We Know What You Did Last Summer: Revelations of a Lighting Panel Study

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ABSTRACT

In the past, program administrators have relied primarily on changes in lighting saturation over time, self-reported data from customer surveys, or store intercepts to help them understand consumer lighting purchases and use. However, this approach has failed to reveal what types of bulbs are actually replaced when newly purchased bulbs are installed. In the past, researchers have tried to capture this information using self-reported data—asking customers what type of bulb had been installed prior to the current CFL or LED. However, self-reported lighting data are notoriously inaccurate.

This paper explores the results of an ongoing panel study begun in 2013 involving repeat visits to the same homes over multiple years. Revisiting households makes it possible to directly monitor changes in specific sockets over time, thus finally answering the question of what types of bulbs customers choose to replace bulbs that burn out or are otherwise removed. The panel study design allows for a deeper understanding of the effects of EISA in people's homes, making it possible to answer difficult questions including: What are households using to replace incandescent bulbs? How many CFLs are used to replace other CFLs? What type of bulbs are LEDs replacing? What are households doing with all those bulbs they have in storage? When a bulb burns out, how do customers decide what bulb to use to replace it? The answers to these questions can help inform program designs and assess savings in response to market trends.

Background

This paper reports on a lighting panel study. On the surface, this does not appear to be ground-breaking research—after all, lighting panel studies have been attempted before. In fact, the authors attempted such a study in 2010, but efforts were hindered by a lack of consistency in on-site data collection protocols. This inconsistency made it nearly impossible to tell whether observed differences reflected changes in lighting or simply data collection errors. This led to a careful examination of long-standing on-site protocols used, an issue explored in more depth in a 2011 IEPEC paper (Filiberto et al.).

When the opportunity arose to attempt another lighting panel study in 2013, the authors, armed with past study findings as well as new protocols that had been established and tested with the express purpose of enabling panel studies, were confident they could design and implement a study that would overcome past failures.[1]

Methodology

To date, two waves of panel visits have been completed in Massachusetts using these improved protocols. As Figure 1 shows, in 2013 we visited 150 homes for the first time. In 2014, we returned to

[1] For an overview of on-site protocol improvements and findings, we invite interested readers to attend the IEPEC 2015 poster session during which we will present a comprehensive review of enhancements to on-site data collection processes and protocols in a poster titled *Fifteen Secret Tips That Will Change Everything You Know about On-site Data Collection*.

111 of the homes first visited in 2013 and visited an additional 150 homes for the first time. In 2015, we returned to 203 homes—89 that were first visited in 2013 and 114 that were first visited in 2014—and visited an additional 151 homes for the first time. Throughout this paper, *Wave 1* refers to the 111 visits with panelists conducted in 2014, and *Wave 2* refers to the 203 visits with panelists conducted in 2015. A third wave of visits, drawing on the 354 visits completed in 2015, is planned for 2016.

During panel visits, technicians collected comprehensive lighting inventory data comparing observed bulbs to those found during previous lighting inventories. In addition to inventory data, during the initial visit year, technicians inscribed markings on bulbs using a heat-resistant marker. Thus, any new bulbs were easily identified due to the lack of such markings. Bulbs found in storage were marked with a different color, making it easy to identify bulbs installed from storage between visits. Technicians designated each bulb as *New* (for bulbs that had been installed since the last on-site visit) or *Same* (for bulbs that were included in the 2014 on-site data and were the same in 2015). Additional methodological details can be found in the Methods section of this paper.

Figure 1. On-site Lighting Visits by Year and Type

Results and Analysis

Bulb Replacements

Sockets where the customer had replaced the bulb or installed a bulb in an empty socket since the previous visit were of particular interest for the panel visits. This stems largely from the desire to understand bulb replacement behavior in the face of EISA, upstream lighting programs, and direct-install programs. As Table 1 shows, between the 2014 and 2015 visits (roughly five months), the 203 Wave 2 panelists replaced bulbs in 941 sockets, or 9% of the total observed sockets (10,930). In comparison, between the 2013 and 2014 visits (roughly 13 months), the 111 Wave 1 panelists replaced bulbs in 834 sockets, or 13% of the total observed sockets (6,200).

Table 1. Panel Replacement Behavior Summary

Panel year	Wave 1	Wave 2
Homes	111	203
Baseline Visits	Dec. 2012 – Mar. 2013	May – Jun. 2014
Most Recent Visits	May – Jun. 2014	Dec. – Jan. 2015
Months Between Visits	13	5
Bulbs Replaced	834	941
Avg. per Home	7.5	4.6
Avg. per Home per Month	0.6	0.9
Homes Replacing at least one bulb	103 (93%)	169 (83%)

While we analyzed bulb changes separately for Wave 1 and Wave 2, in general we found that replacement behavior was similar in both waves; therefore, we present the combined bulb change results here. Figure 2 provides an overview of what bulbs were replaced and what replaced them in panel homes between 2013 and 2015. The distribution of bulbs before replacement (replaced bulbs) is shown in the leftmost column; this shows what bulbs were installed in these sockets during the baseline visits (the first time a home is visited). The outer ring shows the distribution of bulbs in the same 1,552 sockets at the time of the most recent visits (replacement bulbs). The column chart provides an overview of the types of bulbs that replaced incandescent bulbs, CFLs, and LEDs.[2] The data reveal a dramatic shift toward energy-efficient CFLs and LEDs. Among sockets with bulb changes, 68% contained inefficient bulbs (1,055 bulbs: 1,024 incandescents and 31 halogens) prior to replacement, and only 26% contained energy-efficient bulbs (404 bulbs: 388 CFLs and 16 LEDs); after replacement, these same sockets contained 1,024 (66%) energy-efficient bulbs (1,024 bulbs: 760 CFLs and 264 LEDs) and only 27% inefficient bulbs (419 bulbs: 388 incandescents and 31 halogens). Note that linear fluorescent tubes were replaced only by other linear fluorescent tubes—thus, the proportion is the same before and after.

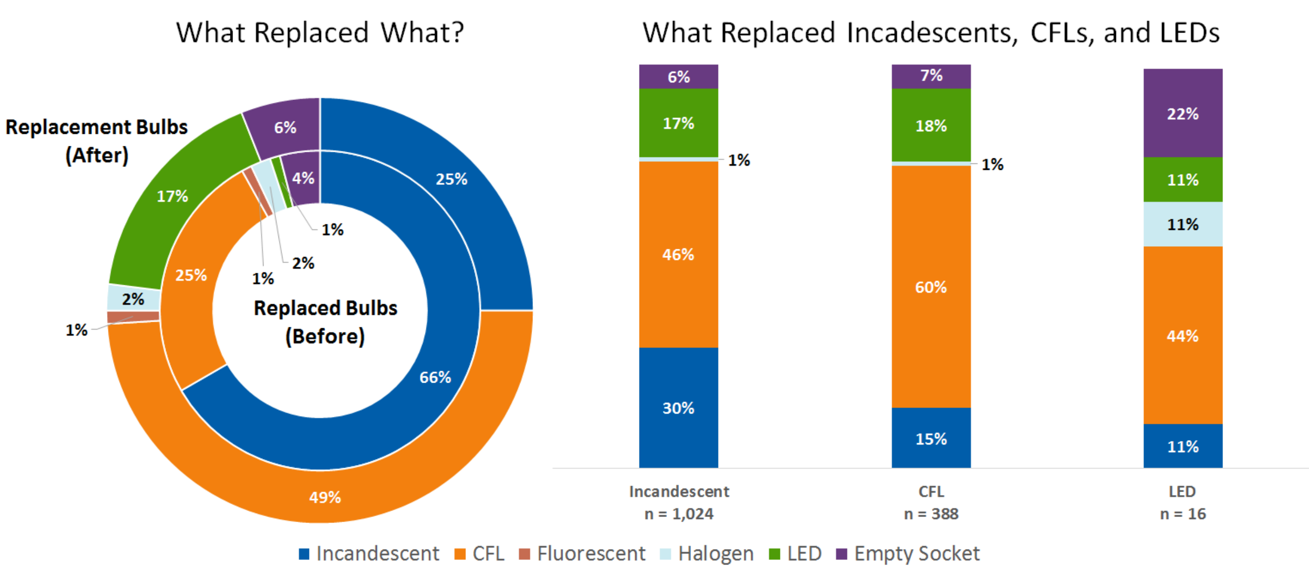

Figure 2. Panelists Were Most Likely to Replace Incandescent Bulbs with CFLs

[2] Note that only 16 LEDs were replaced in Wave 1 and Wave 2 of the panel. This is not unexpected given the relatively low saturation of LEDs and their extremely long useful lives. While only 16 LEDs were replaced, 264 LEDs replaced other bulbs in Wave 1 and Wave 2.

Table 2 examines bulb replacement behavior in detail for all bulb types. The proportion of bulbs installed in sockets before replacement is shown in the column labeled *Total,* and the proportions of bulbs that replaced the various bulb types are shown in the rows. For example, the table shows that, before replacement, two-thirds (66%) of all sockets contained incandescent bulbs, and that 30% of those bulbs were replaced by new incandescent bulbs and 46% were replaced by incandescent bulbs. The bullets below call out a few key observations.

- Among replaced sockets, **incandescent bulbs** were present in 66% of sockets before replacement and only 25% after replacement. Only 30% of incandescent bulbs were replaced by other incandescent bulbs.
- The share of **CFLs** in replaced sockets overall increased from 25% before replacement to 49% after replacement. Three-fifths of CFLs that were replaced were replaced with other CFLs.
- Only 2% of replaced sockets contained **halogen** bulbs both before and after replacement. Note that halogen bulbs occupied only 5% of total sockets, which explains why halogens account for only 2% of replaced bulbs.
- **LED** bulbs occupied only 1% of the replaced bulbs, but made up 17% of replacement bulbs. Given the relatively low saturation of LEDs (6% in 2015) and their extremely long useful lives, it is not surprising to find that only 16 LEDs were replaced between 2013 and 2015.
- Four percent of these sockets were empty before replacement versus 6% after replacement. Households installed CFLs in 59% of the previously **empty sockets**, LEDs in 15%, and incandescent bulbs in 26%.

Table 2. Sockets with Bulb Replacements 2013 – 2015 (203 households, 1,552 sockets)

		Replacement Bulbs (After)							
		Total	**Incand.**	**CFL**	**Fluor.**	**Halogen**	**LED**	**Empty**	**Other**
Replaced Bulbs (Before)	**Total**	**100%**	**25%**	**49%**	**1%**	**2%**	**17%**	**6%**	**0%**
	Incand.	**66%**	30%	46%	0%	1%	17%	6%	0%
	CFL	**25%**	15%	60%	0%	1%	18%	7%	0%
	Fluor.	**1%**	0%	0%	82%	0%	0%	18%	0%
	Halogen	**2%**	11%	28%	0%	39%	22%	0%	0%
	LED	**1%**	11%	44%	0%	11%	11%	22%	0%
	Empty	**4%**	26%	59%	0%	0%	15%	0%	0%
	Other	**1%**	33%	50%	0%	0%	0%	8%	8%

Impact of Bulb Replacements (Delta Watts)

Perhaps a more straightforward metric to decipher the impact of bulb replacements is the change in wattage observed among replaced bulbs. Examining the wattage of bulbs replaced (before) and replacement bulbs (after) shows a large drop in the observed wattage in those same sockets. When we look at all bulbs replaced among panel households between 2013 and 2015, the average wattage in those sockets before replacement was 48. After replacement, the average wattage dropped to 27 (21 delta watts). Figure 3 provides an illustration of the change in the distribution of wattages between 2013 and 2015 for replaced bulbs, and Figure 4 provides a detailed breakdown of delta watts by bulb type. As the data show, CFL and LED replacements are driving the large delta watts. Incandescent bulbs are the only replacement type resulting in average increased wattage.

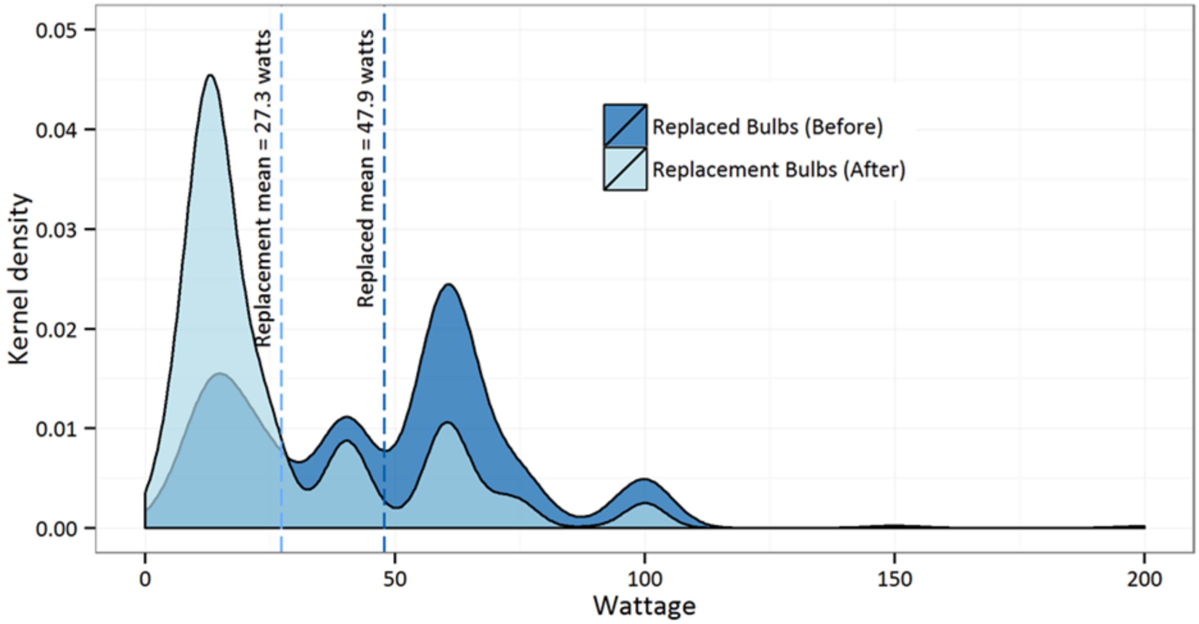

Figure 3. Average Wattage per Bulb Dropped Dramatically Between 2013 and 2015[3,4]

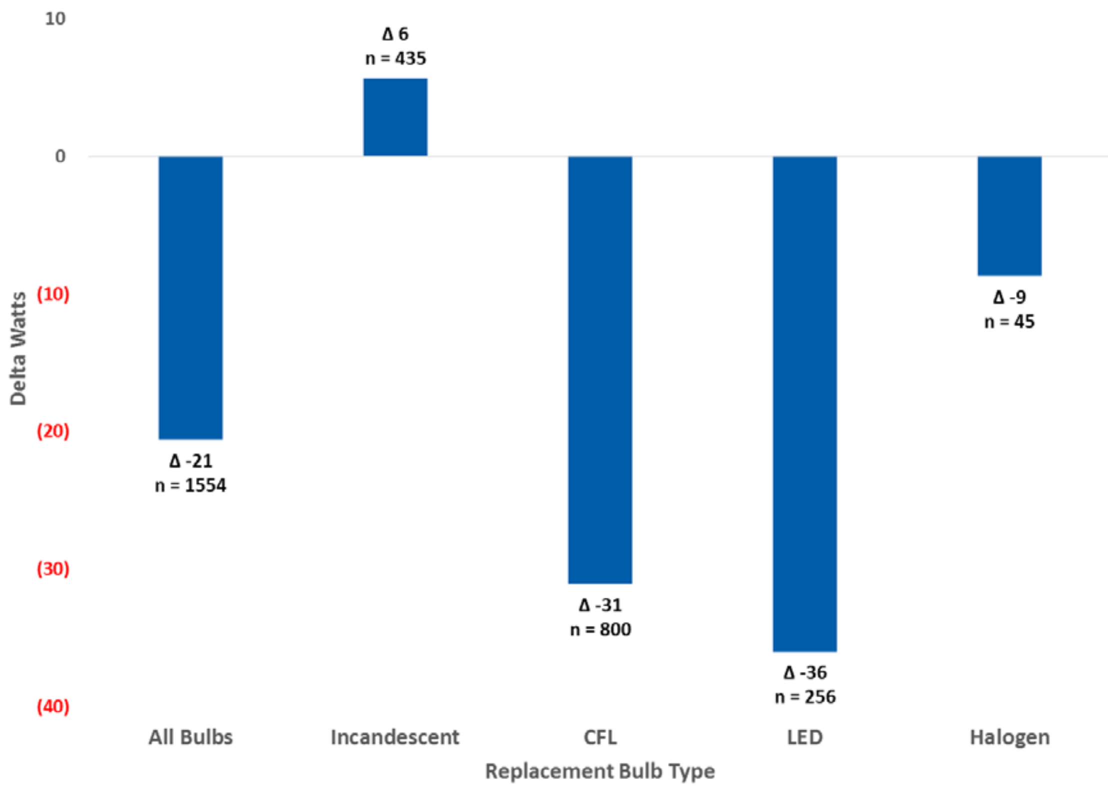

Figure 4. Delta Watts by Replacement Bulb Type

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3 Excludes sockets that were empty either before or after replacement.

4 Kernel density plots are akin to histograms. They show the distribution of values of a variable, but reduce the distortions that can be introduced by varying the bin widths in a histogram. In this plot, the y-values on the curves represent the probability density for a given wattage. Taking a particular wattage range and calculating the area under the curve for that range would give the probability of finding bulbs of that wattage range

Replacement Drivers

While on site, technicians asked panelists what motivated them to replace bulbs. As Figure 5 illustrates, the majority of bulbs (65%) were replaced due to failure. If we include bulbs that were replaced because they were the *wrong bulb for the application*[5] (10%), three-quarters of all replaced bulbs could be considered replaced for failing completely or not meeting panelists' needs. Just over one-fifth (21%) of all replaced bulbs were replaced before the end of their useful lives, comprising 12% that were replaced by direct-install energy efficiency programs and 9% that were replaced by customers on their own because they wanted more efficient bulbs.

When faced with the need to replace a light bulb, 2015 panelists were nearly three times as likely to purchase a new bulb instead of using a bulb from storage. In fact, when we examined the disposition of stored bulbs found in homes in 2014, we found that fewer than one in ten (8%) stored bulbs had been installed in fixtures and that more than seven in ten were still in storage (73%).

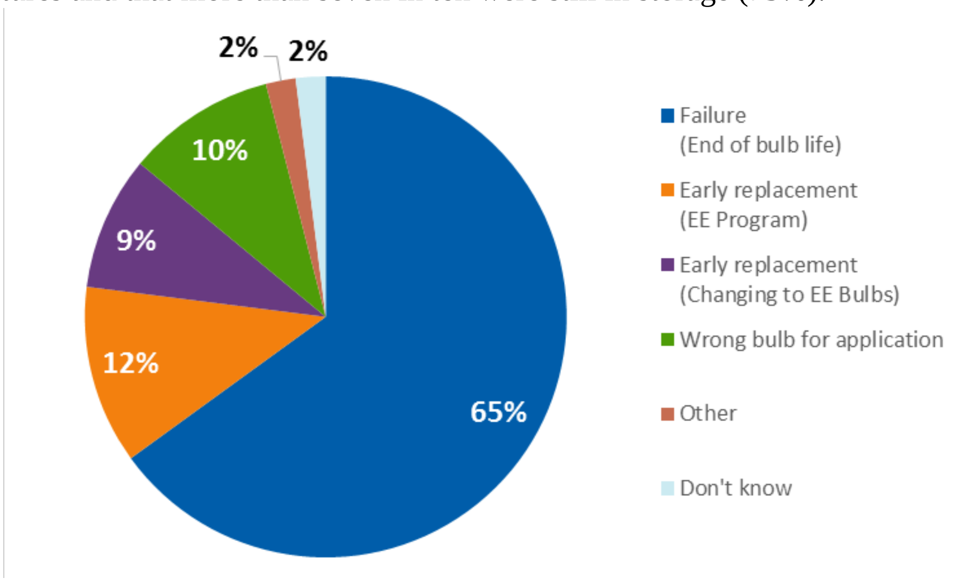

Figure 5. Panelists' Motivations for Bulb Replacement

Technicians also asked why households had chosen to replace bulbs with different bulb types. Table 3 shows the results for CFLs or LEDs that replaced incandescent bulbs. Responses from the 2015 panel closely align with those from the 2014 panel, with the largest difference being that fewer 2015 panelists answered *Don't know* compared to 2014 panelists.[6] Responses also support earlier findings that customers wait until incandescent bulbs burn out to replace them with more efficient CFLs or LEDs, and that bulbs in storage have little bearing on when households choose to replace incandescent bulbs with CFLs or LEDs.

[5] Replaced bulbs were categorized as the wrong bulb for the application if the respondent said they were not working properly (e.g., installed in dimming fixture but not dimmable, three-way fixture but not a three-way bulb, wrong size) or if the respondent did not like the bulb in the location (e.g., wrong size, wrong color, too dim, too bright).
[6] The increase in respondent recall is likely due to the shorter period between visits (five months in Wave 2 versus 13 months in Wave 1).

Table 3. Reasons CFL or LED Replaced Incandescent Bulb

Reason	2014	2015
Sample Size	71	72
Sockets	**390**	**324**
Replacing incandescent bulbs with efficient bulbs as they burn out	54%	58%
Energy efficiency program installed the bulb	26%	31%
That was the only type we had in storage	3%	5%
Other	2%	5%
Don’t know	16%	1%

In contrast, as Table 4 shows, having incandescent bulbs available in storage appears to influence households to replace CFLs or LEDs with incandescent bulbs (38% in 2014 and 30% in 2015). In 2015, bulb brightness was the primary driver behind households removing CFLs or LEDs in favor of incandescent bulbs.

Table 4. Reasons Incandescent Replaced CFL or LED

Reason	2014	2015
Sample Size	27	20
Sockets	**44**	**30**
I wanted a brighter or dimmer bulb in this fixture	33%	50%
That was the only type we had in storage	38%	30%
I do not like CFLs in general	18%	6%
What was available when purchasing	5%	--
CFLs did not work in this application	4%	--
Don't know	21%	13%

Exploration of Snapback Behavior

The 2014 Northeast Residential Lighting Hours-of-Use (HOU) Study raised some questions regarding whether the difference in HOU observed between inefficient and efficient bulbs was evidence of snapback, differential socket selection, or shifting usage. Ultimately, the study lacked sufficient evidence to allocate differences to any one theory and, instead, recommended a conservative approach, treating each theory equally (NMR 2014).

Fortunately, the Wave 2 panelists offered the opportunity to examine the issue further. To explore the extent of “snapback” behavior—i.e., using a fixture more after installing an energy-efficient bulb—technicians asked panelists who had replaced a screw-base incandescent or halogen bulb with a CFL or LED bulb a series of three questions:

- **Snapback 1:** For screw-base CFLs or LEDs that had replaced incandescent or halogen bulbs, ask: *Since installing this CFL/LED bulb, would you say you use it the same amount of time, more, or less than the bulb it replaced?*
- **Snapback 2:** If Snapback 1 is More or Less, ask: *Would you say that you use the light less/more because you installed a CFL/LED bulb?*
- **Snapback 3a/b/c:** If Snapback 1 is More and Snapback 2 is Yes, ask whether the customer agrees or disagrees with the following statements:
    - *a: I use this fixture more since I installed this CFL/LED because it uses less electricity.*
    - *b: I use this fixture more instead of another fixture that does not have a CFL/LED bulb.*
    - *c: I use this fixture more for another reason (If Yes, ask for reason).*

These questions were asked for each of the 308 CFL or LED bulbs that replaced an incandescent or halogen bulb between 2014 and 2015. Households almost universally said that they used the fixture or bulb the same amount after replacing an inefficient bulb with an efficient one (98%). In only six instances did panelists say they had changed their use after replacement—five[7] were reported to be used less and one[8] was reported to be used more. This suggests that any difference in usage may be explained by households installing efficient bulbs in fixtures that are used most frequently in any given room. This explanation makes intuitive sense because bulbs that are used more frequently are the most likely to be in need of replacement, and, as discussed earlier, customers are likely to replace bulbs only at the end of their useful life. Still, the findings rely on self-reported data and should be treated with appropriate caution.

Storage Behavior

As previously discussed, households do not rely on stored bulbs as their primary source of replacement bulbs. This raises the question of what households do with bulbs in storage. Figure 6 shows the disposition of stored bulbs based on actual observed changes in storage. Based on these data, we know that the vast majority of bulbs remain in storage (77%), have been disposed of (7%), or have been given away (2%). Relatively few stored bulbs have actually been installed (9%). Between 2014 and 2015, the average number of bulbs found in storage remained constant (about 16 bulbs per home), indicating that households were replenishing bulbs taken out of storage.

Among the stored bulbs that were installed between 2014 and 2015, 50% were incandescent bulbs, 44% were CFLs, 4% were halogens, 2% were LEDs, and 1% were linear fluorescent bulbs. Interestingly, while incandescent bulbs have a much greater share than CFLs among stored bulbs, the installation rate of the two types is quite similar.

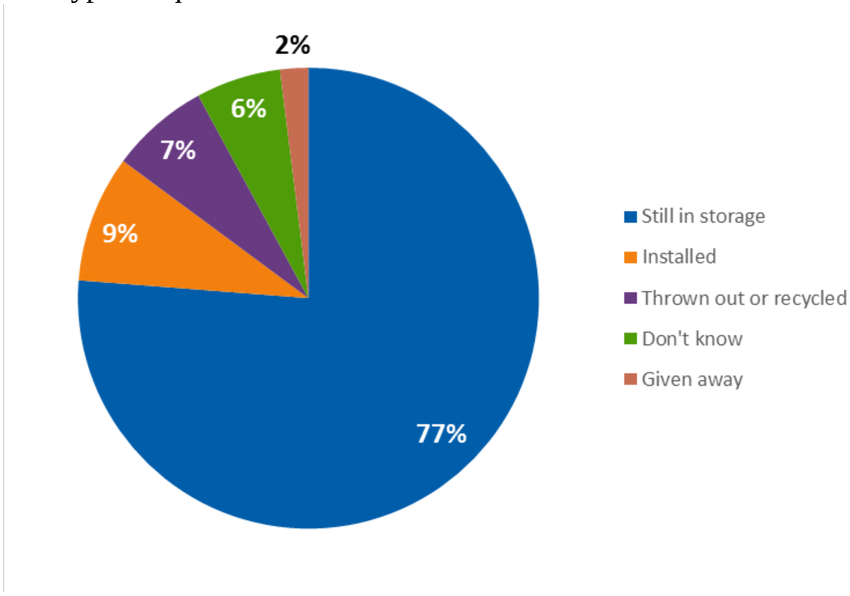

Figure 6. Disposition of Bulbs in Storage

Methods

For this study, trained technicians visited each panel site at least twice and visited a sample of

[7] Three of the five cases where households reported using bulbs less reported that they did not like the light quality of the CFL or LED. The other two respondents said the decrease in usage was not related to the CFL or LED.
[8] The respondent who said he/she used the efficient bulb more indicated it was because the new bulb had better light quality.

new homes each year to serve as a comparison to check for any study effects within the panel. During the first visit, technicians collected detailed lighting inventory data and marked each bulb found installed or in storage with a temperature-safe marker. During subsequent panel visits, technicians compared lighting data from previous visits with the current lighting inventory. Marks on bulbs helped to identify bulbs that were new or moved from stored to installed. In general, lighting inventory visits lasted about two hours.

To ensure that all populations in Massachusetts were represented, we set quotas for multifamily and single-family households with the goal of achieving an equal number of visits with each group. Sponsors offered incentives and set aggressive goals to convert those who agreed to on-site visits in order to reduce potential non-response bias and panel attrition.[9]

Panel Recruitment

Panelists were initially recruited using computer-assisted telephone interviewing (CATI). To generate a sample, the authors obtained customer names, telephone numbers, and addresses from a list of utility customers. Prior to calling, potential respondents were sent advance letters informing them about the study. While response rates varied, in general response rates for initial recruitment in 2013 (17%), 2014 (20%), and 2015 (27%) were high.[10,11] The take rate—those respondents who also agreed to an on-site visit—was also high for all three years (about 50%).

After initial visits, Wave 1 and Wave 2 panelists were recruited from the sample of on-site participants from the previous year (see Figure 1). Potential panelists were sent advance letters and emails before being called to schedule visits. The response rate for the panel visits was very high in both Wave 1 (74%) and Wave 2 (78%). In fact, interest was so high in 2015 that we exceeded our initial target of 185 households by 18 homes. An additional six homes were put on a waiting list but were not visited. These high response rates helped to protect against potential non-response from within the sample of panelists.

Table 5. Panel Disposition Wave 1 and Wave 2

	Wave 1		Wave 2	
Disposition	**Count**	**Percent**	**Count**	**Percent**
Complete	111	74%	203	78%
No response	9	6%	29	11%
Moved	24	16%	16	6%
Did not contact	4	3%	6	2%
Refused	2	1%	1	<1%
Wait list	--	--	6	2%
Total	150		261	

Examination of Non-Response Bias

Given the high response rate, it is not surprising that the demographics of Wave 1 and Wave 2 panelists closely align with the pool of potential panelists from each given year (Table 6). Again, the similarity between the pool of possible panelists and the panel suggest that there is no or little non-

[9] Panelists received an incentive of $225 for each visit conducted in Wave 1 and Wave 2.
[10] The response rate for similar surveys conducted in New York and Rhode Island in 2013 ranged from 10% to 14%. These surveys did not include an advance letter or pre-incentive (NMR 2014).
[11] In 2014, sponsors began sending a pre-incentive of $5 along with advance letters, which resulted in an increased response rate. Additional details on this experimental technique can be found in another IEPEC paper being presented in Long Beach (Na'im et al. 2015).

response bias among panelists. In addition, the composition of the panel is consistent between Wave 1 and Wave 2 with no statistically significant differences between the 2014 and 2015 panelists.

Table 6. Panel Demographics Wave 1 and Wave 2

	Wave 1 Panelists (n = 111)		Wave 2 Panelists (n = 203)	
Demographics	**All**	**Completes**	**All**	**Completes**
Home Type				
Single Family	46%	50%	50%	50%
Multifamily	56%	50%	50%	50%
Education				
Graduate degree	38%	38%	36%	36%
Bachelor's degree	20%	21%	26%	29%
Some college	27%	29%	25%	24%
High school/GED	13%	11%	11%	9%
Less than high school	2%	2%	1%	1%
DK/Ref	--	--	1%	1%
Income				
Low income	31%	27%	31%	31%
Non-low income	69%	73%	63%	63%
DK/Ref	--	--	6%	6%
Tenure				
Own/Buying	65%	72%	66%	67%

Examination of Potential Study Effects

With any panel, there exists a concern that continued interaction with subjects may impact panelist behavior. To assess the extent to which this was occurring, technicians conducted on-site visits with a sample of new participants concurrent with the panel. As an initial step in panel analysis, the authors compared data from Wave 1 and Wave 2 panelists to data from new visits in the same year. The purpose of this comparison was to identify any systematic differences between the two on-site samples in order to assess the following:

- Whether panel and new visits should be treated as two separate groups or combined
- Whether any reactive or Hawthorne[12] effects are observed among the panelists

For Wave 1, we found that the panel and new visits showed very similar or identical levels of penetration, saturation, and purchase behavior. For example, Table 7 compares the saturation rates between the pool of potential panelists in Wave 1 and Wave 2. Note that for Wave 1 panelists, the saturation rates shown are from the 2013 on-site visits, and for Wave 2 panelists, the saturation rates shown are from the 2014 on-site visits. These are the last common comparison points between panelists and the pool of potential panelists. The similarity of the saturation data between the pool of potential panelists and the panelists in each wave initially suggests that there are few or no reactive effects or Hawthorne-type effects on panel saturation rates.

[12] The Hawthorne effect, also called reactive effects or observation bias, occurs when subjects of an experiment alter behavior due to observation.

Table 7. Wave 1 and Wave 2 Saturation Comparison

Bulb Type	2014 Panelists (n = 111) [2013 Saturation Rates]		2015 Panelists (n = 203) [2014 Saturation Rates]	
	All	Completes	All	Completes
Incandescent	53%	53%	45%	45%
CFL	30%	31%	34%	33%
Fluorescent	8%	9%	9%	9%
Halogen	5%	4%	7%	7%
LED	2%	1%	3%	3%
Other	2%	2%	3%	3%

A full discussion of the Wave 1 results can be found in Appendix D of the 2014 report (NMR 2014). Similarly, as part of the Wave 2 analysis, we found that the Wave 2 panelists and the 2015 new visits were statistically similar in terms of penetration, saturation, and purchase behavior. However, differences between the two samples were relatively more pronounced than in Wave 1. This is an area of continued interest, and we will continue to monitor key variables for differences between the panel and new visits in future waves. If significant differences or trends are detected, we will consider how best to treat data to avoid biased results.

Weighting

The on-site survey data were weighted to reflect the population proportions for home ownership (tenure) and education in Massachusetts based on Public Use Microdata Sample (PUMS) from the American Community Survey (ACS) 1-Year Estimates. The guiding principles behind the schemes are:

- To maintain comparability with previous schemes dating back to 2008; this is very important for tracking changes in saturation, use, purchase, and storage behavior
- To reflect the population of Massachusetts
- To make certain that the panel data are treated properly—i.e., that the panel data correctly represent the population and what we want to compare over time

Conclusions

The authors offer a word of caution to others wishing to use results from this study. Massachusetts has a long history of uninterrupted residential lighting programs covering CFLs and LEDs. This means that households in other areas without similarly high levels of program activity may exhibit vastly different behavior. Still, the results do offer insights into customer behavior that may translate to other jurisdictions, as may lessons learned regarding panel design and implementation.

Setting up a panel study can be difficult and requires careful attention to data collection protocols. Others wishing to establish panels should learn from past efforts and look for opportunities to examine existing longitudinal data while preparing data collection protocols. In addition, the inclusion of additional sample serves both to combat attrition and to examine data for potential study effects.

Following are the key study takeaways:

Among replaced bulbs, there was a dramatic shift from inefficient to efficient bulbs. Between 2013 and 2015, panelists replaced 1,775 bulbs. Among these sockets, 68% contained inefficient bulbs prior to replacement and only 27% contained inefficient bulbs after replacement.

Incandescent bulbs were replaced most frequently, and panelists most often used CFLs to replace them. CFLs and LEDs combined accounted for two-thirds of all replacement bulbs. In 2015, CFLs (49%) were the most popular replacement bulb regardless of the bulb type that was replaced, followed by incandescents (25%) and LEDs (17%).

The average wattage of sockets with replaced bulbs decreased dramatically. When we look at all bulbs replaced in panel households between 2013 and 2015, the average wattage in those sockets before replacement was 48. After replacement, the average wattage dropped to 27 (21 delta watts). CFL and LED replacement bulbs drive the large delta watts, averaging 31 and 36 delta watts, respectively.

Three-quarters of all bulbs were replaced either due to failure (65%) or because the customer had chosen the wrong bulb for the application (10%). Early replacement accounted for just over one-fifth of all replacements (21%)—more specifically, energy efficiency program participation (12%) or changing to energy-efficient bulbs (9%).

Stored bulbs were not the main source for replacement bulbs. Wave 2 panelists were nearly three times as likely to purchase a new bulb instead of using a bulb from storage when replacing an installed bulb. In fact, we found that fewer than one in ten (8%) stored bulbs had been installed in a fixture, and that more than seven out of ten were still found in storage (73%).

Incandescent bulbs in storage may influence households to replace CFLs or LEDs with incandescent bulbs. While panelists were unlikely to use bulbs from storage in general, 38% of Wave 1 CFLs and LEDs that had been replaced by incandescent bulbs and 30% of these bulbs in Wave 2 were reportedly changed to less efficient incandescent bulbs because that was the only type of bulb the panelists had in storage.

Panelists indicated they are replacing inefficient bulbs with efficient ones as they burn out. When asked why they had replaced an incandescent bulb with a CFL or LED, in more than one-half of all instances they said they were replacing inefficient bulbs with efficient bulbs as they burned out.

There is little evidence that panelists consciously change usage in response to replacing inefficient bulbs with efficient bulbs. The results to questions included in Wave 2 suggest that differences in efficient and inefficient HOU observed as part of the Northeast HOU study may be due to households installing efficient bulbs in more commonly used fixtures because those bulbs burn out most often.

The response rate for panel visits was very high and there appears to be no or little non-response bias or reactive effects among panelists. About three-quarters of potential panelists participated in Wave 1 (74%) and Wave 2 (78%). The composition of the panel was consistent between Wave 1 and Wave 2 and the similarity of demographics and lighting inventory characteristics suggests little to no non-response bias or reactive effects.

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