**Work Paper WPSDGENRLG0198**

**Revision 0**

**San Diego Gas & Electric**

**Energy Efficiency Engineering**

**Exterior LED Sports & Athletic Field Lighting Fixtures**

### Core Measure Summary Table

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| General Measure Information | | | | | | | | | | | | | | | | | | | PT | | 1st Baseline Period | | | | 2nd Baseline Period | | | | TOU |
| Measure Name | PreDesc | StdDesc | Measure RunID | Product Code | CZ | Building Type | UseCategory | UseSubCategory | TechGroup | TechType | PreTechGroup | PreTechType | StdTechGroup | StdTechType | Load Shape | EUL\_ID | EUL | Unit Definition | Program Type (NEW, ROB, RET) | Applicable Code | Gross Unit Annual Electricity Savings (kWh/unit) | User Entered kW Savings per unit (kW/unit) | Gas Savings (Therms) | 1st Baseline Useful Life | Gross Unit Annual Electricity Savings (kWh/unit) | User Entered kW Savings per unit (kW/unit) | Gas Savings (Therms) | 2nd Baseline Useful Life | % Eligible for TOU AC Adjustment |
| Lighting - Exterior LED Sports & Athletic Field Lighting Fixtures | MH | MH | NA |  | Any | Misc - Commercial | Lighting | OutSports | Ltg\_Fixture | LED\_fixt | Ltg\_Fixture | HID\_fixt | Ltg\_Fixture | HID\_fixt | 01-ALC-AllCommercial-ExtLight | Oltg-LED | 15.0 | Per kW of installed new fixture kW | ROB | NA | 945 | 0 | 0 | 15.00 |  |  |  |  | 0 |

Note: **For the complete list of Measures, refer to workpaper Attachment #1.**

### Costing and NTG Summary Table

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| General Measure Information | | | | PT | | NTG | | | IR | 1st Baseline Period | 2nd Baseline Period | IMC | DIM |
| Measure Name | Product Code | CZ | Unit Definition | Program Type (NEW, ROB, RET) | Applicable Code | NTG Non-Res. | NTG Res. | NTG Multi Family | Installation Rate | Gross Measure Cost per unit | Gross Measure Cost per unit | Incremental Measure Cost per unit | Delivery & Incentive Method |
| Lighting – Exterior LED Sports & Athletic Field Lighting Fixtures |  | any | Per kW of installed new fixture kW | ROB | No | 0.85 |  |  | 1.00 | $3170 | NA | $2350 | Financial Support / Down-Stream Incentive - Deemed |

Note: **For the complete list of Measures, refer to workpaper Attachment #1.**

# Document Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| Revision # | MM/DD/YY | Author/Affiliation | Summary of Changes |
| 0 | 9/1/2015 | Charles Harmstead / SDGE | Original work |

# Section 1. General Measure & Baseline Data

## 1.1 Measure & Delivery Description

### 1.1a Measure Description

This work paper details the replacement of existing exterior metal halide with more efficient exterior light emitting diode (LED) fixtures for the retrofit of outdoor sports and athletic field lighting systems. LED provides higher fixture lumen/ watt than metal halide. Evaluation of retrofit lighting configuration for each application (site) further increases energy and power savings by optimizing LED optics while reducing spill and glare. Energy consumption is reduced by over 50%. Since the sports and athletic field lighting retrofit is considered as a system approach the lighting designer may change fixture placement, number, and wattage of fixtures to provide a retrofit system solution for the customer. Since a system, rather than a fixture approach is used to complete the lighting retrofit a rebate is evaluated on the total watts of the replacement system. The measure description units become kW saved per new total fixture kW installed.

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

Table 1 Measure Descriptions

|  |  |
| --- | --- |
| **Product Code** | **Measure Description Classifications** |
|  | Exterior LED Sports & Athletic Field Lighting Fixtures |

### 1.1b Delivery and Incentive Mechanism

The delivery methods for these measures are:

* Financial-Support Down-Stream Incentive Deemed

The measure install types are:

* Replace on Burnout (ROB) or New Construction (NEW)

### 1.1c Measure Requirements

For Energy Efficiency deemed measures, measure eligibility requirements are established in the San Diego Gas & Electric Energy Efficiency Business Rebates Lighting Product Catalog [[[1]](#endnote-1)].

Measure requirements include:

* The total system wattage of the replacement lighting system must be less than the total wattage of the existing lighting system.
* New fixture refers to new equipment being installed based on fixture (lamp and driver) wattage.
* Qualifying fixtures must be listed on one of the following lists:
  + DLC: http://www.designlights.org/QPL
  + Appendix E: Table of Approved LED Lighting & Utility Approval Process(xls)
* Lumen Maintenance – IES TM-21-11 shall be used for projecting lumen maintenance. The TM-21-11 life shall be 30,000 hours minimum.
* New fixtures must replace an existing Metal Halide Exterior Sports & Athletic Field Lighting Fixtures greater than or equal to 500 watts
* Complete, new LED fixtures qualify

Note:

Energy Star specifications are for residential LED lamps and are not applicable for sports and field lighting.

The California Energy Commission Voluntary California Quality Lamp Specification applies only to LED lamps that are intended to be installed directly into incandescent luminaires. The CEC specification is not applicable to Sports and Athletic Field Lighting

## 1.2 DEER Differences Analysis

The Database for Energy Efficient Resources (DEER) 2014 release does not include exterior LED sports and athletic field lighting fixture measures. Therefore, DEER values will not be used as the savings estimates.

**Table 2 DEER Difference Summary**

|  |  |
| --- | --- |
| DEER Difference Summary Table | |
| Modified DEER Methodology | No |
| Scaled DEER Measure | No |
| DEER Building Prototypes Used | No |
| Deviation from DEER | DEER does not contain measures found in this workpaper. |
| DEER Version | N/A |
| DEER Run ID and Measure Name (Sample) | N/A |

## 1.3 Code Analysis

The 2014 California Title 20 Appliance Efficiency Regulations [[[2]](#endnote-2)] include standards for both federally regulated appliances and nonfederally-regulated appliances that are sold or offered for sale in California; however, Title 20 does not govern the measures found in this workpaper.

The 2013 California Title 24 Building Energy Efficiency Standards [[[3]](#endnote-3)] focus on key areas to improve the energy efficiency of newly constructed buildings and additions and alterations to existing buildings.

* Section 130.2 does not address exterior sports and athletic field lighting. Section 130.2 outlines standards for outdoor lighting controls and equipment, which state that all outdoor luminaires rated for use with lamps greater than 150 lamp watts, determined in accordance with Section 130.0(c), shall comply with Backlight, Uplight, and Glare (collectively referred to as "BUG" in accordance with IES TM-15-11, Addendum A). Section 130.2 (c) lists specific requirements for controls for outdoor lighting. No exemptions are listed for exterior sports and athletic field lighting.
* Section 140.7 outlines the prescriptive requirements for outdoor lighting. Lighting for sports and athletic fields are exempt.

Federal DOE or EPA Energy Regulations do not govern the measures found in this workpaper.

**Table 3 Code Summary**

|  |  |  |
| --- | --- | --- |
| Code | Applicable Code Reference | Effective Dates |
| Title 24 (2013) | 2013 Title 24 Building Energy Efficiency Standards, Sections 130.2 and 140.7 | July 1, 2014 |
| Title 20 (2014) | N/A | N/A |
| Federal Standards | N/A | N/A |

## 1.4 Measure Effective Useful Life

DEER and the CPUC ED Workpaper Disposition for Lighting Retrofits documentation provide EUL and RUL information to be used on [www.deeresources.com](http://www.deeresources.com).

## To obtain the EUL value, the updated CPUC ED EUL table documentation issued on February 5, 2014, “DEER2014-EUL-table-update\_2014-02-05.xlsx”, was consulted. Table 4 below identifies the value/methodology used for the measures in this work paper. Please consult workpaper attachment #1 [[[4]](#endnote-4)] for the actual EUL values used for all of the building types in this workpaper.

Table 4 DEER EUL Value/Methodology

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Market | Enduse | Measure | EUL (Years) | RUL (Years) |
| Non-Residential | Outdoor Lighting | Exterior LED Sports and Athletic Field Lighting Fixtures | EUL = Rated Life of Fixture (30,000 hours) / Annual usage. DEER provides EUL = 15 years maximum for lighting. Outdoor Sports and athletic field maximum operating hours is around 1400 hours per year. Fixture life requirements for 30,000 hours minimum provide EUL exceeding 20 years | NA |

Table 5 identifies the EUL and RUL IDs used in this workpaper.

Table 5 EUL/RUL ID Summary

|  |  |  |  |
| --- | --- | --- | --- |
| EUL\_ID | RUL-ID | Description | Sector |
| OLtg-LED |  | LED Lighting | CC |
|  | OLtg-HPS | HID Lighting | CC |

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

The NTG value was obtained from the “DEER2011\_NTGR\_2012-05-16.xls” on the DEER website as required by Version 4 of the California Public Utilities Commission (CPUC) Energy Efficiency Policy Manual [132]. The relevant NTGR for the measures are shown in Table 6 below.

Table 6 Net-to-Gross Ratio

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NTGR\_ID\* | Description\* | Sector\* | BldgType\* | ProgDelivID |
| ET-Default | Emerging Technologies approved by ED through work paper review | All | Any | All |
| 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 | All |
| Ind-Default>2yrs | All other EEMs with no evaluated NTGR; existing EEM in programs with same delivery mechanism for more than 2 years | Ind | Any | All |
| Agric-Default>2yrs | All other EEMs with no evaluated NTGR; existing EEM in programs with same delivery mechanism for more than 2 years | Ag | Any | All |

\*Denotes that the column is taken from the DEER NTG Table.

## 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. Since this is not an A/C measure, the TOU adjustment factor is 0. Additionally, if a measure is assigned a DEER08 load shape, i.e. the load shape starts with “DEER:” the TOU assigned to that measure should also be zero.

Table 7 TOU Summary Table

|  |  |
| --- | --- |
| Measure | % |
| Lighting Fixtures | 0 |

Note: Check Section 3 if a measure appears to require a non-zero percentage but is assigned zero. If the load shape is a DEER08 load shape, a TOU of 0 is correct.

# Section 2. Energy Savings & Demand Reduction Calculations

**2.1 Energy Savings Calculations**

The energy savings (ΔkW/new installed fixture kW) is the difference in wattage from the base case to the measure case as shown below.

ΔkW/ new installed fixture kW = (Base Case Exterior MH system kW -Installed Exterior LED system kW)/ Installed Exterior LED System kW

Beyond the delta kW calculation, other energy variables are considered in estimating energy savings. The annual energy savings are based exterior sports and athletic field average 945 annual operating hours. See Attachment 3

**Equation 1** illustrates the energy savings estimation methodology used to calculate exterior LED sports and athletic field lighting fixture measures. Sports and athletic field lighting hours are set at 945 hours per year (average of local evening golf and municipal soccer/baseball fields). In addition, there are no interactive effects from exterior lights.

**Equation 1**



Note: unit is defined as watts saved/new fixture installed watt

Table 8 Energy Savings Summary

| Product  Code | Measure Description Classifications | Customer Ave  Δ kW/kW installed new fixture | Code  Δ kW | Annual  hours | Customer Ave  Energy  Savings  (kW)/installed fixture kW | Code  Energy  Savings  (kWh) |
| --- | --- | --- | --- | --- | --- | --- |
|  | Exterior LED Sports and Athletic Field Lighting Fixture | 1 | NA | 945 | 945 | NA |

**2.2 Demand Reduction Estimation Methodologies**

The demand reduction estimates are based upon the DEER methodology for Express Efficiency type programs [21]. **Equation 2** illustrates the peak demand reduction estimation method used. However, these exterior lighting measures do not have any on-peak demand savings as the lights do not operate during the DEER peak hours of 2-5 pm.

**Equation 2**



Table 9 provides a summary of the measure and delta wattages used in the demand reduction calculation methodology, as described in the CPUC ED Workpaper Disposition for Lighting Retrofits documentation issued on November 12, 2013 [[[5]](#endnote-5)].

Table 9 Measure Wattage Summary

| Product Code | Measure Description Classifications | Baseline Technology | Code Technology | Measure Technology | Customer Ave  Δ kW/kW installed new fixture | Code Watts | Meas kW/ kW | Customer Ave  Δ kW/ kW Installed new fixture | Code  Δ kW |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Exterior LED Sports and Athletic Field Lighting Fixture) | MH | LED | LEDFixt-Ext | 2 |  | 1 | 1 |  |

**2.3 Gas Energy Saving Estimation**

Gas savings do not apply to the measures found in this workpaper.

For all the savings discussed above, there is an installation rate applied to values associated with the installation GSIA ID in Table 10. The GSIA ID is identified in the ex-ante implementation tables for all programs and measures. The installation rate (IR) is applied to the gross savings calculations using the values associated with the IDs below.

Table 10 Gross Savings Installation Adjustment (GSIA) IDs

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| GSIA\_ID | Description | Sector | BldgType | UseCategory | TechType |
| Def-GSIA | Default GSIA | Any | Any | Any | Any |

# 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 are available. Therefore, the closest load shape was chosen for these measures. See Table 11 for a list of all Building Types and Load Shapes. See the KEMA report [31] for a more thorough discussion regarding the load shapes for this measure.

Table 11 Building Types and Load Shapes

| Building Type | Load Shape |
| --- | --- |
| All Commercial | 01-ALC-AllCommercial-ExtLight |

# Section 4. Base Case & Measure Costs

## 4.1 Base Case Cost

DEER data does not provide information on costs for LED exterior lighting fixtures. Base case costs for sports and athletic field lighting were referenced from the 2014 RS MEANS database and provided in the costing attachment 2.

## 4.2 Gross Measure Cost

The 2014 RS MEANS database was consulted as a reference for the measure case costs for the Sports and Athletic Field lighting measures defined in this workpaper Measure case costs and references are provided in the Attachment 2.

Per the E3, the gross measure cost (GMC) is the cost to install an energy efficient measure. In the case of ROB, GMC means the cost premium required to install the energy efficient measure over a less efficient piece of equipment.

For NEW and ROB, GMC is represented by the equation below:

*GMC = (Measure Equipment Cost + Measure Labor Cost) – (Base Case Equipment Cost + Base Case Labor Cost)*

Note: Unless stated otherwise the measure case labor and base case labor are assumed to be the same value reducing the equation to the following:

*GMC = Measure Equipment Cost – Base Case Equipment Cost*

Table 12 shows Gross Measure Cost of the LED fixtures for ROB measures. It employs weighting of the most popular measures in accordance with contractor observed retrofit applications (weighted 90 % for 1500 W MH retrofit and 10 % for 1000 W HM retrofit). The labor cost for installing a metal halide or LED fixture is approximately equal.

Table Gross Measure Costs (GMC) of ROB Measures

| Product Code | WP Measure Description | Base Cost/ new fixture installed kW | Base Labor Cost | Gross Measure Cost/ new fixture installed kW | Measure Labor Cost | Gross/Inc. Measure Cost/ new fixture installed kW |
| --- | --- | --- | --- | --- | --- | --- |
|  | Exterior LED Sports and Athletic Field Lighting Fixtures | $820 | --- | $3170 | --- | $2350 |

## 4.3 Incremental Measure Cost

Incremental Measure Cost (IMC) is the premium cost to install an energy efficient measure over a standard efficiency measure or code baseline measure.

For ROB, the incremental measure cost (IMC) is the same as the gross measure cost.

# Attachments

Not used



1. 

# References



[21]

[31]

[132]

Lookup Table ID Summary

EUL

|  |  |  |
| --- | --- | --- |
| EUL\_ID | Description | Sector |
| OLtg-LED | LED Lighting | CC |

NTGR

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NTGR\_ID\* | Description\* | Sector\* | BldgType\* | ProgDelivID |
| ET-Default | Emerging Technologies approved by ED through work paper review | All | Any | All |
| 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 | All |
| Ind-Default>2yrs | All other EEMs with no evaluated NTGR; existing EEM in programs with same delivery mechanism for more than 2 years | Ind | Any | All |
| Agric-Default>2yrs | All other EEMs with no evaluated NTGR; existing EEM in programs with same delivery mechanism for more than 2 years | Ag | Any | All |

GSIA

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| GSIA\_ID | Description | Sector | BldgType | UseCategory | TechType |
| Def-GSIA | Default GSIA | Any | Any | Any | Any |

BUILDING TYPE & LOAD SHAPE

| Building Type | Load Shape |
| --- | --- |
| All Commercial | 01-ALC-AllCommercial-ExtLight |

1. [] SDG&E Energy Efficiency Business Rebates Lighting Product Catalog - https://www.sdge.com/rebates-finder/earn-rebates-your-improvements [↑](#endnote-ref-1)
2. [] The 2014 Appliance Efficiency Regulations – Title 20: http://www.energy.ca.gov/2014publications/CEC-400-2014-009/CEC-400-2014-009-CMF.pdf [↑](#endnote-ref-2)
3. [] The 2013 Building Energy Efficiency Standards for Residential and Nonresidential Buildings – Title 24, Part 6: http://www.energy.ca.gov/2012publications/CEC-400-2012-004/CEC-400-2012-004-CMF-REV2.pdf [↑](#endnote-ref-3)
4. [] Attachment # 1 – Calculation Template v2.2.xlsm [↑](#endnote-ref-4)
5. [] CPUC ED Workpaper Disposition for Lighting Retrofits documentation issued on November 12, 2013, “2013-2014\_LightingRetrofit\_Disposition-12November2013.xlsx” [↑](#endnote-ref-5)