Table of Revisions/Changes

Revision Number	Addition/ Revision	Issue Date	Effective Date	Measure	Description of Change	Location/Page in TRM
9-23-3	R	10/31/2023	1/1/2024	C/I Advanced RTU Control	Clarified application for single-zone systems only; added restriction to retrofit applications only or where not otherwise required by code; removed peak demand savings; included "from application" option for fan hours with default to align with C/I interior lighting hours	Pg. 853
9-23-5	R	10/31/2023	1/1/2024	Appendix P (EUL)	Added EUL for R/MF Attic Access Insulation & Sealing, C/I Refrigeration Condenser Coil Cleaning	Pg. 1389

Note: Revisions and additions to the measures listed above were undertaken by the Joint Utilities Technical Resource Manual (TRM) Management Committee between July 14, 2023 – October 21, 2023.

HEATING, VENTILATION AND AIR CONDITIONING (HVAC) – CONTROL

ADVANCED RTU CONTROL

Measure Description

This measure covers the installation of advanced rooftop unit (RTU) control on a single-zone, constant volume, rooftop HVAC unit with a single-speed supply fan. Advanced RTU control consists of integrated demand-controlled ventilation (DCV), a multi/variable-speed fan, and dual enthalpy control air-side economizers. DCV systems determine occupancy using a CO2 sensor and reduce heating and cooling loads by modulating outdoor air intake to meet ventilation requirements. Multi/variable-speed fan motors reduce the fan speed for first stage cooling and ventilation. Air-side economizers reduce mechanical cooling requirements by supplying outside air to the space when the outside air meets conditions deemed suitable for cooling. This measure is only eligible in retrofit applications or where variable speed fan control, DCV and/or dual enthalpy economizers are not required by code.

Method for Calculating Annual Energy and Summer Peak Coincident Demand Savings

Annual Electric Energy Savings

$$\Delta kWh = \Delta kWh_{fan} + \Delta kWh_{DCV} + \Delta kWh_{Econ}$$

$$\Delta kWh_{fan} = hp \times ESF_{fan} \times hrs$$

$$\Delta kWh_{DCV} = \frac{SF}{1{,}000} \times \left(\frac{\Delta kWh}{kSF}\right)_{DCV,cool} + \frac{SF}{1{,}000} \times \left(\frac{\Delta kWh}{kSF}\right)_{DCV,heat} \times F_{ElecHeat}$$

$$\Delta kWh_{Econ} = tons \times (\Delta kWh/\text{ton})_{Econ}$$

Summer Peak Coincident Demand Savings

$$\Delta kW = N/A$$

Annual Fossil Fuel Energy Savings

$$\Delta MMBtu = \frac{SF}{1{,}000} \times \left(\frac{\Delta MMBtu}{kSF}\right)_{DCV} \times F_{FuelHeat}$$

where:

ΔkWh	= Annual electricity energy savings
ΔkW	= Peak coincident demand electric savings
ΔMMBtu	= Annual fossil fuel energy savings
ΔkWh_{fan}	= Annual electricity energy savings resulting from supply fan control
ΔkWh_{DCV}	= Annual electricity energy savings resulting from DCV
ΔkWh_{Econ}	= Annual electricity energy savings resulting from economizer
hp	= Horsepower of RTU supply fan

ESF_{fan} = Energy savings factor for supply fan control (kWh/hp/hour)
hrs = Annual operating hours of RTU supply fan
SF = Total square footage of the conditioned space impacted by the measure
$(\Delta kWh/kSF)_{DCV,cool}$ = Energy savings factor for cooling (kWh/1,000 ft^2)
$(\Delta kWh/kSF)_{DCV,heat}$ = Energy savings factor for electric heating (kWh/1,000 ft^2)
$F_{ElecHeat}$ = Electric heating factor, used to account for the presence or absence of an electric heating system
tons = Tons of air conditioning supplied by RTU, based on nameplate data
$(\Delta kWh/ton)_{Econ}$ = Annual electric energy savings per ton of cooling
$(\Delta MMBtu/kSF)_{DCV}$ = Energy savings factor for heating (MMBtu/1,000 ft^2)
$F_{FuelHeat}$ = Fuel heating factor, used to account for the presence or absence of a fossil fuel heating system
1,000 = Conversion to 1,000 ft^2

Summary of Variables and Data Sources

Variable	Value	Notes
hp		From application.
ESF_{fan}	0.580	Pacific Northwest National Laboratory.[1]
hrs		From application. If unknown, assume fan operating hours align with the operating hours prescribed in the C&I Interior and Exterior Lighting measure found in this document, based on facility type.
SF		From application.
$(\Delta kWh/kSF)_{DCV,cool}$		Lookup from Electric Cooling Savings Associated DCV table below based on location and building type.
$(\Delta kWh/kSF)_{DCV,heat}$		Lookup from Electric Heating Savings with Heat Pump or Electric Heating Savings with Electric Resistance table below depending on electric heating type from application, based on location and building type.
$F_{ElecHeat}$		Use a value of 1.0 if the building is electrically heated. Otherwise, use 0.0.
tons		From application.
$(\Delta kWh/ton)_{Econ}$		Lookup based on building type and location in the Air Side Economizer table in Appendix J.
$(\Delta MMBtu/kSF)_{DCV}$		Lookup from Fuel Savings Associated with DCV table below based on location and building type.
$F_{FuelHeat}$		Use a value of 1.0 if the building is fossil fuel heated. Otherwise, use 0.0.

[1] Unweighted average of kWh/hp/hour fan savings across all test cases in Advanced Rooftop Control (ARC) Retrofit: Field-Test Results, PNNL22656, Table 10: TMY weather normalized annual savings for all units. Fan Energy Savings (kWh) is divided by RTU Fan Power (hp) and Annual RTU Running Time (hr) to determine Energy Savings Factor for supply fan controls (kWh/hp/hr).

Unit energy savings associated with operation of an air-side economizer were calculated from a DOE-2.2 simulation of a series of prototypical small commercial buildings. The prototype building characteristics are described in Appendix A. The unit energy savings by building type and city are shown in Appendix J.

Electric Cooling Savings Associated with DCV (ΔkWh/kSF)[2]

	(kWh/kSF)$_{DCV,cool}$						
Building Type	**Albany**	**Binghamton**	**Buffalo**	**Massena**	**NYC**	**Poughkeepsie**	**Syracuse**
Office - Low-rise (1 to 3 Stories)	237	134	227	136	369	281	218
Office - Mid-rise (4 to 11 Stories)	187	105	179	107	291	222	171
Office - High-rise (12+ Stories)	222	126	213	128	346	264	203
Religious Building	638	362	613	367	997	760	587
Restaurant	418	236	401	240	652	496	384
Retail - Department Store	322	182	309	184	502	382	296
Retail - Strip Mall	223	126	214	128	348	265	205
Convenience Store	292	166	281	168	456	347	269
Elementary School	300	171	288	172	469	357	276
High School	294	167	282	169	459	349	270
College/ University	349	197	334	201	545	414	320
Healthcare Clinic	290	164	278	167	453	345	267
Lodging (Hotel/Motel)	335	190	321	192	522	398	308
Manufacturing	144	82	139	83	226	172	133
Special Assembly Auditorium	476	270	456	273	742	566	437
Other	315	179	303	181	492	375	290
Enclosed Parking Garage	757	429	727	436	1182	900	696

Electric Heating Savings with Heat Pump Associated with DCV (ΔkWh/kSF)[3]

	(kWh/kSF)$_{DCV,heat}$						
Building Type	**Albany**	**Binghamton**	**Buffalo**	**Massena**	**NYC**	**Poughkeepsie**	**Syracuse**
Office - Low-rise (1 to 3 Stories)	206	234	207	261	147	201	213
Office - Mid-rise (4 to 11 Stories)	138	158	140	175	99	135	143
Office - High-rise (12+ Stories)	186	211	187	235	133	181	192
Religious Building	1,339	1,521	1,348	1,698	958	1,308	1,382
Restaurant	967	1,097	973	1,226	691	943	998
Retail - Department Store	331	375	332	419	236	322	341

[2] Deemed savings calculated based on IL TRM V11 (4.4.19 Demand Controlled Ventilation, pg. 357) values for Chicago, adjusted by the ratio of Cooling Degree Days for each listed NY city and Chicago, based on NCEI 1991 – 2020 Climate Normals using base 65º balance point as detailed in "Advanced RTU Control – Weather Normalized DCV Savings.xlsx"

[3] Ibid.

(kWh/kSF)$_{DCV,heat}$							
Building Type	**Albany**	**Binghamton**	**Buffalo**	**Massena**	**NYC**	**Poughkeepsie**	**Syracuse**
Retail - Strip Mall	217	245	217	274	154	211	223
Convenience Store	164	186	165	208	117	160	169
Elementary School	575	653	579	728	411	561	593
High School	561	637	564	710	401	548	578
College/ University	1,120	1,272	1,127	1,419	801	1,093	1,156
Healthcare Clinic	398	452	400	504	285	389	410
Lodging (Hotel/Motel)	185	210	186	234	133	180	191
Manufacturing	114	130	115	145	82	112	119
Special Assembly Auditorium	1,572	1,785	1,582	1,992	1,123	1,534	1,623
Other	538	611	541	682	384	525	555

Electric Heating Savings with Electric Resistance Associated with DCV (ΔkWh/kSF)[4]

(kWh/kSF)$_{DCV,heat}$							
Building Type	**Albany**	**Binghamton**	**Buffalo**	**Massena**	**NYC**	**Poughkeepsie**	**Syracuse**
Office - Low-rise (1 to 3 Stories)	618	702	622	783	442	603	638
Office - Mid-rise (4 to 11 Stories)	415	472	418	526	296	406	428
Office - High-rise (12+ Stories)	557	633	560	705	398	544	574
Religious Building	4,018	4,564	4,045	5,094	2,873	3,922	4,148
Restaurant	2,900	3,293	2,919	3,676	2,073	2,831	2,994
Retail - Department Store	992	1,127	998	1,257	709	968	1,023
Retail - Strip Mall	650	737	653	823	464	634	670
Convenience Store	490	557	493	622	351	479	506
Elementary School	1,723	1,958	1,735	2,184	1,233	1,682	1,779
High School	1,681	1,909	1,692	2,131	1,202	1,641	1,735
College/ University	3,357	3,814	3,380	4,255	2,400	3,277	3,466
Healthcare Clinic	1,194	1,356	1,202	1,513	853	1,166	1,232
Lodging (Hotel/Motel)	554	629	557	702	396	541	572
Manufacturing	344	391	347	436	247	336	356
Special Assembly Auditorium	4,714	5,354	4,745	5,975	3,370	4,601	4,866
Other	1,614	1,833	1,624	2,045	1,154	1,575	1,666

Fuel Savings Associated with DCV (ΔMMBtu/kSF)[5]

(MMBtu/kSF)$_{DCV}$							
Building Type	**Albany**	**Binghamton**	**Buffalo**	**Massena**	**NYC**	**Poughkeepsie**	**Syracuse**
Office - Low-rise (1 to 3 Stories)	2.6	2.9	2.6	3.3	1.9	2.5	2.7
Office - Mid-rise (4 to 11 Stories)	1.8	2.0	1.8	2.3	1.3	1.8	1.9
Office - High-rise (12+ Stories)	2.4	2.7	2.4	3.1	1.8	2.4	2.5

[4] Ibid.
[5] Ibid.

(MMBtu/kSF)$_{DCV}$							
Building Type	**Albany**	**Binghamton**	**Buffalo**	**Massena**	**NYC**	**Poughkeepsie**	**Syracuse**
Religious Building	17.2	19.5	17.3	21.8	12.3	16.7	17.7
Restaurant	12.4	14.1	12.4	15.7	8.9	12.0	12.8
Retail - Department Store	4.2	4.8	4.3	5.3	3.0	4.1	4.4
Retail - Strip Mall	2.9	3.2	2.8	3.5	2.0	2.7	2.9
Convenience Store	2.1	2.4	2.1	2.7	1.5	2.1	2.2
Elementary School	7.3	8.3	7.4	9.3	5.3	7.2	7.6
High School	7.2	8.1	7.2	9.1	5.1	7.0	7.3
College/ University	14.4	16.3	14.4	18.2	10.2	14.0	14.8
Healthcare Clinic	5.2	5.8	5.1	6.5	3.7	5.0	5.3
Lodging (Hotel/Motel)	2.3	2.6	2.3	3.0	1.7	2.3	2.4
Manufacturing	1.5	1.7	1.6	1.9	1.1	1.5	1.6
Special Assembly Auditorium	20.1	22.8	20.3	25.5	14.3	19.6	20.8
Other	6.9	7.7	6.9	8.7	4.9	6.7	7.0

Coincidence Factor (CF)

The prescribed coincidence factor for this measure is N/A.

Baseline Efficiencies from which Energy Savings are Calculated

The baseline case for this measure is a single zone, packaged rooftop HVAC unit with a single speed fan, and no occupancy-based ventilation or dual enthalpy economizer controls.

Compliance Efficiency from which Incentives are Calculated

The compliance case for this measure is the installation of an advanced rooftop controller consisting of a DCV system, multi or variable speed supply fan, and a dual enthalpy control air-side economizer on a single zone, packaged rooftop HVAC unit.

The efficient condition must comply with all applicable provisions of federal, state, local and municipal mechanical/ventilation and construction code, including but not limited to section C403.2.6.1 of ECCCNYS and section 402 of NYS Mechanical Code.

Operating Hours

HVAC system operating hours are embedded into the deemed savings shown in Appendix J and vary by building type for economizers. Similarly, HVAC system operating hours are embedded into the deemed savings provided for the DCV component. For fan operation annual hours shall come from application. If unknown, assume fan operating hours align with the operating hours prescribed in the C&I Interior and Exterior Lighting measure found in this document, based on facility type.

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

An advanced rooftop control system is installed on a 25 ton constant volume, rooftop HVAC unit with a single-speed supply fan at a 10,000 square foot small office building located near Albany. The AC fan motor has a rated horsepower of 7.5 hp and is estimated to run approximately 3,500 hours per year. The building is gas-heated. Annual Electric Energy Savings, Summer Peak Coincident Demand Savings and Annual Fossil Fuel Energy Savings are calculated as below.

$$\Delta kWh = \Delta kWh_{fan} + \Delta kWh_{DCV} + \Delta kWh_{Econ}$$

$$\Delta kWh_{fan} = hp \times ESF_{fan} \times hrs$$

$$\Delta kWh_{DCV} = \frac{ft^2}{1{,}000} \times \left(\frac{\Delta kWh}{1000\ ft^2}\right)_{DCV,cool} + \frac{ft^2}{1{,}000} \times \left(\frac{\Delta kWh}{1000\ ft^2}\right)_{DCV,heat} \times F_{ElecHeat}$$

$$\Delta kWh_{Econ} = tons \times (\Delta kWh/\text{ton})_{Econ}$$

$$\Delta MMBtu = \frac{ft^2}{1{,}000} \times \left(\frac{\Delta MMBtu}{1000\ ft^2}\right)_{DCV} \times F_{FuelHeat}$$

hp = 7.5, from application
ESF_{fan} = 0.580, from Summary of Variables and Data Sources table
hrs = 3,500, from application
ft^2 = 10,000, from application
$(\Delta kWh/1000ft^2)_{DCV,cool}$ = 237, from Electric Cooling Savings Associated with DCV table based on location and building type from application
$(\Delta kWh/1000ft^2)_{DCV,heat}$ = N/A
$F_{ElecHeat}$ = 0, from Summary of Variables and Data Sources table based on application
Tons = 25, from application
$(\Delta kWh/ton)_{Econ}$ = 202, from Appendix J based on location and building type from application
$(\Delta MMBtu/1000ft^2)_{DCV}$ = 2.6, from Fuel Savings Associated with DCV table based on location and building type from application
$F_{FuelHeat}$ = 1, from Summary of Variables and Data Sources table based on application

$$\Delta kWh_{fan} = 7.5 \times 0.580 \times 3{,}500 = 15{,}225\ kWh$$

$$\Delta kWh_{DCV} = \frac{10{,}000}{1{,}000} \times 237 + \frac{10{,}000}{1{,}000} \times N/A \times\ 0 =\ 2{,}370\ kWh$$

$$\Delta kWh_{Econ} = 25 \times 202 = 5{,}050\ kWh$$

$$\Delta kWh = 15{,}225 + 2{,}370 + 5{,}050 = 22{,}645\ kWh$$

$$\Delta MMBtu = \frac{10{,}000}{1{,}000} \times\ 2.6 \times 1 = 26\ MMBtu$$

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. ECCCNYS 2020; C403.2.2 Ventilation.
   Available from: https://codes.iccsafe.org/content/NYSECC2020P1/chapter-4-[ce]-commercial-energy-efficiency#NYSECC2020P1_CE_Ch04_SecC403
2. NYSMC 2020 402 Natural Ventilation.
   Available from: https://codes.iccsafe.org/content/NYSMC2020P1/chapter-4-ventilation
3. Advanced Rooftop Control (ARC) Retrofit: Field-Test Results, PNNL22656. U.S. Department of Energy, July 2013.
   Available from: https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-22656.pdf
4. IL TRM Version 11.0 (4.4.19 Demand Controlled Ventilation, pg. 357), September 22, 2022, used to inform weather normalized DCV component savings.
   Available from: https://www.ilsag.info/wp-content/uploads/IL-TRM-Version-11.0-Volumes-1-4-Compiled-Final.pdf
5. Advanced RTU Control – Weather Normalized DCV Savings.xlsx
   Available from: *To be published on DMM.*

Record of Revision

Record of Revision Number	Issue Date
7-20-13	7/31/2020
7-21-16	8/30/2021
9-23-3	10/31/2023

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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[6]
	Clothes Dryer (incl. Heat Pump Clothes Dryer)	Residential	14	ENERGY STAR® M&I Scoping Report[7]
	Clothes Washer	Residential	11	DEER 2014 EUL ID: Appl-EffCW
	Dehumidifier	Residential	12	ENERGY STAR® Calc[8]
	Dishwasher	Residential	11	DEER 2014 EUL ID: Appl-EffDW
	Fireplace	Residential	15	DOE[9]
	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[10]
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

[6] Savings Calculator for ENERGY STAR® Qualified Appliances (last updated October 2016). https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/save-energy/purchase-energy-saving-products

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

[8] ENERGY STAR® Dehumidifier Calculator. https://www.energystar.gov/ia/partners/promotions/cool_change/downloads/CalculatorConsumerDehumidifier.xls

[9] 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

[10] Retail Products Platform Product Analysis, Last Updated May 25, 2016. https://www.energystar.gov/sites/default/files/asset/document/ESPPM_Increasing%20the%20Volume%20on%20Sound%20Bars_Littlehales.pdf

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[11]
	Air Leakage Sealing	Residential	15	GDS[12]
	Attic Access Insulation & Sealing	Residential	15	GDS[13]
	Insulation – Hot Water and Steam Pipe	Residential	15	GDS[14]
	Insulation – Opaque Shell	Residential	25	GDS[15]
	Plastic Window Insulation	Residential	1	See Note[16]
	Storm Window	Residential	20	DOE[17]
	Window	Residential	20	DEER 2014 EUL ID: BS-Win
	Window - Film	Residential	10	DEER 2014 EUL ID: Glaz-Daylt-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 Group[18]
	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 Valve	Residential	10	UPC[19]

[11] Average/typical manufacturer warranty period for AC covers.
[12] GDS Associates, Inc., Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007, Table 1 – Residential Measures.
[13] Ibid.
[14] Ibid.
[15] Ibid.
[16] 1 year is assumed to be the EUL since plastic window insulation comes in the form of single-use kits that are disposed of when the heating season ends.
[17] https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-22864rev2.pdf
[18] PA Consulting Group Inc., Focus on Energy Evaluation Business Programs: Measure Life Study, final report dated August 25, 2009. https://focusonenergy.com/sites/default/files/bpmeasurelifestudyfinal_evaluationreport.pdf
[19] 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[20]
	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[21]
	Boiler and Furnace - Combination ("Combi") Furnace	Residential	20	DEER 2014[22] 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

[20] GDS Associates, Inc., Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007, Table 1 – Residential Measures.
[21] 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.
https://energy.mo.gov/sites/energy/files/technical-support-document---residential-furances_doe.pdf
[22] 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[23]
	Furnace, Gas Fired	Residential	22	DOE[24,25]
	Gas Heat Pump	Residential	15	DEER 2014 EUL ID: HV-Res HP
	Heat Pump - Air Source (ASHP) and Air-to-Water (AWHP)	Residential	15	DEER 2014 EUL ID: HV-Res HP
	Heat Pump – Ground Source (GSHP)	Residential	25	ASHRAE[26]
	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-Ref-Chrg
	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
	Advanced Boiler Control	Residential	EUL = Boiler RUL = Boiler EUL – (Current Year – Mfr. Year) **Default = 5**	N/A

[23] PA Consulting Group Inc., Focus on Energy Evaluation Business Programs: Measure Life Study, final report dated August 25, 2009. https://focusonenergy.com/sites/default/files/bpmeasurelifestudyfinal_evaluationreport.pdf
[24] 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. https://www.regulations.gov/document?D=EERE-2014-BT-STD-0031-0217
[25] U.S. DOE. "Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial Warm Air Furnaces." December 30, 2015. https://www.regulations.gov/document?D=EERE-2013-BT-STD-0021-0050
[26] 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	Outdoor Temperature Setback Control for Hydronic Boiler	Residential	EUL = Boiler RUL = Boiler EUL – (Current Year – Mfr. Year) **Default = 5**	N/A
	Steam Trap – Low Pressure Space Heating	Residential	6	DEER 2014 EUL ID: HVAC-StmTrp
	Submetering	Multifamily	10	NYSERDA[27]
	Thermostat – All Types	Residential	11	DEER 2014 EUL ID: HVAC-ProgTStats
	Thermostatic Radiator Valve – One Pipe Steam Radiator	Multifamily	15	DOE[28]
	Smart Thermostatic Radiator Enclosure	Residential	15	DEER 2014 EUL ID: Motors-fan[29]
Lighting[30]	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[31]

[27] NYSERDA Residential Electric Submetering Manual.
[28] U.S. DOE, "Thermostatic Radiator Valve Evaluation", January 2015, Table 4. pg. 16.
[29] Based on assumed EUL of integrated fan, which is expected to be the first component to fail.
[30] 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
[31] ENERGY STAR® Program Requirements Product Specification for Lamps (Light Bulbs) V2.1, June 2017, pg. 19 (Capped at 20 years). https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Lamps%20V2.1%20Final%20Specification.pdf

Category	Single and Multi-family Residential Measures		Sector	EUL (years)	Source
Lighting[32]	Light Fixture		Residential LED (Interior)	50,000 hours	DLC[33]
				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
	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[34]
		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[35]

[32] 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

[33] 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.

[34] ENERGY STAR® Program Requirements Product Specification for Luminaires (Light Fixtures) V2.2, August 2019, pg. 18 (Capped at 20 years). https://www.energystar.gov/sites/default/files/Luminaires%20V2.2%20Final%20Specification.pdf

[35] ComEd Luminaire Level Lighting Control IPA Program Impact Evaluation Report prepared by Navigant. https://www.ilsag.info/wp-

Category	Single and Multi-family Residential Measures	Sector	EUL (years)	Source
	Connected Lighting	Residential	3	GE and Philips Hue Bridge[36]
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[37]
	Solar Pool Heater	Residential	15	DOE[38]

content/uploads/SAG_files/Evaluation_Documents/ComEd/ComEd_EPY9_Evaluation_Reports_Final/ComEd_PY9_LLLC_IPA_Program_Impact_Evaluation_Report_2018-06-05_Final.pdf

[36] 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)

[37] DOE, Chapter 8, Life-Cycle Cost and Payback Period Analyses, Table 8.75. https://www.regulations.gov/document?D=EERE-2006-STD-0129-0170

[38] 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[39]
	Livestock Waterer	C&I	10	PA Consulting Group[40]
	Milk Pre-Cooler Heat Ex-changer	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-Scroll-Comp
Agricultural Equipment - Control	Engine Block Heater Timer	C&I	8	See note below[41]
	Variable Speed Drive Milk Pump Plate Cooler	C&I	15	PA Consulting Group[42]
	Variable Speed Drive Vacuum Pump	C&I	15	PA Consulting Group[43]
Appliance	Air Purifier	C&I	9	ENERGY STAR® Calc[44]
	Clothes Dryer	C&I	14	ENERGY STAR®M&I Report[45]
	Clothes Washer	C&I	11	DEER 2014 EUL ID: Appl-EffCW
	Cooking Equipment[46]	C&I	12	DEER 2014 EUL IDs: Various
	Dehumidifier	C&I	12	ENERGY STAR® Calc[47]
	Dishwasher	C&I	10 – Under Counter 15 – Single Door 20 – Conveyor Type 10 – Pots, Pans & Utensils	ENERGY STAR®Calc[48]

[39] PG&E Work Paper PGE3PAGR117, October 12, 2017.
[40] PA Consulting Group Inc., Focus on Energy Evaluation Business Programs: Measure Life Study, final report dated August 25, 2009. https://focusonenergy.com/sites/default/files/bpmeasurelifestudyfinal_evaluationreport.pdf
[41] Based on EUL's for Advanced Power Strips.
[42] PA Consulting Group Inc., Focus on Energy Evaluation Business Programs: Measure Life Study, final report dated August 25, 2009. https://focusonenergy.com/sites/default/files/bpmeasurelifestudyfinal_evaluationreport.pdf
[43] PA Consulting Group Inc., Focus on Energy Evaluation Business Programs: Measure Life Study, final report dated August 25, 2009. https://focusonenergy.com/sites/default/files/bpmeasurelifestudyfinal_evaluationreport.pdf
[44] Savings Calculator for ENERGY STAR® Qualified Appliances (last updated October 2016). https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/save-energy/purchase-energy-saving-products
[45] ENERGY STAR® Market & Industry Scoping Report: Residential Clothes Dryer, November 2011.
[46] Applicable to all kitchen cooking equipment not otherwise listed.
[47] ENERGY STAR® Dehumidifier Calculator. https://www.energystar.gov/ia/partners/promotions/cool_change/downloads/CalculatorConsumerDehumidifier.xls
[48] 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
Appliance	Fireplace	C&I	15	DOE[49]
	Ice Maker	C&I	10	DEER 2014 EUL ID: Cook-IceMach
	Induction Cooktop	C&I	16	DEER 2014 EUL ID: Appl-Elec_Cook-ing
	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 Re-cycling	Air Conditioner – Room (RAC)	C&I	3	DEER 2014 EUL ID: HV-RAC-RUL
Building Shell	Air Curtains	C&I	15	DEER 2014 EUL ID: Motors-fan
	Air Leakage Sealing	C&I	15	GDS[50]
	Insulation - Hot Water and Steam Pipe	C&I	15	GDS[51]
	Insulation - Opaque Shell	C&I	30	ET & CEC[52]
	Window - Film	C&I	10	DEER 2014 EUL ID: GlazDaylt-Win-Film
	Window - Glazing	C&I	20	DEER 2014 EUL ID: BS-Win
Compressed Air	Air Compressor	C&I	13	Other State TRMs[53]
	Engineered Air Nozzle	C&I	15	Wisconsin PSC[54]
	No Air Loss Water Drain	C&I	13	MA Measure Life Study[55]
	Refrigerated Air Dryer	C&I	13	Other State TRMs [56]
	Compressed Air Heat Recovery	C&I	13	Other State TRMs [57]
	Flow Controller	C&I	13	Other State TRMs [58]

[49] 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

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

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

[52] Energy Trust uses 30 years for commercial applications. CEC uses 30 years for insulation in Title 24 analysis.

[53] 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.

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

[55] 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

[56] 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.

[57] Ibid.

[58] Ibid.

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
Compressed Air	Low Pressure Drop Filter	C&I	5	Navigant EUL Report [59]
Domestic Hot Water (DHW)	Heat Pump Water Heater (HPWH)	C&I	15	DEER 2014 EUL ID: WtrHt-Com
	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[60]
	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[61]
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[62]
	Boiler and Furnace -Combination ("Combi") Furnace	C&I	20	DEER 2014[63] 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

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

[60] 2019 Title 24, Part 6 CASE Report. "Drain Water Heat Recovery – Final Report." http://title24stakeholders.com/wp-content/uploads/2017/09/2019-T24-CASE-Report_DWHR_Final_September-2017.pdf

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

[62] Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Residential Furnaces, February 10, 2015, Table 8.2.17. https://energy.mo.gov/sites/energy/files/technical-support-document---residential-furances_doe.pdf

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

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
Heating, Ventilation and Air Conditioning (HVAC)	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- ClT-wrPkgSys
	Condensing Unit Heater	C&I	18	Ecotope[64]
	Duct Sealing and Insulation	C&I	18	DEER 2014 EUL ID: HVAC-DuctSeal
	Economizer –Dual Enthalpy Air Side	C&I	10	DEER 2014 EUL ID: HVAC-addEcono
	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
	Energy and Heat Recovery Ventilator	C&I	14	PA Consulting Group[65]
	Furnace, Gas Fired	C&I	23	DOE[66,67]
	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 – Ground Source (GSHP)	C&I	25	ASHRAE[68]
	High Volume Low Speed Fan	C&I	15	PA Consulting Group[69]
	Infrared Heater	C&I	17	GDS[70]

[64] Ecotope Natural Gas Efficiency and Conservation Measure Resource Assessment (2003).
[65] PA Consulting Group Inc., Focus on Energy Evaluation Business Programs: Measure Life Study, final report dated August 25, 2009. https://focusonenergy.com/sites/default/files/bpmeasurelifestudyfinal_evaluationreport.pdf
[66] 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. https://www.regulations.gov/document?D=EERE-2014-BT-STD-0031-0217
[67] U.S. DOE. "Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial Warm Air Furnaces." December 30, 2015. https://www.regulations.gov/document?D=EERE-2013-BT-STD-0021-0050
[68] ASHRAE Owning and Operating Cost Database. https://xp20.ashrae.org/publicdatabase/system_service_life.asp?selected_system_type=1
[69] PA Consulting Group Inc., Focus on Energy Evaluation Business Programs: Measure Life Study, final report dated August 25, 2009. https://focusonenergy.com/sites/default/files/bpmeasurelifestudyfinal_evaluationreport.pdf
[70] GDS Associates, Inc. "Natural Gas Efficiency Potential Study." DTE Energy. July 29, 2016. https://www.michigan.gov/documents/mpsc/DTE_2016_NG_ee_potential_study_w_appendices_vFINAL_554360_7.pdf

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
Heating, Ventilation and Air Conditioning (HVAC)	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[71]
	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
	Advanced Rooftop Control	C&I	EUL = RUL of Existing RTU = RTU EUL – (Current Year – Year of Mfr.) **Default = 5**	N/A
	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[72]
	Kitchen Demand Ventilation Control	C&I	15	PG&E[73]
	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

[71] Wisconsin Public Service Commission: Equipment Useful Life Database, 2013. https://focusonenergy.com/sites/default/files/bpmeasurelifestudyfinal_evaluationreport.pdf
[72] Natural Gas Energy Efficiency Potential in Massachusetts, GDS Associates, 2009. https://ma-eeac.org/wp-content/uploads/5_Natural-Gas-EE-Potenial-in-MA.pdf
[73] PG&E Work Paper WPSDGENRCC0019, June 15, 2012.

Category	Commercial & Industrial Measures		Sector	EUL (years)	Source
HVAC – Control	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[74]
Lighting[75]	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[76]
		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®[77]
		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®[78]
		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®[79]

[74] U.S. DOE. "Thermostatic Radiator Valve Evaluation." January 2015. https://www.nrel.gov/docs/fy15osti/63388.pdf

[75] 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

[76] 50,000 hours per L_{70} requirements prescribed by the DLC's Product Qualification Criteria, Technical Requirement Table version 4.4.

[77] Placed on the Qualified Fixture List by ENERGY STAR®, according to the appropriate luminaire classification as specified in the ENERGY STAR® Program with C&I redecoration and business type change patterns).

[78] Ibid. requirements for Luminaires, version 2.1. Divided by estimated annual use, but capped at 20 years regardless (consistent

[79] Ibid.

Category	Commercial & Industrial Measures		Sector	EUL (years)	Source
Lighting[80]	Light Fixture	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
	LED Lamp		C&I	50,000 hours	DLC[81]
				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 Exit Signs & Open Signs		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[82]
Lighting - Control	Bi-Level Lighting		C&I	15	ComEd[83]
	Integrated Interior Control		C&I	15	ComEd[84]
	Non-Integrated Interior Control		C&I	10	GDS[85]
	Plug-Load Occupancy Sensor		C&I	8	DEER[86]
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

[80] 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

[81] 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.

[82] 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. https://energy.mo.gov/sites/energy/files/measure-life-report-2007.pdf

[83] ComEd Luminaire Level Lighting Control IPA Program Impact Evaluation Report prepared by Navigant. https://www.ilsag.info/wp-content/uploads/SAG_files/Evaluation_Documents/ComEd/ComEd_EPY9_Evaluation_Reports_Final/ComEd_PY9_LLLC_IPA_Program_Impact_Evaluation_Report_2018-06-05_Final.pdf

[84] Ibid.

[85] Measure Life Report, Residential and Commercial/Industrial/Industrial Lighting and HVAC Measures, GDS Associates, June 2007. https://energy.mo.gov/sites/energy/files/measure-life-report-2007.pdf

[86] DEER value for lighting occupancy sensors.

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
Motors and Drives	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-VSDSup-Fan
	Elevator Modernization	C&I	15	DEER 2014[87]
Other	Building Operator Certification	C&I	13	ComEd[88]
	Heat Pump Pool Heater	C&I	15	DEER 2014 EUL ID: HV-Res HP
	High Efficiency Transformer	C&I	32	DOE[89]
	High Frequency Battery Charger	C&I	15	PG&E[90]
	High Viscosity Industrial Lubricant	C&I	10	ExxonMobil[91]
	Pool Heater	C&I	8	DOE[92]
	Solar Pool Cover	C&I	5	CALMAC[93]
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[94]
	Process Exhaust Filtration	C&I	15	CIBSE[95]
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

[87] Assumes same EUL as VFD measure.
[88] Average measure life of capital measures from the ComEd CY2020 evaluation.
[89] https://www.federalregister.gov/documents/2019/06/18/2019-12761/energy-conservation-program-energy-conservation-standards-for-distribution-transformers
[90] https://www.kannahconsulting.com/wp-content/uploads/2016/08/2010-10-11_Battery_Charger_Title_20_CASE_Report_v2-2-2.pdf, pg. 43.
[91] Information presented in the ExxonMobil study is confidential.
[92] DOE, Chapter 8, Life-Cycle Cost and Payback Period Analyses, Table 8.75. https://www.regulations.gov/document?D=EERE-2006-STD-0129-0170
[93] http://www.calmac.org/publications/PoolCoverReport_2015_Final_Report_Appendices.pdf
[94] PG&E Work Paper PGECOAPP123, August 22, 2017.
[95] 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. https://www.cibse.org/knowledge-research/knowledge-portal/probabilistic-estimation-of-service-life

Category	Commercial & Industrial Measures	Sector	EUL (years)	Source
Refrigeration	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-FEvap-FanMtr
	Refrigerated Case Door	C&I	12	DEER 2014 EUL ID: GrocDisp-FixtDoors
	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 [96]

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_Measure-LifeStudyLights%2526HVACGDS_1Jun2007.pdf

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[96] 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
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
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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9-23-5	10/31/2023

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