4.5.13 Occupancy Controlled Bi-Level Lighting Fixtures

**Description**

This measure relates to replacing existing uncontrolled continuous lighting fixtures with new bi-level lighting fixtures. This measure can only relate to replacement in an existing building, since multi-level switching is required in the Commercial new construction building energy code (IECC 2012/2015).

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 efficient system is assumed to be an occupancy controlled lighting fixture that reduces light level during unoccupied periods.

**Definition of Baseline Equipment**

The baseline equipment is assumed to be an uncontrolled lighting system on continuously, e.g. in stairwells and corridors for health and safety reasons.

**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 assumed measure cost is $274[[2]](#footnote-2).

**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 the location type. Values are provided for each building type in the reference section below.

**Algorithm**

**Calculation of Savings**

**Electric Energy Savings**

ΔkWh = (KWBaseline - (KWControlled \*(1 –ESF))) \* Hours \* WHFe

Where:

KWBaseline = Total baseline lighting load of the existing/baseline fixture

= Actual

Note that if the existing fixture is only being retrofit with bi-level occpuancy controls and not being replaced KWBaseline will equal KWControlled .

KWControlled = Total contolled lighting load at full light output of the new bi-level fixture

= Actual

Hours = Number of hours lighting is on. This measure is limited to 24/7 operation.

= 8,766

ESF = Energy Savings factor (represents the percentage reduction to the KWControlled due to the occupancy control).

= % Standby Mode \* (1 - % Full Light at Standby Mode)

% Standby Mode = Represents the percentage of the time the fixture is operating in standby (i.e. low-wattage) mode.

% Full Light at Standby Mode = Represents the assumed wattage consumption during standby mode relative to the full wattage consumption. Can be achieved either through dimming or a stepped control strategy.

= Dependent on application. If customer provided or metered data is available for both or either of these inputs a custom savings factor should be calculated. If not defaults are provided below:

| **Application** | **% Standby Mode** | **% Full Light at Standby Mode** | **Energy Savings Factor (ESF)** |
| --- | --- | --- | --- |
| Stairwells | 78.5%[[3]](#footnote-3) | 50% | 39.3% |
| 33% | 52.6% |
| 10% | 70.7% |
| 5% | 74.6% |
| Corridors | 50.0%[[4]](#footnote-4) | 50% | 25.0% |
| 33% | 33.5% |
| 10% | 45.0% |
| 5% | 47.5% |
| Other 24/7 Space Type | 50.0%[[5]](#footnote-5) | 50% | 25.0% |
| 33% | 33.5% |
| 10% | 45.0% |
| 5% | 47.5% |

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[[6]](#footnote-6) = (KWBaseline - (KWControlled \*(1 –ESF))) \* Hours \* -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 = (KWBaseline - (KWControlled \* (1 –ESF))) \* 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.[[7]](#footnote-7)

**Natural Gas Heating Penalty**

If natural gas heating:

Δtherms = (KWBaseline - (KWControlled \*(1 –ESF))) \* Hours \* - 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-OCBL-V02-160601**

1. DEER 2008. [↑](#footnote-ref-1)
2. Consistent with the Multi-level Fixture measure with reference to Goldberg et al, State of Wisconsin Public Service Commission of Wisconsin, Focus on Energy Evaluation, Business Programs: Incremental Cost Study, KEMA, October 28, 2009. Also consistent with field experience of about $250 per fixture and $25 install labor. [↑](#footnote-ref-2)
3. Average found from the four buildings in the State of California Energy Commission Lighting Research Program

   Bi-Level Stairwell Fixture Performance Final Report: <http://www.archenergy.com/lrp/lightingperf_standards/project_5_1_reports.htm> [↑](#footnote-ref-3)
4. Value determined from the Pacific Gas and Electric Company: Bi-Level Lighting Control Credits study for Interior Corridors of Hotels, Motels and High Rise Residential.

   <http://www.energy.ca.gov/title24/2005standards/archive/documents/2002-07-18_workshop/2002-07-18_BILEVEL_LIGHTING.PDF> [↑](#footnote-ref-4)
5. Conservative estimate. [↑](#footnote-ref-5)
6. Negative value because this is an increase in heating consumption due to the efficient lighting. [↑](#footnote-ref-6)
7. 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-7)