



Lighting Purchase Behavior Study (MA22R47-E-LPB)

FINAL

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SUBMITTED TO:

Massachusetts Electric Energy Efficiency Program
Administrators

SUBMITTED BY:

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Executive Summary

The Massachusetts Electric Program Administrators (PAs) and EEAC consultants asked NMR Group, Inc. (NMR) and its partner DNV (the NMR team) to conduct a study to examine the lighting purchase behavior of renters, low and moderate income (collectively LMI), racial or ethnic minority, and/or limited English-proficiency customers (collectively disadvantaged customers). The study aimed to gather information that would help the PAs decide if they should develop a lighting offering targeting disadvantaged customers and to help develop an implementation plan for such an offering.

OBJECTIVES

This study had the following objectives:

- Ascertain whether opportunities exist to generate claimable savings through lighting incentives that target disadvantaged customers
- Describe the pathways such an offering might take
- Establish gross and net savings assumptions (in-service rates [ISRs], net-to-gross ratios [NTGs], and adjusted measure lives [AMLs]) for the offering to be applied when the program commences and until future research suggests changing them
- Outline future research needs to update the gross and net savings assumptions and assess program processes

KEY FINDINGS

Figure 1 summarizes the consumer survey results for renters and moderate-income households.

For the most part, renters and moderate-income households prefer to buy LEDs and placed similar levels of importance on energy efficiency when compared to not-disadvantaged households. However, bulb aesthetics were less important to renters and moderate-income households, and they showed greater sensitivity to price and access to LEDs.

Compared to not-disadvantaged households, when purchasing or otherwise obtaining a bulb, **renters** were *statistically significantly* ...

- more likely to buy bulbs based on what stores had in stock
- more likely to buy the smallest and lowest priced pack that meets their needs
- less likely to say that they always purchased LEDs

Renters and moderate-income households also reported shopping for or obtaining bulbs from different sources than not-disadvantaged households. They were *statistically significantly*...

- more likely to say they had obtained bulbs from a food pantry, community organization, or other similar source and less likely to say they obtained them through the MassSave® program.¹
- less likely to report buying bulbs from large home improvement stores and more likely to report buying them from large grocery and drug stores.
- more likely to report buying bulbs from mass merchandise stores (renters), dollar or discount stores (renters), and small hardware stores (moderate-income households).

Furthermore, **moderate-income households** were *significantly* less likely to say that they lived within 15 minutes of a mass merchandise or home improvement store.

We also examined the survey results for **low-income, non-white, and limited-English speaking** households, but ultimately did not suggest a program for these customer groups. Data for these additional demographic breakdowns are found in [Appendix B](#).

RECOMMENDATIONS

Based on findings above, the NMR Team recommends the PAs offer a program targeting renters and moderate-income households. The NMR team recommends the impact factors in [Table 1](#) for such a program. These factors apply to both bulb shapes offered through the program (A-lines and candelabras):

Table 1: Recommended Impact Factors

ISR	First Year	72%
AML		1 year
NTG	Renters	45%
	Moderate-Income	25%

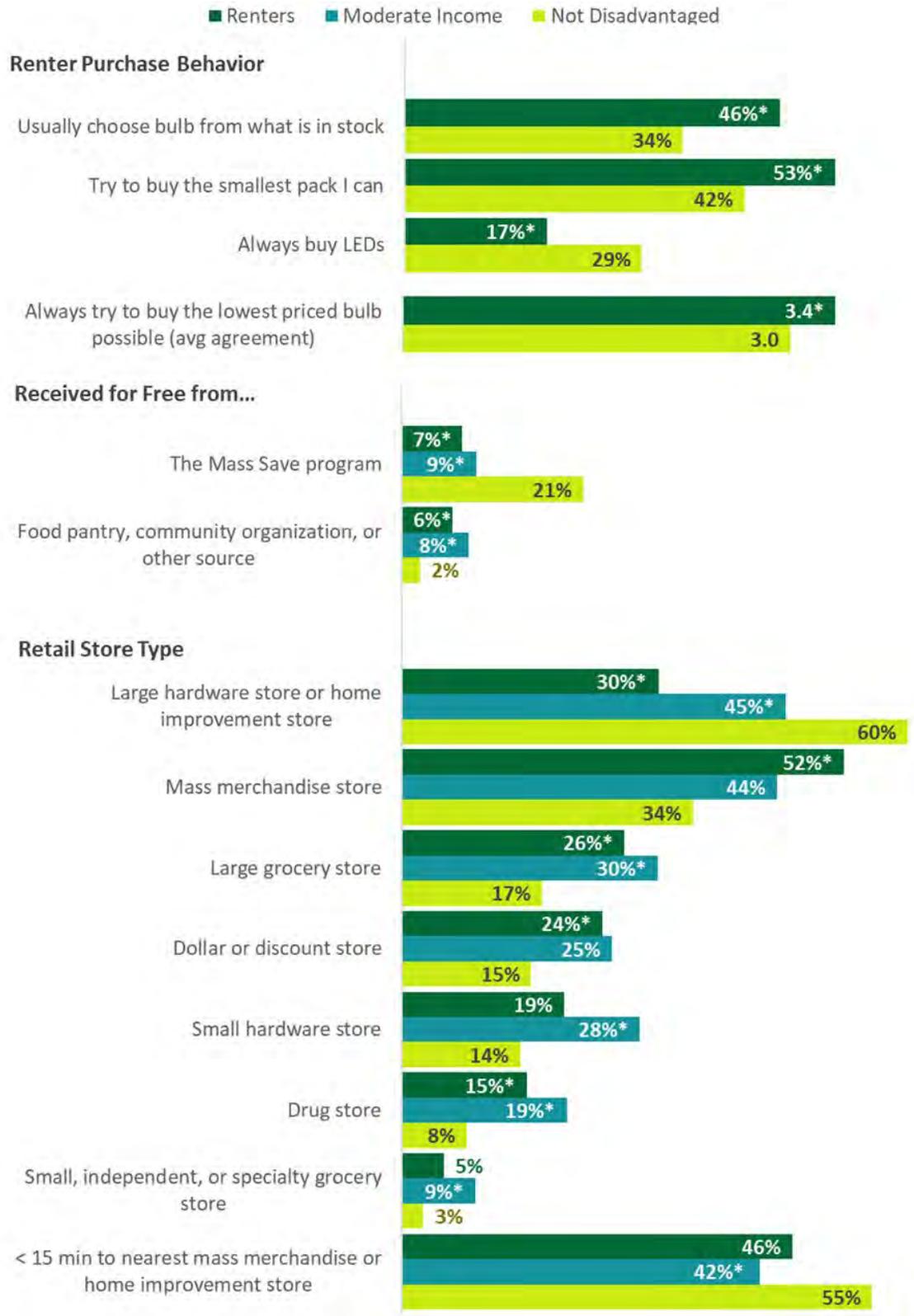
The program will only run through July 2023, as the full implementation of state and federal efficiency standards will likely make LEDs the new standard light bulb by then. Therefore, the NMR team does not suggest future research to update savings assumptions.

The PAs expect that the program will consist of kits of six A-lines or six candelabras. Customers will be eligible to receive up to two kits (up to 12 bulbs) and can get all A-lines, all candelabras, or a combination of the two, depending on their numerical and shape needs.

- Renters will be identified through initial screening calls
- Moderate-income households will be identified through a verification process; most are expected to be engaging the program when calling about heating and insulation incentives

¹ Mass Save program participation was self-reported and has not been verified by the PAs.

Figure 1: Renters and Moderate-Income vs Not Disadvantaged



*Significantly different from Not Disadvantaged at the 90% confidence interval

Section 1 Introduction

The Massachusetts Electric Program Administrators (PAs) asked NMR Group, Inc. (NMR) and its partner DNV (the NMR team) to conduct a study to examine the lighting purchase behavior of renters, low and moderate income (collectively LMI), racial or ethnic minority, and/or limited English-proficiency customers (collectively disadvantaged customers). The study aimed to gather information that would help the PAs decide if they should develop a lighting offering targeting disadvantaged customers and to help develop an implementation plan for such an offering.

BACKGROUND

Prior market assessments and evaluation studies in Massachusetts and elsewhere suggest that LEDs have become the dominant light bulb.² LEDs account for most retail light-bulb sales in states regardless of program history and bulb shape. Given this LED market dominance, the PAs planned to discontinue most residential lighting support in the 2022 – 2024 program cycle.

However, the same market assessments and evaluation studies suggested that LED saturation lagged by about one to two years among renters and low-income households, though combined LED and CFL saturation was similar across tenure and income (Figure 2).³ (The prior research did not conduct analysis on or report results for moderate income, minority, or limited English-proficiency customers.) The lagged LED saturation rates are consistent with the findings from the recent *Residential Nonparticipant Customer Profile Study (MA19X06-B-RESNONPART)* and *Residential Nonparticipant Market Characterization and Barriers Study (MA19R04-B-NP)*.⁴ These studies looked at participation in PA residential programs more broadly and were not able to include the effects of retail lighting programs. As the *Market Barriers* study concludes, “While based on different analysis and data sources, both studies [MA19X06 and MA19R04] found participation rates are negatively associated with renters, lower income, and limited-English speaking customers.”⁵

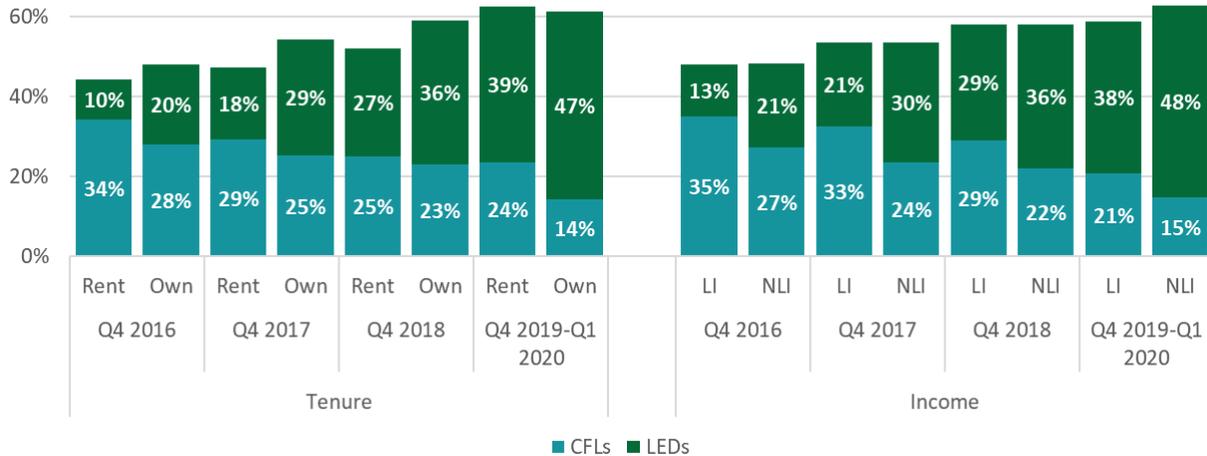
² For example, NMR and DNV. 2020. *Lighting Supplier Insights*. Available at https://ma-eeac.org/wp-content/uploads/MA19R13-E_2019SupplierInterviewsReport_Final_2020.08.14.pdf. NMR. 2020. *2019 Regional Lighting Sales Data Analysis (MA20R22)*. Available at https://ma-eeac.org/wp-content/uploads/MA20R22-E-LtgSalesDataAnalysis_FINAL_2020.12.02.pdf. NMR. 2020. *Residential Lighting Onsites (MA19R15)*. Available at https://ma-eeac.org/wp-content/uploads/MA19R15-E-2019-ResLtgOnsite_FINAL_2020.12.09.pdf. See also documentation in *Record Request DPU-4 (Tr. 4, at 542)*.

³ The MA19R15 study included a disproportionate number of verified direct install participants, which may have inflated the Q4 2019 / Q1 2020 LED saturation estimates.

⁴ DNV. 2020. *Residential Nonparticipant Customer Profile Study (MA19X06-B-RESNONPART)*. https://ma-eeac.org/wp-content/uploads/MA19X06-B-RESNONPART_Report_FINAL_v20200228.pdf. Guidehouse, Illume, and Cadeo. 2020. *Residential Nonparticipant Market Characterization and Barriers Study (MA19R04-B-NP)*. https://ma-eeac.org/wp-content/uploads/MA19R04-A-NP-Nonpart-MarketBarriersStudy_Final.pdf.

⁵ Guidehouse et al. 2020. *Ibid*. Page i.

Figure 2: LED and CFL Saturation by Income and Home Ownership, 2016 to 2019¹



¹ Sources: NMR. 2017. RLPNC 16-7: 2016-17 Lighting Market Assessment Consumer Survey and Onsite Saturation Study. <https://ma-eeac.org/wp-content/uploads/Lighting-Market-Assessment-Consumer-Survey-and-Onsite-Saturation-Study.pdf>. NMR 2018. RLPNC Study 17-9 2017-18 Residential Lighting Market Assessment Study. https://ma-eeac.org/wp-content/uploads/RLPNC_179_LtgMarketAssessment_28March2018_FINAL-1.pdf. NMR. 2019. RLPNC Study 18-10 2018-19 Residential Lighting Market Assessment Study. https://ma-eeac.org/wp-content/uploads/RLPNC_1810_LtgMarketAssessment_FINAL_2019.03.29.pdf. NMR. 2020. Residential Lighting Onsites (MA19R15). Available at https://ma-eeac.org/wp-content/uploads/MA19R15-E-2019-ResLtgOnsite_FINAL_2020.12.09.pdf.

The Massachusetts Department of Public Utilities (DPU) raised questions about whether the PAs had prematurely decided to remove all non-low-income residential lighting support in the 2022 – 2024 program cycle. In particular, the DPU questioned whether remaining opportunities existed among specific customer groups. In DPU 21-120 through DPU 21-129, the DPU ordered the PAs to conduct a study of the light bulb purchasing habits for renters, moderate income, minority, and limited English-proficiency customers.

The DPU also ordered the following:

The evaluation study should assess: (1) the projected cost-effectiveness of a targeted lighting offering, and (2) pathways (e.g., direct install, upstream, midstream, or retail delivery models) that provide effective ways to reach renters, moderate income, minority, and limited English-proficiency customers. The Program Administrators shall file the final evaluation and implementation plan by September 30, 2022.⁶

The NMR team designed this study in response to the second directive in the DPU order⁷. The study scope initially did not include low-income participants as this customer group already has targeted lighting programming; however, the scope ended up including both low-income and moderate-income households as the study team found it impractical to systematically exclude them from the sample due to extensive overlaps between low-income households and the disadvantaged groups being targeted. The NMR team worked closely with the PAs and the

⁶ Pp. 126 – 127 <https://www.mass.gov/doc/2022-2024-three-year-energy-efficiency-plans-order/download>

⁷ The first directive is addressed by the PAs in the Targeted Lighting Offer Cost-Effectiveness memo accompanying this report.

Energy Efficiency Advisor Council (EEAC) consultants to ensure that the study components met the requirements and timeline of the order.⁸

OBJECTIVES AND RESEARCH QUESTIONS

Table 2 presents the study objectives and research questions.

Table 2: Research Objectives and Questions

Objective	Questions
Does the evidence support the need for a lighting offering targeted disadvantaged customers?	What proportion of disadvantaged customers provide their own light bulbs for in-person use?
	How important are the following factors to disadvantaged customers when buying bulbs: price, shape, wattage, energy use, and familiarity?
	What triggers customers to buy light bulbs – when a bulb burns out, or when they see bulbs on sale or displayed in stores? Do they go to the store knowing the bulb they want? Do they typically buy only what they need at the moment, or do they stock up? What influences this choice?
	How aware are customers of different lighting technologies? What are their perceptions of the technologies? Do they correctly identify those that save the most energy?
	For those aware, what lighting technologies do disadvantaged customers buy? Do they have a preferred technology?
	Do the lighting purchase patterns of disadvantaged customers differ from those of other customers (i.e., moderate-to-high income, white, English-proficient homeowners)?
Describe the pathways such an offering might take	Do differences exist in lighting purchase behavior across disadvantaged customer groups?
	Through what retail channels or other sources do disadvantaged customers buy their bulbs? Do disadvantaged customers stock up on bulbs?

⁸ The original study scope also called for examining the implications of state and federal lighting standards on any potential program. However, the PAs later explained that program planners had already assessed the implications and factored them into their draft program design and timeline.

MA LIGHTING PURCHASE BEHAVIOR STUDY (MA22R47-E-LPB)

Objective	Questions
All Objectives – Customer Demographics	<p>What race do respondents self-identify as?</p> <p>Do respondents consider themselves to be Hispanic?</p> <p>How do respondents self-rate how well they speak English?</p> <p>How many respondents primarily speak a language other than English at home? What languages?</p> <p>How many respondents fall into low- or moderate-income categories based on their family size (assessed separately)?</p> <p>What proportion of respondents are renters? What proportion of respondents pay their own electricity bills?</p> <p>How do the characteristics of respondents compare to the most recent Census information available for the state?</p>
What Impact Factors should the PAs claim for a targeted disadvantage customer lighting offering?	<p>What ISRs, AMLs, and NTGs do other jurisdictions claim for lighting programs (not direct install) that target disadvantaged customers?</p> <p>Should impact factors vary by targeted group?</p> <p>What do past impact results in Massachusetts suggest regarding impact factors?</p>

Section 2 Methodology

The study relies on four approaches: 1) a mixed-mode consumer panel survey, 2) a literature review, 3) a reanalysis of prior Massachusetts onsite data collected between Q4 2018 and Q1 2020, and 4) a consensus process.

2.1 CONSUMER SURVEY

The survey provided information on disadvantaged customers' lighting purchase behavior and needs, including awareness and perceptions of different lighting technologies. NMR partnered with Qualtrics to achieve desired completions for key customer groups. Qualtrics recruited respondents through existing third-party consumer panels with adequate representation of Massachusetts residents who met the study screening requirements.

2.1.1 Sample Design

The NMR team, together with Qualtrics, designed a sample for 770 completions targeting four groups: (1) white, non-Hispanic homeowners, (2) white, non-Hispanic renters, (3) racial or ethnic minority (including both homeowners and renters), and (4) limited English speakers (Table 3). NMR used United States Census population counts of individuals to guide the sample design.⁹ The targeted number of completes listed the minimum number of households Qualtrics was to achieve for each demographic group. However, individual respondents often fell into more than one group. Therefore, the actual number of respondents sampled exceeded the target for all but limited-English speakers.¹⁰ The design did not explicitly sample for low- or moderate-income households, as this designation requires analysis of survey responses and low-income households already has targeted lighting programming. NMR assumed that such households would be well-represented among the other disadvantaged groups, and the survey results confirm that this was the case. The design included a completion target for self-identified white homeowners to serve as a comparison group from which to draw conclusions about differences in lighting purchase behavior across groups.

The survey operationalized the groups of interest as follows (see Appendix A for questionnaire):

- Race and ethnicity – self-identified¹¹
- Homeowner vs. renter – self-identified

⁹ We often use household data for surveys, but the screening for this study focused on the characteristics of the individual respondent. Therefore, individual population data provides a better point of reference.

¹⁰ Qualtrics delivered the desired number of completions to NMR, but some of the early respondents answered the survey in English, indicating that they were not limited English speakers. We adjusted the screening to ensure that the quota included only individuals who self-identified as speaking English “not well” or “not at all.”

¹¹ Qualtrics can identify these target groups by pulling embedded data from browsers, profile tags the respondent has set up for themselves, and respondent ID data.

MA LIGHTING PURCHASE BEHAVIOR STUDY (MA22R47-E-LPB)

- English proficiency – self-rated as speaking English “not well” or “not at all;” phone respondents answered survey in Spanish or Portuguese¹² (see [Survey Implementation](#) and [Survey Limitation](#) below)
- Low income – Household income at or below 60% of state median income for the family size
- Moderate income – Household income between 60% and 80% of state median income by family size

For each target group, the sample design achieved better than 10% absolute sampling error at the 90% confidence level assuming a 50% break in responses. The overall absolute sampling error was less than 5%.

Table 3: Sample Design

Target Group	Census Population	Target	Absolute Precision	Sample
Total	6,218,524	770	3.6%	776¹
White, non-Hispanic Owner	3,174,600	200	5.8%	220
White, non-Hispanic Renter	1,014,272	225	5.5%	283
Racial Minority (includes Hispanic)	549,886	210	5.7%	273
Limited English Speaker (any race)	1,479,766	135	7.1%	126
Low Income	-			272
Moderate Income	-			185

¹ Sample sizes by target group sum to greater than 776 because some respondents fell into more than one group.

2.1.2 Survey Implementation

The NMR team and Qualtrics worked closely together to field this survey. NMR developed and programmed the survey questionnaire (see [Survey Development and Design](#)) in English. Qualtrics reviewed the survey questionnaire and program, and NMR finalized both based on the input. Qualtrics fielded a web survey to fulfill targeted quotas for all groups except limited English speakers. Qualtrics also translated the phone version of the survey into Spanish and Portuguese, and NMR staff reviewed the translated instruments. After finalizing, Qualtrics fielded the phone surveys in Spanish and Portuguese.¹³ The web survey was in the field from June 24 to July 3, 2022, and the phone survey from July 6 to July 18, 2022.

The NMR team performed quality control of the survey by examining the data for completed surveys multiple times a week. Early in fielding the phone survey, we noticed that some respondents answered in English. NMR instructed Qualtrics to move a language screener to the beginning of the questionnaire and allow completions only in Spanish or Portuguese by individuals

¹² Based on data from 2019, Spanish and Portuguese speakers make up approximately 52% of the Massachusetts population that speaks a language other than English (<https://www.migrationpolicy.org/data/state-profiles/state/language/MA/>)

¹³ The *Market Barriers* secured very few completions with respondents who primarily spoke languages other than English, Portuguese, or Spanish.

who self-identified as not speaking English “very well” or “at all.” NMR did not use the responses by phone respondents who answered in English.

The mixed-mode survey approach used existing consumer panels provided by Qualtrics to fill NMR’s specific sampling needs. While the NMR team usually plays a direct role in recruiting and incentivizing survey respondents, Qualtrics took full responsibility for these efforts in this study to ensure the confidentiality of panelists and the integrity of the panels.¹⁴ Qualtrics (or their third-party partners) recruited potential web survey respondents via email and called phone survey respondents. The study did not pay an incentive as most panelists receive regular compensation for participation in the panel.

2.1.3 Survey Limitation

The use of the Qualtrics panel was successful at reaching renters, and moderate-income households, and people who self-identify as a minority. However, we had mixed results with reaching limited English speakers. The survey design did not set quotas or limits on education level. The limited-English speaking phone survey respondents were a highly educated sample, even by Massachusetts standards, with its high concentration of colleges and universities as well as technology and medical sector employers (see Table 4). The high education level likely distinguishes the limited-English speaking survey respondents from the broader population of limited-English speakers in the state. NMR does not have access to the Qualtrics sample frames, so we do not know why this bias exists.

Table 4: Level of Education – Limited-English Speaking Phone Respondents vs MA 2020 ACS

Level of Education	Phone Respondents	MA 2020 ACS 5-Year Estimates (population 25+)
n	135	4,815,331
Less than high school	0%*	9%
High school graduate or equivalent	0%*	24%
Some college	0%*	15%
Associate degree	1%*	8%
Bachelor's degree	23%	25%
Master's degree	46%*	20%
Professional or Doctorate degree	30%*	

*Significantly different from MA 2020 ACS at the 90% confidence interval

After examining the impact of the phone respondents on the broader survey results, the PAs and EEAC consultants instructed NMR to remove the phone respondents from the analyses we considered during the Consensus Process. Therefore, the results presented in the main report do

¹⁴ Integrity in the sense of keeping the panel in an unimpaired condition (see <https://www.merriam-webster.com/dictionary/integrity>).

not include a targeted limited-English speaking group and largely reflect the sample design in Table 5.

Table 5: Sample Design without Phone Respondents

Target Group	Sample (Web only)
Total	641
White, non-Hispanic Owner	205
White, non-Hispanic Renter	243
Racial Minority (includes Hispanic)	193
Not English Speaker (any race)	-
Low Income	264
Moderate Income	130

2.1.4 Survey Development and Design

The NMR team worked with the PAs and EEAC consultants to design a questionnaire that met the study needs but was also straightforward and easy to answer. The survey aimed to gather the right types of information to inform the following:

- Lighting purchase behaviors among different customer groups
- Whether the evidence supports the need for a lighting offering for disadvantaged customers
- What a targeted offering might look like
- What savings assumptions the PAs should make for the offering.

To develop the survey, NMR reviewed prior Massachusetts lighting and the non-participant market barriers (MA19R04-B-NP) questionnaires. We also turned to the United State Census bureau for guidance in wording questions about self-identified race and ethnicity, as neither the prior lighting studies nor the non-participant market barriers study asked respondents about race.

NMR submitted a draft questionnaire to the PAs and EEAC consultants on May 11, 2022. We finalized the survey on May 24, 2022.

2.2 LITERATURE REVIEW

The NMR team also conducted a search for studies from Massachusetts and other areas to find literature with estimates of ISRs, NTGs, and AMLs (or similar concepts) for lighting initiatives targeting renters and low- or moderate-income households. We focused on kit, online, and foodbank (or similar) type programs, but we also reviewed retail program reports to see if they listed results for the target populations (none did). We excluded direct install programs.

We identified literature by searches of websites for program administrators, regulatory bodies, and advisory councils. We also searched the ESource Demand Side Management Library, a for-fee service that compiles evaluation studies from program administrators across the United States

and Canada. We focused on studies completed in or after 2017. We used a combination of the following search terms: lighting, renter, and low income, moderate income, food bank, and energy-saving kits.¹⁵ The search yielded only nine usable studies. Most of the studies we found addressed direct installation programs or retail-based programs working with discount or other stores often referred to as “hard-to-reach.”

2.3 REANALYSIS OF MASSACHUSETTS ONSITE DATA

The reanalysis of Massachusetts onsite data assessed variations in socket and fixture needs (e.g., shape, function, screw base size, etc.) among renters versus other households. To describe the types of bulbs the PAs should include in a targeted lighting offering, the NMR team reanalyzed lighting data from two prior panel studies (RLPNC 18-10 and MA19R15). Although data collection for these studies occurred three to four years ago¹⁶, it is likely that the types of sockets and shapes of bulbs identified in these studies still accurately reflect households in Massachusetts. The analysis did *not* compare the studies’ onsite data to each other as this information was not crucial to deciding which products to include in the targeted lighting offering.

The NMR team included the following fields in the analysis, when possible:

- **Lighting:** Number of sockets, socket base, fixture type, bulb shape, and bulb wattage¹⁷
- **Demographic:** Type of building, owner/renter status, low-income status

2.4 CONSENSUS PROCESS

The NMR team held three meetings to facilitate a consensus process to set the ISRs, NTGs, and AMLs for the lighting offering. The team prepared information summaries of the consumers survey, literature review, and onsite data reanalysis results for the PAs and the EEAC consultants to consider. We then facilitated two separate meetings with the PAs and EEAC consultants to review the findings, identify and discuss additional analyses meant to clarify results, and to set deemed ISRs, AMLs, and NTG ratios. We held the first meeting on August 16 and the second on August 24, 2022.

¹⁵ When we found studies using these terms, we also checked to see if they reported results by race or ethnicity or language spoken at home. None of the studies did.

¹⁶ Data collection occurred in Q4 2018 (for RLPNC 18-10) and Q4 2019 and Q1 2020 (for MA 19R15)

¹⁷ The NMR team determined wattage equivalence across technologies and shapes using the most recent Delta Watts report. NMR Group. 2020. *Delta Watts Update (MA19R02-E)*. Available at https://ma-eeac.org/wp-content/uploads/MA19R09-E-DeltaWattReport-Memo_FINAL_2020.03.26.pdf.

Section 3 Consumer Survey Results

The NMR team analyzed the consumer survey data to assess lighting purchase behavior overall and for each targeted customer group. However, the analysis below focuses only on renters, moderate-income households, and non-white households, comparing them each to not-disadvantaged respondents. A respondent was categorized as *disadvantaged* if they fell into at least one of these categories: renter, self-identified limited-English speaker, low income, moderate income, or self-identified as a racial or ethnic minority (non-white Hispanic/Latinx). *Not-disadvantaged* respondents had none of these characteristics.

Limited-English speaking households were not included in the analysis as they were removed due to the sampling issue described in [Section 2.1.3](#). Additionally, while low-income households were not excluded from the sample, they were also not included in the results analysis as the PAs continue to offer lighting measures in low-income direct install programs.

During the consensus group discussions, the team noted that the results did not present as compelling of a case for a program targeting non-white households; non-white households had some similar purchase behavior patterns to renters and moderate-income households, but also had similar behavior patterns to not-disadvantaged households. Furthermore, the PAs stated that it would not be feasible to design a program that targeted limited-English speaking or racial or ethnic minorities due to difficulties identifying such customers. Therefore, they believed that a disadvantaged customer lighting program would target renters and moderate-income households. [Appendix B](#) (delivered as a separate Excel workbook) presents survey results for other customer groups.

3.1 KEY FINDINGS

Responsibility for Paying Bills and Buying Bulbs

- Most renter and moderate-income households (and all not-disadvantaged households) were responsible for providing light bulbs for their home. Similarly, most respondents had purchased at least one bulb in the past year, though significantly fewer renter households had done so than not-disadvantaged households.

Light Bulb Awareness and Knowledge

- LED familiarity was similar between both renters and moderate-income households compared to not-disadvantaged households, but significantly fewer renters were familiar with CFL, halogen, and incandescent bulb types.
- The type of bulb respondents preferred to use in their homes and respondents' perceptions of which bulb type was most expensive did not vary between the targeted customer categories and not-disadvantaged households.

Purchase Behavior

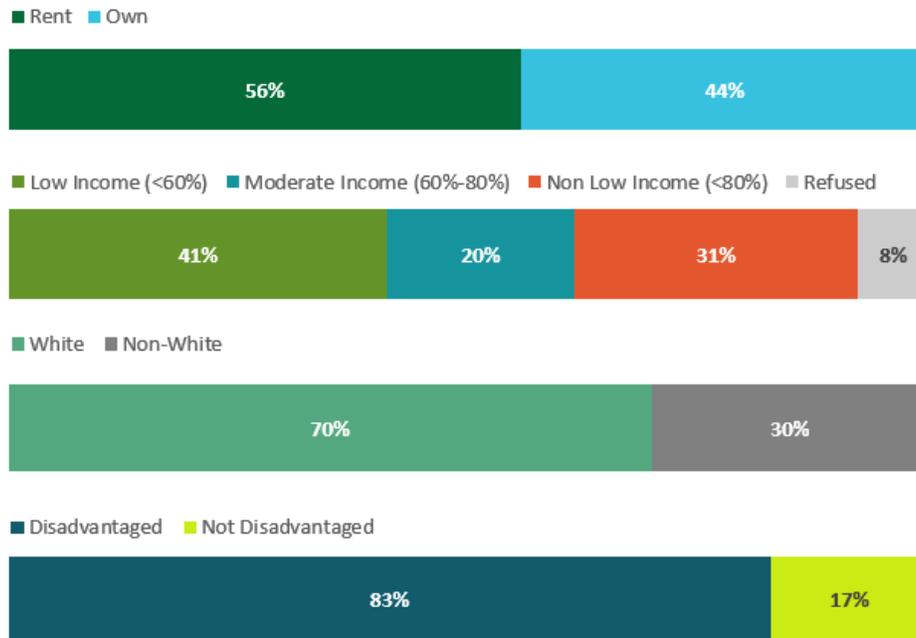
- Renter, moderate-income, and not-disadvantaged households each gave the highest ratings to brightness and energy use/efficiency when asked about the importance of various factors to their bulb purchasing decisions.
- Compared to not-disadvantaged households, renters said that they tend to buy bulbs based on what stores had in stock and the smallest and lowest priced pack that meets their needs.
- Renters were significantly less likely than not-disadvantaged households to say that they always purchase LEDs.
- Renters and moderate-income households reported shopping for or obtaining bulbs from different sources than not-disadvantaged households; more specifically, these two target customer groups are less likely to report purchasing bulbs from and, for moderate-income households, have less access to home improvement stores which have a wide variety of LEDs at relatively low cost.
 - Renters and moderate-income households were more likely to say they had obtained bulbs from a food pantry, community organization, or other similar source and less likely to say they obtained them through the MassSave® program.
 - Renters and moderate-income households were less likely to report buying bulbs from large home improvement stores and more likely to report buying them from large grocery and drug stores. Renters were also more likely to report buying bulbs from mass merchandise stores and dollar or discount stores. Moderate-income households were more likely to say they buy bulbs from small hardware stores.
 - Moderate-income households were less likely to say that they live within 15 minutes of a mass merchandise or home improvement store.

3.2 TENURE AND INCOME DEMOGRAPHICS¹⁸

The survey design successfully recruited renters, moderate-income households, and self-identified non-white households. One-fifth (20%) of survey respondents were moderate income, more than one-half (56%) were renters, and nearly one-third (30%) identified as non-white. (Figure 3). The analysis did not compare these target groups in the analysis below as these groups overlapped. For example, one respondent could be both a renter *and* moderate-income. The overlap violates assumptions of statistical independence. In contrast, these customer groups do not overlap with the not-disadvantaged group, so the analysis compares renters, moderate-income, and non-white households to this group throughout.

¹⁸ Rarely do evaluation studies lead with respondent demographics. However, demographics are critical to this study's research objectives, so we highlight them here.

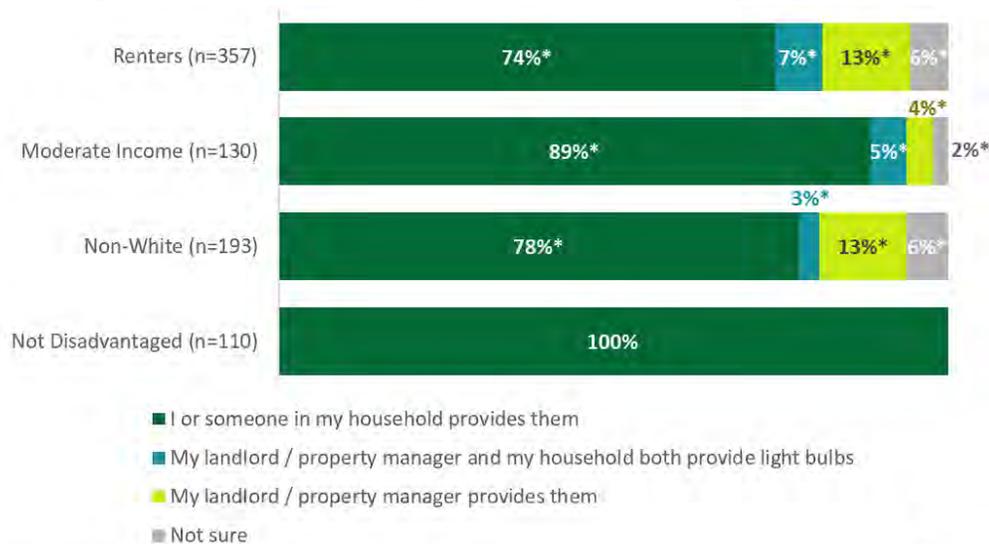
Figure 3: Sample Demographics (n=461)



3.3 RESPONSIBILITY FOR PAYING BILLS AND BUYING BULBS

The majority of renters (74%), moderate-income households (89%) and non-white households (78%) provided their own light bulbs for in-person use (Figure 4). These percentages were significantly lower than the 100% of not-disadvantaged respondents, all of whom owned their homes. A landlord or property manager provided either all or some light bulbs for one-fifth of all renter households (20%), nearly one-tenth (9%) of moderate-income households, and one-fifth of non-white households (20%).

Figure 4: Who was Responsible for Providing Light Bulbs

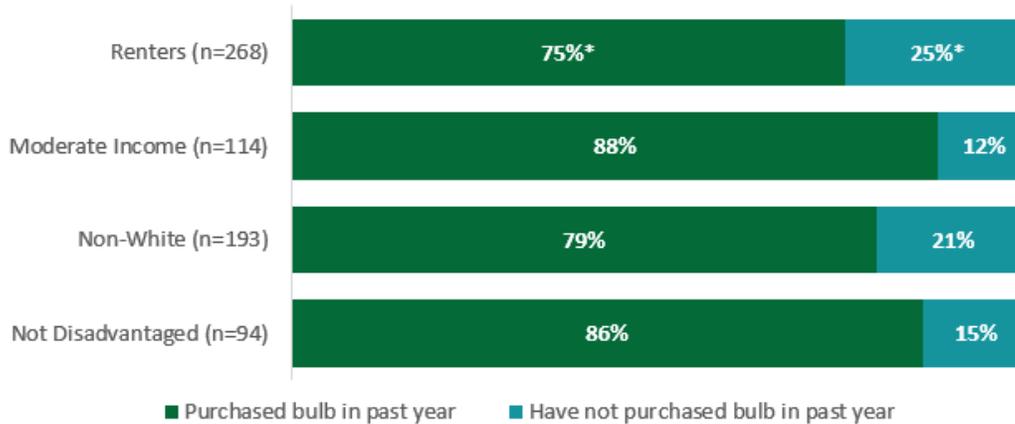


*Significantly different from Not Disadvantaged at the 90% confidence interval

Among households that provided either all or some of their light bulbs, three-quarters (75%) of renters had bought or otherwise obtained at least one bulb in the past year, significantly fewer than not-disadvantaged households (86%) (Figure 5). Nearly nine out of ten (88%) moderate-income households and nearly four out of five non-white households (79%) had obtained at least one light bulb in the past year.

Figure 5: Household Obtained Light Bulbs in the Past Year

(base: renters whose household or landlord/property manager and household provide light bulbs)



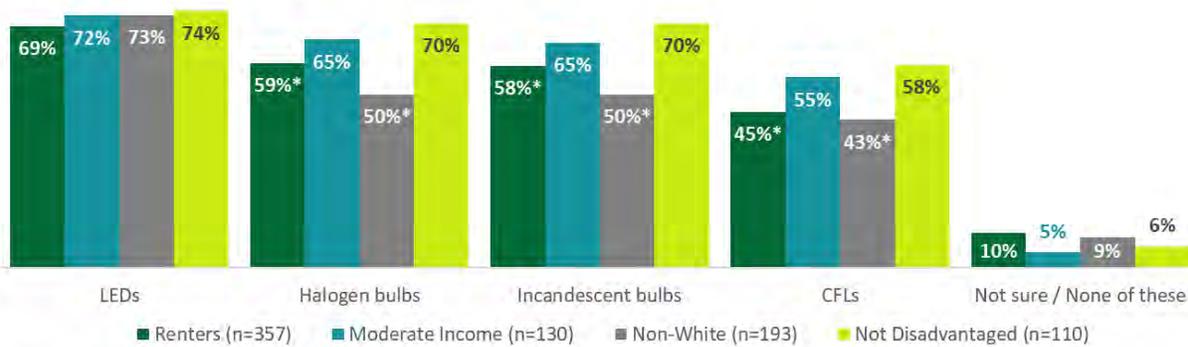
*Significantly different from Not Disadvantaged at the 90% confidence interval

3.4 LIGHT BULB AWARENESS AND KNOWLEDGE

Most moderate-income (55% to 72%) and most not-disadvantaged households (58% to 74%) were familiar with all four bulb types they were asked to consider (Figure 6). Most non-white households were familiar with LEDs (74%), but less (43% to 50%) were familiar with CFLs, halogens, and incandescents.

While a similar percentage of renters were familiar with LEDs (69%), a significantly smaller percentage of renter households were familiar with halogens (59%), incandescents (58%), and CFLs (45%) when compared to not-disadvantaged households. Similarly, while a similar percentage of non-white households were familiar with LEDs (73%), a significantly smaller percentage of non-white households were familiar with incandescents (50%), halogens (50%), and CFLs (43%) when compared to not-disadvantaged households. Bulb type familiarity was statistically similar between moderate-income households and not-disadvantaged households.

Figure 6: Familiarity by Bulb Type

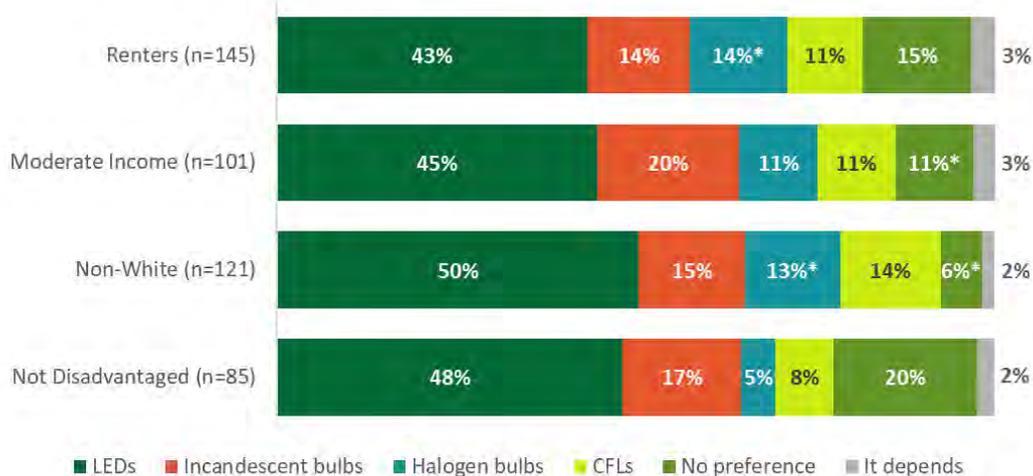


*Significantly different from Not Disadvantaged at the 90% confidence interval

Respondents who said they had heard of more than one bulb type were asked which bulb type they preferred to use in their home. Renters (45%), moderate-income households' (45%), and non-white households' (50%) preference for LEDs did not differ statistically from not-disadvantaged households (48%) (Figure 7). A significantly greater percentage of renters (14%) and non-white households (13%) than not-disadvantaged households preferred halogens (5%) and a significantly smaller percentage of moderate-income households (11%) and non-white households (6%) did not have a preferred bulb type compared to not-disadvantaged households (20%).

Figure 7: Bulb Type Preference

(base: respondents who had heard of more than one bulb type)

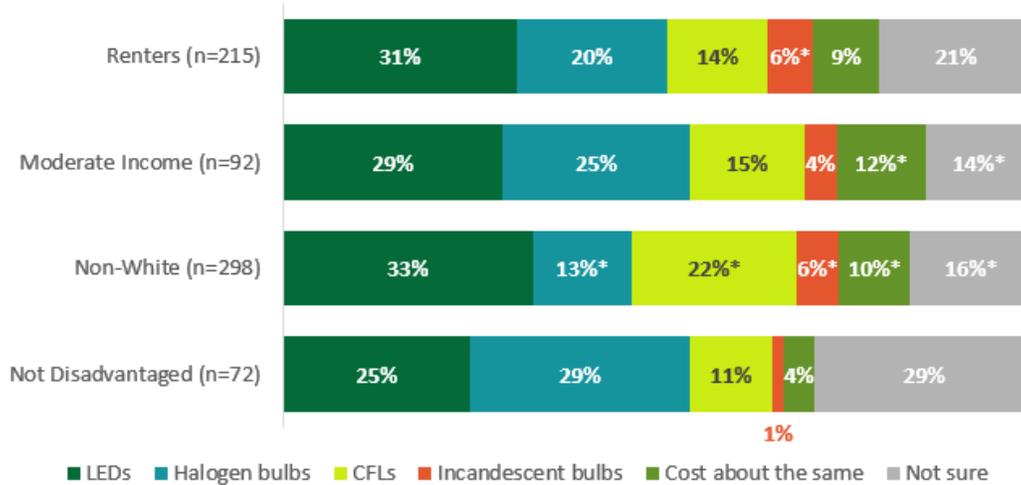


*Significantly different from Not Disadvantaged at the 90% confidence interval

This same group of survey respondents was asked to identify the bulb type they believed was the most expensive to buy. The percentage of renters (31%), moderate-income households (29%), and non-white households (33%) naming LEDs as the most expensive was similar to not-disadvantaged households (25%) (Figure 8). Most other renters and moderate-income households either named halogens as the most expensive or said they were not sure which bulb type was the most expensive. More than one-fifth of non-white households (22%) thought CFLs

were the most expensive bulb type, significantly more than the one-tenth of not-disadvantaged households (11%) who reported the same.

Figure 8: Which Type of Bulb Respondents Believed was Most Expensive
(base: respondents who had heard of more than one bulb type)

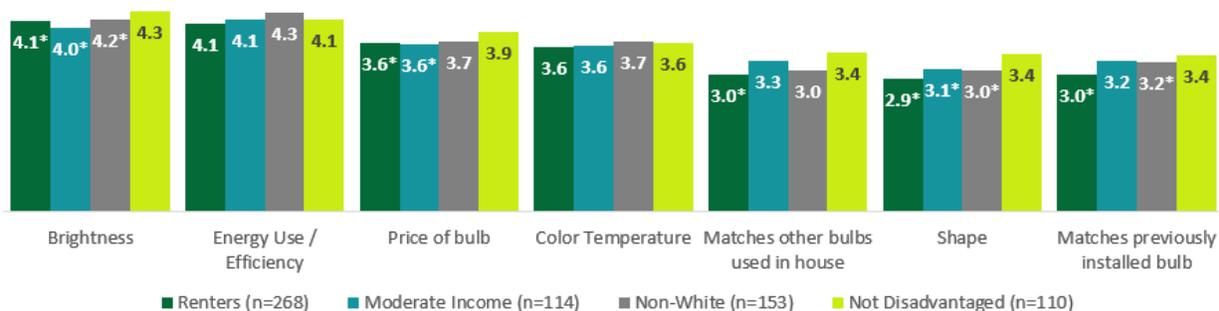


*Significantly different from Not Disadvantaged at the 90% confidence interval

3.5 PURCHASE BEHAVIOR

Respondents were given a list of some common factors people consider when buying a light bulb and asked to indicate the importance of each factor on their own bulb purchases using a scale of one to five, where one was “not at all important” and five was “extremely important” (Figure 9). All four customer groups gave the highest ratings to brightness and energy use/efficiency, followed by price of bulb and color temperature. While the average importance of several factors was significantly lower among renters or moderate-income households when compared to not-disadvantaged households, the order of average importance was similar across all groups.

Figure 9: Average Importance to Bulb Purchase Decision
(base: respondents who had purchased/obtained a bulb in the past year)



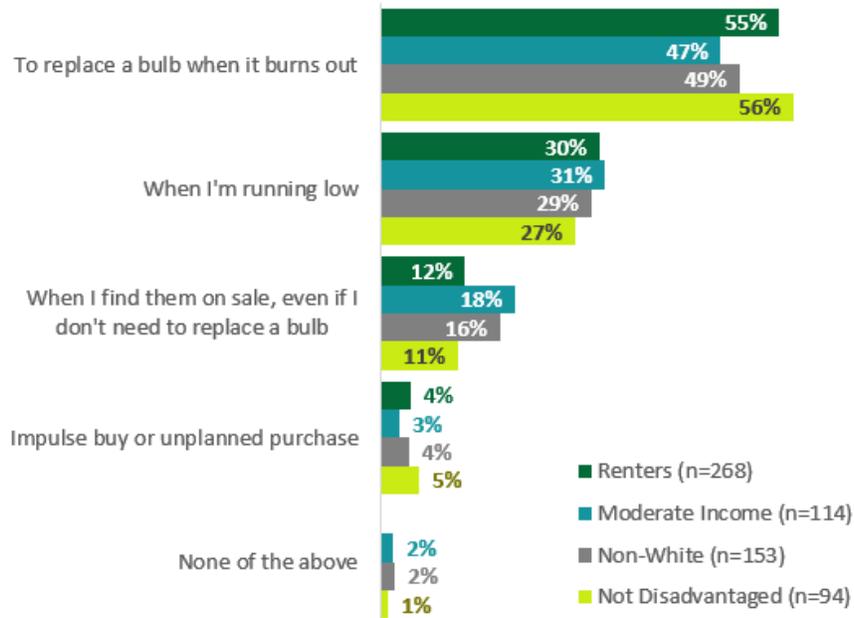
*Significantly different from Not Disadvantaged at the 90% confidence interval

Renters, moderate-income households, and non-white households did not differ from not-disadvantaged households in what situation triggers them to buy light bulbs (Figure 10). The largest percentage across all groups indicated buying bulbs to replace one that burned out (55%

MA LIGHTING PURCHASE BEHAVIOR STUDY (MA22R47-E-LPB)

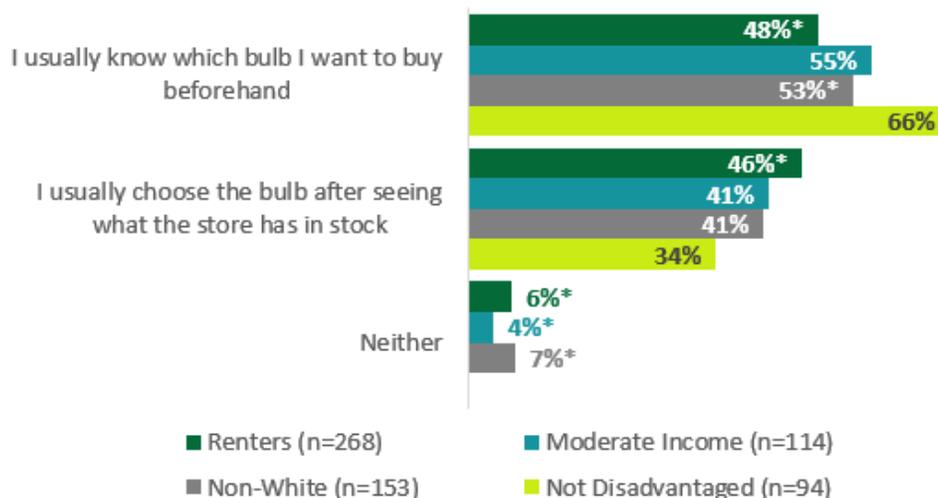
of renters, 47% of moderate-income households, 49% of non-white households, and 56% of not-disadvantaged households) followed by when they are running low on bulbs (30% of renters, 31% of moderate-income households, 29% of non-white households, and 27% of not-disadvantaged households).

Figure 10: When Respondents Usually Buy Light Bulbs
(base: respondents who had purchased/obtained a bulb in the past year)



When compared to not-disadvantaged households, a significantly greater percentage of renters (46% vs 34%) reported they usually choose the bulb they want to buy after seeing what the store has in stock rather than knowing what they want to buy beforehand (Figure 11).

Figure 11: How Respondents Usually Decide Which Bulb to Purchase
(base: respondents who had purchased/obtained a bulb in the past year)

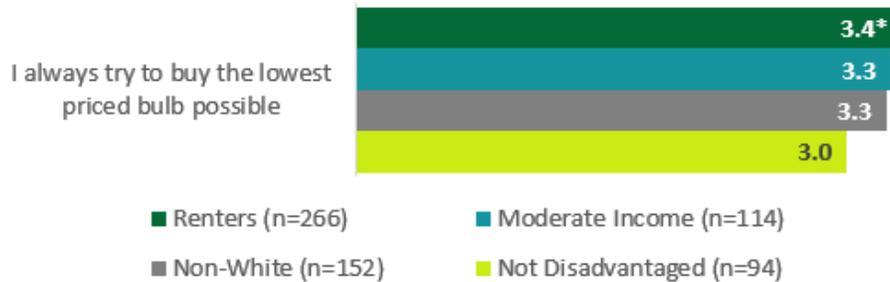


*Significantly different from Not Disadvantaged at the 90% confidence interval

Respondents were asked to rate their level of agreement with the statement “I always try to buy the lowest priced bulb possible” using a scale of one to five, where one was “strongly disagree” and five was “strongly agree”. Renters gave a significantly higher average level of agreement (3.4) than not-disadvantaged households (3.0) (Figure 12).

Figure 12: Average Agreement with “I always try to buy the lowest priced bulb possible”

(base: respondents who had purchased/obtained a bulb in the past year)

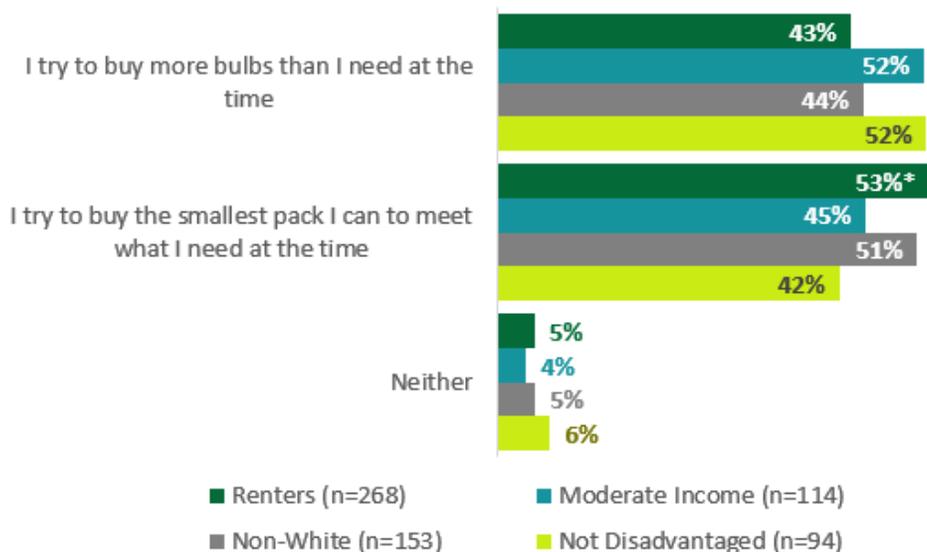


*Significantly different from Not Disadvantaged at the 90% confidence interval

A significantly larger percentage of renters (53%) said they try to buy the smallest pack of bulbs they can to meet what they need at the time compared to not-disadvantaged households (42%). (Figure 13)

Figure 13: How Many Bulbs Respondents Usually Purchase

(base: respondents who had purchased/obtained a bulb in the past year)

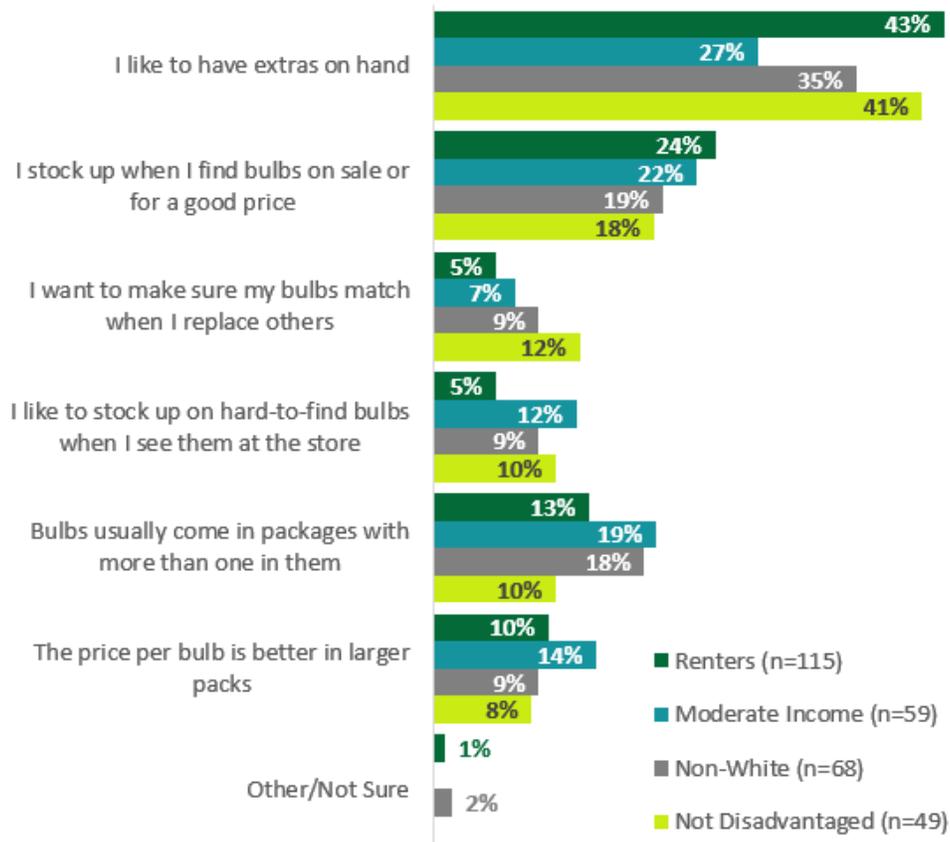


*Significantly different from Not Disadvantaged at the 90% confidence interval

Figure 14 shows the main reasons respondents gave for buying more bulbs than they needed at the time. Responses did not differ significantly when comparing the three target customer groups to not-disadvantaged households. The most common reason respondents gave was that they liked to have extras on hand (43% of renters, 27% of moderate-income households, 35% of non-

white households, and 41% of not-disadvantaged households). Approximately one-fifth of each customer category reported they stock up when they find bulbs on sale or for a good price (24% of renters, 22% of moderate-income households, 19% of non-white households, and 18% of not-disadvantaged households).

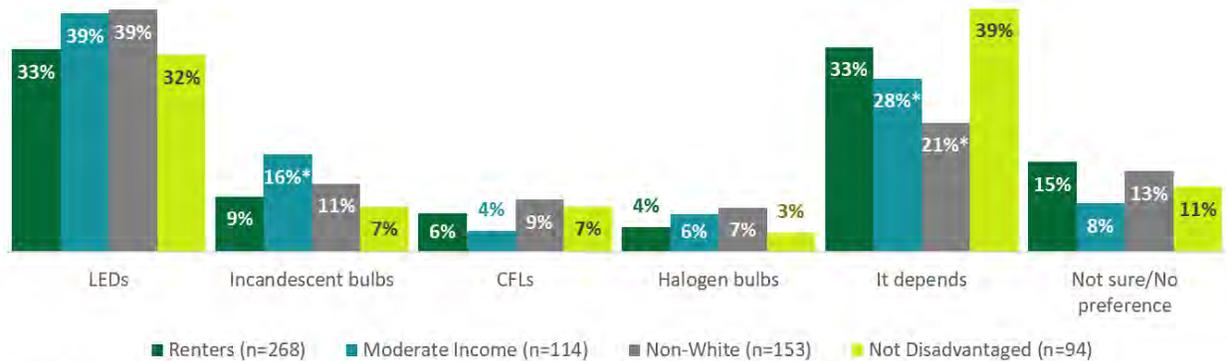
Figure 14: Main Reason Respondents Buy More Bulbs Than Needed
 (base: respondents who had purchased/obtained a bulb in the past year and said they buy more bulbs than they need to at the time of purchase)



If a respondent had heard of more than one bulb type, they were asked which bulb type they buy most often when they go to the store. Approximately one-third of respondents in each customer group (33% of renters, 39% of moderate-income households, 39% of non-white households, and 32% of not-disadvantaged households) said they most often buy LEDs (Figure 15). Moderate-income households were more likely than not-disadvantaged ones to say that they buy incandescents the most often (16% vs 7%). Both moderate-income households (28%) and non-white households (21%) were less likely than not-disadvantaged households (39%) to report that their bulb purchase depends (on fixture type, the room the bulb is in, etc.).

Figure 15: Bulb Types Respondents Buy Most Often

(base: respondents who had purchased/obtained a bulb in the past year and had heard of more than one bulb type)

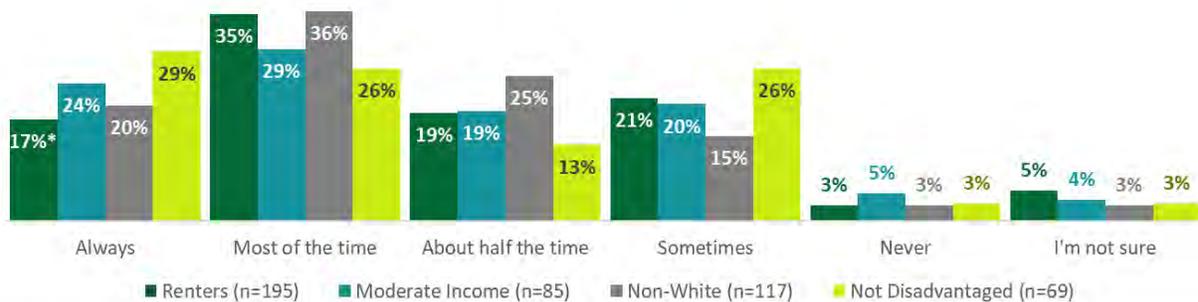


*Significantly different from Not Disadvantaged at the 90% confidence interval

More than one-half of respondents in each customer group who had heard of LEDs said they buy LEDs always or most of the time when purchasing bulbs (53% of renters, 53% of moderate-income households, 56% of non-white households, and 55% of not-disadvantaged households) (Figure 16). However, significantly fewer renters (17%) said they always purchase LEDs than did not-disadvantaged households (29%).

Figure 16: How Often Respondents Buy LEDs when Purchasing Light Bulbs

(base: respondents who had purchased/obtained a bulb in the past year and had heard of LEDs)



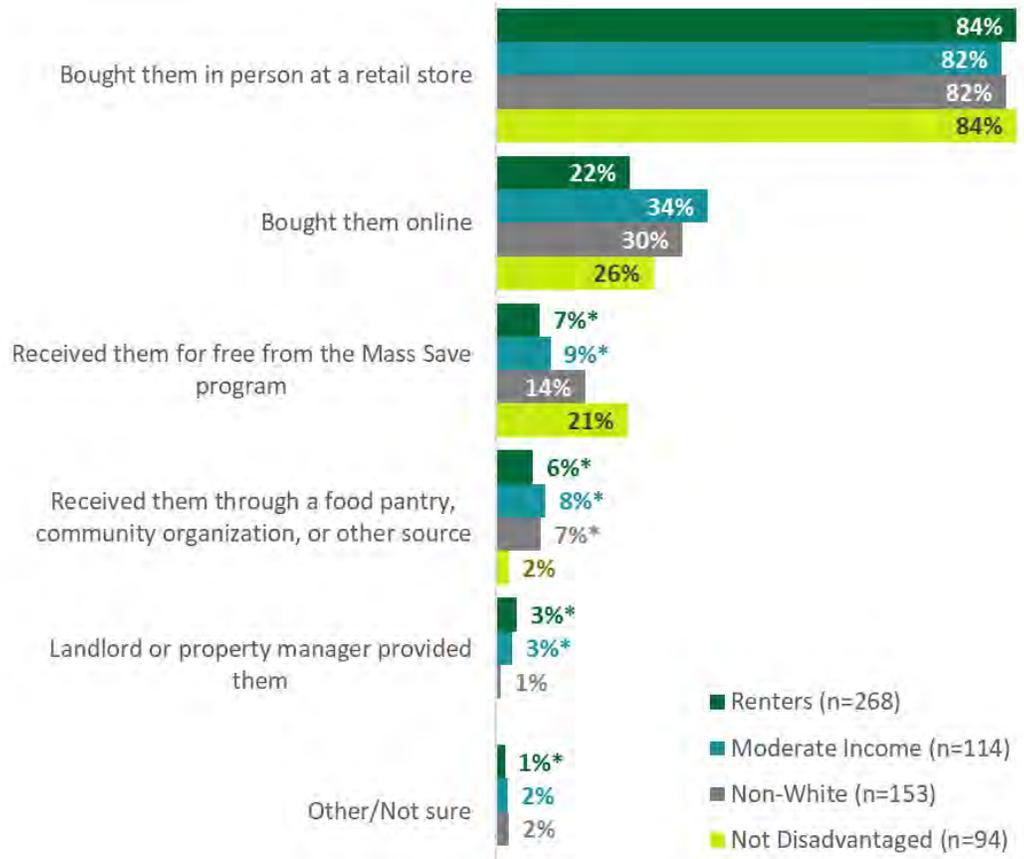
*Significantly different from Not Disadvantaged at the 90% confidence interval

More than four-fifths of respondents in all four customer categories said they had purchased a bulb in the past year in person at a retail store (84% of renters, 82% of moderate-income households, 82% of non-white households, and 84% of not-disadvantaged households) (Figure 17). One-fifth (21%) of not-disadvantaged households said they had received bulbs for free from the Mass Save program¹⁹, which was significantly higher than the percentage of both renters (7%) and moderate-income households (9%). This finding is in keeping with the results of the *Residential Nonparticipant Customer Profile Study (MA19X06-B-RESNONPART)* and *Residential Nonparticipant Market Characterization and Barriers Study (MA19R04-B-NP)*. In contrast, significantly more renters (6%), moderate-income households (8%), and non-white households

¹⁹ Mass Save program participation was self-reported and has not been verified by the PAs.

(7%) had received bulbs through a food pantry, community organization, or other similar source when compared to not-disadvantaged households (2%).

Figure 17: Ways that Respondents Obtained Bulbs in the Past Year
(base: respondents who had purchased/obtained a bulb in the past year)



*Significantly different from Not Disadvantaged at the 90% confidence interval

Figure 18 shows that store types where respondents had purchased bulbs in the past year differed greatly by customer group. Most not-disadvantaged households (60%) said they had purchased bulbs at a large hardware or home improvement store, significantly more than the percentage of renters (30%), moderate-income households (45%), and non-white households (48%) who said they purchase bulbs at those store types.

The most common store type at which renters reported having purchased bulbs was a mass merchandise store (52%), significantly higher than the percentage of not-disadvantaged households (34%). Renters were also significantly more likely than not-disadvantaged households to say they had purchased bulbs at a large grocery store (26% vs 17%), a dollar or discount store (24% vs 15%), or a drug store (15% vs 8%).

Moderate-income households were most likely to have purchased a bulb at a large hardware or home improvement store (45%) or a mass merchandise store (44%). This customer group was also significantly more likely than not-disadvantaged households to say they had purchased bulbs

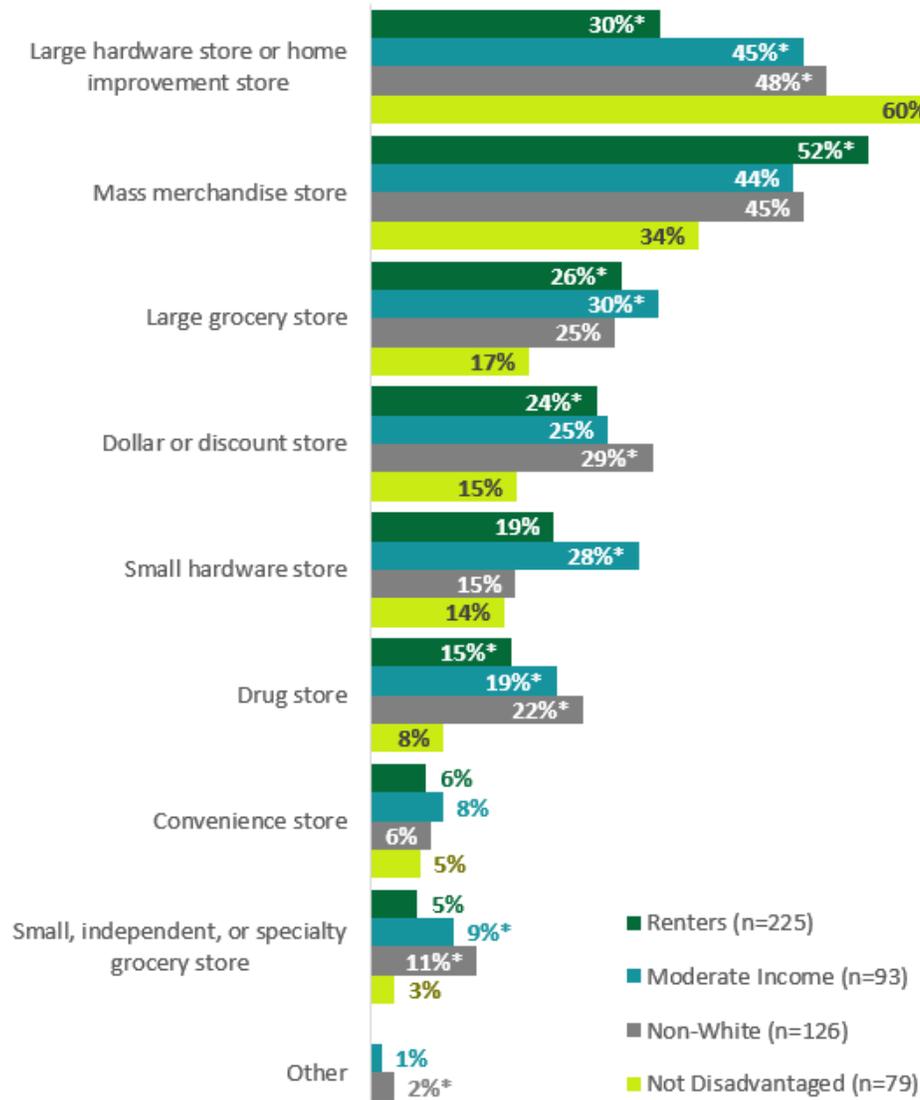
MA LIGHTING PURCHASE BEHAVIOR STUDY (MA22R47-E-LPB)

at a large grocery store (30% vs 17%), a drug store (19% vs 8%), or a small, independent, or specialty grocery store (9% vs 3%).

Non-white households were also most likely to have purchased a bulb at a large hardware or home improvement store (48%) or a mass merchandise store (45%). This customer group was also significantly more likely than not-disadvantaged households to say they had purchased bulbs at a dollar or discount store (29% vs 15%), a drug store (22% vs 8%), or a small, independent, or specialty grocery store (11% vs 3%).

Figure 18: Store Types where Respondent Purchased Bulbs

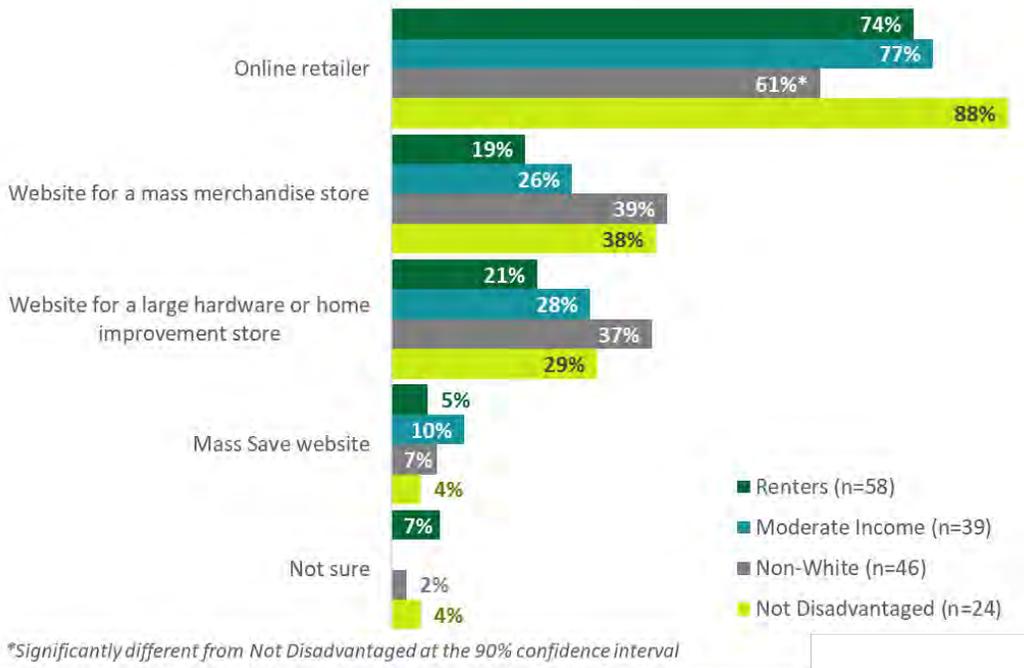
(base: respondents who had purchased/obtained a bulb in the past year at a retail store)



*Significantly different from Not Disadvantaged at the 90% confidence interval

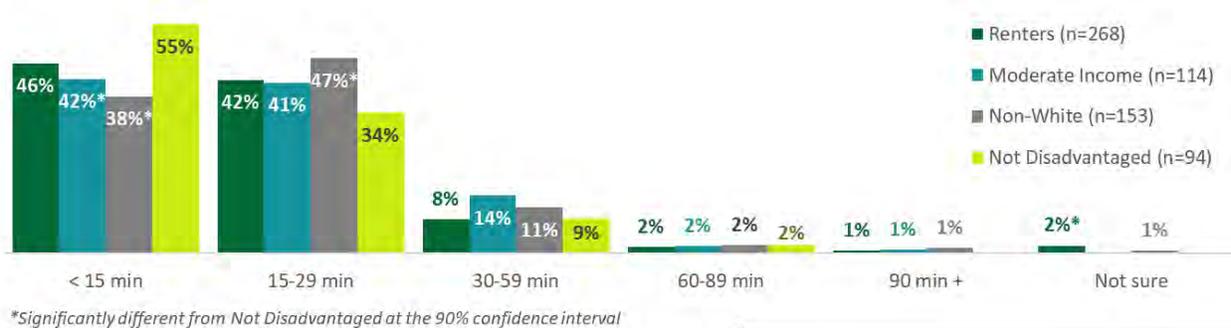
While respondents from all four customer categories made most online bulb purchases through an online retailer, only non-white households (61%) differed significantly when compared to not-disadvantaged households (88%) (Figure 19).

Figure 19: Online Store Types where Respondent Purchased Bulbs
(base: respondents who had purchased/obtained a bulb in the past year online)



All respondents – including those who had not purchased a bulb in the past year – were asked how many minutes on average it took to get to the nearest mass merchandise, such as Target or Walmart, or home improvement store, such as Home Depot or Lowe’s, even if they did not shop at those stores. A significantly smaller percentage of moderate-income households (42%) and non-white households (38%) lived within 15 minutes or less of these store types than did not-disadvantaged households (55%) (Figure 20). However, more than four-fifths (88% of renters, 83% of moderate-income households, 85% of non-white households, and 89% of not-disadvantaged households) said they lived within 30 minutes of the nearest mass merchandise or home improvement store.

Figure 20: Time it Takes to Get to Nearest Mass Merchandise Store
(base: all respondents)



Section 4 Literature Review

Table 6 below lists the literature sources (with hyperlinks), program and study descriptions, and the impact factors. We list the impact factors used for the Residential Coordinated Delivery (RCD) light bulb kit, as agreed upon in March 2022. We reviewed Massachusetts studies, but they only reported impact factors for disadvantaged groups participating in direct install programs.

The literature listed two first-year ISRs: (1) 80% for a 2018 food bank program offered by ComEd, and (2) 60% for a 2020/2021 kit-based program offered by PECO. Lifetime ISRs ranged from 82% for a 2018/2019 kit-based program PPL to 100% for the same PECO program cited above. Most lifetime ISRs hovered around 90%. The literature listed only two NTG ratios, both 100% and both deemed to be 100% because they targeted low-income households.²⁰

A few other key observations about the literature include the following:

- Studies rarely report impact factors broken out for individual disadvantaged customer groups but instead report results for the entire program
- Outside of direct install programs, PAs typically rely on kits and food bank / non-profit distribution approaches to reach disadvantaged customers. Duke Energy served as an exception by using a neighborhood canvass approach
- No studies focused on moderate-income lighting programs
- No studies estimated measure life – adjusted or not – for disadvantaged customers.

²⁰ A statistical modeled developed for the California Public Utilities Commission on the investor-owned utilities' 2017 Upstream Lighting Program controlled for renters. We did not include this study in the table because the model did not suggest a statistically different NTG ratio for renters compared to homeowners for any of the three utilities. DNV. 2020. *Upstream and Residential Downstream Lighting Impact Evaluation Report: Lighting Sector – Program Year 2017.* (https://www.calmac.org/publications/CPUC_Group_A_Upstream_Lighting_Sector_Impact_Eval_Report_FINAL_CAL_MAC.pdf.)

Table 6: Literature Review Summary

Jurisdiction	Title	Program Year	Author	Type	ISR		NTG
					1st	Life	
Massachusetts	Deemed, agreed in March 2022	2022	PAs, EEAC, Evaluators	RCD Leave Behind Kit	72%	72%	58%
Con Edison (NY)	Residential Retail Lighting 2018 Program Evaluation	2018	Guidehouse	Food Bank Impact	58%	74%	N/A
Central Hudson (NY)	Community Lighting Impact Evaluation Final Report	2018 / 2019	Cadmus / DSA	No-cost through non-profits serving low-income	N/A	92%	N/A
Duke Energy Carolinas (NC) ¹	2017 Neighborhood Energy Saver Program Evaluation Report	2017	Opinion Dynamics	Neighborhood Canvas	N/A	92%	N/A
Duke Energy Progress (NC) ¹	2017 Neighborhood Energy Saver Program Evaluation Report	2017	Opinion Dynamics	Neighborhood Canvas	N/A	94%	N/A
District of Columbia	Evaluation of DC Sustainable Energy Utility FY2020 Programs	2020	NMR	Food Bank	N/A		100%
ComEd (IL)	ComEd Food Bank LED Distribution Impact Evaluation Report	2018	Guidehouse & EcoMetric	Food Bank	80%		100%
Duquesne (PA)	Final Annual Report to the Pennsylvania Public Utility Commission Phase III of Act 129	2019 / 2020	Guidehouse	Low Income Kits	N/A	88%	N/A
PECO (PA)	Final Annual Report to the Pennsylvania Public Utility Commission Phase III of Act 129	2020 / 2021	Guidehouse	Low Income Kits	60%	100%	N/A
PPL (PA) ²	PPL Electric Utilities Annual Report to the Pennsylvania Public Utility Commission	2018 / 2019	Cadmus	Kits (not only low income)	N/A	82%	N/A

¹ The hyperlink takes the user to the ESource DSM Library, a for-fee service. We could not find a free version of the report.

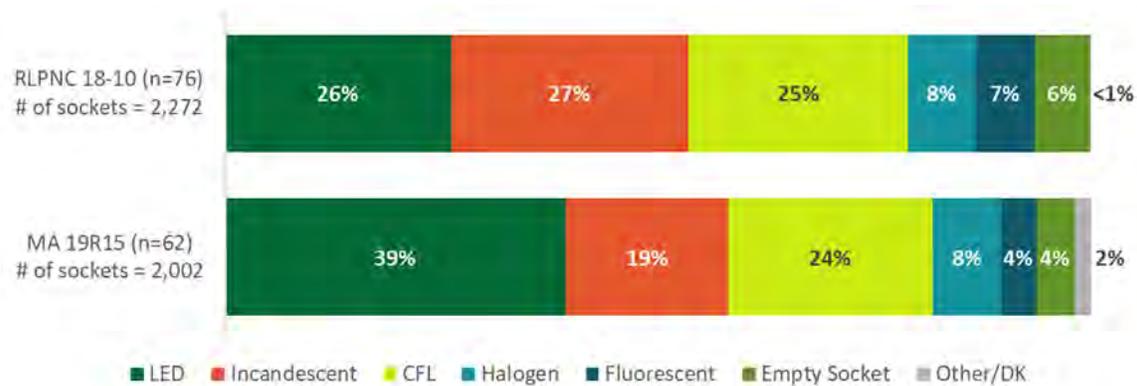
² We included this program as it does include low-income recipients.

Section 5 Reanalysis of Prior Massachusetts Onsite Data

To describe the types of bulbs the PAs should include in a targeted lighting offering, the NMR team reanalyzed lighting data from two prior Massachusetts panel studies, RLPNC 18-10, which collected onsite data between October and December 2018, and MA19R15, which collected onsite data between October 2019 and March 2020). The reanalysis described the lighting shapes and socket needs of renters, low-income households, and multifamily households. The prior panel studies did not collect the information necessary for NMR to reanalyze data for moderate income, minority, or limited English proficiency households. Because the [Consensus Process](#) ultimately focused on renters and moderate-income households, this section presents reanalysis results for renters only (See [Appendix B](#) for the detailed reanalysis of low-income and multifamily households.). The reanalysis examines bulb use, socket type, and socket saturation. Due to a high proportion of households in the MA19R15 panel that took part in a PA direct install program²¹, we limit some reanalysis to RLPNC 18-10. This avoids any bias created by the direct installation of LEDs by the PAs.

In RLPNC 18-10 renter households, sockets were nearly equally filled with LEDs (26%), Incandescents (27%) and CFLs (25%). In MA19R15 renter households, 40% of sockets were filled with LEDs, followed by CFLs (24%), and Incandescents (19%), although the high proportion of direct install participants may have upwardly biased the later LED saturation ([Figure 21](#)).

Figure 21: Renter Socket Saturation by Bulb Type



In renter households in both studies, most bulbs were installed in hardwired fixture types²² ([Figure 22](#)) and medium screw bases ([Figure 23](#)).

²¹ 41% of MA19R15 participants had participated in at least one direct-install program since 2015

²² Hardwired fixtures include flush mount, wall mount, recessed, pendant, and ceiling fan fixture types

Figure 22: Renter Socket Saturation by Fixture Type

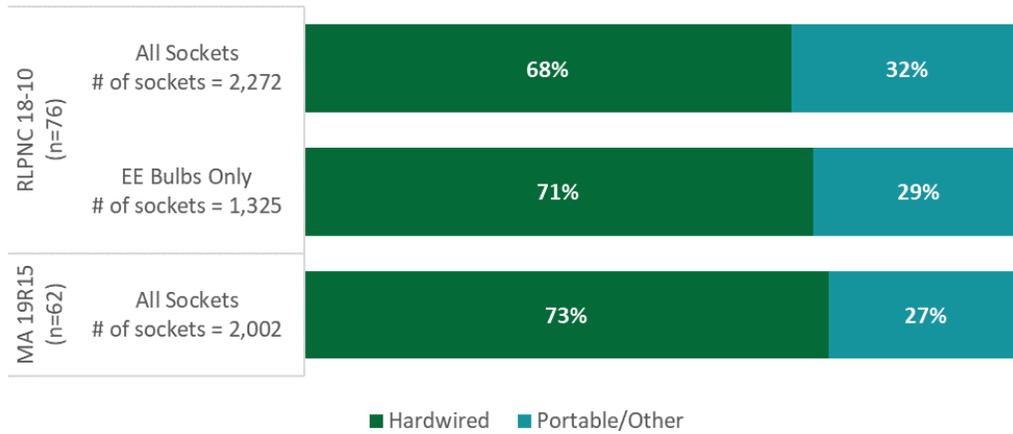
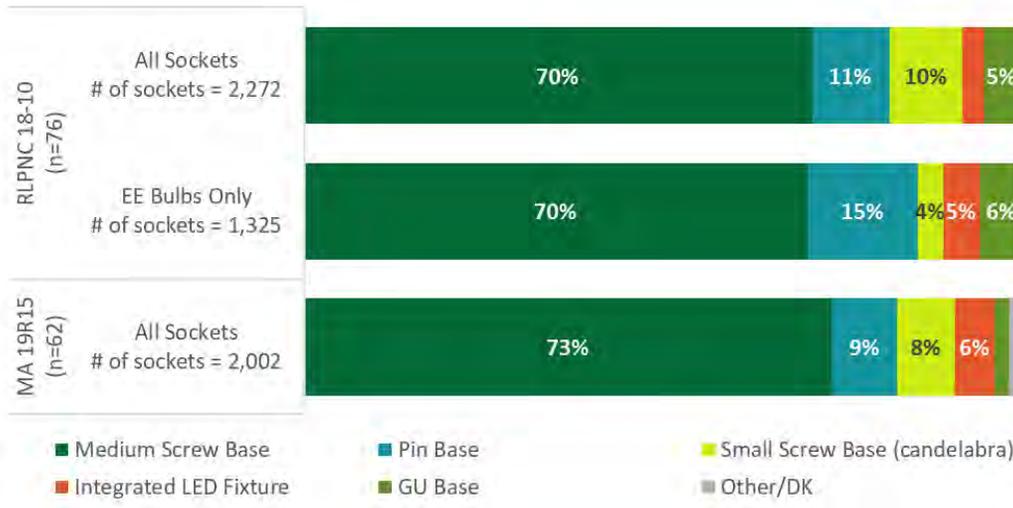


Figure 23: Renter Socket Saturation by Base Type



See [Appendix B](#) for reanalysis on renter socket saturation by bulb shape and wattage equivalence.

Section 6 Consensus Process

The NMR team facilitated a consensus process to set the ISRs, NTGs, and AMLs that should be used if the PAs were to offer a targeted lighting program. The team prepared information summaries of the consumers survey, literature review, and onsite data reanalysis results for the PAs and the EEAC consultants to consider and facilitated three meetings to set impact factors.

Table 7 below summarizes the discussion topics, action items, and decisions for each meeting. The remainder of this section provides more details on the consensus process.

Table 7: Consensus Group Meetings Summary

Date	Discussion Topics	Action Items	Decisions
August 4th	<ul style="list-style-type: none"> ✓ Reanalysis of MA Onsite Data Results ✓ Consumer Survey Results 	Break out survey results by: <ul style="list-style-type: none"> • Owners / Renters-NLI / Renters-LI/MLI • Disadvantaged vs non-disadvantaged 	→ Initial results point to some justification for running a targeted program.
August 16th	<ul style="list-style-type: none"> ✓ Consumer Survey Results ✓ Literature Review Results 	Break out survey results by: <ul style="list-style-type: none"> • Renters / MI / LI vs. • All / Phone / Web vs. • Not Disadvantaged Test significance: <ul style="list-style-type: none"> • MI vs Not Disadvantaged The PAs will discuss program design and report back to the group	<ul style="list-style-type: none"> • AML = 1 Year • ISR = 72% → NTG = Estimate will wait for updated analysis and more information on program design to decide
August 24th	<ul style="list-style-type: none"> ✓ Additional Consumer Survey Results ✓ Program Design 		<ul style="list-style-type: none"> • NTG - Renters = 45% • NTG - MI = 25% → Results present an adequate case for a program targeting renters and a program targeting MI households

6.1 MEETING 1 – AUGUST 4

At the first consensus group meeting, the NMR team shared a PowerPoint presentation with the results of the reanalysis of the Massachusetts onsite data as well as preliminary consumer survey. We held this meeting during a regularly scheduled bi-weekly call.

The preliminary consumer survey results compared disadvantaged households to not-disadvantaged households. The consensus group members were interested in the differences in

types of retail stores where the two customer groups had purchased bulbs in person and the differences in the distance to a mass merchandise or home improvement store.

The consensus group asked for finer grain contrasts of the survey data so they could see any possible dramatic differences between specific customer categories, focusing on important differences between disadvantaged customer categories and not-disadvantaged households. They were especially interested in results for renters, as such households would likely serve as one of the targeted populations.

6.2 MEETING 2 – AUGUST 16

At the second consensus group meeting, the NMR team shared an Excel file showing consumer survey results by tenure, self-identified race and ethnicity, self-rated English-speaking ability, income, and income and tenure combined. We compared each disadvantaged group to not-disadvantaged households.

After reviewing the results, the consensus group concluded that, for the bulk of indicators, there were not many meaningful differences between the disadvantaged groups and not-disadvantaged households. However, they did note some key differences and patterns in renters and moderate-income households related to price sensitivity, importance of aesthetics in bulb choices, where households shop for light bulbs, and the distance to home improvement stores.

During the second meeting, the PAs confirmed that implementation was leaning towards a kit-based program that targeted renters. The group observed that the survey data seemed to support this plan, as it pointed to renters being less concerned with lighting choices than not-disadvantaged households and more likely to wait until a bulb burned out to buy a new bulb, to buy the lowest-priced bulb possible, and to buy as few bulbs as they can. The PAs also identified moderate-income households as a possible program target. The PAs felt a kit program for renters and/or moderate-income households may push recipients to retire bulbs early. The PAs argued that early retirement was important as state and federal lighting standards would likely be fully enacted by early summer 2023, and LEDs would essentially be the new standard bulb for most shapes and lumen bins.

The consensus group also noted that the phone survey respondents who accounted for nearly all limited English speakers seemed to be skewing some of the results. As noted above, the limited English speakers had high education levels, but they also tended to fall into the moderate-income category and demonstrate a strong affinity for LEDs.

Given the discussion, the consensus group asked the NMR team to conduct analyses that separated phone and web respondents among renter, low-income, and moderate-income households. They also requested statistical comparisons between moderate-income and not-disadvantaged households.

The NMR team also walked the consensus group through the literature review results, which were too few to play a meaningful role in the consensus process.

The consensus group meeting ended with a discussion of impact factors for a renter program. The group quickly agreed upon an AML of one year, mainly due to state²³ and DOE efficiency standards that go into effect in 2023. They also settled on an ISR of 72%, drawn from a recently completed impact evaluation of Virtual Home Energy Audit Kits.²⁴ The consensus group reasoned that the ISR was closely applicable to a likely PA renter program; the 72% rate is also currently being applied to lighting kits distributed through Residential Coordinated Delivery (RCD).

The consensus group discussed, but deferred setting, a NTG ratio until they saw the results of the additional requested analyses. During the discussion, one group member suggested an NTG of 25%-50%, noting that the market share for efficient/LED bulb types is generally over 70%, and most disadvantaged groups did not report very different purchasing behavior in this study's survey compared to not-disadvantaged households. Another member suggested 35%-40% noting that the program would not offer reflector bulbs, which typically have the highest free-ridership.

6.3 MEETING 3 – AUGUST 24

At the third and final consensus group meeting, the NMR team shared an Excel file with additional consumer survey results for renters, low-income households, and moderate-income households by web and phone respondents compared to not-disadvantaged households. The PAs also confirmed that the program would offer the same two packages of light bulbs they offer now through their current RCD kit program. Customers who contacted the program would be asked about bulbs they have in the home. Based on their responses, the program would then send them up to two six-packs of bulb, either A-lines, candelabras, or a combination of the two.

The consensus group concluded that removing the phone respondents showed that both renter and moderate-income household lighting purchase behavior were driven by price and access (based on where they shopped and distance to home improvement and mass merchandise stores). They concluded that the study provided adequate evidence of the need for a program or programs that targeted renters and moderate-income households.

The group quickly decided to apply the same ISR and AML to both renter and moderate-income households. However, they engaged in more discussion about the NTG ratios. The consensus group first decided to deem a NTG of 45% for renters, noting that there was reasonably strong evidence supporting a program targeting this customer group, that the program would encourage customers to use the bulbs to early retire existing bulbs, and that most renters are expected to request 12 A-line bulbs. The group then settled on a lower NTG of 25% for moderate-income households, noting the evidence supporting a program for this customer group was not as strong, and that the method by which moderate-income households enter the programs could make them

²³ Massachusetts adopted new appliance efficiency standards in 2021 as part of *An Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy* (<https://www.mass.gov/service-details/appliance-energy-efficiency-standards>). The standards apply to many bulbs – including globes, candelabras, and some reflectors – that are exempt from the Energy Independence and Security Act of 2007 (EISA) and that have been in regulatory and legal limbo for many years. The Massachusetts standards prohibit the sale of what the legislation calls *state-regulated general service lamp[s]* beginning in January 2022 and the installation of such lamps for compensation beginning in January 2023 (<https://malegislature.gov/Laws/GeneralLaws/PartI/TitleII/Chapter25B/Section5>).

²⁴ Guidehouse. 2021. *Residential Coordinated Delivery Virtual Home Energy Assessment Study (MA20R26-B-VHEA)*. Available at https://ma-eeac.org/wp-content/uploads/MA20R26-B-VHEA_Report_FINAL_12MAR2021.pdf.

more likely to be free-riders. Moderate income customers are only identified when they complete an income verification process to receive enhanced insulation and heating system incentives. Therefore, these customers are already showing an interest in energy efficiency.

Appendix A Lighting Purchase Behavior Survey

Topic	Questions
Demographics needed for screening	S1 to S3
Responsibility for electricity bill, bulb purchases	R1 to R3
Bulb buying process, preferences	R4, R5, B1 to B9
Bulb type awareness, knowledge	K1 to K3
Remaining demographics	D1 to D9

Thank you for taking the time to complete this survey for the sponsors of Mass Save®. Berkshire Gas, Cape Light Compact, Eversource, Liberty Utilities, National Grid and Unitil work together as Mass Save® to help residents and businesses across Massachusetts save money and energy, providing energy efficiency programs and services while simultaneously leading the state to a clean and energy efficient future.

NMR Group is conducting this survey on behalf of the sponsors of Mass Save. We want to know about how you buy the light bulbs you use in your home. We are not selling anything. The survey should take about 10 to 15 minutes to complete.

[IF WEB SURVEY] NMR Group is working with Qualtrics to administer this survey. If you have questions about the validity of the survey, please contact Brandy Chambers of Eversource at 781-441-8059.

[IF PHONE SURVEY²⁵] NMR Group is working with Qualtrics to administer this survey. If you have questions about the validity of the survey, please contact Brandy Chambers of Eversource at 781-441-8059.

SCREENING

S1. Are you 18 years of age or older?

1. Yes
2. No **[THANK AND TERMINATE]**
3. Prefer not to answer **[THANK AND TERMINATE]**

S2. Is your primary home – the place you live most of the year – in Massachusetts?

1. Yes
2. No **[THANK AND TERMINATE]**
99. Prefer not to answer **[THANK AND TERMINATE]**

S3. Do you own or rent your Massachusetts home?

1. Own
2. Rent

²⁵ NMR also adapted the web version to be used as a phone survey, which Qualtrics translated into Spanish and Portuguese and fielded.

97. Other; please specify: [REQUIRE OPEN-END RESPONSE]

99. Prefer not to answer [THANK AND TERMINATE]

S4. What is your race or origin? Select all that apply.

1. White
2. Hispanic, Latino, or Spanish origin
3. Black or African American
4. Asian or Asian American
5. American Indian or Alaska Native
6. Native Hawaiian or Other Pacific Islander
97. Some other race or origin; please specify: [SPECIFY]
99. Prefer not to answer [THANK AND TERMINATE]

RESPONSIBILITY FOR PAYING BILLS AND BUYING BULBS

R1. [IF S3 = 2 or 97] Are you or someone in your household responsible for paying the electricity bill at this Massachusetts home?

1. Yes
2. No
99. Prefer not to answer

R2. [IF S3 = 2 or 97] Which of the following statements best describes who is responsible for providing the light bulbs for this Massachusetts home?

If you live in a multifamily building, please answer only about the light bulbs in your unit, not those in common areas.

1. I or someone in my household provides them
2. My landlord / property manager provides them [GO TO K1]
3. My landlord / property manager and my household both provide light bulbs
4. I'm not sure because I haven't had to replace any light bulbs since moving in [GO TO K1]
98. I'm not sure (for any other reason)

R3. Have you or has someone in your household bought or otherwise obtained **any** light bulbs for this home in the past year? [ALLOW BOTH 1 AND 2]

1. Yes, I have
2. Yes, someone else in my household has
3. No [GO TO K1]
98. I'm not sure [GO TO K1]

[IF R3 = 2 but not 1, READ] If possible, please ask the person in your household who bought or otherwise obtained light bulbs to help you answer questions about their experiences doing so.

- R4. **[IF R3 = 1 OR 2]** Please check **all the ways** that you bought or otherwise obtained light bulbs in the past year. Select all that apply.
[ROTATE RESPONSES 1 TO 5]
1. Bought them in person at a retail store
 2. Bought them online
 3. Received them through a food pantry, community organization, or other source
 4. Received them for free from the Mass Save program
 5. **[ALLOW IF R2 = 3]** Landlord or property manager provided them
 97. Other; please specify: **[SPECIFY]**
 98. I'm not sure
- R5. **[IF R4 = 1]** At which type of store(s) did you buy light bulbs in person in the past year? Select all that apply. **[ROTATE RESPONSES 1 TO 8]**
1. Small hardware store (*Ace, True Value, Aubuchon, etc.*)
 2. Large hardware store or home improvement store (*Home Depot, Lowes, etc.*)
 3. Small, independent, or specialty grocery store
 4. Large grocery store (*Market Basket, Shaw's, Stop n Shop, etc.*)
 5. Mass merchandise store (*Walmart; Target; Bed, Bath, and Beyond, etc.*)
 6. Dollar or discount store (*Family Dollar, Ocean State Job Lot, etc.*)
 7. Drug store (*CVS, Walgreens, etc.*)
 8. Convenience corner stores
 97. Other; please specify: **[SPECIFY]**
 98. I'm not sure
- R6. **[IF R4 = 2]** At which type of online store(s) did you buy light bulbs in the past year? Select all that apply. **[ROTATE RESPONSES 1 TO 4]**
1. Website for a large hardware store or home improvement store (*Home Depot, Lowes, etc.*)
 2. Website for a mass merchandise store (*Walmart; Target; Bed, Bath, and Beyond, etc.*)
 3. Mass Save website
 4. Online retailer (*Amazon, 1000Bulbs.com, Bulbs.com, etc.*)
 97. Other **[SPECIFY]**
 98. I'm not sure
- R7. Even if you do not shop at any of these stores, about how many minutes, on average, does it take you get to the nearest mass merchandise such as Target or Walmart, or home improvement store such as Home Depot or Lowes?
1. Less than 15 minutes
 2. 15-29 minutes
 3. 30-59 minutes
 4. 60-89 minutes
 5. 90 minutes or more.
 98. I'm not sure

LIGHT BULB AWARENESS AND KNOWLEDGE

K1. Which of the following bulb types have you heard of? Select all that apply. [ROTATE RESPONSES 1 TO 4]

1. Incandescent bulbs
2. Halogen bulbs
3. Light emitting diode or LED bulbs
4. Compact fluorescent light bulbs or CFLs
5. [DO NOT ALLOW IF ANY 1 TO 4 SELECTED] I have not heard of any of these types of light bulbs
98. I'm not sure

K2. [IF MORE THAN ONE RESPONSE SELECTED FOR K1] Which of these bulb types do you prefer to use in your home? [ALLOW 1 TO 4 ONLY IF SELECTED IN K1; ROTATE RESPONSES 1 TO 4]

1. Incandescent bulbs
2. Halogen bulbs
3. Light emitting diode or LED bulbs
4. Compact fluorescent light bulbs or CFLs
5. It depends [PLEASE EXPLAIN]
6. I do not have a preference

[IF R2 = 2 OR 4, OR R3 = 3 OR 98, SKIP TO D1]

K3. [IF MORE THAN ONE RESPONSE SELECTED FOR K1] Which of these bulb types do you think is the most expensive to buy (that is, has the highest shelf price)? [ALLOW 1 TO 4 ONLY IF SELECTED IN K1; ROTATE RESPONSES 1 TO 4]

1. Incandescent bulbs
2. Halogen bulbs
3. Light emitting diode or LED bulbs
4. Compact fluorescent light bulbs or CFLs
5. They cost about the same to buy
98. I'm not sure

PURCHASE BEHAVIOR

[IF R3 = 1 OR 2]

We'd like you to think about how you decide which light bulbs to buy.

B1. Below we've listed some common things people consider when buying a light bulb. On a scale of 1 to 5, where 1 is "not at all important" and 5 is "extremely important", please indicate how important each is to your light bulb purchase decision:

1. Not at all important
2. Slightly important

3. Moderately important
4. Very important
5. Extremely important
98. I'm not sure

[PROGRAMMER, ROTATE ORDER OF A TO G]

- a. Price of bulb
- b. Shape [NMR will insert images of shapes into program, with appropriate credit to any copyrighted images]
- c. Brightness (wattage, wattage equivalence, lumens)
- d. Energy Use / Efficiency
- e. Color Temperature (warm white, cool white, daylight)
- f. Matches previously installed bulb
- g. Matches other bulbs used in house

B2. Which of the following statements **best** describes **when** you **usually** buy light bulbs?
[ROTATE RESPONSES 1 TO 4]

1. To replace a bulb when it burns out
2. When I find them on sale, even if I don't need to replace a bulb
3. Impulse buy or unplanned purchase
4. When I'm running low
5. None of the above

B3. Which of the following statements **best** describes **how** you **usually** decide which bulb to purchase?

1. I usually know which bulb I want to buy beforehand.
2. I usually choose the bulb after seeing what the store has in stock.
3. Neither

B4. On a scale of 1 to 5, where 1 is "strongly disagree" and 5 is "strongly agree," please rate your level of agreement with this statement: *I always try to buy the lowest priced bulb possible.*

1. Strongly disagree
2. Somewhat disagree
3. Neither agree nor disagree
4. Somewhat agree
5. Strongly agree
98. I'm not sure

B5. Which of the following statements **best** describes **how many** bulbs you **usually** buy?

1. I try to buy the smallest pack I can to meet what I need at the time.
2. I try to buy more bulbs than I need at the time.
3. Neither

- B6. [IF B5 = 2] What is the **main** reason that you buy more bulbs than you need at the time?
[ROTATE RESPONSES 1 TO 6]
1. I like to have extras on hand
 2. I like to stock up on hard-to-find bulbs when I see them at the store
 3. I want to make sure my bulbs match when I replace others
 4. The price per bulb is better in larger packs
 5. Bulbs usually come in packages with more than one in them
 6. I stock up when I find bulbs on sale or for a good price
 97. Other; please specify: [SPECIFY]
 98. I'm not sure
- B7. [IF MORE THAN ONE RESPONSE SELECTED FOR K1] Which of these bulb types do you most often buy when you go to the store?
- [IF ANSWERED K2 READ: "The type of bulb you most often buy may or may not be the same as the type of bulb you prefer to use in your home."] [ALLOW 1 TO 4 ONLY IF SELECTED IN K1; ROTATE RESPONSES 1 TO 4]
1. Incandescent bulbs
 2. Halogen bulbs
 3. Light emitting diode or LED bulbs
 4. Compact fluorescent light bulbs or CFLs
 5. It depends (for example: on the fixture type, the room the bulb is in, etc.)
 6. I do not have a preference
 97. Something else; please specify:
 98. I'm not sure
- B8. [IF K1 = 3] On a scale of 1 to 5, where 1 is "never" and 5 is "always", how often do you buy LEDs when purchasing light bulbs?
1. Never
 2. Sometimes
 3. About half the time
 4. Most of the time
 5. Always
 98. I'm not sure
- B9. [IF K1=3 AND B8 ≠ 5] What are the reasons you do not always buy LEDs? Select all that apply. [ROTATE RESPONSES 1 TO 6]
1. I cannot always find an LED
 2. If I find an LED, it is not always the shape or style I'm looking for
 3. The price is too high
 4. I do not believe LEDs save money
 5. I don't like the quality of light from LEDs
 6. I don't like the appearance of LEDs
 97. Other; please specify: [SPECIFY]
 98. I'm not sure

DEMOGRAPHIC QUESTIONS

D1. Including yourself, how many people in each age category listed below live in your home?
Please remember to include yourself in the count.

1. _____ Number of children 6 and younger
2. _____ Number of children 7 to 17
3. _____ Number of adults 18 to 64
4. _____ Number of adults 65 and older
5. _____ Total household members including yourself [AUTO CALCULATE]
99. Prefer not to answer

D2. [IF D1 ≠ 97] To verify, a total of [insert #5 from D1] people – including yourself – live in your household. Is this correct?

1. Yes
2. No [RETURN TO D1 AND ASK TO CORRECT]

D3. Which best describes the building you live in?

1. A single-family house detached from any other house
2. A row home—a single-family house attached to one or more single-family house(s)
3. A building with 2 units
4. A building with 3 or 4 units
5. A building with 5 to 9 units
6. A building with 10 to 19 units
7. A building with 20 to 49 units
8. A building with 50 or more units
9. A mobile home
10. A boat, RV, van and so on
99. Prefer not to answer

D4. What is the highest level of education you have completed?

1. Less than high school
2. High school graduate or equivalent (e.g., GED)
3. Attended some college, but didn't get a degree
4. Associate degree
5. Bachelor's degree
6. Master's degree
7. Professional or Doctorate degree
99. Prefer not to answer

D5. [SKIP IF D1 = 97] Which of these categories best describes your total annual reported household income in 2021 before tax – counting everyone living in your household?

1. Under [pipe in 60% median income for area & household occupancy]
2. Between [pipe in 60% and 80% for area and household occupancy]
3. Over [pipe in 80% median income for area & household occupancy]

99. Prefer not to answer

D6. Do you speak languages other than English at home?

1. Yes
2. No

99. Prefer not to answer

D7. [IF D6 = 1] What other language(s) do you speak at home? Select all that apply.

1. Spanish
2. Portuguese
3. Chinese
4. French
5. Vietnamese
6. Russian
7. Arabic
8. Italian
9. Khmer

97. Other; please specify: [SPECIFY _____]

99. Prefer not to answer

D8. [IF D6 = 1] When at home, does your household usually speak English or usually speak a language or languages other than English?

1. Usually English
2. Usually language(s) other than English
3. Speak English and (an)other language(s) equally

99. Prefer not to answer

D9. [IF D6 = 1] How well do you speak English?

1. Very well
2. Well
3. Not well
4. Not at all

99. Prefer not to answer

B

Appendix B Detailed Survey Results

The NMR team presents detailed survey and data reanalysis results in a spreadsheet accompanying this report. The spreadsheet includes survey responses for additional demographic groups, including low-income households, racial and ethnic minorities, and limited English speakers. The data reanalysis addresses low-income households and multifamily households.