Commercial/Industrial and Multifamily

Technical Reference Manual

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Introduction

PURPOSE

The Efficiency Maine Trust Retail/Residential 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

[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.

recorded in the relevant program tracking database are used in combination with the TRM deemed parameters to compute savings.

- ***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

[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>.

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.

SAVINGS FORMULAS

The formulas and inputs used to calculate the deemed gross annual energy (∆kWh/yr (electricity) and ∆MMBtu/yr (natural gas and other fuels)) and gross max demand (∆kW) 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:

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

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

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

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

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

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

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.

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

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

[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.

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

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

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

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 56 – ~~Table 56 –~~	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 54 – Commercial Coincidence Factors and Energy Period Factors~~Table 54 – 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

Change Type	TRM Section	Description	Effective Date	effRT Update
Revision	Prescriptive HVAC: PTAC and PTHP	Updated baseline efficiency values	7/1/2014	N/A
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
Revision	Lighting & Appendix B	Updated CF_W, CF_S, RR_e, RR_d and EPF with findings from the BIP Impact Evaluation	1/1/18	Y
Revision	Ductless Heat Pump Commercial/Industrial & Appendix B	Updated CF_W, CF_S, RR_e, RR_d and EPF with findings from the BIP Impact Evaluation	1/1/18	Y

Change Type	TRM Section	Description	Effective Date	effRT Update
Revision	Lighting	Updated SBI FR to reflect results of free-ridership survey	1/1/18	Y
Revision	Appendix D: Installed Measure Wattage and Cost Table	Removed SAVE_EE from SBI measures,	4/1/18	N
Other	Lighting Fixtures – Exterior Spaces	Removed LPD and Area from definitions	4/1/18	N
Other	Various	Corrected footnotes to reference Nexant BIP Impact Eval rather than Opinion Dynamics BIP Eval for measures that were already updated to reflect the more recent evaluation.	4/1/18	N
Other	Various	Footnotes for demand realization rates reset to 100% as a result of incorporating the Nexant BIP Impact Eval findings clarified.	4/1/18	N
Other	Natural Gas Kitchen Equipment	Corrected formula to reference $\Delta Therms_{UNIT}$ parameter. Already reflected in effRT savings.	4/1/18	N
Other	Demand Control Kitchen Ventilation	Clarified AHL parameter is AHL per CFM	4/1/18	N
Other	Prescriptive Compressed Air: Receivers, Low Pressure Drop Filters	Modified SAVE parameter to be %/psi rather than %/2 psi to simplify formula, effRT formulas are unaffected.	4/1/18	N
Other	Various	Corrected footnote number references	4/1/18	N
Other	Multifamily Building Basement Insulation	Replaced references to Attic/roof to Basement	4/1/18	N
Other	Multifamily Common Area Clothes Washer	Clarified that recent change to federal standards does not impact this retrofit measure	4/1/18	N
Other	Various	Updated Nexant, Business Incentive Program Impact Evaluation footnotes from unpublished draft to the published report.	4/1/18	N
Revision	Lighting, Appendix D	Refined derivation of interactive effects	4/1/18	Y
PY19 Updates				
Revision	Lighting, Appendix B, Appendix D	Moved Distributor Lighting Measures from Retail/Residential TRM to Commercial, Industrial, Multifamily TRM, updated LED coincidence and energy period factors to incorporate BIP Impact Evaluation findings, Added new measures for LED replacement lamps for T5 and T8 U-Bend	7/1/18	N
Other	Lighitng, Appendix B, Appendix D	Updated measure codes, incorporated new measures and factors for seasonal businesses, updated lighitng measure costs for FY19	7/1/18	Y
Revision	LED Mogul Interior	Incorporated high/low bay interactive effects	7/1/2018	Y
Revision	LED Mogul Exterior	Updated hours of use to 4380	7/1/2018	Y
Revision	HVAC AF<X>	Refined EFLH to account for average oversize factor and HDD	7/1/18	Y
Revision	Evaporator Fan Motor (R10)	Added deemed hours of use	7/1/18	Y
Revision	Door Heater Controls (R20)	Updated savings factor	7/1/18	Y
Other	Appendix D	Removed unreferenced tables	7/1/18	N

Change Type	TRM Section	Description	Effective Date	effRT Update
Revision	Low-Flow Pre-Rinse Spray Valve	Added K-12 usage, defined location specific hours	7/1//18	N
New	Commercial Dishwasher	New measure added	7/1/2018	N
New	Storage Tank Water Heater	New measure added	7/1/2018	N
New	Low-Flow Faucet Aerator	New measure added	7/1/2018	N
Revision	Appendix D	Updated Existing Fixture list with all applicable options	7/1/2018	Y
Revision	Appendix D	Expanded Reference Lighting Annual Operating Hours by facility and space type to include all facility types	7/1/2018	Y
Revision	Appendix D	Expanded Savings Factors for Lighting Controls to include all space types	7/1/2018	Y
Other	Throughout	Changed Small Business Direct Install to Small Business Initiative	7/1/2018	N
Other	Prescriptive HVAC: Boilers and Furnaces	Modified description to include propane and oil equipment. Removed efficient from title.	10/1/2018	N
Other	Natural Gas Kitchen Equipment: G17-G22	Updated Project type to add Replace on Burnout and remove Retrofit. Removed Energy Star from title.	10/1/2018	N
Correction	Low-Flow Pre-Rinse Spray Valves (HPSV)	Corrected conversion factor.	7/1/2018	Y
Revision	Appendix D	Measure Cost and Avoided O&M by Bulb Type for Distributor Channel table updated with measure cost based on program data	10/12/2018	Y
Revision	Programmable Thermostat	Added kWh savings algorithm	7/1/2018	Y
Correction	Appendix D SBI Lighting	Wattage, material cost and labor cost values corrected to reflect negotiated and implemented values for Small Business Initiative	7/1/2018	N
Revision	Appendix D SBI Lighting	Wattage and labor cost values updated to reflect negotiated values for Small Business Initiative effective 12/1. Wattage values reported to tenths of a watt.	12/1/2018	Y
Revision	Appendix D Distributor Lighting	Measure Cost and Avoided O&M by Bulb Type for Distributor Channel table updated with measure cost based on program data	1/1/2019	Y
Revision	Appendix C: Carbon Dioxide Emission Factors	Updated Electricity emission factor to most recent ISO NE reported value.	1/1/2019	N
Correction	ECMSF, ECMHW	FR and SO set to weighted average of C&I Prescriptive measures. Reflects effRT implementation as of 10/1/2017.	10/1/2017	N
Correction	AF6	Added CF and EPF for electrically heated building. Reflects effRT implementation as of 1/1/2018	1/1/2018	N

Change Type	TRM Section	Description	Effective Date	effRT Update
Correction	Distributor Lighting	Correct effRT implementation to accurately reflect TRM updates. Savings for effRT entries prior to 1/1/2019 remain unchanged.[5]	1/1/2019	Y
Correction	Ductless Heat Pump	Correct effRT implementation to accurately reflect TRM updates. Savings for effRT entries prior to 1/1/2019 remain unchanged.[6]	1/1/2019	Y
Correction	Prescriptive Lighting and Distributor Lighting	Correct effRT implementation to accurately reflect TRM updates. Savings for effRT entries prior to 4/1/2019 for C&I Prescriptive and Small Business Initiative and prior to 1/1/2019 for Distributor Lighting remain unchanged.[7]	1/1/2019 4/1/2019	Y
Revision	Appendix D Distributor Lighting	Measure Cost and Avoided O&M by Bulb Type for Distributor Channel table updated with measure cost based on program data	4/1/2019	Y
PY20 Updates				
Correction	ECM	FR and SO set to non-evaluated default	7/1/2018	Y
Revision	VRF	Added cooling capacity and with/without heat recovery categories. Updated efficiency and cost assumptions	7/1/2019	Y
Revision	Distributor LEDs	Refined measure categories. Marked standard LED inactive.	7/1/2019	Y
Revision	Prescriptive Lighting, Appendix D, Installed Measure Wattage and Cost Table, Wattage and Savings by Bulb Type for Distributor Channel, Measure Cost and Avoided O&M by Bulb Type for Distributor Channel	Refined measure codes. Updated wattage and cost data.	7/1/2019	Y
Revision	Baseline Bulb Replacement Schedule and Avoided O&M	Updated rated hours and baseline replacement schedule and discount rate.	7/1/2019	N
Revision	Ductless heat pumps	Updated savings assumptions with new modeling and evaluated performance.	7/1/2019	Y
Revision	Carbon Dioxide Emission Factors	Updated electricity factor with ISO NE all LMUs from 2017 emissions report	7/1/2019	N
Revision	Heat Pumps	Refinement of model input assumptions and resultant savings estimates. Energy Period Factors refined	8/1/2019	Y
Other	ECM Hot Water Smart Pump	Marked inactive – incorporated into Retail/Residential TRM	7/1/2019	Y
Other	Tankless Water Heater	Marked inactive – incorporated into Retail/Residential TRM	7/1/2019	Y

[5] LEDSTDSLD coincidence factor error introduced with 7/1/2018 effRT update. Outdoor lamp (S6<B/C><L/M/H><S/L> coincidence factor error introduced 10/1/2017.
[6] RRe, RRd update introduced in 1/1/2018 TRM were not reflected in effRT until 1/1/2019.
[7] Interactive effect factor updates for interior fixtures made 4/1/2018 in the TRM were not reflected in effRT until 1/1/2019 for DL. Coincidence factor updates made 7/1/2018 in the TRM were not reflected in effRT until 4/1/2019 for SBI and were temporarily rolled back for C&I Prescriptive between 8/1/2018 and 4/1/2019. RRd and RRe were incorrectly updated for C&I Prescriptive Lighting lighting controls and lighting fixtures for refrigerated spaces on 7/9/2018 and corrected 1/1/2019.

Change Type	TRM Section	Description	Effective Date	effRT Update
Other	Boilers & Furnaces	Removed boilers/furnaces < 500 kBtu/h – incorporated into Retail/Residential TRM Removed warm air and inferred heaters.	7/1/2019	Y
Revision	Appendix D, Wattage and Savings by Bulb Type for Distributor Channel	Updated wattage and cost data with program data	11/1/2019	Y
Other	Emission Factors	Updated emission factors	10/1/2019	N
Correction	AASD EPFs	Corrected energy period factors for savings only occurring Dec – May	7/1/2019	Y
Other	AF6	Clarified applicable heating systems and capacity units.	7/1/2019	N
Correction	Appendix D, Installed Measure Wattage and Cost Table	Measure cost column updated to properly reflect the material and labor costs	7/1/2019	N
Correction	Heat Pumps	Corrected winter peak demand reduction values for electric resistance back up heating system for DHP<X>L, DHP1T2, MPDHPNC, MDHP1RT2 and MDHP2RT2. Corrected CF for MPDHPNC, MDHP1RT2, and MDHP2RT2 (TRM only).	8/1/2019	Y
Revision	Appendix D, Wattage and Savings by Bulb Type for Distributor Channel Measure Cost and Avoided O&M by Bulb Type for Distributor Channel	Updated wattage and prices with recent program data.	4/1/2020	Y
Correction	Appendix D, Wattage and Savings by Bulb Type for Distributor Channel	Corrected application of factors based on application (commercial interior for linear lamps and distributor interior for specialty lamps).	7/1/2019	N
Other	Demand Control Ventilation	Clarified efficient measure description.	4/1/2020	N
Other	High Performance Heat Pumps	Renamed “Ductless Heat Pumps” to “High Performance Heat Pumps”	4/1/2020	N
Revision	Variable Refrigerant Flow	Addition of retrofit case.	4/1/2020	Y
Revision	Packaged Terminal Heat Pump	Re-activate measure, removed PTAC option, updated assumptions	4/1/2020	Y
New	Single Phase Variable Refrigerant Flow	New measure	4/1/2020	Y
Revision	Prescriptive Lighting	Updated measure costs to be actual rather than deemed.	7/1/2020	Y
Revision	Appendix D, Wattage and Savings by Bulb Type for Distributor Channel Measure Cost and Avoided O&M by Bulb Type for Distributor Channel	Updated wattage and prices with recent program data. Updated measure life.	7/1/2020	Y
Revision	Prescriptive Lighting, Appendix D, Installed	Updated wattage and cost data with recent program data for Small Business Initiative. Note	7/1/2020	Y

Change Type	TRM Section	Description	Effective Date	effRT Update
	Measure Wattage and Cost Table	added that C&I Prescriptive data is for reference only.		
Other	High Performance Heat Pump C&I Retrofit	Marked as active for Small Business only. Updated cooling assumptions for commercial applications.	7/1/2020	Y
Revision	Appendix D, Wattage and Savings by Bulb Type for Distributor Channel Measure Cost and Avoided O&M by Bulb Type for Distributor Channel	Updated wattage and prices with recent program data.	11/1/2020	Y
Revision	Refrigeration	Reactivated inactive refrigeration measures. Updated inputs and costs.	11/1/2020	Y
New	Strip Curtains, R25	New refrigeration measure	11/1/2020	Y
Revision	Linear LEDs (S110, S111)	Changed residential/commercial share to 100% commercial to reflect program rules.	1/1/2019	Y[8]
Revision	Appendix D, Wattage and Savings by Bulb Type for Distributor Channel Measure Cost and Avoided O&M by Bulb Type for Distributor Channel	Updated wattage and prices with recent program data.	3/1/2021	Y
New	VPTHP	New measure added for vertical packaged terminal heat pumps	4/1/2021	Y
New	ERV	New measure added for energy recovery ventilation units	4/1/2021	Y
Revision	Prescriptive Lighting (all active measures)	Incorporated evaluation findings for interactive effects including addition of heat demand factor.	7/1/2021	Y
Revision	Prescriptive Lighting (SBI)	Incorporated evaluation findings for measure life, free ridership rate, and spillover.	7/1/2021	Y
Revision	Prescriptive Lighting (DL)	Incorporated evaluation findings for hours of use, residential/commercial mix, measure life, realization rate, free ridership rate, and spillover.	7/1/2021	Y
Revision	Appendix B, Energy Period Factors and Coincidence Factors	Updated Lighting Coincidence Factors and Energy Period Factors with evaluation findings	7/1/2021	Y
Revision	Appendix D, Wattage and Savings by Bulb Type for Distributor Channel, Measure Cost and Avoided O&M by Bulb Type for Distributor Channel Distribution of Heating Fuel	Updated wattage with recent program data and incorporated evaluation findings into calculated savings. Updated prices with recent program data. Updated measure life with evaluation findings. Updated avoided O&M to reflect new measure life.	7/1/2021	Y

[8] Note this change was implemented in effRT prior to being reflected in the TRM. Effective date reflects the effRT implmentation date.

Change Type	TRM Section	Description	Effective Date	effRT Update
		Incorporated evaluation findings for fuel distribution for lighting interactive effects.		
Revision	Prescriptive Lighting, Appendix D, Installed Measure Wattage and Cost Table	Updated wattage and cost data with recent program data for Small Business Initiative.	7/1/2021	Y
New	Prescriptive Horticultural Lighting – Cannabis	New prescriptive measure added.	7/1/2021	Y
Revision	Carbon Dioxide Emission Factors	Updated electricity factor with ISO NE all LMUs from 2019 emissions report	7/1/2021	N
Revision	Appendix D, Installed Measure Wattage and Cost Table	SBI measure costs updated with negotiated prices. CIP material and measure costs removed. New SBI retrofit kit options added.	7/1/2021	N
Revision	AC<X>, AH<X>, WH	Updated baseline equipment efficiency values to reflect IECC 2015 minimum standards	7/1/2021	Y
Other	G<X>, H<X>L	Removed oil and propane.	7/1/2021	N
Revision	High Performance Heat Pumps	Updated savings for lost opportunity measure from revised modeling with better matched baseline HP capacity and correct peak demand coincidence. Corrected inactive multifamily retrofit measure to reflect retrofit savings. Updated DHP<X>L measure life to be consistent with other HP measures.	7/1/2021	Y
Revision	Appendix D, Distribution of Heating Fuel	Updated fuel distribution for heat pumps based on recent program data.	7/1/2021	Y
Revision	Prescriptive Horticultural Lighting – Cannabis	Expanded savings scenarios to include conditions when reheat penalty applies. Inclusion of reheat penalty	3/1/2021	Y
Revision	Appendix D, Wattage and Savings by Bulb Type for Distributor Channel, Measure Cost and Avoided O&M by Bulb Type for Distributor Channel	Updated wattage with recent program data. Updated prices with recent program data.	3/10/2022	Y
New	Prescriptive Agricultural: Stand Alone Dehumidifiers for Indoor Cannabis Cultivation	New measure	3/1/2022	Y
Revision	Appendix B, Energy Period Factors and Coincidence Factors	Added Stand Alone Dehumidifiers for Indoor Cannabis Cultivation Refined Custom Load Profiles	3/1/2022	Y
Appendix D	Installed Measure Wattage and Cost Table	Updated SBI material costs with program data	3/1/2022	N
Correction	VRFSP, VRFSPR	Corrected FR and SO to new measure defaults, effRT implementation correct.	5/1/2020	N

Change Type	TRM Section	Description	Effective Date	effRT Update
Correction	Lighting Controls	Revert realization rates to previous evaluation findings. SBI Evaluation did not address stand-alone lighting controls. EffRT reflects previous RR and does not require an update.	7/1/2021	N
Correction	Prescriptive Lighting	Correct effRT implementation to reflect realization rates in the TRM for C&I program measures that were not addressed by SBI Evaluation.	7/1/2021	Y
Correction	Prescriptive Lighting	Interactive effect factors updated for Lighting fixtures with interactive controls and lighting controls to reflect evaluation findings. effRT implementation is correct.	7/1/2021	N
Correction	Distributor Lighting	Correct effRT implementation to include interactive effect for electric heating demand (all lamps) and in-service rate for linear LEDs.	7/1/2021	Y
New, Revision	PTHP and VPTHP	Added multi-family, new construction measures to PTHP and VPTHP. Updated VPTHP measure cost to "actual".	5/1/2022	Y
Correction	Appendix D, Wattage and Savings by Bulb Type for Distributor Channel	Corrected Summer kW value for S6BLL, S6CLL from 3/10/2022 update. effRT implementation was correct.	3/10/2022	N
Revision	Appendix D, Wattage and Savings by Bulb Type for Distributor Channel, Measure Cost and Avoided O&M by Bulb Type for Distributor Channel	Updated wattage with recent program data. Updated prices with recent program data. Updated measure life. Updated avoided O&M to reflect new measure life. Incorporated evaluation findings for fuel distribution for lighting interactive effects.	7/1/2022	Y
Revision	Appendix D, Installed Measure Wattage and Cost Table	Removed wattage and cost data (collecting actual wattage and costs on all projects) and renamed table to Installation Labor Hours for Lighting Fixtures.	7/1/20222	N
Revision	Multifamily Insulation	Refined heating and cooling degree days.	7/1/2022	Y
Revision	Distribution of Heating Fuel	Added unknown fuel distribution for VRF	7/1/2021	Y
Revision	Emissions	Updated emission factors with most recent EIA and ISO NE reported values	7/1/2022	N
Revision	Appendix D, Wattage and Savings by Bulb Type for Distributor Channel, Measure Cost and Avoided O&M by Bulb Type for Distributor Channel	Updated wattage with recent program data. Updated prices with recent program data.	10/1/2022	Y
Revision	MDHP1RT2, MDHP2RT2	Updated measure cost to reflect retrofit.	10/1/2022	Y
Revision	Multifamily Insulation	Updated consistent with residential insulation assumptions and calculations	10/1/2022	Y
Revision	Appendix D, Distribution of Heating Fuel	Multifamily heat pump and insulation entries added.	10/1/2022	Y
Revision	Custom Thermal, Appendix B	Added Lead by Example initiative.	10/1/2023	Y

Change Type	TRM Section	Description	Effective Date	effRT Update
New	Heat Pump Rooftop Unit	New measure	11/9/2022	Y
Revision	Specialty LED Lamp	Marked GSL measure codes inactive	1/1/2023	Y
Revision	Multifamily heat pump retrofit	Updated measure cost, updated fuel distribution. Measure remains inactive	1/1/2023	N
Revision	Multifamily heat pump lost opportunity	Updated fuel distribution	10/7/2022	Y
Revision	Heat Pump Rooftop Unit	Revised factors from updated regression modeling	1/1/2023	Y
Revision	Custom Measures, Appendix B	Added Ag Fairs to custom electric and custom thermal	4/1/2023	Y
New	HPWHCE, HPWHCU	New heat pump water heater measures	7/1/2023	Y
New	CMSHP, MFMSHP	New mini-split heat pump measures replace high performance heat pump measures and incorporate evaluation findings	7/1/2023	Y
Revision	VRF<X>	Updated measure cost data with recent program data and industry price index Updated measure code to match FY2024 effRT implementation	1/1/2024	Y
Other	DCKV	Marked Demand Control Kitchen Ventilation as inactive	1/1/2024	N
Correction	WH	Modified units to be consistent with effRT data entry	N/A	N
Correction	<X>MSHP	Corrected energy savings factors	7/1/2023	Y

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 (Retrofit/Replacement Lamps), Codes <P/I>S21<Y/S/W>, <P/I>S25<Y/S/W>, IS40<Y/S/W>, <P/I>S51<Y/S/W>, <P/I>S52<Y/S/W>, <P/I>S61<Y/S/W>, <P/I>S62<Y/S/W>, <P/I>S64<Y/S/W>, <P/I>S81<Y/S/W>, <P/I>S82<Y/S/W>, IS110<Y/S/W>[9]	
Last Revised Date	7/1/2021
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 Initiative
Primary Energy Impact	Electric
Sector	Commercial/Industrial
Program(s)	C&I Prescriptive Program, Small Business Initiative
End-Use	Lighting
Project Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) / 1{,}000 \times WHF_{d,cool}$ $\Delta kW_{SP} = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) / 1{,}000 \times WHF_{d,cool} \times CF_S$ $\Delta kW_{WP} = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) / 1{,}000 \times WHF_{d,heat} \times CF_W$
Annual Energy Savings	$\Delta kWh/yr = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) / 1{,}000 \times HoursWk \times Weeks \times WHF_{e,cool}$ $\Delta MMBtu/yr$[10] $= -(Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) / 1{,}000 \times HoursWk \times Weeks \times WHF_{e,heat}$
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) $WHF_{d,cool}$ = 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 $WHF_{d,heat}$ = Waste heat factor for demand to account for increased heating demand 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.

[9] Previous measure codes: S21, S21R, S40, S51, S51R, S52., S61, S61R, S62, S64, S81, S81R, S82, S110, S110R
[10] 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 (Retrofit/Replacement Lamps), Codes <P/I>S21<Y/S/W>, <P/I>S25<Y/S/W>, IS40<Y/S/W>, <P/I>S51<Y/S/W>, <P/I>S52<Y/S/W>, <P/I>S61<Y/S/W>, <P/I>S62<Y/S/W>, <P/I>S64<Y/S/W>, <P/I>S81<Y/S/W>, <P/I>S82<Y/S/W>, IS110<Y/S/W>[9]

PARAMETER VALUES

Measure/Type	Qty_{BASE}	$Watts_{BASE}$	Qty_{EE}	$Watts_{EE}$	HoursWk[11]	Weeks	Life (yrs)	Cost ($)
C&I Prescriptive	Actual	Table 57~~Table 57~~[12]	Actual	Table 56~~Table 56~~[12]	Actual	Actual	13[13]	Actual[14]
Small Business Direct Install (not S40)							20[15]	
S40							7[16]	

Measure/Type	$WHF_{d,cool}$[17]	$WHF_{e,cool}$[18]	$WHF_{d,heat}$[19]	$WHF_{e,heat}$[20]
All	1.0747	1.0222	0.995	0.0011

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	100%[21]	100%[21]	Table 54~~Table 54~~[22]	Table 54~~Table 54~~[22]	26%[23]	1.6%[24]
Small Business Direct Install	100%	81%[25]	100%[26]	Table 54~~Table 54~~[22]	Table 54~~Table 54~~[22]	8.6%[27]	0%[28]

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[11] Use actual hours when known. If hours are unknown, use the values from Table 59.
[12] See Appendix D~~Appendix D~~. The fixture wattages are based on the specified fixture types for baseline and installed fixtures.
[13] 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
[14] Actual project costs collected for all projects. For reference see Appendix D: Parameter Values Reference Tables~~Appendix D: Parameter Values Reference Tables~~
[15] Demand Side Analytics, Small Business Initiative Impact Evaluation, March 2021.
[16] Based on 25,000 hour rated life and 3772 hours of use per year.
[17] 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~~Appendix D: Parameter Values Reference Tables~~ for derivation and input assumptions.
[18] Ibid.
[19] Ibid.
[20] Ibid.
[21] Realization rates are 100 percent since evaluation findings have been incorporated into the program: refined wattage bins, elimination of seasonal businesses, updated coincidence factors. Nexant, Business Incentive Program Impact Evaluation
[22] See Appendix B~~Appendix B~~.
[23] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[24] Ibid.
[25] Demand Side Analytics, Small Business Initiative Impact Evaluation, March 2021.
[26] Demand realization rate is 100 percent since evaluation findings for coincidence factors have been incorporated into the program.
[27] Demand Side Analytics, Small Business Initiative Impact Evaluation, March 2021
[28] Spillover not assessed.

Prescriptive Lighting: Lighting Fixtures with Integrated Controls – Interior Spaces (Retrofit), Code <P/I>S70<Y/S/W>	
Last Revised Date	7/1/2021
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 Initiative
End-Use	Lighting
Project Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = (WHF_{d,cool} / 1{,}000) \times [(Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) + (Qty_{EE} \times Watts_{EE} \times ContOutRed \times (1 - Occ))]$ $\Delta kW_{SP} = (WHF_{d,cool} / 1{,}000) \times [(Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) + (Qty_{EE} \times Watts_{EE} \times ContOutRed \times (1 - Occ)) \times CF_S]$ $\Delta kW_{WP} = (WHF_{d,heat} / 1{,}000) \times [(Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) + (Qty_{EE} \times Watts_{EE} \times ContOutRed \times (1 - Occ)) \times CF_W]$
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%) $WHF_{d,cool}$ = 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 $WHF_{d,heat}$ = Waste heat factor for demand to account for increased heating demand 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 <P/I>S70<Y/S/W>	
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[29]	Weeks	Life (yrs)	Cost ($)
C&I Prescriptive	Actual	Table 57~~Table 57~~[30]	Actual	Table 56~~Table 56~~[31]	Actual	Actual	13[32]	Actual[33]
Small Business Direct Install							20[34]	

Measure/Type	ContOutRed	Occ	$WHF_{d,cool}$[35]	$WHF_{e,cool}$[36]	$WHF_{d,heat}$[37]	$WHF_{e,heat}$[38]
Retrofit	Actual	Actual	1.0747	1.0222	0.995	0.0011

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	99%[39]	101%[40]	Table 54~~Table 54~~[41]	Table 54~~Table 54~~[42]	26%[43]	1.6%[44]
Small Business Direct Install	100%	81%[45]	100%[46]	Table 54~~Table 54~~[47]	Table 54~~Table 54~~[48]	8.6%[49]	0%[50]

[29] Use actual hours when known. If hours are unknown, use the values from Table 59.
[30] See Appendix D~~Appendix D~~. The fixture wattages are based on the specified fixture types for baseline and installed fixtures.
[31] Ibid.
[32] 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.
[33] Actual project costs collected for all projects. For reference see Appendix D: Parameter Values Reference Tables~~Appendix D: Parameter Values Reference Tables~~.
[34] Demand Side Analytics, Small Business Initiative Impact Evaluation, March 2021.
[35] 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~~Appendix D: Parameter Values Reference Tables~~ for derivation and input assumptions.
[36] Ibid.
[37] Ibid.
[38] Ibid.
[39] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Realization Rates for Prescriptive Measures.
[40] Ibid.
[41] See Appendix B~~Appendix B~~.
[42] See Appendix B.
[43] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[44] Ibid.
[45] Demand Side Analytics, Small Business Initiative Impact Evaluation, March 2021.
[46] Demand realization rate is 100 percent since evaluation findings for coincidence factors have been incoported into the program.
[47] See Appendix B~~Appendix B~~.
[48] See Appendix B~~Appendix B~~.
[49] Demand Side Analytics, Small Business Initiative Impact Evaluation, March 2021
[50] Spillover not assessed.

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 Initiative
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) = 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 57~~Table 57~~[51]	Actual	Table 56~~Table 56~~[52]	8,760[53]	13[54]	Table 56~~Table 56~~[55]
Measure/Type	WHF_{d}[56]	$WHF_{e,cool}$[57]	$WHF_{e,heat}$[58]				

[51] See Appendix D~~Appendix D~~. The fixture wattages are based on the specified fixture types for baseline and installed fixtures.
[52] See Appendix D~~Appendix D~~. The fixture wattages are based on the specified fixture types for baseline and installed fixtures.
[53] Exit signs operate continuously, so annual operating hours are 8,760 hours/year (24 hours/day x 365 days/year = 8,760 hours/year).
[54] 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.
[55] See Appendix D: Parameter Values Reference Tables~~Appendix D: Parameter Values Reference Tables~~.
[56] 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~~Appendix D: Parameter Values Reference Tables~~ for derivation and input assumptions.
[57] Ibid.
[58] Ibid.

Prescriptive Lighting: Lighting Fixtures – LED Exit Signs, Code X10 (Inactive)							
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%[59]	101%[59]	Table 54~~Table 54~~[60]	Table 54~~Table 54~~[60]	26%[61]	1.6%[62]
Small Business Direct Install	100%	100%[63]	100%[63]	Table 54~~Table 54~~[60]	Table 54~~Table 54~~[60]	25%[64]	0%[65]

[59] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Realization Rates for Prescriptive Measures.
[60] See Appendix B~~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] Program not yet evaluated, assume default FR of 25%.
[65] Program not yet evaluated, assume default SO of 0%.

Prescriptive Lighting: Lighting Fixtures – Exterior Spaces (Retrofit/Replacement Lamps), Codes IS06<Y/S/W>, <P/I>S08<Y/S/W>, IS09<Y/S/W>, <P/I>S11<Y/S/W>, <P/I>S13<Y/S/W>, <P/I>S17<Y/S/W>, <P/I>S23<Y/S/W>[66]

Last Revised Date	7/1/2021
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 Initiative
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[67]	Weeks	Life (yrs)	Cost ($)
C&I Prescriptive	Actual	Table 57~~Table 57~~[68]	Actual	Table 56~~Table 56~~[68]	Actual	Actual	13[69]	Actual[70]
Small Business Direct Install							12[71]	

[66] Previous codes: S6, S8, S11, S11R, S13, S13R, S17, S17R, S23, S23R
[67] Use actual when available; otherwise, use 4,380 (operating 12 hrs 365 days a year).
[68] See Appendix D~~Appendix D~~. The baseline and installed fixture wattages are based on the specified baseline fixture type.
[69] 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.
[70] Actual project costs collected for all projects. For reference see Appendix D: Parameter Values Reference Tables~~Appendix D: Parameter Values Reference Tables~~.
[71] Demand Side Analytics, Small Business Initiative Impact Evaluation, March 2021.

Prescriptive Lighting: Lighting Fixtures – Exterior Spaces (Retrofit/Replacement Lamps), Codes IS06<Y/S/W>, <P/I>S08<Y/S/W>, IS09<Y/S/W>, <P/I>S11<Y/S/W>, <P/I>S13<Y/S/W>, <P/I>S17<Y/S/W>, <P/I>S23<Y/S/W>[66]							
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	100%[72]	100%[73]	Table 54~~Table 54~~[74]	Table 54~~Table 54~~[74]	26%[75]	1.6%[76]
Small Business Direct Install	100%	100%[77]	100%[78]	Table 54~~Table 54~~[74]	Table 54~~Table 54~~[74]	8.6%[79]	0%[80]

[72] Realization rates are 100 percent since evaluation findings have been incoported into the program: refined wattage bins, elimination of seasonal businesses, updated coincidence factors. Nexant, Business Incentive Program Impact Evaluation
[73] Ibid.
[74] See Appendix B~~Appendix B~~.
[75] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[76] Ibid.
[77] Energy realization rate is 100 percent since evaluation findings have been incoported into the program.
[78] Demand realization rate is 100 percent since evaluation findings for coincidence factors have been incoported into the program.
[79] Demand Side Analytics, Small Business Initiative Impact Evaluation, March 2021.
[80] Spillover not assessed.

Prescriptive Lighting: Lighting Controls – Interior Spaces, Codes <P/I>L60<Y/S/W>, <P/I>L70<Y/S/W>, <P/I>L71<Y/S/W>	
Last Revised Date	5/1/2021 (retroactive to 7/1/2021)
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 Initiative
End-Use	Lighting
Project Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = Qty_{FIXTURES} \times Watts / 1{,}000 \times WHF_{d,cool}$ $\Delta kW_{SP} = Qty_{FIXTURES} \times Watts / 1{,}000 \times WHF_{d,cool} \times CF_{S}$ $\Delta kW_{WP} = Qty_{FIXTURES} \times Watts / 1{,}000 \times WHF_{d,heat} \times CF_{W}$
Annual Energy Savings	$\Delta kWh/yr = Qty_{FIXTURES} \times Watts / 1{,}000 \times HoursWk \times Weeks \times SVG \times WHF_{e,cool}$ ΔMMBtu/yr[81] $= -Qty_{FIXTURES} \times Watts / 1{,}000 \times HoursWk \times Weeks \times SVG \times WHF_{e,heat}$
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 (%) $WHF_{d,cool}$ = 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 $WHF_{d,heat}$ = Waste heat factor for demand to account for increased heating demand 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 baseline case is a manual switch in the absence of controls.
Efficient Measure	Lighting controls that automatically control the connected lighting systems.

[81] 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 <P/I>L60<Y/S/W>, <P/I>L70<Y/S/W>, <P/I>L71<Y/S/W>							
PARAMETER VALUES							
Measure/Type	Qty	Watts[82]	HoursWk[83]	Weeks	SVG	Life (yrs)	Cost ($)
Retrofit	Actual	Table 56Table 56 or Table 57Table 57	Actual	Actual	Table 60Table 60[84]	10[85]	Actual[86]
Measure/Type	$WHF_{d,cool}$[87]	$WHF_{e,cool}$[88]	$WHF_{d,heat}$[89]	$WHF_{e,heat}$[90]			
All	1.0747	1.0222	0.995	0.0011			
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	99%[91]	101%[91]	Table 54Table 54[92]	Table 54Table 54[92]	26%[93]	1.6%[94]
Small Business Direct Install	100%	100%[95]	100%[96]	Table 54Table 54[92]	Table 54Table 54[92]	8.6%[97]	0%[98]

[82] See Appendix D: Parameter Values Reference TablesAppendix 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.
[83] Use actual hours when known. If hours are unknown, use the values from Table 59.
[84] See Appendix D: Parameter Values Reference TablesAppendix 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.
[85] 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.
[86] Actual project costs collected for all projects. For reference see Appendix D: Parameter Values Reference TablesAppendix D: Parameter Values Reference Tables.
[87] 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 TablesAppendix D: Parameter Values Reference Tables for derivation and input assumptions.
[88] Ibid.
[89] Ibid.
[90] Ibid.
[91] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Realization Rates for Prescriptive Measures.
[92] See Appendix BAppendix B.
[93] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[94] Ibid.
[95] Demand Side Analytics, Small Business Initiative Impact Evaluation did not address stand-alone controls. Continue to assume 100% realization rate.
[96] Ibid.
[97] Demand Side Analytics, Small Business Initiative Impact Evaluation, March 2021
[98] Spillover not assessed.

Prescriptive Lighting: Lighting Fixtures – Refrigerated Spaces, Codes <P/I>S30<Y/S/W>, <P/I>S32<Y/S/W>	
Last Revised Date	7/1/2021
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 Initiative
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 <P/I>S30<Y/S/W>, <P/I>S32<Y/S/W>					
PARAMETER VALUES					
Measure/Type	Qty_{BASE}	$Watts_{BASE}$	#doors, #feet	$Watts_{EE}$	$SAVE_{EE}$
New construction	N/A	N/A	Actual	N/A	Table 56~~Table 56~~[99]
Retrofit	Actual	Table 57~~Table 57~~[99]	Actual	Table 56~~Table 56~~[99]	N/A
Measure/Type	HoursWk[100]	Weeks	BF	Life (yrs)	Cost ($)
New construction	Actual	Actual	1.29[101]	15[102]	Actual[103]
Retrofit				13[102]	

IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	99%[104]	101%[104]	Table 54~~Table 54~~[105]	Table 54~~Table 54~~[105]	26%[106]	1.6%[107]
Small Business Direct Install	100%	81%[108]	100%[109]	Table 54~~Table 54~~[105]	Table 54~~Table 54~~[105]	8.6%[110]	0%[111]

[99] See Appendix D~~Appendix D~~. The fixture wattage and wattage reduction values are based on the specified fixture types for both baseline and installed fixtures.
[100] Use actual when available; otherwise use 4,057 (retail average annual operating hours, From New York Technical Reference Manual, 2010).
[101] 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.
[102] 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.
[103] Actual project costs collected for all projects. For reference see Appendix D: Parameter Values Reference Tables~~Appendix D: Parameter Values Reference Tables~~.
[104] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Realization Rates for Prescriptive Measures. The 2017 Nexant Business Incentive Program Impact Evaluation did not include sufficient samples of lighting in refrigerated spaces to calculate a realization rate for this measure.
[105] See Appendix B~~Appendix B~~.
[106] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[107] Ibid.
[108] Demand Side Analytics, Small Business Initiative Impact Evaluation, March 2021.
[109] Demand realization rate is 100 percent since evaluation findings for coincidence factors have been incoported into the program.
[110] Demand Side Analytics, Small Business Initiative Impact Evaluation, March 2021
[111] Spillover not assessed.

Prescriptive Lighting: Lighting Controls – Refrigerated Spaces, Code <P/I>L50<Y/S/W>

Last Revised Date	5/1/2021 (retroactive to 7/1/2021)
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 Initiative
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[112]	HoursWk[113]	Weeks	SF[114]	BF[115]	Life (yrs)[116]	Cost ($)[117]
New construction	Actual	Table 56~~Table 56~~	Actual	Actual	30.7%	1.29	10	Actual
Retrofit							9	

112 See Appendix D~~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.

113 Use actual when available; otherwise, use 168 HoursWk and 52 Weeks (assuming equipment operates 24 hours per day, year round).

114 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.

115 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.

116 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.

117 Actual project costs collected for all projects. For reference see Appendix D: Parameter Values Reference Tables~~Appendix D: Parameter Values Reference Tables~~.

Prescriptive Lighting: Lighting Controls – Refrigerated Spaces, Code <P/I>L50<Y/S/W>							
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	99%[118]	101%[119]	Table 54~~Table 54~~[120]	Table 54~~Table 54~~[120]	26%[121]	1.6%[122]
Small Business Direct Install	100%	100%[123]	100%[124]	Table 54~~Table 54~~[120]	Table 54~~Table 54~~[120]	8.6%[125]	0%[126]

[118] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Realization Rates for Prescriptive Measures. The 2017 Nexant Business Incentive Program Impact Evaluation did not include sufficient samples of lighting in refrigerated spaces to calculate a realization rate for this measure.
[119] Ibid.
[120] See Appendix B~~Appendix B~~.
[121] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[122] Ibid.
[123] Demand Side Analytics, Small Business Initiative Impact Evaluation did not address stand-alone controls. Continue to assume 100% realization rate.
[124] Demand realization rate is 100 percent since evaluation findings for coincidence factors have been incorporated into the program.
[125] Demand Side Analytics, Small Business Initiative Evaluation, March 2021
[126] Spillover not assessed.

Standard LED Lamp – Distributor (LEDSTDLLD, LEDSTDSLD) (Inactive)	
Last Revised Date	11/1/2020
MEASURE OVERVIEW	
Description	Standard (A-Line) LED Lamp (Bulb). This measure involves the installation of a new LED lamp in place of an existing or new inefficient lamp (incandescent or halogen).
Primary Energy Impact	Electric
Sector	Residential, Commercial
Program(s)	Consumer Products Program – Lighting - Distributor
End-Use	Lighting
Decision Type	New Construction, Replace on Burnout
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand savings	See Table 61
Annual energy savings	See Table 61
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	$\Delta kW = \Delta Watt_{LED} / 1{,}000 \times IE_{COOL\_D}$ $\Delta kW_{SP} = \Delta Watt_{LED} / 1{,}000 \times CF_S \times IE_{COOL\_D}$ $\Delta kW_{WP} = \Delta Watt_{LED} / 1{,}000 \times CF_W$
Annual energy savings	$\Delta kWh/yr = \Delta Watts_{LED} / 1{,}000 \times [365 \times HPD_{RES} \times \%RES + HPY_{COMM} \times \%COMM] \times IE_{COOL\_E}$ $\Delta MMBtu = -\Delta Watts_{LED} / 1{,}000 \times [365 \times HPD_{RES} \times \%RES + HPY_{COMM} \times \%COMM] \times IE_{HEAT\_E}$ $\Delta MMBtu_{FUEL} = \Delta MMBtu \times \%FUEL$
Definitions	Unit = 1 lamp $\Delta Watt_{LED}$ = Average wattage difference between baseline bulbs and program LED (Watts) 1,000 = Conversion: 1,000 Watts per kW 365 = Conversion: 365 days per year HPD_{RES} = Average daily operating hours in residential setting (hrs/day) %RES = Share of bulb purchases that are installed in residential setting (%) HPY_{COMM} = Average annual operating hours in commercial setting (hrs/yr) %COMM = Share of bulb purchases that are installed in commercial setting (%) IE_{COOL_D} = Electric demand interactive effect multiplier, accounts for reduced cooling load IE_{COOL_E} = Electric energy interactive effect multiplier, accounts for reduced cooling load IE_{HEAT_E} = MMBtu energy interactive effect multiplier, accounts for increased heat load %FUEL = Heating fuel distribution[127]
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Halogen lamp
Efficient Measure	LED lamp
PARAMETER VALUES (DEEMED)	

Measure	$\Delta Watts_{LED}$	HPD_{RES}	HPY_{COMM}	%RES	%COMM	Life (yrs)	Cost ($)
LED Bulb	Table 61	2[128]	3,772[129]	31%[130]	69%[130]	Table 62	Table 62
	IE_{COOL_D}	IE_{COOL_E}	IE_{HEAT_E}	%FUEL	Avoided O&M ($)		
LED Bulb	1.101[131]	1.039[132]	0.00122[133]	Table 63	Table 62		

[127] Heating fuel distribution is used to allocate savings to different fuels because the interactive effects impact heating energy consumption.
[128] NMR Group, Efficiency Maine Retail Lighting Program Overall Evaluation Report, April 16, 2015, p. 16.
[129] Average annual hours of use for commercial spaces. Efficiency Maine Commercial Technical Reference Manual Version 2015.1 Table 33.
[130] Percent of bulbs sold through distributor channel installed in commercial setting based on program data collected 7/1/2016-3/31/2017.
[131] 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 TablesAppendix D: Parameter Values Reference Tables for derivation and input assumptions.
[132] Ibid.
[133] Ibid.

Standard LED Lamp – Distributor (LEDSTDLLD, LEDSTDSLD) (Inactive)							
IMPACT FACTORS							
Measure	ISR	RR_E	RR_D	CF_W[134]	CF_S[135]	FR	SO
LED Bulb	99%[136]	100%[137]	100%[138]	36.5%	46.1%	26%[139]	1.6%[140]

[134] Composite coincidence factors based on proportion of bulbs installed in residential (31%) and commercial settings (69%). Residential Factors from NMR Group, Efficiency Maine Retail Lighting Program Overall Evaluation Report, April 16, 2015, page 19. Nexant Business Incentive Program Impact Evaluation November 2017. Weighted average coincidence factors based on program facility type distribution.

[135] Composite coincidence factors based on proportion of bulbs installed in residential (31%) and commercial settings (69%). Residential Factors from NMR Group, Efficiency Maine Retail Lighting Program Overall Evaluation Report, April 16, 2015, page 19. Nexant Business Incentive Program Impact Evaluation November 2017. Weighted average coincidence factors based on program facility type distribution.

[136] ISR is based on long-term ISR from NMR Group, Efficiency Maine Retail Lighting Program Overall Evaluation Report, April 16, 2015, p. 14. It is assumed that storage habits are the same for standard efficiency bulbs as LED therefore the equivalent measure life is based on the long-term ISR.

[137] Realization rates are 100 percent since savings estimates are based on evaluation results.

[138] Ibid.

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

[140] Ibid.

Linear LED Lamp – Distributor (Codes: S110A<2/4>L, S110A<2/4>L, S110C4<4/3/2>,S111<A/AHO/AU>, Inactive: LEDSPCCDDL, LEDSPCCDDS, LEDSPCGLDL, LEDSPCGLDS, LEDSPCBRDL, LEDSPCBRDS, LEDSPCPRDL, LEDSPCPRDS, LEDSPCPBDL, LEDSPCPBDS)

Last Revised Date	10/1/2022
MEASURE OVERVIEW	
Description	Linear LED replacement lamps. This measure involves the installation of a new LED in place of an existing or new inefficient lamp (fluorescent).
Primary Energy Impact	Electric
Sector	Residential, Commercial
Program(s)	Consumer Products Program – Lighting – Distributor
End-Use	Lighting
Decision Type	New Construction, Replace on Burnout
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand savings	See Table 61
Annual energy savings	See Table 61
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	$\Delta kW = \Delta Watt_{LED} / 1{,}000 \times IE_{COOL\_D}$ $\Delta kW_{SP} = \Delta Watt_{LED} / 1{,}000 \times CF_{S} \times IE_{COOL\_D}$ $\Delta kW_{WP} = \Delta Watt_{LED} / 1{,}000 \times IE_{HEAT\_D} \times CF_{W}$
Annual energy savings	$\Delta kWh/yr = \Delta Watts_{LED} / 1{,}000 \times [365 \times HPD_{RES} \times \%RES + HPY_{COMM} \times \%COMM] \times IE_{COOL\_E}$ $\Delta MMBtu = -\Delta Watts_{LED} / 1{,}000 \times [365 \times HPD_{RES} \times \%RES + HPY_{COMM} \times \%COMM] \times IE_{HEAT\_E}$ $\Delta MMBtu_{FUEL} = \Delta MMBtu \times \%FUEL$
Definitions	Unit = 1 lamp $\Delta Watt_{LED}$ = Average wattage difference between baseline bulbs and program LED (Watts) 1,000 = Conversion: 1,000 Watts per kW 365 = Conversion: 365 days per year HPD_{RES} = Average daily operating hours in residential setting (hrs/day) %RES = Share of bulb purchases that are installed in residential setting (%) HPY_{COMM} = Average annual operating hours in commercial setting (hrs/yr) %COMM = Share of bulb purchases that are installed in commercial setting (%) IE_{COOL_D} = Electric demand interactive effect multiplier, accounts for reduced cooling load IE_{COOL_E} = Electric energy interactive effect multiplier, accounts for reduced cooling load IE_{HEAT_D} = Electric demand interactive effect multiplier, accounts for increases heating load IE_{HEAT_E} = MMBtu energy interactive effect multiplier, accounts for increased heat load %FUEL = Heating fuel distribution[141]
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Incandescent Lamp
Efficient Measure	LED Lamp
PARAMETER VALUES (DEEMED)	

Measure	IE_{COOL_D}	IE_{COOL_E}	IE_{HEAT_D}	IE_{HEAT_E}	%RES	%COMM	Life (yrs)	Cost ($)
Linear LED Lamp	1.0747[142]	1.0222[143]	00.9955[144]	0.0011[145]	0%[146]	100%[147]	Table 62	Table 62

	$\Delta Watts_{LED}$	HPD_{RES}	HPY_{COMM}	%FUEL	Avoided O&M ($)	
LED Bulb	Table 61	2.1[148]	3,053[149]	Table 63	Table 62	

[141] Heating fuel distribution is used to allocate savings to different fuels because the interactive effects impact heating energy consumption. See Table 63.
[142] 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 TablesAppendix D: Parameter Values Reference Tables for derivation and input assumptions.
[143] Ibid.
[144] Ibid.
[145] Ibid.
[146] Program rules limit sales of Linear LED Lamps (aka TLEDs) to commercial customers. This change was reflected in effRT July 1, 2019.
[147] Ibid.
[148] Demand Side Analytics, Retail and Distributor Lighting Evaluation, March 2021.
[149] Ibid.

Linear LED Lamp – Distributor (Codes: S110A<2/4>L, S110A<2/4>L, S110C4<4/3/2>,S111<A/AHO/AU>, Inactive: LEDSPCCDDL, LEDSPCCDDS, LEDSPCGLDL, LEDSPCGLDS, LEDSPCBRDL, LEDSPCBRDS, LEDSPCPRDL, LEDSPCPRDS, LEDSPCPBDL, LEDSPCPBDS)							
IMPACT FACTORS							
Measure	ISR	RR_E	RR_D	CF_W	CF_S	FR	SO
LED Bulb	99%[150]	100%[151]	100%[152]	Table 54[153]	Table 54[154]	51%[155]	0%[156]

[150] Demand Side Analytics, Retail and Distributor Lighting Evaluation, March 2021.
[151] Realization rates are 100 percent since savings estimates are based on evaluation results.
[152] Ibid.
[153] See Appendix B~~Appendix B~~.
[154] See Appendix B~~Appendix B~~.
[155] Demand Side Analytics, Retail and Distributor Lighting Evaluation, March 2021.
[156] Ibid.

LED Mogul Lamp Interior – Distributor (Codes: S64BCLLL, S64BCLHL, S64BCHLL, S64BCHHL)	
Last Revised Date	10/1/2022
MEASURE OVERVIEW	
Description	LED mogul base lamps. This measure involves the installation of a new LED in place of an existing or new inefficient bulb (incandescent or halogen) in an interior fixture.
Primary Energy Impact	Electric
Sector	Residential, Commercial
Program(s)	Consumer Products Program – Lighting – Distributor
End-Use	Lighting
Decision Type	New Construction, Replace on Burnout
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand savings	See Table 61
Annual energy savings	See Table 61
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	$\Delta kW = \Delta Watt_{LED} / 1,000 \times IE_{COOL\_D}$ $\Delta kW_{SP} = \Delta Watt_{LED} / 1,000 \times CF_S \times IE_{COOL\_D}$ $\Delta kW_{WP} = \Delta Watt_{LED} / 1,000 \times IE_{HEAT\_D} \times CF_W$
Annual energy savings	$\Delta kWh/yr = \Delta Watts_{LED} / 1,000 \times [365 \times HPD_{RES} \times \%RES + HPY_{COMM} \times \%COMM] \times IE_{COOL\_E}$ $\Delta MMBtu = -\Delta Watts_{LED} / 1,000 \times [365 \times HPD_{RES} \times \%RES + HPY_{COMM} \times \%COMM] \times IE_{HEAT\_E}$ $\Delta MMBtu_{FUEL} = \Delta MMBtu \times \%FUEL$
Definitions	Unit = 1 bulb $\Delta Watt_{LED}$ = Average wattage difference between baseline bulbs and program LED (Watts) 1,000 = Conversion: 1,000 Watts per kW 365 = Conversion: 365 days per year HPD_{RES} = Average daily operating hours in residential setting (hrs/day) %RES = Share of bulb purchases that are installed in residential setting (%) HPY_{COMM} = Average annual operating hours in commercial setting (hrs/yr) %COMM = Share of bulb purchases that are installed in commercial setting (%) IE_{COOL_D} = Electric demand interactive effect multiplier, accounts for reduced cooling load IE_{COOL_E} = Electric energy interactive effect multiplier, accounts for reduced cooling load IE_{HEAT_D} = Electric demand interactive effect multiplier, accounts for increased heating load IE_{HEAT_E} = MMBtu energy interactive effect multiplier, accounts for increased heat load %FUEL = Heating fuel distribution[157]
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Incandescent
Efficient Measure	LED bulb
PARAMETER VALUES (DEEMED)	

Measure	$\Delta Watts_{LED}$	HPD_{RES}	HPY_{COMM}	%RES	%COMM	Life (yrs)	Cost ($)
LED Bulb	Table 61	2.1[158]	3,053[159]	0%[160]	100%[161]	Table 62	Table 62
	IE_{COOL_D}	IE_{COOL_E}	IE_{HEAT_D}	IE_{HEAT_E}	%FUEL	Avoided O&M ($)	
LED Bulb	1.0747[162]	1.0222[163]	00.9955[164]	0.0011[165]	Table 63	Table 62	

157 Heating fuel distribution is used to allocate savings to different fuels because the interactive effects impact heating energy consumption. See Table 63.
158 Demand Side Analytics, Retail and Distributor Lighting Evaluation, March 2021.
159 Ibid.
160 Mogul base lamps are primarily applicable to commercial settings. Percent installed in commercial applications is assumed to be 100%.
161 Ibid.
162 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~~Appendix D: Parameter Values Reference Tables~~ for derivation and input assumptions.
163 Ibid.
164 Ibid.
165 Ibid.

LED Mogul Lamp Interior – Distributor (Codes: S64BCLLL, S64BCLHL, S64BCHLL, S64BCHHL)							
IMPACT FACTORS							
Measure	ISR	RR_E	RR_D	CF_W	CF_S	FR	SO
LED Bulb	99%[166]	100%[167]	100%[168]	Table 54[169]	Table 54[170]	51%[171]	0%[172]

[166] Demand Side Analytics, Retail and Distributor Lighting Evaluation, March 2021.
[167] Realization rates are 100 percent since savings estimates are based on evaluation results.
[168] Ibid.
[169] See Appendix B~~Appendix B~~.
[170] See Appendix B~~Appendix B~~.
[171] Demand Side Analytics, Retail and Distributor Lighting Evaluation, March 2021.
[172] Ibid.

LED Mogul Lamp Exterior – Distributor (Codes: S6BLL, S6CLL, S6BML, S6CML, S6BHL, S6CHL)

Last Revised Date	10/1/2022
MEASURE OVERVIEW	
Description	LED mogul base lamp exterior. This measure involves the installation of a new LED in place of an existing or new inefficient bulb (incandescent or halogen) in an exterior fixture.
Primary Energy Impact	Electric
Sector	Residential, Commercial
Program(s)	Consumer Products Program – Lighting – Distributor
End-Use	Lighting
Decision Type	New Construction, Replace on Burnout
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand savings	See Table 61
Annual energy savings	See Table 61
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	$\Delta kW = \Delta Watt_{LED} / 1{,}000$ $\Delta kW_{SP} = \Delta Watt_{LED} / 1{,}000 \times CF_S$ $\quad \Delta kW_{WP} = \Delta Watt_{LED} / 1{,}000 \times CF_W$
Annual energy savings	$\Delta kWh/yr = \Delta Watts_{LED} / 1{,}000 \times [365 \times HPD_{RES} \times \%RES + HPY_{COMM} \times \%COMM]$
Definitions	Unit = 1 bulb $\Delta Watt_{LED}$ = Average wattage difference between baseline bulbs and program LED (Watts) 1,000 = Conversion: 1,000 Watts per kW 365 = Conversion: 365 days per year HPD_{RES} = Average daily operating hours in residential setting (hrs/day) %RES = Share of bulb purchases that are installed in residential setting (%) HPY_{COMM} = Average annual operating hours in commercial setting (hrs/yr) %COMM = Share of bulb purchases that are installed in commercial setting (%)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Incandescent
Efficient Measure	LED bulb

PARAMETER VALUES (DEEMED)

Measure	$\Delta Watts_{LED}$	HPD_{RES}	HPY_{COMM}	%RES	%COMM	Life (yrs)	Cost ($)
LED Lamp	Table 61	2.1[173]	4,248[174]	0%[175]	100%[176]	Table 62	Table 62

Measure	Avoided O&M ($)
LED Lamp	Table 62

IMPACT FACTORS

Measure	ISR	RR_E	RR_D	CF_W	CF_S	FR	SO
LED Bulb	99%[177]	100%[178]	100%[179]	Table 54[180]	Table 54[181]	51%[182]	0%[183]

[173] Demand Side Analytics, Retail and Distributor Lighting Evaluation, March 2021.
[174] Ibid.
[175] Mogul base lamps are primarily applicable to commercial settings. Percent installed in commercial applications is assumed to be 100%.
[176] Ibid.
[177] Demand Side Analytics, Retail and Distributor Lighting Evaluation, March 2021.
[178] Realization rates are 100 percent since savings estimates are based on evaluation results.
[179] Ibid.
[180] See Appendix B~~Appendix B~~.
[181] See Appendix B~~Appendix B~~.
[182] Demand Side Analytics, Retail and Distributor Lighting Evaluation, March 2021.
[183] Ibid.

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	$\Delta kW = HP_{VFD} \times DSVG$
Annual Energy Savings	$\Delta kWh/yr = HP_{VFD} \times ESVG$
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[184]	.432	7[185]	Table 2

IMPACT FACTORS

Program	ISR	RR_E[186]	RR_D	CF_S	CF_W	FR[187]	SO[188]
C&I Prescriptive	100%	100%	N/A	N/A	N/A	25%[189]	0%[190]

[184] 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.
[185] The lifetime is assumed to be half of the life of a new RTU.
[186] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[187] 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).
[188] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-10. Participant Spillover.
[189] Measure not yet evaluated, assume default FR of 25%.
[190] 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	$\Delta kW = HP_{VFD} \times DSVG$
Annual Energy Savings	$\Delta kWh/yr = HP_{VFD} \times ESVG$
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~~	Table 1~~Table 1~~	13[191]	Table 2~~Table 2~~

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2[192]	100%[193]	Table 54~~Table 54~~[194]	Table 54~~Table 54~~[194]	52%[195]	1.6%[196]

[191] 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.
[192] Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
[193] Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.
[194] See Appendix C.
[195] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[196] Ibid.

Table 1 – VFD Energy and Peak Demand Savings Factors (ESVG and DSVG)[197,198]

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[199]

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

[197] 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.

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

[199] 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[200]	15[201]	Table 3
Unitary AC ≥ 11.25 tons	Actual	Table 3	Actual	605[200]	15[201]	Table 3

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

[201] 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.

Prescriptive HVAC: Unitary Air Conditioners, Codes AC1-AC6 (Inactive)						
Window AC	Actual	Table 3	Actual	829[200]	9[202]	Table 3
IMPACT FACTORS							

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	99%[203]	101%[204]	Table 54~~Table 54~~[205]	Table 54~~Table 54~~[206]	52%[207]	1.6%[208]

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)	14.0 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	12.0 EER[A]	$50[D]

[A] IECC 2015, Table C403.2.3(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).

[202] Default assumptions used in the ENERGY STAR® calculator, April 2013.
[203] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Realization Rates for Prescriptive Measures.
[204] Ibid.
[205] See Appendix B~~Appendix B~~.
[206] See Appendix B~~Appendix B~~.
[207] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[208] Ibid.

Prescriptive HVAC: Heat Pump Systems, Codes AH1-AH5, WH	
Last Revised Date	7/1/2021
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):* $\Delta kW_C = CAP_C / 1000 \times (1/SEER_{BASE} - 1/SEER_{EE})$ $\Delta kW_H = CAP_H / 1000 \times (1/HSPF_{BASE} - 1/HSPF_{EE})$ *For air-to-air equipment ≥ 5.4 tons (≥ 65,000 Btuh) and all water and ground source equipment:* $\Delta kW_C = CAP_C / 1000 \times (1/EER_{BASE} - 1/EER_{EE})$ $\Delta kW_H = CAP_H / 1000 \times (1/COP_{BASE} - 1/COP_{EE}) / 3.412$
Annual Energy Savings	*For air-to-air equipment < 5.4 tons (< 65,000 Btuh):* $\Delta kWh_C/yr = CAP_C / 1000 \times (1/SEER_{BASE} - 1/SEER_{EE}) \times EFLH_C$ $\Delta kWh_H/yr = CAP_H / 1,000 \times (1/HSPF_{BASE} - 1/HSPF_{EE}) \times EFLH_H$ *For air-to-air equipment ≥ 5.4 tons (≥ 65,000 Btuh) and all water and ground source equipment:* $\Delta kWh_C/yr = CAP_C / 1000 \times (1/EER_{BASE} - 1/EER_{EE}) \times EFLH_C$ $\Delta kWh_H/yr = CAP_H / 1,000 \times (1/COP_{BASE} - 1/COP_{EE}) \times EFLH_H / 3.412$
Definitions	Unit = 1 new heat pump CAP_C = Rated cooling capacity of the heat pump (Btu/h) CAP_H = Rated heating capacity of the heat pump (Btu/h) $SEER_{BASE}$ = Cooling seasonal energy efficiency ratio of the baseline equipment (Btu/h/Watt) $SEER_{EE}$ = Cooling seasonal energy efficiency ratio of the efficient equipment (Btu/h/Watt) $HSPF_{BASE}$ = Heating seasonal performance factor of the baseline equipment (Btu/h/Watt) $HSPF_{EE}$ = Heating seasonal performance factor of the efficient equipment (Btu/h/Watt) EER_{BASE} = Cooling energy efficiency ratio of the baseline equipment (Btu/h/Watt) EER_{EE} = Cooling energy efficiency ratio of the efficient equipment (Btu/h/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[209]	$SEER_{BASE}$ EER_{BASE}	$SEER_{EE}$ EER_{EE}	$HSPF_{BASE}$ COP_{BASE}	$HSPF_{EE}$ COP_{EE}	$EFLH_C$[210]	$EFLH_H$[211]	Life (yrs)	Cost ($/ton)
Heat Pump < 5.4 tons	Actual	Actual	Table 4	Actual	Table 4	Actual	829	2,200	15[212]	$100[213]
Heat Pump ≥ 5.4 tons and < 11.25 tons	Actual	Actual	Table 4	Actual	Table 4	Actual	829	1,600	15[212]	$100[213]
Heat Pump ≥ 11.25 tons	Actual	Actual	Table 4	Actual	Table 4	Actual	605	1,600	15[212]	$100[213]

IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[214]	100%[215]	Table 54~~Table 54~~[216]	Table 54~~Table 54~~[216]	52%[217]	1.6%[218]

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)	14.0 SEER	8.2 HSPF
	< 5.4 (single package)	< 65,000 (single package)	14.0 SEER	8.0 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	12.2 EER	4.3 COP
	≥ 1.4 and < 11.25	≥ 17,000 and < 135,000	13.0 EER	4.3COP
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] IECC2015, Table C403.2.3(2). Minimum Efficiency Requirements: Electrically Operated Unitary and Applied Heat Pumps.

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[209] 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.
[210] KEMA, NEEP C&I Unitary HVAC Loadshape Project, June 2011, Table 0-3 and 0-4. Values are for the NE-North region.
[211] 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.
[212] 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.
[213] Efficiency Vermont Technical Reference User Manual (TRM) 2014, Table 1, page 40.
[214] Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
[215] Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.
[216] See Appendix B~~Appendix B~~.
[217] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[218] Ibid.

Prescriptive HVAC: Packaged Terminal Heat Pumps (PTHPR, PTHPMFNC)	
Last Revised Date	5/1/2022
MEASURE OVERVIEW	
Description	The retrofit measure involves the purchase and installation of new high-efficiency packaged terminal heat pumps (PTHPs) equipment to replace existing, operational standard-efficiency PTAC equipment. The multi-family measure involves the purchase and installation of new high efficiency packaged terminal heat pump (PTHP) equipment as the primary heating system in new construction, gut-rehab, added capacity, or planned retirement/upgrade multifamily projects.
Primary Energy Impact	Electric
Sector	Commercial
Program	C&I Prescriptive Program
End-Use	HVAC
Project Type	Retrofit, New Construction, Replace on Burnout
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	$\Delta kWh_C/yr = CAP_C / 1{,}000 \times (1/EER_{BASE} - 1/EER_{EE}) \times EFLH_C \times \%Cooling$ $\Delta kWh_H/yr = CAP_H / 1{,}000 \times (1/Eff_{BASE} - 1/COP_{EE}) \times EFLH_H / 3.412 \times \%Heating$
Definitions	Unit = 1 PTHP CAP_C = Rated cooling capacity of the new equipment (Btu/h) CAP_H = Rated heating capacity of the new equipment (Btu/h) EER_{BASE} = Cooling energy efficiency ratio of the baseline equipment (Btuh/Watt) EER_{EE} = Cooling energy efficiency ratio of the efficient equipment (Btuh/Watt) Eff_{BASE} = Heating efficiency 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 %Cooling = Amount of cooling required based on seasonal operation of facility %Heating = Amount of heating required based on seasonal operation of facility
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Existing packaged terminal air conditioner with integrated electric resistance heating element.
Efficient Measure	Rated cooling and heating efficiency of new equipment must meet or exceed the minimum requirements set forth in Table 6Table 6.
PARAMETER VALUES	

Prescriptive HVAC: Packaged Terminal Heat Pumps (PTHPR, PTHPMFNC)								
Measure/Type	CAP_C	CAP_H	EER_{BASE}	EER_{EE}	COP_{BASE}	COP_{EE}	Life (yrs)[219]	Cost ($)
PTHPR	Actual	Actual	Table 5 or Actual	Actual	Table 5 or Actual	Actual	15	Actual
PTHPMFNC								Actual - Table 8[220]
Measure/Type	$EFLH_C$[221]	$EFLH_H$[222]	%Cooling	%Heating				
PTHPR	829	2,200	Table 7	Table 7				
PTHPMFNC			100%	100%				
IMPACT FACTORS								
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO	
C&I Prescriptive	100%	100%[223]	100%[224]	Table 54~~Table 54~~[225]	Table 54~~Table 54~~[225]	25%[226]	0%[227]	

Table 5 – Baseline Efficiencies for PTHP (effective September 20, 2012)[228]

Equipment Class			Minimum Energy Conservation Standards	
Equipment	**Category[A]**	**Cooling Capacity (Btu/h)**	**Cooling (EER)**	**Heating (COP)**
PTHPR/ VPTHPR	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
PTHPMFNC/ VPTHPMFNC	All	All	10.1	1

[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.

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[219] 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.
[220] See table for deemed baseline costs.
[221] KEMA, NEEP C&I Unitary HVAC Loadshape Project, June 2011, Table 0-3 and 0-4. Values are for the NE-North region.
[222] 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.
[223] New measure offering not yet evaluated.
[224] New measure offering not yet evaluated.
[225] See Appendix B~~Appendix B~~.
[226] Measure not yet evaluated, assume default FR of 25%.
[227] Measure not yet evaluated, assume default SO of 0%.
[228] For retrofit projects, actual baseline efficiencies should be recorded and used when known. For unknown existing equipment efficiency and new construction/replace on burn out projects, use the values specified in this table. Standards for Packaged Terminal Air Conditioners and Heat Pumps: http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/45. PTHPMFNC assumes electric resistance baseboard as the heating baseline.

Table 6 – Program Qualifying Equipment Criteria

Cooling Capacity (Btu/h)	EER	COP
< 7,000	13	4
7,000 – 15,000	11.5	3.5
> 15,000	10.8	3.4

Table 7 – Seasonal Heating and Cooling Factors[229]

Operational Season	% Heating	% Cooling	% Heating for Freeze Protection
June-October	11%	100%	1%
November	11%	0%	3%
December-March	66%	0%	31%
April	8%	0%	1%
May	4%	0%	0%

Table 8 - Baseline Costs for Packaged Terminal Heat Pumps[230]

Efficiency Measure	Cooling Capacity (Btu/h)	Baseline Cost
PTHP	**<10,500 Btu/h**	$637.38
	10,500 - 13,500 Btu/h	$784.90
	>13,500 Btu/h	$1,420.43
VPTHP	**≤9,000 Btu/h**	$637.38
	9,000 – 18,000 Btu/h	$969.54
	>18,000 Btu/h	$2,238.40

229 Based on TMY3 heating and cooling degree days base 60 degrees F for defined ranges. Freeze protection is assumed to have a set point of 40 degrees F. A month is included as operational if equipment is on for more than 16 days.

230 Baseline costs assume electric resistance baseboard for heat and window units for cooling. Average costs derived from published equipment costs found online March-April 2022.

Prescriptive HVAC: Vertical Packaged Terminal Heat Pumps (VPTHPR, VPTHPMFNC)

Last Revised Date	5/1/2022
MEASURE OVERVIEW	
Description	The retrofit measure involves the purchase and installation of new high-efficiency vertical packaged terminal heat pumps (VPTHPs) equipment to replace existing, operational standard-efficiency VPTAC equipment. The multi-family measure involves the purchase and installation of new high-efficiency vertical packaged terminal heat pumps (VPTHPs) equipment as the primary heating system in new construction, gut-rehab, added capacity, or planned retirement/upgrade multifamily projects.
Primary Energy Impact	Electric
Sector	Commercial
Program	C&I Prescriptive Program
End-Use	HVAC
Project Type	Retrofit, New Construction, Replace on Burnout
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	$\Delta kWh_C/yr = CAP_C / 1{,}000 \times (1/EER_{BASE} - 1/EER_{EE}) \times EFLH_C \times \%Cooling$ $\Delta kWh_H/yr = CAP_H / 1{,}000 \times (1/COP_{BASE} - 1/COP_{EE}) \times EFLH_H / 3.412 \times \%Heating$
Definitions	Unit = 1 VPTHP CAP_C = Rated cooling capacity of the new equipment (Btu/h) CAP_H = Rated heating capacity of the new equipment (Btu/h) 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 % Cooling = Amount of cooling required based on seasonal operation of facility % Heating = Amount of heating required based on seasonal operation of facility
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Existing vertical packaged terminal air conditioner with integrated electric resistance heating element.
Efficient Measure	Installation of vertical packaged terminal heat pump with rated heating and cooling efficiency that meets or exceeds minimum requirements set forth above.

PARAMETER VALUES

Measure/Type	CAP_C	CAP_H	EER_{BASE}	EER_{EE}	COP_{BASE}	COP_{EE}	Life (yrs)	Cost ($)
VPTHPR	Actual	Actual	Table 5 or Actual	Actual	Table 5 or Actual	Actual	15[231]	Actual
VPTHPMFNC								Actual -Table 8[232]

[231] 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.
[232] See table for deemed baseline costs.

Measure/Type	$EFLH_C$[233]	$EFLH_H$[234]	%Cooling	%Heating		
VPTHP	829	2,200	Table 7	Table 7		

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	100%[235]	100%[236]	Table 54~~Table 54~~[237]	Table 54~~Table 54~~[225]	25%[238]	0%[239]

[233] KEMA, NEEP C&I Unitary HVAC Loadshape Project, June 2011, Table 0-3 and 0-4. Values are for the NE-North Region.
[234] EMT assumes 2,200 heating full load hours for heat pumps smaller than 5.4 tons (65,000 Btu/h) and 1,600 heating full load hours for heat pumps larger than or equal to 5.4 tons.
[235] New measure offering not yet evaluated.
[236] New measure offering not yet evaluated.
[237] See Appendix B~~Appendix B~~.
[238] Measure not yet evaluated, assume default FR of 25%.
[239] Measure not yet evaluated, assume default SO of 0%.

Prescriptive HVAC: Variable Refrigerant Flow, Codes VRFEB, VRFNC	
Last Revised Date	1/1/2024
MEASURE OVERVIEW	
Description	New Construction/Replace on Burnout: This measure involves the purchase and installation of a new high-efficiency variable refrigerant flow (VRF) heat pump system in lieu of other HVAC systems in new construction or end-of-life projects. The new high-efficiency VRF may be installed with or without heat recovery. Retrofit: This measure involves the purchase and installation of a new high-efficiency variable refrigerant flow (VRF) heat pump system to replace existing, operational HVAC systems. The new high-efficiency VRF may be installed with or without heat recovery.
Primary Energy Impact	Electric; Heating Oil; Propane
Sector	Commercial
Program(s)	C&I Prescriptive Program
End-Use	HVAC
Project Type	New construction, Replace on burnout, Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	$kW_c = CAP_c * \left(\frac{1}{IEER_{base}} - \frac{1}{IEER_{ee}}\right)/1000$ For electric heating system baseline: $kW_h = kBtu_{heat\ load} * \left(\frac{1}{COP_{base}} - \frac{1}{COP_{ee}}\right) * \frac{1}{3.412} * \frac{1}{EFLH_h}$ For non-electric heating system baseline: $kW_h = -kBtu_{heat\ load} * \left(\frac{1}{COP_{ee}}\right) * \frac{1}{EFLH_h}$
Annual energy savings	$kWh = kWh_c + kWh_h kWh_c = CAP_c * \left(\frac{1}{IEER_{base}} - \frac{1}{IEER_{ee}}\right) * EFLH_c/1000$ For electric heating system baseline: $kWh_h = kBtu_{heat\ load} * \left(\frac{1}{COP_{base}} - \frac{1}{COP_{ee}}\right) * \frac{1}{3.412}$ For non-electric heating system baseline: $kWh_h = -kBtu_{heat\ load} * \left(\frac{1}{COP_{ee}}\right) * \frac{1}{3.412}$ $MMBtu_h = kBtu_{heat\ load} * \left(\frac{1}{Eff_{base}}\right)/1000$
Definitions	CAP_c = Cooling capacity of equipment (Btu/h) $IEER_{base}$ = 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 $kBtu_{heat\ load}$ = Annual heat load of area served. 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 Eff_{base} = Efficiency of baseline heating system 1000 = Conversion factor: kBtu/MMBtu
EFFICIENCY ASSUMPTIONS	

Prescriptive HVAC: Variable Refrigerant Flow, Codes VRFEB, VRFNC	
Baseline Efficiency	Retrofit: Existing equipment being replaced. New Construction: Alternate equipment considered by the participant.
Efficient Measure	High-efficiency variable refrigerant flow unit with or without heat recovery that meets the efficiency criteria in Table 9.

PARAMETER VALUES (DEEMED)

Measure/Type	$kBtu/hr_{capacity}$	$IEER_{base}$	$IEER_{ee}$	$EFLH_c$	$EFLH_h$	$kBtu_{heat\ load}$	COP_{base}	COP_{ee}
NC/ROB & Retrofit	Actual	Actual[240]	Actual	829[241]	1600[242]	Actual[243]	Actual[244]	Actual

Measure/Type	Conditioned Space (sq. ft.)	Life (yrs)	Cost ($)[245]
NC/ROB	Actual	20	Table 10
Retrofit without heat recovery	Actual	20	$17.68/sqft
Retrofit with heat recovery	Actual	20	$20.15/sqft

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
NC/ROB	100%	112.2%[246]	100%[247]	Table 54~~Table 54~~[248]	Table 54~~Table 54~~[249]	52%[250]	1.6%[251]
Retrofit	100%	112.2%[246]	100%[247]	Table 54~~Table 54~~[248]	Table 54~~Table 54~~[249]	25%[252]	0%[253]

240 For New Construction/Replace on Burnout projects, baseline efficiency is determined by the alternate equipment under consideration. For Retrofit projects, baseline efficiency is the efficiency of existing equipment being replaced. See Table 10 for New Construction/Replace on Burnout and Table 11 for Retrofit equipment references.
241 KEMA, NEEP C&I Unitary HVAC Loadshape Project, June 2011, Table 0-3 and 0-4. Values are for the NE-North region.
242 EMT assumes 1,600 heating full load hours.
243 If annual heat load of served area is unknown, annual heat load can be calculated as Area Served [sqft] x 47.4 kBtu/sqft – New England average heating load from 2003 CBECs.
244 See Table 10 for OpportunityNew Construction/Replace on Burnout and Table 11 for Retrofit examples.
245 Cost developed from 42 completed VRF projects (December 2023).
246 Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
247 Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.
248 See Appendix C.
249 See Appendix C.
250 Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
251 Ibid.
252 Measure not yet evaluated, assume default FR of 25%.
253 Measure not yet evaluated, assume default SO of 0%.

Table 9 – Measure Criteria for High Efficiency VRF Equipment

Equipment Type	Cooling Capacity	High Efficiency Criteria[254]
VRF Air-Cooled Heat Pump without heat recovery	≥ 65,000 Btu/h < 135,000 Btu/h	20 IEER
	≥ 135,000 Btu/h < 240,000 Btu/h	18.3 IEER
	≥ 240,000 Btu/h	18.2 IEER
VRF Air-Cooled Heat Pump with heat recovery	≥ 65,000 Btu/h < 135,000 Btu/h	20 IEER
	≥ 135,000 Btu/h < 240,000 Btu/h	19 IEER
	≥ 240,000 Btu/h	18.1 IEER

Table 10 – New Construction/Replace on Burnout Baseline Equipment Efficiency and Incremental Cost[255]

Cooling Capacity	Baseline Equipment Type				
	Standard Efficiency VRF	Air Source Heat Pump[256]	PTAC with electric heating	RTU with DX cooling and furnace heating	AHU with air-cooled chiller and hot water boiler
<65,000 Bth/h (applicable to single phase only)	12.9 IEER 2.25 COP	11 EER 3.3 COP	12.5 IEER 1 COP	12 EER 13.8 IEER 0.82 COP	12 EER 13.8 IEER 0.80 COP
Incremental Cost per Sqft	$2.30	$3.68	$3.69	$1.86	$1.06
≥ 65,000 Btu/h < 135,000 Btu/h	12.9 IEER 2.25 COP	11 EER 3.3 COP	12.5 IEER 1 COP	12 EER 13.8 IEER 0.82 COP	12 EER 13.8 IEER 0.80 COP
Incremental Cost per Sqft without heat recovery	$4.00	$6.16	$6.17	$3.35	$2.09
Incremental Cost per Sqft with heat recovery	$4.15	$6.28	$6.30	$3.50	$2.26
≥135,000 Btu/h <240,000 Btu/h	12.3 IEER 2.05 COP	10.6 EER 3.2 COP	12.5 IEER 1 COP	12 EER 13 IEER 0.82 COP	12 EER 13 IEER 0.80 COP
Incremental Cost per Sqft without heat recovery	$2.98	$4.58	$4.60	$3.18	$1.56
Incremental Cost per Sqft with heat recovery	$3.14	$4.73	$4.74	$3.33	$1.73
≥ 240,000 Btu/h	11 IEER 2.05 COP	10.6 EER 3.2 COP	12.5 IEER 1 COP	9.8 EER 11.4 IEER 0.82 COP	9.8 EER 11.4 IEER 0.80 COP
Incremental Cost per Sqft without heat recovery	$3.27	$5.03	$5.04	$3.48	$1.71
Incremental Cost per Sqft with heat recovery	$3.43	$5.16	$5.18	$3.64	$1.88

[254] Based on AHRI certified models
[255] VRF Cost Tables Update prepared by Collins CEA using completed VRF projects and historical price index for HVAC and refrigeration equipment.
[256] Projects with a baseline of Air-Source Heat Pump are not eligible for incentives.

Table 11 – Retrofit Baseline Equipment Efficiency[257]

Cooling Capacity	Baseline Equipment Type					
	Through-wall A/C with Boiler or Furnace	Standard Efficiency Mini-split Air-source heat pump[258]	Ducted Air-source heat pump with central air handler[259]	PTAC with electric heating	RTU with DX cooling and furnace heating	AHU with air-cooled chiller and hot water boiler
<65,000 Bth/h (applicable to single phase only)	9.7 SEER 0.8 COP	10 EER 6.8 HPSF 2 COP	9.9 EER 2.2 COP	12.5 EER 1 COP	10.1 EER 0.8 COP	9.6 EER 0.8 COP
≥ 65,000 Btu/h < 135,000 Btu/h	9.7 SEER 0.8 COP	10 EER 6.8 HPSF 2 COP	9.9 EER 2.2 COP	12.5 EER 1 COP	10.1 EER 0.8 COP	9.6 EER 0.8 COP
≥135,000 Btu/h <240,000 Btu/h	9.7 SEER 0.8 COP	11 EER 6.8 HPSF 2 COP	9.1 EER 2.2 COP	9.9 EER 1 COP	9.5 EER 0.8 COP	9.6 EER 0.8 COP
≥ 240,000 Btu/h	9.7 SEER 0.8 COP	12 EER 6.8 HPSF 2 COP	8.8 EER 2.2 COP	9.9 EER 1 COP	9.3 EER 0.8 COP	9.6 EER 0.8 COP

257 Equipment efficiency based on ASHRAE 90.1-2004 requirements.
258 Projects with air source heat pump baselines are not eligible for incentives.
259 Projects with air source heat pump baselines are not eligible for incentives.

Prescriptive HVAC: Single Phase Variable Refrigerant Flow, Codes VRFSPNC, VRFSPEB	
Last Revised Date	5/1/2022 (retroactive to 4/1/2020)
MEASURE OVERVIEW	
Description	New Construction/Replace on Burnout: This measure involves the purchase and installation of a new high-efficiency single phase variable refrigerant flow (VRF) heat pump system in lieu of other HVAC systems in new construction or end-of-life projects. Retrofit: This measure involves the purchase and installation of a new high-efficiency single phase variable refrigerant flow (VRF) heat pump system to replace existing, operational HVAC systems.
Primary Energy Impact	Electric; Heating Oil; Propane
Sector	Commercial
Program(s)	C&I Prescriptive Program
End-Use	HVAC
Project Type	New construction, Replace on burnout, Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	$kW_c = CAP_c * \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{ee}}\right)/1000$ For electric heating system baseline: $kW_h = kBtu_{heat\ load} * \left(\frac{1}{HSPF_{base}} - \frac{1}{HSPF_{ee}}\right) * \frac{1}{EFLH_h}$ For non-electric heating system baseline: $kW_h = -kBtu_{heat\ load} * \left(\frac{1}{COP_{ee}}\right) * \frac{1}{EFLH_h}$
Annual energy savings	$kWh = kWh_c + kWh_h$ $kWh_c = CAP_c * \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{ee}}\right) * EFLH_c/1000$ For electric heating system baseline: $kWh_h = kBtu_{heat\ load} * \left(\frac{1}{3.412 \times COP_{base}} - \frac{1}{HSPF_{ee}}\right)$ For non-electric heating system baseline: $kWh_h = -kBtu_{heat\ load} * \left(\frac{1}{HSPF_{ee}}\right)$ $MMBtu_h = kBtu_{heat\ load} * \left(\frac{1}{Eff_{base}}\right)/1000$
Definitions	CAP_c = Cooling capacity of equipment (Btu/h) $SEER_{base}$ = Seasonal energy efficiency ratio for baseline system $SEER_{ee}$ = Seasonal 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[260]) COP_{base} = Coefficient of performance for baseline system at 17 deg F $HSPF_{ee}$ = Heating season performance factor for VRF system Eff_{base} = Efficiency of baseline heating system 3.412 = Conversion factor: kBtu/kWh

[260] New England average heating load from 2003 CBECs

Prescriptive HVAC: Single Phase Variable Refrigerant Flow, Codes VRFSPNC, VRFSPEB	
	1000 = Conversion factor: kBtu/MMBtu
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Retrofit: Existing equipment being replaced. New Construction: Alternate equipment considered by the participant.
Efficient Measure	High-efficiency single phase variable refrigerant flow unit with SEER 17.0 or better, HSFP 10.0 or better and cooling capacity less than 65,000 Btu/h.
PARAMETER VALUES (DEEMED)	

Measure/Type	CAP_c	$SEER_{base}$	$SEER_{ee}$	$EFLH_c$	$EFLH_h$	$kBtu_{heat\ load}$	COP_{base}	$HSPF_{ee}$
NC/ROB & Retrofit	Actual	Actual[261]	Actual	829[262]	1600[263]	Actual	Actual[264]	Actual

Measure/Type	Conditioned Space (sq. ft.)		Life (yrs)	Cost ($)[265]
NC/ROB	Actual		20	Table 10
Retrofit				$13.62/sqft

IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[266]	100%[267]	Table 54~~Table 54~~[268]	Table 54~~Table 54~~[269]	25%[270]	0%[271]

[261] For New Construction/Replace on Burnout projects, baseline efficiency is determined by the alternate equipment under consideration. For Retrofit projects, baseline efficiency is the efficiency of existing equipment being replaced. See Table 10 for New Construction/Replace on Burnout and Table 11 for Retrofit equipment references.
[262] KEMA, NEEP C&I Unitary HVAC Loadshape Project, June 2011, Table 0-3 and 0-4. Values are for the NE-North region.
[263] EMT assumes 1,600 heating full load hours.
[264] 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.
[265] Cost developed from 42 completed VRF projects (December 2023).
[266] Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
[267] Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.
[268] See Appendix C.
[269] See Appendix C.
[270] Program not yet evaluated, assume default FR of 25%.
[271] Program not yet evaluated, assume default SO of 0%.

Mini-Split Heat Pump – Codes CMSHP, MFMSHP	
Last Revised Date	3/1/2024 (retroactive to 7/1/2023)
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of a Mini-Split Heat Pump system as the primary heating system in new construction, gut-rehab, added capacity, planned retirement/upgrade projects, or replacement of operational heating system. The new mini-split heat pump may have one (single-zone) or multiple (multi-zone) indoor units per outdoor unit. Indoor units can be ducted, ductless, or a mix. Buildings with existing natural gas-fired heating systems are not eligible.
Energy Impacts	Electric, Heating Oil, Propane
Sector	Residential
Program(s)	C&I Prescriptive Program
End-Use	Cooling, Heating
Decision Type	New construction, replace on burnout, retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings[272]	$kW_{WP} = DSF_{WP} \times AHL$ $kW_{SP} = DSF_{SP} \times AHL$
Annual Energy Savings	$kWh/y = ESF_{kWhH} \times AHL \times \%Heating + ESF_{kWhC} \times AHL \times \%Cooling$ $MMBtu/y = ESF_{MMBtu} \times AHL \times \%Heating$ Annual Heat Load Calculation: From Manual J: $AHL = HDH \times DL / (T_i - T_o) / 1,000,000$ From Equipment Capacity: $AHL = CAP_{ES} \times HDH / dT / OF / 1,000,000$
Definitions	Unit = 1 outdoor unit attached to 1 or more indoor units. DSF_{WP} = Demand Savings Factor Winter Peak (kW/MMBtu of provided heat) DSF_{SP} = Demand Savings Factor Summer Peak (kW/MMBtu of provided heat) ESF_{kWhH} = Energy Savings Factor – electricity heating (kWh/MMBtu of provided heat) ESF_{kWhC} = Energy Savings Factor – electricity cooling (kWh/MMBtu of provided heat) ESF_{MMBtu} = Energy Savings Factor - combustion (MMBtu/MMBtu of provided heat) AHL = Annual Heat Load (MMBtu/y) %Heating = Amount of heating required based on seasonal operation of facility %Cooling = Amount of cooling required based on seasonal operation of facility HDH = Heating Degree Hours DL = Design Load from Manual J (Btu/h) T_i = Indoor Design Temperature used in Manual J (deg F) T_o = Outdoor Design Temperature used in Manual J (deg F) 1,000,000 = BTU to MMBTU conversion Cap_{ES} = capacity of pre-existing heating system (Btu/h) dT = Assumed temperature difference at design conditions OF = Oversize Factor
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The baseline case assumes a blend of retrofit and new construction/replace on burn out and fuel types found during the C&I Heat Pump Evaluation.
Efficient Measure	The high-efficiency case assumes a new Mini-Split Heat Pump that meets minimum efficiency requirements for program rebate: HSPF2 10.4 for single-zone, HSPF2 8.5 for multi-zone.

[272] Winter demand savings are set to zero if MSHP is turned off December – March. Summer demand savings are set to zero if MSHP is turned off June – October.

Mini-Split Heat Pump – Codes CMSHP, MFMSHP						
PARAMETER VALUES						
Measure	DSF_{WP}[273]	DSF_{SP}[274]	T_i	T_o	Life (yrs)[275]	Cost ($)[276]
MSHP	-0.00796	0.00388	Actual or 68	Actual or -2	18	.733 x Project Cost
Baseline	ESF_{kWhH}[277]	ESF_{kWhC}[278]	ESF_{MMBtu}[279]		%Heating	%Cooling
Non-electric	-92.46	4.7	1.27		Table 7	Table 7
Electric	200.6		0			
Measure	AHL[280]	DL	Cap_{ES}	dT[281]	OF[282]	HDH[283]
MSHP	Actual	Actual	Actual	70.14	1.7	186,648

IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%[284]	100%[285]	100%[286]	100%[287]	100%[311][312]	25%[288]	0%[289]

273 Derived from Commercial &Industrial High-Performance Heat Pump Program Impact Evaluation, 4/6/2023. The evaluation did not assess summer and winter demand impacts separately for different baselines. Demand Savings Factor defined here is a weighted average of all baseline types.
274 Ibid.
275 GDS Associates, Inc., Measure Life Report – Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007; Table 2.
276 Weighted average measure cost as a percent of project cost based on baseline blend from Commercial &Industrial High-Performance Heat Pump Program Impact Evaluation, 4/6/2023.
277 Derived from Commercial &Industrial High-Performance Heat Pump Program Impact Evaluation, 4/6/2023.Cooling savings factor is a weighted average of 1. Added cooling, 2. replaced cooling, and 3. not used for cooling.
278 Ibid.
279 Ibid.
280 See formulas defined in Annual Energy Savings section.
281 Average 70.14°F temperature difference between the 99% winter design outdoor air dry bulb and indoor design heating temperature of 72°F. Population weighted average 99% temperature of Portland, Bangor, and Caribou.
282 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
283 Population weighted average of TMY3 heating degree hours for Portland, Bangor, and Caribou, ME using a base temperature of 60.
284 EMT assumes that all purchased units are installed (i.e., ISR = 100%).
285 Energy saving factors reflect evaluation findings.
286 Demand saving factors reflect evaluation findings.
287 The on-peak summer and winter kW savings are calculated directly.
288 Program offering and rules have significantly changed from the period evaluated. Default FR of 25% assumed.
289 Program offering and rules have significantly changed from the period evaluated. Default SO of 0% assumed.

High Performance Heat Pump – Commercial/Industrial Lost Opportunity, Codes DHP1L-DHP4L, DHP1T2 (Inactive, replaced by CMSHP, MFMSHP)

Last Revised Date	7/1/2021
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of a high performance heat pump (HPHP) system as the primary heating system in new construction, gut-rehab, added capacity, or planned retirement/upgrade projects. The new HPHP equipment may have one (single-head) or multiple (multi-head) indoor units per outdoor unit.
Energy Impacts	Primary: Electric, Secondary: Heating Oil, Propane, Kerosene, Wood
Sector	Residential
Program(s)	C&I Prescriptive Program
End-Use	Cooling, Heating
Decision Type	New construction, replace on burnout

DEEMED ENERGY SAVINGS (UNIT SAVINGS) for Tier 1 (>=HSPF 12 (single), HSPF 10 (multi)[290])

Demand savings

Non-electric central heating system

	ΔkW_{WP}	ΔkW_{SP}
1 Unit	0.024	0.116
Additional Units (each)	0.015	0.064

Electric central heating system

	ΔkW_{WP}	ΔkW_{SP}
1 Unit	0.040	0.116
Additional Units (each)	0.024	0.064

Annual energy savings

Non-electric central heating system

	∆ kWh/y	∆ MMBtu/y
1 Unit	165	2.30
Additional Units (each)	142	1.12

Electric central heating system

	∆ kWh/y	∆ MMBtu/y
1 Unit	717	0.00
Additional Units (each)	406	0.00

DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS) for DHP1LT2, Tier 2 (>=HSPF 13) (Inactive)

Demand savings

Non-electric central heating system

	ΔkW_{WP}	ΔkW_{SP}
1st Unit	0.024	0.127
Additional Units (each)	0.028	0.070

Electric central heating system

	ΔkW_{WP}	ΔkW_{SP}
1st Unit	0.057	0.127
Additional Units (each)	0.044	0.070

Annual energy savings

Non-electric central heating system

	∆ kWh/y	∆ MMBtu/y
1st Unit	342	4.06
Additional Units (each)	316	1.46

Electric central heating system

	∆ kWh/y	∆ MMBtu/y
1st Unit	1304	0.00
Additional Units (each)	671	0.00

GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)

Demand Savings	Modeled[291]
Annual Energy Savings	Modeled[291][292] Heating and cooling savings are modeled using TMY3 data for Portland, Bangor and Caribou. Results are weighted based on population (71.2% Portland, 23.4% Bangor, 5.4% Caribou).[292] Savings were calculated based on a model employing the following key assumptions:

[290] For multizone systems the savings are equal to the sum of "1st Unit" plus only one "Additional Unit" except in the special case where the 1st unit is a single zone unit and the second unit is a multizone unit. In this special case, the single zone unit is assigned the "1st Unit" savings and the multizone unit is assigned savings for one "Additional Unit."

[291] DHP_Model developed by Efficiency Maine Trust and Bruce Harley Energy Consulting.

[292] Calculated based on population of each region; U.S. Census Bureau Census 2010 Summary File 1 population by census tract

High Performance Heat Pump – Commercial/Industrial Lost Opportunity, Codes DHP1L-DHP4L, DHP1T2 (Inactive, replaced by CMSHP, MFMSHP)	
	• Heating and cooling are temperature and season dependent. A behavior model is applied to the TMY3 data to avoid out of season heating and cooling.[293] • Heating is called for when outside air temperature is less than or equal to 60°F (heating balance point).[294] Cooling is called for when outside temperature is more than 70F (cooling balance point). • Outdoor Heating design temperatures are -2F for Bangor, -10 for Caribou and 2 for Portland. Outdoor Cooling design temperatures are 86F for Bangor, 81F for Caribou and 83F for Portland.[295] • Tier 1 EE Heat pump capacity by temperature is weighted average based on program saturation and rated performance. Baseline heat pump capacity by temperature is weighted average of corresponding standard efficiency. • Tier 2 EE heat pump COP is based on weighted average of rated performance of qualifying units adjusted by the same factor found between rated performance and evaluated performance. • Design load is proportional to the design capacity of the heat pump as defined by the sizing factor. • Heating and cooling loads are linearly dependent on temperature between the balance point and design temperature. • EE Heat pump coefficient of performance by temperature is based on in-situ evaluated performance and varies linearly with temperature.[296] • Baseline heat pump COP is based on weighted average of rated performance adjusted by the same factor found between rated performance and evaluated performance for EE Heat Pump. • There is an interaction between the heat pump and the central system based on occupant behavior, building characteristics and capacity differences. This interaction is modeled through a load factor and a capacity ratio. When the existing heating system is electric resistance baseboard, heat is only called for when the heat pump capacity falls below the heat loss (i.e. perfect gap filling). • Energy savings are measured against the baseline heat pump up to its capacity. Above the baseline heat pump's capacity, energy savings are measured against the central heating system.
Definitions	Unit = 1 outdoor unit attached to 1 indoor unit. Additional indoor units (whether attached to the same outdoor unit or additional units) are assessed as "Additional Units." SF = sizing factor - ratio of the heat pump capacity at design temperature to heat loss at design temperature LF = load factor - ratio of heat pump capacity to heat loss above which heat is called for from the central system Eff_{CS} = overall system efficiency of the central heating system Cap_{CS} = capacity of central heating system (kBtu/h)
EFFICIENCY ASSUMPTIONS	

[293] Annex G, section 3 of the CSA EXP07 Public Review Draft / September, 2017
[294] BHEC Letter re SNOPR 2016-18993 HLL-Final
[295] ASHRAE
[296] West Hill Energy and Computing, Home Energy Savings Impact Evaluation, WHEC_DHP_COPbyTemp.

High Performance Heat Pump – Commercial/Industrial Lost Opportunity, Codes DHP1L-DHP4L, DHP1T2 (Inactive, replaced by CMSHP, MFMSHP)	
Baseline Efficiency	The baseline case assumes that the business would be heated with new 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 performance heat pump that meets minimum efficiency requirements for program rebate: Tier 1: HSPF>=12.0 (single-headzone), 10.0 (multi-headzone); Tier 2: HSPF>=13.0.

PARAMETER VALUES

Measure	SF	LF	Eff_{CS}	Cap_{CS}			Life (yrs)	Cost ($)
1st Tier 1	1[297]	3[298]	80.5[299]	27[300]			18[301]	Table 12
2nd Tier 1	1.8[302]	3.6[303]						
1st Tier 2	1[304]	2.5[305]		27.8[306]				
2nd Tier 2	1.8[307]	3.6[308]						

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%[309]	100%[310]	100%[310][311]	100%[311]	100%[311][312]	33%[312]	1.6%[313]

Table 12 – Measure Cost for HPHP Equipment[314]

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

[297] A sizing factor of 1 indicates that the heat pump capacity at the design temperature is perfectly matched to the heat loss of the area it serves, alternately, the area served by the heat pump is matched to the heat pump's capacity at the design temperature.
[298] A load factor of 3 indicates that heat is called for from the central system when the temperature specific heat pump capacity falls below 3 times the heat loss of the area being served. The value is informed by the BIP evaluation.
[299] NMR, 2015 Maine Residential Baseline Study
[300] Capacity of central heating system is set at 1.5 times the design load of the area served by the heat pump for non-electric resistance heating systems.
[301] GDS Associates, Inc., Measure Life Report – Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007; Table 2.
[302] A sizing factor of 1.8 indicates that the heat pump is oversized for the area it serves. Represents a 2nd heat pump being located in a less than ideal location.
[303] A load factor of 3.6 indicates that heat is called for from the central system more often. Represents a 2nd heat pump that is only heating a small portion of a central heating system zone.
[304] A sizing factor of 1 indicates that the heat pump capacity at the design temperature is perfectly matched to the heat loss of the area it serves, alternately, the area served by the heat pump is matched to the heat pump's capacity at the design temperature.
[305] A load factor of 2.5 indicates that heat is called for from the central system when the temperature specific heat pump capacity falls below 2.5 times the heat loss of the area being served. The value is informed by imperical data.
[306] Capacity of central heating system is set at 1.5 times the design load of the area served by the heat pump for non-electric resistance heating systems.
[307] A sizing factor of 1.8 indicates that the heat pump is oversized for the area it serves. Represents a 2nd heat pump being located in a less than ideal location.
[308] A load factor of 3.6 indicates that heat is called for from the central system more often. Represents a 2nd heat pump that is only heating a small portion of a central heating system zone.
[309] EMT assumes that all purchased units are installed (i.e., ISR = 100%).
[310] Modeled results informed by evaluation findings.
[311] The on-peak summer and winter kW savings are calculated directly from the modeling.
[312] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[313] IBid.
[314] The measure cost is based on program average incremental cost. Measure cost will be refined for number of zones as data become available.

High Performance Heat Pump Commercial/Industrial Retrofit (DHPCR,DHPSR) (Inactive, replaced by CMSHP, MFMSHP)

Last Revised Date	7/1/2021
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of a high performance heat pump (HPHP) system as a supplemental heating system to offset the central heating system and to replace existing cooling systems. Currently only small businesses are eligible for this measure[315].
Energy Impacts	Electric, Heating Oil, Propane, Kerosene, Wood
Sector	Commercial
Program(s)	C&I Prescriptive
End-Use	Heating, Cooling
Decision Type	Retrofit

DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)

Demand savings

Non-electric central heating system

	Δ kW_{WP}	Δ kW_{SP}
1st Unit	-0.673	0.071
Additional Units (each)	-0.448	0.039

Electric central heating system

	Δ kW_{WP}	Δ kW_{SP}
1st Unit	1.169	0.071
Additional Units (each)	0.755	0.039

Annual energy savings

Non-electric central heating system

	Δ kWh/y	Δ MMBtu/y
1st Unit	-3197	37.71
Additional Units (each)	-2034	23.96

Electric central heating system

	Δ kWh/y	Δ MMBtu/y
1st Unit	6169	0
Additional Units (each)	3797	0

GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)

Demand Savings	Modeled[316]
Annual Energy Savings	Modeled[291][292] Heating and cooling savings are modeled using TMY3 data for Portland, Bangor and Caribou. Results are weighted based on population (71.2% Portland, 23.4% Bangor, 5.4% Caribou). [317] Savings were calculated based on a model employing the following key assumptions: • Heating and cooling are temperature and season dependent. A behavior model is applied to the TMY3 data to avoid out of season heating and cooling.[318] • Heating is called for when outside air temperature is less than or equal to 60°F (heating balance point).[319] Cooling is called for when outside temperature is more than 70F (cooling balance point). • Outdoor Heating design temperatures are -2F for Bangor, -10 for Caribou and 2 for Portland. Outdoor Cooling design temperatures are 86F for Bangor, 81F for Caribou and 83F for Portland.[320] • EE Heat pump capacity by temperature is weighted average based on program saturation and rated performance. • Design load is proportional to the design capacity of the heat pump as defined by the sizing factor. • Heating and cooling loads are linearly dependent on temperature between the balance point and design temperature.

315 Small business as defined by rule. 95-648 EFFICIENCY MAINE TRUST, Chapter 3.
316 DHP_Model developed by Efficiency Maine Trust and Bruce Harley Energy Consulting.
317 Calculated based on population of each region; U.S. Census Bureau Census 2010 Summary File 1 population by census tract
318 Annex G, section 3 of the CSA EXP07 Public Review Draft / September, 2017
319 BHEC Letter re SNOPR 2016-18993 HLL-Final
320 ASHRAE

High Performance Heat Pump Commercial/Industrial Retrofit (DHPCR,DHPSR) (Inactive, replaced by CMSHP, MFMSHP)

- Tier 1 EE Heat pump coefficient of performance by temperature is based on in-situ evaluated performance and varies linearly with temperature.[321]
- Tier 2 EE heat pump COP is based on weighted average of rated performance of qualifying units adjusted by the same factor found between rated performance and evaluated performance.
- There is an interaction between the heat pump and the central system based on occupant behavior, building characteristics and capacity differences. This interaction is modeled through a load factor and a capacity ratio. When the existing heating system is electric resistance baseboard, heat is only called for when the heat pump capacity falls below the heat loss (i.e. perfect gap filling).
- Each btu provided by the heat pump offsets a btu produced by the central system.
- 60% of businesses have or would have installed cooling equivalent to the cooling provided by the heat pump. 21% of businesses do not have and would not have installed any cooling. The balance of the businesses has/would have had partial cooling.

Definitions		
	Unit	= 1 outdoor unit attached to 1 indoor unit. Additional indoor units (whether attached to the same outdoor unit or additional units) are assessed as "Additional Units."
	SF	= sizing factor – ratio of the heat pump capacity at design temperature to heat loss at design temperature
	LF	= load factor – ratio of heat pump capacity to heat loss above which heat is called for from the central system
	Eff_{CS}	= overall system efficiency of the central heating system
	Cap_{CS}	= capacity of central heating system (kBtu/h)

EFFICIENCY ASSUMPTIONS

Baseline Efficiency	Average existing central heating system with a system efficiency of 80.5%.
Efficient Measure	The high-efficiency case assumes a new high performance heat pump that meets minimum efficiency requirements for program rebate: Tier 2: HSPF>=12.5.

PARAMETER VALUES (DEEMED)

Measure	SF	LF	Eff_{CS}	Cap_{CS}	Life (yrs)	Cost ($)
1st Tier 2	1[322]	2.5[323]	80.5[324]	27.8[325]	18[326]	$2,605[327]
2nd Tier 2	1.8[328]	3.6[329]				

IMPACT FACTORS

Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
High Performance Heat Pump	100%[330]	100%[331]	100%[310] ~~[311]~~	100%[332]	100%[311] ~~[312]~~	25%[333]	0%[334]

[321] West Hill Energy and Computing, Home Energy Savings Impact Evaluation, WHEC_DHP_COPbyTemp.
[322] A sizing factor of 1 indicates that the heat pump capacity at the design temperature is perfectly matched to the heat loss of the area it serves, alternately, the area served by the heat pump is matched to the heat pump's capacity at the design temperature.
[323] A load factor of 2.5 indicates that heat is called for from the central system when the temperature specific heat pump capacity falls below 2.5 times the heat loss of the area being served. The value is based on empirical data.
[324] NMR, 2015 Maine Residential Baseline Study
[325] Capacity of central heating system is set at 1.5 times the design load of the area served by the heat pump for non-electric resistance heating systems.
[326] GDS Associates, Inc., Measure Life Report – Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007; Table 1.
[327] PY2020 averages were $1,526 material and $1,079 labor.
[328] A sizing factor of 1.8 indicates that the heat pump is oversized for the area it serves. Represents a 2nd heat pump being located in a less than ideal location.
[329] A load factor of 3.6 indicates that heat is called for from the central system more often. Represents a 2nd heat pump that is only heating a small portion of a central heating system zone.
[330] EMT assumes that all purchased units are installed (i.e. ISR = 100%). This is consistent with the MA 2013-2015 TRM.
[331] Modeled results informed by evaluation findings.
[332] The on-peak summer and winter kW savings are calculated directly from the modeling.
[333] New measure not yet evaluated.
[334] Assumed to be 0%.

High Performance Heat Pump – Multifamily Lost Opportunity, Code MPDHPNC (Inactive, replaced by CMSHP, MFMSHP)	
Last Revised Date	7/1/2021
Description	This measure involves the purchase and installation of a high performance heat pump (HPHP) system as the primary heating system in new construction, gut-rehab, added capacity, or planned retirement/upgrade multifamily projects.
Energy Impacts	Primary: Electric, Secondary: Heating Oil, Propane, Kerosene, Wood
Sector	Residential
Program(s)	Multifamily Program
End-Use	Cooling, Heating
Decision Type	New Construction, Replace on Burnout

DEEMED GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS) for Tier 1 (>=HSPF 12 (single), HSPF 10 (multi)[335])

Demand Savings

Non-electric central heating system

	Δ kW$_{WP}$	Δ kW$_{SP}$
1 Unit	0.026	0.058
Additional Units (each)	0.015	0.064

Electric central heating system

	Δ kW$_{WP}$	Δ kW$_{SP}$
1 Unit	0.034	0.058
Additional Units (each)	0.024	0.064

Annual Energy Savings

Non-electric central heating system

	Δ kWh/y	Δ MMBtu/y
1 Unit	179	0.89
Additional Units (each)	142	1.12

Electric central heating system

	Δ kWh/y	Δ MMBtu/y
1 Unit	381	0
Additional Units (each)	406	0

GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)

Demand Savings: Modeled

Annual Energy Savings: Modeled[336]

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).[337]

Savings were calculated based on a model employing the following key assumptions:

- Heating and cooling are temperature and season dependent. A behavior model is applied to the TMY3 data to avoid out of season heating and cooling.[338]
- Heating is called for when outside air temperature is less than or equal to 60°F (heating balance point).[339] Cooling is called for when outside temperature is more than 70F (cooling balance point).
- Outdoor Heating design temperatures are -2F for Bangor, -10 for Caribou and 2 for Portland. Outdoor Cooling design temperatures are 86F for Bangor, 81F for Caribou and 83F for Portland.[340]
- EE Heat pump capacity by temperature is weighted average based on program saturation and rated performance. Baseline heat pump capacity by temperature is weighted average of corresponding standard efficiency.
- Design load is proportional to the design capacity of the heat pump as defined by the sizing factor.

[335] For multizone systems the savings are equal to the sum of "1st Unit" plus only one "Additional Unit" except in the special case where the 1st unit is a single zone unit and the second unit is a multizone unit. In this special case, the single zone unit is assigned the "1st Unit" savings and the multizone unit is assigned savings for one "Additional Unit."

[336] Based on Excel Workbook for Ductless Heat Pump.

[337] Calculated based on population of each region; U.S. Census Bureau Census 2010 Summary File 1 population by census tract.

[338] Annex G, section 3 of the CSA EXP07 Public Review Draft / September, 2017

[339] BHEC Letter re SNOPR 2016-18993 HLL-Final

[340] ASHRAE

High Performance Heat Pump – Multifamily Lost Opportunity, Code MPDHPNC (Inactive, replaced by CMSHP, MFMSHP)	
	• Heating and cooling loads are linearly dependent on temperature between the balance point and design temperature. • Tier 1 EE Heat pump coefficient of performance by temperature is based on in-situ evaluated performance and varies linearly with temperature.[341] • Tier 2 EE heat pump COP is based on weighted average of rated performance of qualifying units adjusted by the same factor found between rated performance and evaluated performance. • Baseline heat pump COP is based on weighted average of rated performance adjusted by the same factor found between rated performance and evaluated performance for EE Heat Pump. • There is an interaction between the heat pump and the central system based on occupant behavior, building characteristics and capacity differences. This interaction is modeled through a load factor and a capacity ratio. When the existing heating system is electric resistance baseboard, heat is only called for when the heat pump capacity falls below the heat loss (i.e. perfect gap filling). • Energy savings are measured against the baseline heat pump up to its capacity. Above the baseline heat pump's capacity, energy savings are measured against the central heating system. • EE heat pump is used in the same manner as the baseline heat pump would have been for both heating and cooling.
Definitions	Unit = 1 outdoor unit attached to 1 indoor unit. Additional indoor units (whether attached to the same outdoor unit or additional units) are assessed as "Additional Units." Multiple-head systems or more than one single head unit installed count as 2 units. For residential applications, no more than 2 units can be claimed per dwelling. SF = sizing factor - ratio of the heat pump capacity at design temperature to heat loss at design temperature LF = load factor - ratio of heat pump capacity to heat loss above which heat is called for from the central system Eff_{CS} = overall system efficiency of the central heating system Cap_{CS} = capacity of central heating system (kBtu/h)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The baseline case assumes the multifamily units would be heated with new 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 performance heat pump that meets minimum efficiency requirements for program rebate: Tier 1: HSPF>=12.0 (single-zone), 10.0 (multi-zone); Tier 2: HSPF>=13.0.

PARAMETER VALUES

Measure	SF	LF	Eff_{CS}	Cap_{CS}			Life (yrs)	Cost ($)
1st Tier 1	2[342]	2.5[343]						

[341] West Hill Energy and Computing, Home Energy Savings Impact Evaluation, WHEC_DHP_COPbyTemp.
[342] A sizing factor of 2 indicates that the heat pump capacity is oversized for the heat loss of the area it serves. This accounts for the small heat loss generally experienced by multifamily units due to shared walls and smaller floorplans.
[343] A load factor of 2.5 indicates that heat is called for from the central system when the temperature specific heat pump capacity falls below 2.5 times the heat loss of the area being served. The value is based on empirical data.

High Performance Heat Pump – Multifamily Lost Opportunity, Code MPDHPNC (Inactive, replaced by CMSHP, MFMSHP)

2nd Tier 1	1.8[348]	3.6[349]	80.5[344]	27[345]			18[346]	$682[347]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%[350]	100%[351]	100%[351]~~[352]~~	100%[352]	100%[311]~~[312]~~	11.0%[353]	1.0%[353]~~[354]~~

[348] A sizing factor of 1.8 indicates that the heat pump is oversized for the area it serves. Represents a 2nd heat pump being located in a less than ideal location.
[349] A load factor of 3.6 indicates that heat is called for from the central system more often. Represents a 2nd heat pump that is only heating a small portion of a central heating system zone.
[344] NMR, 2015 Maine Residential Baseline Study
[345] Capacity of central heating system is set at 1.5 times the design load of the area served by the heat pump for non-electric resistance heating systems.
[346] GDS Associates, Inc., Measure Life Report – Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007; Table 1.
[347] 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).
[350] EMT assumes that all purchased units are installed (i.e., ISR = 100%).
[351] This measure is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[352] The on-peak summer and winter kW savings are calculated directly from the modeling.
[353] Opinion Dynamics, Efficiency Maine Multifamily Efficiency Program Evaluation Final, March 2014; Table 1-2.

High Performance Heat Pump – Multifamily Retrofit, Code MDHP1RT2, MDHP2RT2, MDHP3RT2 (Inactive)

Last Revised Date	10/1/2022
Description	This measure involves the purchase and installation of a high performance heat pump (HPHP) system as a supplemental heating system to offset the central heating system and to replace existing cooling systems.
Energy Impacts	Electric, Heating Oil, Propane, Kerosene, Wood
Sector	Residential
Program(s)	Multifamily Program
End-Use	Cooling, Heating
Decision Type	Retrofit

DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)

Demand Savings

Non-electric central heating system

	ΔkW_{WP}	ΔkW_{SP}
1st Unit	-0.614	0.016
Additional Units (each)	-0.448	0.017

Electric central heating system

	ΔkW_{WP}	ΔkW_{SP}
1st Unit	0.913	0.016
Additional Units (each)	0.755	0.017

Annual Energy Savings

Non-electric central heating system

	Δ kWh/y	Δ MMBtu/y
1st Unit	-2374	26.83
Additional Units (each)	-2049	23.96

Electric central heating system

	Δ kWh/y	Δ MMBtu/y
1st Unit	3992	0
Additional Units (each)	3783	0

GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)

Demand Savings: Modeled

Annual Energy Savings: Modeled[354]

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).[355]

Savings were calculated based on a model employing the following key assumptions:

- Heating and cooling are temperature and season dependent. A behavior model is applied to the TMY3 data to avoid out of season heating and cooling.[356]
- Heating is called for when outside air temperature is less than or equal to 60°F (heating balance point).[357] Cooling is called for when outside temperature is more than 70F (cooling balance point).
- Outdoor Heating design temperatures are -2F for Bangor, -10 for Caribou and 2 for Portland. Outdoor Cooling design temperatures are 86F for Bangor, 81F for Caribou and 83F for Portland.[358]
- EE Heat pump capacity by temperature is weighted average based on program saturation and rated performance. Baseline heat pump capacity by temperature is weighted average of corresponding standard efficiency.
- Design load is proportional to the design capacity of the heat pump as defined by the sizing factor.
- Heating and cooling loads are linearly dependent on temperature between the balance point and design temperature.
- Tier 1 EE Heat pump coefficient of performance by temperature is based on in-situ evaluated performance and varies linearly with temperature.[359]
- Tier 2 EE heat pump COP is based on weighted average of rated performance of qualifying units adjusted by the same factor found between rated performance and evaluated performance.
- Baseline heat pump COP is based on weighted average of rated performance adjusted by the same factor found between rated performance and evaluated performance for EE Heat Pump.

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[354] Based on Excel Workbook for Ductless Heat Pump.
[355] Calculated based on population of each region; U.S. Census Bureau Census 2010 Summary File 1 population by census tract.
[356] Annex G, section 3 of the CSA EXP07 Public Review Draft / September, 2017
[357] BHEC Letter re SNOPR 2016-18993 HLL-Final
[358] ASHRAE
[359] West Hill Energy and Computing, Home Energy Savings Impact Evaluation, WHEC_DHP_COPbyTemp.

High Performance Heat Pump – Multifamily Retrofit, Code MDHP1RT2, MDHP2RT2, MDHP3RT2 (Inactive)	
	• There is an interaction between the heat pump and the central system based on occupant behavior, building characteristics and capacity differences. This interaction is modeled through a load factor and a capacity ratio. When the existing heating system is electric resistance baseboard, heat is only called for when the heat pump capacity falls below the heat loss (i.e. perfect gap filling).
Definitions	Unit = 1 outdoor unit attached to 1 indoor unit. Additional indoor units (whether attached to the same outdoor unit or additional units) are assessed as "Additional Units." For residential applications, no more than 2 units can be claimed per dwelling. SF = sizing factor - ratio of the heat pump capacity at design temperature to heat loss at design temperature LF = load factor - ratio of heat pump capacity to heat loss above which heat is called for from the central system Eff_{CS} = overall system efficiency of the central heating system Cap_{CS} = capacity of central heating system (kBtu/h)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Average existing central heating system with a system efficiency of 80.5%.
Efficient Measure	The high-efficiency case assumes a new high performance heat pump that meets minimum efficiency requirements for program rebate: Single Zone: HSPF>=12.5, Multizone: HSPF >= 10.

PARAMETER VALUES

Measure	SF	LF	Eff_{CS}	Cap_{CS}	Life (yrs)	Cost ($)
1st Zone	2[360]	2.5[361]	80.5[362]	27.1[363]	18[364]	$4,600 single zone $7,383 two zone $10,166 three zone[365]
2nd & 3rd Zone	1.8[366]	3.6[367]				

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%[368]	100%[369]	100%[351]~~[352]~~	100%[370]	100%[311]~~[312]~~	0%[371]	0%[372]

[360] A sizing factor of 2 indicates that the heat pump is oversized for the area it serves.
[361] A load factor of 2.5 indicates that heat is called for from the central system more often.
[362] NMR, 2015 Maine Residential Baseline Study
[363] Capacity of central heating system is set at 1.5 times the design load of the area served by the heat pump for non-electric resistance heating systems.
[364] GDS Associates, Inc., Measure Life Report – Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007; Table 1.
[365] Based on Home Energy Savings Program data.
[366] A sizing factor of 1.8 indicates that the heat pump is oversized for the area it serves. Represents a 2nd heat pump being located in a less than ideal location.
[367] A load factor of 3.6 indicates that heat is called for from the central system more often. Represents a 2nd heat pump that is only heating a small portion of a central heating system zone.
[368] EMT assumes that all purchased units are installed (i.e., ISR = 100%).
[369] This measure is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[370] The on-peak summer and winter kW savings are calculated directly from the modeling.
[371] Because the program share allocated to retrofits is directly related to the growth in additional projects driven by enhanced incentives, retrofit projects can not be free riders. Free riders on the program are captured in the lost opportunity share.
[372] Assumed to be 0%.

High Performance Heat Pump Retrofit – Low-Income Multifamily, Code LIDHP (Inactive)	
Last Revised Date	8/1/2019
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of a high performance heat pump (HPHP) system to supplement the existing heating system in electric heated homes and to replace existing window air conditioning units.
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_{WP} = 0.249 ΔkW_{SP} = 0.004
Annual Energy Savings	ΔkWh/yr = 1,112
Demand Savings	Modeled
Annual Energy Savings	Modeled[373] 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).[374] Savings were calculated based on a model employing the following key assumptions: • Heating and cooling are temperature and season dependent. A behavior model is applied to the TMY3 data to avoid out of season heating and cooling. • Heating is called for when outside air temperature is less than or equal to 60°F (heating balance point). Cooling is called for when outside temperature is more than 70F (cooling balance point). • Outdoor Heating design temperatures are -2F for Bangor, -10 for Caribou and 2 for Portland. Outdoor Cooling design temperatures are 86F for Bangor, 81F for Caribou and 83F for Portland. • EE Heat pump capacity by temperature is weighted average based on program saturation and rated performance. • Design load is proportional to the design capacity of the heat pump as defined by the sizing factor. • Heating and cooling loads are linearly dependent on temperature between the balance point and design temperature. • Tier 1 EE Heat pump coefficient of performance by temperature is based on in-situ evaluated performance and varies linearly with temperature. • Tier 2 EE heat pump COP is based on weighted average of rated performance of qualifying units adjusted by the same factor found between rated performance and evaluated performance. • There is an interaction between the heat pump and the central system based on occupant behavior, building characteristics and capacity differences. This interaction is

373 Based on Excel Workbook for Ductless Heat Pump.
374 Calculated based on population of each region; U.S. Census Bureau Census 2010 Summary File 1 population by census tract.

High Performance Heat Pump Retrofit – Low-Income Multifamily, Code LIDHP (Inactive)	
	modeled through a load factor and a capacity ratio. When the existing heating system is electric resistance baseboard, heat is only called for when the heat pump capacity falls below the heat loss (i.e. perfect gap filling). • 40% of homes have the equivalent of full-home cooling. 21% of homes have no cooling. • For homes that have equivalent of whole home A/C already installed, HPHP will replace the cooling load equivalent to the HPHP's rated capacity. • For homes that have existing partial cooling (i.e. 1 or 2 existing window A/C units), it is unknown if the HPHP will be installed in the same areas served by the existing window A/C units. If installed in the same area, the HPHP will replace the existing cooling load and result in positive savings due to increased efficiency. However, if installed in a different area, HPHP 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 HPHP will be used to its full cooling capacity.
Definitions	Unit = 1 outdoor unit attached to 1 indoor unit. SF = sizing factor - ratio of the heat pump capacity at design temperature to heat loss at design temperature LF = load factor - ratio of heat pump capacity to heat loss above which heat is called for from the central system Eff_{CS} = overall system efficiency of the central heating system
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The baseline is an electric resistance heating system.
Efficient Measure	The high-efficiency case assumes the home retains its existing heating system and adds a new high performance heat pump that meets minimum efficiency requirements for program rebate: HSPF>=13.0 Btu/W-h.

PARAMETER VALUES

Measure	SF	LF	Eff_{CS}		Life (yrs)	Cost ($)
HPHP Retrofit	1.8[375]	2.8[376]	80.5[377]		18[378]	$Actual[379]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
Low-Income	100%[380]	100%[381]	100%[381] ~~[382]~~	100%[382]	100%[311] ~~[312]~~	0%[383]	0%[383] ~~[384]~~

[375] A sizing factor of 2.5 indicates that the heat pump capacity is oversized for the heat loss of the area it serves, accounts for generally smaller floorplan and lower heat loss due to shared walls of multifamily units.
[376] A load factor of 2.8 indicates that heat is called for from the central system when the temperature specific heat pump capacity falls below 2.8 times the heat loss of the area being served. The value is based on empirical data.
[377] NMR, 2015 Maine Residential Baseline Study
[378] GDS Associates, Inc., Measure Life Report – Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007; Table 1.
[379] Total cost to program that covers 100% of installation cost.
[380] EMT assumes that all purchased units are installed (i.e., ISR = 100%).
[381] This measure is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[382] The on-peak summer and winter kW savings are calculated directly from the modeling.
[383] Program assumes no free ridership or spillover for the low-income direct install program.

Prescriptive HVAC: Heat Pump Rooftop Units (RTUHPR, RTUHPN)	
Last Revised Date	1/1/2023
MEASURE OVERVIEW	
Description	This measure includes the replacement of RTUs equipped with propane fired heating sections or coupled with an oil-fired boiler or furnace heating system with high efficiency heat pump RTUs in retrofit or lost opportunity situations. The high efficiency heat pump RTU will be equipped with electric resistance or dual fuel heating sections (propane, natural gas or oil). Installations of high efficiency heat pump RTUs that offset natural gas use are not eligible. The RTU must be the primary heating system.
Primary Energy Impact	Electric, Propane, Oil
Sector	Commercial
Program	C&I Prescriptive Program
End-Use	HVAC
Project Type	New construction, Replace on Burnout, Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	*For air-to-air equipment < 5.4 tons (< 65,000 Btu/h):* $\Delta kW_C = CAP_{CBASE} \times 12 \times (1/SEER_{BASE} - 1/SEER_{EE})$ $\Delta kW_H = (CAP_{HBASE} \times a) + (CAP_{HEE} \times b) + c$ *For air-to-air equipment ≥ 5.4 tons (≥ 65,000 Btuh):* $\Delta kW_C = CAP_{CBASE} \times 12 \times (1/EER_{BASE} - 1/EER_{EE})$ $\Delta kW_H = (CAP_{HBASE} \times a) + (CAP_{HEE} \times b) + c$
Annual Energy Savings	*For air-to-air equipment < 5.4 tons (< 65,000 Btuh):* $\Delta kWh_C/yr = CAP_{CBASE} \times 12 \times (1/SEER_{BASE} - 1/SEER_{EE}) \times EFLH_C$ $\Delta kWh_H/yr = (CAP_{HBASE} \times a) + (CAP_{HEE} \times b) + c$ $\Delta MMBtu/yr = ((CAP_{HBASE} \times a) + (CAP_{HEE} \times b) + c) \times f$ *For air-to-air equipment ≥ 5.4 tons (≥ 65,000 Btuh) :* $\Delta kWh_C/yr = CAP_{CBASE} \times 12 \times (1/EER_{BASE} - 1/EER_{EE}) \times EFLH_C$ $\Delta kWh_H/yr = (CAP_{HBASE} \times a) + (CAP_{HEE} \times b) + c$ $\Delta MMBtu/yr = ((CAP_{HBASE} \times a) + (CAP_{HEE} \times b) + c) \times f$
Definitions	Unit = 1 new heat pump rooftop unit CAP_{CBASE} = Rated cooling capacity of the existing or new baseline RTU (tons) CAP_{HBASE} = Rated heating capacity of the existing or new baseline system. For propane or oil-fired, baseline capacity is expressed as 1,000 Btu/h (MBH). For electric baseline, capacity is expressed in kW. CAP_{HEE} = Rated Heat pump heating capacity at 17 F (1,000 Btu/h or MBH) $SEER_{BASE}$ = Cooling seasonal energy efficiency ratio of the baseline equipment (Btu/h/Watt) $SEER_{EE}$ = Cooling seasonal energy efficiency ratio of the efficient equipment (Btu/h/Watt) $AFUE_{BASE}$ = Annual Fuel Utilization Efficiency (Btu/Btu) $HSPF_{EE}$ = Heating seasonal performance factor of the efficient equipment (Btu/h/Watt) EER_{BASE} = Cooling energy efficiency ratio of the baseline equipment (Btu/h/Watt) EER_{EE} = Cooling energy efficiency ratio of the efficient equipment (Btu/h/Watt) $EFLH_C$ = Cooling equivalent full load hours per year (hrs/yr) a = Polynomial coefficient multiplied by CAP_{HBASE} per Table 1. Based on parametric hourly weather dependent modeling b = Polynomial coefficient multiplied by CAP_{HEE} per Table 1. Based on parametric hourly weather dependent modeling c = Polynomial coefficient per Table 1. Based on parametric hourly weather dependent modeling

Prescriptive HVAC: Heat Pump Rooftop Units (RTUHPR, RTUHPN)		
	f	= Baseline efficiency factor per Table 1. Based on parametric hourly weather dependent modeling
	12	= Conversion: 1 ton = 12,000 Btu/h
	3.412	= Conversion: 3.412 Btu/h per W

EFFICIENCY ASSUMPTIONS

Baseline Efficiency	See Table 5 for details on baseline system characterization.
Efficient Measure	Rated cooling and heating efficiency of new equipment must meet or exceed the minimum requirements on the program. See Table 14.

PARAMETER VALUES

Measure/Type	CAP_{CBASE}	CAP_{HBASE}	CAP_{EE}	$SEER_{BASE}$ EER_{BASE}	$SEER_{EE}$ EER_{EE}	$AFUE_{BASE}$	Life (yrs)	Cost ($/ton)
Heat Pump RTU	Actual	Actual	Actual	Table 15	Actual	Table 15	15[384]	Table 16

Measure/Type	$HSPF_{EE}$ COP_{EE}	$EFLH_C$[385]	a	b	c	f
Heat Pump RTU	Actual	829	Table 13			

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	100%[386]	100%[387]	Table 54[388]		25%[389]	0%[390]

Table 13 - Energy Impact Coefficient and Efficiency Factor Reference Table

Impact	RT/LO	Baseline	Proposed Dual Fuel	Base Heating MBh	a	b	c	f
kW	All	Electric Resistance	Propane/NG/Oil	Any	0.1257645	-0.066331	1.1082325	1
kW	All	Electric Resistance	Electric Resistance	Any	0.0224165	0.0693982	-0.7713552	1
kW	All	Oil/Propane	Propane/NG/Oil	60-160	0.006235	-0.0269285	-3.2629072	1
kW	All	Oil/Propane	Propane/NG/Oil	200-600	-0.0058314	-0.114216	1.6150929	1
kW	All	Oil/Propane	Electric Resistance	60-160	-0.1252659	0.0182852	3.1629275	1
kW	All	Oil/Propane	Electric Resistance	200-600	-0.1170138	0.0693982	-0.7713552	1
kWh	All	Electric Resistance	Electric Resistance	Any	131.61016	245.74621	-4486.6175	1
kWh	All	Electric Resistance	Propane/NG/Oil	Any	435.2997	-215.90722	5291.9481	1
kWh	All	Oil/Propane	Propane/NG/Oil	60-160	-62.547089	-220.44027	6004.5546	1
kWh	All	Oil/Propane	Propane/NG/Oil	200-600	-62.547089	-220.44027	6004.5546	1
kWh	All	Oil/Propane	Electric Resistance	60-160	-370.72786	53.227423	8356.0285	1
kWh	All	Oil/Propane	Electric Resistance	200-600	-366.11933	245.74621	-4486.6175	1
MMBtu	All	Electric Resistance	Electric Resistance	Any	0	0	0	1
MMBtu	All	Electric Resistance	Propane/NG/Oil	Any	-1.4253814	1.9013791	-39.881997	1
MMBtu	All	Oil	Propane/NG/Oil	200-600	0.4729795	3.5288511	-78.847266	1.16

384 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.
385 KEMA, NEEP C&I Unitary HVAC Loadshape Project, June 2011, Table 0-3 and 0-4. Values are for the NE-North region.
386 Measure is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
387 Ibid.
388 See Appendix BAppendix B.
389 Measure not yet evaluated, assume default FR of 25%.
390 Measure not yet evaluated, assume default SO of 0%.

MMBtu	LO	Propane	Propane/NG/Oil	200-600	0.4729795	3.5288511	-78.847266	1
MMBtu	Retro	Propane	Propane/NG/Oil	200-600	0.4729795	3.5288511	-78.847266	1.16
MMBtu	All	Oil	Propane/NG/Oil	60-160	0.4838036	0.4945803	71.176959	1.16
MMBtu	LO	Propane	Propane/NG/Oil	60-160	0.4838036	0.4945803	71.176959	1
MMBtu	Retro	Propane	Propane/NG/Oil	60-160	0.4838036	0.4945803	71.176959	1.16
MMBtu	All	Oil	Electric Resistance	Any	2.1228163	-2.00E-14	-5.20E-12	1.143
MMBtu	LO	Propane	Electric Resistance	Any	2.1228163	-2.00E-14	-5.20E-12	1
MMBtu	Retro	Propane	Electric Resistance	Any	2.1228163	-2.00E-14	-5.20E-12	1.143

Table 14 – Efficiency Requirements for Heat Pump RTU Systems

Existing RTU or Baseline Fossil Fuel Heating Section Input Capacity or Heating Coil Capacity - MBH	Proposed Heat Pump RTU Heating COP 17 F or HSPF	Proposed Heat Pump RTU SEER/EER
60-80	8.5 HSPF	15 SEER
81-120	8.5 HSPF	15 SEER
121-160	2.2	12 EER
161-200	2.2	12 EER
201-300	2.2	11 EER
301-400	2.2	11 EER
401-450	2.2	11 EER

Table 15 –RTU Systems Baseline Efficiency Assumptions

	Base Efficiency			
Cooling	**Cooling Capacity - Tons**	**Cooling**		**Footnote**
	< 5.4 tons	14.0 SEER		391
	≥ 5.4 tons and < 11.25 tons	11 EER		
	≥ 11.25 tons and <20 tons	10.6 EER		
Heating	**Project Type**	**Baseline Fuel**	**Heating Efficiency**	**Footnote**
	Retrofit	Propane	70%	392
		Oil		
	New Construction/Lost Opportunity	Propane	80%	393
		Oil	70%	394

Table 16 - Heat Pump RTU Systems Baseline Cost Assumptions[395]

Cooling Capacity	Measure Cost	
	Retrofit	**NC/LO**
< 5.4 tons	Actual Project Cost	Actual Project Cost – $1,667/ton or actual
≥ 5.4 tons and < 10 tons	Actual Project Cost	Actual Project Cost – $1,533/ton or actual
> 10 tons and <15 tons	Actual Project Cost	Actual Project Cost – $1,350/ton or actual

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[391] IECC 2009, Table 503.2.3(2).
[392] https://www.nrel.gov/docs/fy14osti/56402.pdf; https://www.esmagazine.com/articles/101464-assessment-of-seasonal-boiler-efficiency-in-individual-buildings
[393] IECC 2009, Table 503.2.3(2).
[394] https://www.nrel.gov/docs/fy14osti/56402.pdf; https://www.esmagazine.com/articles/101464-assessment-of-seasonal-boiler-efficiency-in-individual-buildings
[395] Costs include equipment and installation. Baseline costs based on representative costs of twelve standard gas fired RTUs collected October 2022 for sizes ranging from 3 tons to 25 tons.

> 15 tons to 20 tons	Actual Project Cost	Actual Project Cost – $1,275/ton or actual

Prescriptive HVAC: Demand Control Ventilation, Codes DCVE, DCVN							
Last Revised Date	4/1/2020						
MEASURE OVERVIEW							
Description	This measure involves installation of demand control ventilation (DCV) on 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	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 DCV system installed.						
PARAMETER VALUES							
Measure/Type	Area	VentilationRate	SF_{kW}	EER_{EE}	$EFLH_C$	Life (yrs)	Cost ($)
All	Actual	Table 64	0.000433[396]	Actual	719[397]	10[398]	$2,100 (Retrofit) $850 (NC)[399]

[396] 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.

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

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

[399] 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 HVAC: Demand Control Ventilation, Codes DCVE, DCVN							
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[400]	100%[401]	Table 54Table 54[402]	Table 54Table 54[402][403]	52%[403]	1.6%[404]

[400] Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
[401] Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.
[402] See Appendix BAppendix B.
[403] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[404] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.

Prescriptive HVAC: Energy Recovery Ventilator	
Last Revised Date	4/1/2021
MEASURE OVERVIEW	
Description	This measure involves the installation of an energy recovery ventilator (ERV) on existing or new HVAC equipment. The ERV system recovers energy from exhaust air and is used to pre-condition incoming outdoor air, resulting in energy savings.
Primary Energy Impact	Natural Gas, Propane, Oil, Electric
Sector	Commercial
Program	C&I Prescriptive Program
End-Use	HVAC
Project Type	Retrofit, New Construction
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = 0.075 \times 60 \times CFM \times Eff_{HX} \times (H_{OUT} - H_{RETURN}) / Eff_{COOL}/1{,}000 - kW_{FAN}$ $\Delta kW_{WP} = - kW_{FAN} \times CF_W$ $\Delta kW_{SP} = (0.075 \times 60 \times CFM \times Eff_{HX} \times (H_{OUT} - H_{RETURN}) / Eff_{COOL}/1{,}000 - kW_{FAN}) \times CF_S$
Annual Energy Savings	$\Delta MMBtu/yr = (1.08 \times CFM \times (RA - OA)) \times Eff_{ERV,H} \times Hours_H \times \%On) / (1{,}000{,}000 \times Eff_{HEAT})$ $\Delta kWh/yr = 0.075 \times 60 \times CFM \times Eff_{ERV,C} \times (H_{OUT} - H_{RETURN}) / Eff_{COOL}/1{,}000 \times Hours_C \times \%On - kW_{FAN} \times 8760 \times \%On$ $kW_{FAN} = CFM \times \Delta P / ((33{,}013/5.202) \times Eff_{FAN} \times Eff_{MOTOR}) \times 0.746$
Definitions	Unit = 1 ERV $Hours_H$ = Hours per year facility is heated $Hours_C$ = Hours per year facility is cooled %On = Portion of the time the ERV is operating = X hours/24 hours * Y days/7 days 1.08 = Sensible heat gain factor: 60 m/h*0.075 lb/ft^3*0.24 Btu/lb/°F CFM = Design supply air flow (cubic feet per minute) RA = Return air temperature (°F) OA = Outside air design temperature (°F) $Eff_{ERV,H}$ = Efficinecy of energy recovery ventilator when heating[405] 1,000,000 = Conversion: 1,000,000 BTU/MMBTU Eff_{HEAT} = Heating system efficiency (AFUE) 0.075 = Constant: Specific density of air (lb/ft^3) 60 = Conversion: 60 m/h $Eff_{ERV,C}$ = Efficiency of energy recovery ventilator when cooling[406] H_{OUT} = Enthalpy of outside air (Btu/lb) H_{RETURN} = Enthalpy of return air (Btu/lb) Eff_{COOL} = Seasonal energy efficiency ratio of the cooling equipment (Btu/h/Watt) 1,000 = Conversion: 1,000 W/kW 8760 = Constant: 8,760 hours per year ΔP = Pressure Drop [inches of water][407] 33,012 = Conversion: 1 horsepower = 33,013 ft-lb/min 5.202 = Conversion: 1 inch of water = 5.202 lb/ft^2 Eff_{FAN} = Fan mechanical efficiency Eff_{MOTOR} = Fan motor efficiency 0.746 = Conversion: 1 horsepower = 0.746 kW

[405] AHRI Certified Ratings - Heating at 100% Airflow - Sensible
[406] AHRI Certified Ratings - Cooling at 100% Airflow - Total
[407] AHRI Certified Ratings - Pressure Drop (at nominal airflow, in. H2O)

EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	HVAC equipment with no ERV system installed.
Efficient Measure	Installation of ERV on an HVAC system where not required by energy code.

PARAMETER VALUES

Measure/Type	$Hours_H$	$Hours_C$	CFM	RA (°F)	OA (°F)	TE	Life (yrs)	Cost ($)
ERV	6492[408]	932[409]	Actual	68[410]	36.5[411]	Actual	15[412]	$3.75/CFM[413]

Measure/Type	Eff_{HEAT}	$EFF_{ERV,C}$	H_{OUT}	H_{RETURN}	Eff_{COOL}	Eff_{FAN}	Eff_{MOTOR}	%On	ΔP
ERV	Actual	Actual	31.1[414]	28.3[415]	Actual	0.67[416]	0.70 [417]	77%[418]	Actual

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	100%[419]	100%[420]	Table 54~~Table 54~~[421]	Table 54~~Table 54~~[225]	25%[422]	0%[423]

[408] Weighted average annual hours below 60°F using TMY3 data for Portland, Bangor and Caribou. Results are weighted based on population (71.2% Portland, 23.4% Bangor, 5.4% Caribou

[409] Weighted average annual hours above 65°F using TMY3 data for Portland, Bangor and Caribou. Results are weighted based on population (71.2% Portland, 23.4% Bangor, 5.4% Caribou

[410] Assumed thermostat set point.

[411] Weighted average temperature below 60°F using TMY3 data for Portland, Bangor and Caribou. Results are weighted based on population (71.2% Portland, 23.4% Bangor, 5.4% Caribou.

[412] Assumed service life limited by controls - "Demand Control Ventilation Using CO2 Sensors", pg. 19, by US Department of Energy Efficiency and Renewable Energy.

[413] "National Cost-Effectiveness of ASHRAE Standard 90.1-2010 Compared to AHRAE 90.1-2007", PNNL, November 2007 (page 4-16).

[414] Average enthalpy of outside air during cooling season based on TMY3 data weighted based on population for Portland, Bangor and Caribou, ME. Assumes cooling season at temperatures above 65°F.

[415] Enthalpy of inside air, 75°F / 50% RH.

[416] ASHRAE 90.1 2013. Section 6.5.3.1.3.

[417] Code of Federal Regulations CFR 10 431.446 for ¼ HP motor.

[418] Assumes 70% of systems are continuous operation at constant air volume and 30% of systems are variable air volume equivalent to single shift operation (8 hours/day, 5 days/week).

[419] New measure offering not yet evaluated.

[420] New measure offering not yet evaluated.

[421] See Appendix B~~Appendix B~~.

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

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

Prescriptive HVAC: Modulating Burner Controls for Boilers and Heaters, Code AF1

Last Revised Date	7/1/2018
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[424]	T (Process)	T (Space Heating)[425]	Life (yrs)[426]	Cost ($)[427]
All	Actual	3%	Hours of Operation	1,565 EFLH	21	$2.14/MBtuh

IMPACT FACTORS

Program	ISR	RR_E[428]	RR_D	CF_S	CF_W	FR[429]	SO[430]
C&I Prescriptive	100%	100%	N/A	N/A	N/A	52%[431]	1.6%[432]

[424] Xcel Energy, 2010/2011/2012 Triennial Plan, Minnesota Electric and Natural Gas Conservation Improvement Program, E,G002/CIP-09-198. Page 474: 80% baseline boiler to 83% overall efficiency with improvement.
[425] Equivalent full load hours scaled by average oversize factor. Full Load Hours (2,661): 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. Oversize factor (1.7): 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 (2,661/1.7 = 1,565)
[426] Illinois Statewide Technical Reference Manual version 4.0, measure 4.4.20 – High Turndown Burner.
[427] 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
[428] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[429] 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).
[430] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-10. Participant Spillover.
[431] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[432] 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[433]	SF[434]	Life (yrs)[435]	Cost ($)[436]		
Standard Economizer	Actual	1,565	5%	20	$1,500/MMBtu/h		
Condensing Economizer	Actual	1,565	10%	20	$2,120/MMBtu/h		
IMPACT FACTORS							
Program	ISR	RR_E[437]	RR_D	CF_S	CF_W	FR[438]	SO[439]
C&I Prescriptive	100%	100%	N/A	N/A	N/A	52%[440]	1.6%[441]

433 Equivalent full load hours scaled by average oversize factor. Full Load Hours (2,661): 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. Oversize factor (1.7): 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 (2,661/1.7 = 1,565)

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

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

436 Ibid.

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

438 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).

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

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

441 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[442]	SF[443]	Life (yrs)[444]	Cost ($)[445]
All	Actual	1,565	8%	20	$612/boiler

IMPACT FACTORS

Program	ISR	RR_E[446]	RR_D	CF_S	CF_W	FR[447]	SO[448]
C&I Prescriptive	100%	100%	N/A	N/A	N/A	52%[449]	1.6%[450]

442 Equivalent full load hours scaled by average oversize factor. Full Load Hours (2,661): 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. Oversize factor (1.7): 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 (2,661/1.7 = 1,565)
443 Illinois Statewide TRM version 4, measure 4.4.4. http://www.icc.illinois.gov/electricity/TRM.aspx.
444 Ibid.
445 Ibid.
446 This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
447 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).
448 Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-10. Participant Spillover.
449 Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
450 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[451]	T (Process)	T (Space Heating)[452]	Life (yrs)[453]	Cost ($)
All	Actual	2%	Actual Hours of Operation	1,565	15	$20,000[454]

IMPACT FACTORS

Program	ISR	RR_E[455]	RR_D	CF_S	CF_W	FR[456]	SO[457]
C&I Prescriptive	100%	100%	N/A	N/A	N/A	52%[458]	1.6%[459]

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[451] United States EPA, Climate Wise: Wise Rules for industrial Efficiency, July 1998.
[452] Equivalent full load hours scaled by average oversize factor. Full Load Hours (2,661): 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. Oversize factor (1.7): 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 (2,661/1.7 = 1,565)
[453] Michigan Master Database of Deemed Savings - 2014 - Weather Sensitive Commercial, Adjusted for Maine heating hours.
[454] 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
[455] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[456] 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).
[457] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-10. Participant Spillover.
[458] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[459] 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[460] 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[461]	Life (yrs)[462]	Cost ($)[463]	
All	Actual	0.70[464]	Actual	1,565	20	$15 per turbulator	
IMPACT FACTORS							
Program	ISR	RR_E[465]	RR_D	CF_S	CF_W	FR[466]	SO[467]
C&I Prescriptive	100%	100%	N/A	N/A	N/A	52%[468]	1.6%[469]

[460] http://energy.gov/sites/prod/files/2014/05/f16/steam25_firetube_boilers.pdf.
[461] Equivalent full load hours scaled by average oversize factor. Full Load Hours (2,661): 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. Oversize factor (1.7): 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 (2,661/1.7 = 1,565)
[462] CenterPoint Energy, Triennial CIP/DSM Plan 2010-2012, June 1, 2009.
[463] http://energy.gov/sites/prod/files/2014/05/f16/steam25_firetube_boilers.pdf.
[464] 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.
[465] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[466] 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).
[467] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-10. Participant Spillover.
[468] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[469] Ibid.

Prescriptive HVAC: Programmable Thermostat, Code AF6							
Last Revised Date	4/1/2019						
MEASURE OVERVIEW							
Description	This measure involves the purchase and installation of a single programmable thermostat connected to a single boiler/furnace or electric resistance zone.						
Energy Impacts	Natural gas, Heating oil, Propane, Electric						
Sector	Commercial, Industrial						
Program(s)	C&I Prescriptive Program						
End-Use	Space heating						
Decision Type	Retrofit						
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)							
Demand savings	$\Delta kW = 0$						
Annual energy savings	$\Delta MMBtu/yr = (CAP_{INPUT} \times EFLH \times \%_{SAVE}) / 1{,}000$ $\Delta kWh/yr = (CAP_{INPUT} \times EFLH \times \%_{SAVE}) / 1{,}000 / 0.003412$						
Definitions	Unit = Single thermostat connected to a single boiler CAP_{INPUT} = Heating system input capacity (kBtu/hr) EFLH = Equivalent full load hours $\%_{SAVE}$ = Savings percentage with installation of a programmable thermostat 1,000 = Conversion 1,000 MBtu per MMBtu 0.003412 = Conversion 0.003412 MMBtu/kWh						
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[470]	$\%_{SAVE}$[471]	Life (yrs)[472]	Cost ($)[473]
All	Actual	1,565	6.8%	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%[474]	1.6%[475]

[470] Equivalent full load hours scaled by average oversize factor. Full Load Hours (2,661): 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. Oversize factor (1.7): 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 (2,661/1.7 = 1,565)

[471] New York Technical Reference Manual, Commercial Programmable Thermostat ESF, revised 10.15.10.

[472] 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.

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

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

[475] Ibid.

Prescriptive HVAC: Boilers and Furnaces, Codes G9-G11, H2L, H3L (see Retail/Residential TRM for boilers and furnaces with <500,000 btu/h capacities)	
Last Revised Date	7/1/2021
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of a new high-efficiency natural gas, instead of a new code-compliant unit with equivalent capacity.
Energy Impacts	Natural Gas, , 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	$\Delta MMBtu/yr = AHL \times (1 / Eff_{BASE} - 1 / Eff_{EE})$ Where AHL can be calculated as follows: From Manual J: $AHL = 186{,}648 \times DL / (T_i - T_o) / 1{,}000{,}000$ From Equipment Capacity: $AHL = CAP \times EFLH_h / OF / 1{,}000{,}000$
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 17~~Table 17~~

Prescriptive HVAC: Boilers and Furnaces, Codes G9-G11, H2L, H3L (see Retail/Residential TRM for boilers and furnaces with <500,000 btu/h capacities)

PARAMETER VALUES (DEEMED)

Measure/Type	AHL	Eff_{BASE}[476,477]	Eff_{EE}	Life (yrs)[478]	Cost ($)[479]
Boiler	Calculated	Table 17~~Table 17~~	Actual	24	Table 17~~Table 17~~
Furnace				18	

Measure/Type	DL	T_i	T_o	OF	Cap	$ELFH_h$
Boiler	Actual	Actual	Actual	1.7[480]	Actual	2661[481]
Furnace						

IMPACT FACTORS

Program	ISR	RR_E[482]	RR_D	CF_S	CF_W	FR[483]	SO[484]
Downsteam	100%	100%	N/A	N/A	N/A	52%[485]	1.6%[486]
Midstream						25%[487]	0%[488]

476 U.S. Federal Standards for Commercial Packaged Boilers. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/74.
477 U.S. Federal Standards for Commercial Warm Air Furnaces. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/71.
478 "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,
479 Incremental cost difference between quoted installation cost and efficient quoted installation cost.
480 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
481 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.
482 This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
483 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).
484 Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-10. Participant Spillover.
485 Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
486 Ibid.
487 Measure not yet evaluated, assume default FR of 25%.
488 Measure not yet evaluated, assume default SO of 0%.

Table 17 – Commercial Boiler and Furnace Efficiencies: Baseline Efficiencies and Efficient Minimums

Equipment Type	Subcategory	Measure Code	CAP_{INPUT} (MBtu/hr)	Eff_{BASE}[489]	Eff_{EE}	Eff Ref[490]	Incremental Cost[491]	Cost Ref[492]
Hot Water Commercial Packaged Boilers	Gas-fired—NG	G9	≥500 & < 1,000	80% Et	95% Et	[3]	$1,982+3.47 MBH	[A]
		G10	≥1,000 & < 2,500	80% Et	95% Et	[3]		
		G11	≥2,500	82% Ec	95% Et	[3]		
Hot Water Commercial Packaged Boilers	Oil-fired	Inactive	≥500 & < 1,000	82% Et	85% Et	[3]	$1,039	[D]
			≥1,000 & < 2,500	82% Et	87% Et	[3]	$7,612	
			≥2,500	84% Ec	87% Et	[3]	$8,416	
Steam Commercial Packaged Boilers	Gas-fired— NG & Propane	Inactive	< 300	80% AFUE	82% AFUE	[2]	$1,200	[C]
			≥300 & < 2,500	77% Et	82% Et	[3]	$3,125	[C]
			≥2,500	77% Et	82% Et	[3]	$3,800	[C]
Steam Commercial Packaged Boilers	Oil-fired	Inactive	≥500 & < 1,000	81% Et	84% Et	[3]	$858	[D]
			≥1,000 & < 2,500	81% Et	84% Et	[3]	$2,826	
			≥2,500	81% Et	85% Et	[3]	$4,738	

[489] Where AFUE is annual fuel utilization efficiency, Et is thermal efficiency and Ec is combustion efficiency as defined in 10 CFR 431.82.
[490] 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).
[491] 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..
[492] [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

Electronically Commutated Supply Fan Motor (ECMSF) (Inactive)							
Last Revised Date	7/1/2019 (retroactive to 7/1/2018)						
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[493] ΔkW = 0.18 winter kW[494]						
Annual Energy Savings	ΔkWh/yr = 387.8 for heating only[495] = 73.0 for cooling only[496] = 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[497]	$200[498]					
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR[499]	SO
C&I Prescriptive	100%	100%	100%	Table 54[500]	Table 54[501]	25%	0%

493 UI/Eversource C&LM Program Savings Documentation – 2017, Page 145.
494 UI/Eversource C&LM Program Savings Documentation – 2017, Page 145.
495 Calculated using equations from UI/Eversource C&LM Program Savings Documentation – 2017, Page 145, using weighted average Maine HDD of 7,777.
496 Calculated using equations from UI/Eversource C&LM Program Savings Documentation – 2017, Page 145, using weighted average Maine CDD of 480.
497 UI/Eversource C&LM Program Savings Documentation – 2017, Page 327.
498 Estimated incremental cost for efficient motor only. Sachs and Smith, 2003, Page 12.
499 Measure not yet evaluated, assume default FR of 25% and SO of 0%.
500 See Appendix C. Reference impact factors for "VFDs on Supply Fan".
501 Ibid.

Electronically Commutated Hot Water Smart Pump (ECMHW) (Inactive – see Retail/Residential TRM)							
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 18						
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[502]				20	Table 18	
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR[503]	SO
C&I Prescriptive	100%	100%	100%	Table 54[504]	Table 54[505]	25%	0%

Table 18 - Savings and Measure Cost for EC Circulator Pump Motors

Rated Current (Amps)	Energy Savings[506] (kWh/yr)	Measure Cost[507] ($)
< 1.25	426	$368
1.25 – 5	804	$758
> 5	2,586	$1,018

502 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.
503 Measure not yet evaluated, assume default FR of 25% and SO of 0%.
504 See Appendix C. Reference impact factors for “VFDs on Heating Hot Water Pumps”.
505 Ibid.
506 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).
507 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	11/1/2020							
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.							
Primary Energy Impact	Electric							
Sector	Commercial							
Program(s)	C&I Prescriptive Program							
End-Use	Refrigeration							
Project Type	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	Table 19	Actual	0.035[508]	50%[509]	Table 65[510]	8,760[511]	10[512]	$520[513]
IMPACT FACTORS								
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO	

[508] Wattage of fan is used by Freeaire and Cooltrol.
[509] 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.
[510] See Appendix F.
[511] Contnuous operation assumed.
[512] ERS, Measure Life Study Prepared for the Massachusetts Joint Utilities, November 2005, Table 1-1.
[513] Northeast Energy Efficiency Partnerships, Incremental Cost Study Phase 4, June 23, 201. Assumes 5.7 fans.

C&I Prescriptive	100%	112.2%[514]	100%[515]	Table 54~~Table 54~~[516]	Table 54~~Table 54~~[516][517]	52%[517]	1.6%[518]

Table 19 – Evaporator Fan Connected Load

Motor Type	kW_{EVAP}
ECM	0.040
Synchronous	0.046
PSC	0.088
Shaded Pole	0.132
Unknonwn	0.097

[514] Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
[515] Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.
[516] See Appendix C.
[517] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[518] Ibid.

Prescriptive Refrigeration: Door Heater Controls for Cooler/Freezer, Code R20	
Last Revised Date	11/1/2020
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	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}[519]	n_{door}	BF	SF	Hours	Life (yrs)	Cost ($)
All	0.075 for cooler 0.200 for freezer	Actual	Table 65[520]	Table 20~~Table 20~~	8,760[521]	10[522]	$300[523]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[524]	100%[525]	Table 54~~Table 54~~[526]	Table 54~~Table 54~~[526]~~[527]~~	52%[527]	1.6%[528]

[519] Based on range of wattages from two manufacturers and metered data (cooler 50-130 W, freezer 200-320 W).
[520] See Appendix F.
[521] Refrigeration equipment is assumed to operate continuously.
[522] ERS, Measure Life Study Prepared for the Massachusetts Joint Utilities, November 2005, Table 1-1.
[523] 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.
[524] Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
[525] Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.
[526] See Appendix C.
[527] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[528] Ibid.

Table 20 – Savings Factor for Door Heater Controls[529]

Refrigerated Space	SF
Cooler	74%
Freezer	46%

[529] Per Massachusetts TRM: The value is an estimate by NRM based on hundreds of downloads of hours of use data from Door Heater controllers. These values are also supported by Select Energy Services, Inc. (2004). Cooler Control Measure Impact Spreadsheet User's Manual. Prepared for NSTAR.

Prescriptive Refrigeration: Strip Curtains, Code R25							
Last Revised Date	11/1/2020 (new)						
MEASURE OVERVIEW							
Description	Installation of a strip curtain on a walk-in cooler/freezer. This measure is only applicable for walk-in coolers and freezers in the following facility types: (1) Grocery stores (2) Retail/Service (Convenience stores) (3) Restaurants						
Primary Energy Impact	Electric						
Sector	Commercial						
Program	C&I Prescriptive Program						
End-Use	Refrigeration						
Project Type	Retrofit						
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)							
Demand Savings	$\Delta kW = \Delta kWh / Hours$						
Annual Energy Savings	$\Delta kWh = \Delta kWh / sq. ft. \times Area$						
Definitions	ΔkW = Connected load reduction ΔkWh = Energy Savings Area = Doorway Area. See Table 22 for default values if area is unknown Hours = Annual operating hours (hrs/yr)						
EFFICIENCY ASSUMPTIONS							
Baseline Efficiency	The baseline scenario is a walk-in cooler or freezer with no strip curtains installed.						
Efficient Measure	The high efficiency scenario is a walk-in cooler or freezer with strip curtains installed at least 0.06 inches thick.[530]						
PARAMETER VALUES							
Measure/Type	ΔkWh/sq. ft.[531]	Area[532]	Hours	Life (yrs)[533]	Cost ($)[534]		
All	Table 21	Table 22	8,760	4	$10.22 / sq. ft.		
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	99%[535]	101%[536]	Table 39[537]	Table 39[538]	52%[539]	1.6%[540]

[530] Pennsylvania Public Utility Commission TRM, August 2019, Section 3.5.8, Strip Curtains for Walk-in Freezers and Coolers.
[531] Database for UES Measures, Regional Technical Forum. Strip Curtains, version 1.7. December 2016. https://rtf.nwcouncil.org/measure/strip-curtains
[532] Database for UES Measures, Regional Technical Forum. Strip Curtains, version 1.7. December 2016. https://rtf.nwcouncil.org/measure/strip-curtains
[533] California Public Utilities Commission Database for Energy Efficient Resources (DEER) EUL Support Table for 2020, http://www.deeresources.com/files/DEER2020/download/SupportTable-EUL2020.xlsx.
[534] 2008 Database for Energy Efficiency Resources (DEER), Version 2008.2.05, "Cost Values and Summary Documentation", California Public Utility Commission, December 16, 2008.
[535] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Realization Rates for Prescriptive Measures.
[536] Ibid.
[537] See Appendix B.
[538] Ibid.
[539] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[540] Ibid.

Table 21 – Default Energy Savings for Strip Curtains[541]

Facility / Type of Refrigeration	ΔkWh/sq. ft.
Grocery - Cooler	123
Grocery - Freezer	535
Convenience Store - Cooler	19
Convenience Store - Freezer	31
Restaurant - Cooler	24
Restaurant - Freezer	129

Table 22 – Default Doorway Areas[542]

Facility / Type of Refrigeration	Doorway Area (ft^2)
Grocery - Cooler	21
Grocery - Freezer	21
Convenience Store - Cooler	21
Convenience Store - Freezer	21
Restaurant - Cooler	21
Restaurant - Freezer	21

[541] Database for UES Measures, Regional Technical Forum. Strip Curtains, version 1.7. December 2016. https://rtf.nwcouncil.org/measure/strip-curtains
[542] Database for UES Measures, Regional Technical Forum. Strip Curtains, version 1.7. December 2016. https://rtf.nwcouncil.org/measure/strip-curtains

Prescriptive Refrigeration: Zero Energy Doors for Coolers/Freezers, Codes R30, R31 (Inactive)

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}[543]	BF	Hours	Life (yrs)	Cost ($)
Cooler (R30)	0.075	Table 65[544]	8,760	10[545]	$275[546]
Freezer (R31)	0.200	Table 65[544][545]	8,760	10[545][546]	$800[546][547]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[547]	100%[548]	Table 54Table 54[549]	Table 54Table 54[549][550]	52%[550]	1.6%[551]

[543] Based on range of wattages from two manufacturers and metered data (cooler 50-130 W, freezer 200-320 W).
[544] See Appendix D: Parameter Values Reference TablesAppendix D: Parameter Values Reference Tables.
[545] ERS, Measure Life Study Prepared for the Massachusetts Joint Utilities, November 2005, Table 1-1.
[546] 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
[547] Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
[548] Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.
[549] See Appendix BAppendix B.
[550] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[551] Ibid.

Prescriptive Refrigeration: High-Efficiency Evaporative Fan Motors, Codes R40, R41, R42	
Last Revised Date	11/1/2020
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.[552]
Primary Energy Impact	Electric
Sector	Commercial
Program(s)	C&I Prescriptive Program
End-Use	Refrigeration
Project Type	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}[553]	kW_{BDC}[554]	DC_{Evap}[555]	BF[556]	Hours[557]	Life (yrs)[558]	Cost ($)
Walk-in Cooler/Freezer (R40) Refrigerated Warehouse (R41) Merchandise Case (R42)	0.123	0.040	100% for cooler, 94% for freezer	Table 65	8,760	15	Table 23~~Table 23~~

[552] Energy Independence and Securities Act of 2007, Section 312.
[553] 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%).
[554] Based on research for typical power demand high-efficiency evaporator fan motors for refrigeration applications (40 Watts).
[555] 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),
[556] SeeAppendix D: Parameter Values Reference Tables~~Appendix D: Parameter Values Reference Tables~~.
[557] Refrigeration equipment is assumed to operate continuously.
[558] 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%[559]	100%[560]	Table 54Table 54[561]	Table 54Table 54[561][562]	52%[562]	1.6%[563]

Table 23 – Measure Costs for Evaporative Fan Motors[564]

Measure Code	Application	Measure Cost
R40	Walk-in Coolers/Freezers	$144
R41	Refrigerated Warehouses	$144
R42	Merchandise Cases	$117

[559] Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
[560] Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.
[561] See Appendix BAppendix B.
[562] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[563] Ibid.
[564] Average incremental cost based on NEEP Incremental Cost Report – Emerging Technology – Q-sync Motor Incremental Cost, 2016; CPUC Ex Ante Measure Cost Study Report figure 3-21.

Prescriptive Refrigeration: Floating-Head Pressure Controls, Codes R50, R51, R52	
Last Revised Date	11/1/2020
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 24~~Table 24~~	7,221[565]	15[566]	Table 25

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[567]	100%[568]	Table 54~~Table 54~~[569]	Table 54~~Table 54~~[569]~~[570]~~	52%[570]	1.6%[571]

[565] 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.

[566] California DEER 2014 Effective Useful Life (EUL) table. .

[567] Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.

[568] Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.

[569] See Appendix B~~Appendix B~~.

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

[571] Ibid.

Table 24 – Floating-Head Pressure Control kWh Savings per Horsepower (kWh/yr/hp)[572]

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 25 – Measure Costs for Floating-Head Pressure Control[573]

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

[572] Average savings values are based on previous EMT projects.
[573] 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: Scroll Compressors, Codes R70, R71, R72, R73, R74	
Last Revised Date	11/1/2020
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	$HP_{COMPRESSOR}$	ΔkWh/hp	FLH	Life (yrs)	Cost ($)
All	Actual	Table 26	5,858[574]	15[575]	Table 27~~Table 27~~

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[576]	100%[577]	Table 54~~Table 54~~[578]	Table 54~~Table 54~~[578]~~[579]~~	52%[579]	1.6%[580]

[574] 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.
[575] ERS, Measure Life Study Prepared for the Massachusetts Joint Utilities, November 2005, Table 1-1.
[576] Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
[577] Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.
[578] See Appendix B~~Appendix B~~.
[579] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[580] Ibid.

Table 26 – Compressor kWh Savings per Horsepower (kWh/hp)[581]

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)
Scroll	208	432	363

Table 27 – Measure Costs for Discus and Scroll Compressors[582]

Equipment Type	Measure Code	Size (hp)	Measure/Incremental Cost
Scroll	R70	2	$400
	R71	3	$525
	R72	4	$600
	R73	5	$1,000
	R74	6	$1,300

[581] Savings calculations summarized in <Compressor kWh compared.xls>; calculations performed in spreadsheet tool <Refrigeration Compressor Evaluation Vers. 2.01 July 2003.xls>.
[582] 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 (Inactive)

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)	Commercial Kitchen Distributor Discount Initiative
End-Use	Refrigeration
Project Type	New construction
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 28	5,858[583]	12[584]	155[585]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[586]	100%[587]	Table 54Table 54[588]	Table 54Table 54[588][589]	52%[589]	1.6%[590]

[583] 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.
[584] Environmental Protection Agency, "Savings Calculator for ENERGY STAR Qualified Commercial Kitchen Equipment." Accessed April 8, 2013.
[585] 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.
[586] Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
[587] Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.
[588] See Appendix BAppendix B.
[589] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[590] Ibid.

Table 28 – 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[591]	Qualifying Products[592]	
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)

591 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

592 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 (Inactive)	
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)	Commercial Kitchen Distributor Discount Inititive
End-Use	Refrigeration
Project Type	New construction
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 29	5,858[593]	8[594]	$0[595]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[596]	100%[597]	Table 54Table 54[598]	Table 54Table 54[598][599]	52%[599]	1.6%[600]

[593] 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.
[594] Environmental Protection Agency, "Savings Calculator for ENERGY STAR Qualified Commercial Kitchen Equipment." Accessed April 8, 2013.
[595] ENERGY STAR® Commercial Kitchen Equipment Calculator.
[596] Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
[597] Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.
[598] See Appendix BAppendix B.
[599] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[600] Ibid.

Table 29 – CEE Specifications for Air-Cooled Self-Contained Ice Makers[601]

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

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

Water Heating

Heat Pump Water Heater (HPWHCE, HPWHCU)							
Last Revised Date	07/01/2023						
MEASURE OVERVIEW							
Description	ENERGY STAR®-certified air source commercial Heat Pump Water Heaters (HPWH). This measure involves the purchase and installation of a new commercial ENERGY STAR® certified HPWH in place of a new code-compliant or standard efficiency water heater or as an early replacement of an operational water heater or to retrofit an existing hot water heater. Savings are counted only for the improved water heater efficiency. Eligible HPWH are 80 and 120 gallon storage units in qualifying building types per Table 26 with efficiency criteria meeting the standards in Table 27 below. HPWHs replacing or installed in lieu of natural gas fired hot water heaters are not eligible.						
Primary Energy Impact	Electric, Propane, Oil						
Sector	Commercial						
Program(s)	C&I Prescriptive Program						
End-Use	Domestic Hot Water						
Decision Type	New Construction (NC), Replace on Burnout (ROB), Retrofit						
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)							
EFFICIENCY ASSUMPTIONS							
Baseline Efficiency	Storage tank water heater that meets federal minimum efficiency standards for commercial water heaters						
Efficient Measure	ENERGY STAR®-certified commercial storage tank HPWH						
PARAMETER VALUES (DEEMED)							
Parameter	TE_{BASE}	TE_{EE}	GAL			Life (yrs)	Cost ($)
Value	Table 27	Actual	Table 33~~Table 33~~			15[602]	Table 30
IMPACT FACTORS							
Parameter	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
Value	100%[603]	100%[604]	100%[605]	N/A	N/A	25%[606]	0%[607]

602 DEER 08, EUL_Summary_10-1-08.xls
603 EMT assumes that all purchased units are installed (i.e. ISR = 100%).
604 New measure not yet evaluated.
605 New measure not yet evaluated.
606 Measure not yet evaluated, assume default FR of 25%
607 Measure not yet evaluated, assume default SO of 0%

Table 30 HPWH Deemed Energy Impacts and Measure Costs[608]

Facility Type	Project Type	Baseline	Gallons storage	Electric impact (kWh/y)	Winter peak impact (kW)	Summer peak impact (kW)	Fuel Impact (MMbtu/y)	Measure cost
Hospital	NC/ROB	Electric	80	13,794	0.89	0.69	-	$2,582.04
			120	20,691	1.34	1.03	-	$3,873.06
		Oil	80	(25,252)	(1.45)	(1.12)	224.1	$3,821.46
			120	(37,878)	(2.18)	(1.68)	336.2	$5,732.19
		Propane	80	(25,252)	(1.45)	(1.12)	188.3	$3,821.46
			120	(37,878)	(2.18)	(1.68)	282.4	$5,732.19
	Retrofit	Electric	80	32,457	2.10	1.61	-	$6,676.44
			120	48,685	3.15	2.42	-	$10,014.66
		Oil	80	(25,252)	(1.45)	(1.12)	224.1	$6,676.44
			120	(37,878)	(2.18)	(1.68)	336.2	$10,014.66
		Propane	80	(25,252)	(1.45)	(1.12)	251.0	$6,676.44
			120	(37,878)	(2.18)	(1.68)	376.5	$10,014.66
Hotel	NC/ROB	Electric	80	17,407	1.64	1.34	-	$2,582.04
			120	26,110	2.46	2.02	-	$3,873.06
		Oil	80	(28,262)	(2.76)	(2.26)	238.6	$3,821.46
			120	(42,394)	(4.15)	(3.39)	357.9	$5,732.19
		Propane	80	(28,262)	(2.76)	(2.26)	200.4	$3,821.46
			120	(42,394)	(4.15)	(3.39)	300.6	$5,732.19
	Retrofit	Electric	80	40,957	3.86	3.16	-	$6,676.44
			120	61,436	5.79	4.74	-	$10,014.66
		Oil	80	(28,262)	(2.76)	(2.26)	238.6	$6,676.44
			120	(42,394)	(4.15)	(3.39)	357.9	$10,014.66
		Propane	80	(28,262)	(2.76)	(2.26)	267.2	$6,676.44
			120	(42,394)	(4.15)	(3.39)	400.8	$10,014.66
Motel	NC/ROB	Electric	80	2,205	0.30	0.22	-	$2,582.04
			120	3,308	0.44	0.33	-	$3,873.06
		Oil	80	(9,168)	(1.24)	(0.91)	84.4	$3,821.46
			120	(13,752)	(1.87)	(1.37)	126.6	$5,732.19
		Propane	80	(9,168)	(1.24)	(0.91)	70.9	$3,821.46
			120	(13,752)	(1.87)	(1.37)	106.4	$5,732.19
	Retrofit	Electric	80	5,189	0.70	0.51	-	$6,676.44
			120	7,783	1.05	0.77	-	$10,014.66
		Oil	80	(9,168)	(1.24)	(0.91)	84.4	$6,676.44
			120	(13,752)	(1.87)	(1.37)	126.6	$10,014.66
		Propane	80	(9,168)	(1.24)	(0.91)	94.5	$6,676.44
			120	(13,752)	(1.87)	(1.37)	141.8	$10,014.66
Multi-family	NC/ROB	Electric	80	1,894	0.11	0.06	-	$2,582.04
			120	2,841	0.16	0.09	-	$3,873.06
		Oil	80	(2,956)	(0.16)	(0.09)	33.5	$3,821.46
			120	(4,434)	(0.24)	(0.14)	50.2	$5,732.19
		Propane	80	(2,956)	(0.16)	(0.09)	28.1	$3,821.46
			120	(4,434)	(0.24)	(0.14)	42.2	$5,732.19
	Retrofit	Electric	80	4,456	0.25	0.14	-	$6,676.44
			120	6,684	0.37	0.21	-	$10,014.66
		Oil	80	(2,956)	(0.16)	(0.09)	33.5	$6,676.44
			120	(4,434)	(0.24)	(0.14)	50.2	$10,014.66
		Propane	80	(2,956)	(0.16)	(0.09)	37.5	$6,676.44
			120	(4,434)	(0.24)	(0.14)	56.2	$10,014.66

[608] Savings are based on the DEER Water Heater Calculator V5.0. The calculator was modified to include Maine weather data. Multiple system iterations were modeled, and linear regressions were developed from the model outputs to generate the deemed savings on a per unit basis. Cost research was performed by EMT April 2023 for electric, propane and oil fired commercial hot water heaters. Equipment and labor cost estimates are based on information provided by equipment manufacturers, online vendors, RS Means estimating software, and secondary research including Updated Buildings Sector Appliance and Equipment Costs and Efficiencies, EIA, March 2023 https://www.eia.gov/analysis/studies/buildings/equipcosts/pdf/full.pdf. New construction and replace on burnout costs are the incremental equipment cost between the efficient and standard measure. Retrofit costs include equipment and labor costs.

Facility Type	Project Type	Baseline	Gallons storage	Electric impact (kWh/y)	Winter peak impact (kW)	Summer peak impact (kW)	Fuel Impact (MMbtu/y)	Measure cost
Long Term Care	NC/ROB	Electric	80	15,490	0.75	0.42	-	$2,582.04
			120	23,234	1.13	0.63	-	$3,873.06
		Oil	80	(26,520)	(1.38)	(0.78)	228.5	$3,821.46
			120	(39,780)	(2.07)	(1.17)	342.8	$5,732.19
		Propane	80	(26,520)	(1.38)	(0.78)	192.0	$3,821.46
			120	(39,780)	(2.07)	(1.17)	288.0	$5,732.19
	Retrofit	Electric	80	36,446	4.62	4.60	-	$6,676.44
			120	54,669	6.94	6.90	-	$10,014.66
		Oil	80	(26,520)	(1.38)	(0.78)	228.5	$6,676.44
			120	(39,780)	(2.07)	(1.17)	342.8	$10,014.66
		Propane	80	(26,520)	(1.38)	(0.78)	256.0	$6,676.44
			120	(39,780)	(2.07)	(1.17)	383.9	$10,014.66
Office (large)	NC/ROB	Electric	80	6,159	0.03	0.03	-	$2,582.04
			120	9,238	0.04	0.04	-	$3,873.06
		Oil	80	(12,583)	(0.05)	(0.04)	107.2	$3,821.46
			120	(18,875)	(0.07)	(0.06)	160.7	$5,732.19
		Propane	80	(12,583)	(0.05)	(0.04)	90.0	$3,821.46
			120	(18,875)	(0.07)	(0.06)	135.0	$5,732.19
	Retrofit	Electric	80	14,492	0.07	0.06	-	$6,676.44
			120	21,738	0.10	0.09	-	$10,014.66
		Oil	80	(12,583)	(0.05)	(0.04)	107.2	$6,676.44
			120	(18,875)	(0.07)	(0.06)	160.7	$10,014.66
		Propane	80	(12,583)	(0.05)	(0.04)	120.0	$6,676.44
			120	(18,875)	(0.07)	(0.06)	180.0	$10,014.66

Table 31 Qualifying Facilities

Facility Type	Minimum Facility Size – sq.ft.	Includes
Hospital	Any	Full-service hospital with inpatient and outpatient services
Hotel	Any	Full-service hotel with dining and laundry
Motel	5,000	Motel with laundry
Multifamily	900 per unit	Two-bedroom one-bath with kitchen and laundry
Long Term Care	Any	Long term care facility with kitchen facilites and laundry
Office	10,000	

Table 32 Efficiency Criteria[609]

HPWH Integrated Storage - Gallons	Minimum Qualifying Efficiency Criteria	
80	3.5 UEF	
120	4.0 COP	
Baseline Fuel	**Eff_{BASE} Retrofit**	**Eff_{BASE} NC/LO**
Electric Resistance	0.945	1.9 (assumes a heat pump baseline)
Propane	0.675	0.9
Oil	0.756	0.756

[609] Baseline efficiencies based on US DOE energy efficiency standard (10 CFR Part 430).

Storage Tank Water Heater (Inactive)								
Last Revised Date	7/1/2018							
MEASURE OVERVIEW								
Description	ENERGY STAR®-certified storage tank water heaters. This measure involves the purchase and installation of a new ENERGY STAR® certified storage water tank heater in place of a standard efficiency storage tank water heater. Savings are counted only for the improved water heater efficiency.							
Primary Energy Impact	Natural Gas, Propane							
Sector	Commercial							
Program(s)	C&I Prescriptive Program							
End-Use	Domestic Hot Water							
Decision Type	New Construction, Replace on Burnout							
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)								
Annual Energy Savings	$\Delta MMBtu/yr = [\ GAL \times 8.33 \times 1 \times (T_{WH} - T_{in}) \times (1/\ TE_{BASE} - 1/\ TE_{EE}) / 1{,}000{,}000\ ] + SLS$							
	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}	= Inlet water temperature (°F)						
	TE_{BASE}	= Thermal efficiency for baseline stand-alone tank water heater						
	TE_{EE}	= Thermal efficiency for energy efficient tank 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						
	Tank	= Rated storage capacity of water heater (gallons)						
	Input	= Rated input capacity of water heat (Btu/hr)						
	SLS	= Standby Loss savings of efficient water heater (MMBtu)						
EFFICIENCY ASSUMPTIONS								
Baseline Efficiency	Storage tank water heater that meets federal minimum efficiency standards for commercial gas-fired water heaters							
Efficient Measure	ENERGY STAR®-certified commercial storage tank water heater							
PARAMETER VALUES (DEEMED)								
Parameter	TE_{BASE}	TE_{EE}	GAL	T_{WH}	T_{IN}	SLS	Life (yrs)	Cost ($)[610]
Value	80%[611]	Actual	Table 33	126.2[612]	50.8[613]	2.82[614]	15[615]	1,050 for < 100 gal 1,950 for ≥ 100 gal

[610] Illinois Statewide Technical Reference Manual for Energy Efficiency Version 6.0, page 84.
[611] Federal minimum standard for Gas Storage Water Heaters > 75,000 Btu/h from 10 CFR 431.110.
[612] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014.
[613] Standard Building America DHW Schedules, weighted average by population of all Maine water main sources.
[614] Average standby losses based on AHRI rated standby losses of ENERGYSTAR® storage water heaters compared to federal standards.
[615] DEER 08, EUL_Summary_10-1-08.xls

Storage Tank Water Heater (Inactive)							
IMPACT FACTORS							
Parameter	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
Value	100%[616]	100%[617]	100%[618]	N/A	N/A	25%[619]	0%[620]

Table 33 – Storage Water Heater Annual Consumption per Tank Capacity[621]

Building Type	Consumption/Cap
Convenience	368
Education	480
Grocery	368
Health	1,241
Large Office	667
Large Retail	368
Lodging	1,815
Other Commercial	237
Restaurant	686
Small Office	667
Small Retail	368
Warehouse	237
Nursing	1,866
Multi-Family	1,815

[616] EMT assumes that all purchased units are installed (i.e. ISR = 100%).
[617] Realization rates are 100 percent since savings estimates are based on evaluation results.
[618] Realization rates are 100 percent since savings estimates are based on evaluation results.
[619] 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).
[620] Measure not yet evaluated, assume default SO of 0%
[621] Methodology based on Michaels Energy analysis. Annual hot water usage in gallons based on CBECS (2012) consumption data of New England (removed outliers of 1,000 kBtuh or less) to calculate hot water usage. Annual hot water gallons per tank size (gallons) based on the tank sizing methodology found in ASHRAE 2015 HVAC Applications. Chapter 50 Service Water Heating. Annual gallons of hot water use calculated based on annual water heating energy use from CBECS data assuming a hot water heater efficiency of 80% and a temperature rise of 80 degrees between incoming water and hot water supply temperature.

Low-flow Faucet Aerator (Inactive)	
Last Revised Date	7/1/2018
MEASURE OVERVIEW	
Description	This measure involves the replacement of existing faucet aerators with low-flow aerators rated at 1.5 GPM or less.
Primary Energy Impact	Electric, Natural Gas, Propane
Sector	Commercial
Program(s)	C&I Prescriptive Program
End-Use	Domestic Hot Water
Decision Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = \Delta kWh/y \times F_{ED}$
Annual Energy Savings	If electric resistance or heat pump: $\Delta kWh/y = N_{ppl} \times t \times Days \times (GPM_{BASE} - GPM_{EE}) \times DF \times GPM\ Factor / N_{fixtures} \times \rho_{H20} \times Cp_{H20} / 3{,}412 \times (T_{pou} - T_{in}) / RE_{WH}$ If natural gas or propane: $\Delta MMBtu/y = N_{ppl} \times t \times Days \times (GPM_{BASE} - GPM_{EE}) \times DF \times GPM\ Factor / N_{fixtures} \times \rho_{H20} \times Cp_{H20} \times (T_{pou} - T_{in}) / (1{,}000{,}000 \times RE_{WH})$
Annual Water Savings	$\Delta Gallons/y = N_{ppl} \times t \times 365 \times (GPM_{BASE} - GPM_{EE}) \times GPM\ Factor / N_{fixtures}$
Definitions	Unit = 1 faucet aerator F_{ED} = Energy to Demand ratio (kW/kWh) N_{ppl} = Number of people in building $N_{fixtures}$ = Number of faucets in building t = Total time faucet is used per day per person (min/day/person) GPM_{BASE} = Baseline flowrate of aerator (gallon/min) GPM_{EE} = Measure flowrate of aerator (gallon/min) T_{pou} = Temperature at point of use (°F) T_{in} = Temperature of water mains (°F) RE_{WH} = Recovery efficiency of water heater ρ_{H20} = Density of water (8.33 lbs per gallons) Cp_{H20} = Specific heat of water: 1 Btu/lb/°F DF = Drain Factor – accounts for uses that are volumetric in nature & not affected by aerator GPM Factor = Factor to account for differences in use between commercial and residential applications 3,412 = Conversion: 3,412 Btu per kWh Days = Days per year of facility use 60 = Conversion: 60 minutes per hour
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Federal standards set a maximum 2.2 GPM for faucet aerators manufactured after January 1, 1994.[622]
Efficient Measure	High-efficiency Faucet Aerator (1.5 GPM)

[622] Federal Standard, Code of Federal Regulations, Title 10, Part 430, Subpart C.

Low-flow Faucet Aerator (Inactive)							
PARAMETER VALUES (DEEMED)							
Measure	t	N_{ppl}	GPM_{BASE}	GPM_{EE}	$N_{fixtures}$	Life (yrs)	Cost ($)
Low-flow Kitchen Aerator	3[623]	Actual (if known), or Table 35~~Table 35~~	1.39[624]	0.94[625]	Actual (if known), or 3[626]	10[627]	Actual[628]
Measure	RE_{WH}	F_{ED}	T_{pou}	T_{in}	Days	DF	GPM Factor
Electric Resistance	0.98[629]	0.00008013[630]	93[631]	50.8[632]	Table 35~~Table 35~~	Table 34	Table 34
Heat Pump	3.5[633]						
Natural Gas or Propane	0.80[634]						
IMPACT FACTORS							
Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
Retail	100%[635]	100%[636]	100%	0.8%[637]	1.2%	25%[638]	0%[639]

Table 34 - Faucet Characteristics[624~~625~~,640]

Application	DF	GPM Factor
Kitchen	75%	1.0
Restroom	90%	0.4
Unknown	85%	0.5

[623] Connecticut UI and CLP Program Savings Documentation. September 9, 2009.
[624] State of Illinois Energy Efficiency Technical Reference Manual, Version 4.0, Page 647-655. February 13, 2015. Rated flow rate of baseline aerator (2.2 GPM) is adjusted for throttled use.
[625] State of Illinois Energy Efficiency Technical Reference Manual, Version 4.0, Page 647-655. February 13, 2015. Rated flow rate of efficient aerator (1.5 GPM) is adjusted for throttled use.
[626] Assumed value.
[627] NREL, National Residential Efficiency Measure Database.
[628] Total cost. For direct install it includes installation cost.
[629] NREL, Building America Research Benchmark Definition, 2009, p.12, http://www.nrel.gov/docs/fy10osti/47246.pdf
[630] State of Pennsylvania, Technical Reference Manual, Rev date: March 2015, p. 126.
[631] State of Illinois Energy Efficiency Technical Reference Manual, Version 6.0, page 98. Temperature at point of use assumed to be 93ºF for kitchen faucets. This is also consistent with the point of use temperature specified for kitchen faucets in the Maine Retail/Residential TRM measure for kitchen aerators.
[632] Standard Building America DHW Schedules, weighted average by population of all Maine water main sources.
[633] Program heat pump water heater required energy factor.
[634] Current Federal commercial water heater minimum thermal efficiency
[635] EMT assumes that all purchased units are installed (i.e. ISR = 100%). This is consistent with the MA 2013-2015 TRM.
[636] This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100 percent realization rate.
[637] See Table 54.
[638] Program not yet evaluated, assume default FR of 25%.
[639] Program not yet evaluated, assume default SO of 0%.
[640] Minnesota Technical Reference Manual, version 2.1, page 165.

Table 35 - Deemed Annual Occupied Days by Building Type

Facility Type	Days[641]	N_{ppl}[642,643]
Office	250	10
Warehouse	250	5
Education	200	60
Restaurant	365	70
Retail	365	5
Grocery	365	5
Health	365	180
Hotel/Motel	365	20
Other Commercial	250	20
Unknown	304.4	20

641 Data from Table 2 in Technology Data Characterizing Water Heating in Commercial Buildings: Application to End-Use Forecasting, Osman Sezgen and Jonathan G. Koomey, Lawrence Berkeley National Laboratory, December 1995.

642 Estimated based on data provided in Appendix E; "Waste Not, Want Not: The Potential for Urban Water Conservation in California"; http://www.pacinst.org/reports/urban_usage/appendix_e.pdf

643 Based on review of the Illinois plumbing code (Employees and students per faucet). Retail, grocery, warehouse and health are estimates. Meals per faucet estimated as 4 bathroom and 3 kitchen faucets and average meals per day of 250 (based on California study above) – 250/7 = 36. Fast food assumption estimated.

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[644]	Weeks	Life (yrs)	Cost ($)
New Construction	Actual	Actual	Table 57~~Table 57~~[645]	Table 56~~Table 56~~[646]	Actual	Actual	15[647]	$96[648]
Retrofit	Actual	Actual	Table 57~~Table 57~~[645][~~646~~]	Table 56~~Table 56~~[646][~~647~~]	Actual	Actual	13[647][~~648~~]	$96[648][~~649~~]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[649]	100%[649][~~650~~]	Table 54~~Table 54~~[650]	Table 54~~Table 54~~[650][~~651~~]	52%[651]	1.6%[652]

[644] Use actual hours when known. If hours are unknown, use the values from Table 35.
[645] 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.
[646] See Appendix D~~Appendix D~~.
[647] 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.
[648] Measure Costs assume 50% retrofit and 50% market opportunity for 1 lamp fixture based on cost data provided in Vermont TRM 2014.
[649] Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
[650] See Appendix B~~Appendix B~~.
[651] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[652] 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	$\Delta kWh/yr = \Delta kWh_{COMP} + \Delta kWh_{DHW}$ ΔkWh_{COMP} = MPD x 365 x CP_{MILK} x ETR / EER / 1,000 ΔkWh_{DHW} = MPD x 365 x CP_{MILK} x ETR x EF_{HX} x 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 ($)

Prescriptive Agricultural: Plate Heat Exchangers for Milk Processing (Inactive)									
PHX without DHW	Actual	Actual	35[653]	0.93[654]	2,850[655]	N/A	0	20[656]	2,500[657]
PHX with Electric DHW	Actual	Actual	35[653]~~[654]~~	0.93[654]~~[655]~~	2,850[655]~~[656]~~	59%	1.0	20[656]~~[657]~~	2,500[657]~~[658]~~

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	99%[658]	101%[658]~~[659]~~	Table 54~~Table 54~~[659]	Table 54~~Table 54~~[659]~~[660]~~	52%[660]	1.6%[661]

[653] Estimated average temperature reduction: PHX typically reduce milk temperatures from 98°F to temperatures to between 55˚F and 70˚F.
[654] K M Sahay, K. K. Singh, *Unit Operations of Agricultural Processing*, 2001; page 346.
[655] 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.
[656] PA Consulting Group for the State of Wisconsin Public Service Commission, Focus on Energy Evaluation. Business Programs: Measure Life Study. August 25, 2009.
[657] 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.
[658] Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 1-1. Realization Rates for Prescriptive Measures.
[659] See Appendix B~~Appendix B~~.
[660] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[661] Ibid.

Prescriptive Agricultural: Adjustable Speed Drives for Dairy Vacuum Pumps, Codes AMVP<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	$\Delta kW = HP \times 0.746 \times LF / M_{EFF} – (0.0495 \times 2 \times \#MilkUnits + 1.7729)$						
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}[662]	#MilkUnits	DRT	Life (yrs)	Cost ($)
All	Table 36	75%[663]	Actual	Actual	Actual	15[664]	$5,322[665]
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[666]	100%[667]	Table 54Table 54[668]	Table 54Table 54[668669]	52%[669]	1.6%[670]

[662] Use rated motor efficiency for the actual equipment. If the actual efficiency value is unknown, use the values in Table 36 for existing or new motors.
[663] Assumed value based on typical operations.
[664] PA Consulting Group for the State of Wisconsin Public Service Commission, Focus on Energy Evaluation. Business Programs: Measure Life Study. August 25, 2009.
[665] 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.
[666] Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
[667] Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.
[668] See Appendix BAppendix B.
[669] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[670] Ibid.

Table 36 – Standard Motor Efficiency[671]

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%

[671] 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 $HP_{COMPRESS}$ = 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	$HP_{COMPRESSOR}$	ΔkWh/hp	FLH	Life (yrs)	Cost ($)
All	Actual	432[672]	2,850[673]	15[674]	Table 37

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[675]	100%[676]	Table 54~~Table 54~~[677]	Table 54~~Table 54~~[677]~~[678]~~	52%[678]	1.6%[679]

[672] Average savings value based on Wisconsin Focus on Energy Dairy Audit tool, used for a 100 herd dairy farm in Maine.
[673] 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.
[674] PA Consulting Group for the State of Wisconsin Public Service Commission, Focus on Energy Evaluation. Business Programs: Measure Life Study. August 25, 2009.
[675] Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
[676] Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.
[677] See Appendix B~~Appendix B~~.
[678] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[679] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.

Table 37 – Measure Costs for Scroll Compressor[680]

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

680 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[681]	15[682]	Table 38

Measure/Type	LF	EF	A	B	C	SF_F	SF_H
All	0.8[683]	0.91[683][684]	0.22[684]	–0.87[684][685]	1.65[684][685]	1	0.5

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[685]	100%[686]	Table 54Table 54[687]	Table 54Table 54[687][688]	52%[688]	1.6%[689]

[681] Fans can run at half speed 24/7 from December 1 to April 30 as reported by Steve Belyea, ME Dept of Agriculture, evaluation.
[682] 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.
[683] Program assumption.
[684] Fan Default Curve Correlation Coefficients for VFD. Variable Frequency Drive Evaluation Protocol, SBW Consulting, Inc., Table 1.
[685] Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
[686] Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.
[687] See Appendix BAppendix B.
[688] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[689] Ibid.

Table 38 – Measure Cost for ASD on Ventilation Fans[690]

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

690 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%[691]	Actual	Actual	80%[692]	3,660[693]	15[694]	1,165[695]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[696]	100%[697]	Table 54~~Table 54~~[698]	Table 54~~Table 54~~[698]~~[699]~~	52%[699]	1.6%[700]

[691] Conservative estimate for efficiency of existing 1–2 hp fan motors, based on minimum efficiency requirements in the Energy Policy Act of 2007.
[692] Assumed value based on typical operations.
[693] Fan typically operates 5 months out of the year or approximately 3,660 hours.
[694] PA Consulting Group for the State of Wisconsin Public Service Commission, Focus on Energy Evaluation. Business Programs: Measure Life Study. August 25, 2009.
[695] 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
[696] Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
[697] Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.
[698] See Appendix C.
[699] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[700] Ibid.

Prescriptive Horticultural Lighting: Cannabis lighting – Flower and Vegetative Rooms, Code HLF,HLV	
Revision Date	3/1/2021
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of high efficiency horticultural lighting for indoor cannabis cultivation facilities. The measure is limited to facilities not using central plant systems (i.e., chilled water systems, water source heat pump systems or large multi-zone direct expansion systems with four-pipe air handling units). The eligible facilities are indoor facilities and must have packaged unitary or split systems (including mini-split heat pumps) for cooling flower, vegetative or mother cultivation areas with either in-room standalone dehumidifies, electric or thermal reheat coils, or hot gas reheat coils selected to provide all the required dehumidification. Facilities with central plant systems are typically larger facilities with potential for an HVAC efficiency measure; the lighting systems in these facilities should be reviewed by the custom program. All lighting fixtures must meet the Design Lights Consortium (DLC) Horticultural Lighting Qualified Products List (QPL).
Primary electric impact	Electric, Oil, Natural Gas, Propane
Sector	Commercial/Industrial
Programs	C&I Prescriptive Program
End-Use	Horticultural Lighting – Cannabis flower and vegetative rooms
Project Type	New Construction and Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = \Delta kW_{LIGHTING} + \Delta kW_{HVAC}$ $\Delta kW_{SP} = (\Delta kW_{LIGHTING} + \Delta kW_{HVAC}) \times CF_S$ $\Delta kW_{WP} = (\Delta kW_{LIGHTING} + \Delta kW_{HVAC}) \times CF_W$ $\Delta kW_{LIGHTING} = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) / 1,000$ <u>HVAC Impacts</u> Packaged systems with stand-alone in-room dehumidifiers: $\Delta kW_{HVAC} = BF_{HVAC} \times \Delta kW_{LIGHTING}$ Packaged systems with electric resistance reheat coils: $\Delta kW_{HVAC} = (HVAC_{BONUS} \times \Delta kW_{LIGHTING}) + (RP_{KWH} \times \Delta kW_{LIGHTING})$ Packaged systems with thermal (hot water) reheat coils or hotgas reheat coils: $\Delta kW_{HVAC} = HVAC_{BONUS} \times \Delta kW_{LIGHTING}$
Annual Energy Savings	$\Delta kWh/yr = \Delta kWh_{LIGHTING} + \Delta kWh_{HVAC}$ $\Delta MMBtu/yr = \Delta MMBtu_{HVAC}$ $\Delta kWh_{LIGHTING} = (Qty_{BASE} \times Watts_{BASE} - Qty_{EE} \times Watts_{EE}) / 1,000 \times HoursWk \times Weeks$ <u>HVAC Impacts</u> Packaged systems with stand-alone in-room dehumidifiers: $\Delta kWh_{HVAC} = BF_{HVAC} \times \Delta kWh_{LIGHTING}$ Packaged systems with electric resistance reheat coils:

	ΔkWh_{HVAC} = ($HVAC_{BONUS}$ x $\Delta kWh_{LIGHTING}$) + (RP_{KWH} x $\Delta kWh_{LIGHTING}$) Packaged systems with thermal (hot water) reheat coils: ΔkWh_{HVAC} = $HVAC_{BONUS}$ x $\Delta kWh_{LIGHTING}$ $\Delta MMBtu_{HVAC}$ = RP_{MMBtu} X $\Delta kWh_{LIGHTING}$ Packaged Systems with hotgas reheat coils: ΔkWh_{HVAC} = $HVAC_{BONUS}$ x $\Delta kWh_{LIGHTING}$ Factors LR_{FACTOR} = (Qty_{BASE} x $Watts_{BASE}$ – Qty_{EE} x $Watts_{EE}$) / (Qty_{BASE} x $Watts_{BASE}$) BF_{HVAC} = m_{FACTOR} x LR_{FACTOR} + b_{FACTOR} BF_{HVAC} = m_{FACTOR} x LR_{FACTOR} + b_{FACTOR} RP_{MMBtu} = m_{FACTOR} x LR_{FACTOR} + b_{FACTOR} RP_{KWH} = m_{FACTOR} x LR_{FACTOR} + b_{FACTOR}
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) LR_{FACTOR} = Lighting reduction factor (%) BF_{HVAC} = HVAC energy bonus factor for facilities with in-room stand-alone dehumidifiers $HVAC_{BONUS}$ = HVAC system savings factor from reduced lighting load for systems with reheat coils RP_{KWH} = Reheat penalty from reduced lighting loads for systems with electric resistence reheat coils RP_{MMBtu} = Reheat penalty from reduced lighting loads for systems with hot water reheat coils m_{FACTOR} = slope of the reheat penalty linear regression b_{FACTOR} = intercept of the reheat penalty linear regression 1,000 = Conversion: 1,000 Watts per kW SEER/IEER = Cooling system Seasonal Energy Efficiency Ratio (SEER) or Integral Energy Efficiency (IEER) 3.412 = Conversion: 1 Watthour = 3.412 Btu
EFFICIENCY ASSUMPTIONS	
Baseline efficiency – New Construction[701]	Flowering – 1000-W class Double Ended High Pressure Sodium or Metal Halide Vegetative – 600-W class Double Ended High Pressure Sodium or Metal Halide
Efficient measure	Flowering – 600 W to 800 W LED horticultural fixture - DLC QPL listed Vegetative – 300 W to 400 W LED Horticultural fixture – same criteria as flower
PARAMETER VALUES	

[701] Standard practice systems for indoor cannabis growing. Vegetative rooms base wattage adjusted from 1000-W class downward to 600-W class to reflect observed conditions in Maine. Sources: Massachusetts Cannabis Industry Standard Practice Study, Table 1-1, Page 1-4: https://ma-eeac.org/wp-content/uploads/MA-Cannabis_ISP_Final-Report_06132020_final.pdf and Indoor Cannabis Cultivation Horticultural Lighting Baseline Study, April 19, 2019, Table 3, Page 4, prepared by ERS for the Massachusetts Energy Advisory Council.

Measure/Type	Qty_{BASE}	$Watts_{BASE}$[702]	Qty_{EE}[703]	$Watts_{EE}$	HoursWk[704]	Weeks[705]	Life (yrs)[706]	Cost ($)[707]
Flowering	Actual	1100	Actual	Actual	84	50	10	Actual
Vegetative		675			126		8	

Measure/Type	SEER/IEER[708]	Canopy	$HVAC_{BONUS}$	m_{FACTOR}	b_{FACTOR}	
All	13	Actual	Table 39 for Flower, Table 40 for Veg and Mother			

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	100%[709]	100%[710]	Table 54Table 54[711]	Table 54Table 54[712]	26%[713]	1.6%[714]

Table 39. Flower Room Factors[715]

	BF_{HVAC} Stand-alone Dehumidifiers	RP_{KWH} Electric Resistance Reheat Coil	RP_{MMBtu} Thermal (hot water) Reheat Coil	Hot Gas Reheat Coil
b_{FACTOR}	0.28	0.06	0.0002	0.00
m_{FACTOR}	-0.25	-1.56	-0.0062	0.00
$HVAC_{BONUS}$	N/A	0.26	0.26	0.26

Table 40. Veg and Mother Room Factors[716]

	BF_{HVAC} Stand-alone Dehumidifiers	RP_{KWH} Electric Resistance Reheat Coil	RP_{MMBtu} Thermal (hot water) Reheat Coil	Hot Gas Reheat Coil
b_{FACTOR}	0.26	0.26	0.001	0.00
m_{FACTOR}	-0.17	-1.36	-0.0054	0.00
$HVAC_{BONUS}$	N/A	0.23	0.23	0.23

[702] Appendix D, Table 57.See HPS – 1000W and HPS – 600W.
[703] Higher wattage LED fixtures that are not a one for one replacement should be reviewed by the custom program
[704] Standard practice cannabis growing hours: flower room 12 hours/day and vegetative rooms 18 hours/day. Source: Massachusetts Cannabis Industry Standard Practice Study, Table 1-1, Page 1-4: https://ma-eeac.org/wp-content/uploads/MA-Cannabis_ISP_Final-Report_06132020_final.pdf
[705] Assume 2 weeks of downtime per year, based on standard indoor cannabis growing facility operation
[706] Measure life based on 50,000 hours life for LED-based Horticultural Lighting requirement by DLC: https://www.designlights.org/default/assets/File/Horticultural/DLC_Hort-V2-0-Interim-Application-Period-Guidance_V2%206_4_21.pdf
[707] Actual project costs collected for all projects. Incremental cost for lost opportunity is calculated as project cost minus $14/sq ft, where $14/sq ft is the average baseline cost per square foot of canopy for horticultural lighting projects processed through the Custom Program in FY2021.
[708] Typical of packaged equipment operating at target cultivation temperatures and relative humidity. Based on part load data for York Sunline 20-ton unit.
[709] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[710] Ibid.
[711] See Appendix B. Use the same factors as the Prescriptive Lighting: Lighting Fixtures – Interior Spaces measures until first impact evaluation for this measure.
[712] Ibid.
[713] Use Prescriptive Lighting: Lighting Fixtures – Interior Spaces measures factors (from Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58) until first impact evaluation for this measure.
[714] Ibid.
[715] Factors are based on modeling and energy balances performed by Efficiency Maine using input values based on typical cultivation facility packaged HVAC systems, target environmental conditions, modeled equipment performance, and internal loads based on a survey of cannabis facility technical reviews.
[716] Ibid

Prescriptive Agricultural: Stand Alone Dehumidifiers for Indoor Cannabis Cultivation	
Last Revised Date	03/01/2022
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of packaged stand-alone dehumidifiers for use in the flower rooms in indoor cannabis cultivation facilities. Parameters are provided for flower rooms with high pressure sodium (HPS) horticultural lights and LED horticultural lights
Primary Energy Impact	Electric
Sector	Commercial
Program(s)	C&I Prescriptive Program
End-Use	Agriculture
Project Type	New construction, Replace on failure, Refit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	ΔkW_{SUMMER} = Canopy x DF_{SUMMER} ΔkW_{WINTER} = Canopy x DF_{WINTER}
Annual Energy Savings	ΔkWh/yr = Canopy x DHFactor x DHEnergy
Definitions	Unit = One stand-alone dehumidifier (quantity does not drive savings) Canopy = Area in square feet of plant canopy served by the packaged stand-alone dehumidifiers (ft^2) DF_{SUMMER} = Demand impact factor for the summer demand impact period per square foot of canopy served (kW/ft^2) DF_{WINTER} = Demand impact factor for the winter demand impact period per square foot of canopy served (kW/ft^2) DHFactor = Pints per day (PPD) of water removed by the dehumidifiers per square foot of canopy served (PPD/ft^2) DHEnergy = Annual kWh savings per pint per day ($kWh_{SAVINGS}$/PPD) Energy Factor = Rated energy factor of dehumidifier (liter/kWh)
EFFICIENCY ASSUMPTIONS[717]	
Baseline Efficiency	A packaged stand-alone dehumidifier with an energy factor of 2.1 liters/kWh at a rated condition of 80 F and 60% relative humidity.
Efficient Measure	A packaged stand-alone dehumidifier with an energy factor of 2.9 liters/kWh at a rated condition of 80 F and 60% relative humidity.

[717] The deemed standard efficiency value is based on manufacturer performance information as found during a December 2021 survey of packaged commercial and industrial dehumidifiers. The deemed high efficiency value is based on manufacturer performance information as found during a December 2021 survey of packaged commercial and industrial dehumidifiers.

Prescriptive Agricultural: Stand Alone Dehumidifiers for Indoor Cannabis Cultivation							
PARAMETER VALUES							
Type of Lighting	Canopy	DF_{SUMMER}[718]	DF_{WINTER}[719]	DHFactor[720]	DHEnergy[721]	Life(yrs)[722]	Cost[723]
High Efficiency - HPS	Actual	0.0022	0.0016	0.37	27.6	5	Actual – 8.92*PPD
High Efficiency - LED				0.56	24.3		

IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	100%[724]	100%[725]	N/A[726]	N/A[727]	25%[728]	0%[729]

Table 41. Horticultural Dehumidification Model Inputs

Model Inputs	Horticultural Lighting Type		Units	Notes
	LED	HPS		
Evapotranspiration daily average	1.2		lbs./sf/day	Pounds of water released into the atmosphere over 24 hours per square foot of plant canopy
Photoperiod	8:00-20:00		Hours	Most common schedule observed in flower rooms
Percent transpiration - lights on	80%		%	Based on measurement and verification activities performed by ERS and other consulting engineers for the Massachusetts utilities
Percent transpiration - lights off	20%		%	Based on measurement and verification activities performed by ERS and other consulting engineers for the Massachusetts utilities
Temperature - lights on	80		Fahrenheit	Typical based on projects reviewed by EMT
Relative humidity - lights on	60%		%	Typical based on projects reviewed by EMT
Temperature - lights on	72		Fahrenheit	Typical based on projects reviewed by EMT
Relative humidity - lights off	55%		%	Typical based on projects reviewed by EMT
Lighting power density	38	63	watts/sf	Operating wattage of the horticultural lights per square foot of plant canopy
HVAC System	Performance modeling based on part load data for Daikin FTXS36			

718 Factor is based on an 8760 model developed by Efficiency Maine of a prototypical cannabis cultivation facility. The input values for this model are based on typical cultivation facility packaged HVAC systems, target environmental conditions, modeled equipment performance, and internal and external loads based on a survey of cannabis facility technical reviews.

719 Ibid

720 Ibid

721 Ibid

722 Secondary research found no published information on the measure life or EUL of commercial or industrial dehumidifiers. A recent report (*Comprehensive TRM Review MA19R17-B-TRM Final ReportPrepared for: The Electric and Gas Program Administrators of Massachusetts Part of the Residential Evaluation Program Area,* Guidehouse 04/12/2021) found the measure life of residential dehumidifiers to be 17 years. Surveys of cannabis cultivators and dehumidifier manufacturers suggest the typical life of a dehumidifier in a cannabis cultivation facility is 5 years. Engineering judgment is used to assign a measure life of 5 years based on the direct and consistent feedback of end-users of this equipment.

723 The standard efficiency equipment costs, dollars per pint per day of equipment capacity, are based on a survey conducted in December of 2021 of online retailers of packaged commercial and industrial dehumidifiers. For high efficiency equipment cost actual costs in dollars for equipment and labor are recorded. For new construction, the measure cost is actual material minus the cost of standard efficiency equipment. For retrofit, the measure cost is actual material plus labor.

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

725 Ibid.

726 Peak demand impacts are calculated directly.

727 Peak demand impacts are calculated directly.

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

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

Model Inputs	Horticultural Lighting Type		Units	Notes
	LED	HPS		
Stand-alone dehumidifier energy factor - Standard Efficiency	2.1		l/kWh	Liters removed by the stand-alone dehumidifier per kWh of energy used
Stand-alone dehumidifier energy factor - High Efficiency	2.9		l/kWh	Liters removed by the stand-alone dehumidifier per kWh of energy used
Weather Data	TMY3 Portland, ME			None

Commercial Kitchen Equipment

Natural Gas Kitchen Equipment, Codes G17–G22	
Last Revised Date	10/1/2018
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of new high-efficiency natural gas kitchen equipment.
Primary Energy Impact	Natural gas
Sector	Commercial, Industrial
Program(s)	Commercial Kitchen Distributor Discount Inititive
End-Use	Natural gas
Project Type	New construction, Replace on Burnour
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Annual Energy Savings	$\Delta MMBtu/yr = \Delta Therms_{UNIT} \times 10$
Definitions	Unit = 1 new kitchen equipment $\Delta Therms_{UNIT}$ = Deemed annual savings per unit (Therms/yr)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Standard-efficiency natural gas kitchen equipment.
Efficient Measure	High-efficiency natural gas kitchen equipment.

PARAMETER VALUES

Measure/Type	$\Delta Therms_{UNIT}$		Life (yrs)	Cost ($)
All	Table 42~~Table 42~~		12[730]	Table 42~~Table 42~~

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	100%[731]	N/A	N/A	N/A	25%[732]	0%[733]

[730] 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.
[731] This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
[732] Measure not yet evaluated, assume default FR of 25%.
[733] Measure not yet evaluated, assume default SO of 0%.

Table 42 – Natural Gas Kitchen Equipment Measure Detail[734]

Measure Code	Description	Size	Deemed Savings $\Delta Therms_{UNIT}$	Incremental Cost ($/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

[734] 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 (Inactive)	
Last Revised Date	4/1/2018
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	$\Delta MMBtu/yr = 611 \times HP \times AHL_{CFM} / (Eff_{heat} \times 1{,}000{,}000)$
Definitions	Unit = 1 Controlled Exhaust Fan 611 = CFM reduction per exhaust fan horsepower[735] HP = Exhaust fan horsepower AHL_{CFM} = Annual heating load per CFMof outside air through MUA unit (Btu/CFM) 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_{CFM}[736]	Eff_{heat}[737]	Life (yrs)[738]	Cost ($)[739]
All	Actual	Actual	Actual	15	$2,000 per exhaust fan

IMPACT FACTORS

Program	ISR	RR_E[740]	RR_D	CF_S	CF_W	FR[741]	SO[742]
C&I Prescriptive	100%	100%	N/A	N/A	N/A	25%[743]	0%[744]

735 Commercial Kitchen Demand Ventilation Controls study, PG&E, PGECOFST116, June 2009, average reduction and fan horsepower.
736 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.
737 Expressed as a decimal, i.e., 80% AFUE is .80.
738 DEER Database 2014.
739 GDS review of regional databases and TRMs.
740 This program is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes a 100% RR.
741 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).
742 Opinion Dynamics Corporation, Evaluation of the Efficiency Maine Trust Business Program, November 30, 2011, Table 5-10. Participant Spillover.
743 Measure not yet evaluated, assume default FR of 25%.
744 Measure not yet evaluated, assume default SO of 0%.

Low-Flow Pre-Rinse Spray Valves, Code HPSV	
Last Revised Date	10/1/2018 (retroactive to 7/1/2018)
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	ΔMMBtu/yr = (Vol_{base} – Vol_{ee}) x 60 x Hours x Days x 8.33 x 1 x (T_{out} – T_{in}) / Eff / 1,000,000 ΔkWh/yr = (Vol_{base} – Vol_{ee}) x 60 x Hours x Days x 8.33 x 1 x (T_{out} – T_{in}) / Eff / 1,000,000 / 0.003412
Annual water savings	ΔGallons/yr = (Vol_{base} – Vol_{ee}) x 60 x Hours x 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.

Low-Flow Pre-Rinse Spray Valves, Code HPSV

PARAMETER VALUES (DEEMED)

Measure/Type	Vol_{base}	Vol_{ee}[745]	T_{out}[746]	T_{in}[747]	Hours	Days	Eff_{fuel}[748]	Eff_{elec}[749]	Life[750] (yrs)	Cost ($)
Point of Purchase/Replace on Burnout	1.6[751]	1.15	120	50.8	Table 43	Table 43	80%	98%	5	Actual
Food Service Retrofit	2.25[752]									
Grocery Retrofit	2.15[753]									

IMPACT FACTORS

Measure/Type	ISR	RR_E[754]	RR_D	CF_S	CF_W		FR[755]	SO[756]
All	100%	100%	N/A	N/A	N/A		25%	0%

Table 43 – Hours per Day and Days per Year that the Pre-Rinse Spray Valve is used at Different Sites

Site	Hours[757,758,759] (hrs/day)	Days (days/y)[760,761]
Small, quick-service restaurants	0.5	312
Medium-sized casual dining restaurants	1.5	312
Large institutional establishments with cafeteria	3.0	365
Grocery Store	0.1	312
K-12 School	1.5	180

745 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/

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

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

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

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

750 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

751 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

752 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

753 Ibid.

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

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

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

757 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.

758 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

759 K-12 duraction assumed to be half the duration of institutions (breakfast served for half the students and full lunch service).

760 312 days/y is based on an assumption of 6 days/week and 52 weeks/year.

761 K-12 hours based on average length of school year.

Commercial Dishwasher (Inactive)							
Last Revised Date	7/1/2018						
MEASURE OVERVIEW							
Description	ENERGY STAR® Commercial Dishwashers. This measure involves the purchase and installation of a new ENERGY STAR®-certified commercial dishwasher in place of a new standard efficiency dishwasher. Commercial dishwashers that are ENERGY STAR® certified are on average 40% more efficient in energy and water use compared to standard models.						
Primary Energy Impact	Electric (additional impacts include: natural gas, propane and water)						
Sector	Commercial						
Program(s)	C& I Prescriptive Program						
End-Use	Process						
Decision Type	New Construction, Replace on Burnout						
GROSS ENERGY SAVINGS (UNIT SAVINGS)							
Annual Energy Savings	**Table 44**						
Annual water savings	**Table 44**						
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)							
Demand savings	None						
Annual energy savings	Per ENERGY STAR® calculator						
Annual water savings	Per ENERGY STAR® calculator						
Definitions	Unit = 1 dishwasher						
EFFICIENCY ASSUMPTIONS							
Baseline Efficiency	Baseline efficiency metrics are those specified in the ENERGY STAR® Commercial Kitchen Equipment Calculator.						
Efficient Measure	ENERGY STAR®-certified commercial dishwasher (see Table 45 for criteria)						
PARAMETER VALUES (DEEMED)							
Measure						Life (yrs)	Cost ($)
ENERGY STAR® Dishwasher						Table 44	Table 44
IMPACT FACTORS							
Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
ENERGY STAR® Dishwasher	100%[762]	100%[763]	100%[764]	N/A[765]	N/A[766]	25%[767]	0%[768]

[762] EMT assumes that all purchased units are installed (i.e. ISR = 100%).
[763] This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100 percent realization rate.
[764] This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100 percent realization rate.
[765] Peak coincidence has not been established for this measure.
[766] Peak coincidence has not been established for this measure.
[767] Measure not yet evaluated, assume default FR of 25%
[768] Measure not yet evaluated, assume default SO of 0%

Table 44 - Commercial Dishwasher Savings, Incremental Costs, and Equipment Lives

Dishwasher Type	Water Heating Type	Electric Savings (kWh)[769]	Gas or Propane Savings (MMBtu)[769~~770~~]	Water Savings (gallons)[769~~770~~]	Incremental Cost ($)[770]	Equipment Life (years)[771]
Under Counter, Low Temp	Electric	2,735	0	15,000	50	10
	Natural Gas or Propane	0	11.4			
Under Counter, High Temp	Electric	3,254	0	6,000	120	10
	Natural Gas or Propane	2,089	4.9			
Stationary Single Tank Door, High Temp	Electric	12,405	0	41,000	770	15
	Natural Gas or Propane	4,840	31.6			
Pot, Pan, and Utensil	Electric	3,473	0	12,000	1,710	10
	Natural Gas or Propane	1,204	9.5			
Single Tank Conveyor, High Temp	Electric	9,540	0	25,000	2,050	20
	Natural Gas or Propane	4,948	19.2			
Multi Tank Conveyor, Low Temp	Electric	20,262	0	110,000	970	20
	Natural Gas or Propane	0	84.7			
Multi Tank Conveyor, High Temp	Electric	28,656	0	94,000	970	20
	Natural Gas or Propane	11,230	72.9			

Table 45 - Commercial Dishwasher ENERGY STAR® Criteria

Commercial dishwasher Energy efficiency requirements are based on dishwasher type, idle energy rate (measured in kW), and water consumption rate (measured in gallons per rack (GPR), gallons per square foot of rack space (GPSF), or gallons per hour (GPH)). ENERGY STAR® requirements are summarized below.

Dishwasher Type	High Temperature		Low Temperature	
	Idle Energy Rate (kW)	Water Use	Idle Energy Rate (kW)	Water Use
Under Counter	≤ 0.50	≤ 0.86 GPR	≤ 0.50	≤ 1.19 GPR
Stationary Single Tank Door	≤ 0.70	≤ 0.89 GPR	N/A[772]	N/A[772~~773~~]
Pot, Pan, and Utensil	≤ 1.20	≤ 0.58 GPSF	≤ 1.00	≤ 0.58 GPSF
Single Tank Conveyor	≤ 1.50	≤ 0.70 GPR	N/A[772~~773~~]	N/A[772~~773~~]
Multi Tank Conveyor	≤ 2.25	≤ 0.54 GPR	≤ 2.00	≤ 0.54 GPR

769 Savings values calculated using ENERGY STAR® commercial kitchen equipment calculator using default values, except for water heating temperature rise, which was set to 75.4 based on average water heating temperature rise in Maine (50.8 degrees to 126.2 degrees). NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014.
770 Incremental Cost data taken from ENERGY STAR® commercial kitchen equipment calculator
771 Lifetime from ENERGY STAR Commercial Kitchen Equipment Savings Calculator which cites reference as "EPA/FSTC research on available models, 2013"
772 ENERGY STAR® data shows the incremental cost for these dishwasher types to be $0, thus no savings were assessed for these dishwasher types.

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.[773]						
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 46	Actual	Actual	15[774]	$164/HP[775]	
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[776]	100%[777]	Table 54~~Table 54~~[778]	Table 54~~Table 54~~[778]~~[779]~~	52%[779]	1.6%[780]

[773] 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.
[774] 2005 Measure Life Study prepared for the Massachusetts Joint Utility by Energy Resource Solutions (2005). Measure life study prepared for the Massachusetts Joint Utilities.
[775] 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.
[776] Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
[777] Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.
[778] See Appendix C.
[779] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[780] Ibid.

Table 46 – Stipulated Savings per Compressor Based on Compressor Size[781]

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

[781] (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 47	Actual	Actual	15[782]	$6.54/CFM[783]	
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[784]	100%[785]	Table 54~~Table 54~~[786]	Table 54~~Table 54~~[786]~~[787]~~	52%[787]	1.6%[788]

Table 47 – Input Power Reduction per Full-Flow Rating (CFM) of Dryer[789]

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

[782] 2005 Measure Life Study prepared for the Massachusetts Joint Utility by ERS.
[783] Based on historical measure cost for EMT projects, provided by Greg Scott, Trask-Decrow Machinery.
[784]Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
[785] Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.
[786] See Appendix C.
[787] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[788] Ibid.
[789] Massachusetts Technical Reference Manual for Estimating Savings from Energy Efficiency Measures, 2013-2015 Program Years – Plan Version, October 2012, Page 262.

C15	≥ 300 and < 400	0.00290
C16	≥ 400	0.00272

Prescriptive Compressed Air: Receivers, Codes C20–C27							
Last Revised Date	4/1/2018						
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	ΔkW = $HP_{COMPRESSOR}$ × 0.746 × Δpsi × SAVE						
Annual Energy Savings	ΔkWh/yr = $HP_{COMPRESSOR}$ × 0.746 × Δpsi × SAVE × Hours/Week × 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[790]	Actual	Actual	0.5%/ psi[791]	10[792]	Table 48
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO

[790] 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.
[791] 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.
[792] 2012 Technical Reference User Manual, Efficiency Vermont, 12/19/12, page 193.

C&I Prescriptive	100%	112.2%[793]	100%[794]	Table 54~~Table 54~~[795]	Table 54~~Table 54~~[795]~~[796]~~	52%[796]	1.6%[797]

Table 48 – Measure Cost for Compressed Air Receivers[798]

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.

[793] Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
[794] Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.
[795] See Appendix C.
[796] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[797] Ibid.
[798] Cost data provided by Greg Scott, Trask-Decrow Machinery.

Prescriptive Compressed Air: Low Pressure Drop Filters, Codes C30–C33

Last Revised Date	4/1/2018
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	$\Delta kW = HP_{COMPRESSOR} \times 0.746 \times \Delta psi \times SAVE$
Annual Energy Savings	$\Delta kWh/yr = HP_{COMPRESSOR} \times 0.746 \times \Delta psi \times SAVE \times HoursWk \times Weeks$
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[799]	0.5%/psi[800]	Actual	Actual	4[801]	$4.60/HP[802]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[803]	100%[804]	Table 54Table 54[805]	Table 54Table 54[805][806]	52%[806]	1.6%[807]

[799] Based on information derived from the Compressed Air Challenge and confirmed with Trask-Decrow Machinery.
[800] 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.
[801] Rhode Island Technical Reference, 2012 Program Year. EMT uses the average of measure life for retrofit (3 years) and for new construction (5 years).
[802] Based historical measure cost data for EMT projects, provided by Greg Scott, Trask-Decrow Machinery.
[803] Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
[804] Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.
[805] See Appendix C.
[806] Nexant, Business Incentive Program Process Evaluation, Published October 31, 2016, page 58.
[807] 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 49	Actual	Actual	5%[808]	10[809]	14[810]

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Prescriptive	100%	112.2%[811]	100%[812]	Table 54~~Table 54~~[813]	Table 54~~Table 54~~[813]~~[814]~~	52%[814]	1.6%[815]

808 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.

809 2012 Technical Reference User Manual, Efficiency Vermont, 12/19/12, page 186.

810 2010 Ohio Technical Reference Manual, Vermont Energy Investment Corp, August 6, 2010, pages 226–227.

811 Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.

812 Summer and Winter CF adjusted to account for BIP program evalution findings as presented in Appendix D. Realization rate reset to 100%.

813 See Appendix C.

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

815 Ibid.

Table 49 – 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 Building Insulation (MIA, MIB, MIF) (inactive: MIW)	
Last Revised Date	10/1/2022
MEASURE OVERVIEW	
Description	This measure involves the insulation of the attic floor, exterior walls, basement walls or floor exposed to exterior to decrease heating and cooling losses. The participant must also complete a comprehensive air-sealing project of the zone being insulated. The total savings below reflect savings due to the added insulation and improved air sealing attributable to the insulation.
Energy Impacts	Electric, Natural Gas, Oil, Propane, Wood, Kerosene
Sector	Multifamily
Program(s)	C&I Prescriptive Program
End-Use	Heating, Cooling
Decision Type	Retrofit
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	$\Delta kW_{SP} = \Delta MMBtu_{COOL}$ / EER x 1000 x %COOL x LSF_{SP} For known electric heat: $\Delta kW_{WP} = \Delta MMBtu_{HEAT}$ / 0.003412 / EFF x LSF_{WP}
Annual Energy savings	For known fuel and non-electric heat: $\Delta MMBtu_{FUEL} = \Delta MMBtu_{HEAT}$ / EFF $\Delta kWh = \Delta MMBtu_{COOL}$ / EER x 1000 x %COOL For electric heat: $\Delta kWh = \Delta MMBtu_{HEAT}$ / 0.003412 / EFF + $\Delta MMBtu_{COOL}$ / EER x 1000 x %COOL For unknown fuel: $\Delta MMBtu_{FUEL} = \Delta MMBtu_{HEAT}$ / EFF x %FUEL $\Delta kWh = \Delta MMBtu_{HEAT}$ / 0.003412 / EFF x %FUEL + $\Delta MMBtu_{COOL}$ / EER x 1000 x %COOL Where $\Delta MMBtu_{COOL}$ = (1/ ($RVAL_{PRE}$ + RAdj) – 1/$RVAL_{POST}$ + ΔCFM50Factor/14.8 x 60 x 0.014) x SQFT x Aadj x CDH / 1000000 $\Delta MMBtu_{HEAT}$ = (1/ ($RVAL_{PRE}$ + RAdj) – 1/$RVAL_{POST}$ + ΔCFM50Factor/14.8 x 60 x 0.014) x SQFT x Aadj x HDH / 1000000
Definitions	Unit = single zone of insulation (attic, walls, basement) with the same pre and post R values $\Delta MMBtu_{HEAT}$ = 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 representative heating system (Btu/Btu) EER = Energy-efficiency ratio of representative cooling system (Btu/Wh) %FUEL = Home heating fuel distribution[816] LSF_{SP} = Summer peak load shape factor (kW/kWh/y) LSF_{WP} = Winter peak load shape factor (kW/kWh/y) %COOL = Equivalent percentage of homes with full electric cooling equipment (%) 0.003412 = Conversion factor (MMBtu/kWh) 1000 = Conversion factor (W/kW) SQFT = Area of insulation (ft^2) installed $RVAL_{PRE}$ = Pre-upgrade R-value (ft^2-°F-h/Btu) $RVAL_{POST}$ = Post-upgrade R-value (ft^2-°F-h/Btu) RAdj = Adjustment to Pre-upgrade R-value (ft^2-°F-h/Btu) ΔCFM50Factor = Change in air leakage per square foot of insulation resulting from improved air sealing ($ft^3/h/ft^2$) 14.8 = Conversion factor (CFM50 to CFM natural)[817] 60 = Conversion factor (minutes/hour) 0.014 = heat loss reduction factor from improved air sealing (Btu/(ft^3/h)/°F)[818] AAdj = Area adjustment (used to adjust the effective insulated area for basement walls due to ground effects)

[816] Heating fuel distribution is used to allocate savings to different fuels when fuel type is unknown because the savings achieved through insulation impact heating energy consumption.
[817] Based on LBNL "N" factors Zone 2, 1.5-2 stories.
[818] Btu savings estimated using 0.014 Btu/CFH natural/delta temperature* delta temperature * hours per year for each delta temperature as recommended by the West Hill Energy, Efficiency Maine Trust Home Energy Savings Program Impact Evaluation, 2019.

Multifamily Building Insulation (MIA, MIB, MIF) (inactive: MIW)		
	HDH	= Heating Degree Hours derived from TMY3 hourly dry bulb temperature (°F-h)
	CDH	= Cooling Degree Hours derived from TMY3 hourly dry bulb temperature (°F-h)
	$Base_T$	= Base temperature against which HDH and CDH are calculated
EFFICIENCY ASSUMPTIONS		
Baseline Efficiency	The baseline is the existing (pre-upgrade) insulation	
Efficient Measure	The high-efficiency case is the upgraded insulation	

PARAMETER VALUES (DEEMED)

Measure	EFF	EER	%FUEL	LSF_{SP}	LSF_{WP}	%COOL	Life (yrs)	Cost ($)
Insulation	83%[819]	9.8[820]	Table 63	0.00213[821]	0.000248[822]	53%[823]	25[824]	Actual

Measure	SQFT	$RVAL_{PRE}$	$RVAL_{POST}$	RAdj	ΔCFM50Factor	AAdj	HDH	CDH
Insulation	Actual	Actual	Actual	Table 50			Table 51	

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
HESP	100%[825]	100%[826]	100%[827]	100%[828]	100%[829]	25%[830]	0%[831]

Table 50. Insulation Zone Parameters

Zone	Variable	Attic/Ceiling	Wall	Basement	Floor
Base temperature cooling[832]	$Base_T$	70	70	95	95
Base temperature heating[833]	$Base_T$	60	60	40	50
Pre-upgrade R-value adjustment[834]	RAdj	2.5	2.5	0.5	0.5
CFM50 reduction per sqft[835]	ΔCFM50Factor	0.3922	0	0.8337	0.259

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819 Recommended assumption from HESP Impact Evaluation. For electric heat, 100% efficiency is assumed.
820 Average existing cooling efficiency 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.
821 Based on temperature bin analysis of seasonal cooling using TMY3 temperature bins and base temperature of 60 deg F.
822 Based on temperature bin analysis of seasonal heating using TMY3 temperature bins and base temperature of 60 deg F.
823 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/C's); 39 percent of homes have total cooling capacity equivalent of 1 or 2 window A/C units. The remaining 21 percent have no cooling equipment installed. Assuming that the 39 percent of homes with 1 or 2 window units are equivalent to 33% of whole home cooling, the resulting equivalent cooling for all homes is 53 percent (40%*100% + 39%*33%).
824 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.
825 EMT assumes all insulation is installed.
826 This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100 percent realization rate.
827 This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100 percent realization rate.
828 Peak coincidence factors for this measure are embedded in the peak demand impacts formulas.
829 Peak coincidence factors for this measure are embedded in the peak demand impacts formulas.
830 Program not yet evaluated, assume default FR of 25%.
831 Program not yet evaluated, assume default SO of 0%.
832 Assumed temperature above which cooling is required. Basement cooling base temperature set to avoid cooling savings which are not applicable to basement insulation improvements. Floor cooling base temperature set assuming a blend of insulated floors above unconditioned basements and above spaces exposed to ambient temperatures.
833 Assumed temperature below which heating is required as recommended by West Hill, Efficiency Maine Trust Home Energy Savings Program Impact Evaluation, 2019. Basement heating base temperature set lower than other zones to account for unconditioned basements. Floor heating base temperature assuming a blend of insulated floors above unconditioned basements and above spaces exposed to ambient temperatures.
834 Recommended adjustments from West Hill Energy, Efficiency Maine Trust Home Energy Savings Program Impact Evaluation, 2019: Attic: no adjustment, Wall: + R2.5 for framing, Basement: + R-0.50 for cement wall. In addition to the pre R-value adjustments, minimum pre and post R-values are implemented in the effRT formulas to guard against 0 values: Attic: 10 pre/20 post, Wall: 5 pre/10 post, Basement 2 pre/10 post.
835 Recommended assumption from West Hill Energy, Efficiency Maine Trust Home Energy Savings Program Impact Evaluation, 2019 divided by average area of each insulated zone.

Area adjustment[836]	AAdj	1	1	0.31	1
Cooling Degree Hours[837]	CDH	5,570	5,570	0	0
Heating Degree Hours[838]	HDH	152,580	152,580	51,257	94,019

Table 51. Heating and Cooling Degree Hours[839]

Heating/Cooling	Base Temperature ($Base_T$)	Portland	Caribou	Bangor	Population Weighted Average
Heating	60	149366	199010	151623	152580
Heating	50	90886	134836	94114	94019
Heating	40	48718	84495	51297	51257
Cooling	70	5139	3829	7284	5570
Cooling	75	2116	1462	3400	2381
Cooling	95	0	0	0	0
	Population Weight	71%	5%	23%	100%

836 Area of insulation for basements is adjusted to account for portion of wall exposed to ambient temperature. Recommended value from West Hill Energy, Efficiency Maine Trust Home Energy Savings Program Impact Evaluation, 2019.
837 Population weighted cooling degree hours derived from TMY 3 dry bulb temperatures. See Table 51.
838 Population weighted heating degree hours derived from TMY 3 dry bulb temperatures. See Table 51.
839 Sum of the differences between the assumed base temperature and the TMY3 hourly dry bulb temperature for each location. Population weights derived from population of each region; U.S. Census Bureau Census 2010 Summary File 1 population by census tract.

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	$kW = \Delta kWh/yr / Loads$[840]
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 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 became effective January 1, 2018 but do not yet affect this retrofit measure.
Efficient Measure	ENERGY STAR®-certified front loading clothes washer.

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

Multifamily Common Area Clothes Washer (MCW)						
PARAMETER VALUES (DEEMED)						
Measure	CAP_{EE}[841]	Loads[842]	$IMEF_{BASE}$[843]	$IMEF_{EE}$[844]	Life (yrs)[845]	Cost ($)
ENERGY STAR® CW	3.81	967.2	1.29	2.38	11	Actual
	$\%E_{MACHINE\_B}$[846]	$\%E_{MACHINE\_EE}$[847]	$\%E_{DRYER\_B}$[848]	$\%E_{DRYER\_EE}$[849]	$\%E_{DHW\_B}$[850]	$\%E_{DHW\_EE}$[851]
	8%	8%	61%	69%	31%	23%
	Eff_{GAS}[852]	%Dried[853]	IWF_{BASE}[854]	IWF_{EE}[855]		
	Actual or 62%	100%	8.4	3.7		

IMPACT FACTORS							
Program	ISR[856]	RR_E[857]	RR_D[858]	CF_S[859]	CF_W[860]	FR[861]	SO[862]
Low Income Initiatives	100%	100%	100%	4.8%%	6.3%	0%	0%

[841] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, Table 2-13.
[842] Assumed to be 3 times the average number of loads for a single family home with one clothes washer provided for every three apartments
[843] Federal Standard for Top Loading units
[844] ENERGYSTAR®criteria for Front Loading units
[845] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, Table 2-18.
[846] Illinois Statewide TRM Effective 06/01/15.
[847] Ibid.
[848] Ibid.
[849] Ibid.
[850] Ibid.
[851] Ibid.
[852] EMT assumes 62 percent efficiency for existing natural gas-fired water heaters based on an autmospheric, storage tank water heater.
[853] 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.
[854] Federal Standard for Top Loading units
[855] ENERGYSTAR®criteria for Front Loading units
[856] EMT assumes all units are installed (i.e. ISR = 100%).
[857] The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100 percent realization rate.
[858] The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100 percent realization rate.
[859] Derived from summer peak demand NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, p. 45
[860] Derived from winter peak demand Memo provided to supplement NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014
[861] Program assumes no free ridership for Low Income Initiatives
[862] 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[863]
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}[864]	Loads[865]	CEF_{BASE}[866]	CEF_{EE}[867]	Life (yrs)[868]	Cost ($)
ENERGY STAR® CW	9.21	967.2	3.3	3.8	11	Actual

IMPACT FACTORS

Program	ISR[869]	RR_E[870]	RR_D[871]	CF_S	CF_W	FR[872]	SO[873]
Low Income Initiatives	100%	100%	100%	N/A	N/A	0%	0%

863 All savings are attributed to Natural Gas
864 Average capacity of ENERGYSTAR® certified units as of August 15, 2017
865 Assumed to be 3 times the average number of loads for a single family home with one clothes washer provided for every three apartments
866 Federal Standard for gas units
867 Average combined energy factor for ENERGYSTAR® certified units as of August 15, 2017
868 NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, Table 2-18.
869 EMT assumes all units are installed (i.e. ISR = 100%).
870 The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100 percent realization rate.
871 The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100 percent realization rate.
872 Program assumes no free ridership for Low Income Initiatives
873 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)[874]	Cost($)[875]
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[876]	RR_E[877]	RR_D[878]	CF_S	CF_W	FR	SO
AB - <X>	100%	100%	100%	Custom	Custom	0%	0%

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

Custom – C&I Custom Electric Projects, Codes CC<X>, CG<X>, CSS<X>, CSolar, AFAPL, AFAPHS, AFAPHM	
Last Revised Date	4/1/2023
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 33,333 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.[879] 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 666,666 kWh. ***Agricultural Fairs*** Agricultural Fairs projects are energy efficiency projects involving lighting and heat pumps in retrofit applications.
Primary Energy Impact	Electric
Sector	Commercial and Industrial
Program(s)	C&I Custom Program
End-Use	See Table 53~~Table 53~~
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	

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

Custom – C&I Custom Electric Projects, Codes CC<X>, CG<X>, CSS<X>, CSolar, AFAPL, AFAPHS, AFAPHM	
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.

PARAMETER VALUES

Measure	Parameters for Energy and Demand Savings Calculations	Life (yrs)[880]	Cost ($)
All	All parameters required for energy and demand savings are determined from project-specific details documented in the project application forms.	Table 53~~Table 53~~	Actual

IMPACT FACTORS

Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Custom	100%	96.5%[881]	94.6%[882]	Custom	Custom	8.2%[883]	0.7%[884]

[880] Measure life should be determined by the project engineer. The referenced table provides suggested measure life values for various custom projects.
[881] Nexant, Large Customer Program Evaluation, April 7, 2017.
[882] Nexant, Large Customer Program Evaluation, April 7, 2017.
[883] Nexant, Large Customer Program Evaluation, unpublished draft May 2016, page 27.
[884] 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 53~~Table 53~~
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.

Custom – C&I Custom Natural Gas Projects, Codes CC<X>, CG<X>, CSS<X>							
PARAMETER VALUES							
Measure	Parameters for Energy Savings Calculations					Life (yrs)[885]	Cost ($)
All	All parameters required for energy and demand savings are determined from project-specific details documented in the project application forms.					Table 53~~Table 53~~	Actual
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Custom	100%	96.5%[886]	94.6%[887]	Custom	Custom	8.2%[888]	0.7%[889]

885 Measure life should be determined by the project engineer. The referenced table provides suggested measure life values for various custom projects.
886 Nexant, Large Customer Program Evaluation, April 7, 2017.
887 Nexant, Large Customer Program Evaluation, April 7, 2017.
888 Nexant, Large Customer Program Evaluation, April 7, 2017.
889 Ibid.

Custom – C&I Custom Thermal Projects, Codes CC<X>, CG<X>, CSS<X>, AFAPL, AFAPHS, AFAPHM	
Last Revised Date	4/1/2023
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 ***Lead by Example*** Lead by Example Initiative projects promote the increased installation and use of clean, cost-effective energy measures at state properties. The Lead by Example Initiative provides technical support, project screening, and enhanced incentives to develop projects at Maine state buildings currently heated with oil or propane to convert to heat-pump-based systems for space and water heating. ***Agricultural Fairs*** Agricultural Fairs projects are energy efficiency projects involving lighting and heat pumps in retrofit applications.
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 53~~Table 53~~
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.

Custom – C&I Custom Thermal Projects, Codes CC<X>, CG<X>, CSS<X>, AFAPL, AFAPHS, AFAPHM							
	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 and Demand Savings Calculations					Life (yrs)[890]	Cost ($)
All	All parameters required for energy and demand savings are determined from project-specific details documented in the project application forms.					Table 53~~Table 53~~	Actual
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Custom	100%	96.5%[891]	94.6%[892]	Custom	Custom	8.2%[893]	0.7%[894]

[890] Measure life should be determined by the project engineer. The referenced table provides suggested measure life values for various custom projects.
[891] Nexant, Large Customer Program Evaluation, April 7, 2017.
[892] Nexant, Large Customer Program Evaluation, April 7, 2017.
[893] Nexant, Large Customer Program Evaluation, unpublished draft May 2016, page 27.
[894] 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 53~~Table 53~~
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.

Custom – C&I Custom Distributed Generation Projects, Codes CC<X>, CG<X>, CSS<X>, CSolar							
PARAMETER VALUES							
Measure	Parameters for Energy and Demand Savings Calculations					Life (yrs)[895]	Cost ($)
All	All parameters required for energy and demand savings are determined from project-specific details documented in the project application forms.					Table 53~~Table 53~~	Actual
IMPACT FACTORS							
Program	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
C&I Custom	100%	96.5%[896]	94.6%[897]	Custom	Custom	8.2%[898]	0.7%[899]

[895] Measure life should be determined by the project engineer. The referenced table provides suggested measure life values for various custom projects.
[896] Nexant, Large Customer Program Evaluation, April 7, 2017.
[897] Nexant, Large Customer Program Evaluation, April 7, 2017.
[898] Nexant, Large Customer Program Evaluation, unpublished draft May 2016, page 27.
[899] Ibid.

Table 52 – 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 53 – Measure Life Reference for Custom Projects[900]

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

[900] 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: [901]

- **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 [902]:

- **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 54~~Table 54~~ includes a listing of measure coincidence factors and energy period allocations.

Table 54 – Commercial Coincidence Factors and Energy Period Factors

Measure	End-Use	Coincidence Factor		Energy Period Factors				Footnote Reference	
		Winter On-Peak	Summer On-Peak	Winter		Summer			
				Peak	Off Peak	Peak	Off Peak	CF	EPF
Lighting Fixtures – Interior Spaces – Year Round – CIP	Lighting	37.2%	64.5%	45.0%	21.8%	22.9%	10.3%	903	
Lighting Fixtures – Interior Spaces – Summer Seasonal – CIP	Lighting	0.0%	64.5%	14.1%	6.5%	54.8%	24.6%	904	

[901] http://www.iso-ne.com/markets-operations/markets/demand-resources/about
[902] http://www.efficiencymaine.com/docs/2015-AESC-Report-With-Appendices-Attached.pdf, p. 2-71.
[903] Demand Side Analytics, Retail and Distributor Lighting Products Impact Evaluation, March 2021.
[904] Summer Seasonal businesses assumed to keep similar hours as year-round facilities with operation from June 1 – Oct 31.

Measure	End-Use	Coincidence Factor		Energy Period Factors				Footnote Reference	
		Winter	Summer	Winter		Summer			
		On-Peak	On-Peak	Peak	Off Peak	Peak	Off Peak	CF	EPF
Lighting Fixtures – Interior Spaces – Winter Seasonal – CIP	Lighting	37.2%	0.0%	66.8%	33.2%	0.0%	0.0%	905	
Lighting Fixtures – Interior Spaces – Year Round – SBI	Lighting	26.7%	60.8%	49.4%	18.0%	24.6%	8.0%	906	
Lighting Fixtures – Interior Spaces – Summer Seasonal – SBI	Lighting	0.0%	60.8%	15.7%	5.4%	59.5%	19.4%	907	
Lighting Fixtures – Interior Spaces – Winter Seasonal – SBI	Lighting	26.7%	0.0%	72.8%	27.2%	0.0%	0.0%	908	
Lighting Fixtures – LED Exit Signs	Lighting	100.0%	100.0%	30.4%	36.2%	15.6%	17.9%	909	
Lighting Fixtures – Exterior Spaces – Year Round	Lighting	82.4%	6.6%	27.3%	45.0%	9.5%	18.2%	910	
Lighting Fixtures – Exterior Spaces – Summer Seasonal	Lighting	0.0%	6.6%	9.7%	15.1%	25.8%	49.4%	911	
Lighting Fixtures – Exterior Spaces – Winter Seasonal	Lighting	82.4%	0.0%	37.2%	62.8%	0.0%	0.0%	912	
Lighting Fixtures with Integrated Controls – Year Round	Lighting	63.0%	76.0%	50.0%	19.0%	23.0%	9.0%	913	914
Lighting Fixtures with Integrated Controls – Summer Seasonal	Lighting	0.00%	76.00%	16.06%	5.76%	56.19%	21.99%	915	

[905] Winter Seasonal businesses assumed to keep similar hours as year-round facilities with operation from Nov 1 – Mar 31.
[906] Demand Side Analytics, Small Business Initiative Impact Evaluation, March 2021.
[907] Summer Seasonal businesses assumed to keep similar hours as year-round facilities with operation from June 1 – Oct 31.
[908] Winter Seasonal businesses assumed to keep similar hours as year-round facilities with operation from Nov 1 – Mar 31.
[909] 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.
[910] Demand Side Analytics, Retail and Distributor Lighting Products Impact Evaluation, March 2021.
[911] Summer Seasonal businesses assumed to keep similar hours as year-round facilities with operation from June 1 – Oct 31.
[912] Winter Seasonal businesses assumed to keep similar hours as year-round facilities with operation from Nov 1 – Mar 31.
[913] Coincidence factors for interior lighting fixtures. KEMA, C&I Lighting Load Shape Project FINAL Report, July 2011.
[914] Nexant Business Incentive Program Impact Evaluation November 2017
[915] Summer Seasonal businesses assumed to keep similar hours as year-round facilities with operation from June 1 – Oct 31.

Measure	End-Use	Coincidence Factor		Energy Period Factors				Footnote Reference	
		Winter On-Peak	Summer On-Peak	Winter		Summer		CF	EPF
				Peak	Off Peak	Peak	Off Peak		
Lighting Fixtures with Integrated Controls – Winter Seasonal	Lighting	63.00%	0.00%	71.96%	28.04%	0.00%	0.00%	916	
Lighting Controls – Interior Spaces – Year Round	Lighting	12.0%	18.0%	50.0%	19.0%	23.0%	9.0%	917	918
Lighting Controls – Interior Spaces – Summer Seasonal	Lighting	0.00%	18.00%	16.06%	5.76%	56.19%	21.99%	919	
Lighting Controls – Interior Spaces – Winter Seasonal	Lighting	12.00%	0.00%	71.96%	28.04%	0.00%	0.00%	920	
Lighting Fixtures – Refrigerated Spaces	Lighting	84.7%	90.8%	39.7%	26.7%	19.7%	13.9%	921	
Lighting Fixtures – Refrigerated Spaces – Summer Seasonal	Lighting	0.00%	90.80%	12.39%	7.86%	46.76%	32.99%	922	
Lighting Fixtures – Refrigerated Spaces – Winter Seasonal	Lighting	84.70%	0.00%	59.18%	40.82%	0.00%	0.00%	923	
Lighting Controls – Refrigerated Spaces	Lighting	30.7%	30.7%	30.4%	36.2%	15.6%	17.9%	924	
Lighting Controls – Refrigerated Spaces – Summer Seasonal	Lighting	0.00%	30.70%	9.52%	10.70%	37.15%	42.63%	925	

[916] Winter Seasonal businesses assumed to keep similar hours as year-round facilities with operation from Nov 1 – Mar 31.
[917] The Cadmus Group, Inc. (2012). Final Report, Small Business Direct Install Program: Pre/Post Occupancy Sensor Study.
[918] Nexant Business Incentive Program Impact Evaluation November 2017
[919] Summer Seasonal businesses assumed to keep similar hours as year-round facilities with operation from June 1 – Oct 31.
[920] Winter Seasonal businesses assumed to keep similar hours as year-round facilities with operation from Nov 1 – Mar 31.
[921] Efficiency Vermont TRM 2012, Grocery/Convenience Store Indoor Lighting.
[922] Summer Seasonal businesses assumed to keep similar hours as year-round facilities with operation from June 1 – Oct 31.
[923] Winter Seasonal businesses assumed to keep similar hours as year-round facilities with operation from Nov 1 – Mar 31.
[924] 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.
[925] Summer Seasonal businesses assumed to keep similar hours as year-round facilities with operation from June 1 – Oct 31.

Measure	End-Use	Coincidence Factor		Energy Period Factors				Footnote Reference	
		Winter	Summer	Winter		Summer			
		On-Peak	On-Peak	Peak	Off Peak	Peak	Off Peak	CF	EPF
Lighting Controls – Refrigerated Spaces – Winter Seasonal	Lighting	30.70%	0.00%	45.02%	54.98%	0.00%	0.00%	926	
LED Lamp – Distributor	Lighting	25.4%	30.9%	42.3%	24.9%	21.0%	11.8%	927	928
LED Lamp Commercial Interior	Lighting	37.2%	64.5%	45%	21.8%	22.9%	10.3%	929	
LED Lamp Commercial Exterior	Lighting	82.4%	6.6%	27.3%	45%	9.5%	18.2%		
VFDs on Heating Hot Water Pumps & Electronically Commutated Hot Water Smart Pump	Motors	73.7%	0.0%	53.6%	46.3%	0.0%	0.1%	930	931
Electronically Commutated Supply Fan Motor (heating only)	Motors	100.0%	0.0%	53.6%	46.3%	0.0%	0.1%	932	933
Electronically Commutated Supply Fan Motor (cooling only)	Motors	0.0%	100.0%	17.0%	3.0%	62.0%	18.0%	934	935
Electronically Commutated Supply Fan Motor (heating and cooling)	Motors	100.0%	100.0%	39.0%	30.5%	21.6%	8.9%	936	937
VFDs on Chilled Water Pumps	Motors	0.0%	86.5%	30.9%	18.1%	35.9%	15.1%	938	931~~932~~
VFDs on Supply Fan	Motors	14.6%	48.7%	39.0%	30.5%	21.6%	8.9%		931~~932~~
VFDs on Return Fan	Motors	21.0%	68.3%	39.0%	30.8%	21.4%	8.8%		931~~932~~

[926] Winter Seasonal businesses assumed to keep similar hours as year-round facilities with operation from Nov 1 – Mar 31.
[927] Composite coincidence factors based on proportion of bulbs installed in residential and commercial settings. Demand Side Analytics, Retail and Distributor Lighting Impact Evaluation, March 2021.
[928] Composite Energy Period Factors based on proportion of bulbs installed in residential and commercial settings. Demand Side Analytics, Retail and Distributor Lighting Evaluation, March 2021.
[929] Demand Side Analytics, Retail and Distributor Lighting Evaluation, March 2021.
[930] See Appendix D for evaluation adjusted coincidence factors.
[931] 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
[932] Coincidence factor embedded in deemed peak demand reduction.
[933] Based on VFDs for Heating Hot Water Pumps
[934] Coincidence factor embedded in deemed peak demand reduction.
[935] Based on Unitary Air Conditioners
[936] Coincidence factor embedded in deemed peak demand reduction.
[937] Based on VFDs on Supply Fan
[938] See Appendix D for evaluation adjusted coincidence factors.

Measure	End-Use	Coincidence Factor		Energy Period Factors				Footnote Reference	
		Winter	Summer	Winter		Summer			
		On-Peak	On-Peak	Peak	Off Peak	Peak	Off Peak	CF	EPF
VFDs on Exhaust Fan	Motors	73.7%	35.5%	44.4%	22.2%	16.0%	17.4%		931~~932~~
Unitary Air Conditioners and Split Systems (< 11.25 tons)	HVAC	0.0%	37.2%	17.0%	3.0%	62.0%	18.0%	939	940
Unitary Air Conditioners and Split Systems (≥ 11.25 tons)	HVAC	0.0%	29.0%	17.0%	3.0%	62.0%	18.0%		
Heat Pump Systems (< 11.25 tons)	HVAC	42.0%	35.7%	17.0%	3.0%	62.0%	18.0%	941	
Heat Pump Systems (≥ 11.25 tons)	HVAC	42.0%	27.8%	17.0%	3.0%	62.0%	18.0%		
Demand Control Ventilation	HVAC	1.5%	77.7%	17.0%	3.0%	62.0%	18.0%		
Variable Refrigerant Flow (VRF), Heat Pump Rooftop Unit (RTUHP)	HVAC	42.0%	35.7%	17.0%	3.0%	62.0%	18.0%		
Energy Recovery Ventilation	HVAC	70%	100%	40.94%	25.69%	20.84%	12.53%	942	
Packaged Terminal Heat Pumps (PTHP, VPTHP)	HVAC	57.0%	37.2%	17.0%	3.0%	62.0%	18.0%	943	944
High Performance Heat Pump blended baseline, Tier 1	HVAC	100.0%	100.0%	35.9%	49.5%	8.3%	6.3%	945	
High Performance Heat Pump blended baseline, Tier 2	HVAC	100.0%	100.0%	36.4%	49.7%	7.8%	6.1%		
High Performance Heat Pump, retrofit, except multi-family, blended baseline and Lead-by-example heat pump	HVAC	100.0%	100.0%	38.0%	53.2%	4.6%	4.2%		
High Performance Heat Pump, multi-family retrofit, blended baseline	HVAC	100.0%	100.0%	38.9%	55.0%	3.2%	2.9%		

939 KEMA, NEEP Unitary HVAC AC Load Shape Project Final Report, June 2011.
940 Central Maine Power, Non-residential load profile for 3/1/08-2/28/09.
941 See Appendix D for evaluation adjusted coincidence factors.
942 Assumes 30% single shift occupancy and 70% continuous operation.
943 KEMA, NEEP Unitary HVAC AC Load Shape Project Final Report, June 2011.
944 Central Maine Power, Non-residential load profile for 3/1/08-2/28/09.
945 Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.

Measure	End-Use	Coincidence Factor		Energy Period Factors				Footnote Reference	
		Winter On-Peak	Summer On-Peak	Winter Peak	Winter Off Peak	Summer Peak	Summer Off Peak	CF	EPF
High Performance Heat Pump, low income, multi-family retrofit, electric	HVAC	100.0%	100.0%	40.3%	54.3%	2.2%	3.2%		
Programable Thermostat Electric Resistance Heat (AF6)	HVAC	0%	0%	39.0%	30.5%	21.6%	8.9%	946	947
Evaporator Fan Motor Control for Cooler/Freezer, Code R10	Refrigeration	33.8%	41.2%	29.1%	39.5%	13.7%	17.7%	930~~931~~	948
Door Heater Controls for Cooler/Freezer, Code R20	Refrigeration	73.7%	95.9%	47.6%	52.4%	0.0%	0.0%	930~~931~~	949
Zero Energy Doors for Coolers/Freezers, Code R30, R31	Refrigeration	73.7%	95.9%	30.4%	36.2%	15.6%	17.8%	930~~931~~	950
H.E. Evaporative Fan Motors, Code R40, R41, R42	Refrigeration	73.7%	95.9%	30.4%	36.2%	15.6%	17.8%	930~~931~~	951
Floating-Head Pressure Controls, Code R50, R51, R52	Refrigeration	73.7%	0.0%	33.3%	37.1%	12.8%	16.8%	930~~931~~	952
Discus & Scroll Compressors, Code R60-R63, R70-R74 Strip Curtains, Code R25	Refrigeration	50.9%	74.0%	33.0%	32.6%	17.0%	17.4%	930~~931~~	953
Commercial Reach-in Cooler/Refrigerator and Freezers and Ice Makers, Code R80, R90	Refrigeration	50.9%	74.0%	33.0%	32.6%	17.0%	17.4%	930~~931~~	954

[946] No demand savings.
[947] 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
[948] Efficiency Vermont TRM 2012, Evaporator Fan Control.
[949] Efficiency Vermont TRM 2012, Door Heater Control.
[950] Central Maine Power, Non-residential load profile for 3/1/08-2/28/09.
[951] Central Maine Power, Non-residential load profile for 3/1/08-2/28/09.
[952] Efficiency Vermont TRM 2012, Floating-Head Pressure Control.
[953] Efficiency Vermont TRM 2012, Commercial Refrigeration.
[954] Efficiency Vermont TRM 2012, Commercial Refrigeration.

Measure	End-Use	Coincidence Factor		Energy Period Factors				Footnote Reference	
		Winter	Summer	Winter		Summer			
		On-Peak	On-Peak	Peak	Off Peak	Peak	Off Peak	CF	EPF
New Vapor-Tight High Performance T8 Fluorescent Fixtures	Lighting	63.0%	76.0%	50.0%	19.0%	23.0%	9.0%	930~~931~~	955
Plate Heat Exchangers for Milk Processing	Refrigeration	27.0%	16.1%	29.0%	16.4%	31.6%	23.0%	956	
Adjustable Speed Drives for Dairy Vacuum Pumps	Motors	46.7%	27.5%	36.9%	30.1%	18.2%	14.8%	930~~931~~	957
Scroll Compressors	Refrigeration	67.4%	32.7%	43.6%	23.2%	21.7%	11.5%	930~~931~~	958
Adjustable Speed Drives on Ventilation Fans, potato storage equipment	Motors	73.7%	0.0%	66.7%	33.3%	0%	0%	930~~931~~	959
HVLS Fans	Motors	67.4%	32.6%	43.6%	23.2%	21.7%	11.5%	930~~931~~	960
Stand Alone Dehumidifiers Indoor Cannabis Cultivation	HVAC	100%	100%	33.7%	32.9%	17.5%	15.9%	961	962
High-Efficiency Air Compressors, Codes C1-C4	Compressed Air	70.0%	91.1%	30.4%	36.1%	15.6%	17.9%	930~~931~~	909~~910~~
High-Efficiency Dryers, Codes C10-C16	Compressed Air	70.0%	91.1%	30.4%	36.1%	15.6%	17.9%	930~~931~~	909~~910~~
Receivers, Codes C20-C27	Compressed Air	70.0%	91.1%	30.4%	36.1%	15.6%	17.9%	930~~931~~	909~~910~~

[955] Central Maine Power, Non-residential load profile for 3/1/08-2/28/09.
[956] Efficiency Vermont TRM 2012, Farm Plate Cooler/Heat Recover Unit.
[957] Efficiency Vermont TRM 2012, VFD Milk Vacuum Pump.
[958] Efficiency Vermont TRM 2012, Dairy Farm Combined End Uses.
[959] Savings are realized 24/7 Dec 1 – April 30.
[960] Efficiency Vermont TRM 2012, Dairy Farm Combined End Uses.
[961] Peak demand impacts are calculated directly.
[962] Modeling shows 63% of savings occur during photoperiod. Photoperiod assumed to be 8:00 am to 8:00 pm seven days a week.

Measure	End-Use	Coincidence Factor		Energy Period Factors				Footnote Reference	
		Winter On-Peak	Summer On-Peak	Winter		Summer			
				Peak	Off Peak	Peak	Off Peak	CF	EPF
Low Pressure Drop Filters, Codes C30-C33	Compressed Air	70.0%	91.1%	30.4%	36.1%	15.6%	17.9%	930931	909910
Air-Entraining Nozzles, Code C40	Compressed Air	70.0%	91.1%	30.4%	36.1%	15.6%	17.9%	930931	909910
Multifamily Attic Insulation	HVAC	100%	100%	2.78%	0.55%	66.56%	30.12%		
Multifamily Basement Insulation	HVAC	100%	100%	39.4%	60.5%	0%	0.1%	963	964
Multifamily Floor Insulation	HVAC	100%	100%	39.4%	60.5%	0%	0.1%		
Custom – Compressed Air	Compressed Air	Custom	Custom	44.3%	30.3%	15.2%	10.2%		
Custom - Lighting	Lighting	Custom	Custom	44.3%	30.3%	15.2%	10.2%		
Custom – VFD	Motors	Custom	Custom	44.3%	30.3%	15.2%	10.2%		
Custom – HVAC	HVAC	Custom	Custom	44.3%	30.3%	15.2%	10.2%		966
Custom – Miscellaneous	All	Custom	Custom	44.3%	30.3%	15.2%	10.2%	965	
Custom – Generic	Various	Custom	Custom	44.3%	30.3%	15.2%	10.2%		
Custom– Continuous Process	Process	Custom	Custom	29.8%	36.8%	15.5%	17.9%		967
Custom – Single Shift Process	Process	Custom	Custom	65.8%	0.0%	34.2%	0.0%		968
Custom – Agricultural Fairs	Lighting & HVAC	Custom	Custom	12.7%	10.3%	42.6%	34.4%		969
Custom – Solar PV	Solar PV	0	36.3%	38.1%	18.4%	28.8%	14.7%	970	971
Lead-by-example HPWH	Hot Water	100.0%	100.0%	35.8%	30.8%	17.9%	15.5%	972	973

[963] Coincidence factor embedded in deemed peak demand reduction.
[964] Values developed based on the bin analysis calculations for insulation savings using typical annual hours in each weather bin during each energy period.
[965] Coincidence factors for custom projects are estimated for each project based on project-specific information.
[966] Values based on CMP loadshape for "Process C&I."
[967] Assumes 24/7 operation, year-round. EPFs calculated using four-year average of how 8760 hours in a year fall into the energy periods adjusted to 8766 hours to account for February 29th every four years.
[968] Assumes shift starts after 7 AM and ends before 11 PM in summer and winter on weekdays only. EPFs calculated using four-year average of how 8760 hours in a year fall into the energy periods adjusted to 8766 hours to account for February 29th every four years.
[969] 50/50 blend of Lighting Fixtures – Interior Spaces – Summer Seasonal – SBI and Lighting Fixtures – Exterior Spaces – Summer Seasonal.
[970] Analysis performed by ERS. Factors based on TMY3 solar radiation averaged for Portland, Lewiston-Auburn, Bangor and Presque Isle.
[971] Based on sunrise/sunset for Augusta, Maine. Sunrise and sunset for winter adjusted to shorten the day by two hours to account for generally cloudier days in Winter. EPFs calculated using four-year average of how 8760 hours in a year fall into the energy periods adjusted to 8766 hours to account for February 29th every four years.
[972] Peak coincidence factors for this measure are embedded in the evaluated peak demand impacts.
[973] Memo provided to supplement NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014.

Measure	End-Use	Coincidence Factor		Energy Period Factors				Footnote Reference	
		Winter On-Peak	Summer On-Peak	Winter		Summer		CF	EPF
				Peak	Off Peak	Peak	Off Peak		
Modulating Burner Controls for Boilers and Heaters (AF1)	HVAC	N/A	N/A	N/A	N/A	N/A	N/A	974	
Boiler Stack Heat Exchanger (Boiler Economizer) (AF2)	HVAC	N/A	N/A	N/A	N/A	N/A	N/A		
Boiler Reset/Lockout Controls (AF3)	HVAC	N/A	N/A	N/A	N/A	N/A	N/A		
Oxygen Trim for Boilers and Heaters (AF4)	HVAC	N/A	N/A	N/A	N/A	N/A	N/A		
Boiler Turbulator (AF5)	HVAC	N/A	N/A	N/A	N/A	N/A	N/A		
Programmable Thermostat non-Electric Heat (AF6)	HVAC	N/A	N/A	N/A	N/A	N/A	N/A		
Natural Gas Heating Equipment	HVAC	N/A	N/A	N/A	N/A	N/A	N/A		
Natural Gas Kitchen Equipment	Process	N/A	N/A	N/A	N/A	N/A	N/A		
Oil/Propane Boilers and Furnaces	HVAC	N/A	N/A	N/A	N/A	N/A	N/A		

[974] Measure applicable to non-electric savings only.

Appendix C: Carbon Dioxide Emission Factors

Table 55 – Emission Factors[975]

Carbon Dioxide (CO_2) Factors:	Pounds CO2 Per Unit of Volume or Mass		Kilograms CO2 Per Unit of Volume or Mass		Pounds CO2 Per Million Btu	Kilograms CO2 Per Million Btu
For homes and businesses						
Propane	12.68	gallon	5.75	gallon	138.63	62.88
Coal	4,027.93	Short ton	1,827.04	Short ton	211.06	95.74
Kerosene	21.78	gallon	9.88	gallon	161.35	73.19
Gasoline	19.37	Gallon	8.78	Gallon	155.77	70.66
Natural Gas	120.96	thousand cubic feet	54.87	thousand cubic feet	116.65	52.91
Home Heating and Diesel Fuel (Distillate)	22.46	gallon	10.19	gallon	163.45	74.14
Residual Heating Fuel (Businesses only)	24.78	gallon	11.24	gallon	165.55	75.09
Other fuels						
Municiple Solid Waste	5,771.04	short ton	2,617.70	short ton	91.90	41.69
Tire-derived fuel	5,961.03	short ton	2,703.88	short ton	189.54	85.97
Waste oil	22.51	gallon	10.21	gallon	163.14	74.00
Carbon Dioxide (CO2) Factors:					**Pounds CO2 Per kWh**	**Kilograms CO2 Per kWh**
Electricity[976]					0.706	0.320

[975]Carbon Dioxide Emissions Coefficients. U.S. Energy Information Administration - EIA - Independent Statistics and Analysis
[976] Table 5-3 Time-Weighted Marginal Emission Rate - All LMUs, Annual Average (All Hours), https://www.iso-ne.com/static-assets/documents/2022/05/2020_air_emissions_report.pdf

Appendix D: Parameter Values Reference Tables

Table 56 – Installation Labor Hours for Lighting Fixtures[977]

Description	Measure Code	Deemed Labor Hours
LED Outdoor Retrofit Kits <50W	S08	0.5
LED Outdoor Retrofit Kits >=50 - <100W	S08	0.5
LED Outdoor Retrofit Kits >=100 - <200W	S08	0.5
LED Outdoor Retrofit Kits >=200W	S08	0.5
LED Outdoor Parking Fixture <50W	S11	0.75
LED Outdoor Parking Fixture 50W - 100W	S11	0.75
LED Outdoor Parking Fixture 100W - 250W	S11	0.75
LED Outdoor Parking Fixture >250W	S11	0.75
LED Pole-Mounted Streetlight <50W	S11	0.75
LED Pole-Mounted Streetlight 50W - 100W	S11	0.75
LED Pole-Mounted Streetlight 100W - 250W	S11	0.75
LED Pole-Mounted Streetlight >250W	S11	0.75
LED Outdoor Wall Pack <30W	S13	0.75
LED Outdoor Wall Pack 30 - 60W	S13	0.75
LED Outdoor Wall Pack 60 - 100W	S13	0.75
LED Outdoor Wall Pack >100W	S13	0.75
LED Canopy/Parking Garage Fixture <50W	S17	0.75
LED Canopy/Parking Garage Fixture >=50 - <80W	S17	0.75
LED Canopy/Parking Garage Fixture >=80 - 130W	S17	0.75
LED Canopy/Parking Garage Fixture >=130W	S17	0.75
LED 5" Recessed Can Retrofit Kit	S21	0.5
LED 6-8" Recessed Can Retrofit Kit	S21	0.5

977 Installation labor hours established by the Efficiency Maine Lighting Advisory Group.

 ~~Appendix D: Parameter Values Reference Tables~~

Description	Measure Code	Deemed Labor Hours
LED Surface-Mounted Downlight	S21	0.5
LED Flood/Spot <50W	S23	0.75
LED Flood/Spot 50 - 100W	S23	0.75
LED Flood/Spot >100W	S23	0.75
LED Interior Flood/Spot <50W	S25	0.75
LED Interior Flood/Spot 50 - 100W	S25	0.75
LED Interior Flood/Spot >100W	S25	0.75
LED Refrigerated Caselight (Vertical) - 3' Fixture Center	S30	0.75
LED Refrigerated Caselight (Vertical) - 3' Fixture End	S30	0.75
LED Refrigerated Caselight (Vertical) - 4' Fixture Center	S30	0.75
LED Refrigerated Caselight (Vertical) - 4' Fixture End	S30	0.75
LED Refrigerated Caselight (Vertical) - 5' Fixture Center	S30	0.75
LED Refrigerated Caselight (Vertical) - 5' Fixture End	S30	0.75
LED Refrigerated Caselight (Vertical) - 6' Fixture Center	S30	0.75
LED Refrigerated Caselight (Vertical) - 6' Fixture End	S30	0.75
LED Refrigerated Caselight (Horizontal) - 3' Fixture	S32	1
LED Refrigerated Caselight (Horizontal) - 4' Fixture	S32	1
LED Refrigerated Caselight (Horizontal) - 5' Fixture	S32	1
LED Refrigerated Caselight (Horizontal) - 6' Fixture	S32	1
LED 2x2 Recessed Fixture <40W	S51	0.5
LED 2x2 Recessed Fixture >=40W	S51	0.5
LED 2x4 Recessed Fixture <50W	S51	0.5
LED 2x4 Recessed Fixture >=50W	S51	0.5
LED 1x4 Recessed Fixture <40W	S51	0.5

Description	Measure Code	Deemed Labor Hours
LED 1x4 Recessed Fixture >=40W	S51	0.5
Integrated Retrofit Kit for LED 2x2 Interior Fixture <40W	S52	0.5
Integrated Retrofit Kit for LED 2x2 Interior Fixture >=40W	S52	0.5
Integrated Retrofit Kit for LED 2x4 Interior Fixture <50W	S52	0.5
Integrated Retrofit Kit for LED 2x4 Interior Fixture >=50W	S52	0.5
Integrated Retrofit Kit for LED 1x4 Interior Fixture <40W	S52	0.5
Integrated Retrofit Kit for LED 1x4 Interior Fixture >=40W	S52	0.5
Linear Retrofit Kit for LED 2x2 Interior Fixture <40W	S52	0.5
Linear Retrofit Kit for LED 2x2 Interior Fixture >=40W	S52	0.5
Linear Retrofit Kit for LED 2x4 Interior Fixture <50W	S52	0.5
Linear Retrofit Kit for LED 2x4 Interior Fixture >=50W	S52	0.5
Linear Retrofit Kit for LED 1x4 Interior Fixture <40W	S52	0.5
Linear Retrofit Kit for LED 1x4 Interior Fixture >=40W	S52	0.5
LED High/Low Bay Fixture <100W	S61	1.0
LED High/Low Bay Fixture >=100 - <150W	S61	1.0
LED High/Low Bay Fixtures >=150 - <200W	S61	1.0
LED High/Low Bay Fixtures >=200 - <300W	S61	1.0
LED High/Low Bay Fixtures >=300W	S61	1.0
LED High/Low Bay Retrofit Kit <150W	S62	1.0
LED High/Low Bay Retrofit Kit >=150W	S62	1.0
Stairwell and Passageway Luminaires ≤ 30W	S70	0.75
Stairwell and Passageway Luminaires >30 W	S70	0.75
Linear Ambient <50W (Strip)	S81	0.5
Linear Ambient <50W (Wrap)	S81	0.5

Description	Measure Code	Deemed Labor Hours
Linear Ambient 50-100W	S81	0.5
Linear Ambient >100W	S81	0.5
Retrofit Kit for LED Direct Linear Ambient Luminaires <50W	S82	0.5
Retrofit Kit for LED Direct Linear Ambient Luminaires >= 50W - <100W	S82	0.5
Retrofit Kit for LED Direct Linear Ambient Luminaires >=100W	S82	0.5
Cooler Case Mounted Occupancy Sensor For LED Fixtures	L50	0.5
Fixture Mounted Occupancy Sensor	L60	0.5
Remote Mounted Occupancy Sensor	L70	1
Vacancy Sensor	L71	1

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 57 – Existing Fixture Rated Wattage Table ($Watts_{BASE}$)[978]

Description	Wattage	Description	Wattage	Description	Wattage	Description	Wattage
Halogen - 20W	20	LED High/Low Bay 100-<150W	123	PSMH - 400W	435	T8 - 1-Lamp 4' HPT8	28
Halogen - 50W	50	LED High/Low Bay 150-<200W	170	Replacement Lamps for High-Bay <120W	105	T8 - 1-Lamp 4' HPT8 (25&28 Watts)	24
HPS - 1000W	1100	LED High/Low Bay 200-<300W	233	Replacement Lamps for High-Bay >=120W	138	T8 - 1-Lamp 4' HPT8 HIGH LMN	39
HPS - 100W	138	LED High/Low Bay Retrofit Kit < 150W	108	Replacement Lamps for Low-Bay <80W	57	T8 - 1-Lamp 4' HPT8 LOW PWR	25
HPS - 150W	188	LED High/Low Bay Retrofit Kit >= 150W	180	Replacement Lamps for Low-Bay >=80W	99	T8 - 1-Lamp 4' T8	31
HPS - 200W	240	LED Kit (<50W)	38	Replacement Lamps Type A <50W	40	T8 - 1-Lamp 4' T8 HO	53
HPS - 225W	275	LED Kit (>=200W)	241	Replacement Lamps Type A >=50W	143	T8 - 1-Lamp 5' T8 HO	62
HPS - 250W	295	LED Kit (100W-<200W)	128	Retrofit Kit for LED Direct Linear Ambient Luminaires <50W	33	T8 - 1-Lamp 6' T8 HO	80
HPS - 310W	350	LED Kit (50-<100W)	73	Retrofit Kit for LED Direct Linear Ambient Luminaires ≥ 50W <100W	69	T8 - 2-Lamp 2' HPT8	37
HPS - 35W	45	LED Linear Ambient <50W	35	Retrofit Kit for LED Direct Linear Ambient Luminaires ≥100W	124	T8 - 2-Lamp 4' HPT8	53
HPS - 360W	435	LED Linear Ambient >100W	122	T12 - 1-Lamp 4' T12	41.7	T8 - 2-Lamp 4' HPT8 (25&28 Watts)	44
HPS - 400W	465	LED Linear Ambient 50-100W	71	T12 - 1-Lamp 4' T12 HO	84	T8 - 2-Lamp 4' HPT8 HIGH LMN	78
HPS - 50W	65	LED MR16	7	T12 - 1-Lamp 5' T12 HO	97	T8 - 2-Lamp 4' HPT8 LOW PWR	47
HPS - 600W	675	LED Outdoor Wall Pack: <30W	23	T12 - 1-Lamp 6' T12 HO	113	T8 - 2-Lamp 4' T8	59
HPS - 70W	95	LED PAR 20	9	T12 - 1-Lamp 8' T12	60.3	T8 - 2-Lamp 4' T8 HO	100
HPS - 750W	835	LED PAR 30	12	T12 - 2-Lamp 4' T12	70.7	T8 - 2-Lamp 5' T8 HO	116
Incandescent - 100W	100	LED PAR 38	22	T12 - 2-Lamp 4' T12 HO	131	T8 - 2-Lamp 6' T8 HO	136
Incandescent - 40W	40	LED R	38	T12 - 2-Lamp 5' T12 HO	170	T8 - 2-Lamp U T8	60
Incandescent - 60W	60	LED Retrofit Kit 1x4<40W	26	T12 - 2-Lamp 6' T12 HO	193	T8 - 3-Lamp 2' HPT8	53
Incandescent - 65W	65	LED Retrofit Kit 1x4>=40W	49	T12 - 2-Lamp 8' T12	120.6	T8 - 3-Lamp 4' HPT8	77
Incandescent - 75W	75	LED Retrofit Kit 2x2<40W	28	T12 - 2-Lamp 8' T12 HO	197.9	T8 - 3-Lamp 4' HPT8 (25&28 Watts)	67

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

Description	Wattage	Description	Wattage	Description	Wattage	Description	Wattage
LED 1x4 Recessed Fixture <40W	31	LED Retrofit Kit 2x2>=40W	46	T12 - 2-Lamp U T12	72.5	T8 - 3-Lamp 4' HPT8 HIGH LMN	112
LED 1x4 Recessed Fixture >=40W	47	LED Retrofit Kit 2x4<50W	36	T12 - 3-Lamp 4' T12	112.3	T8 - 3-Lamp 4' HPT8 LOW PWR	73
LED 2' LED Lamp T8	11.2	LED Retrofit Kit 2x4>=50W	53	T12 - 4-Lamp 4' T12	141.2	T8 - 3-Lamp 4' T8	89
LED 2x2 Recessed Fixture <40W	31	LED RH	2.4	T5 - 10-Lamp 4' T5 HO	588	T8 - 4-Lamp 2' HPT8	62
LED 2x2 Recessed Fixture >=40W	47	MH - 1000W	1077	T5 - 1-Lamp 4' T5	32	T8 - 4-Lamp 4' HPT8	101
LED 2x4 Recessed Fixture <50W	39	MH - 100W	128	T5 - 1-Lamp 4' T5 HO	56	T8 - 4-Lamp 4' HPT8 (25&28 Watts)	88
LED 2x4 Recessed Fixture >=50W	64	MH - 150W	190	T5 - 2-Lamp 4' T5	63	T8 - 4-Lamp 4' HPT8 HIGH LMN	156
LED 4' LED Lamp T5	19	MH - 175W	215	T5 - 2-Lamp 4' T5 HO	117	T8 - 4-Lamp 4' HPT8 LOW PWR	93
LED 4' LED Lamp T5HO	29	MH - 200W	232	T5 - 3-Lamp 4' T5 HO	177	T8 - 4-Lamp 4' T8	112
LED 4' LED Lamp T8	18.7	MH - 250W	288	T5 - 4-Lamp 4' T5 HO	234	T8 - 6-Lamp 4' HPT8	154
LED 4' LED Lamp T8 U-Bend	16	MH - 400W	458	T5 - 5-Lamp 4' T5 HO	294	T8 - 6-Lamp 4' HPT8 HIGH LMN	224
LED A	10	PSMH - 100W	118	T5 - 6-Lamp 4' T5 HO	351	T8 - 6-Lamp 4' HPT8 LOW PWR	134
LED D	12	PSMH - 150W	170	T5 - 8-Lamp 4' T5 HO	468	T8 - 8-Lamp 4' HPT8	202
LED High/Low Bay < 100W	74	PSMH - 200W	219	T8 - 10-Lamp 4' HPT8	279	T9 - Circline Fuorescent	32
LED High/Low Bay >= 300W	418	PSMH - 320W	349	T8 - 1-Lamp 2' HPT8	17		

Table 58 – Seasonal Hours Adjustments[979]

Seasonalilty	Year Round	Summer	Winter
Begin	1/1	6/1	11/1
End	12/31	10/31	3/31
Energy Period	**Hours/y**	**Hours/y**	**Hours/y**
Winter Peak	2,616	344	1,604
Winter Off-Peak	3,222	400	2,026
Summer Peak	1,356	1,356	0
Summer Off-Peak	1,572	1,572	0
Total Annual Hours	8,766	3,672	3,630
Seasonal Hours Factor	100.0%	41.9%	41.4%

[979] Based on total hours in each energy period using 2018 calendar.

Table 59 – Reference Lighting Annual Operating Hours by facility and space type[980]

Space Type	Facility Type: Health			Lodging/ Residences			Manufacturing/ Industrial				Dining/ Drinking			Retail				Schools		All Others											
	Health Care - Hospital	Health Care - Outpatient	Health Care - Assisted/Nursing	Apartments / Condos 5+ Units	Hotel/Motel	University - Dormitory	Manufacturing (1 Shift)	Manufacturing (2 shifts)	Manufacturing (3 shifts)	Other Industrial - USER DEFINED	Restaurant - Fast Food	Restaurant - Casual Dining	Bar/Lounge	Retail - General	Retail - Convenience Store	Retail - Chain Stores	Retail - Grocery Store	School(K-12)	University	Office Building	Assembly	Family Entertainment Centers	Movie Theaters	Fitness Center	Religious	Warehouse	Automotive Facility (Sales & Service)	Correctional	Fire/Police/Public Safety	Municipal/Government	Other Commercial - USER DEFINED
Assembly	2,080	N/A	2,912	N/A	N/A	600	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,600	2,400	2,040	1,064	1,952	1,954	5,836	1,955	N/A	4,056	5,477	1,872	2,400	
Break_Room	5,096	2,550	3,640	N/A	2,912	1,600	1,257	2,514	3,771		2,496	2,496	2,496	1,802	1,802	2,514	2,514	1,303	1,303	1,829	884	1,562	1,456	2,514	391	2,918	1,257	2,912	7,655	2,400	
Cafeteria	3,640	2,550	3,640	N/A	3,640	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	2,356	3,024	2,550	375	N/A	N/A	N/A	N/A	1,775	N/A	3,640	N/A	N/A	
Classroom	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	4,842	4,842	N/A	N/A	1,429	1,800	NA	596	N/A	N/A	N/A	715	N/A	N/A	900	N/A	N/A	
Conference	675	2,040	2,600	N/A	2,550	480	1,671	3,342	5,013		N/A	N/A	N/A	1,018	1,018	3,342	3,342	1,221	1,800	971	488	1,456	1,456	624	600	1,277	1,671	2,184	1,456	1,680	
Dining	3,640	N/A	3,640	N/A	3,640	N/A	N/A	N/A	N/A		4,452	3,120	3,213	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,952	N/A	N/A	416	N/A	N/A	3,640	2,912	960	
Equipment/Engineering Space	975	1,560	1,560	N/A	1,560	1,680	765	1,020	2,040		2,448	2,448	2,448	2,034	2,034	2,448	2,448	1,560	2,448	2,064	707	976	1,563	1,456	1,560	2,295	780	4,368	2,184	1,560	
Exterior	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380		4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	4,380	
Gym/Fitness	3,640	2,040	2,912	2,856	2,912	N/A	N/A	N/A	N/A		N/A	N/A	N/A	6,566	6,566	N/A	N/A	2,545	3,360	NA	101	N/A	N/A	5,712	N/A	N/A	N/A	3,640	2,184	N/A	
Hallway_or_Corridor	8,640	3,570	8,766	8,640	8,766	3,066	2,995	5,877	8,766		4,896	3,427	N/A	2,262	2,262	5,877	5,877	3,598	3,598	1,914	1,424	1,952	586	3,598	1,955	2,483	2,995	8,766	7,655	2,400	
Kitchen	4,368	3,120	4,368	2,912	4,368	2,240	1,936	3,872	5,808		5,081	3,557	3,213	1,737	1,737	3,872	3,872	1,626	1,626	3,000	1,308	1,562	1,759	N/A	978	1,925	1,936	5,081	3,640	N/A	
Library	N/A	N/A	3,640	1,820	N/A	3,920	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,767	3,024	N/A	1,782	N/A	N/A	N/A	978	N/A	N/A	3,920	N/A	2,400	
Office_Closed	1,291	1,291	1,291	1,785	2,250	1,671	1,620	3,240	4,860		2,448	2,448	2,448	2,449	2,449	3,240	3,240	1,444	1,444	1,671	678	1,366	586	4,377	782	1,994	1,620	2,250	2,496	2,400	
Office_Open	2,455	2,455	2,455	1,785	2,250	2,240	2,334	4,668	7,002		2,448	2,448	2,448	3,417	3,417	4,668	4,668	2,338	2,338	2,378	2,734	1,562	1,563	1,459	782	2,758	2,334	2,250	3,640	2,400	
Other - User defined																															
Production	N/A	N/A	N/A	N/A	N/A	N/A	2,959	5,918	8,640		N/A	N/A	N/A	2,897	2,897	5,918	5,918	NA	NA	1,972	N/A	N/A	N/A	N/A	N/A	3,351	2,959	N/A	N/A	N/A	
Restroom	685	685	685	2912	267	685	431	862	1,293		3,212	3,212	3,212	587	587	862	862	1,515	1,515	1,212	873	1,171	1,563	5,712	1,955	1,140	431	3,640	3,276	1,680	
Retail	2,716	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	4,284	4,284	4,284	4,284	N/A	N/A	3,558	3,184	N/A	N/A	N/A	N/A	N/A	3,120	N/A	N/A	N/A	
Storage	984	984	984	1,456	17	1,420	927	1,854	2,781		3,077	510	714	1,801	1,801	1,854	1,854	1,420	1,420	992	401	586	728	2,918	1,560	1,516	927	714	2,184	960	
Warehouse	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	2,550	2,550	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2,918	N/A	2,295	4,056	N/A	N/A	1,920	
Lobby_or_Concierge	8,766	3,570	8,766	8,766	8,766	5,950	2,295	2,295	2,295		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3,570	N/A	1,952	1,954	5,836	1,955	2,295	2,295	8,766	6,124	2,400	
Sleeping_or_Living_Spaces	N/A	N/A	5,096	5,460	2,600	3,066	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5,477	3,828	N/A	
Nurses_Station	8,640	3,000	8,640	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Patient_Rooms	2,912	N/A	2,912	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Treatment_Rooms	3,640	2,600	2,600	N/A	N/A	N/A	N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

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

 ~~Appendix D: Parameter Values Reference Tables~~

Table 60 – Savings Factors for Lighting Controls

Commercial/Industrial	
Space Type	**% of Annual Lighting Energy Saved (SVG)[A]**
Assembly	0.25
Break Room	0.2
Cafeteria	0.25
Classroom	0.3
Conference	0.45
Cooler/Freezer Case	0.31
Dining	0.25
Equipment/Engineering Space	0.25
Gym/Fitness	0.35
Hallway/Corridor	0.15
Kitchen	0.25
Library	0.25
Lobby or Concierge	0.25
Nurses_Station	0.25
Office_Closed	0.3
Office_Open	0.15
Other - User defined	0.25
Patient_Rooms	0.25
Production	0.25
Restroom	0.4
Retail_Space	0.25

Commercial/Industrial	
Space Type	**% of Annual Lighting Energy Saved (SVG)[A]**
Sleeping/Living Spaces	0.25
Storage	0.55
Treatment_Rooms	0.25
Warehouse	0.5

[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 61 – Wattage and Savings by Bulb Type for Distributor Channel[981]

Bulb Type	Measure Codes	Baseline Wattage	Efficient Wattage	$\Delta Watts_{LED}$	Energy and Demand Savings with Interactive Effects							
					Electricity	Winter	Summer	Natural Gas	Propane	Wood	Kerosene	Oil
					kWh/y	kW	kW	MMBtu	MMBtu	MMBtu	MMBtu	MMBtu
Specialty LED - Candelabra	LEDSPCCDDL	47	5	42	73	0.011	0.014	-0.010	-0.006	-0.012	-0.002	-0.048
Specialty LED - R20	LEDR20	36	7	29	50	0.007	0.010	-0.007	-0.004	-0.008	-0.001	-0.033
Specialty LED - MR16	LEDMR16	36	6	30	52	0.008	0.010	-0.007	-0.004	-0.008	-0.001	-0.034
Specialty LED - Globe	LEDGlobe	36	5	31	54	0.008	0.010	-0.007	-0.004	-0.009	-0.001	-0.036
Specialty LED - BR30	LEDBR30	42	9	33	57	0.008	0.011	-0.008	-0.004	-0.009	-0.001	-0.038
Specialty LED - PAR16	LEDPAR16	42	6	36	62	0.009	0.012	-0.008	-0.005	-0.010	-0.002	-0.041
Specialty LED - PAR20	LEDPAR20	59	6	53	92	0.013	0.018	-0.012	-0.007	-0.015	-0.002	-0.061
Specialty LED - PAR30	LEDPAR30	59	12	47	81	0.012	0.016	-0.011	-0.006	-0.013	-0.002	-0.054
Specialty LED - PAR38	LEDPAR38	84	14	70	121	0.018	0.023	-0.016	-0.009	-0.020	-0.003	-0.080
Specialty LED - BR40	LEDBR40	84	14	70	121	0.018	0.023	-0.016	-0.009	-0.020	-0.003	-0.080
Linear LED 2 ft Type A	S110A2L	17	9	8	25	0.003	0.006	-0.011	-0.003	-0.002	0.000	-0.011
Linear LED 4 ft Type A T8 Replacement	S110A4L	31	16	15	47	0.006	0.010	-0.020	-0.005	-0.005	-0.001	-0.020
LED Replacement Lamps T5 (Type A)	S111A	32	16	16	50	0.006	0.011	-0.021	-0.005	-0.005	-0.001	-0.021
LED Replacement Lamps T5HO (Type A)	S111AHO	58	28	30	93	0.011	0.021	-0.039	-0.009	-0.009	-0.002	-0.040
LED Replacement Lamps T8 U-Bend (Type A)	S111AU	31	17	14	43	0.005	0.010	-0.018	-0.004	-0.004	-0.001	-0.019
4' LED Lamp T8/Type C Kit (2 Lamp/1 external driver)	S110C42	62	28	34	106	0.013	0.024	-0.044	-0.011	-0.010	-0.002	-0.045
4' LED Lamp T8/Type C Kit (3 Lamp/1 external driver)	S110C43	93	44	49	142	0.018	0.025	-0.007	-0.01	-0.03	-0.005	-0.114
4' LED Lamp T8/Type C Kit (4 Lamp/1 external driver)	S110C44	124	45	79	245	0.029	0.055	-0.103	-0.025	-0.024	-0.004	-0.105

[981] Weighted average wattage and equivalent baseline wattage for program lamps April – June 2022. Savings calculated with delta watts and assumptions defined in TRM measure entries for hours of use, waste heat factors, and coincidence factors, and fuel distribution in Table 63.

Bulb Type	Measure Codes	Baseline Wattage	Efficient Wattage	$\Delta Watts_{LED}$	Energy and Demand Savings with Interactive Effects							
					Electricity	Winter	Summer	Natural Gas	Propane	Wood	Kerosene	Oil
					kWh/y	kW	kW	MMBtu	MMBtu	MMBtu	MMBtu	MMBtu
LED Low Bay Mogul Screw-Base Low Output	S64BCLLL	295	77	218	677	0.081	0.151	-0.285	-0.069	-0.066	-0.011	-0.289
LED Low Bay Mogul Screw-Base High Output	S64BCLHL	363	80	283	878	0.105	0.196	-0.370	-0.089	-0.086	-0.014	-0.375
LED High Bay Mogul Screw-Base Low Output	S64BCHLL	295	83	212	658	0.079	0.147	-0.277	-0.067	-0.064	-0.011	-0.281
LED High Bay Mogul Screw-Base High Output	S64BCHHL	463	134	329	1021	0.122	0.228	-0.430	-0.104	-0.099	-0.017	-0.436
Outdoor Mogul Screw-Base Low Output	S6BLL, S6CLL	144	36	108	459	0.089	0.007	0.000	0.000	0.000	0.000	0.000
Outdoor Mogul Screw-Base Medium Output	S6BML, S6CML	296	66	230	977	0.190	0.015	0.000	0.000	0.000	0.000	0.000
Outdoor Mogul Screw-Base High Output	S6BHL, S6CHL	458	115	343	1457	0.283	0.023	0.000	0.000	0.000	0.000	0.000

Table 62 – Measure Cost and Avoided O&M by Bulb Type for Distributor Channel[982]

Bulb Type	Measure Codes	Baseline Retail Price	Average Efficient Product Retail Price Before Incentive	Incremental First Cost	Measure Life	Avoided O&M
Specialty LED - Candelabra	**LEDSPCCDDL**	$1.12	$11.99	$10.87	3	$2.31
Specialty LED - R20	**LEDR20**	$4.15	$3.91	$0[A]	1	$0.85
Specialty LED - MR16	**LEDMR16**	$4.41	$11.49	$7.08	1	$0.90
Specialty LED - Globe	**LEDGlobe**	$1.24	$9.00	$7.76	3	$2.55
Specialty LED - BR30	**LEDBR30**	$3.86	$6.52	$2.66	1	$0.79
Specialty LED - PAR16	**LEDPAR16**	$4.99	$12.53	$7.54	1	$1.02
Specialty LED - PAR20	**LEDPAR20**	$3.90	$7.26	$3.36	1	$0.80

[982] Cost values based on weighted average pre-incentivized distributor costs from program sales data April – June 2022 for efficient cost. Baseline cost sources are CREED 2021, and shelf surveys. Measure life based on rated hours and assumed hours of use for lamps not subject to EISA. An equivalent measure life has been defined for bulbs where market transformation beyond program influence is likely to replace the baseline technology. Yearly sales by lamp technology are modeled and the savings against an evolving baseline calculated. Equivalent measure life is set to the nvp of the yearly savings divided by the first-year savings. Because the efficient measure has a longer effective life than the baseline measure, future replacement costs are avoided. The avoided O&M cost is based on the NPV of avoided replacement costs for baseline products throughout the lifetime of the efficient products taking market transformation into account. No labor costs have been included. See Table 66 for baseline bulb replacement schedule.

Specialty LED - PAR30	**LEDPAR30**	$4.17	$9.88	$5.71	1	$0.85
Specialty LED - PAR38	**LEDPAR38**	$4.50	$13.40	$8.90	1	$0.92
Specialty LED - BR40	**LEDBR40**	$4.74	$9.12	$4.38	1	$0.97
Linear LED 2 ft Type A	**S110A2L**	$1.95	$10.40	$8.45	16	$1.61
Linear LED 4 ft Type A T8 Replacement	**S110A4L**	$2.90	$10.38	$7.48	16	$2.39
LED Replacement Lamps T5 (Type A)	**S111A**	$2.04	$12.89	$10.85	16	$1.68
LED Replacement Lamps T5HO (Type A)	**S111AHO**	$2.72	$13.59	$10.87	16	$2.24
LED Replacement Lamps T8 U-Bend (Type A)	**S111AU**	$5.59	$15.55	$9.96	16	$4.61
4' LED Lamp T8/Type C Kit (2 Lamp/1 external driver)	**S110C42**	$8.05	$21.83	$13.78	16	$6.64
4' LED Lamp T8/Type C Kit (3 Lamp/1 external driver)	**S110C43**	$9.41	$30.53	$21.12	16	$7.76
4' LED Lamp T8/Type C Kit (4 Lamp/1 external driver)	**S110C44**	$10.77	$39.23	$28.46	16	$8.88
LED Low Bay Mogul Screw-Base Low Output	**S64BCLLL**	$43.41	$150.60	$107.19	16	$70.75
LED Low Bay Mogul Screw-Base High Output	**S64BCLHL**	$59.14	$185.00	$125.86	16	$96.38
LED High Bay Mogul Screw-Base Low Output	**S64BCHLL**	$55.33	$153.93	$98.60	16	$90.17
LED High Bay Mogul Screw-Base High Output	**S64BCHHL**	$59.95	$206.93	$146.98	16	$97.70
Outdoor Mogul Screw-Base Low Output	**S6BLL, S6CLL**	28.97	$70.31	$41.34	12	$49.82
Outdoor Mogul Screw-Base Medium Output	**S6BML, S6CML**	$48.70	$87.01	$38.31	12	$83.75
Outdoor Mogul Screw-Base High Output	**S6BHL, S6CHL**	$91.66	$186.55	$94.89	12	$157.62

[A] LEDR20 lamps have an average price before rebate less than the average price for baseline R20 reflector bulbs. The incremental cost has been overridden to $0.

Table 63 – Distribution of Heating Fuel

Measure	Fuel Distribution for "Unknown"						Footnote Reference
	Natural Gas	Propane	Oil	Kerosene	Wood	Electricity	
Lighting Interactive Effects, Commercial Interior	38.9%	9.4%	39.5%	1.5%	9.0%	1.7%	983
Lighting Interactcive Effects, Distributor Screw-in	12.1%	7.2%	61.3%	2.3%	14.9%	2.2%	
HPHP, Multifamily Retrofit HP Backup Heat	23%	9%	48%	0%	0%	20%	984
Multifamily Lost Opportunity HP Backup Heat	6%	20%	43%	2%	25%	4%	985
Variable Refrigerant Flow, and Insulation, Unknown fuel type	42%	16%	23%	0%	0%	19%	986

[983] Derived from NMR, 2015 Residential Baseline Study based on primary heating system adjusted for commercial applications and Demand Side Analytics, Retail and Distributor Lighting Evaluation, March 2021.
[984] Based on program data for projects completed between 1/1/2021 and 6/30/2021.
[985] Heat Pump Survey data collected May 2020 through April 2021 on what additional heating sources were used in conjunction with the HP.
[986] Based on program data for projects completed between 7/1/2021 and 5/31/2022.

Table 64 – Ventilation Rates (CFM/ft²)[987]

Space Type	Ventilation Rate	Space Type	Ventilation Rate
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

[987] 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	Ventilation Rate	Space Type	Ventilation Rate
Gambling casinos	1.08	Spectator areas	1.19
Game arcades	0.33	Sports arena (play area)	0.3
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 65 – Refrigeration Bonus Factors

		Temperature		
Measures	**Bonus Factor**	**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).

Table 66 - Baseline Bulb Replacement Schedule and Avoided O&M

Commercial Hours/Year	Residential Hours/Year
3771	730
Outdoor Hours/Year	Real Discount Rate
4380	2.80%

	Distributor		Commercial		Outdoors
Life Category					
Rated Hours	25,000	15,000	50,000	50,000	50,000
% Commercial	69%	69%	100%	100%	100%
Hours/Year	2828.29	2828.29	3771	3771	4380
Rated Life (Years)	9	5	13	13	11
Baseline Rated Hours	2000	2000	30000	15000	15000
Baseline Rated Life (Years)	0.71	0.71	7.96	3.98	3.42
Baseline bulbs per EE life	12	6	1	2	2
Check	12	6	1	2	2
NPV of Bulbs	10.48	5.53	0.82	1.63	1.72

Baseline Replacement Schedule: Number of Bulbs Replaced per year					
Year	Dis25_2	Dis15_2	Com50_30	Com50_15	Out50_15
1	2	1	0	0	0
2	1	1	0	0	0
3	1	2	0	0	0
4	1	1	0	0	1
5	2	1	0	1	0
6	1		0	0	0
7	1		1	0	1
8	1		0	0	0
9	2		0	0	0
10			0	1	0
11			0	0	0
12			0	0	
13			0	0	

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. For cooling, applicability is calculated as the product of % of bulbs installed in interior sockets (%I) and the % of buildings with mechanical cooling (%A/C) (%A = %I*%A/C). For heating demand, applicability is calculated as the product of % of bulbs installed in interior sockets (%I) and the % of buildings with heat pumps providing heating (%HP) (%A = %I*%HP).

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 67 – Interactive Effects Input Factors and resulting IE Factors[988]

Sector	Mode	Resource	IGC	% Applicability	Concurrency	Eff_{HVAC}	IE Value
Residential	Cool	Demand	60.0%	59.7%	68.2%	400.0%	1.0611
Residential	Cool	Energy	60.0%	59.7%	9.7%	400.0%	1.0086
Residential	Heat	Demand	60.0%	6.0%	100.0%	300.0%	0.9879
Residential	Heat	Energy	60.0%	80.6%	75.9%	97.0%[989]	0.0013
Commercial Interior	Cool	Demand	55.0%	62.5%	95.1%	437.6%	1.0747
Commercial Interior	Cool	Energy	55.0%	62.5%	28.3%	437.6%	1.0222
Commercial Interior	Heat	Demand	55.0%	2.1%	100.0%	259.1%	0.9955
Commercial Interior	Heat	Energy	55.0%	84.6%	54.5%	81.4%	0.0011
Blended Interactive Effects by Program							
Retail Lighting						IE_COOL_D	1.0620
Retail Lighting						IE_COOL_E	1.0095
Retail Lighting						IE_HEAT_D	0.9884
Retail Lighting						IE_HEAT_E	0.0013
Distributor Lighting Screw-In						IE_COOL_D	1.0667
Distributor Lighting Screw-In						IE_COOL_E	1.0142
Distributor Lighting Screw-In						IE_HEAT_D	0.9910
Distributor Lighting Screw-In						IE_HEAT_E	0.0012

988 Demand Side Analytics, Retail and Distributor Lighting Evaluation, March 2021.
989 The HVAC efficiency term is a weighted average of electric heat pumps (300% efficient) and fossil fuel systems (80.5% efficient)

Table 68 – Realization Rate Adjusted Coincidence Factors for Prescriptive Non-Lighting Measures[990]

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%	991	73.7%	95.9%	14.6%	48.7%
SFP Prescriptive Variable Frequency Drives (VFD) for HVAC	19.8%	50.8%	991~~992~~	73.7%	95.9%	14.6%	48.7%
RFA Prescriptive Variable Frequency Drives (VFD) for HVAC	28.5%	71.2%	991~~992~~	73.7%	95.9%	21.0%	68.3%
RFP Prescriptive Variable Frequency Drives (VFD) for HVAC	28.5%	71.2%	991~~992~~	73.7%	95.9%	21.0%	68.3%
BEF Prescriptive Variable Frequency Drives (VFD) for HVAC	100.0%	37.0%	991~~992~~	73.7%	95.9%	73.7%	35.5%
CWP Prescriptive Variable Frequency Drives (VFD) for HVAC	0.0%	90.2%	991~~992~~	73.7%	95.9%	0.0%	86.5%
HHWP Prescriptive Variable Frequency Drives (VFD) for HVAC	100.0%	0.0%	991~~992~~	73.7%	95.9%	73.7%	0.0%
DCVE, DCVN Prescriptive HVAC: Demand Control Ventilation	2.0%	81.0%	992	73.7%	95.9%	1.5%	77.7%
VRF<*> Prescriptive HVAC: Variable Refrigerant Flow	57.0%	37.2%	993	73.7%	95.9%	42.0%	35.7%
AH1-AH3, WH Heat Pump Systems (< 11.25 tons)	57.0%	37.2%	994	73.7%	95.9%	42.0%	35.7%
Heat Pump Systems (≥ 11.25 tons)	57.0%	29.0%	994~~995~~	73.7%	95.9%	42.0%	27.8%

[990] RR_D used to adjust Summer and Winter CF to account for BIP program evalution findings. Nexant, Business Incentive Program Impact Evaluation, November 11, 2017.
[991] 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.
[992] Central Maine Power, Non-residential load profile for 3/1/08-2/28/09.
[993] KEMA, NEEP Unitary HVAC AC Load Shape Project Final Report, June 2011.
[994] 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
R10 Prescriptive Refrigeration: Evaporator Fan Motor Control for Cooler/Freezer	45.9%	43.0%	995	73.7%	95.9%	33.8%	41.2%
R20 Prescriptive Refrigeration: Door Heater Controls for Cooler/Freezer	100.0%	100.0%	996	73.7%	95.9%	73.7%	95.9%
R30, R31 Prescriptive Refrigeration: Zero Energy Doors for Coolers/Freezers	100.0%	100.0%	997	73.7%	95.9%	73.7%	95.9%
R40, R41, R42 Prescriptive Refrigeration: High-Efficiency Evaporative Fan Motors	100.0%	100.0%	997998	73.7%	95.9%	73.7%	95.9%
R50, R51, R52 Prescriptive Refrigeration: Floating-Head Pressure Controls	100.0%	0.0%	998	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%	999	73.7%	95.9%	50.9%	74.0%
R80 Prescriptive Refrigeration: ENERGY STAR® Reach-in Coolers and Freezers	69.0%	77.2%	9991000	73.7%	95.9%	50.9%	74.0%
R90 Prescriptive Refrigeration: ENERGY STAR® Commercial Ice Makers	69.0%	77.2%	9991000	73.7%	95.9%	50.9%	74.0%

995 Efficiency Vermont TRM 2012, Evaporator Fan Control.
996 Efficiency Vermont TRM 2012, Door Heater Control.
997 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.
998 Efficiency Vermont TRM 2012, Floating-Head Pressure Control.
999 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
VP<X> Prescriptive Agricultural: Adjustable Speed Drives for Dairy Vacuum Pumps	63.4%	28.7%	1000	73.7%	95.9%	46.7%	27.5%
AMSC<X> Prescriptive Agricultural: Scroll Compressors	91.5%	34.1%	1001	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%	1002	73.7%	95.9%	73.7%	0.0%
AOLSF Prescriptive Agricultural: High-Volume Low-Speed Fans	91.5%	34.0%	10021003	73.7%	95.9%	67.4%	32.6%
C1–C4 Prescriptive Compressed Air: High-Efficiency Air Compressors	95.0%	95.0%	1003	73.7%	95.9%	70.0%	91.1%
C10–C16 Prescriptive Compressed Air: High-Efficiency Dryers	95.0%	95.0%	10031004	73.7%	95.9%	70.0%	91.1%
C20–C27 Prescriptive Compressed Air: Receivers	95.0%	95.0%	10031004	73.7%	95.9%	70.0%	91.1%
C30–C33 Prescriptive Compressed Air: Low Pressure Drop Filters	95.0%	95.0%	10031004	73.7%	95.9%	70.0%	91.1%
C40 Prescriptive Compressed Air: Air-Entraining Nozzles	95.0%	95.0%	10031004	73.7%	95.9%	70.0%	91.1%

[1000] Efficiency Vermont TRM 2012, VFD Milk Vacuum Pump.
[1001] Efficiency Vermont TRM 2012, Dairy Farm Combined End Uses.
[1002] Savings are realized 24/7 Dec 1 – April 30.
[1003] Efficiency Vermont TRM 2012, page 13.