

DEEMED SAVINGS TECHNICAL ASSUMPTIONS

11.1 Home Lighting

Algorithms

$$kW \text{ Savings per Bulb} = (Wattage_{Baseline} - Wattage_{LED})/1000$$

$$Customer \text{ kW} = \text{Number of Bulbs} \times kW \text{ Savings per Bulb}$$

$$Customer \text{ kWh} = Customer \text{ kW} \times \text{Hours}$$

$$Peak \text{ Coincident kW} = Customer \text{ kW} \times \text{Coincident Factor}$$

Variables

Number of Bulbs	Vendor Input	Number of bulbs sold.
Wattage <sub>Baseline</sub>	Tables 11.1.1-11.1.5	Baseline wattages are determined using an adjusted ENERGYSTAR lumen equivalency rating, adjusted for EISA requirements based on lumen output. Direct install measures use removed wattage. Linear lamps based on past participation. <sup>1, 2</sup>
Wattage <sub>LED</sub>	Manufacturer	Wattage of the LED bulb, provided by each manufacturer.
Lifetime Hours	Table 11.1.6	Lifetime Hours for LEDs. <sup>5</sup>
Hours	Table 11.1.7	Annual hours of operation for the bulbs for both residential and non-residential segments. <sup>3, 4, 8, 9</sup>
Coincident Factor	Table 11.1.7	Probability that peak demand of the bulb will coincide with peak utility system demand. <sup>3, 4, 8</sup>
Measure Life	Tables 11.1.9- Table 11.1.7	Measure life of the average bulb sold, determined by lifetime hours divided by hours of use by segment.
Incremental Cost of Bulbs	Table 11.1.9	Cost difference between baseline and efficient bulb options. <sup>6, 7</sup>
Labor Costs	Table 11.1.10	Cost of labor to install fixtures, Type B, and Type C lamps. <sup>15</sup>
NTG	61%	Net-to-Gross for A-Line and Specialty bulbs. <sup>9</sup>
NTG	100%	Net-to-Gross for LED Tubes, PL and Mogul lamps. <sup>10</sup>
NTG	Table 11.1.11	Net-to-gross factor. <sup>5, 10, 17</sup>
Installation Rate	99%	Future savings for bulbs purchased and put in storage and installed in later years. The net present value of the saving for all bulbs purchased is 100% if all bulbs are installed when purchased. <sup>8</sup>
Non-Energy O&M savings	\$0.00	Non-Energy operation and maintenance savings are assumed to be zero.

<b>Provided by Product Vendor</b>	<b>M&amp;V Verified</b>
Number and type of bulbs purchased	Yes

Assumptions

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 rapid 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. Specialty bulbs on the forecast include Specialty, R, BR, and ER Bulbs, 3-way Bulbs as well as PAR, MR, and MRX Bulbs. Assume all sales made through the pro-desk will be to small business customers. If the formula below for the PAR, MR and MRX Lamp baseline equivalent results in a negative or undefined value, the manufacturer recommendation is used.

Table 11.1.1: 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 11.1.2: Specialty Bulbs <sup>1</sup>

Decorative Shape	Lumen Bins	Globe Shape		Incandescent Equivalent Wattage	
		Baseline	Baseline	Baseline	Baseline
		1100	1300	150	72
		650	1099	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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Table 11.1.3: R, BR, and ER Bulbs<sup>1,2</sup>  
EISA Impacted<sup>1,2,14</sup>

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
	3,000	4,500	200
*R, BR, and ER with medium screw bases w/diameter <=2.25"	400	449	40
	450	499	45
	500	649	50
	650	1,199	65
*ER30, BR30, BR40, or ER40	400	449	40
	450	499	45
	500	649	50
*BR30, BR40, or ER40	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
	2,340	3,075	150
*All reflector lamps below lumen ranges specified above	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

Table 11.1.4: PAR, MR, MRX Bulbs - Energy Star Permitted Wattages<sup>1,2</sup>

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 11.1.5: Linear Lamps<sup>11</sup>

	Watts
Baseline	30.50

Table 11.1.6: Lifetime Hours<sup>9</sup>

Bulb Category	Lifetime (Hours)
A-Line	16,695
Specialty	23,118
Specialty (Exempt)	53,639
Reflectors	23,380
Globe/Decorative	15,068
3-Way	15,241
Fixtures (Retrofit kits)	53,639
Linear Lamps	49,714

Table 11.1.7: Hours, CF, Measure Lifetime<sup>3,4,8,13</sup>

Bulb Category	Installation Type	Hours	CF	% Breakdown	Measure Lifetime 2021	Measure Lifetime 2022
A-Line	Residential	986	12.6%	94%	16.9	16.9
Specialty					20.0	20.0
Specialty (Exempt)					20.0	20.0
Reflectors					3.0	2.0
Globe/Decorative					3.0	2.0
3-Way					15.5	15.5
Fixtures (Retrofit kits)					20.0	20.0
Linear Lamps					20.0	20.0
A-Line	Non-Residential	4,897	75.3%	6%	3.4	3.4
Specialty					4.7	4.7
Specialty (Exempt)					11.0	11.0
Reflectors					3.0	2.0
Globe/Decorative					3.0	2.0
3-Way					3.1	3.1
Fixtures (Retrofit kits)					11.0	11.0
Linear Lamps					10.2	10.2
				76%		

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**Table 11.1.8: Measure Life (Years)**

Installation Type	Program Year	Specialty- (Non-Exempt)	Specialty- (Exempt)
Residential	2021	6-5	20
	2022	5-1	20
Non-Residential	2021	3-7	11-0
	2022	2-7	11-0

**Table 11.1.9: Average Costs\*** <sup>6, 7, 12, 15</sup>

Type	Rebate
A-Line	\$1.24
Fixtures (Retrofit kits) Residential	\$1.47
Fixtures (Retrofit kits) Business	\$2.88
Reflectors Residential	\$1.47
Reflectors Business	\$1.47
Globe/Decorative Residential	\$1.47
Globe/Decorative Business	\$1.47
3-Way Residential	\$1.47
3-Way Business	\$1.47
Specialty-Residential-	\$1.65
Specialty-Business	\$1.74
Linear Lamps Residential	\$2.00
Linear Lamps Business	\$2.75
MFBE LED Globe	\$5.00
MFBE LED A19 EnergyStar Rated Lamp	\$5.00
MFBE LED Candelabra	\$5.00
MFBE LED BR30 Flood	\$5.00
MFBE LED MR16 Reflector	\$5.00
MFBE LED PAR30	\$5.50
School kits 9W LED	\$3.19
School kits 11W LED	\$4.81
School kits 15W LED	\$2.65
School kits 8W Reflector	\$2.65
School kits 6W Globe	\$2.65
School kits 3-Way LED	\$2.65
School kits 5W Candelabra	\$2.65
Squad LEDs	\$2.65

Costs are provided by the vendor and are re-evaluated throughout the year to account for the rapidly evolving market.

**Table 11.1.10: Labor Costs\*** <sup>15</sup>

Bulb Category	Labor Cost
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

**Table 11.1.11: NTG Values\*** <sup>9,10,17</sup>

Bulb Category	Program Year 2021	Program Year 2022
LED Bulb - A-Line	61.0%	47.9%
LED Bulb - Fixtures (Retrofit kits)	61.0%	78.0%
LED Bulb - Reflectors	61.0%	22.2%
LED Bulb - Globe/Decorative	61.0%	47.9%
LED Bulb 3-Way	61.0%	71.8%
LED Tubes (Linear Lamps)	100.0%	78.0%

**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 CO 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
17. 2021 CO home Lighting and Recycling Evaluation by TRC and Apex Analytics, Jan 25 2022. Page 5

**Changes from Recent Filing:**

1. Updating NTG Values to reflect the most recent program evaluation completed by TRC Apex Analytics provided to Xcel on Jan 25 2022.