Work Paper SCE13LG063

**Revision 1**

**Southern California Edison**

**Low Wattage Cold Cathode Replacing Incandescent Lighting**

# At-a-Glance Summary

|  |  |
| --- | --- |
| **Measure Codes** | LT-17454, LT-30219, LT-45910, LT-71923 |
| **Measure Description** | Cold Cathode Lamps |
| **Base Case Description** | Incandescent Lamps |
| **Units** | per 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** | Iltg-Com-CldCthd-25000hr: varies by building type |
| **Measure Installation Type** | Replace on Burnout (ROB), Retrofit or Early Retirement (RET/ER) |
| **Net-to-Gross Ratio** | See NTG table in Section 1.4 |
| **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 | 05/31/12 | Mary Anne Schmitt/ Lincus, Inc. | * Changed title of work paper * Updated workpaper format to latest template “SP&TS Work Paper Template 2013 v0.1.docx” * Clarified base/measure cases and unit description * Revision to language based on code updates * Updated measure costs * Updated annual operating hours of building types according to DEER 2011 * Updated NTG values |
| 1 | 02/05/16 | Yun Han/SCE | * New template update for 2016 program year * WP effective from 1/1/2016 thru 12/31/2016 * Removed SCE building types * No value modifications |

# Commission Staff and Cal TF Comments

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

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 existing incandescent lights with Cold Cathode Fluorescent Lamps (CCFL).

**Base, Standard, and Measure Cases**

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | Cold Cathode Lamps |
| Existing Condition | Incandescent Lamps |
| Code/Standard | N/A |
| Industry Standard Practice | N/A |

Measures and Codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Codes** | | | | **Measure Name** |
| SCG | SDG&E | SCE | PG&E |
|  |  | LT-17454 |  | 5 Watt Cold Cathode replacing 15 Watts Incandescent Lighting |
|  |  | LT-30219 |  | 8 Watt Cold Cathode replacing Incandescent Average Watts = 28.24 |
|  |  | LT-45910 |  | 2-8 watts Cold Cathode replacing 10-20 watts Incandescent Lighting |
|  |  | LT-71923 |  | 5 Watt Cold Cathode replacing Incandescent Average Watts = 17.65 |

LT-17454: The base case for both ROB and RET measures is a 15 W incandescent lamp. The measure case is a 5 W cold cathode lamp. The measure unit definition is “lamp.”

LT-30219: The base case for ROB measures is incandescent lighting with an average wattage of 28.24 W. The measure case is an 8 W cold cathode lamp. The measure unit definition is “lamp.” This solution code applies to the upstream program only.

LT-45910: The base case for both ROB and RET measures is an incandescent lamp rated between 10 and 20 W. The measure case is a cold cathode lamp rated between 2 and 8 W. The measure unit definition is “lamp.”

LT-71923: The base case for ROB measures is incandescent lighting with an average wattage of 17.65 W. The measure case is a 5 W cold cathode lamp. The measure unit definition is “lamp.” This solution code applies to the upstream program only.

Documentation requirements include verification of existing and proposed wattage of lamps and invoices showing all project costs.

## 1.2 Technical Description

Cold Cathode Fluorescent Lamps work similarly to Linear Fluorescent Lamps. Ultraviolet (UV) light is emitted when mercury is vaporized. The UV will hit the phosphor atom (fluorescent coating) which then emits visible light.

## 1.3 Installation Types and Delivery Mechanisms

The Installation Types are:

* Replace on Burnout (ROB)
* Retrofit or Early Replacement (RET/ER)

**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 |
| Retrofit or Early Replacement (RET/ER) | Above Customer Existing | Above Code or Standard | RUL | EUL-RUL |

The Delivery Methods are:

* Financial Support – Down-Stream Incentive – Deemed
* Financial Support – Direct Install
* Mid-Stream Programs – Mid-Stream Incentive
* Up-Stream Programs – Up-Stream Buy Down

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. |
| Mid-Stream Programs | *See Mid-Stream Incentive in the Incentive Method Descriptions table.* |
| Up-Stream Programs | *See Up-Stream Incentive in the Incentive Method Descriptions table.* |

**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. |
| Up-Stream Incentive  Up-Stream Buy Down | The program gives a financial incentive to an upstream market actor (manufacturer or distributor) to encourage the manufacture, provision, or distribution 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

Upstream measures LT-30219 and LT-71923 are from DEER 2011. Other measures are Non-DEER.

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 | DEER2011 |
| Reason for Deviation from DEER | DEER does not contain this type of measure. |
| DEER Measure IDs Used | Com-Lighting-InGen\_CFLratio0357\_CFLscw-5w  Com-Lighting-InGen\_CFLratio0357\_CFLscw-8w |

**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** |
| Com-Default>2yrs | All other EEMs with no evaluated NTGR; existing EEM in programs with same delivery mechanism for more than 2 years | Com | Any | Any | 0.60 |
| Ind-Default>2yrs | All other EEMs with no evaluated NTGR; existing EEM in programs with same delivery mechanism for more than 2 years | Ind | Any | Any | 0.60 |
| Agric-Default>2yrs | All other EEMs with no evaluated NTGR; existing EEM in programs with same delivery mechanism for more than 2 years | Ag | Any | Any | 0.60 |
| Com-Default-HTR-di | All other EEM with no evaluated NTGR; direct install to hard-to-reach only. | Com | Any | DirInstall | 0.85 |
| Ind-Default-HTR-di | All other EEM with no evaluated NTGR; direct install to hard-to-reach only. | Ind | Any | DirInstall | 0.85 |
| Agricult-Default-HTR-di | All other EEM with no evaluated NTGR; direct install to hard-to-reach only. | Ag | Any | DirInstall | 0.85 |

Note: Direct install measures that are not hard-to-reach will use the default NTG value.

This work paper includes measures that are offered via direct install activities into hard-to-reach (HTR) customer facilities. “Final Resolution E-4700”, dated December 18, 2014, defines specific criteria to classify customer facilities as HTR and also states that two criteria are sufficient to identify HTR customers if one of the criteria met is the geographic criteria.

SCE’s Commercial Direct Install program delivers free and low cost energy efficiency hardware retrofits through installation contractors to reduce peak demand and energy savings for small and medium commercial customers. The barriers for customer participation include limited capital resources, lack of expertise and understanding of the understanding of the benefits of energy efficiency, a suspicion of the “free offer” and its legitimacy, and language and cultural barriers. The program also addresses the ongoing concern with “split incentives”, where the customer is not the owner of the property, and therefore, lack incentive to improve their energy usage. SCE’s Commercial Direct Install program will track the following three (3) customer data points to identify direct install activities in HTR customer facilities. If geography and business size criteria are satisfied, SCE will identify the customer as HTR. If geography and language criteria are satisfied, SCE will identify the customer as HTR. Other measures in the Commercial Direct Install program will receive default NTG (NTGR\_ID: Com-Default>2), unless otherwise specified in DEER.

o **Business Size** – Customer must have less than ten employees

o **Language** – Customer’s primary language spoken is not English

o **Geography** – Businesses in areas other than the United States Office of Management and Budget (OMB) Combined Statistical Areas (CSA) of the San Francisco Bay Area, the Greater Los Angeles Area and the Greater Sacramento Area or the OBM metropolitan statistical areas or San Diego County

The “Required Corrections to Measure Level Input Parameters Identified by Commission Staff per D.14-10-046 Order Paragraph 16”, dated November 3, 2014, includes additional clarification for the geographic criteria:

“Notes on OMB CSA designations:

The OMB has designated a 12-county CSA titled the San Jose-San Francisco-Oakland, CA Combined Statistical Area which includes the nine counties of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma which border the San Francisco Bay plus the three counties of San Joaquin, Santa Cruz, and San Benito that are economically tied to the nine counties that that border the San Francisco Bay.”

The OMB definition of this CSA includes Los Angeles, Orange, San Bernardino, Riverside and Ventura counties.

The OMB definition of this CSA includes Sacramento, Yolo, El Dorado, Placer, Sutter, Yuba, and Nevada counties.”

**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)** |
| Iltg-Com-CldCthd-25000hr | Iltg-Com-CldCthd-25000hr | Com | Lighting | Varies by Building Type | EUL/3 |

### 1.4.2 Codes and Standards Analysis

In Section 149(b) of California’s Title 24 2008 Non-Residential Building Energy Efficiency Standards [66], the Alteration codes and standards language states:

I. Alterations to existing indoor lighting systems shall meet the following requirements:

1. Alterations that increase the connected lighting load, replace, or remove and re-install a total of 50 percent or more of the luminaires in an enclosed space, shall meet the requirements of Sections 130 and 146; and

2. The following wiring alterations shall meet the requirements of Sections 119, 131, and 134:

i. Where new or moved wiring is being installed to serve added or moved luminaires; or

ii. Where conductor wiring from the panel or from a light switch to the luminaires is being replaced, or

iii. Where a lighting panel is installed or relocated.

3. For an alteration where an existing enclosed space is subdivided into two or more spaces, the new enclosed spaces shall meet the requirements of Sections 131(a) and (d); and

4. Alterations that have less than 0.5 watts per square foot and increase the existing lighting power density to 0.5 watts per square foot or greater shall meet the requirements of Sections 119, 130, 131, 134,143(c), and 146.

The measures in this work paper are not affected by the alteration above code requirements because this work paper only involves the replacement of lamps. In addition, this work paper assumes that the existing lighting fixture housing and wiring are not being altered or replaced nor is the connected lighting load being increased as a result of the replacement of the lamps.

In Section 1605.3 State Standards for Non-Federally-Regulated Appliances, table K-7 of Title 20 2010 [277] lists the maximum power use in Watts for state-regulated general service incandescent lamps. Table K-9 in section 1605.3 of Title 20 outlines the maximum rated wattage for general service incandescent lamps. As of January 1, 2013, the maximum rated wattage is 72 W.

Although Title 20 provides maximum power usage based on lumen ranges for incandescent bulbs manufactured on or after January 1st, 2008, CPUC Ruling R06-04-010 and Decision D.07-10-032 require the utilities use the most up to date and final version of DEER along with the associated assumptions that go into estimating the energy savings for different measures within DEER. DEER uses different sets of assumptions and studies to establish the incandescent base case wattage consumption for incandescent bulbs irrespective of the lumens emitted by the incandescent light source as illustrated in the Title 20 Appliance Efficiency Regulations.

Code Summary

|  |  |  |
| --- | --- | --- |
| **Code** | **Reference** | **Effective Dates** |
| Title 24 (2013) | N/A | July 1, 2014 |
| Title 20 (2014) | N/A | July 1, 2014 |

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

N/A

## 1.6 Data Quality and Future Data Needs

N/A

# Section 2. Calculation Methodology

The following table indicates which measures are taken directly from or created with the DEER READI tool which can be found in Attachment 3 & 4. The measures below are used by the Upstream Programs only.

READI Data Used

|  |  |  |
| --- | --- | --- |
| **Measure Code** | **Measure Name** | **READI Data** |
| LT-30219 | 8 Watt Cold Cathode replacing Incandescent Average Watts = 28.24 | Com-Lighting-InGen\_CFLratio0357\_CFLscw-8w |
| LT-71923 | 5 Watt Cold Cathode replacing Incandescent Average Watts = 17.65 | Com-Lighting-InGen\_CFLratio0357\_CFLscw-5w |

For the Downstream Programs, the annual energy savings and demand reduction estimates are based on the majority of program-observed base case and measure wattages. Program observation has shown base case Wattages are between 10 and 20 Watts, with an average of 15 Watts. The installed CCFL measure is between 3 and 8 Watts, with an average of 5.33 Watts. Note that the downstream program measures are from 2-8 watts, even though the savings are conservatively based upon the 3-8 W analysis in the study.

Equation 1 illustrates the energy savings estimation methodologies for the 2-8 Watts CCFL measure used to calculate Non-CFL interior lighting measures for Primary School target sector in Climate Zone 6.

[Equation 1]





Equation 2 illustrates the peak demand reduction estimation method used for Primary School target sector.

[Equation 2]





The calculations for average wattage can be found in Attachment 2.

Full list of savings for different building types and climate zones can be found in Attachment 1.

# 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 - Community College | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Education - Primary School | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Education - Relocatable Classroom | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Education - Secondary School | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Education - University | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Grocery | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Lodging - Guest Rooms | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Health/Medical - Hospital | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Lodging - Hotel | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Manufacturing - Bio/Tech | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Manufacturing - Light Industrial | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Lodging - Motel | DEER:Indoor\_CFL\_Ltg | NON\_RES |
| Health/Medical - Nursing Home | 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 |

# Section 4. Costs

## 4.1 Base Case Cost

The base case cost for the 10 to 30 Watt incandescent lamps were taken from a similar DEER ID, shown in the table below. The lamp wattage from DEER is a 40 Watt lamp but the price for an incandescent lamp is very similar regardless of wattage. Additionally, the DEER cost is similar in price found for various retailers selling 15 Watt lamps. Therefore the DEER cost of $0.64 will be used.

Base Case Cost

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Base Case Description** | **DEER ID** | **Base** | **Labor** | **Total** |
| 40W Incandescent | D08-NE-ILtg-Inc-40W | $0.64 | $6.25 | $6.89 |

## 4.2 Measure Case Cost

The measure cost was taken from various online retailers and can be found in Attachment 2. The labor cost was obtained from RS Means [A].

|  |  |  |  |
| --- | --- | --- | --- |
| **Solution Code** | **Measure** | **Labor** | **Total** |
| LT-17454 | $13.64 | $6.25 | $19.89 |
| LT-30219 | $18.08 | $6.25 | $24.33 |
| LT-45910 | $14.88 | $6.25 | $21.13 |
| LT-71923 | $13.64 | $6.25 | $19.89 |

## 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 |
| RET/ER | (MEC + MLC) – (BEC + BLC) | MEC + MLC | (MEC + MLC) – (BEC + BLC) |

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-17454 | ROB | $13.00 | $13.00 | N/A |
| LT-30219 | ROB | $17.44 | $17.44 | N/A |
| LT-45910 | ROB | $14.24 | $14.24 | N/A |
| LT-71923 | ROB | $13.00 | $13.00 | N/A |
| LT-17454 | RET | $13.00 | $19.89 | $13.00 |
| LT-30219 | RET | $17.44 | $24.33 | $17.44 |
| LT-45910 | RET | $14.24 | $21.13 | $14.24 |
| LT-71923 | RET | $13.00 | $19.89 | $13.00 |

# Attachments

1. 2. 3. 4. 

# References



[66]

[277]

[A] RS Means, 2009