Work Paper SCE17LG109

**Revision 2**

**Southern California Edison**

**Exterior LED Lamp Replacement**

# At-a-Glance Summary

|  |  |
| --- | --- |
| **Measure Codes** | LT-20670, LT-20671. LT-20672, LT-20673, LT-20674, LT-20675, LT-20676, LT-20677, LT-20678, LT-20679, LT-20680, LT-20681 |
| **Measure Description** | Outdoor LED lamps: PAR30, PAR38 |
| **Base Case Description** | LED Base Case Total Watts = WRR x Msr Watts as indicated in READi v2.5.1 |
| **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** | OLtg-Res-LED-20000hr: 16 years  OLtg-Res-LED-20000hr-Cmn: 5.9 years |
| **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 | 11/16/2016 | Siobhan McCabe (TRC) | * This work paper is an update of SCE13LG109.3 * Updated calculation template to the new calculation template for 2017 * Updated for DEER17 * Added the most recent Energy Star bulb list and Energy Star lamp requirements * Updated applicable cost data * Removed peak demand savings because they are not applicable for exterior lighting measures * Added all (16) California Climate Zones to Calculation template |
| 1 | 6/19/2017 | Lake Casco (TRC) | The following updates were made based on CPUC Lighting dispositions provided on March 1st and May 26th of 2017.   * Removed A-lamp measures due to new required methodology (Solution codes removed: LT-37176, LT-64932, LT-60894, LT-59328) * Updated WRR values for remaining lamp types * Updated based on new WRR and base wattage values * Updated implementation data per EAR review on 8/09/2017. * Updated NTG ID’s per March 1st Screw-In Lamp Disposition. |
| 2 | 10/12/18 | Stephen Brett Reno (TRC) | 1. Updated savings methodology and WRR to reflect DEER 2019. 2. Updated costs to reflect 2018 values (research done in Q4 2018). 3. Updated all measures to new DEER NTG value for all LED using WRR methodology. |

# Commission Staff and Cal TF Comments

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Rev** | **Party** | **Submittal Date** | **Comment Date** | **Comments** | **WP Developer Response** |
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|  |  |  |  |  |  |

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

# Section 1. General Measure & Baseline Data

## 1.1 Measure Description & Background

**Base, Standard, and Measure Cases**

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | Outdoor LED lamps: PAR30, PAR38 |
| Existing Condition | N/A |
| Code/Standard | LED Base Case Total Watts = WRR x Msr Watts as indicated in READi v 2.5.1 |
| Industry Standard Practice | N/A |

Measures and Codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Codes** | | | | **Measure Name** |
| SCG | SDG&E | SCE | PG&E |
|  |  | LT-20670 |  | Exterior LED PAR30: 12 Watts (Common Area) |
|  |  | LT-20671 |  | Exterior LED PAR30: 15 Watts (Common Area) |
|  |  | LT-20672 |  | Exterior LED PAR30: 6 Watts (Common Area) |
|  |  | LT-20673 |  | Exterior LED PAR38: 17 Watts (Common Area) |
|  |  | LT-20674 |  | Exterior LED PAR38: 19 Watts (Common Area) |
|  |  | LT-20675 |  | Exterior LED PAR38: 7 Watts (Common Area) |
|  |  | LT-20676 |  | Exterior LED PAR30: 12 Watts (Dwelling Area) |
|  |  | LT-20677 |  | Exterior LED PAR30: 15 Watts (Dwelling Area) |
|  |  | LT-20678 |  | Exterior LED PAR30: 6 Watts (Dwelling Area) |
|  |  | LT-20679 |  | Exterior LED PAR38: 17 Watts (Dwelling Area) |
|  |  | LT-20680 |  | Exterior LED PAR38: 19 Watts (Dwelling Area) |
|  |  | LT-20681 |  | Exterior LED PAR38: 7 Watts (Dwelling Area) |

**Eligibility Requirements**

* Eligible products must be UL certified, market-available, and rated for outdoor use.
* Eligible lamps shall generate equal or greater luminous output at lower power consumption than their base case counterparts or provide equal or greater center beam candle power for directional lamps to achieve energy savings.
* Eligible lamps must be on the Energy Star Qualified LED Lamp List and feature the DOE’s LED Lighting Facts label.

## 1.2 Technical Description

A light-emitting diode (LED) is a semiconductor device that produces visible light when an electrical current is passed through it. A heat sink absorbs the heat produced by the process. LEDs are directional light sources, and their lamp type is used to shape the light output. LEDs can be more efficient than incandescent (including halogen) and CFL lighting.

## 1.3 Installation Types and Delivery Mechanisms

These measures are offered through the Multifamily Energy Efficiency Rebate Program.

The install type is ROB.

The delivery mechanism is Financial Support: Down-Stream Incentive – Deemed and Direct install

**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 |

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.

**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. |

**Incentive Method Descriptions**

|  |  |
| --- | --- |
| **Incentive Method** | **Description** |
| 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. |
| Direct Install | The program implements energy efficiency measures for qualifying customers, at no cost to the 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 | Yes |
| 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 has wattages for this workpaper. |
| DEER Measure IDs Used | N/A |

**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 | LED Lamps and Fixtures using WRR for 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** | **UseCategory** | **EUL (Years)** | **RUL (Years)** |
| OLtg-Res-LED-20000hr | LED lamp - Outdoor- Residential | Res | Lighting | 20,000 hours / 935 hours/year = 21.4, capped at **16 years** | 5.33 years |
| OLtg-Res-LED-20000hr-Cmn | LED lamp - Outdoor- Residential Common Area | Res | Lighting | 20,000 hours / 3,390 hours/year = **5.9 years** | 1.97 years |

### 1.4.2 Codes and Standards Analysis

**Title 20:** California Energy Commission (CEC) Title 20 [493] defines that a “LED luminaire” is a complete lighting unit consisting of an LED light source, meaning one or more LED lamps or LED light engines, together with parts to distribute light, to position and protect the light source, and to connect the light source to the electrical power.

It further specified that the test methods for LED luminaires using LED lamps and light engines are California Joint Appendix JA8 – 2008, “Testing of Light Emitting Diode Light Sources,” or IES LM79-08, “Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products,” at manufacturer’s option. Title 20, Table N-3, also outlines the Minimum Requirements for Portable LED Luminaires, and Portable Luminaires with LED Light Engines with Integral Heat Sink.

This work paper uses recommended wattage ratios from the Energy Division’s Workpaper Disposition for Integral LED Lamp Replacements (May 14, 2012) (Attachment 3) to calculate the base case wattage. Therefore, code requirements are not used in the energy savings calculation.

**Title 24:** These measures do not fall under Title 24 of the California Energy Regulations [496].

**Energy Star:** The ENERGY STAR Program Requirements for Lamps – Partner Commitments Version 2.1 details the performance requirements for LED Lamps. Eligible LED lamps must meet these requirements.

Code Summary

|  |  |  |
| --- | --- | --- |
| **Code** | **Reference** | **Effective Dates** |
| Title 20 (2015) | Table N-3 | July 1, 2015 |
| Energy Star | Program Requirements for Lamps v2.1 | October 1, 2017 |

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

No studies were references in the development of this work paper.

## 1.6 Data Quality and Future Data Needs

Since the energy savings are based on DEER methodology, no future data needs are anticipated.

# Section 2. Calculation Methodology

The measures in this work paper are defined by wattage ranges. The following tables shows the average measure wattages, the associated wattage reduction ratio (WRR) for each lamp type, and the base wattage (measure watts \* WRR).

|  |  |  |  |
| --- | --- | --- | --- |
| **Solution Code** | **Measure Name** | **Average Measure Watts** | **WRR** |
| LT-20670 | Exterior LED PAR30: 12 Watts (Common Area) | 12 | 2.34 |
| LT-20671 | Exterior LED PAR30: 15 Watts (Common Area) | 15 | 2.34 |
| LT-20672 | Exterior LED PAR30: 6 Watts (Common Area) | 6 | 2.34 |
| LT-20673 | Exterior LED PAR38: 17 Watts (Common Area) | 17 | 3.21 |
| LT-20674 | Exterior LED PAR38: 19 Watts (Common Area) | 19 | 3.21 |
| LT-20675 | Exterior LED PAR38: 7 Watts (Common Area) | 7 | 3.21 |
| LT-20676 | Exterior LED PAR30: 12 Watts (Dwelling Area) | 12 | 2.34 |
| LT-20677 | Exterior LED PAR30: 15 Watts (Dwelling Area) | 15 | 2.34 |
| LT-20678 | Exterior LED PAR30: 6 Watts (Dwelling Area) | 6 | 2.34 |
| LT-20679 | Exterior LED PAR38: 17 Watts (Dwelling Area) | 17 | 3.21 |
| LT-20680 | Exterior LED PAR38: 19 Watts (Dwelling Area) | 19 | 3.21 |
| LT-20681 | Exterior LED PAR38: 7 Watts (Dwelling Area) | 7 | 3.21 |

**Energy Savings**

The following parameters from READI v2.5.1 were used to calculate energy savings:

|  |  |  |  |
| --- | --- | --- | --- |
| **Area type** | **Annual hours of operation (HOU)** | **Coincident demand factor (CDF)** | **kWh and therm interactive effects (IEs)** |
| Dwelling Area | 935 | 0 | 1 (no interactive effects for outdoors) |
| Common Area | 3,390 | 0 | 1 (no interactive effects for outdoors) |

The energy savings calculation equation is:

Demand savings are not included because they are not eligible for exterior lighting measures.

**Example**

LT-20670: Exterior PAR30 (Common Area) Multifamily building type, 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** |
| Residential Mobile Home - Double-Wide | Outdoor Lt | Misc.\_Commercial |
| Residential Multi-family | Outdoor Lt | Misc.\_Commercial |

# Section 4. Costs

Costing for this short form is based on prices obtained through web scraping. These prices were updated to 2018 values with research conducted in Q4 2018, and additional costing samples added in wattage ranges that lacked sufficient sampling.

All cost data can be found in the Attachment 2.

## 4.1 Base Case Cost

Base case costs were based on a blend of LED, CFL, and Halogen lamp costs obtained by the technology mix presented in the WRR. The labor cost

**Base Case Cost**

|  |  |  |  |
| --- | --- | --- | --- |
| **Solution Code** | **Measure Name** | **Equipment Cost** | **Labor Cost** |
| LT-20670 | Exterior LED PAR30: 12 Watts (Common Area) | $8.95 | $4.48 |
| LT-20671 | Exterior LED PAR30: 15 Watts (Common Area) | $11.05 | $4.48 |
| LT-20672 | Exterior LED PAR30: 6 Watts (Common Area) | $6.67 | $4.48 |
| LT-20673 | Exterior LED PAR38: 17 Watts (Common Area) | $14.82 | $4.48 |
| LT-20674 | Exterior LED PAR38: 19 Watts (Common Area) | $17.11 | $4.48 |
| LT-20675 | Exterior LED PAR38: 7 Watts (Common Area) | $7.01 | $4.48 |
| LT-20676 | Exterior LED PAR30: 12 Watts (Dwelling Area) | $8.95 | $4.48 |
| LT-20677 | Exterior LED PAR30: 15 Watts (Dwelling Area) | $11.05 | $4.48 |
| LT-20678 | Exterior LED PAR30: 6 Watts (Dwelling Area) | $6.67 | $4.48 |
| LT-20679 | Exterior LED PAR38: 17 Watts (Dwelling Area) | $14.82 | $4.48 |
| LT-20680 | Exterior LED PAR38: 19 Watts (Dwelling Area) | $17.11 | $4.48 |
| LT-20681 | Exterior LED PAR38: 7 Watts (Dwelling Area) | $7.01 | $4.48 |

## 4.2 Measure Case Cost

Measure case costs were calculated by applying a linear best fit line based on average cost per watt. As costs for low wattage (6-7W) PAR30 and PAR38 lamps were not readily available, PAR20 and PAR16 lamp costs were used to estimate at this range. Each measure case lamp shape (PAR20, PAR30, and PAR38) used a separate linear fit line to estimate costs. All lamp shapes were used to estimate the base case costs together. 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 details.

**Measure Case Cost**

|  |  |  |  |
| --- | --- | --- | --- |
| **Solution Code** | **Measure Name** | **Equipment Cost** | **Labor Cost** |
| LT-20670 | Exterior LED PAR30: 12 Watts (Common Area) | $13.13 | $4.48 |
| LT-20671 | Exterior LED PAR30: 15 Watts (Common Area) | $18.22 | $4.48 |
| LT-20672 | Exterior LED PAR30: 6 Watts (Common Area) | $ 8.43 | $4.48 |
| LT-20673 | Exterior LED PAR38: 17 Watts (Common Area) | $ 20.92 | $4.48 |
| LT-20674 | Exterior LED PAR38: 19 Watts (Common Area) | $ 26.65 | $4.48 |
| LT-20675 | Exterior LED PAR38: 7 Watts (Common Area) | $ 9.01 | $4.48 |
| LT-20676 | Exterior LED PAR30: 12 Watts (Dwelling Area) | $13.13 | $4.48 |
| LT-20677 | Exterior LED PAR30: 15 Watts (Dwelling Area) | $18.22 | $4.48 |
| LT-20678 | Exterior LED PAR30: 6 Watts (Dwelling Area) | $8.43 | $4.48 |
| LT-20679 | Exterior LED PAR38: 17 Watts (Dwelling Area) | $20.92 | $4.48 |
| LT-20680 | Exterior LED PAR38: 19 Watts (Dwelling Area) | $26.65 | $4.48 |
| LT-20681 | Exterior LED PAR38: 7 Watts (Dwelling Area) | $ 9.01 | $4.48 |

## 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 |
|  |

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-20670 | ROB | $4.18 | $4.18 | N/A |
| LT-20671 | ROB | $7.17 | $7.17 | N/A |
| LT-20672 | ROB | $1.76 | $1.76 | N/A |
| LT-20673 | ROB | $6.11 | $6.11 | N/A |
| LT-20674 | ROB | $9.54 | $9.54 | N/A |
| LT-20675 | ROB | $2.00 | $2.00 | N/A |
| LT-20676 | ROB | $4.18 | $4.18 | N/A |
| LT-20677 | ROB | $7.17 | $7.17 | N/A |
| LT-20678 | ROB | $1.76 | $1.76 | N/A |
| LT-20679 | ROB | $6.11 | $6.11 | N/A |
| LT-20680 | ROB | $9.54 | $9.54 | N/A |
| LT-20681 | ROB | $2.00 | $2.00 | N/A |

# Attachments

1. SCE17LG109.2 A1 – Calculation Template\_Final.zip
2. SCE17LG109.2 A2 – Cost Calculations.xls

# References

References\_10252018\_101513.xlsx

[493]

[495]

[496]