Standard Practice Efficacy Performance Analysis of LED Fixtures, Lamps and Retrofit Kits

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Summary

This document describes the development of the annual update to the standard practice baseline (SP) used in the Modified Lighting Calculator including:

- A description of the analysis performed on current EnergyStar (E*) and Design Lights Consortium (DLC) product lists to estimate SP and minimum eligibility performance in terms of efficacy (in lumens per Watt or lm/W)
- Updates to the SP for Normal Replacement (NR) and New Construction (NC) measure application types (MAT)
- Minimum efficacy (in lm/W) required for LED products to be eligible for incentives
- Updates to anticipated annual improvements to the SP that estimate the future standard practice applicable to Accelerated Replacement (AR) MATs.A comparison of methods and results of this SP update to the previous SP update
- An explanation of differences compared to Willdan's 2021 standard practice study[1]

Background

The currently approved MLC includes SP for the following scenarios:

1. Current industry SP for Normal Replacement (NR) and New Construction (NC) measure application types (MAT): This SP represents typical product choices and installations for lighting projects currently occurring outside of an energy efficiency program.
2. Future SP for all MATs: CPUC staff directed that second baselines in Accelerated Replacement (AR) MATs as well as subsequent years of NR/NC to consider the anticipated improvements of fixture performance into the future.

In addition to the SP levels, the MLC also identifies two efficiency tiers set at 50% and 75% levels of available market efficacy range for all the products. The MLC includes warnings when any measure does not at least meet the lower tier requirements.

In its most recent early opinion (EO) CPUC directed the MLC be updated in annually[2]. The PAs, Willdan and the CPUC have also been meeting quarterly to review MLC topics. During the most recent meeting, CPUC staff requested the SP update be submitted through SDG&E as a stand-alone document. CPUC staff also requested the SP update include the following:

[1] See document "MLC-StandardPracticeDevelopement-27Aug2021-Final.docx"
[2] See document "Early Opinion_ SDGE-MLC_CPUC staff 3rd response_20210916.docx"

1. Minimum eligibility criteria applicable to all measures. This minimum eligibility requirement would replace the warnings in the current MLC with minimum efficacy requirements that must be met for products to be eligible for incentives.
2. Standard practice for indoor cannabis growth, which may, depending on industry trends, includ a mixture of LED and non-LED technologies. Willdan is in the process of completing this analysis and should complete this work by November 4, 2022.

1. Standard Practice Baseline Development

To estimate current standard practice, we (Willdan staff and contractors) collected and analyzed several product datasets published in the Design Lights Consortium (DLC) and EnergyStar product databases. We reduced the total number of data records using the following process[3]:

1. DLC "Parent" Fixtures: Products listed as "Parent" in the DLC include test results for input power and output lumens. We limited our analysis to only products listed in the DLC as being a parent product.
2. California Title 20 Compliant Energy Star Lamps and Fixtures: For Energy Star, we limited our analysis to products that met the efficacy and compliance score required by California Title 20.
3. Trimming of Outliers: Examination of the best and worst performing products in any particular product class shows that these products are not readily available in the marketplace, or, in some cases, the efficacy listed in the database is much higher (or lower) than the efficacy listed in the manufacturer literature. We found that limiting the products analyzed to those between the 1st and 99th percentile of efficacy range of products introduced onto the list in each year removed the extreme highest and lowest performers that are typically not available in the market.

The updated standard practice baseline reflects the 25th percentile of listed products within a particular product class, filtered as described above. We also limited the analysis to listing the years 2020, 2021 and 2022. This resulted in a limited number of delisted previously listed under older technical versions (e.g., DLC 4.0 or E* 2.0) with most of the products, typically about 90%, listed under current or recently expired requirements (DLC 5.0/5.1, E* 2.1). While products listed under older versions of DLC and E* are no longer considered "qualifying products" within their respective rating systems, we assumed that delisted products within this time frame were likely still available for purchase and therefore should be considered in the development of the standard practice baseline. For some product classes there were not sufficient quantities of listed products in the years 2020, 2021 or 2022 needed to develop a reasonable standard practice so additional, earlier years were added to develop the standard practice baseline. The standard practice is the average efficacy of the 25th percentile of all selected years, weighted by the efficacy and quantity of listed products of each selected year.

2. Development of Minimum Eligibility Criteria

Eligibility requirements were developed following the same process as the standard practice development. Minimum eligibility is set at the 75th percentile. Setting this level as the minimum efficacy

[3] The general data filtering process is described in the document "MLC-StandardPracticeDevelopement-27Aug2021-Final.docx" submitted in response to CPUC early opinion. See CPUC early opinion and Willdan response document "Early Opinion_ SDGE-MLC_CPUC staff 2nd response_06222021 (RESPONSE 8.20.2021)-FINAL.docx".

to qualify for incentives means that 25% of listed products would be eligible for incentives. This is consistent with CPUC best practices to target the best technologies available in the marketplace[4].

3. Development of Annual Efficacy Improvement

Estimates of annual incremental improvements are required to calculate the standard practice baseline that would be installed at the end of the RUL period in accelerated replacement measures. When a listed product type is showing a clear trend of improvement in efficacy year-over-year, then it is reasonable to assume that product installed several years in the future will be more efficient than products installed today with the same level of service. The incremental improvement was developed using the same set of filtered products lists as the standard practice baselines and minimum eligible performance levels described above. The incremental improvement is equal to the linear slope through the selected years, subject to the following adjustments:

a. Annual changes in efficacy are assumed to never be negative
b. When the slope of the performance improvement appeared to be overweighted by a single year with much higher performance, the slope of the trend was reduced by 50%. In general, most products showed no incremental improvement. Those that did ranged from 1 to 3 lm/W/yr.

4. Example of Steps 1, 2 and 3

The figures below illustrate and example, using interior high-bay fixtures, of the steps followed to develop the standard practice baseline, minimum measure performance and annual improvement to both the standard practice and measure performance. See Attachment A for the full results of this analysis along with a comparison to values from the previous study.

Figure 1 shows the 25th, 50th and 75th percentile values for products filtered for parent products, trimmed outliers and the years of 2017-2022.

Figure 2 shows the results with an additional filter for the years 2020, 2021 and 2022. Furthermore, the results are weight-averaged using the counts of listed products in each year.

[4] D.18-05-041 COL3 (**bold underline** emphasis added):
The following guidance with respect to design of incentives to be paid to customers or implementers should be considered "best practices" and both program administrators and third parties should strive for consistency with these guidelines within the business plan period, but these are not mandatory:

a. Incentives should generally be calculated on a net lifecycle savings basis, not a first-year savings basis, to support and align with achievement of portfolio net lifecycle savings goals.
b. Incentives should generally be tiered to promote increasing degrees of efficiency above code, particularly when an existing conditions baseline is used and when the direct install delivery channel is used.
c. Incentives should generally be strategically targeted at commercially available products that offer higher and highest degrees of efficiency and quality, not at all above-code high efficiency products.
d. Incentive structure should take into consideration the variation in barriers to efficiency upgrades faced by different customer segments, instead of being set uniformly for a measure class.
e. For performance based programs, payment of customer and contractor incentives should tie, in significant part (50 percent or more), to independently verified savings performance estimated on a 12 month post-implementation period for capital projects and 24 months, if the project includes behavioral, retrocommissioning, or operational savings, for projects with savings measured with normalized metered energy consumption approaches.

These additional steps result in increased values for the standard practice baseline (25th percentile) and minimum measure performance (75th percentile).

Figure 3 shows the determination of the annual incremental improvement. For high-bay fixtures, there is no expected improvement in the standard practice performance.

High Bays for Commercial and Industrial Buildings

	Measure and Savings Values Calculated Based on Percentile Bins									
	Minimum Efficacy of Each Bin					Savings %		Quantity Within Each Bin		
Year	0	25%	50%	75%	100%	Tier 1	Tier 2	25%	50%	75%
2011	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	0	0
2012	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	0	0
2013	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	0	0
2014	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	0	0
2015	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	0	0
2016	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	0	0
2017	103.1	123.4	128.8	133.0	154.5	0.06	0.14	1,509	754	758
2018	105.0	127.9	131.1	138.3	170.1	0.05	0.16	1,316	661	659
2019	105.1	130.0	133.6	140.3	172.8	0.05	0.16	991	501	497
2020	116.1	134.2	136.0	144.5	175.0	0.04	0.15	584	447	340
2021	120.0	135.0	137.7	145.0	178.4	0.04	0.16	795	376	421
2022	118.8	135.0	138.9	148.3	177.4	0.06	0.16	409	205	205
ALL	105.0	128.7	134.0	140.0	171.0	0.06	0.16	5,690	2,728	3,020

Using the list trimmed to include only parent products and removing products below the 1st and above the 99th percentile results in a standard practice (25th percentile) of 128.7 lm/W and a minimum measure performance (75th percentile) of 140.0 lm/W

Figure 1 - Step 1a: Filter for Parent Products and Removing Outliers

Year	Gen. App.	Percentiles			Quantity		
		25%	50%	75%	25%	50%	75%
2020	High-Bay	134.2	136.0	144.5	584	447	340
2021	High-Bay	135.0	137.7	145.0	795	376	421
2022	High-Bay	135.0	138.9	148.3	409	205	205
ALL	**High-Bay**	**128.7**	**134.0**	**140.0**	**5,690**	**2,728**	**3,020**

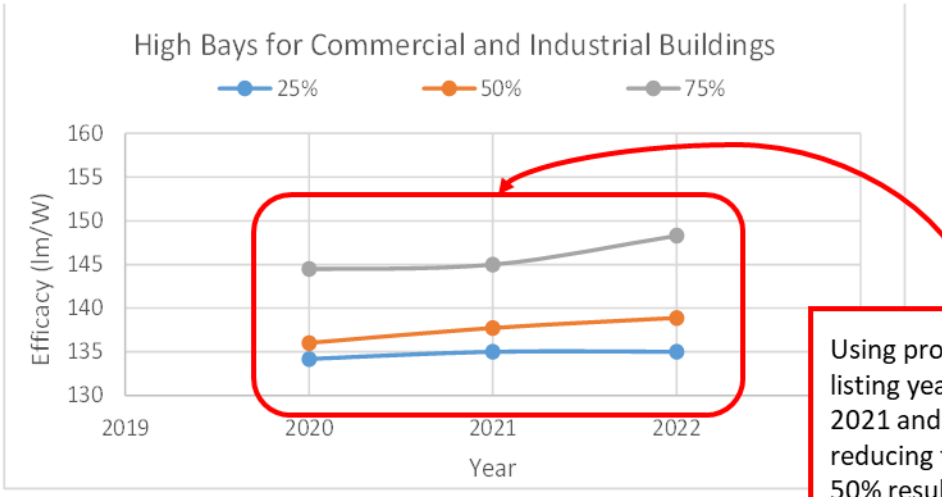
	weighted averages		
	25%	50%	75%
2020, 2021, 2022 High-Bay	**135.0**	**137.0**	**146.0**

Weighted average values for years 2017-2022 from Figure 1

Values for only the years of 2020, 2021, 2022 from Figure 1

Removing older listing years (using only 2020, 2021 and 2022) results in higher standard practice (25th percentile) and minimum measure performance (75th) percentile

Figure 2 - Step 1b/Step 2: Filter Most Recent Listing Years (2020, 2021 and 2022)



ROUND	Mult.
0	0.5

weighted averages			slopes		
25%	**50%**	**75%**	**25%**	**50%**	**75%**
135.00	137.00	146.00	0.21	0.72	0.95
135.00	137.00	146.00	0.00	1.00	1.00

Using products from listing years of 2020, 2021 and 2022 and reducing the slope by 50% results in no annual increase for the standard practice (25th percentile) and an annual increase of 1 lm/W in the minimum measure performance (75th percentile).

Figure 3 – Step 3: Annual Performance Improvement

5. Comparison to 2021 Standard Practice Study Methods

There are several differences in assumptions and methods compared to the 2021 standard practice study, each described below:

a. Fewer analysis years: We chose to filter the products to those listed in 2017 based on and assumption that products listed prior to 2017 had likely been replaced by newer models. Furthermore, if the years 2020-2022 included sufficient products to estimate standard practice, minimum measure performance and annual improvements, then the data set of listed products was further filtered by those years.

b. Use of percentile (product count) instead of the range of efficacy: This version of the standard practice is efficacy of the 25th percentile of a selected product data set. That is, the standard practice represents a performance where 25 percent of the listed products have lower efficacy and would not represent what would typically be installed outside of an energy efficiency program. Furthermore, a single minimum measure performance has been selected at the 75th percentile, or a point where 75% of the listed products have lower efficacy and 25% have higher efficacy. In contrast, the previous standard practice study established two efficiency tiers representing: Tier 1, represented by 50% of the difference between the minimum and maximum efficacy observed for a selected product data set, and Tier 2 representing 75% of that difference.

   This approach was explored for this update. What we found (and this was true for the 2021 study as well) is that this limited the number of available products in the highest tier and created a wide range of available products in Tier 1. Furthermore, the relative distribution between the efficiency tiers was not consistent across product classes which had the appearance of setting different performance standards for different products. Ultimately, we decided on a single minimum performance, set at the 75th percentile. This new definition is higher than the 2021 Tier 1 and is sometimes lower than 2021 Tier 2 efficacy.

c. Minimum measure performance: This study also includes a proposal to set a minimum measure performance equal to the 75th percentile of products within a selected product data set. It is proposed that this minimum performance be required for all custom and deemed measures, including measures available in the MLC. The MLC will be revised to remove, by default, savings and costs from the total savings and costs for the projects that do not meet or exceed the minimum required performance. Records in the "Inputs" sheet of the MLC that do not meet the 75th percentile performance requirement will be noted with a warning that savings will not be counted toward the overall project savings. Willdan also proposes that users be allowed to override this exclusion, thus allowing the savings and costs, and then require additional evidence and documentation supporting the difficulty in purchasing products that meet the minimum performance requirements. Examples of products that might fall into this category are fixtures used in sanitary and severe conditions such as refrigerated food or meat processing and fixtures used in high security areas such as prison cell blocks or jail cells.

6. Comparison to 2021 Standard Practice Study Results

Table 1 provides a comparison of 2021 and 2022 performance analysis results. Note the following:

1. 25% columns represent the standard practice baseline. For the 2021 study, this was 25% of the range of minimum and maximum efficacies for the listed product type. For the 2022 update, this represents efficacy of the 25th percentile (or the lowest performing fourth) of all listed products for a product type.
2. 50% columns represent the "market midpoint." For the 2021 study, this was 50% of the range of minimum and maximum efficacies for the listed product type. For the 2022 update, this represents efficacy of the 50th percentile (or the lowest performing half) of all listed products for a product type. Also note that for the 2022 study this value will not be used in the MLC and will not be the basis for any measures.
3. 75% columns represent the highest performing products available. For the 2021 study, this was 75% of the range of minimum and maximum efficacies for the listed product type. For the 2022 update, this represents efficacy of the 75th percentile (or the performing three-forths) of all listed products for a product type. Also note that for the 2022 study this value represents the minimum performance required for a lighting product to be eligible for incentives.
4. Entries of "n/a" for 2021 can mean either of the following:
    a. The 2021 standard practice study did not examine the product type, or
    b. The 2021 standard practice study included an analysis of the product type but there were not sufficient quantities of listed products to estimate a standard practice.
5. Entries of "n/a" for 2022 indicates that the current standard practice update included an analysis of the product type but there were not sufficient quantities of listed products to estimate a standard practice.

Table 1 - Comparison of 2021 and 2022 Analysis Results

Product Group	Product Type	Product Application	Performance Level						Annual Performance Improvement					
			25%		50%		75%		25%		50%		75%	
			2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
Indoor Luminaires	Wall-Wash Luminaires	Directional	80	88	90	91	100	94	0	0	0	0	0	0
	Track or Mono-Point Directional Luminaires	Directional	80	85	90	91	100	98	0	2	0	2	0	3
	Display Case Luminaires	Case Lighting	100	109	110	130	120	143	0	0	0	0	0	0
	Horizontal Refrigerated Case Luminaires	Case Lighting	105	93	120	97	130	104	0	0	0	0	0	0
	Vertical Refrigerated Case Luminaires	Case Lighting	96	99	108	110	120	114	0	0	0	0	0	0
	2x2 Luminaires for Ambient Lighting	Troffer	115	111	120	123	130	126	0	0	0	0	0	0
	1x4 Luminaires for Ambient Lighting	Troffer	105	111	115	120	125	125	0	1	0	1	0	0
	2x4 Luminaires for Ambient Lighting	Troffer	115	114	125	125	135	127	0	2	0	0	0	0
	Direct Linear Ambient Luminaires	Linear Ambient	118	121	128	130	140	133	0	1	0	0	0	0
	Linear Ambient Luminaires w Indirect Component	Linear Ambient	112	115	122	117	133	127	0	0	0	0	0	0
	Low Bay for Commercial and Industrial Buildings	Low-Bay	125	129	140	131	150	137	2	1	1	1	0	1
	High Bays for Commercial and Industrial Buildings	High-Bay	133	135	146	137	160	146	4	0	2	1	0	1
	High Bay Aisle Luminaires	High-Bay	129	117	138	127	150	140	5	3	3	3	0	2
Retrofit Kits for Indoor Luminaires	Integrated Retrofit Kits (1x4)	Troffer	115	121	125	126	131	129	1	0	1	0	1	1
	Integrated Retrofit Kits (2x2)	Troffer	113	125	123	126	132	131	0	0	0	1	0	1
	Integrated Retrofit Kits (2x4)	Troffer	120	125	130	127	140	133	0	0	0	0	0	0
	Linear Retrofit Kits (1x4)	Troffer	110	110	118	117	130	126	0	0	0	0	0	0
	Linear Retrofit Kits (2x2)	Troffer	116	114	123	121	130	125	2	2	0	1	0	1
	Linear Retrofit Kits (2x4)	Troffer	117	116	125	126	130	131	2	0	1	0	0	0
	Retrofit Kits for Direct Linear Ambient Luminaires	Linear Ambient	125	130	140	133	153	144	4	0	4	0	4	2
	Retrofit Kits for High-Bay Luminaires	High-Bay	120	124	130	131	145	144	0	1	0	0	0	0
	Retrofit Kits for Low-Bay Luminaires	Low-Bay	120	132	130	140	145	145	0	0	0	0	0	0
Outdoor Luminaires	Architectural Flood and Spot Luminaires	Low Output	110	117	120	123	130	129	2.5	2	2	3	0	2
		Mid Output	110	121	120	126	130	134	1	2	0	1	0	0
		High Output	115	126	130	132	145	138	2.4	0	3.4	0	3.4	0
		Very High Output	120	128	135	135	150	142	3.5	1	4	1	4	1
	Bollards	Low Output	105	116	115	121	120	127	2.5	0	3.5	0	4.5	0

Product Group	Product Type	Product Application	Performance Level						Annual Performance Improvement					
			25%		50%		75%		25%		50%		75%	
			2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
		Mid Output	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		High Output	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Very High Output	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Fuel Pump Canopy Luminaires	Low Output	110	120	125	128	130	137	4	0	4	0	4	0
		Mid Output	120	121	130	126	140	133	4	0	4	0	4	0
		High Output	120	129	130	136	140	144	2.5	0	2.5	0	2.5	0
		Very High Output	120	145	130	148	140	151	0	0	0	0	0	0
	Landscape and Spot Luminaires	Low Output	95	91	105	92	110	98	0	0	0	0	0	0
		Mid Output	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		High Output	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Very High Output	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Outdoor Full-Cutoff Wall-Mounted Area Luminaires	Low Output	110	119	125	126	140	132	0	1	0	1	0	1
		Mid Output	115	120	125	126	135	133	1	1	0	1	0	1
		High Output	115	123	128	130	140	137	0	0	0	0	0	0
		Very High Output	120	n/a	135	n/a	150	n/a	0	n/a	0	n/a	0	n/a
	Outdoor Non-Cutoff & Semi-Cutoff Wall-Mounted Area Luminaires	Low Output	115	121	125	128	135	134	2.5	0	3	0	3.5	0
		Mid Output	120	125	130	134	140	140	3	0	3	1	3	1
		High Output	120	126	130	133	135	139	3	1	2.5	2	1.5	2
		Very High Output	120	n/a	130	n/a	135	n/a	3	n/a	2.5	n/a	1.5	n/a
	Outdoor PoleArm-Mounted Area and Decorative Luminaires	Low Output	100	107	110	115	120	121	2	0	1.5	0	0	2
		Mid Output	105	113	115	121	125	128	0	0	0	0	0	2
		High Output	110	118	118	122	125	132	0	2	0	2	0	5
		Very High Output	105	n/a	115	n/a	120	n/a	0	n/a	0	n/a	0	n/a
	Outdoor PoleArm-Mounted Area and Roadway Luminaires	Low Output	110	117	125	128	140	140	2	2	1	0	0	1
		Mid Output	110	121	125	132	140	138	1	3	1	1	0	1
		High Output	118	126	135	133	150	141	0	0	0	1	0	1
		Very High Output	120	122	135	132	150	141	4	3	4	2	4	2
	Parking Garage Luminaires	Low Output	115	120	125	128	140	135	2.5	3	0	1	0	0

Product Group	Product Type	Product Application	Performance Level						Annual Performance Improvement					
			25%		50%		75%		25%		50%		75%	
			2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
		Mid Output	120	121	130	128	140	132	2.5	1	2.5	0	2.5	1
		High Output	120	127	130	131	140	138	2.5	0	2.5	0	2.5	0
		Very High Output	110	n/a	120	n/a	130	n/a	0	n/a	0	n/a	0	n/a
	Stairwell and Passageway Luminaires	Low Output	110	121	120	125	130	131	0	1	0	1	0	0
		Mid Output	115	123	125	128	130	130	2.5	0	2.5	0	2.5	0
		High Output	110	126	120	128	130	130	0	0	0	0	0	0
	Specialty - Sports Flood	Very High Output	110	108	130	112	140	112	0	2	0	1	0	1
Retrofit Kits for Outdoor Luminaires	Retrofit Kits for Large Outdoor PoleArm-Mounted Area and Roadway Luminaires	Low Output	100	n/a	125	n/a	130	n/a	0	n/a	0	n/a	0	n/a
		Mid Output	100	n/a	125	n/a	130	n/a	0	n/a	0	n/a	0	n/a
		High Output	110	128	120	128	130	128	0	0	0	0	0	0
		Very High Output	110	104	120	106	130	121	0	0	0	0	0	0
	Retrofit Kits for Outdoor Full-Cutoff Wall-Mounted Area Luminaires	Low Output	100	107	110	109	120	111	1	0	0	0	0	0
		Mid Output	100	108	115	110	130	120	0	0	0	0	0	0
		High Output	110	114	120	114	130	114	0	0	0	0	0	0
		Very High Output	110	n/a	120	n/a	130	n/a	0	n/a	0	n/a	0	n/a
	Retrofit Kits for Outdoor Pole-Arm Mounted Area and Roadway	Low Output	110	107	120	109	130	122	0	0	0	0	0	0
		Mid Output	110	106	120	113	130	120	0	0	0	0	0	0
		High Output	110	117	120	123	130	128	0	0	0	0	0	0
		Very High Output	110	107	120	115	130	117	0	0	0	0	0	0
	Retrofit Kits for Outdoor PoleArm-Mounted Decorative Luminaires	Low Output	95	102	107.5	108	120	115	2	0	2	0	0	0
		Mid Output	100	108	110	114	120	118	2	0	2	0	0	0
		High Output	100	118	110	121	120	123	2	0	2	0	0	0
		Very High Output	100	n/a	110	n/a	120	n/a	2	n/a	2	n/a	0	n/a
TLEDs	TLEDs (Type A)	T5 Four-Foot	117	121	121	122	127	125	1	0	0	0	0	0
		T5HO Four-Foot	115	119	118	121	123	123	2	0	2	0	2	0
		T8 Eight-Foot	119	117	121	119	123	123	0	1	0	0	0	2
		T8 Four-Foot	123	122	134	128	142	134	2	0	2	0	2	0
		T8 Two-Foot	118	119	124	120	132	123	1	0	1	0	0	2

Product Group	Product Type	Product Application	Performance Level						Annual Performance Improvement					
			25%		50%		75%		25%		50%		75%	
			2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
		T8 Three-Foot	117	120	121	121	126	122	1	0	1	0	1	2
	TLEDs (Type B)	T5 Four-Foot	128	128	136	134	144	139	2	0	2	0	2	1
		T5HO Four-Foot	115	126	118	130	123	139	2	0	2	0	2	0
		T8 Eight-Foot	132	127	135	131	137	136	0	2	0	1	0	1
		T8 Four-Foot	128	125	143	135	154	148	2	0	2	0	2	0
		T8 Two-Foot	122	120	134	126	142	136	1	0	0	0	0	1
		T8 Three-Foot	120	118	127	120	137	124	1	1	1	0	1	2
	TLEDs (Type C)	T5 Four-Foot	128	124	136	130	144	138	2	2	2	1	2	2
		T5HO Four-Foot	115	123	118	126	123	127	2	1	2	1	2	0
		T8 Eight-Foot	132	126	135	127	137	128	0	0	0	0	0	0
		T8 Four-Foot	128	127	143	136	154	147	2	0	2	0	2	0
		T8 Two-Foot	122	121	134	127	142	133	1	1	0	0	0	0
		T8 Three-Foot	120	119	127	130	137	135	1	0	1	0	1	0
Mogul (E39)	Replacement Lamps for Low-Bay Luminaires (Type B)	Low-Bay	n/a	116	n/a	123	n/a	128	n/a	3	n/a	1	n/a	0
	Replacement Lamps for High-Bay Luminaires (Type B)	High-Bay	n/a	123	n/a	130	n/a	140	n/a	3	n/a	3	n/a	1
	Replacement Lamps for Outdoor PoleArm-mounted Area and Roadway Luminaires (Type B)	Low Output	n/a	111	n/a	116	n/a	117	n/a	0	n/a	0	n/a	1
		Mid Output	n/a	111	n/a	112	n/a	116	n/a	0	n/a	0	n/a	0
		High Output	n/a	108	n/a	113	n/a	116	n/a	1	n/a	0	n/a	0
	Replacement Lamps for Outdoor PoleArm-mounted Decorative Luminaires (Type B)	Low Output	n/a	109	n/a	114	n/a	118	n/a	2	n/a	3	n/a	2
		Mid Output	n/a	105	n/a	112	n/a	115	n/a	2	n/a	0	n/a	1
		High Output	n/a	110	n/a	114	n/a	120	n/a	2	n/a	1	n/a	0
	Replacement Lamps for Outdoor PoleArm-mounted Area and Roadway Luminaires (Type C)	Low Output	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Mid Output	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		High Output	n/a	105	n/a	106	n/a	108	n/a	0	n/a	0	n/a	0
Four Pin-Base	2G11 Base Lamps (Type A)	2G11 Base	n/a	123	n/a	124	n/a	126	n/a	0	n/a	0	n/a	0
	2G11 Base Lamps (Type B)	2G11 Base	n/a	120	n/a	121	n/a	122	n/a	0	n/a	0	n/a	2
	2G11 Base Lamps (Type C)	2G11 Base	n/a	125	n/a	126	n/a	138	n/a	0	n/a	0	n/a	0
	Horizontally Mounted Lamps (Type A)	Horizontal Mount	n/a	87	n/a	92	n/a	100	n/a	0	n/a	0	n/a	0

Product Group	Product Type	Product Application	Performance Level						Annual Performance Improvement					
			25%		50%		75%		25%		50%		75%	
			2021	2022	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
	Vertically Mounted Lamps (Type A)	Vertical Mount	n/a	86	n/a	87	n/a	94	n/a	0	n/a	1	n/a	0
(ES) Downlight Fixtures/ Retrofits	Downlight Retrofits	Retrofit	72	72	83.5	79	95	86	0	0	1	0	1	0
	Downlight Fixtures	Surface Mount	65	70	75	77	85	86	1	0	0	0	0	0
		Recessed	69	64	79	70	89	79	0	1	0	0	0	1
		Pendant	77	82	84.5	90	92	93	0	0	0	0	0	0
		Any	61	63	68	72	75	77	0	0	0	0	0	0
(ES) Bulbs	Bulbs	A Lamp	91	90	105	99	120	112	3	0	3.5	0	4	0
		Candelabra	90	89	93	91	104	93	0	0	0	0	0	2
		Globe	91	89	99	91	108	95	1.5	0	1	0	0.5	2
		MR16	77	73	82	74	89	80	0.5	0	1	0	1	0
		Other	100	92	110	102	120	121	0	0	0	0	0	0
		Reflector	85	84	95	89	105	91	3	0	3	0	3	1