Work Paper SCE17LG103

**Revision 2**

**Southern California Edison**

**Interior LED Downlight Fixtures**

# At-a-Glance Summary

|  |  |
| --- | --- |
| **Measure Codes** | Please refer to Attachment 1 for more details on solution codes. |
| **Measure Description** | LED Downlights fixtures |
| **Base Case Description** | WRR Method Assumptions |
| **Units** | Lamp |
| **Energy Savings** | Refer to Excel Calculation Attachment |
| **Full Measure Cost ($/unit)** | Refer to Excel Calculation Attachment |
| **Incremental Measure Cost ($/unit)** | Refer to Excel Calculation Attachment |
| **Effective Useful Life** | Varies by building type |
| **Measure Installation Type** | Replace on Burnout (ROB) |
| **Net-to-Gross Ratio** | All-Ltg-LED-WRR – 0.91 |
| **Important Comments** | This work paper has a complementary Ex Ante Database data set that will be provided in a separate submission to the California Public Utilities Commission (CPUC). |

# Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Rev** | **Date** | **Author** | **Summary of Changes** |
| 0 | 11/1/16 | Robert Hagstrom (SCE) | * Updated labor cost to RSMeans 2016. * Code language update * Updated WRR per 2016 Lighting Disposition |
| 1 | 4/30/2018 | Ajay Wadhera/SCE | * Removed Early Retirement/Accelerated Replacement (RET) * Updated the material cost data. * Per 3/1/2018 CPUC Lamps Disposition: * Updated the NTG ID and value * Updated the WRR |
| 2 | 10/17/2018 | Stephen Brett Reno (TRC) | * Updated savings methodology and WRR to reflect CPUC Resolution E-4952 DEER 2019. * Updated cost for 2019 program year. * Updated all measures to new DEER NTG value for all LED using WRR methodology. * Included additional solution codes to match DEER measure wattages. |

# Commission Staff and Cal TF Comments

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Rev** | **Party** | **Submittal Date** | **Comment Date** | **Comments** | **WP Developer Response** |
| 0 | CS |  |  |  |  |
| 0 | Cal TF |  |  |  |  |

Cal TF website: <http://www.caltf.org/>

# Section 1. General Measure & Baseline Data

## 1.1 Measure Description & Background

This work paper details the replacement of pendant and recessed incandescent or halogen lamps with LED down light retrofit kits up to 23 watts. Some measures (Non-Res) are shown in table below for all others, please refer to Attachment 1.

**Base, Standard, and Measure Cases**

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | LED Downlight |
| Existing Condition | N/A |
| Code/Standard | N/A |
| Industry Standard Practice | WRR Assumptions Provided by CPUC READi v2.5.1 |

Measures and Codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Codes** | | | | **Measure Name** |
| SCG | SDG&E | SCE | PG&E |
|  |  | LT-20687 |  | 8 Watt Down Light (Non Res) LED Fixture |
|  |  | LT-20688 |  | 9 Watt Down Light (Non Res) LED Fixture |
|  |  | LT-20689 |  | 10 Watt Down Light (Non Res) LED Fixture |
|  |  | LT-20690 |  | 11 Watt Down Light (Non Res) LED Fixture |
|  |  | LT-20691 |  | 12 Watt Down Light (Non Res) LED Fixture |
|  |  | LT-20692 |  | 13 Watt Down Light (Non Res) LED Fixture |
|  |  | LT-20694 |  | 14 Watt Down Light (Non Res) LED Fixture |
|  |  | LT-20695 |  | 15 Watt Down Light (Non Res) LED Fixture |
|  |  | LT-20696 |  | 16 Watt Down Light (Non Res) LED Fixture |
|  |  | LT-20698 |  | 17 Watt Down Light (Non Res) LED Fixture |
|  |  | LT-20699 |  | 18 Watt Down Light (Non Res) LED Fixture |
|  |  | LT-20700 |  | 19 Watt Down Light (Non Res) LED Fixture |
|  |  | LT-20701 |  | 20 Watt Down Light (Non Res) LED Fixture |
|  |  | LT-20702 |  | 21 Watt Down Light (Non Res) LED Fixture |
|  |  | LT-20703 |  | 22 Watt Down Light (Non Res) LED Fixture |
|  |  | LT-20704 |  | 23 Watt Down Light (Non Res) LED Fixture |

## Measures in this work paper must be on Energy Star’s qualified product list to receive incentives.

## 1.2 Technical Description

Downlights are part of a fixture in a 4- or 6-inch can installed flush with the ceiling. LED downlights are typically sold as a retrofit-kit which doesn’t require installation of new fixture housing. They simply replace the existing lamp and its trim.

## 1.3 Installation Types and Delivery Mechanisms

The program/install type for the above measures is:

* Replace on Burnout (ROB)
* New Construction (NC)

**Installation Type Descriptions**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Installation Type** | **Savings** | | **Life** | |
| 1st Baseline (BL) | 2nd BL | 1st BL | 2nd BL |
| Replace on Burnout (ROB) | Above Code or Standard | N/A | EUL | N/A |
| New Construction (NEW/NC) | Above Code or Standard | N/A | EUL | N/A |

A delivery mechanism is a delivery method paired with an incentive method. Delivery mechanisms are used by programs to obtain program participation and energy savings. The delivery mechanisms that are available for these measures are as follows:

**Delivery Method Descriptions**

|  |  |
| --- | --- |
| **Delivery Method** | **Description** |
| Financial Support | The program motivates customers, through financial incentives such as rebates or low interest loans, to implement energy efficient measures or projects. |
| Mid-Stream Programs | *See Mid-Stream Incentive in the Incentive Method Descriptions table.* |
| Partnership | The program implements projects through a partnership between the utility and an institutional, government, or community-based organization. |

**Incentive Method Descriptions**

|  |  |
| --- | --- |
| **Incentive Method** | **Description** |
| Direct Install | The program implements energy efficiency measures for qualifying customers, at no cost to the customer. |
| Down-Stream Incentive | The customer installs qualifying energy efficient equipment and submits an incentive application to the utility program. Upon application approval, the utility program pays an incentive to the customer. Such an incentive may be deemed or customized. |
| Mid-Stream Incentive  Mid-Stream Buy Down | The program gives a financial incentive to a midstream market actor (distributor, vendor, or retailer) to encourage the promotion of efficient measures. Buy Down means that the incentive is required to be passed down to the end-use customer. |

## 1.4 Measure Parameters

### 1.4.1 DEER Data

DEER Difference Summary

|  |  |
| --- | --- |
| **DEER Item** | **Used for Workpaper?** |
| Modified DEER methodology | No |
| Scaled DEER measure | No |
| DEER Base Case | Yes |
| DEER Measure Case | Yes |
| DEER Building Types | Yes |
| DEER Operating Hours | Yes |
| DEER eQUEST Prototypes | No |
| DEER Version | READi v2.5.1 |
| Reason for Deviation from DEER | DEER contains this measure. |
| DEER Measure IDs Used | All wattage by wattage Can Retrofit definitions in READi v2.5.1. |

**Net-to-Gross Ratio**

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.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **NTGR ID** | **Description** | **Sector** | **BldgType** | **Measure Delivery** | **NTGR** |
| All-Ltg-LED-WRR | All LED lamps and fixtures using WRR savings calculations | Any | Any | Any | 0.91 |

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **GSIA ID** | **Description** | **Sector** | **BldgType** | **ProgDelivID** | **GSIAValue** |
| Def-GSIA | Default GSIA values | Any | Any | Any | 1 |

**Effective and Remaining Useful Life**

The EUL and RUL values were obtained using the DEER READI tool. DEER defines the RUL as 1/3 of the EUL value. The RUL value is only applicable to the first baseline period for an RET measure with an applicable code baseline. The relevant EUL and RUL values for the measures in this work paper are in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **EUL ID** | **Description** | **Sector** | **Use Category** | **EUL (Years)** | **RUL (Years)** |
| ILtg-Com-LED-20000hr | LED Lamp - Indoor- Commercial | Com | Lighting | Varies by building type  EUL = Rated Life of Lamp (20,000 hrs) / Annual Usage | Varies by building type  RUL = (20,000/ Annual Usage)/3 |
| ILtg-Res-LED-20000hr | LED lamp - Indoor - Residential | Res | Lighting | 16 | 5.33 |
| ILtg-Res-LED-20000hr-Cmn | LED lamp - Indoor - Residential Common Area | Res | Lighting | 3.33 | 1.1 |

### 1.4.2 Codes and Standards Analysis

Title 24 2016 [496] Section 150.0(k)1 contains codes related to Residential lighting which includes a minimum 50 percent of total rated wattage in kitchen to be high efficacy, and non-high efficacy lighting to be controlled by vacancy sensors in certain areas for new construction. The measures in this work paper for Residential building types are not affected by this code.

Title 24 2016 Section 141.0 (b)2J contains codes related to Nonresidential lighting additions, alterations, and repairs for Luminaire Component Modifications as shown below. The measures in this work paper do change the light source in a luminaire and replace the optical system of a luminaire, which triggers Modifications-in-Place. Triggering Modifications-in-Place requires mandatory control provisions for each enclosed space that includes Area, Shut-off, Multi-level, and if applicable, Daylighting Controls, with some exceptions as outlined below.

|  |
| --- |
| **J. Luminaire Component Modifications.** Luminaire component modifications in place that include  replacing the ballasts or drivers and the associated lamps in the luminaire, permanently changing the  light source of the luminaire, or changing the optical system of the luminaire, where 70 or more  existing luminaires are modified either on any single floor of a building or, where multiple tenants  inhabit the same floor, in any single tenant space, in any single year, shall not prevent or disable the  operation of any multi-level, shut-off, or daylighting controls, and shall:  i. Meet the lighting power allowance in Section 140.6 and comply with Table 141.0-E; or  ii. In office, retail, and hotel occupancies have at least 50 percent, and in all other occupancies have at least 35 percent, lower rated power at full light output as compared to the original luminaires prior to being modified, and meet the requirements of Sections 130.1(a)1, 2, and 3, 130.1(c)1A through C, 130.1(c)2, 130.1(c)3, 130.1(c)4, 130.1(c)5, 130.1(c)6A, and for parking garages 130.1(c)7B.  Lamp replacements alone and ballast replacements alone shall not be considered a modification of the luminaire provided that the replacement lamps or ballasts are installed and powered without modifying the luminaire.  **EXCEPTION 1** to Section 141.0(b)2J. Modification of portable luminaires, luminaires affixed to  moveable partitions, or lighting excluded by Section 140.6(a)3.  **EXCEPTION 2** to Section 141.0(b)2J. In an enclosed space where two or fewer luminaires are  modified.  **EXCEPTION 3** to Section 141.0(b)2J. Modifications that would directly cause the disturbance of  asbestos, unless the modifications are made in conjunction with asbestos abatement.  **EXCEPTION 4** to Section 141.0(b)2J. Acceptance testing requirements of Section 130.4 are not  required for modifications where lighting controls are added to control 20 or fewer luminaires. |

Code Summary

|  |  |  |
| --- | --- | --- |
| **Code** | **Reference** | **Effective Dates** |
| Title 24 2016 | Section 141.0 (b)2J Luminaire Component Modifications. | January 1, 2017 |

## 

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

ET07.15 – Recessed LED Downlights [416] report was used to qualify the technologies in this work paper previously. These measures were eventually adopted by DEER and the savings are now based on WRR methodology as provided by the CPUC.

## 1.6 Data Quality and Future Data Needs

N/A

# Section 2. Calculation Methodology

The methodology of the wattages to be used for energy savings is based on the LED wattage being offered and the Wattage Reduction Ratio (WRR). This workpaper utilizes the Wattage Reduction Ratio provided by the California Public Utilities Commission, Energy Division in READi v2.5.1 for Can Retrofits. A WRR of 2.34 was applied to the measure watts to calculate the baseline wattage. The delta watts between baseline to measure was then multiplied with the Interactive effects and the DEER approved Hours of Usage (HOU) for the respective climate zone and building type to calculate the energy savings.

The energy savings estimates are calculated as follows:



The following is a sample energy savings calculation for 15 Watt Down Light (Non Res) LED Fixture Basecase, Total Watts = 2.34 x Msr Watts for Assembly building type in Climate Zone 6.

The demand reduction estimates are calculated as follows:



The following is a sample demand reduction calculation for 15 Watt Down Light (Non Res) LED Fixture Basecase, Total Watts = 2.34 x Msr Watts for Assembly building type in Climate Zone 6.

# Section 3. Load Shapes

The ideal load shape for net benefits estimates would represent the difference between the base case and measure case. The closest load shapes that are applicable to the measures in this work paper are listed in the table below.

Building Types and Load Shapes

|  |  |  |
| --- | --- | --- |
| **Building Type** | **Load Shape** | **E3 Alternate Building Type** |
| Assembly | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Education - Primary School | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Education - Secondary School | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Education - Relocatable Classroom | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Education - Community College | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Education - University | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Grocery | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Health/Medical - Hospital | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Health/Medical - Nursing Home | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Lodging - Hotel | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Lodging - Motel | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Lodging - Guest Room | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Manufacturing - Bio/Tech | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Manufacturing - Light Industrial | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Office - Large | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Office - Small | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Restaurant - Fast-Food | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Restaurant - Sit-Down | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Retail - Multistory Large | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Retail - Single-Story Large | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Retail - Small | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Storage - Conditioned | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Storage - Unconditioned | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Warehouse - Refrigerated | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Residential Single Family | DEER:Indoor\_CFL\_Ltg | RES |
| Residential Multi-family | DEER:Indoor\_CFL\_Ltg | RES |
| Residential Mobile Home - Double-Wide | DEER:Indoor\_CFL\_Ltg | RES |

# Section 4. Costs

## 4.1 Base Case Cost

Baseline costing for this short form is based on PGE workpaper PGECOLTG141 R9 methodology, which used prices obtained through web scraping and applying the a blend of LED retrofit kit and CFL/Halogen percentage from WRR. Some prices were updated to 2018 web scraped values using online retailers, and additional costing samples added in wattage ranges that lacked sufficient sampling.

Base Case Cost

|  |  |  |
| --- | --- | --- |
| Measure Name | Base Equipment Cost | Labor Cost |
| ≤ 15 Watt Down Light (Res) LED Fixture | $7.19 | $11.31 |
| ≤ 15 Watt Down Light (Non Res) LED Fixture | $7.62 | $11.31 |

Please refer to Attachment 2 for further details on the base cast cost calculations.

## 4.2 Measure Case Cost

Measure case costs were based on LED retrofit kits we scraped data performed in Q4 2018. LED retrofit kit costs were calculated by applying a linear best fit line based on average cost per watt. The CFL and halogen lamp costs were found not to have a good correlation so costs were calculated by taking binned averages of various incandescent equivalent wattage groups. See Attachment 2 for more details.

Labor costs estimate the same 10 minute install time from SCE17LG103.1, however a labor rate of $67.88/hr from the READI Tool (NR-IL-ALL) is used to estimate a cost of $11.31 per unit.

Measure Case Cost

|  |  |  |
| --- | --- | --- |
| Measure Name | Measure Equipment Cost | Labor Cost |
| 8 Watt Down Light (Res) LED Fixture | $9.69 | $11.31 |
| 9 Watt Down Light (Res) LED Fixture | $10.40 | $11.31 |

Please refer to Attachment 2 for further details on the measure case cost calculations.

## 4.3 Full and Incremental Measure Cost

**Full and Incremental Measure Cost Equations**

|  |  |  |  |
| --- | --- | --- | --- |
| **Installation Type** | **Incremental Measure Cost** | **Full Measure Cost** | |
| **1st Baseline** | **2nd Baseline** |
| ROB | (MEC + MLC) – (BEC + BLC) | (MEC + MLC) – (BEC + BLC) | N/A |
| NEW/NC |

MEC = Measure Equipment Cost; MLC = Measure Labor Cost

BEC = Base Case Equipment Cost; BLC = Base Case Labor Cost

**Full and Incremental Costs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure** | **Installation Type** | **Incremental Measure Cost** | **Full Measure Cost** | |
| **1st Baseline** | **2nd Baseline** |
| LT-61219 | ROB | $2.51 | $2.51 | N/A |
| LT-68701 | ROB | $2.78 | $2.78 | N/A |

Please refer to Attachment 2 for further details on the IMC.

# Attachments

1. SCE17LG103.2 A1 – Calculation Template\_Final.zip
2. SCE17LG103.2 A2 – Cost Calculations.xls

**References**

References\_10252018\_101513.xlsx

[416] ET07SCE1150 - Residential LED Down Lighting

[496] 2016 Building Energy Efficiency Standards for Residential and Nonresidential Buildings (Title 24)