14.1 Lighting Controls

Algorithms

$$Customer\ kW = kW\ Connected \times \%\ Savings \times Cooling\ kW\ Savings\ Factor$$

$$Customer\ kWh = kW\ Connected \times \%\ Savings \times Hours \times Cooling\ kWh\ Savings\ Factor$$

$$Customer\ PCkW = kW\ Connected \times \%Savings \times Cooling\ kW\ Savings\ Factor \times CF$$

$$Natural\ Gas\ Savings\ (Dth) = kW\ Connected \times \%\ Savings \times Hours \times Heating\ Penalty\ Factor$$

Variables

Cooling_kW_Savings_Factor	See Table 14.0.1	Cooling system secondary demand savings factor resulting from efficient lighting. Reduction in lighting demand results in a reduction in cooling demand, if the customer has air conditioning. Existence of air conditioning determined by HVAC_Type.
Cooling_kWh_Savings_Factor	See Table 14.0.1	Cooling system secondary energy savings factor resulting from efficient lighting. Reduction in lighting energy results in a reduction in cooling energy, if the customer has air conditioning. Existence of air conditioning determined by HVAC_Type.
Heating_Penalty_Factor	See Table 14.0.1	Heating system secondary energy penalty factor resulting from efficient lighting. Reduction in lighting demand results in an increase in heating usage, if the customer has gas heating. Existence of gas heating to be determined by HVAC_Type.
CF	See Table 14.0.3	Coincidence Factor is the probability that the peak demand of the lights will coincide with the peak utility system demand, determined by Facility_Type.
Hours	See Table 14.0.3	Annual operating hours, determined by Facility_Type.
% Savings	See Table 14.1.1	Stipulated savings percentage based on control type.
Measure Life	See Table 14.0.2	Length of time the lighting equipment will be operational.
NTG	See Table 14.1.2	Net-to-gross.

Customer Inputs	**M&V Verified**	
HVAC_Type	Yes	Type of heating or cooling, verified during M&V.
Facility_Type	No	Type of facility.
kW_Connected	Yes	Total connected fixture load connected to lighting controls, provided by customer and verified during M&V.

Table 14.1.1 Lighting Controls [3, 4, 5, 12, 29 & 30]

Control Type	% Savings	Full Cost Per Watt
Standalone or Integrated LLLC - Occupancy Sensor	24%	$0.49
Standalone or Integrated LLLC - Daylighting (Photocell) Sensor	28%	$0.49
Standalone or Integrated LLLC - Occupancy and Daylighting	38%	$0.49
Networked Lighting Controls (w & w/o LLLC)	49%	$0.97
Integrated LLLC - High End Trim	29%	$0.48

Table 14.1.2 Net To Gross [11, 28]

Program	NTG %
Lighting Efficiency	100%
Small Business Solutions	94%

References:

3. State of Illinois Techncial Reference Manual, Version 9.0 Final Technical Version as of October 17th, 2019. Effective January 1st, 2021.

4. Design Lights Consortium. (2017). Energy Savings from Networked Lighting Control (NLC) Systems. Medford: Design Lights Consortium. Retrieved 1 23, 2020, from https://www.designlights.org/lighting-controls/reports-tools-resources/nlc-energy-savings-report/

5. Lawrence Berkeley National Laboratory. (2011). A Meta-Analysis of Energy Savings from Lighting Controls in Commercial Buildings. Berkeley, CA: Lawrence Berkeley National Laboratory. Retrieved 10 01, 2017, from https://eta.lbl.gov/sites/default/files/publications/a_meta-analysis_of_energy_savings_from_lighting_controls_in_commercial_buildings_lbnl-5095e.pdf

6. Measure Life for automatically controlled measures from the Deemed Savings for CO Energy Management Systems, 2019-2020. (NLC Measure Life)

11. The Unopposed Settlement Agreement in Proceeding No. 18A-0606EG.

12. "Lighting Efficiency - CO" and "Lighting - Small Business" participation data

28. Net-to-Gross factor from the Evaluation of Xcel Energy's Small Business Solutions Program. 2020. EMI Consulting.

29. Design Lights Consortium. Energy Savings from Networked Lighting Control (NLC) Systems with and without LLLC. Sept 24, 2020. https://www.designlights.org/resources/reports/report-energy-savings-from-networked-lighting-control-nlc-systems-with-and-without-lllc/

30. NEEA. 2020 Luminaire Level Lighting Controls Incremental Cost Study. https://neea.org/img/documents/2020-LLLC-Incremental-Cost-Study.pdf

Changes from Recent Filing:

Updated NLC measure to include LLLC type networked controls
Added Luminaire Level Lighting controls version of current standalone occupancy & photocell controls offering
Added High End Trim measure for LLLC
Updated controls costs based on reported values

14.2 Lighting Retrofit

Algorithms

$$Customer\ kW = (kW\ Exist - kW\ Prop) \times Cooling\ kW\ Savings\ Factor$$

$$Customer\ kWh = (kW\ Exist - kW\ Prop) \times Hours \times\ Cooling\ kWh\ Savings\ Factor$$

$$Customer\ PCkW = (kW\ Exist - kW\ Prop) \times Cooling\ kW\ Savings\ Factor \times CF$$

$$kW\ Exist = Qty\ Existing\ Equip \times Existing\ Model\ kW$$

$$kW\ Prop = Qty\ Prop\ Equip \times Equipment\ Model\ kW$$

$$Natural\ Gas\ Savings\ (Dth) = (kW\ Exist - kW\ Prop) \times Hours \times Heating\ Penalty\ Factor$$

Variables

Cooling_kW_Savings_Factor	See Table 14.0.1	Cooling system secondary demand savings factor resulting from efficient lighting. Reduction in lighting demand results in a reduction in cooling demand, if the customer has air conditioning. Existence of air conditioning determined by HVAC_Type.
Cooling_kWh_Savings_Factor	See Table 14.0.1	Cooling system secondary energy savings factor resulting from efficient lighting. Reduction in lighting energy results in a reduction in cooling energy, if the customer has air conditioning. Existence of air conditioning determined by HVAC_Type.
Heating_Penalty_Factor	See Table 14.0.1	Heating system secondary energy penalty factor resulting from efficient lighting. Reduction in lighting demand results in an increase in heating usage, if the customer has gas heating. Existence of gas heating to be determined by HVAC_Type.
CF	See Table 14.0.1	Coincidence Factor is the probability that the peak demand of the lights will coincide with the peak utility system demand, determined by Facility_Type.
Hours	See Table 14.0.1	Annual operating hours, determined by Facility_Type.
Measure Life	See Table 14.0.2	Length of time the lighting equipment will be operational.
NTG	See Table 14.2.1	Net-to-gross

Customer Inputs	M&V Verified	
Qty_Existing_Equip	Yes	Quantity of existing equipment, verified during M&V.
Qty_Prop_Equip	Yes	Quantity of proposed equipment, verified during M&V.
HVAC_Type	Yes	Type of heating or cooling, verified during M&V.
Facility_Type	No	Type of facility.
Existing_Model_kW	Yes	Existing equipment wattage determined from stipulated fixture or lamp wattage. Specific lighting product provided by customer and verified during M&V.
Equipment_Model_kW	Yes	Proposed equipment wattage of fixture or lamp. Specific lighting product provided by customer and verified during M&V.
Baseline Cost	No	Cost of the baseline technology. For Retrofit, the cost is $0.00 since the baseline is to continue to operate the existing system. For New Construction, the cost is that of the lower efficiency option. Costs are determined through market research and provided by vendors.
High Efficiency Cost	No	Cost of the High Efficiency technology. 9 Equipment and Labor costs are also collected on a per measure basis, data is used to evaluate and identify the need to update costs as needed throughout the year to account for the rapidly evolving market.

Table 14.2.1 Net To Gross[9, 28]

Program	NTG %
Lighting Efficiency	81%
Small Business Solutions	94%

References:

9. Net-to-Gross factor from Evaluation of Xcel Energy's Lighting Efficiency Program. 2022. APEX & TRC Consulting.
28. Net-to-Gross factor from the Evaluation of Xcel Energy's Small Business Solutions Program. 2020. EMI Consulting.

Changes from Recent Filing:

Updated the Lighting Efficiency NTG value based on the Xcel Energy 2022 Lighting Efficiency Evaluation

14.3 Lighting Midstream

Algorithms

$$Customer\ kW = Quantity \times \frac{Watts\ Base - Watts\ EE}{1000} \times Cooling\ kW\ Savings\ Factor$$

$$Customer\ kWh = Quantity \times \frac{Watts\ Base - Watts\ EE}{1000} \times Hours \times Cooling\ kWh\ Savings\ Factor$$

$$Customer\ PCkW = Quantity \times \frac{Watts\ Base - Watts\ EE}{1000} \times Cooling\ kW\ Savings\ Factor \times CF$$

$$LPW\ EE = (Lumens\ EE)/(Watts\ EE)$$

$$Watts\ Base = Watts\ EE \times \frac{LPW\ EE}{LPW\ Base}$$

$$Natural\ Gas\ Savings\ (Dth) = Quantity \times \frac{Watts\ Base - Watts\ EE}{1000} \times Hours \times Heating\ Penalty\ Factor$$

Applies to: LED Linear Lamps - Type B & C, LED PL/G based CFL Replacement lamp - Type B, LED Screw-in Lamps - HID Replacement

$$Watts\ Base = Watts\ EE \times \frac{LPW\ EE}{LPW\ Base \times Baseline\ Equivelancy\ Factor \times Ballast\ Factor}$$

*Rest of the equations are the same as the first table

Applies to: LED Linear Lamps - Type A, LED PL/G based CFL Replacement lamp - Type A

$$Customer\ kW = Quantity \times \frac{Watts\ Base - Sys\ Watts\ EE}{1000} \times Cooling\ kW\ Savings\ Factor$$

$$Customer\ kWh = Quantity \times \frac{Watts\ Base - Sys\ Watts\ EE}{1000} \times Hours \times Cooling\ kWh\ Savings\ Factor$$

$$Customer\ PCkW = Quantity \times \frac{Watts\ Base - Sys\ Watts\ EE}{1000} \times Cooling\ kW\ Savings\ Factor \times CF$$

$$Watts\ Base = Watts\ EE \times \frac{LPW\ EE}{LPW\ Base \times Baseline\ Equivelancy\ Factor \times Ballast\ Factor}$$

$$Sys\ Watts\ EE = (Watts\ EE)/(Ballast\ Efficiency)$$

Variables

LPW_Base	See Table 14.3.1	Efficacy of the baseline technology (lumens per watt).
Cooling_kW_Savings_Factor	1.24	Reduction in lighting demand results in a reduction in cooling demand, if the customer has air conditioning. The program will not have direct access to market segment information, so a deemed weighted average was created based on a three year history of downstream participation. [1, 2]
Cooling_kWh_Savings_Factor	1.09	Reduction in lighting energy results in a reduction in cooling energy, if the customer has air conditioning. The program will not have direct access to market segment information, so a deemed weighted average was created based on a three year history of downstream participation. [1, 2]
Heating_Penalty_Factor	-0.000508	Reduction in lighting energy results in an increase in heating usage, if the customer has gas heating (Dth/kWh). [2]
CF	75%	Coincidence Factor is the probability that the peak demand of the lights will coincide with peak utility system demand. The program will not have direct access to market segment information, so a deemed weighted average was created based on a three year history of downstream participation. [1, 2]
Hours	4,897	Annual operating hours. The program will not have direct access to market segment information, so a deemed weighted average based on a three year history of downstream participation was created. [12]
Ballast_Factor	88%	Ballast factor is the measured ability of a fluorescent ballast to produce light from the lamp(s) it powers. In addition to the effect on light output, there is also an indirect impact on energy consumption. A normal ballast factor is assumed here. [16]
Ballast_Efficiency	85%	There is an inefficiency when an LED lamp is running off of a ballast, which adds additional wattage to the nominal lamp wattage. Ballast efficiency may also be referred to as power factor in general terms. Power factor is the fraction of power actually used by the ballast compared to the total power supplied. The ballast efficiency accounts for this inefficiency. [26]
Baseline_Equivalency_Factor	See Table 14.3.2	Accounts for differences in luminaire efficiency (ratio of light emitted by the fixture to the lumen output of the lamp-ballast system alone), lumen depreciation over time, and overdesigned spaces.
Measure Life	See Table 14.3.3	Length of time the lighting equipment will be operational, equals the lifetime hours of the lamp divided by the deemed hours of use.
Baseline Cost	See Table 14.3.4	Cost of the baseline technology.
Labor Cost	See Table 14.3.5	Cost of labor to install fixtures, Type B, and Type C lamps. [1]
NTG	78%	Net-to-gross factor. [14]

Customer Inputs	M&V Verified	
Quantity	No	Quantity of lamps or retrofit kits.
Measure Category	No	Type of lamp or retrofit kit.
Watts_EE	No	High efficiency lamp wattage. This is defined by the manufacturer and maintained and reported by the distributor.
Lumens_EE	No	High efficiency lamp rated brightness (lumens). This is defined by the manufacturer and maintained and reported by the distributor.
High Efficiency Cost	No	Cost of the high efficiency technology. Costs will be collected from the equipment distributor on the product invoice.

Table 14.3.1 Baseline Lamp Efficacy based on Lamp Category [15 - 20]

Measure Category	Avg. Efficacy
A Lamp rated for 310 - 749 Lumens	27.12
A Lamp rated for 750 - 1049 Lumens	36.88
A Lamp rated for 1050 - 1489 Lumens	39.45
A Lamp rated for 1490 - 2600 Lumens	37.93
General Directional (PAR, BR, R)	18.69
Multifaceted Reflector (MR16)	13.00
Decorative (B, BA, Candle, Globe)	10.45
Downlight Retrofit Kit	24.39
Fluorescent Linear Lamps	88.70
PL/G based CFL lamp	69.30
HID Screw-in Lamp	83.20
LED Interior Fixture <= 25W	48.42
LED Interior Fixture 26W - 50W	49.09
LED Exit Sign	7.50

Table 14.3.2 Baseline Equivalency Factor (BEF) [24]

Measure Category	BEF
LED Linear Lamps - Type A	0.70
LED Linear Lamps - Type B, C	0.87
LED PL/G based CFL Replacement Lamp	0.52
LED Screw-in Lamps, HID Replacement	0.62

Table 14.3.3 Measure Lifetimes in Years [8, 21, 23]

Measure Category	2021 Lifetime	2022 Lifetime	2023 Lifetime
LED Interior Lamp - A Lamp	5.2	5.2	5.2
General Directional (PAR, BR, R)	3.3	2.3	1.3
Multifaceted Reflector (MR16)	3.1	2.1	1.1
Decorative (B, BA, Candle, Globe)	3.4	2.4	1.4
Downlight Retrofit Kit	9.4	9.4	9.4
LED Linear & U-Bend Tubes - Type A & B	10.2	10.2	10.2
LED Linear & U-Bend Tubes - Type C & LED Interior Fixtures	20.0	20.0	20.0
LED PL/G based CFL Replacement lamp	10.2	10.2	10.2
LED Screw-in Lamps, HID Replacement	10.2	10.2	10.2

Table 14.3.4 Baseline Costs [22]

Measure Category	Baseline Cost
A19 60W, 750-1049 lm	$2.36
A19 100W, 1490-2600 lm	$3.28
Decorative (Candle/Globe)	$1.84
BR30	$3.39
BR40	$7.06
MR16	$2.64
PAR16	$5.99
PAR20	$5.45
R20	$4.30
PAR30	$6.85
PAR38	$8.89
Downlight Retrofit Kit	$8.41
LED Linear Lamps - Type A	$2.19
LED Linear Lamps - Type B	$2.07
LED Linear Lamps - Type C	$2.18
LED PL/G based CFL Replacement lamp	$4.59
LED Screw-in Lamps, HID Replacement	$37.68

Table 14.3.5 Labor Costs [12]

Measure Category	Labor Cost
LED Linear Lamps - Type B	$8.00
LED Linear Lamps - Type C	$12.00
LED PL/G based CFL Replacement Lamp - Type B	$12.00
LED Screw-in Lamps, HID Replacement	$55.00
LED Interior Fixtures	$40.00
LED/LEC Exit Sign	$60.00

References:

12. "Lighting Efficiency - CO" and "Lighting - Small Business" participation data from 2017 through 2019.
13. Deemed Savings for 2019-2020 "Product: Lighting Efficiency - CO" to reference deemed values used to create weighted averages for HVAC Interactive Factors, Hours and CF.
14. Net-to-Gross factor from 2020 Xcel Energy Small Business Lighting Efficiency Program Evaluation
15. Energy Independence and Security Act. United States Congress. Jan 4, 2007. https://www.govinfo.gov/content/pkg/BILLS-110hr6enr/pdf/BILLS-110hr6enr.pdf
16. Adoption of Light-Emitting Diodes in Common Lighting Applications. Prepared for the U.S. Department Of Energy by Navigant Consulting. April 2013. http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/led-adoption-report_2013.pdf
17. Caliper Benchmark Report - Performance of Incandescent A-Type and Decorative Lamps and LED Replacements. U.S. Department of Energy. November, 2008. https://www1.eere.energy.gov/buildings/publications/pdfs/ssl/a-type_benchmark_11-08.pdf
18. ENERGY STAR ® Integral LED Product Qualifications Requirements. 2010.
19. Caliper Benchmark Report - Performance of Halogen Incandescent MR 16 Lamps and LED Replacements. U.S. Department of Energy. November, 2008. https://www1.eere.energy.gov/buildings/publications/pdfs/ssl/a-type_benchmark_11-08.pdf
20. Incandescent Reflector Lamps minimum efficacy standards. http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/58
21. ENERGY STAR ® Certified Light Bulbs and Light Fixtures Qualified Products Lists. Accessed July 2018.
22. Actual sales data from distributors from 2017-2018. (Baseline Distributor Costs)
23. Design Lights Consortium (2018). Qualified Products List as of February 27, 2018. (Lamp Lifetime Hours)
24. Compared lumen equivalency data in the CO Lighting Efficiency downstream program from 2018 and 2019 to identify the baseline equivalency factors for the lamps.
25. "What is a ballast factor, and how does it affect my fluorescent tubes?". July 7, 2016. https://insights.regencylighting.com/what-is-a-ballast-factor-and-how-does-it-affect-my-fluorescent-tubes
26. Ballast Efficiency (Aka: Power Factor).https://www.yumpu.com/en/document/read/48349742/what-is-the-difference-between-power-factor-and-osram-sylvania

Changes from Recent Filing:

Addition of Ballast Factor, Ballast Efficiency & Baseline Equivalency Factor for determining lamp efficacy
Added Labor Cost of install or Type B & C lamps
Cost updated based on CleaResult market research
Updated the NTG Value used in the Lighting Efficiency and Small Business Solutions Programs based on the 2020 Xcel Lighting Efficiency Midstream and Small Business Solutions Evaluations

14.4 Lighting DI

Algorithms

$$Customer\ kW = (kW\ Exist - kW\ Prop) \times Cooling\ kW\ Savings\ Factor$$

$$Customer\ kWh = (kW\ Exist - kW\ Prop) \times Hours\ X\ Cooling\ kWh\ Savings\ Factor$$

$$Customer\ PCkW = (kW\ Exist - kW\ Prop) \times Cooling\ kW\ Savings\ Factor \times CF$$

$$kW\ Exist = Qty\ Existing\ Equip \times Existing\ Model\ kW$$

$$kW\ Prop = Qty\ Prop\ Equip \times Equipment\ Model\ kW$$

$$Natural\ Gas\ Savings\ (Dth) = (kW\ Exist - kW\ Prop) \times Hours \times Heating\ Penalty\ Factor$$

Variables

Cooling_kW_Savings_Factor	See Table 14.0.1	Cooling system secondary demand savings factor resulting from efficient lighting. Reduction in lighting demand results in a reduction in cooling demand, if the customer has air conditioning. Existence of air conditioning determined by HVAC_Type.
Cooling_kWh_Savings_Factor	See Table 14.0.1	Cooling system secondary energy savings factor resulting from efficient lighting. Reduction in lighting energy results in a reduction in cooling energy, if the customer has air conditioning. Existence of air conditioning determined by HVAC_Type.
Heating_Penalty_Factor	See Table 14.0.1	Heating system secondary energy penalty factor resulting from efficient lighting. Reduction in lighting demand results in an increase in heating usage, if the customer has gas heating. Existence of gas heating to be determined by HVAC_Type.
CF	See Table 14.0.3	Coincidence Factor is the probability that the peak demand of the lights will coincide with the peak utility system demand, determined by Facility_Type.
Hours	See Table 14.0.3	Annual operating hours, determined by Facility_Type.
Measure Life Hours	25,000	Lifetime of lamps installed through the program in hours. Spec sheets provided by third-party implementer.
High Efficiency Cost	See Table 14.4.1 & Table 14.4.2	Costs are provided by the vendor and are re-evaluated throughout the year to account for the rapidly evolving market.
NTG	See Table 14.4.3	Net-to-gross [14]

Customer Inputs

Qty_Existing_Equip	Quantity of existing equipment.
Qty_Prop_Equip	Quantity of proposed equipment
HVAC_Type	Type of heating or cooling
Facility_Type	Type of facility.
Existing_Model_kW	Existing equipment wattage determined from stipulated fixture or lamp wattage. Specific lighting product provided by third-party implementer.
Equipment_Model_kW	Proposed equipment wattage of fixture or lamp. Specific lighting product provided by third-party implementer. Type-A tubes assume a ballast efficiency built into the lamp kW.

Table 14.4.1 DI Lamp Costs [27]

Lamps	Wattage*	Equipment Cost*	Labor W/ Incandescent Baseline*	Labor W/ CFL Baseline*
A-Lamps	9W	$0.84	$5.00	$3.00
	6W	$0.84		
BR30	8W	$1.47		
MR16	7W	$2.72		
	7W	$2.72		
Par20	11W	$2.33		
Par30	15W	$3.26		
Par38	13W	$4.52		
BR20	7W	$1.10		
LED Exit Sign	0.7W-1.8W**	$16.00	$9.00	$25.00

* See note in the variables section on updating costs and lamp wattages throughout the program year.
** Exit sign wattage varies depending on color

Table 14.4.2 DI Tubes Cost

	Equipment Cost*	Labor Cost*
LED Tubes	$4.75	$9.84

* See note in the variables section on updating costs and lamp wattages throughout the program year.

Table 14.4.3 Net To Gross [28]

Program	NTG %
Small Business Solutions	94%
Multifamily Buildings	100%

References:

14. Net-to-Gross factor from 2019 Xcel Energy Small Business Lighting Efficiency Program Evaluation
27. Cost information supplied by direct install implementer
28. Net-to-Gross factor from the Evaluation of Xcel Energy's Small Business Solutions Program. 2020. EMI Consulting.

Changes from Recent Filing:

New Exit sign DI to SBS
Added DI Tubes
Updated the NTG Value used in the Small Business Solutions Program based on the 2020 Xcel Small Business Solutions Evaluation

14.5 Refrigerated Case LED DI

Algorithms

$$Customer\ kW = \frac{(Existing\ Watts\ - Proposed\ Watts)}{1000} \times Cooling\ kW\ Savings\ Factor \times Qty\ Prop\ Equip$$

$$Customer\ kWh = \frac{(Existing\ Watts\ - Proposed\ Watts)}{1000} \times Hours \times\ Cooling\ kWh\ Savings\ Factor \times Qty\ Prop\ Equip$$

$$Customer\ PCkW = \frac{(Existing\ Watts - Proposed\ Watts)}{1000} \times Cooling\ kW\ Savings\ Factor \times CF \times Qty\ Prop\ Equip$$

Variables

Cooling_kW_Savings_Factor	See Table 14.0.1	Cooling system secondary demand savings factor resulting from efficient lighting. Reduction in lighting demand results in a reduction in cooling demand, if the customer has air conditioning. Existence of air conditioning determined by HVAC_Type.
Cooling_kWh_Savings_Factor	See Table 14.0.1	Cooling system secondary energy savings factor resulting from efficient lighting. Reduction in lighting energy results in a reduction in cooling energy, if the customer has air conditioning. Existence of air conditioning determined by HVAC_Type.
CF	100%	Coincidence Factor is the probability that the peak demand of the lights will coincide with the peak utility system demand. For refrigerated case lighting this is deemed to be 100%
Hours	4,897	Annual operating hours. The program will not have direct access to market segment information, so a deemed weighted average based on a three year history of downstream participation was created. [1, 2]
Measure Life Hours	25,000	Lifetime of lamps installed through the program in hours. Spec sheets provided by vendor
High Efficiency Cost	See Table 14.5.1	Costs are provided by the vendor and are re-evaluated throughout the year to account for the rapidly evolving market.
NTG	94%	Net-to-gross [28]

Customer Inputs

Qty_Prop_Equip	Quantity of proposed equipment.
Existing Watts	Existing equipment wattage determined from stipulated fixture or lamp wattage.
Proposed Watts	See Table 14.5.1. Wattage of proposed LED lamp. Specific lighting product provided by vendor.

Table 14.5.1 DI Lamp Costs [27]

Lamps	Proposed Watts*	Equipment Cost*	Labor W/ Incandescent Baseline*	Labor W/ CFL Baseline*
A Lamps	9	$0.84	$5.00	$3.00

* See note in the variables section on updating costs and lamp wattages throughout the program year.

References:

12. "Lighting Efficiency - CO" and "Lighting - Small Business" participation data from 2017 through 2019.
27. Cost information supplied by direct install implementer
28. Net-to-Gross factor from the Evaluation of Xcel Energy's Small Business Solutions Program. 2020. EMI Consulting.

Changes from Recent Filing:

Updated operating hours to allign Midstream
Updated the NTG Value used in the Small Business Solutions Program based on the 2020 Xcel Small Business Solutions Evaluation

14.6 Grow Lighting

Algorithms

$$Customer\ kW = \left(\left(\frac{Proposed\ Fixture\ kW\ *Proposed\ Quantity\ *\ \%Reflector\ Eff_{prop}\ *\ Proposed\ PPE}{\%Reflector\ Eff_{base} * Baseline\ PPE}\right) - Proposed\ Quantity * Proposed\ Fixture\ kW\right) * Cooling\ kW\ Savings\ Factor$$

$$Customer\ kWh = \left(\left(\frac{Proposed\ Fixture\ kW\ *Proposed\ Quantity\ *\ \%Reflector\ Eff_{prop}\ *\ Proposed\ PPE}{\%Reflector\ Eff_{base} * Baseline\ PPE}\right) - Proposed\ Quantity * Proposed\ Fixture\ kW\right) * Hours\ * Cooling\ kWh\ Savings\ Factor$$

$$PCkW = Customer\ kW\ *\ CF$$

Variables

%Reflector Eff_base	78.3%	Accounts for reflector losses and amount of useful light delivered using baseline fixtures [2]
%Reflector Eff_prop	97.2%	Accounts for reflector losses and amount of useful light delivered from LED grow lights [2]
Cooling kW Savings Factor*	1.33	Assuming year round A/C cooling for indoor grow facilities
Cooling kWh Savings Factor*	See Table 14.6.1	Assuming year round A/C cooling for indoor grow facilities
Hours	See Table 14.6.1	Annual Hours of Operation
CF	See Table 14.6.1	Coincidence Factor
Incremental Cost	See Table 14.6.2	Average fixture costs per watt based weighted against total watts from historical custom projects
Baseline PPE	See Table 14.6.3	Average value weighted against historical custom project baseline wattage

** These values assume year round mechanical cooling in all facilities. This is the current standard assumption for custom analysis.*

Customer Inputs	M&V Verified	
Grow Room Type*	Yes	See Table 14.6.1 Operating Schedule
Proposed Fixture Quantity	Yes	Number of proposed LED grow fixtures being installed
Proposed Fixture PPE (PPF/W)	Yes	Umols/J from spec sheet or DLC listing
Proposed Fixture kW	Yes	kW per proposed LED fixture
Total Equipment Cost	No	Field only used for data collection to update cost assumptions to match changing market conditions
Total Labor Cost	No	Field only used for data collection to update cost assumptions to match changing market conditions

Table 14.6.1: Operating Schedule [1, 4]

Grow Room Type	Annual Hours*	CF*	Cooling kWh Savings Factor
Cannabis Flower Room	4,255	0.68	1.16
Cannabis Veg Room	6,498	0.89	1.24
Flowering Crops (Tomatoes/Peppers/Flowers)	4,200	0.76	1.21
Vegetative/Propagation Growth	6,300	0.95	1.21
Microgreens	6,300	0.95	1.21

** Cannabis values are calculated averages of custom indoor grow project operating schedules*

Table 14.6.2: Incremental Cost per Watt [1]

Baseline Cost/W*	Proposed Cost/W**
$ 0.27	$ 1.40

** Calculated as average baseline cost per watt from historical custom projects weighted against baseline wattage*
*** Calculated as average proposed cost per watt from historical custom projects weighted against proposed wattage*

Table 14.6.3: Baseline PPE [2]

	PPE	Wtd Avg PPE** [1]
Mogul Based HPS	1.02	1.08
DE HPS	1.7	
CMH	1.46	
Fluorescent*	0.84	

** The reference for this was specific to T8. Due to lack of sources T5 is assumed to be equivelant*

*** Baseline average PPE calculated form historical custom projects and weighted against total baseline watts. We investigated using seperate values based on room type but found only a 3% difference between flower and veg and determined a single value was sufficient.*

References:

1. Historical custom grow lighting projects from 2020. 54 spaces and over 5500 proposed fixtures.
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Table 14.0.1: HVAC Interactive Factors [1, 2]

HVAC_Type	Cooling_kWh_ Savings_Factor	Cooling_kW_ Savings_Factor	Heating_Penalty _ Factor (Dth/kWh)
Heating Only	1.00	1.00	-0.000508
Heating and Cooling	1.13	1.33	-0.000508
Cooler Door Retrofit to LED	1.44	1.44	N/A
Freezer Door Retrofit to LED	1.70	1.70	N/A

Table 14.0.2: Measure Lifetimes in Years [3, 6, 7 & 8]

Measure	Lifetime
LED Fixtures & Retrofit Kits	20.0
Lighting Sensors	8.0
Networked Lighting Controls	15.0
Luminaire Level Lighting Controls	15.0
LED Interior Lamp	7.0
LED Ref and Frz Screw In Fixture Retrofit	5.0
LED Tubes	11.0

Table 14.0.3: Coincident Peak Demand Factors and Annual Operating Hours by Facility Type [3]

Facility_Type	CF	Annual Operating Hours
24-Hour Facility	100%	8,760
Assisted Living	66%	7,862
College	63%	3,395
Elementary School	65%	3,038
Exterior - Dusk to Dawn	0%	4,380
Grocery/Convenience Store	79%	4,661
Healthcare Office / Outpatient	67%	3,890
Hospital	56%	7,616
Hotel/Motel Common Areas	85%	6,138
Hotel/Motel Guest Rooms	46%	2,390
Manufacturing	81%	4,618
Office - Low Rise	52%	2,698
Office - Mid Rise	60%	3,266
Office - High Rise	59%	2,886
Other/Misc.	67%	3,379
Religious Building	48%	2,085
Restaurant	100%	5,571
Retail - Department Store	94%	4,099
Retail - Strip Mall	71%	4,093
Safety or Code Required (Including Exit Signs)	100%	8,760
Secondary School	65%	3,038
Warehouse	85%	3,135

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