Commercial/Industrial and Multifamily

Technical Reference Manual

Version 2018.3

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Introduction

PURPOSE

The Efficiency Maine Trust Residential/Retail and Commercial/Industrial and Multifamily Technical Reference Manuals (TRMs) provide documentation for the Trust's calculation of energy and demand savings from energy-efficiency measures. Each TRM serves as a central repository and common point of reference for the methods, formulas, assumptions, and sources that are used to estimate savings from energy-efficiency measures, and provides a common platform for analyzing energy savings across measures and programs. The importance of the TRM is derived from the importance of energy and demand savings calculations, which are at the foundation of the Trust's program planning and management, cost-effectiveness analysis, program evaluation, Annual Report, and Independent System Operator – New England (ISO-NE) Forward Capacity Market (FCM) participation.

GENERAL FORMAT

The TRM is organized by end use and then by measure category, which may include one or more measures. Each measure category is presented in its own section as a measure characterization, following a standard format. The measure characterization includes: a measure overview; energy and demand savings algorithms; baseline assumptions; deemed parameter values or instructions for inputs to savings algorithms, measure life and measure costs and impact factors for calculating adjusted gross savings and net savings. When there is a set of common values across measures, summary tables are provided at the end of the relevant section or in an appendix.

Where deemed savings values are specified, Efficiency Maine Trust (the Trust or EMT) uses integer values when reporting in units of kWh, one decimal place when reporting in units of MMBtu, and three decimal places for all demand (kW) values.

GUIDANCE & COMMON ASSUMPTIONS

In using the Trust's TRMs, it is helpful to note the following:

- ***Gross savings****:* Algorithms are specified for *gross* savings. To calculate *adjusted gross* savings or *net* savings, impact factors that account for verified measure performance (adjusted gross) and attribution (net) must be applied. The formulas used to calculate adjusted gross and net savings are described below.
- ***Annual savings****:* Algorithms are specified for *annual* savings. Unless otherwise noted, annual savings are assumed to be realized for each year of the measure life.
- ***Unit savings****:* Algorithms are specified for *per unit* savings. The Trust's programs' databases track and record the number of units delivered through the program.
- ***Meter-level savings****:* Savings are assumed to be those that occur at the customer's meter (or point of use for non-electric savings); line losses are not included in these calculations.
- ***Non-electric savings****:* When applicable, savings are counted for natural gas, oil, propane, kerosene, wood, and/or water. The deemed unit savings, algorithms and assumptions for these non-electric impacts are described in the measure characterizations whenever those savings are counted. If a non-electric impact is not described for a measure, it can be assumed that no non-electric impacts are counted for that measure.
- ***In-Service Rate (ISR)****:* The in-service rate represents the percentage of program units that are installed or implemented. Unless otherwise stated in the measure-specific sections of this TRM, the ISR is set to 100 percent for all commercial measures for the following reasons:

- Purchased units are assumed to be installed. In the commercial sector, it is uncommon for customers to purchase equipment and not immediately install or use it.
- The Trust's programs include some level of verification of the measure purchase and/or installation. These verification procedures ensure that projects and savings are counted only for measures that are implemented.
- The effects of non-implemented units may be identified in the program impact evaluation and accounted for in the energy and demand realization rates (RRs).
- For most commercial measures, it is common to assume ISR = 100% or, equivalently, not include an ISR factor. For example, the 2013–2015 Massachusetts TRM assumes a 100% ISR for all commercial measures except screw-in measures, stating that "All installations have 100% in service rate since all programs include verification of equipment installations." Many other TRMs, including New York, Connecticut, and the Mid-Atlantic TRM, do not include an ISR in savings equations for commercial measures.

- ***Coincidence Factors (CF)**:* Coincidence factors are provided for the summer and winter on-peak periods as defined by the ISO-New England for the 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 PM to 5:00 PM on non-holiday weekdays in June, July, and August
  - **Winter on-peak**: average demand reduction from 5:00 PM to 7:00 PM on non-holiday weekdays in December and January

- ***Life***: "Life" refers to the effective useful life of the measure. It represents the equivalent number of years the savings are expected to be realized. Lifetime savings = annual savings x life. Measure life takes one or more of the following aspects into consideration: 1) projected equipment life, 2) documented equipment warranty, 3) measure persistence,[1] and 4) savings persistence.[2] Life is set to represent a conservative estimate of the aggregate life of all measures of that type installed and not the characterization of the life of a single, specific installed measure.

- ***Deemed savings value vs. deemed savings algorithm**:* For some measures, deemed savings values are provided representing the estimated average savings per unit for the measure. The deemed savings value may be based directly on the results from an evaluation or other research study, or may be based on a set of deemed input parameters applied to the stated energy and demand savings algorithms.

  For other measures, deemed values are provided for only some of the parameters in the algorithm and actual values for a given measure are required to calculate savings. In these cases, project-specific (or "actual") data recorded in the relevant program tracking database are used in combination with the TRM deemed parameters to compute savings.

[1] Measure persistence is a quantification of how long the measure will remain in place. Causes of reduced measure persistence include any activity that removes the measure or eliminates the savings, such as equipment upgrade, refurbishment or renovation of the building, closure of a business, and override of efficiency controls.
[2] Savings persistence is a quantification of how long the defined savings will remain. Causes of reduced savings persistence include a change to the baseline over the useful life of the measure so that future savings are less than first year savings and changes in usage behavior over time.

- ***Project-specific ("actual") data for parameter inputs****:* The savings methods for most commercial measures specify "Actual" data for at least one of the input parameters. Actual data refers to values that are specific to the project. Unless otherwise stated, these actual project data should be collected and documented on the project application forms. For some measures, the TRM provides alternative values if the actual data are unknown.

- ***Data Sources for deemed parameter inputs****:* Wherever possible, deemed parameter values and assumptions are based on Maine-specific research and data. When such data are not available, the TRM relies on relevant data sources from other areas within the U.S.; in doing so, data sources from neighboring states and regions are prioritized. In some cases, engineering judgment and scaling for regional differences are used.

- ***Project type****:* The project type describes the underlying scenario that is assumed for the savings calculation of a given measure. The decision type has implications for the baseline efficiency case and the measure cost assumptions as shown below.[3] For each energy-efficiency measure, the TRM identifies the relevant project type, or types, corresponding to the scenarios in which the given measure may be implemented.

Decision Type	Scenario	Baseline	Measure Cost
New Construction	Customer is in the market to purchase new equipment for a new construction or new capacity project or as part of a planned renovation or to add controls to improve the performance of new equipment	Federal standards or standard market practice for new equipment	Incremental cost: difference between the cost of baseline and cost of high-efficiency equipment
Replace on Burnout	Customer is in the market to purchase new equipment to replace existing equipment that has worn out or otherwise needs replacing	Federal standards or standard market practice for new equipment	Incremental cost: difference between the cost of baseline and cost of high-efficiency equipment
Retrofit	Customer's existing equipment is in working order and has remaining useful life or customer is adding controls to improve the performance of operating equipment in an existing facility	Existing equipment or conditions	Full measure cost: cost of the high-efficiency equipment (including installation)

- ***Efficiency standards****:* The TRM anticipates the effects of changes in efficiency standards for some measures, including shifts in the baseline for CFLs due to changes in Federal standards for lighting products under the Energy Independence & Security Act of 2007 (EISA).

- ***TRM Updates****:* The TRMs are reviewed and updated annually, or more frequently if needed, to reflect new information obtained through research and evaluation studies, changes in program offerings (measures), and shifts in technology and baselines. Annual updates to the TRM are published as a new version (Version YYYY.1) with a specific effective date. Inter-year updates are published as iterations to the version year (Version YYYY.x) with changes and effective date indicated.

[3] Table adapted from National Action Plan for Energy Efficiency (2008). Understanding Cost-Effectiveness of Energy Efficiency Programs: Best Practices, Technical Methods, and Emerging Issues for Policy-Makers. Energy and Environmental Economics, Inc. and Regulatory Assistance Project. < https://www.epa.gov/sites/production/files/2015-08/documents/napee_report.pdf>.

SAVINGS FORMULAS

The formulas and inputs used to calculate the deemed gross annual energy (ΔkWh/yr (electricity) and ΔMMBtu/yr (natural gas and other fuels)) and gross max demand (ΔkW) savings for each measure are described in the measure sections. The formulas used to calculate adjusted gross savings, on-peak demand savings, and lifetime savings are described below. For measures that have different gross max demand savings for winter and summer, max heating (ΔkW_H) and max cooling (ΔkW_C) demand savings are reported. For measures where coincident demand reductions are estimated directly, winter (ΔkW_{WP}) and summer peak (ΔkW_{SP}) demand savings are reported and the coincidence factors set to 100 percent.

Adjusted Gross Savings

Adjusted gross savings represent the total energy and demand savings achieved by measures implemented through the Trust's programs. The adjusted gross savings values are calculated by applying various evaluation parameters to the gross annual energy and demand savings:

$$\text{Adjusted Gross Annual kWh} = \Delta\text{kWh/yr} \times ISR \times RR_E$$

$$\text{Adjusted Gross Lifetime kWh} = \Delta\text{kWh/yr} \times ISR \times RR_E \times \text{Measure Life}$$

$$\text{Adjusted Gross Annual MMBtu}^{4} = \Delta\text{MMBtu/yr} \times ISR \times RR_E$$

$$\text{Adjusted Gross Lifetime MMBtu}^{4} = \Delta\text{MMBtu/yr} \times ISR \times RR_E \times \text{Measure Life}$$

$$\text{Adjusted Gross Summer On-Peak kW} = \Delta\text{kW} \times ISR \times RR_D \times CF_S$$

$$\text{Adjusted Gross Winter On-Peak kW} = \Delta\text{kW} \times ISR \times RR_D \times CF_W$$

The Adjusted Gross Summer On-Peak kW value is equivalent to the Demand Reduction Value reported to the ISO-NE FCM.

Net Savings

Net savings represent the total realized energy and demand savings that are attributable to the Trust's programs. These net savings are calculated by applying the net-to-gross (NTG) factors, such as free ridership (FR) and spillover (SO), to the adjusted gross savings.

$$\text{Net Annual kWh} = \Delta\text{kWh/yr} \times ISR \times RR_E \times (1 - FR + SO)$$

$$\text{Net Lifetime kWh} = \Delta\text{kWh/yr} \times ISR \times RR_E \times (1 - FR + SO) \times \text{Measure Life}$$

$$\text{Net Summer On-Peak kW} = \Delta\text{kW} \times ISR \times RR_D \times CF_S \times (1 - FR + SO)$$

$$\text{Net Winter On-Peak kW} = \Delta\text{kW} \times ISR \times RR_D \times CF_W \times (1 - FR + SO)$$

Note the parameter (1 – FR + SO) may be replaced with the NTG ratio.

[4] In this document and other reporting documents, fossil fuel savings are reporting in unit of MMBtu. In the program tracking database (effRT), natural gas savings are calculated in units of therms and then must be converted to MMBtu.

SAVINGS CALCULATIONS

The actual calculation of energy efficiency savings, pursuant to the algorithms and assumptions documented in the TRM, occurs in the Trust's program tracking databases. In 2012, the Trust initiated a significant effort to upgrade and transform its existing program-specific databases into a comprehensive, unified database system that supports multiple programs with standardized internal processes, features, and quality. This initiative builds on the foundation of the successful Efficiency Maine Reporting and Tracking (effRT) database system that historically supported the Business Programs to create a new multi-program database system, effRT 2.0. As part of this effort, the Trust is mapping the TRM deemed values and algorithms into effRT, and establishing processes for updates to effRT to coincide with TRM updates.

As of January 1, 2014, the Trust added adjustment factors for the in-service rate (ISR) and the evaluated realization rate (RR) to the formulas used to calculate the demand reduction value (DRV) for Forward Capacity Market (FCM monthly reporting. Results using these two additional factors are referred to as *Adjusted Gross Savings* in the effRT report.

TRM Change Log

Change Type	TRM Section	Description	Effective Date	effRT Update
PY2014 Addendum				
Correction	Table 32 - Installed Fixture Rated Wattage Reduction Table (SAVEEE)	• Corrected the $SAVE_{EE}$ values to show the average wattage reduction per fixture code. The previous values showed the fixture wattage rather than the wattage reduction. • Added wattage savings values for new measure codes S51 and S61.	11/12/2013	N/A
New	Prescriptive Lighting: Lighting Fixtures – Interior Spaces (New Construction)	Added new fixture codes: • Code S51 – LED Recessed Fixtures • Code S61 – LED High/Low Bay Fixtures	11/12/2013	Y
New	Prescriptive Lighting: Lighting Fixtures – Interior Spaces (Retrofit)	Added new fixture codes: • Code S50 – LED Recessed Fixtures • Code S60 – LED High/Low Bay Fixtures	11/12/2013	Y
New	Prescriptive Lighting: Lighting Fixtures – Refrigerated Spaces	Added new fixture codes: • Code S32 – LED Refrigerated Case Light – Horizontal (Retrofit) • Code S33 – LED Refrigerated Case Light – Horizontal (New Construction)	11/12/2013	Y
Revision	Table 31 – Installed Measure Wattage and Cost Table (WattsEE, SAVEEE, CostEE)	Added fixture wattage values for new measure codes S50, S51, S60, S61, S32 and S32	11/12/2013	Y
Revision	Table 35 – Installed Costs for Prescriptive Lighting High Efficiency Measures	Added measure costs for new measure codes S50, S51, S60, and S61.	11/12/2013	Y
New	Prescriptive DHP Retrofit: Ductless Heat Pump Retrofit	Added two new measures: • DHP Retrofit (Electric Heat Baseline) • DHP Retrofit (Non-Electric Heat Baseline)	12/17/2013	Y
Revision	Table 29 – Commercial Coincidence Factors and Energy Period Factors	Added coincidence and energy period factors for the two new DHP Retrofit measures	12/17/2013	Y
Revision	Appendix G: Custom Projects – Process Documentation	Updated eligibility requirements to reflect a mid-year change announced in a January 30, 2013 program opportunity notice	2/25/2014	N/A
PY2015 Updates				
New	Multifamily Efficiency Program lighting measures	Added Multifamily Efficiency Program for retrofit lighting measures (superseded by subsequent modification)	7/1/2014	N/A
Revision	Prescriptive HVAC: Unitary Air-Conditioners	Updated baseline efficiency for Window AC units to reflect change to federal minimum efficiency standards	7/1/2014	N/A
Revision	Natural Gas Heating Equipment	Update baseline efficiency values based on new federal minimum efficiency requirements; updated measure costs	7/1/2014	Y
Other	Prescriptive Lighting: Lighting Controls – Interior Spaces	Revised description of savings calculation method to improve clarity; the change does not change the savings estimation approach	7/1/2014	N/A
Revision	Prescriptive HVAC: PTAC and PTHP	Updated baseline efficiency values	7/1/2014	N/A

Change Type	TRM Section	Description	Effective Date	effRT Update
New	Prescriptive HVAC: Ductless Heat Pump Retrofit	Updated the existing Ductless Heat Pump Retrofit measure to include multi-head option; updated measure cost	7/1/2014	Y
Other	Small Business Direct Install Program	The PY2014 Direct Install Pilot Program is changed to the Small Business Direct Install Program in PY2015.	7/1/2014	N/A
Revision	DHP Retrofit	Updated the formula to include an HSPF adjustment factor and updated the annual EFLH value based on updates to the DHP workbook. Updates also included CF and EPF values for this measure.	7/1/2014	Y
Revision	HVAC: VRF	Updated baseline COP to reflect cold climate operation.	9/23/2014	Y
Revision	DHP Retrofit	Updated measure life	9/27/2014	Y
Other	DHP Retrofit	Removed qualifications table, revised measure cost for 4 zones to be 4+ zones	11/30/2014	Y
Other	Introduction	Updated TRM Update section. Inter-year updates will be released as iterations of the complete document.	11/30/2014	N
Other	Prescriptive Lighting: Lighting Fixtures – Multifamily (Retrofit), Prescriptive Lighting: Lighting Controls – Multifamily	Moved Multifamily lighting measures from Commercial TRM to Multifamily TRM	1/1/2015	N
Other	Prescriptive DHP	Removed Multifamily option. Included in Multifamily TRM	1/1/2015	N
Other	Custom Electric, Custom Natural Gas	Removed Multifamily section. Included in Multifamily TRM. Custom Natural Gas criteria updated.	1/1/2015	N
Other	Custom Natural Gas	Modified minimum savings threshold	3/1/2015	N
New	Prescriptive HVAC	Added new measures: Boiler Turbulator, Modulating Burner Controls, Oxygen Trim Controls, Boiler Economizer, Programmable Thermostats, Boiler Reset/Lockout Controls	3/1/2015	Y
New	Prescriptive Water Heating	Tankless Water Heater	3/1/2015	Y
New	Prescriptive Lighting	Added new measure codes:	3/1/2015	Y
New	Prescriptive Lighting: Lighting Fixtures – Interior Spaces (New Construction)	Added new fixture codes: • Code S81 – LED Linear Ambient Fixtures	3/1/2015	Y
New	Prescriptive Lighting: Lighting Fixtures – Interior Spaces (Retrofit)	Added new fixture codes: • Code S80 – LED Linear Ambient Fixtures	3/1/2015	Y

Change Type	TRM Section	Description	Effective Date	effRT Update
New	Prescriptive Lighting: Lighting Fixtures with Integrated Controls – Interior Spaces (New Construction)	Added new fixture codes: • Code S71 – LED StairwayFixtures	3/1/2015	Y
New	Prescriptive Lighting: Lighting Fixtures with Integrated Controls – Interior Spaces (Retrofit)	Added new fixture codes: • Code S70 – LED Stairway Fixtures	3/1/2015	Y
PY2016 Updates				
Revision	Lighting Equipment	Revised waste heat factors for cooling. Added waste heat factor for heating	7/1/2015	Y
Revision	Lighting Equipment	Revised sub-division for LED Flood/Spot and High/Low Bay fixtures.	7/1/2015	Y
Revision	Appendix E: Lighting Costs	Revised measure costs for lighting measures	7/1/2015	Y
Revision	Ductless Heat Pump	Changed decision type to Lost Opportunity. Revised parameters based on updated modeling.	7/1/2015	Y
Revision	Prescriptive HVAC	Updated measure cost for Unitary A/C, Heat Pump Systems, Oxygen Trim Controls	7/1/2015	Y
Revision	Prescriptive Refrigeration	Updated measure cost for R80, R90	7/1/2015	Y
Revision	Prescriptive Agriculture	Updated measure cost for vapor-tight high performance T8,	7/1/2015	Y
Revision	Prescriptive Agriculture	Adjustable Speed Drive savings calculation updated to reflect Variable Frequency Drive Evaluation Protocol	7/1/2015	Y
Revision	Prescriptive Natural Gas	Updated measure cost for natural gas heating equipment and natural gas kitchen equipment	7/1/2015	Y
Revision	Custom Incentives	Updated measure life for heating system replacement/upgrade and maintenance	7/1/2015	Y
Other	Appendix: Carbon Dioxide Emission Factors	Added carbon dioxide emission factors table	7/1/2015	N
Other	Lighting	Expanded Hospital entries to include all health care facilities	7/1/2015	Y
Other	Appendix: Average Annual Lighting Operating Hours and other Lookup Tables	Added annual operation hours reference for nursing homes/assisted living/health care and agriculture, added health care ventilation rates	7/1/2015	N
Other	Multiple	Updated kBtuh per kW conversion factor from 3.413 to 3.412	7/1/2015	Y
Revision	S11	New wattage sub-division added	7/1/2015	Y
Correction	Ductless Heat Pump	Corrected measure life to 15 years	7/1/2015	N
Revision	Table 25 Measure Life Reference for Custom Projects	Added Solar PV to table with measure life of 20 years	7/1/2015	Y
Revision	Appendix B	Corrected energy period factors for custom single shift process	7/1/2015	Y
New	Prescriptive HVAC Efficient Oil or Propane Boilers and Furnaces	New measure for PY16	9/1/2015	Y

Change Type	TRM Section	Description	Effective Date	effRT Update
PY2017 Updates				
Revision	All	Free ridership and spillover rates updated for all measures based on draft evaluation reports for BIP and LCP; measures not yet evaluated assigned default FR of 25% and default SO of 0%	7/1/2016	Y
Other	Prescriptive Lighting	All non-LED measures have been removed, new measure codes added	7/1/2016	Y
Other	Prescriptive Lighting – Interior	Summer and winter peak demand savings algorithms added to clarify that interactive effects for cooling systems only apply to summer peak demand savings	7/1/2016	N
Revision	Prescriptive Lighting – Fixtures with Integrated Controls	Demand savings algorithms updated to properly reflect decreased wattage and decreased run time	7/1/2016	N
Revision	Table: Installed Fixture Rated Wattage Table ($Watts_{EE}$)	Removed non-LED fixtures, revised wattage based on updated binning, added new fixtures	7/1/2016	Y
Revision	Table: Installed Fixture Rated Wattage Reduction Table ($SAVE_{EE}$)	Revised wattage based on updated binning, removed ineligible fixtures	7/1/2016	Y
Revision	Table: Existing Fixture Rated Wattage Table	Added new measures eligible for controls	7/1/2016	Y
Revision	Table: Measure Costs for Prescriptive Lighting	Removed non-LED fixtures, revised costs based on updated binning, added new fixtures	7/1/2016	Y
Other	Table: Savings Factors for Lighting Controls	Added Cooler/Freezer Case factor to table	7/1/2016	N
Revision	VFD	Savings factors updated based on more recent study, ineligible sizes removed	7/1/2016	Y
Other	Ductless Heat Pump MF and LIMF	Added multifamily and low-income multifamily ductless heat pump measures from Multifamily TRM to Commercial TRM; multifamily TRM to be discontinued in 2017	7/1/2016	N
Other	Efficient Oil or Propane Boilers and Furnaces	Ineligible sizes removed	7/1/2016	Y
Revision	Natural Gas Heating Equipment	Modified savings algorithm to use annual heat load, measure cost for G7, G15 and G16 updated based on recent projects when available	7/1/2016	Y
Other	Commercial Kitchen Equipment	Split kitchen equipment into separate section	7/1/2016	N
New	Demand Control Kitchen Ventilation	New measure	7/1/2016	Y
Other	Custom	Revised description to better describe small and large custom programs	7/1/2016	N
Other	Custom Thermal Projects	Renamed Custom Greenhouse Gas Projects to Custom Thermal Projects and added an energy content by fuel type reference table	7/1/2016	N
Other	Title	Renamed Commercial TRM to Commercial/Industrial and Multifamily TRM	7/1/2016	N

Change Type	TRM Section	Description	Effective Date	effRT Update
Other	Appendix G: Custom Projects – Process Documentation	Appendix removed	7/1/2016	N
New	Prescritive Lighting & Appendicies	New measure S81 added to Lighting Fixtures – Interior Spaces (Retrofit/Replacement Lamps). S81 and new bins for S52 added to Appendix: Lighting Installed Baseline Fixture Rated Wattage Tables and Baseline Lighting Power Density (LPD), Appendix: Prescriptive Lighting Measure Cost	10/1/2016	Y
Correction	Appendix: Lighting Installed Baseline Fixture Rated Wattage Tables and Baseline Lighting Power Density (LPD)	LED Retrofit Kit 2x2 Recessed Fixture bin wattage corrected	7/1/2016	N
Revision	Appendix: Prescriptive Lighting Measure Cost	S52 measure costs updated	10/1/2016	Y
New	Prescritive Lighting & Appendicies	New measure S40 added to Lighting Fixtures – Interior Spaces (Retrofit/Replacement Lamps), Appendix: Lighting Installed Baseline Fixture Rated Wattage Tables and Baseline Lighting Power Density (LPD)	7/1/2016	Y
Other	Reference tables in Appendices	Combined into a single table Table: Installed Fixture Rated Wattage Table ($Watts_{EE}$), Table: Installed Fixture Rated Wattage Reduction Table ($SAVE_{EE}$), and Table: Measure Costs for Prescriptive Lighting. Combined all parameter values reference tables into a single appendix.	N/A	N
Revision	Prescriptive Lighting	New fixture retrofit measure codes added to interior and exterior measures in support of Small Business Direct Install.	7/1/2016	Y
Revision	Lighting Reference Tables	Added separate parameter values for SBDI based on specific program participating measures.	7/1/2016	Y
New	High Efficiency Pre-Rinse Spray Valve	New measure added	11/1/2016	Y
Revision	ENERGY STAR® Natural Gas Kitchen Equipment	Savings estimates and measure cost updated based on current ENERGY STAR® calculator.	11/1/2016	Y
Revision	Lighting Reference Tables	Added new bin to S11 Pole-Mounted Streetlights and Parking Fixtures specifically for 1000 W MH replacements.	12/1/2016	Y
Revision	Lighting Reference Tables	Revised wattages and costs for S6, S8, S11, S17, S51 and S61 based on program analysis.	12/1/2016	Y
Revision	Lighting Reference Table	Revised wattage on S11 and costs for S6, S13, S51, S52, S61 based on review of Q1 and Q2 program projects	1/1/2017	Y
Correction	Lighting Fixtures with Integrated Controls	Corrected equation to properly calculate peak demand reduction	4/1/2017	N

Change Type	TRM Section	Description	Effective Date	effRT Update
Revision	High Efficiency Pre-Rinse Spray Valve	Added savings for electric resistance water heater, updated measure cost to be actual	1/1/2017	Y
Revision	Reference Lighting Annual Operating Hours	Revised reference hours table to use KEMA Lighting Load Shape Project values and added a facilty/space type reference table based on Michigan Statewide Commercial and Industrial Lighting Hours-of-Use Study	4/1/2017	N
Revision	Tankless Water Heater	Added Propane	4/1/2017	Y
Other	Custom Programs	Updated descriptions to match program implementation	7/1/2016	N
New	Custom Program – Distributed Generation	Added new measure to separate out DG from other custom programs	7/1/2016	N
Revision	Prescriptive Gas	Updated savings formula	5/1/2017	Y
PY2018 Updates				
New	HVAC Equipment	The addition of the "Electronically Commutated Hot water Circulator Pump Motors" measure to the HVAC equipment section as per the recommendation from Michaels Energy June 14, 2017 memo	TBD	N
New	HVAC Equipment	The addition of the "Electronicically Commutated Supply Fan Motor" measure to the HVAC equipment section as pet the recommendation from Michaels Energy June 14, 2017 memo	TBD	N
New	HVAC Equipment	The addition of the "Advanced Rooftop Controls" measure to the HVAC equipment section as per the recommendation from Michaels Energy June 14, 2017 memo	TBD	N
Other	HVAC Equipment	Incorporate Gas Equipment measures into HVAC equipment section, combine all boiler/furnace measures into a single table	N/A	N
New	Custom Program	Created Advanded Building entry to contextualize parameters	N/A	N
Revision	HVAC Equipment	Addition of oversize factor, rated input capcity of unit, and effective full load hours for heating (and corresponding values) to the natural gas heating equipment, codes G1-G16, CNG1-CNG16, G01M, G07M, G08M, G15M, G16M, H1M, H2M, H3M	7/1/17	Y
Revision	HVAC Equipment	Set PACT and Unitary measures to "inactive"	7/1/17	N
Revision	HVAC Equipment	Updated AH and DHP EFLH as per recommendations from Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017	7/1/17	N
Revision	Prescriptive Lighting	Updated waste heat factors for interactive effects based on new derivation	7/1/2017	Y
Other	Appendix D	Added derivation of interactive effects	7/1/2017	N

Change Type	TRM Section	Description	Effective Date	effRT Update
Revision	Prescriptive Non-Lighting Measures	Used Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017 RR Demand values to adjust both the summer and winter peak Coincidence Factors; RRD Dchanged to 100% to reflect this change	7/1/17	Y
New	Table 41	Created new table in Appendix D to reflect the changes made to the prescriptive non-lighting measures Coincidence Factors	7/1/17	N
Correction	Lighting	Updated waste heat factors consistent with derivation in Appendix D (update was not included in published 7/1/17 version)	7/1/17	Y
Correction	Variable Refrigerant Flow	Added conversion factor (kBtu to kWh)	7/1/17	Y
New	Thermal Envelope	Added new measures for multifamily thermal envelope upgrades	8/1/17	Y
New	Commercial Laundry Equipment	Added new measures for multifamily common area clothes washers and dryers	8/1/17	Y
Revision	Appendix D: Installed Measure Wattage and Cost Table	Wattage and Cost updated with FY18 SBI specific measures.	9/1/17	N
Revision	Appendix D: Installed Measure Wattage and Cost Table	Cost updated with most recent program data for S11, S13, S17, S23, S30, S51, S52, S61, S81, L60.1, L70.1 S6, S64, S110 removed from CIP portion of the table (moved to Retail/Residential TRM)	10/1/17	Y
Revision	HVAC Equipment	Updated incremental cost with most recent program data for AF1, AF6, G01M, G07M, G08M and VRF	10/1/17	Y
Revision	HVAC Equipment	Updated capacity bins for G07M and G08M	10/1/17	Y
Revision	Water Heating Equipment	Updated incremental cost for WH1	10/1/17	Y
Revision	C&I Custom	Updated RR_e and RR_d with findings from the LCP Evaluation	10/1/17	Y
Revision	ECM Supply Fan and Hot Water Smart Pump	Made active 10/1/2017	10/1/17	Y
Revision	Appendix B	Added ECM Supply Fan and Hot Water Smart Pump	10/1/17	Y
Revision	Appendix D: Installed Measure Wattage and Cost Table	Wattage and Cost updated with FY18 SBI specific measures changes (S52, S81, S110).	1/1/18	Y
Revision	Appendix D: Installed Measure Wattage and Cost Table	Cost updated with most recent program data for S11, S13, S21, S30, S51, S52, S61, S81, L60.1, L70.1	1/1/18	Y

Change Type	TRM Section	Description	Effective Date	effRT Update

Correction: indicates a correction to an existing error in the previous TRM.
New: indicates a measure that was not included in the previous TRM.
Revision: indicates a revision to the savings or costs of an existing measure.
Other: indicates a change to an existing measure or existing text that does not affect savings or cost calculation.

Note that the change log provides a running history of changes. The order of precedence is in reverse order of date. More recent changes may supersede previous changes. Previous change log entries are not changed so as to provide historic reference of past changes.

Lighting Equipment

Prescriptive Lighting: Lighting Fixtures – Interior Spaces (New Fixtures), Codes S21, S51, S61, S81	
Last Revised Date	10/1/2017 (retroactive to 7/1/2016)
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of high-efficiency interior lighting fixtures instead of new standard-efficiency fixtures.
Primary Energy Impact	Electric
Sector	Commercial/Industrial
Program(s)	C&I Prescriptvie Program, Small Business Direct Install Program
End-Use	Lighting
Project Type	New construction, Replace on burnout
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = (LPD_{BASE} \times Area - Qty_{EE} \times Watts_{EE}) / 1{,}000 \times WHF_d$ $\Delta kW_{SP} = (LPD_{BASE} \times Area - Qty_{EE} \times Watts_{EE}) / 1{,}000 \times WHF_d \times CF_S$ $\Delta kW_{WP} = (LPD_{BASE} \times Area - Qty_{EE} \times Watts_{EE}) / 1{,}000 \times CF_W$
Annual Energy Savings	$\Delta kWh/yr = (LPD_{BASE} \times Area - Qty_{EE} \times Watts_{EE}) / 1{,}000 \times HoursWk \times Weeks \times WHF_{e,cool}$ $\Delta MMBtu/yr$[5] $= -(LPD_{BASE} \times Area - Qty_{EE} \times Watts_{EE}) / 1{,}000 \times HoursWk \times Weeks \times WHF_{e,heat}$
Definitions	Unit = Lighting fixture upgrade measure Qty_{EE} = Quantity of energy-efficient fixtures $Watts_{EE}$ = Watts of energy-efficient fixture (based on the specified installed fixture type) (Watts) $SAVE_{EE}$ = Average wattage reduction of fixture (based on the specified installed fixture type) (Watts) LPD_{BASE} = Baseline maximum lighting power density (LPD) for space type (Watts/ft^2) Area = Area of the building or space associated with the design LPD_{BASE} value (ft^2) HoursWk = Weekly hours of equipment operation (hrs/week) Weeks = Weeks per year of equipment operation (weeks/year) WHF_d = Waste heat factor for demand to account for cooling savings from efficient lighting $WHF_{e,cool}$ = Waste heat factor for energy to account for cooling savings from efficient lighting $WHF_{e,heat}$ = Waste heat factor for energy to account for increased heating load from efficient lighting 1,000 = Conversion: 1,000 Watts per kW BC = Baseline Cost EEC = Installed Fixture Cost
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The baseline is represented by building code or standard design practice for the building or space type.
Efficient Measure	High-efficiency lighting system that exceeds building code by at least 20%.

[5] Fuel interactive effects are distributed across fuels types as follows: 76% Oil, 10% Natural Gas, 7% Propane, 7% Kerosene.

Prescriptive Lighting: Lighting Fixtures – Interior Spaces (New Fixtures), Codes S21, S51, S61, S81

PARAMETER VALUES

Measure/Type	Qty_{EE}	$Watts_{EE}$	$SAVE_{EE}$	Area	Life (yrs)	Cost ($)
New construction	Actual	Table 31[6]	Table 31[6]	Actual	15[7]	Table 31
Measure/Type	HoursWk	Weeks	WHF_d[8]	$WHF_{e,cool}$[9]	$WHF_{e,heat}$[10]	LPD_{BASE}
New construction	Actual[11]	Actual	1.144	1.06	0.00159	**Table 33**[6]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S[12]	CF_W	FR	SO
C&I Prescriptive	100%	99%[13]	101%[13]	Table 29	Table 29	26%[14]	1.6%[15]
Small Business Direct Install	100%	100%[16]	100%	Table 29	Table 29	25%[17]	0%[18]

[6] See Appendix D. The fixture wattage and wattage reduction values are based on the specified fixture type. The baseline LPD is based on the specified space type.
[7] GDS Associates, Inc., Residential and Commercial/Industrial Lighting and HVAC Measures Prepared for The New England State Program Working Group (SPWG), June 2007 and the 2005 Measure Life Study Report prepared for The Massachusetts Joint Utilities, by ERS and the 2005 *Measure Life Study Report* prepared for The Massachusetts Joint Utilities, by ERS.
[8] Derived from the concept set forth in Rundquist, R.A., Johnson, K.F., Aumann, D.J. (1993). Calculating Lighting and HVAC Interactions. ASHRAE Journal, 35(11), 28-37. See Appendix D: Parameter Values Reference Tables for derivation and input assumptions.
[9] Ibid.
[10] Ibid.
[11] Use actual hours when known. If hours are unknown, use the values from Table 34 or Table 35.
[12] See Appendix B.
[13] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Values for prescriptive measures.
[14] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[15] Ibid.
[16] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[17] Program not yet evaluated, assume default FR of 25%.
[18] Program not yet evaluated, assume default SO of 0%.

Prescriptive Lighting: Lighting Fixtures – Interior Spaces (Retrofit/Replacement Lamps), Codes S40, S52, S62, S64, S21R, S51R, S61R, S81R, S110R	
Last Revised Date	10/1/2017 (retroactive to 7/1/2016)
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of high-efficiency interior lamps or retrofit kits to replace existing operating lighting equipment (retrofit). Note S40 is only applicable to Small Business Direct Install
Primary Energy Impact	Electric
Sector	Commercial/Industrial
Program(s)	C&I Prescriptive Program, Small Business Direct Install Program
End-Use	Lighting
Project Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) / 1{,}000 \times WHF_d$ $\Delta kW_{SP} = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) / 1{,}000 \times WHF_d \times CF_S$ $\Delta kW_{WP} = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) / 1{,}000 \times CF_W$
Annual Energy Savings	$\Delta kWh/yr = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) / 1{,}000 \times HoursWk \times Weeks \times WHF_{e,cool}$ ΔMMBtu/yr[19] $= -(Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) / 1{,}000 \times HoursWk \times Weeks \times WHF_{e,heat}$
Definitions	Unit = Lighting fixture upgrade measure Qty_{BASE} = Quantity of baseline fixtures $Watts_{BASE}$ = Watts of baseline fixture (based on the specified existing fixture type) (Watts) Qty_{EE} = Quantity of energy-efficient fixtures $Watts_{EE}$ = Watts of energy-efficient fixture (based on the specified installed fixture type) (Watts) HoursWk = Weekly hours of equipment operation (hrs/week) Weeks = Weeks per year of equipment operation (weeks/year) WHF_d = Waste heat factor for demand to account for cooling savings from efficient lighting $WHF_{e,cool}$ = Waste heat factor for energy to account for cooling savings from efficient lighting $WHF_{e,heat}$ = Waste heat factor for energy to account for increased heating load from efficient lighting 1,000 = Conversion: 1,000 Watts per kW
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The existing lighting system.
Efficient Measure	High-efficiency lighting system that exceeds building code.
PARAMETER VALUES	

Measure/Type	Qty_{BASE}	$Watts_{BASE}$	Qty_{EE}	$Watts_{EE}$	HoursWk[20]	Weeks	Life (yrs)	Cost ($)
All but S40	Actual	Table 32[21]	Actual	Table 31[21]	Actual	Actual	13[22]	Table 31[23]
S40							7[24]	

[19] Fuel interactive effects are distributed across fuels types as follows: 76% Oil, 10% Natural Gas, 7% Propane, 7% Kerosene
[20] Use actual hours when known. If hours are unknown, use the values from Table 34 or Table 35.
[21] See Appendix D. The fixture wattages are based on the specified fixture types for baseline and installed fixtures.
[22] GDS Associates, Inc., Residential and Commercial/Industrial Lighting and HVAC Measures Prepared for The New England State Program Working Group (SPWG), June 2007 and the 2005 Measure Life Study Report prepared for The Massachusetts Joint Utilities, by ERS and the 2005 *Measure Life Study Report* prepared for The Massachusetts Joint Utilities, by ERS
[23] Actual project costs collected for SBI. For C&I Prescriptive see Appendix D: Parameter Values Reference Tables
[24] Based on 25,000 hour rated life and 3772 hours of use per year.

Prescriptive Lighting: Lighting Fixtures – Interior Spaces (Retrofit/Replacement Lamps), Codes S40, S52, S62, S64, S21R, S51R, S61R, S81R, S110R							
Measure/Type	WHF_d[25]	$WHF_{e,cool}$[26]	$WHF_{e,heat}$[27]				
Retrofit	1.144	1.06	0.00159				
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	99%[28]	101%[28]	Table 29[29]	Table 29[29]	26%[30]	1.6%[31]
Small Business Direct Install	100%	100%[32]	100%[32]	Table 29[29]	Table 29[29]	25%[33]	0%[34]

[25] Derived from the concept set forth in Rundquist, R.A., Johnson, K.F., Aumann, D.J. (1993). Calculating Lighting and HVAC Interactions. ASHRAE Journal, 35(11), 28-37. See Appendix D: Parameter Values Reference Tables for derivation and input assumptions.
[26] Ibid.
[27] Ibid.
[28] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Realization Rates for Prescriptive Measures.
[29] See Appendix B.
[30] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[31] Ibid.
[32] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[33] Program not yet evaluated, assume default FR of 25%.
[34] Program not yet evaluated, assume default SO of 0%.

Prescriptive Lighting: Lighting Fixtures with Integrated Controls – Interior Spaces (New Construction), Code S71 (Inactive)	
Last Revised Date	10/1/2017 (retroactive to 7/1/2015)
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of LED stairway lighting fixtures instead of new standard-efficiency fixtures (new construction). The fixtures must meet one of the following conditions: include integral controls, operate off of remote sensors where remote sensor is packaged together with the luminaire under a single model number, or be designed to operate off of remote sensors, where the luminaire and sensors are sold separately, but the luminaire has features enabling communication with a remote sensor. Controls must ensure that the luminaire reverts to lower-power, lower-light output state when there are no occupants in the vicinity.
Primary Energy Impact	Electric
Sector	Commercial/Industrial
Program(s)	C&I Prescriptive Program
End-Use	Lighting
Project Type	New construction, Replace on burnout
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta Kw = (WHF_d / 1{,}000) \times (LPD_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE})$ $\Delta kW_{SP} = (WHF_d / 1{,}000) \times [(LPD_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) \times CF_S + (Qty_{EE} \times Watts_{EE} \times ContOutRed \times \times CR_S]$ $\Delta kW_{WP} = (1 / 1{,}000) \times [(LPD_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) \times CF_W + (Qty_{EE} \times Watts_{EE} \times ContOutRed \times \times CR_W]$
Annual Energy Savings	$\Delta kWh/yr = (HoursWk \times Wks \times WHF_{e,cool} / 1{,}000) \times [(LPD_{BASE} \times Area - Qty_{EE} \times Watts_{EE}) + (Qty_{EE} \times Watts_{EE} \times ContOutRed \times (1 - Occ))]$ $\Delta MMBtu/yr = -(HoursWk \times Wks \times WHF_{e,heat} / 1{,}000) \times [(LPD_{BASE} \times Area - Qty_{EE} \times Watts_{EE}) + (Qty_{EE} \times Watts_{EE} \times ContOutRed \times (1 - Occ))]$
Definitions	Unit = Lighting fixture upgrade measure Qty_{EE} = Quantity of energy-efficient fixtures $Watts_{EE}$ = Watts of energy-efficient fixture (based on the specified installed fixture type) (Watts) SAVEEE = Average wattage reduction of fixture (based on the specified installed fixture type) (Watts) LPD_{BASE} = Baseline maximum lighting power density (LPD) for space type (Watts/ft2) Area = Area of the building or space associated with the design LPD value (ft2) HoursWk = Weekly hours of equipment operation (hrs/week) Weeks = Weeks per year of equipment operation (weeks/year) ContOutRed = % light output reduction sensor set point (must be minimum of 50%) Occ = % occupancy for space (default to 10%) WHF_d = Waste heat factor for demand to account for cooling savings from efficient lighting $WHF_{e,cool}$ = Waste heat factor for energy to account for cooling savings from efficient lighting $WHF_{e,heat}$ = Waste heat factor for energy to account for increased heating load from efficient lighting 1,000 = Conversion: 1,000 Watts per kW CR_S = Coincidence reduction factor for summer CR_W = Coincidence reduction factor for winter

Prescriptive Lighting: Lighting Fixtures with Integrated Controls – Interior Spaces (New Construction), Code S71 (Inactive)								
EFFICIENCY ASSUMPTIONS								
Baseline Efficiency	The baseline is represented by building code or standard design practice for the building or space type.							
Efficient Measure	High-efficiency lighting system that exceeds building code with controls that automatically control the connected lighting systems.							
PARAMETER VALUES								
Measure/Type	Qty_{EE}	$Watts_{EE}$	$SAVE_{EE}$	Area	HoursWk[35]	Weeks	Life (yrs)	Cost ($)
Retrofit	Actual	Table 31[21]	Table 31[21]	Actual	Actual	Actual	13[36]	Table 31[37]
Measure/Type	ContOutRed	Occ	WHF_d[38]	$WHF_{e,cool}$[39]	$WHF_{e,heat}$[40]	CR_S	CR_W	
Retrofit	Actual	Actual	1.144	1.06	0.00159	18%[41]	12%[42]	
IMPACT FACTORS								
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO	
C&I Prescriptive	100%	99%[43]	101%[44]	Table 29[45]	Table 29[46]	26%[47]	1.6%[48]	

[35] Use actual hours when known. If hours are unknown, use the values from Table 34 or Table 35.
[36] GDS Associates, Inc., Residential and Commercial/Industrial Lighting and HVAC Measures Prepared for The New England State Program Working Group (SPWG), June 2007 and the 2005 Measure Life Study Report prepared for The Massachusetts Joint Utilities, by ERS and the 2005 *Measure Life Study Report* prepared for The Massachusetts Joint Utilities, by ERS.
[37] See Appendix D: Parameter Values Reference Tables
[38] Derived from the concept set forth in Rundquist, R.A., Johnson, K.F., Aumann, D.J. (1993). Calculating Lighting and HVAC Interactions. ASHRAE Journal, 35(11), 28-37. See Appendix D: Parameter Values Reference Tables for derivation and input assumptions.
[39] Ibid.
[40] Ibid.
[41] Reduction of demand due to reduced coincidence driven by controls measured against install wattage. The Cadmus Group, Inc. (2012). Final Report, Small Business Direct Install Program: Pre/Post Occupancy Sensor Study.
[42] Ibid.
[43] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Realization Rates for Prescriptive Measures.
[44] Ibid.
[45] See Appendix B.
[46] See Appendix B.
[47] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[48] Ibid.

Prescriptive Lighting: Lighting Fixtures with Integrated Controls – Interior Spaces (Retrofit), Code S70 (Inactive)	
Last Revised Date	7/1/2016
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of LED stairway lighting fixtures to replace existing operating lighting equipment (retrofit). The fixtures must meet one of the following conditions: include integral controls, operate off of remote sensors where remote sensor is packaged together with the luminaire under a single model number, or be designed to operate off of remote sensors, where the luminaire and sensors are sold separately, but the luminaire has features enabling communication with a remote sensor. Controls must ensure that the luminaire reverts to lower-power, lower-light output state when there are no occupants in the vicinity.
Primary Energy Impact	Electric
Sector	Commercial/Industrial
Program(s)	C&I Prescriptive Program, Small Business Direct Install Program
End-Use	Lighting
Project Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = (WHF_d / 1{,}000) \times [(Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) + (Qty_{EE} \times Watts_{EE} \times ContOutRed \times (1 - Occ))]$ $\Delta kW_{SP} = (WHF_d / 1{,}000) \times [(Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) + (Qty_{EE} \times Watts_{EE} \times ContOutRed \times (1 - Occ)) \times CF_S]$ $\Delta kW_{WP} = (1 / 1{,}000) \times [(Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) + (Qty_{EE} \times Watts_{EE} \times ContOutRed \times (1 - Occ)) \times CF_W]$
Annual Energy Savings	$\Delta kWh/yr = (HoursWk \times Wks \times WHF_{e,cool} / 1{,}000) \times [(Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) + (Qty_{EE} \times Watts_{EE} \times ContOutRed \times (1 - Occ))]$ $\Delta MMBtu/yr = -(HoursWk \times Wks \times WHF_{e,heat} / 1{,}000) \times [(Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) + (Qty_{EE} \times Watts_{EE} \times ContOutRed \times (1 - Occ))]$
Definitions	Unit = Lighting fixture upgrade measure Qty_{BASE} = Quantity of baseline fixtures $Watts_{BASE}$ = Watts of baseline fixture (based on the specified existing fixture type) (Watts) Qty_{EE} = Quantity of energy-efficient fixtures $Watts_{EE}$ = Watts of energy-efficient fixture (based on the specified installed fixture type) (Watts) HoursWk = Weekly hours of equipment operation (hrs/week) Weeks = Weeks per year of equipment operation (weeks/year) ContOutRed = % light output reduction sensor set point (must be minimum of 50%) Occ = % occupancy for space (default to 10%) WHF_d = Waste heat factor for demand to account for cooling savings from efficient lighting $WHF_{e,cool}$ = Waste heat factor for energy to account for cooling savings from efficient lighting $WHF_{e,heat}$ = Waste heat factor for energy to account for increased heating load from efficient lighting 1,000 = Conversion: 1,000 Watts per kW

Prescriptive Lighting: Lighting Fixtures with Integrated Controls – Interior Spaces (Retrofit), Code S70 (Inactive)

EFFICIENCY ASSUMPTIONS

Baseline Efficiency	The existing lighting system.
Efficient Measure	High-efficiency lighting system that exceeds building code with controls that automatically control the connected lighting systems.

PARAMETER VALUES

Measure/Type	Qty_{BASE}	$Watts_{BASE}$	Qty_{EE}	$Watts_{EE}$	HoursWk[49]	Weeks	Life (yrs)	Cost ($)
Retrofit	Actual	Table 32[50]	Actual	Table 31[51]	Actual	Actual	13[52]	Table 31[53]

Measure/Type	ContOutRed	Occ	WHF_d[54]	$WHF_{e,cool}$[55]	$WHF_{e,heat}$[56]
Retrofit	Actual	Actual	1.144	1.06	0.00159

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	99%[57]	101%[58]	Table 29[59]	Table 29[60]	26%[61]	1.6%[62]
Small Business Direct Install	100%	100%[63]	100%[64]	Table 29[65]	Table 29[66]	25%[67]	0%[68]

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[49] Use actual hours when known. If hours are unknown, use the values from Table 34 or Table 35.
[50] See Appendix D. The fixture wattages are based on the specified fixture types for baseline and installed fixtures.
[51] Ibid.
[52] GDS Associates, Inc., Residential and Commercial/Industrial Lighting and HVAC Measures Prepared for The New England State Program Working Group (SPWG), June 2007 and the 2005 Measure Life Study Report prepared for The Massachusetts Joint Utilities, by ERS and the 2005 *Measure Life Study Report* prepared for The Massachusetts Joint Utilities, by ERS.
[53] See Appendix D: Parameter Values Reference Tables.
[54] Derived from the concept set forth in Rundquist, R.A., Johnson, K.F., Aumann, D.J. (1993). Calculating Lighting and HVAC Interactions. ASHRAE Journal, 35(11), 28-37. See Appendix D: Parameter Values Reference Tables for derivation and input assumptions.
[55] Ibid.
[56] Ibid.
[57] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Realization Rates for Prescriptive Measures.
[58] Ibid.
[59] See Appendix B.
[60] See Appendix B.
[61] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[62] Ibid.
[63] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[64] Ibid.
[65] See Appendix B.
[66] See Appendix B.
[67] Program not yet evaluated, assume default FR of 25%.
[68] Program not yet evaluated, assume default SO of 0%.

Prescriptive Lighting: Lighting Fixtures – LED Exit Signs, Code X10 (Inactive)	
Last Revised Date	7/1/2016
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of new LED exit signs to replace existing, operating incandescent or fluorescent exit signs (retrofit).
Primary Energy Impact	Electric
Sector	Commercial/ Industrial
Program(s)	C&I Prescriptive Program, Small Business Direct Install Program
End-Use	Lighting
Project Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE} / 1{,}000) \times WHF_d$ $\Delta kW_{SP} = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE} / 1{,}000) \times WHF_d \times CF_S$ $\Delta kW_{WP} = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE} / 1{,}000) \times CF_W$
Annual Energy Savings	$\Delta kWh/yr = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE} / 1{,}000) \times HoursYr \times WHF_{e,cool}$ $\Delta MMBtu/yr = -(Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE} / 1{,}000) \times HoursYr \times WHF_{e,heat}$
Definitions	Unit = Exit sign upgrade measure Qty_{BASE} = Quantity of baseline fixtures Qty_{EE} = Quantity of installed fixtures $Watts_{BASE}$ = Watts of baseline fixture (based on the specified existing fixture type) (Watts) $Watts_{EE}$ = Watts of Energy-efficient fixture (based on the specified installed fixture type) (Watts) HoursYr = Annual operating hours (hrs/yr) WHF_d = Waste heat factor for demand to account for cooling savings from efficient lighting $WHF_{e,cool}$ = Waste heat factor for energy to account for cooling savings from efficient lighting $WHF_{e,heat}$ = Waste heat factor for energy to account for increased heating load from efficient lighting 1,000 = Conversion: 1,000 Watts per kW
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Existing incandescent or fluorescent exit sign.
Efficient Measure	Exit sign illuminated with LED.
PARAMETER VALUES	

Measure/Type	Qty_{BASE}	$Watts_{BASE}$	Qty_{EE}	$Watts_{EE}$	HoursYr	Life (yrs)	Cost ($)
Retrofit	Actual	Table 32[69]	Actual	Table 31[70]	8,760[71]	13[72]	Table 31[73]
Measure/Type	WHF_d[74]	$WHF_{e,cool}$[75]	$WHF_{e,heat}$[76]				
Retrofit	1.144	1.06	0.00159				

[69] See Appendix D. The fixture wattages are based on the specified fixture types for baseline and installed fixtures.
[70] See Appendix D. The fixture wattages are based on the specified fixture types for baseline and installed fixtures.
[71] Exit signs operate continuously, so annual operating hours are 8,760 hours/year (24 hours/day x 365 days/year = 8,760 hours/year).
[72] GDS Associates, Inc., Residential and Commercial/Industrial Lighting and HVAC Measures Prepared for The New England State Program Working Group (SPWG), June 2007 and the 2005 Measure Life Study Report prepared for The Massachusetts Joint Utilities, by ERS and the 2005 *Measure Life Study Report* prepared for The Massachusetts Joint Utilities, by ERS.
[73] See Appendix D: Parameter Values Reference Tables.
[74] Derived from the concept set forth in Rundquist, R.A., Johnson, K.F., Aumann, D.J. (1993). Calculating Lighting and HVAC Interactions. ASHRAE Journal, 35(11), 28-37. See Appendix D: Parameter Values Reference Tables for derivation and input assumptions.
[75] Ibid.
[76] Ibid.

Prescriptive Lighting: Lighting Fixtures – LED Exit Signs, Code X10 (Inactive)							
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	99%[77]	101%[77]	Table 29[78]	Table 29[78]	26%[79]	1.6%[80]
Small Business Direct Install	100%	100%[81]	100%[81]	Table 29[78]	Table 29[78]	25%[82]	0%[83]

77 Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Realization Rates for Prescriptive Measures.

78 See Appendix B.

79 Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.

80 Ibid.

81 This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.

82 Program not yet evaluated, assume default FR of 25%.

83 Program not yet evaluated, assume default SO of 0%.

Prescriptive Lighting: Lighting Fixtures – Exterior Spaces (New fixtures), Codes S11, S13, S17, S23

Last Revised Date	7/1/2013
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of high-efficiency exterior lighting fixtures instead of new standard-efficiency lighting fixtures.
Primary Energy Impact	Electric
Sector	Commercial/Industrial
Program(s)	C&I Prescriptive Program, Small Business Direct Install Program
End-Use	Lighting
Project Type	New construction, Replace on burnout
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = Qty_{EE} \times SAVE_{EE} / 1{,}000$
Annual Energy Savings	$\Delta kWh/yr = Qty_{EE} \times SAVE_{EE} / 1{,}000 \times HoursWk \times Weeks$
Definitions	Unit = Lighting fixture upgrade measure Qty_{EE} = Quantity of installed fixtures $Watts_{EE}$ = Watts of energy-efficient fixture (based on the specified installed fixture type) (Watts) $SAVE_{EE}$ = Average wattage reduction of fixture (based on the specified installed fixture type) (Watts) LPD_{BASE} = Baseline maximum lighting power density (LPD) for space type (Watts/ft^2) Area = Area of the building or space associated with the design LPD_{BASE} value (ft^2) HoursWk = Weekly hours of equipment operation (hrs/week) Weeks = Weeks per year of equipment operation (weeks/year) 1,000 = Conversion: 1,000 Watts per kW
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Building code or standard design practice for the building or space type.
Efficient Measure	High-efficiency lighting system that exceeds building code.

PARAMETER VALUES

Measure/Type	Qty_{EE}	$Watts_{EE}$	$SAVE_{EE}$	Area	LPD_{BASE}	HoursWk[84]	Weeks	Life (yrs)	Cost ($)
New construction	Actual	Table 31[85]	Table 31[86]	Actual	Table 33[87]	Actual	Actual	15[88]	Table 31[89]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	99%[90]	101%[90]	Table 29[91]	Table 29[91]	26%[92]	1.6%[93]
Small Business Direct Install	100%	100%[94]	100%[32]	Table 29[29]	Table 29[29]	25%[95]	0%[96]

[84] Use actual when available; otherwise, use 4,380 (operating 12 hrs 365 days a year).
[85] See Appendix D. The installed fixture wattage and wattage reduction values are based on the specified installed fixture type.
[86] See Appendix D. The installed fixture wattage and wattage reduction values are based on the specified installed fixture type.
[87] See Appendix D. The baseline LPD is based on the specified space type.
[88] GDS Associates, Inc., Residential and Commercial/Industrial Lighting and HVAC Measures Prepared for The New England State Program Working Group (SPWG), June 2007 and the 2005 Measure Life Study Report prepared for The Massachusetts Joint Utilities, by ERS and the 2005 *Measure Life Study Report* prepared for The Massachusetts Joint Utilities, by ERS.
[89] See Appendix D: Parameter Values Reference Tables.
[90] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Realization Rates for Prescriptive Measures.
[91] See Appendix B.
[92] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[93] Ibid.
[94] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[95] Program not yet evaluated, assume default FR of 25%.
[96] Program not yet evaluated, assume default SO of 0%.

Prescriptive Lighting: Lighting Fixtures – Exterior Spaces (Retrofit/Replacement Lamps), Codes S6, S8, S11R, S13R, S17R, S23R

Last Revised Date	7/1/2016
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of high-efficiency exterior lighting fixtures to replace existing operating lighting equipment (retrofit).
Primary Energy Impact	Electric
Sector	Commercial/Industrial
Program(s)	C&I Prescriptive Program, Small Business Direct Install Program
End-Use	Lighting
Project Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) / 1{,}000$
Annual Energy Savings	$\Delta kWh/yr = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) / 1{,}000 \times HoursWk \times Weeks$
Definitions	Unit = Lighting fixture upgrade measure Qty_{BASE} = Quantity of baseline fixtures Qty_{EE} = Quantity of installed fixtures $Watts_{BAE}$ = Watts of baseline fixture (based on the specified existing or baseline fixture type) (Watts) $Watts_{EE}$ = Watts of energy-efficient fixture (based on the specified installed fixture type) (Watts) HoursWk = Weekly hours of equipment operation (hrs/week) Weeks = Weeks per year of equipment operation (weeks/year) 1,000 = Conversion: 1,000 Watts per kW
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The existing lighting system.
Efficient Measure	High-efficiency lighting system that exceeds building code.

PARAMETER VALUES

Measure/Type	Qty_{BASE}	$Watts_{BASE}$	Qty_{EE}	$Watts_{EE}$	HoursWk[97]	Weeks	Life (yrs)	Cost ($)
Retrofit	Actual	Table 32[98]	Actual	Table 31[98]	Actual	Actual	13[99]	Table 32[100]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	99%[101]	101%[102]	Table 29[103]	Table 29[103]	26%[104]	1.6%[105]
Small Business Direct Install	100%	100%[106]	100%[106]	Table 29[103]	Table 29[103]	25%[107]	0%[108]

[97] Use actual when available; otherwise, use 4,380 (operating 12 hrs 365 days a year).
[98] See Appendix D. The baseline and installed fixture wattages are based on the specified baseline fixture type.
[99] GDS Associates, Inc., Residential and Commercial/Industrial Lighting and HVAC Measures Prepared for The New England State Program Working Group (SPWG), June 2007 and the 2005 Measure Life Study Report prepared for The Massachusetts Joint Utilities, by ERS and the 2005 *Measure Life Study Report* prepared for The Massachusetts Joint Utilities, by ERS.
[100] Actual project cost collected for SBI. For C&I Prescriptive see Appendix D: Parameter Values Reference Tables.
[101] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Realization Rates for Prescriptive Measures.
[102] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Realization Rates for Prescriptive Measures.
[103] See Appendix B.
[104] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[105] Ibid.
[106] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[107] Program not yet evaluated, assume default FR of 25%.
[108] Program not yet evaluated, assume default SO of 0%.

Prescriptive Lighting: Lighting Controls – Interior Spaces, Codes L60.1, L70.1, L71.1	
Last Revised Date	10/1/2017 (retroactive to 7/1/2016)
MEASURE OVERVIEW	
Description	This measure involves the installation of lighting controls on new or existing interior lighting fixtures.
Primary Energy Impact	Electric
Sector	Commercial/Industrial
Program(s)	C&I Prescriptive Program, Small Business Direct Install Program
End-Use	Lighting
Project Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	ΔkW = $Qty_{FIXTURES}$ x Watts / 1,000 x WHF_d ΔkW_{SP} = $Qty_{FIXTURES}$ x Watts / 1,000 x WHF_d x CF_S ΔkW_{WP} = $Qty_{FIXTURES}$ x Watts / 1,000 x CF_W
Annual Energy Savings	$\Delta kWh/yr$ = $Qty_{FIXTURES}$ x Watts / 1,000 x HoursWk x Weeks x SVG x $WHF_{e,cool}$ $\Delta MMBtu/yr$[109] = -$Qty_{FIXTURES}$ x Watts / 1,000 x HoursWk x Weeks x SVG x $WHF_{e,heat}$
Definitions	Unit = Lighting control project or space $Qty_{FIXTURES}$ = Total quantity of fixtures connected to the new controls Watts = Wattage per fixture connected to the new control (Watts) HoursWk = Weekly hours of equipment operation before installation of controls (hrs/week) Weeks = Weeks per year of equipment operation (weeks/year) SVG = % of annual lighting energy saved by lighting control (%) WHF_d = Waste heat factor for demand to account for cooling savings from reduced run time $WHF_{e,cool}$ = Waste heat factor for energy to account for cooling savings from reduced run time $WHF_{e,heat}$ = Waste heat factor for energy to account for increased heating load from efficient lighting 1,000 = Conversion: 1,000 Watts per kW
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The baseline case is a manual switch in the absence of controls.
Efficient Measure	Lighting controls that automatically control the connected lighting systems.

[109] Fuel interactive effects are distributed across fuels types as follows: 76% Oil, 10% Natural Gas, 7% Propane, 7% Kerosene.

Prescriptive Lighting: Lighting Controls – Interior Spaces, Codes L60.1, L70.1, L71.1							
PARAMETER VALUES							
Measure/Type	Qty	Watts[110]	HoursWk[111]	Weeks	SVG	Life (yrs)	Cost ($)
Retrofit	Actual	Table 31 or Table 32	Actual	Actual	Table 36[112]	10[113]	Table 32[114]

Measure/Type	WHF_d[115]	$WHF_{e,cool}$[116]	$WHF_{e,heat}$[117]
Retrofit	1.144	1.06	0.00159

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	99%[118]	101%[118]	Table 29[119]	Table 29[119]	26%[120]	1.6%[121]
Small Business Direct Install	100%	100%[122]	100%[122]	Table 29[119]	Table 29[119]	25%[123]	0%[124]

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110 See Appendix D: Parameter Values Reference Tables. The controlled fixture may be selected from either the baseline or installed wattage tables. The controlled wattage is determined using the wattage tables and the selected of controlled fixture type.
111 Use actual hours when known. If hours are unknown, use the values from Table 34 or Table 35.
112 See Appendix D: Parameter Values Reference Tables. The savings factor is determined using the Lighting Control Savings table and the space type specified in the project Data Collection and Information Form. If the space type is unknown, use the "Other" space type value.
113 GDS Associates, Inc., Residential and Commercial/Industrial Lighting and HVAC Measures Prepared for The New England State Program Working Group (SPWG), June 2007 and the 2005 Measure Life Study Report prepared for The Massachusetts Joint Utilities, by ERS.
114 See Appendix D: Parameter Values Reference Tables.
115 Derived from the concept set forth in Rundquist, R.A., Johnson, K.F., Aumann, D.J. (1993). Calculating Lighting and HVAC Interactions. ASHRAE Journal, 35(11), 28-37. See Appendix D: Parameter Values Reference Tables for derivation and input assumptions.
116 Ibid.
117 Ibid.
118 Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Realization Rates for Prescriptive Measures.
119 See Appendix B.
120 Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
121 Ibid.
122 This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
123 Program not yet evaluated, assume default FR of 25%.
124 Program not yet evaluated, assume default SO of 0%.

Prescriptive Lighting: Lighting Fixtures – Refrigerated Spaces, Codes S30, S32	
Last Revised Date	11/12/2013
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of high-efficiency lighting fixtures in refrigerated spaces instead of standard lighting fixtures (new construction projects) or to replace existing operating lighting fixtures (retrofit). The new fixtures may be installed vertically or horizontally in the refrigerated cases.
Primary Energy Impact	Electric
Sector	Commercial/Industrial
Program(s)	C&I Prescriptive Program, Small Business Direct Install Program
End-Use	Lighting
Project Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	*For retrofit vertical:* $\Delta k = (Qty_{BASE} \times Watts_{BASE} - \#doors \times Watts_{EE}) / 1{,}000 \times BF$ $\Delta kW_{SP} = (Qty_{BASE} \times Watts_{BASE} - \#doors \times Watts_{EE}) / 1{,}000 \times BF \times CF_S$ $\Delta kW_{WP} = (Qty_{BASE} \times Watts_{BASE} - \#doors \times Watts_{EE}) / 1{,}000 \times CF_W$ *For retrofit horizontal:* $\Delta kW = (Qty_{BASE} \times Watts_{BASE} - \#feet \times Watts_{EE}) / 1{,}000 \times BF$ $\Delta kW_{SP} = (Qty_{BASE} \times Watts_{BASE} - \#feet \times Watts_{EE}) / 1{,}000 \times BF \times CF_S$ $\Delta kW_{WP} = (Qty_{BASE} \times Watts_{BASE} - \#feet \times Watts_{EE}) / 1{,}000 \times CF_W$
Annual Energy Savings	*For retrofit-vertical:* $\Delta kWh/yr = (Qty_{BASE} \times Watts_{BASE} - \#doors \times Watts_{EE}) / 1{,}000 \times HoursWk \times Weeks \times BF$ *For retrofit horizontal:* $\Delta kWh/yr = (Qty_{BASE} \times Watts_{BASE} - \#feet \times Watts_{EE}) / 1{,}000 \times HoursWk \times Weeks \times BF$
Definitions	Unit = Lighting fixture upgrade measure Qty_{BASE} = Quantity of baseline fixtures #doors = Quantity of refrigerated doors with installed LED fixtures #feet = Horizontal feet of new lighting fixture(s) (ft) $SAVE_{EE}$ = Average wattage reduction per door (vertical) or per foot (horizontal) with LED (Watts) $Watts_{BASE}$ = Watts of baseline fixture (based on the specified baseline fixture type) (Watts) $Watts_{EE}$ = Watts per refrigerated door (vertical) or per foot (horizontal) with LED fixture (Watts) HoursWk = Weekly hours of equipment operation (hrs/week) Weeks = Weeks per year of equipment operation (weeks/year) BF = Bonus factor to account for refrigeration savings due to reduced waste heat 1,000 = Conversion: 1,000 Watts per kW
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	For new construction projects, the baseline is represented by building code or standard design practice for the building or space type. For retrofit projects, the baseline is the existing lighting system.
Efficient Measure	High-efficiency lighting system that exceeds building code.

Prescriptive Lighting: Lighting Fixtures – Refrigerated Spaces, Codes S30, S32

PARAMETER VALUES

Measure/Type	Qty_{BASE}	$Watts_{BASE}$	#doors, #feet	$Watts_{EE}$	$SAVE_{EE}$
New construction	N/A	N/A	Actual	N/A	Table 31[125]
Retrofit	Actual	Table 32[125]	Actual	Table 31[125]	N/A
Measure/Type	HoursWk[126]	Weeks	BF	Life (yrs)	Cost ($)
New construction	Actual	Actual	1.29[127]	15[128]	Table 32[129]
Retrofit	Actual	Actual	1.29[127]	13[128]	Table 32[129]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	99%[130]	101%[130]	Table 29[131]	Table 29[131]	26%[132]	1.6%[133]
Small Business Direct Install	100%	100%[134]	100%[134]	Table 29[131]	Table 29[131]	25%[135]	0%[136]

[125] See Appendix D. The fixture wattage and wattage reduction values are based on the specified fixture types for both baseline and installed fixtures.
[126] Use actual when available; otherwise use 4,057 (retail average annual operating hours, From New York Technical Reference Manual, 2010).
[127] For prescriptive refrigerated lighting measures, the default value is 1.29 (calculated as (1 + (1.0 / 3.5))), based on the assumption that all lighting in refrigerated cases is mechanically cooled, a typical refrigeration efficiency 3.5 COP, and assuming 100% of lighting heat needs to be mechanically cooled at time of summer peak.
[128] GDS Associates, Inc., Residential and Commercial/Industrial Lighting and HVAC Measures Prepared for The New England State Program Working Group (SPWG), June 2007 and the 2005 Measure Life Study Report prepared for The Massachusetts Joint Utilities, by ERS and the 2005 Measure Life Study Report prepared for The Massachusetts Joint Utilities, by ERS.
[129] See Appendix D: Parameter Values Reference Tables.
[130] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Realization Rates for Prescriptive Measures.
[131] See Appendix B.
[132] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[133] Ibid.
[134] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR
[135] Program not yet evaluated, assume default FR of 25%.
[136] Program not yet evaluated, assume default SO of 0%.

Prescriptive Lighting: Lighting Controls – Refrigerated Spaces, Code L50	
Last Revised Date	7/1/2013
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of occupancy-based lighting controls on new high-efficiency lighting fixtures in refrigerated spaces. The program does not provide incentives for lighting controls on existing inefficient lighting.
Primary Energy Impact	Electric
Sector	Commercial/Industrial
Program(s)	C&I Prescriptive Program, Small Business Direct Install Program
End-Use	Lighting
Project Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	ΔkW = Qty x Watts / 1,000 x BF
Annual Energy Savings	ΔkWh/yr = Qty x Watts / 1,000 x HoursWk x Weeks x SF x BF
Definitions	Unit = 1 new sensor (that may control multiple lighting fixtures) Qty = Quantity of fixtures connected to the control Watts = Fixture wattage of the fixture(s) connected to the control (Watts) HoursWk = Weekly hours of equipment operation (hrs/week) Weeks = Weeks per year of equipment operation (weeks/year) SF = Savings factor, or percentage of savings resulting from a reduction in operating hours BF = Bonus factor to account for refrigeration savings due to reduced waste heat 1,000 = Conversion: 1,000 Watts per kW
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	No occupancy sensor.
Efficient Measure	Lighting controls which automatically control connected lighting systems based on occupancy.
PARAMETER VALUES	

Measure/Type	Qty	Watts[137]	HoursWk[138]	Weeks	SF[139]	BF[140]	Life (yrs)[141]	Cost ($)[142]
New construction	Actual	Table 31	Actual	Actual	30.7%	1.29	10	Table 32
Retrofit	Actual	Table 31	Actual	Actual	30.7%	1.29	9	Table 32

[137] See Appendix D. The controlled fixture may be selected from either the baseline or installed wattage tables. The controlled wattage is determined using the wattage tables and the selected of controlled fixture type.
[138] Use actual when available; otherwise, use 168 HoursWk and 52 Weeks (assuming equipment operates 24 hours per day, year round).
[139] US DOE, "Demonstration Assessment of Light-Emitting Diode (LED) Freezer Case Lighting." Refrigerated cases were metered for 12 days to determine savings from occupancy sensors. Assumes that refrigerated freezers and refrigerated coolers will see the same amount of savings from sensors.
[140] For prescriptive refrigerated lighting measures, the default value is 1.29 (calculated as (1 + (1.0 / 3.5))). Based on the assumption that all lighting in refrigerated cases is mechanically cooled, with a typical 3.5 COP refrigeration system efficiency, and assuming 100% of lighting heat needs to be mechanically cooled at time of summer peak.
[141] GDS Associates, Inc., Residential and Commercial/Industrial Lighting and HVAC Measures Prepared for The New England State Program Working Group (SPWG), June 2007 and the 2005 Measure Life Study Report prepared for The Massachusetts Joint Utilities, by ERS.
[142] See Appendix D: Parameter Values Reference Tables.

Prescriptive Lighting: Lighting Controls – Refrigerated Spaces, Code L50							
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	99%[143]	101%[144]	Table 29[145]	Table 29[145]	26%[146]	1.6%[147]
Small Business Direct Install	100%	100%[148]	100%[148]	Table 29[145]	Table 29[145]	25%[149]	0%[150]

143 Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Realization Rates for Prescriptive Measures.
144 Ibid.
145 See Appendix B.
146 Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
147 Ibid.
148 This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
149 Program not yet evaluated, assume default FR of 25%.
150 Program not yet evaluated, assume default SO of 0%.

Variable Frequency Drives

Advanced Rooftop Controls	
Last Revised Date	6/2/2017
MEASURE OVERVIEW	
Description	This measure involves the installation of a rooftop controller to rooftop units that provide cooling to interior spaces. The installed equipment must incorporate a variable frequency drive which controls RTU supply fan speed. The installed system must be capable of modulating the fan speed based on based on the RTU heating, cooling, ventilation or other control input, and must be installed on an existing constant volume RTU.
Primary Energy Impact	Electricity
Sector	Commercial, Industrial
Program(s)	C&I Prescriptive Program
End-Use	Electricity, Space cooling
Project Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	ΔkW = HP_{VFD} x DSVG
Annual Energy Savings	ΔkWh/yr = HP_{VFD} x ESVG
Definitions	Unit = 1 VFD (that may control multiple motors) HP_{VFD} = Total horsepower of motor(s) connected to VFD (hp) ESVG = energy savings factor (kWh/yr/hp) DSVG = demand savings factor (kW/hp)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The baseline reflects an existing RTU without supply fan speed or damper controls.
Efficient Measure	The high-efficiency case involves the installation of controls that allow for fan speed control based on

PARAMETER VALUES

Measure/Type	HP_{VFD}	ESVG	DSVG	Life (yrs)	Cost ($)
Value	Actual	3049.5[151]	.432	7[152]	Table 2

IMPACT FACTORS

Program	ISR	RR_E[153]	RR_D	CF_S	CF_W	FR[154]	SO[155]
C&I Prescriptive	100%	100%	N/A	N/A	N/A	25%[156]	0%[157]

[151] The baseline equipment controls are assumed to be constant volume units. The ESVG and DSVG have been increased by 50% relative to the values used for the prescriptive VFD measure to reflect the increased savings for the installation of this measure on constant volume units.
[152] The lifetime is assumed to be half of the life of a new RTU.
[153] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[154] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes the program overall values from the Business Incentive Program Evaluation (Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-8. NTG Impacts for Program Overall).
[155] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-10. Participant Spillover.
[156] Measure not yet evaluated, assume default FR of 25%.
[157] Measure not yet evaluated, assume default SO of 0%.

Prescriptive VFD: Variable Frequency Drives (VFDs) for HVAC, Codes SFA, SFP, RFA, RFP, BEF, CWP, HHWP	
Last Revised Date	7/1/2013
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of a variable frequency drive (VFD) on an electric motor serving HVAC loads. A VFD is a specific type of adjustable-speed drive. VFDs are also known as adjustable-frequency drives (AFDs), variable-speed drives (VSDs), AC drives, and inverter drives. This measure covers VFDs on 5 HP to 100 HP motors for the following HVAC equipment: supply fans, return fans, building exhaust fans, chilled water distribution pumps, and heating hot water circulation pumps. For VFDs on other equipment type or serving non-HVAC loads, use the Custom Measure approach. This measure is not eligible for new construction applications for which VSDs are required per Section 503.2.5.1 of IECC 2009.
Primary Energy Impact	Electric
Sector	Commercial
Program(s)	C&I Prescriptive Program
End-Use	VFDs for HVAC
Project Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	ΔkW = HP_{VFD} x DSVG
Annual Energy Savings	ΔkWh/yr = HP_{VFD} x ESVG
Definitions	Unit = 1 VFD (that may control multiple motors) HP_{VFD} = Total horsepower of motor(s) connected to VFD (hp) ESVG = energy savings factor (kWh/yr/hp) DSVG = demand savings factor (kW/hp)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The baseline reflects no VFD installed on the HVAC equipment.
Efficient Measure	The high-efficiency case involves a VFD installed on existing HVAC equipment to reduce the average motor speed.

PARAMETER VALUES

Measure/Type	HP_{VFD}	ESVG	DSVG	Life (yrs)	Cost ($)
All	Actual	Table 1	Table 1	13[158]	Table 2

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2[159]	100%[160]	Table 29[161]	Table 29[161]	52%[162]	1.6%[163]

[158] GDS Associates, Inc., Residential and Commercial/Industrial Lighting and HVAC Measures Prepared for The New England State Program Working Group (SPWG), June 2007 and the 2005 Measure Life Study Report prepared for The Massachusetts Joint Utilities, by ERS.
[159] Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.
[160] RR_D used to adjust Summer and Winter CF to account for BIP program evalution findings as presented in Appendix D
[161] See Appendix C.
[162] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[163] Ibid.

Table 1 – VFD Energy and Peak Demand Savings Factors (ESVG and DSVG)[164,165]

Measure Code	Measure Description	ESVG (kWh/yr/hp)	DSVG (kW/hp)
SFA, SFP	Supply Fans	2,033	0.288
RFA, RFP	Return Fans	1,788	0.302
BEF	Exhaust Fans	755	0.12
CWP	Chilled Water Pumps	1,633	0.183
HHWP	Heating Hot Water Circulation Pump	1,548	0.096

Table 2 – Measure Costs for VFD[166]

Cumulative Motor HP Controlled by Each VFD (HP_{VFD})	Measure Cost ($)
5	$2,425
7.5	$2,648
10	$2,871
15	$3,317
20	$3,763
25	$4,209
30	$4,655

[164] Values for exhaust fans were taken from National Grid 2001 values averaged from previous evaluations of VFD installations. Values are those used for existing construction, except for chilled water pumps, which is used for new construction. National Grid existing construction baseline is similar to Vermont baseline for new and existing applications.

[165] Values for applications other than exhaust fans were taken from: Cadmus. *Variable Speed Drive Loadshape Study.* Prepared for Northeast Energy Efficiency Partnership. August 2014.

[166] Cost data estimated based on correlation between total cost and controlled HP results from: Navigant, NEEP Incremental Cost Study Phase Two Final Report, January 2013, Table 15.

HVAC Equipment

Prescriptive HVAC: Unitary Air Conditioners, Codes AC1-AC6 (Inactive)	
Last Revised Date	7/1/2013
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of new high-efficiency air conditioning equipment instead of new standard-efficiency air conditioning equipment. This measure includes high-efficiency electrically operated air-cooled single package and split system air conditioners, including room or window air conditioners for commercial/industrial facilities.
Primary Energy Impact	Electric
Sector	Commercial
Program	C&I Prescriptive Program
End-Use	HVAC
Project Type	New construction, Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	*For equipment with rated size < 5.4 tons (< 65,000 Btuh):* $\Delta kW = Tons \times 12 \times (1/SEER_{BASE} - 1/SEER_{EE})$ *For equipment with rated size ≥ 5.4 tons (≥ 65,000 Btuh):* $\Delta kW = Tons \times 12 \times (1/EER_{BASE} - 1/EER_{EE})$
Annual Energy Savings	*For equipment with rated size < 5.4 tons (< 65,000 Btuh):* $\Delta kWh/yr = Tons \times 12 \times (1/SEER_{BASE} - 1/SEER_{EE}) \times EFLH_C$ *For equipment with rated size ≥ 5.4 tons (≥ 65,000 Btuh):* $\Delta kWh/yr = Tons \times 12 \times (1/EER_{BASE} - 1/EER_{EE}) \times EFLH_C$
Definitions	Unit = 1 air conditioning unit Tons = Nominal rating of the capacity of the heat pump in tons (tons = kBtuh/12) $SEER_{BASE}$ = Cooling seasonal energy efficiency ratio of the baseline equipment < 5.4 tons (Btuh/Watt) $SEER_{EE}$ = Cooling seasonal energy efficiency ratio of the efficient equipment < 5.4 tons (Btuh/Watt) EER_{BASE} = Cooling energy efficiency ratio of the baseline equipment ≥ 5.4 tons (Btuh/Watt) EER_{EE} = Cooling energy efficiency ratio of the efficient equipment ≥ 5.4 tons (Btuh/Watt) $EFLH_C$ = Cooling equivalent full load hours per year (hrs/yr) 12 = Conversion: 1 ton = 12 kBtuh
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Meets minimum cooling efficiency requirements based on IECC 2009, Table 503.2.3(1).
Efficient Measure	Rated cooling and heating efficiency of new equipment must meet or exceed the minimum requirements on the program Data Collection and Measure Code Reference Forms (available on the Efficiency Maine website: http://www.efficiencymaine.com/).

PARAMETER VALUES

Measure/Type	Tons	$SEER_{BASE}$, EER_{BASE}	$SEER_{EE}$, EER_{EE}	$EFLH_C$	Life (yrs)	Cost ($)
Unitary AC < 11.25 tons	Actual	Table 3	Actual	829[167]	15[168]	Table 3
Unitary AC ≥ 11.25 tons	Actual	Table 3	Actual	605[167]	15[168]	Table 3
Window AC	Actual	Table 3	Actual	829[167]	9[169]	Table 3

[167] KEMA, NEEP C&I Unitary HVAC Loadshape Project, June 2011, Table 0-3 and 0-4. Values are for the NE-North region.
[168] GDS Associates, Inc., Residential and Commercial/Industrial Lighting and HVAC Measures Prepared for The New England State Program Working Group (SPWG), June 2007 and the 2005 Measure Life Study Report prepared for The Massachusetts Joint Utilities, by ERS.
[169] Default assumptions used in the ENERGY STAR® calculator, April 2013.

Prescriptive HVAC: Unitary Air Conditioners, Codes AC1-AC6 (Inactive)							
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	99%[170]	101%[171]	Table 29[172]	Table 29[173]	52%[174]	1.6%[175]

Table 3 – Baseline Efficiency Values and Measure Cost for Unitary AC Systems

Equipment Type	Cooling Capacity (Tons)	Cooling Capacity (Btuh)	Base Efficiency[A]	Incremental Cost ($/ton)[B]
Air Conditioners, Air-Cooled	< 5.4 (Split System)	< 65,000 (Split System)	13.0 SEER	$115
	< 5.4 (Single Package)	< 65,000 (Single Package)	13.0 SEER	$115
	≥ 5.4 and < 11.25	≥ 65,000 and < 135,000	11.2 EER	$91
	≥ 11.25 and < 20	≥ 135,000 and < 240,000	11.0 EER	$99
	≥ 20 and < 63.3	≥ 240,000 and < 760,000	10.0 EER	$100[C]
	≥ 63.3	≥ 760,000	9.7 EER	$100[C]
Window AC	All	All	11.0 EER[C]	$50[D]

[A] IECC 2009, Table 503.2.3(1): Minimum Efficiency Requirements: Electrically Operated Unitary Air Conditioners and Condensing Units.
[B] The total incremental cost values are comparable to the values found in Navigant, NEEP Incremental Cost Study Report Final, September 2011, Table 1-15.
[C] Vermont TRM 2014 Tier 1.
[D] The baseline efficiency and measure cost for window AC units is based on a 10,000 Btu/h unit (same as assumption for window AC in the Residential TRM).

[170] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Realization Rates for Prescriptive Measures.
[171] Ibid.
[172] See Appendix B.
[173] See Appendix B.
[174] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[175] Ibid.

Prescriptive HVAC: Heat Pump Systems, Codes AH1-AH5, WH	
Last Revised Date	7/1/2017
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of a new high-efficiency heat pump system instead of a new standard-efficiency heat pump. It includes high-efficiency electric air-to-air, water source (open loop), and ground source (closed loop) heat pump systems.
Primary Energy Impact	Electric
Sector	Commercial
Program	C&I Prescriptive Program
End-Use	HVAC
Project Type	New construction, Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	*For air-to-air equipment < 5.4 tons (< 65,000 Btuh):* $\Delta kW_C = CAP_C \times 12 \times (1/SEER_{BASE} - 1/SEER_{EE})$ $\Delta kW_H = CAP_H \times 12 \times (1/HSPF_{BASE} - 1/HSPF_{EE})$ *For air-to-air equipment ≥ 5.4 tons (≥ 65,000 Btuh) and all water and ground source equipment:* $\Delta kW_C = CAP_C \times 12 \times (1/EER_{BASE} - 1/EER_{EE})$ $\Delta kW_H = CAP_H \times 12 \times (1/COP_{BASE} - 1/COP_{EE}) / 3.412$
Annual Energy Savings	*For air-to-air equipment < 5.4 tons (< 65,000 Btuh):* $\Delta kWh_C/yr = CAP_C \times 12 \times (1/SEER_{BASE} - 1/SEER_{EE}) \times EFLH_C$ $\Delta kWh_H/yr = CAP_H / 1{,}000 \times (1/HSPF_{BASE} - 1/HSPF_{EE}) \times EFLH_H$ *For air-to-air equipment ≥ 5.4 tons (≥ 65,000 Btuh) and all water and ground source equipment:* $\Delta kWh_C/yr = CAP_C \times 12 \times (1/EER_{BASE} - 1/EER_{EE}) \times EFLH_C$ $\Delta kWh_H/yr = CAP_H / 1{,}000 \times (1/COP_{BASE} - 1/COP_{EE}) \times EFLH_H / 3.412$
Definitions	Unit = 1 new heat pump CAP_C = Rated cooling capacity of the heat pump in tons (tons) CAP_H = Rated heating capacity of the heat pump (Btuh) $SEER_{BASE}$ = Cooling seasonal energy efficiency ratio of the baseline equipment (Btuh/Watt) $SEER_{EE}$ = Cooling seasonal energy efficiency ratio of the efficient equipment (Btuh/Watt) $HSPF_{BASE}$ = Heating seasonal performance factor of the baseline equipment (Btuh/Watt) $HSPF_{EE}$ = Heating seasonal performance factor of the efficient equipment (Btuh/Watt) EER_{BASE} = Cooling energy efficiency ratio of the baseline equipment (Btuh/Watt) EER_{EE} = Cooling energy efficiency ratio of the efficient equipment (Btuh/Watt) COP_{BASE} = Heating coefficient of performance of the baseline equipment COP_{EE} = Heating coefficient of performance of the efficient equipment $EFLH_C$ = Cooling equivalent full load hours per year (hrs/yr) $EFLH_H$ = Heating equivalent full load hours per year (hrs/yr) 12 = Conversion: 1 ton = 12 kBtuh 3.412 = Conversion: 3.412 kBtuh per kW
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Meets minimum cooling and heating efficiency requirements based on IECC 2009, Table 503.2.3(2).
Efficient Measure	Rated cooling and heating efficiency of new equipment must meet or exceed the minimum requirements on the program Data Collection and Measure Code Reference Forms (available on the Efficiency Maine website: http://www.efficiencymaine.com/).

Prescriptive HVAC: Heat Pump Systems, Codes AH1-AH5, WH										
PARAMETER VALUES										
Measure/Type	CAP_C	CAP_H[176]	$SEER_{BASE}$ EER_{BASE}	$SEER_{EE}$ EER_{EE}	$HSPF_{BASE}$ COP_{BASE}	$HSPF_{EE}$ COP_{EE}	$EFLH_C$[177]	$EFLH_H$[178]	Life (yrs)	Cost ($/ton)
Heat Pump < 5.4 tons	Actual	Actual	Table 4	Actual	Table 4	Actual	829	2,200	15[179]	$100[180]
Heat Pump ≥ 5.4 tons and < 11.25 tons	Actual	Actual	Table 4	Actual	Table 4	Actual	829	1,600	15[179]	$100[180]
Heat Pump ≥ 11.25 tons	Actual	Actual	Table 4	Actual	Table 4	Actual	605	1,600	15[179]	$100[180]

IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[181]	100%[181]	Table 29[182]	Table 29[182]	52%[183]	1.6%[184]

Table 4 – Efficiency Requirements and Measure Cost for Heat Pump Systems

Equipment Type	Rated Cooling Capacity, CAP_C		Base Efficiency[A]	
	Tons	**Btuh**	**Cooling**	**Heating**
Air-Cooled	< 5.4 (split system)	< 65,000 (split system)	13.0 SEER	7.7 HSPF
	< 5.4 (single package)	< 65,000 (single package)	13.0 SEER	7.7 HSPF
	≥ 5.4 and < 11.25	≥ 65,000 and < 135,000	11.0 EER	3.3 COP
	≥ 11.25 and < 20	≥ 135,000 and < 240,000	10.6 EER	3.2 COP
	≥ 20	≥ 240,000	9.5 EER	3.2 COP
Water Source	< 1.4	< 17,000	11.2 EER	4.2 COP
	≥ 1.4 and < 11.25	≥ 17,000 and < 135,000	12.0 EER	4.2 COP
Groundwater Source (open loop)	< 11.25	< 135,000	16.2 EER	3.6 COP
Ground Source (closed loop)	< 11.25	< 135,000	13.4 EER	3.1 COP

[A] IECC 2009, Table 503.2.3(2). Minimum Efficiency Requirements: Electrically Operated Unitary and Applied Heat Pumps.

[176] Use actual heating capacity based on application form or equipment specifications. If the heating capacity is unknown, calculate heating capacity based on cooling capacity as follows: for equipment < 5.4 tons: heating capacity = cooling capacity; for equipment ≥ 5.4 tons, heating capacity = cooling capacity × 13,900 / 12,000.

[177] KEMA, NEEP C&I Unitary HVAC Loadshape Project, June 2011, Table 0-3 and 0-4. Values are for the NE-North region.

[178] EMT assumes 2,200 heating full load hours for heat pumps smaller than 5.4 tons (65,000 BTUh) and 1,600 heating full load hours for heat pumps larger than or equal to 5.4 tons.

[179] GDS Associates, Inc., Residential and Commercial/Industrial Lighting and HVAC Measures Prepared for The New England State Program Working Group (SPWG), June 2007 and the 2005 Measure Life Study Report prepared for The Massachusetts Joint Utilities, by ERS.

[180] Efficiency Vermont Technical Reference User Manual (TRM) 2014, Table 1, page 40.

[181] Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.

[182] See Appendix B.

[183] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.

[184] Ibid.

Prescriptive HVAC: Packaged Terminal Air Conditioners and Heat Pumps (Inactive)	
Last Revised Date	7/1/2013
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of new high-efficiency packaged terminal air conditioners (PTACs) and packaged terminal heat pumps (PTHPs) equipment instead of new standard-efficiency PTAC or PTHP equipment.
Primary Energy Impact	Electric
Sector	Commercial
Program	C&I Prescriptive Program
End-Use	HVAC
Project Type	New construction, Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW_C = CAP_C / 1,000 \times (1/EER_{BASE} - 1/EER_{EE})$ $\Delta kW_H = CAP_H / 1,000 \times (1/COP_{BASE} - 1/COP_{EE}) / 3.412$
Annual Energy Savings	$\Delta kWh_C/yr = CAP_C / 1,000 \times (1/EER_{BASE} - 1/EER_{EE}) \times EFLH_C$ $\Delta kWh_H/yr = CAP_H / 1,000 \times (1/COP_{BASE} - 1/COP_{EE}) \times EFLH_H / 3.412$
Definitions	Unit = 1 PTAC or PTHP CAP_C = Rated cooling capacity of the new equipment (Btuh) CAP_H = Rated heating capacity of the new equipment (Btuh) EER_{BASE} = Cooling energy efficiency ratio of the baseline equipment (Btuh/Watt) EER_{EE} = Cooling energy efficiency ratio of the efficient equipment (Btuh/Watt) COP_{BASE} = Heating coefficient of performance of the baseline equipment COP_{EE} = Heating coefficient of performance of the efficient equipment $EFLH_C$ = Cooling equivalent full load hours per year (hrs/yr) $EFLH_H$ = Heating equivalent full load hours per year (hrs/yr) 3.412 = Conversion: 3.412 kBtuh per kW
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The baseline equipment must meet the minimum cooling and heating efficiency requirements based on the current federal energy conservation standards (effective September 30, 2012).
Efficient Measure	Rated cooling and heating efficiency of new equipment must meet or exceed the minimum requirements on the program Data Collection and Measure Code Reference Forms (available on the Efficiency Maine website: http://www.efficiencymaine.com/).

PARAMETER VALUES

Measure/Type	CAP_C	CAP_H	EER_{BASE}	EER_{EE}	COP_{BASE}	COP_{EE}	$EFLH_C$[185]	$EFLH_H$[186]	Life (yrs)[187]	Cost ($)[188]
PTAC	Actual	Actual	Table 5	Actual	Table 5	Actual	829	N/A	15	$75
PTHP	Actual	Actual	Table 5	Actual	Table 5	Actual	605	2,200	15	$75

[185] KEMA, NEEP C&I Unitary HVAC Loadshape Project, June 2011, Table 0-3 and 0-4. Values are for the NE-North region.
[186] EMT assumes 2,200 heating full load hours for heat pumps smaller than 5.4 tons (65,000 BTUh) and 1,600 heating full load hours for heat pumps larger than or equal to 5.4 tons.
[187] GDS Associates, Inc., Residential and Commercial/Industrial Lighting and HVAC Measures Prepared for The New England State Program Working Group (SPWG), June 2007 and the 2005 Measure Life Study Report prepared for The Massachusetts Joint Utilities, by ERS.
[188] Environmental Protection Agency, ENERGY STAR® Market & Industry Scoping Report Packaged Terminal Air Conditioners and Heat Pumps, December 2011.

Prescriptive HVAC: Packaged Terminal Air Conditioners and Heat Pumps (Inactive)							
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	99%[189]	101%[189]	Table 29[190]	Table 29[190]	52%[191]	1.6%[192]

Table 5 – Baseline Efficiencies for PTAC and PTHP (effective September 20, 2012)[193]

Equipment Class			Minimum Energy Conservation Standards	
Equipment	**Category[A]**	**Cooling Capacity (Btu/h)**	**Cooling (EER)**	**Heating (COP)**
PTAC	Standard Size	< 7,000	11.7	N/A
		7,000 – 15,000	13.8 – (0.300 × Cap[B])	N/A
		> 15,000	9.3	N/A
	Non-Standard Size	< 7,000	9.4	N/A
		7,000 – 15,000	10.9 – (0.213 × Cap[B])	N/A
		> 15,000	7.7	N/A
PTHP	Standard Size	< 7,000	11.9	3.3
		7,000 – 15,000	14.0 – (0.300 × Cap[B])	3.7 – (0.052 x Cap[B])
		> 15,000	9.5	2.9
	Non-Standard Size	< 7,000	9.3	2.7
		7,000 – 15,000	10.8 – (0.213 × Cap[B])	2.9 – (0.026 × Cap[B])
		> 15,000	7.6	2.5

[A] Standard size PTAC or PTHP refers to equipment with wall sleeve dimensions having an external wall opening ≥ 16 inches high or ≥ 42 inches wide, and a cross-sectional area ≥ to 670 square inches. Non-standard size refers to PTAC or PTHP equipment with existing wall sleeve dimensions having an external wall opening of < 16 inches high or < 42 inches wide, and a cross-sectional area < 670 square inches.
[B] "Cap" means cooling capacity in thousand Btu/h at 95 °F outdoor dry-bulb temperature.

189 Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Realization Rates for Prescriptive Measures.
190 See Appendix B.
191 RR_D used to adjust Summer and Winter CF to account for BIP program evalution findings as presented in Appendix D.
192 Ibid.
193 Standards for Packaged Terminal Air Conditioners and Heat Pumps: http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/45.

Prescriptive HVAC: Demand Control Ventilation, Codes DCVE, DCVN	
Last Revised Date	7/1/2017
MEASURE OVERVIEW	
Description	This measure involves installation of demand control ventilation (DCV) on new high-efficiency HVAC systems to reduce heating/cooling requirements when spaces are unoccupied. Typically, DCV involves the installation of CO_2 sensors and controls to measure CO_2 levels in the controlled space and the outdoor ventilation air and to reduce heating/cooling of the ventilated air during low occupancy periods. This measure is not eligible for new construction applications for which DCV is already required per Section 503.2.5.1 of IECC 2009.
Primary Energy Impact	Electric
Sector	Commercial
Program(s)	C&I Prescriptive Program
End-Use	HVAC
Project Type	New construction, Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = Area \times VentilationRate \times SF_{kW} \times 12 / EER_{EE}$
Annual Energy Savings	$\Delta kWh/yr = Area \times VentilationRate \times SF_{kW} \times 12 / EER_{EE} \times EFLH_C$
Definitions	Unit = 1 DCV system Area = Area of conditioned space benefitting from the DCV (ft^2) VentilationRate = Design outdoor air ventilation rate, based on space type (CFM/ft^2) SF_{kW} = Savings factor is the average demand cooling load savings per CFM of ventilated air provided to the conditioned space (tons/CFM) EER_{EE} = Cooling energy efficiency ratio of the new equipment, from application form or customer information; EER may be estimated as SEER/1.1 (Btuh/Watt) $EFLH_C$ = Cooling equivalent full load hours (hrs/yr) 12 = Conversion: 12 kBtuh per ton
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	No DCV system installed on the HVAC units.
Efficient Measure	New high-efficiency HVAC unit with DCV system installed.

PARAMETER VALUES

Measure/Type	Area	VentilationRate	SF_{kW}	EER_{EE}	$EFLH_C$	Life (yrs)	Cost ($)
All	Actual	Table 37	0.000433[194]	Actual	719[195]	10[196]	$2,100 (Retrofit) $850 (NC)[197]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[198]	100%[198]	Table 29[199]	Table 29[199]	52%[200]	1.6%[201]

[194] The demand cooling load saving factor is dependent on the amount of ventilated air brought into the conditioned space, which in turns depend on the occupancy within the space. If the space is frequently filled to its designed capacity, then there will not be any demand savings. This is because the system will bring in the corresponding amount of ventilated air required for the occupants, which is the same as the baseline system minimum ventilation. However, from our past experience, such spaces are typically occupied 85% to 90% of their designed capacities. Thus, there is an approximate savings of 10% to 15% in the amount of ventilated air brought in. This also translates to about the same amount of demand saved in conditioning the ventilated air.

[195] KEMA, NEEP C&I Unitary HVAC Loadshape Project, June 2011, Table 0-2. Values are for the NE-North region.

[196] Studies have shown that the typical life of most electronic control devices and sensor is approximately 10 years

[197] Average incremental cost for this measure has not changed since the Efficiency Maine TRM revision 8/15 2010 based on interviews with suppliers in Maine and the review of Efficiency Maine projects by GDS Associates, December 2011

[198] Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.

[199] See Appendix B.

[200] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.

[201] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.

Prescriptive HVAC: Variable Refrigerant Flow, Code VRF	
Last Revised Date	10/1/2017 (retroactive to 7/1/2017)
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of a new high-efficiency variable refrigerant flow (VRF) AC or heat pump system instead of a new standard-efficiency variable refrigerant flow (VRF) AC or heat pump system.
Primary Energy Impact	Electric; Natural Gas; Heating Oil
Sector	Commercial
Program(s)	C&I Prescriptive Program
End-Use	HVAC
Project Type	New construction, Replace on burnout/End of useful life
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	$kW_c = kBtu/hr_{capacity} * \left(\frac{1}{IEER_{base}} - \frac{1}{IEER_{ee}}\right)$ $kW_h = kBtu_{heat\ load} * \left(\frac{1}{COP_{base}} - \frac{1}{COP_{ee}}\right) * \frac{1}{EFLH_h}$
Annual energy savings	$kWh_c = kBtu/hr_{capacity} * \left(\frac{1}{IEER_{base}} - \frac{1}{IEER_{ee}}\right) * EFLH_c$ $kWh_h = kBtu_{heat\ load} * \left(\frac{1}{COP_{base}} - \frac{1}{COP_{ee}}\right) * \frac{1}{3.412}$
Definitions	$kBtu/hr_{capacity}$ = Cooling capacity of equipment $IEER_{base}$ = Integrated energy efficiency ratio for baseline system $IEER_{ee}$ = Integrated energy efficiency ratio for VRF system $EFLH_c$ = Cooling equivalent full load hours $EFLH_h$ = Heating equivalent full load hours $kBtu_{heat\ load}$ = (Square feet of building) x (47.4 kBtu/sf[202]) COP_{base} = Coefficient of performance for baseline system COP_{ee} = Coefficient of performance for VRF system at 47°F db/43°F wb outdoor air 3.412 = Conversion factor: kBtu/kWh
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Air cooled variable refrigerant flow unit that meets minimum efficiency standards of 90.1-2007.
Efficient Measure	High-efficiency variable refrigerant flow unit with IEER of 17 or greater.

[202] New England average heating load from 2003 CBECs

Prescriptive HVAC: Variable Refrigerant Flow, Code VRF								
PARAMETER VALUES (DEEMED)								
Measure/Type	$kBtu/hr_{capacity}$	$IEER_{base}$	$IEER_{ee}$	$EFLH_c$	$EFLH_h$	$kBtu_{heat\ load}$	COP_{base}	COP_{ee}
VRF HVAC System	Actual	12.7[203]	Actual	829[204]	1600[205]	Actual	2.25[206]	Actual
Measure/Type	Conditioned Space (sq. ft.)						Life (yrs)	Cost ($)[207]
VRF HVAC System	Actual						20	$3.10/sf
IMPACT FACTORS								
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO	
C&I Prescriptive	100%	112.2%[208]	100%[209]	Table 29[210]	Table 29[211]	52%[212]	1.6%[213]	

[203] ANSI/ASHRAE/IES Addenda CE and CP to ANSI/ASHRAE/IESNA 90.1-2007, Table 6.8.1M, VRF Air Cooled (cooling mode) ≥ 65,000 Btu/h and < 135,000 Btu/h.
[204] KEMA, NEEP C&I Unitary HVAC Loadshape Project, June 2011, Table 0-3 and 0-4. Values are for the NE-North region.
[205] EMT assumes 1,600 heating full load hours.
[206] ANSI/ASHRAE/IES Addenda CE and CP to ANSI/ASHRAE/IESNA 90.1-2007, Table 6.8.1M, VRF Air Cooled (heating mode) ≥ 65,000 Btu/h and < 135,000 Btu/h (cooling capacity) 17ºF db/15ºF wb outdoor air.
[207] Based on project data. VRF = $3.61/sf. Standard Efficiency Heat Pump with same capacity = $0.51/sf.
[208] Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.
[209] RR_D used to adjust Summer and Winter CF to account for BIP program evalution findings as presented in Appendix D.
[210] See Appendix C.
[211] See Appendix C.
[212] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[213] Ibid.

Ductless Heat Pump – Commercial/Industrial, Codes DHP1L-DHP4L	
Last Revised Date	7/1/2015
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of a high-efficiency ductless heat pump (DHP) system as the primary heating system in new construction, gut-rehab, or planned retirement/upgrade projects. The new DHP equipment may have one (single-head) or multiple (multi-head) indoor units per outdoor unit.
Energy Impacts	Electric
Sector	Residential
Program(s)	C&I Prescriptive Program
End-Use	Cooling, Heating
Decision Type	New construction, replace on burnout
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = \max(\Delta kW_C, \Delta kW_H)$ $\Delta kW_C = CAP_{COOL} \times [(1 / EER_B) - (1 / EER_{EE})] / 1,000$ $\Delta kW_{SP} = \Delta kW_C \times CF_S$ $\Delta kW_H = CAP_{HEAT} \times [(1/ HSPF_B) - (1 / HSPF_{EE})] / 1,000$ $\Delta kW_{WP} = \Delta kW_H \times CF_W$
Annual Energy Savings	$\Delta kWh_C = CAP_{COOL} \times [(1/ SEER_B) - (1 / SEER_{EE})] \times EFLH_{COOL} / 1,000$ $\Delta kWh_H = CAP_{HEAT} \times [1 / (HSPF_B) - 1 / (HSPF_{EE})] \times ADJ \times EFLH_{HEAT} / 1,000$
Definitions	Unit = 1 ductless heat pump (DHP) system $HSPF_B$ = Heating seasonal performance factor of the baseline DHP (Btu/Watt-hr) $HSPF_{EE}$ = Heating seasonal performance factor of the high-efficiency DHP (Btu/Watt-hr) CAP_{Cool} = Rated cooling capacity of the DHP (kBtu/h) CAP_{Heat} = Rated heating capacity of the DHP (kBtu/h) $SEER_B$ = Seasonal energy efficiency ratio for baseline cooling unit (Btu/Watt-hr) $SEER_E$ = Seasonal energy efficiency ratio for high-efficiency DHP (Btu/Watt-hr) EER_B = Energy efficiency ratio for baseline cooling unit (Btu/Watt-hr) EER_E = Energy efficiency ratio for high-efficiency DHP (Btu/Watt-hr) $EFLH_{COOL}$ = Cooling equivalent full load hours $EFLH_{HEAT}$ = Heating equivalent full load hours ADJ = Adjustment factor to account for realized HSPF during Maine winter
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The baseline case assumes that the business would be heated with new ductless heat pumps that meet Federal minimum efficiency requirement for units manufactured on or after January 1, 2015: HSPF=8.2 and SEER=14.0.
Efficient Measure	The high-efficiency case assumes a new *high-efficiency* ductless heat pump that meets minimum efficiency requirements for program rebate: HSPF=12.0 (single-head), 10.0 (multi-head). Ductless heat pump is sized to provide 100% of the heat load of the area served at 11°F ambient temperature.

Ductless Heat Pump – Commercial/Industrial, Codes DHP1L-DHP4L								
PARAMETER VALUES								
Measure	CAP_{HEAT}	CAP_{COOL}	$HSPF_E$	$HSPF_B$	$SEER_E$	$SEER_B$	Life (yrs)	Cost ($)
DHP NC/ROB	Actual	Actual	Actual	8.2[214]	Actual	14[215]	15[216]	Table 6
Measure	EER_E	EER_B	ADJ	$EFLH_{HEAT}$	$EFLH_{COOL}$			
DHP NC/ROB	Actual	11.7[217]	0.79[218]	1,195[219]	709[220]			
IMPACT FACTORS								
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO	
C&I Prescriptive	100%[221]	100%[222]	100%[222]	Table 29[223]	Table 29[223]	33%[224]	1.6%[225]	

Table 6 – Measure Cost for DHP Equipment[226]

# of Indoor Units per Outdoor Unit	Measure Cost ($)
1	$682
2	$682
3	$682
4+	$682

[214] Federal minimum efficiency requirement for units manufactured on or after January 1, 2015.
[215] DOE standards for central air conditioners and central air conditioning heat pumps manufactured on or after January 1, 2015 (http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75).
[216] GDS Associates, Inc., Measure Life Report – Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007; Table 2.
[217] DOE standards for central air conditioners and central air conditioning heat pumps manufactured on or after January 1, 2015 (http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75).
[218] Adjustment factor is estimated using the weather bin analysis for Portland, Bangor, and Caribou, ME, and manufacturer curves to estimate unit efficiency during each weather bin.
[219]Ibid
[220] Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.

[221] EMT assumes that all purchased units are installed (i.e., ISR = 100%).
[222] This measure is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[223] See Appendix B.
[224] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[225] IBid.
[226] The measure cost is based on program average incremental cost. Measure cost will be refined for number of zones as data become available.

Ductless Heat Pump – Multifamily, Code MPDHPNC	
Last Revised Date	7/1/2015
Description	This measure involves the purchase and installation of a high-efficiency ductless heat pump (DHP) system as the primary heating system in new construction, gut-rehab, or planned retirement/upgrade multifamily projects.
Energy Impacts	Electric
Sector	Residential
Program(s)	Multifamily Program
End-Use	Cooling, Heating
Decision Type	New Construction, Replace on Burnout
DEEMED GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	ΔkW_{max} = 0.57, ΔkW_{WP} = 0.18, ΔkW_{SP} = 0.02
Annual Energy Savings	ΔkWh/yr = 874 ΔkWh_H = 845 ΔkWh_C = 29
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	Modeled
Annual Energy Savings	Modeled[227] Heating and cooling savings are modeled using TMY3 data for Portland, Bangor, and Caribou, ME. Results are weighted based on population (71.2% Portland, 23.4% Bangor, 5.4% Caribou).[228] Savings were calculated based on a model employing the following key assumptions: • Average annual Heat Loss is 30 MMBtu per year per housing unit corresponding to an average UA of 161 MMBtu/h/deg F. • DHP's contribution to heating does not exceed 50% of the home's heating load in any temperature bin. Even in temperature bins in which 100% of the home's heating load can be supplied by the DHP, the DHP supplies 50% of the heating load, and the remaining 50% is supplied by the existing heating system to account for behavior effects.[229] • DHP heating output capacity and DHP heating efficiency vary linearly with outside air temperature. • Heating is called for when outside air temperature is less than or equal to 65°F. • Cooling is called for when outside air temperature is greater than or equal to 70°F.
Definitions	Unit = 1 ductless heat pump (DHP) system $HSPF_B$ = Heating seasonal performance factor of the baseline DHP (Btu/Watt-hr) $HSPF_{EE}$ = Heating seasonal performance factor of the high-efficiency DHP (Btu/Watt-hr) CAP_{Cool} = Rated cooling capacity of the DHP (kBtu/h) CAP_{Heat} = Rated heating capacity of the DHP (kBtu/h) $SEER_B$ = Seasonal energy efficiency ratio for baseline cooling unit (Btu/Watt-hr) $SEER_E$ = Seasonal energy efficiency ratio for high-efficiency DHP (Btu/Watt-hr)

227 Based on Excel Workbook for Ductless Heat Pump.
228 Calculated based on population of each region; U.S. Census Bureau Census 2010 Summary File 1 population by census tract.
229 Heat load offset of 50% is extrapolated from other findings. Ecotope, Ductless Heat Pump Retrofits in Multifamily and Small Commercial Buildings, December 7, 2012 reported savings were equivalent to 43%–75% heat load offset in multifamily buildings.

Ductless Heat Pump – Multifamily, Code MPDHPNC	
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The baseline case assumes the multifamily units would be heated with new ductless heat pumps that meets Federal minimum efficiency requirement for units manufactured on or after January 1, 2015: HSPF=8.2 and SEER=14.0.
Efficient Measure	The high-efficiency case assumes a new *high-efficiency* ductless heat pump that meets minimum efficiency requirements for program rebate: HSPF=12.0 Btu/W-h HSPF=12.0 and SEER=18.0.

PARAMETER VALUES

Measure	CAP_{Heat}	CAP_{Cool}	$HSPF_E$	$HSPF_B$	$SEER_E$	$SEER_B$	Life (yrs)	Cost ($)
DHP Retrofit	17.5[230]	14.2[230]	13.2[230]	8.2[231]	25.6[230]	14[232]	18[233]	$682[234]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%[235]	100%[236]	100%[236]	Table 31[237]	Table 31[237]	11.0%[238]	1.0%[238]

[230] Weighted average values of the most popular units that have been incentivized under the Efficiency Maine program.
[231] Federal minimum efficiency requirement for units manufactured on or after January 1, 2015.
[232] DOE standards for central air conditioners and central air conditioning heat pumps manufactured on or after January 1, 2015 (http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75).
[233] GDS Associates, Inc., Measure Life Report – Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007; Table 1.
[234] The incremental cost is the difference in cost between a typical high-efficiency unit ($1,645 based on Fujitsu model 12RLS2, ecomfort.com) and a typical baseline unit ($963 based on LG model LS093HE, ecomfort.com).
[235] EMT assumes that all purchased units are installed (i.e., ISR = 100%).
[236] This measure is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[237] See Appendix B.
[238] Opinion Dynamics, Efficiency Maine Multifamily Efficiency Program Evaluation Final, March 2014; Table 1-2.

Ductless Heat Pump Retrofit – Low-Income Multifamily, Code LIDHP	
Last Revised Date	7/1/2015
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of a high-efficiency ductless heat pump (DHP) system to supplement the existing heating system in electric heated homes and to replace existing window air conditioning units. The new DHP equipment may have one (single-head) or multiple (multi-head) indoor units per outdoor unit.
Energy Impacts	Electric
Sector	Residential
Program(s)	Low-Income Program
End-Use	Cooling, Heating
Decision Type	Retrofit
DEEMED GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	ΔkW_{max} = 0.89 ΔkW_{WP} = 0.62 ΔkW_{SP} = 0.00
Annual Energy Savings	ΔkWh/yr = 3,013
Demand Savings	Modeled
Annual Energy Savings	Modeled[239] Heating and cooling savings are modeled using TMY3 data for Portland, Bangor, and Caribou, ME. Results are weighted based on population (71.2% Portland, 23.4% Bangor, 5.4% Caribou).[240] Savings were calculated based on a model employing the following key assumptions: • Average annual heat loss is 30 MMBtu, corresponding to an average UA of 161 MMBtu/h/deg F. • DHP's contribution to heating does not exceed 35% of the home's heating load in any temperature bin. Even in temperature bins in which 100% of the home's heating load can be supplied by the DHP, the DHP supplies 35% of the heating load, and the remaining 65% is supplied by the existing heating system to account for distribution and behavior effects.[241] • DHP heating output capacity and DHP heating efficiency (both baseline and efficient units) vary linearly with outside air temperature. • Heating is called for when outside air temperature is ≤ to 65°F. • Cooling is called for when outside air temperature is ≥ to 70°F. • For homes that have equivalent of whole home air conditioning already installed, DHP will replace the cooling load equivalent to the DHP's rated capacity. • For homes that have existing partial cooling (i.e., 1 or 2 existing window air conditioning units), it is unknown if the DHP will be installed in the same areas served by the existing window air conditioning units. If installed in the same area, the DHP will replace the existing cooling load and result in positive savings due to increased efficiency. However, if installed in a different area, the DHP may result in additional cooling load and hence increased energy use. Without any in-situ data, zero net savings is assumed for homes with existing partial cooling. For homes with no existing cooling equipment, it is assumed that the DHP will be used to its full cooling capacity.

[239] Based on Excel Workbook for Ductless Heat Pump.
[240] Calculated based on population of each region; U.S. Census Bureau Census 2010 Summary File 1 population by census tract.
[241] Heat load offset of 16% is consistent with findings of the Low-Income Weatherization Program Evaluation, NMR Group, 7/1/2015.

Ductless Heat Pump Retrofit – Low-Income Multifamily, Code LIDHP		
Definitions	Unit	= 1 ductless heat pump (DHP) system
	EF_B	= Efficiency Factor of electric baseboard heating system (Btu/Watt-hr)
	$HSPF_E$	= Heating seasonal performance factor of the high-efficiency DHP (Btu/Watt-hr)
	CAP_{Cool}	= Rated cooling capacity of the DHP (kBtu/h)
	CAP_{Heat}	= Rated heating capacity of the DHP (kBtu/h)
	$SEER_B$	= Seasonal energy efficiency ratio for baseline DHP (Btu/Watt-hr)
	$SEER_E$	= Seasonal energy efficiency ratio for high-efficiency DHP (Btu/Watt-hr)
	$\%COOL_{FULL}$	= Percentage of homes with existing cooling equipment equivalent of a whole home air conditioner (equivalent of 3 window air conditioning units)
	$\%COOL_{NONE}$	= Percentage of homes with no existing cooling equipment
	%FUEL	= Home heating fuel distribution excluding coal and other
EFFICIENCY ASSUMPTIONS		
Baseline Efficiency	The baseline case assumes the home retains its existing electric resistance, natural gas, oil, kerosene, or propane heating system and uses a window air conditioning unit for cooling (or has no cooling). A weighted average of the blended baseline fuel heating systems and electric resistance heating systems in Maine homes and single package air conditioner are used in the model (see **Table 7**).	
Efficient Measure	The high-efficiency case assumes the home retains its existing heating system and adds a new *high-efficiency* DHP that meets minimum efficiency requirements for program rebate: HSPF=12.0 Btu/W-h.	

PARAMETER VALUES

Measure	CAP_{Heat}	CAP_{Cool}	$HSPF_E$	EF_B	$SEER_E$	$SEER_B$	$\%COOL_{FULL}$	$\%COOL_{NONE}$
DHP Retrofit	17.5[242]	14.2[243]	13.2[244]	3.4[245]	25.6[242]	9.8[246]	40%[247]	21%[248]
Measure							Life (yrs)	Cost ($)
DHP Retrofit							18[249]	$Actual[250]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
Low-Income	100%[251]	100%[252]	100%[252]	0.0%[253]	69.5%[253]	0%[254]	0%[254]

[242] Weighted average values of the most popular units that have been incentivized under the Efficiency Maine program.
[243] Weighted average values of the most popular units that have been incentivized under the Efficiency Maine program.
[244] Weighted average values of the most popular units that have been incentivized under the Efficiency Maine program.
[245] Assumes electric baseboard heating system has virtually no distribution losses.
[246] Federal minimum efficiency requirement for units manufactured before January 1, 2015.
[247] Portland Press Herald, http://www.pressherald.com/2014/05/26/put_power_rates_on_ice___that_s_a_cool_idea_/. In 2010, an estimated 79% of customers in ISO-New England region had room air conditioners. Of the 79%, 40% of homes had equivalent of whole home air conditioning (3 window units); 39% of homes had total cooling capacity equivalent of 1 or 2 window air conditioning units. The remaining 21% have no cooling equipment installed.
[248] Portland Press Herald, http://www.pressherald.com/2014/05/26/put_power_rates_on_ice___that_s_a_cool_idea_/. In 2010, an estimated 79% of customers in ISO-New England region had room air conditioners. Of the 79%, 40% of homes had equivalent of whole home air conditioning (3 window units); 39% of homes had total cooling capacity equivalent of 1 or 2 window air conditioning units. The remaining 21% have no cooling equipment installed.
[249] GDS Associates, Inc., Measure Life Report – Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007; Table 1.
[250] Total cost to program that covers 100% of installation cost.
[251] EMT assumes that all purchased units are installed (i.e., ISR = 100%).
[252] This measure is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[253] See Appendix B.
[254] Program assumes no free ridership or spillover for the low-income direct install program.

Table 7. Parameters for Existing Heating Systems

Fuel	Baseline: Main Heating Equipment	Efficiency Measure	Share	Efficiency
Heating Baseline Assumptions				
Electric	Electric Baseboard	HSPF	Calculated Separately	3.4
Gas	Gas-Fired Forced Hot Water Boiler	AFUE	6%	75%
Gas	Gas-Fired Steam Boiler	AFUE	3%	75%
Propane	Propane-Fired Forced Hot Water Boiler	AFUE	8%	75%
Propane	Propane-Fired Steam Boiler	AFUE	4%	75%
Oil	Oil-Fired Forced Hot Water Boiler	AFUE	22%	75%
Oil	Oil-Fired Steam Boiler	AFUE	22%	75%
Oil	Oil-Fired Ducted Furnace	AFUE x Duct Efficiency	22%	56%
Wood	Wood Stove	AFUE	12%	60%
Blended	Blended MMBtu Baseline	Blended Efficiency	100.0%	76%
		Duct Efficiency		*75%*
Cooling Baseline Assumptions				
Electric	Single-Package Air Conditioner	SEER	40%	14
Electric	Single-Package Air Conditioner	EER	40%	12

Sources

DOE standards for boilers manufactured on or after September 1, 2012 (http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/72)
DOE standards for furnaces manufactured on or after May 1, 2013 (http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/72)
US DOE: Better Duct Systems for Home Heating and Cooling (http://www.nrel.gov/docs/fy05osti/30506.pdf)
DOE standards for central air conditioners and central air conditioning heat pumps manufactured on or after January 1, 2015 (http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75)
Maine Governor's Energy Office, SPACE HEATING FUEL COMPARISON CALCULATOR (http://www.maine.gov/energy/fuel_prices/heating-calculator.php)
DOE standards for AC and Heat Pump (on or after January 23, 2006, and before January 1, 2015) (http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75)

Prescriptive HVAC: Modulating Burner Controls for Boilers and Heaters, Code AF1	
Last Revised Date	10/1/2017
MEASURE OVERVIEW	
Description	This measure is for a non-residential boiler providing heat with a current turndown capacity less than 6:1 between the high firing rate and low firing rate. The modulating burner controls will reduce burner startup and shutdown and allow the burners to meet load more effectively between the high firing rate and the low firing rate. It will also allow for an increased turn down rate to eliminate startup and shutdown when the load is lower than the low firing rate.
Energy Impacts	Natural gas, Heating oil, Propane
Sector	Commercial, Industrial
Program(s)	C&I Prescriptive Program
End-Use	Boilers, Space heating, Process heating
Decision Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Annual energy savings	ΔMMBtu/yr = Ngi x SF x T / 1,000
Definitions	Unit = Modulating burner control installed on a single boiler Ngi = Boiler/heater gas input size (MBtuh) SF = Estimate of annual fuel consumption conserved by modulating burner T = Hours of operation. (Space heating = Effective full load heating hours (EFLH)) 1,000 = Conversion 1,000 MBtu per MMBtu
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	A baseline boiler high and low firing rate ratio must be a maximum of 6:1 or be subject to loads of less than 30% of the boiler/heater full firing rate for at least 60% of the time.
Efficient Measure	A boiler burner must have a turn down rate of 10:1 or greater and be able to effectively modulate the burner firing rate between the low and high firing rates.

PARAMETER VALUES (DEEMED)

Measure/Type	Ngi	SF[255]	T (Process)	T (Space Heating)[256]	Life (yrs)[257]	Cost ($)[258]
All	Actual	3%	Hours of Operation	1,600 EFLH	21	$2.14/MBtuh

IMPACT FACTORS

Program	ISR	RR_E[259]	RR_D	CF_S	CF_W	FR[260]	SO[261]
C&I Prescriptive	100%	100%	N/A	N/A	N/A	52%[262]	1.6%[263]

[255] Xcel Energy, 2010/2011/2012 Triennial Plan, Minnesota Electric and Matural Gas Conservation Improvement Program, E,G002/CIP-09-198. Page 474: 80% baseline boiler to 83% overall efficiency with improvement.
[256] EMT assumes 1,600 heating full load hours for all natural gas heating equipment. The value is comparable to the recommended value of 1,400 FLH for Massachusetts, which has a shorter heating season than Maine, determined in the following study: KEMA, Project 15 Prescriptive Gas – Final Program Evaluation Report, June 2012, Table ES 2.
[257] Illinois Statewide Technical Reference Manual version 4.0, measure 4.4.20 – High Turndown Burner.
[258] Based on program data 7/1/2016-8/30/2017. Supplier cost of unit + 20% mark up plus labor ($1.07*1.2+$0.86)/Mbtu/h
[259] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[260] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes the program overall values from the Business Incentive Program Evaluation (Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-8. NTG Impacts for Program Overall).
[261] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-10. Participant Spillover.
[262] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[263] Ibid.

Prescriptive HVAC: Boiler Stack Heat Exchanger (Boiler Economizer), Code AF2	
Last Revised Date	3/1/2015 (New)
MEASURE OVERVIEW	
Description	Boiler stack economizers are heat exchangers with hot flue gas on one side and boiler feed water on the other. The waste heat from the stack is used to preheat the boiler feed water, which reduces the energy required by the boiler to heat the water. There are two types of stack heat exchangers: standard and condensing. Condensing units conserve more energy by recovering even more energy from the flue gas. But since reducing the stack temperature lower causes the flue gas to condense, additional venting and moisture control precautions must be added, which increases the cost of the unit.
Energy Impacts	Natural gas, Heating oil, Propane
Sector	Industrial
Program(s)	C&I Prescriptive Program
End-Use	Boiler, Process heat recovery
Decision Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Annual energy savings	$\Delta MMBtu/yr = CAP_{INPUT} \times EFLH \times SF / 1{,}000$
Definitions	Unit = 1 boiler retrofitted to add stack heat exchanger CAP_{INPUT} = Boiler input capacity (MBH = MBtu/h) EFLH = Equivalent full load heating hours SF = Estimate of annual gas consumption conserved by adding boiler stack heat exchanger 1,000 = Conversion 1,000 MBtu per MMBtu
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Assumed to be a non-condensing boiler with no existing stack heat exchanger installed.
Efficient Measure	Assumed to be a boiler with newly installed stack heat exchanger.

PARAMETER VALUES (DEEMED)

Measure/Type	CAP_{INPUT}	EFLH[264]	SF[265]	Life (yrs)[266]	Cost ($)[267]
Standard Economizer	Actual	1,600	5%	20	$1,500/MMBtu/h
Condensing Economizer	Actual	1,600	10%	20	$2,120/MMBtu/h

IMPACT FACTORS

Program	ISR	RR_E[268]	RR_D	CF_S	CF_W	FR[269]	SO[270]
C&I Prescriptive	100%	100%	N/A	N/A	N/A	52%[271]	1.6%[272]

[264] EMT assumes 1,600 heating full load hours for all natural gas heating equipment. The value is comparable to the recommended value of 1,400 FLH for Massachusetts, which has a shorter heating season than Maine, determined in the following study: KEMA, Project 15 Prescriptive Gas – Final Program Evaluation Report, June 2012, Table ES 2.

[265] GDS Associates, Inc. (2009). *Natural Gas Energy Efficiency Potential in Massachusetts*. Prepared for GasNetworks.

[266] GDS Associates, Inc. (2009). *Natural Gas Energy Efficiency Potential in Massachusetts*. Prepared for GasNetworks. The study references NYSERDA Deemed Savings Database, Rev 09-082006.

[267] Ibid.

[268] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.

[269] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes the program overall values from the Business Incentive Program Evaluation (Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-8. NTG Impacts for Program Overall).

[270] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-10. Participant Spillover.

[271] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.

[272] Ibid.

Prescriptive HVAC: Boiler Reset/Lockout Controls, Code AF3	
Last Revised Date	3/1/2015 (New)
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of boiler reset and lockout controls for a non-residential boiler that does not currently have such controls installed. Reset controls achieve energy savings by reducing the hot water supply temperature as a function of outdoor air temperature (OAT). As the site heating load decreases (higher OAT), the temperature to which the boiler must heat the supply hot water decreases. Lockout controls achieve energy savings by shutting down (locking out) the boiler entirely when the OAT is high enough to ensure that there is no heating load. For the purposes of this measure, the lockout temperature should be set no higher than 55°F. **Boiler reset controls should not be implemented in conjunction with—or on boilers that already have—modulating burner controls.**
Energy Impacts	Natural gas, Heating oil, Propane
Sector	Commercial, Industrial
Program(s)	C&I Prescriptive Program
End-Use	Boilers, Space heating, Process heating
Decision Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Annual energy savings	ΔMMBtu/yr = CAP_{INPUT} × EFLH x SF / 1,000
Definitions	Unit = 1 boiler retrofitted with reset and lockout controls CAP_{INPUT} = Boiler input capacity (MBH = MBtu/h) EFLH = Equivalent full load heating hours SF = Estimate of annual fuel consumption conserved by adding boiler reset controls 1,000 = Conversion 1,000 MBtu per MMBtu
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Assumed to be a boiler with no boiler reset or lockout controls installed.
Efficient Measure	Assumed to be a boiler with newly installed reset and lockout controls.

PARAMETER VALUES (DEEMED)

Measure/Type	CAP_{INPUT}	EFLH[273]	SF[274]	Life (yrs)[275]	Cost ($)[276]
All	Actual	1,600	8%	20	$612/boiler

IMPACT FACTORS

Program	ISR	RR_E[277]	RR_D	CF_S	CF_W	FR[278]	SO[279]
C&I Prescriptive	100%	100%	N/A	N/A	N/A	52%[280]	1.6%[281]

[273] EMT assumes 1,600 heating full load hours for all natural gas heating equipment. The value is comparable to the recommended value of 1,400 FLH for Massachusetts, which has a shorter heating season than Maine, determined in the following study: KEMA, Project 15 Prescriptive Gas – Final Program Evaluation Report, June 2012, Table ES 2.
[274] Illinois Statewide TRM version 4, measure 4.4.4. http://www.icc.illinois.gov/electricity/TRM.aspx.
[275] Ibid.
[276] Ibid.
[277] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[278] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes the program overall values from the Business Incentive Program Evaluation (Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-8. NTG Impacts for Program Overall).
[279] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-10. Participant Spillover.
[280] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[281] Ibid.

Prescriptive HVAC: Oxygen Trim for Boilers and Heaters, Code AF4	
Last Revised Date	3/1/2015 (New)
MEASURE OVERVIEW	
Description	This measure is for a non-residential boiler providing heat without controls for the amount of excess oxygen provided to the burner for combustion. The amount of oxygen is dependent on the amount of air provided. The measure involves the installation of an oxygen sensor in the flue exhaust and a fuel valve and combustion air controls to adjust from that sensor.
Energy Impacts	Natural gas, Heating oil, Propane
Sector	Commercial, Industrial
Program(s)	C&I Prescriptive Program
End-Use	Boilers, Space heating, Process heating
Decision Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Annual energy savings	ΔMMBtu/yr = Ngi x SF x T / 1,000
Definitions	Unit = Single boiler with oxygen trim sensor and control installed Ngi = Boiler/Heater gas input size (MBtu/hr) SF = Estimate of annual fuel consumption conserved by adding oxygen trim controls T = Hours of operation. (Space heating = Effective full Load heating hours (EFLH)) 1,000 = Conversion 1,000 MBtu per MMBtu
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	A baseline boiler utilizes a single point positioning for burner combustion control.
Efficient Measure	A boiler burner will have an oxygen control system allowing the combustion air to be adjusted based upon operating parameters and the output of oxygen sensors in the flue exhaust or other comparable control scenarios.

PARAMETER VALUES (DEEMED)

Measure/Type	Ngi	SF[282]	T (Process)	T (Space Heating)[283]	Life (yrs)[284]	Cost ($)
All	Actual	2%	Actual Hours of Operation	1,600 EFLH	15	$20,000[285]

IMPACT FACTORS

Program	ISR	RR_E[286]	RR_D	CF_S	CF_W	FR[287]	SO[288]
C&I Prescriptive	100%	100%	N/A	N/A	N/A	52%[289]	1.6%[290]

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282 United States EPA, Climate Wise: Wise Rules for industrial Efficiency, July 1998.

283 EMT assumes 1,600 heating full load hours for all natural gas heating equipment. The value is comparable to the recommended value of 1,400 FLH for Massachusetts, which has a shorter heating season than Maine, determined in the following study: KEMA, Project 15 Prescriptive Gas – Final Program Evaluation Report, June 2012, Table ES 2.

284 Michigan Master Database of Deemed Savings - 2014 - Weather Sensitive Commercial, Adjusted for Maine heating hours.

285 CODES AND STANDARDS ENHANCEMENT INITIATIVE (CASE) PROCESS BOILERS, 2013 California Building Energy Efficiency Standards, California Utilities Statewide Codes and Standards Team, October 2011, pg. 22

286 This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.

287 This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes the program overall values from the Business Incentive Program Evaluation (Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-8. NTG Impacts for Program Overall).

288 Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-10. Participant Spillover.

289 Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.

290 Ibid.

Prescriptive HVAC: Boiler Turbulator, Code AF5	
Last Revised Date	3/1/2015 (New)
MEASURE OVERVIEW	
Description	This measure involves the installation of turbulators in the tubes of firetube boilers to help increase heat transfer efficiency. Normally located inside of only the last pass tubes, turbulators help recreate lost turbulence and extract the maximum heat transfer possible before the gases exit the unit.
Energy Impacts	Natural gas, Heating oil, Propane
Sector	Commercial, Industrial
Program(s)	C&I Prescriptive Program
End-Use	Boilers, Space heating, Process heating
Decision Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Annual energy savings	$\Delta MMBtu/yr = CAP_{INPUT} \times EFLH \times OF \times \Delta E / 1{,}000$
Definitions	Unit = single boiler with turbulators installed CAP_{INPUT} = Boiler input capacity (MBtu/hr) OF = Oversize factor (decimal) ΔE = Efficiency improvement; an efficiency improvement of 1% is gained per each 40°F reduction of flue gas temperature[291] EFLH = Equivalent full load hours 1,000 = Conversion 1,000 MBtu per MMBtu
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Assumed to be a boiler with no turbulators installed.
Efficient Measure	Assumed to be a boiler with newly installed turbulators in the boiler tubes.

PARAMETER VALUES (DEEMED)

Measure/Type	CAP_{INPUT}	OF	ΔE	EFLH[292]	Life (yrs)[293]	Cost ($)[294]
All	Actual	0.70[295]	Actual	1,600	20	$15 per turbulator

IMPACT FACTORS

Program	ISR	RR_E[296]	RR_D	CF_S	CF_W	FR[297]	SO[298]
C&I Prescriptive	100%	100%	N/A	N/A	N/A	52%[299]	1.6%[300]

[291] http://energy.gov/sites/prod/files/2014/05/f16/steam25_firetube_boilers.pdf.
[292] EMT assumes 1,600 heating full load hours for all natural gas heating equipment. The value is comparable to the recommended value of 1,400 FLH for Massachusetts, which has a shorter heating season than Maine, determined in the following study: KEMA, Project 15 Prescriptive Gas – Final Program Evaluation Report, June 2012, Table ES 2.
[293] CenterPoint Energy, Triennial CIP/DSM Plan 2010-2012, June 1, 2009.
[294] http://energy.gov/sites/prod/files/2014/05/f16/steam25_firetube_boilers.pdf.
[295] PA Consulting, KEMA, Focus on Energy Evaluation, Business Programs: Deemed Savings Manual V1.0, March 22, 2010. This factor implies that boilers are 30% oversized on average.
[296] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[297] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes the program overall values from the Business Incentive Program Evaluation (Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-8. NTG Impacts for Program Overall).
[298] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-10. Participant Spillover.
[299] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[300] Ibid.

Prescriptive HVAC: Programmable Thermostat, Code AF6	
Last Revised Date	10/1/2017
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of a single programmable thermostat connected to a single boiler.
Energy Impacts	Natural gas, Heating oil, Propane
Sector	Commercial, Industrial
Program(s)	C&I Prescriptive Program
End-Use	Space heating
Decision Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Annual energy savings	$\Delta MMBtu/yr = (CAP_{INPUT} \times EFLH \times \%_{SAVE}) / 1{,}000$
Definitions	Unit = Single thermostat connected to a single boiler CAP_{INPUT} = Boiler input capacity (MBtu/hr) EFLH = Equivalent full load hours $\%_{SAVE}$ = Savings percentage with installation of a programmable thermostat 1,000 = Conversion 1,000 MBtu per MMBtu
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Assumed to be a non-programmable thermostat.
Efficient Measure	Assumed to be a programmable thermostat with setbacks.

PARAMETER VALUES (DEEMED)

Measure/Type	CAP_{INPUT}	EFLH[301]	$\%_{SAVE}$[302]	Life (yrs)[303]	Cost ($)[304]
All	Actual	1,600	.068	8	$157

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	100%	N/A	N/A	N/A	52%[305]	1.6%[306]

301 EMT assumes 1,600 heating full load hours for all natural gas heating equipment. The value is comparable to the recommended value of 1,400 FLH for Massachusetts, which has a shorter heating season than Maine, determined in the following study: KEMA, Project 15 Prescriptive Gas – Final Program Evaluation Report, June 2012, Table ES 2.

302 New York Technical Reference Manual, Commercial Programmable Thermostat ESF, revised 10.15.10. While designated as a percentage, the value should be used as a decimal in the savings algorithm.

303 Illinois Statewide Technical Reference Manual version 4.0, measure 4.4.18 – Small Commercial Programmable Thermostats. 100% persistence factor has been assumed for Maine due to the nature of a new measure and lack of data. http://www.icc.illinois.gov/electricity/TRM.aspx.

304 Based on program data 7/1/2016-8/30/2017. Supplier cost of unit + 20% mark up plus labor ($67*1.2+$77).

305 Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.

306 Ibid.

Prescriptive HVAC: Boilers and Furnaces, Codes G9-G11, G01M, G07M, G08M, G15M, G16M, H2L, H3L, H1M, H2SM, H2MM, H3VSM, H3SM, H3MM	
Last Revised Date	7/1/2017
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of a new high-efficiency natural gas furnace, boiler, or unit heater instead of a new code-compliant unit with equivalent capacity.
Energy Impacts	Natural Gas, Heating oil, Propane, Compressed Natural Gas
Sector	Commercial, Industrial
Program(s)	C&I Prescriptive Program, C&I Midstream
End-Use	Space Heating
Decision Type	Replace on burnout, New Construction
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Annual energy savings	ΔMMBtu/yr = AHL x (1 / EffBASE – 1 / EffEE) Where AHL can be calculated as follows: From Manual J: AHL = 186,648 X DL / (T_i-T_o) / 1,000,000 From Equipment Capacity: AHL = CAP x $EFLH_h$ / OF / 1,000,000
Definitions	Unit = Single boiler AHL = Annual Heat Load (MMBtu/y) Eff_{BASE} = Efficiency of baseline boiler (in Et, or Ec or AFUE) Eff_{EE} = Efficiency of new, efficient boiler (in Et, or Ec or AFUE) 186,648 = Population weighted average of TMY3 heating degree hours for Portland, Bangor, and Caribou, ME DL = Design Load from Manual J T_i = Indoor Design Temperature used in Manual J T_o = Outdoor Design Temperature used in Manual J 1,000,000 = BTU to MMBTU conversion OF = Oversize Factor CAP =Rated Input Capacity of Unit (Btu/hr) $EFLH_h$ =Effective full load hours for heating
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	A baseline boiler meets the minimum corresponding federal standards for Commercial Packaged Boilers.
Efficient Measure	An efficient boiler that meets or exceeds the EE_{EE} values as listed in Table 8

Prescriptive HVAC: Boilers and Furnaces, Codes G9-G11, G01M, G07M, G08M, G15M, G16M, H2L, H3L, H1M, H2SM, H2MM, H3VSM, H3SM, H3MM

PARAMETER VALUES (DEEMED)

Measure/Type	AHL	Eff_{BASE}[307,308]	Eff_{EE}	Life (yrs)[309]	Cost ($)[310]
Boiler	Calculated	Table 8	Actual	24	Table 8
Furnace				18	

Measure/Type	DL	T_i	T_o	OF	Cap	$ELFH_h$
Boiler	Actual	Actual	Actual	1.7[311]	Actual	2661[312]
Furnace						

IMPACT FACTORS

Program	ISR	RR_E[313]	RR_D	CF_S	CF_W	FR[314]	SO[315]
Downsteam	100%	100%	N/A	N/A	N/A	52%[316]	1.6%[317]
Midstream						25%[318]	0%[319]

[307] U.S. Federal Standards for Commercial Packaged Boilers. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/74.
[308] U.S. Federal Standards for Commercial Warm Air Furnaces. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/71.
[309] "Buildings Energy Data Book," 2011. Table 5.3.9. Published by the Department of Energy. http://buildingsdatabook.eren.doe.gov/docs%5CDataBooks%5C2011_BEDB.pdf,
[310] Incremental cost difference between quoted installation cost and efficient quoted installation cost.
[311] DEPARTMENT OF ENERGY 10 CFR Parts 429 and 430 [Docket No. EERE-2012-BT-TP-0024] RIN: 1904-AC79 Energy Conservation Program for Consumer Products: Test Procedures for Residential Furnaces and Boilers. Page 62. https://energy.gov/sites/prod/files/2015/02/f19/2014_FB_TP_NOPR.pdf
[312] [312] 7,777 HDD multiplied by 24 hrs per day, divided by an average 70.14°F temperature difference between the 99% winter design outdoor air dry bulb and indoor design heating temperature of 72°F. The average temperature was the weighted average of Portland, Bangor, and Caribou.
[313] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[314] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes the program overall values from the Business Incentive Program Evaluation (Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-8. NTG Impacts for Program Overall).
[315] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-10. Participant Spillover.
[316] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[317] Ibid.
[318] Measure not yet evaluated, assume default FR of 25%.
[319] Measure not yet evaluated, assume default SO of 0%.

Table 8 – Commercial Boiler and Furnace Efficiencies: Baseline Efficiencies and Efficient Minimums

<table>
<tr><th>Equipment Type</th><th>Subcategory</th><th>Measure Code</th><th>CAP_{INPUT} (MBtu/hr)</th><th>Eff_{BASE}[320]</th><th>Eff_{EE}</th><th>Eff Ref[321]</th><th>Incremental Cost[322]</th><th>Cost Ref[323]</th></tr>
<tr><td>Commercial Warm Air Furnace</td><td>Gas-fired—NG & Propane</td><td>G01M</td><td>< 300</td><td>80% Et</td><td>90% AFUE</td><td>[1]</td><td>$300</td><td>[A]</td></tr>
<tr><td>Commercial Warm Air Furnace</td><td>Oil-Fired</td><td>H1M</td><td>< 300</td><td>81% Et</td><td>82% Et</td><td>[1]</td><td>$300</td><td>[D]</td></tr>
<tr><td rowspan="5">Hot Water Commercial Packaged Boilers</td><td rowspan="5">Gas-fired—NG & Propane</td><td>G07M</td><td>< 350</td><td>82% AFUE</td><td>95% AFUE</td><td>[2]</td><td>$2,003</td><td>[B]</td></tr>
<tr><td>G08M</td><td>≥350 & < 500</td><td>80% Et</td><td>95% Et</td><td>[3]</td><td>$2,800</td><td rowspan="4">[A]</td></tr>
<tr><td>G9</td><td>≥500 & < 1,000</td><td>80% Et</td><td>95% Et</td><td>[3]</td><td rowspan="3">$1,982+3.47 MBH</td></tr>
<tr><td>G10</td><td>≥1,000 & < 2,500</td><td>80% Et</td><td>95% Et</td><td>[3]</td></tr>
<tr><td>G11</td><td>≥2,500</td><td>82% Ec</td><td>95% Et</td><td>[3]</td></tr>
<tr><td rowspan="6">Hot Water Commercial Packaged Boilers</td><td rowspan="6">Oil-fired</td><td rowspan="2">H2SM</td><td>< 200</td><td>84% AFUE</td><td>87% AFUE</td><td>[2]</td><td>$484</td><td rowspan="6">[D]</td></tr>
<tr><td>≥200 & < 300</td><td>84% AFUE</td><td>87% AFUE</td><td>[2]</td><td>$927</td></tr>
<tr><td>H2MM</td><td>≥300 & < 500</td><td>82% Et</td><td>85% Et</td><td>[3]</td><td>$983</td></tr>
<tr><td rowspan="3">H2L</td><td>≥500 & < 1,000</td><td>82% Et</td><td>85% Et</td><td>[3]</td><td>$1,039</td></tr>
<tr><td>≥1,000 & < 2,500</td><td>82% Et</td><td>87% Et</td><td>[3]</td><td>$7,612</td></tr>
<tr><td>≥2,500</td><td>84% Ec</td><td>87% Et</td><td>[3]</td><td>$8,416</td></tr>
<tr><td rowspan="3">Steam Commercial Packaged Boilers</td><td rowspan="3">Gas-fired— NG & Propane</td><td rowspan="3">Inactive</td><td>< 300</td><td>80% AFUE</td><td>82% AFUE</td><td>[2]</td><td>$1,200</td><td>[C]</td></tr>
<tr><td>≥300 & < 2,500</td><td>77% Et</td><td>82% Et</td><td>[3]</td><td>$3,125</td><td>[C]</td></tr>
<tr><td>≥2,500</td><td>77% Et</td><td>82% Et</td><td>[3]</td><td>$3,800</td><td>[C]</td></tr>
<tr><td rowspan="6">Steam Commercial Packaged Boilers</td><td rowspan="6">Oil-fired</td><td>H3VSM</td><td>< 200</td><td>82% AFUE</td><td>85% AFUE</td><td>[2]</td><td>$326</td><td rowspan="6">[D]</td></tr>
<tr><td>H3SM</td><td>≥200 & < 300</td><td>82% AFUE</td><td>84% AFUE</td><td>[2]</td><td>$592</td></tr>
<tr><td>H3MM</td><td>≥300 &7 < 500</td><td>81% Et</td><td>84% Et</td><td>[3]</td><td>$725</td></tr>
<tr><td rowspan="3">H3L</td><td>≥500 & < 1,000</td><td>81% Et</td><td>84% Et</td><td>[3]</td><td>$858</td></tr>
<tr><td>≥1,000 & < 2,500</td><td>81% Et</td><td>84% Et</td><td>[3]</td><td>$2,826</td></tr>
<tr><td>≥2,500</td><td>81% Et</td><td>85% Et</td><td>[3]</td><td>$4,738</td></tr>
</table>

320 Where AFUE is annual fuel utilization efficiency, Et is thermal efficiency and Ec is combustion efficiency as defined in 10 CFR 431.82.

321 https://www.ecfr.gov/cgi-bin/text-idx?SID=0436f2692d9b501e05e0ec53e15c26d3&mc=true&tpl=/ecfrbrowse/Title10/10CIIsubchapD.tpl

[1] 10 CFR 431.77
[2] 10 CFR 430.32
[3] 10 CFR 431.87
[4] IECC 2009, Table 503.2.3(4).

322 Incremental cost difference between standard equipment and efficient equipment based on program data 7/1/2016-8/30/0217, online research (performed Aug-Oct 2017) and distributor interviews..

323 [A] Based on incremental cost assumptions in the Mid-Atlantic TRM Version 3.0. For boilers, the incremental cost is based on the on the correlation between equipment size and incremental cost in the "Lost Opportunity Incremental Cost" table.

[B] Based on sample of FY16 projects and survey of standard-efficiency boilers performed June 2016.
[C] Based on incremental cost gathered from various program participating contractors June 2015.
[D] Program estimates

Equipment Type	Subcategory	Measure Code	CAP_{INPUT} (MBtu/hr)	Eff_{BASE}[320]	Eff_{EE}	Eff Ref[321]	Incremental Cost[322]	Cost Ref[323]
Infrared Unit Heater	Gas-Fired – NG & Propane	G15M	All	80%	n/a	[4]	$425	[B]
Warm Air Unit Heater	Gas-Fired – NG & Propane	G16M	All	80%	93% Et	[4]	$525	[B]

Electronically Commutated Supply Fan Motor (ECMSF)							
Last Revised Date	7/1/2017						
MEASURE OVERVIEW							
Description	This measure involves the installation of an electronically commutated motor (ECM) or brushless permanent magnet motor (BLPM) as part of a new high efficiency HVAC system or as a new replacement for an existing HVAC fan motor.						
Primary Energy Impact	Electric						
Sector	Commercial						
Program(s)	C&I Prescriptive Program, C&I Midstream						
End-Use	HVAC Motors						
Project Type	New Construction or Retrofit						
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)							
Demand Savings	ΔkW = 0.16 summer kW[324] ΔkW = 0.18 winter kW[325]						
Annual Energy Savings	ΔkWh/yr = 387.8 for heating only[326] = 73.0 for cooling only[327] = 460.8 for heating and cooling						
Definitions	Unit = 1 HVAC fan motor						
EFFICIENCY ASSUMPTIONS							
Baseline Efficiency	The baseline is an HVAC fan with a permanent split capacitor (PSC) motor						
Efficient Measure	The high-efficiency case involves an HVAC fan with an electronically commutated motor or brushless permanent magnet motor						
PARAMETER VALUES							
Measure/Type	Life (yrs)	Cost ($)					
All	18[328]	$200[329]					
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR[330]	SO[331]
C&I Prescriptive	100%	100%	100%	Table 29[332]	Table 29[333]	25%	0%

[324] UI/Eversource C&LM Program Savings Documentation – 2017, Page 145.
[325] UI/Eversource C&LM Program Savings Documentation – 2017, Page 145.
[326] Calculated using equations from UI/Eversource C&LM Program Savings Documentation – 2017, Page 145, using weighted average Maine HDD of 7,777.
[327] Calculated using equations from UI/Eversource C&LM Program Savings Documentation – 2017, Page 145, using weighted average Maine CDD of 480.
[328] UI/Eversource C&LM Program Savings Documentation – 2017, Page 327.
[329] Estimated incremental cost for efficient motor only. Sachs and Smith, 2003, Page 12.
[330] Measure not yet evaluated, assume default FR of 25%.
[331] Measure not yet evaluated, assume default FR of 25%.
[332] See Appendix C. Reference impact factors for “VFDs on Supply Fan”.
[333] Ibid.

Electronically Commutated Hot Water Smart Pump (ECMHW)							
Last Revised Date	7/1/2017						
MEASURE OVERVIEW							
Description	This measure involves the installation of hot water circulation pumps with electronically commutated (EC) motors, and the installation of controls to modulate the speed of the circulation pump to match the system load.						
Primary Energy Impact	Electric						
Sector	Commercial						
Program(s)	C&I Prescriptive Program, C&I Midstream						
End-Use	Hot Water Heating						
Project Type	Retrofit						
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)							
Demand Savings	ΔkW = (ΔkWh/yr)/Hours						
Annual Energy Savings	ΔkWh/yr = See Table 9						
Definitions	Unit = 1 Circulation pump motor						
EFFICIENCY ASSUMPTIONS							
Baseline Efficiency	The baseline is a permanent split-capacitor motor						
Efficient Measure	The high-efficiency case involves an electronically commutated motor and controls to reduce motor speed with reduced heating load						
PARAMETER VALUES							
Measure/Type	Hours			Life (yrs)	Cost		
All	4,858[334]			20	Table 9		
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR[335]	SO
C&I Prescriptive	100%	100%	100%	Table 29[336]	Table 29[337]	25%	0%

Table 9 - Savings and Measure Cost for EC Circulator Pump Motors

Rated Current (Amps)	Energy Savings[338] (kWh/yr)	Measure Cost[339] ($)
< 1.25	426	$368
1.25 – 5	804	$758
> 5	2,586	$1,018

[334] Annual hours per year from October 1 through April 30 where the dry bulb temperature is less than 55°F. Weighted average of Portland, Bangor, and Caribou.
[335] Measure not yet evaluated, assume default FR of 25% and SO of 0%.
[336] See Appendix C. Reference impact factors for "VFDs on Heating Hot Water Pumps".
[337] Ibid.
[338] Efficiency Vermont TRM User Manual No. 2014-87 (3/16/2015), page 29. Adjusted by ratio of hours from ME to VT (4858 to 4684).
[339] From Efficiency Vermont TRM User Manual No. 2014-87 (3/16/2015), page 29.

Refrigeration Equipment

Prescriptive Refrigeration: Evaporator Fan Motor Control for Cooler/Freezer, Code R10	
Last Revised Date	7/1/2013
MEASURE OVERVIEW	
Description	This measure involves the installation of evaporator fan controls on refrigeration systems (coolers and freezers). These systems save energy by turning off cooler/freezer evaporator fans while the compressor is not running, and instead turning on an energy-efficient 35 watt fan to provide air circulation. This measure is not eligible for systems already equipped with electronically commutated motor (ECM) evaporator fan motors.
Primary Energy Impact	Electric
Sector	Commercial
Program(s)	C&I Prescriptive Program
End-Use	Refrigeration
Project Type	New construction, Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = (kW_{EVAP} \times n_{EVAP} - kW_{CIRC}) \times (1 - DC_{COMP}) \times BF$
Annual Energy Savings	$\Delta kWh/yr = (kW_{EVAP} \times n_{EVAP} - kW_{CIRC}) \times (1 - DC_{COMP}) \times Hours \times BF$
Definitions	Unit = 1 evaporator fan control kW_{EVAP} = Connected load kW of each evaporator fan (kW) n_{EVAP} = Number of controlled evaporator fans kW_{CIRC} = Connected load kW of the circulating fan (kW) DC_{COMP} = Duty cycle of the compressor BF = Bonus factor for reduced cooling load from replacing the evaporator fan with a lower wattage circulating fan when the compressor is not running Hours = Annual operating hours (hrs/yr)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	A refrigeration system equipped with either shaded-pole or PSC evaporator fans motors and no evaporator fan control.
Efficient Measure	A refrigeration system with an evaporator fan control and a smaller wattage circulating fan.

PARAMETER VALUES

Measure/Type	kW_{EVAP}	n_{EVAP}	kW_{CIRC}	DC_{COMP}	BF	Hours	Life (yrs)	Cost ($)
All	0.123[340]	Actual	0.035[341]	50%[342]	Table 38[343]	Actual	10[344]	$2,254[345]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[346]	100%[346]	Table 29[347]	Table 29[347]	52%[348]	1.6%[349]

340 Based on a weighted average of 80% shaded-pole motors at 132 watts and 20% PSC motors at 88 watts. This weighted average is based on discussions with refrigeration contractors and is considered conservative (market penetration estimated at approximately 10%).
341 Wattage of fan is used by Freeaire and Cooltrol.
342 A 50% duty cycle is assumed based on examination of duty cycle assumptions from Richard Traverse, Freeaire Refrigeration (35%-65%), Cooltrol (35%-65%), Natural Cool (70%), Pacific Gas & Electric (58%). Also, manufacturers typically size equipment with a built-in 67% duty factor and contractors typically add another 25% safety factor, which results in a 50% overall duty factor.
343 See Appendix F.
344 ERS, Measure Life Study Prepared for the Massachusetts Joint Utilities, November 2005, Table 1-1.
345 Average incremental cost for this measure has not changed since the Efficiency Maine TRM revision 8/15 2010 based on interviews with suppliers in Maine and the review of Efficiency Maine projects by GDS Associates, December 2011.
346 Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.
347 See Appendix C.
348 Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
349 Ibid.

Prescriptive Refrigeration: Door Heater Controls for Cooler/Freezer, Code R20							
Last Revised Date	7/1/2013						
MEASURE OVERVIEW							
Description	This measure involves the installation of door heater controls on refrigeration systems (coolers and freezers). Door heater controls save energy by allowing "on-off" control of the door heaters based on either the relative humidity in the space or the door conductivity level. Door heater controls are not applicable to freezers or coolers with "zero energy" doors.						
Primary Energy Impact	Electric						
Sector	Commercial						
Program(s)	C&I Prescriptive Program						
End-Use	Refrigeration						
Project Type	New construction, Retrofit						
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)							
Demand Savings	$\Delta kW = kW_{door} \times n_{door} \times BF$						
Annual Energy Savings	$\Delta kWh/yr = kW_{door} \times n_{door} \times BF \times Hours \times SF$						
Definitions	Unit = 1 door heater control kW_{door} = Connected load kW of a typical reach-in cooler or freezer door with a heater (kW) n_{door} = Number of doors controlled by sensor BF = Bonus factor for reduced cooling load from eliminating heat generated by the door heater from entering the cooler or freezer SF = Demand savings factor to account for cycling of door heaters after installation of controls Hours = Annual operating hours (hrs/yr)						
EFFICIENCY ASSUMPTIONS							
Baseline Efficiency	A cooler or freezer glass door that is continuously heated to prevent condensation.						
Efficient Measure	A cooler or freezer glass door with either a humidity-based or conductivity-based door-heater control.						
PARAMETER VALUES							
Measure/Type	kW_{door}[350]	n_{door}	BF	SF	Hours	Life (yrs)	Cost ($)
All	0.075 for cooler 0.200 for freezer	Actual	Table 38[351]	Table 10	8,760[352]	10[353]	$300[354]
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[355]	100%[355]	Table 29[356]	Table 29[356]	52%[357]	1.6%[358]

350 Based on range of wattages from two manufacturers and metered data (cooler 50-130 W, freezer 200-320 W).
351 See Appendix F.
352 Refrigeration equipment is assumed to operate continuously.
353 ERS, Measure Life Study Prepared for the Massachusetts Joint Utilities, November 2005, Table 1-1.
354 Average incremental cost for this measure has not changed since the Efficiency Maine TRM revision 8/15 2010 based on interviews with suppliers in Maine and the review of Efficiency Maine projects by GDS Associates, December 2011.
355 Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.
356 See Appendix C.
357 Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
358 Ibid.

Table 10 – Savings Factor for Door Heater Controls[359]

Control Type	SF
Conductivity	80%[360]
Humidity	55%[361]

[359] Based on the average of standard reciprocating and discus compressor efficiencies with Saturated Suction Temperatures of -20°F, 20°F, and 45°F, respectively, and a condensing temperature of 90°F, and manufacturers assumption that 65% of heat generated by door enters the refrigerated case (1 + 0.65/COP).
[360] Door Miser savings claim.
[361] R.H. Travers' Freeaire Refrigeration, estimated savings.

Prescriptive Refrigeration: Zero Energy Doors for Coolers/Freezers, Codes R30, R31	
Last Revised Date	7/1/2013
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of zero energy doors for refrigeration systems (coolers and freezers) instead of standard doors for new construction or retrofit projects. The zero energy doors consist of two or three panes of glass and include a low-conductivity filler gas (e.g., argon) and low-emissivity glass coatings. Standard cooler or freezer doors are glass doors that typically have electric resistance heaters within the door frames to prevent condensation from forming on the glass and to prevent frost formation on door frames.
Primary Energy Impact	Electric
Sector	Commercial
Program(s)	C&I Prescriptive Program
End-Use	Refrigeration
Project Type	New construction, Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = kW_{door} \times BF$
Annual Energy Savings	$\Delta kWh/yr = kW_{door} \times BF \times Hours$
Definitions	Unit = 1 zero energy door kW_{door} = Connected load kW of a typical reach-in cooler or freezer door with a heater (kW) BF = Bonus factor for reduced cooling load from eliminating heat generated by the door heater from entering the cooler or freezer Hours = Annual operating hours (hrs/yr)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	A cooler or freezer glass door that is continuously heated to prevent condensation.
Efficient Measure	A cooler or freezer glass door that prevents condensation with multiple panes of glass, inert gas, and low-e coatings instead of using electrically generated heat.

PARAMETER VALUES

Measure/Type	kW_{door}[362]	BF	Hours	Life (yrs)	Cost ($)
Cooler (R30)	0.075	Table 38[363]	8,760	10[364]	$275[365]
Freezer (R31)	0.200	Table 38[363]	8,760	10[364]	$800[365]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[366]	101%[366]	Table 29[367]	Table 29[367]	52%[368]	1.6%[369]

[362] Based on range of wattages from two manufacturers and metered data (cooler 50-130 W, freezer 200-320 W).
[363] See Appendix D: Parameter Values Reference Tables.
[364] ERS, Measure Life Study Prepared for the Massachusetts Joint Utilities, November 2005, Table 1-1.
[365] Average incremental cost for this measure has not changed since the Efficiency Maine TRM revision 8/15 2010 based on interviews with suppliers in Maine and the review of Efficiency Maine projects by GDS Associates, December 2011
[366] Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.
[367] See Appendix B.
[368] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[369] Ibid.

Prescriptive Refrigeration: High-Efficiency Evaporative Fan Motors, Codes R40, R41, R42							
Last Revised Date	7/1/2013						
MEASURE OVERVIEW							
Description	This measure involves the purchase and installation of a new high-efficiency brushless DC fan electronically commutated motor (ECM) on a refrigeration system, instead of conventional, shaded-pole or permanent split capacitor (PSC) evaporator fan motor. Refrigeration systems typically contain two to six evaporator fans that run nearly 24 hours per day, 365 days a year. If the system has single-phase power, electricity usage can be reduced by choosing brushless DC, or ECM, motors. This measure is not eligible for high-efficiency motors installed in new construction walk-in coolers and freezer applications, as high-efficiency motors are required by federal codes and standards.[370]						
Primary Energy Impact	Electric						
Sector	Commercial						
Program(s)	C&I Prescriptive Program						
End-Use	Refrigeration						
Project Type	New construction (refrigerated cases only), Retrofit (refrigerated cases and walk-in coolers/freezers)						
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)							
Demand Savings	$\Delta kW = (kW_{BASE} - kW_{BDC}) \times BF$						
Annual Energy Savings	$\Delta kWh/yr = (kW_{BASE} - kW_{BDC}) \times Hours \times DC_{EVAP} \times BF$						
Definitions	Unit = 1 ECM fan kW_{BASE} = Connected load kW of the baseline evaporator fan (kW) kW_{BDC} = Connected load kW of a brushless DC evaporator fan (kW) DC_{Evap} = Duty cycle of the evaporator fan (%) BF = Bonus factor for reduced cooling load Hours = Annual operating hours (hrs/yr)						
EFFICIENCY ASSUMPTIONS							
Baseline Efficiency	A refrigeration system equipped with either shaded-pole or PSC evaporator fan motor.						
Efficient Measure	A refrigeration system with a brushless DC fan ECM.						
PARAMETER VALUES							
Measure/Type	kW_{BASE}[371]	kW_{BDC}[372]	DC_{Evap}[373]	BF[374]	Hours[375]	Life (yrs)[376]	Cost ($)
Walk-in Cooler/Freezer (R40)	0.123	0.040	100% for cooler, 94% for freezer	Table 38	8,760	15	Table 11
Refrigerated Warehouse (R41)	0.123	0.040	100% for cooler, 94% for freezer	Table 38	8,760	15	Table 11
Merchandise Case (R42)	0.123	0.040	100% for cooler, 94% for freezer	Table 38	8,760	15	Table 11

[370] Energy Independence and Securities Act of 2007, Section 312.
[371] Based on a weighted average of 80% shaded-pole motors at 132 watts and 20% PSC motors at 88 watts. This weighted average is based on discussions with refrigeration contractors and is considered conservative (market penetration estimated at approximately 10%).
[372] Based on research for typical power demand high-efficiency evaporator fan motors for refrigeration applications (40 Watts).
[373] A evaporator fan in a cooler runs all the time, but a freezer runs only 8,273 hours per year due to defrost cycles (4 20-min defrost cycles per day),
[374] SeeAppendix D: Parameter Values Reference Tables.
[375] Refrigeration equipment is assumed to operate continuously.
[376] ERS, Measure Life Study Prepared for the Massachusetts Joint Utilities, November 2005, Table 1-1.

Prescriptive Refrigeration: High-Efficiency Evaporative Fan Motors, Codes R40, R41, R42							
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[377]	100%[377]	Table 29[378]	Table 29[378]	52%[379]	1.6%[380]

Table 11 – Measure Costs for Evaporative Fan Motors[381]

Measure Code	Application	Measure Cost
R40	Walk-in Coolers/Freezers	$60
R41	Refrigerated Warehouses	$135
R42	Merchandise Cases	$25

[377] Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.
[378] See Appendix B.
[379] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[380] Ibid.
[381] Average incremental cost for this measure has not changed since the Efficiency Maine TRM revision 8/15 2010 based on interviews with suppliers in Maine and the review of Efficiency Maine projects by GDS Associates, December 2011.

Prescriptive Refrigeration: Floating-Head Pressure Controls, Codes R50, R51, R52	
Last Revised Date	7/1/2013
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of a "floating-head pressure control" condenser system on a refrigeration system. The floating-head pressure control changes the condensing temperatures in response to different outdoor temperatures so that as the outdoor temperature drops, the compressor does not have to work as hard to reject heat from the cooler or freezer.
Primary Energy Impact	Electric
Sector	Commercial
Program(s)	C&I Prescriptive Program
End-Use	Refrigeration
Project Type	New construction, Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = HP_{COMPRESSOR} \times \Delta kWh/hp / FLH$
Annual Energy Savings	$\Delta kWh/yr = HP_{COMPRESSOR} \times \Delta kWh/hp$
Definitions	$HP_{COMPRESSOR}$ = Compressor horsepower (hp) $\Delta kWh/hp$ = Average kWh savings per hp (kWh/yr/hp) FLH = Full load hours (hrs/yr)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	A refrigeration system without a floating-head pressure control system.
Efficient Measure	A refrigeration system with a floating-head pressure control system.

PARAMETER VALUES

Measure/Type	$HP_{COMPRESSOR}$	$\Delta kWh/hp$	FLH	Life (yrs)	Cost ($)
All	Actual	Table 12	7,221[382]	10[383]	Table 13

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[384]	100%[384]	Table 29[385]	Table 29[385]	52%[386]	1.6%[387]

[382] The refrigeration is assumed to be in operation every day of the year, while savings from floating-head pressure control are expected to occur when the temperature outside is below 75°F, or 8,125 hours. However, due to varied levels of savings at different temperatures, the full load hours are assumed to be 7,221 hours.
[383] ERS, Measure Life Study Prepared for the Massachusetts Joint Utilities, November 2005, Table 1-1.
[384] Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.
[385] See Appendix B.
[386] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[387] Ibid.

Table 12 – Floating-Head Pressure Control kWh Savings per Horsepower (kWh/yr/hp)[388]

Compressor Type	Range of Saturated Suction Temperature (SST)		
	Low Temperature (−35°F to −5°F SST) (Ref. Temp −20°F SST)	Medium Temperature (0°F to 30°F SST) (Ref. Temp 20°F SST)	High Temperature (35°F to 55°F SST) (Ref. Temp 45°F SST)
Standard Reciprocating	695	727	657
Discus	607	598	694
Scroll	669	599	509

Table 13 – Measure Costs for Floating-Head Pressure Control[389]

Measure Code	Description	Measure/Incremental Cost
R50	Controlling 1 Coil	$518
R51	Controlling 2 Coils	$734
R52	Controlling 3 Coils	$984

388 Average savings values are based on previous EMT projects.
389 Average incremental cost for this measure has not changed since the Efficiency Maine TRM revision 8/15 2010 based on interviews with suppliers in Maine and the review of Efficiency Maine projects by GDS Associates, December 2011.

Prescriptive Refrigeration: Discus & Scroll Compressors, Codes R60, R61, R62, R63, R70, R71, R72, R73, R74	
Last Revised Date	7/1/2013
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of a high-efficiency discus or scroll compressor in a refrigeration system. The high-efficiency discus or scroll compressor increases operating efficiency and reduces energy consumption of the system.
Primary Energy Impact	Electric
Sector	Commercial
Program(s)	C&I Prescriptive Program
End-Use	Refrigeration
Project Type	New construction, Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = HP_{COMPRESSOR} \times \Delta kWh/hp / FLH$
Annual Energy Savings	$\Delta kWh/yr = HP_{COMPRESSOR} \times \Delta kWh/hp$
Definitions	Unit = 1 compressor $HP_{COMPRESSOR}$ = Compressor horsepower (hp) $\Delta kWh/hp$ = kWh per HP (kWh/yr/hp) FLH = Full load hours (hrs/yr)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Standard hermetic or semi-hermetic reciprocating compressor.
Efficient Measure	High-efficiency discus or scroll compressor.

PARAMETER VALUES

Measure/Type	$HP_{COMPRESSOR}$	$\Delta kWh/hp$	FLH	Life (yrs)	Cost ($)
All	Actual	Table 14	5,858[390]	15[391]	Table 15

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[392]	100%[392]	Table 29[393]	Table 29[393]	52%[394]	1.6%[395]

[390] Derived from Washington Electric Coop data by West Hill Energy Consultants. The freezer is assumed to always be plugged in but because of compressor and fan cycling the full load hours are 5,858 hours.
[391] ERS, Measure Life Study Prepared for the Massachusetts Joint Utilities, November 2005, Table 1-1.
[392] Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.
[393] See Appendix B.
[394] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[395] Ibid.

Table 14 – Compressor kWh Savings per Horsepower (kWh/hp)[396]

Compressor Type	Temperature Range		
	Low Temperature (−35°F to −5°F SST) (Ref. Temp −20°F SST)	Medium Temperature (0°F to 30°F SST) (Ref. Temp 20°F SST)	High Temperature (35°F to 55°F SST) (Ref. Temp 45°F SST)
Discus	517	601	652
Scroll	208	432	363

Table 15 – Measure Costs for Discus and Scroll Compressors[397]

Equipment Type	Measure Code	Size (hp)	Measure/Incremental Cost
Discus	R60	3	$650
	R61	4	$765
	R62	5	$900
	R63	6	$1,330
Scroll	R70	2	$400
	R71	3	$525
	R72	4	$600
	R73	5	$1,000
	R74	6	$1,300

[396] Savings calculations summarized in <Compressor kWh compared.xls>; calculations performed in spreadsheet tool <Refrigeration Compressor Evaluation Vers. 2.01 July 2003.xls>.
[397] Average incremental cost for this measure has not changed since the Efficiency Maine TRM revision 8/15 2010 based on interviews with suppliers in Maine and the review of Efficiency Maine projects by GDS Associates, December 2011.

Prescriptive Refrigeration: ENERGY STAR® Reach-in Coolers and Freezers, Code R80	
Last Revised Date	7/1/2013
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of a new ENERGY STAR®-qualified commercial cooler (refrigerator) or freezer instead of a new standard-efficiency cooler or freezer.
Primary Energy Impact	Electric
Sector	Commercial
Program(s)	C&I Prescriptive Program
End-Use	Refrigeration
Project Type	New construction, Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = \Delta kWh_{UNIT} / FLH$
Annual Energy Savings	$\Delta kWh/yr = \Delta kWh_{UNIT}$
Definitions	Unit = 1 reach-in cooler or freezer ΔkWh_{UNIT} = Average annual energy savings from high-efficiency unit (kWh/yr) FLH = Full load hours (hrs/yr)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Commercial reach-in refrigerators or freezers of at least 15 cubic feet interior volume that meet the Federal Code requirements for maximum daily energy consumption (MDEC).
Efficient Measure	Commercial reach-in refrigerators or freezers of at least 15 cubic feet interior volume that meet ENERGY STAR® MDEC requirements.

PARAMETER VALUES

Measure/Type	ΔkWh_{UNIT}	FLH	Life (yrs)	Cost ($)
All	Table 16	5,858[398]	12[399]	155[400]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[401]	100%[401]	Table 29[402]	Table 29[402]	52%[403]	1.6%[404]

[398] Derived from Washington Electric Coop data by West Hill Energy Consultants. The freezer is assumed to always be plugged in but because of compressor and fan cycling the full load hours are 5,858 hours.
[399] Environmental Protection Agency, "Savings Calculator for ENERGY STAR Qualified Commercial Kitchen Equipment." Accessed April 8, 2013.
[400] Representative cost of participating units based on the following cost data from Vermont TRM 2014: Solid Ref/Freezer Tier 1 $95 one door; $125 two door; $155 three door – Tier 2 is TWICE Tier 1; Glass Ref Tier 1 $120 one door; $155 two door; $195 three door – Tier 2 is TWICE Tier 1; Glass Freezer only 1 Tier $142 < 15 cu ft; $166 15–50 cu ft; $407 > 50 cu ft.
[401] Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.
[402] See Appendix B.
[403] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[404] Ibid.

Table 16 – Stipulated Annual Energy Consumption and Savings for Commercial Reach-in Coolers and Freezers

Equipment Type	Type	Internal Volume (cubic feet)	Annual Energy Consumption per Unit (kWh/yr)		Annual Energy Savings per Unit (kWh/yr)
			Federal Code[405i]	Qualifying Products[406]	
Coolers/Refrigerators	Solid Door (*VCS.SC.M)*	15 ≤ V < 30	907	655	252
		30 ≤ V < 50	1226	971	255
		50 ≤ V	1637	1174	463
	Glass Door *(VCT.SC.M)*	15 ≤ V < 30	1135	819	316
		30 ≤ V < 50	1774	1212	562
		50 ≤ V	2595	1946	649
Freezers	Solid Door (*VCS.SC.L)*	15 ≤ V < 30	2310	1624	686
		30 ≤ V < 50	3716	3138	578
		50 ≤ V	5522	4506	1016
	Glass Door *(VCT.SC.L)*	15 ≤ V < 30	3458	2172	1286
		30 ≤ V < 50	5311	3540	1771
		50 ≤ V	7692	5218	2474

Note: V = internal volume (ft^3)

[405] Derived from Department of Energy Docket Number EERE-2010_BT-STD_0003; Energy Conservation Program: Energy Conservation Standards for Commercial Refrigeration Equipment, Table I.1

[406] Derived from ENERGY STAR Program Requirements: Product Specification for Commercial Refrigerators and Freezers, Eligibility Criteria. DRAFT 1: Version 4.0, Table 1

Prescriptive Refrigeration: ENERGY STAR® Commercial Ice Makers, Code R90							
Last Revised Date	7/1/2013						
MEASURE OVERVIEW							
Description	This measure involves the purchase and installation of new self-contained air-cooled ice makers that meet current ENERGY STAR® or CEE Tier 2 specifications for use in commercial applications (e.g., hospitals, hotels, food service, and food preservation) instead of standard-efficiency ice makers. High-efficiency ice makers typically use high-efficiency compressors and fan motors and thicker insulation. A list of qualified CEE commercial ice makers (as of January 2015) is available at: http://library.cee1.org/sites/default/files/library/9558/2015-01_Ice_Machines.xlsx.						
Primary Energy Impact	Electric						
Sector	Commercial						
Program(s)	C&I Prescriptive Program						
End-Use	Refrigeration						
Project Type	New construction, Retrofit						
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)							
Demand Savings	$\Delta kW = \Delta kWh_{ICEMACHINE} / FLH$						
Annual Energy Savings	$\Delta kWh/yr = \Delta kWh_{ICEMACHINE}$						
Definitions	Unit = 1 commercial ice maker $\Delta kWh_{ICEMACHINE}$ = Average annual energy savings from high-efficiency ice machine (kWh/yr) FLH = Full load hours (hrs/yr)						
EFFICIENCY ASSUMPTIONS							
Baseline Efficiency	Commercial ice maker that meets the federal minimum efficiency requirements.						
Efficient Measure	Commercial ice maker that meets current ENERGY STAR® or CEE Tier 2 specifications.						
PARAMETER VALUES							
Measure/Type	$\Delta kWh_{ICEMACHINE}$	FLH	Life (yrs)	Cost ($)			
All	Table 17	5,858[407]	8[408]	$0[409]			
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[410]	100%[410]	Table 29[411]	Table 29[411]	52%[412]	1.6%[413]

[407] Derived from Washington Electric Coop data by West Hill Energy Consultants. The freezer is assumed to always be plugged in but because of compressor and fan cycling the full load hours are 5,858 hours.
[408] Environmental Protection Agency, "Savings Calculator for ENERGY STAR Qualified Commercial Kitchen Equipment." Accessed April 8, 2013.
[409] ENERGY STAR® Commercial Kitchen Equipment Calculator.
[410] Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.
[411] See Appendix B.
[412] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[413] Ibid.

Table 17 – CEE Specifications for Air-Cooled Self-Contained Ice Makers[414]

Equipment	Harvest Rate range (lbs ice per day)	Savings (kWh/yr)
Air Cooled, Self-Contained	≤ 175 lbs ice per day	758
	> 175 and ≤ 400 lbs ice per day	2,344
	> 400 and ≤ 600 lbs ice per day	6,029
	> 600 lbs ice per day	8,045

[414] From CEE, High Efficiency Specifications for Commercial Ice Makers effective 07/01/2011, and energystar.gov.

Water Heating Equipment

Prescriptive Water Heating: Tankless Water Heater, Code WH1M	
Last Revised Date	10/1/2017
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of a new tankless (on-demand) natural gas water heater instead of a new storage natural gas water heater.
Energy Impacts	Natural gas, Propane
Sector	Commercial, Industrial
Program(s)	C&I Midstream
End-Use	Water heating
Decision Type	New, Replace on burnout
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Annual energy savings	$\Delta MMBtu/yr = [\ GAL \times 8.33 \times 1 \times (T_{WH} - T_{in}) \times (1/\ TE_{BASE} - 1/\ TE_{EE})\ /\ 1{,}000{,}000\ ] + [\ SL \times 8760\ /\ 1{,}000{,}000]$
Definitions	Unit = Single water heater GAL = Average amount of hot water consumed annually per water heater (gal/yr) T_{WH} = Water heater setpoint temperature (°F) T_{in} = Average water at the main (°F) TE_{BASE} = Thermal efficiency for baseline stand-alone tank water heater TE_{EE} = Thermal efficiency for on-demand water heater 8.33 = Density of water: 8.33 lb/gallon water 1 = Specific heat of water: 1 Btu/lb-°F 1,000,000 = Conversion: 1,000,000 Btu/MMBtu Input = Input rating of water heater (Btu/hr) Tank = Tank volume of baseline water heater (gallons) SL[415] = Maximum standby losses (in Btu/hr) for gas fired storage water heaters ($SL = Input / 800 + 110 \times \sqrt{Tank}$)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Assumed to be a standard gas-fired storage water heater with a Federal Minimum Thermal Efficiency and Federal Maximum Standby Loss.
Efficient Measure	Assumed to be a newly installed tankless water heater with a minimum efficiency of 0.82.

PARAMETER VALUES (DEEMED)

Measure/Type	GAL	T_{WH}	T_{in}	TE_{BASE}	TE_{EE}	Input	Tank	Life (yrs)	Cost ($)
< 155,000Btuh	Actual[416]	126.2[417]	50.8[418]	0.80[419]	Actual	Actual	75	20[420]	$780[421]
≥ 155,000Btuh							150		

IMPACT FACTORS

Program	ISR	RR_E[422]	RR_D	CF_S	CF_W	FR[423]	SO[424]
C&I Prescriptive	100%	100%	N/A	N/A	N/A	25%	0%

[415] Commercial Water Heating Equipment, Gas-fired storage water heaters http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/51.
[416] Use actual annual hot water gallons per year. Alternatively, default values from the DEER Database (www.deeresources.com) may be used based on building type.
[417] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014.
[418] Standard Building America DHW Schedules, weighted average by population of all Maine water main sources.
[419] Federal Standards for Commercial Gas Water Heaters. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/51.
[420] DEER Database, updated 2/5/2014. http://www.deeresources.com/files/DEER2013codeUpdate/download/DEER2014-EUL-table-update_2014-02-05.xlsx.
[421] Incremental cost is shown as calculated by GDS engineering review of available cost data. Average tankless water heater $1,356. Average gas storage water heater $576.
[422] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[423] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes the program overall values from the Business Incentive Program Evaluation (Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-8. NTG Impacts for Program Overall).
[424] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-10. Participant Spillover.

Agricultural Equipment

Prescriptive Agricultural: New Vapor-Tight High Performance T8 Fluorescent Fixtures (Inactive)	
Last Revised Date	7/1/2013
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of new High-Performance T8 (HPT8) lamps and ballasts with vapor-tight housing.
Primary Energy Impact	Electric
Sector	Commercial
Program(s)	C&I Prescriptive Program
End-Use	Agriculture
Project Type	New construction, Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) / 1{,}000$
Annual Energy Savings	$\Delta kWh/yr = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) / 1{,}000) \times HoursWk \times Weeks$
Definitions	Unit = 1 new fixture with 1–4 lamps and 1 ballast Qty_{BASE} = Quantity of baseline fixtures (fixtures) Qty_{EE} = Quantity of new efficient fixtures (fixtures) $Watts_{BASE}$ = Watts of baseline fixture (Watts/fixture) $Watts_{EE}$ = Watts new fixture (Watts/fixture) HoursWk = Weekly hours of equipment operation (hrs/week) Weeks = Weeks per year of equipment operation (weeks/year) 1,000 = Conversion: 1,000 Watts per kW
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	T12 lighting fixtures.
Efficient Measure	High-Performance T8 lamps and ballasts with vapor-tight housing.

PARAMETER VALUES

Measure/Type	Qty_{BASE}	Qty_{EE}	$Watts_{BASE}$	$Watts_{EE}$	HoursWk[425]	Weeks	Life (yrs)	Cost ($)
New Construction	Actual	Actual	Table 32[426]	Table 31[427]	Actual	Actual	15[428]	$96[429]
Retrofit	Actual	Actual	Table 32[426]	Table 31[427]	Actual	Actual	13[428]	$96[429]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[430]	100%[430]	Table 29[431]	Table 29[431]	52%[432]	1.6%[433]

425 Use actual hours when known. If hours are unknown, use the values from Table 35.
426 See Appendix E. The baseline fixture wattage is determined using the Baseline Fixture Rated Wattage table and the baseline fixture type specified in the project Data Collection and Information form.
427 See Appendix D.
428 GDS Associates, Inc., Residential and Commercial/Industrial Lighting and HVAC Measures Prepared for The New England State Program Working Group (SPWG), June 2007 and the 2005 Measure Life Study Report prepared for The Massachusetts Joint Utilities, by ERS.
429 Measure Costs assume 50% retrofit and 50% market opportunity for 1 lamp fixture based on cost data provided in Vermont TRM 2014.
430 Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.
431 See Appendix B.
432 Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
433 Ibid.

Prescriptive Agricultural: Plate Heat Exchangers for Milk Processing (Inactive)	
Last Revised Date	7/1/2013
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of a plate heat exchanger (PHX) that uses tap or well water to pre-cool milk (to between 55°F and 70°F) before the milk enters the cooling tank, thereby reducing the energy required for cooling. The PHX may also use the heat extracted from the milk to preheat water for domestic hot water (DHW) applications.
Primary Energy Impact	Electric
Sector	Commercial
Program(s)	C&I Prescriptive Program
End-Use	Agriculture
Project Type	New construction, Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = \Delta kWh/yr / Hours$
Annual Energy Savings	$\Delta kWh/yr = \Delta kWh_{COMP} + \Delta kWh_{DHW}$ $\Delta kWh_{COMP} = MPD \times 365 \times CP_{MILK} \times ETR / EER / 1{,}000$ $\Delta kWh_{DHW} = MPD \times 365 \times CP_{MILK} \times ETR \times EF_{HX} \times DHW / 3{,}412$
Definitions	Unit = 1 PHX for milk processing ΔkWh_{COMP} = Compressor annual kWh reduction ΔkWh_{DHW} = Domestic hot water annual kWh reduction ETR = Expected Temperature Reduction (°F) MPD = Pounds of milk per day (lb/day) CP_{MILK} = Specific heat of whole milk (Btu/lb- °F) EER = EER of cooling systems (Btuh/Watt) Hours = Annual operating hours (hrs/yr) EF_{HX} = Heat transfer efficiency of device (%) DHW = Indicator for electric DHW system 365 = Conversion: 365 days per year 3,412 = Conversion: 3,412 Btu per kWh 1,000 = Conversion: 1,000 Watts per kW
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	No PHX.
Efficient Measure	PHX installed; may be with or without DHW heat reclaim.
PARAMETER VALUES	

Measure/Type	MPD	EER	ETR	CP_{MILK}	Hours	EF_{HX}	DHW	Life (yrs)	Cost ($)
PHX without DHW	Actual	Actual	35[434]	0.93[435]	2,850[436]	N/A	0	20[437]	2,500[438]
PHX with Electric DHW	Actual	Actual	35[434]	0.93[435]	2,850[436]	59%	1.0	20[437]	2,500[438]

434 Estimated average temperature reduction: PHX typically reduce milk temperatures from 98°F to temperatures to between 55˚F and 70˚F.
435 K M Sahay, K. K. Singh, *Unit Operations of Agricultural Processing*, 2001; page 346.
436 Full load operating hours of 2,850 hours per year assume 6 hours per day of full load operation during milking, with an additional 10% cycle time to maintain tank temperature during non-milking hours.
437 PA Consulting Group for the State of Wisconsin Public Service Commission, Focus on Energy Evaluation. Business Programs: Measure Life Study. August 25, 2009.
438 Average incremental cost for this measure has not changed since the Efficiency Maine TRM revision 8/15 2010 based on interviews with suppliers in Maine and the review of Efficiency Maine projects by GDS Associates, December 2011.

Prescriptive Agricultural: Plate Heat Exchangers for Milk Processing (Inactive)							
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	99%[439]	101%[439]	Table 29[440]	Table 29[440]	52%[441]	1.6%[442]

Prescriptive Agricultural: Adjustable Speed Drives for Dairy Vacuum Pumps, Codes VP<X>

Prescriptive Agricultural: Adjustable Speed Drives for Dairy Vacuum Pumps, Codes VP<X>		
Last Revised Date	7/1/2013	
MEASURE OVERVIEW		
Description	This measure involves the purchase and installation of an Adjustable Speed Drive (ASD) to control the speed of the dairy vacuum pump. This prescriptive measure includes dairy vacuum pumps smaller than 30 HP.	
Primary Energy Impact	Electric	
Sector	Commercial	
Program(s)	C&I Prescriptive Program	
End-Use	Agriculture	
Project Type	New construction, Retrofit	
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)		
Demand Savings	ΔkW	$= HP \times 0.746 \times LF / M_{EFF} - (0.0495 \times 2 \times \#MilkUnits + 1.7729)$
Annual Energy Savings	$\Delta kWh/yr$	$= \Delta kW \times DRT \times 365$
Definitions	Unit	= New ASD
	HP	= Full load HP rating of vacuum pump motor (hp)
	LF	= Average load factor for constant speed vacuum pump (%)
	M_{EFF}	= Motor efficiency (%)
	#MilkUnits	= Number of milk units processed per day
	DRT	= Daily Run Time, hours per day of vacuum pump operation (hrs/day)
	365	= Conversion: 365 days per year
	0.746	= Conversion: 0.746 kW per hp
	0.0495, 2, 1.7729	= Regression coefficients for average ASD speed and processed milk units
EFFICIENCY ASSUMPTIONS		
Baseline Efficiency	Standard dairy vacuum pump operating at constant speed.	
Efficient Measure	Dairy vacuum pump with adjustable speed drive installed.	

PARAMETER VALUES							
Measure/Type	HP	LF	M_{EFF}[443]	#MilkUnits	DRT	Life (yrs)	Cost ($)
All	Table 18	75%[444]	Actual	Actual	Actual	15[445]	$5,322[446]
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO

[439] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Realization Rates for Prescriptive Measures.
[440] See Appendix B.
[441] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[442] Ibid.
[443] Use rated motor efficiency for the actual equipment. If the actual efficiency value is unknown, use the values in Table 18 for existing or new motors.
[444] Assumed value based on typical operations.
[445] PA Consulting Group for the State of Wisconsin Public Service Commission, Focus on Energy Evaluation. Business Programs: Measure Life Study. August 25, 2009.
[446] Average Incremental costs based on interviews with suppliers in Maine, the review of Efficiency Maine projects and incremental costs based from the Efficiency Vermont TRM Users Manual No. 2010-64, 12/14/10 by GDS Associates, December 2011.

C&I Prescriptive	100%	112.2%[447]	100%[448]	Table 29[449]	Table 29[449]	52%[450]	1.6%[451]

Table 18 – Standard Motor Efficiency[452]

Measure	Size (HP)	Existing Motor	New Motor
MILK: Vacuum Pump with Adjustable Speed Drive Package – 7.5 HP	7.5	89.5%	91.7%
MILK: Vacuum Pump with Adjustable Speed Drive Package – 10 HP	10	90.2%	91.7%
MILK: Vacuum Pump with Adjustable Speed Drive Package – 15 HP	15	91.0%	93.0%
MILK: Vacuum Pump with Adjustable Speed Drive Package – 30 HP	30	92.4%	94.1%

447 Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.
448 RR_D used to adjust Summer and Winter CF to account for BIP program evalution findings as presented in Appendix D.
449 See Appendix B.
450 Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
451 Ibid.
452 Values are the highest minimum efficiency values for each size category from the Energy Policy Act of 1992 (for existing motors) and NEMA Premium Efficiency (for new motors).

Prescriptive Agricultural: Scroll Compressors, Codes AMSC<X>	
Last Revised Date	7/1/2013
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of a high-efficiency scroll compressor for use in the milk cooling process.
Primary Energy Impact	Electric
Sector	Commercial
Program(s)	C&I Prescriptive Program
End-Use	Agriculture
Project Type	New construction, Retrofit
GRISS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = HP_{COMPRESSOR} \times \Delta kWh/hp / FLH$
Annual Energy Savings	$\Delta kWh/yr = HP_{COMPRESSOR} \times \Delta kWh/hp$
Definitions	Unit = 1 new scroll compressor $HP_{COMPRESSOR}$ = Compressor horsepower (hp) $\Delta kWh/hp$ = kWh savings per HP (kWh/hp/yr) FLH = Full load hours (hrs/yr)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Standard hermetic compressor. (Note: kWh savings based on an average size dairy farm in Maine with 100 milking cows.)
Efficient Measure	High-efficiency scroll compressor.

PARAMETER VALUES

Measure/Type	$HP_{COMPRESSOR}$	$\Delta kWh/hp$	FLH	Life (yrs)	Cost ($)
All	Actual	432[453]	2,850[454]	15[455]	Table 19

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[456]	100%[457]	Table 29[458]	Table 29[458]	52%[459]	1.6%[460]

Table 19 – Measure Costs for Scroll Compressor[461]

Equipment Type	Size (HP)	Measure/Incremental Cost
Scroll Compressor	2	$400
	3	$525
	5	$1,000
	6	$1,300
	7.5	$1,538
	10	$2,051

[453] Average savings value based on Wisconsin Focus on Energy Dairy Audit tool, used for a 100 herd dairy farm in Maine.
[454] Full load operating hours of 2,850 hours per year assume 6 hours per day of full load operation during milking, with an additional 10% cycle time to maintain tank temperature during non-milking hours.
[455] PA Consulting Group for the State of Wisconsin Public Service Commission, Focus on Energy Evaluation. Business Programs: Measure Life Study. August 25, 2009.
[456] Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.
[457] RR_D used to adjust Summer and Winter CF to account for BIP program evalution findings as presented in Appendix D.
[458] See Appendix B.
[459] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[460] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[461] Average incremental costs based on interviews with suppliers in Maine and the review of Efficiency Maine projects by GDS Associates, December 2011.

Prescriptive Agricultural: Adjustable Speed Drives on Ventilation Fans (Potato Storage Equipment), Codes ASD<X>							
Last Revised Date	7/1/2013						
MEASURE OVERVIEW							
Description	This measure involves the purchase and installation of an Adjustable Speed Drive (ASD) on potato storage ventilation fans. Savings are realized during periods when less than full speed is required.						
Primary Energy Impact	Electric						
Sector	Commercial						
Program(s)	C&I Prescriptive Program						
End-Use	Agriculture						
Project Type	New construction, Retrofit						
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)							
Demand Savings	$\Delta kW = HP_{VFD} \times LF / EF \times (A + B \times SF_F + C \times SF_F^2 - (A + B \times SF_H + C \times SF_H^2))$ $= HP_{VFD} \times 0.71$						
Annual Energy Savings	$\Delta kWh/yr = HP_{VFD} \times LF/EF \times HOU_{HALF} \times (A + B \times SF_F + C \times SF_F^2 - A + B \times SF_H + C \times SF_H^2)$ $= HP_{VFD} \times 2540$						
Definitions	Unit = 1 new ASD HP_{VFD} = Total fan horsepower connected to the ASD (hp) LF = Load factor EF = Motor efficiency HOU_{HALF} = Hours of use at half power A, B, C = Fan Default Curve Correlation Coefficients SF_F = Speed factor for full speed SF_H = Speed factor for half speed						
EFFICIENCY ASSUMPTIONS							
Baseline Efficiency	Standard ventilation fan with no adjustable speed drive installed.						
Efficient Measure	Ventilation fan with ASD installed.						
PARAMETER VALUES							
Measure/Type	HP_{VFD}			HOU_{HALF}	Life (yrs)	Cost ($)	
All	Actual			3600[462]	15[463]	Table 20	
Measure/Type	LF	EF	A	B	C	SF_F	SF_H
All	0.8[464]	0.91[464]	0.22[465]	–0.87[465]	1.65[465]	1	0.5
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[466]	100%[467]	Table 29[468]	Table 29[468]	52%[469]	1.6%[470]

[462] Fans can run at half speed 24/7 from December 1 to April 30 as reported by Steve Belyea, ME Dept of Agriculture, evaluation.
[463] GDS Associates, Inc., Residential and Commercial/Industrial Lighting and HVAC Measures Prepared for The New England State Program Working Group (SPWG), June 2007 and the 2005 Measure Life Study Report prepared for The Massachusetts Joint Utilities, by ERS.
[464] Program assumption.
[465] Fan Default Curve Correlation Coefficients for VFD. Variable Frequency Drive Evaluation Protocol, SBW Consulting, Inc., Table 1.
[466] Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.
[467] RR_D used to adjust Summer and Winter CF to account for BIP program evalution findings as presented in Appendix D.
[468] See Appendix B.
[469] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[470] Ibid.

Table 20 – Measure Cost for ASD on Ventilation Fans[471]

Size (hp)	Measure Cost
3	$963
5	$1,105
7.5	$1,467
10	$1,745
15	$2,525
20	$2,725

[471] Average incremental cost for this measure has not changed since the Efficiency Maine TRM revision 8/15 2010 based on interviews with suppliers in Maine and the review of Efficiency Maine projects by GDS Associates, December 2011.

Prescriptive Agricultural: High-Volume Low-Speed Fans, Code AOLSF	
Last Revised Date	7/1/2013
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of high-volume low-speed (HVLS) fans in a free stall dairy barn to move large amounts of air efficiently (with lower noise).
Primary Energy Impact	Electric
Sector	Commercial
Program(s)	C&I Prescriptive Program
End-Use	Agriculture
Project Type	New construction, Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = (HP_{BASE} / M_{EFF,BASE} - HP_{HVLS} / M_{EFF,HVLS}) \times 0.746 \times LF$
Annual Energy Savings	$\Delta kWh/yr = \Delta kW \times Hours$
Definitions	Unit = 1 new HVLS HP_{BASE} = Total combined horsepower of existing fan motors (hp) $M_{EFF,BASE}$ = Average motor efficiency of existing fan motors (%) HP_{HVLS} = Total combined HP of HVLS fan motors (hp) $M_{EFF,HVLS}$ = Rated motor efficiency of new HVLS fan (%) LF = Average motor load factor Hours = Annual operating hours (hrs/yr) 0.746 = Conversion: 0.746 kW per hp
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	1-hp basket type fans (approximately 10–13 four-foot fans replaced by 1 HVLS).
Efficient Measure	HVLS ventilation fans.

PARAMETER VALUES

Measure/Type	HP_{BASE}	$M_{EFF,BASE}$	HP_{HVLS}	$M_{EFF,HVLS}$	LF	Hours	Life (yrs)	Cost ($)
All	Actual	80%[472]	Actual	Actual	80%[473]	3,660[474]	15[475]	1,165[476]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[477]	100%[478]	Table 29[479]	Table 29[479]	52%[480]	1.6%[481]

[472] Conservative estimate for efficiency of existing 1–2 hp fan motors, based on minimum efficiency requirements in the Energy Policy Act of 2007.
[473] Assumed value based on typical operations.
[474] Fan typically operates 5 months out of the year or approximately 3,660 hours.
[475] PA Consulting Group for the State of Wisconsin Public Service Commission, Focus on Energy Evaluation. Business Programs: Measure Life Study. August 25, 2009.
[476] Average incremental cost for this measure has not changed since the Efficiency Maine TRM revision 8/15 2010 based on interviews with suppliers in Maine and the review of Efficiency Maine projects by GDS Associates, December 2011
[477] Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.
[478] RR_D used to adjust Summer and Winter CF to account for BIP program evalution findings as presented in Appendix D.
[479] See Appendix C.
[480] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[481] Ibid.

Commercial Kitchen Equipment

<table>
<tr><th colspan="8">ENERGY STAR® Natural Gas Kitchen Equipment, Codes G17–G22</th></tr>
<tr><td>Last Revised Date</td><td colspan="7">7/1/2013</td></tr>
<tr><td colspan="8">MEASURE OVERVIEW</td></tr>
<tr><td>Description</td><td colspan="7">This measure involves the purchase and installation of new high-efficiency natural gas kitchen equipment.</td></tr>
<tr><td>Primary Energy Impact</td><td colspan="7">Natural gas</td></tr>
<tr><td>Sector</td><td colspan="7">Commercial, Industrial</td></tr>
<tr><td>Program(s)</td><td colspan="7">C&I Prescriptive Program</td></tr>
<tr><td>End-Use</td><td colspan="7">Natural gas</td></tr>
<tr><td>Project Type</td><td colspan="7">New construction, Retrofit</td></tr>
<tr><td colspan="8">GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)</td></tr>
<tr><td>Annual Energy Savings</td><td colspan="7">$\Delta MMBtu/yr = \Delta MMBTU_{UNIT}$</td></tr>
<tr><td>Definitions</td><td colspan="7">Unit = 1 new kitchen equipment
$\Delta MMBTU_{UNIT}$ = Deemed annual MMBtu savings per unit (MMBtu/yr)</td></tr>
<tr><td colspan="8">EFFICIENCY ASSUMPTIONS</td></tr>
<tr><td>Baseline Efficiency</td><td colspan="7">Standard-efficiency natural gas kitchen equipment.</td></tr>
<tr><td>Efficient Measure</td><td colspan="7">High-efficiency natural gas kitchen equipment.</td></tr>
<tr><td colspan="8">PARAMETER VALUES</td></tr>
<tr><td>Measure/Type</td><td>$\Delta MMBTU_{UNIT}$</td><td colspan="3" rowspan="2"></td><td>Life (yrs)</td><td colspan="2">Cost ($)</td></tr>
<tr><td>All</td><td>Table 21</td><td>12[482]</td><td colspan="2">Table 21</td></tr>
<tr><td colspan="8">IMPACT FACTORS</td></tr>
<tr><td>Program</td><td>ISR</td><td>RR_E</td><td>RR_D</td><td>CF_S</td><td>CF_W</td><td>FR</td><td>SO</td></tr>
<tr><td>C&I Prescriptive</td><td>100%</td><td>100%[483]</td><td>N/A</td><td>N/A</td><td>N/A</td><td>25%[484]</td><td>0%[485]</td></tr>
</table>

[482] Energy Protection Agency, Savings Calculator for ENERGY STAR® Qualified Commercial Kitchen Equipment. Accessed April 9, 2013. The calculator uses a 12-year measure life value for the life-cycle cost analysis for ovens, fryers, griddles, and steamers.

[483] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.

[484] Measure not yet evaluated, assume default FR of 25%.

[485] Measure not yet evaluated, assume default SO of 0%.

Table 21 – Natural Gas Kitchen Equipment Measure Detail[486]

Measure Code	Description	Size	Deemed Savings	Incremental Cost ($/unit)
			$\Delta Therms_{UNIT}$	
G17	Fryer	Standard	508	0
		Large Vat	415	$1,120
G19	Convection oven	Any	129	$0
G20	Combination oven	30 pans	730	$0
G21	Steamer	3 pan	766	$260
		5 pan	962	$0
		6 pan	1,054	$870
		10 pan	1,622	$870
G22	Griddle	2 feet wide	57	$360
		3 feet wide	131	$360
		4 feet wide	206	$360
		5 feet wide	280	$360
		6 feet wide	355	$360

486 Savings and measure cost values are based on: ENERGY STAR® Commercial Kitchen Equipment Calculator. Accessed November 2016 using default assumptions.

Demand Control Kitchen Ventilation, Code DCKV	
Last Revised Date	7/1/2016 (New Measure for PY17)
MEASURE OVERVIEW	
Description	This measure involves the installation of a controls package on the ventilation exhaust system of commercial cooking equipment to be operated in tandem with a dedicated Make-Up Air (MUA) unit serving the space. The installed system must be capable of varying the rate of kitchen exhaust air through VFD control and the rate of outside air delivered to the space through VFD or outside air damper modulation. The installed system must have thermal and opacity (smoke) sensors.
Primary Energy Impact	Natural gas
Sector	Commercial, Industrial
Program(s)	C&I Prescriptive Program
End-Use	Natural gas, Space heating
Project Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Annual Energy Savings	ΔMMBtu/yr = 611 x HP x AHL / (Eff_{heat} x 1,000,000)
Definitions	Unit = 1 Controlled Exhaust Fan 611 = CFM reduction per exhaust fan horsepower[487] HP = Exhaust fan horsepower AHL = Annual heating load (Btu) of outside air through MUA unit Eff_{heat} = Heating efficiency of MUA unit 1,000,000 = Conversion of Btu to MMBtu
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Assumed to be a standard commercial kitchen ventilation system with dedicated MUA and standard on/off controls.
Efficient Measure	Assumed to be a ventilation system with VFDs and interlocked controls that vary based on the energy required for cooking exhaust effluence.

PARAMETER VALUES

Measure/Type	HP	AHL[488]	Eff_{heat}[489]	Life (yrs)[490]	Cost ($)[491]
All	Actual	Actual	Actual	15	$2,000 per exhaust fan

IMPACT FACTORS

Program	ISR	RR_E[492]	RR_D	CF_S	CF_W	FR[493]	SO[494]
C&I Prescriptive	100%	100%	N/A	N/A	N/A	25%[495]	0%[496]

[487] Commercial Kitchen Demand Ventilation Controls study, PG&E, PGECOFST116, June 2009, average reduction and fan horsepower.
[488] Refer to the Food Service Technology Center Outside Air Load Calculator (http://www.fishnick.com/ventilation/oalc/oac.php). Enter a design Outdoor Air Flow as 1 CFM under Air Setpoints and retrieve the Total Annual Heating Load in **Btu**, do not retrieve the Design Heating Load.
[489] Expressed as a decimal, i.e., 80% AFUE is .80.
[490] DEER Database 2014.
[491] GDS review of regional databases and TRMs.
[492] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[493] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes the program overall values from the Business Incentive Program Evaluation (Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-8. NTG Impacts for Program Overall).
[494] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-10. Participant Spillover.
[495] Measure not yet evaluated, assume default FR of 25%.
[496] Measure not yet evaluated, assume default SO of 0%.

High Efficiency Pre-Rinse Spray Valves (HPSV)	
Last Revised Date	1/1/2017
MEASURE OVERVIEW	
Description	This measure involves the installation of a high efficiency pre-rinse spray valve in Commercial/Industrial kitchens
Energy Impacts	Natural Gas, Heating Oil, Propane, Electric
Sector	Commercial, Industrial
Program(s)	C& I Prescriptive Program
End-Use	Boilers, Water Heating
Decision Type	Retrofit, ROB
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Annual energy savings	$\Delta MMBtu/yr = (Vol_{base} – Vol_{ee}) \times 60 \times Hours \times Days \times 8.33 \times 1 \times (T_{out} – T_{in}) / Eff / 1{,}000{,}000$ $\Delta kWh/yr = (Vol_{base} – Vol_{ee}) \times 60 \times Hours \times Days \times 8.33 \times 1 \times (T_{out} – T_{in}) / Eff / 1{,}000{,}000 \times 0.003413$
Annual water savings	$\Delta Gallons/yr = (Vol_{base} – Vol_{ee}) \times 60 \times Hours \times Days$
Definitions	Unit = Single pre-rinse spray valve Vol_{base} = Base case flow in gallons per minute (gal/min) Vol_{ee} = Efficient case flow in gallons per minute (gal/min) 60 = Conversion factor: minutes per hour (min/hr Hours = Hours per day that the pre-rinse spray valve is used at the site (hrs/day) Days = Days per year (days/yr) 8.33 = Conversion factor: pounds per gallon of water (lb/gal) 1 = Heat capacity of water (Btu/lb/°F) T_{out} = Average mixed hot water discharge (after spray valve) temperature (°F) T_{in} = Average water temperature at the main (°F) Eff_{elec} = Efficiency of electric water heater supplying hot water to pre-rinse spray valve (%) Eff_{fuel} = Efficiency of fuel water heater supplying hot water to pre-rinse spray valve 1,000,000 = Conversion: 1,000,000 Btu/MMBtu 0.003413 = Conversion: 0.003413 MMBtu/kWh
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	For Retrofit, the baseline is the standard defined by The Energy Policy Act. For ROB, the baseline is the average population efficiency taken from an evaluation report for California Urban Water Conservation Council.
Efficient Measure	High efficiency pre-rinse spray valve with a maximum flowrate of 1.15 gallons per minute.

High Efficiency Pre-Rinse Spray Valves (HPSV)

PARAMETER VALUES (DEEMED)

Measure/Type	Vol_{base}	Vol_{ee}[497]	T_{out}[498]	T_{in}[499]	Hours	Days[500]	Eff_{fuel}[501]	Eff_{elec}[502]	Life[503] (yrs)	Cost ($)
Point of Purchase/Replace on Burnout	1.6[504]	1.15	120	50.8	Table 22	312 days/yr	80%	98%	5	Actual
Food Service Retrofit	2.25[505]									
Grocery Retrofit	2.15[506]									

IMPACT FACTORS

Measure/Type	ISR	RR_E[507]	RR_D	CF_S	CF_W		FR[508]	SO[509]
All	100%	100%	N/A	N/A	N/A		25%	0%

Table 22 – Hours per Day that the Pre-Rinse Spray Valve is used at Different Sites

Site	Hours[510,511] (hrs/day)
Small, quick-service restaurants	0.5
Medium-sized casual dining restaurants	1.5
Large institutional establishments with cafeteria	3.0
Grocery Store	0.1

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497 The FSTC recommends a pre-rinse spray valve with a flow rate of 1.15 gallons per minute or less, and with a cleanability performance of 26 seconds per plate or less, based on the ASTM Standard Test Method for Performance of Pre-Rinse Spray Valves. http://www.fishnick.com/equipment/sprayvalves/

498 According to ASTM F2324 03 Cleanability Test the optimal operating conditions are at 120F discharge temperature.

499 Standard Building America DHW Schedules, weighted average by population of all Maine water main sources.

500 312 days/yr is based on an assumption of 6 days/week and 52 weeks/year

501 Federal Standards for Commercial Gas Water Heaters. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/51

502 NREL, Building America Research Benchmark Definition, 2009, p.12, http://www.nrel.gov/docs/fy10osti/47246.pdf

503 Impact and Process Evaluation Final Report for California Urban Water Conservation Council 2004-5 Pre-Rinse Spray Valve Installation Program (Phase 2), SBW Consulting, 2007, p. 30. http://www.allianceforwaterefficiency.org/WorkArea/DownloadAsset.aspx?id=976

504 The Energy Policy Act (EPAct) of 2005 sets the maximum flow rate for pre-rinse spray valves at 1.6 GPM at 60 pounds per square inch of water pressure when tested in accordance with ASTM F2324-03. https://www3.epa.gov/watersense/products/prsv.html

505 Impact and Process Evaluation Final Report for California Urban Water Conservation Council 2004-5 Pre-Rinse Spray Valve Installation Program (Phase 2), SBW Consulting, 2007, p. 30. http://www.allianceforwaterefficiency.org/WorkArea/DownloadAsset.aspx?id=976

506 Ibid.

507 This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.

508 This program is new and has not yet been evaluated. Until the next program impact evaluation, standard assumption of 25% is to be used.

509 This program is new and has not yet been evaluated. Until the next program impact evaluation, standard assumption of 0% is to be used.

510 Hours based on PG&E savings estimates, algorithms, sources (2005), Food Service Pre-Rinse Spray Valves with review of 2010 Ohio Technical Reference Manual and Act on Energy Business Program Technical Resource Manual Rev05.

511 Grocery Store duration from: Impact and Process Evaluation Final Report for California Urban Water Conservation Council 2004-5 Pre-Rinse Spray Valve Installation Program (Phase 2), SBW Consulting, 2007, Table 3-6, p. 24. http://www.allianceforwaterefficiency.org/WorkArea/DownloadAsset.aspx?id=976

Compressed Air Equipment

Prescriptive Compressed Air: High-Efficiency Air Compressors, Codes C1–C4						
Last Revised Date	7/1/2013					
MEASURE OVERVIEW						
Description	This measure involves the purchase and installation of a high-efficiency variable frequency drive (VFD) or load/no-load air compressor.					
Primary Energy Impact	Electric					
Sector	Commercial/Industrial					
Program(s)	C&I Prescriptive Program					
End-Use	Compressed air					
Project Type	New construction, Retrofit					
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)						
Demand Savings	$\Delta kW = HP_{COMPRESSOR} \times \Delta kW/HP$					
Annual Energy Savings	$\Delta kWh/yr = HP_{COMPRESSOR} \times \Delta kW/HP \times Hours/Week \times Weeks$					
Definitions	Unit = 1 new compressor $HP_{COMPRESSOR}$ = HP of the proposed compressor (hp) ΔkW/HP = Stipulated savings per compressor based on compressor size (kW/hp) Hours/Week = Total operating hours per week (hrs/week) Weeks = Total operating weeks per year (week/yr)					
EFFICIENCY ASSUMPTIONS						
Baseline Efficiency	Inlet modulation fixed-speed compressor.[512]					
Efficient Measure	VFD or load/no-load air compressor.					
PARAMETER VALUES						
Measure/Type	HP	ΔkW/HP	Hours/Week	Weeks	Life (yrs)	Cost ($)
All	Actual	Table 23	Actual	Actual	15[513]	$164/HP[514]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[515]	100%[516]	Table 29[517]	Table 29[517]	52%[518]	1.6%[519]

[512] Stipulated measure savings derived from 149 actual Efficiency Maine projects – inlet modulation fixed-speed compressors were the dominant baseline machines among this sample of projects.
[513] 2005 Measure Life Study prepared for the Massachusetts Joint Utility by Energy Resource Solutions (2005). Measure life study prepared for the Massachusetts Joint Utilities.
[514] Based on a correlation between measure cost and compressor horsepower using measure cost data from 149 custom compressed air projects completed by Efficiency Maine between 2007 and 2011.
[515] Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.
[516] RR_D used to adjust Summer and Winter CF to account for BIP program evalution findings as presented in Appendix D.
[517] See Appendix C.
[518] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[519] Ibid.

Table 23 – Stipulated Savings per Compressor Based on Compressor Size[520]

Measure Code	HP	ΔkW/HP
C1	≤ 15	0.2556
C2	16 HP – 30 HP	0.2358
C3	31 HP – 60 HP	0.2154
C4	> 60 HP	0.1861

[520] (kW/HP) values are derived from 149 actual custom compressed air projects completed by Efficiency Maine between 2007 and 2011.

Prescriptive Compressed Air: High-Efficiency Dryers, Codes C10–C16

Last Revised Date	7/1/2017
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of high-efficiency cycling or VFD-equipped refrigerated air dryers. The dryers must be properly sized and equipped with automated controls that cycle the refrigerant compressor (or reduce the output for VFD modes) in response to compressed air demand.
Primary Energy Impact	Electric
Sector	Commercial/Industrial
Program(s)	C&I Prescriptive Program
End-Use	Compressed air
Project Type	New construction, Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = CFM_{DRYER} \times \Delta kW/CFM$
Annual Energy Savings	$\Delta kWh/yr = CFM_{DRYER} \times \Delta kW/CFM \times Hours/Week \times Weeks$
Definitions	Unit = 1 new dryer CFM_{DRYER} = Full-flow rated capacity of refrigerated air dryer (CFM) ΔkW/CFM = Stipulated input power reduction per full-flow rating (CFM) of dryer (kW/CFM) Hours/Week = Total operating hours per week (hrs/week) Weeks = Total operating weeks per year (week/yr)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Non-cycling refrigerated air dryer.
Efficient Measure	High-efficiency cycling or VFD-equipped refrigerated air dryer.

PARAMETER VALUES

Measure/Type	CFM_{DRYER}	ΔkW/CFM	Hours/Week	Weeks	Life (yrs)	Cost ($)
All	Actual	Table 24	Actual	Actual	15[521]	$6.54/CFM[522]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[523]	100%[524]	Table 29[525]	Table 29[525]	52%[526]	1.6%[527]

Table 24 – Input Power Reduction per Full-Flow Rating (CFM) of Dryer[528]

Measure Code	Dryer CFM	ΔkW/CFM
C10	< 100	0.00474
C11, C12	≥ 100 and < 200	0.00359
C13, C14	≥ 200 and < 300	0.00316
C15	≥ 300 and < 400	0.00290
C16	≥ 400	0.00272

521 2005 Measure Life Study prepared for the Massachusetts Joint Utility by ERS.
522 Based on historical measure cost for EMT projects, provided by Greg Scott, Trask-Decrow Machinery.
523 Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.
524 RR_D used to adjust Summer and Winter CF to account for BIP program evalution findings as presented in Appendix D.
525 See Appendix C.
526 Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
527 Ibid.
528 Massachusetts Technical Reference Manual for Estimating Savings from Energy Efficiency Measures, 2013-2015 Program Years – Plan Version, October 2012, Page 262.

Prescriptive Compressed Air: Receivers, Codes C20–C27							
Last Revised Date	7/1/2013						
MEASURE OVERVIEW							
Description	This measure involves the installation of appropriately sized receivers in a compressed air system to diminish the downstream drop in pressure that results from surges in demand, eliminating the need for artificially high compressor output pressure. Note: When there is insufficient storage capacity in a compressed air system, surges in compressed air consumption cause dramatic dips in the downstream distribution system pressure. This requires that compressor output pressure be adjusted to artificially high levels to sustain downstream pressure at the desired level.						
Primary Energy Impact	Electric						
Sector	Commercial/Industrial						
Program(s)	C&I Prescriptive Program						
End-Use	Compressed air						
Project Type	New construction, Retrofit						
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)							
Demand Savings	$\Delta kW = HP_{COMPRESSOR} \times 0.746 \times \Delta psi / 2 \times SAVE$						
Annual Energy Savings	$\Delta kWh/yr = HP_{COMPRESSOR} \times 0.746 \times \Delta psi / 2 \times SAVE \times Hours/Week \times Weeks$						
Definitions	Unit = 1 air receiver $HP_{COMPRESSOR}$ = Compressor horsepower (hp) Δpsi = Average reduction in system pressure (psi) SAVE = Average percentage demand reduction per pressure drop (%/psi) Hours/Week = Total compressed air system operating hours per week (hrs/week) Weeks = Total compressed air system operating weeks per year (week/yr) 0.746 = Conversion: 0.746 kW per hp						
EFFICIENCY ASSUMPTIONS							
Baseline Efficiency	Compressed air system with inadequate receiver capacity.						
Efficient Measure	Compressed air system with receivers installed to achieve appropriately sized receiver capacity allowing a lower set point on system pressure.						
PARAMETER VALUES							
Measure/Type	$HP_{COMPRESSOR}$	Δpsi	Hours/Week	Weeks	SAVE	Life (yrs)	Cost ($)
All	Actual	5[529]	Actual	Actual	1%/2 psi[530]	10[531]	Table 25
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[532]	100%[533]	Table 29[534]	Table 29[534]	52%[535]	1.6%[536]

[529] Compressed air systems generally range in operating pressure from 105 psi to 115 psi and since most compressed air end uses do not require pressure higher than 100psi, 5psi is a conservative maximum pressure drop available to systems lacking in storage capacity based on achieved results from previous Efficiency Maine projects.
[530] Rule of thumb from Paul Shaw at Scales Industrial Technologies and the instructor of the Compressed Air Challenge course: 1% demand reduction for every 2 psi system pressure reduction.
[531] 2012 Technical Reference User Manual, Efficiency Vermont, 12/19/12, page 193.
[532] Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.
[533] RR_D used to adjust Summer and Winter CF to account for BIP program evalution findings as presented in Appendix D.
[534] See Appendix C.
[535] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[536] Ibid.

Table 25 – Measure Cost for Compressed Air Receivers[537]

Measure Code	Added Capacity (Gallons)	Cost ($)
C20	60	$360 [A]
C21	80	$630
C22	120	$1,058
C23	200	$1,418
C24	240	$1,463
C25	400	$2,195
N/A	500	$3,360
C26	660	$5,327
C27	1060	$7,492

[A] Cost data projected based on correlation between cost and HP for other size levels.

[537] Cost data provided by Greg Scott, Trask-Decrow Machinery.

Prescriptive Compressed Air: Low Pressure Drop Filters, Codes C30–C33							
Last Revised Date	7/1/2013						
MEASURE OVERVIEW							
Description	This measure involves the purchase and installation of low pressure drop (LPD) filters in compressed air systems to remove oil particulates or other contaminates from the compressed air at the front end of the distribution system. The reduction in pressure drop across these filters translates directly to an allowable reduction in the output pressure set point of the compressor.						
Primary Energy Impact	Electric						
Sector	Commercial/Industrial						
Program(s)	C&I Prescriptive Program						
End-Use	Compressed air						
Project Type	New construction, Retrofit						
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)							
Demand Savings	$\Delta kW = HP_{COMPRESSOR} \times 0.746 \times \Delta psi / 2 \times SAVE$						
Annual Energy Savings	$\Delta kWh/yr = HP_{COMPRESSOR} \times 0.746 \times \Delta psi / 2 \times SAVE \times HoursWk \times Weeks$						
Definitions	Unit = 1 low pressure drop filter $HP_{COMPRESSOR}$ = Compressor horsepower (hp) Δpsi = Calculated system pressure reduction per LDP filter (psi) SAVE = Average percentage demand reduction per pressure drop (%/psi) HoursWk = Total compressed air system operating hours per week (hrs/week) Weeks = Total compressed air system operating weeks per year (week/yr) 0.746 = Conversion: 0.746 kW per hp						
EFFICIENCY ASSUMPTIONS							
Baseline Efficiency	Compressed air system with standard filters (that result in a large drop in pressure as air passes through filter).						
Efficient Measure	Compressed air system with low-pressure drop filters.						
PARAMETER VALUES							
Measure/Type	$HP_{COMPRESSR}$	Δpsi	SAVE	Hours/Week	Weeks	Life (yrs)	Cost ($)
All	Actual	2[538]	1%/2 psi[539]	Actual	Actual	4[540]	$4.60/HP[541]
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[542]	100%[543]	Table 29[544]	Table 29[544]	52%[545]	1.6%[546]

[538] Based on information derived from the Compressed Air Challenge and confirmed with Trask-Decrow Machinery.
[539] Rule of thumb from Paul Shaw at Scales Industrial Technologies and the instructor of the Compressed Air Challenge course: 1% demand reduction for every 2 psi system pressure reduction.
[540] Rhode Island Technical Reference, 2012 Program Year. EMT uses the average of measure life for retrofit (3 years) and for new construction (5 years).
[541] Based historical measure cost data for EMT projects, provided by Greg Scott, Trask-Decrow Machinery.
[542] Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.
[543] RR_D used to adjust Summer and Winter CF to account for BIP program evalution findings as presented in Appendix D.
[544] See Appendix C.
[545] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[546] Ibid.

Prescriptive Compressed Air: Air-Entraining Nozzles, Code C40							
Last Revised Date	7/1/2017						
MEASURE OVERVIEW							
Description	This measure involves the purchase and installation of air-entraining nozzles to reduce the consumption of compressed air by "blow-off" nozzles, while maintaining performance by inducing the flow of air surrounding the nozzle.						
Primary Energy Impact	Electric						
Sector	Commercial/Industrial						
Program(s)	C&I Prescriptive Program						
End-Use	Compressed air						
Project Type	New construction, Retrofit						
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)							
Demand Savings	$\Delta kW = \Delta kW_{NOZZLE} \times \%Use$						
Annual Energy Savings	$\Delta kWh/yr = \Delta kW_{NOZZLE} \times \%Use \times HoursWk \times Weeks$						
Definitions	Unit = 1 nozzle ΔkW_{NOZZLE} = Average demand savings per nozzle (kW) HoursWk = Weekly hours of operation (hrs/week) Weeks = Weeks per year of operation (weeks/yr) % Use = % of compressor operating hours when nozzle is in use (%)						
EFFICIENCY ASSUMPTIONS							
Baseline Efficiency	Compressed air system with standard nozzles (without air-entraining design).						
Efficient Measure	Compressed air system with air-entraining nozzles.						
PARAMETER VALUES							
Measure/Type	ΔkW_{NOZZLE}	Hours/Week	Weeks	%Use	Life (yrs)	Cost ($)	
All	Table 26	Actual	Actual	5%[547]	10[548]	14[549]	
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[550]	100%[551]	Table 29[552]	Table 29[552]	52%[553]	1.6%[554]

[547] Assume 5% based on an average of 3 seconds per minute. Assumes 50% handheld air guns and 50% stationary air nozzles. Manual air guns tend to be used less than stationary air nozzles, and a conservative estimate of 1 second of blow-off per minute of compressor runtime is assumed. Stationary air nozzles are commonly more wasteful, as they are often mounted on machine tools and can be manually operated, resulting in the possibility of a long-term open blow situation. An assumption of 5 seconds of blow-off per minute of compressor runtime is used. From 2012 Technical Reference User Manual, Efficiency Vermont, 12/19/12, page 184.
[548] 2012 Technical Reference User Manual, Efficiency Vermont, 12/19/12, page 186.
[549] 2010 Ohio Technical Reference Manual, Vermont Energy Investment Corp, August 6, 2010, pages 226–227.
[550] Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.
[551] RR_D used to adjust Summer and Winter CF to account for BIP program evalution findings as presented in Appendix D.
[552] See Appendix C.
[553] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[554] Ibid.

Table 26 – Stipulated Savings for Standard Nozzle vs. Air-Entraining Nozzle CFM

Size	Standard Nozzle CFM[A]	Air-Entraining Nozzle CFM[B]	ΔkW/CFM[B]	ΔkW_{NOZZLE}[C]
1/8"	21	6	0.19	2.85
1/4"	58	11	0.15	7.05

[A] Machinery's Handbook, 25th Ed. Ed by Erik Oberg (Et Al). Industrial Press, Inc. ISBN-10: 0831125756

[B] 2010 Ohio Technical Reference Manual, Vermont Energy Investment Corp, August 6, 2010 Pg 226-227.

[C] $\Delta kW_{NOZZLE} = (Flow_{Standard} - Flow_{AE}) \times \Delta kW/CFM$

Thermal Envelope

Multifamily Attic/Roof/Ceiling Insulation (MIA)	
Last Revised Date	8/1/2017 (new measure)
MEASURE OVERVIEW	
Description	This measure involves the insulation of the attic floor to decrease heating and cooling losses. The attic floor must also be air-sealed prior to insulation application. The total savings below reflect savings due to the added insulation and improved air sealing.
Energy Impacts	Natural Gas
Sector	Residential/Commercial
Program(s)	Low Income
End-Use	Heating, Cooling
Decision Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	If mechanical cooling equipment is present $\Delta kW_{SP} = \Delta kWh \times LSF_{SP}$
Annual Energy savings	$\Delta MMBtu_{NG} = \Delta MMBtu_{HEAT} / EFF$ If mechanical cooling equipment is present $\Delta kWh = \Delta MMBtu_{COOL} / EER \times 1000$ $\Delta MMBtu_{HEAT} = HDD \times 24 \times [SQFT \times (1/RVAL_{PRE} + 1/RVAL_{POST}) + \Delta CFM50 \times 14.8 \times 0.018 \times 60]/1{,}000{,}000$ $\Delta MMBtu_{COOL} = CDD \times 24 \times [SQFT \times (1/RVAL_{PRE} + 1/RVAL_{POST}) + \Delta CFM50 \times 14.8 \times 0.018 \times 60]/1{,}000{,}000$
Definitions	Unit = Attic/roof insulation project $\Delta MMBtu_{HEAT}$ = Reduction in annual heat loss due to improved insulation and associated air sealing $\Delta MMBtu_{COOL}$ = Reduction in annual heat gain due to improved insulation and associated air sealing EFF = Efficiency factor of heating system (Btu/Btu) EER = Energy-efficiency ratio of cooling system (Btu/Wh) 1000 = Conversion factor (kW/MW) HDD = Heating Degree Days (°F-days) CDD = Cooling Degree Days (°F-days) 24 =Conversion factor (hours/day) SQFT = Area of attic insulation (ft^2) assumed in temperature bin analysis $RVAL_{PRE}$ = Pre-upgrade attic R-value (ft^2-°F-hr/Btu) assumed in temperature bin analysis $RVAL_{POST}$ = Post-upgrade attic R-value (ft^2-°F-hr/Btu) assumed in temperature bin analysis $\Delta CFM50$ = Change in air infiltration measured at 50 Pascals (ft^3/minute) 14.8 = LBNL Conversion factor ($CFM50/CFM_{natural}$) 0.018 = Heatloss from air infiltration ($Btu/CFM_{natural}$ /°F) 60 = Conversion factor (minutes/hour) 1,000,000 = Conversion factor (MMBtu/Btu) LSF_{SP} = Summer peak load shape factor (kW/kWh/yr)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The baseline is the existing (pre-upgrade) insulation
Efficient Measure	The high-efficiency case is the upgraded insulation

Multifamily Attic/Roof/Ceiling Insulation (MIA)						
PARAMETER VALUES (DEEMED)						
Measure	EFF[555]	EER[556]	HDD[557]	CDD[558]	Life (yrs)[559]	Cost ($)[560]
Attic/Roof Insulation	Actual or 80.5	Actual or 9.8	9350	229	25	2,654/[1000 ft^2]
Measure	SQFT[561]	$RVAL_{PRE}$[562]	$RVAL_{POST}$[563]	ΔCFM50[564]		LSF_{SP}[565]
Attic/Roof Insulation	Actual	Actual	Actual	Actual or 392/[1000 ft^2]		0.00176

IMPACT FACTORS							
Program	ISR[566]	RR_E[567]	RR_D[567]	CF_S[568]	CF_W[568]	FR[569]	SO[570]
Low Income Initiatives	100%	100%	100%	100%	100%	0%	0%

[555] If actual heating system efficiency is unknown use stated value. Stated value is for a representative heating system efficiency based on NMR Group, Maine Single-Family Residential Baseline Study, September 14, 2015.
[556] If actual cooling equipment efficiency is unknown use stated value. Stated value is set to the federal standard of 9.8 according to DOE Federal Test Procedure 10 CFR 430, Appendix F: http://buildingsdatabook.eere.energy.gov/TableView.aspx?table=7.5.1. The code was effective for products manufactured on or after October 1, 2000. Since the measure life for room air-conditioners is about 9 years, most units will meet this standard.
[557] Heating Degree Days based on weighted temperature bin analysis using TMY3 temperature bins for Portland (71.2%), Bangor (23.4%) and Caribou (5.4%) with an indoor heating design temperature of 70°. A higher indoor heating design temperature was selected for attic insulation to account for temperature stratification within the building.
[558] Cooling Degree Days based on weighted temperature bin analysis using TMY3 temperature bins for Portland (71.2%), Bangor (23.4%) and Caribou (5.4%) with an indoor cooling design temperature of 70°.
[559] GDS Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures, Prepared for the New England State Program Working Group, June 2007; Table 1.
[560] Average cost of sampled 2016 projects where attic insulation was itemized separately on contractor invoice (N=58).
[561] Actual square footage of insulation installed. This value should exclude area not insulated due to structures and framing.
[562] Actual R-value for existing attic floor construction including insulation, sheathing and other construction materials
[563] Actual resulting R-value from insulation installation including insulation, sheathing and other construction materials
[564] If blower door test results are not available use stated ΔCFM50 value per 1000 square feet insulated. Stated value is based on FY16 project blower-door tests for projects consisting of only air sealing and attic insulation minus the average CFM50 reduction of air sealing only projects.
[565] Based on temperature bin analysis of ductless heat pump seasonal cooling using TMY3 temperature bins
[566] EMT assumes insulation is fully installed (i.e. ISR = 100%).
[567] The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100 percent realization rate.
[568] Peak coincidence factors for this measure are embedded in the evaluated peak demand impacts.
[569] Program assumes no free ridership for Low Income Initiatives
[570] Program not yet evaluated, assume default SO of 0%.

Multifamily Wall Insulation (MIW)	
Last Revised Date	8/1/2017 (new measure)
MEASURE OVERVIEW	
Description	This measure involves the insulation of wall cavaties to decrease heating and cooling losses. The walls must also be air-sealed prior to insulation application. The total savings below reflect savings due to the added insulation and improved air sealing.
Energy Impacts	Natural Gas
Sector	Residential/Commercial
Program(s)	Low Income
End-Use	Heating, Cooling
Decision Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	If mechanical cooling equipment is present $\Delta kW_{SP} = \Delta kWh \times LSF_{SP}$
Annual Energy savings	$\Delta MMBtu_{NG} = \Delta MMBtu_{HEAT} / EFF$ If mechanical cooling equipment is present $\Delta kWh = \Delta MMBtu_{COOL} / EER \times 1000$ $\Delta MMBtu_{HEAT} = HDD \times 24 \times [SQFT \times (1/RVAL_{PRE} + 1/ RVAL_{POST}) + \Delta CFM50 \times 14.8 \times 0.018 \times 60]/1{,}000{,}000$ $\Delta MMBtu_{COOL} = CDD \times 24 \times [SQFT \times (1/RVAL_{PRE} + 1/ RVAL_{POST}) + \Delta CFM50 \times 14.8 \times 0.018 \times 60] /1{,}000{,}000$
Definitions	Unit = Attic/roof insulation project $\Delta MMBtu_{HEAT}$ = Reduction in annual heat loss due to improved insulation and associated air sealing $\Delta MMBtu_{COOL}$ = Reduction in annual heat gain due to improved insulation and associated air sealing EFF = Efficiency factor of heating system (Btu/Btu) EER = Energy-efficiency ratio of cooling system (Btu/Wh) 1000 = Conversion factor (kW/MW) HDD = Heating Degree Days (°F·days) CDD = Cooling Degree Days (°F-days) 24 =Conversion factor (hours/day) SQFT = Area of attic insulation (ft^2) assumed in temperature bin analysis $RVAL_{PRE}$ = Pre-upgrade attic R-value (ft^2-°F-hr/Btu) assumed in temperature bin analysis $RVAL_{POST}$ = Post-upgrade attic R-value (ft^2-°F-hr/Btu) assumed in temperature bin analysis $\Delta CFM50$ = Change in air infiltration measured at 50 Pascals (ft^3/minute) 14.8 = LBNL Conversion factor ($CFM50/CFM_{natural}$) 0.018 = Heatloss from air infiltration ($Btu/CFM_{natural}$ /°F) 60 = Conversion factor (minutes/hour) 1,000,000 = Conversion factor (MMBtu/Btu) LSF_{SP} = Summer peak load shape factor (kW/kWh/yr)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The baseline is the existing (pre-upgrade) insulation
Efficient Measure	The high-efficiency case is the upgraded insulation

Multifamily Wall Insulation (MIW)

PARAMETER VALUES (DEEMED)

Measure	EFF[571]	EER[572]	HDD[573]	CDD[574]	Life (yrs)[575]	Cost ($)[576]
Attic/Roof Insulation	Actual or 80.5	Actual or 9.8	7777	229	25	2,382/[1000 ft^2]
Measure	SQFT[577]	$RVAL_{PRE}$[578]	$RVAL_{POST}$[579]	ΔCFM50[580]		LSF_{SP}[581]
Attic/Roof Insulation	Actual	Actual	Actual	Actual or 710/[1000 ft^2]		0.00176

IMPACT FACTORS

Program	ISR[582]	RR_E[583]	RR_D[567]	CF_S[584]	CF_W[568]	FR[585]	SO[586]
Low Income Initiatives	100%	100%	100%	100%	100%	0%	0%

[571] If actual heating system efficiency is unknown use stated value. Stated value is for a representative heating system efficiency based on NMR Group, Maine Single-Family Residential Baseline Study, September 14, 2015.

[572] If actual cooling equipment efficiency is unknown use stated value. Stated value is set to the federal standard of 9.8 according to DOE Federal Test Procedure 10 CFR 430, Appendix F: http://buildingsdatabook.eere.energy.gov/TableView.aspx?table=7.5.1. The code was effective for products manufactured on or after October 1, 2000. Since the measure life for room air-conditioners is about 9 years, most units will meet this standard.

[573] Heating Degree Days based on weighted temperature bin analysis using TMY3 temperature bins for Portland (71.2%), Bangor (23.4%) and Caribou (5.4%) with an indoor heating design temperature of 65°.

[574] Cooling Degree Days based on weighted temperature bin analysis using TMY3 temperature bins for Portland (71.2%), Bangor (23.4%) and Caribou (5.4%) with an indoor cooling design temperature of 70°.

[575] GDS Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures, Prepared for the New England State Program Working Group, June 2007; Table 1.

[576] Average cost of sampled 2016 projects where wall insulation was itemized separately on contractor invoice (N=42).

[577] Actual square footage of insulation installed. This value should exclude area not insulated due to structures and framing.

[578] Actual R-value for existing attic floor construction including insulation, sheathing and other construction materials

[579] Actual resulting R-value from insulation installation including insulation, sheathing and other construction materials

[580] If blower door test results are not available use stated ΔCFM50 value per 1000 square feet insulated. Stated value is based on FY16 project blower-door tests for projects consisting of only air sealing and attic insulation minus the average CFM50 reduction of air sealing only projects.

[581] Based on temperature bin analysis of ductless heat pump seasonal cooling using TMY3 temperature bins

[582] EMT assumes insulation is fully installed (i.e. ISR = 100%).

[583] The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100 percent realization rate.

[584] Peak coincidence factors for this measure are embedded in the evaluated peak demand impacts.

[585] Program assumes no free ridership for Low Income Initiatives

[586] Program not yet evaluated, assume default SO of 0%.

Multifamily Basement Insulation (MIB)	
Last Revised Date	8/1/2017 (new measure)
MEASURE OVERVIEW	
Description	This measure involves the insulation of the rim joist and the basement wall (at least 2 feet below grade) with 1” spray foam to decrease heating losses. The rim joist must also be air-sealed prior to insulation application. The total savings below reflect savings due to the added insulation and improved air sealing.
Energy Impacts	Natural Gas
Sector	Residential/Commercial
Program(s)	Low Income
End-Use	Heating, Cooling
Decision Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	If mechanical cooling equipment is present $\Delta kW_{SP} = \Delta kWh \times LSF_{SP}$
Annual Energy savings	$\Delta MMBtu_{NG} = \Delta MMBtu_{HEAT} / EFF$ If mechanical cooling equipment is present $\Delta kWh = \Delta MMBtu_{COOL} / EER \times 1000$ $\Delta MMBtu_{HEAT} = HDD \times 24 \times [SQFT \times (1/RVAL_{PRE} + 1/ RVAL_{POST}) + \Delta CFM50 \times 14.8 \times 0.018 \times 60]/1{,}000{,}000$ $\Delta MMBtu_{COOL} = CDD \times 24 \times [SQFT \times (1/RVAL_{PRE} + 1/ RVAL_{POST}) + \Delta CFM50 \times 14.8 \times 0.018 \times 60] /1{,}000{,}000$
Definitions	Unit = Attic/roof insulation project $\Delta MMBtu_{HEAT}$ = Reduction in annual heat loss due to improved insulation and associated air sealing $\Delta MMBtu_{COOL}$ = Reduction in annual heat gain due to improved insulation and associated air sealing EFF = Efficiency factor of heating system (Btu/Btu) EER = Energy-efficiency ratio of cooling system (Btu/Wh) 1000 = Conversion factor (kW/MW) HDD = Heating Degree Days (°F·days) CDD = Cooling Degree Days (°F-days) 24 =Conversion factor (hours/day) SQFT = Area of attic insulation (ft^2) assumed in temperature bin analysis $RVAL_{PRE}$ = Pre-upgrade attic R-value (ft^2-°F-hr/Btu) assumed in temperature bin analysis $RVAL_{POST}$ = Post-upgrade attic R-value (ft^2-°F-hr/Btu) assumed in temperature bin analysis $\Delta CFM50$ = Change in air infiltration measured at 50 Pascals (ft^3/minute) 14.8 = LBNL Conversion factor ($CFM50/CFM_{natural}$) 0.018 = Heatloss from air infiltration ($Btu/CFM_{natural}$ /°F) 60 = Conversion factor (minutes/hour) 1,000,000 = Conversion factor (MMBtu/Btu) LSF_{SP} = Summer peak load shape factor (kW/kWh/yr)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The baseline is the existing (pre-upgrade) insulation
Efficient Measure	The high-efficiency case is the upgraded insulation

Multifamily Basement Insulation (MIB)

PARAMETER VALUES (DEEMED)

Measure	EFF[587]	EER[588]	HDD[589]	CDD[590]	Life (yrs)[591]	Cost ($)[592]
Attic/Roof Insulation	Actual or 80.5	Actual or 9.8	3954	0	25	1,167/[1000 ft^2]
Measure	SQFT[593]	$RVAL_{PRE}$[594]	$RVAL_{POST}$[595]	ΔCFM50[596]		LSF_{SP}[597]
Attic/Roof Insulation	Actual	Actual	Actual	Actual or 259/[1000 ft^2]		0.00176

IMPACT FACTORS

Program	ISR[598]	RR_E[599]	RR_D[567]	CF_S[600]	CF_W[568]	FR[601]	SO[602]
Low Income Initiatives	100%	100%	100%	100%	100%	0%	0%

[587] If actual heating system efficiency is unknown use stated value. Stated value is for a representative heating system efficiency based on NMR Group, Maine Single-Family Residential Baseline Study, September 14, 2015.

[588] If actual cooling equipment efficiency is unknown use stated value. Stated value is set to the federal standard of 9.8 according to DOE Federal Test Procedure 10 CFR 430, Appendix F: http://buildingsdatabook.eere.energy.gov/TableView.aspx?table=7.5.1. The code was effective for products manufactured on or after October 1, 2000. Since the measure life for room air-conditioners is about 9 years, most units will meet this standard.

[589] Heating Degree Days based on weighted temperature bin analysis using TMY3 temperature bins for Portland (71.2%), Bangor (23.4%) and Caribou (5.4%) with an indoor heating design temperature of 50°. A lower indoor design temperature was selected for basement insulation to account for temperature stratification within the building and assumes an unheated basement.

[590] It is assumed that the basement is not air conditioned and heat gain through the basement wall does not contribute to the cooling load of the building.

[591] GDS Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures, Prepared for the New England State Program Working Group, June 2007; Table 1.

[592] Average cost of sampled 2016 projects where basement insulation was itemized separately on contractor invoice (N=42).

[593] Actual square footage of insulation installed. This value should exclude area not insulated due to structures and framing.

[594] Actual R-value for existing attic floor construction including insulation, concrete and other construction materials

[595] Actual resulting R-value from insulation installation including insulation, concrete and other construction materials

[596] If blower door test results are not available use stated ΔCFM50 value per 1000 square feet insulated. Stated value is based on FY16 project blower-door tests for projects consisting of only air sealing and attic insulation minus the average CFM50 reduction of air sealing only projects.

[597] Based on temperature bin analysis of ductless heat pump seasonal cooling using TMY3 temperature bins

[598] EMT assumes insulation is fully installed (i.e. ISR = 100%).

[599] The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100 percent realization rate.

[600] Peak coincidence factors for this measure are embedded in the evaluated peak demand impacts.

[601] Program assumes no free ridership for Low Income Initiatives

[602] Program not yet evaluated, assume default SO of 0%.

Commercial Laundry Equipment

Multifamily Common Area Clothes Washer (MCW)	
Last Revised Date	8/1/2017 (new measure)
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of a new ENERGY STAR®-certified clothes washer in place of an existing top load clothes washer. The associated water heater and clothes dryer must be natural gas.
Energy Impacts	Natural Gas
Sector	Residential/Commercial
Program(s)	Low Income
End-Use	Process
Decision Type	Retrofit
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand savings	$\Delta kW = 0.108$ $\Delta kW_{SP} = 0.005$ $\Delta kW_{WP} = 0.007$
Annual energy savings	$\Delta kWh/yr = 105$ $\Delta MMBtu_{GAS}/yr = 6.624$
Annual water savings	$\Delta Gallons/yr = 17{,}320$
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	$kW = \Delta kWh/yr / Loads$[603]
Annual Energy savings	$\Delta kWh/yr = CAP_{EE} \times Loads \times [(1/IMEF_{BASE}) \times \%E_{MACHINE\_B} - (1/IMEF_{EE}) \times \%E_{MACHINE\_EE}]$ $\Delta MMBtu_{GAS}/yr = CAP_{EE} \times Loads \times [(1/IMEF_{BASE}) \times (\%E_{DHW\_B} + \%E_{DRYER\_B} \times \%Dried) - (1/IMEF_{EE}) \times (\%E_{DHW\_EE} + \%E_{DRYER\_EE} \times \%Dried)] \times 0.003412 / Eff_{GAS}$
Annual water savings	$\Delta Gallons/yr = CAP_{EE} \times (IWF_{BASE} - IWF_{EE}) \times Loads$
Definitions	Unit = 1 clothes washer CAP_{EE} = Rated capacity of the installed clothes washer (ft^3) Loads = Washer loads per year (cycles/yr) $IMEF_{BASE}$ = Rated Integrated Modified Energy Factor for baseline model (ft^3/kWh/cycle) $IMEF_{EE}$ = Rated Integrated Modified Energy Factor for ENERGY STAR® model (ft^3/kWh/cycle) $\%E_{MACHINE\_B}$ = Percentage of baseline clothes washer system energy used for washer machine $\%E_{MACHINE\_EE}$ = Percentage of ENERGY STAR® clothes washer system energy used for washer machine $\%E_{DHW\_B}$ = Percentage of baseline clothes washer system energy used for water heating $\%E_{DHW\_EE}$ = Percentage of ENERGY STAR® clothes washer system energy used for water heating $\%E_{DRYER\_B}$ = Percentage of baseline clothes washer system energy used for the clothes dryer $\%E_{DRYER\_EE}$ = Percentage of ENERGY STAR® clothes washer system energy used for the clothes dryer %Dried = Percentage of washed loads that are dried in dryer (%) Eff_{GAS} = Efficiency of existing gas-fired water heaters (%) IWF_{BASE} = Rated integrated water factor for the baseline clothes washer (gallons/cycle/ft^3) IWF_{EE} = Rated integrated water factor for the ENERGY STAR® clothes washer (gallons/cycle/ft^3) 0.003412 = Conversion factor: 0.003412 MMBtu per kWh
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The baseline is a standard top loading clothes washer. The current federal standard requires a minimum IMEF of 1.29 and IWF of 8.4 for top loading machines. These standards are valid for clothes washers manufactured on or after March 7, 2015. New standards become effective January 1, 2018.
Efficient Measure	ENERGY STAR®-certified front loading clothes washer.

[603] Demand savings algorithm assumes that the average load time is one hour.

Multifamily Common Area Clothes Washer (MCW)

PARAMETER VALUES (DEEMED)

Measure	CAP_{EE}[604]	Loads[605]	$IMEF_{BASE}$[606]	$IMEF_{EE}$[607]	Life (yrs)[608]	Cost ($)
ENERGY STAR® CW	3.81	967.2	1.29	2.38	11	Actual
	$\%E_{MACHINE\_B}$[609]	$\%E_{MACHINE\_EE}$[610]	$\%E_{DRYER\_B}$[611]	$\%E_{DRYER\_EE}$[612]	$\%E_{DHW\_B}$[613]	$\%E_{DHW\_EE}$[614]
	8%	8%	61%	69%	31%	23%
	Eff_{GAS}[615]	%Dried[616]	IWF_{BASE}[617]	IWF_{EE}[618]		
	Actual or 62%	100%	8.4	3.7		

IMPACT FACTORS

Program	ISR[619]	RR_E[620]	RR_D[621]	CF_S[622]	CF_W[623]	FR[624]	SO[625]
Low Income Initiatives	100%	100%	100%	4.8%%	6.3%	0%	0%

[604] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, Table 2-13.
[605] Assumed to be 3 times the average number of loads for a single family home with one clothes washer provided for every three apartments
[606] Federal Standard for Top Loading units
[607] ENERGYSTAR®criteria for Front Loading units
[608] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, Table 2-18.
[609] Illinois Statewide TRM Effective 06/01/15.
[610] Ibid.
[611] Ibid.
[612] Ibid.
[613] Ibid.
[614] Ibid.
[615] EMT assumes 62 percent efficiency for existing natural gas-fired water heaters based on an autmospheric, storage tank water heater.
[616] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, p. 40: consistent with implicit assumption used in the savings algorithm for clothes washers.
[617] Federal Standard for Top Loading units
[618] ENERGYSTAR®criteria for Front Loading units
[619] EMT assumes all units are installed (i.e. ISR = 100%).
[620] The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100 percent realization rate.
[621] The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100 percent realization rate.
[622] Derived from summer peak demand NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, p. 45
[623] Derived from winter peak demand Memo provided to supplement NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014
[624] Program assumes no free ridership for Low Income Initiatives
[625] Program not yet evaluated, assume default SO of 0%.

Multifamily Common Area Clothes Dryer (MCD)	
Last Revised Date	8/1/2017 (new measure)
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of a new ENERGY STAR®-certified clothes dryer in place of an existing clothes dryer.
Energy Impacts	Natural Gas
Sector	Residential/Commercial
Program(s)	Low Income
End-Use	Process
Decision Type	Retrofit
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand savings	N/A
Annual energy savings	$\Delta MMBtu_{GAS}/yr = 1.212$
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	N/A[626]
Annual Energy savings	$\Delta MMBtu_{GAS}/yr = CAP_{EE} \times Loads \times [(1/CEF_{BASE}) - (1/CEF_{EE})] \times 0.003412$
Definitions	Unit = 1 clothes washer CAP_{EE} = Average capacity of clothes dryer (lb) Loads = Washer loads per year (cycles/yr) CEF_{BASE} = Rated Combined Energy Factor for baseline model (lb/kWh/cycle) CEF_{EE} = Rated Combined Energy Factor for ENERGY STAR® model (lb/kWh/cycle) 0.003412 = Conversion factor: 0.003412 MMBtu per kWh
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The baseline is a standard clothes dryer. The current federal standard requires a minimum CEF of 3.3
Efficient Measure	ENERGY STAR®-certified clothes dryer.

PARAMETER VALUES (DEEMED)

Measure	CAP_{EE}[627]	Loads[628]	CEF_{BASE}[629]	CEF_{EE}[630]	Life (yrs)[631]	Cost ($)
ENERGY STAR® CW	9.21	967.2	3.3	3.8	11	Actual

IMPACT FACTORS

Program	ISR[632]	RR_E[633]	RR_D[634]	CF_S	CF_W	FR[635]	SO[636]
Low Income Initiatives	100%	100%	100%	N/A	N/A	0%	0%

626 All savings are attributed to Natural Gas
627 Average capacity of ENERGYSTAR® certified units as of August 15, 2017
628 Assumed to be 3 times the average number of loads for a single family home with one clothes washer provided for every three apartments
629 Federal Standard for gas units
630 Average combined energy factor for ENERGYSTAR® certified units as of August 15, 2017
631 NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, Table 2-18.
632 EMT assumes all units are installed (i.e. ISR = 100%).
633 The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100 percent realization rate.
634 The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100 percent realization rate.
635 Program assumes no free ridership for Low Income Initiatives
636 Program not yet evaluated, assume default SO of 0%.

Commercial and Industrial Custom Program

Advanced Building, Codes AB – <X>

Last Revised Date	7/1/2017
MEASURE OVERVIEW	
Description	This measures involve the various prescriptive criteria as outlined in Tier 2 of the New Construction Guide published by New Buildings Institute (NBI)
Primary Energy Impact	Electricity & Natural Gas or Propane or Fuel Oil
Sector	Commercial and Industrial
Program(s)	Maine Advanced Building (MAB)
End-Use	New Construction > 100,000ft^2
Project Type	New Construction or complete renovation with a change of use
GROSS ENERGY SAVINGS ALGORITHMS	
Annual Energy Savings	Gross annual thermal energy and demand savings projections for Advanced Building projects are calculated using engineering analysis and project-specific details pertaining to equipment performance specifications, operating parameters, and load shapes. Calculation of savings for MAB projects are deemed savings based on savings calculated through NBI's New Construction Guide.
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Efficiency criteria for baseline equipment in replacement (replace on burnout, natural replacement) and new construction situations are based on manufacturer's performance specifications and/or independent test data. Baseline efficiency criteria for these projects must meet or exceed any applicable energy codes.
Efficient Measure	Efficiency criteria for the proposed energy-efficient equipment are project specific and must meet the specifications outlined in NBI's New Construction Guide.

PARAMETER VALUES (DEEMED)

Measure	Parameters for Energy and Demand Deemed Savings	Life (yrs)[637]	Cost($)[638]
AB - <X>	All parameters required for energy and demand savings are determined from NBI's New Construction Guide Tier 2 prescriptive criteria	20	Actual

IMPACT FACTORS

Measure	ISR[639]	RR_E[640]	RR_D[641]	CF_S	CF_W	FR	SO
AB - <X>	100%	100%	100%	Custom	Custom	0%	0%

637 Assumed average equivalent measure life of 20 years across all measures in a project.
638 Measure cost should be determined by the project engineer
639 Program has 100% inspection rate, savings reflect as built
640 This program has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
641 Ibid

Custom – C&I Custom Electric Projects, Codes CC<X>, CG<X>, CSS<X>, CSolar	
Last Revised Date	10/1/2017
MEASURE OVERVIEW	
Description	***Small Custom*** Small Custom projects are energy efficiency projects involving complex site-specific applications that require detailed engineering analysis and/or projects with energy conservation measures that are not covered in the prescriptive incentive offerings. Small Custom project incentives are available for retrofit, replace on burnout, or new installation projects that result in cost-effective electric energy savings. Small Custom project incentives are available only for projects where the validated first-year energy savings, as determined by the Efficiency Maine custom review process, exceeds 35,714 kWh. ***Large Custom*** Large Custom projects are generally targeted for the nearly 500 electric customers in the state with average kW demand of over 400 kW.[642] The program offers incentives for large custom energy efficiency that offset customer demand on the grid. Large Custom projects are designed to reduce kWh consumption or distribution system loading during peak summer demand periods from grid-connected businesses. Large Custom project incentives are available only for projects where the validated first-year energy savings, as determined by the Efficiency Maine custom review process, exceeds 714,280 kWh.
Primary Energy Impact	Electric
Sector	Commercial and Industrial
Program(s)	C&I Custom Program
End-Use	See Table 28
Project Type	New construction, Retrofit
GROSS ENERGY SAVINGS ALGORITHMS	
Demand and Annual Energy Savings	Gross annual energy, summer peak demand, and winter peak demand savings projections for custom projects are calculated using engineering analysis and project-specific details pertaining to equipment performance specifications, operating parameters, and load shapes. Calculation of savings for custom projects typically involves one or more of the following methods: whole-building simulation models, weather-based bin analysis, other spreadsheet-based tools, and generally accepted engineering practice. See additional information in Appendix H, under "Determination of coincident peak demand impact."
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	**Retrofit:** Efficiency criteria for the baseline equipment in retrofit situations is based on the operating efficiency of the existing equipment, which is determined from manufacturer's performance specification and/or actual recorded data related to input power and output capacity. **New Construction:** Efficiency criteria for baseline equipment in replacement (replace on burnout, natural replacement) and new construction situations is based on manufacturer's performance specifications and/or independent test data for standard industry practice equipment. Baseline efficiency criteria for these projects must meet or exceed any applicable energy codes.
Efficient Measure	Efficiency criteria for the proposed energy-efficient equipment are project specific and must be supported by manufacturer's performance specifications and/or independent test data.

[642] Although the program targets these larger customers, there is no minimum average demand requirement for participation.

<table>
<tr><th colspan="8">Custom – C&I Custom Electric Projects, Codes CC<X>, CG<X>, CSS<X>, CSolar</th></tr>
<tr><td colspan="8">PARAMETER VALUES</td></tr>
<tr><td>Measure</td><td colspan="5">Parameters for Energy and Demand Savings Calculations</td><td>Life (yrs)[643]</td><td>Cost ($)</td></tr>
<tr><td>All</td><td colspan="5">All parameters required for energy and demand savings are determined from project-specific details documented in the project application forms.</td><td>Table 28</td><td>Actual</td></tr>
<tr><td colspan="8">IMPACT FACTORS</td></tr>
<tr><td>Program</td><td>ISR</td><td>RR_E</td><td>RR_D</td><td>CF_S</td><td>CF_W</td><td>FR</td><td>SO</td></tr>
<tr><td>C&I Custom</td><td>100%</td><td>96.5%[644]</td><td>94.6%[645]</td><td>Custom</td><td>Custom</td><td>8.2%[646]</td><td>0.7%[647]</td></tr>
</table>

[643] Measure life should be determined by the project engineer. The referenced table provides suggested measure life values for various custom projects.
[644] Nexant, Large Customer Program Evaluation, April 7, 2017.
[645] Nexant, Large Customer Program Evaluation, April 7, 2017.
[646] Nexant, Large Customer Program Evaluation, unpublished draft May 2016, page 27.
[647] Ibid.

Custom – C&I Custom Natural Gas Projects, Codes CC<X>, CG<X>, CSS<X>	
Last Revised Date	10/1/2017
MEASURE OVERVIEW	
Description	***Small Custom*** Small Custom thermal projects are energy efficiency projects involving complex site-specific applications that require detailed engineering analysis and/or projects with energy conservation measures that are not covered in the prescriptive incentive offerings. Small Custom project incentives are available for retrofit, replace on burnout, or new installation projects that result in cost-effective thermal energy savings. Small Custom project incentives are available only for projects where the validated first-year energy savings, as determined by the Efficiency Maine custom review process, exceeds 400 MMBtu (4,000 therms). ***Large Custom*** Large Custom thermal projects are energy efficiency projects involving complex site-specific applications that require detailed engineering analysis and/or projects with energy conservation measures that are not covered in the prescriptive incentive offerings. Large Custom project incentives are available for retrofit, replace on burnout, or new installation projects that result in cost-effective thermal energy savings. Large Custom project incentives are available only for projects where the validated first-year energy savings, as determined by the Efficiency Maine custom review process, exceeds 8,000 MMBtu (80,000 therms).
Primary Energy Impact	Natural gas
Sector	Commercial and Industrial
Program(s)	C&I Custom Incentive Program
End-Use	See Table 28
Project Type	New construction, Retrofit
GROSS ENERGY SAVINGS ALGORITHMS	
Annual Energy Savings	Gross annual natural gas savings projections for custom projects are calculated using engineering analysis and project-specific details pertaining to equipment performance specifications, operating parameters, and load shapes. Calculation of savings for custom projects typically involves one or more of the following methods: whole-building simulation models, weather-based bin analysis, other spreadsheet-based tools, and generally accepted engineering practice.
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	**Retrofit:** Efficiency criteria for the baseline equipment in retrofit situations is based on the operating efficiency of the existing equipment, which is determined from manufacturer's performance specification and/or actual recorded data related to input and output capacity. **New Construction:** Efficiency criteria for baseline equipment in replacement (replace on burnout, natural replacement) and new construction situations is based on manufacturer's performance specifications and/or independent test data. Baseline efficiency criteria for these projects must meet or exceed any applicable energy codes.
Efficient Measure	Efficiency criteria for the proposed energy-efficient equipment are project specific and must be supported by manufacturer's performance specifications and/or independent test data.
PARAMETER VALUES	

Measure	Parameters for Energy Savings Calculations	Life (yrs)[648]	Cost ($)

[648] Measure life should be determined by the project engineer. The referenced table provides suggested measure life values for various custom projects.

Custom – C&I Custom Natural Gas Projects, Codes CC<X>, CG<X>, CSS<X>							
All	All parameters required for energy and demand savings are determined from project-specific details documented in the project application forms.					Table 28	Actual
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Custom	100%	96.5%[649]	94.6%[650]	Custom	Custom	8.2%[651]	0.7%[652]

[649] Nexant, Large Customer Program Evaluation, April 7, 2017.
[650] Nexant, Large Customer Program Evaluation, April 7, 2017.
[651] Nexant, Large Customer Program Evaluation, April 7, 2017.
[652] Ibid.

Custom – C&I Custom Thermal Projects, Codes CC<X>, CG<X>, CSS<X>	
Last Revised Date	10/1/2017
MEASURE OVERVIEW	
Description	***Small Custom*** Small Custom thermal projects are energy efficiency projects involving complex site-specific applications that require detailed engineering analysis and/or projects with energy conservation measures that are not covered in the prescriptive incentive offerings. Small Custom project incentives are available for retrofit, replace on burnout, or new installation projects that result in cost-effective thermal energy savings. Small Custom project incentives are available only for projects where the validated first-year energy savings, as determined by the Efficiency Maine custom review process, exceeds 400 MMBtu ***Large Custom*** Large Custom thermal projects are energy efficiency projects involving complex site-specific applications that require detailed engineering analysis and/or projects with energy conservation measures that are not covered in the prescriptive incentive offerings. Large Custom project incentives are available for retrofit, replace on burnout, or new installation projects that result in cost-effective thermal energy savings. Large Custom project incentives are available only for projects where the validated first-year energy savings, as determined by the Efficiency Maine custom review process, exceeds 8,000 MMBtu
Primary Energy Impact	Heating oil, Natural gas, Propane, Kerosene, Biomass, Other
Sector	Commercial and Industrial
Program(s)	C&I Custom Program
End-Use	See Table 28
Project Type	New construction, Retrofit
GROSS ENERGY SAVINGS ALGORITHMS	
Annual Energy Savings	Gross annual thermal energy savings projections for custom projects are calculated using engineering analysis and project-specific details pertaining to equipment performance specifications, operating parameters, and load shapes. Calculation of savings for custom projects typically involves one or more of the following methods: whole-building simulation models, weather-based bin analysis, other spreadsheet-based tools, and generally accepted engineering practice.
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	**Retrofit:** Efficiency criteria for the baseline equipment in retrofit situations is based on the operating efficiency of the existing equipment, which is determined from manufacturer's performance specification and/or actual recorded data related to input power and output capacity. **New Construction:** Efficiency criteria for baseline equipment in replacement (replace on burnout, natural replacement) and new construction situations is based on manufacturer's performance specifications and/or independent test data. Baseline efficiency criteria for these projects must meet or exceed any applicable energy codes.
Efficient Measure	Efficiency criteria for the proposed energy-efficient equipment are project specific and must be supported by manufacturer's performance specifications and/or independent test data.
PARAMETER VALUES	

Custom – C&I Custom Thermal Projects, Codes CC<X>, CG<X>, CSS<X>							
Measure	Parameters for Energy and Demand Savings Calculations					Life (yrs)[653]	Cost ($)
All	All parameters required for energy and demand savings are determined from project-specific details documented in the project application forms.					Table 28	Actual
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Custom	100%	96.5%[654]	94.6%[655]	Custom	Custom	8.2%[656]	0.7%[657]

[653] Measure life should be determined by the project engineer. The referenced table provides suggested measure life values for various custom projects.
[654] Nexant, Large Customer Program Evaluation, April 7, 2017.
[655] Nexant, Large Customer Program Evaluation, April 7, 2017.
[656] Nexant, Large Customer Program Evaluation, unpublished draft May 2016, page 27.
[657] Ibid.

Custom – C&I Custom Distributed Generation Projects, Codes CC<X>, CG<X>, CSS<X>, CSolar

Last Revised Date	10/1/2017
MEASURE OVERVIEW	
Description	***Distributed Generation*** The program offers incentives cost effective custom distributed generation projects that offset customer demand on the grid. Distributed Generation projects are designed to reduce kWh consumption or distribution system loading during peak summer demand periods from grid-connected businesses. Distributed Generation project incentives are available only for projects where the validated first-year energy savings, as determined by the Efficiency Maine custom review process, exceeds 35,714 kWh.
Primary Energy Impact	Electric
Sector	Commercial and Industrial
Program(s)	C&I Custom Program
End-Use	See Table 28
Project Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS	
Demand and Annual Energy Savings	Gross annual energy, summer peak demand, and winter peak demand savings projections for custom projects are calculated using engineering analysis and project-specific details pertaining to equipment performance specifications, operating parameters, and load shapes. Calculation of savings for custom projects typically involves one or more of the following methods: whole-building simulation models, weather-based bin analysis, other spreadsheet-based tools, and generally accepted engineering practice. See additional information in Appendix H, under "Determination of coincident peak demand impact."
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	**Retrofit:** Efficiency criteria for the baseline equipment in retrofit situations is based on the operating efficiency of the existing equipment, which is determined from manufacturer's performance specification and/or actual recorded data related to input power and output capacity.
Efficient Measure	Efficiency criteria for the proposed energy-efficient equipment are project specific and must be supported by manufacturer's performance specifications and/or independent test data.

PARAMETER VALUES

Measure	Parameters for Energy and Demand Savings Calculations	Life (yrs)[658]	Cost ($)
All	All parameters required for energy and demand savings are determined from project-specific details documented in the project application forms.	Table 28	Actual

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Custom	100%	96.5%[659]	94.6%[660]	Custom	Custom	8.2%[661]	0.7%[662]

[658] Measure life should be determined by the project engineer. The referenced table provides suggested measure life values for various custom projects.
[659] Nexant, Large Customer Program Evaluation, April 7, 2017.
[660] Nexant, Large Customer Program Evaluation, April 7, 2017.
[661] Nexant, Large Customer Program Evaluation, unpublished draft May 2016, page 27.
[662] Ibid.

Table 27 – Default Values Representing the Energy Content of Various Fuels

Fuel	Typical Commercial Unit	Energy Content Btu/Unit	Energy Content MMBtu/Unit		Typical Industrial Units	Energy Content MMBTU/Unit	Source	Source Location
Petroleum Products								
Distillate Fuel (No. 1, No. 2, No. 4, Fuel Oil and Diesel)	Gallon	137,452	0.1375		Barrel	5.773	http://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf	Table A3
Jet Fuel	Gallon	127,500	0.1275		Barrel	5.355	http://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf	Table A1
Kerosene	Gallon	135,000	0.1350		Barrel	5.670	http://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf	Table A1
Liquefied Petroleum Gases	Gallon	84,048	0.0840		Barrel	3.530	http://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf	Table A3
Motor Gasoline	Gallon	120,405	0.1204		Barrel	5.057	http://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf	Table A3
Residual Fuel (No. 5 and No. 6 Fuel Oil)	Gallon	149,690	0.1497		Barrel	6.287	http://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf	Table A1
Natural Gas (pipeline)	CCF	103,200	0.1032		Deca-therm	1.000	http://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf	Table A4
Propane	Gallon	91,333	0.0913		Barrel	3.836	http://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf	Table A1
Other Gaseous Fuels[a]								
Methane	CCF	84,100	0.0841		Deca-therm	1.000	http://www.eia.gov/renewable/renewables/trends06.pdf	Table 1.10
Landfill Gas	CCF	49,000	0.0490		Deca-therm	1.000		Table 1.10
Digester Gas	CCF	61,900	0.0619		Deca-therm	1.000		Table 1.10
Wood-Based Fuels[a]								
0% Moisture	Lb.	8,514	0.0085		Short Ton	17.029	Biomass Energy Data Book -- 2001 -- http://cta.ornl.gov.bedb - Entry is the average of hardwood and softwood values. http://cta.ornl.gov/bedb/appendix_a/The_Effect_of_Moisture_on_Heating_Values.pdf	App. A - Page 202
10% Moisture	Lb.	7,663	0.0077		Short Ton	15.326		
30% Moisture	Lb.	5,960	0.0060		Short Ton	11.920		
50% Moisture	Lb.	4,257	0.0043		Short Ton	8.514		

Fuel	Typical Commercial Unit	Energy Content Btu/Unit	Energy Content MMBtu/Unit		Typical Industrial Units	Energy Content MMBTU/Unit	Source	Source Location
Other Fuels								
Ethanol	Gallon	84,262	0.0843		Barrel	3.539	http://www.eia.gov/renewable/renewables/trends06.pdf	Table 1.10
Biodiesel	Gallon	127,595	0.1276		Barrel	5.359	http://www.eia.gov/renewable/renewables/trends06.pdf	Table 1.10
Black Liquor[a]	N/A	N/A	N/A		Short Ton	11.758	http://www.eia.gov/renewable/renewables/trends06.pdf	Table 1.10
Electricity	kWh	3,412	0.0034		MWh	3.412	Definition of a kWh	

[a] The energy content of some fuels can vary depending on various factors, including the actual fuel composition and the tree species and moisture content associated with wood-based fuels.

The entries in the above table represent default values; alternate values may be accepted if sufficient supporting documentation of actual fuel composition, moisture content, etc. is provided.

For fuels not listed in the table, the applicant must provide documentation of fuel composition and energy content per unit of fuel.

Table 28 – Measure Life Reference for Custom Projects[663]

End-Use	Measure Category	New Construction	Retrofit
Custom Lighting	Equipment	15	13
	Controls	10	9
Custom HVAC	Chillers/Chiller Plant	20	N/A
	HVAC Equipment	15	13
	EMS & HVAC Controls	15	10
	Heating System Replacement/Upgrade	25	18
	Heating System Maintenance (e.g,. burner optimization, tune-up)	5	5
Custom Motors and VFDs	Equipment	15	13
Custom Compressed Air	Equipment	15	13
Custom Miscellaneous	Process Cooling or Heating	15	13
	Commercial Compressors	15	13
	Industrial Compressors	20	18
	Controls	10	9
	O&M	N/A	5
	Retro-commissioning	N/A	5
	Envelope	20	20
Custom Solar PV	Solar PV	20	20

663 ERS, Measure Life Study Prepared for the Massachusetts Joint Utilities, November 2005, Table 1-2.

Appendix A: Glossary

Definitions are based primarily on the Northeast Energy Efficiency Partnerships (NEEP), Regional Evaluation, Measurement & Verification (EMV) Forum, Glossary of Terms, Version 2.0 (PAH Associates, March 2011), indicated below as: NEEP EMV Glossary.

Adjusted Gross Savings: The change in energy consumption and/or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated adjusted for evaluation findings. It adjusts for such factors as data errors, installation and persistence rates, and hours of use, but does not adjust for free ridership or spillover. Adjusted Gross Savings can be calculated as an annual or lifetime value. [NEEP EMV Glossary, edited]

Actual: Actual means the project-specific value that is recorded in the Project Application/Documentation for this measure.

Algorithm: An equation or set of equations, more broadly a method, used to calculate a number. In this case, it is an estimate of energy use or energy savings tied to operation of a piece of equipment or a system of interacting pieces of equipment. An algorithm may include certain standard numerical assumptions about some relevant quantities, leaving the user to supply other data to calculate the use or savings for the particular measure or equipment. [NEEP EMV Glossary]

Annual Demand Savings: The maximum reduction in electric demand in a given year within defined boundaries. The demand reduction is typically the result of the installation of higher efficiency equipment, controls, or behavioral change. The term can be applied at various levels, from individual projects and energy-efficiency programs, to overall program portfolios. [NEEP EMV Glossary, edited]

Annual Energy Savings: The reduction in electricity usage (reported as ΔkWh) or in fossil-fuel use (reported as ΔMMBtu) in a given year from the savings associated with an energy-saving measure, project, or program. [NEEP EMV Glossary, edited]

Average Annual Operating Hours: see Hours of Use.

Baseline Efficiency: The assumed efficiency condition of the baseline equipment that is being replaced by the subject energy-efficiency measure. It is used to determine the energy savings obtained by the more efficient measure. [NEEP EMV Glossary, edited]

Btu: A standard measure of heat energy, one Btu is required to raise the temperature of one pound of water one degree Fahrenheit from 58.5 to 59.5 degrees under standard pressure of 30 inches of mercury at or near its point of maximum density. [NEEP EMV Glossary, edited]

Coincident Demand: The demand of a device, circuit or building that occurs at the same time as the peak demand of a system load or some other peak of interest. The peak of interest should be specified. [NEEP EMV Glossary]

Coincidence Factor (CF): The ratio of the average hourly demand of a group of measures during a specified period of time to the sum of their individual maximum demands (or connected loads) within the same period. [NEEP EMV Glossary, edited]

Deemed Savings: An estimate of energy or demand savings for a single unit of an installed energy-efficiency measure that (a) has been developed from data sources and analytical methods that are widely considered acceptable for the measure and purpose, and (b) is applicable to the situation being evaluated. A measure with deemed savings will have the same savings per unit. Individual parameters used to calculate savings and/or savings calculation methods can also be deemed. [NEEP EMV Glossary, edited]

Delta Watts: The difference in the wattage between existing or baseline equipment and its more efficient replacement or installation at a specific time, expressed in watts or kilowatts. [NEEP EMV Glossary]

Demand: The time rate of energy flow. Demand usually refers to the amount of electric energy used by a customer or piece of equipment at a specific time, expressed in kilowatts (kW). [NEEP EMV Glossary]

Energy Star®: A joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy designed to reduce energy use and its impact on the environment. The ENERGY STAR® label is awarded to products that meet applicable energy-efficiency guidelines as well as to homes and commercial buildings that meet specified energy-efficiency standards. [NEEP EMV Glossary, edited]

Free rider: A program participant who would have implemented the program measure or practice in the absence of the program. A free rider can be: 1) total, in which the participant's activity would have completely replicated the program measure; 2) partial, in which the participant's activity would have partially replicated the program measure; or 3) deferred, in which the participant's activity would have completely replicated the program measure, but at a future time beyond the program's timeframe. [NEEP EMV Glossary, edited]

Free ridership Rate (FR): The percent of energy savings through an energy-efficiency program attributable to free riders. [NEEP EMV Glossary, edited]

Gross Savings: The change in energy consumption and/or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated and not adjusted for any factors. [NEEP EMV Glossary, edited]

Hours of Use (HOU) or Operating Hours: The average number of hours a measure is in use during a specified time period, typically a day or a year. [NEEP EMV Glossary]

Incremental Cost: The difference between the cost of existing or baseline equipment/service and the cost of energy-efficient equipment/service. [NEEP EMV Glossary]

In-Service Rate (ISR): The percentage of energy-efficiency measures adopted in response to program incentives that are actually installed and operating. The in-service rate is calculated by dividing the number of measures installed and operating by the number of incetnives offered by an efficiency program in a defined period of time. [NEEP EMV Glossary, edited]

Interactive Effects (IE) - The influence of one technology's application on the energy required to operate another application. An example is the reduced heat in a facility as a result of replacing incandescent lights with CFLs, and the resulting need to increase space heating from another source, usually oil or gas fired. [NEEP EMV Glossary]**Kilowatt (kW):** A measure of the rate of power used during a preset time period (e.g., minutes, hours, days or months) equal to 1,000 watts. [NEEP EMV Glossary]

Kilowatt-Hour (kWh): A common unit of electric energy; one kilowatt-hour is numerically equal to 1,000 watts used for one hour. [NEEP EMV Glossary]

Lifetime Energy Savings: The energy savings over the lifetime of an installed measure calculated by multiplying the measure's annual energy usage reduction by its expected lifetime. [NEEP EMV Glossary, edited]

Measure Life: The length of time that a measure is expected to be functional. Measure Life is a function of: (1) *equipment life* – meaning the number of years that a measure is installed and will operate until failure; and (2) *measure persistence* which takes into account business turnover, early retirement of installed equipment, and other reasons that measures might be removed or discontinued. Measure Life is sometimes referred to as expected useful life (EUL) [adapted from NEEP EMV Glossary, edited].

Meter-level Savings: Savings from energy-efficiency programs at the customer meter or premise level. [NEEP EMV Glossary, edited]

Net Present Value (NPV): Present value of benefits and costs that occur over the life of the measure taking the time value of money into account.

Net Savings: The savings that is attributable to an energy-efficiency program(which differs from gross savings because it includes the effects of the free ridership and/or spillover rates).

Net-to-Gross Ratio (NTGR or NTG): The ratio of net savings to gross savings. The NTGR may be determined from the free ridership and spillover rates (NTGR = 1 − FR + SO), if available, or it may be a distinct value relating gross savings to the net effect of the program with no separate specification of FR and SO values; it can be applied separately to either energy or demand savings.

Realization Rate (RR): The ratio of savings adjusted for data errors and for evaluated or verified results (verified) to initial estimates of project savings. RR_E (Energy Realization Rate) is applied to kWh and all fuels, while RR_D (Demand Realization Rate) is applied only to kW.

Seasonal Energy Efficiency Ratio (SEER): The total cooling output of a central AC unit in Btus during its normal usage period for cooling divided by the total electrical energy input in watt-hours during the same period, as determined using specified federal test procedures. [NEEP EMV Glossary]

Spillover (SO): Reductions in energy consumption and/or demand caused by the presence of an energy-efficiency program, beyond the program-related gross savings of the participants and without financial or technical assistance from the program. There can be participant and/or non-participant spillover. Participant spillover is the additional energy savings that occur when a program participant independently installs energy-efficiency measures or applies energy-saving practices in response to their participation in the efficiency program. Non-participant spillover refers to energy savings that occur when someone who did not participate in a program still installs energy-efficiency measures or applies energy savings practices as a result of a program's influence. [NEEP EMV Glossary, edited]

Spillover Rate (SO): Estimate of energy savings attributable to spillover effects expressed as a percent of savings installed by participants through an energy efficiency program. [NEEP EMV Glossary]

Typical Meteorological Year 3: The TMY3s are data sets of hourly values of solar radiation and meteorological elements for a 1-year period published by the National Renewable Energy Laboratory. Their intended use is for computer simulations of solar energy conversion systems and building systems to facilitate performance comparisons of different system types, configurations, and locations in the United States and its territories. Because they represent typical rather than extreme conditions, they are not suited for designing systems to meet the worst-case conditions occurring at a location.

Waste Heat Factor (WHF): The interaction between a lighting measure's incidental heat output and installed HVAC systems.

Appendix B: Energy Period Factors and Coincidence Factors

Coincidence factors are used to determine the average electric demand savings during the summer and winter on-peak periods as defined by the ISO-NE Forward Capacity Market (FCM). The on-peak demand periods are defined as follows: [664]

- **Summer On-Peak**: 1:00 PM to 5:00 PM on non-holiday weekdays in June, July, and August.
- **Winter On-Peak**: 5:00 PM to 7:00 PM on non-holiday weekdays in December and January.

Energy period factors are used to allocate the annual energy savings into one of the four energy periods. This allocation is performed in order to apply the appropriate avoided cost values in the calculation of program benefits. The four energy periods are defined as follows [665]:

- **Winter Peak**: 7:00 AM to 11:00 PM on non-holiday weekdays during October through May (8 months).
- **Winter Off Peak**: 11:00 PM to 7:00 AM on non-holiday weekdays and all hours on weekends and holidays during October through May (8 months).
- **Summer Peak**: 7:00 AM to 11:00 PM on non-holiday weekdays during June through September (4 months).
- **Summer Off Peak**: 11:00 PM to 7:00 AM on non-holiday weekdays and all hours on weekends and holidays during June through September (4 months).

Table 29 includes a listing of measure coincidence factors and energy period allocations.

Table 29 – Commercial Coincidence Factors and Energy Period Factors

		Coincidence Factor			Energy Period Factors				
					Winter		Summer		
Measure	End-Use	Winter On-Peak	Summer On-Peak	Footnote Reference	Peak	Off Peak	Peak	Off Peak	Footnote Reference
Lighting Fixtures – Interior Spaces	Lighting	63.0%	76.0%	666	50.0%	19.0%	23.0%	9.0%	667
Lighting Fixtures – LED Exit Signs	Lighting	100.0%	100.0%	668	30.4%	36.2%	15.6%	17.9%	668
Lighting Fixtures – Exterior Spaces	Lighting	70.2%	3.7%	669	20.5%	50.6%	6.1%	22.8%	669

[664] http://www.iso-ne.com/markets-operations/markets/demand-resources/about
[665] http://www.efficiencymaine.com/docs/2015-AESC-Report-With-Appendices-Attached.pdf, p. 2-71.
[666] KEMA, C&I Lighting Load Shape Project FINAL Report, July 2011.
[667] Central Maine Power, Non-residential load profile for 3/1/08-2/28/09.
[668] Values are based on continuous operation. For energy period factors, values may assume that energy savings are evenly distributed across all hours of the year.
[669] Efficiency Vermont TRM 2012, Commercial Outdoor Lighting.

Measure	End-Use	Coincidence Factor		Footnote Reference	Energy Period Factors				Footnote Reference
					Winter		Summer		
		Winter On-Peak	Summer On-Peak		Peak	Off Peak	Peak	Off Peak	
Lighting Fixtures with Integrated Controls	Lighting	63.0%	76.0%	670	50.0%	19.0%	23.0%	9.0%	667
Lighting Controls – Interior Spaces	Lighting	12.0%	18.0%	671	50.0%	19.0%	23.0%	9.0%	667
Lighting Fixtures – Refrigerated Spaces	Lighting	84.7%	90.8%	672	39.7%	26.7%	19.7%	13.9%	672
Lighting Controls – Refrigerated Spaces	Lighting	30.7%	30.7%	673	30.4%	36.2%	15.6%	17.9%	673
VFDs on Heating Hot Water Pumps & Electronically Commutated Hot Water Smart Pump & Electronically Commutated Supply Fan Motor (heating only)	Motors	73.7%	0.0%	674	53.6%	46.3%	0.0%	0.1%	675
Electronically Commutated Supply Fan Motor (heating only)	Motors	100.0%	0.0%	676	53.6%	46.3%	0.0%	0.1%	677
Electronically Commutated Supply Fan Motor (cooling only)	HVAC	0.0%	100.0%	678	17.0%	3.0%	62.0%	18.0%	679
Electronically Commutated Supply Fan Motor (heating and cooling)	HVAC	100.0%	100.0%	680	39.0%	30.5%	21.6%	8.9%	681
VFDs on Chilled Water Pumps	Motors	0.0%	86.5%	674	30.9%	18.1%	35.9%	15.1%	675
VFDs on Supply Fan	Motors	14.6%	48.7%	674	39.0%	30.5%	21.6%	8.9%	675
VFDs on Return Fan	Motors	21.0%	68.3%	674	39.0%	30.8%	21.4%	8.8%	675
VFDs on Exhaust Fan	Motors	73.7%	35.5%	674	44.4%	22.2%	16.0%	17.4%	675

[670] Coincidence factors for interior lighting fixtures. KEMA, C&I Lighting Load Shape Project FINAL Report, July 2011.
[671] The Cadmus Group, Inc. (2012). Final Report, Small Business Direct Install Program: Pre/Post Occupancy Sensor Study.
[672] Efficiency Vermont TRM 2012, Grocery/Convenience Store Indoor Lighting.
[673] US DOE, "Demonstration Assessment of Light-Emitting Diode (LED) Freezer Case Lighting." Refrigerated cases were metered for 12 days to determine savings from occupancy sensors. Assumes that refrigerated freezers and refrigerated coolers will see the same amount of savings from sensors.
[674] See Appendix D for evaluation adjusted coincidence factors.
[675] Efficiency Vermont TRM 2012. Values used for VFDs on VFD Boiler Feedwater Pumps, 10 HP; VFD Chilled Water Pumps, <10 HP; VFD Supply Fans, <10 HP; VFD Returns Fans, <10 HP; and VFD Exhaust Fans, <10 HP
[676] Coincidence factor embedded in deemed peak demand reduction.
[677] Based on VFDs for Heating Hot Water Pumps
[678] Coincidence factor embedded in deemed peak demand reduction.
[679] Bsaed on Unitary Air Conditioners
[680] Coincidence factor embedded in deemed peak demand reduction.
[681] Based on VFDs on Supply Fan

Measure	End-Use	Coincidence Factor		Footnote Reference	Energy Period Factors				Footnote Reference
					Winter		Summer		
		Winter On-Peak	Summer On-Peak		Peak	Off Peak	Peak	Off Peak	
Unitary Air Conditioners and Split Systems (< 11.25 tons)	HVAC	0.0%	37.2%	682	17.0%	3.0%	62.0%	18.0%	667
Unitary Air Conditioners and Split Systems (≥ 11.25 tons)	HVAC	0.0%	29.0%	682	17.0%	3.0%	62.0%	18.0%	667
Heat Pump Systems (< 11.25 tons)	HVAC	42.0%	35.7%	674	17.0%	3.0%	62.0%	18.0%	667
Heat Pump Systems (≥ 11.25 tons)	HVAC	42.0%	27.8%	674	17.0%	3.0%	62.0%	18.0%	667
Packaged Terminal Air Conditioners and Heat Pumps	HVAC	57.0%	37.2%	682	17.0%	3.0%	62.0%	18.0%	667
Demand Control Ventilation	HVAC	1.5%	77.7%	674	17.0%	3.0%	62.0%	18.0%	667
Ductless Heat Pump	HVAC	63.0%	20.0%	683	58.1%	38.8%	1.7%	1.4%	683
Variable Refrigerant Flow, New Construction	HVAC	42.0%	35.7%	674	17.0%	3.0%	62.0%	18.0%	667
Modulating Burner Controls for Boilers and Heaters (AF1)	HVAC	N/A	N/A	684	N/A	N/A	N/A	N/A	684
Boiler Stack Heat Exchanger (Boiler Economizer) (AF2)	HVAC	N/A	N/A	684	N/A	N/A	N/A	N/A	684
Boiler Reset/Lockout Controls (AF3)	HVAC	N/A	N/A	684	N/A	N/A	N/A	N/A	684
Oxygen Trim for Boilers and Heaters (AF4)	HVAC	N/A	N/A	684	N/A	N/A	N/A	N/A	684
Boiler Turbulator (AF5)	HVAC	N/A	N/A	684	N/A	N/A	N/A	N/A	684
Programmable Thermostat (AF6)	HVAC	N/A	N/A	684	N/A	N/A	N/A	N/A	684
Evaporator Fan Motor Control for Cooler/Freezer, Code R10	Refrigeration	33.8%	41.2%	674	29.1%	39.5%	13.7%	17.7%	685
Door Heater Controls for Cooler/Freezer, Code R20	Refrigeration	73.7%	95.9%	674	47.6%	52.4%	0.0%	0.0%	686

[682] KEMA, NEEP Unitary HVAC AC Load Shape Project Final Report, June 2011.
[683] Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.
[684] Measure applicable to non-electric savings only.
[685] Efficiency Vermont TRM 2012, Evaporator Fan Control.
[686] Efficiency Vermont TRM 2012, Door Heater Control.

Measure	End-Use	Coincidence Factor		Footnote Reference	Energy Period Factors				Footnote Reference
					Winter		Summer		
		Winter On-Peak	Summer On-Peak		Peak	Off Peak	Peak	Off Peak	
Zero Energy Doors for Coolers/Freezers, Code R30, R31	Refrigeration	73.7%	95.9%	674	30.4%	36.2%	15.6%	17.8%	667
H.E. Evaporative Fan Motors, Code R40, R41, R42	Refrigeration	73.7%	95.9%	674	30.4%	36.2%	15.6%	17.8%	667
Floating-Head Pressure Controls, Code R50, R51, R52	Refrigeration	73.7%	0.0%	674	33.3%	37.1%	12.8%	16.8%	687
Discus & Scroll Compressors, Code R60-R63, R70-R74	Refrigeration	50.9%	74.0%	674	33.0%	32.6%	17.0%	17.4%	688
Commercial Reach-in Cooler/Refrigerator and Freezers and Ice Makers, Code R80, R90	Refrigeration	50.9%	74.0%	674	33.0%	32.6%	17.0%	17.4%	689
New Vapor-Tight High Performance T8 Fluorescent Fixtures	Agriculture	63.0%	76.0%	674	50.0%	19.0%	23.0%	9.0%	667
Plate Heat Exchangers for Milk Processing	Agriculture	27.0%	16.1%	690	29.0%	16.4%	31.6%	23.0%	690
Adjustable Speed Drives for Dairy Vacuum Pumps	Agriculture	46.7%	27.5%	674	36.9%	30.1%	18.2%	14.8%	691
Scroll Compressors	Agriculture	67.4%	32.7%	674	43.6%	23.2%	21.7%	11.5%	692
Adjustable Speed Drives on Ventilation Fans, potato storage equipment	Agriculture	73.7%	0.0%	674	43.6%	23.2%	21.7%	11.5%	693
HVLS Fans	Agriculture	67.4%	32.6%	674	43.6%	23.2%	21.7%	11.5%	694
High-Efficiency Air Compressors, Codes C1-C4	Compressed Air	70.0%	91.1%	674	30.4%	36.1%	15.6%	17.9%	668

[687] Efficiency Vermont TRM 2012, Floating-Head Pressure Control.
[688] Efficiency Vermont TRM 2012, Commercial Refrigeration.
[689] Efficiency Vermont TRM 2012, Commercial Refrigeration.
[690] Efficiency Vermont TRM 2012, Farm Plate Cooler/Heat Recover Unit.
[691] Efficiency Vermont TRM 2012, VFD Milk Vacuum Pump.
[692] Efficiency Vermont TRM 2012, Dairy Farm Combined End Uses.
[693] Savings are realized 24/7 Dec 1 – April 30.
[694] Savings are realized 24/7 Dec 1 – April 30.

Measure	End-Use	Coincidence Factor		Footnote Reference	Energy Period Factors				Footnote Reference
					Winter		Summer		
		Winter On-Peak	Summer On-Peak		Peak	Off Peak	Peak	Off Peak	
High-Efficiency Dryers, Codes C10-C16	Compressed Air	70.0%	91.1%	674	30.4%	36.1%	15.6%	17.9%	668
Receivers, Codes C20-C27	Compressed Air	70.0%	91.1%	674	30.4%	36.1%	15.6%	17.9%	668
Low Pressure Drop Filters, Codes C30-C33	Compressed Air	70.0%	91.1%	674	30.4%	36.1%	15.6%	17.9%	668
Air-Entraining Nozzles, Code C40	Compressed Air	70.0%	91.1%	674	30.4%	36.1%	15.6%	17.9%	668
Custom – Compressed Air	Compressed Air	Custom	Custom	695	44.3%	30.3%	15.2%	10.2%	696
Custom - Lighting	Lighting	Custom	Custom	695	44.3%	30.3%	15.2%	10.2%	696
Custom – VFD	Motors	Custom	Custom	695	44.3%	30.3%	15.2%	10.2%	696
Custom – HVAC	HVAC	Custom	Custom	695	44.3%	30.3%	15.2%	10.2%	696
Custom – Miscellaneous	All	Custom	Custom	695	44.3%	30.3%	15.2%	10.2%	696
Custom – Generic	Various	Custom	Custom	695	44.3%	30.3%	15.2%	10.2%	696
Custom– Continuous Process	Process	Custom	Custom	695	29.9%	36.7%	15.5%	17.9%	697
Custom – Single Shift Process	Process	Custom	Custom	695	66.7%	0%	33.3%	0%	698
Custom – Solar PV	Solar PV	0	36.3%	699	37.0%	19.0%	29.7%	14.3%	700
Gas Equipment									
Natural Gas Heating Equipment	HVAC	N/A	N/A	684	N/A	N/A	N/A	N/A	684
Natural Gas Kitchen Equipment	Process	N/A	N/A	684	N/A	N/A	N/A	N/A	684
Other Fuels Equipment									
Oil/Propane Boilers and Furnaces	HVAC	N/A	N/A	684	N/A	N/A	N/A	N/A	684

[695] Coincidence factors for custom projects are estimated for each project based on project-specific information.
[696] Values based on CMP loadshape for "Process C&I."
[697] Analysis performed by ERS. Winter peak % = (16 hours per day x 243 days during winter x 5 weekdays per week / 7 days per week – 10 holidays in winter) / 8,760 hours per year; Winter off-peak % = (243 days during winter x 24 hours per day – Winter peak hours) / 8,760 hours per year; Summer peak % = (16 hours per day 122 days during summer x 5 weekdays per week / 7 days per week – 2 holidays in summer) / 8,760 hours per year; Summer off-peak % = (122 days during summer x 24 hours per day – summer peak hours) / 8,760 hours per year.
[698] Analysis performed by ERS. Assumes shift starts after 7 AM and ends before 11 PM in summer and winter on weekdays only. Winter peak % = 243 days in winter / 365 days per year; Summer peak % = 122 days in summer / 365 days per year.
[699] Analysis performed by ERS. Factors based on TMY3 solar radiation averaged for Portland, Lewiston-Auburn, Bangor and Presque Isle.
[700] Analysis performed by ERS. Factors based on TMY3 solar radiation averaged for Portland, Lewiston-Auburn, Bangor and Presque Isle.

Appendix C: Carbon Dioxide Emission Factors

Table 30 – Emission Factors

Fuel	Emission Factor	Units
Coal by Rank		
Anthracite	103.69	kg CO_2 / MMBtu
Bituminous	93.28	kg CO_2 / MMBtu
Sub-bituminous	97.17	kg CO_2 / MMBtu
Lignite	97.72	kg CO_2 / MMBtu
Natural Gas		
Pipeline Natural Gas	53.06	kg CO_2 / MMBtu
	5.306	kg CO_2 / therm
Flared Natural Gas	54.71	kg CO_2 / MMBtu
	5.471	kg CO_2 / therm
Petroleum Fuels		
Middle Distillate Fuels (No. 1, No. 2, No. 4 fuel oil, diesel, home heating oil)	73.15	kg CO_2 / MMBtu
	10.15	kg CO_2 / gallon
Jet Fuel (Jet A, JP-8)	70.88	kg CO_2 / MMBtu
	9.57	kg CO_2 / gallon
Kerosene	72.31	kg CO_2 / MMBtu
	9.76	kg CO_2 / gallon
Heavy Fuel Oil (No. 5, 6 fuel oil), bunker fuel	78.80	kg CO_2 / MMBtu
	11.80	kg CO_2 / gallon
Ethane	59.59	kg CO_2 / MMBtu
	4.14	kg CO_2 / gallon
Propane	63.07	kg CO_2 / MMBtu
	5.74	kg CO_2 / gallon
Isobutane	65.07	kg CO_2 / MMBtu
	6.45	kg CO_2 / gallon
n-Butane	64.95	kg CO_2 / MMBtu
	6.69	kg CO_2 / gallon
Unspecified LPG	62.28	kg CO_2 / MMBtu
	-	kg CO_2 / gallon
Refinery (Still) Gas	64.20	kg CO_2 / MMBtu
	9.17	kg CO_2 / gallon
Crude Oil	74.54	kg CO_2 / MMBtu
	10.29	kg CO_2 / gallon
Petroleum Coke	102.12	kg CO_2 / MMBtu
	14.65	kg CO_2 / gallon
Other Fuels		
Tires/Tire Derived Fuel	85.97	kg CO_2 / MMBtu
Waste Oil	9.98	kg CO_2 / gallon
Waste Oil Blended with Residual Fuel Oil	66.53	kg CO_2 / MMBtu
Waste Oil Blended with Distillate Fuel Oil	71.28	kg CO_2 / MMBtu
Municipal Solid Waste	417.04	kg CO_2 / short ton
Municipal Solid Waste	41.70	kg CO_2 / MMBtu
Plastics Portion of MSW	2,539.80	kg CO_2 / short ton
Electricity[701]	1.029	Pounds per kWh

[701] From Avoided Energy Supply Cost in New England, 2015, Rick Hornby, et al.

Appendix D: Parameter Values Reference Tables

Table 31 – Installed Measure Wattage and Cost Table ($Watts_{EE}$, $SAVE_{EE}$, $Cost_{EE}$)

Description	Note	Measure Code	C&I Prescriptive[702]					Small Business Direct Install[703]				
			Wattage (Watts_EE)	Wattage Reduction (SAVE_EE)	Installed Cost: High Efficiency	Installed Cost: Baseline	Measure Cost (Cost)	Wattage (Watts_EE)	Wattage Reduction (SAVE_EE)	Material Cost (Standard Tier)	Material Cost (Premium Tier)	Labor Hours
LED Outdoor Replacement Lamp: Type B Low Output (250 - 5000 lm)	[2]	S6	N/A	N/A	N/A	N/A	N/A	22	N/A	$35.00	N/A	0.75
LED Outdoor Replacement Lamp: Type B Mid Output (>5000 - 10000 lm)	[2]	S6	N/A	N/A	N/A	N/A	N/A	44	N/A	$67.50	N/A	0.75
LED Outdoor Replacement Lamp: Type B High Output (>10000 lm)	[2]	S6	N/A	N/A	N/A	N/A	N/A	100	N/A	$161.00	N/A	0.75
LED Outdoor Replacement Lamp: Type C Low Output (250 - 5000 lm)	[2]	S6	N/A	N/A	N/A	N/A	N/A	42	N/A	$123.00	N/A	0.75
LED Outdoor Replacement Lamp: Type C Mid Output (>5000 - 10000 lm)	[2]	S6	N/A	N/A	N/A	N/A	N/A	55	N/A	$150.50	N/A	0.75
LED Outdoor Replacement Lamp: Type C High Output (>10000 lm)	[2]	S6	N/A	N/A	N/A	N/A	N/A	121	N/A	$260.00	N/A	0.75
LED Outdoor Retrofit Kits: <50W		S8	38	N/A	$234.00	$0.00	$234.00	35	N/A	$120.00	N/A	1.5
LED Outdoor Retrofit Kits: ≥50 - <100W		S8	73	N/A	$306.00	$0.00	$306.00	62	N/A	$175.00	N/A	1.5
LED Outdoor Retrofit Kits: ≥100 - <200W		S8	128	N/A	$399.00	$0.00	$399.00	103	N/A	$199.00	N/A	1.5
LED Outdoor Retrofit Kits: ≥200W		S8	241	N/A	$431.00	$0.00	$431.00	237	N/A	$299.00	N/A	1.5
LED Outdoor Parking Fixture: <50W		S11/S11R	40	179	$330.00	$215.00	$115.00	45	170	$93.68	$135.00	1.5
LED Outdoor Parking Fixture: 50W - 100W		S11/S11R	80	215	$685.00	$400.00	$285.00	72	333	$122.00	$335.00	1.5
LED Outdoor Parking Fixture: 100W - 250W		S11/S11R	156	289	$926.30	$565.00	$361.30	100	230	$365.00	$425.00	1.5
LED Outdoor Parking Fixture: >250W		S11/S11R	306	769	$1,023.14	$511.00	$512.14	100	230	$365.00	$425.00	1.5
LED Pole-Mounted Streetlight: <50W		S11/S11R	40	179	$330.00	$215.00	$115.00	45	170	$93.68	$135.00	1.5
LED Pole-Mounted Streetlight: 50W - 100W		S11/S11R	80	215	$685.00	$400.00	$285.00	72	333	$122.00	$335.00	1.5
LED Pole-Mounted Streetlight: 100W-250W		S11/S11R	156	289	$778.00	$565.00	$213.00	100	230	$365.00	$425.00	1.5
LED Pole-Mounted Streetlight: >250W		S11/S11R	306	769	$1,012.00	$511.00	$501.00	100	230	$365.00	$425.00	1.5

702 C&I Prescriptive parameter values are deemed based on analysis of program data. They represent expected weighted averages for each measure type.

703 Small Business Direct Install parameter values reflect specific products included in the program.

Description	Note	Measure Code	C&I Prescriptive[702]					Small Business Direct Install[703]				
			Wattage (Watts_EE)	Wattage Reduction (SAVE_EE)	Installed Cost: High Efficiency	Installed Cost: Baseline	Measure Cost (Cost)	Wattage (Watts_EE)	Wattage Reduction (SAVE_EE)	Material Cost (Standard Tier)	Material Cost (Premium Tier)	Labor Hours
LED Outdoor Wall Pack: <30W		S13/S13R	35	155	$307.21	$130.00	$177.21	15	152	$90.00	$100.00	0.75
LED Outdoor Wall Pack: 30 - 60W		S13/S13R	35	155	$307.21	$130.00	$177.21	39	161	$127.00	$127.00	0.75
LED Outdoor Wall Pack: 60 - 100W		S13/S13R	35	155	$307.21	$130.00	$177.21	69	171	$145.00	$325.00	0.75
LED Outdoor Wall Pack: >100W		S13/S13R	35	155	$307.21	$130.00	$177.21	135	173	$235.00	$450.00	0.75
LED Canopy/Parking Garage Fixture: <50W		S17/S17R	37	91	$313.00	$93.00	$220.00	25	96	$100.00	$122.00	1.5
LED Canopy/Parking Garage Fixture: ≥50 - <80W		S17/S17R	64	126	$309.00	$150.00	$159.00	52	133	$124.00	$286.50	1.5
LED Canopy/Parking Garage Fixture: ≥80 - 130W		S17/S17R	99	189	$421.00	$315.00	$106.00	82	174	$309.00	$310.00	1.5
LED Canopy/Parking Garage Fixture: ≥130W		S17/S17R	174	284	$450.00	$356.00	$94.00	N/A	N/A	N/A	N/A	N/A
LED 12W 5" Recessed Can Retrofit Kit	[1]	S21/S21R	12	N/A	$111.10	$60.00	$51.10	10	N/A	$12.50	N/A	0.18
LED 12W 6-8" Recessed Can Retrofit Kit	[1]	S21/S21R	12	N/A	$111.10	$60.00	$51.10	10	N/A	$13.50	N/A	0.18
LED 15W Surface-Mounted Downlight		S21R	N/A	N/A	N/A	N/A	N/A	16	N/A	$19.99	N/A	0.18
LED Flood/Spot: <50W		S23./S23R	29	99	$238.00	$110.00	$128.00	13	109	$35.00	$45.00	1.5
LED Flood/Spot: 50 - 100W		S23./S23R	72	118	$564.00	$210.00	$354.00	50	101	$175.00	$295.00	1.5
LED Flood/Spot: >100W		S23./S23R	134	154	$696.00	$310.00	$386.00	111	180	$299.00	$497.75	1.5
LED Refrigerated Caselight (Vertical) - 3' Fixture: Center		S30	38	N/A	$175.68	$0.00	$175.68	19	N/A	$55.00	N/A	1
LED Refrigerated Caselight (Vertical) - 3' Fixture: End		S30	38	N/A	$175.68	$0.00	$175.68	19	N/A	$55.00	N/A	1
LED Refrigerated Caselight (Vertical) - 4' Fixture: Center		S30	38	N/A	$175.68	$0.00	$175.68	15	N/A	$62.00	N/A	1
LED Refrigerated Caselight (Vertical) - 4' Fixture: End		S30	38	N/A	$175.68	$0.00	$175.68	7	N/A	$62.00	N/A	1

Description	Note	Measure Code	C&I Prescriptive[702]					Small Business Direct Install[703]				
			Wattage (Watts_EE)	Wattage Reduction (SAVE_EE)	Installed Cost: High Efficiency	Installed Cost: Baseline	Measure Cost (Cost)	Wattage (Watts_EE)	Wattage Reduction (SAVE_EE)	Material Cost (Standard Tier)	Material Cost (Premium Tier)	Labor Hours
LED Refrigerated Caselight (Vertical) - 5' Fixture: Center		S30	38	N/A	$175.68	$0.00	$175.68	20	N/A	$78.00	N/A	1
LED Refrigerated Caselight (Vertical) - 5' Fixture: End		S30	38	N/A	$175.68	$0.00	$175.68	10	N/A	$78.00	N/A	1
LED Refrigerated Caselight (Vertical) - 6' Fixture: Center		S30	38	N/A	$175.68	$0.00	$175.68	22	N/A	$85.99	N/A	1
LED Refrigerated Caselight (Vertical) - 6' Fixture: End		S30	38	N/A	$175.68	$0.00	$175.68	22	N/A	$85.99	N/A	1
LED Refrigerated Caselight (Horizontal) - 3' Fixture		S32	7.2	N/A	$220.00	$0.00	$220.00	19	N/A	$63.00	N/A	1
LED Refrigerated Caselight (Horizontal) - 4' Fixture		S32	9.6	N/A	$220.00	$0.00	$220.00	22	N/A	$68.00	N/A	1
LED Refrigerated Caselight (Horizontal) - 5' Fixture		S32	12	N/A	$220.00	$0.00	$220.00	20	N/A	$73.00	N/A	1
LED Refrigerated Caselight (Horizontal) - 6' Fixture		S32	14.4	N/A	$220.00	$0.00	$220.00	30	N/A	$79.00	N/A	1
7 Watt MR16 LED Flood		S40	7	N/A	N/A	N/A	N/A	7	N/A	$7.00	N/A	0.18
7 Watt MR16 LED Spot		S40	7	N/A	N/A	N/A	N/A	7	N/A	$7.00	N/A	0.18
9 Watt PAR20 LED Flood		S40	9	N/A	N/A	N/A	N/A	6	N/A	$5.50	N/A	0.18
9 Watt PAR20 LED Spot		S40	9	N/A	N/A	N/A	N/A	6	N/A	$5.50	N/A	0.18
12 Watt PAR30 LED Flood		S40	12	N/A	N/A	N/A	N/A	10	N/A	$7.50	N/A	0.18
12 Watt PAR30 LED Spot		S40	12	N/A	N/A	N/A	N/A	10	N/A	$7.50	N/A	0.18
22 Watt PAR38 LED Flood		S40	22	N/A	N/A	N/A	N/A	13	N/A	$8.25	N/A	0.18
22 Watt PAR38 LED Spot		S40	22	N/A	N/A	N/A	N/A	13	N/A	$8.28	N/A	0.18
LED BR30 Screw-In		S40	12	N/A	N/A	N/A	N/A	11	N/A	$6.25	N/A	0.18
LED BR40 Screw-In		S40	22	N/A	N/A	N/A	N/A	17	N/A	$8.25	N/A	0.18
LED 2x2 Recessed Fixture: <40W	[1]	S51./S51R	31	N/A	$159.41	$60.00	$99.41	35	N/A	$46.50	$58.00	0.5
LED 2x2 Recessed Fixture: ≥40W	[1]	S51./S51R	47	N/A	$142.81	$78.00	$64.81	40	N/A	$46.50	$65.00	0.5
LED 2x4 Recessed Fixture: <50W	[1]	S51./S51R	39	N/A	$169.75	$72.00	$97.75	40	N/A	$75.00	$80.00	0.5

Description	Note	Measure Code	C&I Prescriptive[702]					Small Business Direct Install[703]				
			Wattage (Watts_EE)	Wattage Reduction (SAVE_EE)	Installed Cost: High Efficiency	Installed Cost: Baseline	Measure Cost (Cost)	Wattage (Watts_EE)	Wattage Reduction (SAVE_EE)	Material Cost (Standard Tier)	Material Cost (Premium Tier)	Labor Hours
LED 2x4 Recessed Fixture: ≥50W	[1]	S51./S51R	64	N/A	$179.13	$90.00	$89.13	50	N/A	$85.50	$95.00	0.5
LED 1x4 Recessed Fixture: <40W	[1]	S51./S51R	31	N/A	$182.00	$61.00	$121.00	33	N/A	$73.00	$99.00	0.5
LED 1x4 Recessed Fixture: ≥40W	[1]	S51./S51R	47	N/A	$200.00	$84.00	$116.00	40	N/A	$112.00	$120.00	0.5
Integrated Retrofit Kit for LED 2x2 Interior Fixture <40W		S52.	28	N/A	$115.33	$0.00	$115.33	22	N/A	$78.75	N/A	0.75
Integrated Retrofit Kit for LED 2x2 Interior Fixture ≥40W		S52.	46	N/A	$99.00	$0.00	$99.00	30	N/A	$89.89	N/A	0.75
Integrated Retrofit Kit for LED 2x4 Interior Fixture <50W		S52.	36	N/A	$153.92	$0.00	$153.92	30	N/A	$97.50	N/A	0.75
Integrated Retrofit Kit for LED 2x4 Interior Fixture ≥50W		S52.	53	N/A	$152.00	$0.00	$152.00	44	N/A	$97.50	N/A	0.75
Integrated Retrofit Kit for LED 1x4 Interior Fixture <40W		S52.	26	N/A	$171.00	$0.00	$171.00	30	N/A	$93.50	N/A	0.75
Integrated Retrofit Kit for LED 1x4 Interior Fixture ≥40W		S52.	49	N/A	$171.00	$0.00	$171.00	43	N/A	$93.50	N/A	0.75
Linear Retrofit Kit for LED 2x2 Interior Fixture <40W		S52.	28	N/A	$109.80	$0.00	$109.80	21	N/A	$54.00	N/A	0.75
Linear Retrofit Kit for LED 2x2 Interior Fixture ≥40W		S52.	46	N/A	$158.00	$0.00	$158.00	20	N/A	$54.00	N/A	0.75
Linear Retrofit Kit for LED 2x4 Interior Fixture <50W		S52.	36	N/A	$113.71	$0.00	$113.71	41	N/A	$65.00	N/A	0.75
Linear Retrofit Kit for LED 2x4 Interior Fixture ≥50W		S52.	53	N/A	$123.34	$0.00	$123.34	48	N/A	$67.00	N/A	0.75
Linear Retrofit Kit for LED 1x4 Interior Fixture <40W		S52.	26	N/A	$124.39	$0.00	$124.39	22	N/A	$59.00	N/A	0.75
Linear Retrofit Kit for LED 1x4 Interior Fixture ≥40W		S52.	49	N/A	$125.35	$0.00	$125.35	N/A	N/A	N/A	N/A	N/A
LED High/Low Bay Fixture: <100W	[1]	S61./S61R	74	N/A	$329.04	$274.00	$55.04	67	N/A	$144.00	$144.00	1.5
LED High/Low Bay Fixture: ≥100 - <150W	[1]	S61./S61R	123	N/A	$501.22	$269.00	$232.22	110	N/A	$165.00	$165.00	1.5
LED High/Low Bay Fixtures: ≥150 - <200W	[1]	S61./S61R	170	N/A	$385.87	$265.00	$120.87	160	N/A	$210.00	$255.00	1.5
LED High/Low Bay Fixtures: ≥200 - <300W	[1]	S61./S61R	233	N/A	$738.08	$265.00	$473.08	221	N/A	$320.00	$320.00	1.5

Description	Note	Measure Code	C&I Prescriptive[702]					Small Business Direct Install[703]				
			Wattage (Watts_EE)	Wattage Reduction (SAVE_EE)	Installed Cost: High Efficiency	Installed Cost: Baseline	Measure Cost (Cost)	Wattage (Watts_EE)	Wattage Reduction (SAVE_EE)	Material Cost (Standard Tier)	Material Cost (Premium Tier)	Labor Hours
LED High/Low Bay Fixtures: ≥300W	[1]	S61./S61R	418	N/A	$652.00	$394.00	$258.00	319	N/A	$375.00	$375.00	1.5
LED High/Low Bay Retrofit Kit: <150W		S62	108	N/A	$246.43	$0.00	$246.43	105	N/A	$150.00	N/A	1.5
LED High/Low Bay Retrofit Kit: ≥150W		S62	180	N/A	$348.47	$0.00	$348.47	152	N/A	$259.99	N/A	1.5
LED High/Low Bay Replacement Lamps: <50W - Type A	[2]	S64	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LED High/Low Bay Replacement Lamps: ≥50W - Type A	[2]	S64	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LED High/Low Bay Replacement Lamps: <80W w/new driver - Type B & C	[2]	S64	N/A	N/A	N/A	N/A	N/A	52	N/A	$75.00	N/A	1
LED High/Low Bay Replacement Lamps: ≥80W w/new driver - Type B & C	[2]	S64	N/A	N/A	N/A	N/A	N/A	96	N/A	$165.00	N/A	1
LED High/Low Bay Replacement Lamps: <120W w/new driver - Type B & C	[2]	S64	N/A	N/A	N/A	N/A	N/A	96	N/A	$165.00	N/A	1
LED High/Low Bay Replacement Lamps: ≥120W w/new driver - Type B & C	[2]	S64	N/A	N/A	N/A	N/A	N/A	119	N/A	$240.00	N/A	1
Linear Ambient <50W (Strip)		S81./S81R	35	N/A	$191.74	$64	$128	32	N/A	N/A	$85.00	0.5
Linear Ambient <50W (Wrap)		S81./S81R	35	N/A	$191.54	$64	$128	41.1	N/A	N/A	$49.00	0.5
Linear Ambient 50-100W		S81./S81R	71	N/A	$293.82	$92	$202	68	N/A	N/A	$135.00	0.75
Linear Ambient >100W		S81./S81R	122	N/A	$430.44	$113	$317	N/A	N/A	N/A	N/A	N/A
2' LED Lamp/Type A (1 lamp)	[2]	S110R	N/A	N/A	N/A	N/A	N/A	9.0	N/A	$7.44	N/A	0.25
2' LED Lamp/Type A (2 lamps)	[2]	S110R	N/A	N/A	N/A	N/A	N/A	18.0	N/A	$14.88	N/A	0.33
2' LED Lamp/Type A (3 lamps)	[2]	S110R	N/A	N/A	N/A	N/A	N/A	27.0	N/A	$22.32	N/A	0.42
2' LED Lamp/Type A (4 lamps)	[2]	S110R	N/A	N/A	N/A	N/A	N/A	36.0	N/A	$29.76	N/A	0.50
4' LED Lamp/Type A (1 lamp)	[2]	S110R	N/A	N/A	N/A	N/A	N/A	15.0	N/A	$6.25	N/A	0.25
4' LED Lamp/Type A (2 lamps)	[2]	S110R	N/A	N/A	N/A	N/A	N/A	20.0	N/A	$12.50	N/A	0.33
4' LED Lamp/Type A (3 lamps)	[2]	S110R	N/A	N/A	N/A	N/A	N/A	45.0	N/A	$18.75	N/A	0.42

Description	Note	Measure Code	C&I Prescriptive[702]					Small Business Direct Install[703]				
			Wattage (Watts_EE)	Wattage Reduction (SAVE_EE)	Installed Cost: High Efficiency	Installed Cost: Baseline	Measure Cost (Cost)	Wattage (Watts_EE)	Wattage Reduction (SAVE_EE)	Material Cost (Standard Tier)	Material Cost (Premium Tier)	Labor Hours
4' LED Lamp/Type A (4 lamps)	[2]	S110R	N/A	N/A	N/A	N/A	N/A	60.0	N/A	$25.00	N/A	0.50
2' LED Lamp/Type C Kit (1 Lamp & 1 external driver)	[2]	S110R	N/A	N/A	N/A	N/A	N/A	10.0	N/A	$14.50	N/A	0.25
2' LED Lamp/Type C Kit (2 Lamps & 1 external driver)	[2]	S110R	N/A	N/A	N/A	N/A	N/A	22.0	N/A	$22.50	N/A	0.33
2' LED Lamp/Type C Kit (3 Lamps & 1 external driver)	[2]	S110R	N/A	N/A	N/A	N/A	N/A	30.0	N/A	$32.04	N/A	0.42
2' LED Lamp/Type C Kit (4 Lamps & 1external driver)	[2]	S110R	N/A	N/A	N/A	N/A	N/A	40.0	N/A	$42.50	N/A	0.50
4' LED Lamp/Type C Kit (1 Lamp & 1 external driver)	[2]	S110R	N/A	N/A	N/A	N/A	N/A	15.0	N/A	$16.75	N/A	0.25
4' LED Lamp/Type C Kit (2 Lamps & 1 external driver)	[2]	S110R	N/A	N/A	N/A	N/A	N/A	30.0	N/A	$28.25	N/A	0.33
4' LED Lamp/Type C Kit (3 Lamps & 1 external driver)	[2]	S110R	N/A	N/A	N/A	N/A	N/A	40.0	N/A	$44.50	N/A	0.42
4' LED Lamp/Type C Kit (4 Lamps & 1external driver)	[2]	S110R	N/A	N/A	N/A	N/A	N/A	50.0	N/A	$58.00	N/A	0.50
Cooler Case Mounted Occupancy Sensor For LED Fixtures		L50	N/A	N/A	$68	$0	$68	N/A	N/A	$60.00	N/A	0.55
Fixture Mounted Occupancy Sensor		L60.1	N/A	N/A	$68.86	$0	$68.9	N/A	N/A	$27.00	N/A	0.55
Remote Mounted Occupancy Sensor		L70.1	N/A	N/A	$173.25	$0	$173.3	N/A	N/A	$62.00	N/A	0.73
Vacancy Sensor		L71.1	N/A	N/A	$59	$0	$59	N/A	N/A	$40.00	N/A	0.73
Interior Occupancy Sensor Power Supply (power pack)		-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$29.00	N/A	0.73
Photo cell		-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1-lamp HPT8 Ballast for Type A Lamps			N/A	N/A	N/A	N/A	N/A	N/A	N/A	$13.00	N/A	0.18
2-lamp HPT8 Ballast for Type A Lamps			N/A	N/A	N/A	N/A	N/A	N/A	N/A	$13.00	N/A	0.18
3-lamp HPT8 Ballast for Type A Lamps			N/A	N/A	N/A	N/A	N/A	N/A	N/A	$13.45	N/A	0.18
4-lamp HPT8 Ballast for Type A Lamps			N/A	N/A	N/A	N/A	N/A	N/A	N/A	$14.07	N/A	0.18

Note 1: Baseline cost is based on the installed cost (material plus labor) of a single standard-efficiency fixture (one-for-one).

Note 2: Because the existing lamp has an expected life of less than 1 year, the replacement cost of the existing lamp type is assumed for the installed cost: baseline.

Table 32 – Existing Fixture Rated Wattage Table ($Watts_{BASE}$)[704]

Existing Fixture Description	Wattage ($Watts_{BASE}$)	Existing Fixture Description	Wattage ($Watts_{BASE}$)
CFL - 11W	11	PSMH - 100W	118
CFL - 13W	13	PSMH - 150W	170
CFL - 27W	27	PSMH - 200W	219
Exit Sign - (2) 20W Incandescent	40	PSMH - 320W	349
Exit Sign - (2) 5W CFL	10	PSMH - 400W	435
Exit Sign - (2) 7.5W Incandescent	15	T12 - 1-Lamp 4' T12	41.7
Exit Sign - (2) 9W CFL	18	T12 - 1-Lamp 4' T12 HO	84
Halogen - 20W	20	T12 - 1-Lamp 5' T12 HO	97
Halogen - 50W	50	T12 - 1-Lamp 6' T12 HO	113
HPS - 100W	138	T12 - 2-Lamp 4' T12	70.7
HPS - 150W	188	T12 - 2-Lamp 4' T12 HO	131
HPS - 250W	295	T12 - 2-Lamp 5' T12 HO	170
HPS - 400W	465	T12 - 2-Lamp 6' T12 HO	193
HPS - 50W	65	T12 - 2-Lamp 8' T12	120.6
HPS - 70W	95	T12 - 2-Lamp 8' T12 HO	197.9
Incandescent - 100W	100	T12 - 2-Lamp U T12	72.5
Incandescent - 40W	40	T12 - 3-Lamp 4' T12	112.3
Incandescent - 60W	60	T12 - 4-Lamp 4' T12	141.2
Incandescent - 65W	65	T8 - 1-Lamp 4' T8	31
Incandescent - 75W	75	T8 - 1-Lamp 4' T8 HO	53
MH - 1000W	1075	T8 - 1-Lamp 5' T8 HO	62
MH - 100W	128	T8 - 1-Lamp 6' T8 HO	80
MH - 150W	190	T8 - 2-Lamp 4' T8	59
MH - 175W	215	T8 - 2-Lamp 4' T8 HO	100
MH - 200W	232	T8 - 2-Lamp 5' T8 HO	116
MH - 250W	288	T8 - 2-Lamp 6' T8 HO	136
MH - 400W	458	T8 - 2-Lamp U T8	60
LED MR16	7	T8 - 3-Lamp 4' T8	89
LED PAR20	9	T8 - 4-Lamp 4' T8	112
LED PAR30	12	LED A	10
LED PAR38	22	LED BR 30	12
		LED BR 40	22

[704] Table also includes fixtures not included in Installed Measure table that may be selected as controlled fixtures for control measures.

Table 33 – Baseline Lighting Power Density (Watt/ft^2) by Space-Type[705]

Space Type	LPD_{BASE}	Space Type	LPD_{BASE}
Active Storage	0.8	Health Care (Operating Room)	2.2
Active Storage (For Health Care)	0.9	Health Care (Patient Room)	0.7
Atrium (Each Additional Floor)	0.2	Health Care (Pharmacy)	1.2
Atrium (First 3 Floors)	0.6	Health Care (Physical Therapy)	0.9
Audience/Seating Area	0.9	Health Care (Radiology)	0.4
Audience/Seating Area (For Convention Center)	0.7	Health Care (Recovery)	0.8
Audience/Seating Area (For Exercise Center)	0.3	Hotel/Motel Guest Rooms	1.1
Audience/Seating Area (For Gymnasium)	0.4	Inactive Storage	0.3
Audience/Seating Area (For Motion Picture Theater)	1.2	Inactive Storage (For Museum)	0.8
Audience/Seating Area (For Penitentiary)	0.7	Laboratory	1.4
Audience/Seating Area (For Performing Arts Theater)	2.6	Library (Card File and Cataloging)	1.1
Audience/Seating Area (For Religious Buildings)	1.7	Library (Reading Area)	1.2
Audience/Seating Area (For Sports Arenas)	0.4	Library (Stacks)	1.7
Audience/Seating Area (For Transportation)	0.5	Lobby	1.3
Automotive (Service/Repair)	0.7	Lobby (For Hotel)	1.1
Bank/Office (Banking Activity Area)	1.5	Lobby (For Motion Picture Theater)	1.1
Classroom/Lecture/Training	1.4	Lobby (For Performing Arts Center)	3.3
Classroom/Lecture/Training (For Penitentiary)	1.3	Lounge/Recreation	1.2
Conference/Meeting/Multipurpose	1.3	Lounge/Recreation (For Health Care)	0.8
Convention Center (Exhibit Space)	1.3	Manufacturing (Control Room)	0.5
Corridor/Transition	0.5	Manufacturing (Detailed Manufacturing)	2.1
Corridor/Transition (For Health Care)	1	Manufacturing (Equipment Room)	1.2
Corridor/Transition (For Manufacturing Facility)	0.5	Manufacturing (High Bay, >25 ft. Ceiling Height)	1.7
Courthouse/Police Station/Penitentiary (Confinement Cells)	0.9	Manufacturing (Low Bay, <25 ft. Ceiling Height)	1.2
Courthouse/Police Station/Penitentiary (Courtroom)	1.9	Museum (General Exhibition)	1
Courthouse/Police Station/Penitentiary (Judges' Chambers)	1.3	Museum (Restoration)	1.7
Dining Area	0.9	Office (Enclosed)	1.1
Dining Area (For Bar/Lounge/Leisure Dining)	1.4	Office (Open Plan)	1.1
Dining Area (For Family Dining)	2.1	Parking Garage (Garage Area)	0.2
Dining Area (For Hotel)	1.3	Post Office (Sorting Area)	1.2
Dining Area (For Motel)	1.2	Religious Buildings (Fellowship Hall)	0.9
Dining Area (For Penitentiary)	1.3	Religious Buildings (Worship Pulpit/Choir)	2.4
Dormitory Living Quarters	1.1	Restrooms	0.9
Dressing/Locker/Fitting Room	0.6	Retail (Mall Concourse)	1.7
Electrical/Mechanical	1.5	Retail (Sales Area)	1.7
Fire Stations (Engine Room)	0.8	Sales Area	1.7
Fire Stations (Sleeping Quarters)	0.3	Sports Arena (Court Sports Area)	2.3

[705] Lighting Power Allowance per IECC 2009, which is based on the ASHRAE 90.1 2007 technical requirements

Space Type	LPD_{BASE}	Space Type	LPD_{BASE}
Food Preparation	1.2	Sports Arena (Indoor Playing Field Area)	1.4
Gymnasium/Exercise Center (Exercise Area)	0.9	Sports Arena (Ring Sports Area)	2.7
Gymnasium/Exercise Center (Playing Area)	1.4	Stairs (Active)	0.6
Health Care (Emergency)	2.7	Transportation (Air/Tran/Bus - Baggage Area)	1
Health Care (Exam/Treatment)	1.5	Transportation (Airport - Concourse)	0.6
Health Care (Laundry/Washing)	0.6	Transportation (Terminal - Ticket Counter)	1.5
Health Care (Medical Supply)	1.4	Warehouse (Fine Material Storage)	1.4
Health Care (Nursery)	0.6	Warehouse (Medium/Bulky Storage)	0.9
Health Care (Nurses' Station)	1	Workshop	1.9

Table 34 – Reference Lighting Annual Operating Hours by facility type[706]

Building Type	Proposed	Data Source
Agricultural	4698	WI 2015
College	3416	KEMA 2011
Convenience Store	6019	KEMA 2011
Garage/Repair	3521	KEMA 2011
Grocery	6019	KEMA 2011
Health	4007	KEMA 2011
Hospital	7666	NY 2016
K-12 School	2456	KEMA 2011
Lodging	4808	KEMA 2011
Manufacturing	4781	KEMA 2011
Nursing Home/Assisted Living/Health Care	5840	NY 2016
Office	3642	KEMA 2011
Other	4265	KEMA 2011
Restaurant	4089	KEMA 2011
Retail	4103	KEMA 2011
Warehouse	4009	KEMA 2011

[706] WI 2005 refers to Wisconcin Technical Reference Manual, 2005; NY2016 refers to New York Technical Reference Manual, 2010; KEMA 2011 refers to KEMA C&I Lighting Load Shape Project FINAL Report, July 19, 2011.

Table 35 – Reference Lighting Annual Operating Hours by by facility and space type[707]

Space Type	Facility Type										
	Apartments	Assembly	Industry	Lodging	Medical	Office	Other	Restaurant	Retail	School(K-12)	Warehouse
Assembly	4,890	1,064	NA	NA	NA	NA	899	NA	NA	NA	NA
Break Room	NA	884	1,257	NA	1,200	1,829	1,682	NA	1,802	1,303	2,918
Cafeteria	NA	375	NA	NA	NA	NA	NA	NA	NA	2,356	1,775
Classroom	NA	596	NA	NA	NA	NA	172	NA	4,842	1,429	NA
Conference	4,035	488	1,671	NA	675	971	261	NA	1,018	1,221	1,277
Dining	1,448	NA	NA	NA	NA	NA	1,758	4,452	NA	NA	NA
Equipment	NA	707	780	NA	975	2,064	1,610	1,324	2,034	NA	NA
Gym	563	101	NA	NA	NA	NA	1,406	NA	6,566	2,545	NA
Hallway	8,528	1,424	2,995	NA	3,778	1,914	2,098	4,896	2,262	3,598	2,483
Kitchen	2,329	1,308	1,936	NA	3,818	2,037	308	5,081	1,737	1,626	1,925
Library/CPU	NA	1,782	NA	NA	NA	NA	NA	NA	NA	1,767	NA
Office (Closed)	1,929	678	1,620	NA	1,291	1,671	1,575	4,683	2,449	1,444	1,994
Office (Open)	3,020	2,734	2,334	8,760	2,455	2,378	2,223	NA	3,417	2,338	2,758
Other	4,366	2,213	1,215	NA	2,523	2,550	1,853	NA	3,263	2,111	2,202
Production	NA	NA	2,959	NA	NA	1,972	NA	NA	2,897	NA	3,351
Restroom	38	873	431	267	685	1,212	1,679	3,212	587	1,515	1,140
Retail	NA	3,184	2,632	NA	2,716	3,558	NA	NA	2,825	NA	NA
Storage	1,904	401	927	17	984	992	1,325	3,077	1,801	1,420	1,516
Warehouse	NA	NA	2,195	NA	NA	1,661	1,945	NA	2,550	NA	2,295

[707] Based on results from Michigan Statewide Commercial and Industrial Lighting Hours-of-Use Study, EMI Consulting, June 6, 2014.

Table 36 – Savings Factors for Lighting Controls

Commercial/Industrial	
Space Type	**% of Annual Lighting Energy Saved (SVG)[A]**
Break Room	20%
Classrooms	30%
Conference rooms	45%
Cooler/Freezer Case	31%
Corridors	15%
Gymnasiums	35%
Open offices	15%
Other Type[B]	25%
Private offices	30%
Restrooms	40%
Storage	55%
Warehouses	50%

[A] SVG values for Gymnasiums, Warehouses, and Storage areas are from IES Paper #43, An Analysis of Energy & Cost Savings Potential of Occupancy Sensors for Commercial Lighting Spaces. 8/16/2000. SVG for Cooler/Freezer case from US DOE, "Demonstration Assessment of Light-Emitting Diode (LED) Freezer Case Lighting." Refrigerated cases were metered for 12 days to determine savings from occupancy sensors. Assumes that refrigerated freezers and refrigerated coolers will see the same amount of savings from sensors. The SVG value for the "other" category is a conservative estimate of savings intended to ensure reported savings are not overstated when the controls are installed in areas other than those specifically listed.

[B] Each industrial/manufacturing space has very specific occupancy patterns, and a literature search revealed no published values for typical savings resulting from controls in these spaces. When sensors are installed in these space types, the "other" category, reflecting the most conservative SVG value should be selected.

Table 37 – Ventilation Rates (CFM/ft^2)[708]

Space Type	VentilationRate	Space Type	VentilationRate
Art classroom	0.38	Health club/weight rooms	0.26
Auditorium seating area	0.81	Kitchen (cooking)	0.27
Bank vaults/safe deposit	0.09	Laundry rooms within dwelling units	0.17
Banks or bank lobbies	0.17	Laundry rooms, central	0.17
Barbershop	0.25	Lecture classroom	0.55
Barracks sleeping areas	0.16	Lecture hall (fixed seats)	1.19
Bars, cocktail lounges	0.93	Legislative chambers	0.31
Beauty and nail salons	0.62	Libraries	0.17
Bedroom/living room	0.11	Lobbies	0.81
Booking/waiting	0.44	Lobbies/prefunction	0.29
Bowling alley (seating)	0.52	Main entry lobbies	0.11
Break rooms	0.19	Mall common areas	0.36
Cafeteria/fast-food dining	0.93	Media center	0.37
Cell	0.25	Multipurpose assembly	0.66
Classrooms (age 9 plus)	0.47	Multi-use assembly	0.81
Classrooms (ages 5–8)	0.37	Museums (children's)	0.42
Coffee stations	0.16	Museums/galleries	0.36
Coin-operated laundries	0.21	Music/theater/dance	0.41
Common corridors	0.06	Occupiable storage rooms for liquids or gels	0.13
Computer (not printing)	0.08	Occupiable storage rooms for dry materials	0.07
Computer lab	0.37	Office space	0.09
Conference/meeting	0.31	Pet shops (animal areas)	0.26
Corridors	0.06	Pharmacy (prep. area)	0.23
Courtrooms	0.41	Photo studios	0.17
Daycare (through age 4)	0.43	Places of religious worship	0.66
Daycare sickroom	0.43	Reception areas	0.21
Dayroom	0.21	Restaurant dining rooms	0.71
Disco/dance floors	2.06	Sales	0.23
Dwelling unit	0.07	Science laboratories	0.43
Electrical equipment rooms	0.06	Shipping/receiving	0.12
Elevator machine rooms	0.12	Sorting, packing, light assembly	0.17
Gambling casinos	1.08	Spectator areas	1.19
Game arcades	0.33	Sports arena (play area)	0.3

[708] ASHRAE Standard 62.1 Outdoor Air Rates, Table 6-1 and Table E-1. The ventilation rates are the combined rates for CFM per person and CFM per area based on default values for occupancy.

Space Type	VentilationRate	Space Type	VentilationRate
General manufacturing (excludes heavy industrial and processes using chemicals)	0.25	Stages, studios	0.76
Guard stations	0.14	Storage rooms	0.12
Gym, stadium (play area)	0.3	Supermarket	0.12
Health Care: Patient Rooms	0.25	Swimming (pool & deck)	0.48
Health Care: Medical Procedure	0.30	Telephone closets	0
Health Care: Operating Rooms	0.60	Telephone/data entry	0.36
Health Care: Recovery and ICU	0.30	Transportation waiting	0.81
Heatlh Care: Autopsy Rooms	0.50	University/college laboratories	0.43
Health Care: Physical Therapy	0.30	Warehouses	0.06
Health club/aerobics room	0.86	Wood/metal shop	0.38

Table 38 – Refrigeration Bonus Factors

Measures	Bonus Factor	Temperature		
		Low (COP = 2.0)	Medium (COP = 3.5)	High (COP = 5.4)
R10 Evaporator Fan Motor Controls R40/R41/R42 H.E. Evaporative Fan Motors	(1 + 1 / COP)[A]	1.5	1.3	1.2
R20 Door Heater Controls R30/R31 Zero Energy Doors for Coolers/Freezers	(1 + 0.65 / COP)[B]	1.3	1.2	1.1

[A] Based on the average of standard reciprocating and discus compressor efficiencies with Saturated Suction Temperatures of −20°F, 20°F, and 45°F, respectively, and a condensing temperature of 90°F.
[B] Based on the average of standard reciprocating and discus compressor efficiencies with Saturated Suction Temperatures of −20°F, 20°F, and 45°F, respectively, and a condensing temperature of 90°F, and manufacturers assumption that 65% of heat generated by door enters the refrigerated case (1 + 0.65 / COP).

Interactive Effects Derivation

More efficient lighting provides the same amount of lumens with fewer watts. Halogen and incandescent bulbs generate a lot of heat in addition to light. The wattage that produces heat rather than light is referred to as waste heat. When cooling is called for, the waste heat generated by inefficient lights requires the cooling system to work harder. By replacing inefficient lights with efficient lights less waste heat is produced which reduces the load on the cooling system. The magnitude of the reduced cooling load is proportional to the magnitude of the wattage reduction of the lights. Conversely, when heating is called for, the reduction in waste heat from the replacement of inefficient lights with efficient lights increases the load on the heating system. To calculate the interactive factors several factors must be considered as define below.

Factors included in the calculation of Interactive Effects Factors:

IGC = Internal Gain Contribution (%) – This factor accounts for some portion of the wattage reduction not contributing to the interactive effects. Some waste heat escapes through ceiling and wall penetrations without contributing to internal gains that affect the load on HVAC systems.

%A = Applicability (%) – Interactive effects are only applicable if the waste heat reduction interacts with a HVAC system. Lights installed in unconditioned spaces do not contribute to interactive effects. Applicability is calculated as the product of % of bulbs installed in interior sockets and the % of buildings with mechanical cooling. (%A = %I*%A/C)

C_{HVAC} = Concurrency with Heating/Cooling – Waste heat only impacts HVAC systems when the lights and the systems are on concurrently. Cooling interactive effects only occur during the cooling season and heating interactive effects only occur during the heating season.

Eff_{HVAC} = Efficiency of the HVAC system – The change in consumption of the HVAC system is determined by the efficiency of the system.

Cooling Demand Interactive Effects Factor

The following formula is used to calculate the cooling demand interactive effects factor. Total demand reduction is calculated by multiplying the demand reduction from the lighting change by the cooling demand factor. The values used in the formula are defined in the table below.

$$IE_{COOL\_D} = 1 + \frac{IGC \times \%A \times C_{HVAC}}{Eff_{HVAC}}$$

Cooling Energy Interactive Effects Factor

The following formula is used to calculate the cooling energy interactive effects factor. Total energy savings is calculated by multiplying the energy savings from the lighting change by the cooling energy factor. The values used in the formula are defined in the table below.

$$IE_{COOL\_E} = 1 + \frac{IGC \times \%A \times C_{HVAC}}{Eff_{HVAC}}$$

Heating Energy Interactive Effects Factor

The following formula is used to calculate the heating energy interactive effects factor. Heating energy increased used (in MMBtu) is calculated by multiplying the energy savings from the lighting change (in kWh) by the heating energy factor. The values used in the formula are defined in the table below.

$$IE_{HEAT\_E} = \frac{IGC \times \%A \times C_{HVAC}}{Eff_{HVAC}} \times 0.003412\ MMBtu/kWh$$

Table 39. Interactive Effects Input Factors and resulting IE Factors

Input Factors	IGC		%A		C_{HVAC}		Eff_{HVAC}		Interactive Effects Factor	
	Value	Note	Value	Note	Value	Note	Value	Note	Term	Value
Residential Cooling Demand	75%	[709]	46%	[710]	100%	[711]	400%	[712]	IE_{COOL_D}	1.085
Residential Cooling Energy	75%	[709]	46%	[710]	25%	[713]	400%	[712]	IE_{COOL_E}	1.021
Residential Heating	75%	[709]	86%	[714]	50%	[715]	80.5%	[716]	IE_{HEAT_E}	0.00137
Commercial Cooling Demand	75%	[709]	77%	[717]	100%	[711]	400%	[712]	IE_{COOL_D}	1.144
Commercial Cooling Energy	75%	[709]	77%	[717]	42%	[718]	400%	[712]	IE_{COOL_E}	1.060
Commercial Heating	75%	[709]	100%	[719]	50%	[715]	80.5%	[716]	IE_{HEAT_E}	0.00159

[709] Based on engineering judgment

[710] Per 2015 Maine Residential Baseline Study, 86% of bulbs are installed in locations that are conditioned. According to Portland Press Herald, http://www.pressherald.com/2014/05/26/put_power_rates_on_ice__that_s_a_cool_idea_/, in 2010, an estimated 79 percent of customers in ISO-New England region had room air conditioners. Of the 79 percent, 40 percent of homes have equivalent of whole home A/C (3 window A/Cs); 39 percent of homes have total cooling capacity equivalent of 1 or 2 window A/C units. The remaining 21percent have no cooling equipment installed. Assuming that a window A/C unit cools 1/3 of a home that works out to be 53% of residential homes are mechanical cooled. (%A = 46% = 86%*53%)

[711] Maximum demand reduction occurs when lights and cooling systems are on concurrently. Coincidence factors are then applied to determine coincidence with peak hours.

[712] Cooling equipment efficiency is assumed to be 400% based on a SEER of 14 which is the current federal minimum efficiency standard.

[713] Cooling season is assumed to be 3 months for residential applications. (3/12 = 25%)

[714] Per 2015 Maine Residential Baseline Study 86% of bulbs are installed in locations that are conditioned. 100% of residences are heated. (%A = 86% = 86%*100%)

[715] Heating season is assumed to be 6 months. (6/12=50%)

[716] Per 2015 Maine Residential Baseline Study, the average heating system efficiency is 80.5%. It is assumed that commercial heating systems have a similar average efficiency.

[717] For commercial applications, it is assumed that all bulbs are installed in interior sockets. The C&I Prescriptive program tracks exterior lights separately and interactive effect factors are not applied to those measures. Based on the cooling system type saturation in the 2012 EMT Baseline Opportunities Study and assuming that window unit A/C cools 1/3 of the conditioned space, 77% of commercial space is mechanically cooled in Maine. (%A = 77% = 100%*53%)

[718] Cooling season is assumed to be 5 months for commercial applications due to higher internal gains. (5/12=42%)

[719] For commercial applications, it is assumed that all bulbs are installed in interior sockets. The C&I Prescriptive program tracks exterior lights separately and interactive effect factors are not applied to those measures. It is assumed that 100% of commercial spaces are heated. (%A = 100% = 100%*100%)

Table 40 – Realization Rate Adjusted Coincidence Factors for Prescriptive Non-Lighting Measures[720]

Measure	Winter CF	Summer CF	Footnote	RR_D Winter	RR_D Summer	RR_D Adjsuted Winter CF	RR_D Adjusted Summer CF
SFA Prescriptive Variable Frequency Drives (VFD) for HVAC	19.8%	50.8%	721	73.7%	95.9%	14.6%	48.7%
SFP Prescriptive Variable Frequency Drives (VFD) for HVAC	19.8%	50.8%	721	73.7%	95.9%	14.6%	48.7%
RFA Prescriptive Variable Frequency Drives (VFD) for HVAC	28.5%	71.2%	721	73.7%	95.9%	21.0%	68.3%
RFP Prescriptive Variable Frequency Drives (VFD) for HVAC	28.5%	71.2%	721	73.7%	95.9%	21.0%	68.3%
BEF Prescriptive Variable Frequency Drives (VFD) for HVAC	100.0%	37.0%	721	73.7%	95.9%	73.7%	35.5%
CWP Prescriptive Variable Frequency Drives (VFD) for HVAC	0.0%	90.2%	721	73.7%	95.9%	0.0%	86.5%
HHWP Prescriptive Variable Frequency Drives (VFD) for HVAC	100.0%	0.0%	721	73.7%	95.9%	73.7%	0.0%
DCVE, DCVN Prescriptive HVAC: Demand Control Ventilation	2.0%	81.0%	722	73.7%	95.9%	1.5%	77.7%
VRF Prescriptive HVAC: Variable Refrigerant Flow	57.0%	37.2%	723	73.7%	95.9%	42.0%	35.7%
AH1-AH3, WH Heat Pump Systems (< 11.25 tons)	57.0%	37.2%	724	73.7%	95.9%	42.0%	35.7%

[720] RR_D used to adjust Summer and Winter CF to account for BIP program evalution findings. Nexant, Business Incentive Program Impact Evaluation, unpublished draft, May 2017.

[721] Efficiency Vermont TRM 2012. Values used for VFDs on VFD Boiler Feedwater Pumps, 10 HP; VFD Chilled Water Pumps, < 10 HP; VFD Supply Fans, < 10 HP; VFD Returns Fans, < 10 HP; and VFD Exhaust Fans, < 10 HP.

[722] Central Maine Power, Non-residential load profile for 3/1/08-2/28/09.

[723] KEMA, NEEP Unitary HVAC AC Load Shape Project Final Report, June 2011.

[724] KEMA, NEEP Unitary HVAC AC Load Shape Project Final Report, June 2011.

Measure	Winter CF	Summer CF	Footnote	RR_D Winter	RR_D Summer	RR_D Adjsuted Winter CF	RR_D Adjusted Summer CF
Heat Pump Systems (≥ 11.25 tons)	57.0%	29.0%	724	73.7%	95.9%	42.0%	27.8%
R10 Prescriptive Refrigeration: Evaporator Fan Motor Control for Cooler/Freezer	45.9%	43.0%	725	73.7%	95.9%	33.8%	41.2%
R20 Prescriptive Refrigeration: Door Heater Controls for Cooler/Freezer	100.0%	100.0%	726	73.7%	95.9%	73.7%	95.9%
R30, R31 Prescriptive Refrigeration: Zero Energy Doors for Coolers/Freezers	100.0%	100.0%	727	73.7%	95.9%	73.7%	95.9%
R40, R41, R42 Prescriptive Refrigeration: High-Efficiency Evaporative Fan Motors	100.0%	100.0%	727	73.7%	95.9%	73.7%	95.9%
R50, R51, R52 Prescriptive Refrigeration: Floating-Head Pressure Controls	100.0%	0.0%	728	73.7%	95.9%	73.7%	0.0%
R60, R61, R62, R63, R70, R71, R72, R73, R74 Prescriptive Refrigeration: Discus & Scroll Compressors	69.0%	77.2%	729	73.7%	95.9%	50.9%	74.0%
R80 Prescriptive Refrigeration: ENERGY STAR® Reach-in Coolers and Freezers	69.0%	77.2%	729	73.7%	95.9%	50.9%	74.0%

[725] Efficiency Vermont TRM 2012, Evaporator Fan Control.
[726] Efficiency Vermont TRM 2012, Door Heater Control.
[727] Values are based on continuous operation. For energy period factors, values may assume that energy savings are evenly distributed across all hours of the year.
[728] Efficiency Vermont TRM 2012, Floating-Head Pressure Control.
[729] Efficiency Vermont TRM 2012, Commercial Refrigeration.

Measure	Winter CF	Summer CF	Footnote	RR_D Winter	RR_D Summer	RR_D Adjsuted Winter CF	RR_D Adjusted Summer CF
R90 Prescriptive Refrigeration: ENERGY STAR® Commercial Ice Makers	69.0%	77.2%	729	73.7%	95.9%	50.9%	74.0%
VP<X> Prescriptive Agricultural: Adjustable Speed Drives for Dairy Vacuum Pumps	63.4%	28.7%	730	73.7%	95.9%	46.7%	27.5%
AMSC<X> Prescriptive Agricultural: Scroll Compressors	91.5%	34.1%	731	73.7%	95.9%	67.4%	32.7%
ASD<X> Prescriptive Agricultural: Adjustable Speed Drives on Ventilation Fans (Potato Storage Equipment)	100.0%	0.0%	732	73.7%	95.9%	73.7%	0.0%
AOLSF Prescriptive Agricultural: High-Volume Low-Speed Fans	91.5%	34.0%	732	73.7%	96.0%	67.4%	32.6%
C1–C4 Prescriptive Compressed Air: High-Efficiency Air Compressors	95.0%	95.0%	733	73.7%	95.9%	70.0%	91.1%
C10–C16 Prescriptive Compressed Air: High-Efficiency Dryers	95.0%	95.0%	733	73.7%	95.9%	70.0%	91.1%
C20–C27 Prescriptive Compressed Air: Receivers	95.0%	95.0%	733	73.7%	95.9%	70.0%	91.1%
C30–C33 Prescriptive Compressed Air: Low Pressure Drop Filters	95.0%	95.0%	733	73.7%	95.9%	70.0%	91.1%
C40 Prescriptive Compressed Air: Air-Entraining Nozzles	95.0%	95.0%	733	73.7%	95.9%	70.0%	91.1%

[730] Efficiency Vermont TRM 2012, VFD Milk Vacuum Pump.
[731] Efficiency Vermont TRM 2012, Dairy Farm Combined End Uses.
[732] Savings are realized 24/7 Dec 1 – April 30.
[733] Efficiency Vermont TRM 2012, page 13.