**Work Paper PGECOLTG165**

**LED A-Lamps**

**Revision #6**

**Pacific Gas & Electric Company**

**Customer Energy Solutions**

**LED A-LAMP**

**Measure Codes LT122 – LT124, LT126 – LT135, LT394 – LT431**

# At-A-Glance Summary

|  |  |
| --- | --- |
| **Measure Codes:** | LT122– LT124, LT126– LT135, LT394 – LT431. |
| **Measure Description:** | LED A-Lamps, CEC and Energy Star |
| **Base Case Description:** | Halogen Incandescent, CFL A-lamp, LED A-lamp |
| **Units:** | Per lamp |
| **Energy Savings (Base Case – Measure):** | Various. Refer to .xlsx file attached  Source: PG&E Calculations. |
| **Full Measure Cost ($/unit)** | Various. Refer to .xlsx file attached  Source: Web links |
| **Incremental Measure Cost($/unit)** | Various. Refer to .xlsx file attached  Source: PG&E Calculations |
| **Effective Useful Life (years):** | ILtg-Res-LED-20000hr  Source: DEER2017 |
| **Measure Installation Type** | ROB & ER |
| **Net-to-Gross Ratios:** | |  |  | | --- | --- | | **NTGR ID** | **NTGR** | | All-Ltg-ScrwInLED | 0.91 |   Source: Source: 2018 Phase 1 Screw-in Lamp Disposition, Section 4 |
| **Important Comments:** |  |

# Document Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Revision #** | **Date** | **Section by Section Description of Revisions** | **Author (Company)** |
| Revision 0 | 8/20/13 | PGECOLTG165 R0 LED A-Lamps.doc. Original Workpaper | Alina Zohrabian (PG&E) |
| Revision 1 | 5/2/14 | PGECOLTG165 R1 LED A-Lamps.doc Added DI values from (PGE3PLTG191-R0). For updated values, see file PGECOLTG165 R1.xlsx | Alina Zohrabian (PG&E) |
| Revision 2 | 1/1/2016 | Updated NTG, annual hours of operation, IE, CDF, EUL, per DEER 2016. Costs have also been updated. | Linda Wan (PG&E)/Alina Zohrabian (PG&E) |
| Revision 3 | 1/1/2017 | Updated from WRR to lumen equivalency method, which was rejected; therefore, updated to WRR of 2.96 as approved in R2 | Alina Zohrabian (PG&E) |
| Revision 4 | 7/1/2017 | Updated from WRR to efficacy method as per May 26, 2017 disposition; Updated Program Restrictions and Guidelines | Alina Zohrabian (PG&E)/Mini Damodaran (PG&E) |
| Revision 5 | 4/28/2018 | Retired measure codes LT121 and LT125 as they will not meet minimum efficacy requirements of 80 LPW effective 1/1/2018 per CEC/Title 20 efficacy requirements. All other measure codes remain unchanged. | Randy Kwok (PG&E) |
| Revision 6 | 4/30/2018 | Excluded all building types for ROB measures except “Res”.  Changed ROB measures to Res DI only.  Added new measure codes for ROB as follows:  LT394 for 40W equivalent 110 LPW,  LT395 for 40W equivalent 120 LPW,  LT396 for 60W equivalent 120 LPW,  LT397 for 100W equivalent 120 LPW for ROB.  Added ER measure type (LT398 to LT431) for Res DI channel only.  Effective 7/1/2018. | Randy Kwok (PG&E) |

Commission Staff and Cal TF Comments:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Rev** | **Party** | **Submittal Date** | **Comment Date** | **Comments** | **WP Developer Response** |
| 3 | PG&E | Sept 22 | Sept 22 | After PG&E’s presentation on Sept 22nd CALTF staff received comments from ED consultant. These comments are presented in the Oct 27 presentation with IOU responses | The responses to the comments from the ED consultant are documented and presented and affirmed during the Oct 27th CALTF meeting |
| 3 | PG&E | Nov 14 | Nov 17 | PG&E discussed the responses to Sept 22nd comments, which were presented to CALTF in OCT 27th meeting, with ED staff and consultants; other IOU’s participated in this discussion.  ED consultant asked for a separate document explaining the baseline model and the excel sheet with functional external links if links are used for reference. | Same comments from Sept22nd were discussed. The comments were addressed in the Oct 27th presentation. With the workpaper these additional materials will be submitted. |

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

Revision 3 of this workpaper was affirmed by CALTF on Sep 27, 2016 meeting, which was rejected by ED and was revised to use the previously approved WRR, based on March, 2017 disposition.

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# Section 1 General Measure & Baseline Data

## 1.1 Measure Description & Background

This workpaper details the replacement of lumen equivalent A-lamp bulbs with Light Emitting Diode (LED) A-lamps.

This version of the workpaper complies with the product efficacy and EISA wattage bin method as outlined in the CPUC’s March1, 2018 disposition and uses the savings values provided in the disposition for ROB measures.

PG&E also included in this workpaper update the early retirement (ER) measure type only applicable to residential direct install (DI) programs targeting hard to reach (HTR) customers. Measure codes are separated between incandescent to LED and CFL to LED early retirements to reflect the customer’s pre-existing equipment in place.

Lamp specifications for ER measures are the same as ROB measures. If Program Restrictions and Guidelines for Early Retirement (ER) Measures cannot be met by programs, ROB residential DI measures will be used instead.

**Base, Standard, and Measure Cases**

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | LED lamp |
| Existing Condition | Incandescent, Halogen incandescent or CFL lamp |
| Code/Standard | NA |
| Industry Standard Practice | Halogen incandescent or CFL lamp |

Table 1 Measures and Codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Codes** | | | | **Measure Name** |
| SCG | SDG&E | SCE | PG&E |
| NA | LXX2 | LXX2 | LT122 | 40W equivalent 80 LPW (lumens/watt) |
| NA | LXX3 | LXX3 | LT123 | 40W equivalent 90 LPW (lumens/watt) |
| NA | LXX4 | LXX4 | LT124 | 40W equivalent 100 LPW (lumens/watt) |
| NA | LXX6 | LXX6 | LT394 | 40W equivalent 110 LPW (lumens/watt) |
| NA | LXX7 | LXX7 | LT395 | 40W equivalent 120 LPW (lumens/watt) |
| NA | LXX8 | LXX8 | LT126 | 60W equivalent 90 LPW (lumens/watt) |
| NA | LXX9 | LXX9 | LT127 | 60W equivalent 100 LPW (lumens/watt) |
| NA | LXX10 | LXX10 | LT128 | 60W equivalent 110 LPW (lumens/watt) |
| NA | LXX11 | LXX11 | LT396 | 60W equivalent 120 LPW (lumens/watt) |
| NA | LXX12 | LXX12 | LT129 | 75W equivalent 90 LPW (lumens/watt) |
| NA | LXX13 | LXX13 | LT130 | 75W equivalent 100 LPW (lumens/watt) |
| NA | LXX14 | LXX14 | LT131 | 75W equivalent 110 LPW (lumens/watt) |
| NA | LXX15 | LXX15 | LT132 | 75W equivalent 120 LPW (lumens/watt) |
| NA | LXX16 | LXX16 | LT133 | 100W equivalent 90 LPW (lumens/watt) |
| NA | LXX17 | LXX17 | LT134 | 100W equivalent 100 LPW (lumens/watt) |
| NA | LXX18 | LXX18 | LT135 | 100W equivalent 110 LPW (lumens/watt) |
| NA | LXX19 | LXX19 | LT397 | 100W equivalent 120 LPW (lumens/watt) |
| NA | LXX20 | LXX20 | LT398 | 40W equivalent 80 LPW, Replacing Incandescent |
| NA | LXX21 | LXX21 | LT399 | 40W equivalent 90 LPW, Replacing Incandescent |
| NA | LXX22 | LXX22 | LT400 | 40W equivalent 100 LPW, Replacing Incandescent |
| NA | LXX23 | LXX23 | LT401 | 40W equivalent 110 LPW, Replacing Incandescent |
| NA | LXX24 | LXX24 | LT402 | 40W equivalent 120 LPW, Replacing Incandescent |
| NA | LXX25 | LXX25 | LT403 | 60W equivalent 90 LPW, Replacing Incandescent |
| NA | LXX26 | LXX26 | LT404 | 60W equivalent 100 LPW, Replacing Incandescent |
| NA | LXX27 | LXX27 | LT405 | 60W equivalent 110 LPW, Replacing Incandescent |
| NA | LXX28 | LXX28 | LT406 | 60W equivalent 120 LPW, Replacing Incandescent |
| NA | LXX29 | LXX29 | LT407 | 75W equivalent 90 LPW, Replacing Incandescent |
| NA | LXX30 | LXX30 | LT408 | 75W equivalent 100 LPW, Replacing Incandescent |
| NA | LXX31 | LXX31 | LT409 | 75W equivalent 110 LPW, Replacing Incandescent |
| NA | LXX32 | LXX32 | LT410 | 75W equivalent 120 LPW, Replacing Incandescent |
| NA | LXX33 | LXX33 | LT411 | 100W equivalent 90 LPW, Replacing Incandescent |
| NA | LXX34 | LXX34 | LT412 | 100W equivalent 100 LPW, Replacing Incandescent |
| NA | LXX35 | LXX35 | LT413 | 100W equivalent 110 LPW, Replacing Incandescent |
| NA | LXX36 | LXX36 | LT414 | 100W equivalent 120 LPW, Replacing Incandescent |
| NA | LXX37 | LXX37 | LT415 | 40W equivalent 80 LPW, Replacing CFL |
| NA | LXX38 | LXX38 | LT416 | 40W equivalent 90 LPW, Replacing CFL |
| NA | LXX39 | LXX39 | LT417 | 40W equivalent 100 LPW, Replacing CFL |
| NA | LXX40 | LXX40 | LT418 | 40W equivalent 110 LPW, Replacing CFL |
| NA | LXX41 | LXX41 | LT419 | 40W equivalent 120 LPW, Replacing CFL |
| NA | LXX42 | LXX42 | LT420 | 60W equivalent 90 LPW, Replacing CFL |
| NA | LXX43 | LXX43 | LT421 | 60W equivalent 100 LPW, Replacing CFL |
| NA | LXX44 | LXX44 | LT422 | 60W equivalent 110 LPW, Replacing CFL |
| NA | LXX45 | LXX45 | LT423 | 60W equivalent 120 LPW, Replacing CFL |
| NA | LXX46 | LXX46 | LT424 | 75W equivalent 90 LPW, Replacing CFL |
| NA | LXX47 | LXX47 | LT425 | 75W equivalent 100 LPW, Replacing CFL |
| NA | LXX48 | LXX48 | LT426 | 75W equivalent 110 LPW, Replacing CFL |
| NA | LXX49 | LXX49 | LT427 | 75W equivalent 120 LPW, Replacing CFL |
| NA | LXX50 | LXX50 | LT428 | 100W equivalent 90 LPW, Replacing CFL |
| NA | LXX51 | LXX51 | LT429 | 100W equivalent 100 LPW, Replacing CFL |
| NA | LXX52 | LXX52 | LT430 | 100W equivalent 110 LPW, Replacing CFL |
| NA | LXX53 | LXX53 | LT431 | 100W equivalent 120 LPW, Replacing CFL |

PG&E is submitting this workpaper as a statewide lead for the other IOUs.

SDG&E and SCE will create their internal codes after the measures are approved and uploaded in READI. The temporary LXX2 to LXX53 is created as a place holder.

For PG&E all measures in this workpaper are revised to have just “Res” building type only, and measures are offered through direct install channel only.

**Requirements:**

* Must replace an incandescent, halogen, or CFL A-lamp

***Program Restrictions and Guidelines for ROB Measures***

For lamps rebated through the commercial programs the minimum efficacy requirements have increased due to stricter Energy Star requirements. IOU’s program staff will work with CPUC program staff to make sure all the rebated lamps meet the appropriate program rules and to reach towards the same common goals. **In addition to Energy Star requirements, Energy Division has issued a disposition on May 26, 2017 that enforces additional minimum efficacy requirements for programs as shown in Table 4.**

* This workpaper covers Direct Install delivery channel.

Table 2 Lamp Specifications

|  |
| --- |
| **Residential: Direct Install** |
| Must be on THE ENERGY STAR Qualified Products List.  Combined minimum efficacy score of 297 (Compliance score = Efficacy + (CRI x 2.3)  See Table 4 for minimum efficacy requirements. |

**Terms and Conditions:**

The customer must be a residential PG&E electric customer.

**Market Applicability:**

The table below shows applicable delivery types, building types, and application types.

Table 3 Delivery Method and Applicable Building Types

|  |  |  |
| --- | --- | --- |
| **Delivery Type** | **Applicable Building Type** | **Measure Application Type** |
| Direct Install | ”Res” | ROB |
| Direct Install | ”Res” | ER |

The May 26, 2017 disposition[[1]](#endnote-1) provided minimum efficacy requirements for program implementation as shown below:

**Table 4 Screw in Lamp disposition, May 26, 2017 minimum efficacy requirements**

|  |  |  |  |
| --- | --- | --- | --- |
| **EISA Wattages (W)** | **2017 efficacy (LPW)** | **2018 efficacy (LPW)** | **2019 efficacy (LPW)** |
| 40 | 68 | **80** | 95 |
| 60 | 80 | **90** | 100 |
| 75 | 90 | **90** | 110 |
| 100 | 90 | **90** | 110 |

***Program Restrictions and Guidelines for Early Retirement (ER) Measures***

For Residential Direct Install Programs targeting Hard to Reach (HTR) customers following program requirements apply:

#### **Option 1**

1. Eligible for Hard to Reach (HTR) customers only. If customer doesn’t qualify for HTR then ROB measures should be utilized. HTR definition pursuant to Resolution G-3497 as referenced in A.17-01-013 et al Proposed Decision (04/04/2018):

*Specific criteria were developed by staff to be used in classifying a customer as hard-to-reach. Two criteria are considered sufficient if one of the criteria met is the geographic criteria defined below. There are common as well as separate criteria when defining hard-to-reach for residential versus small business customers. The barriers common to both include:*

* *Those customers who do not have easy access to program information or generally do not participate in energy efficiency programs due to a combination of language, business size, geographic, and lease (split incentive) barriers. These barriers to consider include:*
* *Language – Primary language spoken is other than English, and/or*
* *Geographic – Businesses or homes in areas other than the United States Office of Management and Budget Combined Statistical Areas of the San Francisco Bay Area, the Greater Los Angeles Area and the Greater Sacramento Area or the Office of Management and Budget metropolitan statistical areas of San Diego County.*
* *For residential added criteria to the above to consider:*
* *Income – Those customers who qualify for the California Alternative Rates for Energy (CARE) or the Family Electric Rate Assistance Program (FERA), and/or*
* *Housing Type – Multi-family and Mobile Home Tenants (rent and lease).*

1. Document inventory of removed equipment by one of the following options:
   1. Record of wattage and type (CFL or Incandescent) of replaced equipment.
      1. In instances where exact lamp type is not available, replacement lamps from adjacent EISA lumen bins are permissible within the same technology type. For example, a 40W equivalent CFL can be replaced by a 40W or 60W CFL to LED measure.
      2. It is not permissible to use a measure code for a different technology type. A 60 W equivalent CFL cannot be replaced by a 60W incandescent to LED measure.
   2. Pictures of replaced equipment - end of day pile or per household.
   3. Recycling receipts with bulb quantity included.
2. Provide field team training documentation that only existing functioning incandescent or CFL lamps, within reach of safe installation, are to be replaced with corresponding allowed LED lamps per Option 1, 2a.

#### **Option 2**

If programs fail to provide any of the above evidence for ER, then ROB measures must be used following all applicable Program Restrictions and Guidelines for ROB Measures.

Lamp specifications for ER measures are the same as ROB measures.

## 1.2 Technical Description

A-lamps are the general purpose lamps that are used vastly in residential applications. Light emitting diode (LED) sources have improved over the past decade making them an efficient and reliable lighting technology. Many LED products successfully replaced other lighting sources and made their way into the market by continuing to improve and to compete in any application.

## 1.3 Installation Type Descriptions

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 5 Measure Application Type

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

All the measures within this workpaper are ROB and ER.

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** |
|  |  |
| Partnership | The program implements projects through a partnership between the utility and an institutional, government, or community-based organization. |
| Up/mid-Stream Programs | See Mid-Stream Incentive in the Incentive Method table. |

**Incentive Method Descriptions**

|  |  |
| --- | --- |
| **Incentive Method** | **Description** |
| Direct Install | The program implements energy efficiency measures for qualifying customers, at no cost to the customer. |
|  |  |
| Mid-Stream Incentive | The program gives a financial incentive to a midstream market actor, such as a retailer or contractor, to encourage the promotion of efficient measures. The incentive may or may not be passed on to the end-use customer. |

## 1.4 Measure Parameters

### 1.4.1 DEER Data

The Database for Energy Efficient Resources (DEER) 2016 does address LED lamp savings by WRR methodology. This workpaper follows the efficacy method as per March 1, 2018 disposition.

**Net-to-Gross Assumption:**

The NTG values are based on “2018ScrewInLampSavingsMethods-1March2018” disposition. The table below summarizes the Net-to-Gross ratio applicable to all programs and delivery channels that offer these measures.

Table 6 Net-to-Gross Ratios

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **NTGR ID** | **Description** | **Sector** | **BldgType** | **Delivery Method** | **NTGR** |
| All-Ltg-ScrwInLED | All LED lamps and Can Retrofits | Any | Any | Any | 0.91 |

**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.

Table 7 Installation Rate

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **GSIA ID** | **Description** | **Sector** | **BldgType** | **ProgDelivID** | **GSIAValue** |
| Com-LED-PGE | Non-Res LED; Non-Upstream Program; Annual Installation Rate | Com | Any | NonUpStrm | 1 |
| Def-GSIA | Default GSIA values | Any | Any | Any | 1 |

**Effective Useful Life / Remaining Useful Life**

The EUL value is from DEER and it is based on 20,000 hour of rated lamp life. The EUL is calculated using the following equation:

EUL = (Rated Life of Lamp (20,000 hours)) / (Average Annual Operating Hours for Building Type)

Table 8 Effective and Remaining Useful Life

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **EUL ID** | **Description** | **Sector** | **UseCategory** | **EUL (Years)** | **RUL (Years)** |
| ILtg-Res-LED-20000hr | LED lamp - Indoor - Residential | Res | Lighting | 16 | 5.33 |
| ILtg-Com-LED-20000hr | LED Lamp - Indoor- Commercial | Com | Lighting | 12 (Max) | 4 |

### 1.4.2 Codes & Standards Analysis

***Title 20:*** These measures do fall under Title 20 of the California Energy Regulations.

***Title 24:*** These measures do not fall under Title 24 [2013 or 2016] of the California Energy Regulations.

***Federal Standards:*** Federal DOE or EPA Energy Regulations are no stricter than, and in the same format as, the Title 20 regulations.

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

The most relevant EM&V reports are summarized in TRC’s LED Lighting baseline data memorandum[[2]](#endnote-2).

1. The residential California Lighting and Appliances Saturation Study (CLASS 2012 - DNV-GL 2014)
2. The California Commercial Saturation Survey (CSS – Itron 2014)
3. The most recent California shelf survey (the “2015/16 winter survey”, conducted by DNV-GL)
4. NEMA provides quarterly data of U.S. A-lamp shipments from its members

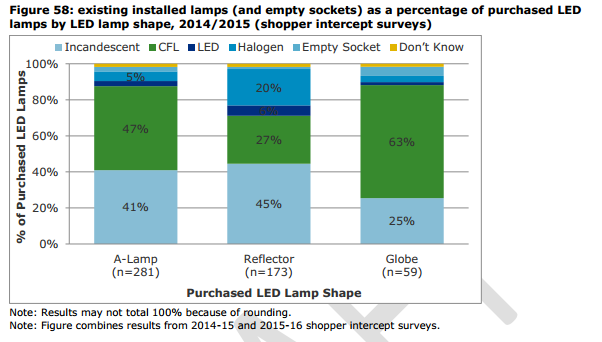
PG&E presented the above data in California Technical Forum (CALTF) and received feedback from the Ex-Ante consultants that although the DNV-GL shelf survey is the most recent data but it is not representative of sales and IOUs should be looking into what LEDs will be replacing next year. The Ex-Ante consultants also mentioned that latest NEMA shipment data (#4) is the best up-to-date source of data to use to find out what LED’s will be replacing in 2017. Ex-Ante consultants also mentioned that the residential saturation data (#1) would have been the most representative but unfortunately it is 4 years old.

Based on the comments provided, PG&E took the residential California Lighting and Appliance Saturation data (#1) and built a model to simulate an update of CLASS saturation based on the NEMA shipment data through Q2 2016. The inputs of the model are the 2012 saturation, NEMA quarterly data, and the expected lamp failures based on lifetime. The model then predicts what percentage of each technology would be failing at this point in time, providing a mix of baseline lamp technologies. Comparing the baseline to the latest NEMA sales shows the differences in the mix of failures and the mix of replacement sales, suggesting where one technology type is replacing failures of another technology in the current market. The model calculation, data sources and assumptions are listed in the excel sheet provided with Revision-3. The results of the model suggest that for new LED A-lamp sales about 58% of the baseline is CFL, 40% of the baseline is traditional incandescent and 2% is LED.

PG&E recommends using 40% halogen incandescent instead of the traditional incandescent to avoid the double dipping issue with codes and standard and to be conservative. Also since the LED percentage is very small PG&E recommend rolling the percentage into the CFL. This will raise the baseline CFL percentage from 58% to 60% CFL. Rolling the LED percentage into the CFL will simplify the calculation since otherwise we need to find out LED lumen equipment wattages for each of the four calculation lumen bins.

Evergreen Economics in their recent (July 2016) preliminary findings from their 1000 audits of residential customers in PG&E territory, PG&E Home Energy Use Study (HEUS), presented the mean lamps per household. The data compared the PG&E HEUS data to the CLASS data from 2012. The data supports that most LEDs will be replacing traditional incandescent lamps and the CFL lamp saturation has not significantly increased from 2012 to 2016. The HEUS data aligns reasonably well with the saturation assumptions in the model, again considering incandescent and halogen as a combined category.

The latest preliminary data from the DNV-GL report on California replacement lamp market status shows in Figure-58, below that 41% of LED A-Lamps purchased would replace traditional incandescent and 5% would replace Halogen incandescent and about 47% would replace CFLs. This suggests overall that the 40% halogen incandescent model is slightly conservative.



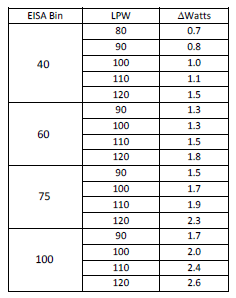
In general all the reports suggest that CFLs should not comprise more than 60% of the baseline for LED A-Lamps.

Energy Division did not accept the above data and presented the following percentages in the May 26, 2017, screw in lamp disposition.

* For lamps greater than or equal to 90 lpw, the baseline is revised to be 75% CFLs and 25% halogens.
* For lamps less than 90 lpw, the baseline is revised to be 55% CFLs, 20% LEDs and 25% halogens.

The latest disposition, “2018 Screw-In Lamp Savings Methods Disposition” dated March 1, 2018 was used to update the energy savings calculations. Please refer to Table 9.

Table 9 Approved LED A-Lamp Measure Definitions effective 1 July 2018

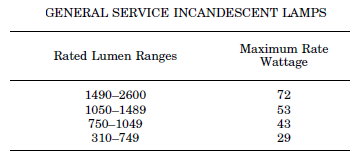


### 1.5.4 Assumptions and Calculations from other sources – Base and Measure Cases

For the base case as discussed above PG&E complied with the percentages in the 2017 ED disposition and used the delta watts provided in the disposition.

The halogen incandescent wattages are defined by EISA for the specified lumen bins as shown in Figure 1. For this version of the workpaper the halogen incandescent wattages are not going to be used but the EISA lumen bins will be used to define the equivalency to the traditional incandescent wattages.

Figure 1-EISA Lumen Bins and Wattages



To define the wattages of CFLs PG&E recommends using lumen equivalency to be consistent within the new methodology. PG&E investigated using both DEER2016 and DEER2014 residential WRR of 2.48 and 3.47 to back calculate the CFL wattages and presented in CALTF. The analysis showed that using DEER WRR would incorrectly increase the LED savings. The following CFL wattages are proposed to be used for savings calculations.

Table 10 Base Case Equivalent Wattages

|  |  |  |
| --- | --- | --- |
| Equivalent Incandescent | max wattage halogen | max wattage CFL (based on Lumen Equivalency) |
| **40** | **29** | **10** |
| **60** | **43** | **13** |
| **75** | **53** | **18** |
| **100** | **72** | **23** |

**The proposal was not accepted by the commission staff. A disposition was issued on May 26, 2017 and PG&E complied with the guidance in the disposition.**

**Delta Wattage Assumption (ΔW)**

The assumptions used in ED screw in lamp disposition, March 1, 2018 disposition are used for savings calculation. Please refer to table Table 9 or the excel spreadsheet to see the details of the calculation for each measure.

# Section 2 Calculation Methods

This version of the workpaper follows the product efficacy and EISA wattage bin method as per March1, 2018 disposition and uses the savings provided within the disposition for ROB measures. Other IOUs will be using the same methodology but calculate their savings using DEER interactive effects appropriate for their service territory.

For ER measures actual lamp rated wattage of incandescent and CFL are used for the base case to reflect the customer’s pre-existing equipment in place. The corresponding wattage equivalent measure case LED wattages are obtained from the “Product Analysis” tab in the “2018ScrewInLampDispositionBackup-21Dec2017-1.xlsm” file provided by the CPUC’s commission staff.

## 2.1 Electric Energy Savings Estimation Methodologies

The lighting wattage difference (Watts per unit) is the difference between the electric demand of the base case unit and the electric demand of the measure case unit. The hours of operation and interactive effects are based on the most recent DEER values.

**Annual Electric Savings:**

Annual Energy Savings [kWh/unit] = (∆Watts/unit) x (Annual Hours of Operation) x (Energy Interactive Effects) / (1,000 Watts / kW)

**Example:**

40W equivalent 80 LPW (lumens/watt), Res



## 2.2. Demand Reduction Estimation Methodologies

The lighting demand difference (Watts per unit) is simply the difference between the electric demand of the base unit and the electric demand of the energy efficient unit. The demand savings is calculated based on the formula below:

**Demand Reduction:**

Demand Reduction [kW/unit] = (∆Watts/unit) x (Lighting Coincident Demand) x (Demand Interactive Effects) / (1,000 Watts/kW)

**Example:**

40W equivalent 80 LPW (lumens/watt), Res



**Demand Reduction:**

Demand Reduction [kW/unit] = (∆Watts/unit) x (Lighting Coincident Demand) x (Demand Interactive Effects) / (1,000 Watts/kW)

## 2.3. Gas Energy Savings Estimation Methodologies

There is no gas energy savings associated with this measure. However the negative impacts are calculated based on the formula below.

**Annual Gas Savings:**

Annual Gas Savings [∆Therms/unit] = (∆Watts/unit) x (Annual Hours of Operation) x (Gas Interactive Effects) / 1,000 Watts/kW

**Example:**

40W equivalent 80 LPW (lumens/watt), Res



**Annual Gas Savings:**

Annual Gas Savings [∆Therms/unit] = (∆Watts/unit) x (Annual Hours of Operation) x (Gas Interactive Effects) / 1,000 Watts/kW

# Section 3. Load Shapes

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 and commercial lighting end use load shape.

## 3.2 Measure Load Shapes

The measure load shape for this measure is determined based on the applicable residential and non-residential market sector and the lighting end-use.

Table 11 Building Types and Load Shapes

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

# Section 4. Costs

PG&E is submitting this workpaper as a statewide lead for the other IOUs. Other IOUs are to provide appropriate costs if measures are offer through different channel(s) than PG&E.

For PG&E all measures in this workpaper are offered through direct install channel only. For Direct Install programs actual costs are reported based on post-install project invoices; however, placeholder material and labor costs are being assigned to each measure code in the work paper.

Direct Install programs are allowed to report full measure cost and are exempted from the early retirement cost calculation.

## 4.1 Base Case Cost

All measures in this workpaper are offered through direct install channel only; therefore, the base case cost is set to zero.

## 4.2 Measure Case Cost

All measures in this workpaper are offered through direct install channel only; therefore, placeholder full measure costs are being assigned to the measure codes in this workpaper.

## 4.3 Full & Incremental Measure Cost

For Direct Install the labor cost of $5.75 is used from the WO17 as a placeholder cost.

Table 12 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 |
| ER | (MEC + MLC) – (BEC + BLC) | MEC + MLC | (MEC + MLC) – (BEC + BLC) |
| REA | MEC + MLC | MEC + MLC | N/A |

MEC = Measure Equipment Cost; MLC = Measure Labor Cost

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

**Incremental Costs**

|  |  |  |  |
| --- | --- | --- | --- |
| **Installation Type** | **Incremental Measure Cost** | **Full Measure Cost** | |
| **1st Baseline** | **2nd Baseline** |
| ROB | Please refer to the LED A-lamp cost workbook for detailed information. | NA | NA |

# References:

1. Comprehensive Workpaper Disposition for: Screw-In Lamps. Revisions to Disposition Originally Issued on March 1, 2017. California Public Utilities Commission, Energy Division. May 26, 2017 [↑](#endnote-ref-1)
2. TRC-LED Lighting baseline data\_10-12-16.pdf [↑](#endnote-ref-2)