Comprehensive Workpaper Disposition for: Screw-In Lamps

California Public Utilities Commission, Energy Division

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# Review Scope

This disposition includes a review of all workpapers covering screw-in lamps. Refer to Table 1 for a list of recently submitted PA workpapers that support these types of measures.

Table - Workpapers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Workpaper ID** | **Rev** | **Workpaper Title** | **Tech Type** | **Official Submittal Date** |
| **Workpapers Submitted for 2017 Program Cycle Phase 1 Review** | | | | |
| **PG&E** |  |  |  |  |
| PGECOLTG139 | 9 | LED Surface, Pendant, Track, Accent, and Recessed Downlight | LED | 1/1/2017 |
| PGECOLTG141 | 7 | LED PAR16, PAR20, PAR30, and PAR38 Lamps | LED | 1/1/2017 |
| PGECOLTG165 |  | LED A-Lamps | LED | 1/1/2017 |
| PGECOLTG175 | 3 | LED Residential Recessed Downlight | LED | 1/1/2017 |
| **SCE** |  |  |  |  |
| SCE17LG017 | 0 | Interior Integral, Non-Dimmable (Screw-in) CFLs | CFL | 1/1/2017 |
| SCE17LG072 | 0 | Upstream Interior 3-way CFLs | CFL | 1/1/2017 |
| SCE17LG133 | 0 | LED A-Lamp | LED | 1/1/2017 |
| **SDG&E** |  |  |  |  |
| WPSDGENRLG0106 | 4 | Integral LED Lamps | LED | 1/1/2017 |
| **Workpapers Not Yet Submitted for 2017 Program Cycle Phase Review** | | | | |
| **PG&E** |  |  |  |  |
| PGECOLTG140 | 5 | LED MR-16 | LED | 1/4/2016 |
| PGECOLTG163 | 4 | LED Candelabra Replacements | LED | 1/4/2016 |
| PGECOLTG164 | 4 | LED Globe Lamps | LED | 1/4/2016 |
| PGECOLTG177 | 3 | LED BR/R Lamps | LED | 1/4/2016 |
| **SCE** |  |  |  |  |
| SCE13LG109 | 1 | Exterior LED Lamp Replacement | LED | 12/21/2015 |

# Directed Revisions to Workpapers

## Directed Revisions to All New and Existing Workpapers Covering Screw-in Lamps

The following revisions are required for all workpapers covering screw-in lamps where savings are calculated using a wattage reduction ratio (WRR):

* Revise fraction of CFLs in LED baseline
* Revise fraction of CFLs and LEDs in CFL baseline
* Revise Net-to-Gross values to incorporate increased CFL lamps in gross baseline

## Directed Revisions to PGECOLTG165 and any Current and Future Screw-in LED Workpapers

This section also applies to the development of new workpapers for LED lamps that use savings calculations other than WRR values:

* Revise savings methods shall be revised to either:

1. Use previously approved methods, but revise the WRR to include 80% CFLs in the gross baseline, or
2. Establish a tiered savings method that assigns increased savings for higher efficacy lamps.

Refer to Section 4.3 for complete description of requirements for revisions to savings methods.

* Immediately revise program eligibility rules for 2017 to include a minimum efficacy of 90 lm/w.
* Raise the minimum efficacy to 100 lm/w starting 1/1/2018.

# Review of Workpapers Using Wattage Reduction Ratios for Savings Calculations

## Background on Lamp Wattage Reduction Methods

The current approved workpaper methodology for all screw-in lamps uses a “Wattage Reduction Ratio” to determine the baseline wattage where:

Baseline Wattage = Measure Wattage × WRR

Wattage Reduction = Measure Wattage × (1 – WRR)

Savings for measures defined using a WRR are only dependent on the installed measure lamp rated input power. There is no consideration for higher efficacy lamps and the possibility that two lamps with the same output but with different wattages, might replace the same wattage CFL or incandescent lamp. Under the current WRR approach, lamps with lower wattage, but high output, are assigned lower savings than higher wattage lamps with lower output.

To address the issue of savings and incentive structures that promote higher efficacy lamps PAs have begun the process of developing new savings calculation methods that assign greater savings to higher efficacy lighting products. For example, lighting retrofit measures for ambient linear fluorescent troffer replacements have higher ex ante savings values for fixtures with 125 lumens/Watt (lm/w) output than fixtures with 100 lm/w. However, as discussed below, the PA proposed approach for LED A-lamps does not reliably accomplish the desired result and thus this disposition takes steps to correct that shortfall.

## Baseline Development

Current approved CFL savings include an assumption that 40% of all newly installed CFLs will be replacing previously installed CFLs and therefore no gross savings is assigned for that fraction of program lamps. The remaining 60% of lamps are assumed to be either new sockets where less efficient technologies would have been installed or existing sockets that would revert to less efficient lamps if the program incented lamps were not available. Currently approved LED savings assume that program incentivized lamps are installed into sockets where there would otherwise be a mixture of CFL, conventional incandescent and halogen incandescent lamps as listed below:

A-Lamps: 50% CFLs, 50% incandescent lamps

Reflectors: 25% CFLs, 75% incandescent lamps

All others: 0% CFLs, 100% incandescent lamps

At this time, the PAs’ programs include incentives for both LED and CFL lamps which raises the possibility that incentives for one technology are influencing choices over another technology. If CFL incentives are influencing the choice for a CFL over an LED, that implies a negative savings for at least some fraction of the installed CFLs. This can happen in situations where a purchaser has decided to opt for a higher efficiency lamp (either a CFL or an LED product) and the program influences the choice of a CFL over a lower wattage LED due to program incentives lowering the CFL price or causing a retailer to maintain CFL product availability at a higher level. This is similar to the existing workpaper assumption that LED incentives influence the choice of an LED over a CFL (either replacing an existing CFL or the conversion of an incandescent or CFL to an LED lamp). Larger fractions of CFLs in a baseline instead of incandescent lamps, cause the savings for the LED measures to be lower.

Lamp shipment data published by the National Electrical Manufacturers Association (NEMA) shows a rapid increase in saturations of LED A-Lamps over the past two years (see ). Currently, shipments of LEDs as a fraction of total lamps is about the same as CFLs were at the beginning of 2012, and CFL saturation has dropped off rapidly as LED saturation has risen. Early 2012 corresponds to the period where incentives for CFLs were at an all-time high. compares the total quantities of program incented lamps by type for 2011 to those from the four quarters from Q4-2015 through Q3-2016[[1]](#footnote-2). The number of incented LED lamps over the last four quarters is small compared to the overall saturation of about 32% of LED lamps shown in for Q3-2016. In contrast, PAs incented more than four times as many CFLs in 2011 yet the saturation of CFLs in Q1-2012 was about the same as the most recent LED saturation. This indicates that the shipments and demand for LEDs is growing rapidly, regardless of program incentives. This also demonstrates a very high market acceptance of these products and also that these products have higher acceptance than CFLs at this time, and perhaps any time in the past. In fact, several manufacturers have already announced that CFL products are being, and will continue to be retired in favor of LED products. CPUC staff reviewers strongly suggest that the continued offering of incentives for CFLs is likely slowing the adoption of competing LED technologies. LEDs have clearly gained wide acceptance, and CFLs should be discontinued. In the case of LEDs covered by this disposition, national market saturation trends and well as the dramatic pricing declines[[2]](#footnote-3) also indicate that incentives must be focused on the highest efficacy and quality products so as to further move the market. CPUC staff reviewers note that an examination of 2016 Q1-Q3 claims indicates an average LED screw-in MSB A-Lamp incentive in the upstream program was slightly over $4 per lamp which seems either unnecessary or unreasonably high if typical non-program products meeting Energy Star and future code efficacy requirements can purchased at major retail stores for less than that $4 average. PAs must review their incentive levels for all LED products to ensure they not over paying and certainly do not exceed common pricing.

Figure - National Lamp Sales Saturations for A-Lamps[[3]](#footnote-4)

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Table - Comparison of Program Screw-in Lamps

|  |  |  |
| --- | --- | --- |
|  | **Claims Reporting Period** | |
| **Lamp Type** | **2011** | **Q4 2015 –**  **Q3 2016** |
| Lighting Indoor CFL Basic | 18,866,437 | 728,939 |
| Lighting Indoor CFL A Lamp | 1,721,009 | 1,721,080 |
| Lighting Indoor CFL > 30 Watts | 351,062 | 3,303,935 |
| Lighting Indoor CFL Reflector | 4,130,011 | 839,373 |
| Lighting Indoor CFL Globe | 628,216 | 1,331 |
| Lighting Indoor CFL Other | 112,739 | 109 |
| Lighting Outdoor CFL Basic | 5,613 | 7,332 |
| Lighting Outdoor CFL > 30 Watts | 53 | - |
| Lighting Outdoor CFL Reflector | 3,286 | 18 |
| Lighting Indoor LED Lamp | - | 5,101,923 |
| Lighting Indoor LED Reflector Lamp | 15,267 | 5,423,470 |

## Net-to-Gross Ratios

The 2016 DEER update revised the screw-in lamp gross baseline assumptions to include an efficient lamp case (only CFLs at that time) as part of the standard practice baseline. These updates were applied only to residential CFL measures[[4]](#footnote-5). The 2016 DEER update to NTG has the effect of lowering the gross savings, raising the NTG value and keeping the total net savings roughly the same. All evaluations through the 2013-2014 program years estimated gross savings above the inefficient lamp baseline and included any efficient baseline case as part of the Net-to-Gross analysis. The 2013-2014 upstream lighting evaluation (2013-2014 evaluation)[[5]](#footnote-6) report included a secondary analysis, developing alternative NTG values for several classes of CFLs and LEDs that considered, in the baseline, some fraction of efficient case lamps as standard practice. Similar to the savings reduction from the 2016 DEER baseline update for residential CFLs, and compared to previous evaluations, the 2013-2014 evaluation finding has the effect of lowering the gross savings, raising the NTG values, and keeping the total net savings roughly the same. Table 3 provides a comparison of current DEER values, 2013-2014 evaluation reported NTG values with no efficient lamps in the baseline, and 2013-2014 evaluation values when considering the efficient case as standard practice in the baseline.

Table - Comparison of DEER and Evaluation Net-To-Gross Values

|  |  |  |  |
| --- | --- | --- | --- |
| **Lamp Type**  (Note: “MSB” refers to “Medium Screw Base”) | **DEER NTG** | **2013-2014 Evaluation NTG (Inefficient Base)** | **2013-2014 Evaluation NTG (Partial Efficient Base)** |
| MSB CFL basic spiral ≤ 30 W | 0.90 | 0.25 | 0.39 |
| MSB CFL A-lamp ≤ 30 W | 0.90 | 0.64 | 1.01 |
| MSB CFL reflector ≤ 30 W | 0.90 | 0.25 | 0.37 |
| MSB CFL globe ≤ 30 W | 0.90 | 0.68 | 1.34 |
| MSB CFL high-wattage (> 30 W) | 0.54 | 0.45 | 0.67 |
| **All CFL** | **varies** | **0.40** | **0.65** |
| LED A-lamp, all wattages | Com: 0.60  Res: 0.55 | 0.39 | 0.33 |
| LED reflector, all wattages | 0.27 | 0.31 |
| **All LED** | **0.30** | **0.96** |

Table 3 shows that the NTG for all CFLs of 0.40 reported in the 2013-2014 evaluation, assuming the inefficient baseline. This NTG is much lower than the DEER 2011 value, which was 0.54[[6]](#footnote-7), indicating an even larger number of CFLs should be included in the gross baseline as a matter of standard practice. Table 4 provides adjusted NTG values, with and without consideration for market effects (spillover) that are currently directed to be applied to the entire portfolio. If the default portfolio level market effects are utilized, the NTG values without market effects shall be utilized in ex ante claims. The overall NTG values for all CFLs and all LEDs are taken from the 2013-2014 evaluation report, also shown in Table 3. Adjusted NTG values for CFLs have been calculated assuming 50% CFLs in the gross baseline while LED the LED adjusted NTG values is taken directly from the 2013-2014 evaluation report.

Table - Adjusted Net-To-Gross With Consideration of CFLs in Baseline

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CFL Type** | **2013-2014 NTG (no CFLs in baseline)** | **DEER 2011 Measure Watts** | **DEER 2011 Base Watts** | **DEER 2011 WRR** | **Frac-tion CFL** | **Revised Base-**  **line w/CFL** | **WRR CFL Base-line** | **Gross Savings Reduc-tion** | **Revised NTG** | **Revised NTG w/out Market Effects** |
| CFL Interior reflector lamps | 0.40 | 16.28 | 66.62 | 4.09 | 50% | 41.45 | 2.55 | 50% | 0.90 | 0.85 |
| CFL Interior non-reflector lamps | 0.40 | 17.19 | 59.67 | 3.47 | 50% | 38.43 | 2.24 | 50% | 0.90 | 0.85 |
| CFL Exterior lamps | 0.40 | 17.88 | 72.72 | 4.07 | 50% | 45.30 | 2.53 | 50% | 0.90 | 0.85 |
| CFL All nonresidential | 0.40 | 17.13 | 61.10 | 3.57 | 50% | 39.11 | 2.28 | 50% | 0.90 | 0.85 |
| LED A-lamp, all wattages | 0.30 | Revised NTG with and without market effects taken directly from 2013-2014 lighting evaluation | | | | | | | 0.96 | 0.91 |
| LED reflector, all wattages | 0.30 | 0.96 | 0.91 |

## Decision Language Supporting the Revision of DEER Values

D.15-10-028 laid out a schedule for updating both DEER and non-DEER workpapers based upon the best available data. The direction in the Decision established a March 1 “bus stop” each year[[7]](#footnote-8); generally, evaluation and other research results available by the bus stop are expected to be included in the analysis used to develop DEER by September 1[[8]](#footnote-9) and non-DEER workpaper updates submitted by the following January 1 or later for new measures[[9]](#footnote-10). Then the new update cycle begins again; research results by March 1, DEER by September 1 and workpaper updates by the following January 1[[10]](#footnote-11). However, workpapers are expected to be updated whenever research results indicate values are significantly out-of-date[[11]](#footnote-12) whereas DEER is only expected to be updated annually.

## Directed Revisions to All Workpapers Covering Screw-in Lamps, with exceptions

### Revise Fraction of CFLs in LED Baseline

All LED workpapers except for those covering LED A-lamps (e.g PGECOLTG165) shall be revised to include 40% CFLs in the gross baseline, which is the same value CFL fraction used in calculating DEER wattage reductions for CFLs.

### Revise Fraction of CFLs and LEDs in CFL Baseline

All CFL workpapers shall be revised to include 50% CFLs and 25% LEDs in the gross baseline. Table 5 shows the development of revised WRR values for all CFL measures starting January 1, 2017.

Table - Revised CFL Wattage Reduction Ratio Values Effective 1/1/2017

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CFL Type** | **DEER 2011 Measure Watts** | **DEER 2011 Base Watts** | **DEER 2011 WRR** | **LED WRR w/out CFLs** | **LED Watts** | **CFL Frac-tion** | **LED Frac-tion** | **2017 Base Watts** | **2017 WRR** | **2016 DEER WRR** |
| Interior reflector lamps | 16.28 | 66.62 | 4.09 | 4.70 | 14.17 | 0.50 | 0.25 | 28.34 | **1.74** | 2.86 |
| Interior non-reflector lamps | 17.19 | 59.67 | 3.47 | 4.60 | 12.97 | 0.50 | 0.25 | 26.76 | **1.56** | 2.48 |
| Exterior lamps | 17.88 | 72.72 | 4.07 | 4.60 | 15.81 | 0.50 | 0.25 | 31.07 | **1.74** | 2.84 |
| All nonresidential | 17.13 | 61.10 | 3.57 | 4.60 | 13.28 | 0.50 | 0.25 | 27.16 | **1.59** | 3.57 |

### Revise Net-to-Gross Values to Incorporate Increased CFL Lamps in Gross Baseline

All screw-in lamp workpapers, without exception, shall be revised to consider energy efficient lamp types in the gross baseline as part of standard practice. Table 6 lists the required NTG values to be used for all screw-in lamps delivered through upstream and midstream programs during 2017.

Table - Revised Screw-in Lamp Net-to-Gross Values Effective 1/1/2017

|  |  |  |
| --- | --- | --- |
| **Lamp Type** | **Revised NTG** | **Revised NTG w/out Market Effects** |
| All Upstream CFL | 0.90 | 0.85 |
| All Upstream LED | 0.96 | 0.91 |

### Immediately revise product eligibility requirements for LEDs

Program eligibility rules shall be immediately revised for 2017 to include a minimum efficacy of 90 lm/w and the minimum shall be raised to 100 lm/w as of 1/1/2018. See Section 4.2.3 for a discussion of lamp efficacy and available products.

# Review of PGECOLTG165, LED A-Lamps

PG&E’s workpaper, PGECOLTG165 covering LED A-Lamps, is the first in a series of planned updates of workpapers for screw-in LED lamps intended to revise savings calculations in a way that assigns higher savings values to higher efficacy products. The workpaper proposes fixed baselines for each of the four wattage “bins” for legacy incandescent lamps as defined in the Energy Independence and Security Act (EISA). shows the proposed fixed baselines developed for this workpaper.

Table - Proposed Workpaper Baseline Development

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| EISA Bin (Watts) | Output (lumens) | | Baseline power (Watts) | | Fraction CFL (note 3) | Baseline Watts (note 4) |
| Min | Max | Halogen (note ) | CFL (note ) |
| 40 | 310 | 749 | 29 | 10 | 0.60 | 17.6 |
| 60 | 750 | 1049 | 43 | 13 | 25.0 |
| 75 | 1050 | 1489 | 53 | 18 | 32.0 |
| 100 | 1490 | 2600 | 72 | 23 | 42.6 |

Notes to Table 7:

1. EISA maximum allowed incandescent wattage for bin
2. Workpaper Table 8 notes: *“max wattage CFL (based on Lumen Equivalency)”*
3. Fraction of baseline lamps that are CFLs with the remaining lamps being halogen incandescent lamps.
4. Baseline Watts = 0.60 x CFL Watts + 0.40 x Halogen Watts

Savings are calculated for any LED by determining that LED’s EISA bin placement based on its rated lumen output. For example, an 11-watt lamp rated at 1,150 lumens falls into the 75 watt EISA bin with a baseline of 32 watts and a wattage reduction of 21 watts. A drawback of this method is that all lamps of a given wattage and within the same EISA bin are assigned the same savings. For instance, an 11 watt lamp rated at 1,400 lumens has the same 32 watt baseline as the previous example, even though the second lamp has 20% greater output. Table 8 and Figure 2 compare proposed and previously approved wattage reductions for LED A-lamps.

Table - Comparison of Proposed to Previously Approved Values for LED A-Lamps

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| EISA Bin |  | Proposed Workpaper Values | | | | | Current Approved Values | | |  |
| Watts | Min lm (note 1) | Max lm/W (note 2) | Base W | ∆W | WRR (note 3) | WRR (note 4) | Base W | ∆W | % change |
| 40W (310-749 lm) | 5 | 350 | 150 | 17.6 | 12.6 | 3.52 | 2.96 | 14.80 | 9.80 | 28.6% |
| 6 | 420 | 125 | 11.6 | 2.93 | 17.76 | 11.76 | -1.4% |
| 7 | 490 | 107 | 10.6 | 2.51 | 20.72 | 13.72 | -22.7% |
| 8 | 560 | 94 | 9.6 | 2.20 | 23.68 | 15.68 | -38.8% |
| 9 | 630 | 83 | 8.6 | 1.96 | 26.64 | 17.64 | -51.2% |
| 10 | 700 | 75 | 7.6 | 1.76 | 29.60 | 19.60 | -61.2% |
| 60W (750-1049 lm) | 7 | 490 | 150 | 25.0 | 18.0 | 3.57 | 20.72 | 13.72 | 31.2% |
| 8 | 560 | 131 | 17.0 | 3.13 | 23.68 | 15.68 | 8.4% |
| 9 | 630 | 117 | 16.0 | 2.78 | 26.64 | 17.64 | -9.3% |
| 10 | 700 | 105 | 15.0 | 2.50 | 29.60 | 19.60 | -23.5% |
| 11 | 770 | 95 | 14.0 | 2.27 | 32.56 | 21.56 | -35.1% |
| 12 | 840 | 87 | 13.0 | 2.08 | 35.52 | 23.52 | -44.7% |
| 13 | 910 | 81 | 12.0 | 1.92 | 38.48 | 25.48 | -52.9% |
| 14 | 980 | 75 | 11.0 | 1.79 | 41.44 | 27.44 | -59.9% |
| 15 | 1050 | 70 | 10.0 | 1.67 | 44.40 | 29.40 | -66.0% |
| 75W (1050-1489 lm) | 10 | 700 | 149 | 32.0 | 22.0 | 3.20 | 29.60 | 19.60 | 12.2% |
| 11 | 770 | 135 | 21.0 | 2.91 | 32.56 | 21.56 | -2.6% |
| 12 | 840 | 124 | 20.0 | 2.67 | 35.52 | 23.52 | -15.0% |
| 13 | 910 | 115 | 19.0 | 2.46 | 38.48 | 25.48 | -25.4% |
| 14 | 980 | 106 | 18.0 | 2.29 | 41.44 | 27.44 | -34.4% |
| 15 | 1050 | 99 | 17.0 | 2.13 | 44.40 | 29.40 | -42.2% |
| 16 | 1120 | 93 | 16.0 | 2.00 | 47.36 | 31.36 | -49.0% |
| 17 | 1190 | 88 | 15.0 | 1.88 | 50.32 | 33.32 | -55.0% |
| 100W (1490-2600 lm) | 14 | 980 | 186 | 42.6 | 28.6 | 3.04 | 41.44 | 27.44 | 4.2% |
| 15 | 1050 | 173 | 27.6 | 2.84 | 44.40 | 29.40 | -6.1% |
| 16 | 1120 | 163 | 26.6 | 2.66 | 47.36 | 31.36 | -15.2% |
| 17 | 1190 | 153 | 25.6 | 2.51 | 50.32 | 33.32 | -23.2% |
| 18 | 1260 | 144 | 24.6 | 2.37 | 53.28 | 35.28 | -30.3% |
| 19 | 1330 | 137 | 23.6 | 2.24 | 56.24 | 37.24 | -36.6% |
| 20 | 1400 | 130 | 22.6 | 2.13 | 59.20 | 39.20 | -42.3% |
| 23 | 1610 | 113 | 19.6 | 1.85 | 68.08 | 45.08 | -56.5% |

Notes to Table 8:

1. Workpaper proposes a minimum efficacy of 70 lm/W. The value in this column is the lamp wattage multiplied by this minimum efficacy.
2. This value is the maximum output for the EISA bin divided by the lamp wattage.
3. WRR = (Workpaper Base Watts) / (Lamp Watts)
4. The current approved WRR for all A-lamps is 2.96

Figure - Comparison of Proposed to Current Approved Wattage Reduction Values



## Baseline Determination Methods

The workpaper identifies the following four types of possible baseline technologies:

* Conventional incandescent lamps
* EISA compliant halogen incandescent lamps
* CFLs
* LED lamps

California Title 20 and now EISA both prohibit the manufacture and sale of most conventional incandescent A-lamps in the lumen ranges covered by this workpaper. The workpaper suggests that, at this time, LED A-lamps comprise a very small percentage of total lamp failures. Therefore, the proposed baseline consists only of a mixture of halogen incandescent lamps and CFLs. Conventional incandescent lamps are not included in the baseline as they are no longer available for purchase due to the Title 20 and the EISA minimum performance requirements for incandescent lamps and thus are not viable for consideration as either a code or standard practice (of ISP) baseline component. NEMA also notes that nearly all incandescent sales at this time are comprised of lamps <25 watts and specialty lamps not covered by EISA.

To develop the mixture of CFL and halogen lamps that make up the baseline, PG&E developed a replacement model that estimates a current baseline-to-sold lamp comparison. The model overlays NEMA sales data for the last four years on top of the 2012 CLASS socket saturation data to estimate current socket saturations and failures. Next, the model estimates how current sales of lamps are distributed among the current failed sockets assuming that the quantity of current failures is equal to the quantity of current sales. The result and proposal from PG&E’s replacement model is a baseline of 60% CFL and 40% halogen.

## Critical Review Issues

### The lamp replacement model does not consider the rapid growth in LED market nor the interaction with CFL programs

As discussed in Section 3.2 above, the rapid market share increase in LED sales absent incentives indicates a high level of voluntary adoption. PG&E’s proposed replacement model only attempts to align sales with historical failure rates, but does not consider that many LED sales are likely contributing to early removals of CFLs. CPUC staff applied some minor modifications listed below to the submitted replacement model and found that an increase in the CFL retirement rate from the DEER value of 18% to 22% resulted in the CFL baseline being 83% instead of the 60% proposed in the workpaper. shows the outcome of several incremental revisions to the replacement model and how each revision or set of revisions changes the fraction of CFL lamps in the baseline calculation.

Table – Alternatives for Correction to CFL replacement models

|  |  |  |  |
| --- | --- | --- | --- |
| Case | Description | Baseline CFL fraction | Work-paper |
| Workpaper | Incandescent HOU: 541  Halogen HOU: 541  Halogen rated life: 4,000  CFL retirement rate: 5.4% | 57.6% | 60% |
| EAR Rev 1 | Incandescent HOU: 438  Halogen HOU: 475  Halogen rated life: 1,000  CFL retirement rate: 18% | 62.7% |  |
| EAR Rev 2 | EAR Rev 1 +  CFL retirement rate: 20% | 73.3% |  |
| EAR Rev 3 | EAR Rev 1 +  CFL retirement rate: 22% | 83.3% |  |
| EAR Rev 4 | EAR Rev 1 +  CFL retirement rate: 24% | 92.7% |  |
| EAR Rev 5 | EAR Rev 1 +  CFL retirement rate: 25.4% | 99% |  |

The row noted “EAR Rev1” includes the following corrections that align assumptions of the replacement model with DEER assumptions:

Incandescent HOU: The most recent loggering studies of residential screw-in lighting was performed for the 2006-2008 program cycle and showed lower operating hours for incandescent lamps. CFLs have higher operating hours, indicating that purchasers tend to install their most efficient lamps in the sockets with highest usage.

Halogen HOU: At the time of the 2006-2008 loggering study, halogen lamps were only available in limited quantities. The value of 475 hours is an estimate that assumes halogen lamps have slighting more operating hours than conventional incandescent lamps, but still not as many as CFLs.

Halogen Rated Life: The value for rated halogen lamp life included in PG&E’s replacement manual is sourced from the IES handbook, which does not appear to represent conventional halogen A-lamps. A cursory review on the internet reveals that most conventional halogen A-lamps have rated life of 1,000 hours, similar to conventional incandescent A-lamps.

CFL Retirement Rate: PG&E’s replacement model calculates a failure rate for CFLs based on a rated life of 10,000 hours and the DEER annual operating hours of 541, or about a 5.4% annual retirement rate. However, the DEER EUL for CFLs is 3.5 years, which corresponds to an annual retirement rate of 18%.

### The proposed EISA bin method does not assign savings relative to efficacy

PG&E proposes a revision from the currently approved WRR method to a method that assumes a fixed wattage baseline for each EISA wattage bin. Embedded in this approach is an assumption that lamp purchasers use only the published EISA wattage bin, and not the published output of the lamp, in their decisions on replacement. The result is that savings calculations mostly do not align with the performance of the lamp. Some examples are presented below. Thus the results of PG&E’s proposed new method do not reliably accomplish their stated intent of providing a higher savings values for higher efficacy lamps.

**Example 1 – Wide variation of performance for a single wattage within a single EISA bin**

Figure 3 shows the output of all program eligible A-lamps by wattage and EISA wattage bin[[12]](#footnote-13). There are several instances where lamps of a specific wattage and EISA bin have widely different outputs. Table 10 includes four examples with high variation. Under the proposed workpaper approach, which fixes the baseline wattage by EISA bin, the higher performing lamps will be assigned the same savings as the lower performing lamps.

Figure -Output (Lumens) vs. Input (Watts) of Proposed Program Eligible LED A-Lamps



Table – Four Cases for Example 1, Variation in Performance

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sample Case | EISA Bin |  | Output (Lumens) | | % difference (min:max) |
| Watts | Min | Max |
| 1 | 40 | 7 | 500 | 700 | 40% |
| 2 | 60 | 9.5 | 800 | 1,000 | 25% |
| 3 | 75 | 11 | 1,100 | 1,380 | 25% |
| 4 | 100 | 15.5 | 1,500 | 1,800 | 20% |

**Example 2 – Similar lamps assigned to different EISA bins receive widely different savings values**

Table 11 provides two cases of how the proposed methodology does not provide the intended results. These examples show where two similar lamps end up in different EISA bins because one lamp has an output at the high end of a lower EISA wattage bin while the other lamp has an output at the lower end of a higher wattage bin. In these cases, the lamp in the higher wattage EISA bin will be assigned higher savings than the lamp in the lower bin. Further background on each sample case is provided below:

Sample Case 1: For this case, PG&E’s submitted products list includes five of the 7 watt lamps and one 7.5 watt lamp. The 7.5 watt lamp is assigned 60% more savings than the 7 watt lamps simply because its output places it in the 60 watt EISA bin. However, the efficacy of these lamps is identical and the total output differs by less than 10%.

Sample Case 2: For this case, PG&E’s submitted products list includes seven 9.5 and 10 watt lamps with 1,000 lumens and three 10 watt lamps with 1,100 lumens. The 1,100 lumen lamps will be assigned 40% more savings because their lumen output places them in the 75 watt EISA bin. However, the efficacy of these lamps is identical and the total output differs by only 10%.

Table – Two Cases for Example 2, Savings Variation at EISA Bin Breakpoint

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sample Case | Lamp Class | Watts | Output | Efficacy (lm/W) | EISA Bin | Baseline Watts | Measure Watts | ∆ Watts | % difference (min:max) |
| 1 | Lamp 1 | 7 | 700 | 100 | 40 | 17.6 | 7 | 10.6 | 60% |
| Lamp 2 | 7.5 | 750 | 100 | 60 | 25 | 8 | 17 |
| 2 | Lamp 1 | 9.5 | 1,000 | 105 | 60 | 25 | 10 | 15 | 40% |
| Lamp 2 | 10.5 | 1,100 | 105 | 75 | 32 | 11 | 21 |

### Eligibility criteria and incentives do not differentiate the most efficient products

The eligibility criteria allow lamps with efficacies as low as 70 lm/w to be eligible. This is the primary contributor to the large savings variances described in the previous section. Additionally, program requirements are only slightly, if at all, better than current Title 20 requirements. Title 20 requirements also become more stringent on January 1, 2018 (see Table 12). The list of available lamps submitted with the workpaper includes 816 lamps that would qualify under the proposed eligibility requirements, 786 would qualify if the minimum efficacy were raised to 80 lm/w and 655 would qualify if the minimum efficacy were raised to 90 lm/w. Even if the minimum efficacy were raised to 100 lm/w, the product list submitted by PG&E still includes 366 lamps that would be eligible for their program. Table 13 lists the number of program eligible lamps within each six different efficacy ranges and shows that most eligible lamps have an efficacy greater than 90 lm/w.

Table - California Requirements for LED Lamps[[13]](#footnote-14)

|  |  |
| --- | --- |
| Effective Date | Minimum Efficacy Lumens Per Watt |
| January 1, 2018 | 68 |
| January 1, 2019 | 80 |

Table - Available Lamps by Efficacy

|  |  |
| --- | --- |
| **Efficacy Range** | **Qty of Lamps** |
| 80 > lm/w > 70 | 30 |
| 90 > lm/w > 80 | 131 |
| 100 > lm/w > 90 | 286 |
| 110 > lm/w > 100 | 303 |
| 120 > lm/w > 110 | 54 |
| lm/w > 120 | 9 |

## Directed Revisions to PGECOLTG165, LED A-Lamps

CPUC staff agrees the PG&E’s intended purpose of developing programs, ex ante savings values, and incentives that encourage the purchase and installation of higher efficacy products. However, the proposed much needs significant revisions to accomplish this goal. Workpaper savings, net-to-gross, and program eligibility requirements are not approved and shall be revised as follows.

### Savings methods shall be revised by one of the following methods

**Option A: Use Current Method but Update Fraction of CFLs in Baseline**

Follow the current method of using a WRR, but revise the current approved WRR to include 80% CFLs in the baseline. Following the same analysis used in the 2012 LED disposition, this results in a WRR of 1.98.

**Option B: Establish a Tiered Savings Method that Assigns Increased Savings for Higher Efficacy**

CPUC staff has developed an alternative method that assumes an 80% CFL baseline content and assigns higher estimated savings for higher efficacy lamps, summarized in below. The full savings method is included in the workbook ScrewInLampDispositionBackup-Mar2017-v1.xlsx.

Table - CPUC Staff Approved Wattage Reduction Values



### Revise net-to-gross

The approved NTG value is listed in Table 6 in Section 3.5.3, above.

### Immediately revise product eligibility requirements

Program eligibility rules shall be immediately revised for 2017 to include a minimum efficacy of 90 lm/w and the minimum shall be raised to 100 lm/w as of 1/1/2018.

1. Q4-2015 through Q3-2016 represents the latest claims data published by the CPUC [↑](#footnote-ref-2)
2. Pricing surveys undertaken by the workpaper review team reveal, for example, that standard (40-60 watt equivalent non-dimmable) A-Lamp LED products are generally available in the price range of $1.50 to $3.00. A casual review of products available on websites of the most common large retailers will yield numerous examples of low-priced LED lamps. [↑](#footnote-ref-3)
3. See NEMA Lamp Indices: http://www.nema.org/Intelligence/Pages/Lamp-Indices.aspx [↑](#footnote-ref-4)
4. Prior to the DEER 2016 update, savings for CFLs were estimated above a baseline consisting only of incandescent lamps, even though research showed that a significant number of lamp purchasers used CFL lamps exclusively, regardless of program incentives. This was handled by considering the CFLs in the determination of NTG. However, CPUC policy requires that gross baselines be determined over standard practice, not the least efficient case. In DEER 2016, the gross baseline for CFLs was revised to include 40% CFLs, which reduced the gross savings. However, since these higher efficient lamps were now included in the gross baseline, they were no longer included (incorrectly so) as free-riders in the NTG determination. Therefore, gross savings were decreased, but the NTG for CFLs was increased, keeping net ex ante savings approximately equal. [↑](#footnote-ref-5)
5. Impact Evaluation of 2013-2014 Upstream and Residential Downstream Lighting Programs prepared by DNVGL for the California Public Utilities Commission, Energy Division, April 1, 2016. [↑](#footnote-ref-6)
6. The value of 0.54 was developed based on EM&V findings through the 2010-2012 program cycles that identified approximately 40% of sockets had been “transformed” to a point that they would never have an incandescent lamp installed. The 2013-2014 evaluation results show an overall NTG with 0.40 for all CFLs statewide. This value was developed assuming that the gross baseline was comprised only of incandescent lamps and any “transformed” CFL sockets were considered free-riders in the NTG calculation. However, the overall NTG of 0.40 indicates an even larger fraction of “transformed” sockets than the 40% indicated in previous evaluations. [↑](#footnote-ref-7)
7. D.15-10-028 at 82 “The annual EM&V plan is expected to be completed at the end of each calendar year. The studies to be implemented in the following year will inform, and be informed by the EM&V plan. March 1 will be a consistent target to ensure information will be available for program planning, ex ante savings updates, and potential and goals, but interim results and actionable findings may be available throughout the year.” [↑](#footnote-ref-8)
8. D.15-10-028 at 83 “With this shift in the EM&V bus stop, the DEER update bus stop needs to shift to the fall. The ex ante update period would run through Q2 and Q3, with draft results released on June 1, and the final DEER released on September 1.” And OP 17 “Commission Staff shall propose changes to the Database of Energy Efficient Resources once annually via resolution, with the associated comment/protest period provided by General Order 96-B. However, Commission staff may make changes at any time without a resolution to fix errors or change documentation.” [↑](#footnote-ref-9)
9. D.15-10-028 at 83: “Accordingly we will maintain the January 1 deadline for updates to workpapers to reflect changes in DEER values. Workpapers for new measures, and workpapers that do more than just update values to conform with revised DEER values, may come in at any time or on the first and third Monday, respectively.” [↑](#footnote-ref-10)
10. D.15-10-028 OP 14: “Parties and Commission staff shall comply with the timeline for energy efficiency portfolio review and related activities as set forth in the Gantt chart in Appendix 10” [↑](#footnote-ref-11)
11. D.12-05-015 OP 156: “Information emerging from the evaluations shall be used to refine and improve programs on an on-going basis, and/or shall be available to assist in portfolio design decisions and revising frozen ex ante savings parameters for the next program cycle.” [↑](#footnote-ref-12)
12. Based on the list of A-lamps submitted with PG&E’s workpaper and included in the workbook “certified-light-bulbs-2016-11-23\_delinked.xlsx.” CPUC staff filtered this list based on the program requirements listed in Table 2, page 3 of PG&E’s submitted workpaper. [↑](#footnote-ref-13)
13. 2016 Appliance Efficiency Regulations, CEC-400-2017-002, California Energy Commission, January 2017 (See Table K-14) [↑](#footnote-ref-14)