4.5.9 Multi-Level Lighting Switch

**Description**

This measure relates to the installation new multi-level lighting switches on an existing lighting system.

This measure can only relate to the adding of a new control 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 a lighting system controlled by multi-level lighting controls.

**Definition of Baseline Equipment**

The baseline equipment is assumed to be an uncontrolled lighting system where all lights in a given area are on the same circuit or all circuits come on at the same time.

**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 incremental capital cost for this measure is assumed to be $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 = KWControlled\* Hours \* ESF \* WHFe

Where:

KWControlled = Total lighting load connected to the control in kilowatts.

= Actual

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 KWcontrolled due to the use of multi-level switching).

= Dependent on building type[[3]](#footnote-3):

| **Building Type** | **Energy Savings Factor (ESF)** |
| --- | --- |
| Private Office | 21.6% |
| Open Office | 16.0% |
| Retail | 14.8% |
| Classrooms | 8.3% |
| Unknown, average | 15% |

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[[4]](#footnote-4) = 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  \* ESF \* WHFd\* CF

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.

CF = Summer Peak Coincidence Factor for measure is provided in the Reference Table in Section 4.5. If unknown, use the Miscellaneous value of 0.66[[5]](#footnote-5).

**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-MLLC-V03-160601**

1. Consistent with Occupancy Sensor control measure. [↑](#footnote-ref-1)
2. Goldberg et al, State of Wisconsin Public Service Commission of Wisconsin, Focus on Energy Evaluation, Business Programs: Incremental Cost Study, KEMA, October 28, 2009. [↑](#footnote-ref-2)
3. Based on results from “Lighting Controls Effectiveness Assessment: Final Report on Bi-Level Lighting Study” published by the California Public Utilities Commission (CPUC), prepared by ADM Associates.

   <http://lightingcontrolsassociation.org/bi-level-switching-study-demonstrates-energy-savings/> [↑](#footnote-ref-3)
4. Negative value because this is an increase in heating consumption due to the efficient lighting. [↑](#footnote-ref-4)
5. By applying the ESF and the same coincidence factor for general lighting savings we are in essence assuming that the savings from multi-level switching are as likely during peak periods as any other time. In the absence of better information this seems like a reasonable assumption and if anything may be on the conservative side since you might expect the peak periods to be generally sunnier and therefore more likely to have lower light levels. It is also consistent with the control type reducing the wattage lighting load, the same as the general lighting measures. [↑](#footnote-ref-5)