Residential

Technical Reference Manual

Version 2015.1

Effective Date: July 1, 2014

Efficiency Maine Trust
168 Capitol Street
Augusta, ME 04333
866-376-2463
efficiencymaine.com

Table of Contents

Introduction

PURPOSE

The Efficiency Maine Trust Residential and Commercial 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 ISO-NE Forward Capacity Market participation.

GENERAL FORMAT

The Residential TRM is organized by program area and then by measure category, where a measure category may include one or more measures. Each measure category is presented in its own section as a measure characterization, which follows 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, the Trust 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 program databases track and record the number of units of a given measure delivered through the program.
- ***Meter-level savings:*** Savings are assumed to be the savings 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 only for those measures for which 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 which are installed or implemented.

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

- ***Deemed savings value vs. deemed savings algorithm:*** Most residential measures have deemed savings values 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.

  The TRM may include some measures with deemed savings algorithms, for which 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, measure-specific data recorded in the relevant program tracking database will be used in combination with the TRM deemed parameters to compute savings.

- ***Project-specific ("Actual") data for Parameter Inputs****:* The savings methods for some 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 is 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 is used.

- ***Decision type*:** The decision 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.[1]

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	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	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 CFL and LED bulbs due to changes in Federal Standards for lighting products under the Energy Independence & Security Act of 2007 (EISA).

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

SAVINGS FORMULAS

The formulas and inputs used to calculate the deemed gross annual energy (ΔkWh/yr) and gross demand (ΔkW) savings for each measure are described in the measure sections. The formulas used to calculate adjusted gross savings, on-peak demand savings, and lifetime savings are described below:

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:

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

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

[1] 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. <http://www.epa.gov/eeactionplan>

Adjusted Gross Annual MMBtu[2] = ΔMMBtu/yr × ISR × RR_E

Adjusted Gross Lifetime MMBtu[2] = ΔMMBtu/yr × ISR × RR_E × Measure Life

Adjusted Gross Summer On-Peak kW = ΔkW × ISR × RR_D × CF_S

Adjusted Gross Winter On-Peak kW = ΔkW × ISR × RR_D × CF_W

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

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 and spillover to the adjusted gross savings.

Net Annual kWh = ΔkWh/yr × ISR × RR_E × (1 – FR + SO)

Net Lifetime kWh = ΔkWh/yr × ISR × RR_E × (1 – FR + SO) × Measure Life

Net Summer On-Peak kW = ΔkW × ISR × RR_D × CF_S × (1 – FR + SO)

Net Winter On-Peak kW = ΔkW × ISR × RR_D × CF_W × (1 – FR + SO)

**The parameter (1 - FR + SO) may be replaced with the net-to-gross (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.

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

TRM Updates from PY2014

Change Type	TRM Section	Description	Effective Date
PY2014 Addendum			
Revision	Table B-1: Coincidence Factors and Energy Period Factors	Added coincidence and energy period factors for the new ductless heat pump and ductless heat pump retrofit measures to existing Table	11/12/2013
New	Ductless Heat Pump	New measure section for Ductless Heat Pump	11/12/2013
Revision	CFL Bulb, LED Bulb	-Updated savings algorithm and savings values to account for evaluation findings indicating a share of retail lighting program measures being used in commercial settings	7/1/2013
PY2015 Updates			
Revision	CFL Bulb, LED Bulb	-Updated savings to include new EISA update for PY2015	7/1/2014
Revision	Refrigerator, Freezer, Dehumidifier	-Updated energy and demand savings based on new evaluation results and a baseline adjustment. -Updated Coincidence Factors to be consistent with updated peak demand savings -Updated free-ridership (FR) and spillover (SO) using new evaluation results	7/1/2014
Revision	Room Air Conditioner	-Updated energy and demand savings using a new baseline condition accounting for new code standard -Updated free-ridership (FR) and spillover (SO) using new evaluation results	7/1/2014
Revision	Room Air Purifier	-Updated free-ridership (FR) and spillover (SO) using new evaluation results	7/1/2014
Revision	Clothes Washer, Dishwasher	-Updated distribution of water heater fuels based on new evaluation results -Updated free-ridership (FR) and spillover (SO) using new evaluation results (the values for the dishwasher measure were based on overall program weighted average)	7/1/2014
Revision	effRT schedules (Appliance Rebate and Retail Lighting Programs)	Savings, Pricing and Factor schedules in effRT updated to reflect 2014 TRM values and formulas.	7/1/2014
Revision	High Efficiency Electric Water Heater	Temperature setpoint of the water heater was updated based on recent evaluation results	7/1/2014
Revision	Heat Pump Water Heater	-Updated savings based on a Heat Pump Water Heaters Field Evaluation report -Updated free-ridership (FR) and spillover (SO) using new evaluation results	7/1/2014
Revision	Table B-1: Coincidence Factors	-Updated Coincidence Factors for the following measures: CFL Bulb, LED Bulb, Refrigerator, Freezer, Dehumidifier, Clothes Washer, Heat Pump Water Heater -Added Coincidence Factors for all newly added measures	7/1/2014

Revision	Table B-1: Energy Period Factors	-Updated Energy Period Factors for the following measures: CFL Bulb, LED Bulb, Refrigerator, Freezer, Dehumidifier, Clothes Washer, Heat Pump Water Heater -Added Energy Period Factors for all newly added measures	7/1/2014
Revision	Ductless Heat Pump	Energy/demand impacts, description of methodology, coincidence factors, and energy period factors for the Ductless Heat Pump measure (added to the TRM as a PY2014 addendum) were updated based on a revised savings model.	7/1/2014
New	Direct Install CFL Bulb	New measure section for Direct Install CFL in Low Income Program	7/1/2014
New	Ductless Heat Pump Retrofit	New measure section for Ductless Heat Pump Retrofit in Low Income Program	7/1/2014
New	Low Income Multifamily Gas Heat , Furnaces and Boilers, Furnace and Boiler Retrofit	New measure sections for heating measures: Low Income Multifamily Gas Heat, Furnaces and Boilers, Furnace and Boiler Retrofit	7/1/2014
New	Home Energy Savings Program	New measure sections for the following measures: Custom Path, Air Sealing, Attic/Roof Insulation, Wall Insulation, Basement Insulation, High-Efficiency Furnaces/Boilers, Furnace and Boiler Retrofit, Pellet/Wood Stove, Pellet Boiler, Central Air Source Heat Pump (Ducted), Central Geothermal (Ground Source) Heat Pump, On-Demand Natural Gas Water Heater	7/1/2014
Removal	Advanced Power Strip	This measure was discontinued, and the TRM entry was removed accordingly	7/1/2014

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
Removal: indicates a removal of measure that is discontinued

Retail Products

CFL Bulb								
Last Revised Date	7/1/2014							
MEASURE OVERVIEW								
Description	ENERGY STAR® Compact Fluorescent Lamps (CFLs). This measure involves the installation of a new ENERGY STAR® certified CFL in place of an existing or new incandescent bulb. ENERGY STAR® key efficiency criteria require that CFLs provide three times more lumens per watt than incandescent bulbs.[3]							
Primary Energy Impact	Electric							
Sector	Residential, Commercial							
Program(s)	Retail Lighting Program							
End-Use	Lighting							
Decision Type	New Construction, Replace on Burnout							
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)								
Demand savings	ΔkW = 0.032							
Annual energy savings	ΔkWh/yr = 27							
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)								
Demand savings	$\Delta kW = \Delta Watt_{CFL} / 1{,}000 \times EISA\%_{CFL}$							
Annual energy savings	$\Delta kWh/yr = \Delta Watt_{CFL} / 1{,}000 \times EISA\%_{CFL} \times [365 \times HPD_{RES} \times \%RES + HPY_{COMM} \times \%COMM]$							
Definitions	Unit = 1 bulb $\Delta Watt_{CFL}$ = Average wattage difference between baseline bulbs and program CFLs (Watts) $EISA\%_{CFL}$ = Savings adjustment factor to account for EISA baseline impacts 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 sockets (%) HPY_{COMM} = Average annual operating hours in commercial setting (hrs/yr) %COMM = Share of bulb purchases that are installed in commercial sockets (%)							
EFFICIENCY ASSUMPTIONS								
Baseline Efficiency	Incandescent/Halogen bulb							
Efficient Measure	ENERGY STAR® certified CFL							
PARAMETER VALUES (DEEMED)								
Measure	$\Delta Watt_{CFL}$	HPD_{RES}	HPY_{COMM}	$EISA\%_{CFL}$	%RES	%COMM	Life (yrs)	Cost ($)
CFL Bulb	49[4]	2.04[5]	3,772[6]	64.8%[7]	96%[8]	4%[8]	12.5[9]	1.40[10]
IMPACT FACTORS								
Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO	
CFL Bulb	73% (first year) 99% (FCM & lifetime)[11]	100%[12]	100%[12]	9.6%[13]	20.2%[14]	34%[15]	0%[15]	

[3] ENERGY STAR® CFL Key Performance Requirements: http://www.energystar.gov/index.cfm?c=cfls.pr_crit_cfls
[4] The Cadmus Group, Efficiency Maine Trust Residential Lighting Program Evaluation, November 1, 2012, page 19.
[5] Ibid, page 20.
[6] Average annual hours of use for commercial spaces. Efficiency Maine Commercial Technical Reference Manual Version 2015.1 Table 33.
[7] See Appendix C, Table C-4.; value for EMT Program Year 2015.
[8] The Cadmus Group, Efficiency Maine Trust Residential Lighting Program Evaluation, November 1, 2012, page 71.
[9] Ibid, page 23.
[10] Ibid, page 33.
[11] The first year in-service rate is 73% (The Cadmus Group, Efficiency Maine Trust Residential Lighting Program Evaluation, November 1, 2012, page 18) and the lifetime in-service rate is 99% (Department of Energy Uniform Methods Protocol for Residential Lighting) based on the UMP-recommended assumption that 99% of program bulbs are installed within 3 years. EMT uses the lifetime in-service rate value to calculate lifetime energy impacts and ISO-NE FCM demand reduction.
[12] Realization rates are 100% since savings estimates are based on evaluation results.
[13] Composite summer coincidence factor: 96% of bulbs in residential sockets with summer CF at 6.8% (The Cadmus Group, Efficiency Maine Trust Residential Lighting Program Evaluation, November 1, 2012. Prepared for Efficiency Maine Trust) and 4% of bulbs in commercial sockets with summer CF at 76% (Efficiency Maine Trust Commercial TRM, July 1, 2013).
[14] Composite winter coincidence factor: 96% of bulbs in residential sockets with winter CF at 18.4% (The Cadmus Group, Efficiency Maine Trust Residential Lighting Program Evaluation, November 1, 2012. Prepared for Efficiency Maine Trust) and 4% of bulbs in commercial sockets with winter CF at 63% (Efficiency Maine Trust Commercial TRM, July 1, 2013).
[15] The Cadmus Group, Efficiency Maine Trust Residential Lighting Program Evaluation, November 1, 2012, page 27.

LED Bulb

Last Revised Date	7/1/2014
MEASURE OVERVIEW	
Description	ENERGY STAR® LED Bulbs. This measure involves the installation of a new ENERGY STAR® certified LED in place of an existing or new incandescent bulb. ENERGY STAR® certified LED lights consume 75% less energy than conventional incandescent lights.[16]
Primary Energy Impact	Electric
Sector	Residential, Commercial
Program(s)	Retail Lighting Program
End-Use	Lighting
Decision Type	New Construction, Replace on Burnout
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand savings	ΔkW = 0.034
Annual energy savings	$\Delta kWh/yr$ = 29
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	$\Delta kW = (Watts_{BASE} - Watts_{LED}) / 1{,}000 \times EISA\%_{LED}$
Annual energy savings	$\Delta kWh/yr = (Watts_{BASE} - Watts_{LED}) / 1{,}000 \times EISA\%_{LED} \times [365 \times HPD_{RES} \times \%RES + HPY_{COMM} \times \%COMM]$
Definitions	Unit = 1 bulb $Watts_{BASE}$ = Average wattage of baseline bulbs (Watts) $Watts_{LED}$ = Average wattage of LED bulbs (Watts) $EISA\%_{LED}$ = Savings adjustment factor to account for EISA baseline updates Hours = Average daily operating hours (hrs/day) 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/Halogen bulb
Efficient Measure	ENERGY STAR® certified LED bulb

PARAMETER VALUES (DEEMED)

Measure	$Watts_{BASE}$	$Watts_{LED}$	HPD_{RES}	HPY_{COMM}	%RES	%COMM	$EISA\%_{LED}$	Life (yrs)	Cost ($)
LED Bulb	63[17]	12[18]	2.04[19]	3,772[20]	96%[21]	4%[21]	66.6%[22]	15[23]	9.61[24]

IMPACT FACTORS

Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
LED Bulb	73% (first year) 99% (FCM & lifetime)[12]	100%[25]	100%[25]	9.6%[13]	20.2%[14]	0%[26]	0%[26]

[16] ENERGY STAR® LED Light Bulbs Key Product Criteria: http://www.energystar.gov/index.cfm?c=iledl.pr_key_product

[17] The Cadmus Group, Efficiency Maine Trust Residential Lighting Program Evaluation, November 1, 2012, page 19. The baseline wattage for LED bulbs is assumed to be the same as the average baseline wattage determine in the CFL evaluation. The weighted average baseline wattage in Table 18 is 63 Watts per bulb.

[18] The average LED wattage is calculated using EMT program sales data from July 1, 2012 through June 30, 2013. Memo: Information Regarding 2015 Draft TRM, August 6, 2014, Seth Craigo-Snell, Ph.D., Applied Proactive Technologies, Inc to Andy Meyer and Laura Martel, Efficiency Maine Trust

[19] Ibid, page 20.

[20] Average annual hours of use for commercial spaces. Efficiency Maine Commercial Technical Reference Manual Version 2015.1 Table 33.

[21] The Cadmus Group, Efficiency Maine Trust Residential Lighting Program Evaluation, November 1, 2012, page 71.

[22] See Appendix C, Table C-5; value for EMT Program Year 2015.

[23] Although LEDs have a rated lifetime of 25,000 hours, EMT assumes 15 year measure life for LED bulbs based on a review of other program TRMs (MI, RTF, PA, IN, VT, DEER) which have LED measure lives ranging from 8 to 20 years).

[24] Based on retail pricing estimates and program data compiled by Applied Proactive Technologies, Inc. Memo: Information Regarding 2015 Draft TRM, August 6, 2014, Seth Craigo-Snell, Ph.D., Applied Proactive Technologies, Inc to Andy Meyer and Laura Martel, Efficiency Maine Trust

[25] Realization rates are 100% since deemed gross savings values are based on evaluation results and estimates using program data.

[26] In 2012, the saturation (% bulbs per home) of LED bulbs was 0.0%: The Cadmus Group, Efficiency Maine Trust Residential Lighting Program Evaluation, November 1, 2012, page 8. Due to the high cost and low saturation of LED bulbs, EMT assumes 0% for free-ridership and spillover. This assumption is consistent with the Massachusetts 2013-2015 TRM.

Refrigerator								
Last Revised Date	7/1/2014							
MEASURE OVERVIEW								
Description	ENERGY STAR® Refrigerator. This measure involves the purchase and installation of a new ENERGY STAR® certified refrigerator in place of a new code-compliant or standard efficiency refrigerator. The ENERGY STAR® key efficiency criteria requires that full-size refrigerators be at least 20% more energy efficient than the minimum federal standard.[27] A list of certified ENERGY STAR® refrigerators is available at: http://downloads.energystar.gov/bi/qplist/refrigerators.xls							
Primary Energy Impact	Electric							
Sector	Residential							
Program(s)	Appliance Rebate Program							
End-Use	Refrigeration							
Decision Type	New Construction, Replace on Burnout							
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)								
Demand savings	ΔkW_{SP} = 0.015[28] ΔkW_{WP} = 0.017[29]							
Annual energy savings	$\Delta kWh/yr$ = 112							
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)								
Demand savings	ΔkW_{SP} = Deemed based on evaluated results ΔkW_{WP} = Deemed based on evaluated results							
Annual energy savings	$\Delta kWh/yr = (kWh_{BASE} - kWh_{EE}) \times ISA \times RATIO_{BASE}$							
Definitions	kWh_{BASE} = Average annual energy consumption for baseline models (kWh/yr) kWh_{EE} = Average annual energy consumption for ENERGY STAR® models (kWh/yr) ISA = In-situ adjustment factor (%) $RATIO_{BASE}$ = Adjustment factor to account for baseline update (%)							
EFFICIENCY ASSUMPTIONS								
Baseline Efficiency	Residential refrigerator that meets the current federal minimum efficiency requirement, effective September 15, 2014[30]							
Efficient Measure	ENERGY STAR® certified refrigerator							
PARAMETER VALUES (DEEMED)								
Measure	kWh_{BASE}	kWh_{EE}	ISA	$RATIO_{BASE}$	Life (yrs)	Cost ($)		
Refrigerator	583.43[31]	453.62[31]	98.8%[32]	87%[33]	12[31]	40[31]		
IMPACT FACTORS								
Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO	
Refrigerator	100%[34]	100%[35]	100%[35]	100%[36]	100%[36]	67.8%[37]	3.3%[37]	

[27] ENERGY STAR® Refrigerators and Freezers Key Product Criteria: http://www.energystar.gov/index.cfm?c=refrig.pr_crit_refrigerators
[28] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, page 30.
[29] Memo provided to supplement NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014.
[30] Federal Standard, Code of Federal Regulations, Title 10, Part 430, Subpart C.
[31] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, page 27.
[32] Ibid., page 28. The in-situ adjustment (ISA) factor is a correction factor applied to a refrigerator's rated kWh consumption to reflect real world conditions, such as door openings, food in the refrigerators, internal temperature settings, and ambient conditions. The ISA factor for refrigerators was derived by comparing the *actual* (metered) kWh consumption with the *rated* kWh consumption; the ratio of each refrigerator's actual metered kWh consumption to its rated kWh consumption was calculated and averaged to calculate the ISA factor.
[33] Percent reduction in rated annual energy consumption for 2015 Federal Standard compared to 2001 Federal Standard; calculations based on weighted average of refrigerator types/configurations.
[34] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, Table 2-41.
[35] Realization rates are 100% since savings estimates are based on evaluation results.
[36] Peak coincidence factors for this measure are embedded in the evaluated peak demand impacts.
[37] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, Table 2-41.

Freezer	
Last Revised Date	7/1/2014
MEASURE OVERVIEW	
Description	ENERGY STAR® Freezer. This measure involves the purchase and installation of a new ENERGY STAR® certified freezer in place of a new code-compliant or standard efficiency freezer. The ENERGY STAR® key efficiency criteria requires that full-size freezers be at least 10% more energy efficient than the minimum federal standard.[38] A list of certified ENERGY STAR® freezers is available at: *http://downloads.energystar.gov/bi/qplist/Freezers%20Product%20List.xls*
Primary Energy Impact	Electric
Sector	Residential
Program(s)	Appliance Rebate Program
End-Use	Refrigeration
Decision Type	New Construction, Replace on Burnout
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand savings	ΔkW_{SP} = 0.010 ΔkW_{WP} = 0.011
Annual energy savings	$\Delta kWh/yr$ = 72
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	$\Delta kW_{SP} = \Delta kW_{SP\text{-}Refrig} \times (\Delta kWh_{FREEZER} / \Delta kWh_{REFRIG})$ $\Delta kW_{WP} = \Delta kW_{WP\text{-}Refrig} \times (\Delta kWh_{FREEZER} / \Delta kWh_{REFRIG})$
Annual energy savings	$\Delta kWh/yr = \Delta kWh_{FREEZER} \times RATIO_{BASE}$
Definitions	Unit = 1 Freezer $\Delta kWh_{FREEZER}$ = Average annual energy savings for ENERGY STAR® freezer compared to non-certified models (kWh/yr) ΔkWh_{REFRIG} = Average annual energy savings for ENERGY STAR® refrigerator compared to non-certified models (kWh/yr) $\Delta kW_{SP\text{-}Refrig}$ = Evaluated summer peak demand reduction for Refrigerator measure (kW) $\Delta kW_{WP\text{-}Refrig}$ = Evaluated winter peak demand reduction for Refrigerator measure (kW) $RATIO_{BASE}$ = Adjustment factor to account for baseline update (%)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Standard residential freezer that meets the current federal minimum efficiency requirement, effective September 15, 2014[39]
Efficient Measure	ENERGY STAR® certified freezer

PARAMETER VALUES (DEEMED)

Measure	$\Delta kWh_{FREEZER}$	$RATIO_{BASE}$	ΔkWh_{REFRIG}	$\Delta kW_{SP\text{-}Refrig}$	$\Delta kW_{WP\text{-}Refrig}$	Life (yrs)	Cost ($)
ENERGY STAR® Freezer	83[40]	87%[41]	129.8[42]	0.015[42]	0.017[42]	12[40]	10[40]

IMPACT FACTORS

Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
ENERGY STAR® Freezer	100%[43]	100%[44]	100%[44]	100%[45]	100%[45]	65.5%[46]	3.3%[46]

[38] ENERGY STAR® Refrigerators and Freezers Key Product Criteria: http://www.energystar.gov/index.cfm?c=refrig.pr_crit_refrigerators
[39] Federal Standard, Code of Federal Regulations, Title 10, Part 430, Subpart C.
[40] United States Environmental Protection Agency (USEPA), ENERGY STAR Appliance Savings Calculator, August 2012. Annual energy savings are based on Upright Freezer (Automatic Defrost) unit with EPA assigned default values. Annual energy savings for other freezer types range from 49 kWh/yr to 114 kWh/yr with an average of 76 kWh/yr.
[41] Percent reduction in rated annual energy consumption for 2015 Federal Standard compared to 2001 Federal Standard; adopted value for refrigerators.
[42] See Refrigerator measure entry
[43] EMT assumes that all purchased units are installed (i.e. ISR = 100%). This is consistent with evaluation findings for other appliance measures.
[44] Realization rates are 100% since savings estimates are based on evaluation results.
[45] Peak coincidence factors for this measure are embedded in the evaluated peak demand impacts.
[46] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, Table 2-41.

Room Air Conditioner	
Last Revised Date	7/1/2014
MEASURE OVERVIEW	
Description	ENERGY STAR® Room AC (RAC). This measure involves the purchase and installation of a new ENERGY STAR® certified room air conditioner in place of a new code-compliant or standard efficiency room air conditioner. The ENERGY STAR® key efficiency criteria require that room air conditioners be at least 10% more energy efficient than the minimum federal standards.[47] A list of certified ENERGY STAR® room air conditioners is available at: *http://downloads.energystar.gov/bi/qplist/Room%20Air%20Conditioners%20Product%20List.xls*
Primary Energy Impact	Electric
Sector	Residential
Program(s)	Appliance Rebate Program
End-Use	Cooling
Decision Type	New Construction, Replace on Burnout
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand savings	ΔkW = 0.024
Annual energy savings	ΔkWh/yr = 2
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	$\Delta kW = CAP_{EE} \times (1 / EER_{BASE} - 1 / EER_{EE}) / 1000$
Annual energy savings	$\Delta kWh/yr = CAP_{EE} \times (1 / EER_{BASE} - 1 / EER_{EE}) / 1000 \times EFLH$
Definitions	Unit = 1 room air conditioner CAP_{EE} = Average capacity of installed room air conditioner (Btu/h) EER_{BASE} = Energy Efficiency Ratio of code-compliant room air conditioner (Btu/h/Watt) EER_{EE} = Energy Efficiency Ratio of ENERGY STAR® certified room air conditioner (Btu/h/Watt) EFLH = Equivalent full load hours for room air conditioner (hrs/yr) 1000 = Conversion: 1000 Watts per kW
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Standard room air conditioner that meets the current federal minimum efficiency requirement effective June 1, 2014[48]
Efficient Measure	ENERGY STAR® certified room air conditioner

PARAMETER VALUES (DEEMED)

Measure	CAP_{EE}	EER_{BASE}	EER_{EE}	EFLH	Life (yrs)	Cost ($)
ENERGY STAR® RAC	10,000[49]	11.0[49]	11.3[50]	102[51]	9[49]	50[49]

IMPACT FACTORS

Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
ENERGY STAR® RAC	100%[52]	100.0%[53]	100.0%[53]	11.1%[54]	0.0%[54]	65.5%[55]	3.3%[55]

[47] ENERGY STAR® Room Air Conditioners Key Product Criteria: http://www.energystar.gov/index.cfm?c=roomac.pr_crit_room_ac
[48] Federal Standard, Code of Federal Regulations, Title 10, Part 430, Subpart C.
[49] Minimum EER for code-compliant room air conditioner effective June 1, 2014.
[50] ENERGY STAR® requirement for room air conditioner as of October 2013.
[51] RLW Analytics, Coincidence Factor Study Residential Room Air Conditioners, June 2008; Table i-2. Values are based on TMY2 weather for Portland, Maine.
[52] EMT assumes that all purchased units are installed (i.e. ISR = 100%). This is consistent with evaluation findings for other appliance measures.
[53] This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.
[54] See Appendix B: Coincidence and Energy Period Factors.
[55] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, Table 2-41.

Room Air Purifier	
Last Revised Date	7/1/2014
MEASURE OVERVIEW	
Description	ENERGY STAR® certified room air purifier (RAP). This measure involves the purchase and installation of a new ENERGY STAR® certified room air purifier (also called room air cleaners) in place of a standard efficiency room air purifier. The ENERGY STAR® key efficiency criteria require that room air purifiers have a minimum efficiency of 2.0 CADR/Watt and maximum standby power of 2.0 Watts.[56] A list of certified ENERGY STAR® room air purifiers is available at: *http://downloads.energystar.gov/bi/qplist/Room_Air_Cleaners_Qualified_Product_List.xls*
Primary Energy Impact	Electric
Sector	Residential
Program(s)	Appliance Rebate Program
End-Use	Appliance
Decision Type	New Construction, Replace on Burnout
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand Savings	ΔkW = 0.128
Annual Energy Savings	ΔkWh/yr = 745
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = CADR \times (1/EF_{BASE} - 1/EF_{ES}) / 1000$
Annual Energy Savings	$\Delta kWh/yr = [CADR \times (1/EF_{BASE} - 1/EF_{ES}) \times Hours + (SBP_{BASE} - SBP_{ES}) \times (8{,}760 - Hours)] / 1000$
Definitions	Unit = 1 room air purifier CADR = Rated Clear Air Delivery Rate (CADR) EF_{BASE} = Rated efficiency for baseline unit (CADR/Watt) EF_{ES} = Rated efficiency for ENERGY STAR® unit (CADR/Watt) SBP_{BASE} = Rated standby power for baseline unit (Watts) SBP_{ES} = Rated standby for ENERGY STAR® unit (Watts) Hours = Annual operating hours (hrs/yr) 8,760 = Total hours in a year (24 hours/day × 365 days/year) 1,000 = Conversion: 1,000 Watts per kW
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Conventional model with CADR = 183, CADR/Watt = 1.0, and standby power = 1.0 Watts
Efficient Measure	Average available ENERGY STAR® certified model

PARAMETER VALUES (DEEMED)

Measure	CADR	EF_{BASE}	SBP_{BASE}	EF_{ES}	SBP_{ES}	Hours	Life (yrs)	Cost ($)
ENERGY STAR® RAP	183[57]	1.0[58]	1.0[58]	3.3[57]	0.6[57]	5,840[59]	9[60]	0[61]

IMPACT FACTORS

Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
ENERGY STAR® RAP	100%[62]	100%[63]	100%[63]	66.7%[64]	66.7%[64]	65.5%[65]	3.3%[65]

[56] ENERGY STAR® Room Air Cleaners Key Product Criteria: http://www.energystar.gov/index.cfm?c=room_airclean.pr_crit_room_airclean
[57] Average of qualified units on ENERGY STAR® QPL (accessed 3/31/2013).
[58] EPA Research based on available models, 2011 (from ENERGY STAR® Appliance Savings Calculator, accessed 3/31/2013).
[59] Assume average 16 hours per day operating (from ENERGY STAR® Appliance Savings Calculator, accessed 3/31/2013).
[60] Appliance Magazine, Portrait of the U.S. Appliance Industry 1998 (from ENERGY STAR® Appliance Savings Calculator, accessed 3/31/2013).
[61] EPA Research based on available models, 2012 (from ENERGY STAR® Appliance Savings Calculator, accessed 3/31/2013).
[62] EMT assumes that all purchased units are installed (i.e. ISR = 100%). This is consistent with evaluation findings for other appliance measures.
[63] This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.
[64] See Appendix B: Coincidence and Energy Period Factors.
[65] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, Table 2-41.

Dehumidifier								
Last Revised Date	7/1/2014							
MEASURE OVERVIEW								
Description	ENERGY STAR® dehumidifiers. This measure involves the purchase and installation of a new ENERGY STAR® certified dehumidifier in place of a new code-compliant or standard efficiency dehumidifier. The ENERGY STAR® key efficiency criteria specify a minimum energy factor of 1.85 Liters/kWh for dehumidifiers < 75 pints per day and a minimum energy factor of 2.80 for dehumidifiers up to 185 pints per day.[66] A list of certified ENERGY STAR® dehumidifiers is available at: *http://downloads.energystar.gov/bi/qplist/dehumid_prod_list.xls*							
Primary Energy Impact	Electric							
Sector	Residential							
Program(s)	Appliance Rebate Program							
End-Use	Appliance							
Decision Type	New Construction, Replace on Burnout							
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)								
Demand savings	ΔkW_{SP} = 0.037 ΔkW_{WP} = 0.000							
Annual energy savings	$\Delta kWh/yr$ = 109							
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)								
Demand savings	ΔkW_{SP} = Deemed based on evaluated results ΔkW_{WP} = Deemed based on evaluated results							
Annual energy savings	$\Delta kWh/yr = CAP_{EE} \times 0.473 \times (1 / EF_{BASE} - 1 / EF_{EE}) \times Hours / 24 \times ISA$							
Definitions	Unit = 1 dehumidifier CAP_{EE} = Rated capacity of the dehumidifier in pints per day (pints/day) EF_{BASE} = Rated Energy Factor for baseline dehumidifier (liters/kWh) EF_{EE} = Rated Energy Factor for ENERGY STAR® dehumidifier (liters/kWh) Hours = Annual operating hours (hrs/yr) 0.473 = Conversion: 0.473 liters per pint 24 = Conversion: 24 hours per day ISA = In-situ Adjustment Factor							
EFFICIENCY ASSUMPTIONS								
Baseline Efficiency	Standard dehumidifier that meets the current federal minimum efficiency requirements, effective October 2012[67]							
Efficient Measure	ENERGY STAR® certified dehumidifier							
PARAMETER VALUES (DEEMED)								
Measure	CAP_{EE}	EF_{BASE}	EF_{EE}	Hours	ISA	Life (yrs)	Cost ($)	
ENERGY STAR® Dehumidifier	63.4[68]	1.65[68]	1.85[68]	1,632[69]	81.6%[69]	12[68]	20[68]	
IMPACT FACTORS								
Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO	
ENERGY STAR® Dehumidifier	100%[70]	100%[71]	100%[71]	100%[72]	100%[72]	65.3%[73]	3.3%[73]	

[66] ENERGY STAR® Dehumidifiers Key Product Criteria: http://www.energystar.gov/index.cfm?c=dehumid.pr_crit_dehumidifiers
[67] Federal Standard, Code of Federal Regulations, Title 10, Part 430, Subpart C.
[68] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, Table 2-25.
[69] Ibid, page 53. The in-situ adjustment (ISA) factor is a correction factor applied to a dehumidifier's *rated* power draw to accurately represent its *actual* power draw. The ISA factor for dehumidifiers was derived by averaging the ratio of actual (metered) power draw of each metered dehumidifier to its rated power draw.
[70] Ibid, page 51.
[71] Realization rates are 100% since savings estimates are based on evaluation results.
[72] Peak coincidence factors for this measure are embedded in the evaluated peak demand impacts.
[73] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, Table 2-42.

Dishwasher	
Last Revised Date	7/1/2014
MEASURE OVERVIEW	
Description	ENERGY STAR® Dishwashers. This measure involves the purchase and installation of a new ENERGY STAR® certified dishwasher in place of a new code-compliant or standard efficiency dishwasher. The current ENERGY STAR® requirements, effective as of January 20, 2012, specify a maximum 295 kWh/year and minimum 4.25 gallons/cycle.[74] The associated water heater may be electric or non-electric. The deemed unit energy savings are weighted averages based on the percentages of homes with electric and non-electric water heaters. A list of certified ENERGY STAR® dishwashers is available at: *http://downloads.energystar.gov/bi/qplist/Dishwashers%20Product%20List.xls*
Primary Energy Impact	Electric (additional impacts include: natural gas, heating oil, propane and water)
Sector	Residential
Program(s)	Appliance Rebate Program
End-Use	Process
Decision Type	New Construction, Replace on Burnout
GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand Savings	ΔkW = 0.159
Annual Energy Savings	ΔkWh/yr = 33 $\Delta MMBtu_{GAS}$/yr = 0.0 $\Delta MMBtu_{OIL}$/yr = 0.1 $\Delta MMBtu_{PROP}$/yr = 0.0
Annual water savings	ΔGallons/yr = 468
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	$\Delta kW = \Delta kWh/yr / Hours$
Annual energy savings	$\Delta kWh/yr = (kWh_{BASE} - kWh_{EE}) / RCycles \times Cycles \times [(1 - \%E_{HW}) + (\%E_{HW} \times \%HW_{ELEC})]$ $\Delta MMBtu_{GAS}/yr = (kWh_{BASE} - kWh_{EE}) / RCycles \times Cycles \times \%E_{HW} \times 0.003413 / Eff_{GAS} \times \%HW_{GAS}$ $\Delta MMBtu_{OIL}/yr = (kWh_{BASE} - kWh_{EE}) / RCycles \times Cycles \times \%E_{HW} \times 0.003413 / Eff_{OIL} \times \%HW_{OIL}$ $\Delta MMBtu_{PROP}/yr = (kWh_{BASE} - kWh_{EE}) / RCycles \times Cycles \times \%E_{HW} \times 0.003413 / Eff_{PROP} \times \%HW_{PROP}$
Annual water savings	$\Delta Gallons/yr = (WC_{BASE} - WC_{EE}) \times Cycles$
Definitions	Unit = 1 dishwasher kWh_{BASE} = Rated annual energy use of baseline dishwasher (kWh/yr) kWh_{EE} = Rated annual energy use of ENERGY STAR® dishwasher (kWh/yr) RCycles = Rated dishwasher cycles per year (cycles/yr) Cycles = Annual dishwasher cycles (cycles/yr) Hours = Annual operating hours (hrs/yr) $\%E_{HW}$ = Percentage of dishwasher energy used for water heating (%) $\%HW_{ELEC}$ = Percentage of homes with electric water heating (%) $\%HW_{GAS}$ = Percentage of homes with natural gas water heating (%) $\%HW_{OIL}$ = Percentage of homes with oil water heating (%) $\%HW_{PROP}$ = Percentage of homes with propane or LNG water heating (%) Eff_{GAS} = Efficiency of existing gas-fired water heaters (%) Eff_{OIL} = Efficiency of existing oil-fired water heaters (%) Eff_{PROP} = Efficiency of existing propane-fired water heaters (%) WC_{BASE} = Rated water consumption per cycle for the baseline dishwasher (gallons/cycle) WC_{EE} = Rated water consumption per cycle for the ENERGY STAR® dishwasher (gallons/cycle) 0.003413 = Conversion factor: 0.003413 MMBtu per kWh
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Standard dishwasher that meets the current federal minimum efficiency requirement, effective May 2013. The requirement states that Standard size dishwashers shall not exceed 355 kwh/year and 6.5

[74] ENERGY STAR® Dishwashers Key Product Criteria: http://www.energystar.gov/index.cfm?c=dishwash.pr_crit_dishwashers

Dishwasher									
	gallons per cycle.[75]								
Efficient Measure	ENERGY STAR® certified dishwasher								
PARAMETER VALUES (DEEMED)									
Measure	kWh_{BASE}	kWh_{EE}	RCycles	Cycles	Hours	WC_{BASE}	WC_{EE}	$\%E_{HW}$	
ENERGY STAR® Dishwasher	355[76]	295[76]	215[76]	208[76]	208[77]	6.5[76]	4.25[76]	56%[76]	
Measure	$\%HW_{ELEC}$	$\%HW_{GAS}$	$\%HW_{OIL}$	$\%HW_{PROP}$	Eff_{GAS}	Eff_{OIL}	Eff_{PROP}	Life (yrs)	Cost ($)
ENERGY STAR® Dishwasher	23%[78]	10%[78]	53%[78]	9%[78]	75%[76]	75%[79]	75%[79]	10[76]	10[76]
IMPACT FACTORS									
Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO		
ENERGY STAR® Dishwasher	100%[80]	100%[81]	100%[81]	2.2%[82]	4.0%[82]	54.9%[83]	3.3%[83]		

[75] Federal Standard, Code of Federal Regulations, Title 10, Part 430, Subpart C.
[76] United States Environmental Protection Agency (USEPA), ENERGY STAR Appliance Savings Calculator, August 2012.
[77] Assume that each cycle is 1 hour so the total operating hours is equal to the total number of cycles.
[78] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, Table 2-15
[79] Values are assumed to be the same as a gas-fired water heater.
[80] EMT assumes that all purchased units are installed (i.e. ISR = 100%). This is consistent with evaluation findings for other appliance measures.
[81] This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.
[82] See Appendix B: Coincidence and Energy Period Factors.
[83] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, Table 2-42; used program average.

Clothes Washer	
Last Revised Date	7/1/2014
MEASURE OVERVIEW	
Description	ENERGY STAR® clothes washer. This measure involves the purchase and installation of a new ENERGY STAR® certified clothes washer in place of a new code-compliant or standard efficiency clothes washer. The current ENERGY STAR® requirements, effective as of February 1, 2013, specify a minimum Modified Energy Factor (MEF) of 2.0 and maximum water factor (WF) of 6.0.[84] The associated water heater and clothes dryer may be electric or non-electric. The deemed unit energy savings are weighted averages based on percentages of homes with electric and non-electric water heaters and clothes dryers. A list of certified ENERGY STAR® clothes washers is available at: *http://www.energystar.gov/productfinder/product/certified-clothes-washers/*
Primary Energy Impact	Electric (additional impacts include: natural gas, heating oil, propane and water)
Sector	Residential
Program(s)	Appliance Rebate Program
End-Use	Process
Decision Type	New Construction, Replace on Burnout
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand savings	ΔkW_{SP} = 0.055[85] ΔkW_{WP} = 0.073[86]
Annual energy savings	$\Delta kWh/yr$ = 372 $\Delta MMBtu_{GAS}/yr$ = 0.2 $\Delta MMBtu_{OIL}/yr$ = 0.3 $\Delta MMBtu_{PROP}/yr$ = 0.1
Annual water savings	$\Delta Gallons/yr$ = 4,299
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	ΔkW_{SP} = Deemed based on evaluated results ΔkW_{WP} = Deemed based on evaluated results
Annual energy savings	$\Delta kWh/yr = \Delta kWh_{MACHINE} + \Delta kWh_{HW} \times \%HW_{ELEC} + \Delta kWh_{DRYER} \times \%Dryer_{ELEC} \times \%Dried$ $\Delta MMBtu_{GAS}/yr = (\Delta kWh_{HW} \times \%HW_{GAS} + \Delta kWh_{DRYER} \times \%Dryer_{GAS} \times \%Dried) \times 0.003412 / Eff_{GAS}$ $\Delta MMBtu_{OIL}/yr = \Delta kWh_{HW} \times \%HW_{OIL} \times 0.003412 / Eff_{OIL}$ $\Delta MMBtu_{PROP}/yr = \Delta kWh_{HW} \times \%HW_{PROP} \times 0.003412 / Eff_{PROP}$ Where: $\Delta kWh_{MEF} = CAP_{EE} \times (1/MEF_{BASE} - 1/MEF_{EE}) \times Loads$ $\Delta kWh_{MACHINE} = \Delta kWh_{MEF} \times \%E_{MACHINE}$ $\Delta kWh_{HW} = \Delta kWh_{MEF} \times \%E_{HW}$ $\Delta kWh_{DRYER} = \Delta kWh_{MEF} \times \%E_{DRYER}$
Annual water savings	$\Delta Gallons/yr = CAP_{EE} \times (WF_{BASE} - WF_{EE}) \times Loads$

[84] ENERGY STAR® Clothes Washers Key Product Criteria: http://www.energystar.gov/index.cfm?c=clotheswash.pr_crit_clothes_washers
[85] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, page 45.
[86] Memo provided to supplement NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014.

Clothes Washer

Definitions	Unit	= 1 clothes washer
	$\Delta kWh_{MACHINE}$	= Annual washer machine energy savings (kWh/yr)
	ΔkWh_{HW}	= Annual electric water heating energy savings (kWh/yr)
	ΔkWh_{DRYER}	= Annual electric dryer energy savings (kWh/yr)
	$\%HW_{ELEC}$	= Percentage of homes with electric water heating
	$\%Dryer_{ELEC}$	= Percentage of homes with electric dryers
	MEF_{BASE}	= Rated Modified Energy Factor for baseline model (ft^3/kWh/cycle)
	MEF_{EE}	= Rated Modified Energy Factor for ENERGY STAR® model (ft^3/kWh/cycle)
	Loads	= Washer loads per year (cycles/yr)
	$\%E_{MACHINE}$	= Percentage of clothes washer system energy used for washer machine energy
	$\%E_{HW}$	= Percentage of clothes washer system energy used for water heating energy
	$\%E_{DRYER}$	= Percentage of clothes washer system energy used for the clothes dryer
	%Dried	= Percentage of washed loads that are dried in dryer (%)
	CAP_{EE}	= Rated capacity of the installed clothes washer (ft^3)
	$\%HW_{GAS}$	= Percentage of homes with natural gas water heating (%)
	$\%HW_{OIL}$	= Percentage of homes with oil water heating (%)
	$\%HW_{PROP}$	= Percentage of homes with other water heating fuel (%)
	$\%HW_{OTHER}$	= Percentage of homes with propane or LNG water heating (%)
	$\%Dryer_{GAS}$	= Percentage of homes with gas clothes dryers (%)
	$\%Dryer_{PROP}$	= Percentage of homes with propane or LNG clothes dryers (%)
	Eff_{GAS}	= Efficiency of existing gas-fired water heaters (%)
	Eff_{OIL}	= Efficiency of existing oil-fired water heaters (%)
	Eff_{PROP}	= Efficiency of existing propane-fired water heaters (%)
	WF_{BASE}	= Rated water factor for the baseline clothes washer (gallons/cycle/ft^3)
	WF_{EE}	= Rated water factor for the ENERGY STAR® clothes washer (gallons/cycle/ft^3)
	0.003413	= Conversion factor: 0.003413 MMBtu per kWh

EFFICIENCY ASSUMPTIONS

Baseline Efficiency	Standard clothes washer. The current federal standard requires a minimum Modified Energy Factor (MEF) of 1.26 and maximum water factor (WF) of 9.5. These standards are valid for clothes washers manufactured on or after January 1, 2011 and before March 7, 2015.[87]
Efficient Measure	ENERGY STAR® certified clothes washer.

PARAMETER VALUES (DEEMED)

Measure	CAP_{EE}	MEF_{BASE}	MEF_{EE}	Loads	$\%E_{DRYER}$			
	3.81[88]	1.26[87]	2.61[88]	322.4[89]	72.2%[90]			
	$\%E_{MACHINE}$	$\%E_{HW}$	%Dried	$\%HW_{ELEC}$	$\%Dryer_{ELEC}$	$\%Dryer_{GAS}$	WF_{BASE}	WF_{EE}
ENERGY STAR® CW	3.5%[90]	24.3%[90]	100%[91]	23%[92]	89.6%[93]	7.8%[93]	9.5[87]	6.0[94]
	$\%HW_{GAS}$	$\%HW_{OIL}$	$\%HW_{PROP}$	Eff_{GAS}	Eff_{OIL}	Eff_{PROP}	Life (yrs)	Cost ($)
	10%[92]	53%[92]	9%[92]	75%[95]	75%[95]	75%[95]	11[96]	50[97]

IMPACT FACTORS

Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
ENERGY STAR® CW	100%[98]	100%[99]	100%[99]	100%[100]	100%[100]	56.7%[101]	3.3%[101]

[87] Federal Standard, Code of Federal Regulations, Title 10, Part 430, Subpart C. The code specifies MEF ≥ 1.26 and WF ≤ 9.5lo.
[88] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, Table 2-13.
[89] Ibid., Table 2-14.
[90] Ibid., Table 2-17.
[91] Ibid., page 40: consistent with implicit assumption used in the savings algorithm for clothes washers.
[92] Ibid., Table 2-15.
[93] Ibid., Table 2-16.
[94] Ibid., Table 2-10: minimum WF for ENERGY STAR v5.0 qualification.
[95] EMT assumes 75% efficiency for existing fossil fuel-fired water heaters.
[96] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, Table 2-18.
[97] EPA Research based on available models, 2013 (from ENERGY STAR® Appliance Savings Calculator, accessed 7/1/2014).
[98] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, page 38.
[99] Realization rates are 100% since savings estimates are based on evaluation results.
[100] Peak coincidence factors for this measure are embedded in the evaluated peak demand impacts.
[101] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, Table 2-41

High Efficiency Electric Water Heater	
Last Revised Date	7/1/2014
MEASURE OVERVIEW	
Description	Super insulated electric water heaters with Energy Factor (EF) ≥ 0.95. This measure involves the purchase and installation of a new high-efficiency electric water heater in place of a code-compliant or standard efficiency electric water heater. This measure will not be eligible for participation in Efficiency Maine programs after April 16, 2015 when Federal Standard changes go into effect.
Primary Energy Impact	Electric
Sector	Residential
Program(s)	Appliance Rebate Program
End-Use	Domestic Hot Water
Decision Type	New Construction, Replace on Burnout
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand Savings	ΔkW = 0.073
Annual Energy Savings	ΔkWh/yr = 184
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = \Delta kWh/yr / Hours$
Annual Energy Savings	$\Delta kWh/yr = GPD \times 365 \times \rho_{H2O} \times Cp_{H2O} / 3{,}413 \times (T_{WH} - T_{in}) \times (1/EF_{BASE} - 1/EF_{HE})$
Definitions	Unit = 1 water heater GPD = Average daily hot water consumption (gallons/day) T_{in} = Temperature of water mains (water into the water heater) (°F) T_{WH} = Water heater temperature set point (°F) EF_{BASE} = Energy factor for baseline electric water heater EF_{HE} = Energy factor for high-efficiency electric water heater ρ_{H2O} = Density of water (8.33 lb/gallon) Cp_{H20} = Specific heat of water (1 Btu/lb/°F) Hours = Annual operating hours for water heater (hrs/yr) 365 = Conversion: 365 days per year 3,413 = Conversion: 3,413 Btu per kWh
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Standard residential water heater. The current federal standard requires a minimum AHRI Energy Factor = 0.904 (50 gallon unit).[102]
Efficient Measure	The rebated electric water heater must have an AHRI Energy Factor that is greater than or equal to 0.95.

PARAMETER VALUES (DEEMED)

Measure	GPD	T_{in}	T_{WH}	EF_{BASE}	EF_{HE}	Hours	Life (yrs)	Cost ($)
Electric Water Heater	51.1[103]	50.8[104]	126.2[105]	0.904[106]	0.95[107]	2,533[108]	10[109]	160[110]

IMPACT FACTORS

Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
Electric Water Heater	100%[111]	100%[112]	100%[112]	9.6%[113]	13.3%[113]	0%[114]	0%[114]

[102] Federal Standard, Code of Federal Regulations, Title 10, Part 430, Subpart C.
[103] GPD is calculated based on average number of people per household (Nppl): 16.286 x Nppl + 13. The relationship is used in NY and Indiana TRMs and is based on: Lutz, James D., Liu, Xiaomin, McMahon, James E., Dunham, Camilla, Shown, Leslie J.McCure, Quandra T; "Modeling patterns of hot water use in households;" LBL-37805 Rev. Lawrence Berkeley Laboratory, 1996.
[104] Standard Building America DHW Schedules, weighted average by population of all Maine water main sources.
[105] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014; adopted value for heat pump water heaters.
[106] Federal Standard, Code of Federal Regulations, Title 10, Part 430, Subpart C. Value is calculated for 50-gallon water heater.
[107] This value is the minimum qualification requirement for program rebate.
[108] Full load hours assumption based on Efficiency Vermont loadshape, calculated from Itron eShapes (Adopted from Ohio TRM, page 87).
[109] NREL, National Residential Efficiency Measures Database.
[110] Incremental cost for 50-gallon unit, based on water heater cost research conducted by Cadmus, June 2013.
[111] EMT assumes that all purchased units are installed (i.e. ISR = 100%). This is consistent with evaluation findings for other appliance measures.
[112] This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.
[113] See Appendix B.
[114] This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% NTG.

Heat Pump Water Heater				
Last Revised Date	7/1/2014			
MEASURE OVERVIEW				
Description	ENERGY STAR® certified Heat Pump Water Heaters (HPWH). This measure involves the purchase and installation of a new ENERGY STAR® certified HPWH in place of a new code-compliant or standard efficiency electric water heater. Savings are counted only for the improved water heater efficiency.[115] A list of certified ENERGY STAR® heat pump water heaters is available at: http://downloads.energystar.gov/bi/qplist/Water_Heaters_Product_List.xls			
Primary Energy Impact	Electric			
Sector	Residential			
Program(s)	Appliance Rebate Program			
End-Use	Domestic Hot Water			
Decision Type	New Construction, Replace on Burnout			
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)				
Demand Savings	ΔkW_{SP} = 0.175 ΔkW_{WP} = 0.374			
Annual Energy Savings	$\Delta kWh/yr$ = 1,687			
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)				
Demand Savings	ΔkW_{SP} = Summer Peak kW savings from a HPWH field-evaluation study[116] ΔkW_{WP} = Winter Peak kW savings from a HPWH Heater field-evaluation study[116]			
Annual Energy Savings	$\Delta kWh/yr = \Delta kWh/yr_{Evaluated}$ = Annual kWh savings from a HPWH field-evaluation study[116] Key assumptions include: • Average tank size for EMT's in-program HPWHs is approximately 50 gallons.[117] • Typical hot water consumption for Maine households is comparable to the hot water consumption in Massachusetts and Rhode Island households metered in the evaluation.[118] • Typical HPWH setpoint temperature in Maine households is expected to be comparable to the setpoint temperature in Massachusetts and Rhode Island households metered.[119] • Most, if not all, of EMT's in-program HPWHs will be installed in conditioned or partially conditioned spaces (i.e. regulated temperature and/or humidity), as was the case for most HPWH units studied in the evaluation[120]			
EFFICIENCY ASSUMPTIONS				
Baseline Efficiency	Standard 50-gallon residential water heater with an AHRI Energy Factor = 0.904.[121]			
Efficient Measure	ENERGY STAR® certified model (EF ≥ 2.0)			
PARAMETER VALUES (DEEMED)				
Measure			Life (yrs)	Cost ($)
ENERGY STAR® HPWH			10[122]	680[123]

[115] Interactive impacts on cooling, heating and humidification energy are assumed to be negligible due to the short cooling season in Maine and the expectation that most water heaters are not located in conditioned spaces. EMT will re-evaluate this assumption as more data and evaluation results are available.
[116] Steven Winters Associates Inc., Heat Pump Water Heaters, Evaluation of Field Installed Performance, June 26, 2012. Table 1
[117] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, Table 2-31; at least 89% of HPWH units in EMT program are 50 gallons units (with the remaining 11% with unknown tank size). Steven Winter Associates Inc., Heat Pump Water Heaters, Evaluation of Field Installed Performance, June 26, 2012 included 10 units with 50 gallon tanks; 1 unit with a 60 gallon tank; and 3 units with 80 gallon tanks.
[118] For Maine, 51.1 GPD is used based on average number of people per household (Nppl): 16.286 x Nppl + 13. The relationship is used in NY and Indiana TRMs and is based on: Lutz, James D., Liu, Xiaomin, McMahon, James E., Dunham, Camilla, Shown, Leslie J.McCure, Quandra T; "Modeling patterns of hot water use in households;" LBL-37805 Rev. Lawrence Berkeley Laboratory, 1996. Average GPD found in the Steven Winters Associates Inc., Heat Pump Water Heaters, Evaluation of Field Installed Performance, June 26, 2012 was 45.5 GPD.
[119] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, Table 2-35; the average setpoint temperature in Maine is 126.2°F, compared to the average setpoint temperature of 127.6°F found in Steven Winter Associates Inc., Heat Pump Water Heaters, Evaluation of Field Installed Performance, June 26, 2012.
[120] Considering Maine's climate (winter), it can be anticipated that most, if not all, properly installed HPWHs will be installed in fully or partially conditioned spaces.
[121] Federal Standard, Code of Federal Regulations, Title 10, Part 430, Subpart C. EF = 0.904 value is calculated for 50-gallon water heater. Steven Winter Associates Inc., Heat Pump Water Heaters, Evaluation of Field Installed Performance, June 26, 2012 uses EF = 0.91 as the baseline ERWH efficiency. The two baselines are very similar; the small ΔEF is negligible, as the difference will effectively be offset by any uncertainties in the data.
[122] NREL, National Residential Efficiency Measure Database.

Heat Pump Water Heater							
IMPACT FACTORS							
Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
ENERGY STAR® HPWH	100%[124]	100%[125]	100%[125]	100%[126]	100%[126]	21.0%[127]	3.3%[127]

[123] Incremental cost for 50-gallon unit, based on water heater cost research conducted by Cadmus, June 2013.
[124] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, page 60.
[125] Realization rates are 100% since savings estimates are based on evaluation results.
[126] Peak coincidence factors for this measure are embedded in the evaluated peak demand impacts.
[127] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014, Table 2-41.

Home Energy Savings Program

Custom Path								
Last Revised Date	7/1/2014 (new in PY2015)							
MEASURE OVERVIEW								
Description	The HESP custom path involves multiple energy-efficiency measures that achieve at least 20% energy savings compared to baseline annual energy consumption.[128]							
Energy Impacts	Electricity, Natural Gas, Oil, Propane, Wood							
Sector	Residential							
Program(s)	Home Energy Savings Program							
End-Use	Lighting, Heating, Cooling, Domestic Hot Water, Refrigeration, Appliances							
Decision Type	Retrofit							
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)								
Demand savings	ΔkW = NA							
Annual energy savings	*Annual energy savings depend on project-specific data.*							
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)								
Demand savings	ΔkW = NA[129]							
Annual Energy savings	$\Delta kWh = \Delta MMBTU \times Share_{ELEC} \times (1{,}000 / 3.412)$ $\Delta MMBtu_{FUEL} = \Delta MMBTU \times \%FUEL$							
Definitions	Unit = HESP custom project ΔMMBTU = Annual energy savings predicted using the Real Home Analyzer (RHA) building simulation software (MMBtu) or other approved modeling software %FUEL = Home heating fuel distribution excluding coal and other[130]							
EFFICIENCY ASSUMPTIONS								
Baseline Efficiency	The baseline case is the baseline annual energy consumption of the existing home, before any energy-efficiency measures are installed.							
Efficient Measure	The high-efficiency case involves multiple measures that reduce baseline annual energy consumption by a minimum of 20%. The energy savings estimate is based on building energy simulation using the RHA or other approved modeling software.							
PARAMETER VALUES								
Measure	ΔMMBTU	%FUEL				Life (yrs)	Cost ($)	
Custom Path	Model[131]	Table D-1				20[132]	Actual	
IMPACT FACTORS								
Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO	
Custom Path	100%	100%[133]	NA	NA	NA	0%[134]	0%[134]	

[128] While not limited to any specific energy-efficiency measure, it is expected that a vast majority of projects in the HESP Custom Path will be weatherization measures that do not perfectly align with the prescriptive weatherization measures offered as part of the Home Energy Savings Program.
[129] While there may be some net kW impact associated with Custom Path measures, they are expected to be insignificant in magnitude, and therefore assumed to be negligible.
[130] Heating fuel distribution is used to allocate savings to different fuels because the vast majority of the HESP Custom Path projects are expected to be weatherization measures, which predominantly impact the home's heating energy consumption.
[131] Annual energy savings are determined on a case-by-case basis by performing building energy simulations using the Real Home Analyzer (RHA) or other approved modeling software.
[132] 20 years is assumed by EMT. Prescriptive building envelope insulation measures in the Home Energy Savings Program have measure lives of 25 years. To account for any projects that are not weatherization measures and potentially have shorter measure lives, the measure life was adjusted down 20%, to 20 years.
[133] The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.
[134] The NTG for savings calculated by RHA model has not been evaluated. EMT assumes 100% NTG.

Air Sealing	
Last Revised Date	7/1/2014 (new in PY2015)
MEASURE OVERVIEW	
Description	This measure involves sealing air leaks in windows, doors, roof, crawlspaces and outside walls resulting in decreased heating and cooling loads.
Energy Impacts	Electric, Natural Gas, Oil, Propane, Wood, Kerosene
Sector	Residential
Program(s)	Home Energy Savings Program
End-Use	Heating, Cooling
Decision Type	Retrofit
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand savings	$\Delta kW_{SP} = 0.766$ $\Delta kW_{WP} = 0.000$
Annual energy savings	$\Delta kWh = 364$ $\Delta MMBtu_{GAS} = 0.8$ $\Delta MMBtu_{OIL} = 5.7$ $\Delta MMBtu_{WOOD} = 0.7$ $\Delta MMBtu_{PROP} = 0.5$ $\Delta MMBtu_{KERO} = 0.5$
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	$\Delta kW = \Delta kWh_{COOL} \times LSF_{SP}$
Annual Energy savings	$\Delta MMBtu_{FUEL} = \Delta MMBtu_{AS} \times \%FUEL$ $\Delta kWh = \Delta kWh_{HEAT} + \Delta kWh_{COOL}$ $\Delta kWh_{HEAT} = \Delta MMBtu_{AS} \times 1{,}000 / 3.412 \times \%FUEL$ $\Delta kWh_{COOL} = \Delta MMBtu_{AS} \times ESR_{COOL} \times \%COOL \times 1{,}000 / 3.412$
Definitions	Unit = Air sealing project $\Delta MMBTU_{AS}$ = Average residential heating energy savings from air sealing measures (MMBtu) %FUEL = Home heating fuel distribution excluding coal and other[135] ESR_{COOL} = Average cooling energy savings from weatherization as a percentage of heating energy savings, for homes with electric cooling (%) %COOL = Percentage of homes with electric cooling equipment (%) ΔCFM50 = Average change in air leakage rate following upgrade (CFM) LSF_{SP} = Summer peak load shape factor (kW/kWh/yr) 3.412 = Conversion: 3.412 kBtu/kWh 1,000 = Conversion: 1,000 kBtu/MMBtu
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The baseline case is the existing home before the air-sealing measures are installed. The program contractor measures the baseline leakage rate ($CFM50_{PRE}$) during the home audit.
Efficient Measure	The high-efficiency case is the home after the air-sealing measures are installed. The program contractor measures the post-upgrade leakage rate ($CFM50_{POST}$) after the air sealing installation is complete.

[135] Heating fuel distribution is used to allocate savings to different fuels because the vast majority of the HESP Custom Path projects are expected to be weatherization measures, which predominantly impact the home's heating energy consumption.

Air Sealing								
PARAMETER VALUES (DEEMED)								
Measure	ΔCFM50	$\Delta MMBtu_{AS}$	ESR_{COOL}	%COOL	LSF_{SP}	%FUEL	Life (yrs)	Cost ($)
Air Sealing	514[136]	8.28[137]	18%[138]	0.79[139]	0.00222[140]	Table D-1	15[141]	818[142]

IMPACT FACTORS							
Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
Air Sealing	100%[143]	100%[144]	100%[144]	100%[145]	100%[145]	0%[146]	0%[146]

[136] Average participant improvement, Opinion Dynamics, Evaluation of the Efficiency Maine Trust PACE, PowerSaver, and RDI Programs – Final Evaluation Report, Volume II: Residential Direct Install Program, October 2013

[137] Opinion Dynamics, Evaluation of the Efficiency Maine Trust PACE, PowerSaver, and RDI Programs – Final Evaluation Report, Volume II: Residential Direct Install Program, October 2013; Table 4-1.

[138] Cadmus, New Hampshire HVAC Load and Savings Research, March 2013; Table 16.

[139] Central Maine Power, percentage of homes with room air conditioners in 2010: http://www.pressherald.com/2014/05/26/put_power_rates_on_ice__that_s_a_cool_idea_/

[140] MA TRM 2013, average kW factor for air sealing and insulation measures (Gas, Oil, Other FF). Conversion factor of kW/kWh is combined with peak coincidence factor of 1.0 to calculate summer peak demand reduction. It is assumed there are no winter peak demand savings due to the small distribution of electrically heated homes.

[141] 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.

[142] Average cost of participant air sealing. Represents installations where air sealing was the sole upgrade installed. Number of participants included in the average cost may very compared to the number of participants included in the average participant improvement.

[143] ISR is 100% because deemed savings results are based on evaluated results that include installation verification.

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

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

[146] This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% NTG.

Attic/Roof Insulation	
Last Revised Date	7/1/2014 (new in PY2015)
MEASURE OVERVIEW	
Description	This measure involves the insulation of attic floor to decrease heating and cooling losses. The participant must also complete a comprehensive air-sealing project. The total savings below reflect savings due to the added attic/roof insulation and improved air sealing. Note that air sealing bonus should only be applied once per building independent of the number of insulation measures installed.
Energy Impacts	Electric, Natural Gas, Oil, Propane, Wood, Kerosene
Sector	Residential
Program(s)	Home Energy Savings Program
End-Use	Heating, Cooling
Decision Type	Retrofit
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand savings	Attic/Roof Insulation + Air Sealing = Total Savings $\Delta kW_{SP} = 0.048 + 0.766 = 0.814$ $\Delta kW_{WP} = 0.000$
Annual energy savings	$\Delta kWh = 16 + 40 + 21 = 77$ $\Delta MMBtu_{GAS} = 0.8 + 1.5 = 2.3$ $\Delta MMBtu_{OIL} = 6.0 + 11.3 = 17.3$ $\Delta MMBtu_{WOOD} = 0.7 + 2.0 = 2.7$ $\Delta MMBtu_{PROP} = 0.6 + 1.0 = 1.6$ $\Delta MMBtu_{KERO} = 0.6 + 1.0 = 1.6$
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	$\Delta kW = \Delta kWh_{COOL} \times LSF_{SP}$
Annual Energy savings	$\Delta MMBtu_{FUEL} = \{SQFT \times ESFH + SAS\} \times \%FUEL$ $\Delta kWh = \{\Delta kWh_{HEAT} + SAS \times 1{,}000 / 3.412\} \times \%FUEL + \Delta kWh_{COOL}$ $\Delta kWh_{HEAT} = \Delta kWh / sqft_{HEAT} \times SQFT$ $\Delta kWh_{COOL} = \Delta kWh / sqft_{COOL} \times SQFT \times \%COOL$
Definitions	Unit = Attic/roof insulation project SQFT = Area of attic insulation (ft^2) $RVAL_{PRE}$ = Pre-upgrade attic R-value (ft^2-°F-hr/Btu) $RVAL_{POST}$ = Post-upgrade attic R-value (ft^2-°F-hr/Btu) ESFH = Heating energy savings factor from attic/roof insulation (MMBtu/SQFT) SAS = Savings from improved air sealing (MMBtu) %FUEL = Home heating fuel distribution excluding coal and other[147] $\Delta kWh/sqft_{HEAT}$ = kWh heating savings per square foot of attic space (kWh/yr/sqft) $\Delta kWh/sqft_{COOL}$ = kWh cooling savings per square foot of attic space (kWh/yr/sqft) LSF_{SP} = Summer peak load shape factor (kW/kWh/yr) %COOL = Percentage of homes with electric cooling equipment (%) SAS = Savings from Air Sealing
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The baseline is the existing (pre-upgrade) insulation, represented by the R-value measured during the audit
Efficient Measure	The high-efficiency case is the upgraded insulation, represented by the R-value measured after the upgrade.

[147] Heating fuel distribution is used to allocate savings to different fuels because the vast majority of the HESP Custom Path projects are expected to be weatherization measures, which predominantly impact the home's heating energy consumption.

Attic/Roof Insulation

PARAMETER VALUES (DEEMED)

Measure	SQFT	$RVAL_{PRE}$	$RVAL_{POST}$	ESFH	LSF_{SP}	$\Delta kWh/sqft_{HEAT}$	SAS	%FUEL
Attic/Roof Insulation	1,000[148]	12[148]	49[148]	0.009[149]	0.00222[150]	2.010[149]	17[151]	Table D-1

Measure	$\Delta kWh/sqft_{COOL}$	$\Delta kW/sqft$	%COOL		Life (yrs)	Cost ($)
Attic/Roof Insulation	0.027[149]	0.000084[149]	0.79[152]		25[153]	3,300[154]

IMPACT FACTORS

Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
Attic/Roof Insulation	100%[155]	100%[156]	100%[156]	100%[157]	100%[157]	0%[158]	0%[158]

[148] Average value, based on program implementer feedback

[149] NY TRM 2010, average roof insulation savings (R11 to R49) for the New York cities of Binghamton and Massena. The savings for these cities were mapped to the Maine cities of Portland, Bangor (Binghamton) and Caribou (Massena). Savings were scaled by degree days for each city. Final savings value represents an average weighted by city population.

[150] MA TRM 2013, average kW factor for air sealing and insulation measures (Gas, Oil, Other FF). Conversion factor of kW/kWh is combined with peak coincidence factor of 1.0 to calculate summer peak demand reduction. It is assumed there are no winter peak demand savings due to the small distribution of electrically heated homes.

[151] Based on RHA data for HESP1 project in 2010 and 2011. Average CFM50 reduction across all insulation types was 1712 CFM50. From this 517 CFM50 was subtracted to account for the air sealing reduction based on RDI evaluation. MMBtu savings estimated at 0.014 MMBtu/CFM50 based on RDI evaluation.

[152] Central Maine Power, percentage of homes with room air conditioners in 2010:
http://www.pressherald.com/2014/05/26/put_power_rates_on_ice__that_s_a_cool_idea_/

[153] 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.

[154] Average cost of participant attic insulation. Represents installations where attic insulation was the sole upgrade installed. Number of participants included in the average cost may vary compared to the number of participants included in the average participant improvement.

[155] EMT assumes that all purchased units are installed (i.e. ISR = 100%).

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

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

[158] This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% NTG.

Wall Insulation	
Last Revised Date	7/1/2014 (new in PY2015)
MEASURE OVERVIEW	
Description	This measure involves the insulation of walls to decrease heating and cooling losses. The participant must also complete a comprehensive air-sealing project. The total savings below reflect savings due to the added attic/roof insulation and improved air sealing. Note that air sealing bonus should only be applied once per building independent of the number of insulation measures installed.
Energy Impacts	Electric, Natural Gas, Oil, Propane, Wood, Kerosene
Sector	Residential
Program(s)	Home Energy Savings Program
End-Use	Heating, Cooling
Decision Type	Retrofit
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand savings	Wall Insulation + Air Sealing = Total Savings $\Delta kW_{SP} = 0.027 + 0.766 = 0.793$ $\Delta kW_{WP} = 0.000$
Annual energy savings	Wall Insulation + Air Sealing = Total Savings $\Delta kWh = 23 + 40 = 63$ $\Delta MMBtu_{GAS} = 0.5 + 1.5 = 2.0$ $\Delta MMBtu_{OIL} = 3.9 + 11.3 = 15.2$ $\Delta MMBtu_{WOOD} = 0.5 + 2.0 = 2.5$ $\Delta MMBtu_{PROP} = 0.4 + 1.0 = 1.4$ $\Delta MMBtu_{KERO} = 0.4 + 1.0 = 1.4$
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	$\Delta kW = \Delta kWh_{COOL} \times LSF_{SP}$
Annual Energy savings	$\Delta MMBtu_{FUEL} = \{SQFT \times ESFH + SAS\} \times \%FUEL$ $\Delta kWh = \{\Delta kWh_{HEAT} + \Delta kWh_{COOL} + SAS \times 1{,}000 / 3.412\} \times \%FUEL$ $\Delta kWh_{HEAT} = \Delta kWh / sqft_{HEAT} \times SQFT$ $\Delta kWh_{COOL} = \Delta kWh / sqft_{COOL} \times SQFT \times \%COOL$
Definitions	Unit = Wall insulation project SQFT = Area of wall insulation (ft^2) $RVAL_{PRE}$ = Pre-upgrade wall R-value (ft^2-°F-hr/Btu) $RVAL_{POST}$ = Post-upgrade wall R-value (ft^2-°F-hr/Btu) ESFH = Heating energy savings factor from wall insulation (MMBtu/SQFT) SAS = Savings from improved air sealing (MMBtu) %FUEL = Home heating fuel distribution excluding coal and other[159] $\Delta kWh/sqft_{HEAT}$ = kWh heating savings per square foot of wall space $\Delta kWh/sqft_{COOL}$ = kWh cooling savings per square foot of wall space LSF_{SP} = Summer peak load shape factor (kW/kWh/yr) %COOL = Percentage of homes with electric cooling equipment (%)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Walls with existing R-value before upgrade, as documented in project application form
Efficient Measure	Walls with post-upgrade R-value, as documented in project application form

[159] Heating fuel distribution is used to allocate savings to different fuels because the vast majority of the HESP Custom Path projects are expected to be weatherization measures, which predominantly impact the home's heating energy consumption.

Wall Insulation

PARAMETER VALUES

Measure	SQFT	$RVAL_{PRE}$	$RVAL_{POST}$	ESFH	LSF_{SP}	$\Delta kWh/sqft_{HEAT}$
Wall Insulation	1,000[160]	4[160]	15[160]	0.006[161]	0.00222[162]	1.287[161]

Measure	$\Delta kWh/sqft_{COOL}$	$\Delta kW/sqft$	%COOL	SAS	%FUEL	Life (yrs)	Cost ($)
Wall Insulation	0.016[161]	0.000036[161]	0.79[163]	17[151]	Table D-1	25[164]	3,400[165]

IMPACT FACTORS

Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
Wall Insulation	100%[166]	100%[167]	100%[167]	100%[168]	100%[168]	0%[169]	0%[169]

[160] Average value, based on program implementer feedback

[161] NY TRM 2010, average wall insulation savings (R0 to R11) for the New York cities of Binghamton and Massena. The savings for these cities were mapped to the Maine cities of Portland, Bangor (Binghamton) and Caribou (Massena). Savings were scaled by degree days for each city. Final savings value represents an average weighted by city population.

[162] MA TRM 2013, average kW factor for air sealing and insulation measures (Gas, Oil, Other FF). Conversion factor of kW/kWh is combined with peak coincidence factor of 1.0 to calculate summer peak demand reduction. Zero winter peak demand savings due to the small distribution of electrically heated homes.

[163] Central Maine Power, percentage of homes with room air conditioners in 2010:
http://www.pressherald.com/2014/05/26/put_power_rates_on_ice__that_s_a_cool_idea_/

[164] 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.

[165] Average cost of participant wall insulation. Represents installations where wall insulation was the sole upgrade installed. Number of participants included in the average cost may very compared to the number of participants included in the average participant improvement.

[166] EMT assumes that all purchased units are installed (i.e. ISR = 100%).

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

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

[169] This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% NTG.

Basement Insulation	
Last Revised Date	7/1/2014 (new in PY2015)
MEASURE OVERVIEW	
Description	This measure involves the insulation of basement/foundation walls (including rim joist) to decrease heating and cooling losses. The participant must also complete a comprehensive air-sealing project. The total savings below reflect savings due to the added attic/roof insulation and improved air sealing. Note that air sealing bonus should only be applied once per building independent of the number of insulation measures installed.
Energy Impacts	Electric, Natural Gas, Oil, Propane, Wood, Kerosene
Sector	Residential
Program(s)	Home Energy Savings Program
End-Use	Heating, Cooling
Decision Type	Retrofit
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand savings	Basement Insulation + Air Sealing = Total Savings ΔkW_{SP} = 0 + 0.766 = 0.766 ΔkW_{WP} = 0.000
Annual energy savings	Basement Insulation + Air Sealing = Total Savings ΔkWh = 9 + 40 = 49 $\Delta MMBtu_{GAS}$ = 0.3 + 1.5 = 1.8 $\Delta MMBtu_{OIL}$ = 2.5 + 11.3 = 13.8 $\Delta MMBtu_{WOOD}$ = 0.3 + 2.0 = 2.3 $\Delta MMBtu_{PROP}$ = 0.2 + 1.0 = 1.2 $\Delta MMBtu_{KERO}$ = 0.2 + 1.0 = 1.2
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	ΔkW = NA
Annual Energy savings	$\Delta MMBtu_{FUEL} = \{\Delta MMBtu_B + SAS\} \times \%FUEL$ $\Delta kWh = \{\Delta MMBtu_B + SAS\} \times 1{,}000 / 3.412 \times \%FUEL$
Definitions	Unit = Basement/floor insulation project $\Delta MMBtu_B$ = Average residential heating energy savings from basement insulation measure (MMBtu) SAS = Savings from improved air sealing (MMBtu) %FUEL = Home heating fuel distribution excluding coal and other[170] SQFT = Area of basement insulation in (ft^2) $RVAL_{PRE}$ = Pre-upgrade basement R-value (ft^2-°F-hr/Btu) $RVAL_{POST}$ = Post-upgrade basement R-value (ft^2-°F-hr/Btu) 3.412 = Conversion: 3.412 kBtu/kWh 1,000 = Conversion: 1,000 kBtu/MMBtu
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Basement walls with pre-upgrade R-value, as measured during insulation upgrade
Efficient Measure	Basement walls with post-upgrade R-value, as measured during insulation upgrade

PARAMETER VALUES (DEEMED)

Measure	SQFT	$RVAL_{PRE}$	$RVAL_{POST}$	$\Delta MMBtu_B$	SAS	%FUEL	Life (yrs)	Cost ($)
Basement Insulation	560[171]	1[171]	10[171]	3.63[172]	17[151]	Table D-1	25[173]	3,100[174]

IMPACT FACTORS

Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
Basement Insulation	100%[175]	100%[176]	100%[176]	100%[177]	100%[177]	0%[178]	0%[178]

[170] Heating fuel distribution is used to allocate savings to different fuels because the vast majority of the HESP Custom Path projects are expected to be weatherization measures, which predominantly impact the home's heating energy consumption.
[171] Average value, based on program implementer feedback
[172] Opinion Dynamics, Evaluation of the Efficiency Maine Trust PACE, PowerSaver, and RDI Programs – Final Evaluation Report, Volume II: Residential Direct Install Program, October 2013; Table 4-1.
[173] 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.
[174] Average cost of participant basement insulation. Represents installations where basement insulation was the sole upgrade installed. Number of participants included in the average cost may very compared to the number of participants included in the average participant improvement.

Ductless Heat Pump	
Last Revised Date	7/1/2014
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of a high efficiency ductless heat pump system, instead of a standard efficiency ductless heat pump system, as a supplemental heating system.
Energy Impacts	Electric
Sector	Residential
Program(s)	Home Energy Savings Program
End-Use	Heating, Cooling
Decision Type	New Construction, Replace on Burnout
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand savings	$\Delta kW_C = 0.140$ $\Delta kW_H = 0.411$
Annual energy savings	$\Delta kWh/yr = 1,517$ $\Delta kWh_H/yr = 1,504$ $\Delta kWh_C/yr = 13$
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	Heating Savings: $\Delta kW_H = maximum[\{Output_{i,Base} / HSPF_{i,Base}\}] – maximum [\{Output_{i,EE} / HSPF_{i,EE}\}]$ Cooling Savings: $\Delta kW_C = CAP_{Cool} \times \left(\frac{1}{EER_B} - \frac{1}{EER_E}\right)$
Annual Energy Savings	$\Delta kWh/yr = \%Portland \times [\Delta kWh_{HEAT}/yr + \Delta kWh_{COOL}/yr]_{Portland}$ $+ \%Bangor \times [\Delta kWh_{HEAT}/yr + \Delta kWh_{COOL}/yr]_{Bangor}$ $+ \%Caribou \times [\Delta kWh_{HEAT}/yr + \Delta kWh_{COOL}/yr]_{Caribou}$ **Energy Savings[179] and Population Weights[180] for Three Cities in Maine** $\Delta kWh_{HEAT}/yr_{Portland} = 1,474$ $\Delta kWh_{COOL}/yr_{Portland} = 14$ %Portland = 71% $\Delta kWh_{HEAT}/yr_{Bangor} = 1,532$ $\Delta kWh_{COOL}/yr_{Bangor} = 11$ %Bangor = 23% $\Delta kWh_{HEAT}/yr_{Caribou} = 1,773$ $\Delta kWh_{COOL}/yr_{Caribou} = 6$ %Caribou = 5% Heating Savings: Heating savings were calculated based on a model employing the following key assumptions: • DHP is sized to be able to meet 100% of the home's heating load with 100% of its available heating capacity when the outside air temperature is equal to 35°F. (i.e. heat pump balance point of 35°F) • DHP's contribution to heating does not exceed 50% of the home's heating load in any temperature bin. Even in temperature bins in which 100% of the home's heating load can be supplied by the DHP, the DHP supplies 50% of the heating load, and the remaining 50% is supplied by the existing heating system.[181] • DHP heating output capacity and DHP heating efficiency (both baseline and efficient units) vary linearly with outside air temperature. • Heating is called for when outside air temperature is less than or equal to 65°F.

[175] EMT assumes that all purchased units are installed (i.e. ISR = 100%).
[176] The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.
[177] Peak coincidence factors for this measure are embedded in the evaluated peak demand impacts.
[178] This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% NTG.
[179] Based on Excel Workbook for Ductless Heat Pump Retrofit: See
[180] Calculated based on population of each region; U.S. Census Bureau Census 2010 Summary File 1 population by census tract
[181] 50% of load assumption accounts for reduced usage of DHP based on homeowners' lack of experience/confidence with a DHP. This value will be reevaluated for PY 2016 based on results of the on-going Bangor Hydro Evaluation. The validity of the resulting load displacement of 46% (% of the home's heating load) has been verified by benchmarking against findings from: Ductless Heat Pump Impact & Process Evaluation, 2013, Ecotope, http://www.ecotope.com/wp/wp-content/uploads/2014/04/2013_006_DHPImpactBilling.pdf.

Ductless Heat Pump

The total percentage of home heating load displaced in Portland, Bangor, and Caribou are 46%, 45%, and 40%, respectively. The corresponding baseline and efficient DHP consumptions, at each 2-degree weather bin, are shown in **Error! Reference source not found.**.

Cooling Savings[182]

$$[\Delta kWh_{COOL}/yr]_{City} = CAP_{Cool} \times \left(\frac{1}{EER_B} - \frac{1}{EER_E}\right) \times EFLH_{Cool,City}$$

Definitions

Unit	= 1 ductless heat pump (DHP) system
$Output_{i,Base}$	= Output heating rate of the baseline DHP in weather bin *i* (kBtu/h)
$Output_{i,EE}$	= Output heating rate of the high-efficiency DHP in weather bin *i* (kBtu/h)
$HSPF_{i,Base}$	= Heating seasonal performance factor of the baseline DHP in weather bin *i* (Btu/Watt-hr)
$HSPF_{i,EE}$	= Heating seasonal performance factor of the high-efficiency DHP in weather bin *i* (Btu/Watt-hr)
CAP_{Cool}	= Rated cooling capacity of the DHP (kBtu/h)
$EFLH_{Cool,City}$	= Equivalent full load cooling hours for each of the three cities in Maine(hrs/yr)
EER_B	= Peak energy efficiency ratio for baseline DHP (Btu/Watt-hr)
EER_E	= Peak energy efficiency ratio for high-efficiency DHP (Btu/Watt-hr)

EFFICIENCY ASSUMPTIONS

Baseline Efficiency	The baseline case assumes the home retains its existing heating system and adds a new ductless heat pump 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 the home retains its existing heating system and adds a new *high efficiency* ductless heat pump that meets minimum efficiency requirements for program rebate: HSPF=12.0 and SEER=18.0.

PARAMETER VALUES (DEEMED)

Measure	CAP_{Heat}	CAP_{Cool}	$HSPF_B$ / $HSPF_E$	EER_B	EER_E
Ductless Heat Pump	18.7[183]	14.8[183]	Table E-1	11.1[184]	12.3[184]
Measure	**$EFLH_{Cool,City}$**[185]			**Life (yrs)**	**Cost ($)**
Ductless Heat Pump	102 (Portland) 81 (Bangor) 42 (Caribou)			18[186]	$682[187]

IMPACT FACTORS

Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
Ductless Heat Pump	100%[188]	100%[189]	100%[189]	10.7%[190]	79.7%[191]	0%[192]	0%[192]

[182] Weather bin analysis is not used for cooling savings because EFLH and on-peak CF results were available from an evaluation of residential air-conditioners.
[183] Average heating and cooling capacity of 439 units included in Bangor Hydro DHP pilot program (based on program data dated 6/8/2013). Future TRM updates will incorporate data on capacity of units in Efficiency Maine program.
[184] Baseline and high-efficiency EER values are based on the expected minimum SEER values of 14.0 (baseline) and 18.0 (efficient), respectively. The rated SEER values are converted to average EER values based on a correlation between rated SEER and EER for the DHP models included in the Bangor Hydro DHP pilot program.
[185] RLW Analytics, Coincidence Factor Study Residential Room Air Conditioners, June 2008; Table i-2. Values are based on TMY2 weather for Portland and Caribou Maine. We determined the value for Bangor by comparing the EFLH values from the study to the typical cooling degree days (CDD) in each region.
[186] GDS Associates, Inc., Measure Life Report – Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007; Table 1.
[187] 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).
[188] EMT assumes that all purchased units are installed (i.e. ISR = 100%). This is consistent with the MA 2013-2015 TRM.
[189] The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.
[190] The on-peak summer kW savings is calculated directly using the 11.1% coincidence factor used for residential room air-conditioners. The summer coincidence factor is the ratio of the calculated summer on-peak kW savings and the gross kW savings value.
[191] The on-peak winter kW savings is calculated directly using the bin analysis. The winter coincidence factor is the ratio of the calculated winter on-peak kW savings (calculated in the bin analysis) and the gross kW savings value.
[192] This measure has not yet been included in a program evaluation. Due to the low saturation of ductless heat pumps and the high first-costs of this equipment, EMT assumes 0% free-ridership and 0% spillover, until the next program impact evaluation.

High-Efficiency Furnaces and Boilers							
Last Revised Date	7/1/2014 (new in PY2015)						
MEASURE OVERVIEW							
Description	This measure involves the installation of a high-efficiency furnace or boiler instead of a code-compliant furnace or boiler of the same fuel type and capacity (i.e., no fuel switching).						
Energy Impacts	Natural Gas, Heating Oil, Kerosene, Propane, Wood, Pellet						
Sector	Residential						
Program(s)	Home Energy Savings Program						
End-Use	Heating						
Decision Type	New Construction, Replace on Burnout						
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)							
Demand Savings	ΔkW = 0.000						
Annual Energy Savings	Furnace Savings ΔkWh/yr = 0 $\Delta MMBtu_{GAS}$ = 1.6 $\Delta MMBtu_{OIL}$ = 11.6 $\Delta MMBtu_{KERO}$ = 1.1 $\Delta MMBtu_{PROP}$ = 1.1 $\Delta MMBtu_{WOOD}$ = 1.4 $MMBtu_{PELLET}$ = 0.7	Boiler Savings ΔkWh/yr = 0 $\Delta MMBtu_{GAS}$ = 1.2 $\Delta MMBtu_{OIL}$ = 8.6 $\Delta MMBtu_{KERO}$ = 0.8 $\Delta MMBtu_{PROP}$ = 0.8 $\Delta MMBtu_{WOOD}$ = 1.1 $\Delta MMBtu_{PELLET}$ = 0.5					
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)							
Demand Savings	ΔkW = 0.0000						
Annual Energy Savings	$\Delta MMBtu_{FUEL}/yr = CAP_{INPUT} \times EFLH_H \times (EF_{EE} / EF_{BASE} - 1) / 1{,}000 \times \%FUEL$						
Definitions	CAP_{INPUT} = Input capacity of the new equipment (kBtu/h) $EFLH_H$ = Equivalent full load heating hours of the installed high-efficiency unit (hrs/yr) EF_{BASE} = Rated efficiency of the baseline code-compliant unit (AFUE) EF_{EE} = Rated efficiency of the high-efficiency unit (AFUE) 1,000 = Conversion: 1,000 kBtu per MMBtu %FUEL = Home heating fuel distribution excluding coal and other						
EFFICIENCY ASSUMPTIONS							
Baseline Efficiency	The baseline case is a new boiler or furnace that meets the federal minimum efficiency requirements. Assuming an efficiency of 84% AFUE for a new boiler and 83% AFUE for a new furnace.						
Efficient Measure	The high-efficiency equipment exceeds the federal minimum efficiency.						
PARAMETER VALUES (DEEMED)							
Measure	CAP_{INPUT}[193]	$EFLH_H$[194]	EF_{BASE}[195]	EF_{EE}[196]	%FUEL	Life (yrs)[197]	Cost ($)[198]
High Efficiency Furnace	80	1,510	83%	95%	Table D-1	25	5,900
High Efficiency Boiler	80	1,510	84%	93%	Table D-1	25	6,800
IMPACT FACTORS							
Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
High Eff. Furnaces/Boilers	100%[199]	100%[200]	100%[200]	NA	NA	0%[201]	0%[201]

[193] Based on the assumed 40 Btuh/sqft furnace sizing ratio and a home size of 2,000 sqft.
[194] Based on the NY 2010 TRM single family detached heating EFLH and adjusted to Maine using a HDD65 adjustment based on NOAA 1970-2000 Normals. The Maine reference cities used are Portland, Bangor and Caribou and the EFLH were weighted together using census population data.
[195] Table D-2. Minimum Efficiency Requirements for Furnaces and Boilers- based on Code of Federal Regulations: http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&sid=61b33caa9460da7b2e875b478972dfdc&rgn=div6&view=text&node=10:3.0.1.4.18.3&idno=10
[196] Average AFUE for new high-efficiency equipment are based on EMT program tracking data.
[197] GDS, Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007; Table 1, value for new construction.
[198] Incremental costs based on the HESP FY14 Program for efficient boilers and furnaces and the baseline costs are based on the DEER 2008 cost workbook for residential sized furnaces and boilers
http://www.deeresources.com/files/deer0911planning/downloads/DEER2008_Costs_ValuesAndDocumentation_080530Rev1.zip
[199] EMT assumes that all purchased units are installed (i.e. ISR = 100%).
[200] This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.
[201] EMT assumes 100% NTG (0% free-ridership) for the low income sector.

Pellet/Wood Stove	
Last Revised Date	7/1/2014 (new in PY2015)
MEASURE OVERVIEW	
Description	This measure involves purchase and installation of an eligible pellet/wood stove to provide supplemental heat for the existing heating system. Energy savings are achieved due to the reduction in distribution losses when heat is provided by the pellet/wood stove.
Energy Impacts	Wood
Sector	Residential
Program(s)	Home Energy Savings Program
End-Use	Heating
Decision Type	New Construction, Replace on Burnout
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand savings	ΔkW_{SP} = NA ΔkW_{WP} = NA
Annual energy savings	$\Delta MMBtu_{WOOD}$ = 11.6
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	ΔkW = NA
Annual Energy savings	$\Delta MMBtu = MMBtu_{HEAT} \times \%STOVE \times (1/EFF_{BASE} - 1/EFF_{EE})$
Definitions	Unit = New pellet/wood stove $MMBtu_{HEAT}$ = Average heating energy consumption for Maine household (MMBtu) %STOVE = Percentage of heat load served by new pellet/wood stove (%) EFF_{BASE} = Baseline heating equipment efficiency (%) EFF_{EE} = Pellet/wood stove heating efficiency (%)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The baseline case is a non EPA certified pellet/wood stove to provide supplemental heat.
Efficient Measure	The high-efficiency case assumes the home retains its existing heating system and adds a new pellet/wood stove to provide supplemental heat.

PARAMETER VALUES

Measure	$MMBtu_{HEAT}$	%STOVE	EFF_{BASE}	EFF_{EE}			Life (yrs)	Cost ($)
Pellet/Wood Stove	97.4[202]	50%[203]	60%[204]	70%[205]			25[206]	3,000[207]

IMPACT FACTORS

Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
Pellet/Wood Stove	100%[208]	100%[209]	100%[209]	100%[210]	100%[210]	0%[211]	0%[211]

[202] Weighted average value based on estimated heating energy and population distribution for Portland (96, 71%), Bangor (96, 23%), and Caribou (122, 5%).
[203] Estimate, comparison against RECS microdata for the New England census division found percentages in a similar range, though these data were not directly comparable. Primary data collection is the best method for refining this input.
[204] Engineering judgement
[205] U.S. DoE, conservative estimate of pellet stove efficiency: http://energy.gov/energysaver/articles/wood-and-pellet-heating
[206] 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; value for new construction.
[207] Average full cost of participant pellet/wood stove installation minus $700 for standard efficiency stove. Represents installations where the stove was the sole upgrade installed.
[208] EMT assumes that all purchased units are installed (i.e. ISR = 100%).
[209] The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.
[210] Peak coincidence factors for this measure are embedded in the evaluated peak demand impacts.
[211] The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 0% free-ridership and 0% spillover.

Pellet Boiler							
Last Revised Date	7/1/2014 (new in PY2015)						
MEASURE OVERVIEW							
Description	This measure involves purchase and installation of a pellet boiler as a whole-home heating system rather than a new fossil fuel boiler. EMT estimates no energy savings for this measure, but the participating customer achieves overall GHG and fuel cost reductions due to the change in fuel type.						
Energy Impacts	Wood, Oil						
Sector	Residential						
Program(s)	Home Energy Savings Program						
End-Use	Heating						
Decision Type	New Construction, Replacement						
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)							
Demand savings	ΔkW_{SP} = NA ΔkW_{WP} = NA						
Annual energy savings	$\Delta MMBtu_{OIL}$ = 116 $\Delta MMBtu_{PELLET}$ = – 115						
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)							
Demand savings	ΔkW = NA						
Annual Energy savings	$\Delta MMBtu_{BASEFUEL}/yr = MMBtu_{HEAT} \times 1 / EFF_{BASE}$ $\Delta MMBtu_{NEWFUEL}/yr = -(MMBtu_{HEAT} \times 1 / EFF_{PB})$						
Definitions	Unit = New pellet boiler $MMBtu_{HEAT}$ = Average heating load for Maine home (MMBtu) EF_{BASE} = Average baseline heating system efficiency (%) EF_{PB} = Average pellet boiler heating system efficiency (%)						
EFFICIENCY ASSUMPTIONS							
Baseline Efficiency	The baseline case is a new standard efficiency fossil fuel boiler.						
Efficient Measure	The high-efficiency case assumes the home replaces its heating system with a new pellet boiler that meets the minimum efficiency requirements for program rebate.						
PARAMETER VALUES (DEEMED)							
Measure	$MMBtu_{HEAT}$	EFF_{BASE}	EFF_{PB}			Life (yrs)	Cost ($)
Pellet Boiler	97.4[212]	84%[213]	85%[214]			25[215]	12,942[216]
IMPACT FACTORS							
Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
	100%[217]	100%[218]	NA	NA	NA	0%[219]	0%[219]

[212] Weighted average value based on estimated heating energy and population distribution for Portland (96, 71%), Bangor (96, 23%), and Caribou (122, 5%).
[213] Code of Federal Regulations: http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&sid=61b33caa9460da7b2e875b478972dfdc&rgn=div6&view=text&node=10:3.0.1.4.18.3&idno=10
[214] Average efficiency of residential pellet boiler, based on the following models: Pellergy KPS-100-5, Woodpecker Wood-Pellet Boiler, Froling P4
[215] 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; value for new construction.
[216] Average incremental cost of participant pellet boiler. Represents installations where pellet boiler was the sole upgrade installed. Baseline cost reflects cost of a new, code-compliant, 80 kBtuh boiler. Baseline cost based on DEER 2008 cost workbook.
[217] EMT assumes that all purchased units are installed (i.e. ISR = 100%).
[218] The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.
[219] The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% NTG.

Central Air Source Heat Pump (ducted)	
Last Revised Date	7/1/2014 (new in PY2015)
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of new high-efficiency air source heat pump for central heating and cooling rather than a new standard-efficiency air source heat pump. Energy savings are achieved by the improved efficiency of the installed equipment compared to federal standards.
Energy Impacts	Electric
Sector	Residential
Program(s)	Home Energy Savings Program
End-Use	Heating, Cooling
Decision Type	New Construction, Replacement
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand savings	ΔkW_{SP} = 0.054 (0.013 after 1/1/17, based on updated EER baseline of 11.8) ΔkW_{WP} = 0.538 (0.395 after 1/1/17, based on updated HSPF baseline of 8.2)
Annual energy savings	$\Delta kWh/yr$ = 3,087 (2,270 after 1/1/17, based on updated SEER and HSPF baselines of 14 and 8.2 respectively)
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	$\Delta kW_{SP} = CAP_C \times (1 / EER_{BASE} - 1 / EER_{EE}) \times CF_{SP}$ $\Delta kW_{WP} = CAP_H \times (1 / HSPF_{BASE} - 1 / HSPF_{EE}) \times CF_{WP}$
Annual Energy savings	$\Delta kWh = \Delta kWh_{COOL} + \Delta kWh_{HEAT}$ $\Delta kWh_{COOL} = CAP_C \times (1 / SEER_{BASE} - 1 / SEER_{EE}) \times EFLH_{COOL}$ $\Delta kWh_{HEAT} = CAP_H \times (1 / HSPF_{BASE} - 1 / HSPF_{EE}) \times EFLH_{HEAT}$
Definitions	Unit = New ASHP equipment CAP_C = Output cooling capacity of ASHP (kBtu/hr) CAP_H = Output heating capacity of ASHP (kBtu/hr) $SEER_{BASE}$ = SEER of new code-compliant ASHP (Btu/w-hr) (baseline code updates 6/30/16) $SEER_{EE}$ = SEER of new high-efficiency ASHP (Btu/w-hr) $HSPF_{BASE}$ = HSPF of new code-compliant ASHP (Btu/w-hr) (baseline code updates 6/30/16) $HSPF_{EE}$ = HSPF of new high-efficiency ASHP (Btu/w-hr) EER_{BASE} = EER of new code-compliant ASHP (Btu/w-hr) EER_{EE} = EER of new high-efficiency ASHP (Btu/w-hr) CF_{SP} = Summer peak coincidence factor (%) CF_{WP} = Winter peak coincidence factor (%) $EFLH_{HEAT}$ = Equivalent Full Load Hours of Heating (hr) $EFLH_{COOL}$ = Equivalent Full Load Hours of Cooling (hr)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The baseline case is a new code-compliant air-source heat pump to provide heating and cooling.
Efficient Measure	The high-efficiency case is a new high-efficiency air source heat pump with a HSPF greater than or equal to 12.0 Btu/W-h to provide heating and cooling.

Central Air Source Heat Pump (ducted)						
PARAMETER VALUES						
Measure	CAP_C	CAP_H	$SEER_{BASE}$	$SEER_{EE}$	$HSPF_{BASE}$	$HSPF_{EE}$
Central ASHP	36[220]	36[220]	13[221]	18[222]	7.7[221]	10.0[223]
Measure	EER_{BASE}	EER_{EE}	$EFLH_{HEAT}$	$EFLH_{COOL}$	Life (yrs)	Cost ($)
Central ASHP	11.2[224]	12[225]	2,706[226]	231[226]	25[227]	2,000[228]
IMPACT FACTORS						
Measure	ISR	RR_E	RR_D	CF_{SP}	CF_{WP}	FR	SO
Central ASHP	100%[229]	100%[230]	100%[230]	25%[231]	50%[231]	0%[232]	0%[232]

[220] Assumed capacity
[221] U.S. DoE Standard, effective in 2006: http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/75. A grace period is in place for an amendment to the 2006 standard, which delays the updated code until June 30, 2016.
[222] NY TRM 2010 p. 42, ASHP measure, SEER correlated to HSPF of 9.2 (closest HSPF value to 10)
[223] Minimum program requirement
[224] Converted baseline SEER to EER using the following conversion: EER = -0.02*SEER^2+1.12*SEER. U.S. DoE Building America House Simulation Protocols, p. 47, Eq 22, http://www.nrel.gov/docs/fy11osti/49246.pdf
[225] ENERGY STAR database, EER correlated to HSPF of 10: most common EER associated with split ASHP systems with HSPF of 10, viewed 7/16/14
[226] Calculated based on 97.4 MMBTU average heating load for Maine household and 36 kBtuh Central GSHP heating capacity. Average heating load for Maine household is a weighted average value based on estimated heating energy and population distribution for Portland (96, 71%), Bangor (96, 23%), and Caribou (122, 5%).
[227] 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; value for new construction.
[228] Survey of standard and high efficiency system costs at ecomfort.com.
[229] EMT assumes that all purchased units are installed (i.e. ISR = 100%).
[230] The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.
[231] MA TRM 2013 TRM 2010, Air source heat pump peak coincidence factor
[232] The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% NTG.

Central Geothermal (Ground source) Heat Pump	
Last Revised Date	7/1/2014 (new in PY2015)
MEASURE OVERVIEW	
Description	This measure involves the purchase and installation of new Tier 3 high-efficiency geothermal heat pump instead of a Tier 1 standard efficiency geothermal heat pump
Energy Impacts	Electric
Sector	Residential
Program(s)	Home Energy Savings Program
End-Use	Heating, Cooling
Decision Type	New Construction, Replace on Burnout
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand savings	ΔkW_C = 0.516 ΔkW_H = 0.357
Annual energy savings	$\Delta kWh/yr$ = 1086 $\Delta kWh_C/yr$ = 119 $\Delta kWh_H/yr$ = 967
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand savings	$\Delta kW_H = CAP_H \times (1/COP_{BASE} - 1 / COP_{EE}) \times 1/3.412$ $\Delta kW_C = CAP_C \times (1/EER_{BASE} - 1/EER_{EE})$
Annual Energy savings	<u>Heating Savings:</u> $\Delta kWh_H/yr = CAP_H \times (1/COP_{BASE} - 1 / COP_{EE}) \times 1 / 3.412 \times EFLH_H$ <u>Cooling Savings:</u> $\Delta kWh_C/yr\ CAP_C \times (1/EER_{BASE} - 1/EER_{EE})] \times EFLH_C$
Definitions	Unit = new geothermal heat pump system CAP_C = Output cooling capacity of geothermal heat pump at 95°F (kBtu/hr) CAP_H = Output heating capacity of geothermal heat pump at 47°F (kBtu/hr) CAP_B = Assumed rated cooling capacity of a window A/C unit at 95°F (kBtu/hr) $\%COOL_{FULL}$ = Percentage of homes with existing cooling equipment equivalent of a whole home air conditioner (equivalent of 3 window A/C units) (%) $\%COOL_{NONE}$ = Percentage of homes with no existing cooling equipment (%) $\%COOL_{PARTIAL}$ = Percentage of homes with existing partial cooling, equivalent of (1-2 window A/C units) (%) $EFLH_C$ = Equivalent full load cooling hours (hours/yr) $AFUE_{BASE}$ = Annual fuel utilization efficiency of the existing heating system (%) EER_B = Assumed energy efficiency ratio for existing cooling equipment (Btu/Watt-hr) EER_E = Rated energy efficiency ratio for GSHP (Btu/Watt-hr) COP_{EE} = COP of geothermal heat pump $EFLH_{HEAT}$ = Equivalent Full Load Hours of Heating (Btu/w-hr) $EFLH_{COOL}$ = Equivalent Full Load Hours of Cooling (Btu/w-hr)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	The baseline case is a Tier 1 standard efficiency geothermal heat pump.
Efficient Measure	The high-efficiency case is a new Tier 3 geothermal heat pump system to provide heating and cooling.

Central Geothermal (Ground source) Heat Pump										
PARAMETER VALUES										
Measure	CAP_H	CAP_C	COP_{BASE}	COP_{EE}	EER_{BASE}	EER_{EE}	$EFLH_H$	$EFLH_C$	Life (yrs)	Cost ($)
GSHP	36[233]	36[234]	3.6[235]	4.1[236]	16.2[237]	21.1[238]	2,706[239]	231[240]	25[241]	2,000[242]
IMPACT FACTORS										
Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO			
GSHP	100%[243]	100%[244]	100%[244]	100%[245]	100%[245]	0%[246]	0%[246]			

[233] As referenced in MA 2013 TRM: ADM Associates, Inc. (2009). Residential Central AC Regional Evaluation. Prepared for NSTAR, National Grid, Connecticut Light & Power and United Illuminating; Page 4-12, Table 4-9.
[234] As referenced in MA 2013 TRM: ADM Associates, Inc. (2009). Residential Central AC Regional Evaluation. Prepared for NSTAR, National Grid, Connecticut Light & Power and United Illuminating; Page 4-12, Table 4-9.
[235] Energy Start Geothermal Heat Pumps Key Product Criteria Open Loop Water-to-air Tier 1
[236] Energy Start Geothermal Heat Pumps Key Product Criteria Open Loop Water-to-air Tier 3
[237] Energy Start Geothermal Heat Pumps Key Product Criteria Open Loop Water-to-air Tier 1
[238] Energy Start Geothermal Heat Pumps Key Product Criteria Open Loop Water-to-air Tier 3
[239] Calculated based on 97.4 MMBTU average heating load for Maine household and 36 kBtuh Central GSHP heating capacity. Average heating load for Maine household is a weighted average value based on estimated heating energy and population distribution for Portland (96, 71%), Bangor (96, 23%), and Caribou (122, 5%).
[240] NY TRM 2010, average EFLH for the New York cities of Binghamton and Massena. The hours for these cities were mapped to the Maine cities of Portland, Bangor (Binghamton) and Caribou (Massena). Hours were scaled by degree days for each city. Final hours represent an average weighted by city population.
[241] 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; value for new construction.
[242] Average full cost of participant geothermal heat pump installation minus assumed cost of standard efficiency system. Represents installations where geothermal heat pump was the sole upgrade installed.
[243] EMT assumes that all purchased units are installed (i.e. ISR = 100%).
[244] The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.
[245] Peak coincidence factors for this measure are embedded in the evaluated peak demand impacts.
[246] The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% NTG.

On-Demand Natural Gas Water Heater							
Last Revised Date	7/1/2014 (new in PY2015)						
MEASURE OVERVIEW							
Description	This measure involves purchase and installation of new on-demand (instantaneous) natural gas-fired water heater rather than a new standard tank water heater. Energy savings are achieved by reducing the standby losses from the tank water heater.						
Energy Impacts	Natural Gas						
Sector	Residential						
Program(s)	Home Energy Savings Program						
End-Use	Heating, Cooling						
Decision Type	New Construction, Replacement						
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)							
Demand savings	ΔkW = NA						
Annual energy savings	ΔkWh/yr = 0 ΔMMBtu/yr = 5.8						
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)							
Demand savings	ΔkW = NA						
Annual Energy savings	ΔkWh/yr = 0 $\Delta MMBtu/yr = GAL \times 8.33 \times 1 \times (T_{WH} - T_{in}) \times (1/EF_{BASE} - 1/EF_{EE}) / 1{,}000{,}000$						
Definitions	Unit = new on-demand natural gas water heater GAL = Average amount of hot water consumed annually per Maine household (gal/yr/home) T_{WH} = Water heater setpoint temperature (°F) T_{in} = Average water at the main (°F) EF_{BASE} = Energy factor for baseline stand alone tank water heater (%) EF_{EE} = Energy factor for on-demand water heater (%) 8.33 = Density of water: 8.33 lb/gallon water 1 = Specific heat of water: 1 Btu/lb-°F 1,000,000 = Conversion: 1,000,000 Btu/MMBtu						
EFFICIENCY ASSUMPTIONS							
Baseline Efficiency	The baseline case is a new standard-efficiency natural gas fired tank water heater.						
Efficient Measure	The high-efficiency case is a new on-demand (instantaneous) natural gas fired water heater with energy factor at least 0.88.						
PARAMETER VALUES							
Measure	GAL	T_{sp}	T_{in}	EF_{BASE}	EF_{EE}	Life (yrs)	Cost ($)
On-Demand Natural Gas Water Heater	18,655[247]	126.2[248]	50.8[249]	0.615[250]	0.88[251]	25[252]	1,171[253]
IMPACT FACTORS							
Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
On-Demand Natural Gas Water Heater	100%[254]	100%[254]	NA	NA	NA	0%[255]	0%[255]

[247] Calculated using 51.1 gallons/day/home, based on people/home in ME, using scaled hot water amounts per NY and IN TRMs
[248] NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014
[249] Standard Building America DHW Schedules, weighted average by population of all Maine water main sources
[250] Federal water heater standard, DoE Standard 10 CFR 430.32(d), EF of 0.615 effective 4/16/2015. Prior to 4/16/2015, EF is 0.594. EF assumes a 40 gallon storage tank
[251] Program minimum requirement
[252] 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; value for new construction.
[253] Average incremental cost of participant on-demand natural gas hot water heater unit. Represents installations where the unit was the sole upgrade installed. Baseline cost reflects cost of a new, code-compliant, storage, gas, hot water heater. Baseline cost based on DEER 2008 cost workbook.
[254] EMT assumes that all purchased units are installed (i.e. ISR = 100%).
[255] The measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% NTG.

Low Income Program

Direct Install CFL Bulb							
Last Revised Date	7/1/2014 (New in PY2015)						
MEASURE OVERVIEW							
Description	This measure involves the direct installation for CFLs to replace existing incandescent bulbs.						
Primary Energy Impact	Electricity						
Sector	Low Income						
Program(s)	Low Income Program						
End-Use	Lighting						
Decision Type	Retrofit						
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)							
Demand savings	ΔkW = 0.049						
Annual energy savings	ΔkWh/yr = 36						
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)							
Demand savings	ΔkW = $\Delta Watt_{CFL}$ / 1,000						
Annual energy savings	ΔkWh/yr = $\Delta Watt_{CFL}$ / 1,000 x Hours x 365						
Definitions	Unit = 1 bulb $\Delta Watt_{CFL}$ = Average wattage difference between baseline bulbs and program CFLs (Watts) Hours = Average daily operating hours (hrs/day) 1,000 = Conversion: 1,000 Watts per kW 365 = Conversion: 365 days per year						
EFFICIENCY ASSUMPTIONS							
Baseline Efficiency	The baseline case is the existing incandescent bulb. Since the baseline is the existing equipment, EISA standards do not apply.						
Efficient Measure	ENERGY STAR® certified CFL bulb						
PARAMETER VALUES (DEEMED)							
Measure	$\Delta Watt_{CFL}$	Hours	Life (yrs)	Cost ($)			
Direct Install CFL Bulb	49[256]	2.04[257]	12.5[258]	Actual			
IMPACT FACTORS							
Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
Direct Install CFL Bulb	100%[259]	100%[260]	100%[12]	6.8%[261]	18.4%[261]	0%[262]	0%[262]

[256] The Cadmus Group, Efficiency Maine Trust Residential Lighting Program Evaluation, November 1, 2012, page 19.
[257] Ibid, page 20.
[258] Ibid, page 23.
[259] EMT assumes 100% installation for direct install measures.
[260] Realization rates are 100% since savings estimates are based on evaluation results.
[261] See Appendix B: Coincidence and Energy Period Factors.
[262] EMT assumes 100% NTG (0% free-ridership) for the low income sector.

Low Income Multifamily Gas Heat							
Last Revised Date	7/1/2014 (new in PY2015)						
MEASURE OVERVIEW							
Description	This measure involves the installation of a new natural gas heating system and building weatherization measures to replace the existing natural gas heating equipment.						
Energy Impacts	Natural Gas						
Sector	Low Income						
Program(s)	Low Income Program						
End-Use	Heating						
Decision Type	Retrofit						
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)							
Demand savings	ΔkW = NA						
Annual energy savings	ΔkWh/yr = 0 $\Delta MMBtu_{GAS}$ = Calculated using project-specific data						
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)							
Demand Savings	The program does not estimate demand savings for these projects.						
Annual Energy Savings	The program estimates annual natural gas savings using project-specific data and building modeling software.						
Definitions	Unit = Low income multifamily gas heat project $\Delta MMBtu_{GAS}$ = Modeled annual natural gas savings for weatherization and heating system upgrade (MMBtu)						
EFFICIENCY ASSUMPTIONS							
Baseline Efficiency	The baseline scenario is the existing low income multifamily building and heating system equipment.						
Efficient Measure	The high-efficiency measures involves weatherizing the building and replacing the existing natural gas heating equipment with new high-efficiency natural gas heating equipment.						
PARAMETER VALUES							
Measure	$\Delta MMBtu_{GAS}$					Life (yrs)	Cost ($)
Multifamily Gas Heat	Model					20[263]	Actual
IMPACT FACTORS							
Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
Multifamily Gas Heat	100%[264]	100%[265]	100%[265]	NA	NA	0%[266]	0%[266]

[263] GDS, Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007; Table 1, value for weatherization measures.
[264] EMT assumes that all purchased units are installed (i.e. ISR = 100%).
[265] This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.
[266] EMT assumes 100% NTG (0% free-ridership) for the low income sector.

Furnace and Boiler Retrofit							
Last Revised Date	7/1/2014 (new in PY2015)						
MEASURE OVERVIEW							
Description	This measure involves the replacement of an existing furnace or boiler with a high-efficiency furnace or boiler of the same fuel type and capacity (i.e., no fuel switching).						
Energy Impacts	Natural Gas, Heating Oil, Kerosene, Propane, Wood, Pellet						
Sector	Residential, Low Income						
Program(s)	Low Income Program, Home Energy Savings Program						
End-Use	Heating						
Decision Type	Retrofit						
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)							
Demand savings	$\Delta kW = 0.000$						
Annual energy savings	Furnace Savings	Boiler Savings					
	$\Delta kWh/yr = 0$	$\Delta kWh/yr = 0$					
	$\Delta MMBtu_{GAS} = 3.0$	$\Delta MMBtu_{GAS} = 2.7$					
	$\Delta MMBtu_{OIL} = 21.4$	$\Delta MMBtu_{OIL} = 19.2$					
	$\Delta MMBtu_{KERO} = 2.0$	$\Delta MMBtu_{KERO} = 1.8$					
	$\Delta MMBtu_{PROP} = 2.0$	$\Delta MMBtu_{PROP} = 1.8$					
	$\Delta MMBtu_{WOOD} = 3.9$	$\Delta MMBtu_{WOOD} = 3.6$					
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)							
Demand savings	$\Delta kW = 0$						
Annual Energy Savings	$\Delta kWh/yr = 0$ $\Delta MMBtu_{FUEL}/yr = CAP_{INPUT} \times EFLH_H \times (EF_{EE} / EF_{BASE} - 1) / 1{,}000 \times \%FUEL$						
Definitions	Unit = 1 new furnace or boiler CAP_{INPUT} = Input capacity of the new equipment (kBtu/h) $EFLH_H$ = Equivalent full load heating hours of the installed high-efficiency unit (hrs/yr) EF_{BASE} = Rated efficiency of the baseline existing unit (AFUE) EF_{EE} = Rated efficiency of the high-efficiency unit (AFUE) 1,000 = Conversion: 1,000 kBtu per MMBtu %FUEL = Home heating fuel distribution excluding coal and other						
EFFICIENCY ASSUMPTIONS							
Baseline Efficiency	The baseline is the existing furnace or boiler.						
Efficient Measure	The high-efficiency case is a new furnace or boiler that exceeds the federal minimum efficiency standards.						
PARAMETER VALUES (DEEMED)							
Measure	CAP_{INPUT}	$EFLH_H$	EF_{BASE}	EF_{EE}	%FUEL	Life (yrs)	Cost ($)
Furnace Retrofit	80[267]	1,510[268]	75%[269]	95%[270]	Table D-1	25[271]	7,200[272]
Boiler Retrofit	80[267]	1,510[268]	75%[269]	93%[270]	Table D-1	25[271]	10,100[272]
IMPACT FACTORS							
Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
Furnace/Boiler Retrofit	100%[273]	100%[274]	100%[274]	NA	NA	0%[275]	0%[275]

[267] Based on the assumed 40 Btuh/sqft furnace sizing ratio and a home size of 2,000 sqft.
[268] Based on the NY 2010 TRM single family detached heating EFLH and adjusted to Maine using a HDD65 adjustment based on NOAA 1970-2000 Normals. The Maine reference cities used are Portland, Bangor and Caribou and the EFLH were weighted together using census population data.
[269] Average AFUE for existing furnace/boiler based on EMT program tracking data. Code of Federal Regulations: http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&sid=61b33caa9460da7b2e875b478972dfdc&rgn=div6&view=text&node=10:3.0.1.4.18.3&idno=10 specified a minimum AFUE of 78% for units manufactured before May 1, 2013. The 3% difference between minimum required AFUE and existing AFUE can be explained by the degradation of combustion efficiency; according to EMT's tracking database, the average manufactured year for existing furnaces/boilers was 1992.
[270] Average AFUE for new high-efficiency equipment are based on EMT program tracking data.
[271] GDS, Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007; Table 1, value for new construction.
[272] Full costs based on the HESP FY14 Program for efficient boilers and furnaces
[273] EMT assumes that all purchased units are installed (i.e. ISR = 100%).
[274] This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.
[275] EMT assumes 100% NTG (0% free-ridership) for the low income sector.

Ductless Heat Pump Retrofit		
Last Revised Date	7/1/2014	
MEASURE OVERVIEW		
Description	This measure involves the purchase and installation of a high efficiency ductless heat pump (DHP) system to supplement the existing heating system in electric, gas, oil, kerosene, propane, wood and pellet heated homes and to replace existing window air conditioning units. The new DHP equipment may have one (single-head) or multiple (multi-head) indoor units per outdoor unit.	
Energy Impacts	Electric, Heating Oil, Propane, Kerosene, Wood, Pellet	
Sector	Residential	
Program(s)	Low Income Program	
End-Use	Cooling, Heating	
Decision Type	Retrofit	
DEEMED GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)		
Demand Savings	*For spaces with baseline electric heating:* ΔkW_C = -0.13, ΔkW_{SP} =- 0.01 ΔkW_H = 2.05, ΔkW_{WP} = 1.72 *For spaces with baseline non-electric heating:* ΔkW_C = −0.13, ΔkW_{SP} =- 0.01 ΔkW_H = −1.18, ΔkW_{WP} = -0.94	
Annual Energy Savings	*For spaces with baseline electric heating:* $\Delta kWh/yr$ = 8,530 ΔkWh_H = 8,559 ΔkWh_C = −29	*For spaces with baseline non-electric heating:* $\Delta kWh/yr$ = -4,347 ΔkWh_H = -4,318 ΔkWh_C = −29 $\Delta MMBTU$ = 78.1
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)		
Demand Savings	<u>Heating Savings:</u> Heating savings were calculated based on a model. See Energy Savings for more details. <u>Cooling Savings:</u> $\Delta kW_C = [\%COOL_{FULL} \times CAP_{COOL} \times [(1/EER_B) - (1/EER_E)]] + [\%COOL_{NONE} \times CAP_{COOL} \times (-1/EER_E)]$	
Annual Energy Savings	<u>Heating Savings</u> Heating savings were calculated based on a model[276] employing the following key assumptions: • Ducted systems have 25% losses due to distribution through the ducts. • DHP is sized to be able to meet 100% of the home's heating load with 100% of its available heating capacity when the outside air temperature is equal to 35°F. (i.e. heat pump balance point of 35°F) • DHP's contribution to heating does not exceed 50% of the home's heating load in any temperature bin. Even in temperature bins in which 100% of the home's heating load can be supplied by the DHP, the DHP supplies 50% of the heating load, and the remaining 50% is supplied by the existing heating system.[277] • DHP heating output capacity and DHP heating efficiency vary linearly with outside air temperature. • Heating is called for when outside air temperature is less than or equal to 65°F. The amount of home's heating load displaced by the Ductless Heat Pump in the full range of temperature bins is shown in Table E-3. The corresponding avoided energy consumption avoided and additional energy consumption are also shown.	

[276] Based on Excel Workbook for Ductless Heat Pump Retrofit: see Table E-3. Heating Load Displaced by Ductless Heat Pump Retrofit**Error! Reference source not found.** for heating load displaced by the measure.

[277] 50% of load assumption accounts for reduced usage of DHP based on homeowners' lack of experience/confidence with a DHP. This value will be reevaluated for PY 2016 based on results of the on-going Bangor Hydro Evaluation. The validity of the resulting load displacement of 46% (% of the home's heating load) has been verified by benchmarking against findings from: Ductless Heat Pump Impact & Process Evaluation, 2013, Ecotope, http://www.ecotope.com/wp/wp-content/uploads/2014/04/2013_006_DHPImpactBilling.pdf.

Ductless Heat Pump Retrofit

Cooling Savings:

$\Delta kWh_{COOL}/yr = EFLH_C \times \{[\%COOL_{FULL} \times CAP_{COOL} \times [(1/EER_B) - (1/EER_E)]] + [\%COOL_{NONE} \times CAP_{COOL} \times (-1/EER_E)]\}$

Cooling savings algorithm is based on the following key assumptions:

- For homes that have equivalent of whole home A/C already installed, DHP will replace the cooling load equivalent to the DHP's rated capacity.
- For homes that have existing partial cooling (i.e. 1 or 2 existing window A/C units), it is unknown if the DHP will be installed in the same areas served by the existing window A/C units. If installed in the same area, the DHP will replace the existing cooling load and result in positive savings due to increased efficiency. However, if installed in a different area, DHP may result in additional cooling load and hence negative savings. Without any in-situ data, zero net savings is assumed for homes with existing partial cooling.
- For homes with no existing cooling equipment, it is assumed that the DHP will be used to its full cooling capacity.

Definitions

$\Delta kWh/yr$	= Electric savings (kWh/yr)
$\Delta MMBTU/yr$	= Fossil fuel savings (MMBTU/yr)
CAP_{HEAT}	= Rated heating capacity of the outdoor unit at 47°F (kBtu/hr)
CAP_{COOL}	= Rated cooling capacity of the outdoor unit at 95°F (kBtu/hr)
$\%COOL_{FULL}$	= Percentage of homes with existing cooling equipment equivalent of a whole home air conditioner (equivalent of 3 window A/C units)
$\%COOL_{NONE}$	= Percentage of homes with no existing cooling equipment
$EFLH_C$	= Equivalent full load cooling hours (hours/yr)
DL_{HEAT}	= Multiplier for heating system distribution losses (e.g., ducts)
ELEC-HEAT	= Binary indicator for electric heating
$EFF\text{-}HEAT_{BASE}$	= Efficiency of baseline heating system (%)
$HSPF_E$	= Heating seasonal performance factor for DHP (Btu/Watt-hr)
EER_B	= Rated energy efficiency ratio for baseline cooling equipment (Btu/Watt-hr)
EER_E	= Rated energy efficiency ratio for DHP (Btu/Watt-hr)

EFFICIENCY ASSUMPTIONS

Baseline Efficiency	The baseline case assumes the home retains its existing electric resistance, oil, kerosene, or propane heating system and uses a window air conditioning unit for cooling (or has no cooling).
Efficient Measure	The high-efficiency case assumes the home retains its existing heating system and adds a new *high efficiency* ductless heat pump that meets minimum efficiency requirements for program rebate: HSPF=12.0 Btu/W-h.

PARAMETER VALUES

Measure	CAP_{COOL}	CAP_{HEAT}	EER_E	EER_B	$\%COOL_{FULL}$	$\%COOL_{NONE}$
DHP Retrofit	14.5[279]	18.7[278]	12.3[279]	9.8[280]	40%[281]	21%[281]
Measure	$EFLH_C$	$EFF\text{-}HEAT_{BASE}$	$HSPF_E$	DL_{HEAT}	Life (yrs)	Cost ($)
DHP Retrofit	231[282]	Table 1	Table E-1	Table 1	10[283]	$2,249[284]

[278] Average heating and cooling capacities of eligible Ductless Heat Pump units were found to be 18.7 kBTU/h and 14.8 kBTU/h, respectively.
[279] Calculated based on Bangor Hydro DHP Pilot unit data; linear regression analysis of SEER and EER values.
[280] 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 9-12 years, most units will meet this standard.
[281] Portland Press Herald, http://www.pressherald.com/2014/05/26/put_power_rates_on_ice__that_s_a_cool_idea_/. In 2010, an estimated 79% of customers in ISO-New England region had room air conditioners. Of the 79%, 40% of homes have equivalent of whole home A/C (3 window A/C's); 39% of homes have total cooling capacity equivalent of 1 or 2 window A/C units. The remaining 21% have no cooling equipment installed.
[282] NY TRM 2010, average EFLH for the New York cities of Binghamton and Massena. The hours for these cities were mapped to the Maine cities of Portland, Bangor (Binghamton) and Caribou (Massena). Hours were scaled by degree days for each city. Final hours represent an average weighted by city population.
[283] TRMs typically use 15-18 years for Commercial HVAC equipment. However, due to the anticipated long run times for DHP equipment, EMT assumes a shorter measure life of 10 years.
[284] Efficiency Maine program actual project costs from PY2014.

Ductless Heat Pump Retrofit							
IMPACT FACTORS							
Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
DHP Retrofit Electric Baseline	100%[285]	100%[286]	100%[286]	10.2%[287]	83.7%[287]	0%[288]	0%[288]
DHP Retrofit Non-Electric Baseline				10.2%287	79.6%[287]		

Table 1. Parameters for Existing Heating Systems

Measure	Existing Heating System	Existing Heating System Efficiency ($EFF\text{-}HEAT_{BASE}$)[A]	Heating System Distribution Losses (DL_{HEAT})[B]
DHP Retrofit (Electric Heat Baseline)	Electric Resistance	1.00	1.00
DHP Retrofit (Non-Electric Heat Baseline)	Ducted Fuel-Fired Heating System (Oil; Propane; Kerosene; Wood/Pellet)	0.75	1.33

[A] Average AFUE for existing furnace/boiler based on EMT program tracking data. Code of Federal Regulations: http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&sid=61b33caa9460da7b2e875b478972dfdc&rgn=div6&view=text&node=10:3.0.1.4.18.3&idno=10 specified a minimum AFUE of 78% for units manufactured before May 1, 2013. The 3% difference between minimum required AFUE and existing AFUE can be explained by the degradation of combustion efficiency; according to EMT's tracking database, the average manufactured year for existing furnaces/boilers was 1992.

[B] Distribution losses are counted for ducted systems. 25% loss is assumed for all ducted systems, based on information from US DOE: Better Duct Systems for Home Heating and Cooling (http://www.nrel.gov/docs/fy05osti/30506.pdf)

[285] EMT assumes that all purchased units are installed (i.e. ISR = 100%).
[286] This measure is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.
[287] See Appendix B.
[288] This measure is new and has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% NTG.

Low Flow Kitchen Aerator

Last Revised Date	7/1/2013
MEASURE OVERVIEW	
Description	This measure involves the replacement of existing kitchen aerators with low-flow aerators. The savings assume all fixtures are served by electric water heaters.
Primary Energy Impact	Electric (additional impacts include: water)
Sector	Residential
Program(s)	Low Income Program
End-Use	Domestic Hot Water
Decision Type	Retrofit
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand Savings	ΔkW = 4.414
Annual Energy Savings	$\Delta kWh/yr$ = 283
Annual Water Savings	$\Delta Gallons/yr$ = 2,696
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = \Delta kWh/yr / (N_{ppl} \times t \times 365 / 60 / N_{fixtures})$
Annual Energy Savings	$\Delta kWh/yr = N_{ppl} \times t \times 365 \times (GPM_{BASE} - GPM_{EE}) / N_{fixtures} \times \rho_{H20} \times Cp_{H20} / 3{,}413 \times (T_{pou} - T_{in}) / RE_{EWH}$
Annual Water Savings	$\Delta Gallons/yr = N_{ppl} \times t \times 365 \times (GPM_{BASE} - GPM_{EE}) / N_{fixtures}$
Definitions	Unit = 1 kitchen aerator N_{ppl} = number of people per home (person/home) t = total time all kitchen aerators are used per day per person (min/day/person) GPM_{BASE} = baseline flowrate of kitchen aerator (gallon/min) GPM_{EE} = measure flowrate of kitchen aerator (gallon/min) $N_{fixtures}$ = number of kitchen sinks (sinks/home) T_{pou} = temperature at point of use (°F) T_{in} = temperature of water mains (°F) RE_{EWH} = Recovery efficiency of electric hot water heater ρ_{H20} = Density of water (8.33 lbs per gallons) Cp_{H20} = Specific heat of water: 1 Btu/lb/°F 3,413 = Conversion: 3,413 Btu per kWh 365 = Conversion: 365 days per year 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.[289]
Efficient Measure	High Efficiency Kitchen Faucet Aerator (1.5 GPM)

PARAMETER VALUES (DEEMED)

Measure	t	N_{ppl}	GPM_{BASE}	GPM_{EE}	$N_{fixtures}$	T_{pou}	T_{in}	RE_{EWH}	Life (yrs)	Cost ($)
Low Flow Kitchen Aerator	4.51[290]	2.34[291]	2.2[289]	1.5**Error! Bookmark not defined.**	1[292]	93[290]	50.8[293]	0.98[294]	5[295]	2[296]

IMPACT FACTORS

Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
Low Flow Kitchen Aerator	100%[297]	100%[298]	100%[298]	0.8%[299]	1.2%[299]	0%[300]	0%[300]

[289] Federal Standard, Code of Federal Regulations, Title 10, Part 430, Subpart C.
[290] The Cadmus Group and Opinion Dynamics, MEMO: Showerhead and Faucet Aerator Meter Study, June 2013. Prepare for Michigan Evaluation Working Group.
[291] American Community Survey, 2011 1 year estimate for population of Maine: http://www.census.gov/acs/www/
[292] Assumed value: 1 kitchen faucet per home.
[293] Standard Building America DHW Schedules, weighted average by population of all Maine water main sources.
[294] NREL, Building America Research Benchmark Definition, 2009, p.12, http://www.nrel.gov/docs/fy10osti/47246.pdf
[295] 2010 Ohio TRM: conservative estimate based on review of TRM assumptions from other states.
[296] 2010 Ohio TRM: Navigant Consulting, Ontario Energy Board; "Measures and Assumptions for Demand Side Management (DSM) Planning", April 2009.

Low Flow Bathroom Aerator

Last Revised Date	7/1/2013
MEASURE OVERVIEW	
Description	EPA WaterSense Low Flow Aerator. This measure involves the replacement of existing bathroom aerators with low-flow aerators. The savings assume all fixtures are served by electric water heaters.
Primary Energy Impact	Electric (additional impacts include: water)
Sector	Residential
Program(s)	Low Income Program
End-Use	Domestic Hot Water
Decision Type	Retrofit
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand Savings	ΔkW = 3.682
Annual Energy Savings	$\Delta kWh/yr$ = 29
Annual Water Savings	$\Delta Gallons/yr$ = 333
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = \Delta kWh/yr / (N_{ppl} \times t \times 365 / 60 / N_{fixture})$
Annual Energy Savings	$\Delta kWh/yr = N_{ppl} \times t \times 365 \times (GPM_{BASE} - GPM_{EE}) / N_{fixture} \times \rho_{H20} \times Cp_{H20} / 3{,}413 \times (T_{pou} - T_{in}) / RE_{EWH}$
Annual Water Savings	$\Delta Gallons/yr = N_{ppl} \times t \times 365 \times (GPM_{BASE} - GPM_{EE}) / N_{fixture}$
Definitions	Unit = 1 bathroom aerator GPM_{BASE} = baseline flowrate of bathroom aerator (gallon/min) GPM_{EE} = measure flowrate of bathroom aerator (gallon/min) t = total time all bathroom aerators are used per day per person (min/day/person) N_{ppl} = number of people per home (person/home) $N_{fixture}$ = number of bathroom sinks (sinks/home) T_{pou} = temperature at point of use (°F) T_{in} = temperature of water mains (°F) RE_{EWH} = recovery efficiency of electric hot water heater ρ_{H20} = Density of water (8.33 lbs per gallons) Cp_{H20} = Specific heat of water: 1 Btu/lb/°F 3,413 = Conversion: 3,413 Btu per kWh 365 = Conversion: 365 days per year 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.[301]
Efficient Measure	USEPA WaterSense High Efficiency Bathroom Sink Faucet (1.5 GPM)[302]

PARAMETER VALUES (DEEMED)

Measure	t	N_{ppl}	$N_{fixture}$	GPM_{BASE}	GPM_{EE}	T_{pou}	T_{in}	RE_{EWH}	Life (yrs)	Cost ($)
Low Flow Bathroom Aerator	1.65[303]	2.34[304]	2.96[305]	2.2[301]	1.5[302]	86[303]	50.8[306]	0.98[307]	5[308]	2[309]

IMPACT FACTORS

Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO

[297] EMT assumes that all purchased units are installed (i.e. ISR = 100%). This is consistent with the MA 2013-2015 TRM.
[298] This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.
[299] See Appendix B: Coincidence and Energy Period Factors.
[300] EMT assumes 0% freeridership and 0% spillover (i.e., NTG = 100%) for all measures implemented through the low income program.
[301] Federal Standard, Code of Federal Regulations, Title 10, Part 430, Subpart C.
[302] http://www.epa.gov/WaterSense/docs/faucet_spec508.pdf
[303] The Cadmus Group and Opinion Dynamics, MEMO: Showerhead and Faucet Aerator Meter Study, June 2013. Prepare for Michigan Evaluation Working Group.
[304] American Community Survey, 2011 1 year estimate for population of Maine: http://www.census.gov/acs/www/
[305] 2009 Residential Energy Consumption Survey (RECS). Microdata for CT, ME, NH, RI, and VT single-family detached homes; assuming 1.5 faucets per full bathroom and 1 per half bathroom.
[306] Standard Building America DHW Schedules, weighted average by population of all Maine water main sources.
[307] NREL, Building America Research Benchmark Definition, 2009, p.12, http://www.nrel.gov/docs/fy10osti/47246.pdf
[308] 2010 Ohio TRM: conservative estimate based on review of TRM assumptions from other states.
[309] 2010 Ohio TRM: Navigant Consulting, Ontario Energy Board; "Measures and Assumptions for Demand Side Management (DSM) Planning", April 2009.

Low Flow Bathroom Aerator	100%[310]	100%[311]	100%[311]	0.3%[312]	0.4%[312]	0%[313]	0%[313]

Low Flow Showerhead									
Last Revised Date	7/1/2013								
MEASURE OVERVIEW									
Description	EPA WaterSense Low Flow Showerhead. This measure involves the replacement of existing showerheads with low-flow showerheads. The savings assume all fixtures are served by electric water heaters.								
Primary Energy Impact	Electric (additional impacts include: water)								
Sector	Residential								
Program(s)	Low Income Program								
End-Use	Domestic Hot Water								
Decision Type	Retrofit								
DEEMED ENERGY SAVINGS (UNIT SAVINGS)									
Demand Savings	ΔkW = 3.751								
Annual Energy Savings	$\Delta kWh/yr$ = 150								
Annual Water Savings	$\Delta Gallons/yr$ = 1,200								
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)									
Demand Savings	$\Delta kW = \Delta kWh/yr / (N_{ppl} \times t \times 365 \times N_{showers} / 60 / N_{fixture})$								
Annual Energy Savings	$\Delta kWh/yr = N_{ppl} \times t \times 365 \times N_{showers} / N_{fixture} \times (GPM_{BASE} - GPM_{EE}) \times \rho_{H20} \times C_{H20} / 3{,}413 \times (T_{pou} - T_{in}) / RE_{EWH}$								
Annual Water Savings	$\Delta Gallons/yr = N_{ppl} \times t \times 365 \times N_{showers} / N_{fixture} \times (GPM_{BASE} - GPM_{EE})$								
Definitions	Unit = 1 efficient showerhead GPM_{BASE} = baseline flowrate of showerhead (gallon/min) GPM_{EE} = measure flowrate of showerhead (gallon/min) t = length of shower (minutes/shower) N_{ppl} = number of people per home (person/home) $N_{showers}$ = number of showers per person per day (showers/person/day) $N_{fixture}$ = number of showerheads (showerhead/home) T_{pou} = temperature at point of use (°F) T_{in} = temperature of water mains (°F) RE_{EWH} = recovery efficiency of electric hot water heater ρ_{H20} = Density of water: 8.33 lbs per gallons C_{H20} = Specific heat of water: 1 Btu/lb/°F 3,413 = Conversion: 3,413 Btu per kWh 365 = Conversion: 365 day per year 60 = Conversion: 60 minutes per hour								
EFFICIENCY ASSUMPTIONS									
Baseline Efficiency	Federal standards set a maximum 2.5 GPM for all showerheads manufactured after January 1, 1994.[314]								
Efficient Measure	USEPA Watersense High Efficiency Showerhead (2.0 GPM)[315]								
PARAMETER VALUES (DEEMED)									
Measure	t	N_{ppl}	$N_{showers}$	$N_{fixture}$	GPM_{BASE}	GPM_{EE}	T_{pou}	T_{in}	RE_{EWH}
Low Flow Showerhead	7.83[316]	2.34[317]	0.61[316]	1.7[318]	2.5[314]	2.0[319]	101[316]	50.8[320]	0.98[321]

[310] EMT assumes that all purchased units are installed (i.e. ISR = 100%). This is consistent with the MA 2013-2015 TRM.
[311] This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.
[312] See Appendix B: Coincidence and Energy Period Factors.
[313] EMT assumes 0% freeridership and 0% spillover (i.e., NTG = 100%) for all measures implemented through the low income program.
[314] Federal Standard, Code of Federal Regulations, Title 10, Part 430, Subpart C.
[315] Water-Efficient Showerheads, WaterSense: An EPA Partnership Program, http://www.epa.gov/WaterSense/products/showerheads.html
[316] The Cadmus Group and Opinion Dynamics, MEMO: Showerhead and Faucet Aerator Meter Study, June 2013. Prepare for Michigan Evaluation Working Group.
[317] American Community Survey, 2011 1 year estimate for population of Maine: http://www.census.gov/acs/www/
[318] 2009 Residential Energy Consumption Survey (RECS). Number of full bathrooms for single family detached home, microdata for CT, ME, NH, RI, and Vermont.
[319] Measure flowrate: http://www.epa.gov/WaterSense/products/showerheads.html
[320] Standard Building America DHW Schedules, weighted average by population of all Maine water main sources.
[321] NREL, Building America Research Benchmark Definition, 2009, p.12, http://www.nrel.gov/docs/fy10osti/47246.pdf

Low Flow Showerhead

Measure	Life (yrs)	Cost ($)							
Low Flow Showerhead	5[322]	6[323]							

IMPACT FACTORS

Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
Low Flow Showerhead	100%[324]	100%[325]	100%[325]	0.5%[326]	0.8%[326]	0%[327]	0%[327]

Domestic Water Heater Temperature Turn-Down

Last Revised Date	7/1/2013
MEASURE OVERVIEW	
Description	The hot water temperature set point of the existing electric domestic water heater (DWH) is reduced by at least 10°F.[328] Savings derive primarily from reducing the energy lost to leaks, dishwashers and standby losses. The savings assume measures are implemented on electric water heaters.
Primary Energy Impact	Electric
Sector	Residential
Program(s)	Low Income Program
End-Use	Domestic Hot Water
Decision Type	Retrofit
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand Savings	ΔkW = 0.010
Annual Energy Savings	ΔkWh/yr = 87
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	ΔkW = ΔkWh/yr / Hours
Annual Energy Savings	ΔkWh/yr = ΔkWh_{EWHTD}
Definitions	Unit = 10°F temperature turndown for 1 electric DHW ΔkWh_{EWHTD} = Average annual energy savings for 10°F turndown on electric water heater (kWh/yr) Hours = Annual operating hours for water heater (hrs/yr)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Electric DWH at original set-point temperature of 130°F or greater.
Efficient Measure	Electric DWH at set-point temperature 10°F below the original set-point temperature. If the original temperature is reduced by less than 10°F, no savings should be claimed. The temperature should not be reduced below 120°F.[329]

PARAMETER VALUES (DEEMED)

Measure	ΔkWh_{EWHTD}	Hours	Life (yrs)	Cost ($)
DWH Turn-Down	87[330]	8,760[331]	4[332]	0[333]

IMPACT FACTORS

Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
DWH Turn-Down	100%[334]	100%[335]	100%[335]	9.6%[336]	13.3%[336]	0%[337]	0%[337]

[322] 2010 Ohio TRM: conservative estimate based on review of TRM assumptions from other states.
[323] 2010 Ohio TRM: Navigant Consulting, Ontario Energy Board; "Measures and Assumptions for Demand Side Management (DSM) Planning", April 2009.
[324] EMT assumes that all purchased units are installed (i.e. ISR = 100%). This is consistent with the MA 2013-2015 TRM.
[325] This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.
[326] See Appendix B: Coincidence and Energy Period Factors.
[327] EMT assumes 0% freeridership and 0% spillover (i.e., NTG = 100%) for all measures implemented through the low income program.
[328] Engineering assumption, conservative compared to Illinois 2012 TRM which claims 15°F setback.
[329] The risk of bacteria growing in the stored hot water increases when the set temperature is reduced below 120°F: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2094925/#B5
[330] Savings are captured by calculating energy savings from reducing the temperature of the water consumed by the following end uses: leaks, clothes washers and the use categorized by "other." No savings are claimed from hot water end uses such as showering or faucet use because it is assumed that the user will continue to operate the end use at the same temperature as prior to implementing this measure. By operating at the same temperature, the user uses water with the same amount of energy as before- thereby not reducing energy use directly. Daily water usages are based on EPA's Water Sense guide: http://www.epa.gov/WaterSense/docs/home_suppstat508.pdf. Savings also include reduced standby losses.
[331] EMT assumes the water heater operates continuously to maintain the water heater temperature set point.
[332] GDS Associates, Inc., Measure Life Report – Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007; Table 1.
[333] Assumes temperature turn-down is performed as part of an audit or direct install program.
[334] EMT assumes that all purchased units are installed (i.e. ISR = 100%). This is consistent with the MA 2013-2015 TRM.
[335] This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.
[336] Appendix B: Coincidence and Energy Period Factors.

[337] EMT assumes 0% freeridership and 0% spillover (i.e., NTG = 100%) for all measures implemented through the low income program.

Domestic Water Heater Pipe Insulation								
Last Revised Date	7/1/2013							
MEASURE OVERVIEW								
Description	Savings are captured by installing 10 feet of pipe insulation on un-insulated water pipes serving the electric domestic hot water heater (DWH). The savings assume measures are implemented on electric water heaters and that the temperature turn-down measure has been implemented.							
Primary Energy Impact	Electric							
Sector	Residential							
Program(s)	Low Income Program							
End-Use	Domestic Hot Water							
Decision Type	Retrofit							
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)								
Demand Savings	ΔkW = 0.012							
Annual Energy Savings	ΔkWh/yr = 103							
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)								
Demand Savings	ΔkW = ΔkWh/yr / Hours							
Annual Energy Savings	ΔkWh/yr = $[GPD \times 365 \times \rho_{H2O} \times C_{H2O} \times (T_{WH} - T_{in}) / 3{,}413 / RE_{EWH}] \times SF_{PI}$							
Definitions	Unit = 1 water heater GPD = Average daily hot water consumption (gallons/day) ρ_{H2O} = Density of water (8.33 lb/gallon) C_{H20} = Specific heat of water (1 Btu/lb-°F) T_{WH} = Water heater temperature set point (°F) T_{in} = Temperature of water mains (water into the water heater) (°F) RE_{EWH} = Recovery Efficiency for baseline electric water heater SF_{PI} = Savings factor for adding pipe insulation Hours = Annual operating hours for water heater (hrs/yr) 365 = Conversion: 365 days per year 3,413 = Conversion: 3,413 Btu per kWh							
EFFICIENCY ASSUMPTIONS								
Baseline Efficiency	Un-insulated DHW heater pipes (both hot and cold). The DWH must have no heat trap installed.							
Efficient Measure	DHW heater pipes with 10 feet of pipe insulation installed. Insulation must be R-3 or greater.[338]							
PARAMETER VALUES (DEEMED)								
Measure	GPD	T_{WH}	T_{in}	RE_{EWH}	SF_{PI}	Hours	Life (yrs)	Cost ($)
DWH Pipe Insulation	51.1[339]	125[340]	50.8[341]	0.98[342]	0.03[343]	8,760[344]	15[345]	$70[346]
IMPACT FACTORS								
Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO	
DWH Pipe Insulation	100%[347]	100%[348]	100%[348]	100%[349]	100%[349]	0%[350]	0%[350]	

[338] Complies with International Residential Code 2009 section N1103.3: mechanical system piping insulation.
[339] Daily household consumption of hot water calculated based on average number of people per household (Nppl): 16.286 x Nppl + 13. The relationship is used in NY and Indiana TRMs and is based on: Lutz, James D., Liu, Xiaomin, McMahon, James E., Dunham, Camilla, Shown, Leslie J.McCure, Quandra T; "Modeling patterns of hot water use in households;" LBL-37805 Rev. Lawrence Berkeley Laboratory, 1996.
[340] The temperature set point is 10 degrees below the typical temperature set point of 135 F, assuming that the temperature turn-down measure is implemented.
[341] Standard Building America DHW Schedules, weighted average by population of all Maine water main sources.
[342] NREL, Building America Research Benchmark Definition, 2009, p.12, http://www.nrel.gov/docs/fy10osti/47246.pdf
[343] ACEEE Report Number E093, p. 117, April 2009, Potential for Energy Efficiency, Demand Response, and Onsite Solar Energy in Pennsylvania: "Insulating 10 feet of exposed pipe in unconditioned space, ¾" thick".
[344] EMT assumes the water heater operates continuously to maintain the water heater temperature set point.
[345] GDS Associates, Inc., Measure Life Report – Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007; Table 1.
[346] NREL, National Residential Efficiency Measures Database, assuming R-5 insulation. The costs range from $44 to $92, with an average of $70.
[347] EMT assumes that all purchased units are installed (i.e. ISR = 100%). This is consistent with the MA 2013-2015 TRM.
[348] This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.
[349] See Appendix B: Coincidence and Energy Period Factors.
[350] EMT assumes 0% freeridership and 0% spillover (i.e., NTG = 100%) for all measures implemented through the low income program.

Domestic Water Heater Wrap	
Last Revised Date	7/1/2013
MEASURE OVERVIEW	
Description	Savings are captured by installing an insulating blanket (wrap) on an existing electric domestic water heater (DWH) in an unconditioned space. For savings to be captured, the DWH must be an inefficient model that does not meet the National Appliance Energy Conservation Act that went into effect in 1991. The savings assume measures are implemented on electric water heaters and that the temperature turn-down measure has been implemented.
Primary Energy Impact	Electric
Sector	Residential
Program(s)	Low Income Program
End-Use	Domestic Hot Water
Decision Type	Retrofit
DEEMED GROSS ENERGY SAVINGS (UNIT SAVINGS)	
Demand Savings	ΔkW = 0.010
Annual Energy Savings	ΔkWh/yr = 89
GROSS ENERGY SAVINGS ALGORITHMS (UNIT SAVINGS)	
Demand Savings	$\Delta kW = \Delta kWh/yr / Hours$
Annual Energy Savings	$\Delta kWh/yr = [GPD \times 365 \times \rho_{H2O} \times Cp_{H2O} \times (T_{WH} - T_{in}) / 3{,}413] \times (1/EF_{BASE} - 1 / EF_{EE})$
Definitions	Unit = 1 water heater with tank wrap GPD = Average daily hot water consumption (gallons/day) 365 = Conversion: 365 days per year ρ_{H2O} = Density of water (8.33 lb/gallon) Cp_{H20} = Specific heat of water (1 Btu/lb-°F) T_{WH} = Water heater temperature set point (°F) T_{in} = Temperature of water mains (water into the water heater) (°F) 3,413 = Conversion: 3,413 Btu per kWh EF_{BASE} = Energy factor for baseline electric water heater EF_{EE} = Energy factor for baseline electric water heater with wrap Hours = Annual operating hours for water heater (hrs/yr)
EFFICIENCY ASSUMPTIONS	
Baseline Efficiency	Inefficient DWH manufactured before 1991 with no insulating wrap in an unconditioned space.
Efficient Measure	Inefficient DWH manufactured before 1991 with an insulating wrap installed in an unconditioned space.

PARAMETER VALUES (DEEMED)

Measure	GPD	T_{WH}	T_{in}	EF_{BASE}	EF_{EE}	Hours	Life (yrs)	Cost ($)
EWH with tank wrap	51.1[351]	125[352]	50.8[353]	0.86[354]	0.88[354]	8,760[355]	7[356]	$30[357]

IMPACT FACTORS

Measure	ISR	RR_E	RR_D	CF_S	CF_W	FR	SO
EWH with tank wrap	100%[358]	100%[359]	100%[359]	100%[360]	100%[360]	0%[361]	0%[361]

[351] Daily household consumption of hot water calculated based on average number of people per household (Nppl): 16.286 x Nppl + 13. The relationship is used in NY and Indiana TRMs and is based on: Lutz, James D., Liu, Xiaomin, McMahon, James E., Dunham, Camilla, Shown, Leslie J.McCure, Quandra T; "Modeling patterns of hot water use in households;" LBL-37805 Rev. Lawrence Berkeley Laboratory, 1996.

[352] The temperature set point is 10 degrees below the typical temperature set point of 135 F, assuming that the temperature turn-down measure is implemented.

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

[354] The Oak Ridge study predicted that wrapping a 40 gal water heater would increase Energy Factor of a 0.86 electric DHW tank by 0.02 (to 0.88) "Meeting the Challenge: The Prospect of Achieving 30 percent Energy Savings Through the Weatherization Assistance Program" by the Oak Ridge National Laboratory - May 2002. http://www.cee1.org/eval/db_pdf/309.pdf

[355] EMT assumes the water heater operates continuously to maintain the water heater temperature set point.

[356] DEER 2008

[357] http://energy.gov/energysaver/projects/savings-project-insulate-your-water-heater-tank

[358] EMT assumes that all purchased units are installed (i.e. ISR = 100%). This is consistent with the MA 2013-2015 TRM.

[359] This measure has not yet been evaluated. Until the next program impact evaluation, EMT assumes 100% realization rate.

[360] See Appendix B: Coincidence and Energy Period Factors.

[361] EMT assumes 0% freeridership and 0% spillover (i.e., NTG = 100%) for all measures implemented through the low income program.

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)***, cited at the end of each definition 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. 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. This can be calculated as an annual or lifetime value. [NEEP EMV Glossary]

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 or gas 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 to energy efficiency programs, to overall program portfolios. [NEEP EMV Glossary]

Annual Energy Savings: The reduction in electricity usage (kWh) or in fossil fuel use in thermal unit(s) from the savings associated with an energy saving measure, project, or program in a given year. [NEEP EMV Glossary]

Average Annual Operating Hours: The annual hours that equipment is expected to operate.

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: The standard measure of heat energy. It takes one Btu 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]

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 during a specified period of time of a group of measures 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 the impact on the environment. The Energy Star label is awarded to products that meet applicable energy efficiency guidelines and to homes and commercial buildings that meet specified energy efficiency standards. [NEEP EMV Glossary]

Free Rider: A program participant who would have implemented the program measure or practice in the absence of the program. Free riders 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 than the program's timeframe. [NEEP EMV Glossary]

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 unadjusted by any factors. [NEEP EMV Glossary]

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 incented by a program 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 measures incented by an efficiency program in a defined period of time. [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 annual energy usage reduction associated with a measure by the expected lifetime of the measure. [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* means the number of years that a measure is installed and will operate until failure; and (2) *measure persistence* takes into account business turnover, early retirement of installed equipment and other reasons measures

might be removed or discontinued. Measure Life is sometimes referred to as expected useful life (EUL). [NEEP EMV Glossary]

Meter Level Savings: Savings from energy efficiency programs that are at the customer meter or premise level. [NEEP EMV Glossary]

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

Net-to-Gross Ratio (NTGR): 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 program tracking system savings data (e.g. initial estimates of project savings).

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: 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 after having participated in the efficiency program as a result of the program's influence. *Non-participant spillover* refers to energy savings that occur when a program non-participant installs energy efficiency measures or applies energy savings practices as a result of a program's influence. [NEEP EMV Glossary]

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]

Appendix B: Coincidence and Energy Period 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:

- **Summer On-Peak**: 1:00 to 5:00 PM on non-holiday weekdays in June, July and August.
- **Winter On-Peak**: 5:00 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:[362]

- **Winter Peak**: 7:00 AM to 11:00 PM on non-holiday weekdays in 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 in October through May (8 months).
- **Summer Peak**: 7:00 AM to 11:00 PM on non-holiday weekdays in 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 in June through September (4 months).

Table B-1 includes a listing of measure coincidence factors and energy period allocations.

[362] http://www.iso-ne.com/support/training/glossary/index-p5.html

Table B-1. Retail and Residential Coincidence Factors and Energy Period Factors

Measure Name	End-Use	Coincidence Factor (CF)		Energy Period Factors (EPF)				Footnote Reference	
				Winter		Summer			
		Winter On-Peak	Summer On-Peak	Peak	Off Peak	Peak	Off Peak	CF	EPF
CFL Bulb	Lighting	20.2%	9.6%	44.5%	31.5%	13.2%	10.8%	363	
LED Bulb	Lighting	20.2%	9.6%	44.5%	31.5%	13.2%	10.8%	363	
Refrigerator	Refrigeration	100.0%	100.0%	33.1%	33.5%	16.6%	16.8%	364	365
Freezer	Refrigeration	100.0%	100.0%	33.1%	33.5%	16.6%	16.8%	364	366
Room AC	Cooling	0.0%	11.1%	0.7%	2.8%	53.3%	43.2%	367	
Room Air Purifier	Cooling	66.7%	66.7%	30.4%	36.2%	15.6%	17.9%	368	
Dehumidifier	Cooling	100.0%	100.0%	17.9%	15.5%	33.9%	32.7%	364	365
Dishwasher	Process	4.0%	2.2%	39.7%	26.8%	20.3%	13.1%	369	
Clothes Washer	Process	100%	100%	40.0%	26.6%	20.1%	13.3%	365	
Electric Water Heater	Domestic Hot Water	13.3%	9.6%	40.9%	25.7%	20.9%	12.5%	369	
Heat Pump Water Heater	Domestic Hot Water	100.0%	100.0%	35.8%	30.8%	17.9%	15.5%	364	365
Custom	Heating, Cooling	79.7%	10.7%	58.4%	33.7%	3.5%	4.5%	370	
Air Sealing	Heating, Cooling	79.7%	10.7%	58.4%	33.7%	3.5%	4.5%	370	
Insulation	Heating, Cooling	79.7%	10.7%	58.4%	33.7%	3.5%	4.5%	370	
Ductless Heat Pump	Heating, Cooling	79.7%	10.7%	58.4%	33.7%	3.5%	4.5%	371	
Ductless Heat Pump Retrofit – Non-Electric Baseline	Heating, Cooling	79.6%	10.2%	58.4%	33.8%	3.6%	4.1%	372	
Ductless Heat Pump Retrofit – Electric Baseline	Heating, Cooling	83.7%	10.2%	58.7%	32.5%	3.9%	4.8%	372	
Central Air Source Heat Pump (Ducted)	Heating	54.8%	10.7%	59.3%	29.3%	4.6%	6.8%	373	
Central Geothermal (Ground Source) Heat Pump	Heating	79.6%	10.2%	58.7%	34.0%	3.2%	4.0%	374	
Direct Install CFL Bulb	Lighting	18.4%	6.8%	44.3%	32.0%	12.8%	10.9%	375	
Low Flow Kitchen Aerator	Domestic Hot Water	1.2%	0.8%	39.7%	26.8%	20.3%	13.1%	369	
Low Flow Bathroom Aerator	Domestic Hot Water	0.4%	0.3%	39.7%	26.8%	20.3%	13.1%	369	
Low Flow Showerhead	Domestic Hot Water	0.8%	0.5%	35.5%	31.1%	18.1%	15.3%	369	
DHW Temperature Turn-Down	Domestic Hot Water	13.3%	9.6%	40.9%	25.7%	20.9%	12.5%	369	
DHW Pipe Insulation	Domestic Hot Water	100.0%	100.0%	30.4%	36.2%	15.6%	17.9%	368	
DHW Wrap	Domestic Hot Water	100.0%	100.0%	30.4%	36.2%	15.6%	17.9%	368	
Low Income Multifamily Gas Heat, Furnaces and Boilers (NC/Retrofit), Pellet/Wood Stove, Pellet Boiler, On Demand Natural Gas Water Heater*	Heating	NA	NA	NA	NA	NA	NA	NA	NA

*Coincidence Factor and Energy Period Factors are not applicable for fossil fuel measures, as avoided costs for fossil fuels do not account for time-of-use.

[363] Composite Energy Period Factors for Residential (96%) and Commercial (4%). Residential energy period allocations are developed based on load shape data collected during The Cadmus Group, Efficiency Maine Trust Residential Lighting Program Evaluation, November 1, 2012. Prepared for Efficiency Maine Trust. Commercial energy period allocations from Central Maine Power, non-residential load profile for 3/1/08-2/28/09.

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

[365] Memo provided to supplement NMR Group, Inc., Efficiency Maine Appliance Rebate Program Evaluation Overall Report – FINAL, July 18, 2014.

[366] Assumed to be the same as refrigerator measure

[367] RLW Analytics, Coincidence Factor Study, Residential Room Air Conditioners, June 2008. Values are based on TMY2 weather for Portland, Maine.

[368] Values developed based on annual hours of use and equipment operating assumptions.

[369] Values developed based on residential hot water usage profiles from: Aquacraft, Inc., The End Uses of Hot Water in Single Family Homes from Flow Trace Analysis.

[370] Assume same factors as Ductless Heat Pump.

[371] Values developed based on the bin analysis calculations for DHP savings using typical annual hours in each weather bin during each demand and energy period.

[372] Values developed based on the bin analysis calculations for DHP retrofit savings using typical annual hours in each weather bin during each demand and energy period.

[373] Factors for the Central ASHP measure were assumed to be identical to the factors of the Ductless Heat Pump (lost opportunity) measure because of the similarity between the two measures.

[374] Factors for the Central GSHP measure were assumed to be identical to the factors of the Ductless Heat Pump Retrofit measure because of the similarity between the two measures.

[375] Assumed to be the same as Residential Retail Lighting CFL Bulb measure

Appendix C: Retail Lighting Assumptions and EISA

A number of critical assumptions for the calculation of annual and lifetime savings and cost effectiveness for retail lighting measures will change throughout this decade primarily as a result of the Energy Independence and Security Act of 2007 (EISA) and new product development in the market. The following tables outline key assumptions and calculations.

Table C-1. Retail Lighting Program: Baseline Wattages and CFL Wattages

Bulb Type	Lumen Bin	Proportion of Total Bulb Sales	Average CFL Wattage	Baseline Wattage (2011)
Standard	3301-4815	0.01%	55.00	200
Standard	2601-3300	0.09%	41.59	150
Standard	1490-2600	8.46%	24.51	100
Standard	1050-1489	3.35%	19.52	75
Standard	750-1049	78.72%	13.41	60
Standard	310-749	4.35%	9.51	40
Standard	0-309	0.02%	5.00	25
Specialty	3301-4815	0.01%	65.00	200
Specialty	1490-2600	0.65%	26.47	100
Specialty	1050-1489	0.23%	19.61	75
Specialty	750-1049	2.27%	14.50	60
Specialty	310-749	0.72%	10.08	40
Giveaway	1490-2600	1.13%	23.00	100
Weighted Average	N/A	100%	14.62	63.71

Table C-2 describes the adjustments to baseline starting in 2012 due to the changing maximum wattages specified in EISA.

Table C-2. EISA Adjustments by Lumen Range (Evaluation, Table 25)[376]

Lumen Range	Assumed Original Baseline	New Maximum Wattage	Effective Date
310-749	40	29	2014
750-1049	60	43	2014
1050-1489	75	53	2013
1490-2600	100	72	2012

Table C-4 shows the changes in the weighted average baseline wattage resulting as the EISA requirements becoming effective for 2011 through 2014. Weighted average wattage for CFL and LED bulbs are presented for 2011 and 2014 along with the resulting percentage change in the savings compared to 2011 based on EISA impacts.

Table C-3. EISA Adjusted Weighted Average Baseline Wattage by Year

Year	Program Year (7/1/(YY-1)-6/30/YY)	EISA Adjusted Weighted Average Baseline Wattage	Weighted Average CFL Wattage	$EISA\%_{CFL}$	Weighted Average LED Wattage	$EISA\%_{LED}$
2011	2012	63.71	14.62	100%	13	100%
2012	2013	61.03	14.62	94.5%	13	94.7%
2013	2014	60.29	14.62	93.0%	13	93.3%
2014	2015	46.43	14.62	64.8%	12	66.6%

[376] The Cadmus Group, Efficiency Maine Trust Residential Lighting Program Evaluation, November 1, 2012, Table 25.

Appendix D: Standard Assumptions for Maine

Table D-1. Distribution of Heating Fuel for Maine Residential Customers

Heating Fuel	Percentage of Homes	Distribution Excluding Coal and Other	
Natural Gas	9%	9%	
Oil	65%	66%	
Wood	8%	8%	
Propane	6%	6%	
Kerosene	6%	6%	
Pellet	4%	4%	
Electricity	0.80%	0.80%	
Coal	0.40%	n/a	
Other	0.30%	n/a	

Table D-2. Minimum Efficiency Requirements for Furnaces and Boilers[377]

Equipment Category	Equipment Type	Federal Code Minimum (AFUE)
Furnaces	Non-weatherized gas furnaces (not including mobile home furnaces)	80%
	Mobile home gas furnaces	80%
	Non-weatherized oil-fired furnaces (not including mobile home furnaces)*	83%
	Mobile home oil-fired furnaces	75%
	Weatherized gas furnaces	81%
	Weatherized oil-fired furnaces	78%
	Electric furnaces	78%
Boilers	Gas-fired hot water boiler	82%
	Gas-fired steam boiler	80%
	Oil-fired hot water boiler*	84%
	Oil-fired steam boiler	82%
	Electric hot water boiler	None
* For the TRM, we use the assumptions for non-weatherized oil-fired furnaces and boilers to represent the typical efficiency for all heating systems.		

[377] Code of Federal Regulations: http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&sid=61b33caa9460da7b2e875b478972dfdc&rgn=div6&view=text&node=10:3.0.1.4.18.3&idno=10

Appendix E: Supplementary Information for Ductless Heat Pumps

Table E-1. DHP Heating Performance at Varying Outside Air Temperatures[378]

Outside Air Temperature (DB) [°F]	Heating Seasonal Performance Factor [BTU/Watt-hr]	
	Efficient DHP Rated HSPF = 12	Baseline DHP Rated HSPF = 8.2[379]
65	12.8	9.5
63	12.6	9.4
61	12.5	9.3
59	12.3	9.2
57	12.2	9.1
55	12.0	8.9
53	11.8	8.8
51	11.7	8.7
49	11.5	8.6
47	11.4	8.5
45	11.2	8.4
43	11.1	8.3
41	10.9	8.1
39	10.8	8.0
37	10.6	7.9
35	10.5	7.8
33	10.3	7.7
31	10.1	7.6
29	10.0	7.4
27	9.8	7.3
25	9.7	7.2
23	9.5	7.1
21	9.4	7.0
19	9.2	6.9
17	9.1	6.8
15	8.9	6.6
13	8.8	6.5
11	8.6	6.4
9	8.4	6.3
7	8.3	6.2
5	8.1	6.1
3	8.0	6.0
1	7.8	5.8
-1	7.7	5.7
-3	7.5	5.6
-5	7.4	5.5
-7	7.2	5.4
-9	7.1	5.3
-11	6.9	5.1

[378] A linear regression analysis of eligible DHP units' heating performance was performed using Coefficients of Performance values specified at select outside air temperatures (based on data provided to EMT by a manufacturer for five eligible DHP units). The slopes and intercepts resulting from separate linear regression analyses of five different models were averaged to define HSPF as a function of outside air temperature. The average R^2 value for the five linear regression analyses was ~0.93.

[379] Minimum efficiency requirement in Federal Energy Codes for units manufactured on or after January 1, 2015.

Table E-2. Electric Consumption by Baseline and Efficient Ductless Heat Pumps[380]

Temp. Bin (DB) [°F]	Portland		Bangor		Caribou	
	Efficient DHP Electric Consumption [kWh]	Baseline DHP Electric Consumption [kWh]	Efficient DHP Electric Consumption [kWh]	Baseline DHP Electric Consumption [kWh]	Efficient DHP Electric Consumption [kWh]	Baseline DHP Electric Consumption [kWh]
92+	-	-	-	-	-	-
90 to 92	-	-	-	-	-	-
88 to 90	-	-	-	-	-	-
86 to 88	-	-	-	-	-	-
84 to 86	-	-	-	-	-	-
82 to 84	-	-	-	-	-	-
80 to 82	-	-	-	-	-	-
78 to 80	-	-	-	-	-	-
76 to 78	-	-	-	-	-	-
74 to 76	-	-	-	-	-	-
72 to 74	-	-	-	-	-	-
70 to 72	-	-	-	-	-	-
68 to 70	-	-	-	-	-	-
66 to 68	-	-	-	-	-	-
64 to 66	11	14	10	13	9	12
62 to 64	23	31	19	26	19	26
60 to 62	33	44	29	38	32	42
58 to 60	22	30	24	32	21	29
56 to 58	55	74	61	82	50	67
54 to 56	68	92	74	99	62	83
52 to 54	81	109	84	113	76	102
50 to 52	187	250	145	195	157	210
48 to 50	124	166	118	158	102	137
46 to 48	149	199	135	181	115	155
44 to 46	140	188	162	218	153	205
42 to 44	111	149	170	228	170	229
40 to 42	54	73	86	116	89	120
38 to 40	147	197	188	253	169	226
36 to 38	211	283	245	329	185	248
34 to 36	226	303	252	339	207	278
32 to 34	407	546	378	507	342	458
30 to 32	264	355	263	353	243	327
28 to 30	274	368	236	317	218	293
26 to 28	243	325	188	252	233	312
24 to 26	219	294	206	277	202	271
22 to 24	115	154	106	143	116	155
20 to 22	235	315	214	287	277	371
18 to 20	231	310	198	266	241	324
16 to 18	130	174	167	224	222	298
14 to 16	173	232	234	314	322	432
12 to 14	113	152	105	141	193	259
10 to 12	67	90	76	102	195	261
8 to 10	56	76	84	112	152	203
6 to 8	49	66	53	71	114	152
4 to 6	20	26	27	36	68	91
2 to 4	30	40	30	40	126	169
0 to 2	14	19	39	52	72	97
-2 to 0	14	18	34	45	55	74
-4 to -2	16	21	17	23	86	116
-6 to -4	4	5	13	17	40	54
-8 to -6	-	0	3	4	34	46
-10 to -8	1	1	4	6	17	23
-12 to -10	0	0	4	6	5	6

[380] Baseline and Efficient DHP consumptions were calculated in accordance with the assumptions specified in Page 38: Ductless Heat Pump. Calculation was performed using a bin analysis of TMY3 weather data in MS Excel. Used for Ductless Heat Pump measure.

Table E-3. Heating Load Displaced by Ductless Heat Pump Retrofit[381]

Temp. Bin (DB) [°F]	TMY Annual Hours	Total Heating Load Displaced by DHP [BTU]	Efficient DHP Electric Consumption [kWh]	Heating Energy Consumption Displaced	
				Baseline Electric Baseboard [kWh]	Baseline Ducted Fuel-Fired System [MMBTU]
92+	2	-	-	-	-
90 to 92	6	-	-	-	-
88 to 90	13	-	-	-	-
86 to 88	31	-	-	-	-
84 to 86	32	-	-	-	-
82 to 84	51	-	-	-	-
80 to 82	56	-	-	-	-
78 to 80	87	-	-	-	-
76 to 78	43	-	-	-	-
74 to 76	119	-	-	-	-
72 to 74	154	-	-	-	-
70 to 72	201	-	-	-	-
68 to 70	339	-	-	-	-
66 to 68	263	-	-	-	-
64 to 66	281	134,624	11	39	0.239
62 to 64	306	293,201	23	86	0.521
60 to 62	284	408,182	33	120	0.726
58 to 60	143	274,038	22	80	0.487
56 to 58	280	670,722	55	197	1.192
54 to 56	285	819,239	68	240	1.456
52 to 54	286	959,133	81	281	1.705
50 to 52	569	2,180,805	187	639	3.877
48 to 50	332	1,431,513	124	420	2.545
46 to 48	353	1,691,178	149	496	3.007
44 to 46	299	1,575,718	140	462	2.801
42 to 44	214	1,230,296	111	361	2.187
40 to 42	95	591,673	54	173	1.052
38 to 40	236	1,582,904	147	464	2.814
36 to 38	311	2,234,942	211	655	3.973
34 to 36	308	2,360,942	226	692	4.197
32 to 34	515	4,194,409	407	1,229	7.457
30 to 32	311	2,681,931	264	786	4.768
28 to 30	301	2,739,900	274	803	4.871
26 to 28	249	2,385,855	243	699	4.242
24 to 26	211	2,122,836	219	622	3.774
22 to 24	104	1,096,152	115	321	1.949
20 to 22	200	2,203,802	235	646	3.918
18 to 20	196	2,130,157	231	624	3.787
16 to 18	114	1,175,376	130	344	2.090
14 to 16	158	1,540,893	173	452	2.739
12 to 14	108	993,023	113	291	1.765
10 to 12	67	578,667	67	170	1.029
8 to 10	59	476,661	56	140	0.847
6 to 8	54	406,143	49	119	0.722
4 to 6	23	160,157	20	47	0.285
2 to 4	37	237,004	30	69	0.421
0 to 2	19	111,106	14	33	0.198
-2 to 0	20	105,797	14	31	0.188
-4 to -2	25	118,300	16	35	0.210
-6 to -4	7	29,219	4	9	0.052
-8 to -6	-	-	-	-	-
-10 to -8	2	6,117	1	2	0.011
-12 to -10	1	2,501	0	1	0.004

[381] Heating load displaced by the Ductless Heat Pump was calculated in accordance with the assumptions specified in Page 54: Ductless Heat Pump Retrofit. Calculation was performed using a bin analysis of TMY3 weather data in MS Excel. Used for Ductless Heat Pump Retrofit measure.