**Work Paper WPSDGENRLG0013**

**Revision 3**

**San Diego Gas & Electric**

Energy Efficiency Engineering

**T12 Fluorescent Lamps with Magnetic Ballast to T8/T5 Fluorescent lamps with Electronic Ballast Retrofit (1x1 replacements)**

# Document Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Revision #** | **Date** | **Summary of Changes** | **Author/Affiliation** |
| 1 | Unknown | N/A | Unknown/PGE |
| 2 | 07/15/2010 | Adopted from SCE Work paper WPSCNRLG0087.2   1. Work paper was reduced to account for only replacement systems only, since SDGE already had a delamping work paper 2. Work paper Was updated to reflect SDGE Service Territory climate zone 7, 10, 14 , DEER 2008 data, including Negative Therms Impacts. | Lucie Sidibe/SDGE |
| 3 | 6-12-2012 | Added Dual baseline requirements for 4’ lamps. Updated NTGR to DEER 2011 Added 4’ T8 NLO to 4’ T8 28W RLO Ballast | Charles Harmstead |

# Section 1. General Measure & Baseline Data

## Measure & Delivery Description

This work paper details the replacement of an existing T12 linear fluorescent lamp and Magnetic ballast with either a T8 or a T5 linear fluorescent lamp with Electronic ballast.

**The delivery methods**:

* Financial Support – Direct Install
* Financial Support – Energy Efficiency Business rebate – Deemed

Table 1 below shows the lists of measures included in the work paper.

Table 1

Measure Descriptions

| **Measure Description Classifications** |
| --- |
| U6 (2)Lamps T12 to U6 (2)Lamps T8 |
| U6 (2)Lamps T12 to U6 (2)Lamps T8 with reflector |
| U6 (2)Lamps T12 to U6 (2)Lamps IS RLO T8 |
| 24" (1)Lamp T12 MB to 24" (1)Lamp T8 Premium IS RLO EB |
| 24" (2)Lamps T12 MB to 24" (2)Lamps T8 IS NLO EB |
| 24" (2)Lamps T12 MB to 24" (2)Lamps T8 Premium IS RLO EB |
| 24" (2)Lamps T12 MB to 22" (2)Lamps T5 EB |
| 24" (2)Lamps T12 MB to 24" (2)Lamps T8 IS NLO EB with reflector |
| 24" (1)Lamp T12 MB to 24" (1)Lamp T8 IS NLO EB (per lamp) |
| 24" (1)Lamp T12 MB to 22" (1)Lamp T5 EB (per lamp) |
| 36" (1)Lamp T12 MB to 36" (1)Lamp T8 IS NLO EB |
| 36" (1)Lamp T12 MB to 36" (1)Lamp T8 IS RLO EB |
| 36" (2)Lamps T12 MB to 36" (2)Lamps T8 Premium IS RLO EB |
| 36" (2)Lamps T12 MB to 34" (2)Lamps T5 Premium EB |
| 36" (1)Lamp T12 MB to 36" (1)Lamp T8 Premium IS RLO EB (per lamp) |
| 36" (1)Lamp T12 MB to 34" (1)Lamp T5 Premium EB (per lamp) |
| 72" (2)Lamps T12 to 72"(2)Lamps T8 IS EB |
| 96" (2)Lamps HO T12 MB to 96"(2)Lamps RLO T8 EB |
| 96"(1)Lamp T12 MB to 96"(1)Lamp T8 RLO IS EB (per lamp) |
| 48" (6)Lamps T12 to 48"(6)Lamps T8 Premium NLO EB |
| 96"(2)Lamps T12 MB to 48"(2)Lamps HO T8 IS EB |
| 48" (2)Lamps T12 MB to 48"(2)Lamps T8 Premium IS RLO EB |
| 48"(1)Lamp T12 MB to 48"(1)Lamp T8 NLO IS EB (per lamp) |
| 48" (2)Lamps T8Premium IS NLO EB to 48"(2)Lamps T8 28W Premium IS RLO EB |
| 48"(1)Lamp T12 MB to 46"(1)Lamp T5 NLO IS EB (per lamp) |
| 48"(2)Lamps T12 MB to 48"(2)Lamps High Performance T8 with Nema Premium High Efficiency EB |
| 48"(1)Lamp T12 MB to 48"(1)Lamp High Performance T8 with Nema Premium High Efficiency EB (per lamp) |
| 48" (3)Lamps T12 MB to 48"(3)Lamps T8 Premium IS RLO EB |
| 48" (4)Lamps T12 MB to 48"(4)Lamps T8 Premium IS RLO EB |
| 48" (1)Lamps T12 MB to 48"(1)Lamps T8 Premium IS RLO EB |
| 48" (3)Lamps T8Premium IS NLO EB to 48"(3)Lamps T8 28W Premium IS RLO EB |
| 48" (4)Lamps T8Premium IS NLO EB to 48"(4)Lamps T8 28W Premium IS RLO EB |
| 48" (1)Lamps T8Premium IS NLO EB to 48"(1)Lamps T8 28W Premium IS RLO EB |
|  |
|  |

## 1.2 DEER Differences Analysis

The specific measures in this work paper are not included in the Database for Energy Efficient Resources (DEER) 2011 release. Although the database contains similar interior lighting retrofit measures, the characteristics of lamps and ballasts covered by this work paper could not be matched to measures in DEER 2011. Therefore, DEER values will not be used as the savings estimates. The measure information was based on specific base case equipment, measures and operating parameters. Table 2 summarizes applicable DEER interior lighting measures for this work paper.

Table 2

Similar DEER Measures

| **Measure** | **Similar DEER Measures**  **(References are DEER 2008)** |
| --- | --- |
| U-Tube Lamp | None |
| 2-Ft Lamp | None |
| 3-Ft Lamp | None |
| 6-Ft Lamp | None |
| 96"(2)Lamps HO T12 MB to 96"(2)Lamps RLO T8 EB | OfS-wSDGE-vEx-bCA-eMS-mNE-ILtg-LFluor-Prim-Rpl-96in60wT12ESMg123w-96in59wT8ISREl98w |
| 48"(6)Lamps T12 to 48"(6)Lamps T8 Premium NLO EB | None |
| 96"(2)Lamps T12 MB to  48"(2)Lamps HO T8 Premium IS EB | None |
| 48" (2)Lamps T12 MB to 48"(2)Lamps T8 Premium IS RLO EB | OfS-wSCE-vSCx-bCA-eMS-mNE-ILtg-LFluor-Prim-Rtr-48in34wT12ESMg72w-48in2g32wT8PISNE154w |

For a discussion of the appropriate effective useful life, see Section 1.4, and for a discussion of the appropriate net-to-gross ratio, see Section 1.5

## 1.3 Code Analysis

2013 Title 24 change in Code requires four foot lamps to be T8 with electronic ballast.

Lighting power densities (LPD) for spaces are regulated by Standards Table 146-C of California’s Title 24 Building Energy Efficiency Standard. However, these LPD requirements only apply when the entire fixture is altered or replaced within a given area. According to the Title 24 Standards for Indoor Lighting (Section 5.14, Page 5-81):

*“Lighting alterations generally refers to replacing the entire luminaires, which includes the housing, lamps, ballasts, and louvers or lenses. Simply replacing the lamps and ballasts in an existing fixture is not considered a lighting alteration.”[[1]](#endnote-1)*

Thus, this measure is not affected by the alteration of above code requirements because the measure only involves replacing lamps and ballasts and is not replacing the housing of the existing fixture nor is it increasing the connected lighting load.

1.4 Measure Effective Useful Life and Remaining Useful Life

The effective useful life (EUL) for (2’, 3’, 6’, and 12’) Linear Fluorescent is calculated using the Rated Life of the Ballast and the hours of operation for the building type it is installed or 15 years (whichever is less). DEER 2008 specifies 70,000 hours for non-residential linear fluorescent. The calculation for “Retail, Single-story Large” market sector is shown below:

EUL(Retail,Single-Story Large) = = 17.40 years

EUL = 15 YEARS

Table 3 summarizes Measure Case EUL’s.

Table 3

Measure Case EUL’s

| **Target Sector** | **EUL (years)** |
| --- | --- |
| Agricultural | 15.0 |
| Assembly | 15.0 |
| Education - Primary School | 15.0 |
| Education - Secondary School | 15.0 |
| Education - Relocatable Classroom | 15.0 |
| Education - Community College | 15.0 |
| Education - University | 15.0 |
| Grocery | 15.0 |
| Food Store | 15.0 |
| Health/Medical - Hospital | 15.0 |
| Health/Medical - Nursing Home | 14.9 |
| Health/Medical - Clinic | 14.9 |
| Lodging - Hotel | 11.8 |
| Lodging - Guest Rooms | 15.0 |
| Lodging - Motel | 11.4 |
| Manufacturing - Bio/Tech | 10.0 |
| Manufacturing - Light Industrial | 15.0 |
| Industrial | 15.0 |
| Misc - Commercial | 15.0 |
| Office - Large | 15.0 |
| Office - Small | 15.0 |
| Restaurant - Fast-Food | 14.4 |
| Restaurant - Sit-Down | 14.5 |
| Retail - Multistory Large | 15.0 |
| Retail - Single-Story Large | 15.0 |
| Retail - Small | 15.0 |
| Storage - Conditioned | 15.0 |
| Storage - Unconditioned | 15.0 |
| Transportation - Communication - Utilities | 15.0 |
| Warehouse - Refrigerated | 14.5 |

## Since 4’ T8 lamps become code baseline in 2013, Dual Baseline is required for 4’ lamps and ballasts. The RUL of these lamps is based upon 1/3 the life of the existing T12 lamp to be replaced. The RUL, in years is calculated as (18000 hour lamp life/3/Target Sector Annual Burn Hours). RUL and EUL-RUL are listed in the Table 3A, below for 4’ T8 Reduced wattage lamp installations

Table 3

Measure Case EUL-RUL and RUL for 4’ lamps and ballasts

| **Target Sector** | **EUL- RUL (years)** | **RUL (years)** |
| --- | --- | --- |
| Agricultural |  |  |
| Assembly | 13 | 2 |
| Education - Primary School | 15 | 3 |
| Education - Secondary School | 15 | 3 |
| Education - Relocatable Classroom |  |  |
| Education - Community College | 15 | 2 |
| Education - University | 15 | 3 |
| Grocery | 15 | 1 |
| Food Store |  |  |
| Health/Medical - Hospital | 15 | 1 |
| Health/Medical - Nursing Home | 14.9 | 1 |
| Health/Medical - Clinic | 14.9 |  |
| Lodging - Hotel | 11.8 | 3 |
| Lodging - Guest Rooms |  |  |
| Lodging - Motel | 11.4 | 4 |
| Manufacturing - Bio/Tech | 10 | 2 |
| Manufacturing - Light Industrial | 15 | 2 |
| Industrial |  |  |
| Misc - Commercial |  |  |
| Office - Large | 15 | 2 |
| Office - Small | 15 | 2 |
| Restaurant - Fast-Food | 14.4 | 1 |
| Restaurant - Sit-Down | 14.5 | 1 |
| Retail - Multistory Large | 15 | 2 |
| Retail - Single-Story Large | 15 | 1 |
| Retail - Small | 15 | 2 |
| Storage - Conditioned | 15 | 2 |
| Storage - Unconditioned | 15 | 2 |
| Transportation - Communication - Utilities |  |  |
| Warehouse - Refrigerated | 14.5 | 1 |

## 1.5 Net-to-Gross Ratios for Different Program Strategies

The recommended Net-To-Gross Ratios (NTGR) for this measure is shown on Table 4a below and were taken from DEER 2011.

Table 4a

Net-To-Gross Ratio

|  |  |  |  |
| --- | --- | --- | --- |
| **Measure Name** | **Delivery Method** | **Target Market** | **NTGR** |
| T8 and T5  Linear Fluorescent | Downstream | Pre Replace on Burnout | .7 |
| T8 and T5  Linear Fluorescent | Direct Install | All Nonresidential | .89 |

## 1.6 Time-of-Use Adjustment Factor

As directed by the CPUC in decision 06-06-063 dated June 29, 2006, time-of-use (TOU) adjustment factors are to be applied for residential A/C and commercial A/C (packaged and split-system direct-expansion cooling) measures only. The specific TOU adjustment factors are inherent in the avoided-cost calculation performed in the E3 calculator. In order to apply the TOU adjustment factor correctly to each measure, the following equation was used to calculate the “% Eligible for TOU AC Adjustment” value found in the summary table:



where *kWAC*is the kW savings associated with the A/C unit, and *kWTotal* is the total kW savings for the sum of kW measures. The %TOU for all measure in this work paper is zero since *kWAC* is equal to zero.

# Section 2. Energy Savings & Demand Reduction Calculations

**2.1 Energy Savings Calculations**

The base case fixture wattages were taken from the following:

1. Appendix B of the 2007 Standard Performance Contract (SPC) Program Manual.

Table 5

Base Case Standard Fixture Wattage

| **Fixture Code** | **Lamp Code** | **Ballast Type** | **# of Lamps/Fixture** | **Wattage/Fixture (W)** |
| --- | --- | --- | --- | --- |
| FU2EE | FU40T12/ES | Mag-ES | 2 | 72 |
| FU2EE | FU40T12/ES | Mag-ES | 2 | 72 |
| FU2EE | FU40T12/ES | Mag-ES | 2 | 72 |
| F21SS | F20T12 | Mag-Std | 1 | 28 |
| F22SS | F20T12 | Mag-ES | 2 | 56 |
| F22SS | F20T12 | Mag-ES | 2 | 56 |
| F22SS | F20T12 | Mag-ES | 2 | 56 |
| F22SS | F20T12 | Mag-ES | 2 | 56 |
| F24SS | F20T12 | Mag-ES | 4 | 112 |
| F31SS | F30T12 | Mag-ES | 1 | 46 |
| F31SS | F30T12 | Mag-ES | 1 | 46 |
| F32EE | F30T12/ES | Mag-ES | 2 | 66 |
| F32EE | F30T12/ES | Mag-ES | 2 | 66 |
| F62SE | F72T12 | Mag-ES | 2 | 122 |
| F62SE | F72T12 | Mag-ES | 2 | 122 |
| F82EE | F96T12/ES | Mag-ES | 2 | 123 |
| F82EHE | F96T12/HO/ES | Mag-ES | 2 | 207 |
| F82EE | F96T12/ES | Mag-ES | 2 | 123 |
| F43EE | F40T12/ES | Mag-ES | 3 | 115 |
| F43EE | F40T12/ES | Mag-ES | 3 | 115 |
| F43EE | F40T12/ES | Mag-ES | 3 | 115 |
| F43EE | F40T12/ES | Mag-ES | 3 | 115 |
| F44ILL | F32T8-STD | IS EB NLO | 4 | 112 |
| F44ILL-R | F32T8-STD | IS EB RLO | 4 | 102 |
| F44EE | F40T12/ES | Mag-ES | 4 | 144 |
| F44EE | F40T12/ES | Mag-ES | 4 | 144 |
| F44EE | F40T12/ES | Mag-ES | 4 | 144 |
| F44EE | F40T12/ES | Mag-ES | 4 | 144 |
| F44EE | F40T12/ES | Mag-ES | 4 | 144 |
| F44EE | F40T12/ES | Mag-ES | 4 | 144 |
| F46EE | F40T12/ES | Mag-ES | 6 | 216 |
| F46EE | F40T12/ES | Mag-ES | 6 | 216 |
| F81EHS | F96T12/HO/ES | Mag-STD | 1 | 112 |
| F82EE | F96T12/ES | Mag-STD | 2 | 123 |
| F82EHE | F96T12/HO/ES | Mag-ES | 2 | 207 |
| F42EE | F40T12/ES | Mag-ES | 2 | 72 |
| F42EE | F40T12/ES | Mag-ES | 2 | 72 |
| F42ILL | F32T8-STD | IS EB NLO | 2 | 59 |
| F41ILL | F32T8-STD | IS EB NLO | 1 | 31 |
| F43ILL | F32T8-STD | IS EB NLO | 3 | 89 |

\*Note: The energy savings for “per lamp” measures were calculated using 2-lamp/ballast configuration divided by 2.

The measure wattages were taken from manufacturer’s Product Catalog. Table 6 shows the SPC fixture and lamp codes as well as the specific features and wattage of the measure fixture.

Table 6

Measure Case Standard Fixture Wattage

| **Fixture Code** | **Lamp Code** | **Ballast Type** | | **# of Lamps/Fixture** | | | **Wattage/Fixture (W)** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| FU2ILL | FU31T8/6 | Electronic | | 2 | | | 59 |
| FU2ILL | FU31T8/6 | Electronic | | 2 | | | 59 |
| FU2ILL-R | FU31T8/6 | Electronic | | 2 | | | 52 |
| F21ILL/T2-R | F17T8 | Electronic | | 1 | | | 14 |
| F221LL | F17T8 | Electronic | | 2 | | | 33 |
| F22ILL-R | F17T8 | Electronic | | 2 | | | 29 |
| F22PL | F14T5 | Electronic | | 2 | | | 34 |
| F221LL | F17T8 | Electronic | | 2 | | | 33 |
| F221LL | F17T8 | Electronic | | 2 | | | 33 |
| REL-2P59-SC[[2]](#endnote-2) | F72T8 | Electronic-PREM | | 2 | | | 90 |
| F81ILL-R | F96T8 | Electronic | | 1 | | | 57 |
| F82ILL-R | F96T8 | Electronic | | 2 | | | 98 |
| F42ILL-R | F32T8-PREM | Electronic-PREM-R | | 2 | | | 48 |
| F42ILL | F32T8-PREM | Electronic-PREM | | 2 | | | 54 |
| F42ILL | F32T8-PREM | Electronic-PREM | | 2 | | | 54 |
| F42ILL | F32T8-PREM | Electronic-PREM | | 2 | | | 54 |
| F42ILL-R | F32T8-PREM | Electronic-PREM-R | | 2 | | | 48 |
| F42ILL-R | F32T8-PREM | Electronic-PREM-R | | 2 | | | 48 |
| F42ILL-R | F32T8-PREM | Electronic-PREM-R | | 2 | | | 48 |
| F42ILL | F32T8-STD | Electronic | | 2 | | | Deleted |
| F42ILL | F32T8-STD | Electronic | | 2 | | | Deleted |
| F42ILL | F32T8-STD | Electronic | | 2 | | | Deleted |
| None | None | Elec-Dim.[[3]](#endnote-3) | | 2 | | | 72 |
| F42ILL | F32T8-PREM | Elec- Prem | | 2 | | | 54 |
| F44ILL | F32T8- PREM | Electronic | | 4 | | | 112 |
| F46LL | F32T8-PREM | Elec-Prem | | 6 | | | 182 |
| F42LL-H | F32T8-PREM | Electronic | | 2 | | | 70 |
| F42ILL-H | F32T8-PREM | Electronic | | 2 | | | 65 |
| F44ILL-R | F32T8-PREM | Elec-PREM-R | | 4 | | | 94 |
| QHE 2X32T8/UNV ISL-SC[[4]](#endnote-4) | FO32/850XPS/ECO3 | | Electronic | | 2 | 48 | |
| F42WLL-R | F28T8-PREM-ES | | Elec-PREM-R | | 2 | 42 | |
| F42WLL-R | F28T8-PREM-ES-Nom w/lamp 25 | | Elec-Prem | | 2 | 40 | |
| F41WLL-R | F28T8-PREM-ES | | Elec-PREM-R | | 1 | 21 | |
| F43WLL-R | F28T8-PREM-ES | | Elec-PREM-R | | 3 | 63 | |
| F44WLL-R | F28T8-PREM-ES | | Elec-PREM-R | | 4 | 84 | |
| F41WLL-R | F28T8-PREM-ES-Nom w/lamp 25 | | Elec-PREM-R | | 1 | 20 | |
| F43WLL-R | F28T8-PREM-ES-Nom w/lamp 25 | | Elec-PREM-R | | 3 | 26 | |
| F44WLL-R | F28T8-PREM-ES-Nom w/lamp 25 | | Elec-PREM-R | | 4 | 79 | |

\*Note: The energy savings for “per lamp” measures were calculated using 2-lamp/ballast configuration divided by 2.

The ΔWatts is the difference in wattage from the base case to the measure as shown in Equation 1 and on Table 7. Table Refer to the embedded excel spreadsheet in the attachment section for the detailed lighting calculation.

ΔWatts = *Base Case Wattage - Measure Wattage* = 72 – 59 = 13 Watts **Equation 1**

Table 7

Wattage Reduction from Base Case to Measure

| **Measure Description Classifications** | **Base Case Fixture Wattage** | **Measure Case Fixture Wattage** | **Delta Watts** |
| --- | --- | --- | --- |
| U6 (2)Lamps T12 to U6 (2)Lamps T8 | 72 | 59 | 13 |
| U6 (2)Lamps T12 to U6 (2)Lamps T8 with reflector | 72 | 59 | 13 |
| U6 (2)Lamps T12 to U6 (2)Lamps IS RLO T8 | 72 | 52 | 20 |
| 24" (1)Lamp T12 MB to 24" (1)Lamp T8 Premium IS RLO EB | 28 | 14 | 14 |
| 24" (2)Lamps T12 MB to 24" (2)Lamps T8 IS NLO EB | 56 | 33 | 23 |
| 24" (2)Lamps T12 MB to 24" (2)Lamps T8 Premium IS RLO EB | 56 | 29 | 27 |
| 24" (2)Lamps T12 MB to 24" (2)Lamps T5 EB | 56 | 34 | 22 |
| 24" (2)Lamps T12 MB to 24" (2)Lamps T8 IS NLO EB with reflector (See NOTE 2 below) | 56 | 33 | 23 |
| 24" (1)Lamp T12 MB to 24" (1)Lamp T8 IS NLO EB (per lamp) | (see attached calculation template)\* | | |
| 24" (1)Lamp T12 MB to 24" (1)Lamp T5 EB (per lamp) | (see attached calculation template)\* | | |
| 36" (1)Lamp T12 MB to 36" (1)Lamp T8 IS NLO EB | 46 | 26 | 20 |
| 36" (1)Lamp T12 MB to 36" (1)Lamp T8 IS RLO EB | 46 | 27 | 19 |
| 36" (2)Lamps T12 MB to 36" (2)Lamps T8 Premium IS RLO EB | 66 | 46 | 20 |
| 36" (2)Lamps T12 MB to 36" (2)Lamps T5 Premium IS RLO EB | 66 | 48 | 18 |
| 36" (1)Lamp T12 MB to 36" (1)Lamp T8 Premium IS RLO EB (per lamp) | (see attached calculation template)\* | | |
| 36" (1)Lamp T12 MB to 36" (1)Lamp T5 Premium IS RLO EB (per lamp) | (see attached calculation template)\* | | |
| 72"(2)Lamps T12 to 72"(2)Lamps T8 IS EB | 122 | 90 | 32 |
| 96"(2)Lamps HO T12 MB to 96"(2)Lamps RLO T8 EB | 207 | 98 | 109 |
| 96"(1)Lamp T12 MB to 96"(1)Lamp T8 RLO IS EB (per lamp) | (see attached calculation template)\* | | |
| 48"(6)Lamps T12 to 48"(6)Lamps T8 Premium NLO EB | 216 | 182 | 34 |
| 96"(2)Lamps T12 MB to 48"(2)Lamps HO T8 IS EB | 123 | 65 | 58 |
| 48" (2)Lamps T12 MB to 48"(2)Lamps T8 Premium IS RLO EB | 72 | 42 | 30 |
| Code 48" (2)Lamps T8Prem IS EB NLO to 48"(2)LampsF28 T8 Premium IS RLO EB | 59 | 42 | 17 |
| Code 48" (2)Lamps T8Prem IS EB NLO to 48"(2)LampsF28 (25W lamp) T8 Premium IS NLO EB | 59 | 44 | 15 |
| 46"(1)Lamp T5HO IS EB to 46"(1)Lamp Reduced 51W T5HO IS EB | 54 | 51 | 3 |
| 46"(2)Lamps T5HO IS EB to 46"(2)Lamps Reduced 51W T5HO IS EB | 116 | 109 | 7 |
| 46"(3)Lamps T5HO IS EB to 46"(3)Lamps Reduced 51W T5HO IS EB | 187 | 176 | 11 |
| 46"(4)Lamps T5HO IS EB to 46"(4)Lamps Reduced 51W T5HO IS EB | 234 | 218 | 16 |
| 46"(1)Lamp T5HO IS EB to 46"(1)Lamp Reduced 49W T5HO IS EB | 54 | 49 | 5 |
| 46"(2)Lamps T5HO IS EB to 46"(2)Lamps Reduced 49W T5HO IS EB | 116 | 106 | 10 |
| 46"(3)Lamps T5HO IS EB to 46"(3)Lamps Reduced 49W T5HO IS EB | 187 | 172 | 15 |
| 46"(4)Lamps T5HO IS EB to 46"(4)Lamps Reduced 49W T5HO IS EB | 234 | 214 | 20 |
| 48"(1)Lamp T12 MB to 48"(1)Lamp T8 NLO IS EB (per lamp) | See workpaper WPSDGENRLG0999 | | |
| 48"(1)Lamp T12 MB to 46"(1)Lamp T5 NLO IS EB (per lamp) | See workpaper WPSDGENRLG0999 | | |
| 48"(1)Lamp T8 IS EB to 48"(1)Lamp Reduced 25W T8 IS EB (per lamp) | See workpaper WPSDGENRLG0999 | | |
| 48"(1)Lamp T8 IS EB to 48"(1)Lamp Reduced 28W T8 IS EB (per lamp) | See workpaper WPSDGENRLG0999 | | |
| 46"(1)Lamp T5HO IS EB to 46"(1)Lamp Reduced 49W T5HO IS EB (per lamp) | See workpaper WPSDGENRLG0999 | | |
| 46"(1)Lamp T5HO IS EB to 46"(1)Lamp Reduced 51W T5HO IS EB (per lamp) | See workpaper WPSDGENRLG0999 | | |
| 48"(1)Lamps T12 MB to 48"(1)28 Watt Premium Lamps w/ RLO IS EB | See workpaper WPSDGENRLG0999 | | |
| 48"(2)Lamps T12 MB to 48"(2)28 Watt Premium Lamps w/ RLO IS EB | See workpaper WPSDGENRLG0999 | | |
| 48"(3)Lamps T12 MB to 48"(3)28 Watt Premium Lamps w/ RLO IS EB | See workpaper WPSDGENRLG0999 | | |
| 48"(4)Lamps T12 MB to 48"(4)28 Watt Premium Lamps w/ RLO IS EB | See workpaper WPSDGENRLG0999 | | |
| 48"(1)Lamps T12 MB to 48"(1)25 Watt Premium Lamps w/ RLO IS EB | See workpaper WPSDGENRLG0999 | | |
| 48"(2)Lamps T12 MB to 48"(2)25 Watt Premium Lamps w/ RLO IS EB | See workpaper WPSDGENRLG0999 | | |
| 48"(3)Lamps T12 MB to 48"(3)25 Watt Premium Lamps w/ RLO IS EB | See workpaper WPSDGENRLG0999 | | |
| 48"(4)Lamps T12 MB to 48"(4)25 Watt Premium Lamps w/ RLO IS EB | See workpaper WPSDGENRLG0999 | | |
| 48"(1)Lamps T8 NLO EB to 48"(1)28 Watt Premium Lamps w/ RLO IS EB | See workpaper WPSDGENRLG0999 | | |
| 48"(2)Lamps T8 NLO EB to 48"(2)28 Watt Premium Lamps w/ RLO IS EB | See workpaper WPSDGENRLG0999 | | |
| 48"(3)Lamps T8 NLO EB to 48"(3)28 Watt Premium Lamps w/ RLO IS EB | See workpaper WPSDGENRLG0999 | | |
| 48"(4)Lamps T8 NLO EB to 48"(4)28 Watt Premium Lamps w/ RLO IS EB | See workpaper WPSDGENRLG0999 | | |
| 48"(1)Lamps T8 NLO EB to 48"(1)25 Watt Premium Lamps w/ RLO IS EB | See workpaper WPSDGENRLG0999 | | |
| 48"(2)Lamps T8 NLO EB to 48"(2)25 Watt Premium Lamps w/ RLO IS EB | See workpaper WPSDGENRLG0999 | | |
| 48"(3)Lamps T8 NLO EB to 48"(3)25 Watt Premium Lamps w/ RLO IS EB | See workpaper WPSDGENRLG0999 | | |
| 48"(4)Lamps T8 NLO EB to 48"(4)25 Watt Premium Lamps w/ RLO IS EB | See workpaper WPSDGENRLG0999 | | |

\*Note: The energy savings for “per lamp” measures were calculated using 2-lamp/ballast configuration divided by 2.

The energy savings estimates are based upon the DEER methodology for Express Efficiency (EEBR) type programs[[5]](#endnote-5). The "unit" referenced in the equation below is a fixture.

Equation 2illustrates the energy savings estimation methodologies used to calculate Non-CFL interior lighting measures.

  Equation 2

The annual energy savings are based on DEER Annual Operating Hours, and Energy Interactive Effects by Building Type for Non-CFL Lighting[[6]](#endnote-6) for each market sector. Energy interactive effects are the additional savings resulting from the reduced air conditioning load because of the reduction in internal heat gains from the more efficient lighting system.

**2.2 Demand Reduction Estimation Methodologies**

The demand reduction estimates are based upon the DEER methodology for Express Efficiency type programs[[7]](#endnote-7).

 Equation 4

**2.3 Gas Energy Saving Estimation**

Only losses in Gas savings are associated with these measures.

*Gas Savings = (∆Watts/unit) x (annual hours* of use) x (3.413 BTU/Watt hours) x Interactive Effects **Equation 3**

100,000 (BTU/Therm)

# Section 3. Load Shapes

The difference between the base case load shape and the measure load shape would be the most appropriate load shape; however, only end-use profiles for some sectors are available.

The closest load shape chosen for this measure is the DEER:Indoor\_Non-CFL\_Ltg which applies to all Target Sectors. Table 8 shows the list of all Building Types, Alternate Buildings and Load Shapes.

**Table 8**

**Target Sectors and Load Shapes**

| **Building Type (Actual)** | **Building (Alternate)** | **Load Shape** |
| --- | --- | --- |
| Agricultural | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Assembly | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Education - Primary School | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Education - Secondary School | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Education - Relocatable Classroom | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Education - Community College | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Education - University | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Grocery | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Food Store | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Health/Medical - Hospital | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Health/Medical - Nursing Home | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Health/Medical - Clinic | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Lodging - Hotel | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Lodging - Guest Rooms | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Lodging - Motel | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Manufacturing - Bio/Tech | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Manufacturing - Light Industrial | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Industrial | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Misc - Commercial | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Office - Large | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Office - Small | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Restaurant - Fast-Food | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Restaurant - Sit-Down | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Retail - Multistory Large | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Retail - Single-Story Large | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Retail - Small | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Storage - Conditioned | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Storage - Unconditioned | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Transportation - Communication - Utilities | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |
| Warehouse - Refrigerated | NON\_RES | DEER:Indoor\_Non-CFL\_Ltg |

# Section 4. Base Case & Measure Costs

**For Direct Install measures:**

SDGE directly utilizes one or more contractors as part of the program. The actual cost can vary by contractor, the date in which the work occurred, and by the volume of business. Contractor costs are confidential information and are based upon contractually agreed upon pricing as established in their purchase order with SDGE; thus, the SDGE program tracking system is the only source for this data. Thus, the costs discussed in sections below apply to Downstream Incentive Rebate programs only.

## 4.1 Base Case Cost

For this measure category, the base case cost is assumed to be zero because these are discretionary modifications (retrofit) to the customers’ existing equipment. Their alternative is to make no changes to their existing system.

## 4.2 Gross Measure Cost

**Retrofit**

For this measure category, the gross measure cost is defined as the cost incurred to install the energy efficient measure. The gross cost includes both the equipment cost and all associated labor cost to install the measure. For retrofit measures the gross measure cost is used for reporting in the cost effectiveness calculations. In the current E3 calculator this value is insert into the column titled “Gross Measure Cost ($/unit)”.

The Measure Costs were taken from contractor’s estimated pricing, except for the 8-ft fixtures which was taken directly from DEER cost spreadsheet (DEER cost case ID 96in59wT8ISREl98w). Costs for the 2-ft and 3-ft [[8]](#endnote-8) fixtures, and the 4-ft 3 fixtures are shown in the reference section. All product prices represent costs to the installer which include 40% mark up cost to end-users. Labor costs were based on SCE engineering judgment and are shown on the attached excel spreadsheet.3 Table 9 shows for the summary of Gross Measure Cost for Down-stream measures only.

**Table 9**

**Summary of Gross Measure Cost**

| **Measure Description** | **Qty Of Lamp(s)** | **Lamp(s)**  **($)** | **Electronic Ballast(s)**  **($)** | | **Labor Cost**  **($)** | | **Gross Measure Cost**  **($)** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 24" (2)Lamps T12 MB to 24" (2)Lamps T8 Premium IS RLO EB | 2 | 6.72 | 22.09 | | 18.24 | | 47.05 |
| 24" (2)Lamps T12 MB to 24" (2)Lamps T5 EB | 2 | 17.50 | 108.01 | | 18.24 | | 143.75 |
| 24" (1)Lamp T12 MB to 24" (1)Lamp T8 IS NLO EB (per lamp) | (see attached calculation template) | | | | | | |
| 24" (1)Lamp T12 MB to 24" (1)Lamp T5 EB (per lamp) | (see attached calculation template) | | | | | | |
| 36" (2)Lamps T12 MB to 36" (2)Lamps T8 Premium IS RLO EB | 2 | 6.72 | 22.09 | | 18.24 | | 47.05 |
| 36" (2)Lamps T12 MB to 36" (2)Lamps T5 Premium IS RLO EB | 2 | 17.50 | 109.90 | | 18.24 | | 145.64 |
| 36" (1)Lamp T12 MB to 36" (1)Lamp T8 Premium IS RLO EB (per lamp) | (see attached calculation template) | | | | | | |
| 36" (1)Lamp T12 MB to 36" (1)Lamp T5 Premium IS RLO EB (per lamp) | (see attached calculation template) | | | | | | |
| 96"(1)Lamp T12 MB to 96"(1)Lamp T8 RLO IS EB (per lamp) | (see attached calculation template) | | | | | | |
| 46"(1)Lamp T5HO IS EB to 46"(1)Lamp Reduced 49W T5HO IS EB (per lamp) | (see attached calculation template) | | | | | | |
| 46"(1)Lamp T5HO IS EB to 46"(1)Lamp Reduced 51W T5HO IS EB (per lamp) | (see attached calculation template) | | | | | | |
| 48"(2)Lamps T12 MB to 48"(2)Lamps High Performance T8 with Nema Premium High Efficiency EB | 2 | 4.14 | 22.19 | 18.24 | | 44.57 | |
| 48"(1)Lamp T12 MB to 48"(1)Lamp High Performance T8 with Nema Premium High Efficiency EB (per lamp) | (see attached calculation template) | | | | | | |

## 4.3 Incremental Measure Cost

The Full Measure Cost was set equal to the Incremental Measure Cost. See Table 9.

# Attachments

# References

1. Title 24 2005 Non-Residential Compliance Manual, Section 5.14 Additions & Alterations, March 2005, page 81. [↑](#endnote-ref-1)
2. The information on the 72 inch, 2-lamp fixture was taken from manufacturer’s catalog “Advance Transformer Lighting Fixture”

    [↑](#endnote-ref-2)
3. Manufacturer Product Sheet

    [↑](#endnote-ref-3)
4. T8 lamp and ballast must be a qualified product listed in the CEE website (<http://www.cee1.org/com/com-lt/lamps-ballasts.xls>).

   [↑](#endnote-ref-4)
5. Itron Inc., “2004-2005 Database for Energy Efficient Resources (DEER) Update Study, Final Report”, December 2005, pages 3-6 [2004-05 DEER Update Final Report-Wo.pdf] [↑](#endnote-ref-5)
6. Ibid, pages 3-9. [↑](#endnote-ref-6)
7. Ibid, pages 3-6. [↑](#endnote-ref-7)
8. 2ft and 3ft estimated measure cost

   

   9 Measure savings provided in workpaper WPSDGE NRLG0999 (provided under separate cover). [↑](#endnote-ref-8)