

### Table of Revisions/Changes

Revision Number	Addition/Revision	Issue Date	Effective Date	Measure	Description of Change	Location/Page in TRM
3-18-17	A	3/29/2018	3/29/2018	R/MF Learning Thermostat	New Measure Added	
3-18-18	A	3/29/2018	3/29/2018	C/I Ovens, Steamers, Fryers and Griddles	New Measure Added	
3-18-19	A	3/29/2018	3/29/2018	C/I Combination Ovens	New Measure Added	
3-18-20	A	3/29/2018	3/29/2018	C/I Insulated Holding Cabinets	New Measure Added	
3-18-21	R	3/29/2018	1/1/2019	Appendix P <sup>1</sup>	Updated EUL entries for all measures contained in this Record of Revision.	Pg. 590
3-18-22	R	3/29/2018	1/1/2019	Glossary <sup>2</sup>	Added entries to align with all measures contained in this Record of Revision.	Pg. 602

**Note:** Revisions and additions to the measures listed above were undertaken by the Joint Utilities Technical Resource Manual (TRM) Management Committee between January 1, 2018 – March 29, 2018.

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<sup>1</sup> Please note the EUL's in Appendix P included in this filing are effective 3/29/2018 for the following measures: 3-18-17 R/MF Learning Thermostat, 3-18-18 C/I Ovens, Steamers, Fryers and Griddles, 3-18-19 C/I Combination Ovens, and 3-18-20 C/I Insulated Holding Cabinets.

<sup>2</sup> Please note the terms in the Glossary included in this filing are effective 3/29/2018 for the following measures: 3-18-17 R/MF Learning Thermostat, 3-18-18 C/I Ovens, Steamers, Fryers and Griddles, 3-18-19 C/I Combination Ovens, and 3-18-20 C/I Insulated Holding Cabinets.

## **LEARNING THERMOSTAT**

### **Measure Description**

This measure covers the installation of ENERGY STAR® qualified smart thermostats with behavioral learning capabilities applied to single-family and multi-family residential HVAC systems. Utilizing Wi-Fi connections, a smart (learning) thermostat provides and receives feedback from users to enhance energy efficiency without compromising comfort. A learning thermostat controls HVAC equipment to regulate the temperature of the room or space in which it is installed, communicates with sources external to the HVAC system for remote adjustment and has the ability to perform automatic adjustments in response to occupant behavior.

Additional learning thermostat capabilities may vary, but at minimum, must meet the following criteria:

- Work as a basic thermostat in absence of connectivity to the service provider.
- Give residents some form of feedback about the energy consequences of their settings.
- Provide information about HVAC energy use, such as monthly run time.
- Provide the ability to set a schedule.
- Provide the ability to work with utility programs to prevent brownouts and blackouts, while preserving consumers' ability to override those grid requests.<sup>1</sup>

This measure is applicable to single and multi-family centralized heating and cooling systems. For single family applications with multiple zones, savings are claimed per residence. While incentives may be provided for multiple thermostat units, the algorithms below shall apply a value of “1” to the “units” term. For multifamily applications, “tons/unit”, “kBTU<sub>h</sub><sub>out</sub>/unit” and “kBTU<sub>h</sub><sub>in</sub>/unit” terms shall be set equal to the total capacity of the central cooling/heating system divided by the total number of dwelling units served by the system. The “units” term shall be set equal to the total number of dwelling units in which learning thermostats are installed. This measure is not applicable to multifamily central heating systems with additional capacity for domestic hot water.

### **Method for Calculating Annual Energy and Peak Coincident Demand Savings**

#### *Annual Electric Energy Savings*

$$\Delta kWh = units \times \left[ \begin{aligned} & \left( tons/unit \times \frac{12}{Eff_{cooling}} \times EFLH_{cooling} \times ESF_{cooling} \times F_{CEC} \right) \\ & + \left( kBTU_{h_{out}}/unit \times \frac{1}{HSPF} \times EFLH_{heating} \times ESF_{heating} \times F_{EH} \right) \end{aligned} \right]$$

#### *Peak Coincident Demand Savings*

$$\Delta kW = N/A$$

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<sup>1</sup> ENERGY STAR® Program Requirements Product Specification for Connected Thermostat Products, Eligibility Criteria Version 1.0, January 2017

*Annual Gas Energy Savings*

$$\Delta \text{therms} = \text{units} \times \left( \text{kBTU}_{\text{in}}/\text{unit} \times \frac{1}{100} \times \text{EFLH}_{\text{heating}} \times \text{ESF}_{\text{heating}} \times F_{\text{GH}} \right)$$

**where:**

$\Delta \text{kWh}$	= Annual electric energy savings
$\Delta \text{kW}$	= Peak coincident demand electric savings
$\Delta \text{therms}$	= Annual gas savings
units	= Number of residences in which the measure is installed under the program
tons/unit	= Tons of air conditioning per residence, based on nameplate data; for multifamily buildings with centralized HVAC, this term shall be set equal to the total cooling capacity of the system divided by the total number of dwelling units it serves
$\text{kBTU}_{\text{out}}/\text{unit}$	= Output electric heating capacity in kBTU/h per residence, based on nameplate data; for multifamily buildings with centralized HVAC, this term shall be set equal to the total heating capacity of the system divided by the total number of dwelling units it serves
$\text{kBTU}_{\text{in}}/\text{unit}$	= Input heating capacity in kBTU/h per residence, based on nameplate data; for multifamily buildings with centralized HVAC, this term shall be set equal to the total heating capacity of the system divided by the total number of dwelling units it serves
$\text{Eff}_{\text{cooling}}$	= Seasonal average energy efficiency over the cooling season, BTU/watt-hour, (used for average U.S. location/region), using either SEER (<5.4 tons) or IEER ( $\geq 5.4$ tons)
HSPF	= Seasonal average energy efficiency over the heating season, Heating seasonal performance factor, BTU/watt-hour, total heating output (supply heat) in BTU (including resistance heat) during the heating season / total electric energy heat pump consumed (in watt-hour); if equipment efficiency is reported in COP, convert to HSPF using the equivalency $\text{HSPF} = \text{COP} \times 3.412$
EFLH	= Equivalent full-load hours
ESF	= Energy savings factor
$F_{\text{CEC}}$	= Central electric cooling factor; used to account for the presence or absence of a central electric cooling system
$F_{\text{EH}}$	= Electric heating factor; used to account for the presence or absence of an electric heating system
$F_{\text{GH}}$	= Gas heating factor; used to account for the presence or absence of a gas heating system
12	= kBTU/h/ton of air conditioning capacity
100	= Conversion factor, one therm equals 100 kBTU

Summary of Variables & Data Sources

Variable	Value	Notes
tons/unit		From application or use 3 tons as a default. <sup>2</sup>
kBTU <sub>h</sub> <sub>out</sub> /unit		From application or use 72 kBTU <sub>h</sub> as a default. <sup>3</sup>
kBTU <sub>h</sub> <sub>in</sub> /unit		From application or use 90 kBTU <sub>h</sub> as a default. <sup>4</sup>
Eff <sub>cooling</sub>		From application or use 14 SEER, assuming a 3-ton central ASHP system. <sup>5</sup>
HSPF		From application or use 8.2 HSPF, assuming a 3-ton central ASHP system. <sup>6</sup> For electric resistance heating and electric furnaces, use 3.4 HSPF. If taken from application, COP must be converted to HSPF using the equivalency HSPF = COP x 3.412.
EFLH <sub>cooling</sub>		Look up based on building type, vintage and city in <a href="#">Appendix G</a> .
EFLH <sub>heating</sub>		Look up based on building type, vintage and city in <a href="#">Appendix G</a> .
ESF <sub>cooling</sub>	0.10	Energy savings factor for cooling. <sup>7</sup>
ESF <sub>heating</sub>	0.08	Energy savings factor for heating. <sup>8</sup>
F <sub>CEC</sub>	Central Cooling: 1 No Central Cooling: 0 Unknown: 0.39	Based on EIA Residential Energy Consumption Survey (RECS) 2015 for Middle Atlantic States. <sup>9</sup>
F <sub>EH</sub>	Electric Heating: 1 No Electric Heating: 0 Unknown: 0.15	Based on EIA Residential Energy Consumption Survey (RECS) 2015 for Middle Atlantic States. <sup>10</sup>
F <sub>GH</sub>	Gas Heating: 1 No Gas Heating: 0 Unknown: 0.60	Based on EIA Residential Energy Consumption Survey (RECS) 2015 for Middle Atlantic States. <sup>11</sup>

<sup>2</sup> Assumes a 1,800 ft<sup>2</sup> home with 20 BTU<sub>h</sub>/ft<sup>2</sup> cooling load: 1,800 ft<sup>2</sup> x 20 BTU<sub>h</sub>/ft<sup>2</sup> x 1/12,000 ton/BTU<sub>h</sub> = 3 tons

<sup>3</sup> Assumes a 1,800 ft<sup>2</sup> home with 40 BTU<sub>h</sub>/ft<sup>2</sup> heating load: 1,800 ft<sup>2</sup> x 40 BTU<sub>h</sub>/ft<sup>2</sup> x 1/1,000 kBTU<sub>h</sub>/BTU<sub>h</sub> = 72 kBTU<sub>h</sub>

<sup>4</sup> Assumes a 1,800 ft<sup>2</sup> home with 40 BTU<sub>h</sub>/ft<sup>2</sup> heating load and 80% AFUE: 1,800 ft<sup>2</sup> x 40 BTU<sub>h</sub>/ft<sup>2</sup> x 1/0.80 x 1/1,000 kBTU<sub>h</sub>/BTU<sub>h</sub> = 90 kBTU<sub>h</sub>

<sup>5</sup> 10 CFR 430.32 (c)(1)

<sup>6</sup> Ibid.

<sup>7</sup> ENERGY STAR® Program Requirements Product Specification for Connected Thermostat Products, Eligibility Criteria Version 1.0, January 2017, pg. 10

<sup>8</sup> Ibid.

<sup>9</sup> EIA Residential Energy Consumption Survey (RECS) 2015 for Middle Atlantic States, Table HC7.7 (“Unknown” calculated as the number of homes with central AC divided by the total number of homes)

<sup>10</sup> EIA Residential Energy Consumption Survey (RECS) 2015 for Middle Atlantic States, Table HC6.7 (“Unknown” calculated as the number of homes with electric heat divided by the total number of homes)

<sup>11</sup> EIA Residential Energy Consumption Survey (RECS) 2015 for Middle Atlantic States, Table HC6.7 (“Unknown” calculated as the number of homes with natural gas heat divided by the total number of homes)

### Coincidence Factor (CF)

The recommended value for the coincidence factor is N/A.

### Baseline Efficiencies from which Savings are Calculated

The baseline condition is an HVAC system controlled by a programmable thermostat without Wi-Fi or behavioral learning capability.

### Compliance Efficiency from which Incentives are Calculated

The compliance condition is an HVAC system controlled by an ENERGY STAR<sup>®</sup> qualified Wi-Fi communicating thermostat with behavioral learning capability as defined in the Measure Description section above.

### Operating Hours

Cooling and heating equivalent full-load hours were calculated from a DOE-2.2 simulation of prototypical single and multi-family residential buildings. Operating hour assumptions for the prototypical building models are described in [Appendix A](#). The heating EFLH for commercial buildings in NY are shown in [Appendix G](#).

### Effective Useful Life (EUL)

See [Appendix P](#).

### Ancillary Fossil Fuel Savings Impacts

N/A

### Ancillary Electric Savings Impacts

Reduced operating hours during the heating and cooling season result in distribution blower electric savings. These effects are not quantified in the prescribed savings estimation methodology for this measure at this time.

### References

1. ENERGY STAR<sup>®</sup> Program Requirements Product Specification for Connected Thermostat Products, Eligibility Criteria Version 1.0, January 2017  
Available from:  
<https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Program%20Requirements%20for%20Connected%20Thermostats%20Version%201.0.pdf>
2. 10 CFR 430.32 Energy and water conservation standards and their compliance dates.  
Available from: [http://www.ecfr.gov/cgi-bin/text-idx?SID=a9921a66f2b4f66a32ec851916b7b9d9&mc=true&node=se10.3.430\\_132&rgn=div8](http://www.ecfr.gov/cgi-bin/text-idx?SID=a9921a66f2b4f66a32ec851916b7b9d9&mc=true&node=se10.3.430_132&rgn=div8)

3. EIA Residential Energy Consumption Survey (RECS) 2015 Survey Data for Middle Atlantic States.

Available from: <https://www.eia.gov/consumption/residential/data/2015/>

**Record of Revision**

<b>Record of Revision Number</b>	<b>Issue Date</b>
3-18-17	3/29/2018

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## **OVENS, STEAMERS, FRYERS AND GRIDDLES**

### **Measure Description**

This measure covers the installation of ENERGY STAR® qualified commercial kitchen equipment that meet the descriptions below. Unless otherwise noted, presented baseline, compliance, and default values are determined from ENERGY STAR® Commercial Food Service Equipment Calculator.<sup>1</sup>

- Convection Ovens<sup>2</sup> - This measure includes gas and electric commercial convection ovens. A convection oven forces hot dry air over the surface of a food product. A full size convection oven can accommodate standard full size sheet pans measuring 18 x 26 x 1 inch. A half size convection oven can accommodate half size sheet pans measuring 18 x 13 x 1 inch. Though not eligible for ENERGY STAR® qualification, this measure includes half size gas convection ovens. Half size gas convection ovens must have an idle rate of 8,000 BTU/h or less, per assumed efficiency of qualified equipment by the Food Service Technology Center (FSTC).<sup>3</sup>
- Rack Ovens<sup>4</sup> - This measure includes gas commercial rack ovens. A rack oven is a high capacity oven in which a rack is wheeled into the oven and can be rotated during the baking process. Rack ovens range in capacity from mini rack ovens to quadruple rack ovens. Single and double rack ovens are included in this measure.
- Steamers<sup>5</sup> - This measure includes gas and electric commercial steamers, also known as compartment steamers. A steamer is a device that contains one or more food steaming compartments in which the energy in the steam is transferred to the food by direct contact. To calculate the savings for this measure, the number of pans must be known. Countertop, wall-mounted, and floor models mounted on a stand, pedestal, or cabinet-style base are included. Commercial steamer microwave ovens are not included in this measure.
- Fryers<sup>6</sup> - This measure includes gas and electric commercial deep-fat fryers. A deep-fat fryer is an appliance in which oils are placed to such a depth that the cooking food is essentially supported by displacement of the cooking fluid rather than by the bottom of the vessel. Depending on the fryer type, heat is delivered to the cooking fluid by means of an immersed electric element or band-wrapped vessel (electric fryers), or by heat transfer from gas burners through either the walls of the fryer or through tubes passing through the cooking fluid (gas fryers). Standard fryers and large vat fryers are included in this measure.

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<sup>1</sup> ENERGY STAR® Commercial Food Service Equipment Calculator (accessed 2/26/2018)

<sup>2</sup> ENERGY STAR® Program Requirements Product Specification for Commercial Ovens, Eligibility Criteria, Version 2.2., March 2015

<sup>3</sup> Food Service Technology Center, Qualified Convection Ovens, February 2018

<sup>4</sup> ENERGY STAR® Program Requirements Product Specification for Commercial Ovens, Eligibility Criteria, Version 2.2., March 2015

<sup>5</sup> ENERGY STAR® Program Requirements for Commercial Steam Cookers, Eligibility Criteria Version 1.2, August 2003

<sup>6</sup> ENERGY STAR® Program Requirements Product Specification for Commercial Fryers, Eligibility Criteria Final Draft Version 3.0. October 2016

- Griddles<sup>7</sup> - This measure includes single-sided gas and electric commercial griddles. A single-sided commercial griddle is a commercial appliance designed for cooking food in oil or its own juices by direct contact with either a flat, smooth, hot surface or a hot channeled cooking surface where plate temperature is thermostatically controlled. To calculate the energy savings in this measure, the griddle dimensions must be known. This measure does not include double-sided gas or electric commercial griddles.
- Gas Conveyor Ovens - Though not eligible for ENERGY STAR<sup>®</sup> qualification, this measure additionally covers the installation of energy efficient gas conveyor ovens. Conveyor ovens cook food by carrying it on a moving belt through a heated chamber. Qualifying conveyor ovens have baking efficiencies greater than or equal to 42% and idle energy rates less than or equal to 57,000 BTUh, per assumed efficiency of qualified equipment by the Food Service Technology Center (FSTC).<sup>8</sup>

### Method for Calculating Annual Energy and Peak Coincident Demand Savings

*Annual Electric Energy Savings (Electric Equipment Only)*

$$\Delta kWh = \text{units} \times \text{days} \times \frac{(\Delta BTU_{preheat} + \Delta BTU_{idle} + \Delta BTU_{cooking})}{3,412}$$

*Peak Coincident Demand Savings (Electric Equipment Only)*

$$\Delta kW = \frac{\Delta kWh}{(\text{days} \times \text{hrs})} \times CF$$

*Annual Gas Energy Savings (Gas Equipment Only)*

$$\Delta \text{therms} = \text{units} \times \text{days} \times \frac{(\Delta BTU_{preheat} + \Delta BTU_{idle} + \Delta BTU_{cooking})}{100,000}$$

**where:**

$$\Delta BTU_{preheat} = N_{preheat} \times (BTU_{preheat,baseline} - BTU_{preheat,ee})$$

$$\Delta BTU_{idle} = BTU_{idle,baseline} \times \left[ \text{hrs} - N_{preheat} \times \text{hrs}_{preheat} - \left( \frac{\text{lbs}}{(\text{lbs/hr})_{baseline}} \right) \right] \\ - BTU_{idle,ee} \times \left[ \text{hrs} - N_{preheat} \times \text{hrs}_{preheat} - \left( \frac{\text{lbs}}{(\text{lbs/hr})_{ee}} \right) \right]$$

$$\Delta BTU_{cooking} = \text{lbs} \times Q_{food} \times \left( \frac{1}{Eff_{baseline}} - \frac{1}{Eff_{ee}} \right)$$

<sup>7</sup> ENERGY STAR<sup>®</sup> Program Requirements for Commercial Griddles, Eligibility Criteria Version 1.2, January 2011

<sup>8</sup> Food Service Technology Center, Qualified Conveyor Ovens, February 2018



*NOTE:  $\Delta BTU_{preheat}$ ,  $\Delta BTU_{idle}$  and  $\Delta BTU_{cooking}$  terms can be calculated per the equations above using either actual qualifying equipment specs or default values as defined in the Common Variables, Baseline Efficiencies, Compliance Efficiency and Operating Hours sections below, or looked up from the Default Values table below.*

**where:**

- $\Delta kWh$  = Annual electric energy savings
- $\Delta kW$  = Peak coincident demand electric savings
- $\Delta therms$  = Annual gas energy savings
- $\Delta BTU_{preheat}$  = Daily preheat energy savings
- $\Delta BTU_{idle}$  = Daily idle energy savings
- $\Delta BTU_{cooking}$  = Daily cooking energy savings
- units = Number of measures installed under the program
- days = Operating days per year
- hrs = Daily operating hours
- baseline = Baseline condition or measure
- ee = Energy efficient condition or measure
- $BTU_{preheat}$  = Equipment preheat energy (BTU)
- $N_{preheat}$  = Number of preheats per day
- $hr_{preheat}$  = Preheat duration (hours)
- $BTU_{idle}$  = Equipment idle energy rate (BTU/h)
- (lbs/hr) = Equipment production capacity (lbs/hr)
- lbs = Total daily food production
- $Q_{food}$  = Heat to food (BTU/lb)
- Eff = Equipment convection/steam mode cooking efficiency
- CF = Coincidence factor
- 3,412 = Conversion factor, one kW equals 3,412.14 BTU/h

**Summary of Variables and Data Sources**

Variable	Value	Notes
$\Delta BTU_{preheat}$		Calculate based on calculations above or look up in Default Values table below.
$\Delta BTU_{idle}$		Calculate based on calculations above or look up in Default Values table below.
$\Delta BTU_{cooking}$		Calculate based on calculations above or look up in Default Values table below.
days		From application or look up based on facility type in Operating Hours section below.
hrs		From application or look up based on facility type in Operating Hours section below.
$N_{preheat}$	1 <sup>9</sup>	
$BTU_{preheat,baseline}$		Look up based on qualifying equipment type in Baseline Efficiencies section below.

<sup>9</sup> Shared assumption from all PG&E Work Papers referenced in this measure

Variable	Value	Notes
$BTU_{preheat,ee}$		From application or look up based on qualifying equipment type in Compliance Efficiency section below.
$BTU_{idle,baseline}$		Look up based on qualifying equipment type in Baseline Efficiencies section below.
$BTU_{idle,ee}$		From application or look up based on qualifying equipment type in Compliance Efficiency section below.
$hr_{spreheat}$		Look up based on qualifying equipment type in Common Variables table below.
$(lbs/hr)_{baseline}$		Look up based on qualifying equipment type in Baseline Efficiencies section below.
$(lbs/hr)_{ee}$		From application or look up based on qualifying equipment type in Compliance Efficiency section below
Lbs		From application or look up based on qualifying equipment type in Common Variables table below.
$Q_{food}$		Look up based on qualifying equipment type in Common Variables table below.
$Eff_{baseline}$		Look up based on qualifying equipment type in Baseline Efficiencies section below.
$Eff_{ee}$		From application or look up based on qualifying equipment type in Compliance Efficiency section below.
CF	0.9	

Default Values

The table below contains values and simplified calculations for  $\Delta BTU_{preheat}$ ,  $\Delta BTU_{idle}$  and  $\Delta BTU_{cooking}$  terms that may be used in the formulation of estimated savings in lieu of utilizing the calculations prescribed above for these terms. These values were established by performing those calculations using assumed values from the Common Variables, Baseline Efficiencies and Compliance Efficiency sections below.

Equipment	$\Delta BTU_{preheat}$	$\Delta BTU_{idle}$	$\Delta BTU_{cooking}$
Convection Oven, Electric, Full Size	1,706	1,365 x hrs - 1,858	3,250
Convection Oven, Electric, Half Size	341	102 x hrs - 1,011	1,553
Convection Oven, Gas, Full Size	8,000	3,100 x hrs - 5,014	2,470
Convection Oven, Gas, Half Size	5,500	3,500 x hrs - 12,087	27,778
Conveyor Oven, Gas	17,000	13,000 x hrs - 55,144	124,405
Rack Oven, Gas, Double Rack	15,000	35,000 x hrs - 179,550	397,692
Rack Oven, Gas, Single Rack	6,000	18,000 x hrs - 89,017	176,250
Steamer, Electric <sup>10</sup>	0	14,581 x hrs - 11,229	19,385
Steamer, Gas <sup>11</sup>	11,000	27,378 x hrs - 24,643	42,368
Fryer, Electric, Standard	2,047	1,365 x hrs - 3,941	10,988
Fryer, Electric, Large Vat	1,194	853 x hrs - 2,005	15,268

<sup>10</sup> Assumes 6 pans

<sup>11</sup> Assumes 6 pans

## Commercial & Industrial Measures

Equipment	$\Delta$ BTU <sub>preheat</sub>	$\Delta$ BTU <sub>idle</sub>	$\Delta$ BTU <sub>cooking</sub>
Fryer, Gas, Standard	4,500	5,000 x hrs - 15,481	73,286
Fryer, Gas, Large Vat	5,000	4,000 x hrs - 8,636	73,286
Griddle, Electric <sup>12</sup>	6,834	1,638 x hrs - 7,451	5,220
Griddle, Gas <sup>13</sup>	6,000	5,100 x hrs - 49,875	23,438

### Common Variables<sup>14</sup>

Equipment	Value		
	hrs <sub>preheat</sub>	lbs	Q <sub>food</sub> (BTU/lb)
Convection Oven, Electric, Full Size	0.25 <sup>15</sup>	100	250
Convection Oven, Electric, Half Size	0.25 <sup>16</sup>	100	250
Convection Oven, Gas, Full Size	0.25 <sup>17</sup>	100	250
Convection Oven, Gas, Half Size	0.25 <sup>18</sup>	100	250
Conveyor Oven, Gas	0.25 <sup>19</sup>	190	250
Rack Oven, Gas, Double Rack	0.33 <sup>20</sup>	1,200 <sup>21</sup>	235
Rack Oven, Gas, Single Rack	0.33 <sup>22</sup>	600	235
Steamer, Electric	0.25 <sup>23</sup>	100	105
Steamer, Gas	0.25 <sup>24</sup>	100	105
Fryer, Electric, Standard	0.25 <sup>25</sup>	150	570
Fryer, Electric, Large Vat	0.25 <sup>26</sup>	150	570
Fryer, Gas, Standard	0.25 <sup>27</sup>	150	570
Fryer, Gas, Large Vat	0.25 <sup>28</sup>	150	570
Griddle, Electric	0.25 <sup>29</sup>	100	475
Griddle, Gas	0.25 <sup>30</sup>	100	475

<sup>12</sup> Assumes 3-foot griddle width, 2-foot griddle depth

<sup>13</sup> Assumes 3-foot griddle width, 2-foot griddle depth

<sup>14</sup> ENERGY STAR® Commercial Food Service Equipment Calculator (accessed 2/26/2018), unless otherwise noted

<sup>15</sup> PG&E Work Paper PGECOFST101 Revision 6, Table 10, pg. 15

<sup>16</sup> PG&E Work Paper PGECOFST101 Revision 6, Table 9, pg. 14

<sup>17</sup> PG&E Work Paper PGECOFST101 Revision 6, Table 13, pg. 18

<sup>18</sup> PG&E Work Paper PGECOFST101 Revision 6, Table 12, pg. 18

<sup>19</sup> PG&E Work Paper PGECOFST117 Revision 5, Table 9, pg. 11-12, where 1 pizza equals 0.76 lbs

<sup>20</sup> PG&E Work Paper PGECOFST109 Revision 6, Table 7, pg. 12

<sup>21</sup> Food Service Technology Center: Gas Rack Oven Life-Cycle Cost Calculator

<sup>22</sup> PG&E Work Paper PGECOFST109 Revision 6, Table 7, pg. 12

<sup>23</sup> PG&E Work Paper PGECOFST104 Revision 6, Table 11, pg. 13

<sup>24</sup> PG&E Work Paper PGECOFST104 Revision 6, Table 12, pg. 15

<sup>25</sup> PG&E Work Paper PGECOFST102 Revision 6, Table 10, pg. 7

<sup>26</sup> PG&E Work Paper PGECOFST102 Revision 6, Table 10, pg. 7

<sup>27</sup> PG&E Work Paper PGECOFST102 Revision 6, Table 11, pg. 10

<sup>28</sup> PG&E Work Paper PGECOFST102 Revision 6, Table 11, pg. 10

<sup>29</sup> PG&E Work Paper PGECOFST103 Revision 7, Table 8, pg. 6

<sup>30</sup> PG&E Work Paper PGECOFST103 Revision 7, Table 9, pg. 9

**Coincidence Factor (CF)**

The recommended value for the coincidence factor is 0.9.<sup>31</sup>

**Baseline Efficiencies from which Savings are Calculated**

The baseline condition is food service equipment as defined in the Measure Description above with operating characteristics per the table below. Values are as reported from referenced ENERGY STAR® Commercial Food Service Equipment Calculator unless otherwise noted.<sup>32</sup> Preheat energy and all values for half size gas convection ovens and conveyor ovens are reported from referenced FSTC sources.

Equipment	BTU <sub>preheat,baseline</sub> (BTU)	BTU <sub>idle,baseline</sub> (BTU/h)	(lbs/hr) <sub>baseline</sub>	Eff <sub>baseline</sub> (%)
Convection Oven, Electric, Full Size	5,118 <sup>33</sup>	6,824	90	65%
Convection Oven, Electric, Half Size	3,412 <sup>34</sup>	3,514	45	68%
Convection Oven, Gas, Full Size	19,000 <sup>35</sup>	15,100	83	44%
Convection Oven, Gas, Half Size <sup>36</sup>	13,000	12,000	45	30%
Conveyor Oven, Gas <sup>37</sup>	35,000	70,000	114	20%
Rack Oven, Gas, Double Rack	100,000 <sup>38</sup>	65,000	250	30%
Rack Oven, Gas, Single Rack	50,000 <sup>39</sup>	43,000	130	30%
Steamer, Electric	5,118 <sup>40</sup>	2,047 + 3,767 x no. pans <sup>41</sup>	23.3 x no. pans	26%
Steamer, Gas	20,000 <sup>42</sup>	9,000 + 6,524 x no. pans <sup>43</sup>	23.3 x no. pans	15%
Fryer, Electric, Standard	8,189 <sup>44</sup>	4,094	65	75%
Fryer, Electric, Large Vat	10,577 <sup>45</sup>	4,606	100	70%
Fryer, Gas, Standard	18,500 <sup>46</sup>	14,000	60	35%
Fryer, Gas, Large Vat	27,000 <sup>47</sup>	16,000	100	35%

<sup>31</sup> Shared assumption from all PG&E Work Papers referenced in this measure

<sup>32</sup> ENERGY STAR® Commercial Food Service Equipment Calculator (accessed 2/26/2018)

<sup>33</sup> Food Service Technology Center: Electric Convection Oven Life-Cycle Cost Calculator

<sup>34</sup> Food Service Technology Center: Electric Convection Oven Life-Cycle Cost Calculator

<sup>35</sup> Food Service Technology Center: Gas Convection Oven Life-Cycle Cost Calculator

<sup>36</sup> Food Service Technology Center: Gas Convection Oven Life-Cycle Cost Calculator

<sup>37</sup> Food Service Technology Center: Gas Conveyor Oven Life-Cycle Cost Calculator, where 1 pizza equals 0.76 lbs

<sup>38</sup> Food Service Technology Center: Gas Rack Oven Life-Cycle Cost Calculator

<sup>39</sup> Food Service Technology Center: Gas Rack Oven Life-Cycle Cost Calculator

<sup>40</sup> Food Service Technology Center: Electric Steamer Life-Cycle Cost Calculator

<sup>41</sup> Represents energy rate when steamers are in idle mode and in constant steam mode:  $(1 - T_s) * BTU_{idle,baseline} + T_s * (lb/hr)_{baseline} * Q_{food} / Eff_{baseline}$ , where  $T_s$  (time in constant steam mode) = 40% of non-cook time and  $BTU_{idle,baseline} = 3,412$  BTU/h for baseline electric steamers

<sup>42</sup> Food Service Technology Center: Gas Steamer Life-Cycle Cost Calculator

<sup>43</sup> Represents energy rate when steamers are in idle mode and in constant steam mode:  $(1 - T_s) * BTU_{idle,baseline} + T_s * (lb/hr)_{baseline} * Q_{food} / Eff_{baseline}$ , where  $T_s$  (time in constant steam mode) = 40% of non-cook time and  $BTU_{idle,baseline} = 15,000$  BTU/h for baseline gas steamers

<sup>44</sup> Food Service Technology Center: Electric Fryer Life-Cycle Cost Calculator

<sup>45</sup> Food Service Technology Center: Electric Fryer Life-Cycle Cost Calculator

<sup>46</sup> Food Service Technology Center: Gas Fryer Life-Cycle Cost Calculator

<sup>47</sup> Food Service Technology Center: Gas Fryer Life-Cycle Cost Calculator

Equipment	BTU <sub>preheat,baseline</sub> (BTU)	BTU <sub>idle,baseline</sub> (BTU/h)	(lbs/hr) <sub>baseline</sub>	Eff <sub>baseline</sub> (%)
Griddle, Electric	2,275 x griddle area <sup>48</sup>	1,365 x griddle area	5.83 x griddle area	65%
Griddle, Gas	3,500 x griddle area <sup>49</sup>	3,500 x griddle area	4.17 x griddle area	32%

### Compliance Efficiency from which Incentives are Calculated

The compliance condition is ENERGY STAR<sup>®</sup> food service equipment or, in the case of conveyor ovens and half size gas convection ovens, equipment aligning with FSTC assumptions for energy efficient products meeting the minimum performance specifications listed in the table below. Operating characteristics shall be taken from application. When unavailable, default characteristics shall be taken from the table below. Values are as reported from the ENERGY STAR<sup>®</sup> Commercial Food Service Equipment Calculator, unless otherwise noted.<sup>50</sup> Preheat energy and all values for half size gas convection ovens and conveyor ovens are reported from referenced FSTC sources.

Equipment	BTU <sub>preheat,ee</sub> (BTU)	BTU <sub>idle,ee</sub> (BTU/h)	(lbs/hr) <sub>ee</sub>	Eff <sub>ee</sub> (%)
Convection Oven, Electric, Full Size	3,412 <sup>51</sup>	5,459	90	71%
Convection Oven, Electric, Half Size	3,071 <sup>52</sup>	3,412	50	71%
Convection Oven, Gas, Full Size	11,000 <sup>53</sup>	12,000	86	46%
Convection Oven, Gas, Half Size <sup>54</sup>	7,500	8,500	55	45%
Conveyor Oven, Gas <sup>55</sup>	18,000	57,000	167	42%
Rack Oven, Gas, Double Rack	85,000 <sup>56</sup>	30,000	250	52%
Rack Oven, Gas, Single Rack	44,000 <sup>57</sup>	25,000	130	48%
Steamer, Electric	5,118 <sup>58</sup>	1,678 x no. pans <sup>59</sup>	16.7 x no. pans	50%

<sup>48</sup> Food Service Technology Center: Electric Griddle Life-Cycle Cost Calculator

<sup>49</sup> Food Service Technology Center: Gas Griddle Life-Cycle Cost Calculator

<sup>50</sup> ENERGY STAR<sup>®</sup> Commercial Food Service Equipment Calculator (accessed 2/26/2018)

<sup>51</sup> Food Service Technology Center: Electric Convection Oven Life-Cycle Cost Calculator

<sup>52</sup> Food Service Technology Center: Electric Convection Oven Life-Cycle Cost Calculator

<sup>53</sup> Food Service Technology Center: Gas Convection Oven Life-Cycle Cost Calculator

<sup>54</sup> Food Service Technology Center: Gas Convection Oven Life-Cycle Cost Calculator

<sup>55</sup> Food Service Technology Center: Gas Conveyor Oven Life-Cycle Cost Calculator, where 1 pizza equals 0.76 lbs

<sup>56</sup> Food Service Technology Center: Gas Rack Oven Life-Cycle Cost Calculator

<sup>57</sup> Food Service Technology Center: Gas Rack Oven Life-Cycle Cost Calculator

<sup>58</sup> Food Service Technology Center: Electric Steamer Life-Cycle Cost Calculator

<sup>59</sup> Represents energy rate when steamer are in idle mode and in constant steam mode:  $(1 - T_s) * BTU_{idle,ee} + T_s * (lb/hr/pan) * Q_{food} / Eff_{ee}$ , where  $T_s$  (time in constant steam mode) = 40% of non-cook time and  $BTU_{idle,ee} = 455 BTU/h \times \text{no. of pans}$  for compliance electric steamers

## Commercial & Industrial Measures

Equipment	BTU <sub>preheat,ee</sub> (BTU)	BTU <sub>idle,ee</sub> (BTU/h)	(lbs/hr) <sub>ee</sub>	Eff <sub>ee</sub> (%)
Steamer, Gas	9,000 <sup>60</sup>	3,463 x no. pans* <sup>61</sup>	20.8 x no. pans	38%
Fryer, Electric, Standard	6,483 <sup>62</sup>	2,730	70	83%
Fryer, Electric, Large Vat	9,383 <sup>63</sup>	3,753	110	80%
Fryer, Gas, Standard	16,000 <sup>64</sup>	9,000	65	50%
Fryer, Gas, Large Vat	22,000 <sup>65</sup>	12,000	110	50%
Griddle, Electric	1,136 x griddle area <sup>66</sup>	1,092 x griddle area	6.67 x griddle area	70%
Griddle, Gas	2,500 x griddle area <sup>67</sup>	2,650 x griddle area	7.5 x griddle area	38%

\* For steamers with greater than 6 pans, assume no. pans equals 6 for steamer idle energy rate

### Operating Hours

Equipment operating hours per day and days per year shall be taken from the application if known. Default operating hours per day and days per year are provided below, established based on a weighted average of values associated with similar facility types, as reported by the California Energy Commission.<sup>68</sup>

Facility Type	hours/day	days/year
Community College	11	283
Fast Food Restaurant	14	363
Full Service Restaurant	12	321
Grocery	12	365
Hospital	11	365
Hotel	20	365
Miscellaneous	9	325
Motel	20	365
Primary School	5	180
Secondary School	8	180
Office	12	250
University	11	283

<sup>60</sup> Food Service Technology Center: Gas Steamer Life-Cycle Cost Calculator

<sup>61</sup> Represents energy rate when steamers are in idle mode and in constant steam mode:  $(1 - T_s) * BTU_{idle,ee} + T_s * (lb/hr/pan) * Q_{food}/Eff_{ee}$ , where  $T_s$  (time in constant steam mode) = 40% of non-cook time and  $BTU_{idle,ee} = 2,088$  BTU/h x no. of pans for compliance gas steamers

<sup>62</sup> Food Service Technology Center: Electric Fryer Life-Cycle Cost Calculator, preheat energy assumes 15in

<sup>63</sup> Food Service Technology Center: Electric Fryer Life-Cycle Cost Calculator, preheat energy assumes 20in

<sup>64</sup> Food Service Technology Center: Gas Fryer Life-Cycle Cost Calculator, preheat energy assumes 15in

<sup>65</sup> Food Service Technology Center: Gas Fryer Life-Cycle Cost Calculator, preheat energy assumes 20in

<sup>66</sup> Food Service Technology Center: Electric Griddle Life-Cycle Cost Calculator

<sup>67</sup> Food Service Technology Center: Gas Griddle Life-Cycle Cost Calculator

<sup>68</sup> California Energy Commission, Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Foodservice Equipment, Appendix E

### Effective Useful Life (EUL)

See [Appendix P](#).

### Ancillary Fossil Fuel Savings Impacts

More efficient food service equipment rejects less heat into the condition space than standard equipment, increasing space heating requirements while decreasing cooling load. However, no relevant studies have been performed to date that would allow quantification of these impacts. Until additional information is available, these impacts are excluded from the prescribed formulation of savings.

### Ancillary Electric Savings Impacts

More efficient food service equipment rejects less heat into the condition space than standard equipment, increasing space heating requirements while decreasing cooling load. However, no relevant studies have been performed to date that would allow quantification of these impacts. Until additional information is available, these impacts are excluded from the prescribed formulation of savings.

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**Record of Revision**

<b>Record of Revision Number</b>	<b>Issue Date</b>
3-18-18	3/29/2018

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## **COMBINATION OVENS**

### **Measure Description**

This measure covers the installation of ENERGY STAR® qualified gas or electric commercial combination ovens.<sup>1</sup> Though not eligible for ENERGY STAR® qualifications, electric combination ovens with capacities of 21 pans or greater aligning with Food Service Technology Center (FSTC) assumptions for energy efficient products per the compliance efficiencies section below are also included in the measure.<sup>2</sup> A combination oven combines the function of hot air convection, saturated and superheating steam heating, and combination convection/steam mode for moist heating. The oven is used for steaming, baking, roasting, re-thermalizing, and proofing of various food products. High efficiency boiler-less combination ovens use nearly half as much water as typical boiler-based combination ovens.<sup>3</sup>

A combination oven can also be referred to as a combi, combo, or combination oven/steamer. Combination ovens come in a range of sizes based on their capacity to accommodate 12 x 20 x 2 1/2 inch hotel pans. This measure includes half size and full size combination ovens. Measure calculations are based on oven pan capacity of full size, 2 1/2 inch hotel pans.

### **Method for Calculating Annual Energy and Peak Coincident Demand Savings**

#### *Annual Electric Energy Savings (Electric Equipment Only)*

$$\Delta kWh = \text{units} \times \text{days} \times \frac{(\Delta BTU_{preheat} + \Delta BTU_{idle,c} + \Delta BTU_{idle,s} + \Delta BTU_{cooking,c} + \Delta BTU_{cooking,s})}{3,412}$$

#### *Peak Coincident Demand Savings (Electric Equipment Only)*

$$\Delta kW = \frac{\Delta kWh}{(\text{days} \times \text{hrs})} \times CF$$

#### *Annual Gas Energy Savings (Gas Equipment Only)*

$$\Delta \text{therms} = \text{units} \times \text{days} \times \frac{(\Delta BTU_{preheat} + \Delta BTU_{idle,c} + \Delta BTU_{idle,s} + \Delta BTU_{cooking,c} + \Delta BTU_{cooking,s})}{100,000}$$

#### **where:**

$$\Delta BTU_{preheat} = N_{preheat} \times (BTU_{preheat,baseline} - BTU_{preheat,ee})$$

$$\Delta BTU_{idle,c} = \left[ \begin{array}{l} BTU_{idle,c,baseline} \times \left( \text{hrs} - N_{preheat} \times \text{hrs}_{preheat} - \frac{\text{lbs}}{(\text{lbs/hr})_{c,baseline}} \right) \\ - BTU_{idle,c,ee} \times \left[ \text{hrs} - N_{preheat} \times \text{hrs}_{preheat} - \frac{\text{lbs}}{(\text{lbs/hr})_{c,ee}} \right] \end{array} \right] \times (1 - F_s)$$

<sup>1</sup> ENERGY STAR® Program Requirements Product Specification for Commercial Ovens, Eligibility Criteria Version 2.2, March 2015

<sup>2</sup> Food Service Technology Center, Qualified Combination Ovens, February 2018

<sup>3</sup> Food Service Technology Center, Combination Ovens, Save Water (accessed 3/15/2018)

$$\Delta BTU_{idle,s} = \left[ \begin{array}{l} BTU_{idle,s,baseline} \times \left( hrs - N_{preheat} \times hrs_{preheat} - \frac{lbs}{(lbs/hr)_{s,baseline}} \right) \\ - BTU_{idle,s,ee} \times \left[ hrs - N_{preheat} \times hrs_{preheat} - \frac{lbs}{(lbs/hr)_{s,ee}} \right] \end{array} \right] \times F_s$$

$$\Delta BTU_{cooking,c} = lbs \times Q_{food,c} \times \left( \frac{1}{Eff_{c,baseline}} - \frac{1}{Eff_{c,ee}} \right) \times (1 - F_s)$$

$$\Delta BTU_{cooking,s} = lbs \times Q_{food,s} \times \left( \frac{1}{Eff_{s,baseline}} - \frac{1}{Eff_{s,ee}} \right) \times F_s$$

*NOTE:  $\Delta BTU_{preheat}$ ,  $\Delta BTU_{idle}$  and  $\Delta BTU_{cooking}$  terms can be calculated per the equations above using any combination of actual qualifying equipment specifications and assumed values as defined in the Baseline Efficiencies, Compliance Efficiency and Operating Hours sections below, or looked up from the Default Values table below.*

**where:**

- $\Delta kWh$  = Annual electric energy savings
- $\Delta kW$  = Peak coincident demand electric savings
- $\Delta therms$  = Annual gas energy savings
- $\Delta BTU_{preheat}$  = Daily preheat energy savings
- $\Delta BTU_{idle}$  = Daily idle energy savings
- $\Delta BTU_{cooking}$  = Daily cooking energy savings
- units = Number of measures installed under the program
- days = Operating days per year
- hrs = Daily operating hours
- baseline = Baseline condition or measure
- ee = Energy efficient condition or measure
- c = Convection mode
- s = Steam mode
- $BTU_{preheat}$  = Equipment preheat energy (BTU)
- $N_{preheat}$  = Number of preheats per day
- $hrs_{preheat}$  = Preheat duration (hours)
- $BTU_{idle}$  = Equipment idle energy rate (BTU/h)
- (lbs/hr) = Equipment production capacity (lbs/hr)
- lbs = Total daily food production
- $Q_{food}$  = Heat to food (BTU/lb)
- Eff = Equipment convection/steam mode cooking efficiency
- $F_s$  = Steam mode time factor
- CF = Coincidence factor
- 3,412 = Conversion factor, one kW equals 3,412.14 BTU/h

**Summary of Variables and Data Sources**

Variable	Value	Notes
$\Delta BTU_{preheat}$		Calculate based on calculations above or look up in Default Values table below.
$\Delta BTU_{idle,c}$		Calculate based on calculations above or look up in Default Values table below.
$\Delta BTU_{idle,s}$		Calculate based on calculations above or look up in Default Values table below.
$\Delta BTU_{cooking,c}$		Calculate based on calculations above or look up in Default Values table below.
$\Delta BTU_{cooking,s}$		Calculate based on calculations above or look up in Default Values table below.
days		From application or look up based on facility type in Operating Hours section below.
hrs		From application or look up based on facility type in Operating Hours section below.
$N_{preheat}$	1 <sup>4</sup>	
$BTU_{preheat,baseline}$		Look up based on qualifying equipment type in Baseline Efficiencies section below.
$BTU_{preheat,ee}$		From application or look up based on qualifying equipment type in Compliance Efficiency section below.
$BTU_{idle,c,baseline}$		Look up based on qualifying equipment type in Baseline Efficiencies section below.
$BTU_{idle,s,baseline}$		Look up based on qualifying equipment type in Baseline Efficiencies section below.
$BTU_{idle,c,ee}$		From application or look up based on qualifying equipment type in Compliance Efficiency section below.
$BTU_{idle,s,ee}$		From application or look up based on qualifying equipment type in Compliance Efficiency section below.
$hr_{preheat}$	0.25 <sup>5</sup>	
$(lbs/hr)_{c,baseline}$		Look up based on qualifying equipment type in Baseline Efficiencies section below.
$(lbs/hr)_{s,baseline}$		Look up based on qualifying equipment type in Baseline Efficiencies section below.
$(lbs/hr)_{c,ee}$		From application or look up based on qualifying equipment type in Compliance Efficiency section below
$(lbs/hr)_{s,ee}$		From application or look up based on qualifying equipment type in Compliance Efficiency section below

<sup>4</sup> PG&E Work Paper PGECOFST100 Revision 6, Table 8, pg. 13

<sup>5</sup> Ibid.

Variable	Value	Notes
lbs	< 15 Pans: 200 15 - 28 Pans: 250 > 28 Pans: 400	From application or use values provided <sup>6</sup>
Q <sub>food,c</sub>	250	Convection mode heat to food (BTU/lb) <sup>7</sup>
Q <sub>food,s</sub>	105	Steam mode heat to food (BTU/lb) <sup>8</sup>
Eff <sub>c,baseline</sub>		Look up based on qualifying equipment type in Baseline Efficiencies section below.
Eff <sub>s,baseline</sub>		Look up based on qualifying equipment type in Baseline Efficiencies section below.
Eff <sub>c,ee</sub>		From application or look up based on qualifying equipment type in Compliance Efficiency section below.
Eff <sub>s,ee</sub>		From application or look up based on qualifying equipment type in Compliance Efficiency section below.
F <sub>s</sub>	50% <sup>9</sup>	
CF	0.9	

Default Values

The table below contains values and simplified calculations for  $\Delta BTU_{preheat}$ ,  $\Delta BTU_{idle}$  and  $\Delta BTU_{cooking}$  terms that may be used in the formulation of estimated savings in lieu of utilizing the calculations prescribed above for these terms. These values were established by performing those calculations using assumed values from the Common Variables, Baseline Efficiencies and Compliance Efficiency sections below.

Equipment	$\Delta BTU_{preheat}$	$\Delta BTU_{idle,c}$	$\Delta BTU_{idle,s}$	$\Delta BTU_{cooking,c}$	$\Delta BTU_{cooking,s}$
Combi Electric Oven, < 15 Pans <sup>10</sup>	5,118	36 x hrs -1,986	5,612 x hrs - 15,647	1,827	2,338
Combi Electric Oven, 15 - 20 Pans <sup>11</sup>	5,971	309 x hrs -1,481	9,227 x hrs - 14,899	2,284	2,922
Combi Electric Oven, 21 - 28 Pans	5,971	2,133 x hrs - 7,997	11,089 x hrs - 38,314	3,434	6,563
Combi Electric Oven, > 28 Pans	8,974	2,133 x hrs - 5,162	15,354 x hrs - 38,933	5,495	10,500
Combi Gas Oven, < 15 Pans <sup>12</sup>	5,000	911 x hrs -1,641	5,073 x hrs - 10,835	3,434	1,313
Combi Gas Oven, 15 - 28 Pans <sup>13</sup>	6,000	1,182 x hrs - 2,942	7,026 x hrs - 16,307	4,293	1,642

<sup>6</sup> ENERGY STAR® Commercial Food Service Equipment Calculator (accessed 2/26/2018)

<sup>7</sup> Ibid.

<sup>8</sup> Ibid.

<sup>9</sup> ENERGY STAR® Commercial Food Service Equipment Calculator (accessed 2/26/2018)

<sup>10</sup> Assumes 10 pans

<sup>11</sup> Assumes 20 pans

<sup>12</sup> Assumes 10 pans

<sup>13</sup> Assumes 20 pans

## Commercial & Industrial Measures

Equipment	$\Delta BTU_{preheat}$	$\Delta BTU_{idle,c}$	$\Delta BTU_{idle,s}$	$\Delta BTU_{cooking,c}$	$\Delta BTU_{cooking,s}$
Combi Gas Oven, 29 - 30 Pans <sup>14</sup>	8,000	432 x hrs -1,862	6,026 x hrs - 16,057	4,293	1,642
Combi Gas Oven, > 30 Pans <sup>15</sup>	8,000	788 x hrs -1,030	14,395 x hrs - 18,555	6,868	2,627

### Coincidence Factor (CF)

The recommended value for the coincidence factor is 0.9.<sup>16</sup>

### Baseline Efficiencies from which Savings are Calculated

The baseline condition is a combination oven as defined in the Measure Description section above with operating characteristics per the table below. Values are as reported from referenced ENERGY STAR® Commercial Food Service Calculator<sup>17</sup> unless otherwise noted. Preheat energy rates and all values for electric combi-ovens with capacities greater than 21 pans are reported from referenced FSTC calculators.

Equipment	$BTU_{preheat, baseline}$ (BTU)	$BTU_{idle, c, baseline}$ (BTU/h)	$BTU_{idle, s, baseline}$ (BTU/h)	(lbs/hr) $c, baseline$	(lbs/hr) $s, baseline$	Eff $c, baseline$ (%)	Eff $s, baseline$ (%)
Combi Electric Oven, < 15 Pans	10,236 <sup>18</sup>	4,504	17,947	79	126	72%	49%
Combi Electric Oven, 15 - 20 Pans	12,795 <sup>19</sup>	7,779	29,719	166	295	72%	49%
Combi Electric Oven, 21 - 28 Pans <sup>20</sup>	12,795	12,795	42,650	100	150	65%	40%
Combi Electric Oven, > 28 Pans <sup>21</sup>	19,210	17,913	61,416	275	350	65%	40%
Combi Gas Oven, < 15 Pans	18,000 <sup>22</sup>	8,747	18,656	125	195	52%	39%
Combi Gas Oven, 15 - 28 Pans	22,000 <sup>23</sup>	10,788	24,562	176	211	52%	39%
Combi Gas Oven, 29 - 30 Pans	32,000 <sup>24</sup>	10,788	24,562	176	211	52%	39%
Combi Gas Oven, > 30 Pans	32,000 <sup>25</sup>	13,000	43,300	392	579	52%	39%

<sup>14</sup> Assumes 30 pans

<sup>15</sup> Assumes 40 pans

<sup>16</sup> PG&E Work Paper PGECOFST100 Revision 6, Table 8, pg. 13

<sup>17</sup> ENERGY STAR® Commercial Food Service Equipment Calculator (accessed 2/26/2018)

<sup>18</sup> Food Service Technology Center, Electric Combination Oven Life-Cycle Cost Calculator

<sup>19</sup> Ibid.

<sup>20</sup> Ibid.

<sup>21</sup> Ibid.

<sup>22</sup> Food Service Technology Center, Gas Combination Oven Life-Cycle Cost Calculator

<sup>23</sup> Ibid.

<sup>24</sup> Ibid.

<sup>25</sup> Ibid.

### Compliance Efficiency from which Incentives are Calculated

The compliance condition is ENERGY STAR® food service equipment as defined in the Measure Description section above. Operating characteristics shall be taken from application. When unavailable, default characteristics shall be taken from the table below. Values are as reported from the referenced ENERGY STAR® Commercial Food Service Calculator<sup>26</sup>, unless otherwise noted. Preheat energy rates and all values for electric combi ovens with capacity greater than 21 pans are reported from referenced FSTC calculators.

Equipment	BTU <sub>preheat, ee</sub> (BTU)	BTU <sub>idle, c, ee</sub> (BTU/h)	BTU <sub>idle, s, ee</sub> (BTU/h)	(lbs/hr) c, ee	(lbs/hr) s, ee	Eff c, ee (%)	Eff s, ee (%)
Combi Electric Oven, < 15 Pans	5,118 <sup>27</sup>	273 x no. pans + 1,702	454 x no. pans + 2,184	119	177	76%	55%
Combi Electric Oven, 15 - 20 Pans	6,824 <sup>28</sup>	273 x no. pans + 1,702	454 x no. pans + 2,184	201	349	76%	55%
Combi Electric Oven, 21 - 28 Pans <sup>29</sup>	6,824	8,530	20,472	125	200	70%	50%
Combi Electric Oven, > 28 Pans <sup>30</sup>	10,236	13,648	30,708	325	400	70%	50%
Combi Gas Oven, < 15 Pans	13,000 <sup>31</sup>	150 x no. pans + 5,425	200 x no. pans + 6,511	124	172	56%	41%
Combi Gas Oven, 15 - 28 Pans	16,000 <sup>32</sup>	150 x no. pans + 5,425	200 x no. pans + 6,511	210	277	56%	41%
Combi Gas Oven, 29 - 30 Pans	24,000 <sup>33</sup>	150 x no. pans + 5,425	200 x no. pans + 6,511	210	277	56%	41%
Combi Gas Oven, > 30 Pans	24,000 <sup>34</sup>	150 x no. pans + 5,425	200 x no. pans + 6,511	394	640	56%	41%

### Operating Hours

Equipment operating hours per day and days per year shall be taken from the application if known. Default operating hours per day and days per year are provided below, established based on a weighted average of values associated with similar facility types, as reported by the California Energy Commission.<sup>35</sup>

Facility Type	Hours/Day	Days/Year
Community College	11	283
Fast Food	14	363
Full Service Restaurant	12	321

<sup>26</sup> ENERGY STAR® Commercial Food Service Equipment Calculator (accessed 2/26/2018)

<sup>27</sup> Food Service Technology Center, Electric Combination Oven Life-Cycle Cost Calculator

<sup>28</sup> Ibid.

<sup>29</sup> Ibid.

<sup>30</sup> Ibid.

<sup>31</sup> Food Service Technology Center, Gas Combination Oven Life-Cycle Cost Calculator

<sup>32</sup> Ibid.

<sup>33</sup> Ibid.

<sup>34</sup> Ibid.

<sup>35</sup> California Energy Commission, Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Foodservice Equipment, Appendix E

Facility Type	Hours/Day	Days/Year
Grocery	12	365
Hospital	11	365
Hotel	20	365
Miscellaneous	9	325
Motel	20	365
Primary School	5	180
Secondary School	8	180
Small Office	12	250
University	11	283

### Effective Useful Life (EUL)

See [Appendix P](#).

### Ancillary Fossil Fuel Savings Impacts

More efficient food service equipment rejects less heat into the condition space than standard equipment, increasing space heating requirements while decreasing cooling load. However, no relevant studies have been performed to date that would allow quantification of these impacts. Until additional information is available, these impacts are excluded from the prescribed formulation of savings.

### Ancillary Electric Savings Impacts

More efficient food service equipment rejects less heat into the condition space than standard equipment, increasing space heating requirements while decreasing cooling load. However, no relevant studies have been performed to date that would allow quantification of these impacts. Until additional information is available, these impacts are excluded from the prescribed formulation of savings.

### References

1. ENERGY STAR® Program Requirements Product Specification for Commercial Ovens, Eligibility Criteria, Version 2.2, March 2015.  
Available from: <https://www.energystar.gov/sites/default/files/Commercial%20Ovens%20Final%20Version%202.2%20Specification.pdf>
2. Food Service Technology Center, Qualified Combination Ovens, February 2018  
Available from: <https://fishnick.com/saveenergy/rebates/combis.pdf>
3. Food Service Technology Center, Combination Ovens, Save Water (accessed 3/15/2018)  
Available from: <https://fishnick.com/savewater/appliances/combinationovens/>
4. Pacific Gas & Electric Company, Work Paper PGECOFST100 Commercial Combination Oven, Revision 6, August 2016.



5. ENERGY STAR® Commercial Food Service Calculator (accessed 2/26/2018)  
Available from: [https://www.energystar.gov/sites/default/files/asset/document/commercial\\_kitchen\\_equipment\\_calculator\\_0.xlsx](https://www.energystar.gov/sites/default/files/asset/document/commercial_kitchen_equipment_calculator_0.xlsx)
6. Food Service Technology Center: Electric Combination Oven Life-Cycle Cost Calculator  
Available from: <https://fishnick.com/saveenergy/tools/calculators/ecombicalc.php>
7. Food Service Technology Center: Gas Combination Oven Life-Cycle Cost Calculator  
Available from: <https://fishnick.com/saveenergy/tools/calculators/gcombicalc.php>
8. California Energy Commission, Energy Research and Development Division, Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Foodservice Equipment, October 2014.  
Available from: <http://www.energy.ca.gov/2014publications/CEC-500-2014-095/CEC-500-2014-095.pdf>

### Record of Revision

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3-18-19	3/29/2018

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**INSULATED HOLDING CABINETS**

**Measure Description**

This measure covers the installation of ENERGY STAR® qualified electric commercial hot food holding cabinets.<sup>1</sup> A food holding cabinet is a fully enclosed compartment designed to maintain the temperature of hot food that has been cooked in a separate appliance. Half-size, full-size and large-size holding cabinets are included in this measure. Half-size holding cabinets are defined as any holding cabinet with an internal measured volume of less than 15ft<sup>3</sup>. Full-size holding cabinets are defined as any holding cabinet with an internal measured volume of greater than or equal to 15ft<sup>3</sup> and less than or equal to 28ft<sup>3</sup>. Large-size holding cabinets are defined as any holding cabinet with an internal measure volume of greater than 28ft<sup>3</sup>. This measure does not include cook-and-hold or re-therm equipment.<sup>2</sup>

**Method for Calculating Annual Energy and Peak Coincident Demand Savings**

*Annual Electric Energy Savings*

$$\Delta kWh = units \times hrs \times days \times \frac{\Delta W_{idle}}{1,000}$$

*Peak Coincident Demand Savings*

$$\Delta kW = \frac{\Delta kWh}{(hrs \times days)} \times CF$$

*Annual Gas Energy Savings*

$$\Delta therms = N/A$$

**where:**

$$\Delta W_{idle} = W_{idle,baseline} - W_{idle,ee}$$

*NOTE:  $\Delta W_{idle}$  term can be calculated per the equation above using actual qualifying equipment specifications or looked up from the Default Values table below.*

**where:**

- $\Delta kWh$  = Annual electric energy savings
- $\Delta kW$  = Peak coincident demand electric savings
- $\Delta therms$  = Annual gas energy savings
- $\Delta W_{idle}$  = Daily idle energy savings
- units = Number of measures installed under the program
- hrs = Daily operating hours

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<sup>1</sup> ENERGY STAR® Program Requirements for Commercial Hot Food Holding Cabinets, Eligibility Criteria Version 2.0, July 2011

<sup>2</sup> PG&E Work Paper PGECOFST105 Revision 5, pg. 1

days	= Operating days per year
v	= Volume of holding cabinet (ft <sup>3</sup> )
baseline	= Baseline condition or measure
ee	= Energy efficient condition or measure
W <sub>idle</sub>	= Equipment idle energy rate by volume (W)
CF	= Coincidence factor
1,000	= Conversion factor, one kW equals 1,000 watts

**Summary of Variables and Data Sources**

Variable	Value	Notes
$\Delta W_{idle}$		Calculate based on calculations above or look up in Default Values table below.
days		From application or look up based on facility type in Operating Hours section below.
hrs		From application or look up based on facility type in Operating Hours section below.
v	Large-Size: 35 Full-Size: 25 Half-Size: 10	From application or use default values provided. <sup>3</sup>
W <sub>idle,baseline</sub>	40v	Equipment idle energy rate by volume (W). <sup>4</sup>
W <sub>idle,ee</sub>	Large-Size: 3.8v + 203.5 Full-Size: 2v + 254 Half-Size: 21.5v	From application or use default value provided. <sup>5</sup>
CF	0.9	

Default Values

The table below contains  $\Delta W_{idle}$  values that may be used in the formulation of estimated savings in lieu of utilizing the calculation prescribed above for this term. These values were established by performing that calculation using default values from the Summary of Variables and Data Sources above.

Equipment	$\Delta W_{idle}$
Insulated Holding Cabinet, Large-Size	1,064
Insulated Holding Cabinet, Full-Size	696
Insulated Holding Cabinet, Half-Size	185

<sup>3</sup> PG&E Work Paper PGECOFST105 Revision 5, Table 6, pg. 5

<sup>4</sup> ENERGY STAR® Program Requirements for Commercial Hot Food Holding Cabinets, Eligibility Criteria Version 2.0, July 2011, where v is holding cabinet volume (ft<sup>3</sup>)

<sup>5</sup> Ibid, where v is holding cabinet volume (ft<sup>3</sup>)

### Coincidence Factor (CF)

The recommended value for the coincidence factor is 0.9.<sup>6</sup>

### Baseline Efficiencies from which Savings are Calculated

The baseline condition is an insulated holding cabinet as defined in the Measure Description above with operating characteristics per the Summary of Variables and Data Sources table above.

### Compliance Efficiency from which Incentives are Calculated

The compliance condition is ENERGY STAR<sup>®</sup> food service equipment as defined in the Measure Description section above. Operating characteristics shall be taken from application. When unavailable, default characteristics shall be taken from the Summary of Variables and Data Sources table above.

### Operating Hours

Equipment operating hours per day and days per year shall be taken from the application if known. Default operating hours per day and days per year are provided below, established based on a weighted average of values associated with similar facility types, as reported by the California Energy Commission.<sup>7</sup>

Facility Type	hours/day	days/year
Community College	11	283
Fast Food Restaurant	14	363
Full Service Restaurant	12	321
Grocery	12	365
Hospital	11	365
Hotel	20	365
Miscellaneous	9	325
Motel	20	365
Primary School	5	180
Secondary School	8	180
Office	12	250
University	11	283

### Effective Useful Life (EUL)

See [Appendix P](#).

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<sup>6</sup> PG&E Work Paper PGECOFST105 Revision 5, pg. 7

<sup>7</sup> California Energy Commission, Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Foodservice Equipment, Appendix E

### **Ancillary Fossil Fuel Savings Impacts**

More efficient food service equipment rejects less heat into the conditioned space than standard equipment, increasing space heating requirements while decreasing cooling load. However, no relevant studies have been found to date that would allow quantification of these impacts. Until additional information is available, these impacts are excluded from the prescribed formulation of savings.

### **Ancillary Electric Savings Impacts**

More efficient food service equipment rejects less heat into the conditioned space than standard equipment, increasing space heating requirements while decreasing cooling load. However, no relevant studies have been found to date that would allow quantification of these impacts. Until additional information is available, these impacts are excluded from the prescribed formulation of savings.

### **References**

1. ENERGY STAR® Program Requirements for Commercial Hot Food Holding Cabinets, Eligibility Criteria Version 2.0, July 2011.  
Available from:  
[https://www.energystar.gov/sites/default/files/specs/private/Commercial\\_HFHC\\_Program\\_Requirements\\_2.0.pdf](https://www.energystar.gov/sites/default/files/specs/private/Commercial_HFHC_Program_Requirements_2.0.pdf)
2. Pacific Gas & Electric Company, Work Paper PGECOFST105 Insulated Holding Cabinet-Electric, Revision 5, July 2016.
3. California Energy Commission, Energy Research and Development Division, Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Foodservice Equipment, October 2014.  
Available from: <http://www.energy.ca.gov/2014publications/CEC-500-2014-095/CEC-500-2014-095.pdf>

### **Record of Revision**

<b>Record of Revision Number</b>	<b>Issue Date</b>
3-18-20	3/29/2018

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## APPENDIX P

**EFFECTIVE USEFUL LIFE (EUL)****SINGLE AND MULTI-FAMILY RESIDENTIAL MEASURES**

Category	Single and Multi-family Residential Measures	Sector	EUL (years)	Source
<b>Appliance</b>	Advanced Power Strips	Residential	8	DEER 2014 EUL ID: Plug-OccSens
	Clothes Washer	Residential	11	DEER 2014 EUL ID: Appl-EffCW
	Clothes Dryer	Residential	14	ESTAR M&I Scoping Report <sup>1</sup>
	Dehumidifier	Residential	12	ESTAR Calc <sup>2</sup>
	Air Purifier (Cleaner)	Residential	9	ESTAR Calc <sup>3</sup>
	Dishwasher	Residential	11	DEER
	Refrigerator Replacement	Residential	14	DEER 2014 EUL ID: Appl-ESRefg
<b>Appliance Recycling</b>	Air Conditioner - Room (RAC), Recycling	Residential	3	DEER 2014 EUL ID: HV-RAC-RUL
	Refrigerator Recycling	Residential	5	DEER 2014 EUL ID: Appl-RecRef
	Freezer Recycling	Residential	4	DEER 2014 EUL ID: Appl-RecFrzr
<b>Building Shell</b>	Air Leakage sealing	Residential	15	GDS <sup>4</sup>
	Hot Water Pipe Insulation	Residential	13 – Electric 11 – Gas	DEER
	Opaque Shell Insulation	Residential	30	Energy Trust of Oregon and CEC <sup>5</sup>
	Window & Through the wall AC cover and Gap Sealer	Residential	5	See note below <sup>6</sup>
	Window Replacement	Residential	20	DEER 2014 EUL ID: BS-Win

<sup>1</sup> ENERGY STAR Market & Industry Scoping Report: Residential Clothes Dryer, November 2011.

<sup>2</sup> ENERGY STAR Dehumidifier Calculator

[www.energystar.gov/ia/business/bulk\\_purchasing/bpsavings\\_calc/CalculatorConsumerDehumidifier.xls](http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorConsumerDehumidifier.xls)

<sup>3</sup> Savings Calculator for ENERGY STAR® Qualified Appliances (last updated October 2016)

Available from: <https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/save-energy/purchase-energy-saving-products>

<sup>4</sup> GDS Associates, Inc., Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007, Table 1 – Residential Measures

<sup>5</sup> [http://energytrust.org/library/reports/resource\\_assesment/gasrptfinal\\_ss103103.pdf](http://energytrust.org/library/reports/resource_assesment/gasrptfinal_ss103103.pdf)

<sup>6</sup> At least one manufactures warranty period. [www.gss-ee.com/products.html](http://www.gss-ee.com/products.html)

## Appendix P: Effective Useful Life (EUL)

Category	Single and Multi-family Residential Measures	Sector	EUL (years)	Source
<b>Domestic Hot Water</b>	Domestic Hot Water Tank Blanket	Residential	10	NYSERDA <sup>7</sup>
	Heat Pump Water Heater – Air Source (HPWH) <sup>8</sup>	Residential	10	DEER 2014 EUL ID: WtrHt-HtPmp
	Indirect Water Heater	Residential	11	DEER 2014 EUL ID: WtrHt-Res-Gas
	Storage Water Heater - Gas	Residential	11	DEER 2014 EUL ID: WtrHt-Res-Gas
	Storage Water Heater - Electric	Residential	13	DEER 2014 EUL ID: WtrHt-Res-Elec
	Instantaneous Water Heater	Residential	20	DEER 2014 EUL ID: WtrHt-Instant-Res
<b>Domestic Hot Water - Control</b>	Faucet – Low Flow Aerator	Residential	10	DEER 2014 EUL ID: WtrHt-WH-Aertr
	Shower Restriction Valve	Residential	10	UPC <sup>9</sup>
	Shower Head – Low Flow	Residential	10	DEER 2014 EUL ID: WtrHt-WH-Shrhd
<b>Heating, Ventilation and Air Conditioning (HVAC)</b>	Air Conditioner and Heat pump – Refrigerant charge correction	Residential	10	DEER
	Air Conditioner and Heat pump – Right sizing	Residential	15	DEER <sup>10</sup>
	Air Conditioner, Central (CAC)	Residential	15	DEER 2014 EUL ID: HV-ResAC
	Air Conditioner – Room (RAC)	Residential	12	GDS <sup>11</sup>
	Boiler, Hot Water – Steel Water Tube	Residential	24	ASHRAE Handbook, 2015
	Boiler, Hot Water – Steel Fire Tube	Residential	25	ASHRAE Handbook, 2015
	Boiler, Hot Water – Cast Iron	Residential	35	ASHRAE Handbook, 2015
	Boiler, Steam – Steel Water Tube	Residential	30	ASHRAE Handbook, 2015
	Boiler, Steam – Steel Fire Tube	Residential	25	ASHRAE Handbook, 2015

<sup>7</sup> NYSERDA Energy Smart Program Deemed Savings Database. Rev 9 – 062006

<sup>8</sup> Electric heat pump used for service hot water heating

<sup>9</sup> UPC certification under the International Association of Plumbing and Mechanical Officials standard IGC 244-2007a. A standard that includes a lifecycle test consisting of 10,000 cycles without fail. 10,000 cycles is the equivalent of three users showering daily for more than nine years.

<sup>10</sup> Savings assumed to persist over EUL of air conditioner or heat pump

<sup>11</sup> GDS Associates, Inc., Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007, Table 1 – Residential Measures

## Appendix P: Effective Useful Life (EUL)

Category	Single and Multi-family Residential Measures	Sector	EUL (years)	Source
<b>Heating, Ventilation and Air Conditioning (HVAC)</b>	Boiler, Steam – Cast Iron	Residential	30	ASHRAE Handbook, 2015
	Circulator – with Electronically Commuted Motor (ECM) for Hydronic distribution	Residential	15	DEER <sup>12</sup>
	Duct sealing and Insulation	Residential	18	DEER
	Fan Motor – with Electronically Commuted Motor (ECM) for Furnace Distribution	Residential	15	DEER 2014 EUL ID: Motors-fan
	Furnace, Gas Fired	Residential	22	DOE <sup>13,14</sup>
	Furnace Tune-Up	Residential	5	DEER 2014 EUL ID: BlrTuneup
	Heat Pump - Air Source	Residential	15	DEER 2014 EUL ID: HV-Res HP
	Heat Pump – Ground Source	Residential	25	ASHRAE <sup>15</sup>
	Unit Heater, Gas Fired	Residential	13	ASHRAE Handbook, 2015
<b>HVAC - Control</b>	Outdoor Reset Control for Hydronic Boiler	Residential	15	ACEEE <sup>16</sup>
	Thermostat – Programmable; Thermostat – Wi-Fi Communicating Thermostat – Learning	Residential	11	DEER 2014 EUL ID: HVAC-ProgTStats
	Thermostatic Radiator Valve	Multifamily	15	DOE <sup>17</sup>

<sup>12</sup> Based on DEER value for furnace fans

<sup>13</sup> U.S. DOE. “Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Residential Furnaces” and “Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial Warm Air Furnaces.” August 30, 2016. Available from: <https://www.regulations.gov/document?D=EERE-2014-BT-STD-0031-0217>

<sup>14</sup> U.S. DOE. “Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial Warm Air Furnaces.” December 30, 2015. Available from: <https://www.regulations.gov/document?D=EERE-2013-BT-STD-0021-0050>

<sup>15</sup> ASHRAE: Owning and Operating Cost Database, Equipment Life/Maintenance Cost Survey: <https://energy.gov/energysaver/geothermal-heat-pumps>

<sup>16</sup> Potential for Energy Efficiency, Demand Response and Onsite Solar Energy in Pennsylvania, ACEEE report number E093. April 2009

<sup>17</sup> U.S. DOE, “Thermostatic Radiator Valve Evaluation”, January 2015, Table 4. Cost-Benefit Financial Assumptions, pg. 16



## Appendix P: Effective Useful Life (EUL)

Category	Single and Multi-family Residential Measures	Sector	EUL (years)	Source
<b>Lighting</b>	Compact Fluorescent Lamp (CFL)	Residential	Coupon – 5	GDS
			Direct Inst. – 7	GDS
			Markdown - 7	GDS
	LED Lamps (Directional)	Residential/ Multifamily Common area	9,000 hrs/ annual lighting operating hrs	See note below <sup>18</sup>
			25,000 hrs/ annual lighting operating hrs or 20 yrs (whichever is less)	ENERGY STAR Lamps <sup>19</sup>
			35,000 or 50,000 hours	DLC <sup>20</sup>
LED Lamps (Decorative & Omnidirectional)	Residential/ Multifamily Common area	15,000 hrs/ annual lighting operating hrs or 20 yrs (whichever is less)	ENERGY STAR Lamps	

<sup>18</sup> Multi-family common areas tend to have longer run hours than dwelling units. Default value from C&I lighting table is 7,665 hours per year

<sup>19</sup> ENERGY STAR Program Requirements Product Specification for Lamps (Light Bulbs) V2.0, August 2016, p. 19 (Capped at 20 years).

[https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Lamps%20V2\\_0%20Revised%20AUG-2016.pdf](https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Lamps%20V2_0%20Revised%20AUG-2016.pdf)

<sup>20</sup> Placed on the Qualified Products List by the Design Light Consortium (DLC) 35,000 or 50,000 hours, according to the appropriate Application Category as specified in the DLC's Product Qualification Criteria, Technical Requirement Table version 4.0 or higher

## Appendix P: Effective Useful Life (EUL)

Category	Single and Multi-family Residential Measures		Sector	EUL (years)	Source
<b>Lighting</b>	Light Fixture	LED (Interior)	Residential/ Multifamily	25,000 hrs/ annual lighting operating hrs or 20 yrs (whichever is less)	ENERGY STAR Fixtures <sup>21</sup>
		LED (Exterior)	Residential/ Multifamily Common area	35,000 hrs/ annual lighting operating hrs or 20 yrs (whichever is less)	ENERGY STAR Fixtures
		Linear Fluorescent	Residential / Multifamily Common area	70,000 hrs / annual lighting operating hrs, or 20 yrs (whichever is less)	DEER 2014 <sup>22</sup> EUL ID: ILtg- Lfluor- CommArea
		CFL	Residential / Multifamily Common area	22,000 hrs / annual lighting operating hrs, or 20 yrs (whichever is less)	See note below <sup>23</sup>
<b>Lighting Control</b>	Stairwell Dimming Light Fixture/Sensor		Multifamily	12	GDS <sup>24</sup>

<sup>21</sup> ENERGY STAR Program Requirements Product Specification for Luminaires (Light Fixtures) V2.0, May 2015, p. 17 (Capped at 20 years).

<https://www.energystar.gov/sites/default/files/Luminaires%20V2%200%20Final.pdf>

<sup>22</sup> Basis value 70,000 hours, capped at 20 years, is common given redecoration patterns

<sup>23</sup> Basis value 22,000 hour ballast life per US EPA. Capped at 20 years as above (2.5 hours per day average lamp operation)

<sup>24</sup> GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group

**COMMERCIAL AND INDUSTRIAL MEASURES**

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
<b>Agricultural</b>	Engine Block Heater Timer	C&I	8	See note below <sup>25</sup>
<b>Appliance</b>	Advanced Power Strips	C&I	8	DEER 2014 EUL ID: Plug-OccSens
	Clothes Dryer	C&I	14	ESTAR M&I Scoping Report <sup>26</sup>
	Electric & Gas Cooking Equipment	C&I	12	DEER 2014 EUL IDs: Various
	Room Air Conditioner Recycling	C&I	9	DEER 2014 EUL ID: HV-RAC-ES
	Refrigerator Replacement	C&I	12	DEER
<b>Appliance Control</b>	Vending Machine/Novelty Cooler Time Clock	C&I	5	DEER
<b>Building Shell</b>	Cool Roof	C&I	15	DEER
	Hot Water Pipe Insulation	C&I	13 – Electric 11 – Natural Gas	DEER
	Window - Film	C&I	10	DEER
	Window - Glazing	C&I	20	DEER 2014 EUL ID: BS-Win
	Opaque Shell Insulation	C&I	30	Energy Trust and CEC <sup>27</sup>
<b>Compressed Air</b>	Air Compressor Upgrade	C&I	13	State TRMs <sup>28</sup>
	Refrigerated Air Dryer	C&I	15	Ohio TRM
	Engineered Air Nozzle	C&I	15	Wisconsin PSC <sup>29</sup>
	No Air Loss Water Drain	C&I	15	Ohio TRM <sup>30</sup>
<b>Domestic Hot Water (DHW)</b>	Domestic Hot Water Tank Blanket	C&I	7	DEER
	Indirect Water Heater	C&I	15	DEER 2014 EUL ID: WtrHt-Com
	Storage Tank Water Heater	C&I	15	DEER 2014 EUL ID: WtrHt-Com
	Tankless Water Heater	C&I	20	DEER
	Heat Pump Water Heater - Air Source (HPWH)	C&I	10	DEER
	Faucet – Low Flow Aerator	C&I	10	DEER

<sup>25</sup> Based on EUL's for similar control technology

<sup>26</sup> ENERGY STAR Market & Industry Scoping Report: Residential Clothes Dryer, November 2011.

<sup>27</sup> Energy Trust uses 30 years for commercial applications.

[http://energytrust.org/library/reports/Residentialource\\_assesment/gasrptfinal\\_ss103103.pdf](http://energytrust.org/library/reports/Residentialource_assesment/gasrptfinal_ss103103.pdf). CEC uses 30 years for insulation in Title 24 analysis

<sup>28</sup> Based on a review of TRM assumptions from [Ohio \(August 2010\)](#), [Massachusetts \(October 2015\)](#), [Illinois \(February 2017\)](#) and [Vermont \(March 2015\)](#). Estimates range from 10 to 15 years.

<sup>29</sup> PA Consulting Group (2009). *Business Programs: Measure Life Study*. Prepared for State of Wisconsin Public Service Commission

<sup>30</sup> EUL for this measure not available. Default to air compressor upgrade EUL from Ohio TRM. [www.OhioTRM.org](http://www.OhioTRM.org)

## Appendix P: Effective Useful Life (EUL)

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
<b>DHW - Control</b>	Showerhead – Low Flow	C&I	10	DEER 2014 EUL ID: WtrHt-WH-Shrhd
	Pre-Rinse Spray Valve	C&I	5	GDS
<b>Heating, Ventilation and Air Conditioning (HVAC)</b>	Air Conditioner and Heat Pump – Refrigerant Charge Correction	C&I	10	DEER
	Air Conditioner – Unitary	C&I	15	DEER 2014 EUL ID: HVAC-airAC
	Air Conditioner – PTAC	C&I	15	DEER 2014 EUL ID: HVAC-PTAC
	Chiller – Air & Water Cooled	C&I	20	DEER 2014 EUL ID: HVAC-Chlr
	Chiller – Cooling Tower	C&I	15	DEER 2014 EUL ID: CITwrPkgSys
	Chiller Tune-Up	C&I	5	WI EUL DB <sup>31</sup>
	Combination Boiler and Water Heater	C&I	20	DEER <sup>32</sup>
	Condensing Gas-Fired Unit Heater for Space Heating	C&I	18	Ecotope <sup>33</sup>
	Duct Sealing and Insulation	C&I	18	DEER
	ECM Motors on HVAC Equipment	C&I	15	DEER <sup>34</sup>
	Economizer – Air Side, with Dual Enthalpy Control	C&I	10	DEER 2014 EUL ID: HVAC-addEcono
	Boiler, Hot Water – Steel Water Tube	C&I	24	ASHRAE Handbook, 2015
	Boiler, Hot Water – Steel Fire Tube	C&I	25	ASHRAE Handbook, 2015
	Boiler, Hot Water – Cast Iron	C&I	35	ASHRAE Handbook, 2015
	Boiler, Steam – Steel Water Tube	C&I	30	ASHRAE Handbook, 2015
	Boiler, Steam – Steel Fire Tube	C&I	25	ASHRAE Handbook, 2015
	Boiler, Steam – Cast Iron	C&I	30	ASHRAE Handbook, 2015

<sup>31</sup> Wisconsin Public Service Commission: Equipment Useful Life Database, 2013

Excerpt available from: [https://focusonenergy.com/sites/default/files/bpmeasurelifefestudyfinal\\_evaluationreport.pdf](https://focusonenergy.com/sites/default/files/bpmeasurelifefestudyfinal_evaluationreport.pdf)

<sup>32</sup> Based on DEER value for high efficiency boiler

<sup>33</sup> Ecotope Natural Gas Efficiency and Conservation Measure Resource Assessment (2003)

<sup>34</sup> DEER value for HVAC fan motors

## Appendix P: Effective Useful Life (EUL)

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
<b>Heating, Ventilation and Air Conditioning (HVAC)</b>	Boiler Tune-Up	C&I	5	DEER 2014 EUL ID: BlrTuneup
	Furnace, Gas Fired	C&I	23	DOE <sup>35, 36</sup>
	Unit Heater, Gas Fired	C&I	13	ASHRAE Handbook, 2015
	Heat Pump – Unitary & Applied	C&I	15	DEER 2014 EUL ID: HVAC-airHP
	Heat Pump – PTHP	C&I	15	DEER 2014 EUL ID: HVAC-PTHP
	Infrared Gas Space Heater	C&I	17	GDS
<b>HVAC - Control</b>	Thermostat – Programmable Thermostat – Wi-Fi Communicating	C&I	11	DEER 2014 EUL ID: HVAC-ProgTStats
	Boiler Reset Control	C&I	15	See note below <sup>37</sup>
	Demand Controlled Ventilation	C&I	15	DEER 2014 EUL ID: HVAC-VSD-DCV
	Energy Management System	C&I	15	DEER
	Hotel Occupancy Sensors for PTAC and HP Units	C&I	8	DEER <sup>38</sup>
	Steam Traps Repair/Replace	C&I	6	DEER 2014 EUL ID: HVAC-StmTrp
<b>Lighting</b>	CFL Lamp	C&I	9,000 hours /annual lighting operating hours	See note below <sup>39</sup>
	CFL Light Fixture	C&I	12	DEER 2014 EUL ID: ILtg-CFLfix-Com
	HID	C&I	70,000 hours /annual lighting operating hours or 15 years (whichever is less)	DEER 2014 EUL ID: ILtg-HPS

<sup>35</sup> U.S. DOE. “Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Residential Furnaces” and “Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial Warm Air Furnaces.” August 30, 2016. Available from: <https://www.regulations.gov/document?D=EERE-2014-BT-STD-0031-0217>

<sup>36</sup> U.S. DOE. “Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial Warm Air Furnaces.” December 30, 2015. Available from: <https://www.regulations.gov/document?D=EERE-2013-BT-STD-0021-0050>

<sup>37</sup> Set to 15 years, consistent with Energy Management System (EMS) value in DEER

<sup>38</sup> DEER value for occupancy sensor controls. Hardwired (not battery powered) controls only

<sup>39</sup> Based on reported annual lighting operating hours; default value by space type in the technical manual (pp. 109-110)

Appendix P: Effective Useful Life (EUL)

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
Lighting	Linear Fluorescent	C&I	70,000 hours /annual lighting operating hours or 15 years, (whichever is less)	DEER 2014 <sup>40</sup> EUL ID: ILtg-Lfluor-Elec
	LED Fixtures (other than refrigerated case)	C&I	50,000 hours /annual lighting operating hours or 20 years (whichever is less)	DLC <sup>41</sup>
			35,000 hours /annual lighting operating hours or 20 years (whichever is less)	Energy Star <sup>42</sup>
			25,000 hours /annual lighting operating hours or 20 years (whichever is less)	Uncertified
	Refrigerated Case LED	C&I	16	DEER 2014 EUL ID: GrocDisp-FixtLtg-LED
	LED Screw-In Lamps	C&I	15,000 hours (decorative) or 25,000 hours (all other)/ annual lighting operating hours or 20 years (whichever is less)	Energy Star
Lighting - Control	Interior Lighting Control	C&I	8	DEER 2014 EUL IDs: GlazDayIT-Daylgtg, ILtg-OccSens
	Stairwell Dimming Light Fixture/Sensor	C&I	12	GDS <sup>43</sup>
	Plug-Load Occupancy Sensor	C&I	8	DEER <sup>44</sup>

<sup>40</sup> Basis Value 70,000 hours, capped at 15 years to reflect C&I redecoration and business type change patterns

<sup>41</sup> 50,000 hours per L<sub>70</sub> requirements prescribed by the DLC's Product Qualification Criteria, Technical Requirement Table version 4.2

<sup>42</sup> Placed on the Qualified Fixture List by Energy Star, according to the appropriate luminaire classification as specified in the Energy Star Program requirements for Luminaires, version 2.0. Divided by estimated annual use, but capped at 20 years regardless (consistent with C&I redecoration and business type change patterns)

<sup>43</sup> GDS Associates, Inc. (2007). Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures. Prepared for The New England State Program Working Group

<sup>44</sup> DEER value for lighting occupancy sensors

Appendix P: Effective Useful Life (EUL)

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
<b>Motors and Drives</b>	Motor replacement (with HE motor)	C&I	15	DEER
	Variable Frequency Drive – Fan and Pump	C&I	15	DEER 2014 EUL ID: HVAC-VSDSupFan
<b>Refrigeration</b>	Air Cooled Refrigeration Condenser	C&I	15	DEER 2014 EUL ID: GrocSys-Cndsr
	Equipment (Condensers, Compressors, and Sub-cooling)	C&I	15	DEER
	Fan Motor – Refrigerated Case and Walk-In Cooler, with ECM	C&I	15	DEER 2014 EUL ID: GrocDisp-FEvapFanMtr
	Refrigerated Case Night Cover	C&I	5	DEER 2014 EUL ID: GrocDisp-DispCvrs
	Auto/Fast Close Door Walk-In Coolers/Freezers	C&I	8	DEER
	Strip Curtains and Door Gaskets for Reach-In or Walk-In Coolers/Freezers	C&I	4	DEER 2014 EUL ID: GrocWlkIn-StripCrtn
<b>Refrigeration - Control</b>	Anti-Condensation Heater Control	C&I	12	DEER 2014 EUL ID: GrocDisp-ASH
	Evaporator Fan Control	C&I	16	DEER 2014 EUL ID: Groc-WalkIn-WEvapFMtrCtrl
	Condenser Pressure and Temperature Controls	C&I	15	DEER

**Record of Revision**

<b>Record of Revision Number</b>	<b>Issue Date</b>
EUL's originally listed in July 18, 2011 Order	7/18/2011
Additional EUL's posted on web site	Subsequent to 7/18/2011 Order
7-13-28	7/31/2013
6-14-1	6/19/2014
6-14-2	6/19/2014
6-15-4	6/1/2015
6-16-2	6/30/2016
1-17-8	12/31/2016
6-17-16	6/30/2017
9-17-11	9/30/2017
12-17-X	12/31/2017
3-18-21	3/29/2018

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## GLOSSARY

<b>ABBREVIATIONS, ACRONYMS, AND EQUATION VARIABLES</b>	
$\overline{\text{COP}}$	Average coefficient of performance
$\eta$	Energy efficiency (0 -100%)
$\overline{\eta}$	Average energy efficiency (0 -100%)
$\overline{\Delta T}$	Average temperature difference
$\overline{\text{EER}}$	Seasonal average energy efficiency ratio over the cooling season BTU/watt-hour, (used for a particular climate/building)
$\Delta \text{kW}$	Peak coincident demand electric savings
$\Delta \text{kWh}$	Annual electric energy savings
$\Delta Q$	Heat difference/loss
$\Delta T$	Temperature difference
$\Delta \text{therms}$	Annual gas energy savings
$\Delta$	Change, difference, or savings
A	Amperage
AC	Air conditioning
ACCA	Air Conditioning Contractors of America
ACEEE	American Council for an Energy-Efficient Economy
ACL	Actual cooling load (Btu/hr) based on Manual J calculation
ACH	Air change per hour
AFUE	Annual fuel utilization efficiency, seasonal energy efficiency for fuel heating equipment
AHAM	Association of Home Appliance Manufacturers
AHL	Actual heating load (Btu/hr) based on Manual J calculation
AHRI	Air Conditioning Heating and Refrigeration Institute
AHU	Air handling unit
AIA	American Institute of Architects
ANSI	American National Standards Institute
APU	Auxiliary power unit
area	Extent of space or surface
ARI	Air-Conditioning & Refrigeration Institute
ARRA	American Recovery and Reinvestment Act of 2009
ASHP	Air source heat pump
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
baseline	Baseline condition or measure
BLDC	Brushless DC electric motor
BTU	British Thermal Unit
BTUh	British Thermal Units per hour
CAC	Central air conditioner
CADR	Clean Air Delivery Rate (CFM)
Capacity	Cooling output rating, in Btu/hr
CAV	Constant air volume

## Glossary

CBECS	Commercial Buildings Energy Consumption Survey
CDD	Cooling degree days - The number of degrees that a day's average temperature is above some baseline temperature, which represents the temperature above which buildings need to be cooled. The baseline temperature is typically 65°F, but may vary based on application.
CEC	State of California Energy Commission
CEE	Consortium for Energy Efficiency
CEF	Combined energy factor (lb/kWh)
CEER	Combined Energy Efficiency Ratio
CF	Coincidence factor
CFL	Compact fluorescent lamp
CFM	Cubic foot per minute
CHW	Chilled water
CHWP	Chilled water pump
CLH	Cooling load hours
CM	Case motor
CMU	Concrete masonry
Comp <sub>eff</sub>	Efficiency of the cooler/freezer compressor (kW/Ton)
COP	Coefficient of performance, ratio of output energy/input energy
CV	Constant volume
CW	Condenser water
CWP	Condenser water pump
Cycles <sub>annual</sub>	Number of dryer cycles per year
D	Demand
DC	Direct current
DCV	Demand controlled ventilation
DEER	Database for Energy Efficiency Resources, California
DF	Demand diversity factor
DFP	Default functional period
DHW	Domestic hot water
Dia	Diameter
DLC	DesignLights Consortium®
DOAS	Dedicated outdoor air system
DOE 2.2	US DOE building energy simulation, and cost calculation tool
DPS	Department of Public Service, New York State
DSF	Demand savings factor
DX	Direct expansion
ECCC NYC	Energy Conservation Construction Code of New York City
ECCC NYS	Energy Conservation Construction Code of New York State
EC	Electronically commutated
Econ	Economizer
Ecotope	Ecotope Consulting, Redlands, CA
ee	Energy efficient condition or measure
EEPS	Energy Efficiency Portfolio Standard

## Glossary

EER	Energy efficiency ratio under peak conditions
EF	Energy factor
Eff	Efficiency
$E_c$	Combustion efficiency
Efficiency Vermont	State of Vermont Energy and Efficiency Initiatives
$E_t$	Thermal efficiency
EFLH	Equivalent full-load hours
EIA	Energy Information Administration, US
EISA	Energy Independence and Security Act (EISA) of 2007
ElecSF	Electric Savings Factor
ENERGY STAR <sup>®</sup>	U.S. Environmental Protection Agency voluntary program
Energy Trust	Energy Trust of Oregon, Inc.
EPA	Environmental Protection Agency (EPA), US
EPACT	Energy Policy and Conservation Act of 2005
EPDM	Ethylene propylene diene monomer roofing membrane
ERV	Energy recovery ventilation
ESF	Energy savings factor
EUL	Effective useful life
EFan	Evaporator fan
Exh	Exhaust
F	Factor
$F_{elec}$	Percentage of energy consumed that is derived from electricity
$F_{gas}$	Percentage of energy consumed that is derived from gas
FEMP	Federal Energy Management Program
FL	Full-load chiller efficiency under peak conditions
FLH	Full-load hours
Flow	Nozzle flow
FPFC	Four pipe fan coil
ft <sup>2</sup>	Square foot
GasSF	Gas Savings Factor
GDS	GDS Associates, Marietta, GA
Glazing area	Aperture area of glazing
GPD	Gallons Per Day
GPM	Gallons Per Minute
GSHP	Ground source heat pump
$H_v$	Heat of vaporization (latent heat), in Btu/lb
$H_2O_{savings}$	Water savings
HDD	Heating degree days - The number of degrees that a day's average temperature is below some baseline temperature, which represents the temperature below which buildings need to be heated. The baseline temperature is typically 65°F, but may vary based on application.
HID	High intensity discharge lamp

## Glossary

hp	Horsepower
HP	High performance
hrs	Hours
hr <sub>Soperating</sub>	Operating hours
HSPF	Heating seasonal performance factor, BTU/watt-hour, total heating output (supply heat) in BTU (including electric heat) during the heating season / total electric energy heat pump consumed (in watt-hour)
ht	Height
HVAC	Heating, ventilation, and air conditioning
HVAC <sub>c</sub>	HVAC interaction factor for annual electric energy consumption
HVAC <sub>d</sub>	HVAC interaction factor at utility summer peak hour
HVAC <sub>g</sub>	HVAC interaction factor for annual natural gas consumption
HW	Hot water
IECC	International Energy Conservation Code
IEER	Integrated energy efficiency ratio
IESNA	Illuminating engineering Society of North America
IPLV	Integrated Part-Load Value, a performance characteristic, typically of a chiller capable of capacity modulation.
k	Thermal conductivity
KBTU <sub>h<sub>in</sub></sub>	Gas input rating (kBTU/h)
kBTU <sub>h<sub>out</sub></sub>	Heating output rating (kBTU/h)
kW	kilowatts
L	Length
LBNL	Lawrence Berkeley National Laboratory
leakage	Estimate of percent of units not installed in service territory
LED	Light emitting diode
LEED	Leadership in Energy and Environmental Design
LF	Load Factor
Load	Average total weight (lbs) of clothes per drying cycle
LPD	Lighting power density
LRAC	Long-run avoided cost
LSAF	Load shape adjustment factor
MEC	Metropolitan Energy Center
NAECA	National Appliance Energy Conservation Act of 1987
NBI	New Buildings Institute
NEA	National Energy Alliances
NEAT	National Energy Audit Tool
NEMA	National Electrical Manufacturers Association
NREL	National Renewable Energy Laboratory
NRM	National Resource Management
NSTAR	Operating company of Northeast utilities
NWPPC	Northwest Power Planning Council
NWRTF	Northwest Regional Technical Forum
NY DPS	New York State Department of Public Service

## Glossary

NYISO	New York Independent System Operator
NYSERDA	New York State Energy Research and Development Authority
°F	Degrees Fahrenheit
OSA	Outdoor supply air
PA Consulting	PA Consulting Group
PF	Power factor
Phase	Number of phases in a motor (1 or 3) Single Phase is a type of motor with low horsepower that operates on 120 or 240 volts, often used in residential appliances. Three phase is a motor with a continuous series of three overlapping AC cycles offset by 120 degrees. Three-phase is typically used in commercial applications.
PLR	Power loss reduction
PNNL	Pacific Northwest National Laboratory
PSC	Public Service Commission, New York State
PSF	Proper sizing factor
psia	Atmospheric pressure (lbs per square inch)
psig	Gauge pressure (lbs per square inch)
PSZ	Packaged single zone
PTAC	Package terminal air conditioner
PTHP	Packaged terminal heat pump
Q	Heat
Q <sub>reduced</sub>	Reduced heat
Q <sub>reject</sub>	Total heat rejection
r	Radius
RA	Return air
RAC	Room air conditioner
RE	Recovery efficiency
RECS	Residential Energy Consumption Survey
RESNET	Residential Energy Services Network
RH	Reduced heat
RLF	Rated load factor
RPM	Revolutions per minute
R-value	A measure of thermal resistance particular to each material
S	Savings
SAPA	State Administrative Procedure Act
SBC	System Benefit Charge
SCFM	Standard cubic feet per minute @ 68°F and 14.7 psi standard condition
SEER	Seasonal average energy efficiency ratio over the cooling season, BTU/watt-hour, (used for average U.S. location/region)
SF	Square foot
SHGC	Solar heat gain coefficient
SL	Standby heat loss
Staff	NYS Department of Public Service Staff
standby	Standby Power (watts)

## Glossary

T	Temperature
TAF	Temperature adjustment factor
TDA	Total Display Area (ft <sup>2</sup> )
TDEC	Total Daily Energy Consumption
TEFC	Totally enclosed fan cooled
th	Thickness
therm	Unit of heat
THR	Total heat rejection
Throttle <sub>fac</sub>	Throttle factor
TMY	Typical meteorological year
tons	Tons of air conditioning
tons/unit	Tons of air conditioning per unit, based on nameplate data
TRC	Total Resources Cost
TRM	Technical Resource Manual
UA	Overall heat loss coefficient (BTU/hr-°F)
UEF	Uniform Energy Factor
unit	Measure
units	Number of measures installed under the program
UPC	Uniform Plumbing Code under the International Association of Plumbing and Mechanical Officials
US DOE	United States Department of Energy
US EPA	United States Environmental Protection Agency
U-value	Measure of heat loss in a building element/overall heat transfer co-efficient
V	Volt
v	Volume
VAV	Variable air volume
VSD	Variable speed drive
W	watts
W <sub>ctrl</sub>	Total wattage of controlled lighting (watts)
Wisconsin PSC	State of Wisconsin Public Service Commission

## Glossary

<b><u>EQUATION CONVERSION FACTORS</u></b>	
0.000584	Conversion factor used in DOE test procedure
0.00132	Electric efficient storage type water heater replacing standard storage tank water heater. NAECA referenced as function of storage volume.
0.0019	Natural gas efficient storage type water heater replacing standard storage tank water heater. NAECA referenced as function of storage volume.
0.284	Conversion factor, one kW equals 0.284 ton
0.293	Conversion factor, one BTU/h equals 0.293071 watt
0.473	Conversion factor (liters/pint)
0.67	Natural gas water heater Energy Factor
0.746	Conversion factor (kW/hp), 746 watts equals one electric horsepower
0.97	Electric resistance water heater Energy Factor
1.08	Specific heat of air × density of inlet air @ 70°F × 60 min/hr
1.6	Typical refrigeration system kW/ton
3.412	Conversion factor, one watt-hour equals 3.412142 BTU
3.517	Conversion factor, one ton equals 3.517 kilowatts
8.33	Energy required (BTU's), to heat one gallon of water by one degree Fahrenheit
12	kBTUh/ton of air conditioning capacity
24	Hours in one day
67.5	Ambient air temperature °F
91	Days in winter months
100	Conversion factor, one therm equals 100 kBTU
274	Days in non-winter months.
365	Days in one year
3,412	Conversion factor, one kWh equals 3,412 BTU
8,760	Hours in one year
12,000	Conversion factor, one ton equals 12,000 BTU/h
1,000	conversion factor, one kW equals 1,000 watts
100,000	conversion factor, (BTU/therm), one therm equals 100,000 BTU's

### Record of Revision

<b>Record of Revision Number</b>	<b>Issue Date</b>
0	12/10/2014
6-15-4	6/1/2014
1-17-9	12/31/2016
6-17-17	6/30/2017
9-17-12	9/30/2017
12-17-Y	12/31/2017
3-18-22	3/29/2018

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**3/29/18 - First Quarter Record of Revision TRM Filing  
Detailed Work Plan**

No.	Task	Estimated Completion Date	Effective Date in TRM	Comments
1	<b>Interim Consolidated Filing, Technical Resource Manual, Version 5.1</b>	3/15/2018	1/1/2018	Filed by RGE/NYSEG on 3/15/2018
2	<b>File Q1 2018 ROR</b>			To be filed by Central Hudson on 3/29/2018
	<b><u>New Measures</u></b>			
R	Learning Thermostat	3/29/2018	3/29/2018	
C&I	Ovens, Steamers, Fryers and Griddles	3/29/2018	3/29/2018	
C&I	Combination Ovens	3/29/2018	3/29/2018	
C&I	Insulated Holding Cabinets	3/29/2018	3/29/2018	
	<b><u>Existing Measure Updates w/ effective date</u></b>			
R	Advanced Power Strip	3/29/2018	1/1/2019	
R	Room Air Conditioner	3/29/2018	1/1/2019	
C&I	Economizer - Air Side with Dual Enthalpy Control	3/29/2018	1/1/2019	
C&I	Refrigerated Case Night Cover	3/29/2018	1/1/2019	
C&I	Evaporator Fan Control	3/29/2018	1/1/2019	
R	Clothes Washer	3/29/2018	1/1/2019	
R	Refrigerator and Freezer Replacement	3/29/2018	1/1/2019	
R	Room Air Conditioner - Recycling	3/29/2018	1/1/2019	
R	Domestic Hot Water Tank Blanket (removal)	3/29/2018	3/30/2018	Measure was marked for removal from the TRM.
C&I	Low-Flow Pre Rinse Spray Valve	3/29/2018	1/1/2019	
R	Dehumidifier	3/29/2018	1/1/2019	
R	Furnace Tune Up	3/29/2018	1/1/2019	
C&I	Indirect Water Heater	3/29/2018	1/1/2019	
C&I	Air Cooled Refrigeration Condenser	3/29/2018	1/1/2019	
C&I	Freezer and Cooler Door Strip	3/29/2018	1/1/2019	
R	Heat Pump - Ground Source	3/29/2018	1/1/2019	
	Appendix P	3/29/2018	1/1/2019	
	Glossary	3/29/2018	1/1/2019	
R	Demand Response Thermostat			Decided to not include this measure as there was not a clear distinction between the T-stat measures and demand savigns associated with DR initiatives are treated seperately by the DR program.
3	<b>Consolidated Filing, Technical Resoruce Manual, Version 6</b>	4/15/2018	1/1/2019	To be filed by Con Edison/O&R
4	<b>File Q2 2018 ROR</b>			To be filed by National Grid
	<b><u>New Measures</u></b>			<i>Measure list for Q2 2018 is an estimate of the measures anticipated to be reviewed for the quarter. This list is subject to change based on TRM MC priorities and workload.</i>
R	Boiler Tune-Up	6/29/2018	6/29/2018	
C&I	Commercial Ice Machines	6/29/2018	6/29/2018	
C&I	Commercial Dishwashers	6/29/2018	6/29/2018	
R	Steam Trap Repair or Replacement - Low Pressure Space Heating	6/29/2018	6/29/2018	
R	Air Conditioner and Heat Pump - Packaged Terminal	6/29/2018	6/29/2018	
	<b><u>Existing Measure Updates w/ effective date</u></b>			
C&I	Demand Control Ventilation	6/29/2018	6/29/2018	To correct an error in excluding NYC in the HDD/CDD
C&I	Freezer and Cooler Door Gaskets	6/29/2018	1/1/2019	
R	Energy Management System (EMS)	6/29/2018	1/1/2019	
C&I	Faucet – Low Flow Aerator	6/29/2018	1/1/2019	
C&I	Motor Replacement	6/29/2018	1/1/2019	
R	Hot Water Pipe Insulation	6/29/2018	1/1/2019	
R	Circulator Pump – with Electronically Commutated (EC) Motor, for Hydronic Distribution	6/29/2018	1/1/2019	
R	Outdoor Reset Control, for Hydronic Boiler	6/29/2018	1/1/2019	
C&I	Vending Machine and Novelty Cooler Time Clock	6/29/2018	1/1/2019	
C&I	Air Dryer - Refrigerated	6/29/2018	1/1/2019	
R	Air Conditioner and Heat Pump - Refrigerant Charge Correction	6/29/2018	1/1/2019	
R	Duct Sealing and Insulation	6/29/2018	1/1/2019	
C&I	Air Conditioner and Heat Pump - Refrigerant Charge Correction	6/29/2018	1/1/2019	
R	Dishwasher	6/29/2018	1/1/2019	
C&I	Electronically Controlled Brushless Permanent Magnet (BPM) Motors for hvac circulation (blower) fan	6/29/2018	1/1/2019	
C&I	Bi-Level Lighting	6/29/2018	1/1/2019	
5	<b>Complete TRM global updates (the entire manual)</b>	<b>12/31/2018</b>		