Delta Watt Update (MA19R02-E)

FINAL

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SUBMITTED TO:
Massachusetts Electric Program Administrators and Energy Efficiency Advisory Council Consultants

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Executive Summary

This evaluation was conducted on behalf of the Massachusetts Program Administrators (PAs) to update some of the inputs used to calculate LED delta watts in the RLPNC 17-6 Lighting Market Adoption Models (MAMs). The PAs and EEAC consultants agreed to update equivalent wattage and sales weights based on 2018 program tracking data, which ties the delta watts directly to program sales. However, they also agreed to retain the estimated future market share values from the 2017 MAMs (RLPNC 17-6). The decision to keep the same future market share estimates reflected the continued market uncertainty related to federal standards, which existed when the estimates were developed in 2017 and remain in place now. Further, based on developments over the past year, the market is generally moving in the direction that MAM participants assumed when they made their predictions in 2017. Therefore, the PAs and EEAC consultants agreed that little value would be gained in updating market share for 2018.

Methods

NMR reviewed and cleaned the 2018 sales data obtained from EFI. In total, the data contained sales records for 7,149,075 LEDs. After cleaning, NMR grouped LEDs into three types: General Service (GSL) (71%), Reflector (17%), and Specialty (11%). NMR was unable to categorize about one-percent of LEDs due to insufficient information.

As the EFI data do not include equivalent incandescent wattage, after categorizing LEDs by type, NMR leveraged web scraping and 2018 shelf stocking data to lookup manufacturer-specified equivalent incandescent wattage. In total, we were able to assign incandescent wattage for 80% of total LEDs sold in 2018 (or 71% of unique LED model numbers). These equivalent incandescent wattages were used to assign LEDs to the appropriate 2017 MAM equivalent wattage bins. After binning LEDs, we updated sales weights, which are equivalent to the proportions of 2018 program-supported bulbs in each wattage bin.

Findings

Updating the wattage by bulb type and sales share based on actual 2018 LED sales resulted in increased delta watts for GSL and Specialty and decreased delta watts for Reflectors (Table 1). These changes are based on differences in types of bulbs purchased through the program in 2018 versus 2017. Generally, in 2018, consumers purchased a higher proportion of high equivalent wattage LEDs in the GSL and Specialty categories, and lower equivalent wattage LEDs in the Reflector category through the program. Net delta watts are presented in Table 7 in the body of this report.

Table 1: MAM Gross Delta Watt Comparison 2017 vs. 2018 (Sales Share and Wattage Update)

Bulb Type and MAM Year	Delta Watts[1]							
	2018	2019	2020	2021	2022	2023	2024	2025
GSL 2017	33	33	34	34	34	34	34	35
GSL 2018	36	36	38	38	38	38	38	38
Reflector 2017	46	46	46	47	47	47	47	47
Reflector 2018	45	45	45	46	46	46	46	46
Specialty 2017	36	37	37	38	39	39	40	40
Specialty 2018	39	40	41	41	42	42	42	43

[1] Note: All values rounded to nearest watt. Values are not rounded in the attached MAM Excel files.

CONSIDERATIONS, AND GUIDANCE

This study does not make any recommendations. However, in this section, NMR offers one consideration and one point of guidance for future study planning. For each, we offer a rationale based on the findings from evaluation activities conducted as part of this study.

Considerations

Consideration 1. The PAs, evaluators, and implementers should meet to discuss how best to track key bulb characteristics, including: lumen output, equivalent incandescent wattage, and bulb shape.

Rationale: These key characteristics are important for determining the blended baseline for LEDs sold through the program. Historically, evaluators have looked up these values based on the model number of LEDs sold through the program. However, such details should be available directly from manufacturers and retailers when products are added to the program. Tracking these data would reduce the need to lookup values at the end of each year and eliminate missing data from the analysis.

Consideration 2. The PAs, evaluators, implementers, and the rebate processing company should meet to discuss how to categorize bulb types.

Rationale: Nearly all filament style lamps were categorized as EISA exempt in the program data. Filament style bulbs are not one of the 22 EISA exempt categories. While some filament bulbs had shapes, lumen output, or base sizes that qualified them as EISA exempt, others should have been classified as GSLs. For a full list of exempt categories and a flowchart detailing exemption, please see Section 2.4.

Guidance for Future Study Planning

Guidance 1: To expedite analysis, future evaluators should consider requesting a preliminary data set from EFI earlier in the year, including key bulb characteristics such as lumen output, equivalent incandescent wattage, and bulb shape.

Rationale: Historically, evaluators have requested program tracking data from EFI once the program year has closed. While this generally has worked, it does not provide much time for data cleaning and analysis. In addition, data is often missing key details (lumen output, equivalent wattage, and other characteristics), and this year many bulbs were miscategorized, which required additional time to reassign. Coupled with delayed data delivery by EFI due to challenges stemming from a tracking system change, NMR has delivered this Delta Watts Update later than anticipated. An interim or early file requested mid-year would have provided us an opportunity to work out some of these issues in advance, well before the analysis deadline.

Section 1 Introduction

This evaluation was developed for the Massachusetts Program Administrators (PAs) to update the inputs used to calculate LED delta watts in the RLPNC 17-6 Lighting Market Adoption Models (MAMs). For the 2018 Annual Report, the PAs and EEAC consultants agreed to pursue a partial update to the MAM, focusing on updating equivalent wattage and sales weights based on 2018 program tracking data, which ties the delta watts directly to program sales, while keeping the market share values from the 2017 MAMs (RLPNC 17-6).[1,2]

The MAM nomenclature and timing are as follows. In Q1 of a given year, evaluation produces annual report MAMs that calculate delta watts based on the most recently completed program year. Thus, in Q1 2017 we delivered the 2016 Annual Report MAMs and in Q1 2018, we delivered the 2017 Annual Report MAMs. Historically, NMR used to produce a special MAM for three-year planning, but recent changes to the MAM inputs and structure mean that the 2017 Annual Report MAMs also doubled as the 2019 to 2021 three-year planning MAMs. This evaluation provides the results of updates to some of the 2017 Annual Report MAM inputs (wattage bins and sales weights), producing new delta watts that will inform the 2018 Annual Report. We suggest referring to this study's deliverables as the 2018 Annual Report Partial MAMs to avoid any future confusion with the 2017 Annual Report MAMs or giving the impression that the Q1 2019 effort represents fully updated MAMs.

METHODS

To update the sales weights and lumen bins, NMR reviewed and cleaned the 2018 sales data obtained from EFI. As the EFI data did not include equivalent incandescent wattage, after categorizing LEDs by type, NMR leveraged web scraping and 2018 shelf stocking data (collected by Lockheed Martin) to lookup manufacturer-specified equivalent incandescent wattage. In total, we were able to assign equivalent incandescent wattage for 80% of total LEDs sold in 2018 (or 71% of unique LED model numbers). These equivalent incandescent wattages were used to assign LEDs to the appropriate 2017 MAM equivalent wattage bins. After binning LEDs, we updated sales weights, which are equivalent to the proportions of 2018 program-supported bulbs in each wattage bin.

[1] To fully update a MAM, the PAs have typically turned to market share estimates from supplier interviews, sales data analysis, and on-site saturation visits and supplemented them with up-to-date market intelligence. The evaluation contractor then facilitated iterative process in which the PAs, EEAC Consultants, and evaluators reviewed the available information submitted market share predictions through 2025, discussed them, and then revised the estimates. The final market share predictions included in the MAM reflected the equally weighted market shares of each of the three groups. The PAs decided against both supplier interviews and the iterative market share predicted process, given the substantial efforts conducted for annual reporting in 2016 and annual reporting and three-year planning in 2017.

[2] http://ma-eeac.org/wordpress/wp-content/uploads/RLPNC_176_MAMMEMO_24APR2018.pdf

Section 2 Updates to 2017 MAM

In this section, we discuss the updates that were made to the 2017 MAMs based on a review of the 2018 sales data. We updated the MAMs in an iterative process so that we could isolate and summarize the impacts each of the updates had independently. The changes to the attached Excel-based MAM instruments are colored teal and bolded—these changes can be found on the Data Sources and Assumptions tab in cells B21-B24 and on the Gross, Net, and DI tabs in columns C, D, E, and F.

Key Findings

- Sales share updates were the primary driver in GSL and Reflector changes.
- Wattage bin and sales share shifts both drove changes in Specialty bulb delta watts.
- The following summarizes changes to first year gross and net delta watts:

	GSL	Reflector	Specialty
• Gross delta watts	**Increased** 3	**Decreased** 1	**Increased** 3
• Net delta watts	**Increased** 2	**Decreased** 2	**Increased** 2

2.1 Updated Sales Shares

Table 2 provides a comparison in the sales weights (proportion of LEDs sold) between 2017 and 2018. Based on our analysis, customers generally purchased a greater proportion of higher-equivalent wattage LEDs in 2018 vs. 2017 in the GSL and Specialty categories. The opposite was true for Reflectors.

Table 2: MAM Wattage Bins 2017 vs. 2018

Equivalent Wattage Category	2017 Proportion	2018 Proportion	Change
General Service LEDs (GSL)			
100 W	1%	11%	+10%
75 W	4%	4%	--
60W	78%	76%	-2%
40W	17%	9%	-8%
Reflectors			
125 W	8%	7%	-1%
65 W	86%	72%	-14%
45 W	6%	21%	+15%
Specialty			
75 W	1%	17%	+16%
60 W	33%	24%	-9%
40 W	66%	59%	-7%

Table 3 summarizes the impact the updated sales weights have on gross delta watts,[3] holding everything else in the 2017 MAM constant, including wattage bin updates. The table shows both the original 2017 delta watts and the updated delta watts for 2018 based on sales share updates. Values are rounded to nearest whole watt.

[3] Note: We show net delta watts at the end of this section, combining updates to sales weights and wattage bins.

Table 3: MAM Gross Delta Watt Comparison 2017 vs. 2018 (Sales Share Update Only)

Bulb Type and MAM Year	Delta Watts[1]							
	2018	2019	2020	2021	2022	2023	2024	2025
GSL 2017	33	33	34	34	34	34	34	35
GSL 2018	36	36	38	38	38	38	38	38
Reflector 2017	46	46	46	47	47	47	47	47
Reflector 2018	42	42	42	43	43	43	43	43
Specialty 2017	36	37	38	38	39	39	39	40
Specialty 2018	37	38	39	39	40	40	41	41

[1] Note: All values rounded to nearest watt. Values are not rounded in the attached MAM Excel files.

2.2 Updated Wattage Bin by Type

Table 4 provides an overview of the wattage assumed for each technology by incandescent-equivalent wattage category in the 2017 MAM and the updated values based on a review of 2018 sales data. For LEDs we used the observed average wattage. For the other lamp types, we matched to available products with the same equivalent wattage and lumen output, by type, found in web scraping and shelf stocking data—identifying CFL, halogen, or incandescent bulbs by lumen-class bin for each of the LEDs sold. For GSL LEDs, we have assumed an increase in efficiency in 2020 which yields two estimates. The 2018-19 GSL LED values are based on the average wattage observed in the 2018 sales data, the 2020-2025 values assume a decrease in LED wattage.

Wattages that were updated (changed) from 2018 are identified in the table as **white text with green background**. Specialty has the most changes in wattage, reflecting both the greater variety of bulbs in that category in 2018 and a general shift in the products purchased through the program.

Table 4: Updated MAM Wattage by Bulb Type

Equivalent Incand. Wattage Category	LEDs 2018-19, 2020-2025[1]		CFLs		Halogen		Incand.	
	2017	2018	2017	2018	2017	2018	2017	2018
General Service LEDs (GSL)								
100 W	15 13	**16** **14**	23	23	72	72	100	100
75 W	10 9	**11** **10**	18	**20**	54	54	75	75
60W	9 8	9 8	13	**14**	53	53	60	60
40W	6 5	6 5	9	**11**	29	29	40	40
Reflectors								
125 W	13	**16**	19	**23**	56	**64**	125	125
65 W	10	10	15	15	55	55	65	65
45 W	5	**6**	11	11	20	**41**	45	45
Specialty								
75 W	10	**16**	14	**26**	43	**88**	75	**100**
60 W	6	**5**	9	**10**	51	**40**	60	60
40 W	4	4	7	**6**	39	**32**	39	39

[1] Multiple values for GSL LEDs reflect assumed greater efficiency in 2020-2025

Table 5 summarizes the changes in gross delta watts (rounded to nearest whole watt) when updating only the wattage by type as shown in Table 4 (above).[4] That is, the values in Table 5 do **not** incorporate updated sales weights. The impact of updated wattage values was minimal (less than one full watt) for GSL and Reflectors moving only a fraction of a watt in both cases. For Specialty, the change was more pronounced with a **decrease** of 3 watts in the first year. The shift in Specialty was primarily the result of changes to the highest wattage bin (75 W equivalent). In 2018, none of the Specialty LEDs sold were 75 W equivalents; instead, they were primarily 100 W equivalent LEDs. As this is an update, we retain the nomenclature for the bins from the 2017 MAMs and refer to the highest bin as 75 W equivalent which could be viewed as 75 W equivalent or higher.

[4] Note: We show net delta watts at the end of this section, combining updates to sales weights and wattage bins.

Table 5: MAM Gross Delta Watt Comparison 2017 vs. 2018 (Wattage Update Only)

Bulb Type and MAM Year	Delta Watts[1]							
	2018	2019	2020	2021	2022	2023	2024	2025
GSL 2017	33	33	34	34	34	34	34	35
GSL 2018	33	33	34	34	34	34	34	35
Reflector 2017	46	46	46	47	47	47	47	47
Reflector 2018	46	45	46	46	46	47	47	47
Specialty 2017	36	37	38	38	39	39	39	40
Specialty 2018	33	34	35	35	36	36	36	37

[1] Note: All values rounded to nearest watt. Values are not rounded in the attached MAM Excel files.

2.3 Updated Sales Share and Wattage

After examining the impacts of changes in sales share and wattage in isolation, we updated both sales share and wattage in the MAM together (Table 6). Gross delta watts for GSL and Specialty increased, while delta watts for reflectors decreased relative to 2017. For Specialty the combination of sales weights and wattage bin shifts led to a net increase in delta watts, even though delta watts absent sales weights showed a decrease. Table 7 provides a summary of changes to net delta watts, which follow a similar pattern to gross delta watts.

Table 6: MAM Gross Delta Watt Comparison 2017 vs. 2018 (Sales Share and Wattage Update)

Bulb Type and MAM Year	Delta Watts[1]							
	2018	2019	2020	2021	2022	2023	2024	2025
GSL 2017	33	33	34	34	34	34	34	35
GSL 2018	36	36	38	38	38	38	38	38
Reflector 2017	46	46	46	47	47	47	47	47
Reflector 2018	45	45	45	46	46	46	46	46
Specialty 2017	36	37	37	38	39	39	40	40
Specialty 2018	39	40	41	41	42	42	42	43

[1] Note: All values rounded to nearest watt. Values are not rounded in the attached MAM Excel files.

Table 7: MAM Net Delta Watt Comparison 2017 vs. 2018 (Sales Share and Wattage Update)

Bulb Type and MAM Year	Delta Watts							
	2018	2019	2020	2021	2022	2023	2024	2025
GSL 2017	21	19	18	17	15	13	11	9
GSL 2018	23	21	20	18	16	14	12	10
Reflector 2017	32	30	29	27	25	23	21	18
Reflector 2018	30	27	26	25	23	21	19	17
Specialty 2017	26	25	24	23	22	20	18	16
Specialty 2018	28	27	26	25	23	22	20	17

[1] Note: All values rounded to nearest watt. Values are not rounded in the attached MAM Excel files.

The updated Excel-based MAMs are embedded below. The PAs use the values from these worksheets to update their lighting savings worksheet. While the values in this report are presented rounded to the nearest whole watt, the values in the worksheets are not.

MA19R02-E_GSL_2018ARPartialMAM_20

MA19R02-E_Reflector_2018ARPartialMA

MA19R02-E_Specialty_2018ARPartialMA

Section 3 Sales Data Review and Cleaning

Summary of steps and findings of deficiency.

Key Findings

- Analysis covers 71% of the recorded models and more than 80% of supported bulbs.
- Program sales data contained inconsistencies, errors and gaps.

3.1 Miscategorized Bulbs

In 91,224 records representing 2.8 million bulbs (39% of the program), the manufacturer was replaced with the name of the store or distributor:

- Ascent Battery en lieu of Duracell
- Central Distributors en lieu of GE
- Crown Supply en lieu of SATCO
- Electric Wholesalers en lieu of Philips
- Elong en lieu of Great Value
- Globe Value Lighting en lieu of EcoSmart
- Granite City en lieu of GE
- Techniart en lieu of QLS

The program tracking data flagged seven percent of bulbs as being EISA exempt that were not and three-percent of bulbs were not flagged as EISA exempt but were. These errors appear to be driven in part by miscategorizing A-line filament LEDs as exempt.

- 507,122 GSL LEDs were incorrectly labeled as EISA exempt
- 292 Reflector LEDs were incorrectly labeled as non-EISA exempt
- 248,272 Specialty LEDs were incorrectly labeled as non-EISA exempt

In addition, a small number of bulbs – 3,329 specialty bulbs (bullet, globe and 3-way) and 13 A-line bulbs – were recorded using a reflector measure code.

3.2 CLEANING

Lumen rating, wattage, equivalent wattage, bulb shape and 3-way status were filled in or cross-checked against the EFI-furnished data in multiple rounds and databases keyed by the make and model of the bulb.[5] Bulbs were checked against the following databases:

- CEE Qualifying Product List
- ENERGY STAR Certified Products
- Lockheed 2018 shelf-stocking
- NMR retailer web-scraping

In addition, the model numbers provided by many manufacturers included some or all of the requisite details, except lumens. For example, ECOSMART "ECS B11 60WE W27 E12 120 G1 3PK" is a 60W-equivalent bullet, 2700K color, with a candelabra base.

Despite drawing on these sources, many of the supported bulbs remained unidentifiable. To further increase the coverage of our analysis, we conducted manual searches for product information of large volume bulbs.

3.3 COVERAGE

The analysis in this report used data representing approximately 71% of the models present in the EFI data, and 80% of the bulbs sold (Table 8). Note that model coverage was difficult to measure accurately due to the industry practice of employing multiple model numbers for the same product, as well as separate designations for multi-packs.

Table 8: Analysis Coverage

Bulb Type	Net Quantity	Models
GSL	91%	75%
Reflectors	92%	76%
Specialty	97%	70%
TOTAL	80%	71%

3.4 EISA EXEMPTIONS

For Phase I of EISA, the DOE specifically identified 22 lamp types that were exempt (not subject to) by the EISA efficiency standards. Table 9 provides a listing of all 22 originally exempt GSL categories, and Figure 1 provides a flowchart to determine if a bulb is covered. Many bulbs were identified as EISA exempt in the program tracking data that were in fact not exempt. In many cases these bulbs were listed as filament style LEDs, which is not itself an exempt category

[5] Note: many model numbers in the EFI data had an extraneous Z appended to them, something future evaluators should be aware of if replicating this exercise.

(although shape, base type, or lumen output could instead make it exempt). In total, after cleaning, NMR estimates that the 71% of supported lamps were GSL, 17% Reflector, and 11% Specialty.

Table 9: EISA Exemptions

Number	GSL Exempt Category
1	Appliance Lamp
2	Black Light Lamp
3	Bug Lamp
4	Colored Lamp
5	Infrared Lamp
6	Left-Hand Thread Lamp
7	Marine Lamp
8	Marine Signal Service Lamp
9	Mine Service Lamp
10	Plant Light Lamp
11	Reflector Lamp
12	Rough Service Lamp
13	Shatter-Resistant Lamp
14	Sign Service Lamp
15	Silver Bowl Lamp
16	Showcase Lamp
17	3-Way Lamp
18	Traffic Signal Lamp
19	Vibration Service Lamp
20	G shape Lamp with diameter of five inches or more
21	T shape lamp of 40 W or less or length of ten inches or more
22	B, BA, CA, F, G16-1/2, G25, G30, S, M-14 lamp of 40 W or less
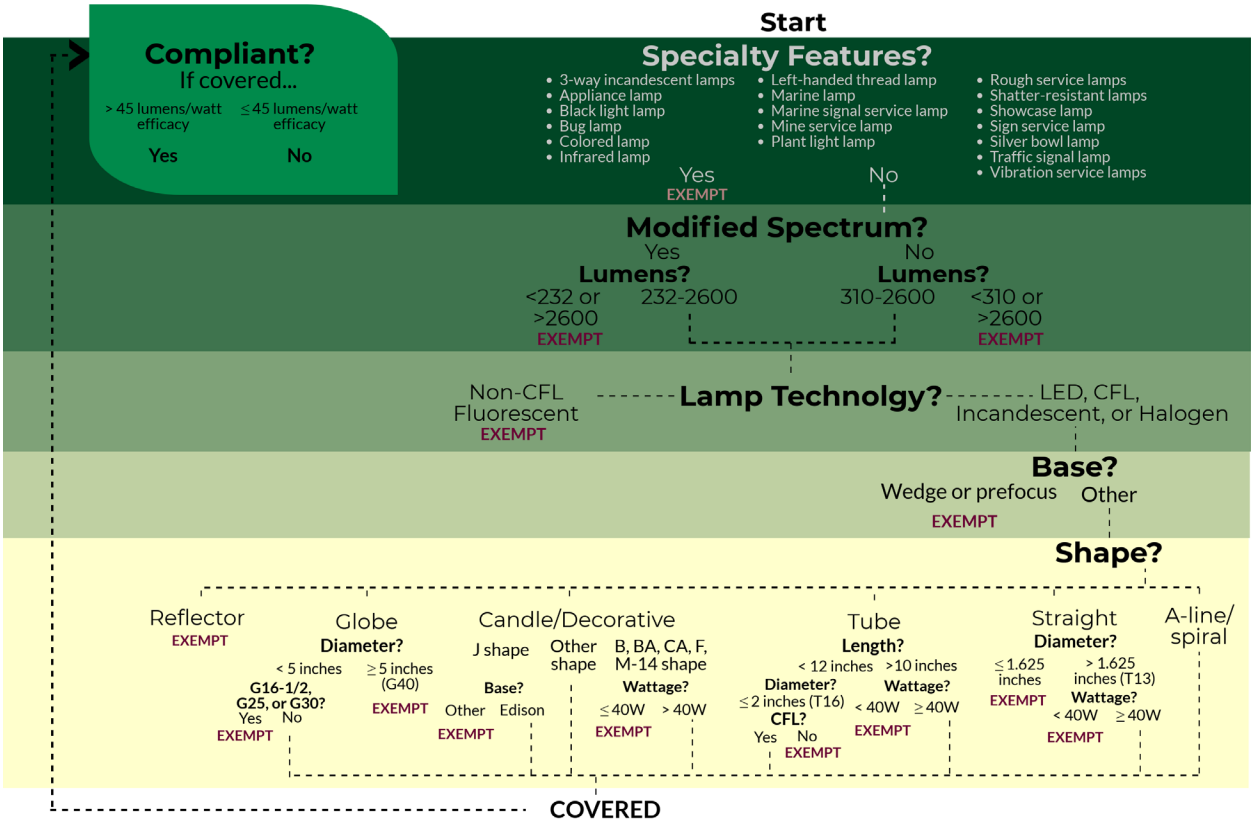
Figure 1: EISA Phase I Categories