Work Paper SCE13LG020

**Revision 2**

**Southern California Edison**

**Wall Mounted Occupancy Sensors – Multifamily**

**For Work Paper Reviewer Use Only**

**List all major comments that occurred during the review. This table may only be removed during management review.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Major Comment** | **Reviewer Name** | **Date** | **Outcome/Resolution** |
| E.g. Please remove measure LT-12345 (LD123) from this work paper because it is no longer eligible for incentives. | Reviewer 1 | 6/1/15 | E.g. Comment incorporated. LT-12345 was removed. |
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# At-a-Glance Summary

|  |  |
| --- | --- |
| **Measure Codes** | LT-78685, LT-60934 |
| **Measure Description** | Wall-mounted occupancy sensor controlling a lighting system in a mobile home or multi-family building |
| **Base Case Description** | Lighting system without automated controls. |
| **Units** | Sensor |
| **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** | ILtg-OccSens: 8 years |
| **Measure Installation Type** | Retrofit Add-on (REA) |
| **Net-to-Gross Ratio** | Res-Default>2: 0.55  Res-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 | 4/25/12 | Andres Fergadiotti (SCE) | Updated to 2013-14 work paper template. |
| 1 | 4/15/14 | Siobhan McCabe (TRC Energy Services) | * Updated work paper template. * Updated calculation template to modify occupancy sensor and interactive effects factors. |
| 6/16/14 | Jason Wang (SCE) | * Work paper updated for reporting period, effective 7/1/14 – 12/31/14. * Non-res savings updated for ED disposition |
| 2 | 9/29/15 | Jason Wang (SCE) | * Updated for DEER2016 HOU and CDF: residential common area hours changed to 4,340 hours/year * Removed unused measures: LT-60778, LT-79435, LT-44912, LT-50932 * Added WO017 occupancy sensor costs * Revised the measure wattage for Dwelling area lighting * Removed “Hospitality” from the work paper name |

# Commission Staff and Cal TF Comments

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Rev** | **Party** | **Submittal Date** | **Comment Date** | **Comments** | **WP Developer Response** |
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Cal TF website: <http://www.caltf.org/>

# Section 1. General Measure & Baseline Data

## 1.1 Measure Description & Background

**Base, Standard, and Measure Cases**

|  |  |
| --- | --- |
| **Case** | **Description of Typical Scenario** |
| Measure | Lighting system with wall-mounted occupancy sensor |
| Existing Condition | Lighting system without controls |
| Code/Standard | Lighting system with occupancy sensor or high efficacy fixtures |
| Industry Standard Practice | N/A |

Measures and Codes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Measure Codes** | | | | **Measure Name** | **Area Description** |
| SCG | SDG&E | SCE | PG&E |
|  |  | LT-78685 |  | Occupancy Sensor (Res Common Area) Control | Laundry Rooms, Clubhouses, etc. |
|  |  | LT-60934 |  | Occupancy Sensor (Res Dwelling Area) Control | Average of Living and Bathroom |

**Eligibility Requirements**

* Only wall-mounted sensors are eligible. Ceiling-mounted sensors and integrated sensors in fixtures are not eligible.
* There may be additional eligibility requirements based upon contractual agreements with entities receiving incentives as part of this program.

**Implementation Requirements**

* This measure is approved for installation in bathroom and common areas of Residential Multi-family and Mobile Home - Double-Wide buildings.
* All SCE climate zones are eligible.

**Documentation Requirements**

The programs offering the measures in this work paper may require submitted paid invoices for approval.

## 1.2 Technical Description

A lighting occupancy sensor is a device that automatically turns lights on when a person enters into a room, and turns lights off when a specified period of time has passed after an area is vacated. Energy savings are achieved by reducing the typical run time of the lights.

## 1.3 Installation Types and Delivery Mechanisms

The measures will be offered through the Multifamily Energy Efficiency Rebate Program and the Comprehensive Manufactured Home Program.

The delivery mechanism is Financial Support - Direct Install.

The install type is Retrofit Add-on (REA).

**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 (NEW/NC) | Above Code or Standard | N/A | EUL | N/A |
| Retrofit or Early Replacement (RET/ER) | Above Customer Existing | Above Code or Standard | RUL | EUL-RUL |
| Retrofit First Baseline Only (REF) | Above Customer Existing | N/A | EUL | N/A |
| Retrofit Add-on (REA) | Above Customer Existing | 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.

**Delivery Method Descriptions**

|  |  |
| --- | --- |
| **Delivery Method** | **Description** |
| Appliance Turn-in and Recycling | The program motivates customers, through financial incentives, to recycle appliances that are functional but inefficient. This prevents the continued use of those appliances, by both the current owner and potential future owners. |
| Audit - Information - Testing Services | The program performs a free assessment of a customer’s facility and provides the customer with information and guidance on energy efficiency opportunities. |
| 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. |
| Up-Stream Programs | *See Up-Stream Incentive in the Incentive Method Descriptions table.* |

**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. |
| Exchange - Replacement | The utility program holds events where customers can trade functional equipment for similar but more energy efficient equipment, free of charge. |
| Giveaway | The program provides customers with energy efficiency equipment or services for free. |
| 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. |
| On-bill Finance – Loan (OBF) | The program offers financing for the cost of an efficient measure as part of the utility bill. This can be an add-on option to an existing program or can serve as an organizing principle for its own program. |
| Up-Stream Incentive  Up-Stream Buy Down | The program gives a financial incentive to an upstream market actor (manufacturer or distributor) to encourage the manufacture, provision, or distribution 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 | DEER 2016, READI v2.3.0 |
| Reason for Deviation from DEER | DEER does not have residential occupancy sensor measures. |
| 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** |
| Res-Default>2 | All other EEM with no evaluated NTGR; existing EEM with same delivery mechanism for more than 2 years | Res | Any | Any | 0.55 |
| Res-Default-HTR-di | All other EEM with no evaluated NTGR; direct install hard-to-reach only. | Res | Any | DirInstall | 0.85 |

Note: Direct install measures that are not hard-to-reach will use the default NTG value.

This work paper includes measures that are offered via direct install activities into hard-to-reach (HTR) customer homes. “Final Resolution E-4700”, dated December 18, 2014, defines specific criteria to classify customer homes as HTR. The “Required Corrections to Measure Level Input Parameters Identified by Commission Staff per D.14-10-046 Order Paragraph 16”, dated November 3, 2014, includes additional clarification for the geographic criteria.

SCE’s Multi-Family Energy Efficiency Rebate (MFEER) program addresses the ongoing concern with “split incentives”, where the residents are not the owners of the property, so they lack incentive to improve their energy usage. Similarly, the property owners do not live on-site and pay higher utility expenses due to inefficient appliances, thus lack any incentive to upgrade. The MFEER is designed to drive this customer segment toward participation by offering property owners a variety of energy efficiency measures and services. The MFEER program will offer and track measure installations in both common and dwelling areas of multifamily complexes and common areas of mobile home parks and condominiums. Measures offered via direct install activities in both common and dwelling areas of multifamily complexes and common areas of mobile home parks and condominiums will receive the HTR NTG. Other measures in the MFEER program will receive default NTG (NTGR\_ID: Res-Default>2), unless otherwise specified in DEER.

**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.

For REA measures, the EUL is typically 1/3 of the EUL of the equipment being modified because the add-on is also removed when the equipment fails. In this case the equipment would be a linear fluorescent or CFL fixture, and the add-on is the occupancy sensor. However, since the occupancy sensors described in this work paper are not integrated into lighting fixtures, they are typically not removed when a lamp and/or ballast fails; the lamp and/or ballast is simply replaced. Therefore, the full EUL of an occupancy sensor is used for this work paper. The RUL is not used for REA measures.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **EUL ID** | **Description** | **Sector** | **UseCategory** | **EUL (Years)** | **RUL (Years)** |
| ILtg-OccSens | Occupancy Sensors | Com | HVAC | 8 | N/A |

### 1.4.2 Codes and Standards Analysis

The measures in this work paper are not affected by the California Appliance Efficiency Regulations – Title 20 (2015) [493].

**Title 24 (2013) [355]**

Section 150.0(k) Residential Lighting (see excerpt below) requires high efficacy fixtures in bathrooms, laundry rooms, utility rooms, and garages. Occupancy or vacancy sensors are optional for bathrooms but required for laundry rooms, garages and utility rooms. Other areas, including multi-family common areas, have the option of installing either high efficacy fixtures or controls. Since the measures in this work paper are Retrofit Add-on, they are not affected by this code.

|  |
| --- |
| **Section 150.0(k) Residential Lighting**  **5. Lighting in Bathrooms.** Lighting installed in bathrooms shall meet the following requirements:   1. A minimum of one high efficacy luminaire shall be installed in each bathroom; and 2. All other lighting installed in each bathroom shall be high efficacy or controlled by vacancy sensors.   **6. Lighting in Garages, Laundry Rooms, and Utility Rooms.** Lighting installed in attached and detached garages, laundry rooms, and utility rooms shall be high efficacy luminaires and controlled by vacancy sensors.  **7. Lighting other than in Kitchens, Bathrooms, Garages, Laundry Rooms, and Utility Rooms.** Lighting installed in rooms or areas other than in kitchens, bathrooms, garages, laundry rooms, and utility rooms shall be high efficacy, or shall be controlled by either dimmers or vacancy sensors.  **EXCEPTION 1 to Section 150.0(k)7:** Luminaires in closets less than 70 square feet.  **EXCEPTION 2 to Section 150.0(k)7:** Lighting in detached storage buildings less than 1,000 square feet located on a residential site.  **12. Interior Common Areas of Low-rise Multi-Family Residential Buildings.**   1. In a low-rise multifamily residential building where the total interior common area in a single building equals 20 percent or less of the floor area, permanently installed lighting for the interior common areas in that building shall be high efficacy luminaires or controlled by an occupant sensor. 2. In a low-rise multifamily residential building where the total interior common area in a single building equals more than 20 percent of the floor area, permanently installed lighting in that building shall: 3. Comply with the applicable requirements in Sections 110.9, 130.0, 130.1, 140.6 and 141.0; and 4. Lighting installed in corridors and stairwells shall be controlled by occupant sensors that reduce the lighting power in each space by at least 50 percent. The occupant sensors shall be capable of turning the light fully On and Off from all designed paths of ingress and egress. |

This workpaper assumes that all base case lighting fixtures are either linear fluorescent or compact fluorescent, both of which classify as high efficacy lighting.

Code Summary

|  |  |  |
| --- | --- | --- |
| **Code** | **Reference** | **Effective Dates** |
| Title 24 (2013) | §150.0(k)5,6,7,12 | July 1, 2014 |

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

No studies were used to develop this work paper.

## 1.6 Data Quality and Future Data Needs

No future data needs are anticipated.

# Section 2. Calculation Methodology

**Controlled Wattage Assumptions**

* For common areas, it is assumed that the occupancy sensor controls four linear fluorescent T8 fixtures.
* For bathrooms, it is assumed that the occupancy sensor controls a vanity fixture and a ceiling fan lighting fixture.
* Dwelling area is the average of the common and bathroom areas.

The fixture code, type, wattage, and total controlled wattages are shown in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Fixture Code\*** | **Location** | **Number of Controlled Fixtures** | **Fixture Type\*** | **Fixture Wattage (W)\*** | **Total Controlled Wattage (W)** |
| F42ILL-R | Common Area | 4 | 2-lamp, 48”, 32-Watt T8 | 52 | **208** |
|  |  |  |  |  |  |
| CFQ13/1 | Bathroom: Vanity Fixture | 4 | 1-lamp, 13-Watt, quad, compact fluorescent\*\* | 17 | 113 |
| CFQ18/2 | Bathroom: Ceiling Fan | 1 | 2-lamp, 18-Watt, quad, compact fluorescent | 45 |
|  |  |  |  |  |  |
| N/A | Dwelling Area | N/A | Average of Common Area with Bathroom Area | N/A | **160.5** |

\*Obtained from Appendix B Table of Standard Fixture Wattages [382].

\*\*The vanity fixture would have used the wattage of a 4-lamp, 13-Watt CFL fixture, but this fixture type was not in Appendix B.

**Occupancy Sensor Percentage Time Off (PTO)**

DEER 2005 [26] provides assumptions for how operating hours are affected by occupancy sensors. The following table and equation show how the DEER assumptions were used to determine the PTO value for this work paper.

DEER Occupancy Sensor Measure Assumptions

|  |  |
| --- | --- |
| **Scenario** | **Annual Hours of Operation** |
| Normal building hours of operation (60 hours/week, 50 weeks/year) | 3000 |
| **Base case:** Occupants manually switch off the lighting 15% of the time | 2550 |
| **Measure Case:** Occupancy sensors switch off lighting 1050 hours/year | 1950 |

The PTO is calculated as follows:

**Energy Savings and Demand Reduction Calculation Example**

The energy savings were calculated as shown in the following example for the Residential Common Area measure, Multi-family building type, climate zone 6:

The demand reduction is calculated as follows:

Complete calculations are in 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** |
| Residential Mobile Home - Double-Wide | Occupancy Sensor | Misc.\_Commercial |
| Residential Multi-family | Occupancy Sensor | Misc.\_Commercial |

# Section 4. Costs

Material and labor costs are from WO017. Material costs vary by the area (sq ft) covered by the occupancy sensor. For both measures it is assumed that the coverage area is 500 sq ft.

## 4.1 Base Case Cost

For REA measures, the base case cost is $0.

## 4.2 Measure Case Cost

Using the WO017 cost model, the equipment cost for an occupancy sensor covering 500 sq ft is $140.45. The labor required is 1.19 install hours at a rate of $71.25/hr, totaling $85.12. Miscellaneous costs of $6.73 are added to the labor cost for a final labor cost of $91.85. The full material and labor cost is $232.30.

## 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 |
| RET/ER | (MEC + MLC) – (BEC + BLC) | MEC + MLC | (MEC + MLC) – (BEC + BLC) |
| REF | (MEC + MLC) – (BEC + BLC) | MEC + MLC | N/A |
| REA | MEC + MLC | MEC + MLC | N/A |

MEC = Measure Equipment Cost; MLC = Measure Labor Cost

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

For REA, the incremental cost is the full measure cost of $232.30.

**Full and Incremental Costs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Measure** | **Installation Type** | **Incremental Measure Cost** | **Full Measure Cost** | |
| **1st Baseline** | **2nd Baseline** |
| Occupancy Sensor (Res Common Area) Control | REA | $232.30 | $232.30 | N/A |
| Occupancy Sensor (Res Dwelling Area) Control | REA | $232.30 | $232.30 | N/A |

# Attachments

1. 

1. 

# References



[26]

[355]

[382]

[493]