Memo to:

Massachusetts Program Administrators

Massachusetts EEAC Consultants

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RE: Massachusetts C&I Adjusted Measure Lives for PY2021 and PY2022

This memo presents the results of the C&I lighting adjusted measure life (AML) calculations. The AML results are expected to be applied retrospectively to PY2021 and prospectively in PY2022. The updated results rely on the same market model forecasts (extended through 2030) as were used to calculate the PY2020 values. The only change in the approach is a methodological update to the replace-on-failure (ROF) component of the lifetime savings calculations to account for two-period savings due to different rated lifetimes for equipment types. Additionally, because of the time period of the analysis, we were able to improve the approach for determining the early replacement (ER) first period baseline. Rather than using the 2016 market share as a proxy for equipment that is being replaced, we used saturation estimates from the model to support the year of analysis.

1 INTRODUCTION

Gross lifetime savings for the Massachusetts Program Administrators' (PAs) C&I lighting programs are assessed as a product of the first-year annualized savings and the AML. The AML is the ratio of lifetime savings to first-year savings, as shown in Equation 1-1. Since lighting measures are subject to dual baseline savings methods, the AML is used to account for both replace-on-failure (ROF) and early replacement (ER). To estimate future baselines, the AMLs rely on market share forecasts in the program-ending scenario of the LED Market Model (the model).[1]

Equation 1-1. AML Ratio

$$Adjusted\ Measure\ Life\ =\ \frac{Lifetime\ Savings_{Program}}{First\ Year\ Savings_{Program}}$$

Due to the rapid adoption of LED technologies and a transforming market, first-year savings are declining, and future baselines are becoming more efficient over time. As the ratio of first-year savings and lifetime savings change, the AMLs are changing on an annual basis. It is important to note that AMLs are not the same as the expected useful life (EUL). Whereas the EUL is the average amount of years that a measure is estimated to function when its installed, the AML is the ratio of savings that the PAs use to calculate lifetimes savings in their tracking systems.

2 METHODOLOGY UPDATES

The following subsections outline changes made to the AML calculations for this update. The primary change was driven by the need to account for two-period lifetime savings estimates in the ROF component of the calculations. In addition to this change, we also used more reflective data to support the first-period baseline in the ER component of the calculations rather than a proxy value. There was no primary data collection or re-calibration of the model market share forecasts; however, the model forecasts were extended to address the need to estimate future baselines beyond the prior forecast period.

2.1 Replace-on-Failure Savings Update

The AML calculations are based on the same methodological approach as used in prior studies with one major exception – the lifetime savings for ROF measures, which represent 29% of installed program measures. This change was driven by the need to account for two-period lifetime savings estimates. Previously, LEDs installed through a ROF event were credited

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[1] https://ma-eeac.org/wp-content/uploads/MA20C09-E-LMC_LightingMarketCharacterization_FinalReport.pdf

with first-year savings for the full rated lifetime of the LED technology (50,000 hours/4,398 hours per year = 11.4 years). However, since non-LED technologies have a rated lifetime less than their LED counterparts, the hypothetical fluorescent fixture that serves as the first-year baseline would burn out prior to an LED, causing the customer to face market conditions for a second period of savings. The second period savings are instead based on a future baseline at which point the market has shifted further towards more efficient technologies. This shift in baselines between the first period and second period is compounded due to the fact that in the first period, LEDs are not included in the baseline to avoid overlap with net-to-gross (NTG) adjustments. However, in the second period, LEDs are included in the baseline since there are no longer conflicts with NTG.

As an example, in the ambient linear submarket, a hypothetical fluorescent (weighted combination of fluorescent T12, T5, and T8 sales) would burn out in 6.3 years. At that point, the customer would face market conditions in 6 years and would then be credited for 5.1 years (11.4 - 6.3) of savings at a more efficient baseline. Figure 2-1 diagrams this revised component of the AML calculation.

Figure 2-1. Diagram of ROF component of AML calculation (Ambient Linear LED)
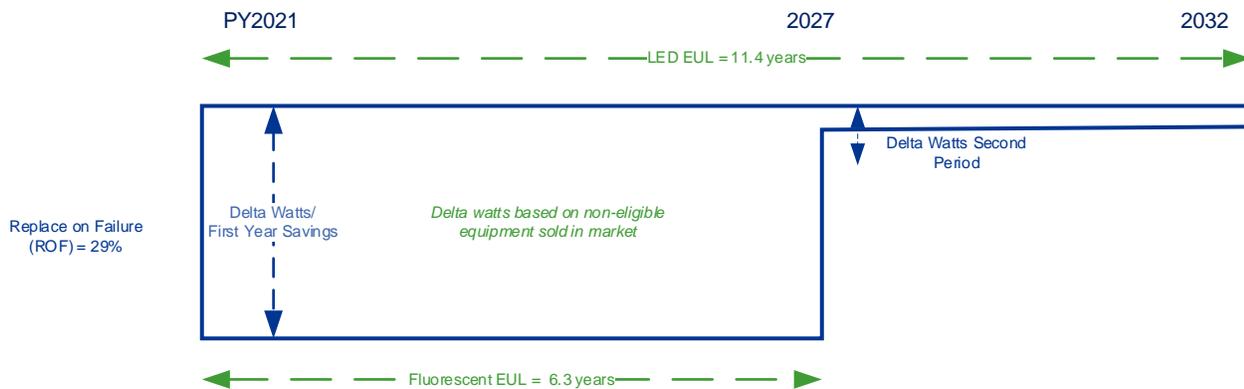
2.2 Extended Market Model Forecasts

The DNV team did not make any changes to the model forecasts that are used to estimate future baselines for this update. However, we extended the forecast period from 2027 to 2030 as estimating 2021 and 2022 AMLs requires baselines beyond 2027. Given the timing of this update, no primary data was collected to inform a re-calibration of the model, so the model forecasts used match those estimated as part of MA20C09-E-LMC: 2020 C&I lighting Market Characterization.[2]

The AML calculations leverage the program-ending scenario from the model. This scenario assumes that there is program activity in the market up until the year in which we calculate the AMLs. For 2020 AML calculations, we modeled the scenario as if the program ended at the start of 2020. To ensure consistency in methodology, we updated the end date of the program within the model scenarios for each year. For PY2021, we end the program at the start of 2021. Similarly, for PY2022, we end the program at the start of 2022. Forecasts of LED market share in these scenarios is presented in Appendix A for reference.

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[2] https://ma-eeac.org/wp-content/uploads/MA20C09-E-LMC_LightingMarketCharacterization_FinalReport.pdf

2.3   Improved Proxy for Early-Replacement Baselines

The first period baseline in the ER component of the AML calculation represents the savings compared to the equipment that was installed and thus replaced early. We assume one-third of the existing equipment's EUL remains. In past AML updates we used 2016 market share as a proxy for this baseline as the model began forecasting market share in 2016. Developing estimates of the exact mix of equipment that is being replaced early is complex and market share is an imperfect representation of what is being replaced as it represents what is being sold in a single year but does not account for what was installed in other years. Furthermore, market share only represents what was sold and installed, it does not represent what was replaced. Saturation data may be more indicative of what is being replaced than past market share data.

As part of this reanalysis, we used saturation data to develop the first-period baseline for ER rather than the 2016 market share proxy used in prior analyses. However, using the saturation from the analysis year likely also overstates the mix of technology that is being replaced in that year since what is installed in the market contains equipment of different vintages and is not equivalent to what is likely being replaced through ER. In the absence of having specific information about what is being replaced in a single year, we used saturation estimates from five years prior.[3] For the 2021 AML estimate we used 2016 saturation (rather than market share) to inform what is being replaced. In 2022, we used 2017 saturation. As an example, Table 2-1 compares different options for the first-period baseline options for ambient linear LEDs in 2021.

Table 2-1. Early replacement baseline comparisons

Equipment Type	2016 Market Share (original baseline)	2016 Saturation (revised baseline)	2021 Saturation (for comparison only)
T12 (101 watts)	16.8%	12.8%	6.7%
T5 (58 watts)	10.5%	10.0%	2.6%
T8 (77 watts)	53.5%	68.9%	35.6%
LED Fixture (32 watts)	10.8%	2.9%	22.4%
TLED (36 watts)	8.4%	5.4%	32.7%
BASELINE WATTAGE	**70.6 watts**	**74.5 watts**	**54.5 watts**

This shift in what is used as the proxy for ER first-period baseline impacts AML in two ways – lifetime savings and first-year savings. As the first period baseline becomes more efficient, there will be declining lifetime savings because the delta watts between the baseline and the program measure changes. Previously, the first-period baseline in ER was held constant at the 2016 market share baseline so the savings from the first period were static. This change impacts the numerator (lifetime savings) of the AML calculations. Similarly, the denominator of the AML calculations (first-year savings) also changes. The magnitude of the changes in the numerator and denominator impacts the directionality of the trend in AMLs over time.

3   RESULTS

The results of the AML calculations are shown in Table 3-1 below. The averaged values of 2021 and 2022 should be applied both retrospectively to PY2021 and prospectively to PY2022. The averaged values minimize the uncertainty across years associated with the input assumptions within the AML calculations. The recommended values from MA20C09-E-LMC for

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[3] The five-year assumption is based on the fact that equipment installed in 2016 has a weighted lifetime of 7.5 years meaning that if that equipment were to be replaced through ER, it would happen in roughly 5 years on average.

PY2020 retrospective application are also included as reference; however, these values have not been updated with the updated methodology described below.

Table 3-1. Recommended AMLs for PY2021 and PY2022

Application	Equipment Type	*PY2020*	2021	2022	PY2021-PY2022
Ambient Linear	**LED Fixture**	*8.8*	6.9	6.8	6.9
	TLED	*8.5*	6.7	6.6	6.7
High/Low Bay	**LED Fixture**	*8.6*	7.8	8.1	7.9
	TLED	*8.5*	7.7	8.1	7.9
	LED Lamp	*8.2*	7.5	7.9	7.7
Exterior/Outdoor	**LED Fixture**	*7.4*	6.0	6.2	6.1
	TLED	*7.4*	5.9	6.3	6.1
	LED Lamp	*6.9*	5.6	5.8	5.7
Screw-Based	**A-Line**	*3.5*	2.2	2.2	2.2
	Downlight	*6.0*	2.1	2.2	2.2
	Decorative	*3.0*	1.7	1.8	1.7

4   RECOMMENDATION

We recommend that the PAs adopt the PY2021 – PY2022 averaged AMLs for all ER and ROF measures reflected in Table 3-1 for upstream, prescriptive, and custom lighting program installations. New construction and major renovations measures should continue using the full rated lifetimes for LED measures.

APPENDIX A   MARKET MODEL FORECASTS

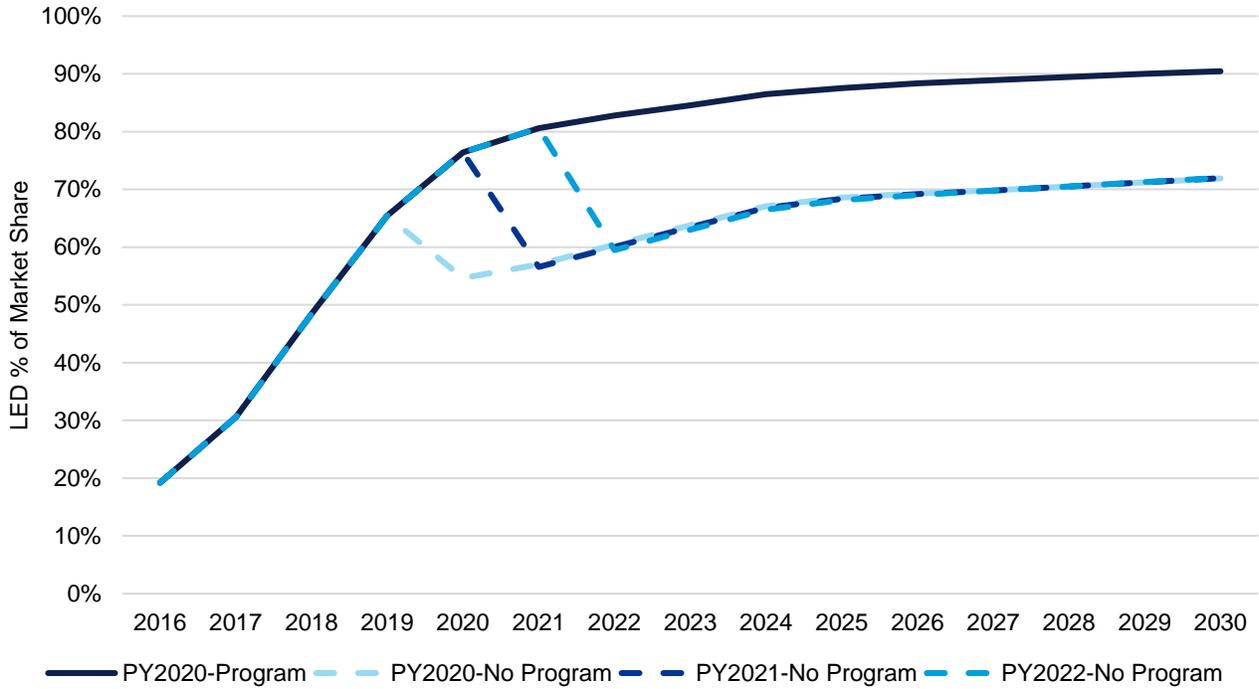**Figure 4-1. Ambient Linear LED Market Share Forecasts**

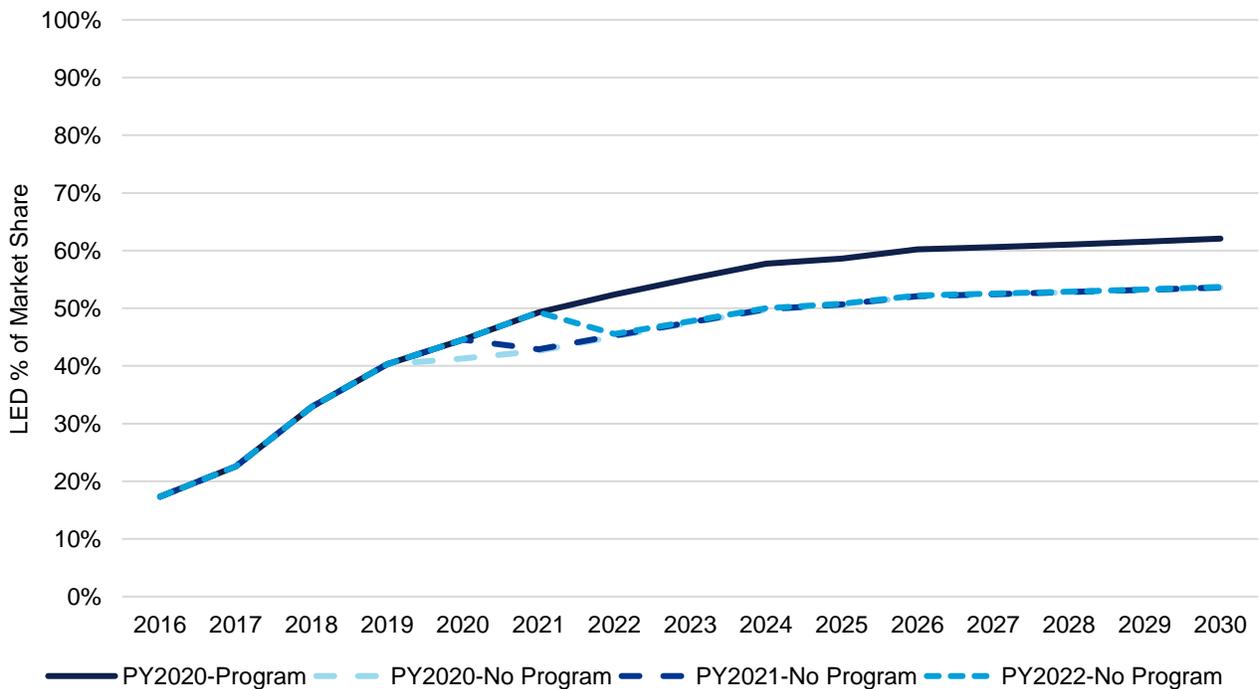**Figure 4-2. High/Low Bay LED Market Share Forecasts**

Figure 4-3. Exterior/Outdoor LED Market Share Forecast