**Work Paper PGECOLTG177**

**LED BR-R Lamps**

**Revision 3**

**Pacific Gas & Electric Company**

**Customer Energy Solutions**

**LED BR/R Lamps**

**Measure Codes L1071, L1072, L1073**

# At-a-Glance Summary

|  |  |  |  |
| --- | --- | --- | --- |
| **Applicable Measure Codes:** | L1071 | L1072 | L1073 |
| **Measure Description:** | LED R-BR:  <11 Watts | LED R-BR:  11 to <14 Watts | LED R-BR:  14 to ≤22 Watts |
| **Energy Impact Common Units:** | Lamp. | | |
| **Base Case Description:** | Incandescent R, BR or ER lamps or CFL R,BR Lamps  Source: Energy Star, and PG&E Calculations. | | |
| **Base Case Energy Consumption:** | Various.  Source: PG&E Calculations | | |
| **Measure Energy Consumption:** | Various.  Source: PG&E Calculations. | | |
| **Energy Savings (Base Case – Measure)** | Various.  Source: PG&E Calculations. | | |
| **Costs Common Units:** | $ per lamp. | | |
| **Base Case Equipment Cost ($/lamp):** | Various. | | |
| **Measure Equipment Cost ($/lamp):** | Various. | | |
| **Gross Measure Cost ($/lamp)** | Various. | | |
| **Measure Incremental Cost ($/lamp):** | Various. | | |
| **Effective Useful Life (years):** | Various.  Source: 2016 DEER | | |
| **Program Type:** | ROB. | | |
| **Net-to-Gross Ratios:** | |  |  | | --- | --- | | **NTGR ID** | **NTGR** | | Com-Default>2yrs | 0.6 | | Res-Default>2 | 0.55 | | NonRes-sAll-MLtgLED-Deemed | 0.6 | | Res-sAll-MLtgLED-Deemed | 0.6 |   Source: DEER 2016 | | |
| **Important Comments:** |  | | |

# Document Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Revision #** | **Date** | **Section by Section Description of Revisions** | **Author (Company)** |
| Revision 0 | 2/26/13 | PGECOLTG177 R0 LED BR/R-Lamps.doc  Original Workpaper | Alina Zohrabian (PG&E) |
| Revision 1 | 9/16/13 | PGECOLTG177 R1 LED BR/R-Lamps.doc  Created WRR from the original workpaper calculation and applied it to the lowest wattage in the range (based on a direction from a phone conversation with Kevin Madison on 9/12/13. | Alina Zohrabian (PG&E) |
| Revision 1 | 10/8/13 | PGECOLTG177 R1 LED BR/R-Lamps.doc  Revised program description | Alina Zohrabian (PG&E) |
| Revision 2 | 5/7/14 | PGECOLTG177 R2 LED BR/R-Lamps.doc  Added DI values (No original DI workpaper existed) and Revised savings values per ED workpaper Disposition for lighting Retrofit, December 14, 2013. For updated savings values, see file PGECOLTG177 R2.xlsx | Alina Zohrabian (PG&E) |
| Revision 3 | 1/1/2016 | Updated NTG, GSIA, EUL, annual hours of operation, CDF, and IE per DEER 2016. Base case costs and measure costs have also been updated. | Linda Wan (PG&E)/ Alina Zohrabian (PG&E) |

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# Section 1. General Measure & Baseline Data

## 1.1 Product Measure Description & Background

This work paper details the replacement of existing incandescent or CFL R/BR lamps with LED R/BR lamps.

**Requirements:**

* Must replace an incandescent or CFL R/BR lamp
* Must be on the ENERGY STAR qualified product list and be listed with the Department of Energy Lighting Facts Program

Table 1 Measure Codes and Descriptions

|  |  |
| --- | --- |
| **Product Code** | **Description** |
| L1071 | LED R-BR: <11 Watts |
| L1072 | LED R-BR: 11 to <14 Watts |
| L1073 | LED R-BR: 14 to ≤22 Watts |

***Program Restrictions and Guidelines***

The delivery method is Upstream/Midstream Programs for commercial customers and the Upstream Lighting Program for residential customers. For Multifamily customer this product is also available through the downstream program.

In support of the transition to the California Energy Commission’s Voluntary California Quality Light-Emitting Diode (LED) Lamp Specification (CEC Spec), to qualify for a rebate in the program, the replacement LED lamps must fall into one of the categories shown in the table below. Only lamps that fully meet the CEC Spec will be supported in the Upstream Lighting Program after Dec 1, 2013.

Table 2 CEC Voluntary California Quality LED Lamp Specification

|  |  |
| --- | --- |
| **Upstream** | **Midstream / Downstream** |
| Close to or meets full CEC Spec by having at least:   * CA beam shape requirements * CCT of 2700K or 3000K * CRI>=90 * R9>0 (“best in lamp class and channel”)\* * Dimmable * Must either be on THE ENERGY STAR Qualified Products List (QPL), or have begun ENERGY STAR Rated Life testing, and continue in testing until the product is accepted for the QPL. * Must be listed on the QPL within 9 months of the applicable IOU's allocation begin/confirmation date. * Must be listed on the Department of Energy LED Lighting Facts Product List within 9 months of the applicable IOU's allocation begin/confirmation date. | * Must be on THE ENERGY STAR Qualified Products List. |
| Meets ENERGY STAR Plus lamp specifications, plus at least:   * CA beam shape requirements * CCT of 2700K or 3000K * CRI>=80 (“best in lamp class and channel”) * R9>0 (“best in lamp class and channel”) * Dimmable * Must either be on THE ENERGY STAR Qualified Products List (QPL), or have begun ENERGY STAR Rated Life testing, and continue in testing until the product is accepted for the QPL. * Must be listed on the QPL within 9 months of the applicable IOU's allocation begin/confirmation date. * Must be listed on the Department of Energy LED Lighting Facts Product List within 9 months of the applicable IOU's allocation begin/confirmation date. |  |

\*Best in lamp class and channel - Utility managers will choose the products that are “best in class”. What represents “best in class” will change depending on the specific product and channel. Thus, categories with a greater number of high-CRI products available (i.e. PARs and retrofit kits) will be held to a higher standard than other categories with fewer options (i.e. A-Lamps and BRs). Furthermore, channels with more choices of energy efficient lighting (i.e. large home improvement stores) will be held to a higher standard than other categories with fewer options (i.e. mom and pop hardware stores).

**Terms and Conditions:**

The customer must be a residential or non-residential PG&E electric customer.

**Market Applicability:**

Single and Multi-Family Installations are eligible. These measures include mid and upstream rebates and Direct Install where noted in the data.

Please refer to the table below for applicable delivery types, building types, and application types:

Table 3 Delivery Method and Applicable Building Types

|  |  |  |
| --- | --- | --- |
| **Delivery Type** | **Applicable Building Types** | **Application Type** |
| Upstream | “Com” and “Res,” | ROB |
| Direct Install | DEER Building Types | ROB |
| Downstream | DEER Building Types | ROB |

***1.2 Product Technical Description***

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 to be able to compete in any application.

The R symbol (short for Reflector) is to indicate that a bulb includes a parabolic or elliptical section below the major diameter designed to have a reflector coating to direct the light beam. The B symbol on the BR (Bulged Reflector) lamp is to indicate a bulb in which the curve making up the major portion of the side of the bulb has a radius greater than one-half the bulb diameter and a center in the plane of maximum diameter. The first number symbol indicates the diameter of the bulb in eights of an inch. For example, a BR30 lamp has a nominal diameter of 30 eights of an inch, or 3.75 inches[[1]](#endnote-1).

R/BR lamps are directional lamps but have a softer distribution and wider beam angles than PAR lamps and are used mostly in residential applications. These lamps come in different size diameters R20/BR/20, R30, BR30LEDs are inherently directional, which makes them well suited for use in lamps intended to replace conventional reflector lamps. Additionally, the optics can be arranged at the LED package level, eliminating the need for reflectors and lenses that shape the beam.

## 1.3 Transaction Types

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 4 Measure Application Type[[2]](#endnote-2)

Identifies the measure application type in the Measure Implemenation 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 most common base case wattages for R/BR lamps are 45 watt, 65 watt and 75 watt lamps. The recommendation from Energy Division to use 25% as CFLs in the base case was used. The CFL base wattages are calculated based on the Energy Division’s approved 4.09 Wattage Reduction Ratio (WRR) for incandescent to CFL. Therefore the CFL wattages used as 25% of the base cases are 11 watt, 16 watt and 18 watt. The measure case wattages were selected by analyzing Energy Star data (downloaded on 1/31/13). The Lighting Facts database was not analyzed since usually there are more products listed in the Lighting Facts than in Energy Star; therefore, making this process a more conservative approach.

The DOE Solid-State Lighting CALiPER Reports are used for justification of wattage equivalency. The most recent report that is relevant to this workpaper is CALiPER application summary report #16.

## 1.4.1 DEER Base Case and Measure Case Information

The Database for Energy Efficient Resources (DEER) 2016 contains measures for LED R/BR lamps using the WRR method. The base case wattage is calculated using the WRR of 6.09 for <11W, 4.80 for 11-13W and 4.34 for ≥14W as recommended by Energy Division. The measure case is the associated LED wattage.

**Hours of Operation**

The DEER 2016 hours of operation and interactive effects are used for the savings calculations.

**Net to Gross Values**

The NTG values are from DEER 2016. The table below summarizes all applicable Net-to-Gross ratios for programs that may be used by this measure.

Table-5 Net-to-Gross Ratios

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **NTGR ID** | **Description** | **Sector** | **BldgType** | **Delivery Method** | **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 | 0.6 |
| Res-Default>2 | All other EEM with no evaluated NTGR; existing EEM with same delivery mechanism for more than 2 years | Res | Any | Any | 0.55 |
| NonRes-sAll-MLtgLED-Deemed | Nonresidential LED: replacing CFL or incandescent lamps; deemed; all delivery mechanisms except upstream | NonRes | Any | NonUpStrm | 0.6 |
| Res-sAll-MLtgLED-Deemed | Residential LED: replacing CFL or incandescent lamps; deemed; all delivery mechanisms except upstream | Res | Any | NonUpStrm | 0.6 |

**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.

Table 6 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**

Although the EULs for both products are listed as min 25,000 and max 50,000 hours, Energy Division recommended a lamp life of 20,000 hours for LED BR/R Lamps. Since the EUL is dependent on the hours of operation, the EUL varies by building type. The Energy Division also recommended using a maximum value of 12 years for EUL, which is the life of a pin-based CFL fixture in commercial application. For residential application the life of a pin-based CFL fixture is 16 years.

The EUL is based on 20,000 hours approved Lamp life divided by average annual hours of operation for each building type:

EUL = (Lamp Life (20,0000 hours)) / (Average Operating Hours Per Year)

Table 7 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 | Varies (max 12) | Varies |

## 1.4.2 Codes & Standards Requirements Base Case and Measure Information

***Title 20:*** Under Title 20 [2015] incandescent reflector lamps manufactured before July 15, 2012 must meet Table K-3 minimum average lamp efficacy (LPW). For incandescent reflector lamps manufactured on or after July 15, 2012, Table K-4 must be satisfied. Additional minimum average lamp efficacy requirements of Table K-9 are in effect for state-regulated incandescent reflector lamps manufactured on or after January 1, 2008.

***Title 24:*** These measures do not fall under Title 24 [2013] 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

***1.4.3.1 CALiPER Application Summary Report 162:***

The most recent CALiPER report stated that as of January of 2012, DOE estimated that BR30 lamps made up approximately 38% of the installed base case of PAR, BR, and R lamps, which corresponds to approximately 2.02 million units in the US. Approximately 89% of the products were estimated to be installed in residential applications.

Based on the CALiPER report product selection the BR30/R30 with 65 watts is the most common of all the BR/R lamps especially in residential applications. CALiPER tested a few BR/R lamps in the earlier rounds (4 products in round 2, one product in round 3, and one product in round 9). The test ID RT42 was reported in “retail replacement lamps in April, 2012. CALiPER tested not only for lumen output, input wattage and efficacy, but for CCT (Correlated Color Temperature),CRI (Color Rendering Index), power factor, R9 (Special color rendering index, mostly for red colors), Duv (the distance from Planckian locus on the CIE 1960 chromaticity diagram). Some of the results of the tests are shown in Table 8.

Table 8-Previous CALiPER Testing of BR30 and R30 LED Lamps

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **DOE CALiPER Test ID** | **Initial Output (lm)** | **Total Input Power**  **(w)** | **Efficacy**  **(lm/W)** | **Power Factor** | **CRI** | **CCT** |
| 07-08 | 229 | 8.8 | 27 | 0.58 | 72 | 2945 |
| 07-09 | 310 | 9.1 | 34 | 0.59 | 82 | 5973 |
| 07-13 | 406 | 15.6 | 26 | 0.47 | 14 | 2689 |
| 07-14 | 352 | 13.8 | 25 | 0.46 | 13 | 4006 |
| 07-18 | 180 | 8.6 | 21 | 0.60 | 77 | 7878 |
| 09-64 | 186 | 3.5 | 53 | 0.50 | 71 | 5554 |
| RT42 | 365 | 8.0 | 46 | 0.49 | 67 | 3225 |
| **Minimum** | **180** | **3.5** | **21** | **0.46** | **13** | **2689** |
| **Mean** | **291** | **9.6** | **33** | **0.53** | **57** | **4610** |
| **Maximum** | **406** | **15.6** | **53** | **0.60** | **82** | **7878** |

As we can see from the earlier results of the testing the efficacy, of the LED lamps were between 21 to 53 (lm/W) with a mean of 33 lm/W. The minimum lumen output and the minimum efficacy of these LED lamps don’t come close to the conventional lamps tested by CALiPER and shown in Table 9. Although the mean efficacy of the LED and conventional are close, the mean lumen outputs do not come close.

Table 9- CALiPER Testing of Conventional BR30 and R30 Lamps

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **DOE CALiPER Test ID** | **Source Type** | **Initial Output (lm)** | **Total Input Power**  **(w)** | **Efficacy**  **(lm/W)** | **Power Factor** | **CRI** | **CCT** |
| 12-54 | Incandescent | 650 | 65.7 | 10 | 1.00 | 100 | 2698 |
| 08-13 | Incandescent | 732 | 65.0 | 11 | 1.00 | 99 | 2681 |
| 12-21 | CFL | 776 | 14.9 | 52 | 0.60 | 83 | 2684 |
| 12-58 | CFL | 732 | 16.1 | 46 | 0.57 | 83 | 2883 |
| 08-06 | CFL | 841 | 15.8 | 53 | 0.55 | 82 | 2740 |
| **Minimum** |  | **650** | **14.9** | **10** | **0.55** | **82** | **2681** |
| **Mean** |  | **746** | **35.5** | **34** | **0.74** | **89** | **2737** |
| **Maximum** |  | **841** | **65.7** | **53** | **1.00** | **100** | **2883** |

In the most recent CALiPER study, 13 LED lamps were tested and the results are considerably different than previous LED test data. The efficacy of these newer products are in the range of 51 to 91 (lm/W) with a mean of 59 lm/W, which is very comparable and in many cases much better than the conventional lamps. The lumen output of these LED’s is from 463 to 860 lumens with a mean of 662 lumens. The light output of these products in also well comparable to the conventional lamps. CALiPER tested for color consistency and color temperature and for other characteristics and the results are shown in the Table 10.

Table 10- Results of the CALiPER Testing of BR30/R30 for the series 16 LED Lamps

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **DOE CALiPER Test ID** | **Initial Output (lm)** | **Total Input Power**  **(w)** | **Efficacy**  **(lm/W)** | **Power Factor** | **CRI** | **CCT** |
| 12-15 | 544 | 6.0 | 91 | 0.53 | 81 | 5389 |
| 12-16 | 564 | 11.1 | 51 | 0.97 | 83 | 3520 |
| 12-17 | 745 | 12.1 | 62 | 0.74 | 84 | 2675 |
| 12-18 | 859 | 14.0 | 61 | 0.78 | 81 | 2704 |
| 12-19 | 740 | 11.3 | 65 | 0.98 | 77 | 6586 |
| 12-20 | 550 | 9.5 | 58 | 0.93 | 83 | 2769 |
| 12-51 | 595 | 11.7 | 51 | 0.88 | 92 | 2663 |
| 12-52 | 463 | 8.1 | 57 | 0.93 | 85 | 2966 |
| 12-53 | 616 | 12.1 | 51 | 0.94 | 93 | 2729 |
| 12-55 | 699 | 13.5 | 52 | 0.76 | 83 | 2734 |
| 12-56 | 667 | 11.6 | 58 | 0.87 | 82 | 2709 |
| 12-57 | 705 | 12.6 | 56 | 0.80 | 82 | 3112 |
| 12-59 | 860 | 14.3 | 60 | 0.77 | 81 | 3000 |
| **Minimum** | **463** | **6.0** | **51** | **0.53** | **77** | **2663** |
| **Mean** | **662** | **11.4** | **59** | **0.84** | **84** | **3350** |
| **Maximum** | **860** | **14.3** | **91** | **0.98** | **93** | **6586** |

A few of the conclusions that CALiPER reported for the LED testes were:

* The lumen output of many of the products was equivalent to 65 Watt or 75 Watt incandescent BR30/R30 lamps.
* Most of the “series 16” LED’s had color quality attributes similar to incandescent lamps.
* The power factor of the “series 16” LED’s was considerably better than previously tested LED BR30/R30 lamps, with all but one of the products exceeding the ENERGY STAR minimum requirements.
* Many of the manufacturer claims were accurate; however, there was a tendency for the lamps to exhibit higher efficacies than reported in the manufacturer’s literature.

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

This workpaper follows the Workpaper Disposition for Integral LED Lamp Replacements from the California Public Utilities Commission, Energy Division dated May 14, 2012.

# Section 2. Calculation Methods

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 from DEER 2016.

**∆Watts/lamp:** The demand difference (watts per lamp) is simply the difference between the electric demand of the base case lamp and the electric demand of the measure case lamp.

**∆Watts/lamp = Base Case Watts/lamp - Measure Case Watts/lamp**

**Example:**

∆Watts/lamp = (6\*6.09) W – 6 W = 30.54 ∆Watts/lamp = 0.03054 kW/lamp

## 2.1 Electric Energy Savings Estimation Methodologies

Energy savings vary by market sector and building type because of differences in operating hours and interactive effect multipliers. The operating hours and interactive effects for each segment were taken from DEER 2016 data. Refer to the equation below for the energy savings calculation:



The following example calculation demonstrates the annual energy savings, kWh per year, for the ASM building type, for a 6W LED R/BR lamp:



## 2.2. Demand Reduction Estimation Methodologies

Demand reduction varies by market sector and building type due to different HVAC interactive effects and coincident peak demand multipliers for each type of building type. The operating hours, interactive effects, and coincident diversity factors (CDF) for each segment were taken from DEER 2016 data. Below is the equation to calculate demand savings:



The following example calculation demonstrates the annual energy demand savings, kW per year, for the ASM building type, for a 6W LED R/BR lamp:



## 2.3. Gas Energy Savings Estimation Methodologies

Gas estimates are entirely based on the estimated increased gas use through calculated interactive effects. This measure includes HVAC interactive effects savings. The equation below calculates the gas savings:



The following example calculation demonstrates the annual energy demand savings, kW per year, for the

ASM building type, for a 6W LED R/BR lamp:



# 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

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 is determined by the E3 calculator based on the applicable residentialand commercialmarket sector and the lighting end-use.

Table 11 Building Types and Load Shapes

|  |  |  |
| --- | --- | --- |
| **Building Type** | **Load Shape** | **E3 Alternate Building Type** |
| All Commercial, “Com,” “OTR” | PGE:DEER:Com:Indoor\_CFL\_Ltg | NON\_RES |
| All Residential, “Res” | 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. Please refer to the LED lamp cost workbook for detailed information.

## 4.1 Base Case(s) Costs

The base case costs are split into 25% CFL and 75% halogen/incandescent. CFL costs are taken from the READI Tool v 2.3.0. Costs not available from READI have been interpolated. Halogen/incandescent costs are calculated from WO017[[3]](#endnote-3) workbook. The base case wattages are mapped to individual LED wattages using a table from the Energy Star Calculator.

## 4.2 Measure Case Costs

An average equation was calculated using the equations for reflector lamps (PAR20, PAR30, PAR38, and MR16) webscraped internally from Home Depot. This average equation was used to determine the BR/R cost.

## 4.3 Incremental & Full Measure Costs

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 |
| RET/ER | (MEC + MLC) – (BEC + BLC) | MEC + MLC | (MEC + MLC) – (BEC + BLC) |
| REF | (MEC + MLC) – (BEC + BLC) | MEC + MLC | N/A |
| 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

## 4.3.1 Full Measure Cost

Full Measure Cost is the cost to install an energy efficient measure per the CPUC calculators. This definition implies a different meaning depending on the Measure Application type.

The Full measure cost is used for Direct Install Measures. A labor cost of $4.48 is used from WO017. For full measure costs please refer to the LED lamp cost spreadsheet.

## 4.3.2 Incremental Measure Costs

The labor required installing base case or measure case is equivalent. Therefore, labor cost is not considered in incremental measure costs. For incremental measure costs please refer to the LED lamp cost spreadsheet.

# References

1. CALiPER, Application Summary Report 16: LED BR30 and R30 Lamps, July 2012 [↑](#endnote-ref-1)
2. 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-2)
3. 2010-2012 WO017 Ex Ante Measure Cost Study Final Report. Submitted by: Itron, Inc. May 27, 2014. [↑](#endnote-ref-3)