Table of Revisions/Changes

Revision Number	Addition/ Revision	Issue Date	Effective Date	Measure	Description of Change	Location/Page in TRM
12-21-01	A	01/28/2022	01/28/2022	R/MF Induction Cooktops	New Measure Added	Pg. xx
12-21-05	A	01/28/2022	01/28/2022	R/MF DHW Aquastat Turndown	New Measure Added	Pg. xx
12-21-10	A	01/28/2022	01/28/2022	C/I Livestock Waterer	New Measure Added	Pg. xx
12-21-15	A	01/28/2022	01/28/2022	C/I DHW Aquastat Turndown	New Measure Added	Pg. xx
12-21-20	A	01/28/2022	01/28/2022	C/I LED Open Sign	New Measure Added	Pg. xx
12-21-21	A	01/28/2022	01/28/2022	C/I High Viscosity Index Industrial Lubricant - Gear Box	New Measure Added	Pg. xx
12-21-22	A	01/28/2022	01/28/2022	C/I High Viscosity Index Industrial Lubricant - Hydraulic System	New Measure Added	Pg. xx
12-21-25	R	01/28/2022	01/28/2022	Appendix P	Updated EUL entries for all measures contained in this Record of Revision	Pg. 1,271

Note: Revisions and additions to the measures listed above were undertaken by the Joint Utilities Technical Resource Manual (TRM) Management Committee between August 30, 2021 – January 28, 2022.

APPLIANCES

INDUCTION COOKTOPS

Measure Description

This measure is applicable to the replacement of electric resistance and fossil fuel cooktops with electric induction cooktops. 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.[1] Conventional residential cooktops typically employ fossil fuel or resistance heating elements to transfer energy with efficiencies of approximately 32% and 75-80% respectively. Residential 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 85% efficiency.[2]

Method for Calculating Annual Energy and Summer Peak Coincident Demand Savings

Annual Electric Energy Savings

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

Summer Peak Coincident Demand Savings

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

Annual Fossil Fuel Energy Savings

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

where:

ΔkWh	= Annual electricity energy savings
ΔkW	= Peak coincident demand electric savings
ΔMMBtu	= Annual fossil fuel energy savings
$kWh_{baseline}$	= Energy consumption by electric baseline cooktop
$F_{Elec,baseline}$	= Electric factor; used to account for the presence or absence of an electric cooktop in the baseline condition
kWh_{ee}	= Energy consumption by induction cooktop
hrs	= Annual operating hours
$MMBtu_{baseline}$	= Energy consumption by 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

[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.
[2] ENERGY STAR®, Emerging Technology, 2021-2022 Residential Induction Cooking Tops

Summary of Variables and Data Sources

Variable	Value	Notes
$kWh_{baseline}$		From application. If unknown, assume $kWh_{baseline}$ = 1.135 x kWh_{ee}.[3]
$F_{Elec,baseline}$		Use a value of 1.0 if the baseline cooktop is electric. Otherwise, use 0.0.
kWh_{ee}		From application. If unknown, use 125kWh.[4]
hrs		From application. If unknown, use 365.[5]
$MMBtu_{baseline}$		From application. If unknown, assume $MMBtu_{baseline}$.= 2.1 x kWh_{ee} x 3,412/1,000,000.[6]
$F_{Fuel,baseline}$		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.[7]

Baseline Efficiencies from which Energy Savings are Calculated

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

Compliance Efficiency from which Incentives are Calculated

The compliance condition is an induction cooktop with compatible cookware.

Operating Hours

Annual operating hours shall come from application. If unknown, use 365 as default.[8]

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

An existing residential customer replaces their electric resistance cooktop that consumes 150 kWh with an electric induction cooktop that consumes 120 kWh annually. The cooktop is in use for approximately 400 hours per year. Annual Electric Energy Savings and Summer Peak Coincident Demand Savings are calculated as below.

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

[3] SWAP015-01, Induction Cooking with or without Electric Range, May 2020, pg 7; based on relative efficiency of induction to resistance cooktops,0.84/0.74 = 1.135
[4] ENERGY STAR®, Emerging Technology, 2021-2022 Residential Induction Cooking Tops
[5] Frontier Energy, Residential Cooktop Performance and Energy Comparison Study, Frontier Energy Report # 501318071-R0, July 2019, Table 9
[6] SWAP013-01, Residential Cooking Appliances – Fuel Substitution, May 2020, pg 10; based on relative efficiency of induction to gas cooktops,0.84/0.4 = 2.1
[7] *No source specified – update pending availability and review of applicable references.*
[8] Frontier Energy, Residential Cooktop Performance and Energy Comparison Study, Frontier Energy Report # 501318071-R0, July 2019, Table 9

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

units = 1, from application
$kWh_{baseline}$ = 150 kWh, from application
kWh_{ee} = 120 kWh, from application
$F_{Elec,baseline}$ = 1.0, from Summary of Variables and Data Sources table
CF = 0.8, from Summary of Variables and Data Sources table

$$\Delta kWh = 1 \times (150 \times 1.0 - 120) = 30\ kWh$$

$$\Delta kW = 1 \times \frac{(150 \times 1.0 - 120)}{400} \times 0.8 = 0.06\ kW$$

Effective Useful Life (EUL)

See Appendix P.

Ancillary Fossil Fuel Savings Impacts

Induction cooktops expel less heat than standard cooktops. Interactivity with heating/cooling systems is expected, but there is insufficient information available to inform estimates. Until additional information is available, these impacts are excluded from the prescribed formulation of savings.

Ancillary Electric Savings Impacts

Induction cooktops expel less heat than standard cooktops. Interactivity with heating/cooling systems is expected, but there is insufficient information available to inform estimates. 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. ENERGY STAR®, Emerging Technology, 2021-2022 Residential Induction Cooking Tops
   Available from:
   https://www.energystar.gov/about/2021_residential_induction_cooking_tops
3. SWAP013-01 Residential Cooking Appliances – Fuel Substitution, May 2020
   Available from: http://deeresources.net/workpapers
4. SWAP015-01 Induction Cooking with or without Electric Range, May 2020
   Available from: http://deeresources.net/workpapers

5. Frontier Energy, Residential Cooktop Performance and Energy Comparison Study, Frontier Energy Report # 501318071-R0, July 2019
Available from: https://cao-94612.s3.amazonaws.com/documents/Induction-Range-Final-Report-July-2019.pdf

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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

$$\Delta kWh = \left[\frac{UA}{Eff} \times \frac{\Delta T}{3{,}412} \times 8{,}760\right] \times ElecSF$$

Summer Peak Coincident Demand Savings

$$\Delta kW = \frac{\Delta kWh}{8{,}760} \times CF$$

Annual Fossil Fuel Energy Savings

$$\Delta MMBtu = \left[\frac{UA}{Eff} \times \frac{\Delta T}{1{,}000{,}000} \times 8{,}760\right] \times FuelSF$$

where:

ΔkWh	= Annual electricity energy savings
ΔkW	= Peak coincident demand electric savings
ΔMMBtu	= 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).[9]
Eff	Electric DHW: 0.98 Fossil Fuel DHW: 0.75	Recovery efficiency of typical electric[10] and gas[11,] storage type water heater.
CF	0.8	

Coincidence Factor (CF)

The prescribed value for the coincidence factor is 0.8. [12]

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.

[9] 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.

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

[11] 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.

[12] *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.

$$\Delta kWh = \left[\frac{UA}{Eff} \times \frac{\Delta T}{3{,}412} \times 8{,}760\right] \times ElecSF$$

$$\Delta kW = \frac{\Delta kWh}{8{,}760} \times CF$$

UA = 7.85, from Summary of Variables and Data Sources table
Eff = 0.98, from Summary of Variables and Data Sources table
ΔT = 140 – 120 = 20°F
ElecSF = 1, from Summary of Variables and Data Sources table

$$\Delta kWh = \left[\frac{7.85}{0.98} \times \frac{20}{3{,}412} \times 8{,}760\right] \times 1 = 411.30\ kWh$$

$$\Delta kW = \frac{411.30}{8{,}760} \times 0.8 = 0.03\ kW$$

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=80dfa785ea350ebeee184bb0ae03e7f0&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=80dfa785ea350ebeee184bb0ae03e7f0&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

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12-21-5	1/28/2022

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AGRICULTURAL EQUIPMENT

LIVESTOCK WATERER

Measure Description

This measure is applicable to the installation of energy efficient and energy free livestock waterers in replacement and new construction scenarios. A livestock waterer provides clean drinking water for livestock and is typically heated during the winter months when the outdoor temperature falls below 32°F to prevent water from freezing.

Conventional livestock waterers require large electric resistance heating elements and include no insulation. Energy efficient and energy free livestock waterers are installed with 2 inches of insulation to reduce the heat load required to maintain water above freezing temperature. Energy efficient waterers include a significantly smaller heating element while energy free systems operate with no heating element, relying on groundwater to prevent freezing.

This measure is restricted to waterers located outside or near exterior adjacent walls where electric heaters are required to keep water above freezing temperature.

Method for Calculating Annual Energy and Summer Peak Coincident Demand Savings

Annual Electric Energy Savings

$$\Delta kWh = \frac{(W_{baseline} - W_{ee})}{1{,}000} \times hrs$$

Summer Peak Coincident Demand Savings

$$\Delta kW = N/A$$

Annual Fossil Fuel Energy Savings

$$\Delta MMBtu = N/A$$

where:

ΔkWh	= Annual electricity energy savings
ΔkW	= Peak coincident demand electric savings
ΔMMBtu	= Annual fossil fuel energy savings
W	= Rated wattage of livestock waterer heating element (Watts)
baseline	= Characteristic of the baseline condition
ee	= Characteristic of the energy efficient condition
hrs	= Annual hours of operation during the winter when temperature is below 32F
1,000	= Conversion factor, one kW equals 1,000 watts

Summary of Variables and Data Sources

Variable	Value	Notes
$W_{baseline}$		From application, if unavailable use 1,100 W as default in replacement scenarios and 500 W for new construction.[13]
W_{ee}		From application. Energy free waterers with no heating elements will result in energy efficient wattage being equal to 0.
hrs		From application. If unavailable, lookup in operating hours section below.

Coincidence Factor (CF)

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

Baseline Efficiencies from which Energy Savings are Calculated

The baseline condition is an electrically heated livestock waterer with no insulation.

Compliance Efficiency from which Incentives are Calculated

The compliance condition is an energy efficient or energy free livestock waterer with a minimum of 2 inches of insulation. Energy efficient equipment heating elements must be rated at 250 W or less. Energy free waterers shall contain no heating elements. The new waterer must be able to serve the same herd size as the existing equipment.

Operating Hours

Operating hours shall come from application. If operating hours are unknown, the prescribed hours shall come from the lookup table below based on location for agricultural applications. Default hours are developed from NOAA hourly normal by summing annual hours dry bulb temperature is below 32ºF.[14]

City	Hours below 32°F
Albany	2,160
Binghamton	2,402
Buffalo	2,181
Massena*	2,489
NYC	319
Poughkeepsie**	738
Syracuse	2,206

* Massena hourly normals are approximated from Burlington airport data due to limited available data
** Poughkeepsie hourly normals are approximated from Long Island ISLIP airport data due to limited available data

[13] EnSave, Energy Efficient Stock Waterers
[14] Average annual outdoor temperatures taken from NCEI 1981-2010 climate normals

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

A conventional waterer with heating elements rated at 1,000 W is replaced with an energy efficient unit with 200 W heating elements on a farm near Albany. The heating elements are anticipated to operate 1,800 hours per year to prevent freezing. Annual Electric Energy Savings are calculated below.

$$\Delta kWh = \frac{(W_{baseline} - W_{ee})}{1{,}000} \times hrs$$

$W_{baseline}$ = 1, 000 W, from application
W_{ee} = 200 W, from application
hrs = 1,800 hours, from application

$$\Delta kWh = \frac{(1{,}000 - 200)}{1{,}000} \times 1{,}800 = 1{,}440\ kWh$$

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. NOAA National Centers for Environmental Information – NCEI 1981-2010 Climate Normals
   Available from: https://www.ncdc.noaa.gov/cdo-web/datatools/normals
2. EnSave, Energy Efficient Stock Waterers

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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

$$\Delta kWh = \left[\frac{UA}{E_t} \times \frac{\Delta T}{3{,}412} \times 8{,}760\right] \times ElecSF$$

Summer Peak Coincident Demand Savings

$$\Delta kW = \frac{\Delta kWh}{8{,}760} \times CF$$

Annual Fossil Fuel Energy Savings

$$\Delta MMBtu = \left[\frac{UA}{E_t} \times \frac{\Delta T}{1{,}000{,}000} \times 8{,}760\right] \times FuelSF$$

where:

ΔkWh	= Annual electricity energy savings
ΔkW	= Peak coincident demand electric savings
ΔMMBtu	= Annual fossil fuel energy savings
ΔT	= Temperature difference between pre and post-turn down temperature setting
E_t	= Thermal efficiency of storage water heater
UA	= Overall heat transfer coefficient (BTU/hr-°F)
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.
E_t		Thermal efficiency rating of the water heater, from application.
ElecSF	Electric DHW: 1 Fuel DHW: 0	
FuelSF	Electric DHW: 0 Fuel DHW: 1	
UA		Overall heat loss coefficient of the baseline condition (BTU/h-°F). Calculate based on baseline standby loss per the Baseline Heat Loss Coefficient section below.
CF	0.8	

Baseline Heat Loss Coefficient ($UA_{baseline}$)

$UA_{baseline}$ is calculated from the assumed equipment standby loss specification ($SL_{baseline}$), which is determined per minimum effective federal standards for commercial gas storage type water heaters (see Baseline Standby Losses section below).[15]

$$UA_{baseline} = \frac{SL_{baseline}}{70}$$

where:

$SL_{baseline}$ = Standby heat loss (BTU/h) specification. For the baseline condition ($SL_{baseline}$), use the intermediate standby loss equation from the Baseline Standby Losses section below.

70 = Temperature difference associated with standby loss specification (°F)[16]

Baseline Standby Losses ($SL_{baseline}$)

Standby losses ($SL_{baseline}$) for commercial gas storage type water heaters:[17]

$$SL_{baseline} = \frac{Q_{baseline}}{800} + 110\sqrt{v_{baseline}}$$

where:

$V_{baseline}$ = Baseline tank volume (gal)

$Q_{baseline}$ = Baseline input capacity (BTU/h)

Coincidence Factor (CF)

The prescribed value for the coincidence factor is 0.8. [18]

[15] 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

[16] Ibid.

[17] Ibid.

[18] *No source specified – update pending availability and review of applicable references.*

Baseline Efficiencies from which Energy Savings are Calculated

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

Compliance Efficiency from which Incentives are Calculated

The compliance condition is a commercial 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.

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

A fossil fuel fired commercial DHW system that is 78% efficient has its temperature turned down from 140°F to 120°F. The input capacity of the unit is 110,000 BTU/h and has a volume of 100 gallons. Annual Fossil Fuel Energy Savings are calculated below.

$$\Delta MMBtu = \left[\frac{UA}{E_t} \times \frac{\Delta T}{1{,}000{,}000} \times 8{,}760\right] \times FuelSF$$

$$UA_{baseline} = \frac{SL_{baseline}}{70}$$

where,

$$SL_{baseline} = \frac{Q_{baseline}}{800} + 110\sqrt{v_{baseline}}$$

ΔT = 140 - 120 = 20°F
E_t = 0.78, from application
FuelSF = 1, from Summary of Variables and Data Sources

$$SL_{baseline} = \frac{110{,}000}{800} + 110\sqrt{100} = 1{,}237.5$$

$$UA_{baseline} = \frac{1{,}237.5}{70} = 17.67$$

$$\Delta MMBtu = \left[\frac{17.67}{0.78} \times \frac{20}{1{,}000{,}000} \times 8{,}760\right] \times 1 = 3.97\ MMBtu$$

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=80dfa785ea350ebeee184bb0ae03e7f0&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 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
   Available from: https://energy.gov/sites/prod/files/2016/08/f33/Water%20Heaters%20Test%20Procedure%20SNOPR.pdf

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LIGHTING

LED OPEN SIGN

Measure Description

This measure is applicable to the installation of LED open signs. The LED signs must replace existing neon or fluorescent signage. This technology provides the required illumination at reduced input power.

Method for Calculating Annual Energy and Summer Peak Coincident Demand Savings

Annual Electric Energy Savings

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

Summer Peak Coincident Demand Savings

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

Annual Fossil Fuel Energy Savings

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

where:

ΔkWh	= Annual electricity energy savings
ΔkW	= Peak coincident demand electric savings
ΔMMBtu	= Annual fossil fuel energy savings
W	= Equipment wattage
baseline	= Characteristic of the baseline condition
ee	= Characteristic of the energy efficient condition
$HVAC_c$	= 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 fuel consumption (MMBtu/kWh)
hrs	= Annual hours of operation
CF	= Coincidence Factor
1000	= Conversion factor, one kilowatt equals 1,000 watts

Summary of Variables and Data Sources

Variable	Value	Notes
$W_{baseline}$		From application. If unknown, use 46 W.[19]
W_{ee}		From application.

[19] Southern California Edison, Workpaper SCE13LG070.2, page 4

Variable	Value	Notes
$HVAC_c$	Exterior and Unconditioned Spaces: 0	HVAC interaction factor for annual electric energy consumption (dimensionless). Vintage and HVAC type weighted average by city. See Appendix D.
$HVAC_d$	Exterior and Unconditioned Space: 0	HVAC interaction factor for peak demand at utility summer peak hour (dimensionless). Vintage and HVAC type weighted average by city. See Appendix D.
$HVAC_{ff}$	Exterior and Unconditioned Space: 0	HVAC interaction factor for annual fuel energy consumption (MMBtu/kWh). Vintage and HVAC type weighted average by city. See Appendix D.
hrs		From application or default. Hours of operation for signage with a photocell control are 4,380 hours, Time switch control are 2,190 hours. For hours of operation during business hours, lookup Operating Hours table
CF		CF = 0 for photocell control and time switch control scenarios. Lookup Interior CF based on facility type in Operating Hours section below for operation aligned with business hours.

Coincidence Factor (CF)

Look up interior lighting CF from the table in the Operating Hours section below based on facility type.[20]

Baseline Efficiencies from which Energy Savings are Calculated

The baseline condition is fluorescent lighting or neon type illuminated LED open sign.

Compliance Efficiency from which Incentives are Calculated

The compliance condition is an LED type illuminated LED open sign.

Operating Hours

Operating hours of the building are to come from application. In the scenario of a signage with photocell control, the LED open sign would operate for 4,380 hours. The hours of operation for a time switch control are 2,190 hours[21]. If the LED open sign were to remain on during business hours, lookup from table below and use building specific operating hours wherever applicable. The average lighting operating hours are defined by building type, as shown in the table below. These are typical average values for the building types shown.

[20] ConEd Large C&I Program Impact and Process Evaluation Report prepared by Navigant, August 2019, slide 71
21 Time switch control – assume 6 hours per day, 365 days per year

Facility Type	Lighting Hours (hrs/yr)	CF[22]	HVAC Int	Facility Type	Lighting Hours (hrs/yr)	CF[23]	HVAC Int
Auto Related*	2,810	0.89	AR	Manufacturing Facility	2,857	0.67	Ind
Automotive / Transportation Service or Repair Facility (24/7)	8,760	0.89	AR	Medical Offices	3,748	0.92	SOfc
Bakery	2,854	0.79	FS	Motion Picture Theatre	1,954	0.89	Asy
Banks	3,748	0.92	SOfc	Multi-Family (Common Areas)	7,665	0.98	MFL
Church	1,955	0.89	Rel	Museum	3,748	0.89	Asy
College–Cafeteria**	2,713	0.79	FS	Nursing Homes	5,840	0.92	MFL
College – Classes	2,586	0.54	CC	Office (General Office Types)**	3,013	0.92	SOfc/ LOfc
College - Dormitory	3,066	0.92	Dorm	Parking Garages	4,368	0.0	None
Commercial Condos***	3,100	0.92	SOfc	Parking Garages (24/7)	7,717	0.0	None
Convenience Stores	6,376	0.97	SRet	Parking Lots	4,100	0.0	None
Convention Center	1,954	0.89	Asy	Penitentiary	5,477	0.37	MFL
Court House	3,748	0.92	LOfc	Performing Arts Theatre	2,586	0.89	Asy
Dining: Bar Lounge/Leisure	4,182	0.79	FS	Police / Fire Stations (24 Hr)	7,665	0.89	Asy
Dining: Cafeteria / Fast Food	6,456	0.79	FF	Post Office	3,748	0.97	SRet
Dining: Family	4,182	0.79	FS	Pump Stations	1,949	0.67	Ind
Entertainment	1,952	0.89	Asy	Refrigerated Warehouse	2,602	0.67	RWH
Exercise Center	5,836	0.89	SRet	Religious Building	1,955	0.89	Rel
Fast Food Restaurants	6,376	0.79	FF	Restaurants	4,182	0.79	FS
Fire Station (Unmanned)	1,953	0.89	Asy	Retail	3,463	0.85	SRet/ LRet
Food Stores	4,055	0.98	Gro	School / University	2,187	0.54	Univ
Gymnasium	2,586	0.89	Asy	Schools (Jr./Sr. High)	2,187	0.54	HS

[22] ConEd Large C&I Program Impact and Process Evaluation Report prepared by Navigant, August 2019, slide 71
[23] ConEd Large C&I Program Impact and Process Evaluation Report prepared by Navigant, August 2019, slide 71

Facility Type	Lighting Hours (hrs/yr)	CF[22]	HVAC Int	Facility Type	Lighting Hours (hrs/yr)	CF[23]	HVAC Int
Hospitals	7,674	0.74	Hosp	Schools (Preschool/ Elementary)	2,187	0.54	Sch
Hospitals / Health Care	7,666	0.74	Hosp	Schools (Technical/ Vocational)	2,187	0.54	CC
Industrial - 1 Shift	2,857	0.67	Ind	Small Services	3,750	0.92	SOfc
Industrial - 2 Shift	4,730	0.67	Ind	Sports Arena	1,954	0.89	Asy
Industrial - 3 Shift	6,631	0.67	Ind	Town Hall	3,748	0.89	Asy
Laundromats	4,056	0.89	SRet	Transportation	6,456	0.89	Asy
Library	3,748	0.89	LOfc	Warehouse (Not Refrigerated)	2,602	0.67	WH
Light Manufacturers**	2,613	0.67	Ind	Waste Water Treatment Plant	6,631	0.67	Ind
Lodging (Hotels/Motels)	3,064	0.92	Hotel/ Motel	Workshop	3,750	0.67	Ind
Mall Concourse	4,833	0.85	LRet				

* New car showrooms and Big Box retail stores with evening and/or weekend hours should use the Facility Type "Retail" for lighting operating hours.
** Lighting operating hours data from the 2008 California DEER Update study
*** Lighting operating hours data for offices used

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

A 50 W neon illuminated open sign is replaced with a 30 W LED open sign in a fast-food restaurant in NYC. The restaurant is equipped with central air conditioning with fuel heat. Annual Electric Energy Savings, Summer Peak Coincident Demand Savings and Annual Fossil Fuel Energy Savings are calculated as below.

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

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

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

$W_{baseline}$ = 50 W, from application
W_{ee} = 30 W, from application
Hrs = 6,376, from Operating Hours section
$HVAC_c$ = 0.110, from Appendix D
$HVAC_d$ = 0.200, from Appendix D
$HVAC_{ff}$ = -0.003, from Appendix D

$$\Delta kWh = \left(\frac{50 - 30}{1{,}000}\right) \times 6{,}376 \times (1 + 0.110) = 141.54\ kWh$$

$$\Delta kW = \left(\frac{50 - 30}{1{,}000}\right) \times (1 + 0.200) \times 0.79 = 0.018\ kW$$

$$\Delta MMBtu = \left(\frac{50 - 30}{1{,}000}\right) \times 6{,}376 \times (-0.003) = -0.38\ MMBtu$$

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. Southern California Edison, Workpaper SCE13LG070.2, Replace Open Neon Sign with LED Sign.
2. Large Commercial & Industrial (Large C&I) Program Impact and Process Evaluation, Presented to Con Edison, Prepared by Navigant, August 2019
   Available from:
   http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7BFCA2BA08-4767-4D75-B8FD-1FDE6C09A72F%7D
3. Lighting operating hour data taken from the CL&P and UI Program Savings Documentation for 2008 Program Year, with exceptions as noted.
   Available from:
   https://library.cee1.org/system/files/library/8821/CEE_Eval_2008ProgramSavingsDocumentPSD_1Jan2008.pdf
4. Additional lighting operating hour data taken from 2008 DEER Update – Summary of Measure Energy Analysis Revisions, August, 2008
   Available from: www.deeresources.com

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HIGH VISCOSITY INDEX INDUSTRIAL LUBRICANT – GEAR BOX

Measure Description

This measure covers application of lubricants with high viscosity index ratings in industrial gear reduction systems. Commercial and industrial gear reduction systems use lubricants to lower the coefficient of friction between gears meshing together. Gear oils also protect critical components from premature wear. Two key areas contribute to energy losses in these industrial systems: mechanical losses (energy lost to the friction of gears meshing) and volumetric losses (energy lost as the result of fluid leakage). A high viscosity index allows the lubricant to maintain constant viscosity over a range of operating temperatures which optimizes volumetric and mechanical efficiency and decreases energy losses.

This measure is applicable to gear reduction systems. All lubricants installed under this measure are to be tested in accordance with all pertinent federal testing standards (ASTM).

Method for Calculating Annual Energy and Summer Peak Coincident Demand Savings

Annual Electric Energy Savings

$$\Delta kWh = \frac{hp \times LF \times 0.746}{Eff} \times hrs \times ESF$$

Summer Peak Coincident Demand Savings

$$\Delta kW = \frac{hp \times LF \times 0.746}{Eff} \times ESF \times CF$$

Annual Fossil Fuel Energy Savings

$$\Delta MMBtu = N/A$$

where:

ΔkWh	= Annual electricity energy savings
ΔkW	= Peak coincident demand electric savings
ΔMMBtu	= Annual fossil fuel energy savings
hp	= Rated horsepower of motor
LF	= Average load factor for a constant speed pump
Eff	= Rated motor efficiency
hrs	= Annual hours of motor operation
ESF	= Energy savings Factor
0.746	= Conversion factor (kW/hp), 746 watts equals one electric horsepower

Summary of Variables and Data Sources

Variable	Value	Notes
hp		From application.
LF		From application. If unknown, assume 0.75.[24]
Eff		From application.
hrs		From application.
ESF	0.033	Focus on Energy Verification Study[25,26]

Coincidence Factor (CF)

The prescribed value for the coincidence factor is 0.8[27].

Baseline Efficiencies from which Energy Savings are Calculated

The baseline condition is a gear reduction system operating with a low-viscosity lubricant.

Compliance Efficiency from which Incentives are Calculated

The compliance condition is a gear reduction system operating with a high-viscosity lubricant with a viscosity index of greater than 110.[28]

Operating Hours

Operating hours shall come from application.

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

The lubricant in a gear box system with a 100 hp motor is replaced with a lubricant with a viscosity index greater than 110. The 100 hp motor has a loading of 70%, a rated efficiency of 93%, and is operational 2,000 hours annually.

$$\Delta kWh = \frac{hp \times LF \times 0.746}{Eff} \times hrs \times ESF$$

$$\Delta kW = \frac{hp \times LF \times 0.746}{Eff} \times ESF \times CF$$

hp = 100, from application
LF = 0.7, from application
Eff = 0.93, from application
hrs = 2,000, from application

[24] DOE, Determining Electric Motor Load and Efficiency, pg 1. Assumes average load factor for maximum efficiency.
[25] Ibid, pg 1
[26] Focus on Energy Press Release, Plastics Today, Lubricant Improves Efficiency in New Study, October 30, 2017
[27] *No source specified – update pending availability and review of applicable references.*
[28] Focus on Energy Emerging Technologies Program, EVCO Plastics High Efficiency Hydraulic Fluid Measurement and Verification Study, 2017. pg 3

ESF = 0.033, from Summary of Variables and Data Sources table
CF = 0.8, from Summary of Variables and Data Sources table

$$\Delta kWh = \frac{100 \times 0.7 \times 0.746}{0.93} \times 2{,}000 \times 0.033 = 3{,}706\ kWh$$

$$\Delta kW = \frac{100 \times 0.7 \times 0.746}{0.93} \times 0.033 \times 0.8 = \ 1.48\ kW$$

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. Department of Energy, Determining Electric Motor Load and Efficiency, Motor Challenge, Fact Sheet,
   Available from: https://www.energy.gov/sites/prod/files/2014/04/f15/10097517.pdf
2. Focus on Energy Emerging Technologies Program, EVCO Plastics High Efficiency Hydraulic Fluid Measurement and Verification Study, 2017.
3. Focus on Energy Press Release, Plastics Today, Lubricant Improves Efficiency in New Study, October 30, 2017
   Available from: https://focusonenergy.com/newsroom/lubricant-improves-efficiency-new-study

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HIGH VISCOSITY INDEX INDUSTRIAL LUBRICANT – HYDRAULIC SYSTEM

Measure Description

This measure covers application of lubricants with high viscosity index ratings in industrial hydraulic systems. Commercial and industrial hydraulic systems use lubricants to transfer input energy to output power by converting the mechanical energy of the prime mover into fluid flow. Hydraulic oils also protect critical components from premature wear. Two key areas contribute to energy losses in these industrial systems: mechanical losses (energy lost to fluid friction between rotating pump equipment and hydraulic oil) and volumetric losses (energy lost as the result of internal fluid leakage within the pump). A high viscosity index allows the lubricant to maintain a constant viscosity over a range of operating temperatures which optimizes volumetric and mechanical efficiency at a pump's rated output and decreases energy losses.

This measure is applicable to hydraulic systems. All lubricants installed under this measure are to be tested in accordance with all pertinent federal testing standards (ASTM).

Method for Calculating Annual Energy and Summer Peak Coincident Demand Savings

Annual Electric Energy Savings

$$\Delta kWh = \frac{hp \times LF \times 0.746}{Eff} \times hrs \times ESF$$

Summer Peak Coincident Demand Savings

$$\Delta kW = \frac{hp \times LF \times 0.746}{Eff} \times ESF \times CF$$

Annual Fossil Fuel Energy Savings

$$\Delta MMBtu = N/A$$

where:

ΔkWh	= Annual electricity energy savings
ΔkW	= Peak coincident demand electric savings
ΔMMBtu	= Annual fossil fuel energy savings
hp	= Rated horsepower of motor
LF	= Average load factor for a constant speed pump
Eff	= Rated motor efficiency
hrs	= Annual hours of motor operation
ESF	= Energy savings Factor
0.746	= Conversion factor (kW/hp), 746 watts equals one electric horsepower

Summary of Variables and Data Sources

Variable	Value	Notes
hp		From application.
LF		From application. If unknown, assume 0.75.[29]
Eff		From application.
hrs		From application.
ESF	0.033	Focus on Energy Verification Study[30,31]

Coincidence Factor (CF)

The prescribed value for the coincidence factor is 0.8[32].

Baseline Efficiencies from which Energy Savings are Calculated

The baseline condition is a hydraulic system operating with a low-viscosity lubricant.

Compliance Efficiency from which Incentives are Calculated

The compliance condition is a hydraulic system operating with a high-viscosity lubricant with a viscosity index of greater than 110.[33]

Operating Hours

Operating hours shall come from application.

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

The lubricant in a hydraulic injection molding machine is replaced with a lubricant with a viscosity index greater than 110. The 50 hp motor has an average loading of 35%, a rated efficiency of 92%, and is operational 6,000 hrs annually.

$$\Delta kWh = \frac{hp \times LF \times 0.746}{Eff} \times hrs \times ESF$$

$$\Delta kW = \frac{hp \times LF \times 0.746}{Eff} \times ESF \times CF$$

hp = 50, from application
LF = 0.35, from application
Eff = 0.92, from application
hrs = 6,000, from application

[29] DOE, Determining Electric Motor Load and Efficiency, pg 1. Assumes average load factor for maximum efficiency.
[30] Ibid, pg 1
[31] Focus on Energy Press Release, Plastics Today, Lubricant Improves Efficiency in New Study, October 30, 2017
[32] *No source specified – update pending availability and review of applicable references.*
[33] Focus on Energy Emerging Technologies Program, EVCO Plastics High Efficiency Hydraulic Fluid Measurement and Verification Study, 2017. pg 3

ESF = 0.033, from Summary of Variables and Data Sources table
CF = 0.8, from Summary of Variables and Data Sources table

$$\Delta kWh = \frac{50 \times 0.35 \times 0.746}{0.92} \times 6{,}000 \times 0.033 = 2{,}810\ kWh$$

$$\Delta kW = \frac{50 \times 0.35 \times 0.746}{0.92} \times 0.033 \times 0.8 = \ 0.375\ kW$$

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. Department of Energy, Determining Electric Motor Load and Efficiency, Motor Challenge, Fact Sheet,
   Available from: https://www.energy.gov/sites/prod/files/2014/04/f15/10097517.pdf
2. Focus on Energy Emerging Technologies Program, EVCO Plastics High Efficiency Hydraulic Fluid Measurement and Verification Study, 2017.
3. Focus on Energy Press Release, Plastics Today, Lubricant Improves Efficiency in New Study, October 30, 2017
   Available from: https://focusonenergy.com/newsroom/lubricant-improves-efficiency-new-study

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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[34]
	Clothes Dryer	Residential	14	ENERGY STAR® M&I Scoping Report[35]
	Clothes Washer	Residential	11	DEER 2014 EUL ID: Appl-EffCW
	Dehumidifier	Residential	12	ENERGY STAR® Calc[36]
	Dishwasher	Residential	11	DEER 2014 EUL ID: Appl-EffDW
	Fireplace	Residential	15	DOE[37]
	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[38]
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

[34] 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
[35] ENERGY STAR® Market & Industry Scoping Report: Residential Clothes Dryer, November 2011.
[36] ENERGY STAR® Dehumidifier Calculator
https://www.energystar.gov/ia/partners/promotions/cool_change/downloads/CalculatorConsumerDehumidifier.xls
[37] 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
[38] Retail Products Platform Product Analysis, Last Updated May 25, 2016.
Available from: https://drive.google.com/file/d/0B9Fd3ckbKJp5OEpWSHg1eksyZ1U/view

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[39]
	Air Leakage Sealing	Residential	15	GDS[40]
	Insulation – Hot Water and Steam Pipe	Residential	15	GDS[41]
	Insulation – Opaque Shell	Residential	25	GDS[42]
	Storm Window	Residential	20	DOE[43]
	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[44]
	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	DHW Thermostat Setback	Residential	RUL of DHW System **Default = 5**	N/A
	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
DHW - Control	Thermostatic Shower Restriction Valve	Residential	10	UPC[45]

[39] Average/typical manufacturer warranty period for AC covers
[40] GDS Associates, Inc., Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007, Table 1 – Residential Measures
[41] Ibid.
[42] Ibid.
[43] https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-22864rev2.pdf
[44] 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
[45] 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.

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[46]
	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[47]
	Boiler and Furnace - Combination ("Combi") Furnace	Residential	20	DEER 2014[48] 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

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

[47] 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

[48] Based on DEER value for high efficiency boiler and instantaneous water heater

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[49]
	Furnace, Gas Fired	Residential	22	DOE[50,51]
	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[52]
	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

[49] 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

[50] 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

[51] 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

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

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[53]
	Thermostat – All Types	Residential	11	DEER 2014 EUL ID: HVAC-ProgTStats
	Thermostatic Radiator Valve – One Pipe Steam Radiator	Multifamily	15	DOE[54]
	Smart Thermostatic Radiator Enclosure	Residential	15	DEER 2014 EUL ID: Motors-fan[55]
Lighting	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[56]
	Light Fixture	Residential LED (Interior)	50,000 hours	DLC[57]
			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

[53] NYSERDA Residential Electric Submetering Manual
[54] U.S. DOE, "Thermostatic Radiator Valve Evaluation", January 2015, Table 4. pg. 16
[55] Based on assumed EUL of integrated fan, which is expected to be the first component to fail
[56] 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
[57] 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

Category	Single and Multi-family Residential Measures		Sector	EUL (years)	Source
Lighting	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[58]
		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[59]
Motors and Drives	Pool Pump		Residential	10	DEER 2014 EUL ID: OutD-PoolPump
	Pool Circulator Timer		Residential	10	DEER 2014 EUL ID: OutD-PoolPump
	Heat Pump Pool Heater		Residential	15	DEER 2014 EUL ID: HV-Res HP
Other	Pool Heater		Residential	8	DOE[60]
	Solar Pool Heater		Residential	15	DOE[61]

[58] 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

[59] 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_PY9_LLLC_IPA_Program_Impact_Evaluation_Report_2018-06-05_Final.pdf

[60] 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

[61] 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[62]
	Livestock Waterer	C&I	10	PA Consulting Group[63]
	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[64]
	Variable Speed Drive Milk Pump Plate Cooler	C&I	15	PA Consulting Group[65]
	Variable Speed Drive Vacuum Pump	C&I	15	PA Consulting Group[66]
Appliance	Clothes Dryer	C&I	14	ENERGY STAR®M&I Report[67]
	Clothes Washer	C&I	11	DEER 2014 EUL ID: Appl-EffCW
	Cooking Equipment[68]	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[69]
	Ice Maker	C&I	10	DEER 2014 EUL ID: Cook-IceMach
	Refrigerator and Freezer	C&I	12	DEER 2014 EUL ID: Cook-SDRef
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-VendCtrler
Appliance Recycling	Air Conditioner – Room (RAC)	C&I	9	DEER 2014 EUL ID: HV-RAC-ES

[62] PG&E Work Paper PGE3PAGR117, October 12, 2017
[63] 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
[64] Based on EUL's for Advanced Power Strips
[65] 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
[66] 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
[67] ENERGY STAR® Market & Industry Scoping Report: Residential Clothes Dryer, November 2011.
[68] Applicable to all kitchen cooking equipment not otherwise listed
[69] 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

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
Building Shell	Air Leakage Sealing	C&I	15	GDS[70]
	Cool Roof	C&I	15	DEER 2014 EUL ID: BldgEnv-CoolRoof
	Insulation - Hot Water and Steam Pipe	C&I	15	GDS[71]
	Insulation - Opaque Shell	C&I	30	ET & CEC[72]
	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[73]
	Engineered Air Nozzle	C&I	15	Wisconsin PSC[74]
	No Air Loss Water Drain	C&I	13	MA Measure Life Study[75]
	Refrigerated Air Dryer	C&I	13	Other State TRMs [76]
	Compressed Air Heat Recovery	C&I	13	Other State TRMs [77]
	Flow Controller	C&I	13	Other State TRMs [78]
	Low Pressure Drop Filter	C&I	5	Other State TRMs [79]
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 Thermostat Setback	C&I	RUL of DHW System **Default = 5**	N/A

[70] GDS Associates, Inc., Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007, Table 1 – Residential Measures
[71] GDS Associates, Inc., Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007, Table 1 – Residential Measures
[72] Energy Trust uses 30 years for commercial applications. CEC uses 30 years for insulation in Title 24 analysis.
[73] 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.
[74] PA Consulting Group (2009). *Business Programs: Measure Life Study*. Prepared for State of Wisconsin Public Service Commission
[75] 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
[76] 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.
[77] Ibid.
[78] Ibid.
[79] Ibid.

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
DHW – Control	Drain Water Heat Recovery (DWHR)	C&I	30	2019 Title 24[80]
	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[81]
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[82]
	Boiler and Furnace - Combination ("Combi") Furnace	C&I	20	DEER 2014[83] 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
	Chiller – Air & Water Cooled	C&I	20	DEER 2014 EUL ID: HVAC-Chlr
	Chiller – Cooling Tower	C&I	15	DEER 2014 EUL ID: HVAC-ClTwrPkgSys
	Condensing Unit Heater	C&I	18	Ecotope[84]
	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

[80] 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

[81] https://www.nrel.gov/docs/fy16osti/64541.pdf

[82] 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

[83] Based on DEER value for high efficiency boiler and instantaneous water heater

[84] Ecotope Natural Gas Efficiency and Conservation Measure Resource Assessment (2003)

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
Heating, Ventilation and Air Conditioning (HVAC)	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[85,86]
	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[87]
	High Volume Low Speed Fan	C&I	15	PA Consulting Group[88]
	Infrared Heater	C&I	17	GDS[89]
	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[90]
	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

[85] 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

[86] 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

[87] ASHRAE Owning and Operating Cost Database
Available from: https://xp20.ashrae.org/publicdatabase/system_service_life.asp?selected_system_type=1

[88] 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

[89] 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

[90] Wisconsin Public Service Commission: Equipment Useful Life Database, 2013
Excerpt available from: https://focusonenergy.com/sites/default/files/bpmeasurelifestudyfinal_evaluationreport.pdf

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
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[91]
	Kitchen Demand Ventilation Control	C&I	15	PG&E[92]
	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[93]
	Advanced Rooftop Control	C&I	EUL = RUL of Existing RTU = RTU EUL – (Current Year – Year of Mfr.) **Default = 5**	N/A

[91] Natural Gas Energy Efficiency Potential in Massachusetts, GDS Associates, 2009. Available from: http://ma-eeac.org/wordpress/wp-content/uploads/5_Natural-Gas-EE-Potenial-in-MA.pdf
[92] PG&E Work Paper WPSDGENRCC0019, June 15, 2012
[93] U.S. DOE. "Thermostatic Radiator Valve Evaluation." January 2015. Available from: https://www.nrel.gov/docs/fy15osti/63388.pdf

Category	Commercial & Industrial Measures		Sector	EUL (years)	Source
Lighting	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[94]
	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®[95]
		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®[96]
		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®[97]
		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

[94] 50,000 hours per L_{70} requirements prescribed by the DLC's Product Qualification Criteria, Technical Requirement Table version 4.4

[95] 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

[96] 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

[97] 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

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
Lighting	LED Lamp	C&I	50,000 hours	DLC[98]
			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[99]
Lighting - Control	Bi-Level Lighting	C&I	15	ComEd[100]
	Integrated Interior Control	C&I	15	ComEd[101]
	Non-Integrated Interior Control	C&I	10	GDS[102]
	Plug-Load Occupancy Sensor	C&I	8	DEER[103]
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[104]

[98] 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

[99] 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

[100] 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_PY9_LLLC_IPA_Program_Impact_Evaluation_Report_2018-06-05_Final.pdf

[101] 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_PY9_LLLC_IPA_Program_Impact_Evaluation_Report_2018-06-05_Final.pdf

[102] 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

[103] DEER value for lighting occupancy sensors

[104] Assumes same EUL as VFD measure.

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[105]
	High Frequency Battery Charger	C&I	15	PG&E[106]
	High Viscosity Industrial Lubricant	C&I	10	ExxonMobil
	Pool Heater	C&I	8	DOE[107]
	Solar Pool Cover	C&I	5	CALMAC[108]
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[109]
	Process Exhaust Filtration	C&I	15	CIBSE[110]
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

[105] https://www.federalregister.gov/documents/2019/06/18/2019-12761/energy-conservation-program-energy-conservation-standards-for-distribution-transformers
[106] https://www.kannahconsulting.com/wp-content/uploads/2016/08/2010-10-11_Battery_Charger_Title_20_CASE_Report_v2-2-2.pdf, pg 43
[107] 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
[108] http://www.calmac.org/publications/PoolCoverReport_2015_Final_Report_Appendices.pdf
[109] PG&E Work Paper PGECOAPP123, August 22, 2017
[110] 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.

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 [111]

Common References

1. DEER 2014 EUL
   Available from:
   http://www.deeresources.com/files/DEER2013codeUpdate/download/DEER2014-EUL-table-update_2014-02-05.xlsx
2. GDS Associates, Inc., Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007
   Available from:
   https://library.cee1.org/system/files/library/8842/CEE_Eval_MeasureLifeStudyLights%2526HVACGDS_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
6-19-14	6/30/2019

[111] 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

Record of Revision Number	Issue Date
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

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