### LED Bulbs and Fixtures

###### Description

This characterization provides savings assumptions for a variety of LED lamps including Omnidirectional (e.g. A-Type lamps), Decorative (e.g. Globes and Torpedoes) and Directional (PAR Lamps, Reflectors, MR16), and fixtures including refrigerated case, recessed and outdoor/garage fixtures.

If the implementation strategy does not allow for the installation location to be known, a deemed split of 96% Commercial and 4% Residential should be used[[1]](#footnote-1).

This measure was developed to be applicable to the following program types:  TOS, NC, RF.

If applied to other program types, the measure savings should be verified.

###### Definition of Efficient Equipment

In order for this characterization to apply, new lamps must be Energy Star labeled. Lamps and fixtures should be found in the reference tables below. Fixtures must be Energy Star labeled or on the Design Lights Consortium qualifying fixture list.

###### Definition of Baseline Equipment

Refer to the baseline tables. In 2012, Federal legislation stemming from the Energy Independence and Security Act of 2007 (EIAS) required all general-purpose light bulbs between 40 watts and 100 watts to have ~30% increased efficiency, essentially phasing out standard incandescent technology. In 2012, the 100 w lamp standards apply; in 2013 the 75 w lamp standards will apply, followed by restrictions on the 60 w and 40 w lamps in 2014.

###### Deemed Lifetime of Efficient Equipment

Lifetime is the life of the product, at the reported operating hours (lamp life in hours divided by operating hours per year – see reference table "LED component Costs and Lifetime." The analysis period is the same as the lifetime, capped at 15 years. (15 years from GDS Measure Life Report, June 2007).

###### Deemed Measure Cost

Wherever possible, actual incremental costs should be used. Refer to reference table “LED component Cost & Lifetime” for defaults.

###### Loadshape

|  |
| --- |
| Loadshape C06 - Commercial Indoor Lighting |
| Loadshape C07 - Grocery/Conv. Store Indoor Lighting |
| Loadshape C08 - Hospital Indoor Lighting |
| Loadshape C09 - Office Indoor Lighting |
| Loadshape C10 - Restaurant Indoor Lighting |
| Loadshape C11 - Retail Indoor Lighting |
| Loadshape C12 - Warehouse Indoor Lighting |
| Loadshape C13 - K-12 School Indoor Lighting |
| Loadshape C14 - Indust. 1-shift (8/5) (e.g., comp. air, lights) |
| Loadshape C15 - Indust. 2-shift (16/5) (e.g., comp. air, lights) |
| Loadshape C16 - Indust. 3-shift (24/5) (e.g., comp. air, lights) |
| Loadshape C17 - Indust. 4-shift (24/7) (e.g., comp. air, lights) |
| Loadshape C18 - Industrial Indoor Lighting |
| Loadshape C19 - Industrial Outdoor Lighting |
| Loadshape C20 - Commercial Outdoor Lighting |

###### Coincidence Factor

The summer peak coincidence factor for this measure is dependent on the location type. Values are provided for each building type in the reference section below.

**Algorithm**

###### Calculation of Savings

###### Electric Energy Savings

ΔkWh = ((Wattsbase-WattsEE)/1000) \* Hours \*WHFe\*ISR

Where:

Wattsbase = Input wattage of the existing or baseline system. Reference the “LED New and Baseline Assumptions” table for default values.

WattsEE = Actual wattage of LED purchased / installed. If unknown, use default provided below:

For ENERGY STAR rated lamps the following lumen equivalence tables should be used:

**Omnidirectional Lamps - ENERGY STAR Minimum Luminous Efficacy = 50Lm/W for <10W lamps and 55Lm/W for >=10W lamps.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Minimum Lumens** | **Maximum Lumens** | **Lumens used to calculate LED Wattage (midpoint)** | **LED Wattage[[2]](#footnote-2) (WattsEE)** | **Baseline 2014-2019 (WattsBase)** | **Delta Watts 2014-2019 (WattsEE)** | **Baseline Post EISA 2020 requirement[[3]](#footnote-3)  (WattsBase)** | **Delta Watts Post 2020 (WattsEE)** |
|
|
| 5280 | 6209 | 5745 | 104.4 | 300.0 | 195.6 | 300.0 | 195.6 |
| 3000 | 5279 | 4140 | 75.3 | 200.0 | 124.7 | 200.0 | 124.7 |
| 2601 | 2999 | 2800 | 50.9 | 150.0 | 99.1 | 150.0 | 99.1 |
| 1490 | 2600 | 2045 | 37.2 | 72.0 | 34.8 | 45.4 | 8.3 |
| 1050 | 1489 | 1270 | 23.1 | 53.0 | 29.9 | 28.2 | 5.1 |
| 750 | 1049 | 900 | 16.4 | 43.0 | 26.6 | 20.0 | 3.6 |
| 310 | 749 | 530 | 9.6 | 29.0 | 19.4 | 11.8 | 2.1 |
| 250 | 309 | 280 | 5.6 | 25.0 | 19.4 | 25.0 | 19.4 |

**Decorative Lamps - ENERGY STAR Minimum Luminous Efficacy = 40Lm/W for all lamps**

|  |  |  |  |
| --- | --- | --- | --- |
| Nominal wattage of lamp to be replaced  (Wattsbase) | Minimum initial light output of LED lamp (lumens) | LED Wattage  (WattsEE) | Delta Watts |
| 10 | 70 | 1.75 | 8.25 |
| 15 | 90 | 2.25 | 12.75 |
| 25 | 150 | 3.75 | 21.25 |
| 40 | 300 | 7.5 | 32.5 |
| 60 | 500 | 12.5 | 47.5 |

Decorative lamps are exempt from EISA regulations.

**Directional Lamps -** ENERGY STAR Minimum Luminous Efficacy = 40Lm/W for lamps with rated wattages less than 20Wand 50 Lm/W for lamps with rated wattages >= 20 watts[[4]](#footnote-4).

For Directional R, BR, and ER lamp types[[5]](#footnote-5):

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Bulb Type** | **Lower Lumen Range** | **Upper Lumen Range** | **WattsBase** | **Lumens used to calculate LED Wattage (midpoint)** | **LED Wattage (WattsEE)** | **Delta Watts** |
| **R, ER, BR with medium screw bases w/ diameter >2.25" (\*see exceptions below)** | 420 | 472 | 40 | 446 | 11 | 29 |
| 473 | 524 | 45 | 499 | 12 | 33 |
| 525 | 714 | 50 | 620 | 15 | 35 |
| 715 | 937 | 65 | 826 | 21 | 44 |
| 938 | 1259 | 75 | 1099 | 22 | 53 |
| 1260 | 1399 | 90 | 1330 | 27 | 63 |
| 1400 | 1739 | 100 | 1570 | 31 | 69 |
| 1740 | 2174 | 120 | 1957 | 39 | 81 |
| 2175 | 2624 | 150 | 2400 | 48 | 102 |
| 2625 | 2999 | 175 | 2812 | 56 | 119 |
| 3000 | 4500 | 200 | 3750 | 75 | 125 |
| **\*R, BR, and ER with medium screw bases w/ diameter <=2.25"** | 400 | 449 | 40 | 425 | 11 | 29 |
| 450 | 499 | 45 | 475 | 12 | 33 |
| 500 | 649 | 50 | 575 | 14 | 36 |
| 650 | 1199 | 65 | 925 | 23 | 42 |
| **\*ER30, BR30, BR40, or ER40** | 400 | 449 | 40 | 425 | 11 | 29 |
| 450 | 499 | 45 | 475 | 12 | 33 |
| 500 | 649 | 50 | 575 | 14 | 36 |
| **\*BR30, BR40, or ER40** | 650 | 1419 | 65 | 1035 | 21 | 44 |
| **\*R20** | 400 | 449 | 40 | 425 | 11 | 29 |
| 450 | 719 | 45 | 585 | 15 | 30 |
| **\*All reflector lamps below lumen ranges specified above** | 200 | 299 | 20 | 250 | 6 | 14 |
| 300 | [[6]](#footnote-6)399 | 30 | 350 | 9 | 21 |

Directional lamps are exempt from EISA regulations.

For PAR, MR, and MRX Lamps Types:

For these highly focused directional lamp types, it is necessary to have Center Beam Candle Power (CBCP) and beam angle measurements to accurately estimate the equivalent baseline wattage. The formula below is based on the Energy Star Center Beam Candle Power tool.[[7]](#footnote-7) If CBCP and beam angle information are not available or if the equation below returns a negative value (or undefined), use the manufacturer’s recommended baseline wattage equivalent.[[8]](#footnote-8)

Where:

D = Bulb diameter (e.g. for PAR20 D = 20)

BA = Beam angle

CBCP = Center beam candle power

The result of the equation above should be rounded DOWN to the nearest wattage established by Energy Star:

|  |  |
| --- | --- |
| **Diameter** | **Permitted Wattages** |
| 16 | 20, 35, 40, 45, 50, 60, 75 |
| 20 | 50 |
| 30S | 40, 45, 50, 60, 75 |
| 30L | 50, 75 |
| 38 | 40, 45, 50, 55, 60, 65, 75, 85, 90, 100, 120, 150, 250 |

Hours = Average hours of use per year are provided in the Reference Table in Section 4.5,Screw based bulb annual operating hours, for each building type. If unknown, use the Miscellaneous value.

WHFe = Waste heat factor for energy to account for cooling energy savings from efficient lighting are provided below for each building type in the Referecne Table in Section 4.5. If unknown, use the Miscellaneous value.

ISR = In Service Rate -the percentage of units rebated that actually get installed.

=100%[[9]](#footnote-9) if application form completed with sign off that equipment is not placed into storage. If sign off form not completed assume the following 3 year ISR assumptions:

| **Weighted Average 1st year In Service Rate (ISR)** | **2nd year Installations** | **3rd year Installations** | **Final Lifetime In Service Rate** |
| --- | --- | --- | --- |
| 95.7%[[10]](#footnote-10) | 1.2% | 1.1% | 98.0%[[11]](#footnote-11) |

###### Heating Penalty

If electrically heated building:

ΔkWhheatpenalty[[12]](#footnote-12) = (((WattsBase-WattsEE)/1000) \* ISR \* Hours \* -IFkWh

Where:

IFkWh = Lighting-HVAC Interation Factor for electric heating impacts; this factor represents the increased electric space heating requirements due to the reduction of waste heat rejected by the efficent lighting. Values are provided in the Reference Table in Section 4.5. If unknown, use the Miscellaneous value.

For example, For example, a 9W LED lamp, 450 lumens, is installed in a heat pump heated office in 2014 and sign off form provided:

ΔkWhheatpenalty = ((29-9/1000)\*1.0\*3088\* -0.151

= - 9.3 kWh

###### Deferred Installs

As presented above, if a sign off form is not completed the characterization assumes that a percentage of bulbs purchased are not installed until Year 2 and Year 3 (see ISR assumption above). The Illinois Technical Advisory Committee has determined the following methodology for calculating the savings of these future installs.

Year 1 (Purchase Year) installs: Characterized using assumptions provided above or evaluated assumptions if available.

Year 2 and 3 installs: Characterized using delta watts assumption and hours of use from the Install Year i.e. the actual deemed (or evaluated if available) assumptions active in Year 2 and 3 should be applied.

The NTG factor for the Purchase Year should be applied.

###### Summer Coincident Peak Demand Savings

ΔkW =( (Wattsbase-WattsEE)/1000) \* ISR \* WHFd \* CF

Where:

WHFd = Waste Heat Factor for Demand to account for cooling savings from efficient lighting in cooled buildings is provided in Referecne Table in Section 4.5. If unknown, use the Miscellaneous value.

CF = Summer Peak Coincidence Factor for measure is provided in the Referecne Table in Section 4.5. If unknown, use the Miscellaneous value.

For example, For example, a 9W LED lamp, 450 lumens, is installed in an office in 2014 and sign off form provided:

ΔkW = ((29-9/1000)\* 1.0\*1.3\*0.66

= 0.002 kW

###### Natural Gas Energy Savings

Heating Penalty if fossil fuel heated building (or if heating fuel is unknown):

ΔTherms = (((WattsBase-WattsEE)/1000) \* ISR \* Hours \* - IFTherms

Where:

IFTherms = Lighting-HVAC Integration Factor for gas heating impacts; this factor represents the increased gas space heating requirements due to the reduction of waste heat rejected by the efficient lighting. Values are provided in the Referecne Table in Section 4.5. If unknown, use the Miscellaneous value.

For example, For example, a 9W LED lamp, 450 lumens, is installed in an office in 2014 and sign off form provided:

ΔTherms = ((29-9/1000)\*1.0\*3088\* -0.016

= - 0.99 therms

###### Water Impact Descriptions and Calculation

N/A

###### Deemed O&M Cost Adjustment Calculation

For all measures except Standard Omnidirectional lamps (which have an EISA baseline shift) the individual component lifetimes and costs are provided in the reference table section below[[13]](#footnote-13).

In order to account for the falling EISA Qualified bulb replacement cost provided above, an equivalent annual levelized baseline replacement cost over the lifetime of the LED bulb (assumed to be 25,000/4576 =5.5 years) is calculated (see “C&I OmniDirectional LED O&M Calc.xls”). The key assumptions used in this calculation are documented below[[14]](#footnote-14):

|  | **Std Inc.** | **EISA Compliant Halogen** | **CFL** |
| --- | --- | --- | --- |
| 2014 | $0.34 | $1.25 | N/A |
| 2015 | $0.34 | $0.90 | N/A |
| 2016 | $0.34 | $0.80 | N/A |
| 2017 | $0.34 | $0.70 | N/A |
| 2018 | $0.34 | $0.60 | N/A |
| 2019 | $0.34 | $0.60 | N/A |
| 2020 & after | $0.34 | N/A | $2.50 |

The NPV for replacement lamps and annual levelized replacement costs using the statewide real discount rate of 5.23% are presented below:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Location** | **Lumen Level** | **NPV of replacement costs for period** | | | **Levelized annual replacement cost savings** | | |
| **June 2014 - May 2015** | **June 2015 - May 2016** | **June 2016 - May 2017** | **June 2014 - May 2015** | **June 2015 - May 2016** | **June 2016 - May 2017** |
| Commercial | Lumens <310 or >2600 (EISA exempt) | $6.94 | $6.94 | $6.94 | $1.49 | $1.49 | $1.49 |
| Lumens ≥ 310 and ≤ 2600 (EISA compliant) | $16.86 | $13.90 | $11.51 | $3.63 | $2.99 | $2.48 |
| Multi Family Common Areas | Lumens <310 or >2600 (non-EISA compliant) | $7.13 | $7.13 | $7.13 | $1.93 | $1.93 | $1.93 |
| Lumens ≥ 310 and ≤ 2600 (EISA compliant) | $18.75 | $15.57 | $13.79 | $5.09 | $4.22 | $3.74 |

For halogen bulbs, we assume the same replacement cycle as incandescent bulbs.[[15]](#footnote-15) The replacement cycle is based on the miscellaneous hours of use. Both incandescent and halogen lamps are assumed to last for 1,000 hours before needing replacement and CFLs after 10,000 hours.

LED New and Baseline Assumptions[[16]](#footnote-16)

| LED Measure Description | WattsEE | Baseline Description | WattsBASE | Basis for Watt Assumptions | LED Lamp Cost | Baseline Cost (EISA 2012-2014, EISA 2020) | Incremental Cost (EISA 2012-2014, EISA 2020) | LED Minimum Lamp Life (hrs) |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| LED Screw and Pin-based Bulbs, Omnidirectional, < 10W | See tables above | | | | $30.00 | $0.34 ($1.25, $2.50) | $29.66 ($28.75, $27.50) | 25,000 |
| LED Screw and Pin-based Bulbs, Omnidirectional, >= 10W | $40.00 | $0.34 ($1.25, $2.50) | $39.66 ($38.75, $37.50) | 25,000 |
| LED Screw and Pin-based Bulbs, Decorative | $30.00 | $1.00 | $29.00 | 25,000 |
| LED Screw-based Bulbs, Directional, < 15W | $45.00 | $5.00 | $40.00 | 35,000 |
| LED Screw-based Bulbs, Directional, >= 15W | $55.00 | $5.00 | $50.00 | 35,000 |
| LED Recessed, Surface, Pendant Downlights | 17.6 | Baseline LED Recessed, Surface, Pendant Downlights | 54.3 | 2008-2010 EVT Historical Data of 947 Measures | 50,000 |  | $50.00 |  |
| LED Track Lighting | 12.2 | Baseline LED Track Lighting | 60.4 | 2008-2010 EVT Historical Data of 242 Measures | 50,000 |  | $100.00 |  |
| LED Wall-Wash Fixtures | 8.3 | Baseline LED Wall-Wash Fixtures | 17.7 | 2008-2010 EVT Historical Data of 220 Measures | 50,000 |  | $80.00 |  |
| LED Portable Desk/Task Light Fixtures | 7.1 | Baseline LED Portable Desk/Task Light Fixtures | 36.2 | 2008-2010 EVT Historical Data of 21 Measures | 50,000 |  | $50.00 |  |
| LED Undercabinet Shelf-Mounted Task Light Fixtures (per foot) | 7.1 | Baseline LED Undercabinet Shelf-Mounted Task Light Fixtures | 36.2 | 2008-2010 EVT Historical Data of 21 Measures | 50,000 |  | $25.00 |  |
| LED Refrigerated Case Light, Horizontal or Vertical (per foot of light bar) | 7.6 | Baseline LED Refrigerated Case Light, Horizontal or Vertical (per foot of light bar) | 15.2 | PG&E Refrigerated Case Study[[17]](#footnote-17) normalized to per foot of light bar. | 50,000 |  | $50.00 |  |
| LED Freezer Case Light, Horizontal or Vertical (per foot) | 7.7 | Baseline LED Freezer Case Light, Horizontal or Vertical (per foot) | 18.7 | PG&E Refrigerated Case Study normalized to per foot. | 50,000 |  | $50.00 |  |
| LED Display Case Light Fixture (per foot) | 7.1 | Baseline LED Display Case Light Fixture | 36.2 | Modeled after LED Undercabinet Shelf-Mounted Task Light Fixtures (per foot) | 35,000 |  | $25.00 |  |
| LED 2x2 Recessed Light Fixture | 44.9 | T8 U-Tube 2L-FB32 w/ Elec - 2' | 61.0 | Based on average watts of DLC qualified products as of 11/21/11 | 35,000 |  | $75.00 |  |
| LED 2x4 Recessed Light Fixture | 53.6 | T8 3L-F32 w/ Elec - 4' | 88.0 | Based on average watts of DLC qualified products as of 11/21/11 | 35,000 |  | $125.00 |  |
| LED 1x4 Recessed Light Fixture | 32.2 | T8 2L-F32 w/ Elec - 4' | 59.0 | Based on average watts of DLC qualified products as of 11/21/11 | 35,000 |  | $100.00 |  |
| LED High- and Low-Bay Fixtures | 160.2 | MH 250 W CWA Pulse Start | 295.0 | Based on average watts of DLC qualified products as of 11/21/11 | 35,000 |  | $200.00 |  |
| LED Outdoor Pole/Arm Mounted Parking/Roadway, < 30W | 18.6 | Baseline LED Outdoor Pole/Arm Mounted Parking/Roadway, < 30W | 124.3 | 2008-2010 EVT Historical Data of 2,813 Measures | 50,000 |  | $125.00 |  |
| LED Outdoor Pole/Arm Mounted Parking/Roadway, 30W - 75W | 52.5 | Baseline LED Outdoor Pole/Arm Mounted Parking/Roadway, 30W - 75W | 182.9 | 2008-2010 EVT Historical Data of 1,081 Measures | 50,000 |  | $250.00 |  |
| LED Outdoor Pole/Arm Mounted Parking/Roadway, >= 75W | 116.8 | Baseline LED Outdoor Pole/Arm Mounted Parking/Roadway, >= 75W | 361.4 | 2008-2010 EVT Historical Data of 806 Measures | 50,000 |  | $375.00 |  |
| LED Outdoor Pole/Arm Mounted Decorative Parking/Roadway, < 30W | 18.6 | Baseline LED Outdoor Pole/Arm Mounted Decorative Parking/Roadway, < 30W | 124.3 | 2008-2010 EVT Historical Data of 2,813 Measures | 50,000 |  | $125.00 |  |
| LED Outdoor Pole/Arm Mounted Decorative Parking/Roadway, 30W - 75W | 52.5 | Baseline LED Outdoor Pole/Arm Mounted Decorative Parking/Roadway, 30W - 75W | 182.9 | 2008-2010 EVT Historical Data of 1,081 Measures | 50,000 |  | $250.00 |  |
| LED Outdoor Pole/Arm Mounted Decorative Parking/Roadway, >= 75W | 116.8 | Baseline LED Outdoor Pole/Arm Mounted Decorative Parking/Roadway, >= 75W | 361.4 | 2008-2010 EVT Historical Data of 806 Measures | 50,000 |  | $375.00 |  |
| LED Parking Garage/Canopy, < 30W | 18.6 | Baseline LED Parking Garage/Canopy, < 30W | 124.3 | 2008-2010 EVT Historical Data of 2,813 Measures | 50,000 |  | $125.00 |  |
| LED Parking Garage/Canopy, 30W - 75W | 52.5 | Baseline LED Parking Garage/Canopy, 30W - 75W | 182.9 | 2008-2010 EVT Historical Data of 1,081 Measures | 50,000 |  | $250.00 |  |
| LED Parking Garage/Canopy, >= 75W | 116.8 | Baseline LED Parking Garage/Canopy, >= 75W | 361.4 | 2008-2010 EVT Historical Data of 806 Measures | 50,000 |  | $375.00 |  |
| LED Wall-Mounted Area Lights, < 30W | 18.6 | Baseline LED Wall-Mounted Area Lights, < 30W | 124.3 | 2008-2010 EVT Historical Data of 2,813 Measures | 50,000 |  | $125.00 |  |
| LED Wall-Mounted Area Lights, 30W - 75W | 52.5 | Baseline LED Wall-Mounted Area Lights, 30W - 75W | 182.9 | 2008-2010 EVT Historical Data of 1,081 Measures | 50,000 |  | $250.00 |  |
| LED Wall-Mounted Area Lights, >= 75W | 116.8 | Baseline LED Wall-Mounted Area Lights, >= 75W | 361.4 | 2008-2010 EVT Historical Data of 806 Measures | 50,000 |  | $375.00 |  |
| LED Bollard, < 30W | 13.9 | Baseline LED Bollard, < 30W | 54.3 | 2008-2010 EVT Historical Data of 33 Measures | 50,000 |  | $150.00 |  |
| LED Bollard, >= 30W | 41.0 | Baseline LED Bollard, >= 30W | 78.0 | 2008-2010 EVT Historical Data of 15 Measures | 50,000 |  | $250.00 |  |
| LED Flood Light, < 15W | 8.7 | Baseline LED Flood Light, < 15W | 51.7 | Consistent with LED Screw-base Directional | 50,000 |  | $35.00 |  |
| LED Flood Light, >= 15W | 16.2 | Baseline LED Flood Light, >= 15W | 64.4 | Consistent with LED Screw-base Directional | 50,000 |  | $45.00 |  |

LED Component Costs & Lifetime[[18]](#footnote-18)

| **LED Measure Description** | **LED Minimum Lamp Life (hrs)** | **LED Lamp Cost Total** | **LED Driver Life (hrs)** | **LED Driver Cost Total** | **Baseline Technology (1)** | **Lamp (1) Life (hrs)** | **Lamp (1) Total Cost** | **Ballast (1) Life (hrs)** | **Ballast (1) Total Cost** | **Baseline Technology (2)** | **Lamp (2) Life (hrs)** | **Lamp (2) Total Cost** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| LED Screw and Pin-based Bulbs, Decorative | 25,000 | N/A | N/A | N/A | 53W EISA Halogen | 2,000 | $4.67 | N/A | N/A | N/A | N/A | N/A |
| LED Screw-based Bulbs, Directional, < 15W | 35,000 | N/A | N/A | N/A | 15% CFL 18W Pin Base | 10,000 | $11.62 | 40,000 | $36.00 | 85% Halogen PAR20 | 2,500 | $12.67 |
| LED Screw-based Bulbs, Directional, >= 15W | 35,000 | N/A | N/A | N/A | 15% CFL 26W Pin Base | 10,000 | $12.62 | 40,000 | $36.00 | 85% Halogen PAR30/38 | 2,500 | $12.67 |
| LED Recessed, Surface, Pendant Downlights | 50,000 | $47.50 | 70,000 | $47.50 | 40% CFL 26W Pin Base | 10,000 | $12.62 | 40,000 | $36.00 | 60% Halogen PAR30/38 | 2,500 | $12.67 |
| LED Track Lighting | 50,000 | $47.50 | 70,000 | $47.50 | 10% CMH PAR38 | 12,000 | $62.92 | 40,000 | $110.00 | 90% Halogen PAR38 | 2,500 | $12.67 |
| LED Wall-Wash Fixtures | 50,000 | $47.50 | 70,000 | $47.50 | 40% CFL 42W Pin Base | 10,000 | $15.72 | 40,000 | $67.50 | 60% Halogen PAR38 | 2,500 | $12.67 |
| LED Portable Desk/Task Light Fixtures | 50,000 | $47.50 | 70,000 | $47.50 | 50% 13W CFL Pin Base | 10,000 | $5.52 | 40,000 | $25.00 | 50% 50W Halogen | 2,500 | $12.67 |
| LED Undercabinet Shelf-Mounted Task Light Fixtures (per foot) | 50,000 | $47.50 | 70,000 | $47.50 | 50% 2' T5 Linear | 7,500 | $9.92 | 40,000 | $45.00 | 50% 50W Halogen | 2,500 | $12.67 |
| LED Refrigerated Case Light, Horizontal or Vertical (per foot) | 50,000 | $9.50 | 70,000 | $9.50 | 5' T8 | 15,000 | $2.77 | 40,000 | $9.50 | N/A | N/A | N/A |
| LED Freezer Case Light, Horizontal or Vertical (per foot) | 50,000 | $8.75 | 70,000 | $7.92 | 6' T12HO | 12,000 | $11.03 | 40,000 | $59.58 | N/A | N/A | N/A |
| LED Display Case Light Fixture (per foot) | 35,000 | $47.50 | 70,000 | $28.75 | 50% 2' T5 Linear | 7,500 | $9.92 | 40,000 | $45.00 | 50% 50W Halogen | 2,500 | $12.67 |
| LED 2x2 Recessed Light Fixture | 35,000 | $47.50 | 70,000 | $47.50 | T8 U-Tube 2L-FB32 w/ Elec - 2' | 15,000 | $24.95 | 40,000 | $52.00 | N/A | N/A | N/A |
| LED 2x4 Recessed Light Fixture | 35,000 | $72.50 | 70,000 | $47.50 | T8 3L-F32 w/ Elec - 4' | 15,000 | $17.00 | 40,000 | $35.00 | N/A | N/A | N/A |
| LED 1x4 Recessed Light Fixture | 35,000 | $47.50 | 70,000 | $47.50 | T8 2L-F32 w/ Elec - 4' | 15,000 | $11.33 | 40,000 | $35.00 | N/A | N/A | N/A |
| LED High- and Low-Bay Fixtures | 35,000 | $112.50 | 70,000 | $62.50 | 250W MH | 10,000 | $41.25 | 40,000 | $130.25 | N/A | N/A | N/A |
| LED Outdoor Pole/Arm Mounted Parking/Roadway, < 30W | 50,000 | $62.50 | 70,000 | $62.50 | 100W MH | 10,000 | $54.25 | 40,000 | $166.70 | N/A | N/A | N/A |
| LED Outdoor Pole/Arm Mounted Parking/Roadway, 30W - 75W | 50,000 | $87.50 | 70,000 | $62.50 | 175W MH | 10,000 | $48.25 | 40,000 | $110.00 | N/A | N/A | N/A |
| LED Outdoor Pole/Arm Mounted Parking/Roadway, >= 75W | 50,000 | $112.50 | 70,000 | $62.50 | 250W MH | 10,000 | $41.25 | 40,000 | $130.25 | N/A | N/A | N/A |
| LED Outdoor Pole/Arm Mounted Decorative Parking/Roadway, < 30W | 50,000 | $62.50 | 70,000 | $62.50 | 100W MH | 10,000 | $54.25 | 40,000 | $166.70 | N/A | N/A | N/A |
| LED Outdoor Pole/Arm Mounted Decorative Parking/Roadway, 30W - 75W | 50,000 | $87.50 | 70,000 | $62.50 | 175W MH | 10,000 | $48.25 | 40,000 | $110.00 | N/A | N/A | N/A |
| LED Outdoor Pole/Arm Mounted Decorative Parking/Roadway, >= 75W | 50,000 | $112.50 | 70,000 | $62.50 | 250W MH | 10,000 | $41.25 | 40,000 | $130.25 | N/A | N/A | N/A |
| LED Parking Garage/Canopy, < 30W | 50,000 | $47.50 | 70,000 | $47.50 | 100W MH | 10,000 | $36.92 | 40,000 | $151.70 | N/A | N/A | N/A |
| LED Parking Garage/Canopy, 30W - 75W | 50,000 | $72.50 | 70,000 | $47.50 | 175W MH | 10,000 | $30.92 | 40,000 | $95.00 | N/A | N/A | N/A |
| LED Parking Garage/Canopy, >= 75W | 50,000 | $97.50 | 70,000 | $47.50 | 250W MH | 10,000 | $23.92 | 40,000 | $115.25 | N/A | N/A | N/A |
| LED Wall-Mounted Area Lights, < 30W | 50,000 | $47.50 | 70,000 | $47.50 | 100W MH | 10,000 | $36.92 | 40,000 | $151.70 | N/A | N/A | N/A |
| LED Wall-Mounted Area Lights, 30W - 75W | 50,000 | $72.50 | 70,000 | $47.50 | 175W MH | 10,000 | $30.92 | 40,000 | $95.00 | N/A | N/A | N/A |
| LED Wall-Mounted Area Lights, >= 75W | 50,000 | $97.50 | 70,000 | $47.50 | 250W MH | 10,000 | $23.92 | 40,000 | $115.25 | N/A | N/A | N/A |
| LED Bollard, < 30W | 50,000 | $47.50 | 70,000 | $47.50 | 50W MH | 10,000 | $36.92 | 40,000 | $135.50 | N/A | N/A | N/A |
| LED Bollard, >= 30W | 50,000 | $72.50 | 70,000 | $47.50 | 70W MH | 10,000 | $36.92 | 40,000 | $142.50 | N/A | N/A | N/A |
| LED Flood Light, < 15W | 50,000 | $47.50 | 70,000 | $47.50 | 25% 50W MH | 10,000 | $36.92 | 40,000 | $135.50 | 75% Halogen PAR20 | 2,500 | $12.67 |
| LED Flood Light, >= 15W | 50,000 | $47.50 | 70,000 | $47.50 | 50% 50W MH | 10,000 | $36.92 | 40,000 | $135.50 | 50% Halogen PAR30/38 | 2,500 | $12.67 |

###### Measure Code: CI-LTG-LEDB-V05-160601

1. Based on final ComEd’s BILD program data from PY4,PY5 and PY6. For Residential installations, hours of use assumptions from ‘5.5.6 LED Downlights’ should be used for LED fixtures and ‘5.5.8 LED Screw Based Omnidirectional Bulbs’ should be used for LED bulbs. [↑](#footnote-ref-1)
2. Based on ENERGY STAR specs – minimum luminous efficacy for Omnidirectional Lamps. For LED lamp power <10W = 50lm/W and for LED lamp power >=10W = 55lm/W. [↑](#footnote-ref-2)
3. Calculated as 45lm/W for all EISA non-exempt bulbs. [↑](#footnote-ref-3)
4. From pg 10 of the Energy Star Specification for lamps v1.1 [↑](#footnote-ref-4)
5. From pg 11 of the Energy Star Specification for lamps v1.1 [↑](#footnote-ref-5)
6. [↑](#footnote-ref-6)
7. http://energystar.supportportal.com/link/portal/23002/23018/Article/32655/ [↑](#footnote-ref-7)
8. The Energy Star Center Beam Candle Power tool does not accurately model baseline wattages for lamps with certain bulb characteristic combinations – specifically for lamps with very high CBCP. [↑](#footnote-ref-8)
9. Illinois evaluation of PY1 through PY3 has not found that fixtures or lamps placed into storage to be a significant enough issue to warrant including an “In-Service Rate” when commercial customers complete an application form. [↑](#footnote-ref-9)
10. Based on ComEd’s BILD program data from PY5 and PY6, see “IL Commercial Lighting ISR\_2014.xls”. [↑](#footnote-ref-10)
11. In the absence of any data for LEDs specifically it is assumed that the same proportion of bulbs eventually get installed as for CFLS. The 98% CFL assumption is based upon review of two evaluations:

    ‘Nexus Market Research, RLW Analytics and GDS Associates study; “New England Residential Lighting Markdown Impact Evaluation, January 20, 2009’ and ‘KEMA Inc, Feb 2010, Final Evaluation Report:, Upstream Lighting Program, Volume 1.’ This implies that only 2% of bulbs purchased are never installed. The second and third year installations are based upon Ameren analysis of the Californian KEMA study showing that 54% of future installs occur in year 2 and 46% in year 3. The 2nd and 3rd year installations should be counted as part of those future program year savings. Note that this Final Install Rate does NOT account for leakage of purchased bulbs being installed outside of the utility territory. EM&V should assess how and if data from evaluation should adjust this final installation rate to account for this impact [↑](#footnote-ref-11)
12. Negative value because this is an increase in heating consumption due to the efficient lighting. [↑](#footnote-ref-12)
13. See “LED reference tables.xls” for breakdown of component cost assumptions. [↑](#footnote-ref-13)
14. Based upon pricing forecast developed by Applied Proactive Technologies Inc (APT) based on industry input and provided to Ameren. [↑](#footnote-ref-14)
15. The manufacturers of the new minimally compliant EISA Halogens are using regular incandescent lamps with halogen fill gas rather than halogen infrared to meet the standard and so the component rated life is equal to the standard incandescent. [↑](#footnote-ref-15)
16. Data is based on Efficiency Vermont derived cost and actual installed wattage information. [↑](#footnote-ref-16)
17. LED Refrigeration Case Ltg Workpaper 053007 rev1, May 30, 2007 [↑](#footnote-ref-17)
18. Note some measures have blended baselines. All values are provided to enable calculation of appropriate O&M impacts. Total costs include lamp, labor and disposal cost assumptions where applicable, see “LED reference tables.xls” for more information. [↑](#footnote-ref-18)