**Work Paper Abstract**

**Lighting**

**Revision # 0**

**California Technical Forum**

**WP Abstract Prepared by: Name, Organization**

**T8 LED Tube Lamp Replacement**

***Abstract***

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| --- |
| WP Abstract Tracking Log |
| Task | **Date Issued** | **Due By** | **Version** | **Author Last Name** **(or primary editor)** |
| Submitted to TF Staff for review | 10//2014 | 02/2015 | 0 | Vu |
| TF Staff sent to TF Members for 10-day review |  |  |  |  |
| Abstract presented at meeting | 01/2015 | 02//2015 |  |  |
| Cal TF Staff summarizes comments, sends back to abstract developer |  |  |  |  |
| Abstract developer incorporates TF comments into abstract, sends back to TF Staff |  |  |  |  |
| Abstract presented to Subcommittee (if applicable) |  |  |  |  |
| TF Staff summarizes TF Subcommittee recommendations, sends back to abstract developer |  |  |  |  |
| Abstract developer incorporates TF Subcommittee comments into abstract, sends back to TF Staff |  |  |  |  |
| TF Staff sends abstract to Commission staff for 10-day review |  |  |  |  |
| Comments from Commission staff received (if applicable) |  |  |  |  |
| Cal TF summarizes comments |  |  |  |  |
| Abstract presented at Meeting; consensus decision-marking |  |  |  |  |
| Cal TF finalizes abstract; prepares comparison exhibit of non-consensus items |  |  |  |  |
| Abstract to TF Subcommittee |  |  |  |  |
| Abstract to TF Subcommittee |  |  |  |  |
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Table 1 Work Paper Abstract Snapshot

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| Work Paper Abstract Snapshot |
| Item | **Details** | **Notes** |
| Measure name | T8 LED Tube Lamp Replacements |  |
| Measure description | This work paper details the replacement of a 32W, 28W, and 25W T8 linear fluorescent lamp with a T8 LED Tube lamp replacement. |  |
| Sector (Res/Non-Res) | Non-Res |  |
| Subsector (e.g. Ag) | Commercial |  |
| Delivery Channel (e.g. Upstream) | Direct Install | May go deemed upon CPUC approval of baseline, quality, measure life, and lumen equivalency concerns. |
| Measure Application Type (e.g. ROB) | Early Retirement | Per CPUC Lighting Disposition |
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1. Measure Description & Key Terms

This work paper details the replacement of a 32W, 28W, and 25W T8 linear fluorescent lamp with a T8 LED Tube lamp replacement. The lamp replacement will not replace the existing instant start or program rapid start electronic ballasts.

Measures and Codes

|  |  |
| --- | --- |
| Product or Solution Code | Measure Name |
| TBD | T8 LED Lamp Replacing 32W T8 IS NLO |
| TBD | T8 LED Lamp Replacing 28W T8 Premium PRS NLO |
| TBD | T8 LED Lamp Replacing 25W T8 Premium PRS NLO |

To qualify for incentives, the Tube LED lamp must have a minimum efficacy of 100 lm/W ±3%, and be on the DLC’s Qualified Products List (QPL) and Listed in the IOU QPL as LED lamp Replacement (Plug-n-Play). The Tube should not have an external driver and work only with existing linear fluorescent ballasts. It is under the customer’s discretion to verify the compatibility of the Tube LED and the existing ballast.

This measure applies to all building types and climate zones.

1. Program Implementation Method

The delivery methods that are available for these measures are:

* Financial Support – Down-Stream Incentive - Deemed
* Midstream Programs – Mid-Stream Incentive Distributor Point of Sale
* Financial Support – Direct Install

The guidance decision, D.12-05-015 at 349 states "The use of a DEER remaining useful life starting point for the acceleration period may be replaced. However, this should be allowed only if credible evidence is available to support an alternative value and that evidence leads Commission Staff to deem it more credible than of the adopted DEER values."

Thus, per CPUC guidance this measure will use an Early Retirement (ER) program type for cost-effectiveness purposes. Program Administrators (PA) may consider a pre-inspection prior installation in order to confirm baselines fixture technologies, ballast failure rates, and ambient and task light levels.

1. Mixed Baseline

The Department of Energy (DOE) CALiPER report estimates 60% of the installed base were fluorescent products using T8 lamps whereas the remainder is predominantly T12, with a small but growing percentage of T5 lamps (2010). Surveying direct install contractors indicate that the pre-existing conditions for T8 systems consist of:

* 70% of T8 32W
* 10% of T8 28W
* 20% of T8 25W
1. Measure Summary

Table 2 Measure Summary

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| --- | --- |
| **Characteristic** | **Measure** |
| Baseline Technology or Mix | T12, T8, and T5 with the majority being T8 |
| Measure Technology | T8 LED Tubes |
| Measure Application Type | ER |
| Delivery Mechanism | Midstream, Downstream, or Direct install |
| Impacted Markets | Commercial |
| Relevant Codes and Standards | T8 LED Tube Replacements do not trigger T24 |

1. Estimated Size of Offer (Number of Participants)

Per the 2006 Commercial End Use Survey data, total commercial floor stock in the covered electric service areas is estimated to be just over 4.9 billion square feet resulting in a total commercial electric consumption of 67,707 GWh annually. Commercial office space accounts for approximately 20% of the total commercial square footage using approximately 24% of the state’s total electric consumption.

1. Estimated Impact of the Measure on Statewide Energy Efficiency Savings.

Per the 2006 Commercial End Use Survey data, large and small commercial offices use 4,331 GWh/yr. An energy savings of 6W per lamp could result in a potential of 866 GWh/year statewide.

1. Applicable DEER & CPUC Guidance

D.12-11-015 OP 30 states “Pacific Gas and Electric Company, San Diego Gas & Electric Company, and Southern California Edison Company shall only offer incentives for light-emitting diode (LED) bulbs to products that are in the top half of quality on the market and that meet the Energy Star requirements prior to the adoption of a California quality specification for LEDs by the California Energy Commission (CEC). Once the CEC quality specification is adopted, the utilities shall design a transition period of less than one year, in consultation with the CEC and Commission staff, after which they shall only offer incentives to LED bulbs that meet the California quality specification.” “Our goal is to avoid offering incentives for lighting products that do not meet consumer expectations and result in a poor lighting experience, discouraging customers from investing in energy efficient lighting in the future.”

In their 2013-2014 applications, Pacific Gas and Electric Company, Southern California Edison Company, San Diego Gas & Electric Company, and Southern California Gas Company shall only propose rebates for Light Emitting Diodes products that have a United States Department of Energy Lighting Facts® label.”

The guidance decision, D.12-05-015 at 349 states "The use of a DEER remaining useful life starting point for the acceleration period may be replaced. However, this should be allowed only if credible evidence is available to support an alternative value and that evidence leads Commission Staff to deem it more credible than of the adopted DEER values."

1. Proposed Measure Parameter Values, Methodology, and Data Sources

Table 3 Proposed Measure Parameter Methods, Data, Assumptions and Sources

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| --- | --- | --- | --- | --- | --- | --- |
| **Measure Parameter** | **Proposed Value** | **Methodology Description** | **Key Assumptions** | **Data Source Name and Description[[1]](#footnote-1)** | **Input Requested from TF** | **Confidence Level** **(High, Medium, Low)** |
| Savings – kWh/yr | 22-35 kWh | DEER | Ballast failure rate is assumed to be less than 1%  | Per DI contractor input | 100% pre-inspection for deem programs? | Medium  |
| Savings – kW/yr | 0.00569-0.00876 | DEER | Same as above | Same as above | Same as above | Medium |
| Savings – therms/yr | Per DEER | DEER | Same as above | Same as above | Same as above | Medium |
| EUL or RUL | 5 | Early Retirement | N/A | Lighting Disposition | Can the PAs live with a 5 year RUL? | High |
| MC or IMC | $22.59-$23.45 | Industry data | N/A | Manufacturer Quotes | Should costs be the full or IMC based on an ER program type? | Medium |
| NTG | 0.70-0.85 | DEER | N/A | DEER NTG Table | Can PAs use a NTG value of 0.85 even for DI programs? | Medium |

|  |  |  |  |
| --- | --- | --- | --- |
| Baseline | Lamp wattage | Replacement wattage | Delta Watts |
| 32W T8 IS NLO | 29.5 | 23 | 6.5 |
| 28W T8 Premium PRS NLO | 25 | 19 | 6 |
| 25W T8 Premium PRS NLO | 22 | 16 | 6 |

The energy savings estimates are calculated as follows:



The following is a sample energy savings calculation for LED T8 Lamp Replacing 32W T8 IS NLO in Agricultural building type, Climate Zone 6.

$$EnergySavings\left[\frac{kWh}{Unit×Year}\right]=\frac{\left(29.5-18.9) ×(3264.34\right)×1.05837}{1,000\left(\frac{Watthours}{kWh}\right)}$$

$$EnergySavings\left[\frac{kWh}{Unit×Year}\right]=36.62$$

The demand reduction estimates are calculated as follows:



The following is a sample demand reduction calculation for LED T8 Lamp Replacing 32W T8 IS NLO in Agricultural building type in Climate Zone 6.

$$Demand Reduction\left[\frac{kW}{Unit}\right]=\frac{\left(25.5-18.9)×(0.790709\right)×1.1082}{1,000\left(\frac{Watthours}{kWh}\right)} Demand Reduction\left[\frac{kW}{Unit}\right]=0.00929$$

1. Proposed Level of Complexity

The method to quantify savings will use DEER approved methods for lighting calculations for commercial applications. Thus, the proposed level of complexity should be low.

1. Preliminary TRC Estimates

Table 4 Preliminary TRC Estimates and Parameters

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| --- | --- | --- | --- |
| **TRC Parameter** | **Parameter Estimate or** **Required Parameter Value Threshold** (specify if estimate or threshold) | **Confidence Level** **(High, Medium, Low)** | **Comments** |
| UES | 22-35 kWh | Medium | Depends on CS consultants feedback on DEER and baseline assumptions |
| IMC | $22.59-$23.45 | High | This can change if the full cost is used rather than the incremental because CS wants this measure to be ER rather than ROB. |
| EUL | 5 years |  | Per CPUC Lighting Disposition |
| NTG | 0.70 or 0.85 |  | DEER NTG tables |
| Incentive/unit | $3-$5 per lamp |  | Per initial feedback from PAs |
| Number of units | TBD |  |  |
| Installation Rate | TBD |  |  |
| Gross Realization Rate | TBD |  |  |
| ***TRC Value:***  | **0.86** |

1. Literature Review

**VA Report**

* "T8 to LED retrofits (changing lamp/ballast for LED/driver) are not recommended because the DOE CALiPER testing has shown that LED retrofits have low lumen outputs compared to the fluorescent lamps they replace. For any LED retrofit product, it is recommended that end users refer to CALiPER product test results.”

**CALiPER Report**

* Includes product test results and specifies a 28W LED equivalent lumen output;
* Indicates T8 fluorescent lamps have an efficacy of 85 lumens/watt;
* Indicates T8 LED tubes have an efficacy of 100 lm/watt;
* Provides a significant level of depth, breadth and rigor relating to quality;
* Compares to other industry established benchmarks including:
* Aligns with LED Lighting Facts;
* Incorporates ENERGY STAR® performance criteria; and
* Incorporates DLC’s Quality Products List (QPL) technical requirements.
1. Additional Research Needed

Based on CPUC decision language, PAs can consider running the deemed program and adjust the baseline once the baseline field trials or pilots are complete to establish an appropriate baseline. Furthermore, PAs can consider direct install or custom delivery channels until a baseline study is commissioned and completed.

1. Questions for CPUC Staff on Applicability of DEER Values, Methods, Tools, Data, Etc.

A timeline of coordination activities and associated questions for CPUC staff and their consultants is shown below. Additionally feedback pertaining to appropriate baselines, lamp quality, measure life, and equivalent level of service will be discussed with CPUC staff on 02/25/2015.

**

1. Cal TF Comments on Proposed Measure Parameter Values, Methodology, and Data Sources

*Cal TF comments on proposed data and sources. Do data represent best available data? If not, what are alternate data/sources that should be considered?*

Table 5 Cal TF Comments on Measure Parameter Methods, Data, Assumptions, and Sources

|  |  |
| --- | --- |
| **Measure Parameter** | **Cal TF Comments / Recommendations** |
| Baseline EnergykWh/yr |  |
| Measure EnergykWh/yr |  |
| Savings – kWh/yr |  |
| Baseline DemandkW/yr |  |
| Measure DemandkW/yr |  |
| Savings – kW/yr |  |
| Baseline EnergyTherms/yr |  |
| Measure EnergyTherms/Yr |  |
| Savings – therms/yr |  |
| EUL or RUL |  |
| MC or IMC |  |
| NTG |  |

1. Cal TF Comments on Proposed Level of Complexity

*Cal TF comments on proposed level of complexity based on input from abstract developer and Cal TF discussion.*

1. Other Cal TF Comments
2. Commission Staff Review and Feedback

*Commission staff should provide feedback on proposed data and sources within 10 days of request.*

Table 7 Commission Staff Feedback on Proposed Data and Sources

|  |  |
| --- | --- |
| **Measure Parameter** | **Commission Staff Comments / Recommendations** |
| Baseline EnergykWh/yr |  |
| Measure EnergykWh/yr |  |
| Savings – kWh/yr |  |
| Baseline DemandkW/yr |  |
| Measure DemandkW/yr |  |
| Savings – kW/yr |  |
| Baseline EnergyTherms/yr |  |
| Measure EnergyTherms/Yr |  |
| Savings – therms/yr |  |
| EUL or RUL |  |
| MC or IMC |  |
| NTG |  |

# Appendix A – Sources

List all source links or embedded documents (reference relevant page number as appropriate)

1. Provide a link to source or embed source in Appendix A of this document with page numbers specified. [↑](#footnote-ref-1)