### Commercial ENERGY STAR Specialty Compact Fluorescent Lamp (CFL)

###### Description

An ENERGY STAR qualified specialty compact fluorescent bulb is installed in place of an incandescent specialty bulb in a commercial location. If the implementation strategy does not allow for the installation location to be known a deemed split should be used. For Residential targeted programs (e.g. an upstream retail program), a deemed split of 96% Residential and 4% Commercial assumptions should be used[[1]](#footnote-1), and for Commercial targeted programs a deemed split of 4% Residential and 96% Commercial should be used[[2]](#footnote-2).

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

Energy Star qualified specialty CFL bulb based upon the draft ENERGY STAR specification for lamps (<http://energystar.gov/products/specs/sites/products/files/ENERGY_STAR_Lamps_V1_0_Draft%203.pdf>).

###### Definition of Baseline Equipment

The baseline is a specialty incandescent light bulb including those exempt of the EISA 2007 standard: three-way, plant light, daylight bulb, bug light, post light, globes G40 (<40W), candelabra base (<60W), vibration service bulb, decorative candle with medium or intermediate base (<40W), shatter resistant and reflector bulbs and standard bulbs greater than 2601 lumens, and those non-exempt from EISA 2007: dimmable, globes (less than 5” diameter and >40W), candle (shapes B, BA, CA >40W, candelabra base lamps (>60W) and intermediate base lamps (>40W).

###### Deemed Lifetime of Efficient Equipment

The expected measure life (number of years that savings should be claimed) should be calculated by dividing the rated life of the bulb (10,000 hours[[3]](#footnote-3)) by the run hours. For example using Miscellaneous at 4,589 hours would give 2.2 years. When the number of years exceeds June 2020, the number of years to that date should be used.

###### Deemed Measure Cost

For the Retail (Time of Sale) measure, the incremental capital cost for this measure is $5[[4]](#footnote-4).

For the Refrtofit measures, the full cost of $8.50 should be used plus $5 labor[[5]](#footnote-5) for a total of $13.50. However actual program delivery costs should be utilized if available.

###### 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 section 4.5.

Algorithm

###### Calculation of Savings

###### Electric Energy Savings

∆kWh = ((WattsBase - WattsEE) / 1000) \* ISR \* Hours \* WHFe

Where:

WattsBase = Actual wattage equivalent of incandescent specialty bulb, use the tables below to obtain the incandescent bulb equivalent wattage[[6]](#footnote-6); use 60W if unknown[[7]](#footnote-7)

EISA exempt bulb types:

| **Bulb Type** | **Lower Lumen Range** | **Upper Lumen Range** | **WattsBase** |
| --- | --- | --- | --- |
| **Standard Spirals >=2601** | 2601 | 2999 | 150 |
| 3000 | 5279 | 200 |
| 5280 | 6209 | 300 |
| **3-Way** | 250 | 449 | 25 |
| 450 | 799 | 40 |
| 800 | 1099 | 60 |
| 1100 | 1599 | 75 |
| 1600 | 1999 | 100 |
| 2000 | 2549 | 125 |
| 2550 | 2999 | 150 |
| **Globe**  **(medium and intermediate bases less than 750 lumens)** | 90 | 179 | 10 |
| 180 | 249 | 15 |
| 250 | 349 | 25 |
| 350 | 749 | 40 |
| **Decorative**  **(Shapes B, BA, C, CA, DC, F, G, medium and intermediate bases less than 750 lumens)** | 70 | 89 | 10 |
| 90 | 149 | 15 |
| 150 | 299 | 25 |
| 300 | 749 | 40 |
| **Globe**  **(candelabra bases less than 1050 lumens)** | 90 | 179 | 10 |
| 180 | 249 | 15 |
| 250 | 349 | 25 |
| 350 | 499 | 40 |
| 500 | 1049 | 60 |
| **Decorative**  **(Shapes B, BA, C, CA, DC, F, G, candelabra bases less than 1050 lumens)** | 70 | 89 | 10 |
| 90 | 149 | 15 |
| 150 | 299 | 25 |
| 300 | 499 | 40 |
| 500 | 1049 | 60 |

EISA non-exempt bulb types:

|  |  |  |  |
| --- | --- | --- | --- |
| **Bulb Type** | **Lower Lumen Range** | **Upper Lumen Range** | **Incandescent Equivalent**  **Post-EISA 2007**  **(WattsBase)** |
| **Dimmable Twist, Globe (less than 5" in diameter and > 749 lumens), candle (shapes B, BA, CA > 749 lumens), Candelabra Base Lamps (>1049 lumens), Intermediate Base Lamps (>749 lumens)** | 310 | 749 | 29 |
| 750 | 1049 | 43 |
| 1050 | 1489 | 53 |
| 1490 | 2600 | 72 |

**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[[8]](#footnote-8).

For Directional R, BR, and ER lamp types[[9]](#footnote-9):

|  |  |  |  |
| --- | --- | --- | --- |
| **Bulb Type** | **Lower Lumen Range** | **Upper Lumen Range** | **WattsBase** |
| **R, ER, BR with medium screw bases w/ diameter >2.25" (\*see exceptions below)** | 420 | 472 | 40 |
| 473 | 524 | 45 |
| 525 | 714 | 50 |
| 715 | 937 | 65 |
| 938 | 1259 | 75 |
| 1260 | 1399 | 90 |
| 1400 | 1739 | 100 |
| 1740 | 2174 | 120 |
| 2175 | 2624 | 150 |
| 2625 | 2999 | 175 |
| 3000 | 4500 | 200 |
| **\*R, BR, and ER with medium screw bases w/ diameter <=2.25"** | 400 | 449 | 40 |
| 450 | 499 | 45 |
| 500 | 649 | 50 |
| 650 | 1199 | 65 |
| **\*ER30, BR30, BR40, or ER40** | 400 | 449 | 40 |
| 450 | 499 | 45 |
| 500 | 649 | 50 |
| **\*BR30, BR40, or ER40** | 650 | 1419 | 65 |
| **\*R20** | 400 | 449 | 40 |
| 450 | 719 | 45 |
| **\*All reflector lamps below lumen ranges specified above** | 200 | 299 | 20 |
| 300 | [[10]](#footnote-10)399 | 30 |

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.[[11]](#footnote-11) 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.[[12]](#footnote-12)

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 |

EISA non-exempt bulb types:

| **Bulb Type** | **Lower Lumen Range** | **Upper Lumen Range** | **Incandescent Equivalent**  **Post-EISA 2007**  **(WattsBase)** |
| --- | --- | --- | --- |
| **Dimmable Twist, Globe (less than 5" in diameter and > 749 lumens), candle (shapes B, BA, CA > 749 lumens), Candelabra Base Lamps (>1049 lumens), Intermediate Base Lamps (>749 lumens)** | 310 | 749 | 29 |
| 750 | 1049 | 43 |
| 1050 | 1489 | 53 |
| 1490 | 2600 | 72 |

WattsEE = Actual wattage of energy efficient specialty bulb purchased, use 15W if unknown[[13]](#footnote-13)

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

=100%[[14]](#footnote-14) 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:

|  |  |  |  |
| --- | --- | --- | --- |
| Weigted Average 1st year In Service Rate (ISR) | 2nd year Installations | 3rd year Installations | Final Lifetime In Service Rate |
| 71.2%[[15]](#footnote-15) | 14.5% | 12.3% | 98.0%[[16]](#footnote-16) |

Hours = Average hours of use per year are provided in Reference Table in Section 4.5,Screw based bulb annual operating hours, for each building type[[17]](#footnote-17). 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 Reference Table in Section 4.5. If unknown, use the Miscellaneous value.

###### Deferred Installs

As presented above, 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.

###### EXAMPLE

For example, for a 14W 500 lumen R20 reflector lamp is installed in an office and sign off form provided.

ΔkWh = (((45 - 14)/1000) \* 1.0 \* 3088 \* 1.25

= 119.7 kWh

###### Heating Penalty

If electrically heated building:

ΔkWhheatpenalty[[18]](#footnote-18) = (((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.

###### EXAMPLE

For example, for a 14W 500 lumen R20 reflector lamp is installed in a heat pump heated office and sign off form provided.

ΔkWhheatpenalty = (((45 - 14)/1000) \* 1.0 \* 3088 \* -0.183

= - 17.5 kWh

###### 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 the Reference Table in Section 4.5. If unknown, use the Miscellaneous value..

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

Other factors as defined above

###### EXAMPLE

For example, for a 14W 500 lumen R20 reflector lamp is installed in an office and sign off form provided.

ΔkW = ((45 - 14)/1000) \* 1.0 \* 1.3 \* 0.66

= 0.027kW

###### Natural Gas Savings

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

ΔTherms[[19]](#footnote-19) = (((WattsBase-WattsEE)/1000) \* ISR \* Hours \*- IFTherms

Where:

IFTherms = Lighting-HVAC Interation Factor for gas heating impacts; this factor represents the increased gas 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.

Other factors as defined above

###### EXAMPLE

For example, for a 14W 500 lumen R20 reflector lamp is installed in a gas heated office and sign off form provided.

ΔTherms = (((45 - 14)/1000) \* 1.0 \* 3088 \* -0.016

= - 1.5 Therms

###### Water Impact Descriptions and Calculation

N/A

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

The following O&M assumptions should be used: Life of the baseline bulb is assumed to be (1000/HOURS) year; baseline replacement cost is assumed to be $3.5 for those bulbs types exempt from EISA and $5 for non-exempt EISA bulb types defined above[[20]](#footnote-20).

###### Measure Code: CI-LTG-SCFL-V02-160601

1. RES v C&I split is based on a weighted (by sales volume) average of ComEd PY4-6 and Ameren PY5-6 in store intercept survey results. [↑](#footnote-ref-1)
2. Based upon final weighted (by sales volume) average of the BILD program (ComEd’s commercial lighting program) for PY 4 and PY5 and PY6. [↑](#footnote-ref-2)
3. Energy Star bulbs have a rated life of at least 8000 hours. In commercial settings you expect significantly less on/off switching than residential and so a rated life assumption of 10,000 hours is used. [↑](#footnote-ref-3)
4. NEEP Residential Lighting Survey, 2011 [↑](#footnote-ref-4)
5. Based on 15 minutes at $20 per hour. [↑](#footnote-ref-5)
6. Based upon the draft ENERGY STAR specification for lamps (<http://energystar.gov/products/specs/sites/products/files/ENERGY_STAR_Lamps_V1_0_Draft%203.pdf>) and the Energy Policy and Conservation Act of 2012. [↑](#footnote-ref-6)
7. A 2006-2008 California Upstream Lighting Evaluation found an average incandescent wattage of 61.7 Watts (KEMA, Inc, The Cadmus Group, Itron, Inc, PA Consulting Group, Jai J. Mitchell Analytics, Draft Evaluation Report: Upstream Lighting Program. Prepared for the California Public Utilities Commission, Energy Division. December 10, 2009) [↑](#footnote-ref-7)
8. From pg 10 of the Energy Star Specification for lamps v1.1 [↑](#footnote-ref-8)
9. From pg 11 of the Energy Star Specification for lamps v1.1 [↑](#footnote-ref-9)
10. [↑](#footnote-ref-10)
11. http://energystar.supportportal.com/link/portal/23002/23018/Article/32655/ [↑](#footnote-ref-11)
12. 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-12)
13. An evaluation (Energy Efficiency / Demand Response Plan: Plan Year 2 (6/1/2009-5/31/2010) Evaluation Report: Residential Energy Star ® Lighting

    <http://ilsag.org/yahoo_site_admin/assets/docs/ComEd_Res_Lighting_PY2_Evaluation_Report_2010-12-21_Final.12113928.pdf> ) reported 13-17W as the most common specialty CFL wattage (69% of program bulbs). 2009 California data also reported an average CFL wattage of 15.5 Watts (KEMA, Inc, The Cadmus Group, Itron, Inc, PA Consulting Group, Jai J. Mitchell Analytics, Draft Evaluation Report: Upstream Lighting Program, Prepared for the California Public Utilities Commission, Energy Division. December 10, 2009). [↑](#footnote-ref-13)
14. 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-14)
15. 1st year in service rate is based upon review of PY4-6 evaluations from ComEd’s commercial lighting program (BILD) (see ‘IL Commercial Lighting ISR\_2014.xls’ for more information. The average first year ISR was calculated weighted by the number of bulbs sold. [↑](#footnote-ref-15)
16. The 98% Lifetime ISR 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-16)
17. Based on ComEd analysis taking DEER 2008 values and averaging with PY1 and PY2 evaluation results. [↑](#footnote-ref-17)
18. Negative value because this is an increase in heating consumption due to the efficient lighting. [↑](#footnote-ref-18)
19. Negative value because this is an increase in heating consumption due to the efficient lighting. [↑](#footnote-ref-19)
20. NEEP Residential Lighting Survey, 2011 [↑](#footnote-ref-20)