

Table of Revisions/Changes

Revision Number	Addition/Revision	Issue Date	Effective Date	Measure	Description of Change	Location/Page in TRM
6-22-01	A	9/2/2022	9/2/2022	R/MF Heat Pump Clothes Dryer	New Measure Added	Pg.xx
6-22-04	Removal	9/2/2022	9/2/2022	R/MF DHW Aquastat Turndown	No revisions applied – measure marked for removal from TRM.	Pg.xx
6-22-06	A	9/2/2022	9/2/2022	R/MF Connected Lighting	New Measure Added	Pg.xx
6-22-13	R	9/2/2022	1/1/2023	Appendix P	Updated EUL entries for all measures contained in this Record of Revision	Pg. 1,271
6-22-16	A	9/2/2022	9/2/2022	C/I Induction Cooktop	New Measure Added	Pg.xx

Note: Revisions and additions to the measures listed above were undertaken by the Joint Utilities Technical Resource Manual (TRM) Management Committee between April 30, 2022 – September 2, 2022.

APPLIANCE

HEAT PUMP CLOTHES DRYER

Measure Description

This measure covers ENERGY STAR® qualified residential clothes dryers utilizing heat pump technology installed in single family and in-unit multifamily applications. A heat pump dryer works as a closed loop system by heating the air using it to remove moisture from the clothes and then reusing it once the moisture is removed. Rather than releasing warm, humid air through a dryer vent to the exterior of the home as a conventional dryer does, a heat pump dryer sends it through an evaporator to remove the moisture without losing too much heat. Making use of a refrigerant as part of this process means less electricity is used to generate heat.

Method for Calculating Annual Energy and Summer Peak Coincident Demand Savings

Annual Electric Energy Savings

$$\Delta kWh = units \times Cycles_{annual} \times Load \times \left(\frac{F_{elec,baseline}}{CEF_{baseline}} - \frac{F_{elec,ee}}{CEF_{ee}} \right)$$

Summer Peak Coincident Demand Savings

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

Annual Fuel Energy Savings

$$\Delta MMBtu = units \times Cycles_{annual} \times Load \times \left(\frac{F_{fuel,baseline}}{CEF_{baseline}} \right) \times \frac{3,412}{1,000,000}$$

where:

- ΔkWh = Annual electricity energy savings
- ΔkW = Peak coincident demand electric savings
- $\Delta MMBtu$ = Annual fuel energy savings
- units = Number of measures installed under the program
- Load = Average total weight (lbs) of clothes per drying cycle
- $Cycles_{annual}$ = Number of dryer cycles per year
- F = Fuel Factor
- elec = Characteristic of electric usage
- fuel = Characteristic of fossil fuel usage
- CEF = Combined Energy Factor (lb/kWh)
- baseline = Characteristic of baseline condition
- ee = Characteristic of energy efficient condition
- 3,412 = Conversion factor, one kWh equals 3,412 BTU
- 1,000,000 = Conversion factor, one MMBtu equals 1,000,000 BTU

Summary of Variables and Data Sources

Variable	Value	Notes
Cycle _{Annual}	283	Based on ENERGY STAR® savings calculator. ¹
Load		Lookup based on efficient dryer type in table below. ²
F _{elec,baseline}		Lookup based on efficient dryer type in table below. ³
F _{elec,ee}		Lookup based on efficient dryer type in table below. ⁴
F _{fuel,baseline}		Lookup based on efficient dryer type in table below. ⁵
CEF _{baseline}		Lookup based on efficient dryer type in table below. ⁶
CEF _{ee}		From Application, using ENERGY STAR® rating
hrs	290	Based on ENERGY STAR® savings calculator. ⁷
CF	0.029	

Key Variables Lookup Table

Variable	Baseline Dryer Type				
	<i>Vented Gas Dryer</i>	<i>Ventless or Vented Electric, Standard ≥ 4.4 ft³</i>	<i>Ventless or Vented Electric, Compact (120V) < 4.4 ft³</i>	<i>Vented Electric, Compact (240V) < 4.4 ft³</i>	<i>Ventless Electric, Compact (240V) < 4.4 ft³</i>
Load	8.45	8.45	3.00	3.00	3.00
F _{elec,baseline}	0.05	1.00	1.00	1.00	1.00
F _{elec,ee}	1.00	1.00	1.00	1.00	1.00
F _{fuel,baseline}	0.95	0.00	0.00	0.00	0.00
CEF _{baseline}	3.30	3.73	3.61	3.27	2.55

Coincidence Factor (CF)

The prescribed coincidence factor is 0.029⁸

Baseline Efficiencies from which Energy Savings are Calculated

The baseline condition for this measure is a standard efficiency, residential clothes dryer with operating specifications as defined in the Key Variables Lookup Table above. For replacement scenarios, the baseline dryer type shall align with the existing product type. For new installations, the baseline dryer type selected shall align with the type of equipment that would have been installed without the influence of the program supporting the installation of this measure.

¹ Savings calculator for ENERGY STAR® Qualified Appliances (accessed 10/18/2017)

² Ibid

³ ENERGY STAR® Program Requirements Product Specification for Clothes Dryers, Eligibility Criteria Version 1.1, May 2017

⁴ Ibid.

⁵ Ibid.

⁶ 10 CFR 430.32 (h)(3)

⁷ Savings calculator for ENERGY STAR® Qualified Appliances (accessed 10/18/2017)

⁸ Based on metered data from Navigant Consulting, “EmPOWER Maryland Draft Final Evaluation Report Evaluation Year 4 (6/1/2012 – 5/31/2013) Appliance Rebate Program.” March 2014, page 36. This report is not publicly available, but is referenced by the Mid-Atlantic Technical Reference Manual, Version 9.0, October 2019

Compliance Efficiency from which Incentives are Calculated

The compliance condition is a residential heat pump clothes dryer appearing on the ENERGY STAR® qualified products list.

Operating Hours

The hours of operation are assumed to be 290 hours.⁹

Example Calculation *(Not to be used as default)*

A customer replaces a vented gas dryer with an ENERGY STAR® rated heat pump clothes dryer with a Combined Energy Factor (CEF) of 6.37. Annual Electric Energy Savings, Summer Peak Coincident Demand Savings and Annual Fossil Fuel Energy Savings are calculated as below.

$$\Delta kWh = units \times Cycles_{annual} \times Load \times \left(\frac{F_{elec,baseline}}{CEF_{baseline}} - \frac{F_{elec,ee}}{CEF_{ee}} \right)$$

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

$$\Delta MMBtu = units \times Cycles_{annual} \times Load \times \left(\frac{F_{fuel,baseline}}{CEF_{baseline}} - \frac{F_{fuel,ee}}{CEF_{ee}} \right) \times \frac{3,412}{1,000,000}$$

units = 1, from application

Cycles_{annual} = 283, from Summary of Data Sources and Variables

Load = 8.45, from Key Variables Lookup Table based on dryer type from application

F_{elec,baseline} = 0.05, from Key Variables Lookup Table based on dryer type from application

F_{fuel,baseline} = 0.95, from Key Variables Lookup Table based on dryer type from application

F_{elec,ee} = 1.00, from Key Variables Lookup Table based on dryer type from application

CEF_{baseline} = 3.30, from Key Variables Lookup Table based on dryer type from application

CEF_{ee} = 6.37, from application

hrs = 290, from Key Variables Lookup Table based on dryer type from application

CF = 0.029, from Summary of Data Sources and Variables

$$\Delta kWh = 1 \times 283 \times 8.45 \times \left(\frac{0.05}{3.30} - \frac{1}{6.37} \right) = -339 kWh$$

$$\Delta kW = \frac{-339}{290} \times 0.029 = -0.03 kW$$

$$\Delta MMBtu = 1 \times 283 \times 8.45 \times \left(\frac{0.95}{3.30} \right) \times \frac{3,412}{1,000,000} = 2.35 MMBtu$$

⁹ Savings calculator for ENERGY STAR® Qualified Appliances (accessed 10/18/2017)

Effective Useful Life (EUL)

See [Appendix P](#).

Ancillary Fossil Fuel Savings Impacts

Ancillary fossil fuel savings impacts, if appropriate, will be researched and incorporated into this measure algorithm in future revisions to the TRM.

Ancillary Electric Savings Impacts

Ancillary electric savings impacts, if appropriate, will be researched and incorporated into this measure algorithm in future revisions to the TRM.

References

1. ENERGY STAR® Program Requirements Product Specification for Clothes Dryers, Eligibility Criteria Version 1.1, May 2017
Available from:
<https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Final%20Version%201.1%20Clothes%20Dryers%20Specification%20-%20Program%20Commitment%20Criteria%20and%20Eligibility%20Criteria.pdf>
2. Purchase energy-saving products, 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>
3. 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
4. Navigant Consulting, EmPOWER Maryland Draft Final Evaluation Report Evaluation Year 4 (6/1/2012 – 5/31/2013) Appliance Rebate Program, March 2014 *via Mid-Atlantic Technical Reference Manual Version 9.0, May 2019*
Available from:
https://neep.org/sites/default/files/resources/Mid_Atlantic_TRM_V9_Final_clean_wUpdateSummary%20-%20CT%20FORMAT.pdf

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6-22-1	9/2/2022

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MEASURE RECOMMENDED FOR REMOVAL FROM TRM

DOMESTIC HOT WATER - CONTROL

DHW AQUASTAT TURNDOWN

Measure Description

This measure covers the turn down of a storage type water heater's temperature setpoint to reduce standby losses and total water heating demand. Water heater thermostats are often factory set to 140°F by manufacturers; however, a setpoint of 125°F is typically sufficient for most DHW applications. Reducing water heater setpoint temperature also reduces risk of scalding and may slow mineral buildup and corrosion in the water heater and distribution pipes. This measure is restricted to direct install program delivery methods only and the post-implementation setpoint shall comply with all applicable health and safety regulations, codes and standards.

Method for Calculating Annual Energy and Summer Peak Coincident Demand Savings

Annual Electric Energy Savings

$$\Delta kWh = \times ElecSF$$

Summer Peak Coincident Demand Savings

$$\Delta kW = \times CF$$

Annual Fossil Fuel Energy Savings

$$\Delta MMBtu = \times FuelSF$$

where:

ΔkWh	= Annual electricity energy savings
ΔkW	= Peak coincident demand electric savings
$\Delta MMBtu$	= Annual fossil fuel energy savings
ΔT	= Temperature difference between pre and post-turn down temperature setting
UA	= Overall heat transfer coefficient (BTU/hr-°F)
Eff	= Thermal efficiency of storage water heater
ElecSF	= Electric Savings Factor: Adjustment to electric energy savings based on fuel type
FuelSF	= Fossil Fuel Savings Factor: Adjustment to fuel energy savings based on fuel type
CF	= Coincidence factor
8,760	= Hours in a day
3,412	= Conversion factor, one kW equals 3,412 BTU/h
1,000,000	= Conversion factor, one MMBtu equals 1,000,000 BTU

Summary of Variables and Data Sources

Variable	Value	Notes
ΔT		From application, calculated as the difference between the pre and post-turn down temperature setpoint.
ElecSF	Electric DHW: 1 Fuel DHW: 0	
FuelSF	Electric DHW: 0 Fuel DHW: 1	
UA	7.85	Overall heat loss coefficient of a typical storage type water heater (BTU/h-°F). ¹⁰
Eff	Electric DHW: 0.98 Fossil Fuel DHW: 0.75	Recovery efficiency of typical electric ¹¹ and gas ¹² , storage type water heater.
CF	0.8	

Coincidence Factor (CF)

The prescribed value for the coincidence factor is 0.8.¹³

Baseline Efficiencies from which Energy Savings are Calculated

The baseline condition for this measure is a residential DHW system with factory temperature setting.

Compliance Efficiency from which Incentives are Calculated

The compliance condition is a residential DHW system with reduced storage setpoint temperature applied through a direct install program delivery method.

Operating Hours

Water heater run hours are not utilized in the estimation of energy or demand savings, but water heater is assumed to be available for operation 8,760 hours per year. Additionally, it is assumed standby losses are incurred 8,760 hours per year.

¹⁰ Based on computation of heat loss coefficients via conversion equations found in 10 CFR 429, 430, and 431 Docket No. EERE-2015-BT-TP-0007, Energy Conservation Program for Consumer Products and Certain Commercial and Industrial Equipment: Test Procedures for Consumer and Commercial Water Heaters. Heat loss coefficient was equated for two minimally code compliant gas storage water heaters found to be the most typical in terms of storage and input capacity, representing storage type water heaters of between 20 and 55 gallon capacity (40 gallon, 40,000 BTU/h assumed) and between 55 and 120 gallon capacity (75 gallon, 76,000 BTU/h assumed). Results of heat loss coefficient evaluation at these two data points agreed to within 0.3%, so the lower of the two was selected to represent the UA term.

¹¹ Per 10 CFR 430 Subpart B Appendix E – Uniform Test Method for Measuring the Energy Consumption of Water Heaters: 6.3.2 Recovery Efficiency

¹² Per 10 CFR 430, typical recovery efficiency of a gas water heater, which is used for the purposes of this measure as a proxy for thermal efficiency, is 0.75. See for example, 10 CFR 430 Subpart B Appendix C1, 5.6.1.1.

¹³ No source specified – update pending availability and review of applicable references.

Example Calculation *(Not to be used as default)*

An electric storage water heater in an existing residential building has its temperature turned down from 140°F to 120°F. Annual Electric Energy Savings and Summer Peak Coincident Demand Savings are calculated as below.

$$\Delta kWh = \times ElecSF$$

$$\Delta kW = \times CF$$

UA = 7.85, from Summary of Variables and Data Sources table

Eff = 0.98, from Summary of Variables and Data Sources table

$\Delta T = 140 - 120 = 20^\circ\text{F}$

ElecSF = 1, from Summary of Variables and Data Sources table

$$\Delta kWh = \times 1 = 411.30 kWh$$

$$\Delta kW = \times 0.8 = 0.03 kW$$

Effective Useful Life (EUL)

See [Appendix P](#).

Ancillary Fossil Fuel Savings Impacts

Ancillary fossil fuel savings impacts, if appropriate, will be researched and incorporated into this measure algorithm in future revisions to the TRM.

Ancillary Electric Savings Impacts

Ancillary electric savings impacts, if appropriate, will be researched and incorporated into this measure algorithm in future revisions to the TRM.

References

1. 10 CFR 430 Appendix E to Subpart B of Part 430 [Uniform](#) Test Method for Measuring the Energy Consumption of Water Heaters, Section 2. Test Conditions, 2.5 Set Point Temperature
Available from: https://www.ecfr.gov/cgi-bin/text-idx?SID=80dfa785ea350ebee184bb0ae03e7f0&mc=true&node=ap10.3.430_127.e&rgn=div9
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

3. 10 CFR 431.110 Energy conservation standards and their effective dates.
Available from: https://www.ecfr.gov/cgi-bin/text-idx?SID=a69096e892b13c204bbe6da3a92f8111&mc=true&node=se10.3.431_1110&rgn=div8
4. 10 CFR 430 Appendix E to Subpart B of Part 430 Uniform Test Method for Measuring the Energy Consumption of Water Heaters, Section 2. Test Conditions, 2.5 Set Point Temperature.
Available from: https://www.ecfr.gov/cgi-bin/text-idx?SID=80dfa785ea350ebee184bb0ae03e7f0&mc=true&node=ap10.3.430_127.e&rgn=div9
5. 10 CFR 430 Subpart B – Test Procedures, Appendix E – Uniform Test Method for Measuring the Energy Consumption of Water Heaters
Available from: https://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=9624a8ba0987aaae248454c49194a661&mc=true&n=pt10.3.430&r=PART&ty=HTML#ap10.3.430_127.e

Record of Revision

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12-21-5	1/28/2022
6-22-4	9/2/2022

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LIGHTING

CONNECTED LIGHTING

Measure Description

This measure covers the use of connected lighting control systems on lighting in residential interior and exterior spaces. Connected lighting control systems are LED-based lighting systems with integrated sensors and controllers that are networked (either wired or wireless), enabling lighting products within the system to communicate and exchange data with other devices. These systems save energy and peak demand by reducing lighting operating hours and dimming lamps.

Method for Calculating Annual Energy and Summer Peak Coincident Demand Savings

Annual Electric Energy Savings

$$\Delta kWh = \left(\frac{W_{ctrl}}{1,000} \right) \times hrs \times ESF \times (1 + HVAC_c)$$

Summer Peak Coincident Demand Savings

$$\Delta kW = \left(\frac{W_{ctrl}}{1,000} \right) \times ESF \times (1 + HVAC_d) \times CF$$

Annual Fuel Energy Savings

$$\Delta MMBtu = \left(\frac{W_{ctrl}}{1,000} \right) \times hrs \times ESF \times HVAC_{ff}$$

where:

ΔkWh	= Annual electricity energy savings
ΔkW	= Peak coincident demand electric savings
$\Delta MMBtu$	= Annual fuel energy savings
W_{ctrl}	= Total wattage of controlled lighting (Watts)
hrs	= Lighting operating hours
$HVAC_c$	= HVAC interaction factor for annual electric energy consumption
$HVAC_d$	= HVAC interaction factor at utility summer peak hour
$HVAC_{ff}$	= HVAC interaction factor for annual fossil fuel consumption
ESF	= Energy savings factor
CF	= Coincidence factor
1,000	= Conversion factor, one kW equals 1,000 Watts

Summary of Variables and Data Sources

Variable	Value	Notes
W_{ctrl}		From application.

Variable	Value	Notes
hrs		From application. If unknown, see Operating Hours section below.
HVAC _c		HVAC interaction factor for annual electric energy consumption (dimensionless). Vintage and HVAC type weighted average by city. If unknown, assume Single Family Home building type, new vintage, and AC with Fuel heat HVAC type. See Appendix D . For lighting in unconditioned space, use a value of 0.
HVAC _d		HVAC interaction factor for peak demand at utility summer peak hour (dimensionless). Vintage and HVAC type weighted average by city. If unknown, assume Single Family Home building type, new vintage, and AC with Fuel heat HVAC type. See Appendix D .
HVAC _{ff}		HVAC interaction factor for annual fossil fuel energy consumption (MMBtu/kWh). Vintage and HVAC type weighted average by city. If unknown, assume Single Family Home building type, new vintage, and AC with Fuel heat HVAC type. See Appendix D .
ESF	0.29	Energy Savings Forecast of Solid State Lighting in General Illumination Applications. ¹⁴
CF	0.13	

Coincidence Factor (CF)

The prescribed value for the coincidence factor is 0.13¹⁵.

Baseline Efficiencies from which Energy Savings are Calculated

The baseline condition for this measure is LED lighting without a connected lighting system.

Compliance Efficiency from which Incentives are Calculated

The compliance condition is LED lighting with a connected lighting system that allows for remote user control of lighting, lighting brightness, and lighting schedules.¹⁶

Operating Hours

Look up operating hours from the table below, based on lamp location and city. See details below for derivation of operating hours. “Interior” designation extends to any covered area not adequately

¹⁴ Navigant Consulting, U.S. DOE, Energy Savings Forecast of Solid State Lighting in General Illumination Applications, December 2019, Page 112, Table F.4.

¹⁵ NMR Group Inc., Northeast Residential Lighting Hour-of Use Study, May 5, 2014, Page XVII, Table ES-7

¹⁶ Navigant Consulting. Department of Energy Solid-State Lighting Program. Energy Savings Forecast of Solid-State Lighting in General Illumination Applications. December 2019, Page 105 Table F.3.

lit during daylight hours by sunlight, thus requiring daytime operation of lighting. “Unknown” is not a valid selection for direct install programs.

City	Interior	Exterior	Unknown
Albany	986	2,081	1,022
Binghamton	986	2,081	1,022
Buffalo	986	2,081	1,022
Massena	986	2,081	1,022
NYC	1,752	2,117	1,752
Poughkeepsie	986	2,081	1,022
Syracuse	986	2,081	1,022

NYS cities other than NYC, Interior

Hours of operation for interior lighting is estimated to be 2.7 operating hours per day or 986 (2.7 x 365) hours per year. This value is derived from on-site lighting inventories of homes in New York, exclusive of New York City and Westchester County, and refined through a hierarchical model that drew upon loggers installed in Connecticut, Massachusetts, and Rhode Island.³

NYS cities other than NYC, Unknown

Hours of operation for lighting installed in an unknown location is estimated to be 2.8 operating hours per day or 1,022 (2.8 x 365) hours per year. This value is a weighted average of interior and exterior lighting hours derived from on-site lighting inventories of homes in New York, exclusive of New York City and Westchester County, and refined through a hierarchical model that drew upon loggers installed in Connecticut, Massachusetts, and Rhode Island.³

NYC, Interior

Hours of operation for exterior lighting is estimated to be 4.8 operating hours per day or 1,752 (4.8 x 365) hours per year. This value is derived from on-site lighting inventories of homes in New York City and Westchester County.³

NYC, Unknown

Hours of operation for lighting installed in an unknown location is estimated to be 4.8 operating hours per day or 1,752 (4.8 x 365) hours per year. This value is a weighted average of interior and exterior lighting hours derived from on-site lighting inventories of homes in New York City and Westchester County.¹⁷

Effective Useful Life (EUL)

See [Appendix P](#).

Ancillary Fossil Fuel Savings Impacts

Reduction in lighting power increases space heating requirements in conditioned spaces. Interactive HVAC impacts are addressed in prescribed energy savings calculation methodology.

¹⁷ NMR Group Inc., “Northeast Residential Lighting Hours-of-Use Study”, May 5, 2014, Page 22, Table 2-10.

Ancillary Electric Savings Impacts

Reduction in lighting power decreases cooling requirements in conditioned spaces. Interactive HVAC impacts are addressed in prescribed energy savings calculation methodology.

References

1. Navigant Consulting. Department of Energy Solid-State Lighting Program. Energy Savings Forecast of Solid-State Lighting in General Illumination Applications. December 2019
Available from: https://www.energy.gov/sites/default/files/2020/02/f72/2019_ssl-energy-savings-forecast.pdf
2. NMR Group Inc., “Northeast Residential Lighting Hours-of-Use Study”, May 5, 2014,
Available from: <https://neep.org/sites/default/files/resources/Northeast-Residential-Lighting-Hours-of-Use-Study-Final-Report1.pdf>

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6-22-6	9/2/2022

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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
Appliance	Air Purifier	Residential	9	ENERGY STAR® Calc ¹⁸
	Clothes Dryer	Residential	14	ENERGY STAR® M&I Scoping Report ¹⁹
	Clothes Washer	Residential	11	DEER 2014 EUL ID: Appl-EffCW
	Dehumidifier	Residential	12	ENERGY STAR® Calc ²⁰
	Dishwasher	Residential	11	DEER 2014 EUL ID: Appl-EffDW
	Fireplace	Residential	15	DOE ²¹
	Induction Cooktop	Residential	16	DEER 2014 EUL ID: Appl-Elec Cooking
	Refrigerator and Freezer	Residential	14	DEER 2014 EUL ID: Appl-ESRefg
	Soundbar	Residential	7	RPP Product Analysis ²²
Appliance Control	Advanced Power Strip (APS)	Residential	8	DEER 2014 EUL ID: Plug-OccSens
Appliance Recycling	Air Conditioner - Room (RAC) Recycling	Residential	3	DEER 2014 EUL ID: HV-RAC-RUL
	Dehumidifier Recycling	Residential	3	Assumes same RUL as RAC
	Refrigerator Recycling	Residential	5	DEER 2014 EUL ID: Appl-RecRef

¹⁸ 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>

¹⁹ ENERGY STAR® Market & Industry Scoping Report: Residential Clothes Dryer, November 2011.

²⁰ ENERGY STAR® Dehumidifier Calculator

https://www.energystar.gov/ia/partners/promotions/cool_change/downloads/CalculatorConsumerDehumidifier.xls

²¹ Technical Support Document: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products. Chapters 7 and 8. Department of Energy (DOE). January 30, 2015, pg 2-12

<https://www.regulations.gov/document?D=EERE-2014-BT-STD-0036-0002>

²² Retail Products Platform Product Analysis, Last Updated May 25, 2016.

Available from: <https://drive.google.com/file/d/0B9Fd3ckbKJp5OEpWSHg1eksyZ1U/view>

Appendix P: Effective Useful Life (EUL)

Category	Single and Multi-family Residential Measures	Sector	EUL (years)	Source
Appliance Recycling	Freezer Recycling	Residential	4	DEER 2014 EUL ID: Appl-RecFrzr
Building Shell	Air Conditioner – Room (RAC) Cover and Gap Sealer	Residential	3	See note below ²³
	Air Leakage Sealing	Residential	15	GDS ²⁴
	Insulation – Hot Water and Steam Pipe	Residential	15	GDS ²⁵
	Insulation – Opaque Shell	Residential	25	GDS ²⁶
	Storm Window	Residential	20	DOE ²⁷
	Window	Residential	20	DEER 2014 EUL ID: BS-Win
	Window - Film	Residential	10	DEER 2014 EUL ID: GlazDaylt-WinFilm
Domestic Hot Water (DHW)	Heat Pump Water Heater (HPWH)	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	15	PA Consulting Group ²⁸
	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
DHW - Control	Low-Flow – Faucet Aerator	Residential	10	DEER 2014 EUL ID: WtrHt-WH-Aertr
	Low-Flow – Showerhead	Residential	10	DEER 2014 EUL ID: WtrHt-WH-Shrhd
	Thermostatic Shower Restriction Valve	Residential	10	UPC ²⁹

²³ Average/typical manufacturer warranty period for AC covers

²⁴ GDS Associates, Inc., Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007, Table 1 – Residential Measures

²⁵ Ibid.

²⁶ Ibid.

²⁷ https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-22864rev2.pdf

²⁸ PA Consulting Group Inc., Focus on Energy Evaluation Business Programs: Measure Life Study, final report dated August 25, 2009. Available from:

https://focusonenergy.com/sites/default/files/bpmeasurelifestudyfinal_evaluationreport.pdf

²⁹ 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.

Appendix P: Effective Useful Life (EUL)

Category	Single and Multi-family Residential Measures	Sector	EUL (years)	Source
Heating, Ventilation and Air Conditioning (HVAC)	Air Conditioner – Central (CAC)	Residential	15	DEER 2014 EUL ID: HV-ResAC
	Air Conditioner – Room (RAC)	Residential	12	GDS ³⁰
	Air Conditioner – PTAC	Residential	15	DEER 2014 EUL ID: HVAC-PTAC
	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
	Boiler, Steam – Cast Iron	Residential	30	ASHRAE Handbook, 2015
	Boiler and Furnace - Combination (“Combi”) Boiler	Residential	22	DOE ³¹
	Boiler and Furnace - Combination (“Combi”) Furnace	Residential	20	DEER 2014 ³² EUL ID: HVAC-Frnc
	Duct Sealing and Insulation	Residential	18	DEER 2014 EUL ID: HV-DuctSeal
	Electronically Commutated (EC) Motor – HVAC Blower Fan	Residential	15	DEER 2014 EUL ID: Motors-fan
	Electronically Commutated (EC) Motor – Hydronic Circulator Pump	Residential	15	DEER 2014 EUL ID: Motors-pump

³⁰ GDS Associates, Inc., Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007, Table 1 – Residential Measures

³¹ Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Residential Furnaces, February 10, 2015, Table 8.2.17. Product definition of furnaces includes electric boilers with firing rates of less than 300,000 BTU/h

Available from: https://energy.mo.gov/sites/energy/files/technical-support-document---residential-furances_doe.pdf

³² Based on DEER value for high efficiency boiler and instantaneous water heater

Appendix P: Effective Useful Life (EUL)

Category	Single and Multi-family Residential Measures	Sector	EUL (years)	Source
Heating, Ventilation and Air Conditioning (HVAC)	Energy and Heat Recovery Ventilator	Residential	14	PA Consulting Group ³³
	Furnace, Gas Fired	Residential	22	DOE ^{34,35}
	Gas Heat Pump	Residential	15	DEER 2014 EUL ID: HV-Res HP
	Heat Pump - Air Source (ASHP)	Residential	15	DEER 2014 EUL ID: HV-Res HP
	Heat Pump – Ground Source (GSHP)	Residential	25	ASHRAE ³⁶
	Heat Pump – PTHP	Residential	15	DEER 2014 EUL ID: HVAC-PTHP
	Refrigerant Charge Correction & Tune-Up – Air Conditioner and Heat Pump	Residential	10	DEER 2014 EUL ID: HV-RefChrg
	Tune-Up - Boiler	Residential	5	DEER 2014 EUL ID: BlrTuneup
	Tune-Up - Furnace	Residential	5	DEER 2014 EUL ID: BlrTuneup
	Unit Heater, Gas Fired	Residential	13	ASHRAE Handbook, 2015
HVAC - Control	Adaptive Photonic Control	Residential	EUL = Retrofitted motor RUL = Retrofitted motor EUL – (Current Year – Mfr. Year) Default = 5	DEER 2014 EUL ID: Motors-fan
	Outdoor Temperature Setback Control for Hydronic Boiler	Residential	EUL = Boiler RUL = Boiler EUL – (Current Year – Mfr. Year) Default = 5	N/A

³³ PA Consulting Group Inc., Focus on Energy Evaluation Business Programs: Measure Life Study, final report dated August 25, 2009. Available from:

https://focusonenergy.com/sites/default/files/bpmeasurelifestudyfinal_evaluationreport.pdf

³⁴ 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>

³⁵ 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>

³⁶ ASHRAE: Owning and Operating Cost Database, Equipment Life/Maintenance Cost Survey: https://xp20.ashrae.org/publicdatabase/system_service_life.asp?selected_system_type=1

Appendix P: Effective Useful Life (EUL)

Category	Single and Multi-family Residential Measures	Sector	EUL (years)	Source
HVAC - Control	Steam Trap – Low Pressure Space Heating	Residential	6	DEER 2014 EUL ID: HVAC- StmTrp
	Submetering	Multifamily	10	NYSERDA ³⁷
	Thermostat – All Types	Residential	11	DEER 2014 EUL ID: HVAC- ProgTStats
	Thermostatic Radiator Valve – One Pipe Steam Radiator	Multifamily	15	DOE ³⁸
	Smart Thermostatic Radiator Enclosure	Residential	15	DEER 2014 EUL ID: Motors- fan ³⁹
Lighting⁴⁰	LED Lamp	Residential	Rated Life listed by ENERGY STAR [®] or default to 15,000 hrs/ annual lighting operating hrs or 15 yrs if rated lifetime or annual operating hours are not known	ENERGY STAR [®] Lamps ⁴¹
	Light Fixture	Residential LED (Interior)	50,000 hours	DLC ⁴²
			Residential	Rated Life listed by ENERGY STAR or default to 25,000 hrs/ annual lighting operating hrs or 15 yrs if rated lifetime or annual operating hours are not known

³⁷ NYSERDA Residential Electric Submetering Manual

³⁸ U.S. DOE, “Thermostatic Radiator Valve Evaluation”, January 2015, Table 4. pg. 16

³⁹ Based on assumed EUL of integrated fan, which is expected to be the first component to fail

⁴⁰ In response to codification of a 45 lm/W backstop requirement for general service lamps (GSLs), EULs for select lighting measures are currently under review by the TRM Management Committee. Revisions will take effect concurrent with other action taken in response to the imposed GSL standard in the V10 NY TRM filing.

https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=4

⁴¹ ENERGY STAR[®] Program Requirements Product Specification for Lamps (Light Bulbs) V2.1, June 2017, p. 19 (Capped at 20 years).

<https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Lamps%20V2.1%20Final%20Specification.pdf>

⁴² Placed on the Qualified Products List by the Design Light Consortium (DLC) 50,000 hours, according to the appropriate Application Category as specified in the DLC’s Product Qualification Criteria, Technical Requirement Table version 4.4 or higher

Appendix P: Effective Useful Life (EUL)

Category	Single and Multi-family Residential Measures		Sector	EUL (years)	Source
Lighting ⁴³	Light Fixture	LED (Exterior)	Residential	Rated Life listed by ENERGY STAR or default to 35,000 hrs/ annual lighting operating hrs or 15 yrs if rated lifetime or annual operating hours are not known	ENERGY STAR® Fixtures ⁴⁴
		LED (Inseparable)	Residential	Rated Life listed by ENERGY STAR or default to 50,000 hrs/ annual lighting operating hrs or 15 yrs if rated lifetime or annual operating hours are not known	ENERGY STAR® Fixtures
Lighting Control	Bi-Level Lighting		Multifamily Common Area	15	ComEd ⁴⁵
	Connected Lighting		Residential	3	GE and Philips Hue Bridge ⁴⁶

⁴³ In response to codification of a 45 lm/W backstop requirement for general service lamps (GSLs), EULs for select lighting measures are currently under review by the TRM Management Committee. Revisions will take effect concurrent with other action taken in response to the imposed GSL standard in the V10 NY TRM filing.

https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=4

⁴⁴ ENERGY STAR® Program Requirements Product Specification for Luminaires (Light Fixtures) V2.2, August 2019, p. 18 (Capped at 20 years).

<https://www.energystar.gov/sites/default/files/Luminaires%20V2.2%20Final%20Specification.pdf>

⁴⁵ ComEd Luminaire Level Lighting Control IPA Program Impact Evaluation Report prepared by Navigant Available from:

http://ilsagfiles.org/SAG_files/Evaluation_Documents/ComEd/ComEd_EPY9_Evaluation_Reports_Final/ComEd_P_Y9_LLLC_IPA_Program_Impact_Evaluation_Report_2018-06-05_Final.pdf

⁴⁶ Cync by General Electric Limited Warranty for Smart Bulbs and Light Strips <https://www.gelighting.com/smart-home/warranty> and Philips End of Support Policy : [End of Support Policy | Philips Hue \(philips-hue.com\)](https://www.philips-hue.com/support/end-of-support)

Appendix P: Effective Useful Life (EUL)

Category	Single and Multi-family Residential Measures	Sector	EUL (years)	Source
Motors and Drives	Pool Pump	Residential	10	DEER 2014 EUL ID: OutD-PoolPump
	Pool Circulator Timer	Residential	10	DEER 2014 EUL ID: OutD-PoolPump
Other	Heat Pump Pool Heater	Residential	15	DEER 2014 EUL ID: HV-Res HP
	Pool Heater	Residential	8	DOE ⁴⁷
	Solar Pool Heater	Residential	15	DOE ⁴⁸

⁴⁷ DOE, Chapter 8, Life-Cycle Cost and Payback Period Analyses, Table 8.75 Available from: <https://www.regulations.gov/document?D=EERE-2006-STD-0129-0170>

⁴⁸ <https://www.energy.gov/energysaver/solar-swimming-pool-heaters>

COMMERCIAL AND INDUSTRIAL MEASURES

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
Agricultural Equipment	High Speed Fans	C&I	10	PG&E ⁴⁹
	Livestock Waterer	C&I	10	PA Consulting Group ⁵⁰
	Milk Pre-Cooler Heat Exchanger	C&I	15	Ibid
	Refrigeration Heat Recovery	C&I	14	DEER 2014 EUL ID: HVAC-ChlrComp-Ag
	Scroll Compressor	C&I	12	DEER 2014 EUL ID: RefgWrhs-ScrollComp
Agricultural Equipment - Control	Engine Block Heater Timer	C&I	8	See note below ⁵¹
	Variable Speed Drive Milk Pump Plate Cooler	C&I	15	PA Consulting Group ⁵²
	Variable Speed Drive Vacuum Pump	C&I	15	PA Consulting Group ⁵³
Appliance	Clothes Dryer	C&I	14	ENERGY STAR [®] M&I Report ⁵⁴
	Clothes Washer	C&I	11	DEER 2014 EUL ID: Appl-EffCW
	Cooking Equipment ⁵⁵	C&I	12	DEER 2014 EUL IDs: Various
	Dishwasher	C&I	10 – Under Counter 15 – Single Door 20 – Conveyor Type 10 – Pots, Pans & Utensils	ENERGY STAR [®] Calc ⁵⁶
	Fireplace	C&I	15	DOE ⁵⁷
	Ice Maker	C&I	10	DEER 2014 EUL ID: Cook-IceMach
	Refrigerator and Freezer	C&I	12	DEER 2014 EUL ID: Cook-SDRef

⁴⁹ PG&E Work Paper PGE3PAGR117, October 12, 2017

⁵⁰ PA Consulting Group Inc., Focus on Energy Evaluation Business Programs: Measure Life Study, final report dated August 25, 2009. Available from:

https://focusonenergy.com/sites/default/files/bpmeasurelifestudyfinal_evaluationreport.pdf

⁵¹ Based on EUL’s for Advanced Power Strips

⁵² PA Consulting Group Inc., Focus on Energy Evaluation Business Programs: Measure Life Study, final report dated August 25, 2009. Available from:

https://focusonenergy.com/sites/default/files/bpmeasurelifestudyfinal_evaluationreport.pdf

⁵³ PA Consulting Group Inc., Focus on Energy Evaluation Business Programs: Measure Life Study, final report dated August 25, 2009. Available from:

https://focusonenergy.com/sites/default/files/bpmeasurelifestudyfinal_evaluationreport.pdf

⁵⁴ ENERGY STAR[®] Market & Industry Scoping Report: Residential Clothes Dryer, November 2011.

⁵⁵ Applicable to all kitchen cooking equipment not otherwise listed

⁵⁶ ENERGY STAR[®] Savings Calculator for ENERGY STAR[®] Certified Commercial Kitchen Equipment
www.energystar.gov/buildings/sites/default/uploads/files/commercial_kitchen_equipment_calculator.xlsx?5da4-3d90&5da4-3d90

⁵⁷ Technical Support Document: Energy Conservation Program for Consumer Products: Energy Conservation Standards for Hearth Products. Chapters 7 and 8. Department of Energy (DOE). January 30, 2015, pg 2-12

<https://www.regulations.gov/document?D=EERE-2014-BT-STD-0036-0002>

Single and Multi-Family Residential Measures

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
Appliance - Control	Advanced Power Strip (APS)	C&I	8	DEER 2014 EUL ID: Plug-OccSens
	Vending Machine and Novelty Cooler Control	C&I	5	DEER 2014 EUL ID: Plug-VendCtrlr
Appliance Recycling	Air Conditioner – Room (RAC)	C&I	9	DEER 2014 EUL ID: HV-RAC-ES
Building Shell	Air Leakage Sealing	C&I	15	GDS ⁵⁸
	Cool Roof	C&I	15	DEER 2014 EUL ID: BldgEnv-CoolRoof
	Insulation - Hot Water and Steam Pipe	C&I	15	GDS ⁵⁹
	Insulation - Opaque Shell	C&I	30	ET & CEC ⁶⁰
	Window - Film	C&I	10	DEER 2014 EUL ID: GlazDaylt-WinFilm
	Window - Glazing	C&I	20	DEER 2014 EUL ID: BS-Win
	Air Curtains	C&I	15	DEER 2014 EUL ID: Motors-fan
Compressed Air	Air Compressor	C&I	13	Other State TRMs ⁶¹
	Engineered Air Nozzle	C&I	15	Wisconsin PSC ⁶²
	No Air Loss Water Drain	C&I	13	MA Measure Life Study ⁶³
	Refrigerated Air Dryer	C&I	13	Other State TRMs ⁶⁴
	Compressed Air Heat Recovery	C&I	13	Other State TRMs ⁶⁵
	Flow Controller	C&I	13	Other State TRMs ⁶⁶
	Low Pressure Drop Filter	C&I	5	Navigant EUL Report ⁶⁷

⁵⁸ GDS Associates, Inc., Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007, Table 1 – Residential Measures

⁵⁹ GDS Associates, Inc., Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007, Table 1 – Residential Measures

⁶⁰ Energy Trust uses 30 years for commercial applications. CEC uses 30 years for insulation in Title 24 analysis.

⁶¹ Based on a review of TRM assumptions from [Ohio \(August 2010\)](#), [Massachusetts \(October 2015\)](#), [Illinois \(February 2017\)](#) and [Vermont \(December 2018\)](#). Estimates range from 10 to 15 years. Cited TRMs are reviewed annually for updates and potential to replace TRM citations with primary reference material.

⁶² PA Consulting Group (2009). *Business Programs: Measure Life Study*. Prepared for State of Wisconsin Public Service Commission

⁶³ Measure Life Study prepared for The Massachusetts Joint Utilities, Energy & Resource Solutions, 2005 http://www.ers-inc.com/wp-content/uploads/2018/04/Measure-Life-Study_MA-Joint-Utilities_ERS.pdf

⁶⁴ Based on a review of TRM assumptions from [Ohio \(August 2010\)](#), [Massachusetts \(October 2015\)](#), [Illinois \(February 2017\)](#) and [Vermont \(December 2018\)](#). Estimates range from 10 to 15 years. Cited TRMs are reviewed annually for updates and potential to replace TRM citations with primary reference material.

⁶⁵ Ibid.

⁶⁶ Ibid.

⁶⁷ Navigant ComEd Effective Useful Life Research Report. <https://www.icc.illinois.gov/docket/P2017-0312/documents/287811/files/501915.pdf>

Single and Multi-Family Residential Measures

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
Domestic Hot Water (DHW)	Heat Pump Water Heater (HPWH)	C&I	10	DEER EUL ID: WtrHt-HtPmp
	Indirect Water Heater	C&I	15	DEER 2014 EUL ID: WtrHt-Com
	Instantaneous Water Heater	C&I	20	DEER 2014 EUL ID: WtrHt-Instant-Com
	Storage Tank Water Heater	C&I	15	DEER 2014 EUL ID: WtrHt-Com
DHW - Control	DHW Temperature Turndown	C&I	RUL of DHW System Default = 5	N/A
	Drain Water Heat Recovery (DWHR)	C&I	30	2019 Title 24 ⁶⁸
	Low-Flow – Faucet Aerator	C&I	10	DEER 2014 EUL ID: WtrHt-WH-Aertr
	Low-Flow – Pre-Rinse Spray Valve (PRSV)	C&I	5	GDS
	Low-Flow – Salon Valve	C&I	10	DEER 2014 EUL ID: WtrHt-WH-Shrhd
	Low-Flow – Showerhead	C&I	10	DEER 2014 EUL ID: WtrHt-WH-Shrhd
	Central DHW Control	C&I	15	NREL ⁶⁹
Heating, Ventilation and Air Conditioning (HVAC)	Air Conditioner – PTAC	C&I	15	DEER 2014 EUL ID: HVAC-PTAC
	Air Conditioner – Unitary	C&I	15	DEER 2014 EUL ID: HVAC-airAC
	Boiler and Furnace - Combination (“Combi”) Boiler	C&I	22	DOE ⁷⁰
	Boiler and Furnace - Combination (“Combi”) Furnace	C&I	20	DEER 2014 ⁷¹ EUL ID: HVAC-Frnc
	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

⁶⁸ 2019 Title 24, Part 6 CASE Report. “Drain Water Heat Recovery – Final Report.” Available from: http://title24stakeholders.com/wp-content/uploads/2017/09/2019-T24-CASE-Report_DWHR_Final_September-2017.pdf

⁶⁹ <https://www.nrel.gov/docs/fy16osti/64541.pdf>

⁷⁰ Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Residential Furnaces, February 10, 2015, Table 8.2.17

Available from: https://energy.mo.gov/sites/energy/files/technical-support-document---residential-furances_doe.pdf

⁷¹ Based on DEER value for high efficiency boiler and instantaneous water heater

Single and Multi-Family Residential Measures

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
Heating, Ventilation and Air Conditioning (HVAC)	Chiller – Air & Water Cooled	C&I	20	DEER 2014 EUL ID: HVAC-Chlr
	Chiller – Cooling Tower	C&I	15	DEER 2014 EUL ID: HVAC-CITwrPkgSys
	Condensing Unit Heater	C&I	18	Ecotope ⁷²
	Duct Sealing and Insulation	C&I	18	DEER 2014 EUL ID: HVAC-DuctSeal
	Electronically Commutated (EC) Motor - HVAC Blower Fan	C&I	15	DEER 2014 EUL ID: Motors-Fan
	Electronically Commutated (EC) Motor – Hydronic Circulator Pump	C&I	15	DEER 2014 EUL ID: Motors-pump
	Economizer –Dual Enthalpy Air Side	C&I	10	DEER 2014 EUL ID: HVAC-addEcono
	Furnace, Gas Fired	C&I	23	DOE ^{73,74}
	Gas Heat Pump	C&I	15	DEER 2014 EUL ID: HV-Res HP
	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
	Heat Pump – Water Source (WSHP)	C&I	25	ASHRAE ⁷⁵
	High Volume Low Speed Fan	C&I	15	PA Consulting Group ⁷⁶
	Infrared Heater	C&I	17	GDS ⁷⁷
	Refrigerant Charge Correction & Tune Up – Air Conditioner and Heat Pump	C&I	10	DEER 2014 EUL ID: HVAC-RefChg
	Tune-Up – Boiler	C&I	5	DEER 2014 EUL ID: BlrTuneup
Tune-Up – Chiller System	C&I	5	WI EUL DB ⁷⁸	

⁷² Ecotope Natural Gas Efficiency and Conservation Measure Resource Assessment (2003)

⁷³ 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>

⁷⁴ 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>

⁷⁵ ASHRAE Owning and Operating Cost Database

Available from: https://xp20.ashrae.org/publicdatabase/system_service_life.asp?selected_system_type=1

⁷⁶ PA Consulting Group Inc., Focus on Energy Evaluation Business Programs: Measure Life Study, final report dated August 25, 2009. Available from:

https://focusonenergy.com/sites/default/files/bpmeasurelifestudyfinal_evaluationreport.pdf

⁷⁷ GDS Associates, Inc. “Natural Gas Efficiency Potential Study.” DTE Energy. July 29, 2016. Available from: https://www.michigan.gov/documents/mpsc/DTE_2016_NG_ee_potential_study_w_appendices_vFINAL_554360_7.pdf

⁷⁸ Wisconsin Public Service Commission: Equipment Useful Life Database, 2013

Excerpt available from: https://focusonenergy.com/sites/default/files/bpmeasurelifestudyfinal_evaluationreport.pdf

Single and Multi-Family Residential Measures

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
Heating, Ventilation and Air Conditioning (HVAC)	Tune-Up – Furnace	C&I	5	DEER 2014 EUL ID: BlrTuneup
	Variable Refrigerant Flow (VRF) System	C&I	15	DEER 2014 EUL ID: HVAC-VSD-pump
	Unit Heater, Gas Fired	C&I	13	ASHRAE Handbook, 2015
HVAC – Control	Adaptive Photonic Control	C&I	EUL = Retrofitted motor RUL = Retrofitted motor EUL – (Current Year – Mfr. Year) Default = 5	DEER 2014 EUL ID: Motors-fan
	Direct Digital Control (DDC) System	C&I	15	DEER 2014 EUL ID: HVAC-EMS
	Demand Control Ventilation (DCV)	C&I	15	DEER 2014 EUL ID: HVAC-VSD-DCV
	Energy Management System	C&I	15	DEER 2014 EUL ID: HVAC-EMS
	Energy Management System – Guest Room	C&I	15	DEER 2014 EUL ID: HVAC-EMS
	Boiler Economizer	C&I	EUL = Boiler RUL = Boiler EUL – (Current Year – Mfr. Year) Default = 5	GDS ⁷⁹
	Kitchen Demand Ventilation Control	C&I	15	PG&E ⁸⁰
	Outdoor Temperature Setback Control for Hydronic Boiler	C&I	EUL = Boiler RUL = Boiler EUL – (Current Year – Mfr. Year) Default = 5	N/A
	Steam Trap – Low-Pressure Space Heating	C&I	6	DEER 2014 EUL ID: HVAC-StmTrp
	Steam Trap Monitoring System – Low-Pressure Space Heating	C&I	15	DEER 2014 EUL ID: HVAC-EMS
	Thermostat – Programmable Thermostat – Wi-Fi (Communicating)	C&I	11	DEER 2014 EUL ID: HVAC-ProgTStats
	Thermostatic Radiator Valve	C&I	15	DOE ⁸¹
Advanced Rooftop Control	C&I	EUL = RUL of Existing RTU = RTU EUL – (Current Year – Year of Mfr.) Default = 5	N/A	

⁷⁹ Natural Gas Energy Efficiency Potential in Massachusetts, GDS Associates, 2009. Available from: http://ma-eeac.org/wordpress/wp-content/uploads/5_Natural-Gas-EE-Potential-in-MA.pdf

⁸⁰ PG&E Work Paper WPSDGENRCC0019, June 15, 2012

⁸¹ U.S. DOE. “Thermostatic Radiator Valve Evaluation.” January 2015. Available from: <https://www.nrel.gov/docs/fy15osti/63388.pdf>

Single and Multi-Family Residential Measures

Category	Commercial & Industrial Measures		Sector	EUL (years)	Source
Lighting⁸²	Light Fixture	LED Fixture (DLC)	C&I	50,000 hrs /annual lighting operating hrs or 15 yrs if annual operating hrs are not known	DLC ⁸³
	Light Fixture	LED Fixture (Interior)	C&I	Rated Life listed by ENERGY STAR or default to 25,000 hrs/annual lighting operating hrs or 15 yrs if rated lifetime or annual operating hrs are not known	ENERGY STAR ^{®84}
		LED Fixture (Exterior)	C&I	Rated Life listed by ENERGY STAR or default to 35,000 hrs/annual lighting operating hrs or 15 yrs if rated lifetime or annual operating hrs are not known	ENERGY STAR ^{®85}
		LED Fixture (Inseparable)	C&I	Rated Life listed by ENERGY STAR or default to 50,000/annual lighting operating hrs or 15 yrs if rated lifetime or annual operating hrs are not known	ENERGY STAR ^{®86}
		LED Fixture (Uncertified)	C&I	Rated Life listed by ENERGY STAR or default to 25,000 hrs /annual lighting operating hrs or 15 yrs if rated lifetime or annual operating hrs are not known	Uncertified

⁸² In response to codification of a 45 lm/W backstop requirement for general service lamps (GSLs), EULs for select lighting measures are currently under review by the TRM Management Committee. Revisions will take effect concurrent with other action taken in response to the imposed GSL standard in the V10 NY TRM filing.

⁸³ 50,000 hours per L₇₀ requirements prescribed by the DLC's Product Qualification Criteria, Technical Requirement Table version 4.4

⁸⁴ 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 2.1. Divided by estimated annual use, but capped at 20 years regardless (consistent with C&I redecoration and business type change patterns)

⁸⁵ Ibid.

⁸⁶ Ibid.

Single and Multi-Family Residential Measures

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
Lighting ⁸⁷	LED Lamp	C&I	50,000 hours	DLC ⁸⁸
			Rated Life listed by ENERGY STAR or default to 15,000 hrs /annual lighting operating hrs or 15 yrs if rated lifetime or annual operating hrs are not known	ENERGY STAR®
	LED Open Sign	C&I	16	DEER 2014 EUL ID: LED-sign
	Refrigerated Case LED	C&I	16	DEER 2014 EUL ID: GrocDisp-FixtLtg-LED
	Lighting Power Density (LPD)	C&I	15	GDS ⁸⁹
Lighting - Control	Bi-Level Lighting	C&I	15	ComEd ⁹⁰
	Integrated Interior Control	C&I	15	ComEd ⁹¹
	Non-Integrated Interior Control	C&I	10	GDS ⁹²
	Plug-Load Occupancy Sensor	C&I	8	DEER ⁹³
Motors and Drives	Motor (incl. PEI Pumps)	C&I	15	DEER 2014 EUL ID: Motors-HiEff
	Notched & Synchronous Belt	C&I	5	DEER 2014 EUL ID: HV-CoggedBelt
	Pool Pump	C&I	10	DEER 2014 EUL ID: OutD-PoolPump
	Variable Frequency Drive (VFD) – Fan and Pump	C&I	15	DEER 2014 EUL ID: HVAC-VSDSupFan
	Elevator Modernization	C&I	15	DEER 2014 ⁹⁴

⁸⁷ In response to codification of a 45 lm/W backstop requirement for general service lamps (GSLs), EULs for select lighting measures are currently under review by the TRM Management Committee. Revisions will take effect concurrent with other action taken in response to the imposed GSL standard in the V10 NY TRM filing.

https://www1.eere.energy.gov/buildings/appliance_standards/standards.aspx?productid=4

⁸⁸ Placed on the Qualified Products List by the Design Light Consortium (DLC) 50,000 hours, according to the appropriate Application Category as specified in the DLC's Product Qualification Criteria, Technical Requirement Table version 4.4 or higher

⁸⁹ Measure Life Report, Residential and Commercial/Industrial/Industrial Lighting and HVAC Measures, GDS Associates, June 2007. As directed in the Interior and Exterior Lighting measure, new construction projects may be evaluated based on LPD. This value is provided for use with new construction LPD projects only.

Available from: <https://energy.mo.gov/sites/energy/files/measure-life-report-2007.pdf>

⁹⁰ ComEd Luminaire Level Lighting Control IPA Program Impact Evaluation Report prepared by Navigant Available from:

http://ilsagfiles.org/SAG_files/Evaluation_Documents/ComEd/ComEd_EPY9_Evaluation_Reports_Final/ComEd_P Y9_LLLC_IPA_Program_Impact_Evaluation_Report_2018-06-05_Final.pdf

⁹¹ Ibid

⁹² Measure Life Report, Residential and Commercial/Industrial/Industrial Lighting and HVAC Measures, GDS Associates, June 2007.

Available from: <https://energy.mo.gov/sites/energy/files/measure-life-report-2007.pdf>

⁹³ DEER value for lighting occupancy sensors

⁹⁴ Assumes same EUL as VFD measure.

Single and Multi-Family Residential Measures

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
Other	Heat Pump Pool Heater	C&I	15	DEER 2014 EUL ID: HV-Res HP
	High Efficiency Transformer	C&I	32	DOE ⁹⁵
	High Frequency Battery Charger	C&I	15	PG&E ⁹⁶
	High Viscosity Industrial Lubricant	C&I	10	ExxonMobil ⁹⁷
	Pool Heater	C&I	8	DOE ⁹⁸
	Solar Pool Cover	C&I	5	CALMAC ⁹⁹
Process Equipment	Steam Trap – Other Applications	C&I	6	DEER 2014 EUL ID: HVAC-StmTrp
	Steam Trap Monitoring System – Other Applications	C&I	15	DEER 2014 EUL ID: HVAC-EMS
	Ozone Laundry	C&I	10	PG&E ¹⁰⁰
	Process Exhaust Filtration	C&I	15	CIBSE ¹⁰¹
Refrigeration	Air-Cooled Refrigeration Condenser	C&I	15	DEER 2014 EUL ID: GrocSys-Cndsr
	Automatic Door Closer for Walk-In Cooler/Freezer	C&I	8	DEER 2014 EUL ID: GrocWlkIn-DrClsr
	Cooler and Freezer Door Gasket	C&I	4	DEER 2014 EUL ID: GrocWlkIn-StripCrtn, GrocWlkIn-WDrGask
	Cooler and Freezer Door Strip	C&I	4	DEER 2014 EUL ID: GrocWlkIn-StripCrtn, GrocWlkIn-WDrGask
	EC Motor – Refrigerated Case or Walk-In Cooler/Freezer Evaporator Fan	C&I	15	DEER 2014 EUL ID: GrocDisp-FEvapFanMtr
	Equipment (Condenser, Compressor, and Sub-cooling)	C&I	15	DEER 2014 EUL ID: GrocSys-MechSubcl
	Evaporator Fan Motor – with Permanent Magnet Synchronous Motor (PMSM)	C&I	15	DEER 2014 EUL ID: GrocDisp-FEvapFanMtr
	Refrigerated Case Door	C&I	12	DEER 2014 EUL ID: GrocDisp-FixtDoors

⁹⁵ <https://www.federalregister.gov/documents/2019/06/18/2019-12761/energy-conservation-program-energy-conservation-standards-for-distribution-transformers>

⁹⁶ https://www.kannahconsulting.com/wp-content/uploads/2016/08/2010-10-11_Battery_Charger_Title_20_CASE_Report_v2-2-2.pdf, pg 43

⁹⁷ Information presented in the ExxonMobil study is confidential.

⁹⁸ DOE, Chapter 8, Life-Cycle Cost and Payback Period Analyses, Table 8.75 Available from: <https://www.regulations.gov/document?D=EERE-2006-STD-0129-0170>

⁹⁹ http://www.calmac.org/publications/PoolCoverReport_2015_Final_Report_Appendices.pdf

¹⁰⁰ PG&E Work Paper PGECOAPP123, August 22, 2017

¹⁰¹ Chartered Institution of Building Services Engineers. “Probabilistic Estimation of Service Life.” An industrial ventilation system consists of a fan and a set of filters; Fan and Filter EUL are 15 to 20 years depending on type. <http://www.cibse.org/knowledge/cibse-technical-symposium-2011/probabilistic-estimation-of-service-life>.

Single and Multi-Family Residential Measures

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
Refrigeration	Refrigerated Case Night Cover	C&I	5	DEER 2014 EUL ID: GrocDisp-DispCvrs
Refrigeration - Control	Anti-Condensation Heater Control	C&I	12	DEER 2014 EUL ID: GrocDisp-ASH
	Condenser Pressure and Temperature Control	C&I	15	DEER 2014 EUL ID: GrocSys-Cndsr
	Evaporator Fan Control	C&I	16	DEER 2014 EUL ID: Groc-WlkIn-WEvapFMtrCtrl
	Floating Head Pressure Control	C&I	10	PA Consulting Group ¹⁰²

Common References

- DEER 2014 EUL
Available from:
http://www.deeresources.com/files/DEER2013codeUpdate/download/DEER2014-EUL-table-update_2014-02-05.xlsx
- GDS Associates, Inc., Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007
Available from:
https://library.cce1.org/system/files/library/8842/CEE_Eval_MeasureLifeStudyLights%20526HVACGDS_1Jun2007.pdf

Record of Revision

Record of Revision Number	Issue Date
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
12-17-17	12/31/2017
3-18-21	3/31/2018
6-18-23	6/30/2018
9-18-21	9/30/2018
12-18-17	12/28/2018
3-19-16	3/29/2019

¹⁰² PA Consulting Group Inc. "State of Wisconsin Public Service Commission of Wisconsin Focus on Energy Evaluation Business Programs: Measure Life Study. Final Report." August 25, 2009.
https://focusonenergy.com/sites/default/files/bpmeasurelifestudyfinal_evaluationreport.pdf

Single and Multi-Family Residential Measures

Record of Revision Number	Issue Date
6-19-14	6/30/2019
9-19-10	9/30/2019
12-19-17	12/23/2019
3-20-17	3/30/2020
7-20-20	7/31/2020
12-20-12	12/31/2020
3-21-18	3/31/2021
7-21-21	8/30/2021
12-21-25	1/28/2022
6-22-13	9/2/2022

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APPLIANCES

INDUCTION COOKTOPS

Measure Description

This measure is applicable to the replacement of electric resistance and fossil fuel cooktops with electric induction cooktops in restaurant and cafeteria settings. Induction cooktops heat food faster, are easier to clean, are less likely to burn those using them, and have a higher cooking efficiency than electrical resistance stoves.¹⁰³ Conventional commercial cooktops typically employ fossil fuel or resistance heating elements to transfer energy with efficiencies of approximately 42% and 74% respectively. Commercial induction cooking tops instead consist of an electromagnetic coil that creates a magnetic field when supplied with an electric current. When brought into this field, compatible cookware is warmed internally, transferring energy with approximately 88% efficiency.¹⁰⁴ This measure is intended for and assumes one-for-one replacement/displacement of existing equipment or assumed baseline, consistent with the conventional assumption for prescriptive measures.

Method for Calculating Annual Energy and Summer Peak Coincident Demand Savings

Annual Electric Energy Savings

$$\Delta kWh = \text{units} \times \text{burners} \times \text{days} \times (kWh_{\text{baseline}} \times F_{\text{Elec,baseline}} - kWh_{\text{ee}})$$

Summer Peak Coincident Demand Savings

$$\Delta kW = \text{units} \times \text{burners} \times \frac{(kWh_{\text{baseline}} \times F_{\text{Elec,baseline}} - kWh_{\text{ee}})}{\text{hrs}} \times CF$$

Annual Fossil Fuel Energy Savings

$$\Delta MMBtu = \text{units} \times \text{burners} \times \text{days} \times MMBtu_{\text{baseline}} \times F_{\text{Fuel,baseline}}$$

where:

ΔkWh	= Annual electricity energy savings
ΔkW	= Peak coincident demand electric savings
$\Delta MMBtu$	= Annual fossil fuel energy savings
units	= Number of cooktops installed
burners	= Number of burners per cooktop
kWh_{baseline}	= Daily electrical energy consumption per burner of electric baseline cooktop
$F_{\text{Elec,baseline}}$	= Electric factor; used to account for the presence or absence of an electric cooktop in the baseline condition
kWh_{ee}	= Daily electrical energy consumption per burner of induction cooktop

¹⁰³ Sweeney, Micah, Jeff Dols, Brian Fortenbery, and Frank Sharp. Induction Cooking Technology Design and Assessment. 2014. ACEEE Summer Study on Energy Efficiency in Buildings.

¹⁰⁴ Food Service Technology Center, Vollrath HIRC/HIMC Induction Range Comparison Appliance Test Report, FSTC Report #501311088-R0, December 2013, Table 1

- days = Operating days per year
- hrs = Operating hours
- MMBtu_{baseline} = Daily energy consumption per burner of fossil fuel baseline cooktop
- F_{Fuel,baseline} = Fossil fuel factor; used to account for the presence or absence of a fossil fuel-fired cooktop in the baseline condition
- CF = Coincidence factor

Summary of Variables and Data Sources

Variable	Value	Notes
burners		From application.
kWh _{baseline}		From application. If unknown for electric stoves, use kWh _{baseline} = 19.3 kWh ¹⁰⁵
F _{Elec,baseline}		Use a value of 1.0 if the baseline cooktop is electric. Otherwise, use 0.0.
kWh _{ee}		From application. If unknown, use 14.2 kWh. ¹⁰⁶
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.
MMBtu _{baseline}		From application. If unknown, use 0.147 MMBtu. ¹⁰⁷
F _{Fuel,baseline}		Use a value of 1.0 is the baseline cooktop is fossil fuel. Otherwise, use 0.0.
CF	0.8	

Coincidence Factor (CF)

The prescribed value for the coincidence factor is 0.8.¹⁰⁸

Baseline Efficiencies from which Energy Savings are Calculated

The baseline condition is a standalone electric resistance or fossil fuel fired cooktop.

¹⁰⁵ Food Service Technology Center, Vollrath HIDC/HIMC Induction Range Comparison Appliance Test Report, FSTC Report #501311088-R0, December 2013, Table 8 and 9. Energy consumption values for all fuel types are computed by averaging the provided daily energy consumption values for the cook to order and buffet style restaurants and then dividing by an assumed 6 burners per range.

¹⁰⁶ Food Service Technology Center, Vollrath HIDC/HIMC Induction Range Comparison Appliance Test Report, FSTC Report #501311088-R0, December 2013, Table 8 and 9. Energy consumption values for all fuel types are computed by averaging the provided daily energy consumption values for the cook to order and buffet style restaurants and then dividing by an assumed 6 burners per range.

¹⁰⁷ Food Service Technology Center, Vollrath HIDC/HIMC Induction Range Comparison Appliance Test Report, FSTC Report #501311088-R0, December 2013, Table 8 and 9. Energy consumption values for all fuel types are computed by averaging the provided daily energy consumption values for the cook to order and buffet style restaurants and then dividing by an assumed 6 burners per range.

¹⁰⁸ No source specified – update pending availability and review of applicable references.

Compliance Efficiency from which Incentives are Calculated

The compliance condition is an induction cooktop with compatible cookware installed in restaurant and cafeteria settings in a facility of one of the types specified in the Operating Hours section below.

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.¹⁰⁹

Facility Type	Hours/Day	Days/Year
Community College	11	283
Fast Food	14	363
Full Service Restaurant	12	321
Hospital	20	365
Primary School	5	180
Secondary School	8	180
University	11	283

Example Calculation *(Not to be used as default)*

A full-service restaurant in Albany replaces a gas cooktop with a 6 burner induction range with an assumed daily consumption of 14.2 kWh per burner. The assumed consumption of the existing gas range is 0.147 MMBtu per burner. Annual Electric Energy Savings, Annual Fossil Fuel Energy Savings and Summer Peak Coincident Demand Savings are calculated as below.

$$\Delta kWh = units \times burners \times days \times (kWh_{baseline} \times F_{Elec,baseline} - kWh_{ee})$$

$$\Delta kW = units \times burners \times \frac{(kWh_{baseline} \times F_{Elec,baseline} - kWh_{ee})}{hrs} \times CF$$

$$\Delta MMBtu = units \times burners \times days \times MMBtu_{baseline} \times F_{Fuel,baseline}$$

units= 1, from application

burners = 6, from application

days = 321, from Operating Hours section

kWh_{baseline} = 0 (existing equipment is gas-fired)

kWh_{ee} = 14.2, from Summary of Variables and Data Sources table

MMBtu_{baseline} = 0.147, from Summary of Variables and Data Sources table

F_{Elec,baseline} = 0, from Summary of Variables and Data Sources table

F_{Fuel,baseline} = 1, from Summary of Variables and Data Sources table

¹⁰⁹ California Energy Commission, Characterizing the Energy Efficiency Potential of Gas-Fired Commercial Foodservice Equipment, Appendix E

hrs = 12, from Operating Hours section
CF = 0.80, from Summary of Variables and Data Sources table

$$\Delta kWh = 1 \times 6 \times 321 \times (0 \times 0 - 14.2) = -27,349 kWh$$

$$\Delta kW = 1 \times 6 \times \frac{(0 \times 0 - 14.2)}{12} \times 0.8 = -7.1 kW$$

$$\Delta MMBtu = 1 \times 6 \times 321 \times 0.147 \times 1 = 283.12 MMBtu$$

Effective Useful Life (EUL)

See [Appendix P](#).

Ancillary Fossil Fuel Savings Impacts

Induction cooktops expel less heat than standard cooktops. However, it is assumed a substantial portion of the baseline excess heat would be vented through the kitchen exhaust so interactive HVAC savings and impacts are assumed to be marginal and excluded from this measure.

Ancillary Electric Savings Impacts

Induction cooktops expel less heat than standard cooktops. However, it is assumed a substantial portion of the baseline excess heat would be vented through the kitchen exhaust fans so interactive HVAC savings and impacts are assumed to be marginal and excluded from this measure. Decreased ventilation fan run time and decreased cooktop hours of use are anticipated for this measure, however there is not sufficient available information to quantify this impact. Until additional information is available, these impacts are excluded from the prescribed formulation of savings.

References

1. Sweeney, Micah, Jeff Dols, Brian Fortenbery, and Frank Sharp. Induction Cooking Technology Design and Assessment. 2014. ACEEE Summer Study on Energy Efficiency in Buildings.
Available from: <https://www.aceee.org/files/proceedings/2014/data/papers/9-702.pdf>
2. Food Service Technology Center, Vollrath HIDC/HIMC Induction Range Comparison Appliance Test Report, FSTC Report #501311088-R0, December 2013
Available from: https://caenergywise.com/report-library/induction-appliances/Vollrath_HIDC-HIMC_Induction_Range_Comparison.pdf
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/CEC500-2014-095.pdf>

Record of Revision

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