**Work Paper PGECOLTG109**

**Compact Fluorescent Exterior Fixture**

**Revision 6**

**Pacific Gas & Electric Company**

**Customer Energy Efficiency Department**

**Compact Fluorescent Exterior Fixture**

**Measure Codes L811, L855**

# At-a-Glance Summary

|  |  |  |
| --- | --- | --- |
| **Applicable Measure Codes:** | L811(tenant dwelling) , L855 (common area) | |
| **Measure Description:** | Source: PG&E Lighting Rebate Catalog  Replace an existing incandescent fixture that is rated greater than 60 watts and is attached to tenant dwelling (L811), such as porch lights and common area (e.g., walkways, carport/garage) (L855). | |
| **Base Case Description:** | The base case wattage is based on the wattage reduction ratio (WRR = 3.53).  Source: 2014 DEER | |
| **Energy Impact Common Units:** | Per fixture. | |
| **Base Case Energy Consumption:** | Source: 2016 DEER and PG&E Calculations  66.1 kWh/yr | Source: 2016 DEER and PG&E Calculations  180 kWh/yr |
| **Measure Energy Consumption:** | Source: 2016 DEER and PG&E Calculations  18.7 kWh/yr | Source: 2016 DEER and PG&E Calculations  50.9 kWh/yr |
| **Energy Savings (Base Case – Measure)** | Source: 2016 DEER and PG&E Calculations  47.4 kWh/yr | Source: 2016 DEER and PG&E Calculations  129 kWh/yr |
| **Costs Common Units:** | $ per fixture | |
| **Base Case Equipment Cost ($/unit):** | Source: Home Depot WebScrape  $38.69 | |
| **Measure Equipment Cost ($/unit):** | Source: Home Depot WebScrape  $45.04 | |
| **Measure Incremental Cost ($/unit):** | Source: Home Depot WebScrape  $6.35 | |
| **Effective Useful Life (years):** | Source: 2016 DEER  16 Years, OLtg-CFLfix  15 Years, OLtg-CFLfix-ResCmnArea | |
| **Program Type:** | Replace on Burnout (ROB) | |
| **Net-to-Gross Ratios:** | Source:  2014 DEER  0.55, Res-Default>2 | |
| **Comments:** |  | |

# Document Revision History

Revision # Date Description Author (Company)

|  |  |  |  |
| --- | --- | --- | --- |
| Superseded | 02/28/06 | Energy Star Exterior CF Fixture.doc | Helen Fisicaro (PG&E) |
| Revision 0 | 02/28/08 | Energy Star Exterior CF Fixture PGECOLTG109 R0.doc | Tawni Tidwell (HDR) |
| Revision 1 | 08/03/09 | Energy Star Exterior CF Fixture PGECOLTG109 R1.doc | Jenny Roecks (PG&E) |
| Revision 2 | 03/24/10 | Energy Star Exterior CF Fixture PGECOLTG109 R2.doc | Jenny Roecks (PG&E) |
| Revision 3 | 6/19/12 | Energy Star Exterior CF Fixture PGECOLTG109 R3.doc  NTG updated to 2013 DEER, wattage reduction ratio updated to 2011 DEER, cost updated for new measure case wattage. Cost changed to ROB. | Jenny Roecks (PG&E),  Reviewed by Alina Zohrabian |
| Revision 3 | 8/28/12 | There is no OTR in this workpaper, only MFM. For Vintage AV is changed to EX and For Climate Zone All is changed to IOU | Alina Zohrabian (PG&E) |
| Revision 4 | 7/12/13 | Revised Savings values per ED Workpaper Disposition for Lighting Retrofit, issue March, 2013. For updated savings values, see file PGECOLTG109 R4-Calcs.xlsx  PGE used 60 watts for base case and 14.7 watt for measure case. ED suggested using WRR of 4.07 on a 15 Watt CFL to calculate the base case in the disposition. This changed the base case from 60 watts to 61.05 watts, and the measure case from 14.7 to 15 watts. | Alina Zohrabian (PG&E) |
| Revision 5 | 5/16/14 | PGE used a WRR of 4.07 based on March disposition and 4100 hours for exterior Res based on READI V0.99.6, ED recommended WRR of 3.53 for all CFL fixtures and 3390 hours for exterior common area in Multifamily building type in Lighting disposition December 14, 2013. EUL in Dec, 14, 2013 disposition shows 12 years, which is a typo since the EUL in READI, v1.0.5 is 16 years.  Revised savings values per ED Workpaper Disposition for lighting Retrofit, December 14, 2013. For updated savings values, see file PGECOLTG109 R5.xlsx | Alina Zohrabian (PG&E) |
| Revision 6 | 1/1/2016 | Updated base case costs and measure costs. The new format template was used. | Linda Wan (PG&E)/Alina Zohrabian (PG&E)/Tai Voong (PG&E) |

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# Section 1. General Measure & Baseline Data

## 1.1 Product Measure Description & Background

***Catalog Description –*** Must replace an existing incandescent fixture that is rated greater than or equal to 60 watts and is attached to tenant dwelling, such as porch lights and common area (e.g., walkways, carport/garage).

***Program Restrictions and Guidelines***

***Terms and Conditions:***

Make and model number must be included with a copy of receipt.

***Market Applicability:***

Measure applies to multifamily residences only.

The multifamily downstream program encourages residential customers to replace an existing incandescent fixture that is rated greater than 60 watts and is attached to tenant dwelling (L811), such as porch lights and common area (e.g., walkways, carport/garage) (L855).

## 1.2 Product Technical Description

A lighting fixture with an incandescent lamp greater than or equal to 60 watt is replaced with a new hardwired fixture with a pin-based compact fluorescent lamp. Compact fluorescent lamps are more efficient than incandescent lamps and therefore provide similar illumination levels at lower wattage than incandescent lamps. This measure includes those fixtures attached to the tenant dwelling such as porch lights and common area lighting.

## 1.3 Measure Application Type

The DEER Measure Cost Data Users Guide found on [www.deeresources.com](http://www.deeresources.com) under DEER2011 Database Format hyperlink, DEER2011 for 13-14, spreadsheet SPTdata\_format-V0.97.xls, defines the terms as follows:

Table 1 Measure Application Type[[1]](#endnote-1)

Identifies the measure application type in the Measure Implementation table in DEER2011.

|  |  |  |
| --- | --- | --- |
| Code | Description | Comment |
| ER | Early retirement | measure applied while existing equipment still viable, or retrofit of existing equipment |
| ROB | Replace on Burnout | measure applied when existing equipment fails or maintenance requires replacement |
| NC | New Construction | measure applied during construction design phase as an alternative to a code-compliant standard design |

All the measures within this workpaper are ROB.

## 1.4 Product Base Case and Measure Case Data

The base case is any incandescent hardwired exterior fixture at or above 60W. The savings calculations for this work paper are based on a 60W CFL exterior fixture. The measure wattage is mapped to 15W CFL fixtures with a WRR of 3.53 based on the lighting retrofit disposition issued December 14, 2013[[2]](#endnote-2).

## 1.4.1 DEER Base Case and Measure Case Information

The base case for CFL fixtures is defined by the 2014 DEER wattage reduction ratio for a “Res” building type. The measure can be found in the READI Tool, v2.3.0.

**Hours of Operation**:

As described in the Lighting Disposition from December 2014, the annual hours of operation for CFLs and CDF depend on the building type and area. The annual hours of operation and coincident diversity factors are listed in the table below:

Table Hours of Operation and CDF for CFLs

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Hours of Operation [hr/yr]** | **CDF** | **Measure Code** |
| **Multifamily - Exterior Attached to Dwelling** | 1249 | 0 | L811 |
| **Multifamily - Exterior Common Areas** | 3390 | 0.09 | L855 |

**Net-to-Gross Assumption:**

The NTG values were obtained using the DEER READI tool. The relevant NTG values for the measures in this work paper are in the table below.

Table Net-to-Gross

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **NTGR ID** | **Description** | **Sector** | **BldgType** | **Measure Delivery** | **NTGR** |
| Res-Default>2 | All other EEM with no evaluated NTGR; existing EEM with same delivery mechanism for more than 2 years | Res | Any | Any | 0.55 |

**Spillage Rate:**

Spillage rates are not tracked in work papers; they are tracked in an external document which will be supplied to the Commission Staff.

**Installation Rate:**

The IR value was obtained using the DEER READI tool. The relevant IR value for the measures in this work paper is in the table below.

Table Installation Rate

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **GSIA ID** | **Description** | **Sector** | **BldgType** | **ProgDelivID** | **GSIAValue** |
| MFm-ExtCF-PGE | Exterior Compact Fluorescent Fixture; Annual Installation Rate; Multi-family | Res | MFm | NonUpStrm | 0.89 |

**Effective Useful Life:**

The EUL values were obtained using the DEER READI tool. The relevant EUL values for the measures in this work paper are in the table below:

Table Effective Useful Life

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **EUL ID** | **Description** | **Sector** | **UseCategory** | **EUL (Years)** |
| OLtg-CFLfix | CFL Fixtures – Outdoor – Residential | Res | Lighting | 16 |
| OLtg-CFLfix-ResCmnArea | CFL Fixtures - Outdoor - Residential Common Area | Res | Lighting | 15 |

***1.4.2 Codes & Standards Requirements Base Case and Measure Information***

**Title 20:** These measures do not fall under Title 20 of the California Energy Regulations.

**Title 24:** This measure does not directly fall under Title 24 of the California Energy Regulations.

**Federal Standards:** These measures do not fall under Federal DOE or EPA Energy Regulations.

## 1.4.3 EM&V, Market Potential, and Other Studies – Base Case and Measure Case Information

Some relevant lighting studies include Heschong Mahone’s *CEC Lighting Efficiency Technology Report*[[3]](#endnote-3)and the 2005 KEMA *CFL Metering Study*.

## 1.4.4 Assumptions and Calculations from other sources Base and Measure Cases

The savings calculation in this work paper followed the 2016 DEER and 2015 Uncertain Measures Update as well as the 2014 DEER and Lighting Disposition from December 14, 2013.

# Section 2. Calculation Methods

## 2.1 Electric Energy Savings Estimation Methodologies

Energy savings were derived from 2014 DEER residential exterior lighting methodology for these measures. The replacement CFL wattage for a 60 Watt incandescent fixture was calculated using the 2014 DEER methodology. No interactive effects were considered since these measures are for exterior fixtures in unconditioned space.

Annual Electric Savings:

Energy Savings [kWh/fixture] = (∆Watts/unit) x (hours/day)x(days/year)

1,000 Watts / kW

**L855:**

Energy Savings [kWh/ fixture] =(15\*3.53-15W) x (3390 hrs/yr) / (1,000W/kW)

= 129 kWh annually

**L811:**

Energy Savings [kWh/ fixture] =(15\*3.53-15W) x (1249 hrs/yr) /(1,000W/kW)

= 47.4 kWh annually

## 2.2. Demand Reduction Estimation Methodologies

The demand savings estimation follows the equation below:

*Annual Demand Savings [kW/Unit] = (∆Watts/unit)\* CDF \* HVAC IE*

*1,000 Watts / kW*

The demand savings calculations are presented below:

**L811:**

Annual Demand Savings [kW/ fixture] =(15\*3.53-15W) x (0) / (1,000W/kW)

= 0 kW annually

**L855:**

Annual Demand Savings [kW/ fixture] =(15\*3.53-15W) x (0.09) x 1/ (1,000W/kW)

= 0.00342 kW annually

## 2.3. Gas Energy Savings Estimation Methodologies

Because these CFL fixtures are exterior, they are assumed to be located in unconditioned spaces. Therefore no gas impacts due to HVAC interactive effects have been included. There is also no gas savings associated with these electric measures.

# Section 3. Load Shapes

The Load Shapes for the Measure are identical to the Base Case. Load Shapes are an important part of the life-cycle cost analysis of any energy efficiency program portfolio. The net benefits associated with a measure are based on the amount of energy saved and the avoided cost per unit of energy saved. For electricity, the avoided cost varies hourly over an entire year. Thus, the net benefits calculation for a measure requires both the total annual energy savings (kWh) of the measure and the distribution of that savings over the year. The distribution of savings over the year is represented by the measure’s load shape. The measure’s load shape indicates what fraction of annual energy savings occurs in each time period of the year. An hourly load shape indicates what fraction of annual savings occurs for each hour of the year. A Time-of-Use (TOU) load shape indicates what fraction occurs within five or six broad time-of-use periods, typically defined by a specific utility rate tariff. Formally, a load shape is a set of fractions summing to unity, one fraction for each hour or for each TOU period. Multiplying the measure load shape with the hourly avoided cost stream determines the average avoided cost per kWh for use in the life cycle cost analysis that determines a measure’s Total Resource Cost (TRC) benefit.

## 3.1 Base Case Load Shapes

The base case load shape would be expected to follow a typical exterior lighting load shape.

## 3.2 Measure Load Shapes

For purposes of the net benefits estimates in the E3 calculator, what is required is the load shape that ideally represents the *difference* between the base equipment and the installed energy efficiency measure. This *difference* load profile is what is called the Measure Load Shape and would be the preferred load shape for use in the net benefits calculations.

The measure load shape for this measure as determined by the E3 calculator would be based on the applicable market sector and lighting end-use. However, the load shape with the measure compared to that with the base case is identical. The closest load shape for these measures is listed below:

Table Building Types and Load Shapes

|  |  |  |
| --- | --- | --- |
| **Building Type** | **Load Shape** | **E3 Alternate Building Type** |
| Commercial | PGE:DEER:Com:Indoor\_CFL\_Ltg | NON\_RES |
| Commercial | PGE:2 = Commercial Outdoor Lighting | COM |

# Section 4. Base Case & Measure Costs

A joint effort was made between SCE and PG&E to update base case and measure costs for DEER 2016 affected measures.

## 4.1 Base Cases Costs

The technique of web scraping (aka web harvesting, web crawling, web data extraction) was used to gather pricing information from the Home Depot website for base case costs. The methodology used for measure costs applies to base case costs. See Section 4.2 for the methodology. The base case costs are reduced by 30% as suggested by the Navigant LED Study4. The 30% reduction factor is “to account for the difference between online and typical purchase price” (page 1-3).

## 4.2 Measure Costs

The same technique of web scraping was used to gather pricing information from the Home Depot website for measure case costs. First, a small sample of products was examined between different online retailers to determine the need to include items from various retailers and the discrepancy between pricing. Please refer to the Competitive Pricing tab in the cost spreadsheet. Due to the competitive pricing of the same fixture from different retailers, only Home Depot data was examined in detail.

A manual process of examining reasonable cost was conducted by viewing the scatterplot of all costs and its associated rated wattages and categorizing the items into a high, medium, or low cost bin. Note that in some cases where enough data was scraped, only Energy Star lamps and fixtures were considered in the measure case and CA Title 20 compliant lamps and fixtures were considered in the base case.

Item descriptions were also viewed to understand the reasoning of such high costs.  It was almost always found that items with high costs were associated with architectural features and/or specialty finishes.  As a result, items that fell into the high cost category was not used in the calculations of cost for the work papers because it does not appropriately reflect the approach most consumers would take to implement energy efficiency projects. Refer to the cost spreadsheet for detailed information. Furthermore, the latest EM&V Study from Navigant for LED costs uses the 25th percentile for the median price.[[4]](#endnote-4)

Using the low and medium cost data from Home Depot, the best-fit line or linear regression was used to determine the association between fixture wattages and cost. Please see the cost spreadsheet for the specific linear regression equation generated for the low cost and medium cost. Raw data points are also included in the spreadsheet.

For work paper purposes, the costs are an equal representation of the medium and low cost categories.  Therefore, the best representative association is the average of the trendline for medium cost and the trendline of the low cost. This process is not the same as a linear regression determined from the low and medium cost items combined.  Due to the quantity in the data sampling, the items associated with the low or medium cost would influence the linear regression.  For this reason, the best representative cost comes from the average of the linear regression from the medium cost and the linear regression from the cost.  This is how cost is propagated for all the technology categories.

As with base case costs, the measure costs are also reduced by 30%4 to account for the bulk wholesale pricing discrepancy.

## 4.3 Incremental & Full Measure Costs

The incremental cost for CFL fixtures is the difference between the base case costs and the measure costs. Please refer to the cost calculation spreadsheet for detailed incremental or full cost information.

# References

1. The DEER Measure Cost Data Users Guide found on [www.deeresources.com](http://www.deeresources.com) under *DEER2011 Database Format* hyperlink, DEER2011 for 13-14, spreadsheet *SPTdata\_format-V0.97.xls.* [↑](#endnote-ref-1)
2. CPUC Energy Division -- CPUC Energy Division – Lighting Disposition 2013-2014\_LightingRetrofit\_Disposition-14December2013.Docx

   DEER 2012 Lighting 13-14 dispositions 2013-2014\_LightingRetrofit\_Disposition-14December2013.xlsx {from Dec. 2013] [from December 2013] [↑](#endnote-ref-2)
3. Heschong Mahone Group, *CEC Lighting Efficiency Technology Report – Volume II Appendix.*. September 1999. Accessed at: <http://www.calmac.org/warn_dload.asp?e=0&id=2071> [↑](#endnote-ref-3)
4. California LED Workpaper Update Study. Navigant Consulting. August 28, 2015. [↑](#endnote-ref-4)