the early replacement of existing inefficient AC or heat pump units over the remaining life of the existing equipment.

Baseline Efficiency

The baseline efficiency case is assumed to be a typical 10-12 year-old central air-conditioning or heat pump unit with SEER 10, EER 8.5, and HSPF 7.0

High Efficiency

For the retirement savings over the remaining life of the existing AC unit, the efficient case is a SEER 13, EER 11, HSPF 7.6 unit. For the high efficiency savings over the lifetime of the new AC unit, the efficient case is a new high efficiency EER 14.5, EER 12, 8.2 HSPF unit.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with deemed inputs

Unit: Installation of a new efficient air conditioner.

Algorithm:

Gross kWh = Tons × 12 × [(1/SEER_base - 1/SEER_ee) × Hours_C

Gross kW = Tons × 12 × [(1/SEER_base - 1/SEER_ee)

Where:

Tons = Deemed average equipment cooling capacity: 3 tons **6**

SEER_base = Seasonal Energy Efficiency Ratio of baseline equipment.

SEER_ee = Seasonal Energy Efficiency Ratio of new equipment.

Hours_C = Deemed average equivalent full load cooling hours

12 = Conversion factor: 12 kBtu/hr per ton.

Hours

Equivalent full load hours are 1200 hours/year for heating and 360 hours/year for cooling

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Early Replacement HP (EE)	EnergyStar® HVAC	32 (102)	0.038 (102)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Early Replacement HP (Retire)	EnergyStar® HVAC	1273 (102)	1.197 (102)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Early Replacement AC (EE)	EnergyStar® HVAC	103 (6)	0.273 (6)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Early Replacement AC (Retire)	EnergyStar® HVAC	299 (6)	0.963 (6)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Early Replacement HP (EE)	EnergyStar® HVAC	18 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.25 (6)	0.5 (6)
Early Replacement HP (Retire)	EnergyStar® HVAC	7 (N30)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.25 (6)	0.5 (6)
Early Replacement AC (EE)	EnergyStar® HVAC	18 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.25 (6)	0 (6)
Early Replacement AC (Retire)	EnergyStar® HVAC	7 (N30)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.25 (6)	0 (6)

Sources

102 RI Heat Pump Calculations 2015.xls

55 GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.

6 ADM Associated, Inc. (2009). Residential Central AC Regional Evaluation. Prepared for NSTAR, National Grid, Connecticut Light & Power and United Illuminating.

N30 Massachusetts Common Assumption

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - ECM Circulator Pumps

Version Date: PY 2015

Description

Heating hot water circulation retrofit projects replacing the existing hot water circulation systems with ECM pumps and zone valves.

Baseline Efficiency

The baseline case is standard efficiency steady-state motor without variable speed capabilities.

High Efficiency

The efficient case is the installation of a pump with an electronically commutated motor (ECM) with variable speed capabilities on a boiler.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed ECM circulator pump retrofit project.

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
ECM Pumps	EnergyStar® HVAC	142.3 (125)	0.406 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
ECM Pumps	EnergyStar® HVAC	15 (125)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0 (135)	1 (135)

Sources

125 The Cadmus Group (2012). Impact Evaluation of the 2011-2012 ECM Circulation Pump Pilot Program.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - ESH Heating, Cooling, and DHW Measures

Version Date: PY 2015

Description

To capture lost opportunities, encourage the construction of energy-efficient homes, and drive the market to one in which new homes are moving towards net-zero energy.

Baseline Efficiency

The User Defined Reference Home was revised in 2012 as a result of a baseline study.

High Efficiency

The high efficiency case is represented by the specific energy characteristics of each "as-built" home completed through the program.

Sector:	Residential
End Use:	HVAC
Market (Lost Opportunity):	Yes
Market (Retrofit):	No

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	Yes
Propane Impact:	Yes
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Completed ESH heating, cooling, or DHW project.

Algorithm:

The implementation vendor for this program uses a proprietary model to calculate electric and fossil fuel savings for new construction homes in comparison to the Rhode Island User Defined Reference Home.

Gross Summer kW = ΔkW_sp_custom
Gross Winter kW = ΔkW_wp_custom

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
ESH Cooling	Residential New Construction	Calc (N45)	Calc (N45)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
ESH DHW	Residential New Construction	Calc (N45)	Calc (N45)	0 (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)
ESH Heating	Residential New Construction	Calc (N45)	Calc (N45)	0 (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
ESH Cooling	Residential New Construction	25 (N30)	1.00 (N4)	1.00 (N43)	1 (N36)	1 (N36)	1 (N36)	1 (N15)	1 (N15)
ESH DHW	Residential New Construction	15 (N30)	1.00 (N4)	1.00 (N43)	1 (N36)	1 (N36)	1 (N36)	1 (N15)	1 (N15)
ESH Heating	Residential New Construction	25 (N30)	1.00 (N4)	1.00 (N43)	1 (N36)	1 (N36)	1 (N36)	1 (N15)	1 (N15)

Sources

N15 Coincidence factors are custom calculated based on project-specific detail.

N30 Massachusetts Common Assumption

N36 Realization rate is assumed 100% because energy savings are custom calculated.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

N45 supplied by vendor

HVAC - EW Air Sealing

Version Date: PY 2015

Description

Thermal shell air leaks are sealed through strategic use and location of air-tight materials.

Baseline Efficiency

The baseline efficiency case is the existing building before the air sealing measure is implemented. The baseline building is characterized by the existing CFM50 measurement (CFM50PRE) for single family homes, or the existing air changes per hour (ACHPRE)

High Efficiency

The high efficiency case is the existing building after the air sealing measure is implemented. The high efficiency building is characterized by the new CFM50 measurement for single family homes (CFM50POST), or the new air changes per hour (ACHPOST) for multi-family facilities, which is measured after the air sealing measure is implemented.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Completed air sealing project.

Algorithm:

Gross kWh = Stories × SQFT × (CFM/SQFT_pre - CFM/SQFT_post) × ΔkWh/CFM
Gross kW = Gross kWh × kW/kWh

Where:

Stories = Total stories in the multi-family building

SQFT = Area of building in square feet

CFM/SQFT_pre = Estimate of pre-retrofit air leakage in CFM/SQFT based on number of stories in the building and air-tightness ratings of the existing roof and floor

CFM/SQFT_post = Estimate of post-retrofit air leakage in CFM/SQFT based on number of stories in the building and air-tightness ratings of the improved roof and floor

ΔkWh/CFM = Average annual kWh reduction per CFM
kW/kWh = Average kW reduction per kWh reduction

Hours

Heating hours are characterized by the heating degree days for the facility, 6061.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
EW LI Air Sealing (electric)	Income Eligible MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW Air Sealing (electric)	EnergyWise MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
EW LI Air Sealing (electric)	Income Eligible MultiFamily	15 (39)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.01 (135)	1 (135)
EW Air Sealing (electric)	EnergyWise MultiFamily	15 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.01 (135)	1 (135)

Sources

131 The Cadmus Group (2014). Impact Evaluation: Rhode Island Income Eligible Services, Volume II. Prepared for National Grid.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

14 Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.

39 Environmental Protection Agency (2010). Life Cycle Cost Estimate for Programmable Thermostats. Accessed on 10/12/2011.

55 GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N40 Realization rates are 100% since savings estimates are based on evaluation results.

N43 Savings persistence is assumed to be 100%.

HVAC - EW Other Insulation

Version Date: PY 2015

Description

Insulation upgrades (other than basement, roofs, and walls) applied in existing facilities.

Baseline Efficiency

The baseline efficiency case is the existing facility or equipment prior to the implementation of additional insulation.

High Efficiency

The high efficiency case is the existing facility or equipment after the implementation of additional insulation.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Completed insulation project.

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

ΔkW = Deemed average kW reduction per unit.

Hours

Heating hours are characterized by the heating degree days for the facility, 6061.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
EW LI Insulation (electric)	Income Eligible MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW Insulation (electric)	EnergyWise MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
EW LI Insulation (electric)	Income Eligible MultiFamily	25 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.01 (135)	1 (135)
EW Insulation (electric)	EnergyWise MultiFamily	25 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.01 (135)	1 (135)

Sources

131 The Cadmus Group (2014). Impact Evaluation: Rhode Island Income Eligible Services, Volume II. Prepared for National Grid.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

14 Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.

55 GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N40 Realization rates are 100% since savings estimates are based on evaluation results.

N43 Savings persistence is assumed to be 100%.

HVAC - EW Shell Insulation

Version Date: PY 2015

Description

Shell insulation upgrades applied in existing facilities including improved insulation in attics, basements and sidewalls.

Baseline Efficiency

The baseline efficiency case is any existing home shell measures.

High Efficiency

The high efficiency case includes increased weatherization insulation levels.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Completed insulation project.

Algorithm:

Gross kWh = SQFT × ΔkWh/SQFT × (1/R_pre - 1/R_post)
Gross kW = Gross kWh × kW/kWh

Where:
SQFT = Square feet of insulation installed
R_pre = R-Value of the existing insulation
R_post = R-Value of the new installed insulation
kWh/SQFT = Average annual kWh reduction per SQFT of insulation **Reference Table 1**
kW/kWh = Average annual kW reduction per kWh reduction: 0.000125 kW/kWh

Hours

Heating hours are characterized by the heating degree days for the facility, 6061.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
EW LI Insulation (electrict)	Income Eligible MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW Insulation (electric)	EnergyWise MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW SF Wx - GAS- Non Elec	EnergyWise	251 (133)	0.134 (135)	0 (N/A)	0 (N/A)	0 (N/A)	11 (N/A)
EW SF Wx - OIL- Non Elec	EnergyWise	336 (133)	0.179 (135)	0 (N/A)	23.68 (133)	0 (N/A)	10 (N/A)
EW SF Wx-Electric - Elec	EnergyWise	1558 (133)	0.832 (135)	0 (N/A)	0 (N/A)	0 (N/A)	9 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
EW LI Insulation (electrict)	Income Eligible MultiFamily	25 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.01 (135)	1 (135)
EW Insulation (electric)	EnergyWise MultiFamily	25 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.01 (135)	1 (135)
EW SF Wx - GAS- Non Elec	EnergyWise	20 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0 (135)	1 (135)
EW SF Wx - OIL- Non Elec	EnergyWise	20 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0 (135)	1 (135)
EW SF Wx-Electric - Elec	EnergyWise	20 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0 (135)	1 (135)

Sources

131 The Cadmus Group (2014). Impact Evaluation: Rhode Island Income Eligible Services, Volume II. Prepared for National Grid.

133 The Cadmus Group, Inc (2012). Rhode Island EnergyWise Single Family Impact Evaluation.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

14 Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.

55 GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N40 Realization rates are 100% since savings estimates are based on evaluation results.

N43 Savings persistence is assumed to be 100%.

HVAC - Furnace Fan Motors

Version Date: PY 2015

Description

Installation of high efficiency motors on residential furnace fans, including electronically commutated motors (ECMs) or steady state brushless furnace fan motors.

Baseline Efficiency

The baseline efficiency case is the installation of a furnace with a standard efficiency steady state motor.

High Efficiency

The high efficiency case is the installation an electronically commutated motor or brushless fan motor on a residential furnace.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed high-efficiency furnace fan motor.

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW
Gross MMBtu_Gas = Qty × ΔMMBtu_Gas
Gross MMBtu_Oil = Qty × ΔMMBtu_Oil
Gross MMBtu_Propane = Qty × ΔMMBtu_Propane

Where:

Qty = Total number of units.
ΔkWh = Average annual kWh reduction per unit.
ΔkW = Average kW reduction per unit.
ΔMMBtu_Gas = Average annual natural gas reduction per unit.
ΔMMBtu_Oil = Average annual oil reduction per unit
ΔMMBtu_Propane = Average annual propane reduction per unit

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
ECM Gas Rebate	EnergyStar® HVAC	168 (26)	0.124 (26)	-0.72 (48)	0 (N/A)	0 (N/A)	0 (N/A)
ECM / Oil Replace Furnace	EnergyStar® HVAC	168 (26)	0.124 (26)	0 (N/A)	7.22 (32)	0 (N/A)	0 (N/A)
Brushless Furnace Fan motor (BFM)	EnergyStar® HVAC	246 (1)	0.182 (1)	-0.68 (1)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
ECM Gas Rebate	EnergyStar® HVAC	18 (110)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0 (26)	0 (26)
ECM / Oil Replace Furnace	EnergyStar® HVAC	18 (110)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0 (26)	0.16 (26)
Brushless Furnace Fan motor (BFM)	EnergyStar® HVAC	18 (N49)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.26 (1)	0.25 (1)

Sources

1 The Cadmus Group (2012). Massachusetts Residential Retrofit and Low Income Program Area: Brushless Fan Motors Impact Evaluation. Prepared for The Electric and Gas Program Administrators of Massachusetts.

110 Sachs, Harvey (2003). Energy Savings from Efficient Furnace Air Handlers in Massachusetts.

26 Energy & Resource Solutions (2011). BFM Impact Evaluation Report. Prepared for the Electric and Gas Program Administrators of Massachusetts.

32 Environmental Protection Agency (2009). Life Cycle Cost Estimate for an ENERGY STAR Qualified Gas Residential Furnace.

48 ERS (2011). BFM Impact Evaluation Report. Prepared for the Electric and Gas Program Administrators of Massachusetts.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

N49 The technical lifetime is 18 years, but since these measures are installed on existing furnaces, they will only remain for 9 years.

HVAC - Heat Pump Digital Check-up/Tune-up

Version Date: PY 2015

Description

Tune-up of an existing heat pump system.

Baseline Efficiency

The baseline efficiency case is a standard residential heat pump system that does not operating according to manufacturer specifications.

High Efficiency

The high efficiency case is the same baseline system but which operates according to manufacturer specifications.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with deemed inputs

Unit: Completed tune-up of existing heat pump system

Algorithm:

Gross kWh = Tons × 12 × (1/SEER × Hours_C + 1/HSPF × Hours_H) × %SAVE
Gross kW = Tons × 12 × max[(1/EER),(1/HSPF)] × %SAVE

Where:

Tons = Deemed average equipment cooling capacity: 3 tons **6**
SEER = Seasonal Energy Efficiency Ratio of existing equipment
EER = Peak efficiency of existing equipment
Hours_C = Deemed average equivalent full load cooling hours
%SAVE = Average percent demand reduction: 5.0% **National Grid assumption based on regional PA workin groups.**

HSPF = Heating efficiency of existing equipment
Hours_H = Deemed average equivalent full load heating hours
12 = Conversion factor: 12 kBtu/hr per ton.

Hours

Equivalent full load hours are 1200 hours/year for heating and 360 hours/year for cooling

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
CoolSmart HP Digital Check-up/Tune-up	EnergyStar® HVAC	373.4 (6)	0.257 (6)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
CoolSmart HP Digital Check-up/Tune-up	EnergyStar® HVAC	5 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.21 (N30)	0.5 (N30)

Sources

55 GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.

6 ADM Associated, Inc. (2009). Residential Central AC Regional Evaluation. Prepared for NSTAR, National Grid, Connecticut Light & Power and United Illuminating.

N30 Massachusetts Common Assumption

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Heat Pump Quality Installation Verification (QIV)

Version Date: PY 2015

Description

The verification of proper charge and airflow during installation of new Heat Pump systems.

Baseline Efficiency

The baseline efficiency case is a heating and cooling system with SEER = 14.5, EER = 12 and HSPF = 8.2) not installed according to manufacturer specifications.

High Efficiency

The high efficiency case is the same heating and cooling system not installed according to manufacturer specifications.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with deemed inputs

Unit: Completed QIV on new heat pump system

Algorithm:

Gross kWh = Tons × 12 × (1/SEER × Hours_C + 1/HSPF × Hours_H) × %SAVE
Gross kW = Tons × 12 × max[(1/EER),(1/HSPF)] × %SAVE

Where:

Tons = Deemed average equipment cooling capacity: 3 tons **6**
SEER = Seasonal Energy Efficiency Ratio of existing equipment
EER = Peak efficiency of existing equipment
Hours_C = Deemed average equivalent full load cooling hours
%SAVE = Average percent demand reduction: 5.0% **National Grid assumption based on regional PA workin groups.**

HSPF = Heating efficiency of existing equipment
Hours_H = Deemed average equivalent full load heating hours
12 = Conversion factor: 12 kBtu/hr per ton.

Hours

Equivalent full load hours are 1200 hours/year for heating and 360 hours/year for cooling

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
CoolSmart HP QIV NES	EnergyStar® HVAC	308 (6)	0.22 (6)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
CoolSmart HP QIV ES	EnergyStar® HVAC	308 (6)	0.22 (6)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
CoolSmart HP QIV NES	EnergyStar® HVAC	18 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.26 (6)	0.26 (6)
CoolSmart HP QIV ES	EnergyStar® HVAC	18 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.26 (6)	0.26 (6)

Sources

55 GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.

6 ADM Associated, Inc. (2009). Residential Central AC Regional Evaluation. Prepared for NSTAR, National Grid, Connecticut Light & Power and United Illuminating.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Heating System (Rebate)

Version Date: PY 2015

Description

Replacement of existing oil or propane heating system with a new high efficiency system. Electric savings can be attributed to reduced fan run time and reduced usage of electric space heaters.

Baseline Efficiency

The baseline efficiency case is the existing inefficient heating equipment.

High Efficiency

The high efficiency case is the new efficient heating equipment.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	Yes
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed high-efficiency heating system.

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW
Gross MMBtu_Gas = Qty × ΔMMBtu_Gas
Gross MMBtu_Oil = Qty × ΔMMBtu_Oil
Gross MMBtu_Propane = Qty × ΔMMBtu_Propane

Where:
Qty = Total number of units.
ΔkWh = Average annual kWh reduction per unit.
ΔkW = Average kW reduction per unit.
ΔMMBtu_Gas = Average annual natural gas reduction per unit.
ΔMMBtu_Oil = Average annual oil reduction per unit
ΔMMBtu_Propane = Average annual propane reduction per unit

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Oil Heat Replacement	EnergyStar® HVAC	132 (136)	0.07 (135)	0 (N/A)	18.4 (136)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Oil Heat Replacement	EnergyStar® HVAC	18 (32)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.01 (135)	1 (135)

Sources

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

136 The Cadmus Group, Inc. (2012). Low Income Single Family Impact Evaluation. Prepared for the Electric and Gas Program Administrators of Massachusetts.

32 Environmental Protection Agency (2009). Life Cycle Cost Estimate for an ENERGY STAR Qualified Gas Residential Furnace.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Heating System Replacement

Version Date: PY 2015

Description

Replacement of existing oil heating system with a new high efficiency system. Electric savings can be attributed to reduced fan run time and reduced usage of electric space heaters.

Baseline Efficiency

The baseline efficiency case is the existing inefficient heating equipment.

High Efficiency

The high efficiency case is the new efficient heating equipment.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	Yes
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed high-efficiency heating system.

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW
Gross MMBtu_Gas = Qty × ΔMMBtu_Gas
Gross MMBtu_Oil = Qty × ΔMMBtu_Oil
Gross MMBtu_Propane = Qty × ΔMMBtu_Propane

Where:
Qty = Total number of units.
ΔkWh = Average annual kWh reduction per unit.
ΔkW = Average kW reduction per unit.
ΔMMBtu_Gas = Average annual natural gas reduction per unit.
ΔMMBtu_Oil = Average annual oil reduction per unit
ΔMMBtu_Propane = Average annual propane reduction per unit

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Heating system replacement	Single Family Appliance	132 (131)	0.07 (135)	0 (N/A)	18.4 (131)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Heating system replacement	Single Family Appliance Management	18 (32)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0 (135)	1 (135)

Sources

131 The Cadmus Group (2014). Impact Evaluation: Rhode Island Income Eligible Services, Volume II. Prepared for National Grid.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

32 Environmental Protection Agency (2009). Life Cycle Cost Estimate for an ENERGY STAR Qualified Gas Residential Furnace.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Programmable Thermostats

Version Date: PY 2015

Description

Installation of programmable thermostats with the ability to adjust heating or air-conditioning operating times according to a pre-set schedule to meet occupancy needs and minimize redundant HVAC operation.

Baseline Efficiency

The baseline efficiency case is an HVAC system providing space heating without a programmable thermostat.

High Efficiency

The high efficiency case is an HVAC system providing space heating with a programmable thermostat installed.

Sector:	Residential
End Use:	HVAC
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	No
Gas Energy Impact:	No
Oil Energy Impact:	Yes
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed programmable thermostat.

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$
$$\text{Gross MMBtu\_Gas} = \text{Qty} \times \Delta\text{MMBtu\_Gas}$$
$$\text{Gross MMBtu\_Oil} = \text{Qty} \times \Delta\text{MMBtu\_Oil}$$
$$\text{Gross MMBtu\_Propane} = \text{Qty} \times \Delta\text{MMBtu\_Propane}$$

Where:

Qty = Total number of units.
ΔkWh = Average annual kWh reduction per unit.
ΔkW = Average kW reduction per unit.
ΔMMBtu_Gas = Average annual natural gas reduction per unit.
ΔMMBtu_Oil = Average annual oil reduction per unit
ΔMMBtu_Propane = Average annual propane reduction per unit

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Programmable thermostat	Single Family Appliance	0 (N/A)	0 (N/A)	3.2 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Wifi Programmable Thermostat	Income Eligible MultiFamily	104 (123)	0.231 (123)	0 (N/A)	6.6 (127)	0 (N/A)	0 (N/A)
EW Programmable thermostat (electric)	Income Eligible MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW Programmable thermostat (electric)	EnergyWise MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW WiFi programmable thermostat (electric)	EnergyWise MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW SF THERMOSTAT	EnergyWise	330 (133)	0.176 (135)	0 (N/A)	0 (N/A)	0 (N/A)	3 (N/A)
EW SF WiFi Thermostat	EnergyWise	104 (133)	0.231 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Wifi Programmable Thermostat	EnergyStar® Products	104 (133)	0.23 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
WiFi programmable thermostat with cooling	EnergyStar® HVAC	104 (123)	0.231 (123)	0 (N/A)	6.6 (127)	0 (N/A)	0 (N/A)
WiFi programmable thermostat with cooling	EnergyStar® HVAC	104 (123)	0.231 (123)	6.6 (127)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Programmable thermostat	Single Family Appliance Management	15 (39)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.03 (135)	1 (135)
Wifi Programmable Thermostat	Income Eligible MultiFamily	15 (39)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (135)	1 (135)
EW Programmable thermostat (electric)	Income Eligible MultiFamily	15 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.01 (135)	1 (135)
EW Programmable thermostat (electric)	EnergyWise MultiFamily	15 (39)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.01 (135)	1 (135)
EW WiFi programmable thermostat (electric)	EnergyWise MultiFamily	15 (39)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0 (135)	0 (135)
EW SF THERMOSTAT	EnergyWise	15 (39)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0 (135)	1 (135)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
EW SF WiFi Thermostat	EnergyWise	15 (39)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (135)	0 (135)
Wifi Programmable Thermostat	EnergyStar® Products	15 (39)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (135)	0 (135)
WiFi programmable thermostat with cooling (oil)	EnergyStar® HVAC	15 (39)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (135)	1 (135)
WiFi programmable thermostat with cooling (gas)	EnergyStar® HVAC	15 (39)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (135)	1 (135)

Sources

123 The Cadmus Group (2011). Memo: Wi-fi Programmable Thermostat Billing Analysis. Prepared for Keith Miller and Whitney Domigan, National Grid.

124 The Cadmus Group (2012). Home Energy Services Impact Evaluation. Prepared for Massachusetts Program Administrators.

127 The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for the Massachusetts Program Administrators.

133 The Cadmus Group, Inc (2012). Rhode Island EnergyWise Single Family Impact Evaluation.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

14 Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.

39 Environmental Protection Agency (2010). Life Cycle Cost Estimate for Programmable Thermostats. Accessed on 10/12/2011.

55 GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N40 Realization rates are 100% since savings estimates are based on evaluation results.

N43 Savings persistence is assumed to be 100%.

HVAC - Quality Installation with Duct Modification

Version Date: PY 2015

Description

50% reduction in duct leakage from 20% to 10%. This measure may also include duct modifications.

Baseline Efficiency

The baseline efficiency case is a system with an installation that is inconsistent with manufacturer specifications and may include leaky ducts.

High Efficiency

The high efficiency case is a system with an installation that is consistent with manufacturer specifications and may have reduced duct leakage.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Completed job

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW

Where:
Qty = Total number of units.
ΔkWh = Deemed average annual kWh reduction per unit.
ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Energy Star QI with Duct Modifications	EnergyStar® HVAC	513 (103)	0.85 (103)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Energy Star QI with Duct Modifications	EnergyStar® HVAC	18 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.26 (6)	0 (6)

Sources

103 RLW Analytics (2002). Market Research for the Rhode Island, Massachusetts, and Connecticut Residential HVAC Market. Prepared for National Grid, Northeast Utilities, NSTAR, Fitchburg Gas and Electric Light Company and United Illuminating;

55 GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.

6 ADM Associated, Inc. (2009). Residential Central AC Regional Evaluation. Prepared for NSTAR, National Grid, Connecticut Light & Power and United Illuminating.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Renovation Rehab

Version Date: PY 2015

Description

Renovation Rehab projects include the installation of roof, wall, and basement insulation

Baseline Efficiency

The baseline case is the performance of the house before participation in the program

High Efficiency

The efficient case is the post-retrofit performance of a house participating the program

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs.

Unit: Complete Renovation Rehab project

Algorithm:

Gross energy and demand savings estimates for custom projects are calculated with engineering analyses of project-specific details. The analyses also include an evaluation of the project's cost-effectiveness.

Gross Summer kW = ΔkW_sp_custom
Gross Winter kW = ΔkW_wp_custom
Gross MMBtu Gas = ΔMMBtu_Gas_custom
Gross MMBtu Oil = ΔMMBtu_Oil_custom

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Renovation Rehab Heating	Residential New Construction	Calc (N45)	Calc (N45)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Renovation Rehab Domestic Hot Water	Residential New Construction	Calc (N45)	Calc (N45)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Renovation Rehab Cooling	Residential New Construction	Calc (N45)	Calc (N45)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Renovation Rehab Heating	Residential New Construction	25 (N20)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (N15)	1 (N15)
Renovation Rehab Domestic Hot Water	Residential New Construction	25 (N20)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (N15)	1 (N15)
Renovation Rehab Cooling	Residential New Construction	25 (N20)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (N15)	1 (N15)

Sources

N15 Coincidence factors are custom calculated based on project-specific detail.

N20 Common measure life for insulation measures.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

N45 supplied by vendor

HVAC - Right Sizing

Version Date: PY 2015

Description

Documentation that system size is in compliance with manual J calculations.

Baseline Efficiency

The baseline efficiency case is a system that is not sized in accordance with a manual J calculation.

High Efficiency

The high efficiency case is a system that is sized in accordance with a manual J calculation.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Completed job compliant with Manual J sizing

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Rightsizing Top Tier 15/12.5	EnergyStar® HVAC	123 (103)	0.15 (103)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Rightsizing on ES Tier 2 14.5 12	EnergyStar® HVAC	123 (103)	0.15 (103)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Rightsizing Top Tier 15/12.5	EnergyStar® HVAC	18 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.26 (6)	0 (6)
Rightsizing on ES Tier 2 14.5 12	EnergyStar® HVAC	18 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.26 (6)	0 (6)

Sources

103 RLW Analytics (2002). Market Research for the Rhode Island, Massachusetts, and Connecticut Residential HVAC Market. Prepared for National Grid, Northeast Utilities, NSTAR, Fitchburg Gas and Electric Light Company and United Illuminating;

55 GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.

6 ADM Associated, Inc. (2009). Residential Central AC Regional Evaluation. Prepared for NSTAR, National Grid, Connecticut Light & Power and United Illuminating.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Weatherization

Version Date: PY 2015

Description

Installation of weatherization measures such as air sealing and insulation in homes heated with electricity, oil, or propane. Non-heating electric savings are achieved from reduced fan run time for heating and cooling systems.

Baseline Efficiency

The baseline efficiency case is any existing home shell measures.

High Efficiency

The high efficiency case includes increased weatherization insulation levels.

Sector:	Residential
End Use:	HVAC
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	Yes
Gas Energy Impact:	Yes
Oil Energy Impact:	Yes
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Completed weatherization project.

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW
Gross MMBtu_Gas = Qty × ΔMMBtu_Gas
Gross MMBtu_Oil = Qty × ΔMMBtu_Oil
Gross MMBtu_Propane = Qty × ΔMMBtu_Propane

Where:

Qty = Total number of units.
ΔkWh = Average annual kWh reduction per unit.
ΔkW = Average kW reduction per unit.
ΔMMBtu_Gas = Average annual natural gas reduction per unit.
ΔMMBtu_Oil = Average annual oil reduction per unit
ΔMMBtu_Propane = Average annual propane reduction per unit

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Weatherization (electric)	Single Family Appliance	1616 (131)	0.86 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Weatherization (oil)	Single Family Appliance	377 (131)	0.2 (135)	0 (N/A)	28.1 (131)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Weatherization (electric)	Single Family Appliance Management	20 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.03 (135)	1 (135)
Weatherization (oil)	Single Family Appliance Management	20 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.03 (135)	1 (135)

Sources

131 The Cadmus Group (2014). Impact Evaluation: Rhode Island Income Eligible Services, Volume II. Prepared for National Grid.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

55 GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Window AC (Retrofit)

Version Date: PY 2015

Description

Replacement of existing inefficient room air conditioners with more efficient models. This is only offered as a measure when an AC timer would not reduce usage during the peak period.

Baseline Efficiency

The baseline efficiency case is the existing air conditioning unit.

High Efficiency

The high efficiency case is the high efficiency room air conditioning unit.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Replacement of existing window AC with high-efficiency window AC.

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW

Where:
Qty = Total number of units.
ΔkWh = Deemed average annual kWh reduction per unit.
ΔkW = Deemed average kW reduction per unit.

Hours

Calculated for Multifamily applications and not applicable for single family.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Window AC Replacements	Single Family Appliance	100 (100)	0.214 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW LI Window AC Replacement	Income Eligible MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Window AC Replacements	Single Family Appliance Management	9 (36)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (135)	0 (135)
EW LI Window AC Replacement	Income Eligible MultiFamily	9 (36)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0 (135)	0 (135)

Sources

100 Quantec, LLC (2005). Evaluation of National Grid's 2003 Appliance Management Program: Room Air Conditioning Metering and Non-Energy Benefits Study. Prepared for National Grid.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

14 Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.

36 Environmental Protection Agency (2009). Life Cycle Cost Estimate for ENERGY STAR Qualified Room Air Conditioner.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N40 Realization rates are 100% since savings estimates are based on evaluation results.

N43 Savings persistence is assumed to be 100%.

Lighting - CFL Bulbs

Version Date: PY 2015

Description

The installation of compact fluorescent bulbs.

Baseline Efficiency

The baseline efficiency case is blend of incandescents, halogens, CFLs and other bulbs types, as provided by market research or for EISA exempt bulbs and bulbs installed through a home energy audit, the base line is a 65 Watt incandescent.

High Efficiency

The high efficiency case is an ENERGY STAR® rated CFL spiral bulb.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	Lighting	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	Yes

Algorithm Type: Engineering algorithm with deemed inputs

Unit: Rebated lamp or fixture.

Algorithm:

Gross kWh = Qty × ΔkW × Hours
Gross kW = Qty × ΔkW

Where:
Qty = Total number of units.

ΔkW = Deemed average kW reduction per unit.

Hours = Deemed average annual operating hours.

Hours

The average annual operating hours are 1,058.5 hours/year for rebated lights purchased by customers and 985.5 hours/year for lights intalled in direct install programs. For multifamily applications, hours are site-specific.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
CFL	Single Family Appliance	44.8 (76)	0.045 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
CFL	Residential New Construction	44.8 (76)	0.045 (76)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW LI CFLs	Income Eligible MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW CFLs	EnergyWise MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW SF CFL	EnergyWise	44.8 (76)	0.045 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Specialty Bulbs	EnergyStar® Lighting	48.1 (76)	0.045 (76)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Screw-in Bulbs	EnergyStar® Lighting	48.1 (76)	0.045 (76)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
School Program Bulbs	EnergyStar® Lighting	48.1 (76)	0.045 (76)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
HTR Bulbs	EnergyStar® Lighting	48.1 (76)	0.045 (76)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Screw-in Bulbs (EISA Exempt)	EnergyStar® Lighting	50.8 (76)	0.048 (76)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
CFL	Single Family Appliance Management	5 (76)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.13 (92)	0.16 (92)
CFL	Residential New Construction	5 (76)	0.99 (80)	1.00 (N5)	1 (N35)	1 (N35)	1 (N35)	0.13 (92)	0.16 (92)
EW LI CFLs	Income Eligible MultiFamily	5 (3)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.13 (135)	0.16 (135)
EW CFLs	EnergyWise MultiFamily	5 (76)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.13 (92)	0.16 (92)
EW SF CFL	EnergyWise	7 (3)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.13 (92)	0.16 (92)
Specialty Bulbs	EnergyStar® Lighting	6 (76)	0.95 ######	1.00 (N5)	1 (N35)	1 (N35)	1 (N35)	0.14 (92)	0.18 (92)
Screw-in Bulbs	EnergyStar® Lighting	6 (76)	0.95 ######	1.00 (N5)	1 (N35)	1 (N35)	1 (N35)	0.14 (92)	0.18 (92)
School Program Bulbs	EnergyStar® Lighting	6 (76)	0.50 ######	1.00 (N5)	1 (N35)	1 (N35)	1 (N35)	0.14 (92)	0.18 (92)
HTR Bulbs	EnergyStar® Lighting	6 (76)	1.00 (N26)	1.00 (N5)	1 (N35)	1 (N35)	1 (N35)	0.14 (92)	0.18 (92)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Screw-in Bulbs (EISA Exempt)	EnergyStar® Lighting	19 (76)	0.95 ######	1.00 (N5)	1 (N35)	1 (N35)	1 (N35)	0.14 (92)	0.18 (92)

Sources

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

14 Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.

3 2013-2015 MA Lighting Worksheet

76 Lighting Worksheet Final - RI Programs. Based on NMR (2014) Northeast Residential Lighting HOU Study.

80 Nexus Market Research & Dorothy Conant (2006). Massachusetts ENERGY STAR® Homes: 2005 Baseline Study: Part II:Homeowner Survey Analysis Incorporating Inspection Data Final Report. Prepared for the Massachusetts Joint ManagementCommittee.

86 Nexus Market Research, RLW Analytics and GDS Associates (2009). Residential Lighting Markdown Impact Evaluation. Prepared for Markdown and Buydown Program Sponsors in CT, MA, RI, and VT. The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for t

92 Northeast Residential Lighting HOU Study

N26 In-service rates are set to 100% based on the assumption that all purchased units are installed.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N40 Realization rates are 100% since savings estimates are based on evaluation results.

N43 Savings persistence is assumed to be 100%.

N5 All PAs use 100% savings persistence factors.

Lighting - Indoor Fixtures

Version Date: PY 2015

Description

The installation of ENERGY STAR® compact fluorescent (CFL) indoor fixtures.Compact fluorescent fixtures offer comparable luminosity to incandescent fixtures at significantlyless wattage and significantly longer lifetimes. Hardwired fluorescent fixtures offer comparableluminosity to incandescent fixtures at significantly lower wattage and offer significantly longerlifespan.

Baseline Efficiency

The baseline efficiency case is a blend of incandescent, compact fluorescent, and halgoen lamps. For home audit applications, the baseline is the existing fixture.

High Efficiency

The high efficiency case is an ENERGY STAR® qualified compact fluorescent light fixture wired for exclusive use with pin-based CFLs.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	Lighting	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	Yes

Algorithm Type: Engineering algorithm with deemed inputs

Unit: Rebated lamp or fixture.

Algorithm:

Gross kWh = Qty × ΔkW × Hours
Gross kW = Qty × ΔkW

Where:
Qty = Total number of units.
ΔkW = Deemed average kW reduction per unit.
Hours = Deemed average annual operating hours.

Hours

The average annual operating hours are 1,058.5 hours/year for rebated lights purchased by customers and 985.5 hours/year for lights intalled in direct install programs. For multifamily applications, hours are site-specific.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Indoor Fixtures	Single Family Appliance	65.1 (76)	0.049 (#N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
ESH Fixtures	Residential New Construction	65.1 (76)	0.066 (76)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW LI Fixtures	Income Eligible MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW Fixtures	EnergyWise MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW SF Fixtures	EnergyWise	65.1 (76)	0.066 (76)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Indoor Fixture	EnergyStar® Lighting	70 (76)	0.066 (76)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Indoor Fixtures	Single Family Appliance Management	11 (76)	1.00 (N4)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	0.13 (92)	0.16 (92)
ESH Fixtures	Residential New Construction	11 (76)	0.95 (N4)	1.00 (80)	1 (N35)	1 (N35)	1 (N35)	0.13 (92)	0.16 (92)
EW LI Fixtures	Income Eligible MultiFamily	11 (3)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.13 (135)	0.16 (135)
EW Fixtures	EnergyWise MultiFamily	11 (76)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.13 (92)	0.16 (92)
EW SF Fixtures	EnergyWise	11 (76)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.13 (92)	0.16 (92)
Indoor Fixture	EnergyStar® Lighting	11 (76)	0.95 ######	1.00 (N5)	1 (N35)	1 (N35)	1 (N35)	0.14 (92)	0.18 (92)

Sources

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

14 Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.

3 2013-2015 MA Lighting Worksheet

76 Lighting Worksheet Final - RI Programs. Based on NMR (2014) Northeast Residential Lighting HOU Study.

80 Nexus Market Research & Dorothy Conant (2006). Massachusetts ENERGY STAR® Homes: 2005 Baseline Study: Part II:Homeowner Survey Analysis Incorporating Inspection Data Final Report. Prepared for the Massachusetts Joint ManagementCommittee.

92 Northeast Residential Lighting HOU Study

N31 National Grid assumption based on regional PA working groups.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N40 Realization rates are 100% since savings estimates are based on evaluation results.

N43 Savings persistence is assumed to be 100%.

N5 All PAs use 100% savings persistence factors.

Lighting - LED Fixtures

Version Date: PY 2015

Description

The installation of Light-Emitting Diode (LED) screw-in bulbs and fixtures. LEDsoffer comparable luminosity to incandescent bulbs at significantly less wattage and significantlylonger lamp lifetimes.

Baseline Efficiency

The baseline efficiency case is blend of incandescents, CFLs and other bulbs types, as provided by market research or for a home energy audit, the base line is a 65 Watt incandescent.

High Efficiency

The high efficiency case is and ENERGY STAR® qualified LED fixture.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	Lighting	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	Yes

Algorithm Type: Engineering algorithm with deemed inputs

Unit: Rebated lamp or fixture.

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kW} \times \text{Hours}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

ΔkW = Deemed average kW reduction per unit.

Hours = Deemed average annual operating hours.

Hours

The average annual operating hours are 1,058.5 hours/year for rebated lights purchased by customers and 985.5 hours/year for lights intalled in direct install programs. For multifamily applications, hours are site-specific.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
EW MF LED Fixtures	EnergyWise MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW SF LED Fixture	EnergyWise	75.8 (76)	0.077 (76)	0 (N/A)	0 (N/A)	0 (N/A)	5 (N/A)
LED Fixtures	EnergyStar® Lighting	57.9 (76)	0.055 (76)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
EW MF LED Fixtures	EnergyWise MultiFamily	11 (76)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.13 (92)	0.16 (92)
EW SF LED Fixture	EnergyWise	11 (76)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.13 (92)	0.16 (92)
LED Fixtures	EnergyStar® Lighting	11 (76)	1.00 (N26)	1.00 (N5)	1 (N35)	1 (N35)	1 (N35)	0.14 (92)	0.18 (92)

Sources

14 Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.

76 Lighting Worksheet Final - RI Programs. Based on NMR (2014) Northeast Residential Lighting HOU Study.

92 Northeast Residential Lighting HOU Study

N26 In-service rates are set to 100% based on the assumption that all purchased units are installed.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N40 Realization rates are 100% since savings estimates are based on evaluation results.

N43 Savings persistence is assumed to be 100%.

N5 All PAs use 100% savings persistence factors.

Lighting - LED Lighting

Version Date: PY 2015

Description

The installation of Light-Emitting Diode (LED) screw-in bulbs and fixtures. LEDsoffer comparable luminosity to incandescent bulbs at significantly less wattage and significantlylonger lamp lifetimes.

Baseline Efficiency

The baseline efficiency case is blend of incandescents, halogens, CFLs and other bulbs types, as provided by market research or for EISA exempt bulbs and bulbs installed through an home energy audit, the base line is a 65 Watt incandescent.

High Efficiency

The high efficiency case is and ENERGY STAR® qualified LED fixture.

Sector:	Residential
End Use:	Lighting
Market (Lost Opportunity):	Yes
Market (Retrofit):	No

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	Yes

Algorithm Type: Engineering algorithm with deemed inputs

Unit: Rebated lamp or fixture.

Algorithm:

Gross kWh = Qty × (kW_base - kW_ee) × Hours
Gross kW = Qty × (kW_base - kW_ee)

Where:
Qty = Total number of units.
kW_base = Deemed average demand per baseline unit.
kW_ee = Deemed average demand per high-efficiency unit.
Hours = Deemed average annual operating hours.

Hours

The average annual operating hours are 1,058.5 hours/year for rebated lights purchased by customers and 985.5 hours/year for lights intalled in direct install programs. For multifamily applications, hours are site-specific.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
LED Bulbs LI	Single Family Appliance	50.9 (76)	0.052 (76)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
LEDs	Residential New Construction	50.9 (76)	0.052 (76)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW LI LED Fixture	Income Eligible MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW LI LED A Lamp	Income Eligible MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	Calc (N45)
EW LED A Lamp	EnergyWise MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW SF LED Bulbs	EnergyWise	50.9 (76)	0.052 (76)	0 (N/A)	0 (N/A)	0 (N/A)	7 (N/A)
Outdoor LED Fixture	EnergyStar® Lighting	101.7 (76)	0.096 (76)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
School Program LED Bulbs	EnergyStar® Lighting	31.3 (76)	0.03 (76)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
LED Bulbs (EISA Exempt)	EnergyStar® Lighting	50.8 (76)	0.048 (76)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
LED A Lamps	EnergyStar® Lighting	38.9 (76)	0.037 (76)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
LED Bulbs LI	Single Family Appliance Management	11 (3)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.13 (92)	0.16 (92)
LEDs	Residential New Construction	11 (76)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.13 (92)	0.16 (92)
EW LI LED Fixture	Income Eligible MultiFamily	11 (129)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.13 (135)	0.16 (135)
EW LI LED A Lamp	Income Eligible MultiFamily	11 (129)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.13 (135)	0.16 (135)
EW LED A Lamp	EnergyWise MultiFamily	11 (76)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.13 (92)	0.16 (92)
EW SF LED Bulbs	EnergyWise	11 (76)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.13 (92)	0.16 (92)
Outdoor LED Fixture	EnergyStar® Lighting	11 (76)	1.00 (N26)	1.00 (N5)	1 (N35)	1 (N35)	1 (N35)	0.14 (92)	0.18 (92)
School Program LED Bulbs	EnergyStar® Lighting	6 (76)	1.00 (N26)	1.00 (N5)	1 (N35)	1 (N35)	1 (N35)	0.14 (92)	0.18 (92)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
LED Bulbs (EISA Exempt)	EnergyStar® Lighting	19 (76)	1.00 (N26)	1.00 (N5)	1 (N35)	1 (N35)	1 (N35)	0.14 (92)	0.18 (92)
LED A Lamps	EnergyStar® Lighting	11 (76)	1.00 (N26)	1.00 (N5)	1 (N35)	1 (N35)	1 (N35)	0.14 (92)	0.18 (92)

Sources

129 The Cadmus Group (2012). Rhode Island EnergyWise Single Family Impact Evaluation. Prepared for National Grid

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

14 Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.

3 2013-2015 MA Lighting Worksheet

76 Lighting Worksheet Final - RI Programs. Based on NMR (2014) Northeast Residential Lighting HOU Study.

92 Northeast Residential Lighting HOU Study

N26 In-service rates are set to 100% based on the assumption that all purchased units are installed.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N40 Realization rates are 100% since savings estimates are based on evaluation results.

N43 Savings persistence is assumed to be 100%.

N5 All PAs use 100% savings persistence factors.

Lighting - Outdoor Fixtures

Version Date: PY 2015

Description

The installation of hardwired ENERGY STAR® fluorescent outdoor fixtures with pin-based bulbs. Savings for this measure are attributable to high efficiency outdoor lighting fixtures and are treated similarly to indoor fixtures.

Baseline Efficiency

The baseline efficiency case is an incandescent, screw-based fixture with an incandescent bulb.

High Efficiency

The high efficiency case is an ENERGY STAR® fixture wired for exclusive use with a pin based CFL bulb.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	Lighting	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	Yes

Algorithm Type: Engineering algorithm with deemed inputs

Unit: Rebated lamp or fixture.

Algorithm:

Gross kWh = Qty × ΔkW × Hours
Gross kW = Qty × ΔkW

Where:
Qty = Total number of units.
ΔkW = Deemed average kW reduction per unit.
Hours = Deemed average annual operating hours.

Hours

The average annual operating hours are 1,058.5 hours/year for rebated lights purchased by customers and 985.5 hours/year for lights intalled in direct install programs.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
EW LI Outdoor Fixtures	Income Eligible MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW Outdoor Fixtures	EnergyWise MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW SF OFIXTURE	EnergyWise	156 (133)	0.048 (135)	0 (N/A)	0 (N/A)	0 (N/A)	1 (N/A)
Outdoor Fixture	EnergyStar® Lighting	100.5 (76)	0.095 (76)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
EW LI Outdoor Fixtures	Income Eligible MultiFamily	11 (3)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0 (135)	1 (135)
EW Outdoor Fixtures	EnergyWise MultiFamily	11 (83)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0 (135)	1 (135)
EW SF OFIXTURE	EnergyWise	6 (3)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0 (135)	1 (135)
Outdoor Fixture	EnergyStar® Lighting	11 (76)	0.87 (82)	1.00 (N5)	1 (N35)	1 (N35)	1 (N35)	0.14 (92)	0.18 (92)

Sources

133 The Cadmus Group, Inc (2012). Rhode Island EnergyWise Single Family Impact Evaluation.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

14 Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.

3 2013-2015 MA Lighting Worksheet

76 Lighting Worksheet Final - RI Programs. Based on NMR (2014) Northeast Residential Lighting HOU Study.

82 Nexus Market Research and RLW Analytics (2004). Impact Evaluation of the Massachusetts, Rhode Island, and Vermont 2003 Residential Lighting Programs. Submitted to The Cape Light Compact, State of Vermont Public Service Department for Efficiency Vermont, N

83 Nexus Market Research and RLW Analytics (2008). Residential Lighting Measure Life Study. Prepared for New EnglandResidential Lighting Program Sponsors.

92 Northeast Residential Lighting HOU Study

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N40 Realization rates are 100% since savings estimates are based on evaluation results.

N43 Savings persistence is assumed to be 100%.

N5 All PAs use 100% savings persistence factors.

Lighting - Torchieres

Version Date: PY 2015

Description

The installation of high-efficiency ENERGY STAR® torchieres. High efficiencytorchieres use fluorescent in place of halogen or incandescent bulbs to provide comparableluminosity at significantly reduced wattage.

Baseline Efficiency

The baseline efficiency case is a halogen (or incandescent) torchiere fixture.

High Efficiency

The high efficiency case is a fluorescent torchiere fixture.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	Lighting	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with deemed inputs

Unit: Rebated lamp or fixture.

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kW} \times \text{Hours}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

ΔkW = Deemed average kW reduction per unit.

Hours = Deemed average annual operating hours.

Hours

The average annual operating hours are 1,204.5 hours/year.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Torchiere	EnergyStar® Lighting	106 (136)	0.088 (82)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Torchiere	EnergyStar® Lighting	8 (82)	0.83 (82)	1.00 (N5)	1 (N35)	1 (N35)	1 (N35)	0.14 (92)	0.18 (92)

Sources

136 The Cadmus Group, Inc. (2012). Low Income Single Family Impact Evaluation. Prepared for the Electric and Gas Program Administrators of Massachusetts.

82 Nexus Market Research and RLW Analytics (2004). Impact Evaluation of the Massachusetts, Rhode Island, and Vermont 2003 Residential Lighting Programs. Submitted to The Cape Light Compact, State of Vermont Public Service Department for Efficiency Vermont, N

92 Northeast Residential Lighting HOU Study

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N5 All PAs use 100% savings persistence factors.

Products - Computer Monitors

Version Date: PY 2015

Description

Rebates for ENERGY STAR® qualified computer monitors.

Baseline Efficiency

The baseline efficiency case is a conventional computer monitor.

High Efficiency

The high efficiency case is an ENERGY STAR® rated LCD monitor.

Sector:	Residential
End Use:	Products
Market (Lost Opportunity):	Yes
Market (Retrofit):	No

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Rebated ENERGY STAR® computer monitor

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW

Where:
Qty = Total number of units.
ΔkWh = Deemed average annual kWh reduction per unit.
ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Monitors	EnergyStar® Products	35 (16)	0.01 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Monitors	EnergyStar® Products	5 (16)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	0.35 (N31)	1 (N31)

Sources

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

16 Consortium for Energy Efficiency (2008). Consumer Electronics Program Guide: Information on Voluntary Approaches for the Promotion of Energy Efficient Consumer Electronics - Products and Practices.

N26 In-service rates are set to 100% based on the assumption that all purchased units are installed.

N31 National Grid assumption based on regional PA working groups.

N43 Savings persistence is assumed to be 100%.

Products - Computers

Version Date: PY 2015

Description

Rebates for ENERGY STAR® computers.

Baseline Efficiency

The baseline efficiency case is a conventional computer.

High Efficiency

The high efficiency case is a subset of computers that are ENERGY STAR® rated or are included in the Top Ten USA ranking.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	Products	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Rebated ENERGY STAR® computer

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

ΔkW = Deemed average kW reduction per unit.

Hours

The operational hours include: 3504 annual idle hours, 438 annual sleep hours, and 4818 annual off hours.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Computers	EnergyStar® Products	70 (43)	0.015 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Top 10 Desktop Computer	EnergyStar® Products	80 (43)	0.017 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Computers	EnergyStar® Products	4 (38)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	0.73 (135)	1 (135)
Top 10 Desktop Computer	EnergyStar® Products	4 (38)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	0.73 (135)	1 (135)

Sources

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

28 Energy Star Program Requirements for Computers Version 5.0

38 Environmental Protection Agency (2010). Life Cycle Cost Estimate for ENERGY STAR Office Equipment.

43 Environmental Protection Agency (2012). ENERGY STAR Desktop & Integrated Computer Product List. August 2, 2012. Average of all units in category

N26 In-service rates are set to 100% based on the assumption that all purchased units are installed.

N31 National Grid assumption based on regional PA working groups.

N43 Savings persistence is assumed to be 100%.

Products - Dehumidifier

Version Date: PY 2015

Description

The Installation of high efficiency dehumidifiers and the turn-in of existing inefficienct dehumidifyers.

Baseline Efficiency

The baseline efficiency for an existing unit (EffBASE) is 1.30 L/kWh, which is the current federal standard for a 35 pint/day unit. The baseline efficiency case for a retired dehumidifier (EffRETIRED) is 1.20 L/kWh, which is the pre-EPACT 2005 efficiency for a 35 pint/day unit

High Efficiency

The high efficiency case is an ENERGY STAR® replacement unit with an efficiency of 1.47 L/kWh. The high efficiency case is an ENERGY STAR® replacement unit with an efficiency of 1.47 L/kWh.

Sector:	Residential
End Use:	Products
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with deemed inputs

Unit: Installed efficient dehumidifyer post turn-in of inefficiency model

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Dehumidifier (Early Retirement)	EnergyStar® Products	34 (146)	0.12 (146)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Dehumidifier	EnergyStar® Products	73 (146)	0.09 (146)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Dehumidifier (Early Retirement)	EnergyStar® Products	5 (N30)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	0.85 (N30)	0 (N30)
Dehumidifier	EnergyStar® Products	12 (31)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	0.85 (N30)	0 (N30)

Sources

146 Dehumidifyer Savings 2015.xls

31 Environmental Protection Agency (2002). Life Cycle Cost Estimate for ENERGY STAR Dehumidifiers.

N26 In-service rates are set to 100% based on the assumption that all purchased units are installed.

N30 Massachusetts Common Assumption

N31 National Grid assumption based on regional PA working groups.

N43 Savings persistence is assumed to be 100%.

Products - Pool Pumps

Version Date: PY 2015

Description

The installation of a 2-speed or variable speed drive pool pump. Operating a pool pump for a longer period of time at a lower wattage can move the same amount of water using significantly less energy.

Baseline Efficiency

The baseline efficiency case is a single speed pump.

High Efficiency

The high efficiency case is a 2-speed or variable speed pump.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	Products	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with deemed inputs

Unit: Installed efficient pool pump.

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \text{kWh\_base} \times \text{\%SAVE}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

kWh_base = Deemed average annual kWh consumption per baseline unit.

%SAVE = Deemed average savings factor.

ΔkW = Deemed average kW reduction per unit.

Hours

Hours are considered on a case-by-case basis since they are dependent on seasonal factors, pool size, and treatment conditions.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Pool pump (variable)	EnergyStar® Products	837 (97)	2.386 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Pool pump (2-speed)	EnergyStar® Products	400 (97)	1.14 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Pool pump (variable)	EnergyStar® Products	10 (17)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	1 (135)	0 (135)
Pool pump (2-speed)	EnergyStar® Products	10 (17)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	1 (135)	0 (135)

Sources

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

17 Davis Energy Group (2008). Proposal Information Template for Residential Pool Pump Measure Revisions. Prepared for Pacific Gas and Electric Company.

97 Pacific Gas and Electric The Multi-Speed Pool Pump Fact Sheet.

N26 In-service rates are set to 100% based on the assumption that all purchased units are installed.

N31 National Grid assumption based on regional PA working groups.

N43 Savings persistence is assumed to be 100%.

Products - Room Air Cleaners

Version Date: PY 2015

Description

Rebates provided for the purchase of an ENERGY STAR® qualified room air cleaner. ENERGY STAR® air cleaners are 40% more energy-efficient than standard models.

Baseline Efficiency

The baseline efficiency case is a conventional unit with clean air delivery rate (CADR) of 51-100.

High Efficiency

The high efficiency case is an ENERGY STAR® qualified air cleaner with a CADR of 51-100.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	Products	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Rebated ENERGY STAR® room air cleaner

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kWh} / \text{Hours}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

Hours = Deemed average annual operating hours.

Hours

The Savings are based on 16 operating hours per day, 365 days per year

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Room air cleaners	EnergyStar® Products	391 (42)	0.084 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Room air cleaners	EnergyStar® Products	9 (42)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	0.73 (135)	1 (135)

Sources

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

42 Environmental Protection Agency (2012), Savings Calculator for Energy Star Qualified Appliances.

N26 In-service rates are set to 100% based on the assumption that all purchased units are installed.

N31 National Grid assumption based on regional PA working groups.

N43 Savings persistence is assumed to be 100%.

Products - Room Air Conditioners

Version Date: PY 2015

Description

The installation of ENERGY STAR® qualified room air conditioners. ENERGY STAR® qualified air conditioners are typically 10% more efficient than models meeting federal standards.

Baseline Efficiency

The baseline efficiency case is a window AC unit that meets the minimum federal efficiency standard for efficiency which currently is EER 9.8.

High Efficiency

The high efficiency level is a room AC unit meeting or exceeding the federal efficiency standard by 10% or more. Average size is 10,000 Btu and average EERs is 10.8.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	Products	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed high-efficiency room air-conditioner.

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkWh / Hours

Where:
Qty = Total number of units.
ΔkWh = Deemed average annual kWh reduction per unit.
Hours = Deemed average annual operating hours.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Room AC (10.8)	Residential New Construction	43 (30)	0.123 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Room AC (10.8)	EnergyStar® Products	43 (30)	0.123 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Room AC (10.8)	Residential New Construction	9 (36)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	1 (135)	0 (135)
Room AC (10.8)	EnergyStar® Products	9 (36)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	1 (135)	0 (135)

Sources

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

30 energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorConsumerRoomAC.xls.

36 Environmental Protection Agency (2009). Life Cycle Cost Estimate for ENERGY STAR Qualified Room Air Conditioner.

N26 In-service rates are set to 100% based on the assumption that all purchased units are installed.

N31 National Grid assumption based on regional PA working groups.

N43 Savings persistence is assumed to be 100%.

Products - Smart Strips

Version Date: PY 2015

Description

The basic measures switches off plug load using current sensors and switching devices which turn off plug load when electrical current drops below threshold low levels. The advanced measure shuts devices off after it no longer senses activity from their infrared controls.

Baseline Efficiency

The baseline efficiency case is the absence power strip and leaving peripheral devices plugged in or using a power surge protector and leaving peripheral devices on

High Efficiency

The high efficiency case is the use of a smart strip or advanced smart strip.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	Products	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Rebated smart strip.

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

ΔkW = Deemed average kW reduction per unit.

Hours

Since the power strip is assumed to be plugged in all year, the savings are based on 8,760 operational hours per year.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Smart strips	Single Family Appliance	75 (131)	0.02 (127)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW LI Smart Strips	Income Eligible MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW Smart Strips	EnergyWise MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW SF Smart Strip	EnergyWise	79 (23)	0.017 (135)	0 (N/A)	0 (N/A)	0 (N/A)	6 (N/A)
Advanced Power Strips	EnergyStar® Products	235 (135)	0.05 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Smart Strips	EnergyStar® Products	79 (23)	0.017 (127)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Smart strips	Single Family Appliance Management	5 (129)	1.00 (N4)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	0.35 (N31)	1 (N31)
EW LI Smart Strips	Income Eligible MultiFamily	6 (83)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0 (135)	1 (135)
EW Smart Strips	EnergyWise MultiFamily	5 (129)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	0.77 (135)	1 (135)
EW SF Smart Strip	EnergyWise	5 (N30)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.73 (135)	1 (135)
Advanced Power Strips	EnergyStar® Products	5 (N30)	1.00 (N4)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	0.73 (135)	1 (135)
Smart Strips	EnergyStar® Products	5 (N30)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	0.73 (135)	1 (135)

Sources

127 The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for the Massachusetts Program Administrators.

129 The Cadmus Group (2012). Rhode Island EnergyWise Single Family Impact Evaluation. Prepared for National Grid

131 The Cadmus Group (2014). Impact Evaluation: Rhode Island Income Eligible Services, Volume II. Prepared for National Grid.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

14 Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.

23 ECOS 2009 Smart Plug Strips: Draft Report

83 Nexus Market Research and RLW Analytics (2008). Residential Lighting Measure Life Study. Prepared for New EnglandResidential Lighting Program Sponsors.

N26 In-service rates are set to 100% based on the assumption that all purchased units are installed.

N30 Massachusetts Common Assumption

N31 National Grid assumption based on regional PA working groups.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N40 Realization rates are 100% since savings estimates are based on evaluation results.

N43 Savings persistence is assumed to be 100%.

Products - Super Efficient Dryer

Version Date: PY 2015

Description

The installation of a clothes dryer promoted by the Super Efficient Dryer Initiative.

Baseline Efficiency

A new electric dryer.

High Efficiency

A super efficient electric dryer such as those promoted through the Super Efficient Dryer Initiative.

Sector:	Residential
End Use:	Products
Market (Lost Opportunity):	Yes
Market (Retrofit):	No

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed super efficient dryer.

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Super Efficient Dyer	EnergyStar® Products	241 (112)	0.044 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Super Efficient Dyer	EnergyStar® Products	13 (112)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	0.73 (135)	1 (135)

Sources

112 SEDI HE Dryer Screening Ver.2 Using DOE2005.xls

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

N26 In-service rates are set to 100% based on the assumption that all purchased units are installed.

N31 National Grid assumption based on regional PA working groups.

N43 Savings persistence is assumed to be 100%.

Products - Televisions

Version Date: PY 2015

Description

Rebates for televisions that meet ENERGY STAR® specifications and are listed under Top Ten USA® rankings.

Baseline Efficiency

The baseline efficiency case is a blend of EnergyStar and federally compliant televisions.

High Efficiency

The high efficiency case is an ENERGY STAR® version 6.0 qualified television rated and included in the Top Ten USA ranking.

Sector:	Residential
End Use:	Products
Market (Lost Opportunity):	Yes
Market (Retrofit):	No

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Rebated television.

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

ΔkW = Deemed average kW reduction per unit.

Hours

Since the TV is assumed to be plugged in all year, the savings are based on 8,760 operational hours per year. The weighted savings are based on 5 hours on and 19 hours standby each day.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Most Efficient TV >32" and <=46"	EnergyStar® Products	54.3 (4)	0.045 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Most Efficient TV >=46"	EnergyStar® Products	112.6 (4)	0.072 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Most Efficient TV <=32"	EnergyStar® Products	27 (4)	0.023 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Top 10 TV >32" and <46"	EnergyStar® Products	56 (4)	0.045 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Top 10 TV >=46"	EnergyStar® Products	97.9 (4)	0.072 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Top 10 TV <=32"	EnergyStar® Products	27.6 (4)	0.023 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Most Efficient TV >32" and <=46"	EnergyStar® Products	6 (37)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	0.73 (135)	1 (135)
Most Efficient TV >=46"	EnergyStar® Products	6 (37)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	0.73 (135)	1 (135)
Most Efficient TV <=32"	EnergyStar® Products	6 (37)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	0.73 (135)	1 (135)
Top 10 TV >32" and <46"	EnergyStar® Products	6 (37)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	0.73 (135)	1 (135)
Top 10 TV >=46"	EnergyStar® Products	6 (37)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	0.73 (135)	1 (135)
Top 10 TV <=32"	EnergyStar® Products	6 (37)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	0.73 (135)	1 (135)

Sources

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

37 Environmental Protection Agency (2008). Life Cycle Cost Estimate for ENERGY STAR Television.

4 2015 TV Savings RI.xls

46 Environmental Protection Agency (2012). Savings Calculator for ENERGY STAR Qualified Consumer Electronics. Energy use of average screen size within category.

N26 In-service rates are set to 100% based on the assumption that all purchased units are installed.

N31 National Grid assumption based on regional PA working groups.

N43 Savings persistence is assumed to be 100%.

Refrigeration - Freezer Replacement

Version Date: PY 2015

Description

This measure covers the replacement of an existing inefficient freezer with a new energy efficient model.

Baseline Efficiency

The baseline efficiency case for both the replaced and baseline new freezer is represented by the existing freezer. It is assumed that low-income customers would replace their freezers with a used inefficient unit.

High Efficiency

The high efficiency case is a new high efficiency freezer.

Sector:	Residential
End Use:	Refrigeration
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	Yes

Algorithm Type: Engineering algorithm with deemed inputs

Unit: Installed high-efficiency freezer.

Algorithm:

Gross kWh = Qty × (kWh_base - kWh_ee)
Gross kW = Qty × (kWh_base - kWh_ee) / Hours

Where:
Qty = Total number of units.
kWh_base = Deemed average annual kWh consumption per baseline unit.
kWh_ee = Deemed average annual kWh consumption per high-efficiency unit.
Hours = Deemed average annual operating hours.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Replacement Freezer	Single Family Appliance	484 (131)	0.06 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Replacement Freezer	Single Family Appliance Management	19 (N31)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (135)	0.93 (135)

Sources

131 The Cadmus Group (2014). Impact Evaluation: Rhode Island Income Eligible Services, Volume II. Prepared for National Grid.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

N31 National Grid assumption based on regional PA working groups.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Refrigeration - Freezers

Version Date: PY 2015

Description

This measure covers the replacement of an existing inefficient freezer with a new efficient freezer.

Baseline Efficiency

For Top Ten® and Most Efficient® refrigerators, the baseline is a 50% mix of available Energy Star® and Federal standard compliant freezers. For Energy Star® refrigerators, the baseline is a freezer that meets Federal standards.

High Efficiency

The high efficiency case is an Energy Star® freezer or a model that is ENERGY STAR® rated and included in the Most Efficient® or Top Ten USA® ranking.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	Refrigeration	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with deemed inputs

Unit: Installed high-efficiency freezer.

Algorithm:

Gross kWh = Qty × (kWh_base - kWh_ee)

Gross kW = Qty × ΔkW

Where:

Qty = Total number of units.

kWh_base = Deemed average annual kWh consumption per baseline unit.

kWh_ee = Deemed average annual kWh consumption per high-efficiency unit.

ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Freezers	EnergyStar® Products	49 (44)	0.006 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Top 10 Freezer	EnergyStar® Products	154 (139)	0.033 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Freezers	EnergyStar® Products	11 (40)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	1 (135)	0.93 (135)
Top 10 Freezer	EnergyStar® Products	11 (40)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	1 (135)	0.93 (135)

Sources

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

139 Top Ten Freezer Calcs.xls

40 Environmental Protection Agency (2011). Life Cycle Cost Estimate for ENERGY STAR Freezer. Accessed 9/7/2011.

44 Environmental Protection Agency (2012). Freezers Qualified Product List. July 18, 2012. Average of all units in category

N26 In-service rates are set to 100% based on the assumption that all purchased units are installed.

N31 National Grid assumption based on regional PA working groups.

N43 Savings persistence is assumed to be 100%.

Refrigeration - Refrigerator Brush

Version Date: PY 2015

Description

The cleaning of refrigerator coils.

Baseline Efficiency

A refrigerator with uncleaned coils.

High Efficiency

A refrigerator with coils cleaned by an auditor.

Sector:	
End Use:	Refrigeration
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	
Gas Energy Impact:	
Oil Energy Impact:	
Propane Impact:	
Water Impact:	
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: A burshed refrigerator coil

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
EW SF Refrigerator Brush	EnergyWise	37 (133)	0.005 (135)	0 (N/A)	0 (N/A)	0 (N/A)	8 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
EW SF Refrigerator Brush	EnergyWise	12 (35)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (135)	0.93 (135)

Sources

133 The Cadmus Group, Inc (2012). Rhode Island EnergyWise Single Family Impact Evaluation.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

35 Environmental Protection Agency (2009). Life Cycle Cost Estimate for ENERGY STAR Qualified Residential Refrigerator.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Refrigeration - Refrigerator Replacement

Version Date: PY 2015

Description

This measure covers the replacement of an existing inefficient refrigerator with a new ENERGY STAR® rated refrigerator. ENERGY STAR® qualified refrigerators use at least 20% less energy than non-qualified models.

Baseline Efficiency

The baseline efficiency case is the existing refrigerator. It is assumed that low-income customers would otherwise replace their refrigerators with a used inefficient unit.

High Efficiency

The high efficiency case is an ENERGY STAR® rated refrigerator that meets the ENERGY STAR® criteria for full-sized refrigerators (7.75 cubic feet), using at least 20% less energy than models meeting the minimum Federal government standard.

Sector:	Residential
End Use:	Refrigeration
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	Yes

Algorithm Type: Engineering algorithm with deemed inputs

Unit: Installed high-efficiency refrigerator.

Algorithm:

Gross kWh = Qty × (kWh_base - kWh_ee)
Gross kW = Qty × (kWh_base - kWh_ee) / Hours

Where:
Qty = Total number of units.
kWh_base = Deemed average annual kWh consumption per baseline unit.
kWh_ee = Deemed average annual kWh consumption per high-efficiency unit.
Hours = Deemed average annual operating hours.

Hours

The average annual operating hours are 8760 hours/year.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Replacement Refrigerator	Single Family Appliance	384 (131)	0.05 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW LI Refrigerator	Income Eligible MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW Refrigerator	EnergyWise MultiFamily	Calc (14)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Replacement Refrigerator	Single Family Appliance Management	19 (N31)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (135)	0.93 (135)
EW LI Refrigerator	Income Eligible MultiFamily	12 (35)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	1 (135)	0.86 (135)
EW Refrigerator	EnergyWise MultiFamily	12 (35)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N40)	1 (135)	0.86 (135)

Sources

131 The Cadmus Group (2014). Impact Evaluation: Rhode Island Income Eligible Services, Volume II. Prepared for National Grid.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

14 Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.

35 Environmental Protection Agency (2009). Life Cycle Cost Estimate for ENERGY STAR Qualified Residential Refrigerator.

N31 National Grid assumption based on regional PA working groups.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N40 Realization rates are 100% since savings estimates are based on evaluation results.

N43 Savings persistence is assumed to be 100%.

Refrigeration - Refrigerator/Freezer Removal

Version Date: PY 2015

Description

The retirement of old, inefficient secondary refrigerators and freezers.

Baseline Efficiency

The baseline efficiency case is an old, inefficient secondary working refrigerator or freezer. Estimated average usage is based on combined weight of freezer energy use and refrigerator energy use.

High Efficiency

The high efficiency case assumes no replacement of secondary unit.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	No
End Use:	Refrigeration	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Removal of existing refrigerator or freezer.

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW

Where:
Qty = Total number of units.
ΔkWh = Deemed average annual kWh reduction per unit.
ΔkW = Deemed average kW reduction per unit.

Hours

The average annual operating hours are 8760 hours/year.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Refrigerator Recycle	EnergyStar® Products	755 (88)	0.089 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Freezer Recycling	EnergyStar® Products	663 (88)	0.082 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Refrigerator Recycle	EnergyStar® Products	8 (88)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	1 (135)	0.92 (135)
Freezer Recycling	EnergyStar® Products	8 (88)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	1 (135)	0.93 (135)

Sources

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

88 NMR Group, Inc. (2011). Massachusetts Appliance Turn-In Program Evaluation Integrated Report Findings – FINAL. Prepared for National Grid, NSTAR Electric, Cape Light Compact, and Western Massachusetts Electric Company.

N26 In-service rates are set to 100% based on the assumption that all purchased units are installed.

N31 National Grid assumption based on regional PA working groups.

N41 Refrigerator and freezer run hours are 8760 hours/year

N43 Savings persistence is assumed to be 100%.

Refrigeration - Refrigerators

Version Date: PY 2015

Description

This measure covers the replacement of an existing inefficient refrigerator with a new efficient refrigerator.

Baseline Efficiency

For Top Ten® and Most Efficient® refrigerators, the baseline is a 50% mix of available Energy Star® and Federal standard compliant refrigerators. For Energy Star® refrigerators, the baseline is a refrigerator that meets Federal standards. For Low Income a

High Efficiency

The high efficiency case is an Energy Star® refrigerator or a model that is ENERGY STAR® rated and included in the Most Efficient® or Top Ten USA® ranking.

Sector:	Residential
End Use:	Refrigeration
Market (Lost Opportunity):	Yes
Market (Retrofit):	No

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with deemed inputs

Unit: Installed high-efficiency refrigerator.

Algorithm:

Gross kWh = Qty × (kWh_base - kWh_ee)
Gross kW = Qty × ΔkW

Where:
Qty = Total number of units.
kWh_base = Deemed average annual kWh consumption per baseline unit.
kWh_ee = Deemed average annual kWh consumption per high-efficiency unit.
ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Appliance Removal	Single Family Appliance	1180 (131)	0.15 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Refrigerators	Residential New Construction	104 (45)	0.013 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
EW SF Refrig rebate	EnergyWise	770 (133)	0.095 (135)	0 (N/A)	0 (N/A)	0 (N/A)	2 (N/A)
Most Efficient Refrigerator	EnergyStar® Products	125 (145)	0.02 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Top 10 Refrigerator	EnergyStar® Products	114 (145)	0.014 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Appliance Removal	Single Family Appliance Management	5 (N31)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (135)	0.93 (135)
Refrigerators	Residential New Construction	12 (35)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (135)	0.93 (135)
EW SF Refrig rebate	EnergyWise	12 (35)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (135)	0.93 (135)
Most Efficient Refrigerator	EnergyStar® Products	12 (47)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	1 (135)	0.93 (135)
Top 10 Refrigerator	EnergyStar® Products	12 (35)	1.00 (N26)	1.00 (N43)	1 (N31)	1 (N31)	1 (N31)	1 (135)	0.93 (135)

Sources

131 The Cadmus Group (2014). Impact Evaluation: Rhode Island Income Eligible Services, Volume II. Prepared for National Grid.

133 The Cadmus Group, Inc (2012). Rhode Island EnergyWise Single Family Impact Evaluation.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

145 Refrigerator calcs.xls

35 Environmental Protection Agency (2009). Life Cycle Cost Estimate for ENERGY STAR Qualified Residential Refrigerator.

45 Environmental Prtection Agency (2012). Refrigerators Qualified Product List. July 18, 2012. Average of all units in category

47 Environmental Protection Agency (2013). Most Efficient List 2013

N26 In-service rates are set to 100% based on the assumption that all purchased units are installed.

N31 National Grid assumption based on regional PA working groups.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Commercial Electric Efficiency Measures

Compressed Air - High Efficiency Air Compressors

Version Date: PY 2015

Description

Covers the installation of oil flooded, rotary screw compressors with Load/No Load, Variable Speed Drive, or Variable Displacement capacity control with properly sized air receiver. Efficient air compressors use various control schemes to improve compression efficiencies at partial loads. When an air compressor fitted with Load/No Load, Variable Speed Drive, or Variable Displacement capacity controls is used in conjunction with a properly-sized air receiver, considerable amounts of energy can be saved.

Baseline Efficiency

The baseline efficiency case is a typical modulating compressor with blow down valve.

High Efficiency

The high efficiency case is an oil-flooded, rotary screw compressor with Load/No Load, Variable Speed Drive, or Variable Displacement capacity control with a properly sized air receiver. Air receivers are designed to provide a supply buffer to meet short-term demand spikes which can exceed the compressor capacity. Installing a larger receiver tank to meet occasional peak demands can allow for the use of a smaller compressor.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	Compressed Air	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Total horsepower (hp) of installed air compressor capacity.

Algorithm:

Gross kWh = HP_compressor × ΔkW/HP × Hours

Gross kW = HP_compressor × ΔkW/HP

Where:

HP_compressor = Nominal rated horsepower of high efficiency air compressor: site-specific

ΔkW/HP = Air compressor kW reduction per HP **Reference Table 18**

Hours = Annual operating hours of the air compressor: site-specific

Hours

The annual hours of operation are site specific and will be determined on a case by case basis.

Reference Tables

Table 18: Air Compressor kW Reduction per Horsepower

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
VSD (25≤HP≤75)	Commercial New Construction	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
VSD (15≤HP<25)	Commercial New Construction	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Variable Displacement (50≤HP≤75)	Commercial New Construction	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Load/No Load (25≤HP≤75)	Commercial New Construction	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Load/No Load (15≤HP<25)	Commercial New Construction	Calc (N3)	Calc (N3)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
VSD (25≤HP≤75)	Commercial New Construction	15 (25)	1.00 (N4)	1.00 (N43)	1 (18)	1 (18)	1 (18)	0.8 (18)	0.54 (18)
VSD (15≤HP<25)	Commercial New Construction	15 (25)	1.00 (N4)	1.00 (N43)	1 (18)	1 (18)	1 (18)	0.8 (18)	0.54 (18)
Variable Displacement (50≤HP≤75)	Commercial New Construction	15 (25)	1.00 (N4)	1.00 (N43)	1 (18)	1 (18)	1 (18)	0.8 (18)	0.54 (18)
Load/No Load (25≤HP≤75)	Commercial New Construction	15 (25)	1.00 (N4)	1.00 (N43)	1 (18)	1 (18)	1 (18)	0.8 (18)	0.54 (18)
Load/No Load (15≤HP<25)	Commercial New Construction	15 (25)	1.00 (N4)	1.00 (N43)	1 (18)	1 (18)	1 (18)	0.8 (18)	0.54 (18)

Sources

18 DMI (2006). Impact Evaluation of 2004 Compressed Air Prescriptive Rebates. Prepared for National Grid. Results analyzed in RLW Analytics (2006). Sample Design and Impact Evaluation.

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

N3 Algorithm Input kwh/horsepower based on NSTAR metering analysis and supported by multiple 3rd part impact evaluations

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Compressed Air - Low Pressure Drop Filters

Version Date: PY 2015

Description

Filters remove solids and aerosols from compressed air systems. Low pressure drop filters have longer lives and lower pressure drops than traditional coalescing filters resulting in higher efficiencies.

Baseline Efficiency

The baseline efficiency case is a standard coalescing filter with initial drop of between 1 and 2 pounds per sq inch (psi) with an end of life drop of 10 psi.

High Efficiency

The high efficiency case is a low pressure drop filter with initial drop not exceeding 1 psi over life and 3 psi at element change. Filters must be deep-bed, "mist eliminator" style and installed on a single operating compressor rated 15 – 75 HP.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	Compressed Air	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Installed filter.

Algorithm:

Gross kWh = Qty × HP_compressor × 0.746 × %SAVE × Hours

Gross kW = Qty × HP_compressor × 0.746 × %SAVE

Where:

Qty = Number of filters installed: site-specific

HP_compressor = Average compressor load: site-specific

%SAVE = Percent change in pressure drop: site-specific

Hours = Annual operating hours of the lower pressure drop filter: site-specific

Hours

The annual hours of operation are site specific and will be determined on a case by case basis.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Low pressure drop filter	Commercial New Construction	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Low pressure drop filter	Commercial New Construction	5 (N7)	1.00 (N4)	1.00 (N43)	1 (18)	1 (18)	1 (18)	0.8 (18)	0.54 (18)

Sources

18 DMI (2006). Impact Evaluation of 2004 Compressed Air Prescriptive Rebates. Prepared for National Grid. Results analyzed in RLW Analytics (2006). Sample Design and Impact Evaluation.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

N7 Based on NSTAR estimates of typical replacement schedule

Compressed Air - Refrigerated Air Dryers

Version Date: PY 2015

Description

The installation of cycling or variable frequency drive (VFD)-equipped refrigerated compressed air dryers. Refrigerated air dryers remove the moisture from a compressed air system to enhance overall system performance. An efficient refrigerated dryer cycles on and off or uses a variable speed drive as required by the demand for compressed air instead of running continuously. Only properly sized refrigerated air dryers used in a single-compressor system are eligible.

Baseline Efficiency

The baseline efficiency case is a non-cycling refrigerated air dryer.

High Efficiency

The high efficiency case is a cycling refrigerated dryer or a refrigerated dryer equipped with a VFD.

Sector:	C&I
End Use:	Compressed Air
Market (Lost Opportunity):	Yes
Market (Retrofit):	No

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Total CFM of installed air dryer capacity.

Algorithm:

Gross kWh = CFM_dryer × ΔkW/CFM × Hours

Gross kW = CFM_dryer × ΔkW/CFM

Where:

CFM_dryer = Full flow rated capacity of the refrigerated air dryer in cubic feet per minute (CFM), typically obtained from equipment's Compressed Air Gas Institute Datasheet: site-specific

ΔkW/CFM = Refrigerated air dryer kW reduction per dryer full flow rated CFM. **Reference Table 17**

Hours = Annual operating hours of the refrigerated air dryer: site-specific

Hours

The annual hours of operation are site specific and will be determined on a case by case basis.

Reference Tables

Table 17: Default kW by Dryer Capacity

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Dryer (CFM<100)	Commercial New Construction	Calc (N2)	Calc (N2)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Dryer (CFM ≥400)	Commercial New Construction	Calc (N2)	Calc (N2)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Dryer (300≤CFM<400)	Commercial New Construction	Calc (N2)	Calc (N2)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Dryer (200≤CFM<300)	Commercial New Construction	Calc (N2)	Calc (N2)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Dryer (100≤CFM<200)	Commercial New Construction	Calc (N2)	Calc (N2)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Dryer (CFM<100)	Commercial New Construction	15 (25)	1.00 (N4)	1.00 (N43)	1 (18)	1 (18)	1 (18)	0.8 (18)	0.54 (18)
Dryer (CFM ≥400)	Commercial New Construction	15 (25)	1.00 (N4)	1.00 (N43)	1 (18)	1 (18)	1 (18)	0.8 (18)	0.54 (18)
Dryer (300≤CFM<400)	Commercial New Construction	15 (25)	1.00 (N4)	1.00 (N43)	1 (18)	1 (18)	1 (18)	0.8 (18)	0.54 (18)
Dryer (200≤CFM<300)	Commercial New Construction	15 (25)	1.00 (N4)	1.00 (N43)	1 (18)	1 (18)	1 (18)	0.8 (18)	0.54 (18)
Dryer (100≤CFM<200)	Commercial New Construction	15 (25)	1.00 (N4)	1.00 (N43)	1 (18)	1 (18)	1 (18)	0.8 (18)	0.54 (18)

Sources

18 DMI (2006). Impact Evaluation of 2004 Compressed Air Prescriptive Rebates. Prepared for National Grid. Results analyzed in RLW Analytics (2006). Sample Design and Impact Evaluation.

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

N2 Algorithm Input kwh/CFM based on NSTAR metering analysis and supported by multiple 3rd part impact evaluations

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Compressed Air - Zero Loss Condensate Drains

Version Date: PY 2015

Description

Drains remove water from a compressed air system. Zero loss condensate drains remove water from a compressed air system without venting any air, resulting in less air demand and consequently greater efficiency.

Baseline Efficiency

The baseline efficiency case is the installation of a standard condensate drain on a compressor system.

High Efficiency

The high efficiency case is the installation of a zero loss condensate drain on a single operating compressor rated ≤ 75 HP.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	Compressed Air	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Installed drain.

Algorithm:

Gross kWh = CFM_pipe × ΔCFM/CFM_pipe × ΔkW/CFM × Hours
Gross kW = CFM_pipe × ΔCFM/CFM_pipe × ΔkW/CFM

Where:
CFM_pipe = CFM capacity of piping: site-specific
ΔCFM/CFM_pipe = Average CFM saved per CFM of piping capacity: 0.049
ΔkW/CFM = Average demand savings per CFM: 0.24386 **N55**
Hours = Annual operating hours of the zero loss condensate drain: site-specific

Hours

The annual hours of operation are site specific and will be determined on a case by case basis.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Zero loss condensate drain	Commercial New Construction	Calc (N/A)	0.244 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Zero loss condensate drain	Commercial New Construction	15 (25)	1.00 (N4)	1.00 (N43)	1 (18)	1 (18)	1 (18)	0.8 (18)	0.54 (18)

Sources

18 DMI (2006). Impact Evaluation of 2004 Compressed Air Prescriptive Rebates. Prepared for National Grid. Results analyzed in RLW Analytics (2006). Sample Design and Impact Evaluation.

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

N55 Based on regional analysis assuming a typical timed drain settings discharge scenario.

Food Service - Commercial Electric Fryers

Version Date: PY 2015

Description

Installation of a qualified ENERGY STAR® commercial fryer, which saves energy during preheating, cooking, and idling.

Baseline Efficiency

The baseline efficiency case is a deep-fat fryer with a cooking efficiency of 75%, a shortening capacity of up to 65 pounds, daily a preheat energy of 2.3 kWh, and an idle energy rate of 1.05 kW

High Efficiency

The high efficiency case is a deep-fat fryer with a cooking energy efficiency of 80%, a shortening capacity of up to 65 pounds, a daily preheat energy of 2.3 kWh, and an idle energy rate of 1.05 kW.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	Food Service	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	

Algorithm Type: Deemed

Unit: Installed high-efficiency electric fryer.

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkWh / Hours

Where:
Qty = Total number of units.
ΔkWh = Deemed average annual kWh reduction per unit.
Hours = Deemed average annual operating hours.

Hours

Fryers are assumed to operate 313 days per year, or 6 days per week.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Commercial Fryer	Commercial New Construction	760 (29)	0.202 (29)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Commercial Fryer	Commercial New Construction	12 (96)	1.00 (N4)	1.00 (N43)	1 (N1)	1 (N1)	1 (N1)	0.9 (N13)	0.9 (N13)

Sources

29 ENERGYSTAR Commercial Kitchen Equipment Savings Calculator: Fryer Calculations. www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorConsumerRoomAC.xls.

96 Pacific Gas & Electric Company – Customer Energy Efficiency Department (2007). Work Paper PGECOFST101, Commercial Convection Oven, Revision #0.

N1 100% realization rates are assumed because savings are based on researched assumptions by FSTC.

N13 Coincidence Factors are .9 for both summer and winter seasons to account for restaurants that close one day per week or may not serve lunch and dinner on weekdays.

N30 Massachusetts Common Assumption

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Food Service - Commercial Electric Griddle

Version Date: PY 2015

Description

Installation of a qualified ENERGY STAR® griddle. ENERGY STAR® griddles save energy during preheat, cooking and idle times due to improved cooking efficiency, and preheat and idle energy rates.

Baseline Efficiency

The baseline efficiency case is a standard efficiency (30% efficient) gas griddle.

High Efficiency

The high efficiency case is a gas griddle with an efficiency of 38%.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	Food Service	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed high-efficiency commercial electric griddle.

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkWh / Hours

Where:
Qty = Total number of units.
ΔkWh = Deemed average annual kWh reduction per unit.
Hours = Deemed average annual operating hours.

Hours

Griddles are assumed to operate 313 days per year. Combination ovens are assumed to operate 12 hours a day, or 3756 hours per year.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Commercial electric griddle	Commercial New Construction	2226 (27)	0.593 (27)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Commercial electric griddle	Commercial New Construction	12 (50)	1.00 (N4)	1.00 (N43)	1 (N1)	1 (N1)	1 (N1)	0.9 (N13)	0.9 (N13)

Sources

118 Technical Assessment of Commercial Ovens <http://www.fishnick.com/equipment/techassessment/7_ovens.pdf>, pg.23

27 ENERGY Star Commercial Kitchen Equipment Savings Calculator: Griddle Calculations <http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/commercial_kitchen_equipment_calculator.xls>

50 Food Service Technology Center (2011). Electric Griddle Life-Cycle Cost Calculator. Accessed on 10/12/2011.

N1 100% realization rates are assumed because savings are based on researched assumptions by FSTC.

N13 Coincidence Factors are .9 for both summer and winter seasons to account for restaurants that close one day per week or may not serve lunch and dinner on weekdays.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Food Service - Commercial Electric Ovens

Version Date: PY 2015

Description

Installation of a qualified ENERGY STAR® commercial oven. ENERGY STAR® commercial ovens save energy during preheat, cooking and idle times due to improved cooking efficiency, and preheat and idle energy rates.

Baseline Efficiency

The baseline efficiency case is a standard oven that meets the baseline cooking energy efficiency requirements shown in Table 15 of Appendix A.

High Efficiency

The high efficiency case is an oven that meets or exceeds the high efficiency ratings shown in Table 15 of Appendix A.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	Food Service	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed high-efficiency commercial electric oven.

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kWh} / \text{Hours}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

Hours = Deemed average annual operating hours.

Hours

Ovens are assumed to operate 313 days per year. Combination ovens are assumed to operate 12 hours a day, or 3756 hours per year.

Reference Tables

Table 15: Baseline Efficiency Requirements for Gas and Electric Ovens

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Commercial Electroic Convection Oven	Commercial New Construction	1364 (27)	0.436 (27)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Commercial electric oven	Commercial New Construction	9688 (27)	2.579 (27)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Commercial Electroic Convection Oven	Commercial New Construction	12 (96)	1.00 (N4)	1.00 (N43)	1 (N1)	1 (N1)	1 (N1)	0.9 (N13)	0.9 (N13)
Commercial electric oven	Commercial New Construction	12 (96)	1.00 (N4)	1.00 (N43)	1 (N1)	1 (N1)	1 (N1)	0.9 (N13)	0.9 (N13)

Sources

118 Technical Assessment of Commercial Ovens <http://www.fishnick.com/equipment/techassessment/7_ovens.pdf>, pg.23

27 ENERGY Star Commercial Kitchen Equipment Savings Calculator: Griddle Calculations <http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/commercial_kitchen_equipment_calculator.xls>

96 Pacific Gas & Electric Company – Customer Energy Efficiency Department (2007). Work Paper PGECOFST101, Commercial Convection Oven, Revision #0.

N1 100% realization rates are assumed because savings are based on researched assumptions by FSTC.

N13 Coincidence Factors are .9 for both summer and winter seasons to account for restaurants that close one day per week or may not serve lunch and dinner on weekdays.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Food Service - Commercial Electric Steamer

Version Date: PY 2015

Description

Installation of a qualified ENERGY STAR® commercial steam cooker. ENERGY STAR® steam cookers save energy during cooling and idle times due to improved cooking efficiency and idle energy rates.

Baseline Efficiency

The baseline efficiency case is a conventional electric steam cooker with a cooking energy efficiency of 30%, pan production capacity of 23.3 pounds per hour, and an idle energy rate of 1.2 kW.

High Efficiency

The high efficiency case is an ENERGY STAR® electric steam cooker with a cooking energy efficiency of 50%, pan production capacity of 16.7 pounds per hour, and an idle energy rate of 0.4 kW.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	Food Service	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed high-efficiency commercial electric steamer.

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kWh} / \text{Hours}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

Hours = Deemed average annual operating hours.

Hours

Steamers are assumed to operate 313 days per year, 12 hours a day, or 3756 hours per year.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Commercial electric steamer	Commercial New Construction	8381 (27)	2.231 (27)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Commercial electric steamer	Commercial New Construction	12 (41)	1.00 (N4)	1.00 (N43)	1 (N1)	1 (N1)	1 (N1)	0.9 (N13)	0.9 (N13)

Sources

27 ENERGY Star Commercial Kitchen Equipment Savings Calculator: Griddle Calculations <http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/commercial_kitchen_equipment_calculator.xls>

41 Environmental Protection Agency (2011). Savings Calculator for ENERGY STAR Qualified Commercial Kitchen Equipment: Steam Cooker Calcs. Accessed on 10/12/2011.

N1 100% realization rates are assumed because savings are based on researched assumptions by FSTC.

N13 Coincidence Factors are .9 for both summer and winter seasons to account for restaurants that close one day per week or may not serve lunch and dinner on weekdays.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Hot Water - Faucet Aerators

Version Date: PY 2015

Description

Installation of a faucet aerator with a flow rate of 1.5 GPM or less on an existing faucet with high flow.

Baseline Efficiency

The baseline efficiency case is an existing faucet with a high flow.

High Efficiency

The high efficiency is a low-flow faucet aerator.

Sector:	C&I
End Use:	Hot Water
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	Yes
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed faucet aerator.

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW

Where:
Qty = Total number of units.
ΔkWh = Deemed average annual kWh reduction per unit.
ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Faucet Aerator	Direct Install	387.4 (116)	0.07 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Faucet Aerator	Direct Install	5 (49)	1.00 (N4)	1.00 (N43)	1 (N31)	1 (N38)	1 (N38)	0.58 (116)	1 (116)

Sources

116 Svgs calcs for SBS non-lighting measures v2.xlsx

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

49 Federal Energy Management Program (2010). Energy Cost Calculator for Faucets and Showerheads. Accessed on 10/12/2011.

N31 National Grid assumption based on regional PA working groups.

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Hot Water - Low-Flow Showerheads

Version Date: PY 2015

Description

Installation of a low flow showerhead with a flow rate of 1.5 GPM or less in a commercial setting with service water heated by natural gas.

Baseline Efficiency

The baseline efficiency case is a 2.5 GPM showerhead.

High Efficiency

The high efficiency case is a 1.5 GPM showerhead.

Sector:	C&I
End Use:	Hot Water
Market (Lost Opportunity):	No
Market (Retrofit):	YEs

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	Yes
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed low-flow showerhead

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW

Where:
Qty = Total number of units.
ΔkWh = Deemed average annual kWh reduction per unit.
ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Low-Flow Showerhead	Direct Install	1185 (116)	0.2 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Low-Flow Showerhead	Direct Install	10 (58)	1.00 (N4)	1.00 (N43)	1 (N31)	1 (N38)	1 (N38)	0.58 (116)	1 (116)

Sources

116 Svgs calcs for SBS non-lighting measures v2.xlsx

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

58 GDS Associates, Inc. and Summit Blue Consulting (2009). Natural Gas Energy Efficiency Potential in Massachusetts. Prepared for GasNetworks.

N31 National Grid assumption based on regional PA working groups.

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Hot Water - Salon Nozzles

Version Date: PY 2015

Description

The installation of a high efficiency salon nozzle.

Baseline Efficiency

An inefficienct salon nozzle.

High Efficiency

An efficient salon nozzle.

Sector:	C&I
End Use:	Hot Water
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	Yes
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed salon valve

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW

Where:
Qty = Total number of units.
ΔkWh = Deemed average annual kWh reduction per unit.
ΔkW = Deemed average kW reduction per unit.

Hours

It is assumed that pre-installation usage is 3.0 hours/day and post-installation usage is 3.6 hours/day

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Salon Nozzle	Direct Install	4648.9 (116)	0.79 (135)	0 (N/A)	0 (N/A)	0 (N/A)	28639 (111)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Salon Nozzle	Direct Install	5 (20)	1.00 (N4)	1.00 (N43)	1 (N31)	1 (N38)	1 (N38)	0.58 (116)	1 (116)

Sources

111 Salon Spray valve data - post op hrs increased.xlsx

116 Svgs calcs for SBS non-lighting measures v2.xlsx

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

20 DNV GL (2014). Impact Evaluation of National Grid Rhode Island Commercial and Industrial Prescriptive Gas Pre-Rinse Spray Valves Measure.

N31 National Grid assumption based on regional PA working groups.

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Chillers

Version Date: PY 2015

Description

This measure promotes the installation of efficient water-cooled and air-cooled water chilling packages for comfort cooling applications. Eligible chillers include air-cooled, water cooled rotary screw and scroll, and water cooled centrifugal chillers for single chiller systems or for the lead chiller only in multi-chiller systems.

Baseline Efficiency

The baseline efficiency case assumes compliance with the efficiency requirements as mandated by Rhode Island State Building Code. As described in Chapter 13 of the aforementioned document, energy efficiency must be met via compliance with the Internationa

High Efficiency

The high efficiency case assumes water chilling packages that exceed the efficiency levels required by Rhode Island State Building Code and meet the minimum efficiency requirements as stated in the New Construction HVAC energy efficiency rebate forms. Energy and demand savings calculations are base on actual equipment efficiencies should be determined on a case-by-case basis.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Installed high-efficiency chiller for space cooling.

Algorithm:

Gross kWh = Tons × (kW/ton_base - kW/ton_ee) × Hours_C
Gross kW = Tons × (kW/ton_base - kW/ton_ee) × LF

Where:

Tons = Rated cooling capacity of the installed equipment: site-specific.

kW/ton_base = Rated efficiency of baseline equipment: code **Reference Table 9**

kW/ton_ee = Energy efficiency rating of the efficient equipment: site-specific.

Hours_C = Equivalent full load cooling hours **Reference Table 11**

LF = Load Factor

Hours

The annual hours of operation are site specific and will be determined on a case by case basis.

Reference Tables

Table 9: Baseline Efficiency Requirements for C&I Chillers, Table 10: Chiller Load Factors

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Water-cooled chiller	Commercial New Construction	Calc (9)	Calc (9)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Air-cooled chiller	Commercial New Construction	Calc (9)	Calc (9)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Water-cooled chiller	Commercial New Construction	23 (55)	1.00 (N4)	1.00 (N43)	1.04 (137)	1 (137)	1 (137)	1 (137)	0 (137)
Air-cooled chiller	Commercial New Construction	23 (55)	1.00 (N4)	1.00 (N43)	1.04 (137)	1 (137)	1 (137)	1 (137)	0 (137)

Sources

137 The Fleming Group (1994). Persistence of Commercial/Industrial Non-Lighting Measures, Volume 2, Energy Efficient HVAC and Process Cooling Equipment. Prepared for New England Power Service Company.

55 GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.

9 Algorithm inputs are based on engineering estimates of cooling hours and 2012 International Code Council (2012). 2012 International Energy Conservation Code; Page C-46, Table C403.2.3(7)

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Demand Control Ventilation

Version Date: PY 2015

Description

The measure is to control quantity of outside air to an air handling system based on detected space CO2 levels. The installed systems monitor the CO2 in the spaces or return air and reduce the outside air use when possible to save energy while meeting indoor air quality standards.

Baseline Efficiency

The baseline efficiency case for this measure assumes the relevant HVAC equipment has no ventilation control.

High Efficiency

The high efficiency case is the installation of an outside air intake control based on CO2 sensors.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	Yes
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Custom

Unit: Installed demand control ventilation project.

Algorithm:

Gross energy and demand savings coincident with the summer and winter on-peak periods are custom calculated using the National Grid's DCV savings calculation tool. The tool is used to calculate energy and peak period demand savings based on site-specific

Gross Summer kW = ΔkW_sp_custom

Gross Winter kW = ΔkW_wp_custom

Gross MMBtu Gas = Gross kWh × ΔMMBtu_Gas/kWh

Gross MMBtu Oil = Gross kWh × ΔMMBtu_Oil/kWh

Where:

ΔMMBtu_Gas/kWh = Deemed average natural gas impact per gross electric energy impact

ΔMMBtu_Oil/kWh = Deemed average heating oil impact per gross electric energy impact

Hours

The annual hours of operation are site specific and will be determined on a case by case basis.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Demand control ventilation	Commercial New Construction	Calc (N9)	Calc (N9)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Demand control ventilation	Commercial New Construction	10 (25)	1.00 (N4)	1.00 (N43)	1 (N36)	1 (N36)	1 (N36)	1 (N16)	1 (N16)

Sources

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

N16 Coincidence Factors are set to 1.00 because coincidence is built into the estimates of Gross kW.

N36 Realization rate is assumed 100% because energy savings are custom calculated.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

N48 The operating hours are site-specific for custom savings calculations.

N9 Calculated with the National Grid DCV savings Tool

HVAC - Dual Enthalpy Economizer Controls

Version Date: PY 2015

Description

The measure is to upgrade the outside-air dry-bulb economizer to a dual enthalpy economizer. The system will continuously monitor the enthalpy of both the outside air and return air. The system will control the system dampers adjust the outside quantity based on the two readings.

Baseline Efficiency

The baseline efficiency case for this measure assumes the relevant HVAC equipment is operating with a fixed dry-bulb economizer.

High Efficiency

The high efficiency case is the installation of an outside air economizer utilizing two enthalpy sensors, one for outdoor air and one for return air.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Total tons of controlled cooling capacity.

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Dual enthalpy economizer controls	Commercial New Construction	289 (98)	0.289 (98)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Dual enthalpy economizer controls	Commercial New Construction	10 (25)	1.00 (N4)	1.00 (N43)	1.05 (137)	1 (137)	1 (137)	0.34 (67)	0 (67)

Sources

137 The Fleming Group (1994). Persistence of Commercial/Industrial Non-Lighting Measures, Volume 2, Energy Efficient HVAC and Process Cooling Equipment. Prepared for New England Power Service Company.

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

67 KEMA (2011). C&I Unitary HVAC Load Shape Project Final Report. Prepared for the Regional Evaluation, Measurement and Verification Forum.

98 Patel, Dinesh (2001). Energy Analysis: Dual Enthalpy Control. Prepared for NSTAR.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - ECM Fan Motors for HVAC

Version Date: PY 2015

Description

This measure is offered through the Cool Choice program and promotes the installation of electronically commutated motors (ECMs) on fan powered terminal boxes, fan coils, and HVAC supply fans on small unitary equipment.

Baseline Efficiency

The baseline efficiency case for this measure assumes the VAV box fans are powered by a single speed fractional horsepower permanent split capacitor (PSC) induction motor.

High Efficiency

The high efficiency case must have a motor installed on new, qualifying HVAC equipment.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Installed ECM fan motor.

Algorithm:

Gross kWh = DesignCFM × BoxSizeFactor × %Flow_Annual × Hours
Gross Summer kW = DesignCFM × BoxSizeFactor × %Flow_Summer × Hours
Gross Winter kW = DesignCFM × BoxSizeFactor × %Flow_Winter × Hours

Where:

DesignCFM = Capacity of the VAV box in cubic feet per minute: site-specific.	
BoxSizeFactor = Savings factor in Watts/CFM	**Reference Table 12**
%Flow_Annual = Average % of design flow over all operating hours	**Reference Table 12**
%Flow_Summer = Average % of design flow during summer peak period	**Reference Table 12**
%Flow_Winter = Average % of design flow during winter peak period	

Hours = Estimated annual operating hours for VAV box fans: site-specific.

Hours

The average cooling EFLHs are taken as 855 hours while the average heating EFLHs are taken as 1137 hours.

Reference Tables

Table 12: Savings Factors for ECM HVAC Fan Motors

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
ECM fan motor for HVAC	Commercial New Construction	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
ECM fan motor for HVAC	Commercial New Construction	20 (25)	1.00 (N4)	1.00 (N43)	1 (N38)	1 (N38)	1 (N38)	1 (N15)	1 (N15)

Sources

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

67 KEMA (2011). C&I Unitary HVAC Load Shape Project Final Report. Prepared for the Regional Evaluation, Measurement and Verification Forum.

N15 Coincidence factors are custom calculated based on project-specific detail.

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Energy Management Systems

Version Date: PY 2015

Description

The measure is the installation of a new building energy management system (EMS) or the expansion of an existing energy management system for control of non-lighting electric and gas end-uses in an existing building on existing equipment.

Baseline Efficiency

The baseline case is the existing equipment and systems without the implemented controls.

High Efficiency

The high efficiency case is the installation of a new EMS or the expansion of an existing EMS to control additional non-lighting electric and/or gas equipment. The EMS must be installed in an existing building on existing equipment.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	Yes
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Custom

Unit: Upgrade to existing energy management system.

Algorithm:

Gross energy and demand savings for energy management systems (EMS) are custom calculated using the National Grid's EMS savings calculation tool. The tool is used to calculate energy and demand savings based on project-specific details including hours of

Gross Summer kW = ΔkW_sp_custom
Gross Winter kW = ΔkW_wp_custom
Gross MMBtu Gas = Gross kWh × ΔMMBtu_Gas/kWh
Gross MMBtu Oil = Gross kWh × ΔMMBtu_Oil/kWh

Where:

ΔMMBtu_Gas/kWh = Deemed average natural gas impact per gross electric energy impact

ΔMMBtu_Oil/kWh = Deemed average heating oil impact per gross electric energy impact

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Energy management system	Commercial Retrofit	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Energy management system	Commercial Retrofit	10 (25)	1.00 (N4)	1.00 (N43)	1.04 (138)	1.03 (138)	1.03 (138)	Custom (N15)	Custom (N15)

Sources

138 The Fleming Group (1994). Persistence of Commercial/Industrial Non-Lighting Measures, Volume 3, Energy Management Control Systems. Prepared for New England Power Service Company.

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

N15 Coincidence factors are custom calculated based on project-specific detail.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Heat Pump Systems

Version Date: PY 2015

Description

This measure applies to the installation of high-efficiency single package or split system air source, water source, ground source (closed loop) and groundwater source (open loop) heat pump systems for space conditioning applications.

Baseline Efficiency

The baseline efficiency case for new installations assumes compliance with the efficiency requirements as mandated by Rhode Island State Building Code. As described in Chapter 13 of the aforementioned document, energy efficiency must be met via compliance

High Efficiency

The high efficiency case assumes the HVAC equipments exceeds the specifications of the International Energy Conservation Code (IECC) 2012.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Installed heat pump system for space cooling.

Algorithm:

For air-source units with cooling capacity < 5.4 tons the heating efficiency is indicated by the HSPF rating.

(1/HSPF_base - 1/HSPF_ee) × Hours_H]

Gross kW = Tons × 12 × (1/EER_base - 1/EER_ee)

Where:

Tons = Rated cooling capacity of the installed equipment: site-specific.

SEER_base = Seasonal Energy Efficiency Ratio of the baseline equipment: code **Reference Table 8**

SEER_ee = Seasonal energy efficiency ratio of the high-efficiency unit: site-specific.

HSPF_base = Heating Seasonal Performance Factor for baseline equipment: code **Reference Table 8**

HSPF_ee = Heating Seasonal Performance Factor for new efficient equipment: site-specific.	
EER_base = Energy Efficiency Ratio of baseline equipment.	**Reference Table 8**
EER_ee = Energy Efficiency Ratio of the new efficient equipment: site-specific. For equipment < 5.4 tons, assume the following conversion: EER≈SEER/1.1	
Hours_C = Equivalent full load cooling hours	**Reference Table 11**
Hours_H = Equivalent full load heating hours	**Reference Table 11**
CR = Capacity Ratio converts rated cooling capacity to heating capacity. For equipment with cooling capacity ≤ 5.4 tons, assume CR=1. For equipment > 5.4 tons, assume CR=1.15.	**95**
12 = Conversion factor: 12 kBtu/hr per ton.	

Hours

If site-specific data is unavailable, the average cooling EFLHs are taken as 855 hours while the average heating EFLHs are taken as 1137 hours.

Reference Tables

Table 8: Baseline Efficiency Requirements for C&I Heat Pump Systems, Table 11: Cooling and Heating Equivalent Full Load Hours

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Water source heat pump	Commercial New Construction	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Groundwater source (open loop) heat pump	Commercial New Construction	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Ground source (closed loop) heat pump	Commercial New Construction	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Air-cooled heat pump	Commercial New Construction	Calc (9)	Calc (10)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Water source heat pump	Commercial New Construction	15 (25)	1.00 (N4)	1.00 (N43)	1.05 (137)	1 (137)	1 (137)	0.4 (67)	0 (67)
Groundwater source (open loop) heat pump	Commercial New Construction	15 (25)	1.00 (N4)	1.00 (N43)	1.05 (137)	1 (137)	1 (137)	0.4 (67)	0 (67)
Ground source (closed loop) heat pump	Commercial New Construction	15 (25)	1.00 (N4)	1.00 (N43)	1.05 (137)	1 (137)	1 (137)	0.4 (67)	0 (67)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Air-cooled heat pump	Commercial New Construction	15 (25)	1.00 (N4)	1.00 (N43)	1.05 (137)	1 (137)	1 (137)	0.4 (67)	0 (67)

Sources

10 Algorithm Inputs based on UI and CL&P Program Savings Documentation for 2011 Program Year, Section 2.2.2 C&I LO Cooling - Unitary AC & Heat Pumps

137 The Fleming Group (1994). Persistence of Commercial/Industrial Non-Lighting Measures, Volume 2, Energy Efficient HVAC and Process Cooling Equipment. Prepared for New England Power Service Company.

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

67 KEMA (2011). C&I Unitary HVAC Load Shape Project Final Report. Prepared for the Regional Evaluation, Measurement and Verification Forum.

9 Algorithm inputs are based on engineering estimates of cooling hours and 2012 International Code Council (2012). 2012 International Energy Conservation Code; Page C-46, Table C403.2.3(7)

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Hotel Occupancy Sensors

Version Date: PY 2015

Description

The measure is to the installation of hotel occupancy sensors (HOS) to control packaged terminal AC units (PTACs) with electric heat, heat pump units and/or fan coil units in hotels that operate all 12 months of the year.

Baseline Efficiency

The baseline efficiency case assumes the equipment has no occupancy based controls.

High Efficiency

The high efficiency case is the installation of controls that include (a) occupancy sensors, (b) window/door switches for rooms that have operable window or patio doors, and (c) set back to 65 degrees Fahrenheit in the heating mode and set forward to 78 F in the cooling mode when occupancy detector is in the unoccupied mode. Sensors controlled by a front desk system are not eligible.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed hotel occupancy sensor.

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Hotel occupancy sensor	Commercial Retrofit	438 (78)	0.09 (78)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Hotel occupancy sensor	Commercial Retrofit	10 (25)	1.00 (N4)	1.00 (N43)	1 (N38)	1 (N38)	1 (N38)	0.3 (N15)	0.7 (N15)

Sources

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

78 National Grid and NSTAR (2010). Energy Analysis: Hotel Guest Occupancy Sensors.

N15 Coincidence factors are custom calculated based on project-specific detail.

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Programmable Thermostats

Version Date: PY 2015

Description

Installation of programmable thermostats with the ability to adjust heating or air-conditioning operating times according to a pre-set schedule to meet occupancy needs and minimize redundant HVAC operation.

Baseline Efficiency

For the intallation of a programmable thermostat, the baseline efficiency case is an HVAC system using natural gas to provide space heating without a programmable thermostat

High Efficiency

The high efficiency case is an HVAC system that has a programmable thermostat or wi-fi programmable thermostat installed.

Sector:	C&I
End Use:	HVAC
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	No
Gas Energy Impact:	No
Oil Energy Impact:	Yes
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installation of programmable thermostat

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Programmable Thermostats	Direct Install	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Programmable Thermostats	Direct Install	8 (25)	1.00 (N4)	0.00 (N43)	1 (N34)	1 (N34)	1 (N34)	0 (N17)	0 (N17)

Sources

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

N17 Coincidence Factors are set to zero since demand savings typically occur during off-peak hours

N34 Realization rate is 100% because estimates are based on post-installation verification.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Unitary Air Conditioners

Version Date: PY 2015

Description

This measure promotes the installation of high efficiency unitary air conditioning equipment in lost opportunity applications. Air conditioning (AC) systems are a major consumer of electricity and systems that exceed baseline efficiencies can save considerable amounts of energy. This measure applies to air, water, and evaporatively-cooled unitary AC systems, both single-package and split systems.

Baseline Efficiency

The baseline efficiency case for new installations assumes compliance with the International Energy Conservation Code (IECC) 2012 as mandated by Rhode Island State Building Code. Table 7 in Appendix A details the specific efficiency requirements by equipm

High Efficiency

The high efficiency case assumes the HVAC equipments exceeds the specifications of the International Energy Conservation Code (IECC) 2012.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Installed unitary AC system for space cooling.

Algorithm:

$$\text{Gross kWh} = \text{Tons} \times 12 \times [(1/\text{SEER\_base} - 1/\text{SEER\_ee}) \times \text{Hours\_C}$$

$$\text{Gross kW} = \text{Tons} \times 12 \times (1/\text{EER\_base} - 1/\text{EER\_ee})$$

Where:

Tons = Rated cooling capacity of the installed equipment: site-specific.

SEER_base = Seasonal Energy Efficiency Ratio of the baseline equipment: code **Reference Table 7**

SEER_ee = Seasonal energy efficiency ratio of the high-efficiency unit: site-specific.

EER_base = Energy Efficiency Ratio of baseline equipment: **Reference Table 7** code. Since IECC 2012 does not provide EER requirements for equipment < 5.4 tons, assume the following conversion: EER ≈ SEER/1.1.

EER_ee = Energy Efficiency Ratio of the new efficient equipment: site-specific. For equipment < 5.4 tons, assume the following conversion: EER≈SEER/1.1.

Hours_C = Equivalent full load cooling hours

Hours

If site-specific data is unavailable, the average cooling EFLHs are taken as 855 hours while the average heating EFLHs are taken as 1137 hours.

Reference Tables

Table 7: Baseline Efficiency Requirements for C&I Unitary Air Conditioners, Table 11: Cooling and Heating Equivalent Full Load Hours

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Unitary AC (evaporatively-cooled)	Commercial New Construction	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Unitary AC (air-cooled)	Commercial New Construction	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Unitary AC (evaporatively-cooled)	Commercial New Construction	15 (25)	1.00 (N4)	1.00 (N43)	1 (67)	1 (67)	1 (67)	0.4 (67)	0 (67)
Unitary AC (air-cooled)	Commercial New Construction	2 (25)	1.00 (N4)	1.00 (N43)	1 (67)	1 (67)	1 (67)	0.4 (67)	0 (67)

Sources

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

67 KEMA (2011). C&I Unitary HVAC Load Shape Project Final Report. Prepared for the Regional Evaluation, Measurement and Verification Forum.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Upstream HVAC

Version Date: PY 2015

Description

The buy-down of efficient HVAC equipment at the distributor level.

Baseline Efficiency

TBD

High Efficiency

TBD

Sector:	C&I
End Use:	HVAC
Market (Lost Opportunity):	Yes
Market (Retrofit):	N o

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed hihg-efficiency HVAC project.

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

ΔkW = Deemed average kW reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Sources

Lighting - Freezer/Cooler LEDs

Version Date: PY 2015

Description

Installation of LED lighting in freezer and/or cooler cases. The LED lighting consumes less energy, and results in less waste heat which reduces the cooling/freezing load.

Baseline Efficiency

The baseline efficiency case is the existing lighting fixtures in the cooler or freezer cases.

High Efficiency

The high efficiency case is the installation of LED lighting fixtures on the cooler or freezer cases, replacing the existing lighting fixtures.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	Lighting	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	Yes

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Completed lighting project.

Algorithm:

Gross kWh = [SUM(QTY_base × Watts_base × Hours_base) - SUM(QTY_ee × kW_ee × Hours_ee)] × (1 + EffRefrig × 3,413 / 12,000)

Gross kW = Gross kWh / Hours_ee

Where:

QTY_base = Quantity of baseline lighting fixtures in cooler/freezer case

Watts_base = Connected wattage of baseline lighting fixtures in cooler/freezer case

Hours_base = Annual operating hours of baseline lighting fixtures in cooler/freezer case

QTY_ee = Quantity of efficient lighting fixtures in cooler/freezer case

Watts_base = Connected wattage of efficient lighting fixtures in cooler/freezer case

Hours_ee = Annual operating hours of efficient lighting fixtures in cooler/freezer case

RefrigEff = Efficiency of typical refrigeration system: 1.9 kW/ton **N6**

3,413 = Conversion factor: 3,413 Btu/hr per kW

12,000 = Converstion factor: 12,000 Btu/hr per ton.

Hours

The average annual operating hours are 8760 hours/year.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
LEDs for freezer/cooler cases	Direct Install	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
LEDs for freezer/cooler cases	Commercial Retrofit	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
LEDs for freezer/cooler cases	Commercial New Construction	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
LEDs for freezer/cooler cases	Direct Install	13 (25)	1.00 (N4)	1.00 (N43)	1.04 (108)	1.07 (108)	1.15 (108)	1 (N14)	1 (N14)
LEDs for freezer/cooler cases	Commercial Retrofit	13 (25)	1.00 (N4)	1.00 (N43)	0.943 (70)	1.01 (70)	1.01 (70)	1 (70)	1 (70)
LEDs for freezer/cooler cases	Commercial New Construction	13 (25)	1.00 (N4)	1.00 (N43)	0.943 (70)	1.01 (70)	1.01 (70)	1 (70)	1 (70)

Sources

108 RLW Analytics (2007). Small Business Services Custom Measure Impact Evaluation. Prepared for National Grid.

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

70 KEMA (2013). Impact Evaluation of 2010 Prescriptive Lighting Installations

N14 Coincidence Factors are assumed to be 1.0 since exit signs are on 8,760 hours a year

N27 It is assumed that the connected equipment operates 24 hours per day, 7 days per week for a total annual operating hours of 8,760.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

N6 Based on National Resource management field observation and experience

Lighting - Lighting Controls

Version Date: PY 2015

Description

This measure promotes the installation of lighting controls in both lost-opportunity and retrofit applications. Promoted technologies include occupancy sensors and daylight dimming controls.

Baseline Efficiency

The baseline efficiency case assumes no controls (retrofit) or code-compliant controls (new construction).

High Efficiency

The high efficiency case involves lighting fixtures connected to controls that reduce the pre-retrofit or baseline hours of operation.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	Lighting	**Oil Energy Impact:**	Yes
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	Yes

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Installed lighting controls project.

Algorithm:

Gross kWh = SUM[QTY_i × Watts_i × (Hours_base_i - Hours_ee_i)] / 1000

Gross kW = SUM(QTY_i × Watts_i) / 1000

Where:

QTY_i = Quantity in controlled fixtures in location i

Watts_i = Connected wattage of controlled fixtures in location i

Hours_base_i = Total annual hours that the connected lighting in location i operated without controls (for retrofit installations) or would have operated with code-compliance controls (for new construction installations).

Hours_ee_i = Total annual hours that the connected lighting in location i operates with the lighting controls implemented.

ΔMMBtu_Gas/kWh = Gross natural gas MMBtu reduction per gross kWh saved.

ΔMMBtu_Oil/kWh = Gross heating oil MMBtu reduction per gross kWh saved.

Hours

The annual hours of operation are site specific and will be determined on a case by case basis.

Reference Tables

Table 3: New Construction Lighting Proposed Wattage, Table 4: Retrofit Lighting Existing Wattage, Table 5: Retrofit Lighting Proposed Wattage, Table 16: Lighting Interactive HVAC Effects

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Occupancy sensors	Direct Install	Calc (N/A)	Calc (N/A)	Calc (95)	Calc (95)	0 (N/A)	0 (N/A)
Occupancy sensors	Commercial Retrofit	Calc (N/A)	Calc (N/A)	Calc (95)	Calc (N/A)	0 (N/A)	0 (N/A)
Occupancy sensors	Commercial New Construction	Calc (N/A)	Calc (N/A)	Calc (95)	Calc (N/A)	0 (N/A)	0 (N/A)
Daylight dimming	Commercial New Construction	Calc (N/A)	Calc (N/A)	Calc (95)	Calc (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Occupancy sensors	Direct Install	9 (25)	1.00 (N4)	1.00 (N43)	0.87 (108)	0.94 (108)	0.94 (108)	0.35 (108)	0.28 (108)
Occupancy sensors	Commercial Retrofit	10 (25)	1.00 (N4)	1.00 (N43)	0.676 (72)	0.964 (72)	0.964 (72)	0.15 (72)	0.18 (72)
Occupancy sensors	Commercial New Construction	10 (25)	1.00 (N4)	1.00 (N43)	0.676 (72)	0.964 (72)	0.964 (72)	0.15 (72)	0.18 (72)
Daylight dimming	Commercial New Construction	10 (25)	1.00 (N4)	1.00 (N43)	0.38 (107)	0.96 (107)	0.96 (107)	0.15 (107)	0 (107)

Sources

107 RLW Analytics (2007). Lighting Controls Impact Evaluation Final Report, 2005 Energy Initiative, Design 2000plus and Small Business Services Program. Prepared for National Grid.

108 RLW Analytics (2007). Small Business Services Custom Measure Impact Evaluation. Prepared for National Grid.

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

72 KEMA (2013). Impact Evaluation of 2011 Rhode Island Prescriptive Lighting Installations

95 Optimal Energy, Inc. (2008). Memo:Non-Electric Benefits Analysis Update. Prepared for Dave Weber, NSTAR.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Lighting - Lighting Systems

Version Date: PY 2015

Description

This measure promotes the installation of efficient lighting including, but not limited to, efficient fluorescent lamps, ballasts, and fixtures, solid state lighting, and efficient high intensity discharge (HID) lamps, ballasts, and fixtures.

Baseline Efficiency

For retrofit installations, the baseline efficiency case is project-specific and is determined using actualfixture types and counts from the existing space. Existing fixture wattages are provided in the Table 4 of Appendix A. For lostopportunity install

High Efficiency

For both new construction and retrofit installations, the high efficiency case is project-specific and isdetermined using actual fixture counts for the project and wattages found in Tables 3 and 5 in Appendix A.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	Lighting	**Oil Energy Impact:**	Yes
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	Yes

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Installed high-efficiency lighting project.

Algorithm:

Gross kWh = [SUM(QTY_base_i × Watts_base_i) - SUM(QTY_ee_j × Watts_ee_j)] / 1000 × Hours

Gross kW = [SUM(QTY_i × Watts_i) - SUM(QTY_j × Watts_j)] / 1000

Where:

QTY_base_i = Quantity of baseline fixtures in location i

Watts_base_i = Connected wattage of baseline fixtures in location i

QTY_ee_i = Quantity of efficient fixtures in location i

Watts_ee_i = Connected wattage of efficient fixtures in location i

Hours = Lighting annual hours of operation: site-specific.

1000 = Conversion factor: 1000 watts per kW

ΔMMBtu_Gas/kWh = Gross natural gas MMBtu reduction per gross kWh saved.

ΔMMBtu_Oil/kWh = Gross heating oil MMBtu reduction per gross kWh saved.

Hours

The annual hours of operation are site specific and will be determined on a case by case basis.

Reference Tables

Table 3: New Construction Lighting Proposed Wattage, Table 4: Retrofit Lighting Existing Wattage, Table 5: Retrofit Lighting Proposed Wattage, Table 16: Lighting Interactive HVAC Effects

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
LED Exit Signs	Direct Install	Calc (N/A)	Calc (N/A)	Calc (95)	Calc (95)	0 (N/A)	0 (N/A)
Screw-in CFL	Direct Install	Calc (N/A)	Calc (N/A)	Calc (95)	Calc (95)	0 (N/A)	0 (N/A)
Lighting systems	Direct Install	Calc (N/A)	Calc (N/A)	Calc (95)	Calc (95)	0 (N/A)	0 (N/A)
Lighting systems	Commercial Retrofit	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)
Lighting systems	Commercial New Construction	Calc (N/A)	Calc (N/A)	Calc (95)	Calc (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
LED Exit Signs	Direct Install	13 (25)	1.00 (N4)	1.00 (N43)	1 (114)	0.98 (114)	0.98 (114)	1 (N14)	1 (N14)
Screw-in CFL	Direct Install	11 (143)	1.00 (N4)	0.87 (61)	1 (115)	0.98 (104)	0.98 (104)	0.79 (66)	0.38 (66)
Lighting systems	Direct Install	11 (25)	1.00 (N4)	1.00 (N43)	1 (115)	0.98 (104)	0.98 (104)	0.79 (66)	0.38 (66)
Lighting systems	Commercial Retrofit	12 (143)	1.00 (N4)	1.00 (N43)	0.889 (72)	0.974 (72)	0.974 (72)	0.65 (72)	0.49 (72)
Lighting systems	Commercial New Construction	15 (25)	1.00 (N4)	1.00 (N43)	0.889 (72)	0.974 (72)	0.974 (72)	0.65 (72)	0.49 (72)

Sources

104 RLW Analytics (2004). Massachusetts Utilities 2003 Multiple Small Business Lighting Retrofit Programs Impact Evaluation.Prepared for Massachusetts Utilities.

114 Summit Blue Consulting (2008). Large Commercial and Industrial Retrofit Program Impact Evaluation 2007. Prepared for National Grid

115 Summit Blue Consulting (2008). Multiple Small Business Services Programs Impact Evaluation 2007. Prepared forMassachusetts Joint Utilities.

143 MA LIGHTING WORKSHEET_T12_Standard-wrb v2 RI Calcs.xls.

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

61 HEC, Inc. (1996). Final Report for New England Power Service Company Persistence of Savings Study. Prepared forNEPSCo.

66 KEMA (2011). C&I Lighting Load Shape Project FINAL Report. Prepared for the Regional Evaluation, Measurement andVerification Forum.

72 KEMA (2013). Impact Evaluation of 2011 Rhode Island Prescriptive Lighting Installations

95 Optimal Energy, Inc. (2008). Memo:Non-Electric Benefits Analysis Update. Prepared for Dave Weber, NSTAR.

N14 Coincidence Factors are assumed to be 1.0 since exit signs are on 8,760 hours a year

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Lighting - Outdoor Fixtures

Version Date: PY 2015

Description

The installation of hardwired ENERGY STAR® fluorescent outdoor fixtures with pin-based bulbs. Savings for this measure are attributable to high efficiency outdoor lighting fixtures and are treated similarly to indoor fixtures.

Baseline Efficiency

High Efficiency

		Electric Energy Impact:	Yes
Sector:	C&i	**Gas Energy Impact:**	No
End Use:	Lighting	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with deemed inputs

Unit:

Algorithm:

Gross kWh = Qty × ΔkW × Hours
Gross kW = Qty × ΔkW

Where:
Qty = Total number of units.
ΔkW = Deemed average kW reduction per unit.
Hours = Deemed average annual operating hours.

Hours

Site specific

Reference Tables

Table 3: New Construction Lighting Proposed Wattage, Table 4: Retrofit Lighting Existing Wattage, Table 5: Retrofit Lighting Proposed Wattage

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Exterior LED Fixtures	Direct Install	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Exterior LED Fixtures	Direct Install	10 (77)	1.00 (N4)	1.00 (N43)	1.02 (91)	1 (N38)	1 (N38)	0 (N18)	0.85 (N12)

Sources

77 Measure Life Study prepared for The Massachusetts Joint Utilities," Energy & Resource Solutions, November 17, 2005, Table 1-1 and 1-2

91 Non-Controls Lighting Evaluation for the Massachusetts Small Business Direct Install Program: Multi-Season Study," The Cadmus Group, May 24, 2012, Table ES-1, p. 3

N12 Coincidence Factor is based on National Grid staff estimates.

N18 Coincidence Factors are set to zero since exterior lights are off during daytime hours.

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Lighting - Performance Lighting

Version Date: PY 2015

Description

Advanced lighting design refers to the implementation of various lighting design principles aimed at creating a quality and appropriate lighting experience while reducingunnecessary light usage. This is often done by a professional in a new construction situation. Advanced lighting design uses techniques like maximizing task lighting and efficient fixtures to create a system of optimal energy efficiency and functionality.

Baseline Efficiency

The baseline efficiency assumes compliance with lighting power density requirements as mandated by Rhode Island State Building Code. Energy efficiency must be met via compliance with the InternationalEnergy Conservation Code (IECC) 2012, as described in

High Efficiency

The high efficiency case assumes lighting systems with lighting power densities below thoserequired by Rhode Island State Building Code. Installed lighting wattage should be determined using the installed fixture counts and wattages.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	Lighting	**Oil Energy Impact:**	Yes
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	Yes

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Installed lighting fixture project.

Algorithm:

Gross kWh = [SUM(LPD_base_i × Area_i × Hours_i) - SUM(QTY_ee_j × Watts_ee_j × Hours_j)] / 1000

Gross kW = [SUM(LPD_base_i × Area_i) - SUM(QTY_ee_j × Watts_ee_j)] / 1000

Where:

LPD_base_i = baseline Lighting Power Density for location i

Area_i = Floor area of location i (SQFT)

Hours_base_i = Total annual operating hours for baseline lighting equipment in location i

QTY_ee_i = Quantity of efficient fixtures in location i

Watts_ee_i = Connected wattage of efficient fixtures in location i

Hours = Lighting annual hours of operation: site-specific.

1000 = Conversion factor: 1000 watts per 1 kW

ΔMMBtu_Gas/kWh = Gross natural gas MMBtu reduction per gross kWh saved.

ΔMMBtu_Oil/kWh = Gross heating oil MMBtu reduction per gross kWh saved.

Hours

The annual hours of operation are site specific and will be determined on a case by case basis.

Reference Tables

Table 1: Lighting Power Densities Using the Building Area Method and Table 2: Lighting Power Densities Using the Space-by-Space Method

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Performance lighting	Commercial New Construction	Calc (N/A)	Calc (N/A)	Calc (95)	Calc (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Performance lighting	Commercial New Construction	15 (25)	1.00 (N4)	1.00 (N43)	1.07 (64)	0.8 (64)	0.73 (64)	Custom (N15)	Custom (N15)

Sources

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

64 KEMA (2009). National Grid USA 2008 Custom Lighting Impact Evaluation, Final Report. Prepared for National Grid. KEMA (2009). // Sample Design and Impact Evaluation Analysis of the 2008 Custom Program. Prepared for National Grid;Table 19.

95 Optimal Energy, Inc. (2008). Memo:Non-Electric Benefits Analysis Update. Prepared for Dave Weber, NSTAR.

N15 Coincidence factors are custom calculated based on project-specific detail.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Lighting - Street Lighting

Version Date: PY 2015

Description

The installation of LED street lights.

Baseline Efficiency

The baseline case is customer owned high-pressure sodium, incandescent, or mercury vapor street lighting.

High Efficiency

The high efficiency case is the installation of LED street lighting.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	Lighting	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Installed LED Streetlight

Algorithm:

Gross kWh = [SUM(QTY_base_i × Watts_base_i) - SUM(QTY_ee_j × Watts_ee_j)] / 1000 × Hours

Gross kW = [SUM(QTY_i × Watts_i) - SUM(QTY_j × Watts_j)] / 1000

Where:

QTY_base_i = Quantity of baseline fixtures in location i

Watts_base_i = Connected wattage of baseline fixtures in location i

QTY_ee_i = Quantity of efficient fixtures in location i

Watts_ee_i = Connected wattage of efficient fixtures in location i

Hours = Lighting annual hours of operation: site-specific.

1000 = Conversion factor: 1000 watts per kW

ΔMMBtu_Gas/kWh = Gross natural gas MMBtu reduction per gross kWh saved.

ΔMMBtu_Oil/kWh = Gross heating oil MMBtu reduction per gross kWh saved.

Hours

The annual hours of operation are site specific and will be determined on a case by case basis.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
LED Street Lights	Commercial New Construction	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
LED Street Lights	Commercial New Construction	12 (75)	1.00 (N4)	1.00 (N43)	1 (N38)	1 (N38)	1 (N38)	Calc (N15)	Calc (N15)

Sources

75 LED Street Light Measure Life Calculator 2015.xlsx

N15 Coincidence factors are custom calculated based on project-specific detail.

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Lighting - Upstream Lighting

Version Date: PY 2015

Description

The installation of efficient lighting discounted at the distribution level.

Baseline Efficiency

The baseline case is a mix of fluorescent and halogen fixtures for LEDs and low efficiency fluorescents for high efficiency fluorescents.

High Efficiency

The high efficiency case is high efficiency LED or linear fluorescent lighting. Please refer to Table 6 in Appendix A for wattage details.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	Lighting	**Oil Energy Impact:**	Yes
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	N o	**Water Impact:**	No
		Non-Energy Impact:	Yes

Algorithm Type: Deemed

Unit: Installed high-efficiency lighting project.

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

ΔkW = Deemed average kW reduction per unit.

Hours

4500 for LEDs and 3380 for fluorescent fixtures.

Reference Tables

Table 6: Upstream Lighting Assumed Wattages and Hours

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Linear Fluorescents	Commercial New Construction	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
LEDs	Commercial New Construction	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Linear Fluorescents	Commercial New Construction	10 (N30)	1.00 (N4)	1.00 (N43)	0950118 (19)	0.938 (19)	0.938 (19)	0.67 (19)	0.56 (19)
LEDs	Commercial New Construction	10 (N23)	1.00 (N4)	1.00 (N43)	.803140 (19)	0.88 (19)	0.88 (19)	0.72 (19)	0.55 (19)

Sources

19 DNV GL (2014). Impact Evaluation of 2012 RI Upstream Lighting

N23 Estimate based on average life of eligible products at retail operating hours

N30 Massachusetts Common Assumption

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Motors/Drives - Variable Speed Drives

Version Date: PY 2015

Description

This measure covers the installation of variable speed drives for multiple end uses and building types.

Baseline Efficiency

The baseline efficiency case for this measure varies with the equipment type. All baselines assume either a constant speed motor or 2-speed motor. In the baselines, air or water volume/temperature is controlled using valves, dampers, and/or reheats.

High Efficiency

In the high efficiency case, pump flow or fan air volume is directly controlled using downstream information. The pump or fan will automatically adjust its speed based on inputted set points and the downstream feedback it receives.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	Motors/Drives	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Installed variable speed drive on exisitng motor or with new NEMA premium efficiency motor.

Algorithm:

Gross kWh = HP_motor × 1/MotorEff × ΔkWh/HP

Gross Summer kW = HP_motor × 1/MotorEff × ΔkW_SP/HP

Gross Winter kW = HP_motor × 1/MotorEff × ΔkW_WP/HP

Where:

HP_motor = Total horsepower of controlled motor: site-specific.

MotorEff = Motor efficiency: site-specific.

ΔkWh/HP = Average annual kWh reduction per horsepower based on building and equipment type **Reference Table 14**

ΔkW_SP/HP = Average summer peak reduction per horsepower based on building and equipment type **Reference Table 14**

ΔkW_WP/HP = Average winter peak reduction per horsepower based on building and equipment type

Hours

The annual hours of operation are site specific and will be determined on a case by case basis.

Reference Tables

Table 14: Savings Factors for C&I VSDs

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Variable speed drives w/motor	Commercial Retrofit	Calc (8)	Calc (8)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Variable speed drives	Commercial Retrofit	Calc (8)	Calc (8)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Variable speed drives w/motor	Commercial New Construction	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Variable speed drives	Commercial New Construction	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Variable speed drives w/motor	Commercial Retrofit	13 (25)	1.00 (N4)	1.00 (N43)	0.94 (74)	1 (N46)	1 (N46)	1 (N46)	1 (N46)
Variable speed drives	Commercial Retrofit	13 (25)	1.00 (N4)	1.00 (N43)	0.94 (74)	1 (N46)	1 (N46)	1 (N46)	1 (N46)
Variable speed drives w/motor	Commercial New Construction	15 (25)	1.00 (N4)	1.00 (N43)	0.94 (74)	1 (N46)	1 (N46)	1 (N46)	1 (N46)
Variable speed drives	Commercial New Construction	15 (25)	1.00 (N4)	1.00 (N43)	0.94 (74)	1 (N46)	1 (N46)	1 (N46)	1 (N46)

Sources

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

74 KEMA, Inc. and DMI, Inc. (2013). 2011-2012 Massachusetts Prescriptive VSD Impact Evaluation. Prepared for the Massahusetts Program Administrators and the Massachusetts Energy Efficiency Advisory Council

8 Algorithm inputs are based on Chan, Tumin (2010). Formation of a Prescriptive Incentive for the VFD and Motors & VFD Impacts Tables at NSTAR. Prepared for NSTAR

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

N46 The MA evaluation did not provide realization rates within sufficient precision so the they are assumed to be 100%, pending a future study by NEEP

Multiple - Custom Measures

Version Date: PY 2015

Description

The Custom project track is offered for energy efficiency projects involving complex site-specific applications that require detailed engineering analysis and/or projects which do not qualify for incentives under any of the prescriptive rebate offering. Projects offered through the custom approach must pass a cost-effectiveness test based on project-specific costs and savings.

Baseline Efficiency

For Lost Opportunity projects, the baseline efficiency case assumes compliance with the efficiency requirements as mandated by Rhode Island State Building Code or industry accepted standard practice. For retrofit projects, the baseline efficiency case is

High Efficiency

The high efficiency case is specific to the custom project and may include one or more energy efficiency measures. Energy and demand savings calculations are based on projected or measured changes in equipment efficiencies and operating characteristics and are determined on a case-by-case basis. The project must be proven cost-effective in order to qualify for energy efficiency incentives.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	Multiple	**Oil Energy Impact:**	Yes
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Custom

Unit: Installed custom energy-efficiency project.

Algorithm:

Gross energy and demand savings estimates for custom projects are calculated with engineering analyses of project-specific details. The analyses also include an evaluation of the project's cost-effectiveness.

Gross Summer kW = ΔkW_sp_custom
Gross Winter kW = ΔkW_wp_custom
Gross MMBtu Gas = ΔMMBtu_Gas_custom
Gross MMBtu Oil = ΔMMBtu_Oil_custom

Hours

The annual hours of operation are site specific and will be determined on a case by case basis.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Custom Lighting	Commercial Retrofit	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)
Custom HVAC	Commercial New Construction	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)
Custom Lighting	Commercial New Construction	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)
Custom Process	Commercial New Construction	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)
Custom Refrigeration	Commercial New Construction	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)
Custom Motor	Commercial New Construction	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)
Custom Other	Commercial New Construction	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)
Custom Comprehensive Design (CDA)	Commercial New Construction	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)
Custom HVAC	Commercial Retrofit	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)
Custom refrigeration	Direct Install	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)
Custom Process	Commercial Retrofit	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)
Custom Compressed Air	Commercial Retrofit	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)
Custom Refrigation	Commercial Retrofit	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)
Custom Motor	Commercial Retrofit	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)
Custom Other	Commercial Retrofit	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)
Custom lighting	Direct Install	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)
Custom other	Direct Install	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)
Comprehensive Retrofit (CR)	Commercial Retrofit	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Custom Lighting	Commercial Retrofit	mult (25)	1.00 (N4)	1.00 (N43)	0.919 (71)	1.107 (71)	0.792 (71)	Custom (N24)	Custom (N24)
Custom HVAC	Commercial New Construction	mult (25)	1.00 (N4)	1.00 (N43)	1.1 (69)	1.13 (69)	0.66 (69)	Custom (N24)	Custom (N24)
Custom Lighting	Commercial New Construction	mult (25)	1.00 (N4)	1.00 (N43)	0.919 (71)	1.107 (71)	0.792 (71)	Custom (N24)	Custom (N24)
Custom Process	Commercial New Construction	mult (25)	1.00 (N4)	1.00 (N43)	0.927 (65)	1.002 (65)	1.038 (65)	Custom (N24)	Custom (N24)
Custom Refrigeration	Commercial New Construction	mult (25)	1.00 (N4)	1.00 (N43)	4827693 (21)	2047028 (21)	0896802 (21)	Custom (N24)	Custom (N24)
Custom Motor	Commercial New Construction	mult (25)	1.00 (N4)	1.00 (N43)	4827693 (21)	2047028 (21)	0896802 (21)	Custom (N24)	Custom (N24)
Custom Other	Commercial New Construction	mult (25)	1.00 (N4)	1.00 (N43)	4827693 (21)	2047028 (21)	0896802 (21)	Custom (N24)	Custom (N24)
Custom Comprehensive Design (CDA)	Commercial New Construction	mult (25)	1.00 (N4)	1.00 (N43)	1.2 (69)	0.84 (69)	0.5 (69)	Custom (N24)	Custom (N24)
Custom HVAC	Commercial Retrofit	mult (25)	1.00 (N4)	1.00 (N43)	1.1 (69)	1.13 (69)	0.66 (69)	Custom (N24)	Custom (N24)
Custom refrigeration	Direct Install	mult (25)	1.00 (N4)	1.00 (N43)	1.6 (108)	1.49 (108)	0.69 (108)	Custom (N24)	Custom (N24)
Custom Process	Commercial Retrofit	mult (25)	1.00 (N4)	1.00 (N43)	0.927 (65)	1.002 (65)	1.038 (65)	Custom (N24)	Custom (N24)
Custom Compressed Air	Commercial Retrofit	mult (25)	1.00 (N4)	1.00 (N43)	0.927 (65)	1.002 (65)	1.038 (65)	Custom (N24)	Custom (N24)
Custom Refrigation	Commercial Retrofit	mult (25)	1.00 (N4)	1.00 (N43)	4827693 (21)	2047028 (21)	0896802 (21)	Custom (N24)	Custom (N24)
Custom Motor	Commercial Retrofit	mult (25)	1.00 (N4)	1.00 (N43)	4827693 (21)	2047028 (21)	0896802 (21)	Custom (N24)	Custom (N24)
Custom Other	Commercial Retrofit	mult (25)	1.00 (N4)	1.00 (N43)	4827693 (21)	2047028 (21)	0896802 (21)	Custom (N24)	Custom (N24)
Custom lighting	Direct Install	mult (25)	1.00 (N4)	1.00 (N43)	1.04 (108)	1.02 (108)	1.13 (108)	Custom (N24)	Custom (N24)
Custom other	Direct Install	mult (25)	1.00 (N4)	1.00 (N43)	0.81 (108)	0.77 (108)	0.53 (108)	Custom (N24)	Custom (N24)
Comprehensive Retrofit (CR)	Commercial Retrofit	mult (25)	1.00 (N4)	1.00 (N43)	1.2 (69)	0.84 (69)	0.5 (69)	Custom (N24)	Custom (N24)

Sources

108 RLW Analytics (2007). Small Business Services Custom Measure Impact Evaluation. Prepared for National Grid.

21 DNV GL (2014). Impact Evaluation of Rhode Island Custom Refrigerator, Motor, and Other Measures.

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

65 KEMA(2012). Impact Evaluation of 2010 Rhode Island Custom Process and Compressed Air Installations.

69 KEMA (2011). Impact Evaluation of Custom Comprehensive and HVAC Installations. Prepared for National Grid.

71 KEMA (2013). Impact Evaluation of 2011 Rhode Island Custom Lighting Installations. Prepared for National Grid.

N24 For all custom projects, gross summer and winter peak coincidence factors are custom-calculated based on project-specific information. The actual or measured coincidence factors are included in the summer and winter demand realization rates.

N33 Realization rate is 100% because estimates are based on post-installation performance verification.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Refrigeration - Case Motor Replacement

Version Date: PY 2015

Description

Installation of various sizes of electronically commutated motors (ECMs) in walk-in coolers and freezers to replace existing evaporator fan motors.

Baseline Efficiency

The baseline efficiency case is an existing case motor.

High Efficiency

The high efficiency case is the replacement of an existing case with an ECM.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	Refrigeration	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Installed electronically commutated motor for evaporator fans in existing cooler/freezer.

Algorithm:

Gross kWh = kW_motor × LRF × Hours × (1 + RefrigEff × 3,413 / 12,0000)
Gross kW = Gross kWh / Hours

Where:
kW_motor = Metered load of existing case motor: site-specific
LRF = Load reduction factor: 53% when shaded pole motors are replaced, 29% when PSC motors are replaced
Hours = Average runtime of case motors: 8,500 hours **N6**
RefrigEff = Efficiency of typical refrigeration system: 1.6 kW/ton **N6**
3,413 = Conversion factor: 3,413 Btu/hr per kW
12,000 = Converstion factor: 12,000 Btu/hr per ton.

Hours

Hours are the annual operating hours of the case motors.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Case ECMs	Commercial Retrofit	Calc (7)	Calc (7)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Case ECMs	Commercial Retrofit	15 (25)	1.00 (N4)	1.00 (N43)	1 (108)	1 (108)	1 (108)	0.87 (108)	0.51 (108)

Sources

108 RLW Analytics (2007). Small Business Services Custom Measure Impact Evaluation. Prepared for National Grid.

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

7 Algorith Inputs are based field experience and evaluation from National Resource Management. Supported by Select Energy (2004). Cooler Control Measure Impact Spreadsheet User's Manual. Prepared for NSTAR.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

N6 Based on National Resource management field observation and experience

Refrigeration - Cooler Night Covers

Version Date: PY 2015

Description

Installation of retractable aluminum woven fabric covers for open-type refrigerated display cases, where the covers are deployed during the facility unoccupied hours in order to reduce refrigeration energy consumption.

Baseline Efficiency

The baseline efficiency case is the annual operation of open-display cooler cases.

High Efficiency

The high efficiency case is the use of night covers to protect the exposed area of display cooler cases during unoccupied hours.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	Refrigeration	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Linear feet of installed night covers on existing cooler cases.

Algorithm:

$$\text{Gross kWh} = \text{Width} \times \Delta\text{kW/feet} \times \text{Hours}$$
$$\text{Gross kW} = \text{Width} \times \Delta\text{kW/feet}$$

Where:

Width = Width in feet of the opening that the night covers protect: site-specific

ΔkW/feet = Savings factor based on the temperature of the case **Reference Table 13**

Hours = Annual hours that the night covers are in use: site-specific

Hours

Hours represent the number of annual hours that the night covers are in use, and should be determined on a case-by-case basis.

Reference Tables

Table 13: Savings Factors for Cooler Night Covers

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Cooler night cover	Commercial Retrofit	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Cooler night cover	Commercial Retrofit	10 (25)	1.00 (N4)	1.00 (N43)	1 (N38)	1 (N38)	1 (N38)	0 (N17)	0 (N17)

Sources

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

N17 Coincidence Factors are set to zero since demand savings typically occur during off-peak hours

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Refrigeration - Door Heater Controls

Version Date: PY 2015

Description

The Installation of controls to reduce the run time of door and frame heaters for freezers and walk-in or reach-in coolers. The reduced heating results in a reduced cooling load.

Baseline Efficiency

The baseline efficiency case is a cooler or freezer door heater that operates 8,760 hours per year without any controls.

High Efficiency

The high efficiency case is a cooler or freezer door heater connected to a heater control system, which controls the door heaters by measuring the ambient humidity and temperature of the store, calculating the dew point, and using pulse width modulation (PWM) to control the anti-sweat heater based on specific algorithms for freezer and cooler doors. Door temperature is typically maintained about 5 degrees Fahrenheit above the store air dew point temperature with the heaters operating at 80% (adjustable).

Sector:	C&I
End Use:	Refrigeration
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	Yes
Gas Energy Impact:	No
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Installed door heater controls on existing cooler/freezer.

Algorithm:

Gross kWh = kW_DoorHeater × %OFF × Hours
Gross kW = kW_DoorHeater × %OFF

Where:
kW_DoorHeater = Total demand of the door heater, calculated as Volts * Amps / 1000: site-specific
%OFF = Door heater Off time: 46% for freezer door heaters or 74% for cooler door heaters
Hours = Door heater annual run hours before controls

Hours

Pre-retrofit hours are 8,760 hours per year. After controls are installed, the door heaters in freezers are on for an average 4,730.4 hours/year (46% off time) and the door heaters for coolers are on for an average 2,277.6 hours/year (74% off time).

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Freezer Door Heater Controls	Direct Install	Calc (7)	Calc (7)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Door Heater Control	Direct Install	Calc (7)	Calc (7)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Door heater control	Commercial Retrofit	Calc (7)	Calc (7)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Freezer Door Heater Controls	Direct Install	10 (25)	1.00 (N4)	1.00 (N43)	1 (N37)	1 (N37)	1 (N37)	0.5 (59)	1 (59)
Door Heater Control	Direct Install	10 (25)	1.00 (N4)	1.00 (N43)	1 (N37)	1 (N37)	1 (N37)	0.5 (59)	1 (59)
Door heater control	Commercial Retrofit	10 (25)	1.00 (N4)	1.00 (N43)	1 (N37)	1 (N37)	1 (N37)	0.5 (59)	1 (59)

Sources

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

59 HEC, Inc. (1995). Analysis of Door Master Walk-In Cooler Anti-Sweat Door Heater Controls Installed at Ten Sites in Massachusetts. Prepared for New England Power Service Compay; Table 9.

7 Algorith Inputs are based field experience and evaluation from National Resource Management. Supported by Select Energy (2004). Cooler Control Measure Impact Spreadsheet User's Manual. Prepared for NSTAR.

N37 Realization rate is assumed 100% because savings are based on researched assumptions.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

N6 Based on National Resource management field observation and experience

Refrigeration - ECM Evaporator Fan Motors for Walk-in Coole

Version Date: PY 2015

Description

Installation of electronically commutated motors (ECMs) in multi-deck and freestanding coolers and freezers, typically on the retail floor of convenience stores, liquor stores, and grocery stores.

Baseline Efficiency

The baseline efficiency case is the existing case motor.

High Efficiency

The high efficiency case is the replacement of the existing case motor with an ECM.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	Refrigeration	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Installed electronically commutated motor for evaporator fans in existing cooler/freezer.

Algorithm:

Gross kWh = kW_Fan × LRF × Hours × (1 + RefrigEff × 3,413 / 12,0000)
Gross kW = Gross kWh / Hours

Where:

kW_Fan = Power demand of evaporator fan calculated from equipment nameplate data and estimated 0.55 power factor/adjustment

LRF = Load reduction factor for motor replacement: 65%

Hours = Annual fan operating hours: site-specific

RefrigEff = Efficiency of typical refrigeration system: 1.6 kW/ton **N6**

3,413 = Conversion factor: 3,413 Btu/hr per kW

12,000 = Converstion factor: 12,000 Btu/hr per ton.

Hours

The annual operating hours are assumed to be 8,760 * (1-%OFF), where %OFF = 0 if the facility does not have evaporator fan controls or %OFF > 0 if the facility has evaporator fan controls. See section: Refrigeration – Evaporator Fan Controls for %OFF valu

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
ECM Evaporator fan Motors for Walk-in	Direct Install	Calc (7)	Calc (7)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
ECM evaporator fan motors (walk–in coolers/	Commercial Retrofit	Calc (7)	Calc (7)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
ECM Evaporator fan Motors for Walk-in Coolers and Freezers	Direct Install	15 (25)	1.00 (N4)	0.00 (N43)	1 (108)	1 (108)	1 (108)	0.87 (108)	0.51 (108)
ECM evaporator fan motors (walk–in coolers/ freezers)	Commercial Retrofit	15 (25)	1.00 (N4)	1.00 (N43)	1 (108)	1 (108)	1 (108)	0.87 (106)	0.51 (106)

Sources

106 RLW Analytics (2007). Impact Evaluation Analysis of the 2005 Custom SBS Program. Prepared for National Grid. Derivation based on site specific results from the study adjusted for current on peak hours.

108 RLW Analytics (2007). Small Business Services Custom Measure Impact Evaluation. Prepared for National Grid.

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

7 Algorith Inputs are based field experience and evaluation from National Resource Management. Supported by Select Energy (2004). Cooler Control Measure Impact Spreadsheet User's Manual. Prepared for NSTAR.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

N6 Based on National Resource management field observation and experience

Refrigeration - Electronic Defrost Controls

Version Date: PY 2015

Description

A control mechanism to skip defrost cycles when defrost is unnecessary.

Baseline Efficiency

The baseline efficiency case is an evaporator fan electric defrost system that uses a time clock mechanism to initiate defrost.

High Efficiency

The high efficiency case is an evaporator fan defrost system with electric defrost controls.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	Refrigeration	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Installed defrost controls in existing cooler/freezer.

Algorithm:

Gross kWh = kW_Defrost × DRF × Hours × (1 + RefrigEff × 3,413 / 12,0000)
Gross kW = Gross kWh / Hours

Where:
kW_Defrost = Load of electric defrost: site-specific
DRF = Defrost reduction factor- percent reduction in defrosts required per year: 35%
Hours = Number of hours defrost occurs over a year without the defrost controls
RefrigEff = Efficiency of typical refrigeration system: 1.6 kW/ton **N6**
3,413 = Conversion factor: 3,413 Btu/hr per kW
12,000 = Converstion factor: 12,000 Btu/hr per ton.

Hours

The number of defrost cycles is estimated to decrease by 35% from an average number of defrost cycles of 1460 defrosts/year at 40 minutes each for a total of 973 hours/year. The number of defrost cycles with the defrost controls is 949 cycles/year, or 633

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Defrost control	Commercial Retrofit	Calc (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Defrost control	Commercial Retrofit	10 (25)	1.00 (N4)	1.00 (N43)	1 (N37)	1 (N37)	1 (N37)	1 (N19)	1 (N19)

Sources

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

N19 Coincidence factors set to 1.00 since gross kW is the average kW reduction during operation.

N37 Realization rate is assumed 100% because savings are based on researched assumptions.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

N6 Based on National Resource management field observation and experience

Refrigeration - Evaporator Fan Controls

Version Date: PY 2015

Description

Installation of controls to modulate the evaporator fans based on temperature control. Energy savings include: fan energy savings from reduced fan operating hours, refrigeration energy savings from reduced waste heat, and compressor energy savings resulting from the electronic temperature control. Electronic controls allow less fluctuation in temperature, thereby creating savings.

Baseline Efficiency

The baseline efficiency case assumes evaporator fans that run 8760 annual hours with no temperature control.

High Efficiency

The high efficiency case is the use of an energy management system to control evaporator fan operation based on temperature.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	Refrigeration	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Installed controls on evaporator fans in existing cooler/freezer.

Algorithm:

Gross kWh = kW_Fan × %OFF × 8,760 × (1 + RefrigEff × 3,413 / 12,0000) + [kW_cp × Hours_cp + kW_fan × 8,760 × (1-%OFF)] × %SAVE

Gross kW = Gross kWh / Hours

Where:

kW_Fan = Power demand of evaporator fan calculated from equipment nameplate data and estimated 0.55 power factor/adjustment

%OFF = Door heater Off time: 46% for freezer door heaters or 74% for cooler door heaters

Hours = 8760

RefrigEff = Efficiency of typical refrigeration system: 1.6 kW/ton **N6**

3,413 = Conversion factor: 3,413 Btu/hr per kW

12,000 = Converstion factor: 12,000 Btu/hr per ton.

kW_compressor = Total power demand of compressor motor and condenser fan calculated from equipment nameplate data and estimated 0.85 power factor

Hours_Compressor = Equivalent annual full load hours of compressor operation: 4,072 hours **N6**

%OFF = Percent of annual hours that the evaporator is turned off: 46% **N6**

%SAVE = Reduced run-time of compressor and evaporator due to electronic controls: 5% **N6**

Hours

The average annual operating hours are 4072 hours/year.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Fan Control	Direct Install	Calc (N11)	Calc (N11)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Evaporator fan control	Commercial Retrofit	Calc (7)	Calc (7)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Fan Control	Direct Install	10 (25)	1.00 (N4)	1.00 (N43)	0.58 (60)	1 (60)	1 (60)	0.23 (59)	0.84 (59)
Evaporator fan control	Commercial Retrofit	10 (25)	1.00 (N4)	1.00 (N43)	0.58 (60)	1 (60)	1 (60)	0.23 (59)	0.84 (59)

Sources

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

59 HEC, Inc. (1995). Analysis of Door Master Walk-In Cooler Anti-Sweat Door Heater Controls Installed at Ten Sites in Massachusetts. Prepared for New England Power Service Compay; Table 9.

60 HEC, Inc. (1996). Analysis of Savings from Walk-In Cooler Air Economizers and Evaporator Fan Controls. Prepared for NEPSCo.

7 Algorith Inputs are based field experience and evaluation from National Resource Management. Supported by Select Energy (2004). Cooler Control Measure Impact Spreadsheet User's Manual. Prepared for NSTAR.

N11 Calculation assumptions based off of NRM field experience and data

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

N6 Based on National Resource management field observation and experience

Refrigeration - Novelty Cooler Shutoff

Version Date: PY 2015

Description

Installation of controls to shut off a facility's novelty coolers for non-perishable goods based on pre-programmed store hours. Energy savings occur as coolers cycle off during facility unoccupied hours.

Baseline Efficiency

The baseline efficiency case is the novelty coolers operating 8,760 hours per year.

High Efficiency

The high efficiency case is the novelty coolers operating fewer than 8,760 hours per year since they are controlled to cycle each night based on pre-programmed facility unoccupied hours.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	Refrigeration	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Installed controls on existing cooler/freezer.

Algorithm:

No electric demand savings are claimed since savings are assumed to occur during evening hours and are therefore not coincident with either summer or winter peak periods.

Gross kW = 0

Where:

kW_nc = Power demand of novelty cooler calculated from equipment nameplate data and estimated 0.85 power factor.

DC_nc = Weighted average annual duty cycle: 48.75% **N6**

HoursOff = Potential hours off every night per year, estimated as one less than the number of hours the store is closed per day: site-specific.

Hours

Energy and demand savings are based on the reduced operation hours of the cooler equipment. Hours reduced per day are estimated on a case-by-case basis, and are typically calculated as one less than the number of hours per day that the facility is closed

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Novelty Cooler Shutoff	Direct Install	Calc (7)	Calc (7)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Novelty cooler shutoff	Commercial Retrofit	Calc (7)	Calc (7)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Novelty Cooler Shutoff	Direct Install	10 (25)	1.00 (N4)	1.00 (N43)	1 (N37)	1 (N37)	1 (N37)	0 (N17)	0 (N17)
Novelty cooler shutoff	Commercial Retrofit	10 (25)	1.00 (N4)	1.00 (N43)	1 (N38)	1 (N38)	1 (N38)	0 (N17)	0 (N17)

Sources

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

7 Algorith Inputs are based field experience and evaluation from National Resource Management. Supported by Select Energy (2004). Cooler Control Measure Impact Spreadsheet User's Manual. Prepared for NSTAR.

N17 Coincidence Factors are set to zero since demand savings typically occur during off-peak hours

N27 It is assumed that the connected equipment operates 24 hours per day, 7 days per week for a total annual operating hours of 8,760.

N37 Realization rate is assumed 100% because savings are based on researched assumptions.

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

N6 Based on National Resource management field observation and experience

Refrigeration - Refrigerator/Freezer Removal

Version Date: PY 2015

Description

The retirement of old, inefficient secondary refrigerators and freezers.

Baseline Efficiency

The baseline efficiency case is an old, inefficient secondary working refrigerator or freezer. Estimated average usage is based on combined weight of freezer energy use and refrigerator energy use.

High Efficiency

The high efficiency case assumes no replacement of secondary unit.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	Refrigeration	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Removal of existing refrigerator or freezer.

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

ΔkW = Deemed average kW reduction per unit.

Hours

The average annual operating hours are 8760 hours/year.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Refrigerator Recycling	Direct Install	720 (88)	0.08 (135)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Refrigerator Recycling	Direct Install	8 (88)	1.00 (N4)	1.00 (N43)	1 (N31)	1 (N38)	1 (N38)	1 (135)	0.92 (135)

Sources

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

88 NMR Group, Inc. (2011). Massachusetts Appliance Turn-In Program Evaluation Integrated Report Findings – FINAL. Prepared for National Grid, NSTAR Electric, Cape Light Compact, and Western Massachusetts Electric Company.

N31 National Grid assumption based on regional PA working groups.

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N41 Refrigerator and freezer run hours are 8760 hours/year

N43 Savings persistence is assumed to be 100%.

Refrigeration - Vending Misers

Version Date: PY 2015

Description

Controls can significantly reduce the energy consumption of vending machine lighting and refrigeration systems. Qualifying controls must power down these systems during periods of inactivity but, in the case of refrigerated machines, must always maintain a cool product that meets customer expectations. This measure applies to refrigerated beverage vending machines, non-refrigerated snack vending machines, and glass front refrigerated coolers. This measure should not be applied to ENERGY STAR® qualified vending machines, as they already have built-in controls.

Baseline Efficiency

The baseline efficiency case is a standard efficiency refrigerated beverage vending machine, non-refrigerated snack vending machine, or glass front refrigerated cooler without a control system capable of powering down lighting and refrigeration systems during periods of inactivity.

High Efficiency

The high efficiency case is a standard efficiency refrigerated beverage vending machine, non-refrigerated snack vending machine, or glass front refrigerated cooler with a control system capable of powering down lighting and refrigeration systems during periods of inactivity.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	No
End Use:	Refrigeration	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed vending miser.

Algorithm:

$$\text{Gross kWh} = \text{Qty} \times \Delta\text{kWh}$$
$$\text{Gross kW} = \text{Qty} \times \Delta\text{kW}$$

Where:

Qty = Total number of units.

ΔkWh = Deemed average annual kWh reduction per unit.

ΔkW = Deemed average kW reduction per unit.

Hours

It is assumed that the connected equipment operates 24 hours per day, 7 days per week for a total annual operating hours of 8,760.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Refrigerated beverage vending machine	Direct Install	1612 (141)	0.184 (141)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Non-refrigerated snack vending machine	Direct Install	343 (141)	0.039 (141)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Glass front refrigerated coolers	Direct Install	1208 (141)	0.138 (141)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Refrigerated beverage vending machine	Commercial Retrofit	1612 (141)	0.184 (141)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Non-refrigerated snack vending machine	Commercial Retrofit	343 (141)	0.039 (141)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Glass front refrigerated coolers	Commercial Retrofit	1208 (141)	0.138 (141)	0 (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Refrigerated beverage vending machine	Direct Install	5 (25)	1.00 (N4)	1.00 (N43)	1 (N38)	1 (N38)	1 (N38)	0 (N17)	0 (N17)
Non-refrigerated snack vending machine	Direct Install	5 (25)	1.00 (N4)	1.00 (N43)	1 (N38)	1 (N38)	1 (N38)	0 (N17)	0 (N17)
Glass front refrigerated coolers	Direct Install	5 (25)	1.00 (N4)	1.00 (N43)	1 (N38)	1 (N38)	1 (N38)	0 (N17)	0 (N17)
Refrigerated beverage vending machine	Commercial Retrofit	5 (25)	1.00 (N4)	1.00 (N43)	1 (N38)	1 (N38)	1 (N38)	0 (N17)	0 (N17)
Non-refrigerated snack vending machine	Commercial Retrofit	5 (25)	1.00 (N4)	1.00 (N43)	1 (N38)	1 (N38)	1 (N38)	0 (N17)	0 (N17)
Glass front refrigerated coolers	Commercial Retrofit	5 (25)	1.00 (N4)	1.00 (N43)	1 (N38)	1 (N38)	1 (N38)	0 (N17)	0 (N17)

Sources

141 USA Technologies Energy Management Product Sheets (2006). Accessed on 09/01/2009.

25 Energy & Resource Solutions (2005). Measure Life Study. Prepared for The Massachusetts Joint Utilities.

N17 Coincidence Factors are set to zero since demand savings typically occur during off-peak hours

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Residential Gas Efficiency Measures

Behavior - Home Energy Reports

Version Date: PY 2015

Description

A Home Energy report sent to gas customers that displays home energy consumption in comparison with peers and prompts energy conserving behavior.

Baseline Efficiency

A control group of homes that does not receive Home Energy Reports.

High Efficiency

A home that receives Home Energy Reports.

		Electric Energy Impact:	No
Sector:	Residential	**Gas Energy Impact:**	Yes
End Use:	Behavior	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Customer receiving energy reports

Algorithm:

Program impacts are estimated by the program implementer using a linear fixed effects regression (LFER) analysis. The analysis is described in Illume and Navigant Consulting (2014). Rhode Island Behavioral Program and Pilots Impact and Process Evaluation

Gross MMBtu Gas = ΔMMBtu_Gas_custom

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Opt-out dual fuel	Home Energy Reports	0 (N/A)	0 (N/A)	Calc (N45)	0 (N/A)	0 (N/A)	0 (N/A)
Opt-out gas	Home Energy Reports	0 (N/A)	0 (N/A)	Calc (N45)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Opt-out dual fuel	Home Energy Reports	1 (94)	1.00 (N4)	1.00 (N42)	0.93 (63)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Opt-out gas	Home Energy Reports	1 (94)	1.00 (N4)	1.00 (N42)	0.89 (63)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

63 Illume and Navigant Consulting (2014). Rhode Island Behavioral Program and Pilots Impact and Process Evaluation

94 Opinion Dynamics with Navigant Consulting (2012). Massachusetts Three Year Cross-Cutting Behavioral Program Evaluation Integrated Report July 2012. Prepared for Massachusetts Energy Efficiency Advisory Council & Behavioral Research Team

N39 Realization rate will be determined by an independent evaluation.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N42 Savings persistence is 100% since measure life is 1 year.

N45 supplied by vendor

Hot Water - DHW Measures

Version Date: PY 2015

Description

DHW measures including high-efficiency low-flow showerheads and faucet aerators save water and water heating energy.

Baseline Efficiency

The baseline efficiency case is the existing domestic hot water equipment.

High Efficiency

The high efficiency case is the installation of high-efficiency domestic hot water equipment such as low-flow showerheads and faucet aerators.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	Yes
End Use:	Hot Water	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	Yes

Algorithm Type: Deemed

Unit: Installed DHW efficiency measure.

Algorithm:

The implementation vendor for this program uses a proprietary model to calculate electric and fossil fuel savings for new construction homes in comparison to the Rhode Island User Defined Reference Home.

Gross MMBtu Gas = ΔMMBtu_Gas_custom

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Hot water heating	Residential New Construction	Calc (90)	0 (N/A)	0.52 (90)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Hot water heating	Residential New Construction	15 (90)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N35)	N/A (N35)	Custom (N15)	Custom (N15)

Sources

90 NMR Group, KEMA, The Cadmus Group, Dorothy Conant (2012). Rhode Island 2011 Baseline Study of Single-Family Residential New Construction. Prepared for National Grid.

N15 Coincidence factors are custom calculated based on project-specific detail.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Hot Water - Faucet Aerators

Version Date: PY 2015

Description

Installation of a faucet aerator with a flow rate of 1.5 GPM or less on an existing faucet with high flow.

Baseline Efficiency

The baseline efficiency case is an existing faucet with a high flow.

High Efficiency

The high efficiency is a low-flow faucet aerator.

Sector: Residential

End Use: Hot Water

Market (Lost Opportunity): No

Market (Retrofit): Yes

Electric Energy Impact: No

Gas Energy Impact: Yes

Oil Energy Impact: No

Propane Impact: No

Water Impact: Yes

Non-Energy Impact: Yes

Algorithm Type: Deemed

Unit: Installed faucet aerator.

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Faucet aerator	Income Eligible MultiFamily	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	332 (127)
Faucet aerator	EnergyWise MultiFamily	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	332 (127)
Faucet aerator	EnergyWise	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Faucet aerator	Income Eligible MultiFamily	7 (127)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Faucet aerator	EnergyWise MultiFamily	7 (127)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Faucet aerator	EnergyWise	7 (127)	1.00 (N4)	1.00 (N43)	0.993 (129)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

127 The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for the Massachusetts Program Administrators.

129 The Cadmus Group (2012). Rhode Island EnergyWise Single Family Impact Evaluation. Prepared for National Grid

14 Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Hot Water - Low-Flow Showerheads

Version Date: PY 2015

Description

Installation of a low flow showerhead with a flow rate of 1.5 GPM or less.

Baseline Efficiency

The baseline efficiency case is a showerhead with a flow of 2.5 gpm. For home audit applications, the baseline is the existing showerhead.

High Efficiency

The high efficiency is a low-flow showerhead with a flow of 1.5 gpm or less.

Sector:	Residential
End Use:	Hot Water
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	No
Gas Energy Impact:	Yes
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	Yes
Non-Energy Impact:	Yes

Algorithm Type: Deemed

Unit: Installed low-flow showerhead

Algorithm:

$$\text{Gross MMBtu\_Gas} = \text{Qty} \times \Delta\text{MMBtu\_Gas}$$

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Low-flow showerhead	Residential New Construction	0 (N/A)	0 (N/A)	0.48 (127)	0 (N/A)	0 (N/A)	3696 (127)
Low-flow showerhead	Income Eligible MultiFamily	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	3696 (127)
Low-flow showerhead	EnergyWise MultiFamily	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	3696 (127)
Low-flow showerhead	EnergyWise	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	3696 (127)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Low-flow showerhead	Residential New Construction	7 (127)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Low-flow showerhead	Income Eligible MultiFamily	7 (127)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Low-flow showerhead	EnergyWise MultiFamily	7 (127)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Low-flow showerhead	EnergyWise	7 (127)	1.00 (N4)	1.00 (N43)	0.993 (129)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

127 The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for the Massachusetts Program Administrators.

129 The Cadmus Group (2012). Rhode Island EnergyWise Single Family Impact Evaluation. Prepared for National Grid

14 Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Hot Water - Low-Flow Showerheads With Controls

Version Date: PY 2015

Description

A showerhead with a control that limits flow once water is heated.

Baseline Efficiency

The baseline case is a showerhead with a flow of 2.5 gallons per minute, or for the case of the adaper, a low flow showerhead with flow of 1.5 gpm or less.

High Efficiency

The high efficiency is a low-flow showerhead with a control that limits flow once the water is heated.

Sector:	Residential
End Use:	Hot Water
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	No
Gas Energy Impact:	Yes
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	Yes
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit:

Algorithm:

$$\text{Gross MMBtu\_Gas} = \text{Qty} \times \Delta\text{MMBtu\_Gas}$$

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Low Flow Showerhead Control - Adapter	Income Eligible MultiFamily	0 (N/A)	0 (N/A)	0.21 (142)	0 (N/A)	0 (N/A)	0 (N/A)
Low Flow Showerhead Control	Income Eligible MultiFamily	0 (N/A)	0 (N/A)	1.4 (142)	0 (N/A)	0 (N/A)	0 (N/A)
Low Flow Showerhead Control - Adapter	EnergyWise MultiFamily	0 (N/A)	0 (N/A)	0.21 (142)	0 (N/A)	0 (N/A)	435 (142)
Low Flow Showerhead Control	EnergyWise MultiFamily	0 (N/A)	0 (N/A)	1.4 (142)	0 (N/A)	0 (N/A)	2888 (142)
Low Flow Showerhead Control - Adapter	EnergyWise	0 (N/A)	0 (N/A)	0.14 (142)	0 (N/A)	0 (N/A)	296 (142)
Low Flow Showerhead Control	EnergyWise	0 (N/A)	0 (N/A)	0.86 (142)	0 (N/A)	0 (N/A)	1768 (142)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Low Flow Showerhead Control - Adapter	Income Eligible MultiFamily	7 (N30)	1.00 (N4)	1.00 (N43)	1 (N31)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Low Flow Showerhead Control	Income Eligible MultiFamily	7 (N30)	1.00 (N4)	1.00 (N43)	1 (N31)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Low Flow Showerhead Control - Adapter	EnergyWise MultiFamily	7 (N30)	1.00 (N4)	1.00 (N43)	1 (N31)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Low Flow Showerhead Control	EnergyWise MultiFamily	7 (N30)	1.00 (N4)	1.00 (N43)	1 (N31)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Low Flow Showerhead Control - Adapter	EnergyWise	7 (N30)	1.00 (N4)	1.00 (N43)	1 (N31)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Low Flow Showerhead Control	EnergyWise	7 (N30)	1.00 (N4)	1.00 (N43)	1 (N31)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

142 Verifying Thermostatic Valve Showerhead Savings.xls

N30 Massachusetts Common Assumption

N31 National Grid assumption based on regional PA working groups.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Hot Water - Water Heaters

Version Date: PY 2015

Description

Installation of high efficiency gas water heaters: Indirect water heaters use storage tank that is heated by the main boiler. The energy stored by the water tank allows the boiler to turn off and on less often, saving considerable energy. Condensing water heaters recover energy by using either a larger heat exchanger or a second heat exchanger to reduce the flue-gas temperature to the point that water vapor condenses, thus releasing even more energy. Stand-alone storage water heaters are high efficiency water heaters that are not combined with space heating devices. Tankless water heaters circulate water through a heat exchanger to be heated for immediate use, eliminating the standby heat loss associated with a storage tank.

Baseline Efficiency

The baseline efficiency case is a standalone tank water heater with an energy factor of 0.61.

High Efficiency

The high efficiency case is a stand-alone storage water heater with an energy factor >= 0.67, a condensing water heater with an energy factor >= 0.95, a tankless water heater with an energy factor >= 0.82, or an indirect water heater attached to an ENERGY STAR® rated forced hot water gas boiler.

		Electric Energy Impact:	No
Sector:	Residential	**Gas Energy Impact:**	Yes
End Use:	Hot Water	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installation of new high-efficiency water heater

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Tankless Water Heaters (EF 0.94)	EnergyStar® HVAC	0 (N/A)	0 (N/A)	7.6 (130)	0 (N/A)	0 (N/A)	0 (N/A)
Hard-to-Reach Tankless Water Heaters (EF 0.94)	EnergyStar® HVAC	0 (N/A)	0 (N/A)	7.6 (130)	0 (N/A)	0 (N/A)	0 (N/A)
Tankless Water Heaters (EF 0.95)	EnergyStar® HVAC	0 (N/A)	0 (N/A)	7.6 (130)	0 (N/A)	0 (N/A)	0 (N/A)
High Efficiency Stand Alone Water Heater	EnergyStar® HVAC	0 (N/A)	0 (N/A)	1.9 (130)	0 (N/A)	0 (N/A)	0 (N/A)
Hard-to-Reach Tankless Water Heaters (EF 0.95)	EnergyStar® HVAC	0 (N/A)	0 (N/A)	7.6 (130)	0 (N/A)	0 (N/A)	0 (N/A)
Hard-to-Reach High Efficiency Stand Alone	EnergyStar® HVAC	0 (N/A)	1 (N/A)	1.9 (130)	0 (N/A)	0 (N/A)	0 (N/A)
Hard-To-Reach Condensing Gas Water	EnergyStar® HVAC	0 (N/A)	0 (N/A)	7.7 (130)	0 (N/A)	0 (N/A)	0 (N/A)
Condensing Gas Water Heater (THERMAL	EnergyStar® HVAC	0 (N/A)	0 (N/A)	7.7 (130)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Tankless Water Heaters (EF 0.94)	EnergyStar® HVAC	20 (22)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Hard-to-Reach Tankless Water Heaters (EF 0.94)	EnergyStar® HVAC	20 (22)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Tankless Water Heaters (EF 0.95)	EnergyStar® HVAC	20 (22)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
High Efficiency Stand Alone Water Heater (0.67 EF)	EnergyStar® HVAC	12 (22)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Hard-to-Reach Tankless Water Heaters (EF 0.95)	EnergyStar® HVAC	19 (22)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Hard-to-Reach High Efficiency Stand Alone Water Heater (0.67 EF)	EnergyStar® HVAC	12 (22)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Hard-To-Reach Condensing Gas Water Heater (THERMAL EFICIENCY 0.95)	EnergyStar® HVAC	20 (22)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Condensing Gas Water Heater (THERMAL EFICIENCY 0.95)	EnergyStar® HVAC	20 (22)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

130 The Cadmus Group (2013). 2012 Residential Heating, Water Heating, and Cooling Equipment Evaluation: Net-to-Gross, Market Effects, and Equipment Replacement Timing.

22 DOE (2008). ENERGY STAR® Residential Water Heaters: Final Criteria Analysis. Prepared for the DOE.

58 GDS Associates, Inc. and Summit Blue Consulting (2009). Natural Gas Energy Efficiency Potential in Massachusetts. Prepared for GasNetworks.

84 Nexus Market Research and The Cadmus Group (2010). HEHE Process and Impact Evaluation. Prepared for GasNetworks.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Hot Water - Water Heating System Replacement

Version Date: PY 2015

Description

Replacement of an existing natural gas water heating system with a new high-efficiency natural gas system.

Baseline Efficiency

The baseline efficiency case is the existing natural gas water heating system.

High Efficiency

The high efficiency case is a high-efficiency natural gas water heating system.

Sector:	Residential
End Use:	Hot Water
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	No
Gas Energy Impact:	Yes
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed high-efficiency natural gas water heating system.

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
LI MF Water heating system replacement	Income Eligible MultiFamily	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
LI MF Water heating system replacement	Income Eligible MultiFamily	25 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

14 Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.

55 GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Boiler Controls

Version Date: PY 2015

Description

Boiler reset controls are devices that improve the efficiency of an existing boiler system by modulating the hot water temperature set point. Reset controls automatically control boiler water temperature based on outdoor temperature using a software program; load controls sense the thermal demand of the heating system and resets the water temperature based on the demand.

Baseline Efficiency

The baseline efficiency case is a boiler without reset or load controls.

High Efficiency

The efficient case is a boiler with reset or load controls, which reset the supply water temperature based on outdoor temperatures and/or building load.

		Electric Energy Impact:	No
Sector:	Residential	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installation of boiler reset control on existing boiler

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Hard-To-Reach Boiler Reset Controls	EnergyStar® HVAC	0 (N/A)	0 (N/A)	4.5 (124)	0 (N/A)	0 (N/A)	0 (N/A)
Boiler Reset Controls	EnergyStar® HVAC	0 (N/A)	0 (N/A)	4.5 (124)	0 (N/A)	0 (N/A)	0 (N/A)
Boiler Load Controls	EnergyStar® HVAC	0 (N/A)	0 (N/A)	2.7 (126)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Hard-To-Reach Boiler Reset Controls	EnergyStar® HVAC	15 (5)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Boiler Reset Controls	EnergyStar® HVAC	15 (5)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Boiler Load Controls	EnergyStar® HVAC	15 (126)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N35)	1 (N35)	0.92 (126)	1 (126)

Sources

124 The Cadmus Group (2012). Home Energy Services Impact Evaluation. Prepared for Massachusetts Program Administrators.

126 The Cadmus Group (2012). Impact Evaluation of the 2012-2013 Boiler Reset Control Pilot Program. Prepared for the Electric and Gas Energy Efficiency Program Administrators of Massachusetts.

5 ACEEE (2006). Emerging Technologies Report: Advanced Boiler Controls. Prepared for ACEEE.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Boilers

Version Date: PY 2015

Description

Installation of a new space heating gas-fired boiler.

Baseline Efficiency

The baseline efficiency case is a boiler with an AFUE equal to 82%.

High Efficiency

The high efficiency case is a boiler with an AFUE greater than or equal to 90% or 95%.

		Electric Energy Impact:	No
Sector:	Residential	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installation of new high-efficiency boiler

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Hard-To-Reach Boiler (forced hot water) 90%	EnergyStar® HVAC	0 (N/A)	0 (N/A)	12.48 (58)	0 (N/A)	0 (N/A)	0 (N/A)
Hard-to-reach Boiler (forced hot water) >=	EnergyStar® HVAC	0 (N/A)	0 (N/A)	13.84 (2)	0 (N/A)	0 (N/A)	0 (N/A)
Boiler (forced hot water) >= 95% AFUE	EnergyStar® HVAC	0 (N/A)	0 (N/A)	13.84 (2)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Hard-To-Reach Boiler (forced hot water) 90% AFUE	EnergyStar® HVAC	18 (33)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Hard-to-reach Boiler (forced hot water) >= 95% AFUE	EnergyStar® HVAC	19 (33)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Boiler (forced hot water) >= 95% AFUE	EnergyStar® HVAC	19 (33)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

130 The Cadmus Group (2013). 2012 Residential Heating, Water Heating, and Cooling Equipment Evaluation: Net-to-Gross, Market Effects, and Equipment Replacement Timing.

2 2013 HEHE Application of Results FINAL.xlsx

33 Environmental Protection Agency (2009). Life Cycle Cost Estimate for ENERGY STAR Qualified Boiler.

58 GDS Associates, Inc. and Summit Blue Consulting (2009). Natural Gas Energy Efficiency Potential in Massachusetts. Prepared for GasNetworks.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Deep Energy Retrofit

Version Date: PY 2015

Description

Deep energy retrofit projects for residential new construction include the installation of a new roof, siding, and or the refinishing of a basement.

Baseline Efficiency

The baseline case is the performance of the house before participation in the program

High Efficiency

The efficient case is the post-retrofit performance of a house participating the program

		Electric Energy Impact:	No
Sector:	Residential	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Completed deep energy retrofit project.

Algorithm:

The Deep Energy Retrofit program uses project-specific information to estimate energy and demand impacts from DER measure installations. The project savings are calculated by the program implementer and provided to National Grid.

Gross MMBtu Gas = ΔMMBtu_Gas_custom

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Deep Energy Retrofit Basements - Air Flow	Residential New Construction	0 (N/A)	0 (N10)	Calc (117)	0 (N/A)	0 (N/A)	0 (N/A)
Deep Energy Retrofit Walls - Air Flow	Residential New Construction	0 (N/A)	0 (N10)	Calc (117)	0 (N/A)	0 (N/A)	0 (N/A)
Deep Energy Retrofit Roofs - Air Flow	Residential New Construction	0 (N/A)	0 (N10)	Calc (117)	0 (N/A)	0 (N/A)	0 (N/A)
Deep Energy Retrofit Basements	Residential New Construction	0 (N/A)	0 (N10)	27.57 (117)	0 (N/A)	0 (N/A)	0 (N/A)
Deep Energy Retrofit Walls	Residential New Construction	0 (N/A)	0 (N10)	42.37 (117)	0 (N/A)	0 (N/A)	0 (N/A)
Deep Energy Retrofit Roofs	Residential New Construction	0 (N/A)	0 (N10)	38.98 (117)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Deep Energy Retrofit Basements - Air Flow Reduction	Residential New Construction	25 (90)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	Custom (N15)	Custom (N15)
Deep Energy Retrofit Walls - Air Flow Reduction	Residential New Construction	25 (90)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	Custom (N15)	Custom (N15)
Deep Energy Retrofit Roofs - Air Flow Reduction	Residential New Construction	25 (90)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	Custom (N15)	Custom (N15)
Deep Energy Retrofit Basements	Residential New Construction	25 (90)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	Custom (N15)	Custom (N15)
Deep Energy Retrofit Walls	Residential New Construction	25 (90)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	Custom (N15)	Custom (N15)
Deep Energy Retrofit Roofs	Residential New Construction	25 (90)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	Custom (N15)	Custom (N15)

Sources

117 Synapse (2012). A Preliminary Analysis of Energy Impacts from Partial Deep Energy Retrofit Projects in National Grid’s Jurisdiction. Prepared for National Grid.

134 The Cadmus Group, Inc. (2012) Memo to HEHE Program Administrators Re: Impacts of Upcoming Federal Standards on HEHE.Gas Space and Water Heating Measures; June 8, 2012.

33 Environmental Protection Agency (2009). Life Cycle Cost Estimate for ENERGY STAR Qualified Boiler.

58 GDS Associates, Inc. and Summit Blue Consulting (2009). Natural Gas Energy Efficiency Potential in Massachusetts. Prepared for GasNetworks.

90 NMR Group, KEMA, The Cadmus Group, Dorothy Conant (2012). Rhode Island 2011 Baseline Study of Single-Family Residential New Construction. Prepared for National Grid.

N10 Calculated, per 100ft2

N15 Coincidence factors are custom calculated based on project-specific detail.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - EW Air Sealing

Version Date: PY 2015

Description

Thermal shell air leaks are sealed through strategic use and location of air-tight materials.

Baseline Efficiency

The baseline efficiency case is the existing building before the air sealing measure is implemented. The baseline building is characterized by the existing CFM50 measurement (CFM50PRE) for single family homes, or the existing air changes per hour (ACHPRE)

High Efficiency

The high efficiency case is the existing building after the air sealing measure is implemented. The high efficiency building is characterized by the new CFM50 measurement for single family homes (CFM50POST), or the new air changes per hour (ACHPOST) for multi-family facilities, which is measured after the air sealing measure is implemented.

		Electric Energy Impact:	No
Sector:	Multifamily	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Completed air sealing project.

Algorithm:

Gross MMBtu Gas = (CFM50_pre - CFM50_post) / LBL × HDD × 24 × 60 × 0.018 × CorrectionFactor / SeasonalEff / 1,000,000

Where:

CFM50_pre = CFM50 measurement before air sealing (cu.ft./min)

CFM50_post = CFM50 measurement after air sealing (cu.ft./min)

LBL = LBL factor **N54**

HDD = Heating degree days (deg. F-day): 6061 **131**

CorrectionFactor = Correction factor determined by auditor (e.g. for seasonal homes): Default = 1.

SeasonalEff = Heating system seasonal efficiency factor determined by auditor: Default = 0.7 for homes heated with

natural gas.
24 = Conversion: 24 hours per day
60 = Conversion: 60 minutes per hour
0.018 = Heat capacity of 1 cubic foot of air at 70 °F (Btu/ft3-°F)
1,000,000 = Conversion: 1,000,000 Btu per MMBtu

Hours

Heating hours are characterized by the heating degree days for the facility, 6061.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
LI MF Air Sealing	Income Eligible MultiFamily	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)
MF Air Sealing	EnergyWise MultiFamily	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)
SF Air Sealing	EnergyWise	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
LI MF Air Sealing	Income Eligible MultiFamily	15 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
MF Air Sealing	EnergyWise MultiFamily	15 (55)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
SF Air Sealing	EnergyWise	15 (55)	1.00 (N4)	1.00 (N43)	0.993 (129)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

129 The Cadmus Group (2012). Rhode Island EnergyWise Single Family Impact Evaluation. Prepared for National Grid

131 The Cadmus Group (2014). Impact Evaluation: Rhode Island Income Eligible Services, Volume II. Prepared for National Grid.

14 Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.

55 GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

N54 The LBL Factor is determined as the product of the N-factor and a Height Correction Factor according to BPI Protoco

HVAC - EW Other Insulation

Version Date: PY 2015

Description

Insulation upgrades (other than basement, roofs, and walls) applied in existing facilities.

Baseline Efficiency

The baseline efficiency case is the existing facility or equipment prior to the implementation of additional insulation.

High Efficiency

The high efficiency case is the existing facility or equipment after the implementation of additional insulation.

		Electric Energy Impact:	No
Sector:	Multifamily	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Completed insulation project.

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

Heating hours are characterized by the heating degree days for the facility, 6061.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
LI MF Other Insulation - Existing Hatches:	Income Eligible MultiFamily	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)
LI MF Other Insulation - attic staircase cover	Income Eligible MultiFamily	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)
MF Other Insulation - Existing Hatches:	EnergyWise MultiFamily	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)
MF Other Insulation - attic staircase cover	EnergyWise MultiFamily	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)
SF Other Insulation - Existing Hatches:	EnergyWise	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)
SF Other Insulation - attic staircase cover	EnergyWise	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
LI MF Other Insulation - Existing Hatches: weaatherstrip, insulate, dam perimeter	Income Eligible MultiFamily	25 (127)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
LI MF Other Insulation - attic staircase cover (therma-dome)	Income Eligible MultiFamily	25 (127)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
MF Other Insulation - Existing Hatches: weaatherstrip, insulate, dam perimeter	EnergyWise MultiFamily	25 (127)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
MF Other Insulation - attic staircase cover (therma-dome)	EnergyWise MultiFamily	25 (127)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
SF Other Insulation - Existing Hatches: weaatherstrip, insulate, dam perimeter	EnergyWise	25 (127)	1.00 (N4)	1.00 (N43)	0.993 (129)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
SF Other Insulation - attic staircase cover (therma-dome)	EnergyWise	25 (127)	1.00 (N4)	1.00 (N43)	0.993 (129)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

127 The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for the Massachusetts Program Administrators.

129 The Cadmus Group (2012). Rhode Island EnergyWise Single Family Impact Evaluation. Prepared for National Grid

131 The Cadmus Group (2014). Impact Evaluation: Rhode Island Income Eligible Services, Volume II. Prepared for National Grid.

14 Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - EW Shell Insulation

Version Date: PY 2015

Description

Shell insulation upgrades applied in existing facilities including improved insulation in attics, basements and sidewalls.

Baseline Efficiency

The baseline efficiency case is any existing home shell measures.

High Efficiency

The high efficiency case includes increased weatherization insulation levels.

		Electric Energy Impact:	No
Sector:	Residential	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Completed insulation project.

Algorithm:

Gross MMBtu Gas = SQFT × [1/R_pre - 1/(R_pre + R_add)] × HDD × 24 × CorrectionFactor × SeasonalEff / 1,000,000

Where:

SQFT = Square feet of insulation installed

R_pre = Total R-value of the existing attic, basement or sidewall (ft2-hr-°F/Btu)

R_add = R-value of the added insulation (ft2-hr-°F/Btu)

HDD = Heating degree days (deg. F-day): 6061 [131]

CorrectionFactor = Correction factor determined by auditor (e.g. for seasonal homes): Default = 1.

SeasonalEff = Heating system seasonal efficiency factor determined by auditor: Default = 0.7 for homes heated with natural gas.

24 = Conversion: 24 hours per day

1,000,000 = Conversion: 1,000,000 Btu per MMBtu

Hours

Heating hours are characterized by the heating degree days for the facility, 6061.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
LI MF Shell Insulation	Income Eligible MultiFamily	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)
MF Shell Insulation	EnergyWise MultiFamily	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)
SF Shell Insulation	EnergyWise	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
LI MF Shell Insulation	Income Eligible MultiFamily	25 (127)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
MF Shell Insulation	EnergyWise MultiFamily	25 (127)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
SF Shell Insulation	EnergyWise	25 (127)	1.00 (N4)	1.00 (N43)	0.993 (129)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

127 The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for the Massachusetts Program Administrators.

129 The Cadmus Group (2012). Rhode Island EnergyWise Single Family Impact Evaluation. Prepared for National Grid

131 The Cadmus Group (2014). Impact Evaluation: Rhode Island Income Eligible Services, Volume II. Prepared for National Grid.

14 Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Furnaces

Version Date: PY 2015

Description

Installation of a new high efficiency space heating gas-fired furnace with an electronically commutated motor (ECM) for the fan.

Baseline Efficiency

The baseline efficiency case is a 90% AFUE furnace.

High Efficiency

The high efficiency case is a new furnace with AFUE >= 95% and an electronically commutated motor or a new furnace with AFUE >= 97% and an electronically commutated motor.

Sector:	Residential
End Use:	HVAC
Market (Lost Opportunity):	Yes
Market (Retrofit):	No

Electric Energy Impact:	No
Gas Energy Impact:	Yes
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installation of new high-efficiency furnace with ECM

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW
Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.
ΔkWh = Average annual kWh reduction per unit.
ΔkW = Average kW reduction per unit.
ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Hard-to-Reach Furnace (forced hot air) 95%	EnergyStar® HVAC	0 (N/A)	0 (N/A)	13.9 (2)	0 (N/A)	0 (N/A)	0 (N/A)
Hard-to-reach Furnace (forced hot air) >= 97%	EnergyStar® HVAC	0 (N/A)	0 (N/A)	15.3 (2)	0 (N/A)	0 (N/A)	0 (N/A)
Furnace (forced hot air) 95% AFUE w/ECM	EnergyStar® HVAC	0 (N/A)	0 (N/A)	13.9 (2)	0 (N/A)	0 (N/A)	0 (N/A)
Furnace (forced hot air) >= 97% AFUE	EnergyStar® HVAC	0 (N/A)	0 (N/A)	15.3 (2)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Hard-to-Reach Furnace (forced hot air) 95% AFUE w/ECM	EnergyStar® HVAC	17 (130)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0 (26)	0.16 (26)
Hard-to-reach Furnace (forced hot air) >= 97% AFUE	EnergyStar® HVAC	17 (32)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0 (26)	0.16 (26)
Furnace (forced hot air) 95% AFUE w/ECM	EnergyStar® HVAC	17 (32)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0 (26)	0.16 (26)
Furnace (forced hot air) >= 97% AFUE	EnergyStar® HVAC	17 (32)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0 (26)	0.16 (26)

Sources

130 The Cadmus Group (2013). 2012 Residential Heating, Water Heating, and Cooling Equipment Evaluation: Net-to-Gross, Market Effects, and Equipment Replacement Timing.

2 2013 HEHE Application of Results FINAL.xlsx

26 Energy & Resource Solutions (2011). BFM Impact Evaluation Report. Prepared for the Electric and Gas Program Administrators of Massachusetts.

32 Environmental Protection Agency (2009). Life Cycle Cost Estimate for an ENERGY STAR Qualified Gas Residential Furnace.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Heat Recovery Ventilators

Version Date: PY 2015

Description

Heat Recovery Ventilators (HRV) can help make mechanical ventilation more cost effective by reclaiming energy from exhaust airflows. An electric penalty results due to the increased electricity consumed by the system fans.

Baseline Efficiency

The baseline efficiency case is an ASHRAE 62.2-compliant exhaust fan system with no heat recovery.

High Efficiency

The high efficiency case is an exhaust fan system with heat recovery.

		Electric Energy Impact:	No
Sector:	Residential	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installation of heat recovery ventilation system

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW
Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:
Qty = Total number of units.
ΔkWh = Average annual kWh reduction per unit.
ΔkW = Average kW reduction per unit.
ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Heat Recovery Ventilator	EnergyStar® HVAC	-133 (58)	-0.07 (135)	7.7 (58)	0 (N/A)	0 (N/A)	0 (N/A)
Hard-to-Reach Heat Recovery Ventilator	EnergyStar® HVAC	-133 (58)	0 (135)	7.7 (58)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Heat Recovery Ventilator	EnergyStar® HVAC	20 (58)	1.00 (N4)	1.00 (N43)	1 (N38)	1 (N35)	1 (N35)	0 (135)	1 (135)
Hard-to-Reach Heat Recovery Ventilator	EnergyStar® HVAC	20 (58)	1.00 (N4)	1.00 (N43)	1 (N38)	1 (N35)	1 (N35)	0 (135)	1 (135)

Sources

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

58 GDS Associates, Inc. and Summit Blue Consulting (2009). Natural Gas Energy Efficiency Potential in Massachusetts. Prepared for GasNetworks.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Heating

Version Date: PY 2015

Description

This measure involves the installation of a high-efficiency natural gas heating system.

Baseline Efficiency

The baseline efficiency case is a standard efficiency natural gas heating system.

High Efficiency

The high efficiency case is the installation of a high-efficiency natural gas heating system.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed high-efficiency natural gas heating system.

Algorithm:

The implementation vendor for this program uses a proprietary model to calculate electric and fossil fuel savings for new construction homes in comparison to the Rhode Island User Defined Reference Home.

Gross MMBtu Gas = ΔMMBtu_Gas_custom

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Heating	Residential New Construction	Calc (90)	Calc (90)	Calc (90)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Heating	Residential New Construction	25 (90)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	Custom (N15)	Custom (N15)

Sources

90 NMR Group, KEMA, The Cadmus Group, Dorothy Conant (2012). Rhode Island 2011 Baseline Study of Single-Family Residential New Construction. Prepared for National Grid.

N15 Coincidence factors are custom calculated based on project-specific detail.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Heating System Replacement

Version Date: PY 2015

Description

Replacement of an existing gas heating system with a new high efficiency system. Electric savings are achieved from reduced run time of the heating system fan(s).

Baseline Efficiency

The baseline efficiency case is the existing inefficient heating equipment.

High Efficiency

The high efficiency case is the new efficient heating equipment.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	Yes
		Non-Energy Impact:	Yes

Algorithm Type: Deemed

Unit: Installation of new high-efficiency gas heating system

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW
Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:
Qty = Total number of units.
ΔkWh = Average annual kWh reduction per unit.
ΔkW = Average kW reduction per unit.
ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Heating system replacement	Single Family Appliance	172 (131)	0.09 (135)	16.8 (131)	0 (N/A)	0 (N/A)	2888 (142)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Heating system replacement	Single Family Appliance Management	18 (127)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.03 (135)	0.03 (135)

Sources

127 The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for the Massachusetts Program Administrators.

131 The Cadmus Group (2014). Impact Evaluation: Rhode Island Income Eligible Services, Volume II. Prepared for National Grid.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Integrated Boiler/Water Heater

Version Date: PY 2015

Description

This measure promotes the installation of a combined high-efficiency boiler and water heating unit. Combined boiler and water heating systems are more efficient than separate systems because they eliminate the standby heat losses of an additional tank.

Baseline Efficiency

The baseline efficiency case is an 80% AFUE boiler with a 0.594 EF water heater.

High Efficiency

The high efficiency case is an integrated water heater/condensing boiler with a 90% AFUE boiler and a 0.9 EF water heater.

		Electric Energy Impact:	No
Sector:	Residential	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installation of new high-efficiency integrated boiler/water heater

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Integrated water heater/condensing boiler	EnergyStar® HVAC	0 (N/A)	0 (N/A)	23.8 (2)	0 (N/A)	0 (N/A)	0 (N/A)
Hard-To-Reach Integrated water	EnergyStar® HVAC	0 (N/A)	0 (N/A)	23.8 (2)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Integrated water heater/condensing boiler	EnergyStar® HVAC	17 (33)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Hard-To-Reach Integrated water heater/condensing boiler	EnergyStar® HVAC	17 (33)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

2 2013 HEHE Application of Results FINAL.xlsx

33 Environmental Protection Agency (2009). Life Cycle Cost Estimate for ENERGY STAR Qualified Boiler.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Programmable Thermostats

Version Date: PY 2015

Description

Installation of a programmable thermostat which gives the ability to adjust heating or air-conditioning operating times according to a pre-set schedule.

Baseline Efficiency

For the intallation of a programmable thermostat, the baseline efficiency case is an HVAC system using natural gas to provide space heating without a programmable thermostat. For the intallation of a wi-fi programmable thermostat, the baseline efficiency case is an HVAC system using natural gas to provide space heating with a programmable thermostat.

High Efficiency

The high efficiency case is an HVAC system that has a programmable thermostat or wi-fi programmable thermostat installed.

		Electric Energy Impact:	No
Sector:	Residential	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installation of programmable thermostat

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:
Qty = Total number of units.
ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Programmable thermostat	Income Eligible MultiFamily	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)
WiFi programmable thermostat	EnergyWise MultiFamily	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)
Programmable thermostat	EnergyWise MultiFamily	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)
WiFi programmable thermostat	EnergyWise	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)
Programmable thermostat	EnergyWise	0 (N/A)	0 (N/A)	Calc (14)	0 (N/A)	0 (N/A)	0 (N/A)
WiFi Enabled Thermostat with Cooling	EnergyStar® HVAC	104 (123)	0.231 (123)	6.6 (127)	0 (N/A)	0 (N/A)	0 (N/A)
WiFi Enabled Thermostat	EnergyStar® HVAC	0 (N/A)	0 (N/A)	6.6 (127)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Programmable thermostat	Income Eligible MultiFamily	15 (39)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
WiFi programmable thermostat	EnergyWise MultiFamily	15 (39)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Programmable thermostat	EnergyWise MultiFamily	15 (39)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
WiFi programmable thermostat	EnergyWise	15 (39)	1.00 (N4)	1.00 (N43)	0.993 (129)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Programmable thermostat	EnergyWise	15 (39)	1.00 (N4)	1.00 (N43)	0.993 (129)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
WiFi Enabled Thermostat with Cooling	EnergyStar® HVAC	15 (39)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	1 (135)	1 (135)
WiFi Enabled Thermostat	EnergyStar® HVAC	15 (39)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

123 The Cadmus Group (2011). Memo: Wi-fi Programmable Thermostat Billing Analysis. Prepared for Keith Miller and Whitney Domigan, National Grid.

124 The Cadmus Group (2012). Home Energy Services Impact Evaluation. Prepared for Massachusetts Program Administrators.

127 The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for the Massachusetts Program Administrators.

129 The Cadmus Group (2012). Rhode Island EnergyWise Single Family Impact Evaluation. Prepared for National Grid

133 The Cadmus Group, Inc (2012). Rhode Island EnergyWise Single Family Impact Evaluation.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

14 Calculated by RISE Engineering according to algorithms found in The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for Massachusetts Program Administrators.

39 Environmental Protection Agency (2010). Life Cycle Cost Estimate for Programmable Thermostats. Accessed on 10/12/2011.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Renovation Rehab

Version Date: PY 2015

Description

Renovation Rehab projects include the installation of roof, wall, and basement insulation

Baseline Efficiency

Renovation Rehab projects include the installation of roof, wall, and basement insulation

High Efficiency

Renovation Rehab projects include the installation of roof, wall, and basement insulation

Sector:	Residential
End Use:	HVAC
Market (Lost Opportunity):	Yes
Market (Retrofit):	No

Electric Energy Impact:	No
Gas Energy Impact:	Yes
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs.

Unit: Complete Renovation Rehab project

Algorithm:

The Renovation Rehab program uses established baseline criteria and project-specific information to estimate energy and demand impacts from measure installations. The project savings are calculated by the program implementer and provided to National Grid

Gross MMBtu Gas = ΔMMBtu_Gas_custom

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Renovation Rehab Heating	Residential New Construction	0 (N/A)	0 (N10)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)
Renovation Rehab Domestic Hot Water	Residential New Construction	0 (N/A)	0 (N10)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Renovation Rehab Heating	Residential New Construction	25 (90)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	Custom (N15)	Custom (N15)
Renovation Rehab Domestic Hot Water	Residential New Construction	25 (90)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	Custom (N15)	Custom (N15)

Sources

90 NMR Group, KEMA, The Cadmus Group, Dorothy Conant (2012). Rhode Island 2011 Baseline Study of Single-Family Residential New Construction. Prepared for National Grid.

N10 Calculated, per 100ft2

N15 Coincidence factors are custom calculated based on project-specific detail.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Weatherization

Version Date: PY 2015

Description

Installation of weatherization measures such as air sealing and insulation in gas heated homes. Electric savings are achieved from reduced run time of the HVAC system fan(s).

Baseline Efficiency

The baseline efficiency case is the existing home shell.

High Efficiency

The high efficiency case can be a combination of increased insulation, air sealing, duct sealing, and other improvements to the home shell.

		Electric Energy Impact:	Yes
Sector:	Residential	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	Yes

Algorithm Type: Deemed

Unit: Household with weatherization measures installed

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW
Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:
Qty = Total number of units.
ΔkWh = Average annual kWh reduction per unit.
ΔkW = Average kW reduction per unit.
ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Weatherization	Single Family Appliance	344 (131)	0.18 (135)	18.8 (131)	0 (N/A)	0 (N/A)	435 (142)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Weatherization	Single Family Appliance Management	20 (33)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N35)	1 (N35)	0.03 (135)	0.03 (135)

Sources

131 The Cadmus Group (2014). Impact Evaluation: Rhode Island Income Eligible Services, Volume II. Prepared for National Grid.

135 The Cadmus Group, Inc. (2012). Demand Impact Model. Prepared for the Massachusetts Program Administrators.

33 Environmental Protection Agency (2009). Life Cycle Cost Estimate for ENERGY STAR Qualified Boiler.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Commercial Gas Efficiency Measures

Food Service - Commercial Fryer

Version Date: PY 2015

Description

The installation of a natural-gas fired fryer that is either ENERGY Star rated or has a heavy-load cooking efficiency of at least 50%. Qualified fryers use advanced burner and heat exchanger designs to use fuel more efficiently, as well as increased insulation to reduce standby heat loss.

Baseline Efficiency

The baseline efficiency case is a typical low-efficiency gas-fired fryer with 35% cooking efficiency, 16,000 Btu preheat energy, 14,000 Btu/h Idle Energy rate, and 60 lbs/h production capacity.

High Efficiency

The high efficiency case cooking efficiency and Idle Energy Rate are site specific and can be determined on a case-by-case basis. To simplify the savings algorithm, typical values for food load (150 lbs/day) and preheat energy (15.500 Btu) are assumed.

		Electric Energy Impact:	No
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	Food Service	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed high-efficiency gas-fired fryer.

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Commercial gas fryer	Commercial New Construction	0 (N/A)	0 (N/A)	58.6 (34)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Commercial gas fryer	Commercial New Construction	12 (34)	1.00 (N4)	1.00 (N43)	1 (N1)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

34 Environmental Protection Agency (2009). Life Cycle Cost Estimate for ENERGY STAR Qualified Gas Fryer.

N1 100% realization rates are assumed because savings are based on researched assumptions by FSTC.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Food Service - Commercial Gas-Fired Ovens

Version Date: PY 2015

Description

Installation of high efficiency gas-fired ovens.

Baseline Efficiency

The baseline efficiency case is a standard oven that meets the baseline cooking energy efficiencyrequirements shown in Table 15.

High Efficiency

The high efficiency case is an oven that meets or exceeds the high efficiency ratings shown in Table 15.

		Electric Energy Impact:	No
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	Food Service	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed high-efficiency gas-fired oven.

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

Table 15: Baseline Efficiency Requirements for Gas and Electric Ovens

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Gas-fired rack oven (>= 50% efficiency)	Commercial New Construction	0 (N/A)	0 (N/A)	211.3 (52)	0 (N/A)	0 (N/A)	0 (N/A)
Gas-fired conveyer oven (>= 44% efficiency)	Commercial New Construction	0 (N/A)	0 (N/A)	84.5 (52)	0 (N/A)	0 (N/A)	0 (N/A)
Gas-fired convection oven (>= 44% efficiency)	Commercial New Construction	0 (N/A)	0 (N/A)	30.6 (54)	0 (N/A)	0 (N/A)	0 (N/A)
Gas-fired combination oven (>= 44%	Commercial New Construction	0 (N/A)	0 (N/A)	110.3 (51)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Gas-fired rack oven (>= 50% efficiency)	Commercial New Construction	12 (52)	1.00 (N4)	1.00 (N43)	1 (N1)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Gas-fired conveyer oven (>= 44% efficiency)	Commercial New Construction	12 (52)	1.00 (N4)	1.00 (N43)	1 (N1)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Gas-fired convection oven (>= 44% efficiency)	Commercial New Construction	12 (54)	1.00 (N4)	1.00 (N43)	1 (N1)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Gas-fired combination oven (>= 44% efficiency)	Commercial New Construction	12 (51)	1.00 (N4)	1.00 (N43)	1 (N1)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

51 Food Service Technology Center (2011). Gas Combination Oven Life-Cycle Cost Calculator.

52 Food Service Technology Center (2011). Gas Conveyor Oven Life-Cycle Cost Calculator.

54 Food Service Technology Center (2012). Gas Convection Oven Life-Cycle Cost Calculator.http://www.fishnick.com/saveenergy/tools/calculators/govencalc.php.

N1 100% realization rates are assumed because savings are based on researched assumptions by FSTC.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Food Service - Commercial Griddle

Version Date: PY 2015

Description

Installation of a high efficiency gas-fired griddle.

Baseline Efficiency

The baseline efficiency case is a standard efficiency (30% efficient) gas griddle.

High Efficiency

The high efficiency case is a gas griddle with an efficiency of 38%.

Sector: C&I

End Use: Food Service

Market (Lost Opportunity): Yes

Market (Retrofit): No

Electric Energy Impact: No

Gas Energy Impact: Yes

Oil Energy Impact: No

Propane Impact: No

Water Impact: No

Non-Energy Impact: No

Algorithm Type: Deemed

Unit: Installed high-efficiency gas-fired griddle

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Commercial gas griddle	Commercial New Construction	0 (N/A)	0 (N/A)	18.5 (53)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Commercial gas griddle	Commercial New Construction	12 (53)	1.00 (N4)	1.00 (N43)	1 (N1)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

53 Food Service Technology Center (2011). Gas Griddle Life-Cycle Cost Calculation. Accessed on 10/12/2011.

N1 100% realization rates are assumed because savings are based on researched assumptions by FSTC.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Food Service - Commercial Steamer

Version Date: PY 2015

Description

The baseline efficiency case is a typical boiler-based steamer with the following operating parameters: Preheat Energy rate = 72,000 Btu/hour, Idle Energy Rate = 18,000 Btu/hour, Heavy Load Efficiency = 18.0%, Production Capacity per pan = 23.3 lbs/hour, Average Water Consumption Rate = 40 gal/hour, and Percentage of Time in Constant Steam Mode = 40%.

Baseline Efficiency

The baseline efficiency case is a typical boiler-based steamer with the following operating parameters: cooking energy efficiency = 18%, production capacity per pan = 23.3 lbs/hr, preheat energy rate = 72,000 Btu/hr, idle energy rate = 18,000 Btu/h, and a

High Efficiency

The high efficiency case is an ENERGY STAR® qualified gas-fired steamer with the following operating parameters for a 6 pan steamer: Preheat Energy Rate = 36,000 Btu/hour, Idle Energy Rate = 12,500 Btu/hour, Heavy Load Efficiency = 38.0%, Production Capacity per pan = 20 lbs/hour, and Average Water Consumption Rate = 3 gallons/hour, and Percentage of Time in Constant Steam Mode = 40%.

		Electric Energy Impact:	No
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	Food Service	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	Yes
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed high-efficiency gas-fired steamer.

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

The deemed savings assumes 4,380 annual operating hours (12 hours a day * 365 days/year).

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Commercial gas steamer (>= 38% efficiency)	Commercial New Construction	0 (N/A)	0 (N/A)	106.6 (41)	0 (N/A)	0 (N/A)	162060 (41)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Commercial gas steamer (>= 38% efficiency)	Commercial New Construction	12 (41)	1.00 (N4)	1.00 (N43)	1 (N1)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

41 Environmental Protection Agency (2011). Savings Calculator for ENERGY STAR Qualified Commercial Kitchen Equipment: Steam Cooker Calcs. Accessed on 10/12/2011.

N1 100% realization rates are assumed because savings are based on researched assumptions by FSTC.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Hot Water - Faucet Aerators

Version Date: PY 2015

Description

Installation of a faucet aerator with a flow rate of 1.5 GPM or less on an existing faucet with high flow in a commercial setting with service water heated by natural gas.

Baseline Efficiency

The baseline efficiency case is a 2.2 GPM faucet.

High Efficiency

The high efficiency case is a faucet with 1.5 GPM or less aerator installed.

		Electric Energy Impact:	No
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	Hot Water	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	Yes
		Non-Energy Impact:	Yes

Algorithm Type: Deemed

Unit: Installed faucet aerator.

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

The calculator used to determine the deemed savings uses a default operation of 30 minuts/day, 260 days/year. Not applicable for Multifamily applications.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Faucet aerator	Commercial and Industrial	0 (N/A)	0 (N/A)	0.36 (127)	0 (N/A)	0 (N/A)	332 (127)
Faucet aerator	Direct Install	0 (N/A)	0 (N/A)	1.7 (49)	0 (N/A)	0 (N/A)	5460 (49)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Faucet aerator	Commercial and Industrial MultiFamily	7 (127)	1.00 (N4)	1.00 (N43)	0.96 (129)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Faucet aerator	Direct Install	5 (49)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

127 The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for the Massachusetts Program Administrators.

129 The Cadmus Group (2012). Rhode Island EnergyWise Single Family Impact Evaluation. Prepared for National Grid

49 Federal Energy Management Program (2010). Energy Cost Calculator for Faucets and Showerheads. Accessed on 10/12/2011.

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Hot Water - Low-Flow Showerheads

Version Date: PY 2015

Description

Installation of a low flow showerhead with a flow rate of 1.5 GPM or less in a commercial setting with service water heated by natural gas.

Baseline Efficiency

The baseline efficiency case is a 2.5 GPM showerhead.

High Efficiency

The high efficiency case is a 1.5 GPM showerhead.

Sector:	C&I
End Use:	Hot Water
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	No
Gas Energy Impact:	Yes
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	Yes
Non-Energy Impact:	Yes

Algorithm Type: Deemed

Unit: Installed low-flow showerhead

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

The calculator used to determine the deemed savings uses a default operation of 20 minutes/day, 365 days/year. Not applicable for Multifamily applications.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Low-flow showerhead	Commercial and Industrial	0 (N/A)	0 (N/A)	0.48 (127)	0 (N/A)	0 (N/A)	3696 (127)
Low-flow showerhead	Direct Install	0 (N/A)	0 (N/A)	5.2 (56)	0 (N/A)	0 (N/A)	7300 (49)
Low-Flow Showerhead	Commercial Retrofit	0 (N/A)	0 (N/A)	5.2 (56)	0 (N/A)	0 (N/A)	7300 (49)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Low-flow showerhead	Commercial and Industrial MultiFamily	7 (127)	1.00 (N4)	1.00 (N43)	0.93 (129)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Low-flow showerhead	Direct Install	10 (58)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Low-Flow Showerhead	Commercial Retrofit	10 (56)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

127 The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for the Massachusetts Program Administrators.

129 The Cadmus Group (2012). Rhode Island EnergyWise Single Family Impact Evaluation. Prepared for National Grid

49 Federal Energy Management Program (2010). Energy Cost Calculator for Faucets and Showerheads. Accessed on 10/12/2011.

56 GDS Associates, Inc. (2009). Natural Gas Efficiency Potential in Massachusetts. Prepared for Gas Networks.

58 GDS Associates, Inc. and Summit Blue Consulting (2009). Natural Gas Energy Efficiency Potential in Massachusetts. Prepared for GasNetworks.

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Hot Water - Pipe Insulation

Version Date: PY 2015

Description

Install insulation on hot water or steam piping located in non-conditioned spaces.

Baseline Efficiency

The baseline efficiency case is un-installed steam or hot water piping in unconditional space.

High Efficiency

The high efficiency condition is steam or hot water piping in unconditional space with insulation installed.

		Electric Energy Impact:	No
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	Hot Water	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed insulation

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Insulation Pipe Diameter 2in Steam	Direct Install	0 (N/A)	0 (N/A)	0.37 (144)	0 (N/A)	0 (N/A)	0 (N/A)
Insulation Pipe Diameter 2in H2O	Direct Install	0 (N/A)	0 (N/A)	0.36 (144)	0 (N/A)	0 (N/A)	0 (N/A)
Insulation Pipe Diameter 1.5in Steam	Direct Install	0 (N/A)	0 (N/A)	0.21 (144)	0 (N/A)	0 (N/A)	0 (N/A)
Insulation Pipe Diameter 1.5in H2O	Direct Install	0 (N/A)	0 (N/A)	0.21 (144)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Insulation Pipe Diameter 2in Steam	Direct Install	15 (56)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Insulation Pipe Diameter 2in H2O	Direct Install	15 (56)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Insulation Pipe Diameter 1.5in Steam	Direct Install	15 (56)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Insulation Pipe Diameter 1.5in H2O	Direct Install	15 (56)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

144 National Grid Staff Calculation (2010). Pipe insulation for SBS DI measures 2010 Excel Workbook

56 GDS Associates, Inc. (2009). Natural Gas Efficiency Potential in Massachusetts. Prepared for Gas Networks.

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Hot Water - Pre-Rinse Spray Valves

Version Date: PY 2015

Description

Retrofitting existing standard spray nozzles in locations where service water is supplied by natural gas fired hot water heater with new low flow pre-rinse spray nozzles with an average flow rate of 1.6 GPM.

Baseline Efficiency

The baseline efficiency case is a standard efficiency spray valve.

High Efficiency

The high efficiency case is a low flow pre-rinse spray valve with an average flow rate of 1.6 GPM.

		Electric Energy Impact:	No
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	Hot Water	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	Yes
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed pre-rinse spray valve.

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Pre-rinse spray valve	Direct Install	0 (N/A)	0 (N/A)	11.4 (20)	0 (N/A)	0 (N/A)	6410 (20)
Pre-rinse spray valve	Commercial Retrofit	0 (N/A)	0 (N/A)	11.4 (20)	0 (N/A)	0 (N/A)	6410 (20)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Pre-rinse spray valve	Direct Install	8 (20)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Pre-rinse spray valve	Commercial Retrofit	8 (20)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

20 DNV GL (2014). Impact Evaluation of National Grid Rhode Island Commercial and Industrial Prescriptive Gas Pre-Rinse Spray Valves Measure.

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Hot Water - Salon Nozzles

Version Date: PY 2015

Description

The installation of a high efficiency salon nozzle.

Baseline Efficiency

An inefficienct salon nozzle.

High Efficiency

An efficient salon nozzle.

Sector:	C&I
End Use:	Hot Water
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	No
Gas Energy Impact:	Yes
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	Yes
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed salon valve

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:
Qty = Total number of units.
ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

It is assumed that pre-installation usage is 3.0 hours/day and post-installation usage is 3.6 hours/day

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Salon Nozzle	Direct Install	0 (N/A)	0 (N/A)	20.4 (111)	0 (N/A)	0 (N/A)	28639 (111)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Salon Nozzle	Direct Install	5 (20)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

111 Salon Spray valve data - post op hrs increased.xlsx

20 DNV GL (2014). Impact Evaluation of National Grid Rhode Island Commercial and Industrial Prescriptive Gas Pre-Rinse Spray Valves Measure.

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Hot Water - Steam Traps

Version Date: PY 2015

Description

The repair or replacement of malfunctioning steam traps.

Baseline Efficiency

The baseline efficiency case is a failed steam trap.

High Efficiency

The high efficiency case is a repaired or replaced steam trap.

Sector:	C&I
End Use:	Hot Water
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	No
Gas Energy Impact:	Yes
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Repaired or replaced steam trap.

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Steam trap	Direct Install	0 (N/A)	0 (N/A)	25.7 (N32)	0 (N/A)	0 (N/A)	0 (N/A)
Steam trap	Commercial Retrofit	0 (N/A)	0 (N/A)	25.7 (N32)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Steam trap	Direct Install	3 (N30)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Steam trap	Commercial Retrofit	3 (N30)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

N30 Massachusetts Common Assumption

N32 National Grid assumption based on regional PA working groups. Assumptions based on historical steam trap surveys. Steam losses in lbs/hr are found using "Boiler Efficiency Institute (1987). Steam Efficiency Improvement; Page 34, Table 4.1 under Steam Leak

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Hot Water - Water Heaters

Version Date: PY 2015

Description

The installation of a high-efficiency water heaters. Indirect water heaters use a storage tank that is heated by the main boiler. The energy stored by the water tank allows the boiler to turn off and on less often, saving considerable energy. Tankless water heaters circulate water through a heat exchanger to be heated for immediate use, eliminating the standby heat loss associated with a storage tank.

Baseline Efficiency

The baseline efficiency case assumes compliance with the efficiency requirements as mandated by Rhode Island State Building Code. For condensing stand-alone water heaters, the baseline is a stand-alone tank water heater with a thermal efficiency of 80%.

High Efficiency

The high efficiency case is either for a condensing stand-alone commercial water heater with a thermal efficiency of 95% or greater and a capacity between 75,000 Btu and 300,000 Btu, a tankless water heater that is ENERGY STAR® rated with an Energy Factor of at least .67 and a nominal input of 75,000 Btu/hour or less, or an indirect water heater with a Combined Appliance Efficiency (CAE) of 85% or greater.

Sector:	C&I
End Use:	Hot Water
Market (Lost Opportunity):	Yes
Market (Retrofit):	No

Electric Energy Impact:	No
Gas Energy Impact:	Yes
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed high-efficiency water heater.

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:
Qty = Total number of units.
ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
On-demand tankless water heater (EF>=0.95)	Commercial New Construction	0 (N/A)	0 (N/A)	9.6 (58)	0 (N/A)	0 (N/A)	0 (N/A)
On-demand tankless water heater (EF>=0.82)	Commercial New Construction	0 (N/A)	0 (N/A)	7.1 (58)	0 (N/A)	0 (N/A)	0 (N/A)
Indirect water heater (EF >= 0.82, CAE >= 85%)	Commercial New Construction	0 (N/A)	0 (N/A)	19 (73)	0 (N/A)	0 (N/A)	0 (N/A)
Condensing stand-alone water heater (75-300	Commercial New Construction	0 (N/A)	0 (N/A)	25 (58)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
On-demand tankless water heater (EF>=0.95)	Commercial New Construction	20 (58)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
On-demand tankless water heater (EF>=0.82)	Commercial New Construction	20 (58)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Indirect water heater (EF >= 0.82, CAE >= 85%)	Commercial New Construction	15 (58)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Condensing stand-alone water heater (75-300 MBH) (TE >= 0.95)	Commercial New Construction	15 (58)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

58 GDS Associates, Inc. and Summit Blue Consulting (2009). Natural Gas Energy Efficiency Potential in Massachusetts. Prepared for GasNetworks.

73 KEMA (2013). Project 25 Prescriptive Gas Program Final Evaluation Report. Prepared for Massachusetts Energy Efficiency Program Administrators; Page 1-5

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Boiler Controls

Version Date: PY 2015

Description

Boiler reset controls are devices that automatically control boiler water temperature based on outdoor temperature using a software program.

Baseline Efficiency

The baseline efficiency case is a boiler without reset controls.

High Efficiency

The high efficiency case is a boiler with reset controls.

Sector:	C&I
End Use:	HVAC
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	No
Gas Energy Impact:	Yes
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Boiler reset control installed on existing boiler.

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:
Qty = Total number of units.
ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Boiler Reset Control	Direct Install	0 (N/A)	0 (N/A)	35.5 (57)	0 (N/A)	0 (N/A)	0 (N/A)
Boiler reset control (multi-stage)	Commercial Retrofit	0 (N/A)	0 (N/A)	35.5 (58)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Boiler Reset Control	Direct Install	20 (5)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Boiler reset control (multi-stage)	Commercial Retrofit	15 (5)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

5 ACEEE (2006). Emerging Technologies Report: Advanced Boiler Controls. Prepared for ACEEE.

57 GDS Associates, Inc. (2009). Natural Gas Energy Efficiency Potential in Massachusetts. Prepared for GasNetworks

58 GDS Associates, Inc. and Summit Blue Consulting (2009). Natural Gas Energy Efficiency Potential in Massachusetts. Prepared for GasNetworks.

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Boilers

Version Date: PY 2015

Description

The installation of a high efficiency natural gas fired condensing boilers. High efficiency boilers take advantage of improved design, sealed combustion and condensing flue gases in a second heat exchanger to achieve improved efficiency. (Only condensing boilers are offered as prescriptive measures. Program incentives for other boiler types are offered through the custom program.)

Baseline Efficiency

The baseline efficiency assumes compliance with the International Energy Conservation Code (IECC) 2012. Table 19 in Appendix A details the specific efficiency requirements by equipment type and capacity.

High Efficiency

The high efficiency case assumes a gas-fired boiler that exceeds the efficiency levels required by Rhode Island State Building Code. Actual site efficiencies should be determined on a case-by-case basis.

		Electric Energy Impact:	No
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed high-efficiency condensing boiler

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

Table 19: Baseline Efficiency Requirements for C&I Gas Boilers

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Condensing boiler 500-999 MBH	Commercial New Construction	0 (N/A)	0 (N/A)	107.3 (73)	0 (N/A)	0 (N/A)	0 (N/A)
Condensing boiler 301-499 MBH	Commercial New Construction	0 (N/A)	0 (N/A)	58.4 (73)	0 (N/A)	0 (N/A)	0 (N/A)
Condensing boiler 1701+ MBH	Commercial New Construction	0 (N/A)	0 (N/A)	345.1 (73)	0 (N/A)	0 (N/A)	0 (N/A)
Condensing boiler 1000-1700 MBH	Commercial New Construction	0 (N/A)	0 (N/A)	197.2 (73)	0 (N/A)	0 (N/A)	0 (N/A)
Condensing boiler <= 300 MBH 95%	Commercial New Construction	0 (N/A)	0 (N/A)	27.8 (13)	0 (N/A)	0 (N/A)	0 (N/A)
Condensing boiler <= 300 MBH 90%	Commercial New Construction	0 (N/A)	0 (N/A)	30.6 (73)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Condensing boiler 500-999 MBH	Commercial New Construction	25 (58)	1.00 (N4)	1.00 (N43)	1 (N22)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Condensing boiler 301-499 MBH	Commercial New Construction	25 (58)	1.00 (N4)	1.00 (N43)	1 (N22)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Condensing boiler 1701+ MBH	Commercial New Construction	25 (58)	1.00 (N4)	1.00 (N43)	1 (N22)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Condensing boiler 1000-1700 MBH	Commercial New Construction	25 (58)	1.00 (N4)	1.00 (N43)	1 (N22)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Condensing boiler <= 300 MBH 95%	Commercial New Construction	25 (58)	1.00 (N4)	1.00 (N43)	1 (N22)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Condensing boiler <= 300 MBH 90%	Commercial New Construction	25 (58)	1.00 (N4)	1.00 (N43)	1 (N22)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

13 Based on the formula found in Opinion Dynamics Corporation (2007). Evaluation Study of KeySpan's Commercial and Industrial High Efficiency Heating Equipment Program. A 2012 Gas Networks decision found that boilers rated 96% AFUE were performing as 95% AFU

58 GDS Associates, Inc. and Summit Blue Consulting (2009). Natural Gas Energy Efficiency Potential in Massachusetts. Prepared for GasNetworks.

73 KEMA (2013). Project 25 Prescriptive Gas Program Final Evaluation Report. Prepared for Massachusetts Energy Efficiency Program Administrators; Page 1-5

N22 Energy realization rate is 100% because deemed savings are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Building Operator Certification

Version Date: PY 2015

Description

Class improves a building operator's ability to optimize facility gas and electricity utilization.

Baseline Efficiency

The baseline efficiency case is a building operator not attending a class on improving the efficiency of facility gas and electricity use.

High Efficiency

The high efficiency case is a building operator attending a class on improving the efficiency of facility gas and electricity use.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	Yes
		Non-Energy Impact:	Yes

Algorithm Type: Deemed

Unit: Course completion by building operator

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW
Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:
Qty = Total number of units.
ΔkWh = Average annual kWh reduction per unit.
ΔkW = Average kW reduction per unit.
ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Building operator certification	Commercial Retrofit	22273 (105)	0 (N/A)	334.1 (105)	0 (N/A)	0 (N/A)	26171 (105)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Building operator certification	Commercial Retrofit	5 (105)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

105 RLW Analytics (2005). Impact and Process Evaluation Building Operator Training and Certification (BOC) Program. Prepared for NEEP.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Condensing Unit Heater

Version Date: PY 2015

Description

The baseline efficiency case is a standard efficiency gas fired unit heater with minimum combustion efficiency of 80%, interrupted or intermittent ignition device (IID), and either power venting or an automatic flue damper.

Baseline Efficiency

The baseline efficiency case is a standard efficiency unit heater.

High Efficiency

The high efficiency case is a condensing gas unit heater with 90% AFUE or greater.

		Electric Energy Impact:	No
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed condensing unit heater.

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:
Qty = Total number of units.
ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Condensing Unit heater	Commercial New Construction	0 (N/A)	0 (N/A)	40.9 (93)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Condensing Unit heater	Commercial New Construction	18 (24)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

24 Ecotrope, Inc. (2003). Natural Gas Efficiency and Conservation Measure Resource Assessment for the Residential and Commercial Sectors. Prepared for the Energy Trust of Oregon.

93 NYSERDA Deemed Savings Database (Rev 11).

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - EW Air Sealing

Version Date: PY 2015

Description

Thermal shell air leaks are sealed through strategic use and location of air-tight materials.

Baseline Efficiency

The baseline efficiency case is the existing building before the air sealing measure is implemented. The baseline building is characterized by the existing CFM50 measurement (CFM50PRE) for single family homes, or the existing air changes per hour (ACHPRE)

High Efficiency

The high efficiency case is the existing building after the air sealing measure is implemented. The high efficiency building is characterized by the new CFM50 measurement for single family homes (CFM50POST), or the new air changes per hour (ACHPOST) for multi-family facilities, which is measured after the air sealing measure is implemented.

		Electric Energy Impact:	No
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Completed air sealing project.

Algorithm:

Gross MMBtu Gas = (CFM50_pre - CFM50_post) / LBL × HDD × 24 × 60 × 0.018 × CorrectionFactor / SeasonalEff / 1,000,000

Where:

CFM50_pre = CFM50 measurement before air sealing (cu.ft./min)

CFM50_post = CFM50 measurement after air sealing (cu.ft./min)

LBL = LBL factor **N54**

HDD = Heating degree days (deg. F-day): 6061 **131**

CorrectionFactor = Correction factor determined by auditor (e.g. for seasonal homes): Default = 1.

SeasonalEff = Heating system seasonal efficiency factor determined by auditor: Default = 0.7 for homes heated with

natural gas.

24 = Conversion: 24 hours per day

60 = Conversion: 60 minutes per hour

0.018 = Heat capacity of 1 cubic foot of air at 70 °F (Btu/ft3-°F)

1,000,000 = Conversion: 1,000,000 Btu per MMBtu

Hours

Heating hours are characterized by the heating degree days for the facility, 6061.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
MF Air Sealing	Commercial and Industrial	0 (N/A)	0 (N/A)	2.1 (127)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
MF Air Sealing	Commercial and Industrial MultiFamily	15 (55)	1.00 (N4)	1.00 (N43)	1 (N22)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

127 The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for the Massachusetts Program Administrators.

131 The Cadmus Group (2014). Impact Evaluation: Rhode Island Income Eligible Services, Volume II. Prepared for National Grid.

55 GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group.

N22 Energy realization rate is 100% because deemed savings are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

N54 The LBL Factor is determined as the product of the N-factor and a Height Correction Factor according to BPI Protoco

HVAC - EW Other Insulation

Version Date: PY 2015

Description

Insulation upgrades (other than basement, roofs, and walls) applied in existing facilities.

Baseline Efficiency

The baseline efficiency case is the existing facility or equipment prior to the implementation of additional insulation.

High Efficiency

The high efficiency case is the existing facility or equipment after the implementation of additional insulation.

Sector:	C&I
End Use:	HVAC
Market (Lost Opportunity):	No
Market (Retrofit):	Yes

Electric Energy Impact:	No
Gas Energy Impact:	Yes
Oil Energy Impact:	No
Propane Impact:	No
Water Impact:	No
Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Completed insulation project.

Algorithm:

$$Gross\ MMBtu\_Gas = Qty \times \Delta MMBtu\_Gas$$

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

Heating hours are characterized by the heating degree days for the facility, 6061.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
MF Other Insulation - Existing Hatches:	Commercial and Industrial	0 (N/A)	0 (N/A)	3.15 (127)	0 (N/A)	0 (N/A)	0 (N/A)
MF Other Insulation - attic staircase cover	Commercial and Industrial	0 (N/A)	0 (N/A)	3.15 (127)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
MF Other Insulation - Existing Hatches: weaatherstrip, insulate, dam perimeter	Commercial and Industrial MultiFamily	25 (127)	1.00 (N4)	1.00 (N43)	1 (N22)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
MF Other Insulation - attic staircase cover (therma-dome)	Commercial and Industrial MultiFamily	25 (127)	1.00 (N4)	1.00 (N43)	1 (N22)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

127 The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for the Massachusetts Program Administrators.

131 The Cadmus Group (2014). Impact Evaluation: Rhode Island Income Eligible Services, Volume II. Prepared for National Grid.

N22 Energy realization rate is 100% because deemed savings are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - EW Shell Insulation

Version Date: PY 2015

Description

Shell insulation upgrades applied in existing facilities including improved insulation in attics, basements and sidewalls.

Baseline Efficiency

The baseline efficiency case is characterized by the total R-value of the existing attic, basement or sidewall (RBASE). This is calculated as the R-value of the existing insulation, estimated by the program contractor, plus the R-value of the ceiling, flo

High Efficiency

The high efficiency case is characterized by the total R-value of the attic after the installation of additional attic, basement or sidewall insulation. This is calculated as the sum of the existing R-value (RBASE) plus the R-value of the added insulation (RADD).

		Electric Energy Impact:	No
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Engineering algorithm with site-specific inputs

Unit: Completed insulation project.

Algorithm:

Gross MMBtu Gas = SQFT × [1/R_pre - 1/(R_pre + R_add)] × HDD × 24 × CorrectionFactor × SeasonalEff / 1,000,000

Where:

SQFT = Square feet of insulation installed

R_pre = Total R-value of the existing attic, basement or sidewall (ft2-hr-°F/Btu)

R_add = R-value of the added insulation (ft2-hr-°F/Btu)

HDD = Heating degree days (deg. F-day): 6061 [131]

CorrectionFactor = Correction factor determined by auditor (e.g. for seasonal homes): Default = 1.

SeasonalEff = Heating system seasonal efficiency factor determined by auditor: Default = 0.7 for homes heated with

natural gas.
24 = Conversion: 24 hours per day
1,000,000 = Conversion: 1,000,000 Btu per MMBtu

Hours

Heating hours are characterized by the heating degree days for the facility, 6061.

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
MF Shell Insulation	Commercial and Industrial	0 (N/A)	0 (N/A)	3.15 (127)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
MF Shell Insulation	Commercial and Industrial MultiFamily	25 (127)	1.00 (N4)	1.00 (N43)	1 (N22)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

127 The Cadmus Group (2012). Massachusetts 2011 Residential Retrofit Multifamily Program Impact Analysis. Prepared for the Massachusetts Program Administrators.

131 The Cadmus Group (2014). Impact Evaluation: Rhode Island Income Eligible Services, Volume II. Prepared for National Grid.

N22 Energy realization rate is 100% because deemed savings are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Furnaces

Version Date: PY 2015

Description

The installation of a high efficiency natural gas warm air furnace with an electronically commutated motor (ECM) for the fan. High efficiency furnaces are better at converting fuel into direct heat and better insulated to reduce heat loss. ECM fan motors significantly reduce fan motor electric consumption as compared to both shaped-pole and permanent split capacitor motors.

Baseline Efficiency

The baseline efficiency case is a 90% AFUE furnace in the <150 kBTuh size category.

High Efficiency

The high efficiency case is a new furnace with AFUE >= 95% and an electronically commutated motor.

		Electric Energy Impact:	Yes
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed high-efficiency warm air furnace with ECM fan motor

Algorithm:

Gross kWh = Qty × ΔkWh
Gross kW = Qty × ΔkW
Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:
Qty = Total number of units.
ΔkWh = Average annual kWh reduction per unit.
ΔkW = Average kW reduction per unit.
ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

Table 20: Baseline Efficiency Requirements for C&I Gas Furnaces

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Furnace 97+ AFUE (<150) w/ECM Motor	Commercial New Construction	168 (26)	0.124 (26)	9.9 (73)	0 (N/A)	0 (N/A)	0 (N/A)
Furnace 95+ AFUE (<150) w/ECM Motor	Commercial New Construction	168 (26)	0.124 (26)	9 (73)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Furnace 97+ AFUE (<150) w/ECM Motor	Commercial New Construction	18 (58)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N38)	1 (N38)	0 (26)	0.16 (26)
Furnace 95+ AFUE (<150) w/ECM Motor	Commercial New Construction	18 (58)	1.00 (N4)	1.00 (N43)	1 (N35)	1 (N38)	1 (N38)	0 (26)	0.16 (26)

Sources

26 Energy & Resource Solutions (2011). BFM Impact Evaluation Report. Prepared for the Electric and Gas Program Administrators of Massachusetts.

58 GDS Associates, Inc. and Summit Blue Consulting (2009). Natural Gas Energy Efficiency Potential in Massachusetts. Prepared for GasNetworks.

73 KEMA (2013). Project 25 Prescriptive Gas Program Final Evaluation Report. Prepared for Massachusetts Energy Efficiency Program Administrators; Page 1-5

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Heating System Replacement

Version Date: PY 2015

Description

Replacement of an existing gas heating system with a new high efficiency system. Electric savings are achieved from reduced run time of the heating system fan(s).

Baseline Efficiency

The baseline case is the existing heating system.

High Efficiency

The high efficiency case is the new efficient heating equipment.

		Electric Energy Impact:	No
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed high-efficiency natural gas heating system.

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
MF Heating System Replacement	Commercial and Industrial	0 (N/A)	0 (N/A)	Calc (N/A)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
MF Heating System Replacement	Commercial and Industrial MultiFamily	18 (147)	1.00 (N4)	1.00 (N43)	1 (N52)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

147 Environmental Protection Agency (2009). Life Cycle Cost Estimate for ENERGY STAR Furnace.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

N52 Energy realization rate is 100% because deemed savings are based on vendor calculations.

HVAC - Infrared Heater

Version Date: PY 2015

Description

The installation of a gas-fired low intensity infrared heating system in place of a unit heater, furnace, or other standard efficiency equipment. Infrared heating uses radiant heat as opposed to warm air to heat buildings. In commercial environments with high air exchange rates, heat loss is minimal because the space's heat comes from surfaces rather than air.

Baseline Efficiency

The baseline efficiency case is a standard efficiency gas-fired unit heater with combustion efficiency of 80%.

High Efficiency

The high efficiency case is a gas-fired low-intensity infrared heating unit.

		Electric Energy Impact:	No
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed infrared heater

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Infrared heater	Commercial New Construction	0 (N/A)	0 (N/A)	12 (73)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Infrared heater	Commercial New Construction	17 (79)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

73 KEMA (2013). Project 25 Prescriptive Gas Program Final Evaluation Report. Prepared for Massachusetts Energy Efficiency Program Administrators; Page 1-5

79 Nexant (2006). DSM Market Characterization Report. Prepared for Questar Gas.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Integrated Boiler/Water Heater

Version Date: PY 2015

Description

This measure promotes the installation of a combined high-efficiency boiler and water heating unit. Combined boiler and water heating systems are more efficient than separate systems because they eliminate the standby heat losses of an additional tank.

Baseline Efficiency

The baseline efficiency case is an 80% AFUE boiler with a 0.594 EF water heater.

High Efficiency

The high efficiency case is a condensing, integrated water heater/boiler with an AFUE >= 90%.

		Electric Energy Impact:	No
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	Yes	**Propane Impact:**	No
Market (Retrofit):	No	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed high efficiency integrated boiler/water heater unit.

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Integrated water heater/condensing boiler	Commercial New Construction	0 (N/A)	0 (N/A)	24.6 (58)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Integrated water heater/condensing boiler (EF 0.90; AFUE 90%)	Commercial New Construction	20 (11)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

11 ASHRAE Applications Handbook (2003); Page 36.3, assumes combined boiler and water heating systems have a measure life similar to a typical boiler.

58 GDS Associates, Inc. and Summit Blue Consulting (2009). Natural Gas Energy Efficiency Potential in Massachusetts. Prepared for GasNetworks.

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

HVAC - Programmable Thermostats

Version Date: PY 2015

Description

Installation of programmable thermostats with the ability to adjust heating or air-conditioning operating times according to a pre-set schedule to meet occupancy needs and minimize redundant HVAC operation.

Baseline Efficiency

The baseline efficiency case is an HVAC system using natural gas to provide space heating without a programmable thermostat.

High Efficiency

The high efficiency case is an HVAC system using natural gas to provide space heating with a programmable thermostat installed.

		Electric Energy Impact:	No
Sector:	C&I	**Gas Energy Impact:**	Yes
End Use:	HVAC	**Oil Energy Impact:**	No
Market (Lost Opportunity):	No	**Propane Impact:**	No
Market (Retrofit):	Yes	**Water Impact:**	No
		Non-Energy Impact:	No

Algorithm Type: Deemed

Unit: Installed programmable thermostat

Algorithm:

Gross MMBtu_Gas = Qty × ΔMMBtu_Gas

Where:

Qty = Total number of units.

ΔMMBtu_Gas = Average annual natural gas reduction per unit.

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
Programmable thermostat	Direct Install	0 (N/A)	0 (N/A)	7.7 (109)	0 (N/A)	0 (N/A)	0 (N/A)
Programmable thermostat	Commercial Retrofit	0 (N/A)	0 (N/A)	7.7 (109)	0 (N/A)	0 (N/A)	0 (N/A)

Non-Energy Impacts

There are no non-energy impacts for this measure category.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
Programmable thermostat	Direct Install	15 (39)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Programmable thermostat	Commercial Retrofit	15 (39)	1.00 (N4)	1.00 (N43)	1 (N35)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

109 RLW Analytics (2007). Validating the Impacts of Programmable Thermostats. Prepared for GasNetworks; Page 2. Conversion factor for CCF to therms is 1.024.

39 Environmental Protection Agency (2010). Life Cycle Cost Estimate for Programmable Thermostats. Accessed on 10/12/2011.

N35 Realization rate is 100% since gross savings values are based on evaluation results.

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Multiple - Custom Measures

Version Date: PY 2015

Description

The Custom project track is offered for energy efficiency projects involving complex site-specific applications that require detailed engineering analysis and/or projects which do not qualify for incentives under any of the prescriptive rebate offering. Projects offered through the custom approach must pass a cost-effectiveness test based on project-specific costs and savings.

Baseline Efficiency

For Lost Opportunity projects, the baseline efficiency case assumes compliance with the efficiency requirements as mandated by Rhode Island State Building Code or industry accepted standard practice. For retrofit projects, the baseline efficiency case is

High Efficiency

The high efficiency case is specific to the custom project and may include one or more energy efficiency measures. Energy and demand savings calculations are based on projected or measured changes in equipment efficiencies and operating characteristics and are determined on a case-by-case basis. The project must be proven cost-effective in order to qualify for energy efficiency incentives.

Sector:	C&I
End Use:	Multiple
Market (Lost Opportunity):	Yes
Market (Retrofit):	Yes

Electric Energy Impact:	Yes
Gas Energy Impact:	Yes
Oil Energy Impact:	Yes
Propane Impact:	No
Water Impact:	Yes
Non-Energy Impact:	No

Algorithm Type: Custom

Unit: Installed custom efficiency application.

Algorithm:

Gross energy and demand savings estimates for custom projects are calculated with engineering analyses of project-specific details. The analyses also include an evaluation of the project's cost-effectiveness.

Gross Summer kW = ΔkW_sp_custom
Gross Winter kW = ΔkW_wp_custom
Gross MMBtu Gas = ΔMMBtu_Gas_custom
Gross MMBtu Oil = ΔMMBtu_Oil_custom

Hours

N/A

Reference Tables

N/A

Measure Gross Savings per Unit (Sources)

Measure	Program	kWh	kW	Gas MMBtu	Oil MMBtu	Propane MMBtu	Water Gallons
SBS Custom Measures	Direct Install	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	Calc (N/A)
Custom Retrofit	Commercial Retrofit	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	Calc (N/A)
Custom New Construction	Commercial New Construction	Calc (N/A)	Calc (N/A)	Calc (N/A)	Calc (N/A)	0 (N/A)	Calc (N/A)

Non-Energy Impacts

See Appendix C: Non-Energy Impacts.

Impact Factors For Calculating Adjusted Gross Savings (Sources)

Measure	Program	Measure Life	ISR	SPF	RRe	RRsp	RRwp	CFsp	CFwp
SBS Custom Measures	Direct Install	mult (N/A)	1.00 (N4)	1.00 (N43)	1 (N38)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Custom Retrofit	Commercial Retrofit	mult (N/A)	1.00 (N4)	1.00 (N43)	0.755 (68)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)
Custom New Construction	Commercial New Construction	mult (N/A)	1.00 (N4)	1.00 (N43)	0.755 (68)	N/A (N/A)	N/A (N/A)	N/A (N/A)	N/A (N/A)

Sources

68 KEMA (2011). Impact Evaluation of C&I Custom Gas Installations. Prepared for National Grid.

N38 Realization rate is assumed to be 100%

N4 All installations have 100% in-service rate since programs include verification of equipment installations.

N43 Savings persistence is assumed to be 100%.

Table 1: Lighting Power Densities Using the Building Area Method ($WATTS_{b,i}$)

Building Area Type	Lighting Power Density (W/ft^2) [1]
Automotive Facility	0.9
Convention Center	1.2
Court House	1.2
Dining: Bar Lounge/Leisure	1.3
Dining: Cafeteria/Fast Food	1.4
Dining: Family	1.6
Dormitory	1.0
Fire Stations	0.8
Exercise Center	1.0
Gymnasium	1.1
Healthcare-Clinic	1.0
Hospital	1.2
Hotel	1.0
Library	1.3
Manufacturing Facility	1.3
Motel	1.0
Motion Picture Theatre	1.2
Multi-Family	0.7
Museum	1.1
Office	0.9
Parking Garage	0.3
Penitentiary	1.0
Performing Arts Theatre	1.6
Police/Fire Station	1.0
Post Office	1.1
Religious Building	1.3
Retail	1.4
School/University	1.2
Sports Arena	1.1
Town Hall	1.1
Transportation	1.0
Warehouse	0.6
Workshop	1.4

Table 2: Lighting Power Densities Using the Space-by-Space Method ($WATTS_{b,i}$)

Common Space Types	Lighting Power Density (W/ft^2)[2]
Atrium – First 40 feet in height	0.03 per ft. ht.
Atrium – Above 40 feet in height	0.02 per ft. ht.
Audience/seating	

[1] IECC 2012
[2] IECC 2012

For Auditorium	0.9
For performing arts theater	2.6
For motion picture theater	1.2
Classroom/lecture/training	1.30
Conference/meeting/multipurpose	1.2
Corridor/transition	0.7
Dining Area	0.9
Bar/lounge/leisure dining	1.40
Family dining area	1.40
Dressing/fitting room performing arts theater	1.1
Electrical/mechanical	1.10
Food preparation	1.20
Laboratory for classrooms	1.3
Laboratory for medical/industrial/research	1.8
Lobby	1.10
Lobby for performing arts theater	3.3
Lobby for motion picture theater	1.0
Locker room	0.80
Lounge/Recreation	0.8
Office - enclosed	1.1
Office – open plan	1.0
Restroom	1.0
Sales area	1.6
Stairway	0.70
Storage	0.8
Workshop	1.60
Courthouse/police station/penitentiary	
Courtroom	1.90
Confinement cells	1.1
Judge Chambers	1.30
Penitentiary audience seating	0.5
Penitentiary classroom	1.3
Penitentiary dining	1.1
BUILDING SPECIFIC SPACE-BY-SPACE TYPES	
Automotive – service/repair	0.70
Bank/office – banking activity area	1.5
Dormitory living quarters	1.10
Gymnasium/fitness center	
Fitness area	0.9
Gymnasium audience/seating	0.40
Playing area	1.40
COMMON SPACE-BY-SPACE TYPES	1.4
Healthcare clinic/hospital	
Corridors/transition	1.00
Exam/treatment	1.70
Emergency	0.80
Public and staff lounge	0.80
Medical Supplies	1.40

Nursery	0.9
Nurse Station	1.00
Physical Therapy	0.9
Patient room	0.70
Pharmacy	1.20
Radiology/imaging	1.3
Operating room	2.20
Recovery	1.2
Lounge Recreation	0.8
Laundry – washing	0.60
Hotel	
Dining area	1.30
Guest rooms	1.10
Hotel lobby	2.10
Highway lodging dining	1.20
Highway lodging guest rooms	1.10
Library	
Stacks	1.70
Card File and cataloguing	1.10
Reading area	1.20
Manufacturing	
Corridors/transition	0.40
Detailed Manufacturing	1.3
Equipment Room	1.0
Extra high bay (> 50-foot floor-ceiling height)	1.1
High bay (25 – 50-foot floor-ceiling height)	1.20
Low bay (< 25-foot floor-ceiling height)	1.20
Museum	
General Exhibition	1.00
Restoration	1.70
Parking Garage – garage areas	0.2
Convention Center	
Exhibit space	1.50
Audience/seating area	0.90
Fire Stations	
Engine Room	0.80
Sleeping quarters	0.30
Post Office	
Sorting area	0.90
Religious building	
Fellowship hall	0.60
Audience seating	2.40
Worship pulpit/choir	2.40
Retail	
Dressing/fitting area	0.9
Mall concourse	1.6
Sales area	1.6
BUILDING SPECIFIC SPACE-BY-SPACE TYPES	

Sports arena	
Audience seating	0.4
Court sports area – Class 4	0.7
Court sports area – Class 3	1.2
Court sports area – Class 2	1.9
Court sports area – Class 1	3.0
Ring sports area	2.7
Transportation	
Air/train/bus baggage area	1.00
Airport concourse	0.60
Terminal – ticket counter	1.50
Warehouse	
Fine material storage	1.40
Medium/bulky material	0.60

Table 3: New Construction Proposed Lighting Wattage Table

Device Code	Device Description	Rated Watts
LED Exit Signs		
1E0002	2.0 WATT LED	2
1E0003	3.0 WATT LED	3
1E0005	5.0 WLED	5
1E0005C	0.5 WATT LEC	0.5
1E0008	8.0 WLED	8
1E0015	1.5 WATT LED	1.5
1E0105	10.5 WATT LED	10.5
Compact Fluorescents (CFL's)		
2C0007S	2/7W COMPACT HW	18
1C0005S	5W COMPACT HW	7
1C0007S	7W COMPACT HW	9
1C0009S	9W COMPACT HW	11
1C0011S	11W COMPACT HW	13
1C0013S	13W COMPACT HW	15
1C0018E	18W COMPACT HW ELIG	20
1C0018S	18W COMPACT HW	20
1C0022S	22W COMPACT HW	24
1C0023E	1/23W COMPACT HW ELIG	25
1C0026E	26W COMPACT HW ELIG	28
1C0026S	26W COMPACT HW	28
1C0028S	28W COMPACT HW	30
1C0032E	32W COMPACT HW ELIG	34
1C0032S	32W CIRCLINE HW	34
1C0042E	1/42W COMPACT HW ELIG	48
1C0044S	44W CIRCLINE HW	46
1C0057E	1/57W COMPACT HW ELIG	65
1C2232S	22/32W CIRCLINE HW	58
1C2D10E	10W 2D COMPACT HW ELIG	12
1C2D16E	16W 2D COMPACT HW ELIG	18
1C2D21E	21W 2D COMPACT HW ELIG	22
1C2D28E	28W 2D COMPACT HW ELIG	28
1C2D38E	38W 2D COMP.HW ELIG	36
1C3240S	32/40W CIRCLINE HW	80
2C0005S	2/5W COMPACT HW	14
2C0009S	2/9W COMPACT HW	22
2C0011S	2/11W COMPACT HW	26
2C0013E	2/13W COMPACT HW ELIG	28
2C0013S	2/13W COMPACT HW	30
2C0018E	2/18W COMP. HW ELIG	40
2C0026E	2/26W COMP. HW ELIG	54
2C0032E	2/32W COMPACT HW ELIG	68
Device Code	**Device Description**	**Rated Watts**
Compact Fluorescents (CFL's) (cont)		
2C0042E	2/42W COMPACT HW ELIG	100
3C0009S	3/9W COMPACT HW	33
3C0013S	3/13W COMPACT HW	45
3C0018E	3/18W COMPACT HW ELIG	60
3C0026E	3/26W COMPACT HW ELIG	82
3C0032E	3/32W COMPACT HW ELIG	114
3C0042E	3/42W COMPACT HW ELIG	141
4C0018E	4/18W COMPACT HW ELIG	80
4C0026E	4/26W COMPACT HW ELIG	108
4C0032E	4/32W COMPACT HW ELIG	152
4C0042E	4/42W COMPACT HW ELIG	188
6C0026E	6/26W COMPACT HW ELIG	162
6C0032E	6/32W COMPACT HW ELIG	228

6C0042E	6/42W COMPACT HW ELIG	282
8C0026E	8/26W COMPACT HW ELIG	216
8C0032E	8/32W COMPACT HW ELIG	304
8C0042E	8/42W COMPACT HW ELIG	376
T5 Systems		
1F14SSE	1L2’ 14W T5/ELIG	16
2F14SSE	2L2’ 14W T5/ELIG	32
3F14SSE	3L2’ 14W T5/ELIG	50
4F14SSE	4L2’ 14W T5/ELIG	68
1F24HSE	1L2’ 24W T5HO/ELIG	29
2F24HSE	2L2’ 24W T5HO/ELIG	52
3F24HSE	3L2’ 24W T5HO/ELIG	80
1F21SSE	1L3' 21W T5/ELIG	24
2F21SSE	2L3' 21W T5/ELIG	47
1F39HSE	1L3' 39W T5HO/ELIG	42
2F39HSE	2L3' 39W T5HO/ELIG	85
1F28SSE	1L4' 28W T5/ELIG	32
2F28SSE	2L4' 28W T5/ELIG	63
3F28SSE	3L4' 28W T5/ELIG	95
4F28SSE	4L4' 28W T5/ELIG	126
6F28SSE	6L4' 28W T5/ELIG	189
1F47HSE	1L4' 47W T5HO/ELIG	53
2F47HSE	2L4' 47W T5HO/ELIG	103
3F47HSE	3L4' 47W T5HO/ELIG	157
4F47HSE	4L4' 47W T5HO/ELIG	200
5F47HSE	5L4' 47W T5HO/ELIG	260
6F47HSE	6L4' 47W T5HO/ELIG	303
1F50HSE	1L4' 50W T5HO/ELIG	58
2F50HSE	2L4' 50W T5HO/ELIG	110

Device Code	**Device Description**	**Rated Watts**
	T5 Systems (cont.)	
3F50HSE	3L4' 50W T5HO/ELIG	168
4F50HSE	4L4' 50W T5HO/ELIG	215
5F50HSE	5L4' 50W T5HO/ELIG	278
6F50HSE	6L4' 50W T5HO/ELIG	325
1F54HSE	1L4' 54W T5HO/ELIG	59
2F54HSE	2L4' 54W T5HO/ELIG	117
3F54HSE	3L4' 54W T5HO/ELIG	177
4F54HSE	4L4’ 54W T5HO/ELIG	234
5F54HSE	5L4' 54W T5HO/ELIG	294
6F54HSE	6L4’ 54W T5HO/ELIG	351
8F54HSE	8L4' 54W T5HO/ELIG	468
10F54HSE	10L4’ 54W T5HO/ELIG	585
Two Foot High Efficient T8 Systems		
1F17ESL	1L2' 17W T8EE/ELEE LOW PWR	14
1F17ESN	1L2' 17W T8EE/ELEE	17
1F17ESH	1L2' 17W T8EE/ELEE HIGH PWR	20
1F28BXE	1L2' F28BX/ELIG	32
2F17ESL	2L2' 17W T8EE/ELEE LOW PWR	27
2F17ESN	2L2' 17W T8EE/ELEE	32
2F17ESH	2L2' 17W T8EE/ELEE HIGH PWR	40
2F28BXE	2L2' F28BX/ELIG	63
3F17ESL	3L2' 17W T8EE/ELEE LOW PWR	39
3F17ESN	3L2' 17W T8EE/ELEE	46
3F17ESH	3L2' 17W T8EE/ELEE HIGH PWR	61
3F28BXE	3L2' F28BX/ELIG	94
Three Foot High Efficient T8 Systems		
1F25ESL	1L3' 25W T8EE/ELEE LOW PWR	21
1F25ESN	1L3' 25W T8EE/ELEE	24
1F25ESH	1L3' 25W T8EE/ELEE HIGH PWR	30
2F25ESL	2L3' 25W T8EE/ELEE LOW PWR	40
2F25ESN	2L3' 25W T8EE/ELEE	45
2F25ESH	2L3' 25W T8EE/ELEE HIGH PWR	60
3F25ESL	3L3' 25W T8EE/ELEE LOW PWR	58
3F25ESN	3L3' 25W T8EE/ELEE	67
3F25ESH	3L3' 25W T8EE/ELEE HIGH PWR	90

Device Code	**Device Description**	**Rated Watts**
Four Foot T8 High Efficient / Reduce Wattage Systems		
1F25EEH	1L4' 25W T8EE/ELEE HIGH PWR	30
1F25EEE	1L4' 25W T8EE/ELEE	22
1F25EEL	1L4' 25W T8EE/ELEE LOW PWR	19
2F25EEH	2L4' 25W T8EE/ELEE HIGH PWR	57
2F25EEE	2L4' 25W T8EE/ELEE	43
2F25EEL	2L4' 25W T8EE/ELEE LOW PWR	37
3F25EEH	3L4' 25W T8EE/ELEE HIGH PWR	86
3F25EEE	3L4' 25W T8EE/ELEE	64
3F25EEL	3L4' 25W T8EE/ELEE LOW PWR	57
4F25EEH	4L4' 25W T8EE/ELEE HIGH PWR	111

4F25EEE	4L4' 25W T8EE/ELEE	86
4F25EEL	4L4' 25W T8EE/ELEE LOW PWR	75
1F28EEH	1L4' 28W T8EE/ELEE HIGH PWR	33
1F28EEE	1L4' 28W T8EE/ELEE	24
1F28EEL	1L4' 28W T8EE/ELEE LOW PWR	22
2F28EEH	2L4' 28WT8EE/ELEE HIGH PWR	64
2F28EEE	2L4' 28W T8EE/ELEE	48
2F28EEL	2L4' 28W T8EE/ELEE LOW PWR	42
3F28EEH	3L4' 28W T8EE/ELEE HIGH PWR	96
3F28EEE	3L4' 28W T8EE/ELEE	72
3F28EEL	3L4' 28W T8EE/ELEE LOW PWR	63
4F28EEH	4L4' 28W T8EE/ELEE HIGH PWR	126
4F28EEE	4L4' 28W T8EE/ELEE	94
4F28EEL	4L4' 28W T8EE/ELEE LOW PWR	83
1F30EEH	1L4' 30W T8EE/ELEE HIGH PWR	36
1F30EEE	1L4' 30W T8EE/ELEE	26
1F30EEL	1L4' 30W T8EE/ELEE LOW PWR	24
2F30EEH	2L4' 30WT8EE/ELEE HIGH PWR	69
2F30EEE	2L4' 30W T8EE/ELEE	52
2F30EEL	2L4' 30W T8EE/ELEE LOW PWR	45
3F30EEH	3L4' 30W T8EE/ELEE HIGH PWR	103
3F30EEE	3L4' 30W T8EE/ELEE	77
3F30EEL	3L4' 30W T8EE/ELEE LOW PWR	68
Device Code	**Device Description**	**Rated Watts**
Four Foot T8 High Efficient / Reduce Wattage Systems (cont.)		
4F30EEH	4L4' 30W T8EE/ELEE HIGH PWR	133
4F30EEE	4L4' 30W T8EE/ELEE	101
4F30EEL	4L4' 30W T8EE/ELEE LOW PWR	89
1F32EEH	1L4' 32W T8EE/ELEE HIGH PWR	38
1F32EEE	1L4' 32W T8EE/ELEE	28
1F32EEL	1L4' 32W T8EE/ELEE LOW PWR	25
2F32EEH	2L4' 32W T8EE/ELEE HIGH PWR	73
2F32EEE	2L4' 32W T8EE/ELEE	53
2F32EEL	2L4' 32W T8EE/ELEE LOW PWR	47
3F32EEH	3L4' 32W T8EE/ELEE HIGH	109

	PWR	
3F32EEE	3L4' 32W T8EE/ELEE	82
3F32EEL	3L4' 32W T8EE/ELEE LOW PWR	72
4F32EEH	4L4' 32W T8EE/ELEE HIGH PWR	141
4F32EEE	4L4' 32W T8EE/ELEE	107
4F32EEL	4L4' 32W T8EE/ELEE LOW PWR	95
6F32EEH	6L4' 32W T8EE/ELEE HIGH PWR	218
6F32EEE	6L4' 32W T8EE/ELEE	168
6F32EEL	6L4' 32W T8EE/ELEE LOW PWR	146
Eight Foot T8 Systems		
1F59SSE	1L8' T8/ELIG	60
1F80SSE	1L8' T8 HO/ELIG	85
2F59SSE	2L8' T8/ELIG	109
2F59SSL	2L8' T8/ELIG LOW PWR	100
2F80SSE	2L8' T8 HO/ELIG	160
LED Lighting Fixtures		
1L002	2 WATT LED	2
1L003	3 WATT LED	3
1L004	4 WATT LED	04
1L005	5 WATT LED	05
1L006	6 WATT LED	06
1L007	7 WATT LED	07
1L008	8 WATT LED	08
1L009	9 WATT LED	09
1L010	10 WATT LED	10
1L011	11 WATT LED	11
1L012	12 WATT LED	12
Device Code	**Device Description**	**Rated Watts**
LED Lighting Fixtures (cont.)		
1L013	13 WATT LED	13
1L014	14 WATT LED	14
1L015	15 WATT LED	15
1L016	16 WATT LED	16
1L017	17 WATT LED	17
1L018	18 WATT LED	18
1L019	19 WATT LED	19
1L020	20 WATT LED	20
1L021	21 WATT LED	21
1L022	22 WATT LED	22
1L023	23 WATT LED	23
1L024	24 WATT LED	24
1L025	25 WATT LED	25

1L026	26 WATT LED	26
1L027	27 WATT LED	27
1L028	28 WATT LED	28
1L029	29 WATT LED	29
1L030	30 WATT LED	30
1L031	31 WATT LED	31
1L032	32 WATT LED	32
1L033	33 WATT LED	33
1L034	34 WATT LED	34
1L035	35 WATT LED	35
1L036	36 WATT LED	36
1L037	37 WATT LED	37
1L038	38 WATT LED	38
1L039	39 WATT LED	39
1L040	40 WATT LED	40
1L041	41 WATT LED	41
1L042	42 WATT LED	42
1L043	43 WATT LED	43
1L044	44 WATT LED	44
1L045	45 WATT LED	45
1L046	46 WATT LED	46
1L047	47 WATT LED	47
1L048	48 WATT LED	48
1L049	49 WATT LED	49
1L050	50 WATT LED	50
1L055	55 WATT LED	55
1L060	60 WATT LED	60
1L070	70 WATT LED	70
1L073	73 WATT LED	73
1L075	75 WATT LED	75
1L080	90 WATT LED	90
1L085	85 WATT LED	85
1L090	90 WATT LED	90
Device Code	**Device Description**	**Device Code**
LED Lighting Fixtures (cont.)		
1L095	95 WATT LED	95
1L100	100 WATT LED	100
1L106	106 WATT LED	106
1L107	107 WATT LED	107
1L116	116 WATT LED	116
1L120	120 WATT LED	120
1L125	125 WATT LED	125
1L130	130 WATT LED	130
1L135	135 WATT LED	135
1L140	140 WATT LED	140
1L145	145 WATT LED	145
1L150	150 WATT LED	150
1L155	155 WATT LED	155
1L160	160 WATT LED	160
1L165	165 WATT LED	165
1L170	170 WATT LED	170
1L175	175 WATT LED	175
1L180	180 WATT LED	180
1L185	185 WATT LED	185
1L190	190 WATT LED	190
1L200	200 WATT LED	200

Device Code	Device Description	Device Code
LED Lighting Fixtures (cont.)		
1L210	210 WATT LED	210
1L220	220 WATT LED	220
1L240	240 WATT LED	240
Electronic Metal Halide Lamps		
1M0150E	150W METAL HALIDE EB	160
1M0200E	200W METAL HALIDE EB	215
1M0250E	250W METAL HALIDE EB	270
1M0320E	320W METAL HALIDE EB	345
1M0350E	350W METAL HALIDE EB	375
1M0400E	400W METAL HALIDE EB	430
1M0450E	400W METAL HALIDE EB	480
MH Track Lighting		
1M0020E	20W MH SPOT	25
1M0025E	25W MH SPOT	25
1M0035E	35W MH SPOT	44
1M0039E	39W MH SPOT	47
1M0050E	50W MH SPOT	60
1M0070E	70W MH SPOT	80
1M0100E	100W MH SPOT	111
1M0150E	150W MH SPOT	162

Table 4: Retrofit Existing Lighting Wattage Tables

Device Code	Device Description	Rated Watts
Incandescent Lamps		
1I0015	15W INC	15
1I0020	20W INC	20
1I0025	25W INC	25
1I0034	34W INC	34
1I0036	36W INC	36
1I0040	40W INC	40
1I0042	42W INC	42
1I0045	45W INC	45
1I0050	50W INC	50
1I0052	52W INC	52
1I0054	54W INC	54
1I0055	55W INC	55
1I0060	60W INC	60
1I0065	65W INC	65
1I0067	67W INC	67
1I0069	69W INC	69
1I0072	72W INC	72
1I0075	75W INC	75
1I0080	80W INC	80
1I0085	85W INC	85
1I0090	90W INC	90
1I0093	93W INC	93
1I0100	100W INC	100
1I0120	120W INC	120
1I0125	125W INC	125
1I0135	135W INC	135
1I0150	150W INC	150
1I0200	200W INC	200
1I0300	300W INC	300
1I0448	448W INC	448
1I0500	500W INC	500
1I0750	750W INC	750
1I1000	1000W INC	1000
1I1500	1500W INC	1500
Low Voltage Halogen Fixture (includes Transformer)		
1R0020	20W LV HALOGEN FIXT	30
1R0025	25W LV HALOGEN FIXT	35
1R0035	35W LV HALOGEN FIXT	45
1R0042	42W LV HALOGEN FIXT	52
1R0050	50W LV HALOGEN FIXT	60

Device Code	Device Description	Rated Watts
1R0065	65W LV HALOGEN FIXT	75
Low Voltage Halogen Fixture (includes Transformer) (cont.)		
1R0075	75W LV HALOGEN FIXT	85
Halogen/Quartz Lamps		
1T0035	35W HALOGEN LAMP	35
1T0040	40W HALOGEN LAMP	40
1T0042	42W HALOGEN LAMP	42
1T0045	45W HALOGEN LAMP	45
1T0047	47W HALOGEN LAMP	47
1T0050	50W HALOGEN LAMP	50
1T0052	52W HALOGEN LAMP	52
1T0055	55W HALOGEN LAMP	55
1T0060	60W HALOGEN LAMP	60
1T0072	72W HALOGEN LAMP	72
1T0075	75W HALOGEN LAMP	75
1T0090	90W HALOGEN LAMP	90
1T0100	100W HALOGEN LAMP	100
1T0150	150W HALOGEN LAMP	150
1T0200	200W HALOGEN LAMP	200
1T0250	250W HALOGEN LAMP	250
1T0300	300W HALOGEN LAMP	300
1T0350	350W HALOGEN LAMP	350
1T0400	400W HALOGEN LAMP	400
1T0425	425W HALOGEN LAMP	425
1T0500	500W HALOGEN LAMP	500
1T0750	750W HALOGEN LAMP	750
1T0900	900W HALOGEN LAMP	900
1T1000	1000W HALOGEN LAMP	1000
1T1200	1200W HALOGEN LAMP	1200
1T1500	1500W HALOGEN LAMP	1500
Mercury Vapor (MV)		
1V0040S	40W MERCURY	50
1V0050S	50W MERCURY	75
1V0075S	75W MERCURY	95
1V0100S	100W MERCURY	120
1V0175S	175W MERCURY	205
1V0250S	250W MERCURY	290
1V0400S	400W MERCURY	455
1V0700S	700W MERCURY	775
1V1000S	1000W MERCURY	1075

2V0400S	2/400W MERCURY	880
Device Code	**Device Description**	**Rated Watts**
Low Pressure Sodium (LPS)		
1L0035S	35W LPS	60
1L0055S	55W LPS	85
1L0090S	90W LPS	130
1L0135S	135W LPS	180
1L0180S	180W LPS	230
High Pressure Sodium (HPS)		
1H0035S	35W HPS	45
1H0050S	50W HPS	65
1H0070S	70W HPS	90
1H0100S	100W HPS	130
1H0150S	150W HPS	190
1H0200S	200W HPS	240
1H0225S	225W HPS	275
1H0250S	250W HPS	295
1H0310S	310W HPS	350
1H0360S	360W HPS	435
1H0400S	400W HPS	460
1H0600S	600W HPS	675
1H0750S	750W HPS	835
1H1000S	1000W HPS	1085
Metal Halide (MH)		
1M0032S	32W METAL HALIDE	40
1M0050S	50W METAL HALIDE	65
1M0070S	70W METAL HALIDE	95
1M0100S	100W METAL HALIDE	120
1M0150S	150W METAL HALIDE	190
1M0175S	175W METAL HALIDE	205
1M0250S	250W METAL HALIDE	295
1M0360S	360W METAL HALIDE	430
1M0400S	400W METAL HALIDE	455
1M0750S	750W METAL HALIDE	825
1M1000S	1000W METAL HALIDE	1075
1M1500S	1500W METAL HALIDE	1615
1M1800S	1800W METAL HALIDE	1875
Pulse Start Metal Halide Lamp/Ballast		
1M0100P	100W MH CWA	128
1M0100R	100W MH LINEAR	118
1M0150P	150W MH CWA	190
1M0150R	150W MH LINEAR	172
1M0175P	175W MH CWA	208
1M0175R	175W MH LINEAR	190
1M0200P	200W MH CWA	232
Device Code	**Device Description**	**Rated Watts**
Pulse Start Metal Halide Lamp/Ballast (cont.)		
1M0200R	200W MH LINEAR	218
1M0250P	250W MH CWA	288
1M0250R	250W MH LINEAR	265
1M0300P	300W MH CWA	342
1M0300R	300W MH LINEAR	324
1M0320P	320W MH CWA	365
1M0320R	320W MH LINEAR	345
1M0350P	350W MH CWA	400
1M0350R	350W MH LINEAR	375
1M0400P	400W MH CWA	455
1M0400R	400W MH LINEAR	430
1M0450P	450W MH CWA	508
1M0450R	450W MH LINEAR	480
1M0750P	750W MH CWA	815
1M0750R	750W MH LINEAR	805
1M0875P	875W MH CWA	950
1M0875R	875W MH LINEAR	927
1M1000P	1000W MH CWA	1080
Two Foot T8 / T12 Systems		
1F20SSS	F20T12/HPF(1)	32
1F80BXE	1L2' F80BXE/ELIG	90
1F55BXE	1L2' F55BX/ELIG	56
2F17SSE	2L2' 17W T8/ELIG	37
2F17SSL	2L2' 17W T8/ELIG LOW POWER	27
2F17SSM	2L2' 17W T8/EEMAG	45
2F20SSS	F20T12/HPF(2)	56
2F24HSS	2L2' 24 T12HO/STD/STD	85
2F40BXE	2L2' F40BX/ELIG	72
2F50BXE	2L2' F50BX/ELIG	108
2F55BXE	2L2'55BXE/ELIG	112
3F17SSE	3L2' 17W T8/ELIG	53
3F17SSL	3L2' 17W T8/ELIG LOW POWER	39
3F20SSS	F20T12/HPF(3)	78
3F40BXE	3L2' F40BX/ELIG	102
3F50BXE	3L2' F50BX/ELIG	162
3F55BXE	3L2' F55BX/ELIG	168
4F17SSE	4L2' 17W T8/ELIG	62
4F36BXE	4L2' F36BX/ELIG	148
4F40BXE	4L2' F40BX/ELIG	144
4F40BXH	4L 40W T5 (Std.) HIGH LMN	170
4F50BXE	4L2' F50BX/ELIG	216

4F55BXE	4L2' F55BX/ELIG	224
5F40BXE	5L2' F40BX/ELIG	190
Device Code	**Device Description**	**Rated Watts**
Two Foot T8 / T12 Systems (cont.)		
5F50BXE	5L2' F50BX/ELIG	270
5F55BXE	5L2' F55BX/ELIG	280
6F36BXE	6L2' F36BX/ELIG	212
6F40BXE	6L2' F40BX/ELIG	204
6F50BXE	6L2' F50BX/ELIG	324
6F55BXE	6L2' F55BX/ELIG	336
8F36BXE	8L2' F36BX/ELIG	296
8F40BXE	8L2' F40BX/ELIG	288
8F50BXE	8L2' F50BX/ELIG	432
8F55BXE	8L2' F55BX/ELIG	448
9F36BXE	9L2' F36BX/ELIG	318
9F40BXE	9L2' F40BX/ELIG	306
9F50BXE	9L2' F50BX/ELIG	486
9F55BXE	9L2' F55BX/ELIG	504
12F40BE	12L2' F40BX/ELIG	408
12F50BE	12L2' F50BX/ELIG	648
12F55BE	12L2' F55BX/ELIG	672
Three Foot T8 / T12 Systems		
1F30SEM	1L3' 30W T12 EE/EEMAG	38
1F30SES	1L3' 30W T12 EE/STD	42
1F30SSS	1L3' 30W T12 STD/STD	46
1F25SSE	1L3' 25W T8/ELIG	24
1F25SSH	1L3' 25W T8/ELIG HIGH LMN	28
2F30SEE	2L3' 30W T12 EE/ELIG	49
2F30SEM	2L3' 30W T12 EE/EEMAG	66
2F30SES	2L3' 30W T12 EE/STD	73
2F30SSS	2L3' 30W T12 STD/STD	80
2F25SSE	2L3' 25W T8/ELIG	47
2F25SSM	2L3' 25W T8/EEMAG	65
3F30SSS	3L3' 30W T12 STD/STD	140
3F30SES	3L3' 30W T12 EE/STD	127
3F25SSE	3L3’ 25W T8/ELIG	68
4F25SSE	4L3' 25W T8/ELIG	88
Four Foot F48 T8 Systems		
1F48SES	1L4' F48T12EE/STD	50
1F48SSS	1L4' F48T12/STD	60
2F48SES	2L4' F48T12EE/STD	82
2F48SSS	2L4' F48T12/STD	102
3F48SES	3L4' F48T12EE/STD	132
3F48SSS	3L4' F48T12/STD	162
4F48SES	4L4' F48T12EE/STD	164
4F48SSS	4L4' F48T12/STD	204

Device Code	**Device Description**	**Rated Watts**
Four Foot F48HO T8 Systems		
1F48HES	1L4' F48HO/EE/STD	80
1F48HSS	1L4' F48H0/STD/STD	85
2F48HES	2L4' F48HO/EE/STD	135
2F48HSS	2L4' F48H0/STD/STD	145
3F48HES	3L4' F48HO/EE/STD	215
3F48HSS	3L4' F48H0/STD/STD	230
4F48HES	4L4' F48HO/EE/STD	270
4F48HSS	4L4' F48H0/STD/STD	290
Four Foot F48VHO T12 Systems		
1F48VES	1L4' F48VHO/EE/STD	123
1F48VSS	1L4' F48VHO/STD/STD	138
2F48VES	2L4' F48VHO/EE/STD	210
2F48VSS	2L4' F48VHO/STD/STD	240
3F48VES	3L4' F48VHO/EE/STD	333
3F48VSS	3L4' F48VHO/STD/STD	378
4F48VES	4L4' F48VHO/EE/STD	420
4F48VSS	4L4' F48VHO/STD/STD	480
Four Foot T12 Systems		
1F40SEE	1L4' EE/ELIG	38
1F40SEM	1L4' EE/EEMAG	40
1F40SES	1L4' EE/STD	50
1F40SSE	1L4' STD/ELIG	46
1F40SSM	1L4' STD/EEMAG	50
1F40SSS	1L4' STD/STD	57
1F40HSE	1L4' HO/STD/ELIG	59
2F40SEE	2L4' EE/ELIG	60
2F40SEM	2L4' EE/EEMAG	70
2F40SES	2L4' EE/STD	80
2F40SSE	2L4' STD/ELIG	72
2F40SSM	2L4' STD/EEMAG	86
2F40SSS	2L4' STD/STD	94
3F40SEE	3L4' EE/ELIG	90
3F40SEM	3L4' EE/EEMAG	110
3F40SES	3L4' EE/STD	130
3F40SSE	3L4' STD/ELIG	110
3F40SSM	3L4' STD/EEMAG	136
3F40SSS	3L4' STD/STD	151
4F40SEE	4L4' EE/ELIG	120
4F40SEM	4L4' EE/EEMAG	140

4F40SES	4L4' EE/STD	160
4F40SSE	4L4' STD/ELIG	144
4F40SSM	4L4' STD/EEMAG	172
4F40SSS	4L4' STD/STD	188
Device Code	**Device Description**	**Rated Watts**
Four Foot T12 Systems (cont.)		
6F40SSS	6L4' STD/STD	282
Four Foot T8 Systems		
1F32SSE	1L4' T8/ELIG	30
1F32SSL	1L4’ T8/ELIG LOW POWER	26
1F32SSM	1L4' T8/EEMAG	37
1F32SSH	1L4’ T8/ELIG HIGH LMN	36
2F32SSE	2L4' T8/ELIG	60
2F32SSH	2L4' T8/ELIG HIGH LMN	78
2F32SSL	2L4’ T8/ELIG LOW PWR	52
2F32SSM	2L4' T8/EEMAG	70
3F32SSE	3L4' T8/ELIG	88
3F32SSH	3L4' T8/ELIG HIGH LMN	112
3F32SSL	3L4’ T8/ELIG LOW POWER	76
3F32SSM	3L4' T8/EEMAG	107
4F32SSE	4L4' T8/ELIG	112
4F32SSH	4L4' T8/ELIG HIGH LMN	156
4F32SSL	4L4’ T8/ELIG LOW PWR	98
4F32SSM	4L4' T8/EEMAG	140
5F32SSE	5L4' T8/ELIG	148
5F32SSH	5L4' T8/ELIG HIGH LMN	190
6F32SSE	6L4' T8/ELIG	174
8F32SSH	8L4' T8/ELIG HIGH LMN	312
Five Foot T8 / T12 Systems		
1F60HSM	1L5' HO/STD/EEMAG	90
1F60HSE	1L5' HO/STD/ELIG	70
1F60SSM	1L5’/STD/EEMAG	73
1F60TSM	1L5’ T10HO/STD/EEMAG	135
2F40HSE	2L5' HO/STD/ELIG	123
2F40TSE	2L5'T8/ELIG	68
2F60HSM	2L5' HO/STD/EEMAG	178
2F60SSM	2L5’/STD/EEMAG	122
3F40TSE	3L5'T8/ELIG	106
Six Foot T12 & T12HO Systems		
1F72HSE	1L6’ T8HO/ELIG	80
1F72HSS	1L6' F72HO/STD/STD	113
1F72SSM	1L6' STD/EEMAG	80
1F72SSS	1L6' STD/STD	95
2F72HSE	2L6'T8 HO/ELIG	160
2F72HSM	2L6' F72HO/STD/EEMAG	193
2F72HSS	2L6' F72HO/STD	195
2F72SSM	2L6' STD/EEMAG	135
2F72SSS	2L6' STD/STD	173
Device Code	**Device Description**	**Rated Watts**
Eight Foot T12HO Systems		
1F96HES	1L8' HO/EE/STD	125
1F96HSS	1L8' HO/STD/STD	135
2F96HEE	2L8' HO/EE/ELIG	170
2F96HEM	2L8' HO/EE/EEMAG	207
2F96HES	2L8' HO/EE/STD	227
2F96HSE	2L8' HO/STD/ELIG	195
2F96HSM	2L8' HO/STD/EEMAG	237
2F96HSS	2L8' HO/STD/STD	257
3F96HES	3L8' HO/EE/STD	352
3F96HSS	3L8' HO/STD/STD	392
4F96HEE	4L8' HO/EE/ELIG	340
4F96HEM	4L8' HO/EE/EEMAG	414
4F96HES	4L8' HO/EE/STD	454
4F96HSE	4L8' HO/STD/ELIG	390
4F96HSM	4L8' HO/STD/EEMAG	474
4F96HSS	4L8' HO/STD/STD	514
Eight Foot T12VHO Systems		
1F96VES	1L8' VHO/EE/STD	200
1F96VSS	1L8' VHO/STD/STD	230
2F96VES	2L8' VHO/EE/STD	390
2F96VSS	2L8' VHO/STD/STD	450
3F96VES	3L8' VHO/EE/STD	590
3F96VSS	3L8' VHO/STD/STD	680
4F96VES	4L8' VHO/EE/STD	780
4F96VSS	4L8' VHO/STD/STD	900
Eight Foot T8 Systems		
1F59SSE	1L8' T8/ELIG	60
1F80SSE	1L8' T8 HO/ELIG	85
2F59SSE	2L8' T8/ELIG	109
2F59SSL	2L8' T8/ELIG LOW PWR	100
2F80SSE	2L8' T8 HO/ELIG	160
Eight Foot T12 Systems		
1F96SEE	1L8' EE/ELIG	60
1F96SES	1L8' EE/STD	83
1F96SSE	1L8' STD/ELIG	70
1F96SSS	1L8' STD/STD	100
2F96SEE	2L8' EE/ELIG	109

Device Code	Device Description	Rated Watts
2F96SEM	2L8' EE/EEMAG	123
2F96SES	2L8' EE/STD	138
2F96SSE	2L8' STD/ELIG	134
2F96SSM	2L8' STD/EEMAG	158
2F96SSS	2L8' STD/STD	173
3F96SES	3L8' EE/STD	221
Eight Foot T12 Systems (cont.)		
3F96SSS	3L8' STD/STD	273
4F96SEE	4L8' EE/ELIG	218
4F96SEM	4L8' EE/EEMAG	246

Device Code	Device Description	Rated Watts
Eight Foot T12 Systems (cont.)		
4F96SES	4L8' EE/STD	276
4F96SSE	4L8' STD/ELIG	268
4F96SSM	4L8' STD/EEMAG	316
4F96SSS	4L8' STD/STD	346

Table 5: Retrofit Proposed Lighting Wattage Tables

Device Code	Device Description	Rated Watts
LED Exit Signs		
1E0002	2.0 WATT LED	2
1E0003	3.0 WATT LED	3
1E0005	5.0 WLED	5
1E0005C	0.5 WATT LEC	0.5
1E0008	8.0 WLED	8
1E0015	1.5 WATT LED	1.5
1E0105	10.5 WATT LED	10.5
Compact Fluorescents (CFL's)		
2C0007S	2/7W COMPACT HW	18
1C0005S	5W COMPACT HW	7
1C0007S	7W COMPACT HW	9
1C0009S	9W COMPACT HW	11
1C0011S	11W COMPACT HW	13
1C0013S	13W COMPACT HW	15
1C0018E	18W COMPACT HW ELIG	20
1C0018S	18W COMPACT HW	20
1C0022S	22W COMPACT HW	24
1C0023E	1/23W COMPACT HW ELIG	25
1C0026E	26W COMPACT HW ELIG	28
1C0026S	26W COMPACT HW	28
1C0028S	28W COMPACT HW	30
1C0032E	32W COMPACT HW ELIG	34
1C0032S	32W CIRCLINE HW	34
1C0042E	1/42W COMPACT HW ELIG	48
1C0044S	44W CIRCLINE HW	46
1C0057E	1/57W COMPACT HW ELIG	65
1C2232S	22/32W CIRCLINE HW	58
1C2D10E	10W 2D COMPACT HW ELIG	12
1C2D16E	16W 2D COMPACT HW ELIG	18
1C2D21E	21W 2D COMPACT HW ELIG	22
1C2D28E	28W 2D COMPACT HW ELIG	28
1C2D38E	38W 2D COMP.HW ELIG	36
1C3240S	32/40W CIRCLINE HW	80
2C0005S	2/5W COMPACT HW	14
2C0009S	2/9W COMPACT HW	22
2C0011S	2/11W COMPACT HW	26
2C0013E	2/13W COMPACT HW ELIG	28
2C0013S	2/13W COMPACT HW	30
2C0018E	2/18W COMP. HW ELIG	40
2C0026E	2/26W COMP. HW ELIG	54
2C0032E	2/32W COMPACT HW ELIG	68

Device Code	Device Description	Rated Watts
Compact Fluorescents (CFL's) (cont.)		
2C0042E	2/42W COMPACT HW ELIG	100
3C0009S	3/9W COMPACT HW	33
3C0013S	3/13W COMPACT HW	45
3C0018E	3/18W COMPACT HW ELIG	60
3C0026E	3/26W COMPACT HW ELIG	82
3C0032E	3/32W COMPACT HW ELIG	114
3C0042E	3/42W COMPACT HW ELIG	141
4C0018E	4/18W COMPACT HW ELIG	80
4C0026E	4/26W COMPACT HW ELIG	108
4C0032E	4/32W COMPACT HW ELIG	152
4C0042E	4/42W COMPACT HW ELIG	188
6C0026E	6/26W COMPACT HW ELIG	162
6C0032E	6/32W COMPACT HW ELIG	228
6C0042E	6/42W COMPACT HW ELIG	282
8C0026E	8/26W COMPACT HW ELIG	216
8C0032E	8/32W COMPACT HW ELIG	304
8C0042E	8/42W COMPACT HW ELIG	376
T5 Systems		
1F14SSE	1L2' 14W T5/ELIG	16
2F14SSE	2L2' 14W T5/ELIG	32
3F14SSE	3L2' 14W T5/ELIG	50
4F14SSE	4L2' 14W T5/ELIG	68
1F24HSE	1L2' 24W T5HO/ELIG	29
2F24HSE	2L2' 24W T5HO/ELIG	52
3F24HSE	3L2' 24W T5HO/ELIG	80
1F21SSE	1L3' 21W T5/ELIG	24
2F21SSE	2L3' 21W T5/ELIG	47
1F39HSE	1L3' 39W T5HO/ELIG	42
2F39HSE	2L3' 39W T5HO/ELIG	85
1F28SSE	1L4' 28W T5/ELIG	32
2F28SSE	2L4' 28W T5/ELIG	63
3F28SSE	3L4' 28W T5/ELIG	95
4F28SSE	4L4' 28W T5/ELIG	126
6F28SSE	6L4' 28W T5/ELIG	189
1F47HSE	1L4' 47W T5HO/ELIG	53
2F47HSE	2L4' 47W T5HO/ELIG	103
3F47HSE	3L4' 47W T5HO/ELIG	157
4F47HSE	4L4' 47W T5HO/ELIG	200
5F47HSE	5L4' 47W T5HO/ELIG	260
6F47HSE	6L4' 47W T5HO/ELIG	303
1F50HSE	1L4' 50W T5HO/ELIG	58

Device Code	Device Description	Rated Watts
T5 Systems (cont.)		
2F50HSE	2L4' 50W T5HO/ELIG	110
3F50HSE	3L4' 50W T5HO/ELIG	168
4F50HSE	4L4' 50W T5HO/ELIG	215
5F50HSE	5L4' 50W T5HO/ELIG	278
6F50HSE	6L4' 50W T5HO/ELIG	325
1F54HSE	1L4' 54W T5HO/ELIG	59
2F54HSE	2L4' 54W T5HO/ELIG	117
3F54HSE	3L4' 54W T5HO/ELIG	177
4F54HSE	4L4’ 54W T5HO/ELIG	234
5F54HSE	5L4' 54W T5HO/ELIG	294
6F54HSE	6L4’ 54W T5HO/ELIG	351
8F54HSE	8L4' 54W T5HO/ELIG	468
10F54HSE	10L4’ 54W T5HO/ELIG	585
Two Foot High Efficient T8 Systems		
1F17ESL	1L2' 17W T8EE/ELEE LOW PWR	14
1F17ESN	1L2' 17W T8EE/ELEE	17
1F17ESH	1L2' 17W T8EE/ELEE HIGH PWR	20
1F28BXE	1L2' F28BX/ELIG	32
2F17ESL	2L2' 17W T8EE/ELEE LOW PWR	27
2F17ESN	2L2' 17W T8EE/ELEE	32
2F17ESH	2L2' 17W T8EE/ELEE HIGH PWR	40
2F28BXE	2L2' F28BX/ELIG	63
3F17ESL	3L2' 17W T8EE/ELEE LOW PWR	39
3F17ESN	3L2' 17W T8EE/ELEE	46
3F17ESH	3L2' 17W T8EE/ELEE HIGH PWR	61
3F28BXE	3L2' F28BX/ELIG	94
Three Foot High Efficient T8 Systems		
1F25ESL	1L3' 25W T8EE/ELEE LOW PWR	21
1F25ESN	1L3' 25W T8EE/ELEE	24
1F25ESH	1L3' 25W T8EE/ELEE HIGH PWR	30
2F25ESL	2L3' 25W T8EE/ELEE LOW PWR	40
2F25ESN	2L3' 25W T8EE/ELEE	45
2F25ESH	2L3' 25W T8EE/ELEE HIGH PWR	60
3F25ESL	3L3' 25W T8EE/ELEE LOW PWR	58
3F25ESN	3L3' 25W T8EE/ELEE	67
3F25ESH	3L3' 25W T8EE/ELEE HIGH PWR	90

Device Code	Device Description	Rated Watts
Four Foot T8 High Efficient / Reduce Wattage Systems		
1F25EEH	1L4' 25W T8EE/ELEE HIGH PWR	30
1F25EEE	1L4' 25W T8EE/ELEE	22
1F25EEL	1L4' 25W T8EE/ELEE LOW PWR	19
2F25EEH	2L4' 25W T8EE/ELEE HIGH PWR	57
2F25EEE	2L4' 25W T8EE/ELEE	43
2F25EEL	2L4' 25W T8EE/ELEE LOW PWR	37
3F25EEH	3L4' 25W T8EE/ELEE HIGH PWR	86
3F25EEE	3L4' 25W T8EE/ELEE	64
3F25EEL	3L4' 25W T8EE/ELEE LOW PWR	57
4F25EEH	4L4' 25W T8EE/ELEE HIGH PWR	111
4F25EEE	4L4' 25W T8EE/ELEE	86
4F25EEL	4L4' 25W T8EE/ELEE LOW PWR	75
1F28EEH	1L4' 28W T8EE/ELEE HIGH PWR	33
1F28EEE	1L4' 28W T8EE/ELEE	24
1F28EEL	1L4' 28W T8EE/ELEE LOW PWR	22
2F28EEH	2L4' 28WT8EE/ELEE HIGH PWR	64
2F28EEE	2L4' 28W T8EE/ELEE	48
2F28EEL	2L4' 28W T8EE/ELEE LOW PWR	42
3F28EEH	3L4' 28W T8EE/ELEE HIGH PWR	96
3F28EEE	3L4' 28W T8EE/ELEE	72
3F28EEL	3L4' 28W T8EE/ELEE LOW PWR	63
4F28EEH	4L4' 28W T8EE/ELEE HIGH PWR	126
4F28EEE	4L4' 28W T8EE/ELEE	94
4F28EEL	4L4' 28W T8EE/ELEE LOW PWR	83
1F30EEH	1L4' 30W T8EE/ELEE HIGH PWR	36
1F30EEE	1L4' 30W T8EE/ELEE	26
1F30EEL	1L4' 30W T8EE/ELEE LOW PWR	24
2F30EEH	2L4' 30WT8EE/ELEE HIGH PWR	69
2F30EEE	2L4' 30W T8EE/ELEE	52
2F30EEL	2L4' 30W T8EE/ELEE LOW PWR	45
3F30EEH	3L4' 30W T8EE/ELEE HIGH PWR	103
3F30EEE	3L4' 30W T8EE/ELEE	77

Device Code	**Device Description**	**Rated Watts**
Four Foot T8 High Efficient / Reduce Wattage Systems (cont.)		
3F30EEL	3L4' 30W T8EE/ELEE LOW PWR	68
4F30EEH	4L4' 30W T8EE/ELEE HIGH PWR	133
4F30EEE	4L4' 30W T8EE/ELEE	101
4F30EEL	4L4' 30W T8EE/ELEE LOW PWR	89
1F32EEH	1L4' 32W T8EE/ELEE HIGH PWR	38
1F32EEE	1L4' 32W T8EE/ELEE	28
1F32EEL	1L4' 32W T8EE/ELEE LOW PWR	25
2F32EEH	2L4' 32W T8EE/ELEE HIGH PWR	73
2F32EEE	2L4' 32W T8EE/ELEE	53
2F32EEL	2L4' 32W T8EE/ELEE LOW PWR	47
3F32EEH	3L4' 32W T8EE/ELEE HIGH PWR	109
3F32EEE	3L4' 32W T8EE/ELEE	82
3F32EEL	3L4' 32W T8EE/ELEE LOW PWR	72
4F32EEH	4L4' 32W T8EE/ELEE HIGH PWR	141
4F32EEE	4L4' 32W T8EE/ELEE	107
4F32EEL	4L4' 32W T8EE/ELEE LOW PWR	95
6F32EEH	6L4' 32W T8EE/ELEE HIGH PWR	218
6F32EEE	6L4' 32W T8EE/ELEE	168
6F32EEL	6L4' 32W T8EE/ELEE LOW PWR	146
Eight Foot T8 Systems		
1F59SSE	1L8' T8/ELIG	60
1F80SSE	1L8' T8 HO/ELIG	85
2F59SSE	2L8' T8/ELIG	109
2F59SSL	2L8' T8/ELIG LOW PWR	100
2F80SSE	2L8' T8 HO/ELIG	160
LED Lighting Fixtures		
1L002	2 WATT LED	2
1L003	3 WATT LED	3
1L004	4 WATT LED	04
1L005	5 WATT LED	05
1L006	6 WATT LED	06
1L007	7 WATT LED	07
1L008	8 WATT LED	08

1L009	9 WATT LED	09
Device Code	**Device Description**	**Rated Watts**
LED Lighting Fixtures (cont.)		
1L010	10 WATT LED	10
1L011	11 WATT LED	11
1L012	12 WATT LED	12
1L013	13 WATT LED	13
1L014	14 WATT LED	14
1L015	15 WATT LED	15
1L016	16 WATT LED	16
1L017	17 WATT LED	17
1L018	18 WATT LED	18
1L019	19 WATT LED	19
1L020	20 WATT LED	20
1L021	21 WATT LED	21
1L022	22 WATT LED	22
1L023	23 WATT LED	23
1L024	24 WATT LED	24
1L025	25 WATT LED	25
1L026	26 WATT LED	26
1L027	27 WATT LED	27
1L028	28 WATT LED	28
1L029	29 WATT LED	29
1L030	30 WATT LED	30
1L031	31 WATT LED	31
1L032	32 WATT LED	32
1L033	33 WATT LED	33
1L034	34 WATT LED	34
1L035	35 WATT LED	35
1L036	36 WATT LED	36
1L037	37 WATT LED	37
1L038	38 WATT LED	38
1L039	39 WATT LED	39
1L040	40 WATT LED	40
1L041	41 WATT LED	41
1L042	42 WATT LED	42
1L043	43 WATT LED	43
1L044	44 WATT LED	44
1L045	45 WATT LED	45
1L046	46 WATT LED	46
1L047	47 WATT LED	47
1L048	48 WATT LED	48
1L049	49 WATT LED	49
1L050	50 WATT LED	50
1L055	55 WATT LED	55
1L060	60 WATT LED	60
1L070	70 WATT LED	70

1L073	73 WATT LED	73
Device Code	**Device Description**	**Rated Watts**
LED Lighting Fixtures (cont.)		
1L075	75 WATT LED	75
1L080	90 WATT LED	90
1L085	85 WATT LED	85
1L090	90 WATT LED	90
1L095	95 WATT LED	95
1L100	100 WATT LED	100
1L106	106 WATT LED	106
1L107	107 WATT LED	107
1L116	116 WATT LED	116
1L120	120 WATT LED	120
1L125	125 WATT LED	125
1L130	130 WATT LED	130
1L135	135 WATT LED	135
1L140	140 WATT LED	140
1L145	145 WATT LED	145
1L150	150 WATT LED	150
1L155	155 WATT LED	155
1L160	160 WATT LED	160
1L165	165 WATT LED	165
1L170	170 WATT LED	170
1L175	175 WATT LED	175
1L180	180 WATT LED	180
1L185	185 WATT LED	185
1L190	190 WATT LED	190

1L200	200 WATT LED	200
Device Code	**Device Description**	**Rated Watts**
LED Lighting Fixtures (cont.)		
1L210	210 WATT LED	210
1L220	220 WATT LED	220
1L240	240 WATT LED	240
Electronic Metal Halide Lamps		
1M0150E	150W METAL HALIDE EB	160
1M0200E	200W METAL HALIDE EB	215
1M0250E	250W METAL HALIDE EB	270
1M0320E	320W METAL HALIDE EB	345
1M0350E	350W METAL HALIDE EB	375
1M0400E	400W METAL HALIDE EB	430
1M0450E	400W METAL HALIDE EB	480
MH Track Lighting		
1M0020E	20W MH SPOT	25
1M0025E	25W MH SPOT	25
1M0035E	35W MH SPOT	44
1M0039E	39W MH SPOT	47
1M0050E	50W MH SPOT	60
1M0070E	70W MH SPOT	80
1M0100E	100W MH SPOT	111
1M0150E	150W MH SPOT	162

Table 6: Upstream Lighting Assumed Wattages and Hours

Product Type	Watts Saved[3]	Measure Life[4]	Run Hours[5]
T8	3.52	10	3380
T5HO	4	10	3380
PAR20	29.8	10	4500
PAR30	40.4	10	4500
PAR38	46.8	10	4500
MR16	23.4	10	4500
A-line	38.63	9	2800
Decoratives	21.07	5	4000
T8-28	3.52	10	3380
T8-25	6.16	10	3380
T8-28 U Bend	3.52	8	3380
T8-25 U Bend	6.16	8	3380
LED Dowlight kit	40.66	10	4500
4’ Stairwell LEDs w/sensor	46	7	8760
2’ Stairwell LEDs w/ sensor	53.4	7	8760

The watts saved by LEDs use a baseline of 85% halogen and 15% fluorescent lights.

[3] Based on MA PA working group findings
[4] Ibid
[5] Ibid

Table 7: Baseline Efficiency Requirements for C&I Unitary Air Conditioners[6]

Equipment Type	Size Category	Subcategory or Rating Condition	Baseline Efficiency After 1/2014
Air conditioners, air cooled	<65,000 Btu/h[b]	Split system	13.0 SEER
		Single package	13.0 SEER
	≥65,000 Btu/h and <135,000 Btu/h	Split system and single package	11.2 EER[a] 11.4 IEER[a]
	≥135,000 Btu/h and <240,000 Btu/h	Split system and single package	11.0 EER[a] 11.2 IEER[a]
	≥240,000 Btu/h and <760,000 Btu/h	Split system and single package	10.0 EER[a] 10.1 IEER[a]
	≥760,000 Btu/h	Split system and single package	9.7 EER[a] 9.8 IEER[a]
Air conditioners, Water cooled	<65,000 Btu/h	Split system and single package	12.1 EER 12.3 IEER
	≥65,000 Btu/h and <135,000 Btu/h	Split system and single package	12.1 EER[a] 12.3 IEER[a]
	≥135,000 Btu/h and <240,000 Btu/h	Split system and single package	12.5 EER[a] 12.7 IEER[a]
	≥240,000 Btu/h	Split system and single package	12.4 EER[a] 12.6 IEER[a]
Air conditioners, evaporatively cooled	<65,000 Btu/h	Split system and single package	12.1 EER 12.3 IEER
	≥65,000 Btu/h and <135,000 Btu/h	Split system and single package	12.1 EER[a] 12.3 IEER[a]
	≥135,000 Btu/h and <240,000 Btu/h	Split system and single package	12.0 EER[a] 12.2 IEER[a]
	≥240,000 Btu/h	Split system and single package	11.9 EER[a] 12.1 IEER[a]

a. Deduct 0.2 from the required EERs for units with a heating section other than electric heat[7].
b. Single-phase air-cooled air conditioners <65,000 Btu/h are regulated by the National Appliance Energy Conservation Act of 1987 (NAECA); SEER values are those set by NAECA.

[6] Baseline determined by International Code Council (2012). *2012 International Energy Conservation Code;* Page C-38, Table C403.2.3(1)
[7] The Pas do not differentiate between units by heating section types. To be conservative, the highest baseline efficiency is assumed for all heating section types in each equipment category

Table 8: Baseline Efficiency Requirements for C&I Heat Pumps

Equipment Type	Size Category (Cooling Capacity)	Subcategory or Rating Condition	Baseline Efficiency After 1/1/2014[8] Cooling Mode	Baseline Efficiency After 1/1/2014[8] Heating Mode
Air cooled	<65,000 Btu/h[b]	Split system	13.0 SEER	7.7 HSPF
		Single package	13.0 SEER	7.7 HSPF
	≥65,000 Btu/h and <135,000 Btu/h	Split system and single package / 47°F db/43°F wb outdoor air	11.0 EER[a] 11.2 IEER[a]	3.3 COP
	≥135,000 Btu/h and <240,000 Btu/h	Split system and single package / 47°F db/43°F wb outdoor air	10.6 EER[a] 10.7 IEER[a]	3.2 COP
	≥240,000 Btu/h	Split system and single package / 47°F db/43°F wb outdoor air	9.5 EER[a] 9.6 IEER[a]	3.2 COP
Water source	<17,000 Btu/h	86°F entering water (Cooling Mode) / 68°F entering water (Heating Mode)	11.2 EER	4.2 COP
	≥17,000 Btu/h and <135,000 Btu/h	86°F entering water / 68°F entering water (Heating Mode)	12.0 EER	4.2 COP
Groundwater source	<135,000 Btu/h	59°F entering water (Cooling Mode) / 50°F entering water (Heating Mode)	16.2 EER	3.6 COP
Ground source	<135,000 Btu/h	77°F entering water / 32°F entering water (Heating Mode)	13.4 EER	3.1 COP

db = dry-bulb temperature, °F; wb = wet-bulb temperature, °F.

a. Deduct 0.2 from the required EERs for units with a heating section other than electric heat[9].
b. Single-phase air-cooled air conditioners <65,000 Btu/h are regulated by the National Appliance Energy Conservation Act of 1987 (NAECA); SEER values are those set by NAECA.

[8] International Code Council (2012). *2012 International Energy Conservation Code.* Page C-40, Table C403.2.3(2)
[9] The Pas do not differentiate between units by heating section types. To be conservative, the highest baseline efficiency is assumed for all heating section types in each equipment category.

Table 9: Water Chilling Packages - Minimum Efficiency Requirements[10]

Equipment Type	Size Category (Tons)	Units	Path A		Path B	
			Full Load	IPLV	Full Load	IPLV
Air-cooled chillers	< 150	EER	9.562	12.5	NA	NA
	≥ 150	EER	9.562	12.75	NA	NA
Water cooled, electrically operated, positive displacement (rotary screw and scroll)	< 75	kW/ton	0.780	0.63	0.800	0.600
	≥ 75 and < 150	kW/ton	0.775	0.615	0.790	0.586
	≥ 150 and < 300	kW/ton	0.680	0.580	0.718	0.540
	≥ 300	kW/ton	0.620	0.540	0.639	0.490
Water cooled, electrically operated, centrifugal	< 150	kW/ton	0.634	0.596	0.639	0.450
	≥ 150 and < 300	kW/ton	0.634	0.596	0.639	0.450
	≥ 300 and < 600	kW/ton	0.576	0.549	0.600	0.400
	≥ 600	kW/ton	0.570	0.539	0.590	0.400

Note: Compliance with this standard may be obtained by meeting the minimum requirements of Path A or B, however, both the Full Load and IPLV must be met to fulfill the requirements of Path A or B.

Table 10: Chiller Load Factors[11]

Equipment Type	Full Load	IPLV
Air-cooled chillers	.715	.715
Water cooled chillers <300 Tons	.882	.823
Water cooled chillers >300 Tons	.762	.765

Table 11: Cooling and Heating Equivalent Full Load Hours

Building (or Space) Type	Cooling Full Load Hours ($EFLH_{cool}$)	Heating Full Load Hours ($EFLH_{heat}$)
National Grid RI (NE – South Coastal)	817	1137

- Average Cooling EFLHs from the 2010 NEEP HVAC Loadshape study.[12]
- Average Heating EFLHs derived from 2010 NEEP HVAC Loadshape study[13] and the Connecticut Program Savings Document for 2011 Program Year. [14]

[10] International Code Council (2012). *2012 International Energy Conservation Code*; Page C-46, Table C403.2.3(7).
[11] National Grid load factors based on a 1994 study.
[12] KEMA (2011). C&I Unitary AC LoadShape Project – Final Report. Prepared for the Regional Evaluation, Measurement & Verification Forum.
[13] Ibid.
[14] United Illuminating Company, Connecticut Light & Power Company (2010). *UI and CL&P Program Savings Documentation for 2011 Program Year*.

Table 12: Savings Factors for ECM HVAC Fan Motors[15]

Factor	Box Size	Value	Units
Box Size Factor	< 1000 CFM	.32	Watts/CFM
Box Size Factor	≥ 1000 CFM	.21	Watts/CFM
$\%Flow_{ANNUAL}$	ALL	.52	-
$\%Flow_{SP}$	ALL	.63	-
$\%Flow_{WP}$	ALL	.33	-

Table 13: Savings Factors for Cooler Night Covers[16]

Cooler Case Temperature	**Savings Factor (ΔkW/foot)**
Low Temperature (-35 F to -5 F)	.03
Medium Temperature (0 F to 30 F)	.02
High Temperature (35 F to 55F)	.01

[15] Factors based on engineering analyses developed at National Grid
[16] CL&P Program Savings Documentation for 2011 Program Year (2010). Factors based on Southern California Edison (1997). *Effects of the Low Emissive Shields on Performance and Power Use of a Refrigerated Display Case.*

Table 14: Savings Factors for C&I VSDs (kWh/HP and kW/HP)[17]

	Building Exhaust Fan	Cooling Tower Fan	Chilled Water Pump	Boiler Feed Water Pump	Hot Water Circulating. Pump	MAF - Make-up Air Fan	Return Fan	Supply Fan	WS Heat Pump Circulating Loop
Annual Energy Savings Factors (kWh/HP)									
University/College	3,641	449	745	2,316	2,344	3,220	1,067	1,023	3,061
Elm/H School	3,563	365	628	1,933	1,957	3,402	879	840	2,561
Multi-Family	3,202	889	1,374	2,340	2,400	3,082	1,374	1,319	3,713
Hotel/Motel	3,151	809	1,239	2,195	2,239	3,368	1,334	1,290	3,433
Health	3,375	1,705	2,427	2,349	2,406	3,002	1,577	1,487	3,670
Warehouse	3,310	455	816	2,002	2,087	3,229	1,253	1,205	2,818
Restaurant	3,440	993	1,566	1,977	2,047	2,628	1,425	1,363	3,542
Retail	3,092	633	1,049	1,949	2,000	2,392	1,206	1,146	2,998
Grocery	3,126	918	1,632	1,653	1,681	2,230	1,408	1,297	3,285
Offices	3,332	950	1,370	1,866	1,896	3,346	1,135	1,076	3,235
Summer Demand Savings Factors (kW/HP_{SP})									
University/College	0.109	-0.023	0.056	0.457	0.457	0.109	0.102	0.064	0.056
Elm/H School	0.377	-0.023	0.056	0.457	0.457	0.109	0.102	0.064	0.275
Multi-Family	0.109	-0.023	0.056	0.457	0.457	0.109	0.102	0.064	0.056
Hotel/Motel	0.109	-0.023	0.056	0.457	0.457	0.109	0.102	0.064	0.056
Health	0.109	-0.023	0.056	0.457	0.457	0.109	0.102	0.064	0.056
Warehouse	0.109	-0.023	0.056	0.457	0.457	0.261	0.102	0.064	0.056
Restaurant	0.261	-0.023	0.056	0.457	0.457	0.109	0.102	0.064	0.178
Retail	0.109	-0.023	0.056	0.457	0.457	0.109	0.102	0.064	0.056
Grocery	0.261	-0.023	0.056	0.457	0.457	0.109	0.102	0.064	0.178
Offices	0.109	-0.023	0.056	0.457	0.457	0.109	0.102	0.064	0.056
Winter Demand Savings Factors (kW/HP_{WP})									
University/College	0.377	-0.006	0.457	0.457	0.457	0.109	0.113	0.113	0.457
Elementary/High School	0.457	-0.006	0.457	0.457	0.457	0.109	0.113	0.113	0.457
Multi-Family	0.109	-0.006	0.457	0.355	0.384	0.109	0.113	0.113	0.355
Hotel/Motel	0.109	-0.006	0.457	0.418	0.444	0.109	0.113	0.113	0.418
Health	0.377	-0.006	0.457	0.275	0.298	0.109	0.113	0.113	0.275
Warehouse	0.377	-0.006	0.457	0.178	0.193	0.261	0.113	0.113	0.178
Restaurant	0.109	-0.006	0.457	0.355	0.384	0.109	0.113	0.113	0.355
Retail	0.109	-0.006	0.457	0.275	0.298	0.109	0.113	0.113	0.275
Grocery	0.457	-0.006	0.457	0.418	0.444	0.109	0.113	0.113	0.418
Offices	0.457	-0.006	0.457	0.418	0.444	0.109	0.113	0.113	0.418

[17] Chan, Tumin (2010). *Formulation of a Prescriptive Incentive for the VFD and Motors & VFD impact tables at NSTAR.* Prepared for NSTAR.

Table 15: Baseline Efficiency Requirements for Gas and Electric Commercial Ovens

Equipment Type	Baseline Efficiency	Efficiency Requirement
Gas-Fired Convection Oven	30%	>=44%
Gas-Fired Combination Oven	35%	>=44%
Gas-Fired Conveyor Oven	20% Heavy Load	>=44%
Gas-Fired Rack Oven	30%	>=50%
Commercial Electric Oven	Convection Cooking: 65% at 80lb/hr, 3.0 kW idle mode, 3.0 kW preheat Steam Cooking: 40% at 100lb/hr, 10.0 kW idle mode, 3.0kW preheat	

Table 16: Lighting Interactive HVAC Effects

Program	**Energy Type**	**Gas Impact (MMBtu/ΔkWh)**[18]	**Oil Impact (MMBtu/ΔkWh)**[19]
C&I New Construction	Lighting Systems	-.00043	-.00083
	Lighting Controls	-.00028	-.00055
	Upstream Lighting - LEDs	-.00030	-.0006
	Upstream Lighting - Fluorescents	-.00039	-.00077
C&I Retrofit	Lighting Systems	-.00043	-.00083
	Lighting Controls	-.00028	-.00055

Table 17: Default kW Reduction per CFM by Dryer Capacity

Dryer Capacity ($CFM_{DRYE}R$)	**kW Reduction per CFM** [20]
<100	.00474
≥100 and <200	.00359
≥200 <300	.00316
≥300 <400	.00290
≥400	.00272

[18] C&I Lighting Interactive Effects 2015.
[19] C&I Lighting Interactive Effects 2015.
[20] From NSTAR analysis based on metering data. The location of the original data and analysis is unknown; however, these values are supported by multipled 3rd party impact evaluations.

Table 18: Air Compressor kW Reduction per Horsepower

Control Type	Nominal Horsepower (HP)	kW Reduction per Horsepower [21]	
		New Construction	Retrofit
Load/No Load	≥15 and <25	.076	.102
Load/No Load	≥25 and <75	.114	.102
VSD	≥15 and <25	.159	.207
VSD	≥25 and <75	.228	.206
Variable Displacement	≥50 and <75	.110	.116

Table 19: Baseline Efficiency Requirements for C&I Gas-Fired Boilers[22]

Equipment Type	Subcategory	Size Category (Input)	Minimum Efficiency[a]	Test Procedure
Boilers, hot water	Gas-fired	<300,000 Btu/h	80% AFUE	10 CFR Part 430
		>=300,000 Btu/h and <=2,500,000 Btu/h[b]	80% E_t	10 CFR Part 431
		>2,500,000 Btu/h[c]	82% E_c	10 CFR Part 430

a. Annual Fuel Utilization Efficiency (AFUE), Thermal efficiency (Et), Combustion efficiency (Ec)

b. Maximum capacity – min. and max. ratings as provided for and allowed by the units controls

c. These requirements apply to boilers with rated input of 8 MMBtu/h or less that are not packaged boilers and to all packaged boilers. Minimum efficiency requirements for boilers cover all capacities of packaged boilers

Table 20: Baseline Efficiency Requirements for Gas-Fired Furnaces[23]

Equipment Type	Size Category (Input)	Minimum Efficiency
Warm air furnaces, gas fired	< 225,000 Btu/h	90% AFUE

[21] From NSTAR Analysis based on metering data. The location of original data and analysis is unknown; however, these values are supported by multiple 3rd party impact evaluations.
[22] Adapted from 2012 International Energy Conservation Code; Table 6.8.1F
[23] 10 CFR 430, page 37548

Appendix B: Net to Gross Factors

Residential Electric Efficiency Measures						
Measure	**Measure Category**	**FR**	**SOp**	**SOnp**	**NTG**	**Source**
EnergyStar® HVAC						
Brushless Furnace Fan motor (BFM)	Furnace Fan Motors	0.00	0.00	0.00	0.65	(N30)
CoolSmart AC Digital Check-up/Tune-up	Central AC Digital Check-up/Tune–up	0.15	0.00	0.00	0.85	(N30)
CoolSmart AC QIV ES	Central AC Quality Installation Verification (QIV)	0.25	0.16	0.00	0.91	(130)
CoolSmart AC QIV NES	Central AC Quality Installation Verification (QIV)	0.25	0.16	0.00	0.91	(130)
CoolSmart AC SEER 15.0 => (Equip) - EER>=12.5	Central AC	0.35	0.28	0.00	0.93	(130)
CoolSmart AC SEER 16.0 => (Equip) - EER>=13.0	Central AC	0.42	0.28	0.00	0.86	(130)
CoolSmart HP Digital Check-up/Tune-up	Heat Pump Digital Check-up/Tune-up	0.15	0.00	0.00	0.85	(N30)
CoolSmart HP QIV ES	Heat Pump Quality Installation Verification (QIV)	0.25	0.16	0.00	0.91	(130)
CoolSmart HP QIV NES	Heat Pump Quality Installation Verification (QIV)	0.25	0.16	0.00	0.91	(130)
CS AC SEER =>14.5, EER =>12, NEW Estar -regardless of sizing	Central AC	0.35	0.28	0.00	0.93	(130)
CS HP Seer => 15, EER 12.5, HSPF 8.5	Air Source Heat Pump Systems	0.35	0.28	0.00	0.93	(130)
CS HP SEER => 16, EER 13, HSPF 8.5	Air Source Heat Pump Systems	0.35	0.28	0.00	0.93	(130)
CS HP SEER =>14.5, EER =>12, HSPF 8.5	Air Source Heat Pump Systems	0.35	0.28	0.00	0.93	(130)
CS HP SEER 15.0, EER 12.5, HSPF 8.2	Air Source Heat Pump Systems	0.35	0.28	0.00	0.93	(130)
Down Size 1/2 ton	Down Size ½ Ton	0.15	0.00	0.00	0.85	(N30)
Duct Sealing - 100 CFM redcution in leaks 15% of flow to 5%	Duct Sealing	0.15	0.00	0.00	0.85	(N30)

Residential Electric Efficiency Measures						
Measure	**Measure Category**	**FR**	**SOp**	**SOnp**	**NTG**	**Source**
EnergyStar® HVAC						
Early Replacement AC (EE)	Early Replacement of Central AC or Heat Pump Unit	0.15	0.00	0.00	0.85	(N30)
Early Replacement AC (Retire)	Early Replacement of Central AC or Heat Pump Unit	0.15	0.00	0.00	0.85	(N30)
Early Replacement HP (EE)	Early Replacement of Central AC or Heat Pump Unit	0.15	0.00	0.00	0.85	(N30)
Early Replacement HP (Retire)	Early Replacement of Central AC or Heat Pump Unit	0.15	0.00	0.00	0.85	(N30)
ECM / Oil Replace Furnace	Furnace Fan Motors	0.00	0.00	0.00	1.00	(120)
ECM Gas Rebate	Furnace Fan Motors	0.00	0.00	0.00	1.00	(120)
ECM Pumps	ECM Circulator Pumps	0.00	0.00	0.00	1.00	(N47)
Energy Star QI with Duct Modifications	Quality Installation with Duct Modification	0.25	0.16	0.00	0.91	(130)
HPWH 50 gallon (electric)	Heat Pump Water Heaters	0.00	0.00	0.00	1.00	(N47)
MiniSplit HP SEER 16, EER 12 , HSPF 8.2	Ductless MiniSplits	0.45	0.07	0.00	0.62	(130)
MiniSplit HP SEER 19, EER 12.5, HSPF 10.0	Ductless MiniSplits	0.45	0.07	0.00	0.62	(130)
MiniSplit HP SEER 19, EER 12.8, HSPF 10.0	Ductless MiniSplits	0.45	0.07	0.00	0.62	(130)
MiniSplit HP SEER 20, EER 13, HSPF 10	Ductless MiniSplits	0.45	0.07	0.00	0.62	(130)
MiniSplit HP SEER 23, EER 13, HSPF 10.6	Ductless MiniSplits	0.45	0.07	0.00	0.62	(130)
Oil Heat Replacement	Heating System (Rebate)	0.00	0.00	0.00	1.00	(N47)
Rightsizing on ES Tier 2 14.5 12	Right Sizing	0.15	0.00	0.00	0.85	(103)
Rightsizing Top Tier 15/12.5	Right Sizing	0.15	0.00	0.00	0.85	(103)
WiFi programmable thermostat with cooling (gas)	Programmable Thermostats	0.00	0.00	0.00	1.00	(N47)
WiFi programmable thermostat with cooling (oil)	Programmable Thermostats	0.00	0.00	0.00	1.00	(N47)
EnergyStar® Lighting						
HTR Bulbs	CFL Bulbs	0.40	0.00	0.00	0.60	(N21)
Indoor Fixture	Indoor Fixtures	0.08	0.04	0.00	0.96	(N21)
LED A Lamps	LED Lighting	0.00	0.00	0.00	1.00	(N47)
LED Bulbs (EISA Exempt)	LED Lighting	0.00	0.00	0.00	1.00	(N47)

Residential Electric Efficiency Measures

Measure	Measure Category	FR	SOp	SOnp	NTG	Source
EnergyStar® Lighting						
LED Fixtures	LED Fixtures	0.00	0.00	0.00	1.00	(N47)
Outdoor Fixture	Outdoor Fixtures	0.12	0.07	0.00	0.95	(N21)
Outdoor LED Fixture	LED Lighting	0.00	0.00	0.00	1.00	(N21)
School Program Bulbs	CFL Bulbs	0.00	0.00	0.00	1.00	(N47)
School Program LED Bulbs	LED Lighting	0.00	0.00	0.00	1.00	(N21)
Screw-in Bulbs	CFL Bulbs	0.57	0.00	0.00	0.43	(N21)
Screw-in Bulbs (EISA Exempt)	CFL Bulbs	0.40	0.00	0.00	0.60	(N21)
Specialty Bulbs	CFL Bulbs	0.40	0.00	0.00	0.60	(N21)
Torchiere	Torchieres	0.06	0.03	0.00	0.97	(N21)
EnergyStar® Products						
Advanced Power Strips	Smart Strips	0.00	0.00	0.00	1.00	(N47)
Clothes Washer (ES Baseline)	Clothes Washer	0.10	0.00	0.00	0.00	(N30)
Computers	Computers	0.25	0.00	0.00	0.75	(N21)
Dehumidifier	Dehumidifier	0.00	0.00	0.00	0.00	(N28)
Dehumidifier (Early	Dehumidifier	0.00	0.00	0.00	0.00	(N28)
Freezer Recycling	Refrigerator/Freezer Removal	0.41	0.00	0.00	0.59	(N21)
Freezers	Freezers	0.25	0.00	0.00	0.75	(N21)
Low Flow Showerhead Control	Low-Flow Showerheads With Controls	0.00	0.00	0.00	1.00	(N47)
Low Flow Showerhead Control - Adapter	Low-Flow Showerheads With Controls	0.00	0.00	0.00	1.00	(N47)
Monitors	Computer Monitors	0.25	0.00	0.00	0.75	(N21)
Most Efficient Refrigerator	Refrigerators	0.25	0.00	0.00	0.75	(N21)
Most Efficient TV <=32"	Televisions	0.25	0.00	0.00	0.75	(N21)
Most Efficient TV >=46"	Televisions	0.25	0.00	0.00	0.75	(N21)
Most Efficient TV >32" and <=46"	Televisions	0.25	0.00	0.00	0.75	(N21)
Pool pump (2-speed)	Pool Pumps	0.00	0.00	0.00	1.00	(N47)
Pool pump (variable)	Pool Pumps	0.00	0.00	0.00	1.00	(N47)
Refrigerator Recycle	Refrigerator/Freezer Removal	0.31	0.00	0.00	0.73	(N21)
Room AC (10.8)	Room Air Conditioners	0.36	0.00	0.00	0.64	(N21)
Room air cleaners	Room Air Cleaners	0.00	0.00	0.00	1.00	(N47)
Smart Strips	Smart Strips	0.00	0.00	0.00	1.00	(N47)

Residential Electric Efficiency Measures

Measure	Measure Category	FR	SOp	SOnp	NTG	Source
EnergyStar® Products						
Super Efficient Dyer	Super Efficient Dryer	0.00	0.00	0.00	1.00	(N47)
Top 10 Desktop Computer	Computers	0.25	0.00	0.00	0.75	(N21)
Top 10 Freezer	Freezers	0.25	0.00	0.00	0.75	(N21)
Top 10 Refrigerator	Refrigerators	0.25	0.00	0.00	0.75	(N21)
Top 10 TV <=32"	Televisions	0.25	0.00	0.00	0.75	(N21)
Top 10 TV >=46"	Televisions	0.25	0.00	0.00	0.75	(N21)
Top 10 TV >32" and <46"	Televisions	0.25	0.00	0.00	0.75	(N21)
Wifi Programmable Thermostat	Programmable Thermostats	0.03	0.00	0.00	0.97	(132)
EnergyWise						
EW SF CFL	CFL Bulbs	0.24	0.00	0.00	0.76	(N28)
EW SF DHW - Elec	EW DHW Measures	0.03	0.00	0.00	0.97	(132)
EW SF Fixtures	Indoor Fixtures	0.03	0.00	0.00	0.97	(132)
EW SF HPWH 50 gallon	Heat Pump Water Heaters	0.03	0.00	0.00	0.97	(132)
EW SF LED Bulbs	LED Lighting	0.03	0.00	0.00	0.97	(132)
EW SF LED Fixture	LED Fixtures	0.03	0.00	0.00	0.97	(132)
EW SF OFIXTURE	Outdoor Fixtures	0.03	0.00	0.00	0.97	(132)
EW SF Refrig rebate	Refrigerators	0.03	0.00	0.00	0.97	(132)
EW SF Refrigerator Brush	Refrigerator Brush	0.03	0.00	0.00	0.97	(132)
EW SF Smart Strip	Smart Strips	0.03	0.00	0.00	0.97	(132)
EW SF THERMOSTAT	Programmable Thermostats	0.03	0.00	0.00	0.97	(132)
EW SF WiFi Thermostat	Programmable Thermostats	0.03	0.00	0.00	0.97	(132)
EW SF Wx - GAS- Non Elec	EW Shell Insulation	0.03	0.00	0.00	0.97	(132)
EW SF Wx - OIL- Non Elec	EW Shell Insulation	0.03	0.00	0.00	0.97	(132)
EW SF Wx-Electric - Elec	EW Shell Insulation	0.03	0.00	0.00	0.97	(132)
EnergyWise MultiFamily						
EW Aerator (Elec Ht)	Faucet Aerators	0.03	0.00	0.00	0.97	(132)
EW Air Sealing (electric)	EW Air Sealing	0.03	0.00	0.00	0.97	(132)
EW CFLs	CFL Bulbs	0.18	0.00	0.00	0.97	(N30)
EW Fixtures	Indoor Fixtures	0.03	0.00	0.00	0.97	(132)
EW Insulation (electric)	EW Other Insulation	0.03	0.00	0.00	0.97	(132)
EW Insulation (electric)	EW Shell Insulation	0.03	0.00	0.00	0.97	(132)
EW LED A Lamp	LED Lighting	0.03	0.00	0.00	0.97	(132)

Residential Electric Efficiency Measures						
Measure	**Measure Category**	**FR**	**SOp**	**SOnp**	**NTG**	**Source**
EnergyWise MultiFamily						
EW MF LED Fixtures	LED Fixtures	0.18	0.00	0.00	0.97	(N30)
EW Outdoor Fixtures	Outdoor Fixtures	0.03	0.00	0.00	0.97	(132)
EW Programmable thermostat (electric)	Programmable Thermostats	0.03	0.00	0.00	0.97	(132)
EW Refrigerator	Refrigerator Replacement	0.03	0.00	0.00	0.97	(132)
EW Showerhead (electric)	Low-Flow Showerheads	0.03	0.00	0.00	0.97	(132)
EW Smart Strips	Smart Strips	0.03	0.00	0.00	0.97	(132)
EW WiFi programmable thermostat (electric)	Programmable Thermostats	0.03	0.00	0.00	0.97	(132)
Home Energy Reports						
Opt-out dual fuel	Home Energy Reports	0.00	0.00	0.00	1.00	(N25)
Opt-Out electric	Home Energy Reports	0.00	0.00	0.00	1.00	(N25)
Income Eligible MultiFamily						
EW LI Aerator (electric)	Faucet Aerators	0.00	0.00	0.00	1.00	(N47)
EW LI Air Sealing (electric)	EW Air Sealing	0.00	0.00	0.00	1.00	(N47)
EW LI CFLs	CFL Bulbs	0.00	0.00	0.00	1.00	(N47)
EW LI Fixtures	Indoor Fixtures	0.00	0.00	0.00	1.00	(N47)
EW LI Insulation (electric)	EW Other Insulation	0.00	0.00	0.00	1.00	(N47)
EW LI Insulation (electrict)	EW Shell Insulation	0.00	0.00	0.00	1.00	(N47)
EW LI LED A Lamp	LED Lighting	0.00	0.00	0.00	1.00	(N47)
EW LI LED Fixture	LED Lighting	0.00	0.00	0.00	1.00	(N47)
EW LI Outdoor Fixtures	Outdoor Fixtures	0.00	0.00	0.00	1.00	(N47)
EW LI Refrigerator	Refrigerator Replacement	0.00	0.00	0.00	1.00	(N47)
EW LI Showerheads (Elec Ht)	Low-Flow Showerheads	0.00	0.00	0.00	1.00	(N47)
EW LI Smart Strips	Smart Strips	0.00	0.00	0.00	1.00	(N47)
EW LI Window AC Replacement	Window AC (Retrofit)	0.00	0.00	0.00	1.00	(N47)
EW Programmable thermostat (electric)	Programmable Thermostats	0.00	0.00	0.00	1.00	(N47)
Wifi Programmable Thermostat	Programmable Thermostats	0.00	0.00	0.00	1.00	(N47)
Residential New Construction						
CFL	CFL Bulbs	0.23	0.00	0.00	0.77	(87)
Deep Energy Retrofit Basements	Deep Energy Retrofit	0.00	0.00	0.00	1.00	(N47)

Residential Electric Efficiency Measures						
Measure	**Measure Category**	**FR**	**SOp**	**SOnp**	**NTG**	**Source**
Residential New Construction						
Deep Energy Retrofit Basements - Air Flow Reduction	Deep Energy Retrofit	0.00	0.00	0.00	1.00	(N47)
Deep Energy Retrofit Roofs	Deep Energy Retrofit	0.00	0.00	0.00	1.00	(N47)
Deep Energy Retrofit Roofs - Air Flow Reduction	Deep Energy Retrofit	0.00	0.00	0.00	1.00	(N47)
Deep Energy Retrofit Walls	Deep Energy Retrofit	0.00	0.00	0.00	1.00	(N47)
Deep Energy Retrofit Walls - Air Flow Reduction	Deep Energy Retrofit	0.00	0.00	0.00	1.00	(N47)
ESH Cooling	ESH Heating, Cooling, and DHW Measures	0.00	0.00	0.00	1.00	(N47)
ESH DHW	ESH Heating, Cooling, and DHW Measures	0.00	0.00	0.00	1.00	(N47)
ESH Fixtures	Indoor Fixtures	0.08	0.04	0.00	0.96	(87)
ESH Heating	ESH Heating, Cooling, and DHW Measures	0.00	0.00	0.00	1.00	(N47)
LEDs	LED Lighting	0.10	0.00	0.00	0.90	(87)
Refrigerators	Refrigerators	0.86	0.00	0.00	0.14	(N21)
Renovation Rehab Cooling	Renovation Rehab	0.00	0.00	0.00	1.00	(N47)
Renovation Rehab Domestic Hot Water	Renovation Rehab	0.00	0.00	0.00	1.00	(N47)
Renovation Rehab Heating	Renovation Rehab	0.00	0.00	0.00	1.00	(N47)
Room AC (10.8)	Room Air Conditioners	0.36	0.00	0.00	0.64	(N21)
Showerheads	Low-Flow Showerheads	0.00	0.00	0.00	1.00	(N47)
Single Family Appliance Management						
Appliance Removal	Refrigerators	0.00	0.00	0.00	1.00	(N47)
Baseload	Basic Educational Measures	0.00	0.00	0.00	1.00	(N47)
CFL	CFL Bulbs	0.00	0.00	0.00	1.00	(N47)
DHWater Measure (electric)	DHW Measures	0.00	0.00	0.00	1.00	(N47)
DHWater Measure (gas & other)	DHW Measures	0.00	0.00	0.00	1.00	(N47)
DHWater Measure (oil)	DHW Measures	0.00	0.00	0.00	1.00	(N47)
Heating system replacement	Heating System Replacement	0.00	0.00	0.00	1.00	(N47)
Indoor Fixtures	Indoor Fixtures	0.00	0.00	0.00	1.00	(N47)
LED Bulbs LI	LED Lighting	0.00	0.00	0.00	1.00	(N47)
Programmable thermostat	Programmable Thermostats	0.00	0.00	0.00	1.00	(N47)

Residential Electric Efficiency Measures

Measure	Measure Category	FR	SOp	SOnp	NTG	Source
Single Family Appliance Management						
Replacement Freezer	Freezer Replacement	0.00	0.00	0.00	1.00	(N47)
Replacement Refrigerator	Refrigerator Replacement	0.00	0.00	0.00	1.00	(N47)
Smart strips	Smart Strips	0.00	0.00	0.00	1.00	(N47)
Waterbed mattress replacement	Waterbed Replacement	0.00	0.00	0.00	1.00	(N47)
Weatherization (electric)	Weatherization	0.00	0.00	0.00	1.00	(N47)
Weatherization (oil)	Weatherization	0.00	0.00	0.00	1.00	(N47)
Window AC Replacements	Window AC (Retrofit)	0.00	0.00	0.00	1.00	(N47)

Commercial Electric Efficiency Measures

Measure	Measure Category	FR	SOp	SOnp	NTG	Source
Commercial New Construction						
Air-cooled chiller	Chillers	0.42	0.00	0.14	0.72	(121)
Air-cooled heat pump	Heat Pump Systems	0.42	0.00	0.14	0.72	(121)
Commercial electric griddle	Commercial Electric Griddle	0.42	0.00	0.14	0.72	(121)
Commercial electric oven	Commercial Electric Ovens	0.42	0.00	0.14	0.72	(121)
Commercial electric steamer	Commercial Electric Steamer	0.42	0.00	0.14	0.72	(121)
Commercial Electroic Convection Oven	Commercial Electric Ovens	0.42	0.00	0.14	0.72	(121)
Commercial Fryer	Commercial Electric Fryers	0.42	0.00	0.14	0.72	(121)
Custom Comprehensive Design (CDA)	Custom Measures	0.11	0.00	0.00	0.89	(119)
Custom HVAC	Custom Measures	0.33	0.00	0.00	0.67	(121)
Custom Lighting	Custom Measures	0.33	0.00	0.00	0.67	(121)
Custom Motor	Custom Measures	0.33	0.00	0.00	0.67	(121)
Custom Other	Custom Measures	0.33	0.00	0.00	0.67	(121)
Custom Process	Custom Measures	0.33	0.00	0.00	0.67	(121)
Custom Refrigeration	Custom Measures	0.33	0.00	0.00	0.67	(121)
Daylight dimming	Lighting Controls	0.42	0.00	0.14	0.72	(121)
Demand control ventilation	Demand Control Ventilation	0.42	0.00	0.14	0.72	(121)
Dryer (100≤CFM<200)	Refrigerated Air Dryers	0.42	0.00	0.14	0.72	(121)
Dryer (200≤CFM<300)	Refrigerated Air Dryers	0.42	0.00	0.14	0.72	(121)
Dryer (300≤CFM<400)	Refrigerated Air Dryers	0.42	0.00	0.14	0.72	(121)
Dryer (CFM ≥400)	Refrigerated Air Dryers	0.42	0.00	0.14	0.72	(121)
Dryer (CFM<100)	Refrigerated Air Dryers	0.42	0.00	0.14	0.72	(121)

Commercial Electric Efficiency Measures						
Measure	**Measure Category**	**FR**	**SOp**	**SOnp**	**NTG**	**Source**
Commercial New Construction						
Dual enthalpy economizer controls	Dual Enthalpy Economizer Controls	0.42	0.00	0.14	0.72	(121)
ECM fan motor for HVAC	ECM Fan Motors for HVAC	0.42	0.00	0.14	0.72	(121)
Ground source (closed loop) heat pump	Heat Pump Systems	0.42	0.00	0.14	0.72	(121)
Groundwater source (open loop) heat pump	Heat Pump Systems	0.42	0.00	0.14	0.72	(121)
LED Street Lights	Street Lighting	0.00	0.00	0.00	1.00	(N47)
LEDs	Upstream Lighting	0.09	0.01	0.00	0.93	(121)
LEDs for freezer/cooler cases	Freezer/Cooler LEDs	0.42	0.00	0.14	0.72	(121)
Lighting systems	Lighting Systems	0.42	0.00	0.14	0.72	(121)
Linear Fluorescents	Upstream Lighting	0.09	0.01	0.00	0.93	(121)
Load/No Load (15≤HP<25)	High Efficiency Air Compressors	0.42	0.00	0.14	0.72	(121)
Load/No Load (25≤HP≤75)	High Efficiency Air Compressors	0.42	0.00	0.14	0.72	(121)
Low pressure drop filter	Low Pressure Drop Filters	0.42	0.00	0.14	0.72	(121)
Occupancy sensors	Lighting Controls	0.42	0.00	0.14	0.72	(121)
Performance lighting	Performance Lighting	0.42	0.00	0.14	0.72	(121)
Unitary AC (air-cooled)	Unitary Air Conditioners	0.42	0.00	0.14	0.72	(121)
Unitary AC (evaporatively-cooled)	Unitary Air Conditioners	0.42	0.00	0.14	0.72	(121)
Variable Displacement (50≤HP≤75)	High Efficiency Air Compressors	0.42	0.00	0.14	0.72	(121)
Variable speed drives	Variable Speed Drives	0.42	0.00	0.14	0.72	(121)
Variable speed drives w/motor	Variable Speed Drives	0.42	0.00	0.14	0.72	(121)
VSD (15≤HP<25)	High Efficiency Air Compressors	0.42	0.00	0.14	0.72	(121)
VSD (25≤HP≤75)	High Efficiency Air Compressors	0.42	0.00	0.14	0.72	(121)
Water source heat pump	Heat Pump Systems	0.42	0.00	0.14	0.72	(121)
Water-cooled chiller	Chillers	0.42	0.00	0.14	0.72	(121)
Zero loss condensate drain	Zero Loss Condensate Drains	0.42	0.00	0.14	0.72	(121)
Commercial Retrofit						
Case ECMs	Case Motor Replacement	0.28	0.07	0.00	0.79	(121)

Commercial Electric Efficiency Measures						
Measure	**Measure Category**	**FR**	**SOp**	**SOnp**	**NTG**	**Source**
Commercial Retrofit						
Comprehensive Retrofit (CR)	Custom Measures	0.09	0.07	0.00	0.99	(121)
Cooler night cover	Cooler Night Covers	0.28	0.07	0.00	0.79	(121)
Custom Compressed Air	Custom Measures	0.09	0.07	0.00	0.99	(121)
Custom HVAC	Custom Measures	0.09	0.07	0.00	0.99	(121)
Custom Lighting	Custom Measures	0.09	0.07	0.00	0.99	(121)
Custom Motor	Custom Measures	0.09	0.07	0.00	0.99	(121)
Custom Other	Custom Measures	0.09	0.07	0.00	0.99	(121)
Custom Process	Custom Measures	0.09	0.07	0.00	0.99	(121)
Custom Refrigation	Custom Measures	0.09	0.07	0.00	0.99	(121)
Defrost control	Electronic Defrost Controls	0.28	0.07	0.00	0.79	(121)
Door heater control	Door Heater Controls	0.28	0.07	0.00	0.79	(121)
ECM evaporator fan motors (walk–in coolers/ freezers)	ECM Evaporator Fan Motors for Walk-in Coolers and Freezers	0.28	0.07	0.00	0.79	(121)
Energy management system	Energy Management Systems	0.28	0.07	0.00	0.79	(121)
Evaporator fan control	Evaporator Fan Controls	0.28	0.07	0.00	0.79	(121)
Glass front refrigerated coolers	Vending Misers	0.28	0.07	0.00	0.79	(121)
Hotel occupancy sensor	Hotel Occupancy Sensors	0.28	0.07	0.00	0.79	(121)
LEDs for freezer/cooler cases	Freezer/Cooler LEDs	0.28	0.07	0.00	0.79	(121)
Lighting systems	Lighting Systems	0.28	0.07	0.00	0.79	(121)
Non-refrigerated snack vending machine	Vending Misers	0.28	0.07	0.00	0.79	(121)
Novelty cooler shutoff	Novelty Cooler Shutoff	0.28	0.07	0.00	0.79	(121)
Occupancy sensors	Lighting Controls	0.28	0.07	0.00	0.79	(121)
Refrigerated beverage vending machine	Vending Misers	0.28	0.07	0.00	0.79	(121)
Variable speed drives	Variable Speed Drives	0.28	0.07	0.00	0.79	(121)
Variable speed drives w/motor	Variable Speed Drives	0.28	0.07	0.00	0.79	(121)
Direct Install						
Custom lighting	Custom Measures	0.10	0.03	0.00	0.93	(120)
Custom other	Custom Measures	0.10	0.03	0.00	0.93	(120)
Custom refrigeration	Custom Measures	0.10	0.03	0.00	0.93	(120)
Door Heater Control	Door Heater Controls	0.10	0.03	0.00	0.93	(120)

Commercial Electric Efficiency Measures

Measure	Measure Category	FR	SOp	SOnp	NTG	Source
Direct Install						
ECM Evaporator fan Motors for Walk-in Coolers and Freezers	ECM Evaporator fan Motors for Walk-in Coolers and Freezers	0.10	0.03	0.00	0.93	(120)
Exterior LED Fixtures	Outdoor Fixtures	0.10	0.03	0.00	0.93	(120)
Fan Control	Evaporator Fan Controls	0.10	0.03	0.00	0.93	(120)
Faucet Aerator	Faucet Aerators	0.10	0.03	0.00	0.93	(120)
Freezer Door Heater Controls	Door Heater Controls	0.10	0.03	0.00	0.93	(120)
Glass front refrigerated coolers	Vending Misers	0.10	0.03	0.00	0.93	(120)
LED Exit Signs	Lighting Systems	0.10	0.03	0.00	0.93	(120)
LEDs for freezer/cooler cases	Freezer/Cooler LEDs	0.10	0.03	0.00	0.93	(120)
Lighting systems	Lighting Systems	0.10	0.03	0.00	0.93	(120)
Low-Flow Showerhead	Low-Flow Showerheads	0.10	0.03	0.00	0.93	(120)
Non-refrigerated snack vending machine	Vending Misers	0.10	0.03	0.00	0.93	(120)
Novelty Cooler Shutoff	Novelty Cooler Shutoff	0.10	0.03	0.00	0.93	(120)
Occupancy sensors	Lighting Controls	0.10	0.03	0.00	0.93	(120)
Pre-Rinse Spray Valve	Pre-Rinse Spray Valves	0.10	0.03	0.00	0.93	(120)
Programmable Thermostats	Programmable Thermostats	0.10	0.03	0.00	0.93	(120)
Refrigerated beverage vending machine	Vending Misers	0.10	0.03	0.00	0.93	(120)
Refrigerator Recycling	Refrigerator/Freezer Removal	0.10	0.03	0.00	0.93	(120)
Salon Nozzle	Salon Nozzles	0.10	0.03	0.00	0.93	(120)
Screw-in CFL	Lighting Systems	0.10	0.03	0.00	0.93	(120)

Residential Gas Efficiency Measures

Measure	Measure Category	FR	SOp	SOnp	NTG	Source
EnergyStar® HVAC						
Boiler (forced hot water) >= 95% AFUE	Boilers	0.32	0.08	0.00	0.76	(130)
Boiler Load Controls	Boiler Controls	0.00	0.00	0.00	1.00	(N47)
Boiler Reset Controls	Boiler Controls	0.00	0.00	0.00	1.00	(N47)
Condensing Gas Water Heater (THERMAL EFICIENCY 0.95)	Water Heaters	0.37	0.00	0.00	0.63	(81)
Furnace (forced hot air) >= 97% AFUE	Furnaces	0.41	0.22	0.00	0.81	(130)

Residential Gas Efficiency Measures						
Measure	**Measure Category**	**FR**	**SOp**	**SOnp**	**NTG**	**Source**
EnergyStar® HVAC						
Furnace (forced hot air) 95% AFUE w/ECM	Furnaces	0.41	0.22	0.00	0.81	(130)
Hard-to-reach Boiler (forced hot water) >= 95% AFUE	Boilers	0.32	0.08	0.00	0.76	(130)
Hard-To-Reach Boiler (forced hot water) 90% AFUE	Boilers	0.11	0.03	0.00	0.92	(130)
Hard-To-Reach Boiler Reset Controls	Boiler Controls	0.00	0.00	0.00	1.00	(N47)
Hard-To-Reach Condensing Gas Water Heater (THERMAL EFICIENCY 0.95)	Water Heaters	0.12	0.00	0.00	0.88	(81)
Hard-to-reach Furnace (forced hot air) >= 97% AFUE	Furnaces	0.14	0.03	0.00	0.89	(130)
Hard-to-Reach Furnace (forced hot air) 95% AFUE w/ECM	Furnaces	0.14	0.07	0.00	0.94	(130)
Hard-to-Reach Heat Recovery Ventilator	Heat Recovery Ventilators	0.00	0.00	0.00	1.00	(N47)
Hard-to-Reach High Efficiency Stand Alone Water Heater (0.67 EF)	Water Heaters	0.04	0.03	0.00	0.98	(130)
Hard-To-Reach Integrated water heater/condensing boiler	Integrated Boiler/Water Heater	0.11	0.03	0.00	0.91	(130)
Hard-to-Reach Tankless Water Heaters (EF 0.94)	Water Heaters	0.08	0.00	0.00	0.92	(130)
Hard-to-Reach Tankless Water Heaters (EF 0.95)	Water Heaters	0.09	0.08	0.00	0.99	(130)
Heat Recovery Ventilator	Heat Recovery Ventilators	0.00	0.00	0.00	1.00	(N47)
High Efficiency Stand Alone Water Heater (0.67 EF)	Water Heaters	0.13	0.13	0.00	1.00	(130)
Integrated water heater/condensing boiler	Integrated Boiler/Water Heater	0.34	0.08	0.00	0.74	(130)
Tankless Water Heaters (EF 0.94)	Water Heaters	0.25	0.20	0.00	0.95	(130)
Tankless Water Heaters (EF 0.95)	Water Heaters	0.28	0.25	0.00	0.97	(130)
WiFi Enabled Thermostat	Programmable Thermostats	0.00	0.00	0.00	1.00	(N47)
WiFi Enabled Thermostat with Cooling	Programmable Thermostats	0.00	0.00	0.00	1.00	(N47)
EnergyWise						

Residential Gas Efficiency Measures

Measure	Measure Category	FR	SOp	SOnp	NTG	Source
EnergyWise						
Faucet aerator	Faucet Aerators	0.00	0.00	0.00	1.00	(N47)
Low Flow Showerhead Control	Low-Flow Showerheads With Controls	0.00	0.00	0.00	1.00	(N47)
Low Flow Showerhead Control - Adapter	Low-Flow Showerheads With Controls	0.00	0.00	0.00	1.00	(N47)
Low-flow showerhead	Low-Flow Showerheads	0.00	0.00	0.00	1.00	(N47)
Programmable thermostat	Programmable Thermostats	0.00	0.00	0.00	1.00	(N47)
SF Air Sealing	EW Air Sealing	0.00	0.00	0.00	1.00	(N47)
SF Other Insulation - attic staircase cover (therma-dome)	EW Other Insulation	0.00	0.00	0.00	1.00	(N47)
SF Other Insulation - Existing Hatches: weaatherstrip, insulate, dam perimeter	EW Other Insulation	0.00	0.00	0.00	1.00	(N47)
SF Shell Insulation	EW Shell Insulation	0.00	0.00	0.00	1.00	(N47)
WiFi programmable thermostat	Programmable Thermostats	0.00	0.00	0.00	1.00	(N47)
EnergyWise MultiFamily						
Faucet aerator	Faucet Aerators	0.00	0.00	0.00	1.00	(N47)
Low Flow Showerhead Control	Low-Flow Showerheads With Controls	0.00	0.00	0.00	1.00	(N47)
Low Flow Showerhead Control - Adapter	Low-Flow Showerheads With Controls	0.00	0.00	0.00	1.00	(N47)
Low-flow showerhead	Low-Flow Showerheads	0.00	0.00	0.00	1.00	(N47)
MF Air Sealing	EW Air Sealing	0.00	0.00	0.00	1.00	(N47)
MF Other Insulation - attic staircase cover (therma-dome)	EW Other Insulation	0.00	0.00	0.00	1.00	(N47)
MF Other Insulation - Existing Hatches: weaatherstrip, insulate, dam perimeter	EW Other Insulation	0.00	0.00	0.00	1.00	(N47)
MF Shell Insulation	EW Shell Insulation	0.00	0.00	0.00	1.00	(N47)
Programmable thermostat	Programmable Thermostats	0.00	0.00	0.00	1.00	(N47)
WiFi programmable thermostat	Programmable Thermostats	0.00	0.00	0.00	1.00	(N47)
Home Energy Reports						
Opt-out dual fuel	Home Energy Reports	0.00	0.00	0.00	1.00	(N25)
Opt-out gas	Home Energy Reports	0.00	0.00	0.00	1.00	(N25)
Income Eligible MultiFamily						

Residential Gas Efficiency Measures

Measure	Measure Category	FR	SOp	SOnp	NTG	Source
Income Eligible MultiFamily						
Faucet aerator	Faucet Aerators	0.00	0.00	0.00	1.00	(N47)
LI MF Air Sealing	EW Air Sealing	0.00	0.00	0.00	1.00	(N47)
LI MF Other Insulation - attic staircase cover (therma-dome)	EW Other Insulation	0.00	0.00	0.00	1.00	(N47)
LI MF Other Insulation - Existing Hatches: weaatherstrip, insulate, dam perimeter	EW Other Insulation	0.00	0.00	0.00	1.00	(N47)
LI MF Shell Insulation	EW Shell Insulation	0.00	0.00	0.00	1.00	(N47)
LI MF Water heating system replacement	Water Heating System Replacement	0.00	0.00	0.00	1.00	(N47)
Low Flow Showerhead Control	Low-Flow Showerheads With Controls	0.00	0.00	0.00	1.00	(N47)
Low Flow Showerhead Control - Adapter	Low-Flow Showerheads With Controls	0.00	0.00	0.00	1.00	(N47)
Low-flow showerhead	Low-Flow Showerheads	0.00	0.00	0.00	1.00	(N47)
Programmable thermostat	Programmable Thermostats	0.00	0.00	0.00	1.00	(N47)
Residential New Construction						
Deep Energy Retrofit Basements	Deep Energy Retrofit	0.00	0.00	0.00	1.00	(N47)
Deep Energy Retrofit Basements - Air Flow Reduction	Deep Energy Retrofit	0.00	0.00	0.00	1.00	(N47)
Deep Energy Retrofit Roofs	Deep Energy Retrofit	0.00	0.00	0.00	1.00	(N47)
Deep Energy Retrofit Roofs - Air Flow Reduction	Deep Energy Retrofit	0.00	0.00	0.00	1.00	(N47)
Deep Energy Retrofit Walls	Deep Energy Retrofit	0.00	0.00	0.00	1.00	(N47)
Deep Energy Retrofit Walls - Air Flow Reduction	Deep Energy Retrofit	0.00	0.00	0.00	1.00	(N47)
Heating	Heating	0.00	0.00	0.00	1.00	(N47)
Hot water heating	DHW Measures	0.00	0.00	0.00	1.00	(N47)
Low-flow showerhead	Low-Flow Showerheads	0.00	0.00	0.00	1.00	(N47)
Renovation Rehab Domestic Hot Water	Renovation Rehab	0.00	0.00	0.00	1.00	(N47)
Renovation Rehab Heating	Renovation Rehab	0.00	0.00	0.00	1.00	(N47)
Single Family Appliance Management						
Heating system replacement	Heating System Replacement	0.00	0.00	0.00	1.00	(N47)

Residential Gas Efficiency Measures						
Measure	**Measure Category**	**FR**	**SOp**	**SOnp**	**NTG**	**Source**
Single Family Appliance Management						
Weatherization	Weatherization	0.00	0.00	0.00	1.00	(N47)

Commercial Gas Efficiency Measures						
Measure	**Measure Category**	**FR**	**SOp**	**SOnp**	**NTG**	**Source**
Commercial and Industrial MultiFamily						
Faucet aerator	Faucet Aerators	0.00	0.00	0.00	1.00	(N47)
Low-flow showerhead	Low-Flow Showerheads	0.00	0.00	0.00	1.00	(N47)
MF Air Sealing	EW Air Sealing	0.00	0.00	0.00	1.00	(N47)
MF Heating System Replacement	Heating System Replacement	0.00	0.00	0.00	1.00	(N47)
MF Other Insulation - attic staircase cover (therma-dome)	EW Other Insulation	0.00	0.00	0.00	1.00	(N47)
MF Other Insulation - Existing Hatches: weaatherstrip, insulate, dam perimeter	EW Other Insulation	0.00	0.00	0.00	1.00	(N47)
MF Shell Insulation	EW Shell Insulation	0.00	0.00	0.00	1.00	(N47)
Commercial New Construction						
Commercial gas fryer	Commercial Fryer	0.37	0.00	0.00	0.63	(120)
Commercial gas griddle	Commercial Griddle	0.37	0.00	0.00	0.63	(120)
Commercial gas steamer (>= 38% efficiency)	Commercial Steamer	0.37	0.00	0.00	0.63	(120)
Condensing boiler <= 300 MBH 90%	Boilers	0.37	0.00	0.00	0.63	(120)
Condensing boiler <= 300 MBH 95%	Boilers	0.37	0.00	0.00	0.63	(120)
Condensing boiler 1000-1700 MBH	Boilers	0.37	0.00	0.00	0.63	(120)
Condensing boiler 1701+ MBH	Boilers	0.37	0.00	0.00	0.63	(120)
Condensing boiler 301-499 MBH	Boilers	0.37	0.00	0.00	0.63	(120)
Condensing boiler 500-999 MBH	Boilers	0.37	0.00	0.00	0.63	(120)
Condensing stand-alone water heater (75-300 MBH) (TE >= 0.95)	Water Heaters	0.37	0.00	0.00	0.63	(120)
Condensing Unit heater	Condensing Unit Heater	0.37	0.00	0.00	0.63	(120)
Custom New Construction	Custom Measures	0.12	0.00	0.00	0.88	(120)

Commercial Gas Efficiency Measures						
Measure	**Measure Category**	**FR**	**SOp**	**SOnp**	**NTG**	**Source**
Commercial New Construction						
Furnace 95+ AFUE (<150) w/ECM Motor	Furnaces	0.37	0.00	0.00	0.63	(120)
Furnace 97+ AFUE (<150) w/ECM Motor	Furnaces	0.37	0.00	0.00	0.63	(120)
Gas-fired combination oven (>= 44% efficiency)	Commercial Gas-Fired Ovens	0.37	0.00	0.00	0.63	(120)
Gas-fired convection oven (>= 44% efficiency)	Commercial Gas-Fired Ovens	0.37	0.00	0.00	0.63	(120)
Gas-fired conveyer oven (>= 44% efficiency)	Commercial Gas-Fired Ovens	0.37	0.00	0.00	0.63	(120)
Gas-fired rack oven (>= 50% efficiency)	Commercial Gas-Fired Ovens	0.37	0.00	0.00	0.63	(120)
Indirect water heater (EF >= 0.82, CAE >= 85%)	Water Heaters	0.37	0.00	0.00	0.63	(120)
Infrared heater	Infrared Heater	0.37	0.00	0.00	0.63	(120)
Integrated water heater/condensing boiler (EF 0.90; AFUE 90%)	Integrated Boiler/Water Heater	0.37	0.00	0.00	0.63	(120)
On-demand tankless water heater (EF>=0.82)	Water Heaters	0.37	0.00	0.00	0.63	(120)
On-demand tankless water heater (EF>=0.95)	Water Heaters	0.37	0.00	0.00	0.63	(120)
Commercial Retrofit						
Boiler reset control (multi-stage)	Boiler Controls	0.00	0.00	0.00	1.00	(120)
Building operator certification	Building Operator Certification	0.00	0.00	0.00	1.00	(120)
Custom Retrofit	Custom Measures	0.17	0.08	0.00	0.91	(120)
Low-Flow Showerhead	Low-Flow Showerheads	0.00	0.00	0.00	1.00	(120)
Pre-rinse spray valve	Pre-Rinse Spray Valves	0.00	0.00	0.00	1.00	(120)
Programmable thermostat	Programmable Thermostats	0.00	0.00	0.00	1.00	(120)
Steam trap	Steam Traps	0.00	0.00	0.00	1.00	(120)
Direct Install						
Boiler Reset Control	Boiler Controls	0.03	0.02	0.00	1.00	(120)
Faucet aerator	Faucet Aerators	0.03	0.02	0.00	1.00	(120)
Insulation Pipe Diameter 1.5in H2O	Pipe Insulation	0.03	0.02	0.00	1.00	(120)
Insulation Pipe Diameter 1.5in Steam	Pipe Insulation	0.03	0.02	0.00	1.00	(120)

Commercial Gas Efficiency Measures						
Measure	**Measure Category**	**FR**	**SOp**	**SOnp**	**NTG**	**Source**
Direct Install						
Insulation Pipe Diameter 2in H2O	Pipe Insulation	0.03	0.02	0.00	1.00	(120)
Insulation Pipe Diameter 2in Steam	Pipe Insulation	0.03	0.02	0.00	1.00	(120)
Low-flow showerhead	Low-Flow Showerheads	0.03	0.02	0.00	1.00	(120)
Pre-rinse spray valve	Pre-Rinse Spray Valves	0.03	0.02	0.00	1.00	(120)
Programmable thermostat	Programmable Thermostats	0.03	0.02	0.00	1.00	(120)
Salon Nozzle	Salon Nozzles	0.03	0.02	0.00	1.00	(120)
SBS Custom Measures	Custom Measures	0.03	0.02	0.00	1.00	(120)
Steam trap	Steam Traps	0.03	0.02	0.00	1.00	(120)

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N21 Consistent with MA TRM

N25 Free-ridership and spillover are not applicable as customers cannot participate without the utility program.

N28 MA Common Assumption

N30 Massachusetts Common Assumption

N47 The Net-to-Gross ratio is assumed to be 100%.

Appendix C: Non-Energy Impacts

Per Measure Residential Non-Energy Impacts for Electric and Gas Programs

End Use	TRM Measures	NEI	Description	Value or Algorithm	Basis	Duration
Lighting	Indoor Fixture Outdoor Fixture LED Fixture	Lighting Quality and Lifetime	O&M savings due to more efficient fixtures	$3.50	per measure	One Time
	CFL Bulb LED Bulb	Lighting Quality and Lifetime	O&M savings due to more efficient bulbs	$3.00	per measure	One Time
Products	Refrigerator/Freezer Recycling	Refrigerator/Freezer Turn-in	Non-energy benefits of turning in a refrigerator and/or freezer as part of the MA turn-in program. The total benefit is comprised of 3 parts: $1.06 for avoided landfill space, $1.25 for recycling of plastics and glass, and $170.22 for incineration insulating foam.	$172.53	per measure	One Time
HVAC	Heating System (Retrofit and Rebate)	Improved Safety	Reduced incidence of fire and carbon monoxide exposure as a result of installing a new heating system	$45.05	per measure	Annual
	Window AC (Retrofit)	Window Air Conditioner Replacement	Non-energy benefits associated with installing a new room air conditioner replacement	$49.50	per measure	Annual

End Use	TRM Measures	NEI	Description	Value or Algorithm	Basis	Duration
Various	All Measures with oil savings	National Security	Reducing the need for foreign energy imports thereby increasing national security	MMBTU Oil Savings * $1.83	per measure	Annual
	All electric measures with kWh savings and all gas measures with MMBTU savings.	Rate Discounts	Financial savings to utility as a result of a smaller portion of energy being sold at the low income rate	**Elec:** (kwh savings per measure)*(A16-A60) **Gas:** (therms savings per measure)*(R12-R13)	per measure	Annual

(1) The NEIs in this table represent impacts that accrue specifically measures in the 2014 RI portfolio of programs.

Per Measure Commercial and Industrial Non-Energy Impacts for Electric and Gas Programs

End Use	TRM Measures	NEI	Description	Value	Basis	Type
Lighting	Large Retrofit Prescriptive Lighting	Varies (1)	A compiled value representing a number of NEI categories studied in the referenced evaluation.	$0.027	Net kWh Saved	Annual
	New Construction CFL O&M	O&M Savings (2)	Operation & Maintenance savings from fewer replacements over the life of the more efficient measure	$17.93	Unit	Annual
	New Construction LED Traffic Light O&M	O&M Savings (2)	Operation & Maintenance savings from fewer replacements over the life of the more efficient measure	$30.02	Unit	Annual
	New Construction Control/Sensor O&M	O&M Savings (2)	Operation & Maintanence savings from fewer replacements over the life of the more efficient measure	$6.69	kW Saved	Annual
Electric HVAC	Large Retrofit Prescriptive HVAC	Multiple (1)	A compiled value representing a number of NEI categories studied in the referenced evaluation.	$0.097	Net kWh Saved	Annual
Electric Custom	Large Retrofit Custom Electric	Multiple (1)	A compiled value representing a number of NEI categories studied in the referenced evaluation.	$0.037	Net kWh Saved	Annual

End Use	TRM Measures	NEI	Description	Value	Basis	Type
CHP	Large Retrofit CHP	Economic development	Economic development benefits, as required by the amendment to the Least Cost Procurement law, R.I.G.L. § 39-1-27.7(c)(6)(ii) – (iv) enacted in June 2012	$0.39	Net kWh Saved	One-Time
		Multiple (1)	A compiled value representing a number of NEI categories studied in the referenced evaluation.	-$0.015	Net kWh Saved	Annual
Gas HVAC	Retrofit Boiler, Reset Controls, Retrofit Thermostat	Multiple (1)	A compiled value representing a number of NEI categories studied in the referenced evaluation.	$0.135	Net kWh Saved	Annual
Gas Custom	Large Retrofit Custom Gas	Multiple (1)	A compiled value representing a number of NEI categories studied in the referenced evaluation.	$0.250	Net kWh Saved	Annual

(1) Source is Tetra Tech Inc. "Massachusetts Program Administrators Final Report - Commercial & Industrial Non-Energy Impacts Study, 6/29/2012
(2) (2) Source is Optimal Energy, Inc. MEMO "Non-Electric Benefits Analysis Update" 11/7/2008

Per Participant Non-Energy Impacts for Residential Electric Measures

Program	NEI	Description	Measure Category	Value	Duration
Residential New Construction	Thermal Comfort	Greater participant-perceived comfort in home	N/A	$77.00	Annual
	Noise Reduction	Less participant-perceived noise in the home		$40.00	Annual
	Property Value Increase	Increased value of property and expected ease of selling home		$72.00	Annual
Residential Cooling and Heating Equipment	Thermal Comfort	Greater participant-perceived comfort in home	Heating System Cooling System Heating and Cooling System	$48.63 $3.92 $5.05	Annual
	Noise Reduction	Less participant-perceived noise in the home	Cooling System Heating and Cooling System	$2.83 $1.42	Annual
	Home Durability	Increased home durability from better quality heating, cooling and structural materials	Heating System Cooling System Heating and Cooling System	$17.42 $1.54 $1.98	Annual
	Equipment Maintenance	Reduced maintenance costs of owning newer and/or more efficient appliance equipment	Heating System Cooling System Heating and Cooling System	$102.40 $7.54 $9.42	Annual
	Health Benefits	Fewer colds and viruses, improved indoor air quality and ease of maintaining healthy relative humidity from weatherization	Heating System Cooling System Heating and Cooling System	$1.56 $0.13 $0.16	Annual
	Property Value Increase	Increased value of property and expected ease of selling home	Heating System Cooling System Heating and Cooling System	$678.52 $62.65 $80.69	One Time
			Air Sealing	$0.32	
			Air Sealing	$135.83	

Program	NEI	Description	Measure Category	Value	Duration
Single Family - Income Eligible Services	Arrearages	Reduced arrearage carrying costs as a result of customers being more able to pay their lower bills	N/A	$2.61	Annual
	Bad Debt Write-offs	Reduced costs to utility of uncollectable, unpaid balances as a result of customers being more able to pay their lower bills		$3.74	Annual
	Terminations and Reconnections	Reduced costs associated with terminations and reconnections to utility due to nonpayment as a result of customers being more able to pay their lower bills		$0.43	Annual
	Customer Calls and Collections	Utility savings in staff time and materials for fewer customer calls as a result of more timely bill payments		$0.58	Annual
	Notices	Financial savings to utility as a result of fewer notices sent to customers for late payments and terminations		$0.34	Annual
	Thermal Comfort	Greater participant-perceived comfort in home	Insulation Air Sealing Heating System	$25.38 $30.23 $28.01	Annual
	Noise Reduction	Less participant-perceived noise in the home	Insulation Air Sealing	$13.56 $16.39	Annual
	Home Durability	Increased home durability from better quality heating, cooling and structural materials	Insulation Air Sealing Heating System	$8.76 $10.61 $9.72	Annual
	Equipment Maintenance	Reduced maintenance costs of owning newer and/or more efficient appliance equipment	Heating System	$27.43	Annual
	Health Benefits	Fewer colds and viruses, improved indoor air quality and ease of maintaining healthy relative humidity from weatherization	Insulation Air Sealing Heating System	$4.77 $5.69 $5.27	Annual

Program	NEI	Description	Measure Category	Value	Duration
Single Family - Income Eligible Services	Property Value Increase	Increased value of property and expected ease of selling home	Insulation Air Sealing Heating System	$223.63 $144.93 $249.20	Annual
	Safety-Related Emergency Calls	Financial savings to the utility as a result of fewer safety related emergency calls being made	Heating System	$8.43	Annual
EnergyWise Single Family and Multifamily	Thermal Comfort	Greater participant-perceived comfort in home	Insulation	$25.15	Annual
			Air Sealing	$10.13	
	Noise Reduction	Less participant-perceived noise in the home	Insulation	$11.54	Annual
			Air Sealing	$4.88	
	Home Durability	Increased home durability in terms of maintenance requirements because of better quality heating, cooling and structural materials	Insulation	$9.82	Annual
			Air Sealing	$3.95	
	Health Benefits	Fewer colds and viruses, improved indoor air quality and ease of maintaining healthy relative humidity as a result of weatherization in home	Insulation	$0.80	Annual
			Air Sealing	$0.32	
	Property Value Increase	Increased value of property and expected ease of selling home	Insulation	$378.05	One Time
			Air Sealing	$135.83	

Program	NEI	Description	Measure Category	Value	Duration
EnergyWise Income Eligible Multifamily Retrofit	Rental Units Marketability	Financial savings to owners of LI rental housing as a result of increased marketability of the more efficient housing.	N/A	$0.96	Annual
	Property Durability	Financial savings to owners of LI rental housing as a result of more durable and efficient materials being installed.		$36.85	Annual
	Reduced Tenant Complaints	Savings to owners of LI rental housing in terms of staff time and materials as a result of fewer tenant complaints with the more efficient measures.		$19.61	Annual
	Rental Unit Increased Property Value	Owner-perceived increased property value due to more energy efficient measures		$17.03	One Time
	Arrearages	Reduced arrearage carrying costs as a result of customers being more able to pay lower bills		$2.61	Annual
	Bad Debt Write-offs	Reduced costs to utility of uncollectable, unpaid balances as a result of customers being more able to pay their lower bills		$3.74	Annual
	Terminations and Reconnections	Reduced costs associated with terminations and reconnections to utility due to nonpayment as a result of customers being more able to pay their lower bills		$0.43	Annual
	Customer Calls and Collections	Utility savings in staff time and materials for fewer customer calls as a result of more timely bill payments		$0.58	Annual
	Notices	Financial savings to utility as a result of fewer notices sent to customers for late payments and terminations		$0.34	Annual

Program	NEI	Description	Measure Category	Value	Duration
EnergyWise Income Eligible Multifamily Retrofit	Thermal Comfort	Greater participant-perceived comfort in home	Insulation	$25.38	Annual
			Air Sealing	$30.23	
	Noise Reduction	Less participant-perceived noise in the home	Insulation	$13.56	Annual
			Air Sealing	$16.39	
	Home Durability	Increased home durability in terms of maintenance requirements because of better quality heating, cooling and structural materials	Insulation	$8.76	Annual
			Air Sealing	$10.61	
	Health Benefits	Fewer colds and viruses, improved indoor air quality and ease of maintaining healthy relative humidity as a result of weatherization in home	Insulation	$4.77	Annual
			Air Sealing	$5.69	
	Property Value Increase	Increased value of property and expected ease of selling home	Insulation	$223.63	Annual
			Air Sealing	$144.93	

1) Source of NEIs is "Massachusetts Program Administrators: Massachusetts Special and Cross-Sector Studies Area, Residential and Low-Income Non-Energy Impacts (NEI) Evaluation," NMR Group, Inc., Tetra Tech. 8.15.2011

Per Participant Non-Energy Impacts for Residential Gas Programs

Program	NEI	Description	Measure Category	Value	Duration
Residential Heating and Hot Water	Thermal Comfort	Greater participant-perceived comfort in home	Heating System Heating and Hot Water System	$48.63 $1.83	Annual
	Home Durability	Increased home durability in terms of maintenance requirements because of better quality heating, cooling and structural materials	Heating System Hot Water System Heating and Hot Water System	$17.42 $2.13 $0.72	Annual
	Equipment Maintenance	Reduced maintenance costs of owning newer and/or more efficient appliance equipment	Heating System Heating and Hot Water System	$102.40 $3.41	Annual
	Health Benefits	Fewer colds and viruses, improved indoor air quality and ease of maintaining healthy relative humidity from weatherization	Heating System Heating and Hot Water System	$1.56 $0.06	Annual
	Property Value Increase	Increased value of property and expected ease of selling home	Heating System Hot Water System Heating and Hot Water System	$678.52 $82.56 $29.17	One Time
EnergyWise Single Family	Thermal Comfort	Greater participant-perceived comfort in home	N/A	$25.00	Annual
	Noise Reduction	Less participant-perceived noise in the home		$11.22	Annual
	Home Durability	Increased home durability from better quality heating, cooling and structural materials		$9.57	Annual
	Health Benefits	Fewer colds and viruses, improved indoor air quality and ease of maintaining healthy relative humidity from weatherization		$0.79	Annual
	Property Value Increase	Increased value of property and expected ease of selling home		$381.28	One Time

Program	NEI	Description	Measure Category	Value	Duration
EnergyWise Multi Family	Thermal Comfort	Greater participant-perceived comfort in home	Insulation	$25.15	Annual
			Air Sealing	$10.13	
	Noise Reduction	Less participant-perceived noise in the home	Insulation	$11.54	Annual
			Air Sealing	$4.88	
	Home Durability	Increased home durability in terms of maintenance requirements because of better quality heating, cooling and structural materials	Insulation	$9.82	Annual
			Air Sealing	$3.95	
	Health Benefits	Fewer colds and viruses, improved indoor air quality and ease of maintaining healthy relative humidity as a result of weatherization in home	Insulation	$0.80	Annual
			Air Sealing	$0.32	
	Property Value Increase	Increased value of property and expected ease of selling home	Insulation	$378.05	One Time
			Air Sealing	$135.83	

Program	NEI	Description	Measure Category	Value	Duration
Single Family - Income Eligible Services	Safety-Related Emergency Calls	Financial savings to the utility as a result of fewer safety related emergency calls being made	Heating System	$8.43	Annual
	Thermal Comfort	Greater participant-perceived comfort in home	Insulation Air Sealing Heating System	$25.38 $30.23 $28.01	Annual
	Noise Reduction	Less participant-perceived noise in the home	Insulation Air Sealing	$13.56 $16.39	Annual
	Home Durability	Increased home durability in terms of maintenance requirements because of better quality heating, cooling and structural materials	Insulation Air Sealing Heating System	$8.76 $10.61 $9.72	Annual
	Equipment Maintenance	Reduced maintenance costs of owning newer and/or more efficient appliance equipment	Heating System	$27.43	Annual
	Health Benefits	Fewer colds and viruses, improved indoor air quality and ease of maintaining healthy relative humidity as a result of weatherization in home	Insulation Air Sealing Heating System	$4.77 $5.69 $5.27	Annual
	Property Value Increase	Increased value of property and expected ease of selling home	Insulation	$223.63	One Time
			Air Sealing	$144.93	
			Heating System	$249.20	

Program	NEI	Description	Measure Category	Value	Duration
Single Family - Income Eligible Services	Arrearages	Reduced arrearage carrying costs as a result of customers being more able to pay their lower bills	N/A	$2.61	Annually
	Bad Debt Write-offs	Reduced costs to utility of uncollectable, unpaid balances as a result of customers being more able to pay their lower bills		$3.74	Annually
	Terminations and Reconnections	Reduced costs associated with terminations and reconnections to utility due to nonpayment as a result of customers being more able to pay their lower bills		$0.43	Annually
	Customer Calls and Collections	Utility savings in staff time and materials for fewer customer calls as a result of more timely bill payments		$0.58	Annually
	Notices	Financial savings to utility as a result of fewer notices sent to customers for late payments and terminations		$0.34	Annually

Program	NEI	Description	Measure Category	Value	Duration
EnergyWise Income Eligible Multifamily Retrofit	Rental Units Marketability	Financial savings to owners of LI rental housing as a result of increased marketability of the more efficient housing.	Air Sealing	$0.07	Annual
	Property Durability	Financial savings to owners of LI rental housing as a result of more durable and efficient materials being installed.	Air Sealing	$2.58	Annual
	Reduced Tenant Complaints	Savings to owners of LI rental housing in terms of staff time and materials as a result of fewer tenant complaints with the more efficient measures.	Air Sealing	$1.37	Annual
	Rental Unit Increased Property Value	Owner-perceived increased property value due to more energy efficient measures	Air Sealing	$1.19	One Time
	Arrearages	Reduced arrearage carrying costs as a result of customers being more able to pay their lower bills	N/A	$2.61	Annual
	Bad Debt Write-offs	Reduced costs to utility of uncollectable, unpaid balances as a result of customers being more able to pay their lower bills		$3.74	Annual
	Terminations and Reconnections	Reduced costs associated with terminations and reconnections to utility due to nonpayment as a result of customers being more able to pay their lower bills		$0.43	Annual
	Customer Calls and Collections	Utility savings in staff time and materials for fewer customer calls as a result of more timely bill payments		$0.58	Annual
	Notices	Financial savings to utility as a result of fewer notices sent to customers for late payments and terminations		$0.34	Annual

Program	NEI	Description	Measure Category	Value	Duration
EnergyWise Income Eligible Multifamily Retrofit	Safety-Related Emergency Calls	Financial savings to the utility as a result of fewer safety related emergency calls being made	Heating System	$8.43	Annual
	Thermal Comfort	Greater participant-perceived comfort in home	Insulation	$25.38	Annual
			Air Sealing	$30.23	
			Heating System	$28.01	
	Noise Reduction	Less participant-perceived noise in the home	Insulation	$13.56	Annual
			Air Sealing	$16.39	
	Home Durability	Increased home durability in terms of maintenance requirements because of better quality heating, cooling and structural materials	Insulation	$8.76	Annual
			Air Sealing	$10.61	
			Heating System	$9.72	
	Equipment Maintenance	Reduced maintenance costs of owning newer and/or more efficient appliance equipment	Heating System	$27.43	Annual
	Health Benefits	Fewer colds and viruses, improved indoor air quality and ease of maintaining healthy relative humidity as a result of weatherization in home	Insulation	$4.77	Annual
			Air Sealing	$5.69	
			Heating System	$5.27	
	Property Value Increase	Increased value of property and expected ease of selling home	Insulation	$223.63	One Time
			Air Sealing	$144.93	
			Heating System	$249.20	

(1) Source of NEIs is "Massachusetts Program Administrators: Massachusetts Special and Cross-Sector Studies Area, Residential and Low-Income Non-Energy Impacts (NEI) Evaluation," NMR Group, Inc., Tetra Tech. 8.15.2011

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1	The Cadmus Group (2012). Massachusetts Residential Retrofit and Low Income Program Area: Brushless Fan Motors Impact Evaluation. Prepared for The Electric and Gas Program Administrators of Massachusetts.	CADMUS_2012_Multifamily_Impacts_Analysis_Report
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3	2013-2015 MA Lighting Worksheet	2013-2015 MA Lighting Worksheet.xls
4	2015 TV Savings RI.xls	2015 TV Savings RI.xls
5	ACEEE (2006). Emerging Technologies Report: Advanced Boiler Controls. Prepared for ACEEE.	ACEEE_2006_Emerging_Technologies_Report_Advanced_Boiler_Controls.pdf
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7	Algorith Inputs are based field experience and evaluation from National Resource Management. Supported by Select Energy (2004). Cooler Control Measure Impact Spreadsheet User's Manual. Prepared for NSTAR.	
8	Algorithm inputs are based on Chan, Tumin (2010). Formation of a Prescriptive Incentive for the VFD and Motors & VFD Impacts Tables at NSTAR. Prepared for NSTAR	
9	Algorithm inputs are based on engineering estimates of cooling hours and 2012 International Code Council (2012). 2012 International Energy Conservation Code; Page C-46, Table C403.2.3(7)	
10	Algorithm Inputs based on UI and CL&P Program Savings Documentation for 2011 Program Year, Section 2.2.2 C&I LO Cooling - Unitary AC & Heat Pumps	
11	ASHRAE Applications Handbook (2003); Page 36.3, assumes combined boiler and water heating systems have a measure life similar to a typical boiler.	

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22	DOE (2008). ENERGY STAR® Residential Water Heaters: Final Criteria Analysis. Prepared for the DOE.	DOE_2008_ENERGY_STAR_Residential_Water_Heaters_Final_Criteria_Analysis.pdf
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29	ENERGYSTAR Commercial Kitchen Equipment Savings Calculator: Fryer Calculations. www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorConsumerRoomAC.xls.	
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46	Environmental Protection Agency (2012). Savings Calculator for ENERGY STAR Qualified Consumer Electronics. Energy use of average screen size within category.	Food_Service_Technology_Center_2010_Gas_Combination_Oven_LifeCycle_Cost_Calculator_Website_Screenshot.pdf
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146	Dehumidifyer Savings 2015.xls	Dehumidifyer Savings 2015.xls
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N1	100% realization rates are assumed because savings are based on researched assumptions by FSTC.	
N2	Algorithm Input kwh/CFM based on NSTAR metering analysis and supported by multiple 3rd part impact evaluations	
N3	Algorithm Input kwh/horsepower based on NSTAR metering analysis and supported by multiple 3rd part impact evaluations	
N4	All installations have 100% in-service rate since programs include verification of equipment installations.	
N5	All PAs use 100% savings persistence factors.	
N6	Based on National Resource management field observation and experience	
N7	Based on NSTAR estimates of typical replacement schedule	
N8	Based on warranty of equipment	
N9	Calculated with the National Grid DCV savings Tool	
N10	Calculated, per 100ft2	
N11	Calculation assumptions based off of NRM field experience and data	
N12	Coincidence Factor is based on National Grid staff estimates.	

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SourceID	Source Description	Digital Document Filename
N13	Coincidence Factors are .9 for both summer and winter seasons to account for restaurants that close one day per week or may not serve lunch and dinner on weekdays.	
N14	Coincidence Factors are assumed to be 1.0 since exit signs are on 8,760 hours a year	
N15	Coincidence factors are custom calculated based on project-specific detail.	
N16	Coincidence Factors are set to 1.00 because coincidence is built into the estimates of Gross kW.	
N17	Coincidence Factors are set to zero since demand savings typically occur during off-peak hours	
N18	Coincidence Factors are set to zero since exterior lights are off during daytime hours.	
N19	Coincidence factors set to 1.00 since gross kW is the average kW reduction during operation.	
N20	Common measure life for insulation measures.	
N21	Consistent with MA TRM	
N22	Energy realization rate is 100% because deemed savings are based on evaluation results.	
N23	Estimate based on average life of eligible products at retail operating hours	
N24	For all custom projects, gross summer and winter peak coincidence factors are custom-calculated based on project-specific information. The actual or measured coincidence factors are included in the summer and winter demand realization rates.	
N25	Free-ridership and spillover are not applicable as customers cannot participate without the utility program.	
N26	In-service rates are set to 100% based on the assumption that all purchased units are installed.	

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SourceID	Source Description	Digital Document Filename
N27	It is assumed that the connected equipment operates 24 hours per day, 7 days per week for a total annual operating hours of 8,760.	
N28	MA Common Assumption	
N29		
N30	Massachusetts Common Assumption	
N31	National Grid assumption based on regional PA working groups.	
N32	National Grid assumption based on regional PA working groups. Assumptions based on historical steam trap surveys. Steam losses in lbs/hr are found using “Boiler Efficiency Institute (1987). Steam Efficiency Improvement; Page 34, Table 4.1 under Steam Leak	
N33	Realization rate is 100% because estimates are based on post-installation performance verification.	
N34	Realization rate is 100% because estimates are based on post-installation verification.	
N35	Realization rate is 100% since gross savings values are based on evaluation results.	
N36	Realization rate is assumed 100% because energy savings are custom calculated.	
N37	Realization rate is assumed 100% because savings are based on researched assumptions.	
N38	Realization rate is assumed to be 100%	
N39	Realization rate will be determined by an independent evaluation.	
N40	Realization rates are 100% since savings estimates are based on evaluation results.	
N41	Refrigerator and freezer run hours are 8760 hours/year	

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SourceID	Source Description	Digital Document Filename
N42	Savings persistence is 100% since measure life is 1 year.	
N43	Savings persistence is assumed to be 100%.	
N44	Site-specific	
N45	supplied by vendor	
N46	The MA evaluation did not provide realization rates within sufficient precision so the they are assumed to be 100%, pending a future study by NEEP	
N47	The Net-to-Gross ratio is assumed to be 100%.	
N48	The operating hours are site-specific for custom savings calculations.	
N49	The technical lifetime is 18 years, but since these measures are installed on existing furnaces, they will only remain for 9 years.	
N50	This value is an average BASE 60 Annual Heating Degree Day value for weather stations in Rhode Island and southeastern Massachusetts based on NOAA 30-year data.	
N51	This value is an average BASE 65 Annual Heating Degree Day value for weather stations in Rhode Island based on NOAA 30-year data, from Cadmus Low Income Evaluation (2014).	
N52	Energy realization rate is 100% because deemed savings are based on vendor calculations.	
N53	Federal Register Vol 76. No. 123 (2011).	
N54	The LBL Factor is determined as the product of the N-factor and a Height Correction Factor according to BPI Protoco	
N55	Based on regional analysis assuming a typical timed drain settings discharge scenario.	

Appendix E: Acronyms

ACRONYM	DESCRIPTION
AC	Air Conditioning
AFUE	Annual Fuel Utilization Efficiency (see the Glossary)
AHU	Air Handling Unit
Btu	British Thermal Unit (see the Glossary)
CF	Coincidence Factor (see the Glossary)
CFL	Compact Fluorescent Lamp
CHP	Combined Heat and Power
COP	Coefficient of Performance (see the Glossary)
DCV	Demand Controlled Ventillation
DHW	Domestic Hot Water
DOER	Department of Energy Resources
DSM	Demand Side Management (see the Glossary)
ECM	Electrically Commutated Motor
EER	Energy Efficiency Ratio (see the Glossary)
EF	Efficiency Factor
EFLH	Equivalent Full Load Hours (see the Glossary)
ES	ENERGY STAR® (see the Glossary)
FCM	Forward Capacity Market
FR	Free-Ridership (see the Glossary)
HE	High-Efficiency
HID	High-Intensity Discharge (a lighting technology)
HP	Horse Power (see the Glossary)
HSPF	Heating Seasonal Performance Factor (see the Glossary)
HVAC	Heating, Ventilating, and Air Conditioning
ISO	Independent System Operator
ISR	In-Service Rate (see the Glossary)
kW	Kilo-Watt, a unit of electric demand equal to 1,000 watts
kWh	Kilowatt-Hour, a unit of energy (1 kilowatt of power supplied for one hour)
LED	Light-Emitting Diode (one type of solid-state lighting)
LCD	Liquid Crystal Display (a technology used for computer monitors and similar displays)
MMBtu	One million British Thermal Units (see “Btu” in the Glossary)
MW	Megawatt – a measure of electric demand equal to 1,000 kilowatts
MWh	Megawatt-hour – a measure of energy equal to 1,000 kilowatt-hours
NEB	Non-Electric Benefit (see the Glossary)
NEI	Non-Energy Impact
NE-ISO	New England Independent System Operator
NTG	Net-to-Gross (see the Glossary)
O&M	Operations and Maintenance
PA	Program Administrator (see the Glossary)
PC	Personal Computer
RR	Realization Rate (see the Glossary)
SEER	Seasonal Energy Efficiency Ratio (see the Glossary)
SO	Spillover (see the Glossary)
SPF	Savings Persistence Factor (see the Glossary)
SSL	Solid-State Lighting (e.g., LED lighting)
VSD	Variable-Speed Drive

Appendix F: Glossary

This glossary provides definitions as they are applied in this TRM for Rhode Island' energy efficiency programs. Alternate definitions may be used for some terms in other contexts.

TERM	DESCRIPTION
Adjusted Gross Savings	Gross savings (as calculated by the measure savings algorithms) that have been subsequently adjusted by the application of all impact factors except the net-to-gross factors (free-ridership and spillover). For more detail, see the section on **Error! Reference source not found.**.
AFUE	Annual Fuel Utilization Efficiency. The measure of seasonal or annual efficiency of a furnace or boiler. AFUE takes into account the cyclic on/off operation and associated energy losses of the heating unit as it responds to changes in the load, which in turn is affected by changes in weather and occupant controls.
Baseline Efficiency	The level of efficiency of the equipment that would have been installed without any influence from the program or, for retrofit cases where site-specific information is available, the actual efficiency of the existing equipment.
Btu	British thermal unit. A Btu is approximately the amount of energy needed to heat one pound of water by one degree Fahrenheit.
Coefficient of Performance (COP)	Coefficient of Performance is a measure of the efficiency of a heat pump, air conditioner, or refrigeration system. A COP value is given as the Btu output of a device divided by the Btu input of the device. The input and output are determined at AHRI testing standards conditions designed to reflect peak load operation.
Coincidence Factor (CF)	Coincidence Factors represent the fraction of connected load expected to occur concurrent to a particular system peak period; separate CF are found for summer and winter peaks. The CF given in the TRM includes both coincidence and diversity factors multiplied into one number. Coincidence factors are provided for peak periods defined by the NE-ISO for FCM purposes and calculated consistent with the FCM methodology.
Connected Load kW Savings	The connected load kW savings is the power saved by the equipment while in use. In some cases the savings reflect the maximum power draw of equipment at full load. In other cases the connected load may be variable, which must be accounted for in the savings algorithm.
Deemed Savings	Savings values (electric, fossil fuel and/or non-energy benefits) determined from savings algorithms with assumed values for all algorithm parameters. Alternatively, deemed savings values may be determined from evaluation studies. A measure with deemed savings will have the same savings per unit since all measure assumptions are the same. Deemed savings are used by program administrators to report savings for measures with well-defined performance characteristics relative to baseline efficiency cases. Deemed savings can simplify program planning and design, but may lead to over- or under-estimation of savings depending on product performance.
Deemed Calculated Savings	Savings values (electric, fossil fuel and/or non-energy benefits) that depend on a standard savings algorithm and for which at least one of the algorithm parameters (e.g., hours of operation) is project specific.
Demand Savings	The reduction in demand due to installation of an energy efficiency measure, usually expressed as kW and measured at the customer's meter (see Connected Load kW Savings).
Demand Side Management (DSM)	Strategies used to manage energy demand including energy efficiency, load management, fuel substitution, and load building.
Diversity	A characteristic of a variety of electric loads whereby individual maximum demands occur at different times. For example, 50 efficient light fixtures may be installed, but they are not necessarily all on at the same time. See Coincidence Factor.

TERM	DESCRIPTION
Diversity Factor	This TRM uses coincidence factors that incorporate diversity (See Coincidence Factor), thus this TRM has no separate diversity factors. A diversity factor is typically calculated as: 1) the percent of maximum demand savings from energy efficiency measures available at the time of the company's peak demand, or 2) the ratio of the sum of the demands of a group of users to their coincident maximum demand.
End Use	Refers to the category of end use or service provided by a measure or technology (e.g., lighting, cooling, etc.). For the purpose of this manual, the list of end-uses include: Lighting / HVAC Refrigeration / Hot Water Food Service / Behavior Compressed Air / Motors & Drives Products / Custom
Energy Efficiency Ratio (EER)	The Energy Efficiency Ratio is a measure of the efficiency of a cooling system at a specified peak, design temperature, or outdoor temperature. In technical terms, EER is the steady-state rate of heat energy removal (i.e. cooling capacity) of a product measured in Btuh output divided by watts input.
ENERGY STAR® (ES)	Brand name for the voluntary energy efficiency labeling initiative sponsored by the U.S. Environmental Protection Agency.
Energy Costing Period	A period of relatively high or low system energy cost, by season. The energy periods defined by ISO-NE are: • **Summer Peak**: 6am–10pm, Monday–Friday (except ISO holidays), June–September • **Summer Off-Peak:** Summer hours not included in the summer peak hours: 10pm–6am, Monday–Friday, all day on Saturday and Sunday, and ISO holidays, June–September • **Winter Peak:** 6am–10pm, Monday–Friday (except ISO holidays), January–May and October–December • **Winter Off-Peak:** Winter hours not included in the sinter peak hours: 10pm–6am, Monday–Friday, all day on Saturday and Sunday, and ISO holidays, January–May and October–December.
Equivalent Full Load Hours (EFLH)	The equivalent hours that equipment would need to operate at its peak capacity in order to consume its estimated annual kWh consumption (annual kWh/connected kW).
Free Rider	A customer who participates in an energy efficiency program, but would have installed some or all of the same measure(s) on their own, with no change in timing of the installation, if the program had not been available.
Free-Ridership Rate	The percentage of savings attributable to participants who would have installed the measures in the absence of program intervention.
Gross kW	Expected demand reduction based on a comparison of standard or replaced equipment and equipment installed through an energy efficiency program.
Gross kWh	Expected kWh reduction based on a comparison of standard or replaced equipment and equipment installed through an energy efficiency program.
Gross Savings	A saving estimate calculated from objective technical factors. In this TRM, "gross savings" are calculated with the measure algorithms and do not include any application of impact factors. Once impact factors are applied, the savings are called "Adjusted Gross Savings". For more detail, see the section on **Error! Reference source not found.**.
High Efficiency (HE)	Refers to the efficiency measures that are installed and promoted by the energy efficiency programs.
Horsepower (HP)	A unit for measuring the rate of doing work. One horsepower equals about three-fourths of a kilowatt (745.7 watts).

TERM	DESCRIPTION
Heating Seasonal Performance Factor (HSPF)	A measure of the seasonal heating mode efficiencies of heat pumps expressed as the ratio of the total heating output to the total seasonal input energy.
Impact Factor	Generic term for a value used to adjust the gross savings estimated by the savings algorithms in order to reflect the actual savings attributable to the efficiency program. In this TRM, impact factors include realization rates, in-service rates, savings persistence, peak demand coincidence factors, free-ridership, spillover and net-to-gross factors. See the section on Impact Factors for more detail.
In-Service Rate	The percentage of units that are actually installed. For example, efficient lamps may have an in-service rate less than 100% since some lamps are purchased as replacement units and are not immediately installed. The in-service rate for most measures is 100%.
Measure Life	The number of years that an efficiency measure is expected to garner savings. These are generally based on engineering lives, but sometimes adjusted based on observations of market conditions.
Lost Opportunity	Refers to a measure being installed at the time of planned investment in new equipment or systems. Often this reflects either new construction, renovation, remodeling, planned expansion or replacement, or replacement of failure.
Measure	A product (a piece of equipment), combination of products, or process designed to provide energy and/or demand savings. Measure can also refer to a service or a practice that provides savings. Measure can also refer to a specific combination of technology and market/customer/practice/strategy (e.g., direct install low income CFL).
Net Savings	The final value of savings that is attributable to a program or measure. Net savings differs from gross savings (or adjusted gross savings) because it includes adjustments due to free-ridership and/or spillover. Net savings is sometimes referred to as "verified" or “final” savings. For more detail see the section on **Error! Reference source not found.**.
Net-to-Gross Ratio	The ratio of net savings to the adjusted gross savings (for a measure or program). The adjusted gross savings include any adjustment by the impact factors other than free-ridership or spillover. Net-to-gross is usually expressed as a percent.
Non-Electric Benefits (NEBs)	Quantifiable benefits (beyond electric savings) that are the result of the installation of a measure. Fossil fuel, water, and maintenance are examples of non-electric benefits. Non-electric benefits can be negative (i.e. increased maintenance or increased fossil fuel usage which results from a measure) and therefore are sometimes referred to as “non-electric impacts”.
Non-Participant	A customer who is eligible to participate in a program, but does not. A non-participant may install a measure because of a program, but the installation of the measure is not through regular program channels; as a result, their actions are normally only detected through evaluations.
On-Peak kW	See Summer/Winter On-peak kW
Operating Hours	Hours that a piece of equipment is expected to be in operation, not necessarily at full load (typically expressed per year).
Participant	A customer who installs a measure through regular program channels and receives any benefit (i.e. incentive) that is available through the program because of their participation. Free-riders are a subset of this group.
Prescriptive Measure	A prescriptive measure is generally offered by use of a prescriptive form with a prescribed incentive based on the parameters of the efficient equipment or practice.
Realization Rate (RR)	The ratio of measure savings developed from impact evaluations to the estimated measure savings derived from the TRM savings algorithms. This factor is used to adjust the estimated savings when significant justification for such adjustment exists. The components of the realization rate are described in detail in the section on Impact Factors.

TERM	DESCRIPTION
Retrofit	The replacement of a piece of equipment or device before the end of its useful or planned life for the purpose of achieving energy savings. "Retrofit" measures are sometimes referred to as "early retirement" when the removal of the old equipment is aggressively pursued.
Savings Persistence Factor (SPF)	Percentage of first-year energy or demand savings expected to persist over the life of the installed energy efficiency equipment. The SPF is developed by conducting surveys of installed equipment several years after installation to determine the operational capability of the equipment. In contrast, *measure persistence* takes into account business turnover, early retirement of installed equipment, and other reasons the installed equipment might be removed or discontinued. Measure persistence is generally incorporated as part of the measure life, and therefore is not included as a separate impact factor.
Seasonal Energy Efficiency Ratio (SEER)	A measurement of the efficiency of a central air conditioner over an entire season. In technical terms, SEER is a measure of equipment the total cooling of a central air conditioner or heat pump (in Btu) during the normal cooling season as compared to the total electric energy input (in watt-hours) consumed during the same period.
Sector	A system for grouping customers with similar characteristics. For the purpose of this manual, the sectors are Commercial and Industrial (C&I), Small Business, Residential, and Low Income.
Spillover Rate	The percentage of savings attributable to the program, but additional to the gross (tracked) savings of a program. Spillover includes the effects of (a) participants in the program who install additional energy efficient measures outside of the program as a result of hearing about the program and (b) non-participants who install or influence the installation of energy efficient measures as a result of being aware of the program.
Summer/Winter On-Peak kW	The average demand reduction during the summer/winter on-peak period. The summer on-peak period is 1pm-5pm on non-holiday weekdays in June, July and August; the winter on-peak period is 5pm-7pm on non-holiday weekdays in December and January.
Ton	Unit of measure for determining cooling capacity. One ton equals 12,000 Btu.
Watt	A unit of electrical power. Equal to 1/1000 of a kilowatt.