### Solar Light Tubes

###### Description

A tubular skylight which is 10” to 21” in diameter with a prismatic or translucent lens is installed on the roof of a commercial facility. The lens reflects light captured from the roof opening through a highly specular reflective tube down to the mounted fixture height. When in use, a light tube fixture resembles a metal halide fixture. Uses include grocery, school, retail and other single story commercial buildings.

In order that the savings characterized below apply, the electric illumination in the space must be automatically controlled to turn off or down when the tube is providing enough light.

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

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

###### Definition of Efficient Equipment

The efficient equipment is assumed to be a tubular skylight that concentrates and directs light from the roof to an area inside the facility.

###### Definition of Baseline Equipment

The baseline equipment for this measure is a fixture with comparable luminosity. The specifications for the baseline lamp depend on the size of the Light Tube being installed.

###### Deemed Lifetime of Efficient Equipment

The estimated useful life for a light tube commercial skylight is 10 years[[1]](#footnote-1).

###### Deemed Measure Cost

If available, the actual incremental cost should be used. For analysis purposes, assume an incremental cost for a light tube commercial skylight is $5002.

###### Loadshape

|  |
| --- |
| Loadshape C14 - Indust. 1-shift (8/5) (e.g., comp. air, lights)[[2]](#footnote-2) |

###### Coincidence Factor

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

**Algorithm**

###### Calculation of Savings

###### Electric Energy Savings

ΔkWh = kWf\* HOURS \* WHFe

Where:

kWf *=* Connected load of the fixture the solar tube replaces

|  |  |  |  |
| --- | --- | --- | --- |
| **Size of Tube** | **Average Lumen output for Chicago Illinois (minimum)[[3]](#footnote-3)** | **Equivalent fixture** | **kW** |
| 21” | 9,775 (4,179) | 50% 3 x 2 32W lamp CFL (207W, 9915 lumens)  50% 4 lamp F32 w/Elec 4’ T8 (114W, 8895 lumens) | 0.161 |
| 14” | 4,392 (1,887) | 50% 2 42W lamp CFL (94W, 4406 lumens)  50% 2 lamp F32 w/Elec 4’ T8 (59W, 4448 lumens) | 0.077 |
| 10” | 2,157 (911) | 50% 1 42W lamp CFL (46W, 2203 lumens)  50% 1 lamp F32 w/Elec 4’ T8 (32W, 2224 lumens) | 0.039 |
|  |  | **AVERAGE** | **0.092** |

HOURS = Equivalent full load hours

= 2400 [[4]](#footnote-4)

WHFe = Waste heat factor for energy to account for cooling energy savings from efficient lighting is selected from 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[[5]](#footnote-5) = kWf\* 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

∆kW*=* ∆kWf \* WHFd \*CF

Where:

WHFd = Waste Heat Factor for Demand to account for cooling savings from efficient lighting in cooled buildings is selected from the Reference Table in Section 4.5 for each building type. If the building is not cooled WHFd is 1.

CF = Summer Peak Coincidence Factor for measure is 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.

###### Natural Gas Savings

ΔTherms[[6]](#footnote-6) = ∆kWf \* 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. Please select from the Reference Table in Section 4.5 for each building type.

###### Water Impact Descriptions and Calculation

N/A

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

###### N/A

###### Measure Code: CI-LTG-STUB-V02-140601

1. Equal to the manufacturers standard warranty [↑](#footnote-ref-1)
2. The savings from solar light tubes are only realized during the sunlight hours. It is therefore appropriate to apply the single shift (8/5) loadshape to this measure. [↑](#footnote-ref-2)
3. Solatube Test Report (2005). http://www.mainegreenbuilding.com/files/file/solatube/stb\_lumens\_datasheet.pdf [↑](#footnote-ref-3)
4. Ibid. The lumen values presented in the kW table represent the average of the lightest 2400 hours. [↑](#footnote-ref-4)
5. Negative value because this is an increase in heating consumption due to the efficient lighting. [↑](#footnote-ref-5)
6. Negative value because this is an increase in heating consumption due to the efficient lighting. [↑](#footnote-ref-6)