### Occupancy Sensor Lighting Controls

###### Description

This measure relates to the installation of new occupancy sensors on a new or existing lighting system. Lighting control types covered by this measure include wall, ceiling or fixture mounted occupancy sensors. Passive infrared, ultrasonic detectors and fixture-mounted sensors or sensors with a combination thereof are eligible. Lighting controls required by state energy codes are not eligible. This must be a new installation and may not replace an existing lighting occupancy sensor control.

This measure was developed to be applicable to the following program types: RF.

If applied to other program types, the measure savings should be verified.

###### Definition of Efficient Equipment

In order for this characterization to apply, the existing system is assumed to be manually controlled or an uncontrolled lighting system which is being controlled by one of the lighting controls systems listed above. This measure is intended for controlling interior lighting only.

A subset of occupancy sensors are those that are programmed as “vacancy” sensors. To qualify as a vacancy sensor, the control must be configured such that manual input is required to turn on the controlled lighting and the control automatically turns the lighting off. Additional savings are achieved compared to standard occupancy sensors because lighting does not automatically turn on and occupants may decide to not turn it on. Note that vacancy sensors are not a viable option for many applications where standard occupancy sensors should be used instead.

###### Definition of Baseline Equipment

The baseline is assumed to be a lighting system uncontrolled by occupancy.

###### Deemed Lifetime of Efficient Equipment

The expected measure life for all lighting controls is assumed to be 8 years[[1]](#footnote-1).

###### Deemed Measure Cost

When available, the actual cost of the measure shall be used. When not available, the following default values are provided:

|  |  |
| --- | --- |
| **Lighting control type** | **Cost**[[2]](#footnote-2) |
| Full cost of wall mounted occupancy sensor | $51 |
| Full cost of ceiling or remote mounted occupancy sensor | $102 |
| Full cost of fixture-mounted occupancy sensor | $91.83 |
| Full cost of fixture embedded occupancy sensor**[[3]](#footnote-6)** | $54 |

###### Loadshape

|  |
| --- |
| Loadshape C06 - Commercial Indoor Lighting |
| Loadshape C07 - Grocery/Conv. Store Indoor Lighting |
| Loadshape C08 - Hospital Indoor Lighting |
| Loadshape C09 - Office Indoor Lighting |
| Loadshape C10 - Restaurant Indoor Lighting |
| Loadshape C11 - Retail Indoor Lighting |
| Loadshape C12 - Warehouse Indoor Lighting |
| Loadshape C13 - K-12 School Indoor Lighting |
| Loadshape C14 - Indust. 1-shift (8/5) (e.g., comp. air, lights) |
| Loadshape C15 - Indust. 2-shift (16/5) (e.g., comp. air, lights) |
| Loadshape C16 - Indust. 3-shift (24/5) (e.g., comp. air, lights) |
| Loadshape C17 - Indust. 4-shift (24/7) (e.g., comp. air, lights) |
| Loadshape C18 - Industrial Indoor Lighting |
| Loadshape C19 - Industrial Outdoor Lighting |
| Loadshape C20 - Commercial Outdoor Lighting |

###### Coincidence Factor

The summer peak coincidence factor for this measure is dependent on location.

**Algorithm**

###### Calculation of Savings

###### Electric Energy Savings

ΔkWh = KWControlled\* Hours \* ESF \* WHFe

Where:

KwControlled = Total lighting load connected to the control in kilowatts. Savings is per control. The total connected load per control should be collected from the customer or the default values presented below used;

| Lighting Control Type | Default kw controlled[[4]](#footnote-7) |
| --- | --- |
| Wall mounted occupancy sensor (per control) | 0.305 |
| Remote mounted occupancy sensor (per control) | 0.517 |
| Fixture mounted sensor (per fixture) | 0.180 |

Hours = total operating hours of the controlled lighting circuit before the lighting controls are installed. This number should be collected from the customer. Average hours of use per year are provided in the Reference Table in Section 4.5, Fixture annual operating hours, for each building type if customer specific information is not collected. If unknown buidling type, use the Miscellaneous value.

ESF = Energy Savings factor (represents the percentage reduction to the operating Hours from the non-controlled baseline lighting system).

|  |  |
| --- | --- |
| **Lighting Control Type** | **Energy Savings Factor[[5]](#footnote-11)** |
| Wall or Ceiling-Mounted Occupancy Sensors | 24% |
| Fixture Mounted Occupancy Sensors | 24% |
| Wall-Mounted Occupancy Sensors Configured as “Vacancy Sensors” | 31%[[6]](#footnote-12) |

WHFe = Waste heat factor for energy to account for cooling energy savings from efficient lighting is provided in the Reference Table in Section 4.5 for each building type. If building is un-cooled, the value is 1.0.

###### Heating Penalty

If electrically heated building:

ΔkWhheatpenalty[[7]](#footnote-13) = KWControlled\* Hours \* ESF \* -IFkWh

Where:

IFkWh = Lighting-HVAC Interation Factor for electric heating impacts; this factor represents the increased electric space heating requirements due to the reduction of waste heat rejected by the efficent lighting. Values are provided in the Reference Table in Section 4.5. If unknown, use the Miscellaneous value.

###### Summer Coincident Peak Demand Savings

ΔkW = KWcontrolled  \* WHFd \* (CFbaseline – CFos)

Where:

WHFd = Waste Heat Factor for Demand to account for cooling savings from efficient lighting in cooled buildings is provided in the Reference Table in Section 4.5. If the building is un-cooled WHFd is 1.

CFbaseline = Baseline Summer Peak Coincidence Factor for the lighting system without Occupancy Sensors installed selected from the Reference Table in Section 4.5 for each building type. If the building type is unknown, use the Miscellaneous value of 0.66

CFos = Retrofit Summer Peak Coincidence Factor the lighting system with Occupancy Sensors installed is 0.15 regardless of building type.[[8]](#footnote-14)

###### Natural Gas Energy Savings

Δtherms = KWControlled\* Hours \* ESF \* - IFTherms

Where:

IFTherms = Lighting-HVAC Integration Factor for gas heating impacts; this factor represents the increased gas space heating requirements due to the reduction of waste heat rejected by the efficient lighting and provided in the Reference Table in Section 4.5 by buidling type.

###### Water Impact Descriptions and Calculation

N/A

###### Deemed O&M Cost Adjustment Calculation

N/A

**Measure Code: CI-LTG-OSLC-V03-150601**

1. DEER 2008 [↑](#footnote-ref-1)
2. Taken from NEEP Commercial Lighting Controls, Incremental Cost Data Analysis, 2011 “NEEP Commercial Lighting Controls 2011\_08\_29.xlsx” [↑](#footnote-ref-2)
3. Taken from NEEP Commercial Lighting Controls, Incremental Cost Data Analysis, 2011 “NEEP Commercial Lighting Controls 2011\_08\_29.xlsx” Taken from NEEP Commercial Lighting Controls, Incremental Cost Data Analysis, 2011 “NEEP Commercial Lighting Controls 2011\_08\_29.xlsx”Taken from NEEP Commercial Lighting Controls, Incremental Cost Data Analysis, 2011 and average of fixture-mounted sensor costs provided “NEEP Commercial Lighting Controls 2011\_08\_29.xlsx” Fixture embedded Occupancy Sensors are included with the fixture and therefore no additional installation costs are incurred for these sensors. Therefore, it is assumed that the costs associated with Fixture-embedded Occupancy Sensors should not surpass those of the wall mounted due to the similarity in installation. [↑](#footnote-ref-6)
4. Based on EVT control data for Occupancy Sensor Costs 2009-2014. [↑](#footnote-ref-7)
5. Lawrence Berkeley National Laboratory. *A Meta-Analysis of Energy Savings from Lighting Controls in Commercial Buildings.* Page & Associates Inc. 2011 [↑](#footnote-ref-11)
6. Papamichael, Konstantions, Bi-Level Switching in Office Spaces, California Lighting Technology Center, February 1,2010. Note: See Figure 8 on page 10 for relevant study results. The study shows a 30% extra savings above a typical occupancy sensor; 24% \* 1.3 = 31%.. [↑](#footnote-ref-12)
7. Negative value because this is an increase in heating consumption due to the efficient lighting. [↑](#footnote-ref-13)
8. Coincidence Factor Study Residential and Commercial Industrial Lighting Measures, RLW Analytics, Spring 2007. Note, the connected load used in the calculation of the CF for occupancy sensor lights includes the average ESF. [↑](#footnote-ref-14)