## Table of Revisions/Changes

| Revision Number | Addition/ Revision | Issue Date | Effective Date | Measure | Description of Change | Location/Page in TRM |
|---|---|---|---|---|---|---|
| 9-19-2 | A | 9/27/2019 | 9/27/2019 | R/MF Window – Low-E Strom | New Measure Added | Pg. xx |
| 9-19-7 | A | 9/27/2019 | 9/27/2019 | C/I Elevator Modernization | New Measure Added | Pg. xx |
| 9-19-10 | R | 9/27/2019 | 9/27/2020 | Appendix P | Updated EUL entries for all measures contained in this Record of Revision | Pg. 765 |

**Note:** Revisions and additions to the measures listed above were undertaken by the Joint Utilities Technical Resource Manual (TRM) Management Committee between June 29, 2019 – September 27, 2019.

## *BUILDING SHELL*

### WINDOW - LOW-E STORM

**Measure Description**

This measure covers the installation of storm windows with low-emissivity (low-e) glass on existing single or double pane windows. Low-e windows are designed to allow the optimal amount of solar heat through windows and lower infiltration rates to reduce passive convective heat transfer between conditioned and unconditioned spaces or outside air, thereby reducing heating and cooling loads and improving occupant comfort. Energy and demand saving are realized through reductions in the building's heating and cooling loads.

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

*Annual Electric Energy Savings*

$$\Delta kWh = units \times (\Delta kWh/SF) \times SF$$

*Summer Peak Coincident Demand Savings*

$$\Delta kW = units \times (\Delta kW/SF) \times SF \times CF$$

*Annual Gas Energy Savings*

$$\Delta therms = units \times (\Delta therms/SF) \times SF$$

**where:**

| | |
|---|---|
| ΔkWh | = Annual electricity energy savings |
| ΔkW | = Peak coincident demand electric savings |
| Δtherms | = Annual gas energy savings |
| units | = Number of measures installed under the program |
| (ΔkWh/SF) | = Annual electricity energy savings per square foot of installed storm window |
| (ΔkW/SF) | = Summer peak coincident demand savings per square foot of installed storm window |
| (Δtherm/SF) | = Annual gas energy savings per square foot of installed storm window |
| SF | = Total area of storm window, in square feet |
| CF | = Coincidence factor |

**Summary of Variables and Data Sources**

| Variable | Value | Notes |
|---|---|---|
| (ΔkWh/SF) | | Lookup in table below based on location, window configuration and HVAC type. |
| (ΔkW/SF) | | Lookup in table below based on location, window configuration and HVAC type. |

| Variable | Value | Notes |
|---|---|---|
| (Δtherm/SF) | | Lookup in table below based on location, window configuration and HVAC type. |
| SF | | From application. |
| CF | 0.69 | |

Unit Energy and Demand Savings

Unit energy and demand savings were derived using LBNL's RESFEN V6.0 software. For additional detail on the derivation of these values, refer to the "NY TRM Residential Low-E Storm Window Supplement.xlsx" workbook.

| City | Baseline Window | HVAC System | ΔkWh/ 100 SF | ΔkW/ 100 SF | Δtherms/ 100 SF |
|---|---|---|---|---|---|
| Albany | Single-Pane | AC w/ Gas Heat | 57 | 0.16 | 72.8 |
| | | Heat Pump | 745 | 0.16 | 0.0 |
| | | AC w/ Resistance Heat | 1,432 | 0.16 | 0.0 |
| | | Gas Heat Only | 0 | 0.00 | 72.8 |
| | | Resistance Heat Only | 1,374 | 0.00 | 0.0 |
| | Double-Pane | AC w/ Gas Heat | 52 | 0.11 | 32.5 |
| | | Heat Pump | 364 | 0.11 | 0.0 |
| | | AC w/ Resistance Heat | 677 | 0.11 | 0.0 |
| | | Gas Heat Only | 0 | 0.00 | 32.5 |
| | | Resistance Heat Only | 625 | 0.00 | 0.0 |
| Binghamton | Single-Pane | AC w/ Gas Heat | 30 | 0.18 | 80.7 |
| | | Heat Pump | 810 | 0.18 | 0.0 |
| | | AC w/ Resistance Heat | 1,589 | 0.18 | 0.0 |
| | | Gas Heat Only | 0 | 0.00 | 80.7 |
| | | Resistance Heat Only | 1,560 | 0.00 | 0.0 |
| | Double-Pane | AC w/ Gas Heat | 30 | 0.13 | 35.7 |
| | | Heat Pump | 379 | 0.13 | 0.0 |
| | | AC w/ Resistance Heat | 729 | 0.13 | 0.0 |
| | | Gas Heat Only | 0 | 0.00 | 35.7 |
| | | Resistance Heat Only | 699 | 0.00 | 0.0 |
| Buffalo | Single-Pane | AC w/ Gas Heat | 47 | 0.18 | 75.7 |
| | | Heat Pump | 758 | 0.18 | 0.0 |
| | | AC w/ Resistance Heat | 1,468 | 0.18 | 0.0 |
| | | Gas Heat Only | 0 | 0.00 | 75.7 |
| | | Resistance Heat Only | 1,421 | 0.00 | 0.0 |
| | Double-Pane | AC w/ Gas Heat | 44 | 0.12 | 33.7 |
| | | Heat Pump | 361 | 0.12 | 0.0 |
| | | AC w/ Resistance Heat | 678 | 0.12 | 0.0 |
| | | Gas Heat Only | 0 | 0.00 | 33.7 |
| | | Resistance Heat Only | 634 | 0.00 | 0.0 |

| City | Baseline Window | HVAC System | ΔkWh/ 100 SF | ΔkW/ 100 SF | Δtherms/ 100 SF |
|---|---|---|---|---|---|
| Massena | Single-Pane | AC w/ Gas Heat | 46 | 0.17 | 83.3 |
| | | Heat Pump | 1,058 | 0.17 | 0.0 |
| | | AC w/ Resistance Heat | 2,069 | 0.17 | 0.0 |
| | | Gas Heat Only | 0 | 0.00 | 83.3 |
| | | Resistance Heat Only | 2,023 | 0.00 | 0.0 |
| | Double-Pane | AC w/ Gas Heat | 42 | 0.11 | 37.5 |
| | | Heat Pump | 502 | 0.11 | 0.0 |
| | | AC w/ Resistance Heat | 962 | 0.11 | 0.0 |
| | | Gas Heat Only | 0 | 0.00 | 37.5 |
| | | Resistance Heat Only | 920 | 0.00 | 0.0 |
| NYC | Single-Pane | AC w/ Gas Heat | 70 | 0.19 | 57.0 |
| | | Heat Pump | 531 | 0.19 | 0.0 |
| | | AC w/ Resistance Heat | 991 | 0.19 | 0.0 |
| | | Gas Heat Only | 0 | 0.00 | 57.0 |
| | | Resistance Heat Only | 921 | 0.00 | 0.0 |
| | Double-Pane | AC w/ Gas Heat | 61 | 0.13 | 23.8 |
| | | Heat Pump | 259 | 0.13 | 0.0 |
| | | AC w/ Resistance Heat | 457 | 0.13 | 0.0 |
| | | Gas Heat Only | 0 | 0.00 | 23.8 |
| | | Resistance Heat Only | 396 | 0.00 | 0.0 |
| Poughkeepsie | Single-Pane | AC w/ Gas Heat | 64 | 0.18 | 64.9 |
| | | Heat Pump | 638 | 0.18 | 0.0 |
| | | AC w/ Resistance Heat | 1,212 | 0.18 | 0.0 |
| | | Gas Heat Only | 0 | 0.00 | 64.9 |
| | | Resistance Heat Only | 1,148 | 0.00 | 0.0 |
| | Double-Pane | AC w/ Gas Heat | 56 | 0.12 | 28.1 |
| | | Heat Pump | 312 | 0.12 | 0.0 |
| | | AC w/ Resistance Heat | 567 | 0.12 | 0.0 |
| | | Gas Heat Only | 0 | 0.00 | 28.1 |
| | | Resistance Heat Only | 511 | 0.00 | 0.0 |
| Syracuse | Single-Pane | AC w/ Gas Heat | 49 | 0.14 | 74.0 |
| | | Heat Pump | 771 | 0.14 | 0.0 |
| | | AC w/ Resistance Heat | 1,494 | 0.14 | 0.0 |
| | | Gas Heat Only | 0 | 0.00 | 74.0 |
| | | Resistance Heat Only | 1,445 | 0.00 | 0.0 |
| | Double-Pane | AC w/ Gas Heat | 43 | 0.10 | 33.1 |
| | | Heat Pump | 366 | 0.10 | 0.0 |
| | | AC w/ Resistance Heat | 689 | 0.10 | 0.0 |
| | | Gas Heat Only | 0 | 0.00 | 33.1 |
| | | Resistance Heat Only | 647 | 0.00 | 0.0 |

### Coincidence Factor (CF)

The prescribed value for the coincidence factor is 0.69.[1]

### Baseline Efficiencies from which Energy Savings are Calculated

The baseline case for this measure is a single or double-pane window unit with clear glass without storm windows.

Unit energy and demand savings were derived using LBNL's RESFEN V6.0 software. Single and two-story houses were modeled assuming glazing area equal to 15% of total home floor area. The homes were modeled for the cities both without storm windows and with low-e storm windows with different emissivity ratings. The analysis assumes an equal weighting between three low-E storm window glass options. For reference, the Emissivity, Solar Transmission, U-factor and Solar Heat Gain Coefficient (SHGC) of the modeled baseline and low-e storm windows are shown in the table below.

| Window Type | Glass Options (3 mm) | Emissivity | Solar Transmission | U-factor | SHGC |
|---|---|---|---|---|---|
| Low-E | AGC Comfort Select 73 | 0.15 | 0.69 | 0.356 | 0.458 |
| | Guardian IS20 | 0.20 | 0.77 | 0.364 | 0.502 |
| | PPG Sungate 500 | 0.22 | 0.69 | 0.367 | 0.468 |

For additional detail on the derivation of per unit savings values, refer to the "NY TRM Residential Low-E Storm Window Supplement.xlsx" workbook.

### Compliance Efficiency from which Incentives are Calculated

The compliance case is a single or double-pane window unit fitted with low-e storm windows installed outside or inside the window unit. Installed storm windows must meet the minimum compliance criteria required by V1.0 of the ENERGY STAR® Exterior and Interior Storm Windows Product Specification.[2] To qualify, installed storm windows must meet the following specifications:

**Emissivity:** ≤ 0.22
**Solar Transmittance:** > 0.55
**Air Leakage (Exterior Storm Windows):** ≤ 1.5 CFM/SF
**Air Leakage (Interior Storm Windows):** ≤ 0.5 CFM/SF

### Operating Hours

These operating hours assumptions are embedded in the RESFEN prototype models used to derive energy and demand savings values. See the "NY TRM Residential Window Supplement.xlsx"

[1] Based on BG&E 'Development of Residential Load Profile for Central Air Conditioners and Heat Pumps' research, the Maryland Peak Definition coincidence factor is 0.69. This study is not publicly available, but is referenced by the Mid-Atlantic TRM Version 6.0 published May 2016. MD factor used as approximation for NY-specific value.
[2] ENERGY STAR® Product Specification Exterior and Interior Storm Windows, V1.0, September 2018

workbook and RESFEN V6.0 User's Manual for additional detail.[3] Operating hour assumptions for the prototypical building models are described in Appendix A. The heating EFLH for C&I buildings in NY by location, building type and vintage are tabulated in Appendix G.

**Effective Useful Life (EUL)**

See Appendix P.

**Ancillary Fossil Fuel Savings Impacts**

N/A

**Ancillary Electric Savings Impacts**

N/A

**References**


1. ENERGY STAR® Product Specification Exterior and Interior Storm Windows Eligibility Criteria, Version 1.0, September 2018
   Available from:
   https://www.energystar.gov/sites/default/files/Storm%20Window%20Product%20Specification_Final.pdf
2. BG&E: Development of Residential Load Profile for Central Air Conditioners and Heat Pumps, via *Mid-Atlantic Technical Reference Manual Version 9.0*, October 2019 (accessed September 6, 2019)
   Available from:
   https://neep.org/sites/default/files/resources/Mid_Atlantic_TRM_V9_Final_clean_wUpdateSummary%20-%20CT%20FORMAT.pdf
3. LBNL RESFEN6 for Calculating the Heating and Cooling Energy Use of Windows in Residential Buildings, December 2012
   Available from: https://windows.lbl.gov/sites/default/files/Downloads/resfen60-user-manual.pdf


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[3] LBNL RESFEN6 for Calculating the Heating and Cooling Energy Use of Windows in Residential Buildings, December 2012

## *MOTORS AND DRIVES*

### ELEVATOR MODERNIZATION

**Measure Description**

This measure covers the upgrade of existing elevators by replacing critical components in order for elevators to be able to handle new technology, have better performance, and to operate more efficiently. Elevator modernization typically includes motor upgrades, elevator drive system upgrades, and elevator controller replacement. This measure covers the installation of Silicon-Controlled Rectifier (SCR) drives, Pulse Width Modulation (PWM) drives, and Variable Voltage Variable Frequency (VVVF) drives only. Only the following upgrade configurations are applicable to this measure: VVVF drive systems replace PWM systems, VVVF or PWM drive systems replace SCR systems, and VVVF, PWM, or SCR drive systems replace Motor-Generator (M-G) set systems. The drives may either be regenerative or non-regenerative.

This measure is only applicable as a retrofit and only applies to office and multi-family buildings (e.g. small office, large office, low-rise multifamily, high-rise multifamily). This measure does not cover Destination Dispatch optimization technique.

Methods for calculating savings for M-G set baseline systems are presented below separate from SCR or PWM drive baseline systems in order to differentiate the baseline efficiency term as described in the Baseline Efficiency section below, but also to account for AC motor idling energy consumption present in an M-G set drive. There is no idling motor present in PWM or SCR drive systems, and thus no savings associated with idle energy is claimed in those cases.

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

*Annual Electric Energy Savings*

With Motor-Generator set (M-G) as baseline system

$$\Delta kWh = units \times \left[\Delta kWh_{baseline} - \Delta kWh_{ee} + \left(RegenSF \times \Delta kWh_{regen}\right)\right]$$

$$\Delta kWh_{baseline} = \left[\frac{lb_{baseline} \times (1 - OCW_{baseline}) \times (ft/min)_{baseline}}{33{,}000 \times Eff_{hoist}} \times \frac{1}{Eff_{baseline}} \times 0.746 \times LF_{avg} \times hrs\right] + \left[\frac{hp \times 0.746 \times LF_{motor,idle}}{Eff_{baseline}} \times (8{,}760 - hrs) \times F_{idle}\right]$$

$$\Delta kWh_{ee} = \frac{lb_{ee} \times (1 - OCW_{ee}) \times (ft/min)_{ee}}{33{,}000 \times Eff_{hoist}} \times \frac{1}{Eff_{ee}} \times 0.746 \times LF_{avg} \times hrs$$

$$\Delta kWh_{regen} = \frac{lb_{ee} \times (1 - OCW_{ee}) \times (ft/min)_{ee} \times Eff_{ee} \times 0.746}{33{,}000} \times Eff_{regen} \times F_{regen} \times hrs$$

With SCR drive or PWM drive as baseline system

$$\Delta kWh = units \times \left[\Delta kWh_{baseline} - \Delta kWh_{ee} + \left(RegenSF \times \Delta kWh_{regen}\right)\right]$$

$$\Delta kWh_{baseline} = \frac{lb_{baseline} \times (1 - OCW_{baseline}) \times (ft/min)_{baseline}}{33{,}000 \times Eff_{hoist}} \times \frac{1}{Eff_{baseline}} \times 0.746 \times LF_{avg} \times hrs$$

$$\Delta kWh_{ee} = \frac{lb_{ee} \times (1 - OCW_{ee}) \times (ft/min)_{ee}}{33{,}000 \times Eff_{hoist}} \times \frac{1}{Eff_{ee}} \times 0.746 \times LF_{avg} \times hrs$$

$$\Delta kWh_{regen} = \frac{lb_{ee} \times (1 - OCW_{ee}) \times (ft/min)_{ee} \times Eff_{ee} \times 0.746}{33{,}000} \times Eff_{regen} \times F_{regen} \times hrs$$

*Summer Peak Coincident Demand Saving*

With Motor-Generator set (M-G) as baseline system

$$\Delta kW = units \times \left\{ \frac{hp \times 0.746 \times LF_{motor,run}}{Eff_{baseline}} - \frac{lb_{ee} \times (1 - OCW_{ee}) \times (ft/min)_{ee} \times 0.746 \times LF_{peak}}{33{,}000 \times Eff_{hoist} \times Eff_{ee}} \right\}$$

With SCR drive or PWM drive as baseline system

$$\Delta kW = units \times \left\{ \left[ \frac{lb_{baseline} \times (1 - OCW_{baseline}) \times (ft/min)_{baseline}}{Eff_{baseline}} - \frac{lb_{ee} \times (1 - OCW_{ee}) \times (ft/min)_{ee}}{Eff_{ee}} \right] \times \frac{LF_{peak} \times 0.746}{33{,}000 \times Eff_{hoist}} \right\}$$

*Annual Gas Energy Savings*

$$\Delta therms = N/A$$

**where:**

| | |
|---|---|
| ΔkWh | = Annual electric energy savings |
| ΔkW | = Peak coincident demand electric savings |
| Δtherms | = Annual gas energy savings |
| units | = Number of units upgraded under the program |

$_{baseline}$ = Baseline condition or measure
$_{ee}$ = Energy efficient measure
$_{regen}$ = Property of regenerative braking
$_{hoist}$ = Property of elevator hoist system component
RegenSF = Savings Factor for regenerative braking system
lb = Capacity of car
OCW = Overweight of counterbalance as a fraction of car capacity
ft/min = Rated top velocity of car, in ft/min
Eff = Energy efficiency
$LF_{avg}$ = Average load factor
hrs = Annual hours of elevator operation
hp = Horsepower of M-G set motor
$LF_{motor,idle}$ = M-G set motor load factor in idling mode
$F_{idle}$ = Idling factor; used to account for fraction of run hours M-G set system in idling mode
$F_{regen}$ = Regenerative breaking factor; used account for fraction of run hours regenerative braking produces energy savings
$LF_{motor,run}$ = M-G set motor load factor when loaded
$LF_{peak}$ = Peak load factor
0.746 = Conversion factor (kW/hp) 0.746 kW equals one electric horsepower
8,760 = Annual hours
33,000 = Conversion factor ((ft-lb/min)/hp), 33,000 foot-pounds per minute equals one electric horsepower

**Summary of Variables and Data Sources**

| Variable | Value | Notes |
|---|---|---|
| RegenSF | Regenerative Breaking: 1<br>No Regenerative Breaking: 0 | From application. |
| $lbs_{baseline}$ | | From application |
| $lbs_{ee}$ | | From application |
| $OCW_{baseline}$ | | From application. Use 0.50 as default. [4] |
| $OCW_{ee}$ | | From application. Use 0.50 as default. [5] |
| $ft/min_{baseline}$ | | From application |
| $ft/min_{ee}$ | | From application |
| $Eff_{hoist}$ | 0.8 | The Vertical Transportation Handbook[6] |
| $Eff_{ee}$ | | See Compliance Efficiencies section below |
| $Eff_{baseline}$ | | See Baseline Efficiency section below |
| $Eff_{regen}$ | 0.5 | Regenerative efficiency |
| $LF_{avg}$ | 0.35 | International Organization for Standardization[7] |

[4] The Vertical Transportation Handbook, 4th Edition , by George R. Strakosch and Robert S. Caporale, Page 213
[5] Ibid, 213
[6] Ibid, pg 2013
[7] ISO 25745-2:2015: Energy Performance of Lifts, Escalators and Moving Walks -- Part 2: Energy Calculation and Classification for Lifts (elevators)

| Variable | Value | Notes |
|---|---|---|
| hrs | | From application. If unknown, use a default of 2,750 hours.[8] |
| $F_{regen}$ | 0.5 | Regenerative braking eliminates excess heat and supplies electric energy to the building 50% of run time: when lightly loaded car is raised, when fully loaded car is lowered, whenever the car decelerates[9] |
| hp | | From application. |
| $LF_{motor,idle}$ | 0.11 | |
| $F_{idle}$ | Timer incorporated: 0.7<br>No timer: 1.0<br>Unknown: 0.7 | A timer may be used to disable the elevator during unoccupied hours. [10] |
| $LF_{motor,run}$ | 0.9 | Assumed value to reflect that motors do not typically fun at 100% of rated power |
| $LF_{peak}$ | 0.75 | International Organization for Standardization[11] |

**Coincidence Factor (CF)**

The prescribed coincidence factor for this measure is N/A. Appling average load factor at peak is a conservative approach for estimating summer peak demand savings. No further adjustment is required.

**Baseline Efficiencies from which Energy Savings are Calculated**

The baseline condition is an existing M-G set, SCR drive, or PWM drive elevator system. The efficiency of an M-G set system is equivalent to the motor efficiency. The efficiency of the baseline elevator drive systems are derived as follows:

*Efficiency for M-G set baseline elevator systems*

$$Eff_{baseline} = Eff_{motor,baseline}$$

*Efficiency for SCR or PWM drive baseline elevator systems*

$$Eff_{baseline} = Eff_{motor,baseline} \times Eff_{gear,baseline} \times Eff_{drive,baseline} \times Eff_{hoist,baseline}$$

[8] The Vertical Transportation Handbook, 4th Edition , by George R. Strakosch and Robert S. Caporale, Table 4.2, Table 4.3, Chart 4.2

[9] Baldor Motors and Drives, Elevator Application Guide, page 3-6

[10] No source specified. Actual idling time is based on specific site operating conditions. A value of 70% has been assumed based on a reasonable and conservative approach.

[11] ISO 25745-2:2015: Energy Performance of Lifts, Escalators and Moving Walks -- Part 2: Energy Calculation and Classification for Lifts (elevators). Coincidence factor is embedded within the peak load factor.

Summary of Variables and Data Sources

| Variable | Value | Notes |
|---|---|---|
| $Eff_{motor,baseline}$ | | NEMA premium efficiency. |
| $Eff_{drive,baseline}$ | | From application. If unknown use the following defaults[12]: SCR6 = 0.85, SCR12 = 0.90, PWM = 0.94. |
| $Eff_{hoist,baseline}$ | 0.90 | International Association of Elevator Consultants[13] |
| $Eff_{gear,baseline}$ | Geared system: 0.85<br>Gearless system: 1.0 | International Association of Elevator Consultants[14] |

**Compliance Efficiencies from which Incentives are Calculated**

The compliance condition may be either Silicon-Controlled Rectifier (SCR) drive, Pulse Width Modulation (PWM) drive or Variable Voltage Variable Frequency (VVVF) based on the baseline condition, as outlined in the table below:

Acceptable Elevator Replacement Configurations

| Baseline Condition | Compliance Condition |
|---|---|
| M-G Set | SCR, PWM, VVVF drives |
| SCR drive | PWM, VVVF drives |
| PWM drive | VVVF drive |

The efficiency of the energy efficient elevator drive systems are derived as follows:

*Efficiency for SCR, PWM, or VVVF drive energy efficient elevator systems*

$$Eff_{ee} = Eff_{motor,ee} \times Eff_{gear,ee} \times Eff_{drive,ee} \times Eff_{hoist,ee}$$

Summary of Variables and Data Sources

| Variable | Value | Notes |
|---|---|---|
| $Eff_{motor,ee}$ | | From application. |
| $Eff_{drive,ee}$ | | From application. If unknown, use the following defaults[15]: SCR6 = 0.85, SCR12 = 0.90, PWM = 0.94, VVVF = 0.95. |
| $Eff_{hoist,ee}$ | 0.90 | International Association of Elevator Consultants[16] |
| $Eff_{gear,ee}$ | Geared system: 0.85<br>Gearless system: 1.0 | International Association of Elevator Consultants[17] |

[12]International Association of Elevator Consultants, Presentation in New York City, May 2011, Slide 11
[13] Ibid, Slide 12, 13
[14] Ibid, Slide 11
[15] Ibid, Slide 11
[16] Ibid, Slide 12, 13
[17] Ibid, Slide 11

### Operating Hours

Elevator operation hours are set by the customer. If elevator operation hours are unknown, use a default value of 2,750 hours

### Effective Useful Life (EUL)

See Appendix P.

### Ancillary Fossil Fuel Savings Impacts

Not addressed.

### Ancillary Electric Savings Impacts

When travelling, elevators convert stored mechanical energy into electrical energy. In non-regenerative braking elevator systems, the energy is dissipated as heat. In regenerative braking elevator systems, the electrical energy is reclaimed by the building and offsets energy loads. When an elevator system is upgraded to a system with regenerative braking, energy savings are realized in the elimination of the dissipated heat and through the alleviation of building load.

### References


1. The Vertical Transportation Handbook, 4th Edition , by George R. Strakosch and Robert S. Caporale
2. Elevator Application Guide, By Baldor Motors and Drives, Page 3-6;
   Available from: https://www.baldor.com/Shared/manuals/770-397.pdf
3. ISO 25745-2:2015: Energy Performance of Lifts, Escalators and Moving Walks -- Part 2: Energy Calculation and Classification for Lifts (elevators)
   ASHRAE 90.1 – 2016
4. International Association of Elevator Consultants, Presentation in New York City, May 2011;
   Available from:
   https://www.iaec.org/IAEC/IAEC_Forum_Presentations_files/Magnetek_Presentation_IAEC_NYC_May2011%5b1%5d.pdf
5. ECCCNYS 2016, per IECC 2015; Table C403.2.3(1): Minimum Efficiency Requirements: Electrically Operated Unitary Air Conditioners And Condensing Units & Table C403.2.3(5): Minimum Efficiency Requirements: Gas- And Oil-Fired Boilers. Available from:
   https://codes.iccsafe.org/public/document/IECC2015NY-1/chapter-4-cecommercial-energy-efficiency


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# APPENDIX P

## *EFFECTIVE USEFUL LIFE (EUL)*

### SINGLE AND MULTI-FAMILY RESIDENTIAL MEASURES

| Category | Single and Multi-family Residential Measures | Sector | EUL (years) | Source |
|---|---|---|---|---|
| **Appliance** | Air Purifier | Residential | 9 | ENERGY STAR® Calc[18] |
| | Clothes Dryer | Residential | 14 | ENERGY STAR® M&I Scoping Report[19] |
| | Clothes Washer | Residential | 11 | DEER 2014 EUL ID: Appl-EffCW |
| | Dehumidifier | Residential | 12 | ENERGY STAR® Calc[20] |
| | Dishwasher | Residential | 11 | DEER 2014 EUL ID: Appl-EffDW |
| | Refrigerator and Freezer | Residential | 14 | DEER 2014 EUL ID: Appl-ESRefg |
| | Soundbar | Residential | 7 | RPP Product Analysis[21] |
| **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 |
| | Refrigerator Recycling | Residential | 5 | DEER 2014 EUL ID: Appl-RecRef |
| | Freezer Recycling | Residential | 4 | DEER 2014 EUL ID: Appl-RecFrzr |
| **Building Shell** | Air Conditioner – Room (RAC) Cover and Gap Sealer | Residential | 5 | See note below[22] |
| | Air Leakage Sealing | Residential | 15 | GDS[23] |

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

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

[20] ENERGY STAR® Dehumidifier Calculator https://www.energystar.gov/sites/default/files/asset/document/appliance_calculator.xlsx

[21] Retail Products Platform Product Analysis, Last Updated May 25, 2016. Available from: https://drive.google.com/file/d/0B9Fd3ckbKJp5OEpWSHg1eksyZ1U/view

[22] At least one manufacturer's warranty period. www.gss-ee.com/products.html

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

| Category | Single and Multi-family Residential Measures | Sector | EUL (years) | Source |
|---|---|---|---|---|
| **Building Shell** | Insulation – Hot Water and Steam Pipe | Residential | 15 | GDS[24] |
| | Insulation – Opaque Shell | Residential | 25 | GDS[25] |
| | Storm Window | Residential | 20 | DOE[26] |
| | Window | Residential | 20 | DEER 2014 EUL ID: BS-Win |
| **Domestic Hot Water** | 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[27] |
| | 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 |
| **Domestic Hot Water - Control** | Drain Water Heat Recovery | Residential | 30 | 2019 Title 24[28] |
| | Low-Flow – Faucet Aerator | Residential | 10 | DEER 2014 EUL ID: WtrHt-WH-Aertr |
| | Low-Flow – Showerhead | Residential | 10 | DEER 2014 EUL ID: WtrHt-WH-Shrhd |
| | Thermostatic Shower Restriction Valve | Residential | 10 | UPC[29] |
| **Heating, Ventilation and Air Conditioning (HVAC)** | Air Conditioner – Central (CAC) | Residential | 15 | DEER 2014 EUL ID: HV-ResAC |
| | Air Conditioner – Room (RAC) | Residential | 12 | GDS[30] |
| | Air Conditioner – PTAC | Residential | 15 | DEER 2014 EUL ID: HVAC-PTAC |
| | Boiler, Hot Water – Steel Water Tube | Residential | 24 | ASHRAE Handbook, 2015 |
| | Boiler, Hot Water – Steel Fire Tube | Residential | 25 | ASHRAE Handbook, 2015 |

[24] Ibid.
[25] Ibid.
[26] https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-22864rev2.pdf
[27] https://focusonenergy.com/sites/default/files/bpmeasurelifestudyfinal_evaluationreport.pdf
[28] 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
[29] UPC certification under the International Association of Plumbing and Mechanical Officials standard IGC 244-2007a. A standard that includes a lifecycle test consisting of 10,000 cycles without fail. 10,000 cycles is the equivalent of three users showering daily for more than nine years.
[30] GDS Associates, Inc., Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007, Table 1 – Residential Measures

| Category | Single and Multi-family Residential Measures | Sector | EUL (years) | Source |
|---|---|---|---|---|
| Heating, Ventilation and Air Conditioning (HVAC) | Boiler, Hot Water – Cast Iron | Residential | 35 | ASHRAE Handbook, 2015 |
| | Boiler, Steam – Steel Water Tube | Residential | 30 | ASHRAE Handbook, 2015 |
| | Boiler, Steam – Steel Fire Tube | Residential | 25 | ASHRAE Handbook, 2015 |
| | Boiler, Steam – Cast Iron | Residential | 30 | ASHRAE Handbook, 2015 |
| | Boiler and Furnace - Combination ("Combi") Boiler | Residential | 22 | DOE[31] |
| | Boiler and Furnace - Combination ("Combi") Furnace | Residential | 20 | DEER[32] |
| | 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 |
| | Furnace, Gas Fired | Residential | 22 | DOE[33,34] |
| | Heat Pump - Air Source (ASHP) | Residential | 15 | DEER 2014 EUL ID: HV-Res HP |
| | Heat Pump – Ground Source (GSHP) | Residential | 25 | ASHRAE[35] |
| | 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 |

[31] Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Residential Furnaces, February 10, 2015, Table 8.2.17. Product definition of furnaces includes electric boilers with firing rates of less than 300,000 BTU/h
Available from: https://energy.mo.gov/sites/energy/files/technical-support-document---residential-furances_doe.pdf
[32] Based on DEER value for high efficiency boiler and instantaneous water heater
[33] 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
[34] 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
[35] 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 = RUL of Existing Boiler = Boiler EUL – (Current Year – Year of Mfr.) | N/A |
| | Steam Trap – Low Pressure Space Heating | Residential | 6 | DEER 2014 EUL ID: HVAC-StmTrp |
| | Submetering | Multifamily | 10 | NYSERDA[36] |
| | Thermostat – Programmable Setback<br>Thermostat – Wi-Fi (Communicating)<br>Thermostat – Learning | Residential | 11 | DEER 2014 EUL ID: HVAC-ProgTStats |
| | Thermostatic Radiator Valve – One Pipe Steam Radiator | Multifamily | 15 | DOE[37] |

[36] NYSERDA Residential Electric Submetering Manual
[37] U.S. DOE, "Thermostatic Radiator Valve Evaluation", January 2015, Table 4. Cost-Benefit Financial Assumptions, pg. 16

| Category | Single and Multi-family Residential Measures | Sector | EUL (years) | Source |
|---|---|---|---|---|
| **Lighting** | Compact Fluorescent Lamp (CFL) | Residential | Coupon – 5 | GDS |
| | | | Direct Inst. – 7 | GDS |
| | | | Markdown - 7 | GDS |
| | | Multifamily Common Area | 9,000 hrs/ annual lighting operating hrs | See note below[38] |
| | LED Lamp (Directional) | Residential/ Multifamily Common Area | 25,000 hrs/ annual lighting operating hrs or 20 yrs (whichever is less) | ENERGY STAR® Lamps[39] |
| | | | 35,000 or 50,000 hours | DLC[40] |
| | LED Lamp (Decorative & Omnidirectional) | Residential/ Multifamily Common Area | 15,000 hrs/ annual lighting operating hrs or 20 yrs (whichever is less) | ENERGY STAR® Lamps |

[38] Multi-family common areas tend to have longer run hours than dwelling units. Default value from C&I lighting table is 7,665 hours per year

[39] ENERGY STAR® Program Requirements Product Specification for Lamps (Light Bulbs) V2.0, August 2016, p. 19 (Capped at 20 years). https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Lamps%20V2_0%20Revised%20AUG-2016.pdf

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

| Category | Single and Multi-family Residential Measures | | Sector | EUL (years) | Source |
|---|---|---|---|---|---|
| **Lighting** | Light Fixture | LED (Interior) | Residential/ Multifamily | 25,000 hrs/ annual lighting operating hrs or 20 yrs (whichever is less) | ENERGY STAR® Fixtures[41] |
| | | LED (Exterior) | Residential/ Multifamily Common Area | 35,000 hrs/ annual lighting operating hrs or 20 yrs (whichever is less) | ENERGY STAR® Fixtures |
| | | Linear Fluorescent | Residential/ Multifamily Common Area | 70,000 hrs / annual lighting operating hrs, or 15 yrs (whichever is less) | DEER 2014[42] EUL ID: ILtg-Lfluor-CommArea |
| | | CFL | Residential/ Multifamily Common Area | 22,000 hrs / annual lighting operating hrs, or 20 yrs (whichever is less) | See note below[43] |
| **Lighting Control** | Bi-Level Lighting | | Multifamily Common Area | 15 | ComEd[44] |
| **Motors and Drives** | Pool Pump | | Residential | 10 | DEER 2014 EUL ID: OutD-PoolPump |
| **Other** | Pool Heater | | Residential | 8 | DOE[45] |

[41] ENERGY STAR® Program Requirements Product Specification for Luminaires (Light Fixtures) V2.0, May 2015, p. 17 (Capped at 20 years).
https://www.energystar.gov/sites/default/files/Luminaires%20V2%200%20Final.pdf
[42] Basis value 70,000 hours, capped at 20 years, is common given redecoration patterns
[43] Basis value 22,000 hour ballast life per US EPA. Capped at 20 years as above (2.5 hours per day average lamp operation)
[44] 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
[45] 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

## COMMERCIAL AND INDUSTRIAL MEASURES

| Category | Commercial & Industrial Measures | Sector | EUL (years) | Source |
|---|---|---|---|---|
| **Agricultural Equipment - Control** | Engine Block Heater Timer | C&I | 8 | See note below[46] |
| **Appliance** | Clothes Dryer | C&I | 14 | ENERGY STAR®M&I Report[47] |
| | Cooking Equipment | C&I | 12 | DEER 2014 EUL IDs: Various |
| | Dishwasher | C&I | 10 – Under Counter<br>15 – Single Door<br>20 – Conveyor Type<br>10 – Pots, Pans & Utensils | ENERGY STAR®Calc[48] |
| | 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 |
| **Building Shell** | Cool Roof | C&I | 15 | DEER 2014 EUL ID: BldgEnv-CoolRoof |
| | Insulation - Hot Water and Steam Pipe | C&I | 15 | GDS[49] |
| | Insulation - Opaque Shell | C&I | 30 | ET & CEC[50] |
| | Window - Film | C&I | 10 | DEER 2014 EUL ID: GlazDaylt-WinFilm |
| | Window - Glazing | C&I | 20 | DEER 2014 EUL ID: BS-Win |
| **Compressed Air** | Air Compressor | C&I | 13 | Other State TRMs[51] |
| | Engineered Air Nozzle | C&I | 15 | Wisconsin PSC[52] |

[46] Based on EUL's for similar control technology
[47] ENERGY STAR® Market & Industry Scoping Report: Residential Clothes Dryer, November 2011.
[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
[49] GDS Associates, Inc., Measure Life Report: Residential and Commercial/Industrial Lighting and HVAC Measures, June 2007, Table 1 – Residential Measures
[50] Energy Trust uses 30 years for commercial applications. CEC uses 30 years for insulation in Title 24 analysis.
[51] Based on a review of TRM assumptions from Ohio (August 2010), Massachusetts (October 2015), Illinois (February 2017) and Vermont (March 2015). Estimates range from 10 to 15 years.
[52] PA Consulting Group (2009). *Business Programs: Measure Life Study*. Prepared for State of Wisconsin Public Service Commission

| Category | Commercial & Industrial Measures | Sector | EUL (years) | Source |
|---|---|---|---|---|
| **Compressed Air** | No Air Loss Water Drain | C&I | 13 | MA Measure Life Study C&I Retrofit EUL[53] |
| | Refrigerated Air Dryer | C&I | 13 | Other State TRMs [54] |
| **Domestic Hot Water (DHW)** | Domestic Hot Water Tank Blanket | C&I | 7 | DEER |
| | Heat Pump Water Heater (HPWH) | C&I | 10 | DEER |
| | 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** | 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 |
| **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[55] |
| | Boiler and Furnace - Combination (“Combi”) Furnace | C&I | 20 | DEER[56] |
| | 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 |

[53] 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

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

[55] 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

[56] 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)** | Chiller – Cooling Tower | C&I | 15 | DEER 2014 EUL ID: HVAC-ClTwrPkgSys |
| | Condensing Unit Heater | C&I | 18 | Ecotope[57] |
| | 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 |
| | Economizer –Dual Enthalpy Air Side | C&I | 10 | DEER 2014 EUL ID: HVAC-addEcono |
| | Furnace, Gas Fired | C&I | 23 | DOE[58],[59] |
| | 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[60] |
| | Infrared Heater | C&I | 17 | GDS[61] |
| | 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[62] |
| | 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** | Direct Digital Control (DDC) System | C&I | 15 | DEER 2014 EUL ID: HVAC-EMS |
| | Demand Controlled Ventilation (DCV) | C&I | 15 | DEER 2014 EUL ID: HVAC-VSD-DCV |
| | Energy Management System | C&I | 15 | DEER 2014 EUL ID: HVAC-EMS |

[57] Ecotope Natural Gas Efficiency and Conservation Measure Resource Assessment (2003)
[58] 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
[59] 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
[60] ASHRAE Owning and Operating Cost Database
Available from: https://xp20.ashrae.org/publicdatabase/system_service_life.asp?selected_system_type=1
[61] 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
[62] 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** | Energy Management System – Guest Room | C&I | 15 | DEER 2014<br>EUL ID: HVAC-EMS |
| | Outdoor Temperature Setback Control for Hydronic Boiler | C&I | EUL = RUL of Existing Boiler = Boiler EUL – (Current Year – Year of Mfr.) | N/A |
| | Steam Trap – Low-Pressure Space Heating | C&I | 6 | DEER 2014<br>EUL ID: HVAC-StmTrp |
| | Thermostat – Programmable Thermostat – Wi-Fi (Communicating) | C&I | 11 | DEER 2014<br>EUL ID: HVAC-ProgTStats |
| | Thermostatic Radiator Valve | C&I | 15 | DOE[63] |
| **Lighting** | CFL Lamp | C&I | 9,000 hours /annual lighting operating hours | See note below[64] |
| | CFL Light Fixture | C&I | 12 | DEER 2014<br>EUL ID: ILtg-CFLfix-Com |
| | HID | C&I | 70,000 hours /annual lighting operating hours or 15 years (whichever is less) | DEER 2014<br>EUL ID: ILtg-HPS |
| | Linear Fluorescent | C&I | 70,000 hours /annual lighting operating hours or 15 years, (whichever is less) | DEER 2014[65]<br>EUL ID: ILtg-Lfluor-Elec |

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

[64] Based on reported annual lighting operating hours; default value by space type in the technical manual (pp. 109-110)

[65] Basis Value 70,000 hours, capped at 15 years to reflect C&I redecoration and business type change patterns

| Category | Commercial & Industrial Measures | Sector | EUL (years) | Source |
|---|---|---|---|---|
| **Lighting** | LED Fixture (other than refrigerated case) | C&I | 50,000 hours /annual lighting operating hours or 20 years (whichever is less) | DLC[66] |
| | | | 35,000 hours /annual lighting operating hours or 20 years (whichever is less) | ENERGY STAR®[67] |
| | | | 25,000 hours /annual lighting operating hours or 20 years (whichever is less) | Uncertified |
| | LED Screw-In Lamp | C&I | 15,000 hours (decorative) or 25,000 hours (all other)/ annual lighting operating hours or 20 years (whichever is less) | ENERGY STAR® |
| | Refrigerated Case LED | C&I | 16 | DEER 2014 EUL ID: GrocDisp-FixtLtg-LED |
| **Lighting - Control** | Bi-Level Lighting | C&I | 15 | ComEd[68] |
| | Integrated Interior Lighting Control | C&I | 15 | ComEd[69] |
| | Non-Integrated Interior Lighting Control | C&I | 10 | GDS[70] |
| | Plug-Load Occupancy Sensor | C&I | 8 | DEER[71] |

[66] 50,000 hours per $L_{70}$ requirements prescribed by the DLC's Product Qualification Criteria, Technical Requirement Table version 4.2

[67] Placed on the Qualified Fixture List by ENERGY STAR®, according to the appropriate luminaire classification as specified in the ENERGY STAR® Program requirements for Luminaires, version 2.0. Divided by estimated annual use, but capped at 20 years regardless (consistent with C&I redecoration and business type change patterns

[68] 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

[69] 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

[70] 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

[71] DEER value for lighting occupancy sensors

| Category | Commercial & Industrial Measures | Sector | EUL (years) | Source |
|---|---|---|---|---|
| **Motors and Drives** | Motor | C&I | 15 | DEER 2014<br>EUL ID: Motors-HiEff |
| | Variable Frequency Drive (VFD) – Fan and Pump | C&I | 15 | DEER 2014<br>EUL ID: HVAC-VSDSupFan |
| | Elevator Modernization | C&I | 15 | DEER 2014<br>*Assumes same EUL as VFD measure* |
| **Other** | Pool Heater | C&I | 8 | DOE[72] |
| **Process Equipment** | Steam Trap – Other Applications | C&I | 6 | DEER 2014<br>EUL ID: HVAC-StmTrp |
| **Refrigeration** | Air-Cooled Refrigeration Condenser | C&I | 15 | DEER 2014<br>EUL ID: GrocSys-Cndsr |
| | Automatic Door Closer for Walk-In Cooler/Freezer | C&I | 8 | DEER |
| | Cooler and Freezer Door Gasket | C&I | 4 | DEER 2014<br>EUL ID: GrocWlkIn-StripCrtn, GrocWlkIn-WDrGask |
| | Cooler and Freezer Door Strip | C&I | 4 | DEER 2014<br>EUL ID: GrocWlkIn-StripCrtn, GrocWlkIn-WDrGask |
| | Electronically Commutated (EC) Motor – Refrigerated Case or Walk-In Cooler/Freezer Evaporator Fan | C&I | 15 | DEER 2014<br>EUL ID: GrocDisp-FEvapFanMtr |
| | Equipment (Condenser, Compressor, and Sub-cooling) | C&I | 15 | DEER |
| | Evaporator Fan Motor – with Permanent Magnet Synchronous Motor (PMSM) | C&I | 15 | DEER 2014<br>EUL ID: GrocDisp-FEvapFanMtr |
| | Refrigerated Case Door | C&I | 12 | DEER 2014<br>EUL ID: GrocDisp-FixtDoors |
| | Refrigerated Case Night Cover | C&I | 5 | DEER 2014<br>EUL ID: GrocDisp-DispCvrs |
| **Refrigeration - Control** | Anti-Condensation Heater Control | C&I | 12 | DEER 2014<br>EUL ID: GrocDisp-ASH |
| | Condenser Pressure and Temperature Control | C&I | 15 | DEER |
| | Evaporator Fan Control | C&I | 16 | DEER 2014<br>EUL ID: Groc-WlkIn-WEvapFMtrCtrl |

[72] 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

**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 | 9/27/2017 |
| 12-17-17 | 12/31/2017 |
| 3-18-21 | 3/31/2018 |
| 6-18-23 | 6/30/2018 |
| 9-18-21 | 9/27/2018 |
| 12-18-17 | 12/28/2018 |
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