**Work Paper PGECOLTG110**

**Energy Star Interior CF Fixture**

**Revision 6**

**Pacific Gas & Electric Company**

**Customer Energy Efficiency Department**

**Energy Star Interior CF Fixture**

**Measure Codes L809, L856**

# At-a-Glance Summary

|  |  |  |  |
| --- | --- | --- | --- |
| **Applicable Measure Codes:** | **L809 (inside dwelling),** | | **L856 (common area)** |
| **Measure Description:** | Must replace an existing incandescent fixture that is rated >= 100 Watts. ENERGY STAR CFL must be included in fixture, and is not eligible for additional rebate. Closets and storage spaces do not qualify for rebate. | | |
| **Energy Impact Common Units:** | Per fixture | | |
| **Base Case Description:** | Source: 2014 DEER  Base case WRR 3.53 | | |
| **Base Case Energy Consumption:** | 54.8 kWh/yr | 622 kWh/yr | |
| **Measure Energy Consumption:** | 15.5 kWh/yr | 176 kWh/yr | |
| **Energy Savings (Base Case – Measure)** | 39.3 kWh/yr | 446 kWh/yr | |
| **Costs Common Units:** | $ per fixture | | |
| **Base Case Equipment Cost ($/unit):** | Source: Home Depot October 29, 2015  $28.92 | | |
| **Measure Equipment Cost ($/unit):** | Source: Home Depot October 29, 2015  $36.75 | | |
| **Measure Incremental Cost ($/unit):** | Source: Home Depot October 29, 2015  $7.83 | | |
| **Effective Useful Life (years):** | Source: 2016 DEER  15 Years, ILtg-CFLfix-ResCmnArea  16 Years, ILtg-CFLfix-Res | | |
| **Program Type:** | Replace on Burnout | | |
| **Net-to-Gross Ratios:** | Source:  2014 DEER  0.55,  Res-Default>2 | | |
| **Important Comments:** |  | | |

# Document Revision History

Revision # Date Description Author (Company)

|  |  |  |  |
| --- | --- | --- | --- |
| **Superceded** |  | **Energy Star Interior CF Fixture - old workpaper.doc** | **Helen Fisicaro (PG&E)** |
| Revision 0 | 2/25/08 | PGECOLTG110 R5 Energy Star Interior CF.docx | Emily Leslie (HDR/BVA) |
| Revision 1 | 08/03/09 | PGECOLTG110 R5 Energy Star Interior CF.docx | Jenny Roecks (PG&E) |
| Revision 2 | 3/24/10 | PGECOLTG110 R5 Energy Star Interior CF.docx | Jenny Roecks (PG&E) |
| Revision 3 | 6/4/12 | PGECOLTG110 R5 Energy Star Interior CF.docx  Workpaper updated to DEER 2011, new NTG, new wattage reduction ratio | Jenny Roecks (PG&E), Reviewed by Alina Zohrabian |
| Revision 3 | 8/28/12 | 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 PGECOLTG110 R4-Calcs.xlsx  PGE used 100 watts for base case and 28.3 watt for measure case. ED suggested using WRR of 3.53 on a 29 Watt CFL to calculate the base case in the disposition. This changed the base case from 100 watts to 102.37 watts, and the measure case from 28.3 to 29 watts.  ISR changed from 0.89 to 0.87. | Alina Zohrabian (PG&E) |
| Revision 5 | 5/16/14 | ED recommended indoor common area hours for multifamily CFL of 6142 and recommended the IE set of MFM. Revised savings values per ED Disposition for lighting Retrofit, December 14, 2013. For updated savings values, see file PGECOLTG110 R5.xlsx | Alina Zohrabian (PG&E) |
| Revision 6 | 1/1/2016 | Updated base case cost and measure cost. | Linda Wan (PG&E)/ Alina Zohrabian (PG&E)/Tai Voong (PG&E) |

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# Section 1. General Measure & Baseline Data

## 1.1 Measure Description & Background

***Catalog Description –*** Must replace an existing hardwired incandescent fixture that is rated greater than or equal to 100 Watts. An ENERGY STAR CFL must be included in fixture and is not eligible for additional rebate.

***Program Restrictions and Guidelines***

Closets and storage spaces do not qualify for rebate.

***Terms and Conditions:***

The customer must be a Multifamily PG&E electric customer. Single family installations are not eligible.

***Market Applicability:***

This measure applies to multifamily residences for “in unit” and interior common areas only. This is a downstream rebate program providing a customer rebate upon receipt of proper application and supporting paperwork.

## 1.2 Product Technical Description

Hardwired compact fluorescent lamp fixtures providing similar illumination levels as incandescent lamp fixtures, but at lower wattages, will replace the incandescent lamps in hardwired fixtures for multifamily units and interior common areas. The two measures include those fixtures inside dwellings, as well as in common areas.

## 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 2016 DEER database contains energy impacts for interior residential compact fluorescent fixtures for all residential building types including multifamily. The lighting retrofit disposition December14. 2013[[2]](#endnote-2) as well as the 2015 Uncertain Measures Update[[3]](#endnote-3) has multifamily common area for interior CFL hours and IE set which are used for savings calculation.

The 2016 DEER methodology is used with the approved WRR of 3.53 and a measure wattage of 29W based on the lighting retrofit disposition above.

## 1.4.1 DEER Base Case and Measure Case Information

The base case used for this measure is any incandescent hardwired interior fixture greater than 100W. For this work paper, we have used 2016 DEER methodology with the approved WRR of 3.53 and a measure wattage of 29W based on the lighting retrofit disposition December 14, 2013.

**Net-to-Gross Assumption:**

The NTG value was obtained using the DEER READI tool. The relevant NTG value for the measures in this work paper are in the table below:

Table 2. Net-to-Gross

|  |  |  |  |
| --- | --- | --- | --- |
| **NTGR\_ID** | **Description** | **NTG** | **Version**  **Version Source** |
| Res-Default>2 | All other EEM with no evaluated NTGR; existing EEM with same delivery mechanism for more than 2 years | 0.55 | DEER 2014  D13 v1.0 |

**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 are in the table below:

Table 3 Installation Rate

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **GSIA ID** | **Description** | **Sector** | **BldgType** | **ProgDelivID** | **GSIAValue** |
| MFm-IntCF-PGE | Interior CFL; Annual Installation Rate; Multi-family | Res | MFm | NonUpStrm | 0.87 |

**Effective Useful Life:**

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

Table 4 Effective Useful Life

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **EUL ID** | **Description** | **Sector** | **UseCategory** | **EUL (Years)** |
| ILtg-CFLfix-Res | CFL Fixtures - Indoor – Residential | Res | Lighting | 16 |
| ILtg-CFLfix-ResCmnArea | CFL Fixtures - Indoor - 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

No additional EM&V studies were used to support the assumptions in this workpaper.

**Hours of Operation**: Hours of operation for multifamily interior spaces are listed in 2014 DEER as 541 hours/year. Multifamily interior common area operating hours of 6142 are based on lighting retrofit disposition Decemeber 14, 2013.

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

The savings calculation in this workpaper followed the 2016 DEER and 2015 Uncertain Measures Update as well as the 2014 DEER and Lighting Disposition from December 14, 20132.

# Section 2. Calculation Methods

## 2.1 Electric Energy Savings Estimation Methodologies

Energy savings were derived from 2016 DEER residential lighting methodology for these measures.

**L809**

The base case wattage uses the 2014 DEER wattage reduction ratio for compact fluorescent fixtures of 3.53. The 2014 DEER multifamily tenant operating hours of 541 hrs/year were applied, as well as the 2014 DEER interactive effects factor.

**L856**

The base case wattage uses the 2014 DEER wattage reduction ratio for compact fluorescent fixtures of 3.53. The hours and IE are based on lighting retrofit disposition December 14, 2013 for interior multifamily common area for CFL fixtures.

## 2.2. Demand Reduction Estimation Methodologies

The demand savings estimation methodology followed the same methodology in DEER 2016 for measure delta wattage. The values for coincident demand factor and HVAC demand interactive effect factors are based on the 2015 Uncertain Measures Update.

**L809**

The peak demand savings were calculated using the 2014 DEER peak demand factor for multifamily buildings.

**L856**

The CDF and IE are based on lighting retrofit disposition December 14, 2013 for interior multifamily common area for CFL fixtures.

## 2.3. Gas Impacts Estimation Methodologies

The gas savings methodology follows the same methodology in DEER 2016. The following formula is used to calculate the gas savings:



**L809**

The IE is based on DEER2014 for interior multifamily common area for CFL fixtures.



**L856**

The hours are based on lighting retrofit disposition December 14, 2013 for interior multifamily common area for CFL fixtures.



# 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 residential lighting end use 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 residential market sector and the lighting end-use.

Table 5 Building Types and Load Shapes

|  |  |  |
| --- | --- | --- |
| **Building Type** | **Load Shape** | **E3 Alternate Building Type** |
| Residential | PGE:DEER:Indoor\_CFL\_Ltg | RES |

# 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 – Lighting Disposition December 14, 2013 [↑](#endnote-ref-2)
3. 2015 Uncertain Measures Update – Database for Energy-Efficient Resources – DEER2015 Updates for Measures Removed from the ESPI Uncertain Measure List found on <http://www.deeresources.com/index.php/deer-versions/2015-uncertain-measures-update> [↑](#endnote-ref-3)
4. California LED Workpaper Update Study. Navigant Consulting. August 28, 2015. [↑](#endnote-ref-4)