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HVAC Integration to Network Lighting Controls

	Measure Details
Measure Master ID	
Workpaper ID	
Measure Unit	
Measure Type	Hybrid
Measure Group	HVAC
Measure Category	Controls
Sector(s)	Commercial, Schools & Government
Annual Energy Savings (kWh)	Calculated
Summer Peak Demand Reduction (kW)	0
Winter Peak Demand Reduction (kW)	0
Annual Therm Savings (Therms)	Calculated
Lifecycle Energy Savings (kWh)	Calculated
Lifecycle Therm Savings (Therms)	Calculated
Water Savings (gal/year)	0
Effective Useful Life (years)	12.2 [4]
Incremental Cost ($/unit)	

Measure Description

HVAC integration to networked lighting controls (NLC) generates HVAC savings by using the luminaire level lighting control sensors to control HVAC setpoints. When the lighting fixture sensors detect unoccupancy in each HVAC control zone, the airflow and temperature setpoints can be adjusted to decrease ventilation, heating, and cooling energy.

Description of Baseline Condition

The baseline condition is an interior lighting system that does not include connected controls strategies. Additionally, the baseline condition for the measure requires an HVAC system in which *individual zones* can be effectively turned down or off via temperature setpoints or ventilation control with input from the occupancy sensors. Some traditional examples include packaged, split, or built-up air handlers, VAV systems, rooftop units, radiant and chilled beam systems, and distributed heat pump systems.

Description of Efficient Condition

The efficient condition includes a networked lighting control system listed on the DLC NLC QPL (Technical Requirements Table v4.0 or higher) that is integrated with the HVAC control sequences. The HVAC system is programmed to respond to occupancy signals from the lighting sensors by reducing ventilation, heating, and cooling setpoints during unoccupied periods. HVAC control sequences should include:

- Thermostat setback
- VAV terminal airflow reduction
- VAV resets based on occupancy (can include some combination of vent reset, demand control ventilation, static pressure, and supply air temperature resets)

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The HVAC system must be capable of zone-level control, with one controller/thermostat per room or per every few rooms (e.g. VAV, distributed heat pumps, small rooftop units, chilled beams, etc.). HVAC systems with a single AHU serving a large area with many rooms (e.g. a single zone RTU serving an entire small office, or 10 or more rooms in a building, etc.) are not applicable.

Annual Energy-Savings Algorithm

$$kWh_{SAVED} = (Area \times EEI_{COOL}) \times SF_{COOL} \times \frac{HOU}{HOU_{TYPICAL}}$$

$$Therm_{SAVED} = (Area \times GEI_{HEAT}) \times SF_{HEAT} \times \frac{HOU}{HOU_{TYPICAL}}$$

Annual Energy and Coincident Peak Demand Savings Variables

Variable	Description	Units	Value
Area	Total gross area of building	sqft	User defined input
EEI_{COOL}	Electricity energy intensity of cooling system	kWh/sqft	Varies by principal building activity, see table below
SF_{COOL}	Deemed cooling savings factor	%	Varies by principal building activity; see table below; 30% default
HOU	Hours of operation per day	Hours/day	User defined input
$HOU_{TYPICAL}$	Typical hours of operation per day	Hours/day	Varies by principal building activity, see table below
GEI_{HEAT}	Gas energy intensity of heating system	Therms/sqft	Varies by principal building activity; see table below
SF_{HEAT}	Deemed heating savings factor	%	Varies by principal building activity, see table below; 28% default

Energy End Use Intensities and Hours of Use by Principal Building Activity

Principal building activity	EEI_{COOL} [1]	GEI_{HEAT} [1]	HOU [2]	SF_{COOL} [3]	SF_{HEAT} [3]
Education	4.8	27.4	8.50	25%	25%
Food sales	9.6	41.1	15.19		
Food service	16	37	12.28		
Health care	11.3	46.6	10.07		
Inpatient	13.5	58.3	10.07		
Outpatient	8.3	28.1	10.07	17%	9%
Lodging[1]	6.8	16.5	9.19	60%[1]	60%[1]
Mercantile	6.9	21.4	11.58	31%	28%
Retail (other than mall)	6.8	19	11.58	45%	45%
Enclosed and strip malls	6.8	22.9	11.58		
Office	6.8	22.7	9.66	31%	28%
Public assembly	8.6	41.1	7.48	12%	12%

[1] Savings applicable to amenity areas of lodging (recreation, conference, assembly, amenities, etc.). No savings in corridors. Savings in guest rooms should use Guest Room Energy Management measure instead.

Principal building activity	EEI_{COOL} [1]	GEI_{HEAT} [1]	HOU [2]	SF_{COOL} [3]	SF_{HEAT} [3]
Public order and safety	6.5	28.5	9.38	31%	28%
Religious worship	2.8	19.6	7.48	31%	28%
Service	4.1	41	7.48	31%	28%
Warehouse and storage	2.5	19.1	9.49	30%	30%
Other	7.7	31.9	10.06		
Vacant	3	20.1	0.00		

Coincident Peak Demand Savings Algorithms

There are no peak savings associated with this measure.

Lifecycle Energy-Savings Algorithms

$$kWh_{LIFECYCLE} = kWh_{SAVED} \times EUL$$

$$Therm_{LIFECYCLE} = Therm_{SAVED} \times EUL$$

Where:

EUL = Effective useful life (= 12.2 years[4])

Assumptions

The baseline HVAC system's electric and natural gas usages are estimated using CBECS data. If actual baseline values are available, they should replace the portion of the equation enclosed in parentheses.

The deemed savings factors are based on a compilation of results from several studies complied by DLC. There was a total number of 21 sites, the results of which were averaged by principal building activity.

To account for sites with abnormally large or small hours of operation, they are scaled by typical annual hours by principal building activity.

The CBECS Survey Data documents several electricity end uses. For the measure calculations, electric space heating, ventilation, and cooling were all summed to get Electricity energy intensity of cooling system.

The CBECS Survey Data presents gas energy intensity in cubic feet of gas per square feet. This was converted to Therms using EIA's 2024 reported heat content of natural gas for Wisconsin of 1,045 Btu per cubic foot.[5]

Revision History

Version Number	Date	Description of Change
00	07/2025	DRAFT

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[1] U.S. Energy Information Administration. 2018 CBECS Survey Data. Tables E6:Electricity consumption intensities and E8: Natural gas consumption and intensities.

[2] PA Consulting Group Inc. State of Wisconsin Public Service Commission of Wisconsin Focus on Energy Evaluation Business Programs: Deemed Savings Manual V1.0. Table 3-5 Hours of Use Values. March 22, 2010.

[3] NLC + HVAC Study and other studies

[4] DesignLights Consortium. Economic Potential of Networked Lighting Controls in Commercial Buildings. August 2023.

[5] U.S. Energy Information Administration. Heat Content of Natural Gas Consumed. https://www.eia.gov/dnav/ng/ng_cons_heat_a_epg0_vgth_btucf_a.htm

Details on How to Add or Delete Sources Using Endnotes

Sources are listed as endnotes at the end of the work paper under Revision History and are in order of their first appearance in the text. The reference to an endnote is a superscript like this.[3]

Revision History

Version Number	Date	Description of Change
01	03/2020	Initial release

1 MaxLite. Website. Accessed March 2020. https://www.maxlite.com/products/photonmax-horticulture-led-spot-light
Osram. Website. Accessed March 2020. https://fluence.science/
Illumitex. Website. Accessed March 2020. https://illumitex.com/products/neopar/
The average specification sheet rated a Q_{90} or L_{90} of 57,433 hours for 600 watt and 1,000 watt replacement LED fixtures. With an HOU of 5,475 for non-stacked indoor units, their EUL is 10 years. With an HOU of 2,120 for supplemented units, their EUL is capped at 20 years.

2 U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy. "Energy Savings Potential of SSL in Horticultural Applications." p. ii (HOU), 2 (definitions), and 5 (baseline condition). December 2017.

3 DesignLights Consortium. "Technical Requirements for Horticultural Lighting." Accessed March 2020. https://www.designlights.org/horticultural-lighting/technical-requirements/

4 Wisconsin Focus on Energy. "Hort Lighting Analysis 051120.xlsx."

Unfortunately, Word's endnote function cannot manage duplicates of that first endnote. Any duplicates of the first endnote (source) are simply hard-keyed. That is, just type the number and change to superscript (Ctrl Shift +) so it looks like this.[5] NOTE: If a new source is added or an existing source is deleted, any superscript duplicates of that change to the endnote (source) must be revised as well.

Adding an endnote for a source:

1. Go to References, click on arrow at lower right corner. Click on the selections as shown in menu at right. Hit "Apply."
2. To insert an endnote in the text, select References/Insert Endnote or "Ctrl Alt D." The prompt for the text will be at the end of the work paper. Type in the source at the prompt.
3. Subsequent endnotes will be numbered automatically in sequence.
4. For subsequent references to the same source, type the same number in the text. Superscript the number by highlighting it and hitting hit Ctrl Shift +.
5. If this is an existing work paper, inserting or deleting an endnote will affect subsequent endnotes. Note that any hard-keyed duplicates of that endnote will not change automatically. Keep track! These hard-keyed duplicates must be retyped to the correct new number.