Prescriptive Path Technical Reference Manual

Version 2014.1

December 2, 2013

TABLE OF CONTENTS

Shell Insulation (Wall & Roof/Ceiling)

Description: Improvements to the thermal conductance of the opaque building shell, which includes upgrading insulation in existing wall and roof/ceiling constructions. Insulation of other building components is not covered under this measure. Energy and demand saving are realized through reductions in the building heating and cooling loads.

Algorithms:

$$\Delta \boldsymbol{kW} = SF \times \frac{\Delta kW}{SF} \times CF$$

$$\Delta \boldsymbol{kWh} = SF \times \frac{\Delta kWh}{SF}$$

$$\Delta \boldsymbol{MMBtu} = SF \times \frac{\Delta MMBtu}{SF}$$

Where:

SF = Square footage of wall and roof/ceiling constructions where shell insulation improvement is being implemented.

ΔkW/SF = kW savings factor based on HVAC type, project location and existing and proposed insulation R-Values.

CF = Summer peak demand coincidence factor; defined as the average fraction of installed capacity of a population of HVAC systems that are operating at the time of system peak. Use a value of 0.8 for shell insulation.

ΔkWh/SF = kWh savings factor based on HVAC type, project location and existing and proposed insulation R-Values.

ΔMMBtu/SF = MMBtu savings factor based on HVAC type, project location and existing and proposed insulation R-Values.

Additional Details: ΔkW/SF , ΔkWh/SF, ΔMMBtu/SF factors are based on New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs building prototype simulation models. This data can be found in Appendix E of that document. For purposes of Efficiency Maine's Prescriptive Tool, the following location mappings have been implemented:

County	NY Location
Androscoggin	Massena
Aroostook - North	Massena
Aroostook - Northwest	Massena
Aroostook - South	Massena
Cumberland	Buffalo
Franklin - South	Binghamton
Franklin - North	Massena
Hancock	Binghamton
Kennebec	Binghamton
Knox	Binghamton
Lincoln	Binghamton
Oxford - Southwest	Massena
Oxford - Southeast	Massena
Oxford - Central & North	Massena

County	NY Location
Penobscot - Central	Massena
Penobscot - North	Massena
Penobscot - South	Binghamton
Piscataquis - North	Massena
Piscataquis - Central & South	Massena
Sagadahoc	Massena
Somerset - North	Massena
Somerset - Central	Massena
Somerset - South	Binghamton
Waldo	Binghamton
Washington - North	Massena
Washington - South	Binghamton
York	Buffalo

Figure 1

Sources:

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; "Opaque Shell Insulation", pg 27-29

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; "Appendix E: Opaque Shell Measure Savings", pg 297-408

Air Leakage Sealing

Description: Reduction in the natural infiltration rate of the building through sealing air leaks in the building envelope. Results of a blower door test are used for low rise (3 stories or less) multi-family buildings where the use of a blower door is required. An alternate method for estimating savings that is based on the building's heated square footage is also provided for larger multi-family buildings.

Algorithms:

Low Rise

$$\Delta \boldsymbol{kW} = \frac{\Delta CFM}{N\ factor} \times \frac{\Delta kW}{CFM} \times CF$$

$$\Delta \boldsymbol{kWh} = \frac{\Delta CFM}{N\ factor} \times \frac{\Delta kWh}{CFM}$$

$$\Delta \boldsymbol{MMBtu} = \frac{\Delta CFM}{N\ factor} \times \frac{\Delta MMBtu}{CFM}$$

High Rise

$$\Delta \boldsymbol{kW} = Floor\ Area\ (1{,}000\ SF) \times \frac{\Delta kW}{1{,}000\ SF} \times CF$$

$$\Delta \boldsymbol{kWh} = Floor\ Area\ (1{,}000\ SF) \times \frac{\Delta kWh}{1{,}000\ SF}$$

$$\Delta \boldsymbol{MMBtu} = Floor\ Area\ (1{,}000\ SF) \times \frac{\Delta MMBtu}{1{,}000\ SF}$$

Where:

ΔCFM = Estimated change in infiltration rate measured at 50 Pa.

N factor = Correction factor from CFM measured at 50 Pa to natural infiltration rate. Use a value of 15 for Air Leakage Sealing.

ΔkW/CFM = kW savings factor based on HVAC type and project location.

CF = Summer peak demand coincidence factor; defined as the average fraction of installed capacity of a population of HVAC systems that are operating at the time of system peak. Use a value of 0.8 for air leakage sealing.

ΔkWh/CFM = kWh savings factor based on HVAC type and project location.

ΔMMBtu/SF = MMBtu savings factor based on HVAC type, project location and existing and proposed insulation R-Values.

Floor Area (1,000 SF) = Conditioned facility square footage in units of 1,000 SF.

ΔkW/1,000 SF = kW savings factor based on HVAC type and project location.

ΔkWh/1,000 SF = kWh savings factor based on HVAC type and project location.

ΔMMBtu/1,000 SF = MMBtu savings factor based on HVAC type and project location.

Additional Details: ΔkW/CFM , ΔkWh/CFM, ΔMMBtu/CFM and ΔkW/1,000 SF, ΔkWh/1,000 SF, ΔMMBtu/1,000 SF factors are based on New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs building prototype simulation models. This data can be found in Appendix E of that document. For purposes of Efficiency Maine's Prescriptive Tool, location mappings per Figure 1 in the Shell Insulation (Wall & Roof/Ceiling) section of this document have been implemented.

Sources:

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; "Air Leakage Sealing", pg 33-36

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; "Appendix E: Opaque Shell Measure Savings", pg 297-408

ENERGY STAR Windows

Description: Replacement of existing single-pane, double-pane or code compliant windows with ENERGY STAR rated windows with reduced thermal conductance and solar heat gain coefficient.

Algorithms:

$$\Delta \boldsymbol{kW} = Glazing\ Area\ (100\ SF) \times \frac{\Delta kW}{100\ SF} \times CF$$

$$\Delta \boldsymbol{kWh} = Glazing\ Area\ (100\ SF) \times \frac{\Delta kWh}{100\ SF}$$

$$\Delta \boldsymbol{MMBtu} = Glazing\ Area\ (100\ SF) \times \frac{\Delta MMBtu}{100\ SF}$$

Where:

Glazing Area SF (100 SF) = Square footage of all replaced windows in units of 100 SF.

ΔkW/100 SF = kW savings factor based on HVAC type, project location and existing window type.

CF = Summer peak demand coincidence factor; defined as the average fraction of installed capacity of a population of HVAC systems that are operating at the time of system peak. Use a value of 0.8 for ENERGY STAR windows.

ΔkWh/100 SF = kWh savings factor based on HVAC type, project location and existing window type.

ΔMMBtu/100 SF = MMBtu savings factor based on HVAC type, project location and existing window type.

Additional Details: ΔkW/100 SF , ΔkWh/100 SF, ΔMMBtu/100 SF factors are based on New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs building prototype simulation models. This data can be found in Appendix F of that document. For purposes of Efficiency Maine's Prescriptive Tool, location mappings per Figure 1 in the Shell Insulation (Wall & Roof/Ceiling) section of this document have been implemented.

Sources:

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; "High Performance Windows", pg 30-32

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; "Appendix F: Window and High Performance Glazing", pg 409-429

<u>Boiler/Furnace Replacement</u>

Description: Replacement of existing boilers and furnaces with high-efficiency condensing and non-condensing hot water and steam boilers and furnaces. This measure does not cover fuel-switching/conversions; savings estimates for fuel-switching measures are to be calculated outside of the Prescriptive Path ERP Tool.

Algorithms:

$$\Delta \boldsymbol{MMBtu} = CAP_{INPUT} \times FLH \times \left[\frac{EF_{EE}}{EF_{BASE}} - 1\right] / 1{,}000$$

Where:

CAP_{INPUT} = Input heating capacity of new equipment in kBtu/h.

FLH = Full load heating hours defined as the total annual fuel consumption of the equipment divided by its full load heating capacity (in Btu and Btu/h, respectively).

EF_{EE} = Efficiency of the proposed heating equipment. *Can be expressed as thermal efficiency (Et), combustion efficiency (Ec), or Annual Fuel Utilization Efficiency (AFUE), depending on equipment type and capacity.

EF_{BASE} = Efficiency of the baseline heating equipment. *Can be expressed as thermal efficiency (Et), combustion efficiency (Ec), or Annual Fuel Utilization Efficiency (AFUE), depending on equipment type and capacity.

1,000 = Conversion factor (1,000 = kBtu/MMBtu).

Additional Details: Full load heating hours are prescribed by the Efficiency Maine Commercial Technical Reference Manual V2014.1 and are set at a constant 1,600 hours per year. In addition, while the Maine TRM specifies baseline efficiency values to be used for existing equipment, the Prescriptive Tool requires user input for this variable.

Sources:

Efficiency Maine Commercial Technical Reference Manual Version 2014.1, Efficiency Maine Trust, August 2013; “Prescriptive Gas: Natural Gas Heating Equipment, Code G1 to G16”, pg 47-49

Boiler Reset Control

Description: Reset of hot water setpoint in multi-family residential buildings with zone thermostat control. For the purposes of the Prescriptive Path Tool, this measure is to be applied to existing non-condensing boiler systems only.

Algorithms:

$$\Delta \boldsymbol{MMBtu} = CAP_{INPUT} \times FLH \times ESF_{heat}/1{,}000$$

Where:

CAP = Input heating capacity of controlled equipment in kBtu/h.

FLH = Full load heating hours defined as the total annual fuel consumption of the equipment divided by its full load heating capacity (in Btu and Btu/h, respectively).

ESF_{heat} = Energy Savings Factor – the estimated percentage reduction in annual fuel consumption resultant from implementation of Boiler Reset Control measure. Use a value of 0.05.

1,000 = Conversion factor (1,000 = kBtu/MMBtu).

Additional Details: Full load heating hours are prescribed by the Efficiency Maine Commercial Technical Reference Manual V2014.1 and are set at a constant 1,600 hours per year.

Sources:

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; “Boiler Reset Controls”, pg 50-52

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; “Appendix G: Heating and Cooling Equivalent Full Load Hours”, pg 430-435

Efficiency Maine Commercial Technical Reference Manual Version 2014.1, Efficiency Maine Trust, August 2013; “Prescriptive Gas: Natural Gas Heating Equipment, Code G1 to G16”, pg 47-49

Programmable T-Stats/TRVs/EMS

Description: Installation of HVAC control systems including:
1) Programmable setback thermostats applied to air conditioners, heat pumps, boilers, furnaces and electric resistance baseboard heating systems.
2) Thermostatic Radiator Valves installed on existing hot water heating system radiators.
3) Energy Management System applied to building HVAC incorporating thermostat control.

Algorithms:

$$\Delta \boldsymbol{kWh} = \left[Tons \times \frac{12}{SEER} \times EFLH_{cool} \times ESF_{cool}\right] + \left[kBtuh_{RH} \times \frac{EFLH_{heat}}{3.413} \times ESF_{heat}\right] + \left[kBtuh_{hpout} \times \frac{EFLH_{heat}}{HSPF} \times ESF_{heat}\right]$$

$$\Delta \boldsymbol{MMBtu} = kBtuh_{in} \times \frac{EFLH_{heat}}{1{,}000} \times ESF_{heat}$$

Where:

Tons = Total electric cooling capacity of all HVAC equipment to be controlled.

12 = Conversion factor (kW = Tons*12/SEER)

SEER = Seasonal average energy efficiency ratio of cooling equipment (Btu/W-h). Prescriptive Path Tool assumes SEER ≈10.

$EFLH_{cool}$ = Full load cooling hours defined as the total annual electric cooling consumption of the equipment divided by its full load cooling capacity (in Btu and Btu/h, respectively).

ESF_{cool} = Cooling Energy Savings Factor - the estimated percentage reduction in annual electric cooling usage resultant from implementation of HVAC controls. Use a value of 0.09.

$kBtuh_{RH}$ = Total heating capacity of controlled electric resistance heating.

$EFLH_{heat}$ = Full load heating hours defined as the total annual electric/fuel heating consumption of the equipment divided by its full load heating capacity (in Btu and Btu/h, respectively).

3.413 = Conversion Factor (3.413 = kBtu/kWh)

ESF_{heat} = Heating Energy Savings Factor – the estimated percentage reduction in annual electric/fuel heating consumption resultant from implementation of HVAC controls. Use a value of 0.068.

$kBtuh_{hpout}$ = Total output heating capacity of controlled heat pumps.

HSPF = Heating seasonal performance factor (Btu/watt-hr), a measure of the seasonal average efficiency of the heat pump/s in the heating mode. Use a value of 6.8

$kBtuh_{in}$ = Total input heating capacity of controlled non-electric heating equipment.

1,000 = Conversion Factor (1,000 = kBtu/MMBtu)

Additional Details: Full load heating hours are prescribed by the Efficiency Maine Commercial Technical Reference Manual V2014.1 and are set at a constant 1,600 hours per year. Full Load Cooling Hours are based on New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs building prototype simulation models. This data can be found in Appendix G of that document. For purposes of Efficiency Maine's Prescriptive Tool, location mappings per Figure 1 in the Shell Insulation (Wall & Roof/Ceiling) section of this document have been implemented.

Sources:

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; "Setback Thermostat", pg 53-56

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; "Appendix G: Heating and Cooling Equivalent Full Load Hours", pg 430-435

Efficiency Maine Commercial Technical Reference Manual Version 2014.1, Efficiency Maine Trust, August 2013; "Prescriptive Gas: Natural Gas Heating Equipment, Code G1 to G16", pg 47-49

ENERGY STAR Room Air Conditioners

Description: Replacement of existing window air conditioner units and heat pumps with high-efficiency, ENERGY STAR rated room air conditioners and heat pumps.

Algorithms:

$$\Delta \boldsymbol{kWh} = Capacity \times \left[\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}\right] \times EFLH_{cool}/1{,}000$$

$$\Delta \boldsymbol{kW} = Capacity \times \left[\frac{1}{EER_{BASE}} - \frac{1}{EER_{EE}}\right]/1{,}000$$

Where:

Capacity = Total cooling capacity of proposed electric cooling equipment in Btu/h.

EER_{base} = Average baseline efficiency of existing AC equipment. Use FIGURE 2 below to determine existing efficiency.

EER_{ee} = Average efficiency of proposed AC equipment.

$EFLH_{cool}$ = Full load cooling hours defined as the total annual electric cooling consumption of the equipment divided by its full load cooling capacity (in Btu and Btu/h, respectively). Use a value of 102 for Maine.

1,000 = Watts/kW

Additional Details: Full load cooling hours are prescribed by the Efficiency Maine Residential Technical Reference Manual V2014.1 and are set at a constant 102 hours per year. Methodology employed corresponds to the second listing within the "Room Air Conditioner" section of the Efficiency Maine Residential TRM. Baseline efficiencies are based on typical values indicated in the "Room Air Conditioner" section of the New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs document, summarized in Figure 2 below.

	AC - Louvered	AC - Non-Louvered	AC - Casement Only	AC - Casement Slider	HP - Louvered	HP - Non-Louvered
Capacity (Tons	EER					
0.00	9.7	9.0	8.7	9.5	9.0	8.5
0.50	9.7	9.0	8.7	9.5	9.0	8.5
0.67	9.8	8.5	8.7	9.5	9.0	8.5
1.17	9.7	8.5	8.7	9.5	9.0	8.0
1.67	8.5	8.5	8.7	9.5	8.5	8.0

Figure 2

Sources:

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; “Room Air Conditioners”, pg 75-78

Efficiency Maine – Residential TRM V2014.1, July 1, 2013; ”Room Air Conditioners”, pg 10

Hot Water Heaters

Description: Replacement of existing storage type water heaters with high-efficiency condensing, power vented, instantaneous, indirect and heat pump type water heating systems. This measure does not cover fuel-switching/conversions; savings estimates for fuel-switching measures are to be calculated outside of the Prescriptive Path ERP Tool.

Algorithms:

Instantaneous/Storage-Type Water Heaters

$$\Delta \boldsymbol{kW} = \frac{(UA_{base} - UA_{ee}) \times \Delta T_s}{3{,}413} \times CF$$

$$\Delta \boldsymbol{kWh} = \frac{GPD \times 365 \times 8.33 \times \Delta T_w}{3{,}413} \times \left[\frac{1}{EF_{base}} - \frac{1}{EF_{ee}}\right]$$

$$\Delta \boldsymbol{MMBtu} = \frac{GPD \times 365 \times 8.33 \times \Delta T_w}{1{,}000{,}000} \times \left[\frac{1}{EF_{base}} - \frac{1}{EF_{ee}}\right]$$

Indirect Water Heaters

$$\Delta \boldsymbol{MMBtu} = \frac{GPD \times 365 \times 8.33 \times \Delta T_w}{1{,}000{,}000} \times \left[\frac{1}{Ec_{base}} - \frac{1}{Ec_{ee}}\right] + \left(\frac{UA_{base}}{Ec_{base}} - \frac{UA_{ee}}{Ec_{ee}}\right) \times \frac{\Delta T_s}{1{,}000{,}000} \times 8760$$

<u>Note: For Indirect system boiler replacement, the second component of this equation (following the "+" sign) is set to 0.</u>

Heat Pump Water Heaters

$$\Delta \boldsymbol{kW} = 0.5$$

$$\Delta \boldsymbol{kWh} = \frac{GPD \times 365 \times 8.33 \times \Delta T_w}{3{,}413} \times \left[\frac{1}{EF_{base}} - \frac{1}{EF_{ee}}\right]$$

Where:

UA_{base} = Heat loss coefficient of baseline hot water heater (Btu/h-°F). See the "Additional Details" section for information on calculating heat loss coefficient.

UA_{ee} = Heat loss coefficient of proposed hot water heater (Btu/h-°F). See the "Additional Details" section for information on calculating heat loss coefficient.

ΔT_s = Temperature difference between stored hot water temperature and ambient air temperature in degrees F. Use a value of 65 °F for hot water heaters.

3,413 = Conversion factor (3,413 = Btu/kWh)

CF = Summer peak demand coincidence factor; defined as the average fraction of installed capacity of a population of systems that are operating at the time of system peak. Use a value of 0.8 for hot water heaters.

GPD = Average daily water consumption (gallons/day). See the "Additional Details" section for information on estimating water consumption.

365 = Days per year.

8.33 = Heat content of water (Btu/gal-°F)

ΔT_w = Temperature difference between cold inlet temperature and hot water delivery temperature in degrees F. Hot water delivery temperature is assumed to be 130 °F. Cold inlet/main temperature is dependent on location. See the "Additional Details" section for information on main temperatures.

EF_{base} = Baseline water heater energy factor. See the "Additional Details" section for information on estimating baseline water heater energy factor.

EF_{ee} = Proposed water heater energy factor, based on manufacturer nameplate.

1,000,000 = Conversion factor (1,000,000 = Btu/MMBtu).

Ec_{base} = Baseline water heater efficiency. Use a value of 0.97 for electric water heaters and 0.75 for non-electric water heaters.

Ec_{ee} = Proposed indirect water heater boiler combustion efficiency, based on manufacturer nameplate.

Additional Details: UA_{base} and UA_{ee} are calculated per guidance in the New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs document as follows:

$$UA = \frac{\frac{1}{EF} - \frac{1}{RE}}{67.5 \times \left(0.000584 - \frac{1}{RE \times CAP}\right)}$$

Where:

EF = Water heater energy factor. Proposed water heater energy factor is based on manufacturer nameplate. Guidance for calculating baseline water heater energy factor is below.

RE = Water heater recovery efficiency. Use a value of 0.97 for electric water heaters and 0.75 for non-electric water heaters.

CAP = Water heater capacity (in Btu/hr).

EF_{base} is calculated as follows:

Electric Water Heaters: $EF_{base} = 0.93 - 0.00132V$

Non-Electric Water Heaters: $EF_{base} = 0.62 - 0.0019V$

Where:

V = Water heater storage tank volume in gallons.

Daily hot water consumption (*GPD* variable) is derived per guidance found in the New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs document and varies depending on family size. Figure 3 below summarizes the occupancy dependent gallons per day per unit used in the Prescriptive Path Tool.

Number of people	Gal/person-day	Gal/day-household
1	29.4	29
2	22.8	46
3	20.6	62
4	19.5	78
5	18.9	94
6	18.5	111

Figure 3

For purposes of calculating the ΔT_w variable, a hot water delivery temperature of 130 °F should be used, along with the cold inlet/main temperatures in Figure 4 below, subject to location mappings per Figure 1 in the Shell Insulation (Wall & Roof/Ceiling) section of this document.

City	Main Temp
Albany	54.2
Binghamton	52.9
Buffalo	54.3
Massena	50.7
Syracuse	54.6
Poughkeepsie	54.2
NYC	62.5

Figure 4

Sources:

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; “Water Heater”, pg 79-83, “Indirect Water Heaters”, pg 84-88, “Heat Pump Water Heater”, pg 89-91.

Insulate Hot Water Tanks

Description: Installation of additional thermal insulation blankets for storage-type fossil fuel-fired water heaters. These blankets are intended to reduce standby heat losses through the side of the water heater.

Algorithms:

$$\Delta \boldsymbol{kW} = Units \times \frac{(UA_{base} - UA_{ee}) \times \Delta T}{3{,}413 \times EF} \times CF$$

$$\Delta \boldsymbol{kWh} = Units \times \frac{(UA_{base} - UA_{ee}) \times \Delta T}{3{,}413 \times EF} \times 8{,}760$$

$$\Delta \boldsymbol{MMBtu} = Units \times \frac{(UA_{base} - UA_{ee}) \times \Delta T}{1{,}000{,}000 \times EF} \times 8{,}760$$

Where:

Units = Quantity of tanks to be insulated.

UA_{base} = Heat loss coefficient of baseline hot water heater tank (Btu/h-°F). See the "Additional Details" section for information on calculating heat loss coefficient.

UA_{ee} = Heat loss coefficient of insulated hot water heater tank (Btu/h-°F). See the "Additional Details" section for information on calculating heat loss coefficient.

ΔT = Temperature difference between stored hot water temperature and ambient air temperature in degrees F. Use a value of 65 °F for hot water heaters.

3,413 = Conversion factor (3,413 = Btu/kWh).

EF = Water heater efficiency. Use a value of 0.97 for electric water heaters and 0.75 for non-electric water heaters.

CF = Summer peak demand coincidence factor; defined as the average fraction of installed capacity of a population of systems that are operating at the time of system peak. Use a value of 0.8 for hot water heaters.

8,760 = Hours per year.

1,000,000 = Conversion factor (1,000,000 = Btu/MMBtu).

Additional Details: UA_{base} and UA_{ee} are determined based on guidance found in the New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs document. These values are summarized in Figures 5, 6 and 7 below.

For single-unit hot water heaters (use nearest tank size):

Water heater size (gal)	Height	Diameter	UAbase	UAee
30	60	16	4.35	1.91
40	61	16.5	4.58	2
50	53	18	4.49	1.96
66	58	20	5.51	2.39
80	58	22	6.18	2.67

Figure 5

For baseline multi-unit, large hot water heaters (use nearest tank size):

Water heater size (gal)	Height (in)	Diameter (in)	UAbase (Btu/hr-F)				
			Bare Tank	Fiberglass		Foam	
				1 in	2 in	1 in	2 in
120	61	24	40.6	10	5.1	7.9	4.1
140	76	24	47.9	12	6.2	9.6	4.9
200	72	30	60.9	14.7	7.6	11.7	6
250	84	30	68.1	16.8	8.6	13.3	6.9
350	88	36	88.8	21.5	11	17.1	8.7
400	97	36	95.3	23.3	11.9	18.5	9.5
500	74	48	115.9	26.3	13.3	20.9	10.6
750	106	48	146.9	34.9	17.7	27.7	14.1
1000	138	48	177.9	43.5	22.1	34.6	17.6

Figure 6

For improved multi-unit, large hot water heaters (use nearest tank size):

Water heater size (gal)	Height (in)	Diameter (in)	UAee (Btu/hr-F) with 2 in Fiberglass wrap				
			Bare tank	Fiberglass		Foam	
				1 in	2 in	1 in	2 in
120	61	24	5.1	3.8	2.7	3.4	2.4
140	76	24	6.2	4.6	3.3	4.1	2.9
200	72	30	7.6	5.6	4	5	3.5
250	84	30	8.6	6.3	4.6	5.7	4
350	88	36	11	8.1	5.7	7.2	5
400	97	36	11.9	8.7	6.2	7.8	5.4
500	74	48	13.3	10.2	6.9	8.9	6
750	106	48	17.7	13.2	9.2	11.7	8
1000	138	48	22.1	16.1	11.5	14.4	10

Figure 7

Sources:

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; "Hot Water Tank Insulation", pg 97-100

Hot Water Pipe Insulation

Description: Installation of insulation in space heating and domestic hot water (DHW) system distribution piping. The savings depend on the type and size of the pipe, insulation type and thickness, hot water temperature and piping system ambient temperature. This measure should only be applied to poorly insulated or uninsulated hot water and steam distribution piping in unconditioned spaces.

Algorithms:

$$\Delta \boldsymbol{kW} = L \times \frac{(UA/L)_{base} - (UA/L)_{ee}}{3{,}413 \times EF} \times \Delta T \times CF$$

$$\Delta \boldsymbol{kWh} = L \times \frac{(UA/L)_{base} - (UA/L)_{ee}}{3{,}413 \times EF} \times \Delta T \times HRS$$

$$\Delta \boldsymbol{MMBtu} = L \times \frac{(UA/L)_{base} - (UA/L)_{ee}}{1{,}000{,}000 \times EF} \times \Delta T \times HRS$$

Note: Energy savings are capped as follows:*

- Service Hot Water = 185,000 Btu/SF of Insulation
- Hot Water Heat = 115,000 Btu/SF of Insulation
- Steam Heat = 150,000 Btu/SF of Insulation

Where:

L = Length of uninsulated pipe to be insulated in feet.

$(UA/L)_{base}$ = Baseline pipe heat loss coefficient per unit length (Btu/hr-°F-ft), based on pipe diameter, hot water end use and piping material. See the “Additional Details” section for information regarding estimating pipe heat loss coefficients.

$(UA/L)_{ee}$ = Insulated pipe heat loss coefficient per unit length (Btu/hr-°F-ft), based on pipe diameter, hot water end use and piping material. See the “Additional Details” section for information regarding estimating pipe heat loss coefficients.

3,413 = Conversion factor (3,413 = Btu/kWh).

EF = Efficiency of water heating equipment. Use a value of 0.97 for electric water heaters, 0.75 for non-electric water heaters, 0.8 for hot water boilers and 0.75 for steam boilers.

ΔT = Temperature difference between water within pipe and ambient air temperature in degrees F. Use a value of 60 °F for domestic hot water, 100 °F for hot water heat and 130 °F for steam heat.

CF = Summer peak demand coincidence factor; defined as the average fraction of installed capacity of a population of systems that are operating at the time of system peak. Use a value of 1.0 for electric hot water heaters, 0 otherwise.

HRS = Hours of hot water usage per year. Use a value of 8,760 for domestic hot water, 3,240 for high rise buildings and New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs Appendix G values subject to location mappings per Figure 1 in the Shell Insulation (Wall & Roof/Ceiling) section of this document for low rise buildings.

1,000,000 = Conversion factor (1,000,000 = Btu/MMBtu).

Additional Details: $(UA/L)_{base}$ and $(UA/L)_{ee}$ are determined based on guidance found in the New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs document. These values are summarized in Figures 8, 9 and 10 below.

*Cap added to a prevent improvements with large lengths of pipe to be insulated from having artificially inflated savings. Cap was developed based on savings analysis of TRM method to align with savings projected in the standard modeling approach

Baseline Uninsulated Pipe Heat Loss Coefficient (UA/L) in Btu/hr-F-ft					
Pipe Size (nominal) (in.)	Bare Copper Piping			Bare Steel Piping	
	Service Hot Water	Hot water heat	Steam heat	Hot water heat	Steamheat
0.75	0.4	0.45	0.49	0.73	0.78
1	0.5	0.56	0.61	0.89	0.95
1.25	0.59	0.67	0.72	1.1	1.18
1.5	0.68	0.78	0.83	1.24	1.33
2	0.86	0.98	1.05	1.52	1.63
2.5	1.04	1.18	1.26	1.81	1.94
3	1.21	1.37	1.47	2.16	2.32
4	1.54	1.75	1.88	2.72	2.92

Figure 8

Insulated Copper Pipe Heat Loss Coefficient (UA/L) in Btu/hr-F-ft								
Pipe Size (nominal) (in.)	Fiberglass				Rigid foam			
	0.5 in	1 in	1.5 in	2.0+ in	0.5 in	1 in	1.5 in	2.0+ in
0.75	0.17	0.11	0.09	0.08	0.12	0.08	0.06	0.05
1	0.21	0.13	0.1	0.09	0.15	0.09	0.07	0.06
1.25	0.24	0.15	0.11	0.1	0.17	0.1	0.08	0.07
1.5	0.27	0.16	0.13	0.11	0.2	0.12	0.09	0.08
2	0.34	0.2	0.15	0.12	0.24	0.14	0.11	0.09
2.5	0.41	0.23	0.17	0.14	0.29	0.17	0.12	0.1
3	0.47	0.26	0.19	0.16	0.34	0.19	0.14	0.11
4	0.6	0.33	0.24	0.19	0.43	0.24	0.17	0.14

Figure 9

Insulated Steel Pipe Heat Loss Coefficient (UA/L) in Btu/hr-F-ft								
Pipe Size (nominal) (in.)	Fiberglass				Rigid foam			
	0.5 in	1 in	1.5 in	2.0+ in	0.5 in	1 in	1.5 in	2.0+ in
0.75	0.2	0.12	0.1	0.08	0.14	0.09	0.07	0.06
1	0.23	0.14	0.11	0.09	0.17	0.1	0.08	0.07
1.25	0.28	0.17	0.13	0.11	0.2	0.12	0.09	0.08
1.5	0.31	0.18	0.14	0.12	0.22	0.13	0.1	0.08
2	0.37	0.21	0.16	0.13	0.27	0.15	0.12	0.1
2.5	0.44	0.25	0.18	0.15	0.32	0.18	0.13	0.11
3	0.52	0.29	0.21	0.17	0.38	0.21	0.15	0.12
4	0.65	0.36	0.26	0.21	0.47	0.26	0.18	0.15

Figure 10

Sources:

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; “Pipe Insulation”, pg 101-104

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; “Appendix G: Heating and Cooling Equivalent Full Load Hours”, pg 430-435

Low-Flow Faucet Aerators

Description: Installation of low-flow (1.5 GPM) faucet aerators on existing, standard flow rate restroom and kitchen faucets with flow rate between 1.5 and 2.2 GPM.

Algorithms:

$$\Delta \boldsymbol{kWh} = \frac{(GPM_{base} - GPM_{ee}) \times MIN \times USES \times 365 \times \Delta T \times 8.33}{3{,}413 \times EF}$$

$$\Delta \boldsymbol{MMBtu} = \frac{(GPM_{base} - GPM_{ee}) \times MIN \times USES \times 365 \times \Delta T \times 8.33}{1{,}000{,}000 \times EF}$$

Where:

GPM_{base} = Flow rate of existing, standard faucet aerators in gallons per minute.

GPM_{ee} = Flow rate of proposed, low-flow faucet aerators in gallons per minute.

MIN = Duration of faucet usage per use in minutes. Use a value of 0.5 for faucet aerators.

USES = Number of uses per day. Use a value of 20* for faucet aerators.

365 = Days per year.

ΔT = Temperature difference between faucet temperature and cold inlet/main temperature in degrees F. See the “Additional Details” section for information on determining this temperature difference.

8.33 = Heat content of water (Btu/gal-°F).

3,413 = Conversion factor (3,413 = Btu/kWh).

EF = Efficiency of water heating equipment. Use a value of 0.97 for electric water heaters and 0.75 for non-electric water heaters.

1,000,000 = Conversion factor (1,000,000 = Btu/MMBtu).

Additional Details: For the ΔT variable, use a value of 80 °F for average faucet temperature and values from Figure 4 in the Hot Water Heater section of this document subject to location mappings in Figure 1 of the Shell Insulation (Wall & Roof/Ceiling) section for cold inlet/main temperature.

*Uses assumption was revised from 30 uses to 20 uses per day to limit savings from being artificially inflated. Value was based on savings analysis completed by Efficiency Maine of TRM method to align with savings projected in the standard modeling approach.

Sources:

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; “Faucet Aerators”, pg 94-96

Low- Flow Showerheads

Description: Replacement of standard flow showerheads between 2.2 and 3.25 GPM with low-flow (2.2 GPM) showerheads in family unit showers.

Algorithms:

$$\Delta \boldsymbol{kWh} = \frac{(GPM_{base} - GPM_{ee}) \times TF \times MIN \times USES \times 365 \times \Delta T \times 8.33}{3{,}413 \times EF}$$

$$\Delta \boldsymbol{MMBtu} = \frac{(GPM_{base} - GPM_{ee}) \times MIN \times USES \times 365 \times \Delta T \times 8.33}{1{,}000{,}000 \times EF}$$

Where:

GPM_{base} = Flow rate of existing, standard showerheads in gallons per minute.

GPM_{ee} = Flow rate of proposed, low-flow showerheads in gallons per minute.

TF = Typical throttle factor of showerhead. Use a value of 0.75.

MIN = Duration of usage per shower in minutes. Use a value of 5* for showerheads.

USES = Number of uses per day. Use a value of 2 for showerheads.

365 = Days per year.

ΔT = Temperature difference between shower temperature and cold inlet/main temperature in degrees F. See the “Additional Details” section for information on determining this temperature difference.

8.33 = Heat content of water (Btu/gal-°F).

3,413 = Conversion factor (3,413 = Btu/kWh).

EF = Efficiency of water heating equipment. Use a value of 0.97 for electric water heaters and 0.75 for non-electric water heaters.

1,000,000 = Conversion factor (1,000,000 = Btu/MMBtu).

Additional Details: For the ΔT variable, use a value of 105 °F for average shower temperature and values from Figure 4 in the Hot Water Heater section of this document subject to location mappings in Figure 1 of the Shell Insulation (Wall & Roof/Ceiling) section for cold inlet/main temperature.

*Minutes assumption was revised from 8 minutes to 5 minutes per shower to limit savings from being artificially inflated. Value was based on savings analysis completed by Efficiency Maine of TRM method to align with savings projected in the standard modeling approach.

Sources:

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; “Low Flow Showerheads”, pg 92-93

ENERGY STAR Refrigerators

Description: Replacement of existing refrigerators at least 10 years old with ENERGY STAR models in multi-family dwellings.

Algorithms:

$$\Delta \boldsymbol{kWh} = \Delta kWh_{REFRIG}$$

$$\Delta \boldsymbol{kW} = \Delta kWh \times LRF$$

Where:

kWh_{REFRIG} = Average annual energy savings for ENERGY STAR® refrigerator compared to noncertified models (kWh/yr). Use a value of 125 kWh.

LRF = Load Reduction Factor (kW/kWh/Yr). Use a value of 0.00026.

Additional Details: None.

Sources:

Efficiency Maine – Residential TRM V2014.1, July 1, 2013; "Refrigerators", pg 8

ENERGY STAR Clothes Washers

Description: Replacement of non-ENERGY STAR in-unit and common area clothes washers with ENERGY STAR rated equipment. Common Area clothes washer calculations and assumptions are consistent with the ENERGY STAR Appliance Savings Calculator.

Algorithms:

$$\Delta \boldsymbol{kWh} = \left[Units_{APT} \times \left(\Delta kWh_{washer,APT} + \Delta kWh_{water\ heater,APT} + \Delta kWh_{dryer,APT}\right) + Units_{CA} \times \left(\Delta kWh_{washer,CA} + \Delta kWh_{water\ heater,CA} + \Delta kWh_{dryer,CA}\right)\right]$$

$$\Delta \boldsymbol{kW} = \Delta kWh \times LRF$$

$$\Delta \boldsymbol{MMBtu} = \left[Units_{APT} \times \left(\Delta MMBtu_{water\ heater,APT} + \Delta MMBtu_{dryer,APT}\right) + Units_{CA} \times \left(\Delta MMBtu_{water\ heater,CA} + \Delta MMBtu_{dryer,CA}\right)\right]$$

Where:

$Units_{APT}$ = Quantity of in-unit clothes washers replaced.

$\Delta kWh_{washer,APT}$ = Annual kWh savings per in-unit clothes washer attributable to clothes washers. Use a value of 24 kWh.

$\Delta kWh_{water\ heater,APT}$ = Annual kWh savings per in-unit clothes washer attributable to electric water heating. Use a value of 127 kWh for electric water heating, 0 otherwise.

$\Delta kWh_{dryer,APT}$ = Annual kWh savings per in-unit clothes washer attributable to electric clothes dryers. Use a value of 73 kWh for electric dryers, 0 otherwise.

$Units_{CA}$ = Quantity of common area clothes washers replaced.

$\Delta kWh_{washer,CA}$ = Annual kWh savings per common area clothes washer attributable to clothes washers. Use a value of 198 kWh.

$\Delta kWh_{water\ heater,CA}$ = Annual kWh savings per common area clothes washer attributable to electric water heating. Use a value of 792 kWh for electric water heating, 0 otherwise.

$\Delta kWh_{dryer,CA}$ = kWh savings per common area clothes washer attributable to electric clothes dryers. Use a value of 746 kWh for electric dryers, 0 otherwise.

LRF = Load Reduction Factor (kW/kWh/Yr). Use a value of 0.00161.

$\Delta MMBtu_{water\ heater,APT}$ = Annual MMBtu savings per in-unit clothes washer attributable to non-electric water heating. Use a value of 0.61 MMBtu for non-electric water heating, 0 otherwise.

$\Delta MMBtu_{dryer,APT}$ = Annual kWh savings per in-unit clothes washer attributable to non-electric clothes dryers. Use a value of 0.29 MMBtu for non-electric dryers, 0 otherwise.

$\Delta MMBtu_{water\ heater,CA}$ = Annual kWh savings per common area clothes washer attributable to non-electric water heating. Use a value of 3.61 MMBtu for non-electric water heating, 0 otherwise.

$\Delta MMBtu_{dryer,CA}$ = kWh savings per common area clothes washer attributable to non-electric clothes dryers. Use a value of 2.55 MMBtu for non-electric dryers, 0 otherwise.

Additional Details: None.

Sources:

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; “Clothes Washer”, pg 24-25

Savings Calculator for ENERGY STAR Qualified Appliances, http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=CW

Efficiency Maine – Residential TRM V2013.1, January 1, 2013; ”Clothes Washers”, pg 14

ENERGY STAR Dishwashers

Description: Replacement of in-unit dishwashers with those meeting the minimum qualifying efficiency standards established under the ENERGY STAR Program. The dishwashers must be located within the residential unit, not a commercial dishwasher in a food service application.

Algorithms:

$$\Delta \boldsymbol{kWh} = Units \times \ \Delta kWh/yr$$

$$\Delta \boldsymbol{kW} = Units \times \Delta kW/yr$$

Where:

Units = Quantity of in-unit dishwashers replaced.

ΔkWh/yr = Annual kWh savings per dishwasher. Use a value of 57 kWh.

ΔkW/yr = Peak kW savings per dishwasher. Use a value of 0.092 kW.

Additional Details: None.

Sources:

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; "ENERGY STAR Dishwashers", pg 26

Efficiency Maine – Residential TRM V2013.1, January 1, 2013; "Dishwashers", pg 13

NEMA Premium Motors

Description: Installation of NEMA premium efficiency motors replacing standard efficiency motors in commercial applications. Proposed motors must be at least 1.0 horsepower.

Algorithms:

$$\Delta \boldsymbol{kW} = Units \times 0.746 \times \left[\frac{HP_{base} \times RLF_{base}}{EFF_{base}} - \frac{HP_{ee} \times RLF_{ee}}{EFF_{ee}}\right] \times CF$$

$$\Delta \boldsymbol{kWh} = Units \times 0.746 \times \left[\frac{HP_{base} \times RLF_{base}}{EFF_{base}} - \frac{HP_{ee} \times RLF_{ee}}{EFF_{ee}}\right] \times EFLH$$

Where:

Units = Quantity of motors replaced.

0.746 = Conversion factor (0.746 = kW/HP).

HP_{base} = Horsepower of the baseline motor.

RLF_{base} = Rated load factor of the baseline motor, defined as the peak true running load of the motor divided by nameplate peak load.

EFF_{base} = Efficiency of the baseline motor.

HP_{ee} = Horsepower of the proposed motor.

RLF_{ee} = Rated load factor of the proposed motor, defined as the peak true running load of the motor divided by nameplate peak load.

EFF_{ee} = Efficiency of the proposed motor.

CF = Summer peak demand coincidence factor; defined as the average fraction of installed capacity of a population of systems that are operating at the time of system peak. Use a value of 0.8 for motors.

EFLH = Equivalent full load run hours of motors, defined as the annual kWh consumption of the motor divided by its peak kW load. Use a value of 7,665 for fan motors, 3,177 for chilled water pumps and cooling tower fan motors, and 6,000 for hydronic system hot water pumps.

Additional Details: None.

Sources:

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; “Motors”, pg 197-200

Electronically Commutated Motors

Description: Replacement of fractional horsepower shaded pole or permanent-split capacitor motors with electronically commutated (brushless) motors on furnace supply fans and hot water circulators.

Algorithms:

Furnace Fans

$$\Delta \boldsymbol{kWh} = Units \times \Delta kWh/Unit$$

Hydronic Heating Pumps

$$\Delta \boldsymbol{kWh} = Units \times HP \times 0.746 \times HRS \times \left[\frac{1}{EFF_{base}} - \frac{1}{EFF_{ee}}\right]$$

Where:

Units = Quantity of furnaces/heating pumps equipped with EC motors.

ΔkWh/Unit = Annual kWh savings per furnace. Use a value of 733 kWh.

HP = Horsepower of proposed EC motors.

0.746 = Conversion factor (0.746 = kW/HP).

HRS = Operating hours of heating pumps. Use a value of 3,240 hours.

EFF_{base} = Efficiency of baseline fractional horsepower motors. Use a value of 50%.

EFF_{ee} = Efficiency of proposed fractional horsepower EC motors. Use a value of 80%.

Additional Details: None.

Sources:

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; "EC Motors on Furnace Fans", pg 65, "EC Motors for Hydronic Heating Pumps", pg 66-67

Variable Frequency Drives

Description: Variable frequency drives applied to HVAC motors between 1 and 30 HP. Applications include supply fans, return fans, exhaust fans, chilled water pumps and hot water heating circulating pumps.

Algorithms:

$$\Delta \boldsymbol{kW} = HP \times DSVG$$

$$\Delta \boldsymbol{kWh} = HP \times ESVG$$

Where:

HP = Horsepower of motors controlled by VFDs.

DSVG = Demand savings factor in kW/HP. See the “Additional Details” section for demand savings factors for each motor type.

ESVG = Energy savings factor in kWh/HP. See the “Additional Details” section for energy savings factors for each motor type.

Additional Details: DSVG and ESVG factors are based on the Commercial Efficiency Maine Technical Resource Manual and are summarized in Figure 11 below.

Motor Type	kWh/HP	kW/HP
Exhaust Fan	755	0.120
Chilled Water Pump	1,746	0.188
Hot Water Pump	1,746	0.188
Return Air Fan	1,524	0.263
Supply Air Fan	1,001	0.173

Figure 11

Sources:

Protocol Efficiency Maine Commercial Technical Reference Manual Version 2014.1, Efficiency Maine Trust, August 2013; “Prescriptive VFD: Variable Frequency Drives (VFD) for HVAC”, pg 16-17

Lighting

Description:

Common Area Lighting & Controls
Installation of energy-efficient lighting equipment, including lamps, ballasts, fixtures, controls and optical improvements such as reflectors in common areas. These technologies, taken separately or combined into an energy efficient lighting fixture, provide the required illumination at reduced input power. Lighting controls covered under Prescriptive Path are Occupancy Sensors, Programmable Controls (time-clocks), Daylight Dimming Controls and Daylight Step Control.

In-Unit Lighting
Installation of energy-efficient lighting equipment, including lamps, ballasts, fixtures, and optical improvements such as reflectors in family units. These technologies, taken separately or combined into an energy efficient lighting fixture, provide the required illumination at reduced input power.

Exterior Lighting
Installation of energy-efficient lighting equipment, including lamps, ballasts, fixtures, and optical improvements on the exterior of buildings. These technologies, taken separately or combined into an energy efficient lighting fixture, provide the required illumination at reduced input power.

Algorithms:

$$\Delta \boldsymbol{kW} = (Units_{base} \times Watt_{base} - Units_{ee} \times Watt_{ee}) \times CF/1{,}000$$

$$\Delta \boldsymbol{kWh} = (Units_{base} \times Watt_{base} \times HRS_{base} - Units_{ee} \times Watt_{ee} \times HRS_{ee})/1{,}000$$

Where:

$Units_{base}$ = Quantity of baseline condition fixtures.

$Watt_{base}$ = Wattage per baseline condition fixture.

$Units_{ee}$ = Quantity of proposed condition fixtures.

$Watt_{ee}$ = Wattage per proposed condition fixture.

CF = Summer peak demand coincidence factor; defined as the average fraction of installed capacity of a population of systems that are operating at the time of system peak. Use a value of 0.75 for lighting.

1,000 = Conversion factor (1,000 = Watts/kW).

HRS_{base} = Hours of operation of lighting in baseline case.

HRS_{ee} = Hours of operation of lighting in the proposed case, including reductions due to lighting controls.

Additional Detail: Hours of operation are user input variables. Guidance for hours of operation can be found in the Commercial and Residential Efficiency Maine Technical Resource Manuals as well as the

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs document. In addition, a list of fixtures and typical wattages for those fixtures can be found in Appendix C of the New York TRM.

Sources:

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; “Interior and Exterior Lighting”, pg 108-112, “Interior Lighting Controls”, pg 113-115

New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, New York Evaluation Advisory Contractor Team & TecMarket Works, October 15, 2010; “Appendix C: Standard Fixture Watts”, pg 254-288

Protocol Efficiency Maine Commercial Technical Reference Manual Version 2014.1, Efficiency Maine Trust, August 2013; pg 7-14

Appendix A: Useful Life of Prescriptive Path Measures

The table below indicates the typical expected useful life of measures covered by this document. These measure lives are used in the Efficiency Maine Prescriptive Path tool to establish life-cycle savings and internal rate of return of measures proposed under the Prescriptive Path of the Efficiency Maine Multifamily Efficiency Program.

Measure Name	Measure Life	Measure Life Source
Wall Insulation	30	3
Roof Insulation	30	3
Air Leakage Sealing	15	3
ENERGY STAR Windows	20	3
Boiler/Furnace Replacement	20	1
Boiler Reset Control	15	2
Programmable Thermostats	11	3
Thermostatic Radiator Valves	12	3
Energy Management System	15	3
ENERGY STAR Room Air Conditioners	9	4
Direct-Fired Hot Water Heaters	13	3
Indirect-Fired Hot Water Heaters	15	3
Insulate Hot Water Tanks	Manual Entry	N/A
Hot Water Pipe Insulation	11	3
Low-Flow Faucet Aerators	10	3
Low-Flow Showerheads	10	3
ENERGY STAR Refrigerators	12	4
ENERGY STAR Clothes Washers	11	4
ENERGY STAR Dishwashers	10	4
NEMA Premium Motors	15	3
Electronically Commutated Motors	15	3
Variable Frequency Drives	13	3
Common Area Lighting & Controls	13	3
In-Unit Lighting	20	3
Exterior Lighting	20	3

	Sources
1	Efficiency Maine Commercial TRM
2	NY Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, Residential, Multi-Family and Commercial/Industrial Measures. October 15, 2010. NY DPS
3	NYSERDA Multifamily Efficiency Program, Version 4.1. Benchmarking Tool Excel Sheet.
4	Efficiency Maine Residential TRM