

## DEEMED SAVINGS TECHNICAL ASSUMPTIONS

<b>Product: Home Lighting &amp; Recycling</b>		
<b>Description:</b>		
The Home Lighting product is an upstream program that offers instant rebates on the purchase of Light Emitting Diodes (LEDs). Customers receive the discounted price at the register and there are no forms to fill out. <del>Free CFL recycling is also available to customers through our program.</del>		
<b>Equations and Program References:</b>		
Electrical Demand Savings (Customer kW)	=Number_of_Bulbs x kW_Savings_per_Bulb	
Electrical Energy Savings (Customer kWh/yr)	=Number_of_Bulbs x kW_Savings_per_Bulb x Hours	
kW_Savings_per_Bulb	=Baseline_Wattage - LED_Wattage	
<b>Variables:</b>		
Number_of_Bulbs	Vendor Input	Number of bulbs sold.
Baseline Wattage	Table 1 - 4	Baseline wattages are determined using an adjusted ENERGY STAR lumen equivalency rating, adjusted for EISA requirements based on lumen output. <sup>1,2</sup>
LED_Wattage	Manufacturer Provided	Wattage of the LED bulb, provided by each manufacturer.
Hours	Table 6	Annual hours of operation for the bulbs for both residential and non-residential segments. The program does not have direct access to market segment information for non-residential installations, so a deemed weighted average was created based on history of small business downstream participation. <sup>3,4,8</sup>
CF	Table 6	Probability that peak demand of the bulb will coincide with peak utility system demand. The program does not have direct access to market segment information for non-residential installations, so a deemed weighted average was created based on history of small business downstream participation. <sup>3,4,8,12</sup>
Lifetime Hours	Table 8	Lifetime Hours for LEDs. <sup>5</sup>
Measure Life	Table 7	Measure life of the average bulb sold, determined by lifetime hours divided by hours of use by segment. <del>The measure life for EISA impacted lamps takes into account the planned elimination of the baseline halogen bulbs. The analysis assumes that halogens will be available to install for 2 years after they can no longer be sold (January 1, 2020).</del>  The measure life is the minimum of the following for EISA impacted lamps: Lifetime Hours/Hours 2023 + (Halogen Bulb Life/Hours) – Current Year
Incremental Cost of Bulbs	Table 8	Cost difference between baseline and efficient bulb options. <sup>6,7</sup>
NTG	61%	Net to Gross for A-Line and Specialty bulbs. <sup>9</sup>
NTG	100%	Net to Gross for LED Tubes (Linear Lamps) <sup>10</sup>
Installation Rate	99%	Future savings for bulbs purchased and put in storage and installed in later years. The net present value of the savings for all bulbs purchased is 99% if all bulbs are installed when purchased. <sup>8</sup>
Savings Reduction	75%	Savings and incremental costs from home lighting sold at stores within 1 mile of our service territory border will be reduced to 75% of their value to account for leakage <sup>10</sup>
Labor Costs	Table 9	Cost of labor to install the LED Linear Lamp Type B, LED Linear Lamp Type C, LED PL Lamp - Type B, LED Mogul Based HID Replacement <sup>6</sup>
O&M savings	\$0.00	Operation and Maintenance savings are assumed to be zero.
<b>Provided by product Vendor:</b>		<b>Verified during M&amp;V:</b>
Number and type of bulbs purchased	Yes	

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**Assumptions:**

Manufacturer-recommended baseline wattages are used for GSL bulbs and Specialty bulbs outside the lumen values shown in Tables 1 and 2 below.<sup>8</sup>  
 The baseline bulb cost and LED bulb cost will be tracked and updated at the end of the year in the status report to account for the rapidly evolving market and cost for LED bulbs. The baseline will be reviewed and updated at least semi-annually and the LED bulb cost will be reviewed and updated monthly.

**Baseline Wattages for Lumen Equivalencies**

**Table 1: GSL Bulbs<sup>1</sup>**

Minimum Lumens	Maximum Lumens	Incandescent Equivalent Wattage	
		Baseline (Exempt Bulbs)	Baseline (Post-EISA)
2,000	2,600	150	72
1,600	1,999	100	72
1,100	1,599	75	53
800	1,099	60	43
450	799	40	29
310	449	25	25

<sup>1</sup>GSL bulbs are medium screw-base bulbs that are not globe, bullet, candle, flood, reflector, or decorative shaped

**Table 2: Specialty Bulbs<sup>1</sup>**

Lumen Bins		Incandescent Equivalent Wattage	
Decorative Shape	Globe Shape	Baseline (Exempt Bulbs)	Baseline (Post-EISA)
	1,100 - 1,300	150	72
	650 - 1,099	100	72
	575 - 649	75	53
500 - 699	500 - 574	60	43
300 - 499	350 - 499	40	29
150 - 299	250 - 349	25	25
90 - 149		15	15
70 - 89		10	10

<sup>1</sup>Specialty bulbs are medium screw-base bulbs that are globe, bullet, candle or decorative shaped

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Tables 3 and 4 - Directional (reflector) Bulbs <sup>1, 4, 14</sup>

Table 3: R, BR, and ER Bulbs

Bulb Type	Lower Lumen Range	Upper Lumen Range	Watts <sub>Base</sub>
R, ER, BR with medium screw bases w/diameter >2.25" (*see exceptions below)	420	472	40
	473	524	45
	525	714	50
	715	937	65
	938	1,259	75
	1,260	1,399	90
	1,400	1,739	100
	1,740	2,174	120
	2,175	2,624	150
	2,625	2,999	175
*R, BR, and ER with medium screw bases w/diameter <=2.25"	3,000	4,500	200
	400	449	40
	450	499	45
	500	649	50
*ER30, BR30, BR40, or ER40	650	1,199	65
	400	449	40
	450	499	45
*BR30, BR40, or ER40	500	649	50
	650	1,419	65
*R20	400	449	40
	450	719	45
*LED Fixtures	420	560	45
	561	837	60
	838	1,203	75
	1,204	1,681	100
	1,682	2,339	120
*All reflector lamps below lumen ranges specified	2,340	3,075	150
	200	299	20
	300	399	30

PAR, MR, MRX Bulbs

The following equation is used to determine the baseline wattage for these bulbs, result should be rounded down to the nearest wattage in Table 4.

$$Watts_{base} = 375.1 - 4.355(D) - \sqrt{227,800 - 937.9(D) - 0.9903(D^2) - 1479(BA) - 12.02(D * BA) + 14.69(BA^2) - 16,720 * \ln(CBCP)}$$

D = Bulb Diameter

BA = Beam Angle

CBCP = Center Beam Candle Power

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**Table 4: PAR, MR, MRX Bulbs - Energy Star Permitted Wattages**

Diameter	Permitted Wattages
16	20, 35, 40, 45, 50, 60, 75
20	50
30S	40, 45, 50, 60, 75
30L	50, 75
38	40, 45, 50, 55, 60, 65, 75, 85, 90, 100, 120, 150, 250

**Table 5: Lifetime Hours <sup>9, 10</sup>**

Bulb Category	Lifetime
A-Line	16,283
Specialty	23,300
Specialty (HB-19 1231 Exempt)	53,639
LED Tubes (Linear Lamps)	47,419

**Table 6: Hours, CF <sup>3, 4, 9, 13</sup>**

	Hours	CF	% Breakdown A-Line and Specialty	% Breakdown LED Tubes (Linear Lamps)
Residential	986	12.6%	94%	24%
Business	3866	67.0%	6%	76%

**Table 7: Measure Life**

Installation Type	2019				2020			
	A-Line (Post-EISA)	Specialty (Post-EISA)	Specialty (Exempt)	LED Tubes (Linear Lamps)	A-Line	Specialty	Specialty (HB-19 1231 Exempt)	LED Tubes (Linear Lamps)
Residential	5.0	6.0	20.0	20.0	16.5	7.5	20.0	20.0
Business	4.2	4.5	6.0	13.1	4.2	4.4	13.9	12.3

**Table 8: Average Costs\* <sup>6, 7, 14, 15</sup>**

	A-Line	Specialty Residential	Specialty Business	LED Tubes (Linear Lamps) Residential	LED Tubes (Linear Lamps) Business
Gross Cost (per bulb)	\$2.67	\$4.67	\$6.05	\$14.00	\$14.98
Baseline (per bulb)	\$0.93	\$2.78	\$2.78	\$2.00	\$2.00
Incremental (per bulb)	\$1.74	\$1.89	\$3.27	\$12.00	\$12.98
Rebate	\$1.33	\$1.46	\$1.74	\$2.00	\$2.75
<b>Net Retail</b>	<b>\$0.41</b>	<b>\$0.44</b>			

\* = See assumption above on baseline costs and LED costs throughout the program year.

**Table 9: Linear Lamps <sup>11</sup>**

	Watts
Baseline	30.50

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**Table 10: Labor Costs <sup>13</sup>**

<b>Bulb Category</b>	<b>Labor Cost</b>
LED Linear Lamps - Type B	\$8.00
LED Linear Lamps - Type C	\$12.00
LED PL Lamp - Type B	\$12.00
LED Mogul Based HID Replacement	\$55.00

**References:**

1. The Uniform Methods Project: Residential Lighting Evaluation Protocol, published April 2013. Page 11.
2. State of Illinois Energy Efficiency Technical Reference Manual Final Technical Version as of February 8th, 2017, effective January 1st, 2018. Vol 3, Pages 244-245.
3. Northeast Residential Lighting Hours-of-Use Study, Pages XVI and 37
4. "Lighting - Small Business" participation data from 3/1/2017 through 2018.
5. Lifetime hours from program administrator for bulbs sold in 2019 used to calculate weighted lifetimes.
6. 2018 CO Home Lighting Product Results compiled by WECC (program administrator).
7. Market survey 2018 (homedepot.com, lowes.com, samsclub.com, target.com, walmart.com, etc)
8. 2016 CO Home Lighting and Recycling Evaluation by Cadmus, 2016. Pages 35, 72-73.
9. 2018 CO Home Lighting and Recycling Evaluation by EMI Consulting, Dec 12 2018. Page 5.
10. 2019 Unopposed Comprehensive Settlement Agreement
11. Estimated values based on ranges provided by Slipstream (WECC) and historical participation in "CO Lighting Efficiency" product
12. 2019 MN Home Lighting Product Results compiled by program administrator.
13. DOE 2015 US Lighting Market Characterization.
14. MN Technical Reference Manual Version 3.0 Page 26.
15. "Lighting Efficiency - CO" and "Lighting - Small Business" participation data from 2017 through 2019.
16. Colorado House Bill 2019-1231