Work Paper SCE17LG114

**Revision 1**

**Southern California Edison**

**LED Exterior Light with Motion Sensor**

# At-a-Glance Summary

|  |  |
| --- | --- |
| **Measure Codes** | Refer to Excel Calculation Attachment |
| **Measure Description** | Exterior LED Fixture with Integrated Autonomous Motion Sensor |
| **Base Case Description** | Exterior HPS/PSMH Fixture without Motion Sensor |
| **Units** | Per fixture |
| **Energy Savings** | Refer to Excel Calculation Attachment |
| **Full Measure Cost ($/unit)** | Refer to Excel Calculation Attachment |
| **Incremental Measure Cost ($/unit)** | Refer to Excel Calculation Attachment |
| **Effective Useful Life** | OILtg-Com-LED-50000hr – 12 years Commercial |
| **Measure Installation Type** | Replace on Burnout (ROB) |
| **Net-to-Gross Ratio** | All-Default<=2yrs – 0.7  Com-Default-HTR-di, Ind-Default-HTR-di, Agricult-Default-HTR-di – 0.85 |
| **Important Comments** | This work paper has a complementary Ex Ante Database data set that will be provided in a separate submission to the California Public Utilities Commission (CPUC). |

# Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Rev** | **Date** | **Author** | **Summary of Changes** |
| 0 | 11/05/16 | M Blum/SCE | * Update SCE13LG114.1 to SCE17LG114.0 * Added new construction * Removed requirements for baseline power * Updated code language to reflect 2016 Title 24Updated references * Updated costs and IMC’s for all measures. |
| 1 | 06/19/2017 | Ajay Wadhera/SCE | * Updated HOU from 4,380 to 4,100 per “2017ExteriorLEDFixturesDisposition-Revised2June2017-FINAL” disposition. |

# Commission Staff and Cal TF Comments

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Rev** | **Party** | **Submittal Date** | **Comment Date** | **Comments** | **WP Developer Response** |
| 1 | CS |  |  |  |  |
| 1 | Cal TF |  |  |  |  |

Cal TF website: <http://www.caltf.org/>

# Section 1. General Measure & Baseline Data

## 1.1 Measure Description & Background

This work paper details the calculation methodology used in determining annual energy savings by replacing exterior high intensity discharge (HID) luminaires (fixtures) in area or structure-mounted (aka wallpack) lighting applications with LED fixtures equipped with integral autonomous motion sensors (IAMS). Each LED IAMS fixture must be dimmable and conform to the Application Notes and Requirements in this Section. Fixtures are to be mounted 24 feet or higher above finished grade (AFG), and aimed downward, as plumb as possible to horizontal grade. Both HID sources are included: high pressure sodium (HPS) and pulse start metal halide (PSMH). Both cobra and shoebox style fixtures are included. The measure savings for this work paper are based on the one-for-one replacement of existing HID lighting sources, specifically HPS and PSMH, with new LED IAMS fixtures. The following tables list all of the measures applicable to this work paper.

**Base, Standard, and Measure Cases**

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | Exterior LED Fixture with Integrated Autonomous Motion Sensor |
| Existing Condition | Exterior HPS/PSMH Fixture without Motion Sensor |
| Code/Standard | N/A |
| Industry Standard Practice | Pulse Start Metal Halide Fixture |

Measures and Codes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure Codes** | | | | **Measure Name** |
| SCG | SDG&E | SCE | PG&E |
|  |  | LT-45412 |  | 50 to 90 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 150 Watt High Pressure Sodium |
|  |  | LT-33429 |  | 91 to 120 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 200 Watt High Pressure Sodium |
|  |  | LT-89769 |  | 121 to 150 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 250 Watt High Pressure Sodium |
|  |  | LT-62170 |  | 151 to 203 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 310 Watt High Pressure Sodium |
|  |  | LT-82363 |  | 204 to 275 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 400 Watt High Pressure Sodium |
|  |  | LT-59558 |  | 276 to 496 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 600 Watt High Pressure Sodium |
|  |  | LT-65209 |  | 497 to 607 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 750 Watt High Pressure Sodium |
|  |  | LT-28370 |  | 608 to 730 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 1000 Watt High Pressure Sodium |
|  |  | LT-71476 |  | 45 to 67 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 150 Watt Pulse Start Metal Halide |
|  |  | LT-27397 |  | 68 to 90 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 175 Watt Pulse Start Metal Halide |
|  |  | LT-73969 |  | 91 to 113 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 200 Watt Pulse Start Metal Halide |
|  |  | LT-25659 |  | 114 to 123 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 250 Watt Pulse Start Metal Halide |
|  |  | LT-89014 |  | 124 to 161 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 320 Watt Pulse Start Metal Halide |
|  |  | LT-62026 |  | 162 to 194 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 350 Watt Pulse Start Metal Halide |
|  |  | LT-24181 |  | 195 to 226 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 400 Watt Pulse Start Metal Halide |
|  |  | LT-55256 |  | 227 to 254 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 450 Watt Pulse Start Metal Halide |
|  |  | LT-30938 |  | 255 to 325 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 575 Watt Pulse Start Metal Halide |
|  |  | LT-56180 |  | 326 to 440 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 750 Watt Pulse Start Metal Halide |
|  |  | LT-19782 |  | 441 to 517 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 875 Watt Pulse Start Metal Halide |
|  |  | LT-19121 |  | 518 to 643 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 1000 Watt Pulse Start Metal Halide |

**Application Notes**

1. Façade, monument, and flag applications are excluded.
2. It is the responsibility of the owner of these fixtures to provide IAMS of adequate range, sensitivity, and pattern overlap (with other IAMS system fixtures) that assure public safety. The time interval to OFF is a discretionary IAMS setting (about 5 to 15 minutes) that should be determined with worker and public safety in mind.
3. The customer selects luminaires for changeover from HID to LED and assumes any and all liability that may be associated with that selection (esp. re adequacy of light).
4. If a customer takes this CPUC incentive it must be the only incentive. There is no double dipping among CPUC rebates or incentives that may be available for lighting.

**Application Requirements**

1. The new LED with IAMS measure must replace existing high pressure sodium (HPS) or pulse start metal halide (PSMH) lights that are mounted more than 24 feet above the ground at the same mounting height.
2. LED fixtures must be on the current Design Lights Consortium (DLC) Qualified Products List (QPL).
3. LED fixtures per CA Title 24 must be timeclocked or photocell controlled to assure dusk-to-dawn only operation.
4. The DLC QPL may not provide enough detail to determine if IAMS is available for the fixture(s) of choice, so it is the customer’s responsibility to verify with the fixture manufacturer that the IAMS option is available. For the dusk to dawn interval of operation the LED with IAMS must couple with the fixture’s dimmable driver and automatically dim to 35% of full power after its coverage area is vacated of occupants, and automatically return to full power when the area is occupied.
5. Fixtures are exclusively IAMS controlled. Interlinking of fixtures, by wireless or hard-wire means, is not part of this measure and is prohibited.
6. If a customer wants to “delamp”, i.e. drop to a lower wattage LED which is NOT comparable in light to the existing HID, the customer finds the HID-to-LED solution code that includes the range within which his desired LED wattage falls. Then, the customer applies for that incentive.

**Application Recommendations**

1. For any of these LED replacements, it is recommended the customer engage a qualified lighting contractor. This is particularly pertinent to Application Note 3 above and Application Requirement 6 above.
2. The luminaire wattage ranges for this workpaper were developed from raw source LEDs of approximately 94 lumens per watt (80 lumens per watt average maintained).
3. LED with IAMS fixtures have no color temperature requirements. An LED color temperature range of 4000K+/-350K CCT is suggested because a national consensus and preference has developed for this range over the last 5 years.
4. Fixture/enclosure type is recommended to be certified by NEMA/IEC as wet.
5. It is recommended the LED IAMS fixture including all of its electrical and mechanical components and the motion sensor be designed for operation in an ambient temperature range of -40 deg C (-40 deg F) to +50 deg C (+122 deg F) for outdoor applications.
6. It is recommended that customers whose light fixtures may experience accelerated corrosion due to coastal salt air environments specify marine finish and stainless steel fittings, fitters, and fasteners.
7. Successful operation of accurately selected, commissioned, and tuned current IAMS technology (predominantly infrared) may be expected in the 24’ to 40’ AFG range. Claims of successful operation at greater mounting heights should be verified by a field demonstration.

These measures are available in all exterior applications in all California climate zones.

## 1.2 Technical Description

The proposed measure cases, shown in Section 1 are based on an SCE Design & Engineering Services LED Assessment and a CLTC Exterior Occupancy Field Studies and Simulations Study [Attachments 2 & 3].

Note: The measure case ranges are based on LED fixture system (light engine + driver) connected wattages.

## 1.3 Installation Types and Delivery Mechanisms

The delivery mechanisms for these measures are:

* Financial Support / Down-Stream Incentive – Deemed
* Partnership / Down-Stream Incentive – Deemed
* Midstream Programs/Mid-Stream Incentive
* Financial Support –Direct Install
* Partnership –Direct Install

The program/install types are Replace on Burnout (ROB) and New Construction (NC) or NEW.

**Installation Type Descriptions**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Installation Type** | **Savings** | | **Life** | |
| 1st Baseline (BL) | 2nd BL | 1st BL | 2nd BL |
| Replace on Burnout (ROB) | Above Code or Standard | N/A | EUL | N/A |
| New Construction (NC) or NEW | Above Code or Standard | N/A | EUL | N/A |

A delivery mechanism is a delivery method paired with an incentive method. Delivery mechanisms are used by programs to obtain program participation and energy savings.

The **SCE Savings by Design Program** offers incentives on a wide variety of energy-saving design and technologies that encourages design teams and building owners/managers to integrate a higher level of energy efficiency for their new construction and major building renovation projects. As a way to streamline incentivizing energy efficient lighting technologies, SBD offers an “express” way to participate in this opportunity using deemed equipment measures.

**Delivery Method Descriptions**

|  |  |
| --- | --- |
| **Delivery Method** | **Description** |
| Financial Support | The program motivates customers, through financial incentives such as rebates or low interest loans, to implement energy efficient measures or projects. |
| Mid-Stream Programs | *See Mid-Stream Incentive in the Incentive Method Descriptions table.* |
| Partnership | The program implements projects through a partnership between the utility and an institutional, government, or community-based organization. |
| New Construction | The program offers financial incentives and/or design assistance to customers involved with new building construction. This is intended is to motivate customer to exceed Title 24 building energy efficiency requirements (residential or nonresidential). |

**Incentive Method Descriptions**

|  |  |
| --- | --- |
| **Incentive Method** | **Description** |
| Direct Install | The program implements energy efficiency measures for qualifying customers, at no cost to the customer. |
| Down-Stream Incentive | The customer installs qualifying energy efficient equipment and submits an incentive application to the utility program. Upon application approval, the utility program pays an incentive to the customer. Such an incentive may be deemed or customized. |
| Mid-Stream Incentive  Mid-Stream Buy Down | The program gives a financial incentive to a midstream market actor (distributor, vendor, or retailer) to encourage the promotion of efficient measures. Buy Down means that the incentive is required to be passed down to the end-use customer. |

## 1.4 Measure Parameters

### 1.4.1 DEER Data

DEER Difference Summary

|  |  |
| --- | --- |
| **DEER Item** | **Used for Workpaper?** |
| Modified DEER methodology | No |
| Scaled DEER measure | No |
| DEER Base Case | No |
| DEER Measure Case | No |
| DEER Building Types | Yes |
| DEER Operating Hours | Yes |
| DEER eQUEST Prototypes | No |
| DEER Version | N/A |
| Reason for Deviation from DEER | DEER does not contain this type of measure. |
| DEER Measure IDs Used | N/A |

**Net-to-Gross Ratio**

The NTG values were obtained using the DEER READI tool. The relevant NTG values for the measures in this work paper are in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **NTGR ID** | **Description** | **Sector** | **BldgType** | **Measure Delivery** | **NTGR** |
| All-Default<=2yrs | All other EEM with no evaluated NTGR; new technology in program for 2 or fewer years | All | Any | Any | 0.7 |

**Spillage Rate**

Spillage rates are not tracked in work papers; they are tracked in an external document which will be supplied to the Commission Staff.

**Installation Rate**

The IR values were obtained using the DEER READI tool. The relevant IR values for the measures in this work paper are in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **GSIA ID** | **Description** | **Sector** | **BldgType** | **ProgDelivID** | **GSIAValue** |
| Def-GSIA | Default GSIA values | Any | Any | Any | 1 |

**Effective and Remaining Useful Life**

The EUL and RUL values were obtained using the DEER READI tool. DEER defines the RUL as 1/3 of the EUL value. The RUL value is only applicable to the first baseline period for an RET measure with an applicable code baseline. The relevant EUL and RUL values for the measures in this work paper are in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **EUL ID** | **Description** | **Sector** | **UseCategory** | **EUL (Years)** | **RUL (Years)** |
| OILtg-Com-LED-50000hr | LED Fixture - Indoor- Commercial | Com | Lighting | 12 | N/A |

### 1.4.2 Codes and Standards Analysis

**Title 20:** These measures do not fall under Title 20 of the California Energy Regulations [493].

**Title 24:** This WP does not trigger requirements in the 2016 California Building Energy Efficiency Standards [496]. Title 24 Outdoor Lighting Requirements are specified in Section 140.7. Section 140.7 requires the actual outdoor lighting installed to meet the lighting power allowances shown in Table 140.7-A for the various Lighting Zones. Exceptions are also listed in Section 140.7. The relative light levels to meet Lighting Zone requirements are shown in Table 114-A, Title 24, Part 1, and Section 10-114.

The 2016 California Building Energy Efficiency Standards Title 24 [496] Outdoor Lighting Controls and Equipment are specified in Section 130.2.

Code Summary

|  |  |  |
| --- | --- | --- |
| **Code** | **Reference** | **Effective Dates** |
| Title 24 (2016) | Section 140.7 – Requirements for Outdoor Lighting | January 1, 2017 |

## 1.5 EM&V, Market Potential, and Other Studies – Base Case and Measure Case Information

### 1.5.1 ET11SCE1221 – Occupancy Sensor Coupled LED Lighting for Exterior Lots

The basis of this work paper is an SCE Design & Engineering Services Project ET11SCE1221 which included the measure presented in this work paper. SCE developed the LED design, directed procurement and installation, oversaw the commissioning and tuning of the IAMS, and designed and implemented the monitoring plan [Attachment 2]. A CLTC study, corroborative to the ET study is also attached [Attachment 3].

## 1.6 Data Quality and Future Data Needs

N/A

# Section 2. Calculation Methodology

This measure is based on the replacement of HID sourced fixtures with LED fixtures. Refer to table below for the base case HID fixture wattages.

The lighting demand difference, or *∆watts/unit*, shown in table below, is simply the difference between the electric demand of the base unit and the electric demand of the energy efficient measure unit.

*∆watts/unit = Base watts/unit – Energy Efficient watts/unit*

Off-Peak Demand Savings

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Solution Codes** | **Measure Description-LED connected range replacing HID connected/nominal Watts(W)** | **Base Case Demand (W-connected)** | **Proposed**  **Measure Case (W-connected)** | **Off-Peak Savings**  ***∆watts*** |
| LT-45412 | 50 to 90 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 150 Watt High Pressure Sodium | 188 | 90 | 98 |
| LT-33429 | 91 to 120 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 200 Watt High Pressure Sodium | 250 | 120 | 130 |
| LT-89769 | 121 to 150 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 250 Watt High Pressure Sodium | 295 | 150 | 145 |
| LT-62170 | 151 to 203 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 310 Watt High Pressure Sodium | 365 | 203 | 162 |
| LT-82363 | 204 to 275 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 400 Watt High Pressure Sodium | 465 | 275 | 190 |
| LT-59558 | 276 to 496 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 600 Watt High Pressure Sodium | 665 | 496 | 169 |
| LT-65209 | 497 to 607 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 750 Watt High Pressure Sodium | 840 | 607 | 233 |
| LT-28370 | 608 to 730 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 1000 Watt High Pressure Sodium | 1100 | 730 | 370 |
| LT-71476 | 45 to 67 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 150 Watt Pulse Start Metal Halide | 190 | 67 | 123 |
| LT-27397 | 68 to 90 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 175 Watt Pulse Start Metal Halide | 208 | 90 | 118 |
| LT-73969 | 91 to 113 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 200 Watt Pulse Start Metal Halide | 232 | 113 | 119 |
| LT-25659 | 114 to 123 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 250 Watt Pulse Start Metal Halide | 288 | 123 | 165 |
| LT-89014 | 124 to 161 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 320 Watt Pulse Start Metal Halide | 365 | 161 | 204 |
| LT-62026 | 162 to 194 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 350 Watt Pulse Start Metal Halide | 400 | 194 | 206 |
| LT-24181 | 195 to 226 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 400 Watt Pulse Start Metal Halide | 456 | 226 | 230 |
| LT-55256 | 227 to 254 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 450 Watt Pulse Start Metal Halide | 506 | 254 | 252 |
| LT-30938 | 255 to 325 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 575 Watt Pulse Start Metal Halide | 640 | 325 | 315 |
| LT-56180 | 326 to 440 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 750 Watt Pulse Start Metal Halide | 818 | 440 | 378 |
| LT-19782 | 441 to 517 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 875 Watt Pulse Start Metal Halide | 950 | 517 | 433 |
| LT-19121 | 518 to 643 Watt Exterior Fixture with Motion Control and Photo Sensor LED replacing 1000 Watt Pulse Start Metal Halide | 1080 | 643 | 437 |

The basis for the HID (comparable light to HPS and PSMH) to LED replacement wattages is in the attachment [Attachment 4]. The LED wattage ranges are developed to approximate HID light levels +/- 15% lumens. It develops an application approach based on engineering judgment and uses relative average raw source efficacies, typical and estimated fixture and light-to-target efficiencies to pick appropriate comparable LED light levels and comparable wattages. Using the *∆watts/unit* and the annual operating hours, the annual electric kWh savings can be calculated. The operating hours are 4,100 hours per year for dusk-to-dawn operation per “2017ExteriorLEDFixturesDisposition-Revised2June2017-FINAL” disposition [Attachment 7].

The following example calculates the annual electric kWh savings for the “LED with IAMS of 50-90 W Replacing 150W nominal HPS ” (based on dimming to 35% power half of the 4100 hours dusk-dawn (i.e. 2190 hours), and the remainder of the night (2050 hours) at 100% power) measure:

**Fixed (full power) plus Part Load (dimmed) Savings**







The measure average connected loads under the dimming condition (35% power half of the 4,100 hours dusk-dawn (i.e. 2050 hours) and the remainder of the night (2050 hours) at 100% power) are shown in the attachment [Attachment 5]. The dimming condition (dimmed level and time at that level) was chosen by engineering judgment and field experience supported by Attachments 2 and 3. CA Title 24 Section 130.2 (c) 3. B. further supports the 35% of full power dimming level of this WP by setting a max/min dimming range of 20% to 60% of full power for lights mounted 24 feet or less above the ground. The same technique, including the additional savings due to the IAMS, can be used for the remainder of the measures to yield the annual electric savings.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Solution Code** | **Base Source** | **Demand (W)** | **Measure Source** | **Demand (W)** | **Savings** |
| LT-45412 | HPS | 188 | LED | 90 | 521.73 |
| LT-33429 | HPS | 250 | LED | 120 | 692.90 |
| LT-89769 | HPS | 295 | LED | 150 | 794.38 |
| LT-62170 | HPS | 365 | LED | 203 | 934.70 |
| LT-82363 | HPS | 465 | LED | 275 | 1145.44 |
| LT-59558 | HPS | 665 | LED | 496 | 1353.82 |
| LT-65209 | HPS | 840 | LED | 607 | 1764.13 |
| LT-28370 | HPS | 1100 | LED | 730 | 2489.73 |
| LT-71476 | PSMH | 190 | LED | 67 | 593.58 |
| LT-27397 | PSMH | 208 | LED | 90 | 603.73 |
| LT-73969 | PSMH | 232 | LED | 113 | 638.47 |
| LT-25659 | PSMH | 288 | LED | 123 | 840.40 |
| LT-89014 | PSMH | 365 | LED | 161 | 1050.93 |
| LT-62026 | PSMH | 400 | LED | 194 | 1103.11 |
| LT-24181 | PSMH | 456 | LED | 226 | 1244.15 |
| LT-55256 | PSMH | 506 | LED | 254 | 1371.66 |
| LT-30938 | PSMH | 640 | LED | 325 | 1724.56 |
| LT-56180 | PSMH | 818 | LED | 440 | 2136.10 |
| LT-19782 | PSMH | 950 | LED | 517 | 2464.20 |
| LT-19121 | PSMH | 1080 | LED | 643 | 2648.50 |

Demand reduction for these measures is reported as zero since exterior fixtures controlled by photocells or timeclocks do not operating during current DEER peak periods.

Savings for all measures in different climate zones can be found in the attachment [Attachment 1].

# Section 3. Load Shapes

The ideal load shape for net benefits estimates would represent the difference between the base case and measure case. The closest load shapes that are applicable to the measures in this work paper are listed in the table below.

Building Types and Load Shapes

|  |  |  |
| --- | --- | --- |
| **Building Type** | **Load Shape** | **E3 Alternate Building Type** |
| Assembly | Outdoor Lt | Misc.\_Commercial |
| Education - Community College | Outdoor Lt | Misc.\_Commercial |
| Education - Primary School | Outdoor Lt | Misc.\_Commercial |
| Education - Relocatable Classroom | Outdoor Lt | Misc.\_Commercial |
| Education - Secondary School | Outdoor Lt | Misc.\_Commercial |
| Education - University | Outdoor Lt | Misc.\_Commercial |
| Grocery | Outdoor Lt | Misc.\_Commercial |
| Lodging - Guest Rooms | Outdoor Lt | Misc.\_Commercial |
| Health/Medical - Hospital | Outdoor Lt | Misc.\_Commercial |
| Lodging - Hotel | Outdoor Lt | Misc.\_Commercial |
| Manufacturing - Bio/Tech | Outdoor Lt | Misc.\_Commercial |
| Manufacturing - Light Industrial | Outdoor Lt | Misc.\_Commercial |
| Lodging - Motel | Outdoor Lt | Misc.\_Commercial |
| Health/Medical - Nursing Home | Outdoor Lt | Misc.\_Commercial |
| Office - Large | Outdoor Lt | Misc.\_Commercial |
| Office - Small | Outdoor Lt | Misc.\_Commercial |
| Restaurant - Fast-Food | Outdoor Lt | Misc.\_Commercial |
| Restaurant - Sit-Down | Outdoor Lt | Misc.\_Commercial |
| Retail - Multistory Large | Outdoor Lt | Misc.\_Commercial |
| Retail - Single-Story Large | Outdoor Lt | Misc.\_Commercial |
| Retail - Small | Outdoor Lt | Misc.\_Commercial |
| Storage - Conditioned | Outdoor Lt | Misc.\_Commercial |
| Storage - Unconditioned | Outdoor Lt | Misc.\_Commercial |
| Warehouse - Refrigerated | Outdoor Lt | Misc.\_Commercial |

# Section 4. Costs

## 4.1 Base Case Cost

Base costs come from multiple online retail sources from a search conducted in December 2016, all compiled in the cost attachment [Attachment 6]. Labor rates are based on RS Means 2016 [503] costs for installation of a 110 watt LED wall mounted fixture. Some of the less common fixture wattages are assumed to have costs that are equivalent to fixtures of similar wattages, which is common for HID fixtures.

Table below shows base case material costs. Details for the fixtures based on comparable HID to LED performance are also attached [Attachment 6].

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Solution Code** | **Base Source** | **Base Wattage – Connected/Nominal** | **Base Material Cost** | **Base Labor** | **Total Base Cost** |
| LT-45412 | HPS | 188/150 | $255.53 | $44.00 | $299.53 |
| LT-33429 | HPS | 250/200 | $350.27 | $44.00 | $394.27 |
| LT-89769 | HPS | 295/250 | $350.27 | $44.00 | $394.27 |
| LT-62170 | HPS | 365/310 | $389.53 | $44.00 | $433.53 |
| LT-82363 | HPS | 465/400 | $389.53 | $44.00 | $433.53 |
| LT-59558 | HPS | 6665/600 | $620.52 | $44.00 | $664.52 |
| LT-65209 | HPS | 840/750 | $620.52 | $44.00 | $664.52 |
| LT-28370 | HPS | 1100/1000 | $620.52 | $44.00 | $664.52 |
| LT-71476 | PSMH | 190/150 | $257.19 | $44.00 | $301.19 |
| LT-27397 | PSMH | 208/175 | $257.19 | $44.00 | $301.19 |
| LT-73969 | PSMH | 200/232 | $390.03 | $44.00 | $434.03 |
| LT-25659 | PSMH | 288/250 | $390.03 | $44.00 | $434.03 |
| LT-89014 | PSMH | 365/320 | $400.09 | $44.00 | $444.09 |
| LT-62026 | PSMH | 400/350 | $417.90 | $44.00 | $461.90 |
| LT-24181 | PSMH | 456/400 | $417.90 | $44.00 | $461.90 |
| LT-55256 | PSMH | 506/450 | $725.38 | $44.00 | $769.38 |
| LT-30938 | PSMH | 640/575 | $725.38 | $44.00 | $769.38 |
| LT-56180 | PSMH | 818/750 | $725.38 | $44.00 | $769.38 |
| LT-19782 | PSMH | 950/875 | $725.38 | $44.00 | $769.38 |
| LT-19121 | PSMH | 1080/1000 | $725.38 | $44.00 | $769.38 |

## 4.2 Measure Case Cost

Measure costs come from multiple online retail sources from a search conducted in December 2016, all compiled in the cost attachment [Attachment 6]. Labor rates are based on RS Means 2016 [503] costs for installation of a 110 watt LED wall mounted fixture.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Solution Code** | **Source** | **Measure Wattage** | **Measure Material Cost** | **Measure Labor** | **Total Measure Cost** |
| LT-45412 | LED | 90 | $532.02 | $44.00 | $576.02 |
| LT-33429 | LED | 120 | $750.31 | $44.00 | $794.31 |
| LT-89769 | LED | 150 | $696.40 | $44.00 | $740.40 |
| LT-62170 | LED | 203 | $940.35 | $44.00 | $984.35 |
| LT-82363 | LED | 275 | $1,014.60 | $44.00 | $1,058.60 |
| LT-59558 | LED | 496 | $1,814.38 | $44.00 | $1,858.38 |
| LT-65209 | LED | 607 | $1,882.51 | $44.00 | $1,926.51 |
| LT-28370 | LED | 730 | $1,986.97 | $44.00 | $2,030.97 |
| LT-71476 | LED | 67 | $493.47 | $44.00 | $537.47 |
| LT-27397 | LED | 90 | $466.99 | $44.00 | $510.99 |
| LT-73969 | LED | 113 | $789.45 | $44.00 | $833.45 |
| LT-25659 | LED | 123 | $663.83 | $44.00 | $707.83 |
| LT-89014 | LED | 161 | $850.94 | $44.00 | $894.94 |
| LT-62026 | LED | 194 | $1,080.18 | $44.00 | $1,124.18 |
| LT-24181 | LED | 226 | $806.11 | $44.00 | $850.11 |
| LT-55256 | LED | 254 | $1,591.84 | $44.00 | $1,635.84 |
| LT-30938 | LED | 325 | $1,591.84 | $44.00 | $1,635.84 |
| LT-56180 | LED | 440 | $1,837.09 | $44.00 | $1,881.09 |
| LT-19782 | LED | 517 | $1,882.51 | $44.00 | $1,926.51 |
| LT-19121 | LED | 643 | $1,986.97 | $44.00 | $2,030.97 |

## 4.3 Full and Incremental Measure Cost

**Full and Incremental Measure Cost Equations**

|  |  |  |  |
| --- | --- | --- | --- |
| **Installation Type** | **Incremental Measure Cost** | **Full Measure Cost** | |
| **1st Baseline** | **2nd Baseline** |
| ROB | (MEC + MLC) – (BEC + BLC) | (MEC + MLC) – (BEC + BLC) | N/A |
| NEW/NC |

MEC = Measure Equipment Cost; MLC = Measure Labor Cost

BEC = Base Case Equipment Cost; BLC = Base Case Labor Cost

**Full and Incremental Costs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure** | **Installation Type** | **Incremental Measure Cost** | **Full Measure Cost** | |
| **1st Baseline** | **2nd Baseline** |
| LT-45412 | ROB | $ 276.50 | $ 276.50 | N/A |
| LT-33429 | ROB | $ 400.04 | $ 400.04 | N/A |
| LT-89769 | ROB | $ 346.13 | $ 346.13 | N/A |
| LT-62170 | ROB | $ 550.83 | $ 550.83 | N/A |
| LT-82363 | ROB | $ 625.07 | $ 625.07 | N/A |
| LT-59558 | ROB | $ 1,193.86 | $ 1,193.86 | N/A |
| LT-65209 | ROB | $ 1,261.99 | $ 1,261.99 | N/A |
| LT-28370 | ROB | $ 1,366.45 | $ 1,366.45 | N/A |
| LT-71476 | ROB | $ 236.28 | $ 236.28 | N/A |
| LT-27397 | ROB | $ 209.80 | $ 209.80 | N/A |
| LT-73969 | ROB | $ 399.42 | $ 399.42 | N/A |
| LT-25659 | ROB | $ 273.79 | $ 273.79 | N/A |
| LT-89014 | ROB | $ 450.85 | $ 450.85 | N/A |
| LT-62026 | ROB | $ 662.28 | $ 662.28 | N/A |
| LT-24181 | ROB | $ 388.21 | $ 388.21 | N/A |
| LT-55256 | ROB | $ 866.46 | $ 866.46 | N/A |
| LT-30938 | ROB | $ 866.46 | $ 866.46 | N/A |
| LT-56180 | ROB | $ 1,111.71 | $ 1,111.71 | N/A |
| LT-19782 | ROB | $ 1,157.13 | $ 1,157.13 | N/A |
| LT-19121 | ROB | $ 1,261.58 | $ 1,261.58 | N/A |

# Attachments

1. A1 SCE17LG114.1 – Calculation Template\_Final.xlsm
2. A2 WED 1030am NGraeber.pdf
3. A3 ET11SCE1220\_21\_LED Coldcase Exterior Lighting.pdf
4. A4 Comparable Light Estimate.xlsx
5. A5 Backup Calcs.xlsx
6. A6 SCE17LG114.1 Costs.xlsx
7. A7 2017ExteriorLEDFixturesDisposition-Revised2June2017-FINAL

# References



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