



August 20, 2019

REPORT # E19-389

Results of the 2018 Northwest Residential Lighting Long-Term Monitoring and Tracking Study

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Executive Summary

Background

Since 2005, the Northwest Energy Efficiency Alliance (NEEA) has tracked trends in the residential retail lighting market. This study is a 2018-2019 update to NEEA's Northwest Residential Lighting Long-Term Monitoring and Tracking (LTMT) Study and combines this most recent year of data with findings from past studies going back to 2012. These findings provide valuable insights into longitudinal trends of lighting technologies, prices, and lamp applications in the Northwest region to guide utilities and other stakeholders on lighting baselines, savings, and the rapidly transforming residential lighting market.

Methodology

This LTMT study utilized three primary data sources to assess lamp sales mix (market share), price, wattage, efficacy (lumens/watt), and lifetime rated operating hours within the Northwest: a shelf stocking study, onsite store manager interviews, and point of sale (POS) data analysis. Each activity provided a unique set of lighting data:

- **Shelf Stocking Study:** The research team collected detailed information from lamps on the shelves of 34 small hardware, club, and do-it-yourself (DIY) stores within NEEA's utility-partner territories during the winter of 2019.
- **Store Manager Interviews:** While researchers were onsite for the shelf stocking study, they interviewed the store or lighting manager about their lighting sales and stocking practices. These interviews informed Chain Logic Method modifications (discussed below).
- **CREED LightTracker POS data:** The research team purchased detailed POS lighting sales data for mass merchandise, grocery, and drug stores within NEEA's utility-partner territories, and the Consortium for Retail Energy Efficiency Data (CREED) team cleaned and corrected it.¹

The research team combined and weighted shelf stocking and POS data using the Chain Logic Method established in 2016.² The Method estimates market share based on shelf stocking data, drawing on assumptions about the ratio of products stocked to products sold and the market share of various retail channels.

¹ CREED is a consortium of program administrators, retailers, and manufacturers working together to collect the necessary data to better plan and evaluate energy efficiency programs. LightTracker is CREED's first initiative, focused on acquiring full-category lighting data, including incandescent, halogen, CFL, and LED lamp applications, for all distribution channels in the United States.

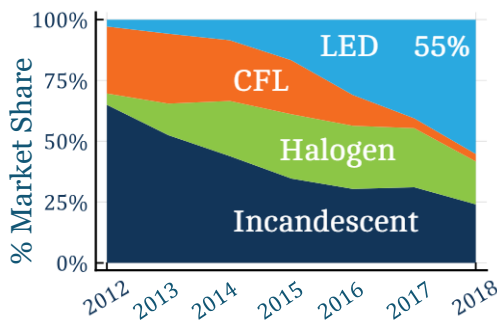
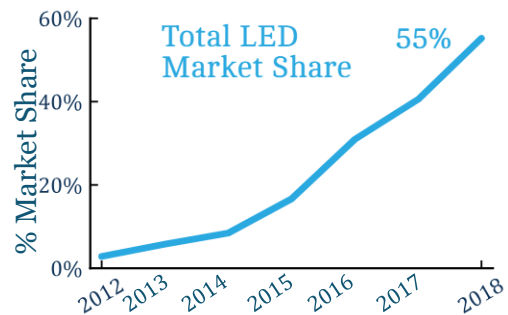
² See Appendix D: Chain Logic Model Methodology for further detail.

The research team updated the Chain Logic Method sales-to-stocking ratio assumptions. Previous years' studies had used a ratio of 1:1 for all store types. However, findings from this year's store manager interviews indicated that in small hardware stores a better estimate for the sales-to-stocking ratio is 2:1 for LEDs and 1:2 for incandescent and halogen lamps. Interview findings indicated that the 1:1 sales-to-stocking ratio was still appropriate for store types other than small hardware. The store manager interviews also indicated that stocking practices change frequently enough that a single-point estimate of shelf stocking does not accurately represent a full year. Thus, the research team retained the decision from last year's study of using an average of two years of shelf stocking data in calculations.

Key Findings

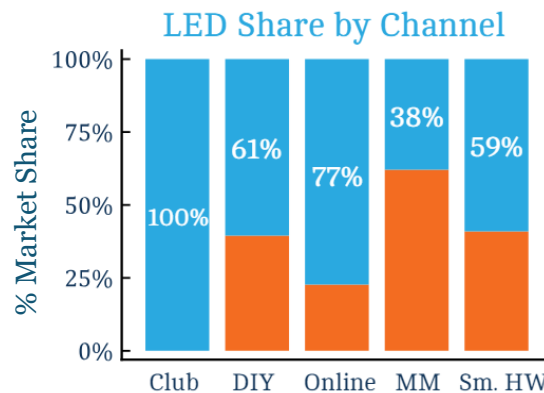
The following key findings emerged from the research team's analysis.

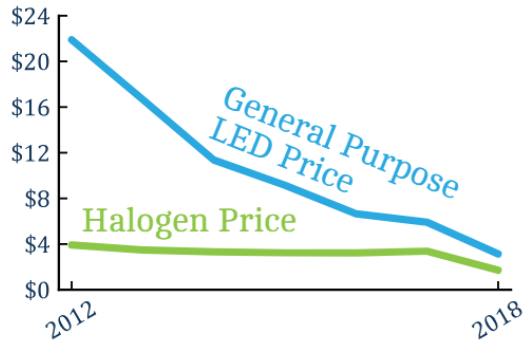
The lighting market continued its shift toward LEDs across all applications in 2018. Overall, LEDs accounted for 55% of all lamp sales in 2018. LEDs made up a larger proportion of general purpose lamp sales (60%) and reflector lamp sales (65%). LEDs made up a smaller proportion of sales for other specialty lamps, but the proportion nonetheless grew in 2018 relative to 2017.



Continued gains in LED share in 2018 came at the expense of incandescent and halogen lamps. By contrast, in 2017, the market share of incandescents and halogens largely remained flat while the share of CFLs declined substantially to a very low percentage.

Grocery, dollar, and mass merchandise retailers may present the greatest opportunity to further increase LED market share. In 2018, LEDs still made up only 38% of lamp sales on average across the combined grocery, dollar, and mass merchandise channel ("MM"), although this channel represents the second-largest volume of lamp sales. Do-It-Yourself (DIY) has the largest volume of lamp sales, and 61% of their sales are LEDs. In the club, online, and small hardware channels, LEDs make up between 59% and 100% of sales.

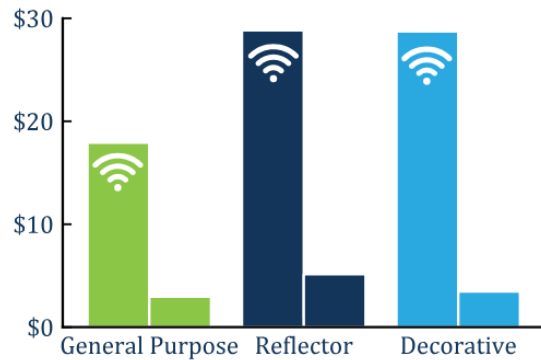




Prices for LEDs across all applications (after any efficiency program, manufacturer, or retailer discounts³) continued to fall in 2018, further narrowing LEDs' price premium over incandescent and halogen lamps. The decline in prices for all applications slowed somewhat in 2017 but again accelerated in 2018. General purpose LED lamps cost an average of \$3.13 in 2018, a decline of 47% from 2017. On average across all applications, the price of general purpose LED lamps was 1.8 times that of halogen lamps in 2018, down from 5.6 times the price of halogen lamps in 2012.

“Smart” LED lamps differ substantially from standard LED lamps in price and market share.

Smart LED lamp prices were approximately six times higher than standard LED lamp prices. Smart LED reflector and decorative lamps were nearly \$30 per lamp. Smart LED lamps also showed different price patterns than standard LED lamps among applications. For example, smart LED reflector lamps and decorative lamps were about the same price; by contrast, standard LED reflector lamps were 48% more expensive than decorative lamps. The study also found the market share of smart LED lamps remained small in 2018, at approximately 1% of all LED sales.



³ As part of the 2017 report, NEEA conducted an analysis of pre-incentive lamp prices. The resulting memorandum is available on request.

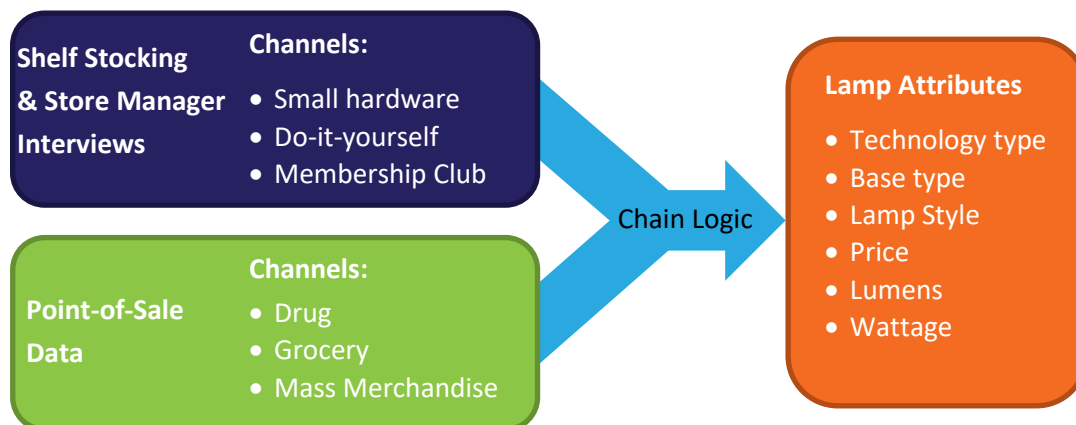
1. Introduction and Objectives

This report presents findings from the 2018-2019 update to NEEA’s Northwest Residential Lighting Long-Term Monitoring and Tracking (LTMT) Study, which assesses the current state and historical trends of the Northwest residential lighting market. NEEA has overseen similar studies since 2011 using a consistent methodology that enables NEEA and its regional partners to track trends in the lighting market. NEEA contracted with Apex Analytics, LLC and DNV GL (the research team) to undertake the 2018-2019 study. In addition to a longitudinal assessment of the lighting market, the research team investigated two aspects of the Chain Logic Method through store manager interviews: the sales-to-stocking ratio and lamp stocking practices. This report details the methods and findings of this research.

2. Methodology

The research team relied on three primary data collection activities for the 2018-2019 LTMT effort: shelf stocking studies, store manager interviews conducted onsite, and point of sale (POS) data analysis. The research team used the Chain Logic Model that incorporated assumptions about the market shares of each retail channel to combine and weight the shelf stocking data and generate estimates of total sales volume.⁴ The store manager interviews informed new sales-to-stocking assumptions underlying this model. Figure 1 illustrates how these data sources complement each other to provide data on a range of lamp attributes across retail channels.⁵

Figure 1: Data Sources



The research team added store manager interviews to the 2018-2019 LTMT effort to evaluate two assumptions of the Chain Logic Method, first, that there is a 1:1 ratio between sales and stocking, and, second, that averaging shelf survey findings over two years is an appropriate representation of the lighting market. Appendix B provides detail on the interview results. The research team attempted

⁴ See appendices for detailed Chain Logic Method

⁵ See appendices for full list of attributes.

interviews at a census of stores visited through the shelf stocking study; a total of 28 interviews were completed as part of this effort (Table 1).

Table 1: Shelf Survey Sample by Retail Channel

Retail Channel	Shelf Surveys Completed	Store Manager Interviews Completed	POS Data Purchased
DIY	11	7	Not Included
Small Hardware	20	18	Not Included
Membership Club	3	3	Not Included
Mass Merchandise	0	0	Included
Drug and Grocery	0	0	Included

3. Findings

This section begins with a summary of lighting market characteristics, including sales and pricing trends, based on the shelf survey and POS data. It also summarizes findings from store manager interviews related to lighting product stocking practices.

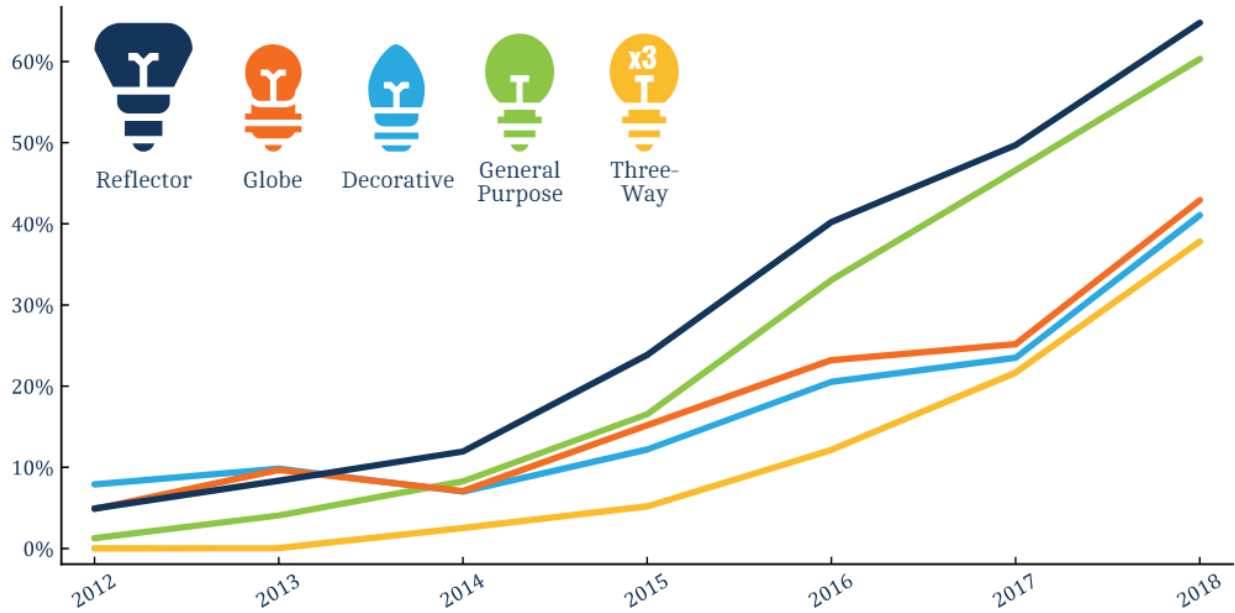
Lighting Market Characteristics

Lamp Sales Trends

The Northwest lighting market continued its transformation toward LEDs in all lamp applications.⁶ Reflector lamps continue to have the highest LED technology share (65%), outpacing general purpose lamps (60%), while the non-reflector specialty styles (i.e., globe, decorative and three-way) lag behind both (Figure 2). The LED share of general purpose lamps grew on a similar trajectory to the prior three years. Growth in the share of LEDs for reflector, globe, decorative, and three-way lamps recovered from a slowdown in 2017 to accelerate in 2018.

⁶ The lamp applications considered in this study were as general purpose, reflector, globe, decorative, and three-way.

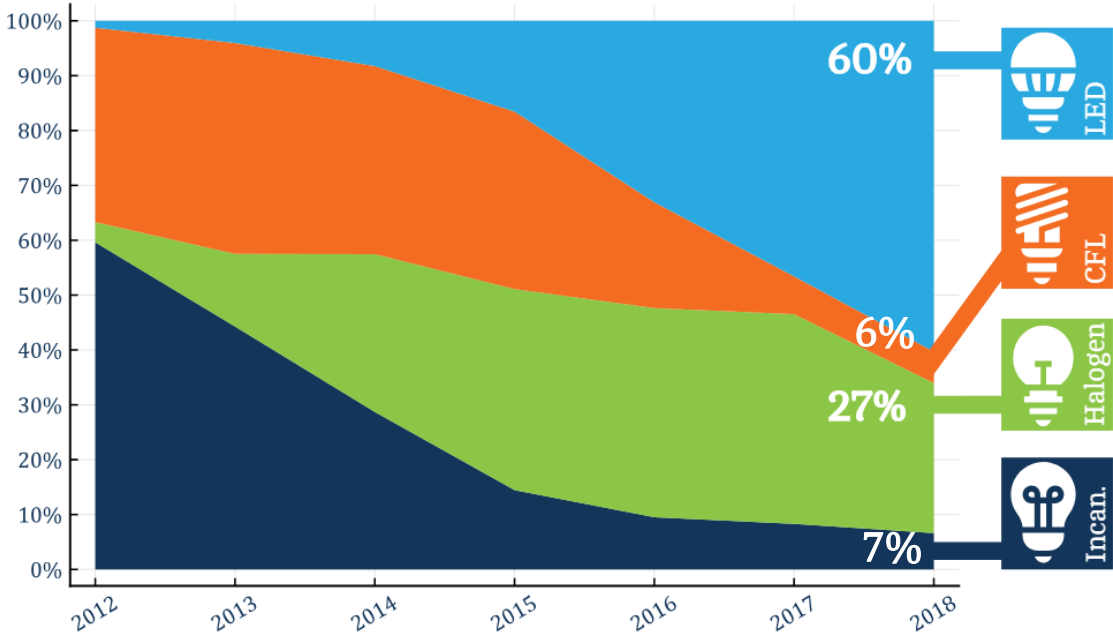
Figure 2. LED Technology Shares by Application, 2012-2018



Data source: Weighted combination of sales data and NEEA shelf data

For general purpose lamps (Figure 3), LEDs had the highest share (60%), followed by halogens (27%). CFLs and incandescents were each less than 10% of the market. Continued growth in the share of LEDs in 2018 came largely at the expense of incandescent and halogen lamps. By contrast, from 2015 to 2017, LED share growth largely came at the expense of CFLs. Figure 3 shows the technology shares within the general purpose application over the last seven years.

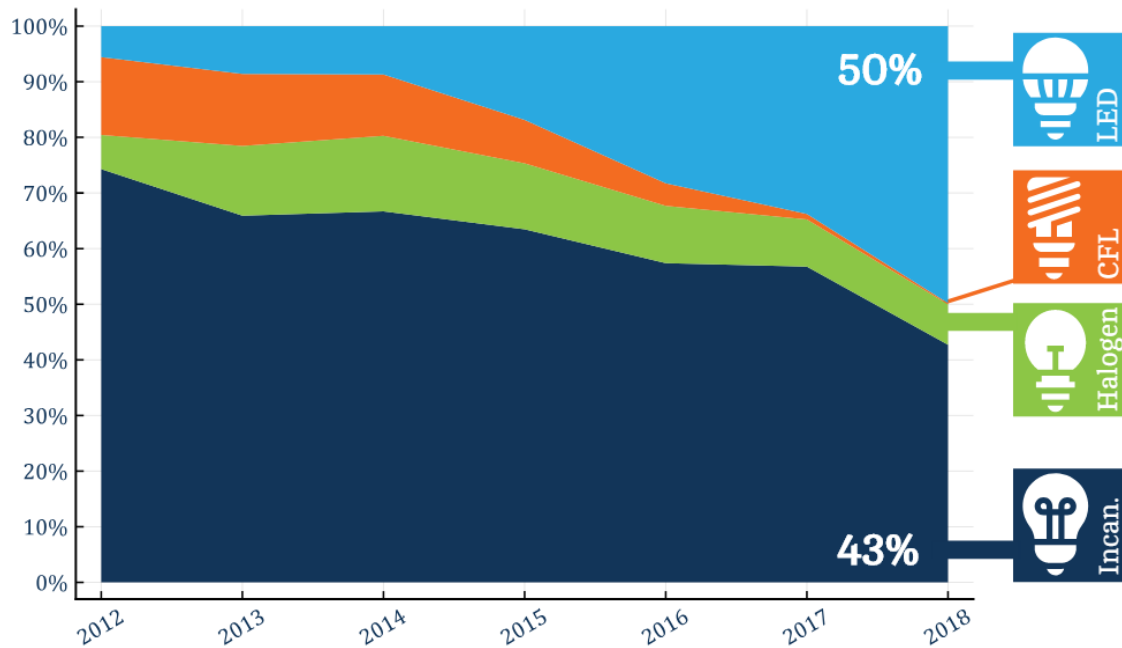
Figure 3. General Purpose Lamps - Technology Shares, 2012-2018



Data source: Weighted combination of sales data and NEEA shelf data

As shown in Figure 4, for specialty lamp categories combined (decorative, globe, reflector, and three-way), incandescents still hold a 43% share. However, LED technology share increased rapidly in 2018 to 50%, at the expense of incandescent lamps..

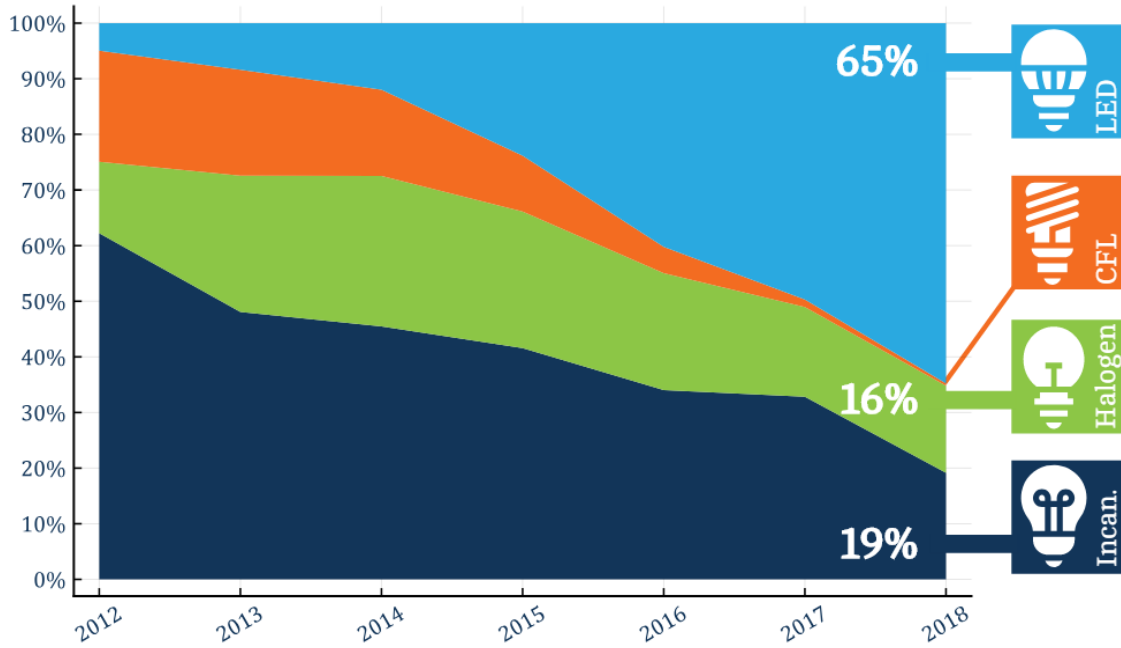
Figure 4. Specialty Lamps (Decorative, Globe, Reflector, and Three-Way) - Technology Shares, 2012-2018



Data source: Weighted combination of sales data and NEEA shelf data

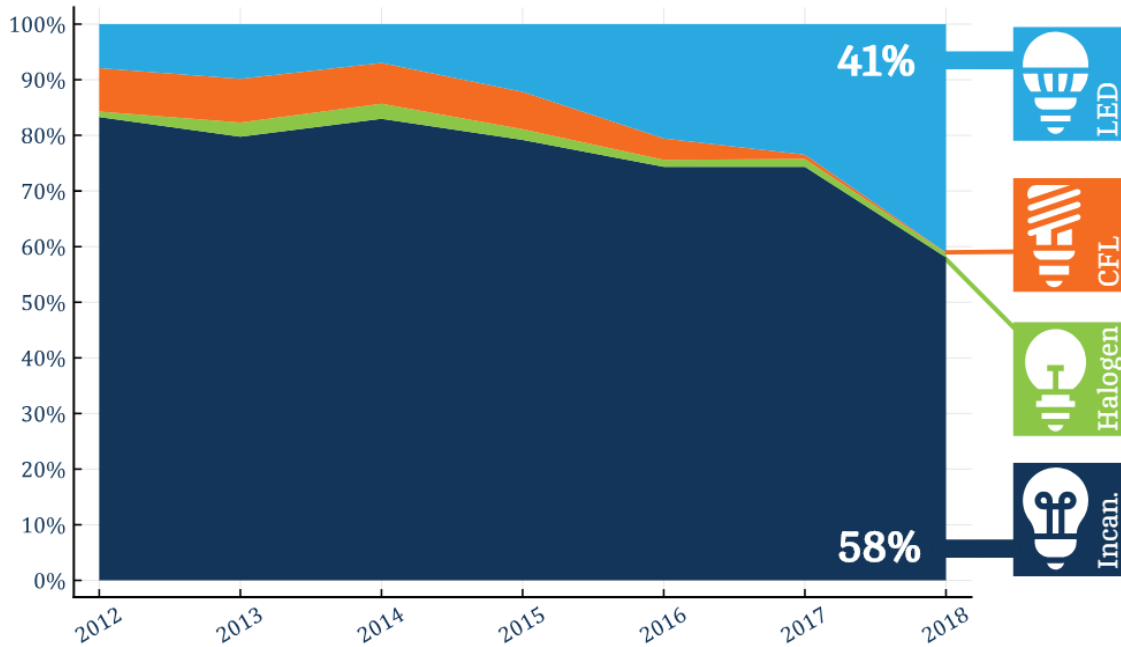
Within various categories of specialty lamps, there are notable differences in the shares of LEDs. In particular, reflector and decorative lamps together comprise 80% of specialty lamps sold but show different trends. For reflectors, LEDs gained technology share rapidly from 2014 through 2018 and now comprise 65% of all reflector lamp sales (Figure 5). Halogens and incandescents each account for roughly half of the remaining market (16% and 19% of the share, respectively). By contrast, for decorative and mini-base lamps, LED adoption has been much slower than for reflector lamps. In 2018, 41% of decorative and mini-base lamps sold were LEDs (Figure 6). Incandescents comprise the largest share (58%). Halogens have made little headway in this application, comprising a negligible share over the last seven years.

Figure 5. Reflector Lamps - Technology Shares, 2012-2018



Data source: Weighted combination of sales data and NEEA shelf data

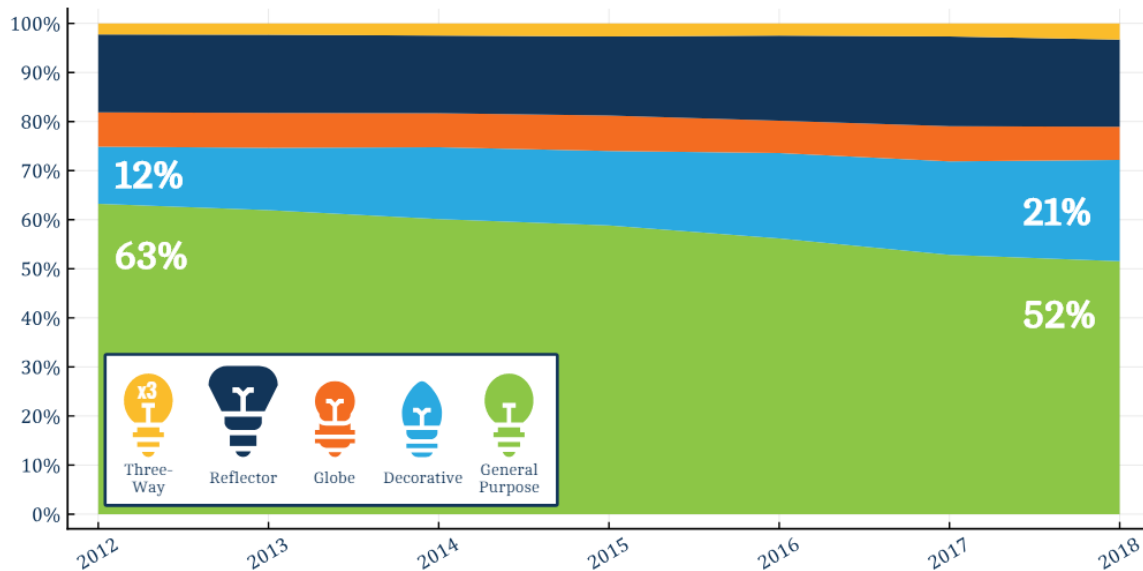
Figure 6. Decorative and Mini-Base Lamps - Technology Shares, 2012-2018



Data source: Weighted combination of sales data and NEEA shelf data

The sales shares of various lamp applications in the residential market have evolved over the last seven years. The sales share for general purpose lamps has declined from 63% to 52% (Figure 7). The growing market share of LEDs may be a contributor to this decline, as LED lamps' longer lives result in less need for replacement than the incandescent or halogen lamps they may have replaced, and thus fewer sales.

Figure 7. All Lamp Sales – Application Shares 2012-2018



Data source: Weighted combination of sales data and NEEA shelf data

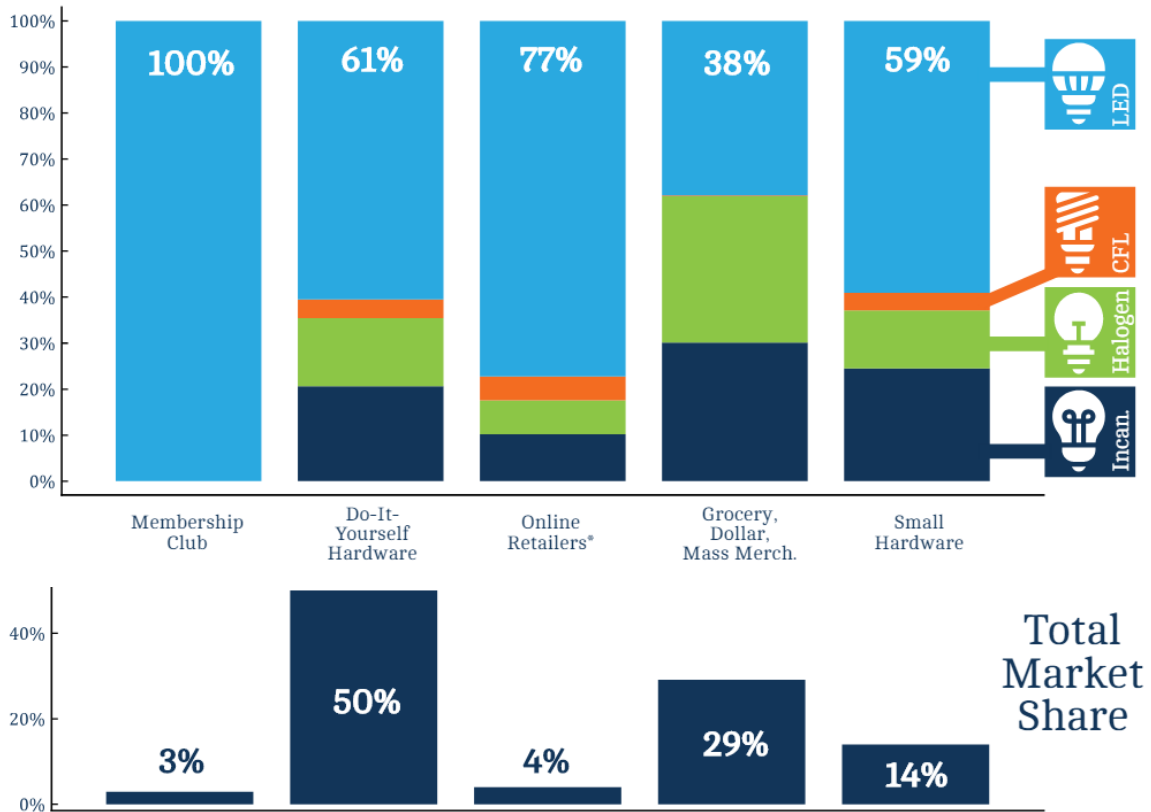
The research team assessed the shares of technologies within various channels (Figure 8). The greatest opportunity to further increase LED technology share is in the combined grocery, dollar, and mass merchandise channel. In this channel, the LED technology share was 38% in 2018 and the channel comprises 29% of total sales.⁷ LED technology share was 61% in the DIY channel, and the channel comprises 50% of total sales. LED technology share in the small hardware channel was 59%⁸ and 77% for online retailers. Finally, although membership club stores (Costco⁹) sold exclusively LEDs as a corporate policy, this channel makes up a relatively small part of the market.

⁷ These estimates are based on a presentation by a major retailer at the 2014 ENERGY STAR Products Partner Meeting.

⁸ These estimates apply a correction to the sales-to-stocking ratio for small hardware stores, as described in Appendix D: Chain Logic Model Methodology.

⁹ Sam's Club has low market share in the Northwest, and was not included in this study

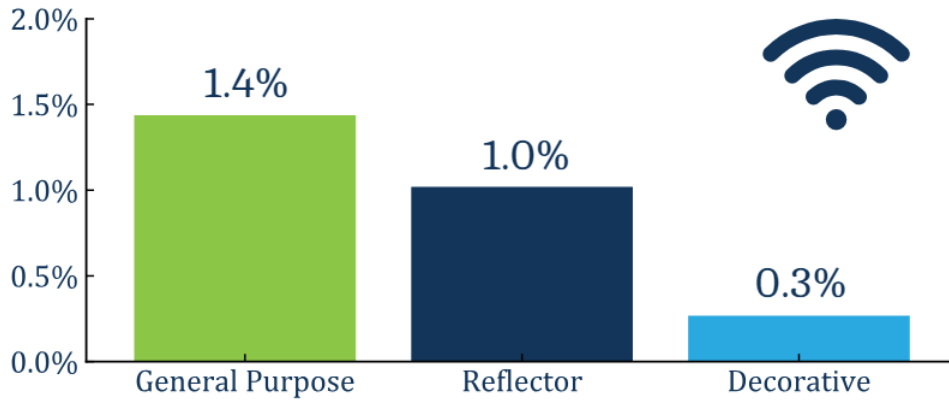
Figure 8. Retail Channel LED Technology Share and Total Market Share, 2018



* Estimated proportionally to DIY store sales, as detailed in Appendix D: Chain Logic Model Methodology
 Data source: Weighted combination of sales data and NEEA shelf data

In this year’s study, the research team analyzed both POS and shelf-stocking data on “smart bulbs,” or lamps, which have self-contained functionality that allows users to control them via local networks or the internet. Smart lamps accounted for 1% of all LED sales in 2018 (Figure 9), with the greatest share among general purpose lamps and minimal or no share among decoratives. Previous years’ analyses combined smart lamps together with other LEDs, so for consistency this analysis also combined them. However, given the large price differential (discussed in the next section) and the additional features smart lamps offer, future analyses would benefit from breaking them out.

Figure 9. Smart Lamp Share of LED Sales, by Application, 2018



Data source: Weighted combination of sales data and NEEA shelf data

Lamp Price Trends

In addition to assessing technology shares, the research team analyzed prices of LEDs relative to other lighting technologies and tracked changes over time. General purpose LED prices, after any efficiency program, manufacturer, or retailer discounts, have steadily declined since 2012. While these declines had slowed starting in 2015, they again accelerated in 2018 (Figure 10). General purpose LED lamps cost \$3.13 on average in 2018 (Table 2), a decline of 47% from 2017. Prices for general purpose CFL and halogen lamps also declined from 2017 to 2018, after remaining flat or increasing slightly in previous years.¹⁰

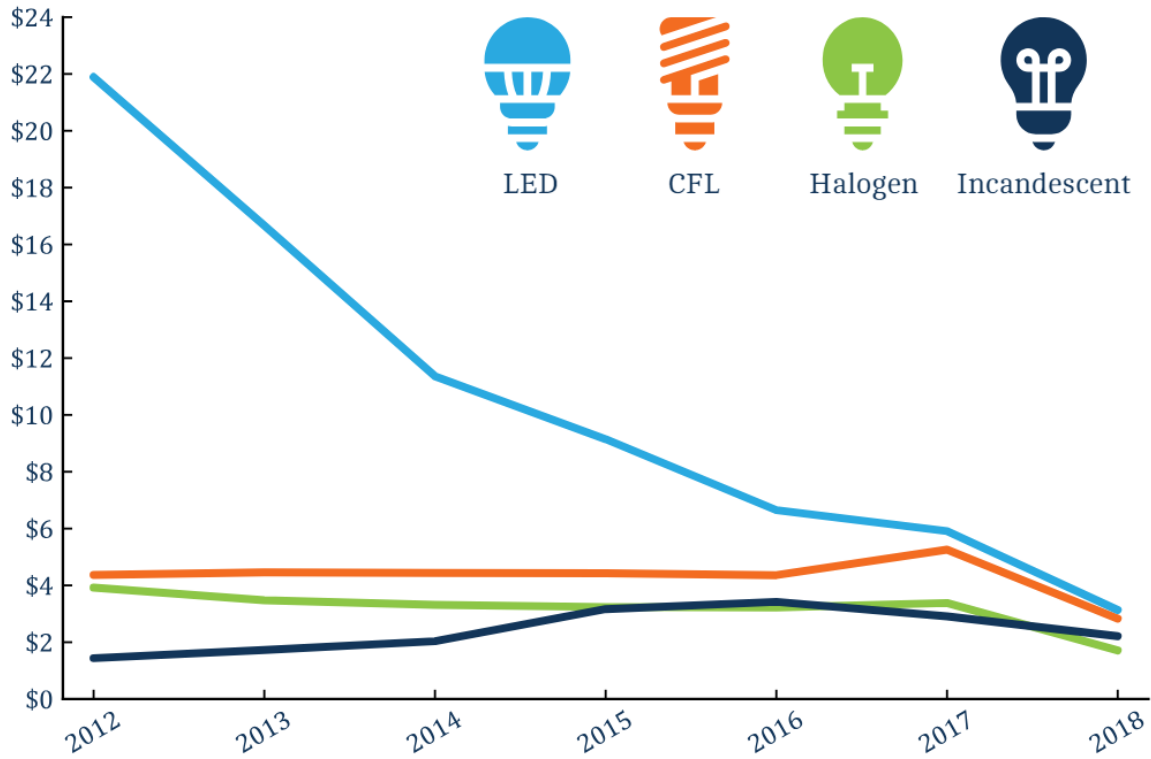
Table 2. Average Price per Lamp, by Application and Technology, 2018

	General Purpose	Reflector	Decorative	Globe	Three-Way
CFL	\$3.10	\$5.83	\$4.57	\$7.58	\$11.72
Halogen	\$1.79	\$6.04	\$2.52	\$3.11	\$3.61
Incandescent	\$2.53	\$3.91	\$1.24	\$2.24	\$2.90
LED	\$3.13	\$6.07	\$3.88	\$5.07	\$12.11

Data source: Weighted combination of sales data and NEEA shelf data

¹⁰ NEEA’s year-over-year analysis does not normalize for inflation.

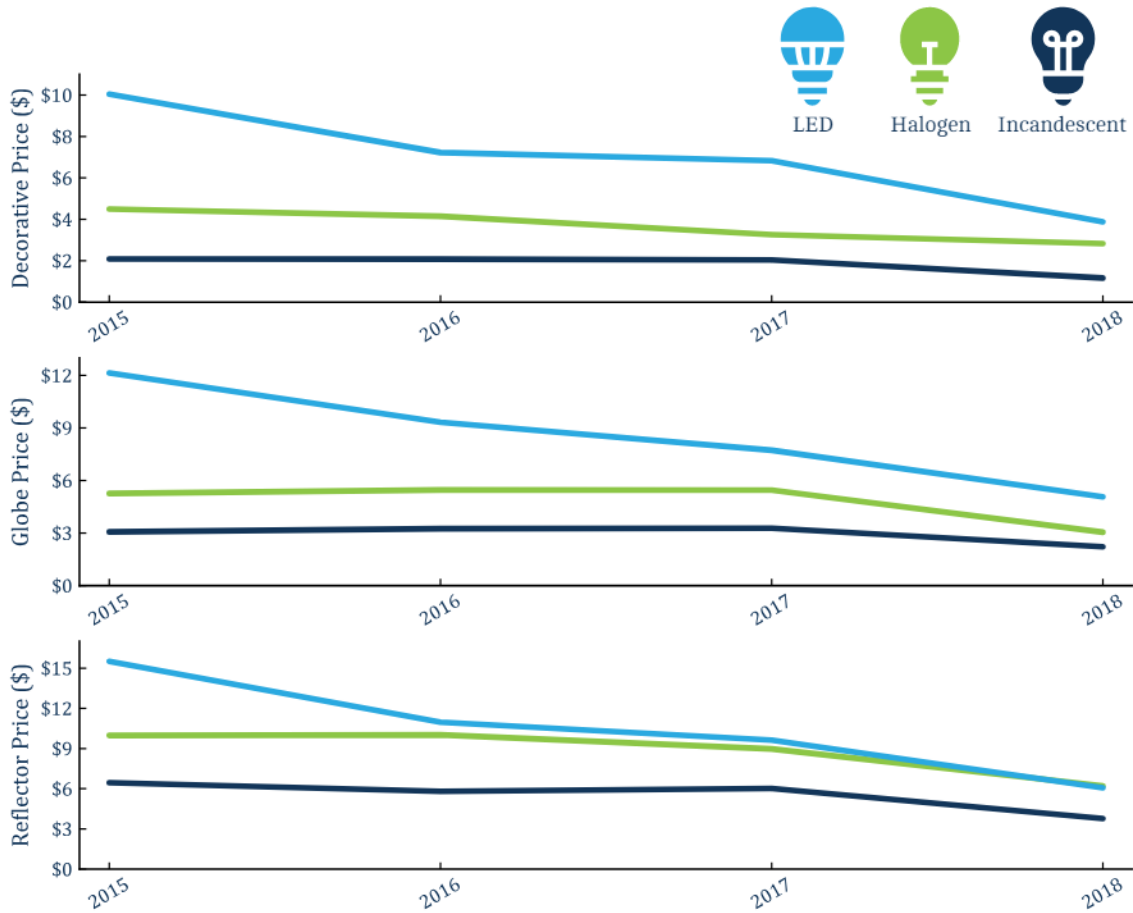
Figure 10. General Purpose Lamps – Average Price (\$/lamp) by Technology, 2012-2018



Data source: Weighted combination of sales data and NEEA shelf data

As shown in Figure 11 below, for each application, falling prices for LEDs have narrowed the price difference between LEDs and other lamp technologies. The price difference has narrowed the most for reflector lamps, with average LED reflector prices in 2018 on par with average prices for halogen reflectors. The largest price difference is in globe lamps, followed by decorative lamps. The low incremental cost of LED reflectors likely contributes to their high and rising technology share. In addition, LED technology is a good fit for reflector lamps which provide directional light.

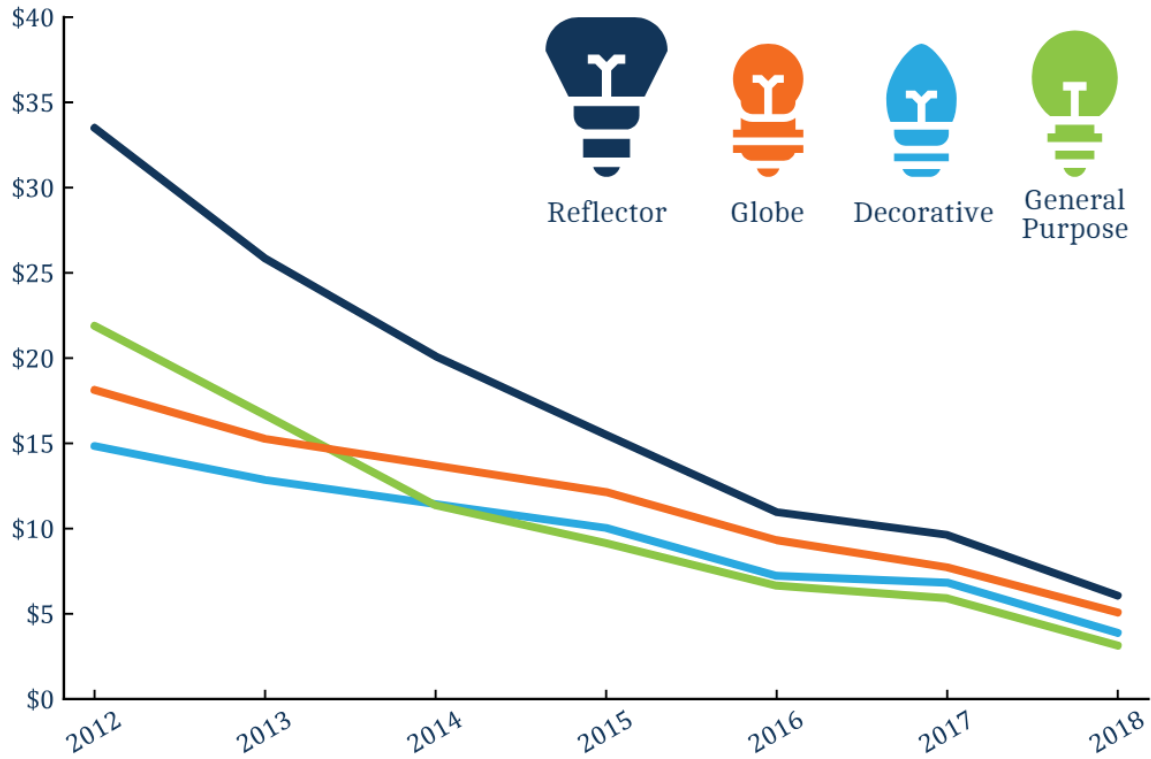
Figure 11. Average Price (\$/lamp) by Technology for Decoratives, Globes, and Reflectors, 2015-2018



Data source: Weighted combination of sales data and NEEA shelf data

As shown in Figure 12, the differences in LED prices among different applications have narrowed dramatically since 2012, with the largest declines in the costs of reflector lamps (Figure 12).

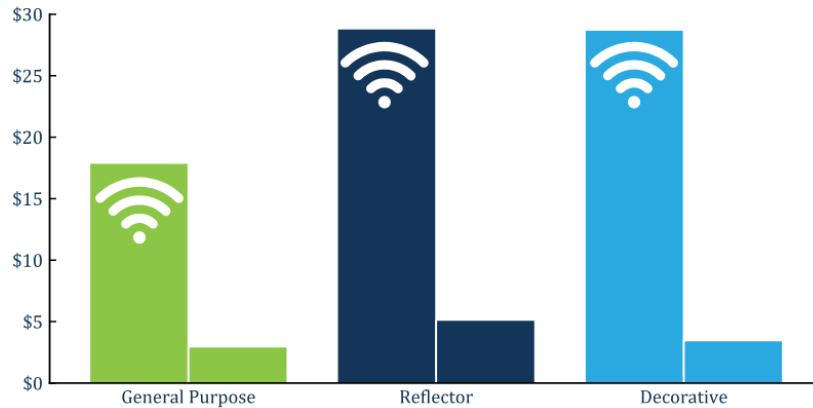
Figure 12. LED Average Price (\$/lamp) by Application, 2012-2018



Data source: Weighted combination of sales data and NEEA shelf data

Smart LED lamps cost substantially more than LEDs without smart features. The average cost of a smart LED lamp in 2018 was \$21, roughly six times the average price of other LEDs. Figure 13 shows the average prices for smart and standard LEDs in 2018, by application. Notably, the smart lamp prices of decorative lamps and reflectors are relatively similar (i.e., around \$28), while LED reflectors and decorative lamps without smart features are more different (\$5.15 and \$3.48, respectively, in Figure 13).

Figure 13. Average prices for standard and smart LEDs, by Application, 2018



Data source: Weighted combination of sales data and NEEA shelf data

Retailer Lighting Practices

Lamp Sales and Observed Stocking

The LED lamp technology sales shares that store managers reported in the on-site interviews were in line with observed stocking levels in most retail channels. This is consistent with past research that found DIY stores and mass merchandise retailers seek a one-to-one ratio between their shelf stocking of lighting products and sales to increase restocking efficiency.¹¹ However, small hardware store managers reported the share of LEDs they sold was considerably larger than the share of their shelf stock devoted to LEDs. Store managers estimated that 70% of their sales were LEDs, while shelf surveys observed that LEDs made up only 30% of the lamps stocked. LED technology sales share estimates and stocking figures varied somewhat by lamp application across small hardware store interviews, but in all cases, the estimated LED technology sales share exceeded the proportion of LEDs in stock, usually by approximately 2:1. Given these findings, this study adjusted the assumed sales to stocking ration for small hardware stores to 2:1 for LED lamps rather than the 1:1 ratio that previous studies had used, and maintained the 1:1 ratio for other retail channels. Changing the ratio only for small hardware stores from 1:1 to 2:1 for LED sales-to-stockage resulted in an increase in LED market share across all retail channels and lamp applications from 51% to 55%.

Temporal Lamp Stocking Practices

Shelf stocking surveys capture data for a snapshot in time. The research team sought to understand the frequency with which retailers change their shelf stocking configurations to determine whether the results of a single shelf stocking survey would provide a reasonable representation of lamps stocked over the course of a year or if combining data from multiple surveys would be necessary to address changes in stocking.

All the interviewed DIY and membership club store managers reported that their corporate offices provide planograms that guide their stocking of lighting products.¹² Small hardware store managers were more divided in their use of planograms, with a slight majority (10 of 18) reporting planograms guide their stocking practices. The small hardware stores that used planograms most often (8 of 10) reported receiving the planograms from their corporate offices, although one respondent reported the planogram was developed in-store, and another that it was developed by a distributor. Across all retail channels, seven of the 18 store managers that reported using planograms reported receiving a new planogram at least twice per year.

Because these findings indicate that retailers' stocking practices change over the course of the year, technology share estimates based on shelf survey data from more than one time period will better

¹¹ Cadeo Group, "2016-2017 Northwest Residential Lighting Long-Term Monitoring and Tracking Study" (Portland, OR: Northwest Energy Efficiency Alliance, October 19, 2017).

¹² A planogram is a diagram detailing the placement of retail products on shelves.

capture changes in stocking and provide more representative findings. These findings confirmed that the method followed in the previous year's study of combining two years of shelf survey data was a sound approach. This year's study combined shelf survey data from the winter of 2018-2019 with data from the previous shelf survey, conducted in the winter of 2017-2018.

Recap of Key Findings

- **The lighting market continued its shift toward LEDs across all applications in 2018.** Overall, LEDs accounted for 55% of all lamp sales in 2018. LEDs made up a larger proportion of general purpose lamp sales (60%) and reflector lamp sales (65%). LEDs made up a smaller proportion of sales for other specialty lamps, but the proportion nonetheless grew in 2018 relative to 2017.
- **Continued gains in LED share in 2018 came at the expense of incandescent and halogen lamps.** By contrast, in 2017, the market share of incandescents and halogens largely remained flat while the share of CFLs declined substantially to a very low percentage.
- **Grocery, dollar, and mass merchandise retailers may present the greatest opportunity to further increase LED market share.** In 2018, LEDs still made up only 38% of lamp sales on average across the combined grocery, dollar, and mass merchandise channel ("MM"), although this channel represents the second-largest volume of lamp sales. Do-It-Yourself (DIY) has the largest volume of lamp sales, and 61% of their sales are LEDs. In the club, online, and small hardware channels, LEDs make up between 59% and 100% of sales.
- **Prices for LEDs across all applications (after any efficiency program, manufacturer, or retailer discounts¹³) continued to fall in 2018, further narrowing LEDs' price premium over incandescent and halogen lamps.** The decline in prices for all applications slowed somewhat in 2017 but again accelerated in 2018. General purpose LED lamps cost an average of \$3.13 in 2018, a decline of 47% from 2017. On average across all applications, the price of general purpose LED lamps was 1.8 times that of halogen lamps in 2018, down from 5.6 times the price of halogen lamps in 2012.
- **Smart lamps differ substantially from standard LEDs in price and functionality.** The market share of smart lamps remained small in 2018, at approximately 1% of all LED sales. Smart lamp prices were approximately six times higher than standard LED prices. Smart lamps also showed different patterns in price difference between lamp applications. For example, while standard LED reflector lamps were 48% more expensive than standard LED decorative lamps, smart lamp reflectors were about the same price as decorative smart lamps.

¹³ As part of last year's analysis for the 2017 calendar year, NEEA conducted an analysis of pre-incentive lamp prices. The resulting memorandum was not formally published but is available on request.

Appendix A: Shelf Survey Sample Design

Purpose and Overview

The purpose of this memorandum is to describe our sampling approach for the 2018-2019 Northwest shelf surveys. Section 2 provides background on the shelf surveys, Section 3 provides details of the 2018-2019 sample design, and Section 4 gives a brief overview of next steps for the project.

Background

Shelf surveys involve field researcher visits to retail stores to collect information about the lamps stocked in those stores. Researchers gather detailed information regarding each lamp model including lamp style, manufacturer, wattage, number of lamps per package, package price, and other detailed characteristics.

For the 2018-2019 study, the evaluation team will use a modified sampling approach compared to the approach used in the prior studies. Since we will have high quality point-of sales data for drug, grocery, and mass merchandise stores, we propose conducting shelf surveys in a reduced sample of 34 stores in do-it-yourself (DIY), membership club, and small hardware stores. The sampling approach will allow us to collect critical stocking data in stores where detailed point-of-sales data are not available using the most efficient sample possible.

Sample Design

The evaluation team will use the same sampling frame that was used in previous years, which is a list of retail stores in the Northwest compiled for NEEA by PECI, Inc. in the mid-2000s. We propose stratifying the 2018-2019 shelf survey sample by store type, as in prior study years, but will visit only those store types for which we do not have detailed point of sales data. Table 3 shows the population and targeted sample of stores by store type for 2018-2019 shelf surveys, and Table 4 shows the population and completed sample of stores by store type for 2017-2018 shelf surveys for comparison purposes. Cells marked in bold in Table 3 represent a change in the number or percentage of stores in the population or sample of stores for a given store type from the 2017-2018 shelf survey study. As shown in Table 3, we propose removing all sample points from drug and grocery and mass merchandise store types. For DIY, we propose adding 2 sample points from the prior year, because the store type has the largest share of sales in the Northwest. Because membership club stores have minimal variation between stores, we propose keeping the number of sample points at 3 stores, which is the same number of sample points as in the 2017-2018 shelf surveys. NEEA asked the evaluation team to update the store sampling frame so that it reflects the number of Home Depot, Lowe's, Costco, and Wal-Mart stores in Idaho, Montana, Oregon, and Washington as of December 2018. The updated sampling frame shows an increase in DIY stores to 187, an increase in Mass Merchandise stores to 512, and an increase in Membership Club

stores to 56. Overall, the number of stores in the sample frame increased from 2,538 in 2017-2018 to 2,611 in 2018-2019.

Table 3: Northwest Lighting Retail Store Population and Sample Points by Store Type, 2018-2019

Store Type	Store Population		2018-2019 Sample	
	Number of Stores	Percent of Stores	Number of Stores	Percent of Stores
Do-It-Yourself	187	7%	11	32%
Drug and Grocery	994	38%	0	0%
Mass Merchandise	512	20%	0	0%
Membership Club	56	2%	3	9%
Small Hardware	862	33%	20	59%
Overall	2,611	100%	34	100%

Table 4: Northwest Lighting Retail Store Population and Sample Points by Store Type, 2017-2018

Store Type	Store Population		2017-2018 Sample	
	Number of Stores	Percent of Stores	Number of Stores	Percent of Stores
Do-It-Yourself	159	6%	9	13%
Drug and Grocery	994	39%	20	29%
Mass Merchandise	490	19%	16	24%
Membership Club	33	1%	3	4%
Small Hardware	862	34%	20	29%
Overall	2,538	100%	68	100%

The evaluation team plans to survey the same stores that were visited as part of the 2017-2018 shelf survey study, except the sample points in store types that we propose to remove. We will also add one Home Depot store and one Lowe’s store in Washington and remove one Home Depot store from Idaho with a replacement Home Depot store in Washington to better balance the distribution of the 2018-2019 sample of stores across the four states. Table 5 shows the distribution of sample points by store type and state.

Table 5: Northwest Lighting Retail Store Sample by Store Type and State, 2018-2019

Store Type	State				
	ID	MT	OR	WA	Overall
Do-It-Yourself	3	1	3	4	11
Membership Club	1	1	1	0	3
Small Hardware	6	4	5	5	20
Overall	10	6	9	9	34

Appendix B: Sales and Stocking Comparison Findings

Executive Summary

This memorandum summarizes the results of surveys of store managers conducted in January 2019 and February 2019 (referred to as “2018-2019” in this memorandum) in do-it-yourself (DIY), small hardware, and membership club stores in Idaho, Montana, Oregon, and Washington, and compares these results to shelf survey data collected at the same time. The two overarching goals of the store manager survey were to gather information to validate or modify the assumption that there is a 1:1 ratio of sales to stocking in these three store types, and to better understand shelf stocking practices to inform whether the 2018-2019 shelf survey data are a good representation of what was on the shelves throughout 2018, or whether averaging of the 2018-2019 and 2017-2018 data would be more representative.

We summarize the key findings and recommendations based on data collected for the store manager and shelf stocking surveys below:

- 1. Key finding – differences in percentage of lamps sold vs. observed stock (all lamps):** While the difference between the average of the estimated percentages of LEDs sold (provided by store managers) and the unweighted percentage of LEDs stocked (observed by DNV GL field staff in the shelf survey) was minimal in DIY stores, the difference was much more substantial in small hardware stores. Store managers in small hardware stores estimated that nearly 70% of lamp sales were LEDs, but field staff observed that only 30% of lamps stocked in those stores were LEDs. Membership club stores sold 100% LEDs, so there were no differences between the percentage of lamps sold and the percentage of lamps stocked in those stores.
- 2. Key finding – differences in percentage of lamps sold vs. observed stock (by lamp style):** There was some variation between different lamp styles in the estimated percentages of LEDs sold compared to observed lamp stock in small hardware stores. Store managers estimated that the percentage of LED A-lamps sold among all A-lamps in hardware stores was 70%, while LED A-lamps comprised only 43% of observed A-lamp stock in hardware stores. Small hardware store managers estimated that 64% of reflector lamps sold were LED reflectors, while field staff found that LED reflectors comprised only 34% of reflector lamp stock. Small hardware store managers estimated that 80% of specialty lamps sold were specialty LEDs compared to only 11% of specialty lamp stock observed.
- 1. Recommendation – sales-to-stocking ratio:** For small hardware stores, we recommend that NEEA estimate sales with a sales-to-stocking ratio of 2:1 for LED lamps and a sales-to-stocking ratio of 1:2 for incandescent and halogen lamps. Based on the data collected in the store manager surveys, there is little evidence to suggest that the sales-to-stocking ratio for CFLs is anything other than 1:1 in small hardware stores. In DIY stores, store managers’ estimated sales percentages for all lamp technologies surveyed more closely matched the observed stocking of those lamps. Store managers’

estimated percentage of LED sales was only slightly higher than observed stock, their estimated percentage of incandescent/halogen sales was only slightly lower than observed stock, and their estimated percentage of CFL sales was roughly the same as observed stock in DIY stores. Given that there were minimal differences between the store managers' estimated percentages of lamps sold versus observed stock in DIY stores, we recommend estimating sales with a sales-to-stocking ratio of 1:1 in DIY stores. For membership club stores, 100% of lamps sold and stocked are LEDs, so we recommend estimating sales with a sales-to-stocking ratio of 1:1 in those stores.

- 3. Key finding – lamp stocking practices:** Most store managers said that their stores used a planogram, including all DIY and membership club store managers and more than half of small hardware store managers. Additionally, most managers of stores with planograms said that they have a regular schedule for their planograms. This suggests that most of the stores and/or corporate offices follow the sales of lamps in their stores closely and make changes to their planograms based on lamp sales.
- 2. Recommendation – averaging shelf survey data across more than one time period:** Because most store managers said they use a planogram and have a regular schedule for changing their planogram, we believe that averaging the 2018-2019 shelf survey data with the 2017-2018 shelf survey data provides a better indication of what was stocked on the shelves over 2018 than using only the 2018-2019 data.

Purpose and Overview

The purpose of this memorandum is to summarize the results of the 2018-2019 store manager survey and to compare the results to the shelf stocking data collected at the same time. The purpose of the store manager survey was to gather information to validate or modify the assumption that there is a 1:1 ratio of sales to stocking in DIY, small hardware stores, and membership club stores and to determine whether to use the 2018-2019 survey data or to average shelf survey data across some time period to estimate what is on the shelves throughout the year. Section 3 gives an overview of the store manager survey and its primary objectives, Section 4 summarizes the estimated percentages of lamps sold provided by store managers and compares these estimates to percentages from the shelf stocking data, Section 5 gives an overview of shelf stocking practices described by store managers, and Section 6 provides conclusions and recommendations based on the results of the store manager surveys and shelf surveys.

Background and Objectives

Apex Analytics developed the store manager survey as a means of better understanding the relationship between the sales of lighting products and the stocking of those products on shelves in do-it-yourself (DIY), small hardware, and membership club stores. Field staff conducted a total of 34 shelf stocking surveys in DIY, small hardware, and membership club stores throughout Idaho, Montana, Oregon, and

Washington, and attempted to also survey store managers in each of those stores. The primary objectives of the store manager surveys were to:

1. Obtain estimates of the percentages of lamps sold by lamp technology (i.e., LEDs, CFLs, and incandescents/halogens)
2. Explore whether the estimates of the percentages of lamps sold by lamp technology differ by lamp style (i.e., A-lamps, reflectors, and specialty lamps)
3. Better understand shelf stocking practices, including whether stores have planograms, how often staff change planograms, and if any significant changes in planograms occurred in the last year.

The first two objectives help inform whether to maintain or modify the assumption of a 1:1 relationship between sales and stocking, and the third objective helps to determine whether to use the most recent shelf survey data or to average shelf survey data across some time period to estimate what is on the shelves throughout the year.

In total, field staff completed 28 store manager surveys and were able to obtain estimates of the percentages of lamps sold in 24 of the surveys. Table 6 shows the disposition of completed shelf stocking surveys and store manager surveys by store type.

Table 6: Number of Surveys Completed and Percentage Estimates of Sales Obtained by Store Type, 2018-2019

Store Type	Shelf Surveys Completed	Store Manager Surveys Completed	Provided Percentage Estimates
DIY	11	7	4
Small Hardware	20	18	17
Membership Club	3	3	3
Overall	34	28	24

Percentage Estimates of Lamps Sold

In this section, we provide store managers’ estimates of the percentages of lamp sold in their stores by lamp technology, and then broken down further by lamp style.

Estimates of Percentages of Lamps Sold: All Lamps

Field staff asked each store manager approximately what percentages of screw-based lamps sold in their store in the last six months were LEDs, CFLs, and incandescents/halogens. While store managers provided estimated percentages of lamps sold based on their knowledge of lamp sales in their stores and did not have access to actual sales data during interviews, DNV GL believes these estimates are valuable given the number of respondents who were able to provide estimates and the consistent

trends that emerged from their answers. Table 7 and Figure 14 show the average estimated percentages of lamps sold for the 24 store managers who were able to provide estimates, compared to the unweighted percentages of lamps stocked on shelves that field staff observed in those stores during shelf surveys. As shown, across all store types combined, managers' estimates of the percentage of LEDs sold through their stores was higher (74%) than the percentage of LED lamps that field staff observed were stocked in those stores (60%).

Table 7: Percentages of Screw-Base Lamps Sold and Stocked by Lamp Technology in DIY, Small Hardware, Membership Club Stores Combined, 2018-2019

Technology	% Sold	% Stocked	% Difference of Sales from Stocking
LEDs	74%	60%	-14%
CFLs	3%	3%	0%
Incand./Halogens	23%	37%	14%
Number of Stores	24	24	24
Number of Lamps		99,474	

Figure 14: Percentages of Screw-Base Lamps Sold and Stocked by Lamp Technology in DIY, Small Hardware, Membership Club Stores Combined, 2018-2019

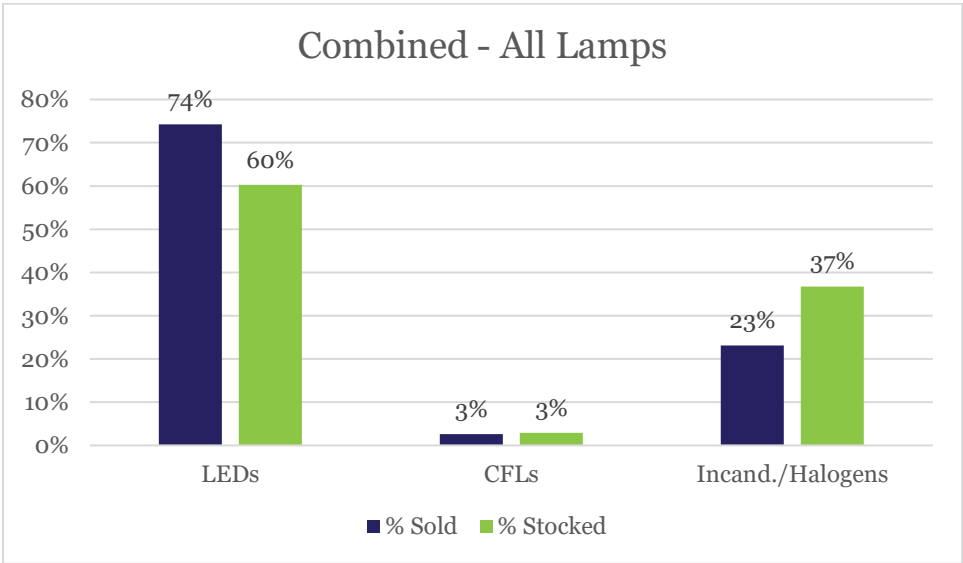


Table 8 and Figure 15 show the average of the estimated percentages of lamps sold provided by DIY store managers who were able to give estimates, compared to the percentage of lamps that field staff observed in those stores by lamp technology. Store managers estimated a slightly higher percentage of LEDs were sold through their stores (76%) than the percent of LED lamps that were stocked in those stores (66%).

Table 8: Percentages of Screw-Base Lamps Sold and Stocked by Lamp Technology in DIY Stores, 2018-2019

Technology	% Sold	% Stocked	% Difference of Sales from Stocking
LEDs	76%	66%	-10%
CFLs	5%	4%	-1%
Incand./Halogens	19%	30%	11%
Number of Stores	4	4	4
Number of Lamps		50,255	

Figure 15: Percentages of Screw-Base Lamps Sold and Stocked by Lamp Technology in DIY Stores, 2018-2019

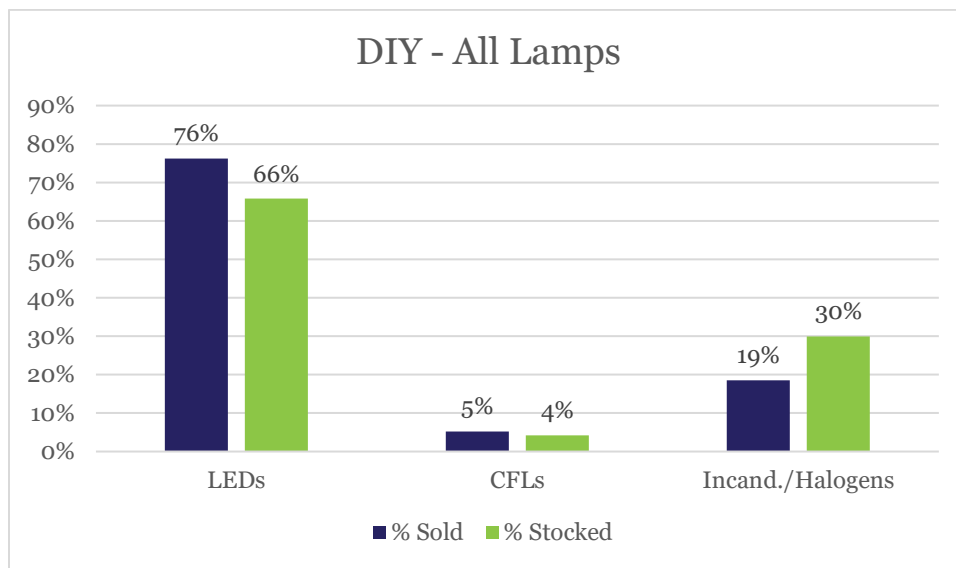
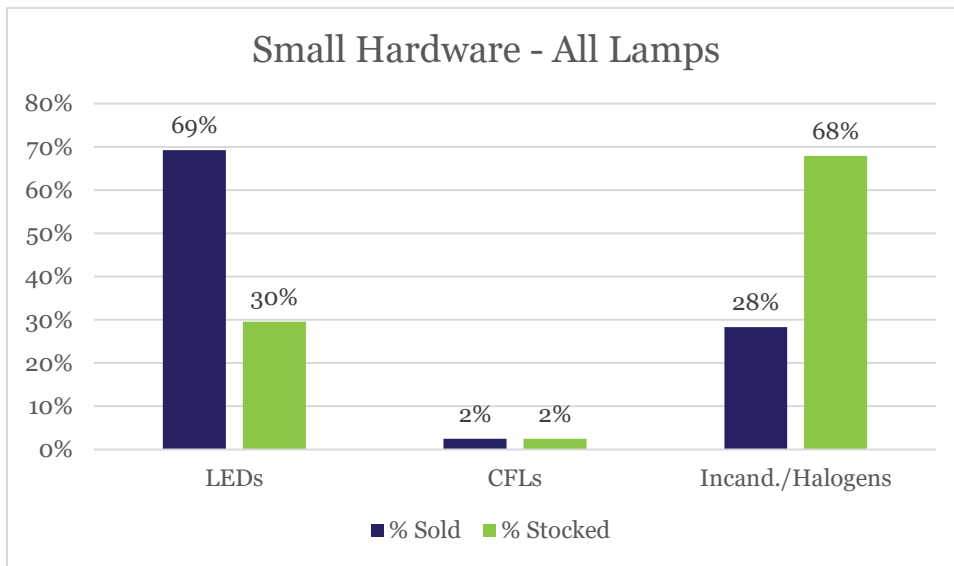


Table 9 and Figure 16 show the average of the estimated percentages of lamps sold provided by small hardware store managers who were able to give estimates compared to the unweighted percentage of lamps that field staff observed, by lamp technology. Small hardware store managers estimated a substantially higher percentage of LEDs were sold through their stores (69%) than the percentage of LED lamps that were stocked (30%).

Table 9: Percentages of Screw-Base Lamps Sold and Stocked by Lamp Technology in Small Hardware Stores, 2018-2019

Technology	% Sold	% Stocked	% Difference of Sales from Stocking
LEDs	69%	30%	-40%
CFLs	2%	2%	0%
Incand./Halogens	28%	68%	40%
Number of Stores	17	17	17
Number of Lamps		31,679	

Figure 16: Percentages of Screw-Base Lamps Sold and Stocked by Lamp Technology in Small Hardware Stores, 2018-2019



In the three membership club stores, field staff observed that those stores stock LEDs exclusively, and store managers confirmed that their stores only sell LEDs. Table 10 shows the average of the percentages of lamps sold for membership club store managers compared to the unweighted percentage of lamps that field staff observed, by lamp technology. As discussed, these stores only sell LEDs, so 100% of lamps sold and 100% of lamps stocked were LEDs.

Table 10: Percentages of Screw-Base Lamps Sold and Stocked by Lamp Technology in Membership Stores, 2018-2019

Technology	% Sold	% Stocked	% Difference of Sales from Stocking
LEDs	100%	100%	0%
CFLs	0%	0%	0%
Incand./Halogens	0%	0%	0%
Number of Stores	3	3	3
Number of Lamps		17,540	

Table 11 shows the estimated percentages of lamps sold provided by each store manager, and the percentages of lamps stocked as observed by field staff, by lamp technology and store type. The percentage of LED sales estimated by DIY store managers were generally closer to the percentage of LEDs stocked than estimates provided by small hardware store managers. For DIY stores, the percentage of LEDs sold ranged from 2% more than observed stock to 27% less than observed stock. For small hardware stores, the percentage of LEDs sold ranged from 2% more than observed stock to as much as 67% less than observed stock. Nine out of the 17 small hardware store managers estimated that the percentage of LEDs sold was at least 40% greater than the percentage of LEDs found in the store.

Table 11: Percentages of Screw-Base Lamps Sold and Stocked by Lamp Technology and Store Type, 2018-2019

Record #	Store Type	Chain/ Independent	LEDs		CFLs		Incandescents/Halogens	
			% Sold	% Stocked	% Sold	% Stocked	% Sold	% Stocked
1	DIY	Chain 1	65%	53%	0%	7%	35%	40%
2	DIY	Chain 1	75%	77%	10%	4%	15%	19%
3	DIY	Chain 2	95%	68%	1%	3%	4%	29%
4	DIY	Chain 2	70%	62%	10%	4%	20%	34%
5	Small Hardware	Chain 1	64%	24%	1%	0%	35%	76%
6	Small Hardware	Chain 1	70%	29%	0%	0%	30%	71%
7	Small Hardware	Chain 1	50%	35%	0%	0%	50%	65%
8	Small Hardware	Chain 1	55%	32%	0%	0%	45%	68%
9	Small Hardware	Chain 1	75%	30%	0%	0%	25%	70%
10	Small Hardware	Chain 1	90%	41%	0%	0%	10%	59%
11	Small Hardware	Chain 2	50%	27%	10%	4%	40%	69%
12	Small Hardware	Chain 2	75%	34%	5%	0%	20%	66%
13	Small Hardware	Chain 3	90%	25%	5%	6%	5%	69%
14	Small Hardware	Independent 1	90%	57%	5%	0%	5%	43%
15	Small Hardware	Independent 2	95%	38%	0%	17%	5%	45%
16	Small Hardware	Independent 3	80%	79%	0%	0%	20%	21%
17	Small Hardware	Independent 4	0%	2%	0%	2%	100%	97%
18	Small Hardware	Independent 5	95%	30%	1%	9%	4%	61%
19	Small Hardware	Independent 6	50%	22%	10%	9%	40%	69%
20	Small Hardware	Independent 7	60%	45%	5%	0%	35%	55%
21	Small Hardware	Independent 8	88%	21%	0%	0%	13%	79%
22	Membership Club	Chain 1	100%	100%	0%	0%	0%	0%
23	Membership Club	Chain 1	100%	100%	0%	0%	0%	0%
24	Membership Club	Chain 1	100%	100%	0%	0%	0%	0%

Percentage Estimates: A-lamps

Field staff asked each store manager whether the percentages of lamps sold in their stores differed by lamp style. Approximately half of DIY store managers (2) and half of small hardware store managers (9) said the percentages of sales did differ by lamp technology. Field staff then asked these store managers approximately what percentages of screw-based A-lamps sold in their store in the last six months were LEDs, CFLs, and incandescents/halogens. Table 12 and Figure 17 show the average of the estimated percentages of A-lamps sold provided by the store managers who were able to give estimates compared to the unweighted percentage of A-lamps that field staff observed in those stores by lamp technology. Similar to estimates provided for all lamps, store managers estimated a slightly higher percentage of LED A-lamps were sold through their stores (76%) than the percentage of LEDs that were stocked (65%).

Table 12: Percentages of Screw-Base A-lamps Sold and Stocked by Lamp Technology in DIY, Small Hardware, Membership Club Stores Combined, 2018-2019

Lamp Technology	% Sold	% Stocked	% Difference of Sales from Stocking
LEDs	76%	65%	-11%
CFLs	2%	6%	4%
Incand./Halogens	22%	29%	7%
Number of Stores	23	23	23
Number of Lamps		49,718	

Figure 17: Percentages of Screw-Base A-Lamps Sold and Stocked by Lamp Technology in DIY, Small Hardware, Membership Club Stores Combined, 2018-2019

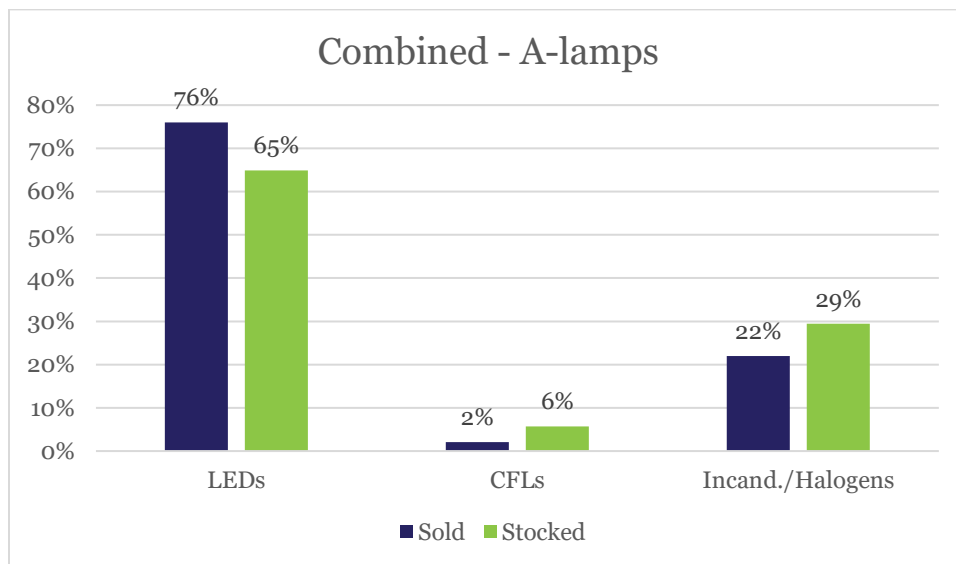


Table 13 and Figure 18 show the average of the estimated percentages of A-lamps sold provided by DIY store managers compared to the unweighted percentage of A-lamps observed in those stores by field staff, by lamp technology.

Table 13: Percentages of Screw-Base A-lamps Sold and Stocked by Lamp Technology in DIY Stores, 2018-2019

Lamp Technology	% Sold	% Stocked	% Difference of Sales from Stocking
LEDs	85%	63%	-22%
CFLs	4%	9%	5%
Incand./Halogens	11%	28%	17%
Number of Stores	3	3	3
Number of Lamps		24,005	

Figure 18: Percentages of Screw-Base A-lamps Sold and Stocked by Lamp Technology in DIY Stores, 2018-2019

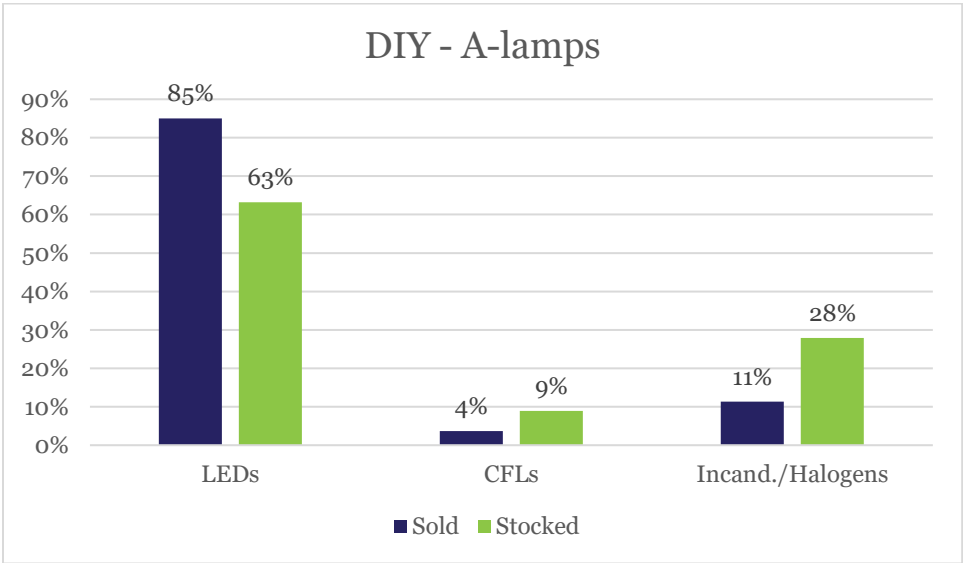


Table 14 and Figure 19 show the average of the estimated percentages of A-lamps sold provided by small hardware store managers compared to the unweighted percentage of A-lamps observed in those stores by field staff, by lamp technology.

Table 14: Percentages of Screw-Base A-lamps Sold and Stocked by Lamp Technology in Small Hardware Stores, 2018-2019

Lamp Technology	% Sold	% Stocked	% Difference of Sales from Stocking
LEDs	70%	43%	-28%
CFLs	2%	5%	3%
Incand./Halogen	28%	53%	25%
Number of Stores	17	17	17
Number of Lamps		15,019	

Figure 19: Percentages of Screw-Base A-lamps Sold and Stocked by Lamp Technology in Small Hardware Stores, 2018-2019

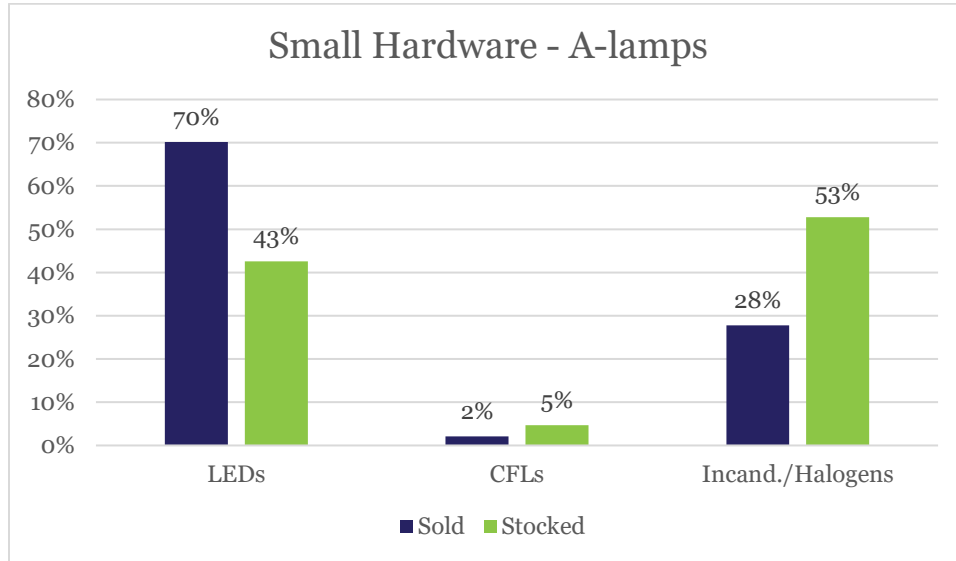


Table 15 shows the average of the estimated percentages of A-lamps sold provided by membership club store managers compared to the unweighted percentage of lamps that field staff observed in those stores, by lamp technology.

Table 15: Percentages of Screw-Base A-lamps Sold and Stocked by Lamp Technology in Membership Club Stores, 2018-2019

Lamp Technology	% Sold	% Stocked	% Difference of Sales from Stocking
LEDs	100%	100%	0%
CFLs	0%	0%	0%
Incand./Halogens	0%	0%	0%
Number of Stores	3	3	3
Number of Lamps		10,694	

Percentage Estimates: Reflectors

Field staff asked store managers approximately what percentages of screw-based reflectors sold in their store in the last six months were LEDs, CFLs, and incandescents/halogens. Table 16 and Figure 20 show the average of the estimated percentages of reflector lamp sold provided by the store managers who were able to give estimates compared to the unweighted percentage of reflector lamps that field staff observed in those stores, by lamp technology. The average of store managers’ estimates of the percentages of LED reflectors sold through their stores was higher (71%) than the percentage of LEDs stocked as observed by field staff (65%). However, the difference between the percentage of LEDs sold and the percentage of LEDs stocked is slightly less than the difference for all lamps and A-lamps.

Table 16: Percentages of Screw-Base Reflector Lamps Sold and Stocked by Lamp Technology in DIY, Small Hardware, Membership Club Stores Combined, 2018-2019

Lamp Technology	% Sold	% Stocked	% Difference of Sales from Stocking
LEDs	71%	65%	-6%
CFLs	1%	6%	4%
Incandescents/Halogens	28%	29%	2%
Number of Stores	22	22	22
Number of Lamps		18,712	

Figure 20: Percentages of Screw-Base Reflector Lamps Sold and Stocked by Lamp Technology in DIY, Small Hardware, Membership Club Stores Combined, 2018-2019

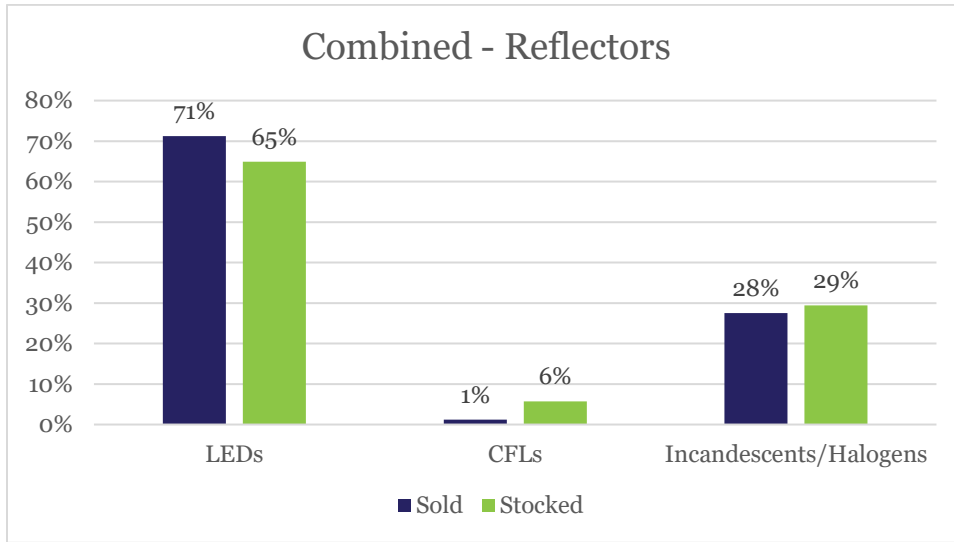


Table 17 and Figure 21 show the average of the estimated percentages of reflector lamps sold provided by the DIY store managers compared to the unweighted percentage of reflectors observed in those stores, by lamp technology.

Table 17: Percentages of Screw-Base Reflector Lamps Sold and Stocked by Lamp Technology in DIY Stores, 2018-2019

Lamp Technology	% Sold	% Stocked	% Difference of Sales from Stocking
LEDs	83%	70%	-13%
CFLs	4%	0%	-3%
Incandescents/Halogens	13%	30%	17%
Number of Stores	3	3	3
Number of Lamps		9,048	

Figure 21: Percentages of Screw-Base Reflector Lamps Sold and Stocked by Lamp Technology in DIY Stores, 2018-2019

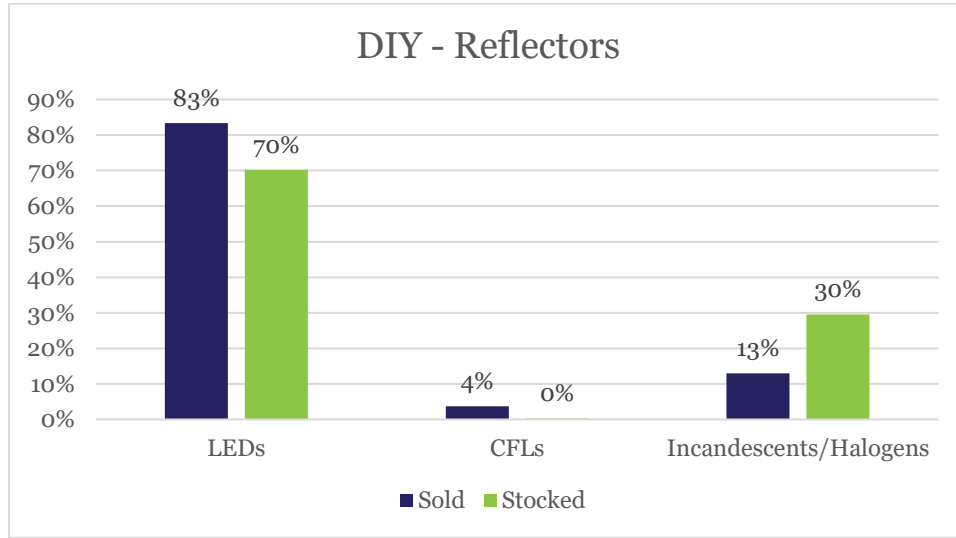


Table 18 and Figure 22 show the average of the estimated percentages of reflector lamp sold provided by small hardware store managers compared to the unweighted percentage of reflector lamps that field staff observed in those stores, by lamp technology.

Table 18: Percentages of Screw-Base Reflector Lamps Sold and Stocked by Lamp Technology in Small Hardware Stores, 2018-2019

Lamp Technology	% Sold	% Stocked	% Difference of Sales from Stocking
LEDs	64%	34%	-29%
CFLs	1%	1%	0%
Incandescents/Halogens	35%	65%	30%
Number of Stores	16	16	16
Number of Lamps		4,984	

Figure 22: Percentages of Screw-Base Reflector Lamps Sold and Stocked by Lamp Technology in Small Hardware Stores, 2018-2019

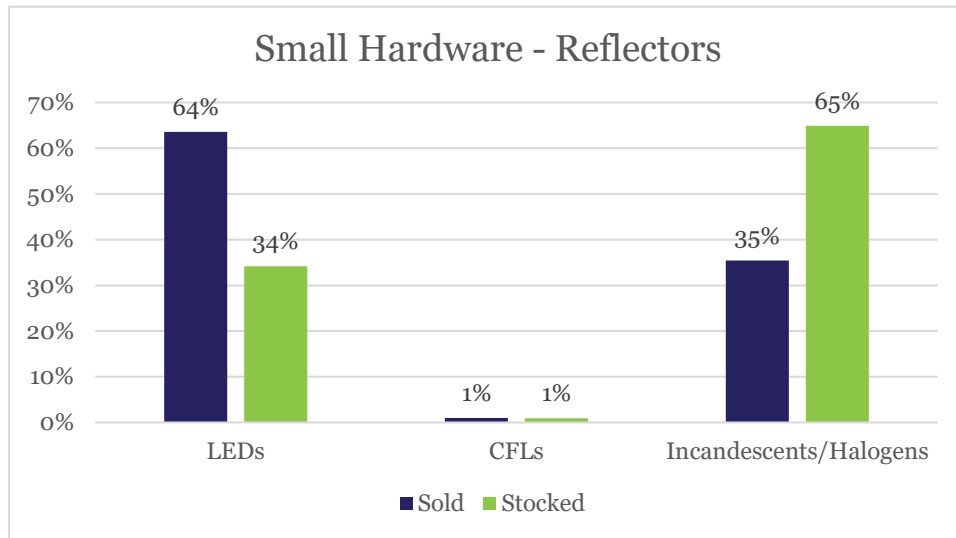


Table 19 shows the average of the estimated percentages of reflector lamps sold provided by membership club store managers compared to the unweighted percentage of lamps that field staff observed in those stores, by lamp technology.

Table 19: Percentages of Screw-Base Reflector Lamps Sold and Stocked by Lamp Technology in Membership Club Stores, 2018-2019

Lamp Technology	% Sold	% Stocked	% Difference of Sales from Stocking
LEDs	100%	100%	0%
CFLs	0%	0%	0%
Incandescents/Halogens	0%	0%	0%
Number of Stores	3	3	3
Number of Lamps		4,680	

Percentage Estimates: Specialty Lamps

Field staff asked store managers approximately what percentages of screw-based specialty lamps sold in their store in the last six months were LEDs, CFLs, and incandescents/halogens. Table 20 and Figure 23 show the average of the estimated percentages of specialty lamp sold provided by the store managers who were able to give estimates compared to the unweighted percentage of specialty lamps that field staff observed in those stores by lamp technology. Store managers estimated a substantially higher percentage of LED specialty lamps were sold through their stores (71%) than the percentage of LEDs that were stocked in those stores (47%). Additionally, the difference between the average estimated percentage of LEDs sold versus the percentage of LEDs stocked was much larger than the difference for all lamps, A-lamps, and reflectors.

Table 20: Percentages of Screw-Base Specialty Lamps Sold and Stocked by Lamp Technology in DIY, Small Hardware, Membership Club Stores Combined, 2018-2019

Lamp Technology	% Sold	% Stocked	% Difference of Sales from Stocking
LEDs	71%	47%	-24%
CFLs	3%	0%	-3%
Incandescents/Halogen	26%	53%	27%
Number of Stores	22	22	22
Number of Lamps		31,044	

Figure 23: Percentages of Screw-Base Specialty Lamps Sold and Stocked by Lamp Technology in DIY, Small Hardware, Membership Club Stores Combined, 2018-2019

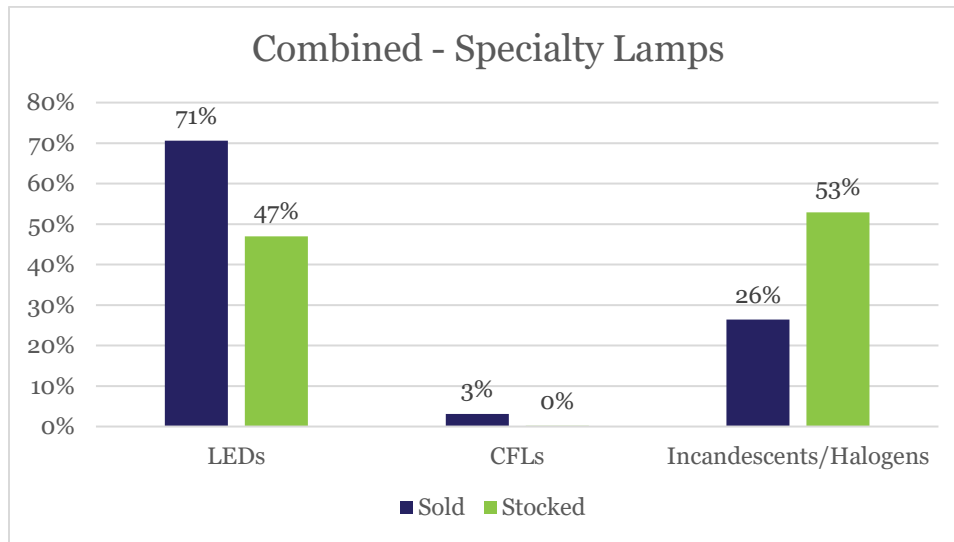


Table 21 and Figure 24 show the average of the estimated percentages of specialty lamp sold provided by DIY store managers compared to the unweighted percentage of specialty lamps observed in those stores by field staff, by lamp technology.

Table 21: Percentages of Screw-Base Specialty Lamps Sold and Stocked by Lamp Technology in DIY Stores, 2018-2019

Lamp Technology	% Sold	% Stocked	% Difference of Sales from Stocking
LEDs	80%	65%	-15%
CFLs	7%	0%	-7%
Incandescents/Halogen	13%	35%	22%
Number of Stores	3	3	3
Number of Lamps		17,202	

Figure 24: Percentages of Screw-Base Specialty Lamps Sold and Stocked by Lamp Technology in DIY Stores, 2018-2019

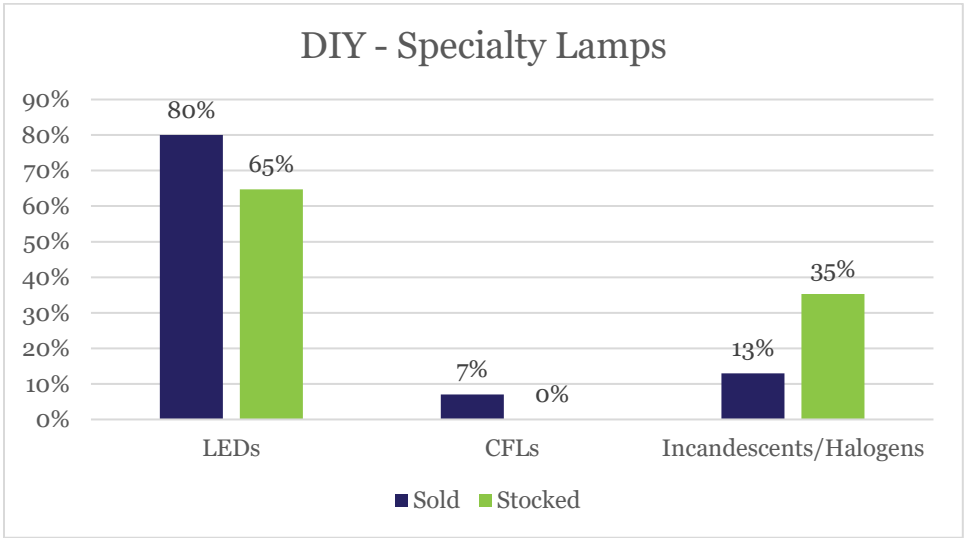


Table 22 and Figure 25 show the average of the estimated percentages of specialty lamp sold provided by small hardware store managers compared to the unweighted percentage of specialty lamps observed in those stores by field staff, by lamp technology.

Table 22: Percentages of Screw-Base Specialty Lamps Sold and Stocked by Lamp Technology in Small Hardware Stores, 2018-2019

Lamp Technology	% Sold	% Stocked	% Difference of Sales from Stocking
LEDs	63%	11%	-52%
CFLs	3%	0%	-3%
Incandescents/Halogen	34%	89%	55%
Number of Stores	16	16	16
Number of Lamps		11,676	

Figure 25: Percentages of Screw-Base Specialty Lamps Sold and Stocked by Lamp Technology in Small Hardware Stores, 2018-2019

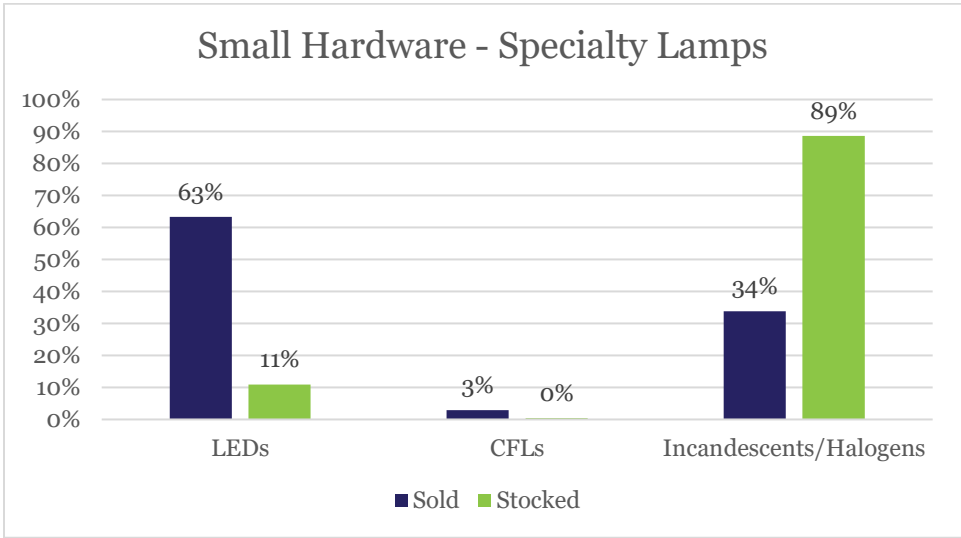


Table 23 shows the average of the percentages of specialty lamps sold provided by membership club store managers compared to the unweighted percentage of lamps observed by field staff in those stores, by lamp technology.

Table 23: Percentages of Screw-Base Specialty Lamps Sold and Stocked by Lamp Technology in Membership Club Stores, 2018-2019

Lamp Technology	% Sold	% Stocked	% Difference of Sales from Stocking
LEDs	100%	100%	0%
CFLs	0%	0%	0%
Incandescents/Halogens	0%	0%	0%
Number of Stores	3	3	3
Number of Lamps		2,166	

Shelf Stocking Practices

In this section, we provide a summary of the data collected from store managers regarding their stores’ stocking practices. Field staff asked store managers whether their store uses a planogram (i.e., shelf stocking plan).

Table 24 shows the number of respondents who said whether their store uses a planogram by store type. As shown, more than two-thirds of the store managers surveyed said they use a planogram. All DIY and membership club store managers said they use a planogram compared to just over half of small hardware store managers.

Table 24: Number of Stores that Use a Planogram by Store Type, 2018-2019

Store Type	Use Planogram	No Planogram	Total
DIY	7	0	7
Small Hardware	10	8	18
Membership Club	3	0	3
Overall	20	8	28

Field staff asked store managers who said their store uses a planogram who is responsible for developing the planogram. Table 25 shows who develops the planogram by store type. Nearly 90% of the managers of stores that use a planogram said that the corporate office develops their planograms, including nearly all DIY and membership club stores. Seven out of the nine managers from small hardware stores said that the corporate office develops the planogram for their stores.

Table 25: Developer of Planogram by Store Type, 2018-2019

Store Type	Corporate	Store	Distributors	Total
DIY	6	0	0	6
Small Hardware	7	1	1	9
Membership Club	3	0	0	3
Overall	16	1	1	18

Field staff asked store managers who said their store uses a planogram whether there was a regular month or season during the year when their planogram changes. Roughly two-thirds of store managers said that there was a regular schedule for changing their planogram (13 stores). Field staff then asked the 13 store managers who said that their store has a regular schedule for changing their planogram when they typically change their planogram. Table 21 shows the timing of planogram development by store type. Answered varied, but six respondents said that their store changed their planogram annually and six said that their store changed their planogram four or more times per year.

Table 26: Timing of Planogram by Store Type, 2018-2019

Store Type	Annually	4 or more times per year	Twice per year	Total
DIY	1	3	1	5
Small Hardware	4	2	0	6
Membership Club	1	1	0	2
Overall	6	6	1	13

At the end of the survey, field staff asked store managers of stores with a planogram whether their planograms have changed much over the past year. Answered varied, and all but 4 of the 20 store managers said that their stores' planograms changed over the past year. We list the changes described by store managers below.

- More shelf space devoted to LEDs (9 mentions)
- Fewer CFLs (5 mentions)
- Fewer incandescents (4 mentions)
- LEDs featured more prominently (3 mentions)
- Added smart LEDs (2 mentions)
- Frequent changes in end-caps (1 mention)

Key Findings and Recommendations

We summarize the key findings and recommendations based on data collected for the store manager and shelf stocking surveys below:

1. **Key finding – differences in percentage of lamps sold vs. observed stock (all lamps):** While the difference between the average of the estimated percentages of LEDs sold provided by store managers and the unweighted percentage of lamps (observed by DNV GL field staff in the shelf survey) was minimal in DIY stores, the difference was much more substantial in small hardware stores. Store managers in small hardware stores estimated that nearly 70% of lamp sales were LEDs, but field staff observed that only 30% of lamps stocked in those stores were LEDs. Membership club stores sold 100% LEDs, so there were no differences between the percentage of lamps sold and the percentage of lamps stocked in those stores.
2. **Key finding – differences in percentage of lamps sold vs. observed stock (by lamp style):** There was some variation between different lamp styles in the estimated percentages of LEDs sold compared to observed lamp stock in small hardware stores. Store managers estimated that percentage of LED A-lamps sold among all A-lamps in hardware stores was 70%, while LED A-lamps comprised only 43% of observed A-lamp stock in hardware stores. Small hardware store managers estimated that 64% of reflector lamps sold were LED reflectors, while field staff found that LED reflectors comprised only 34% of reflector lamp stock. Small hardware store managers estimated that 80% of specialty lamps sold were specialty LEDs compared to only 11% of specialty lamp stock observed.
1. **Recommendation – sales to stocking ratio:** For small hardware stores, we recommend that NEEA estimate sales with a sales-to-stock ratio of 2:1 for LED lamps and a sales-to-stock ratio of 1:2 for incandescent and halogen lamps. Based on the data collected in the store manager surveys, there is little evidence to suggest that the sales-to-stock ratio for CFLs is anything other than 1:1 in small hardware stores. In DIY stores, store managers' estimated sales percentages for all lamp technologies surveyed more closely matched the observed stocking of those lamps. Store managers' estimated percentage of LED sales was only slightly higher than observed stock, their estimated percentage of incandescent/halogen sales was only slightly lower than observed stock, and their estimated percentage of CFL sales was roughly the same as observed stock in DIY stores. Given that

there were minimal differences between the store managers' estimated percentages of lamps sold versus observed stock in DIY stores, we recommend estimating sales with a sales-to-stocking ratio of 1:1 in DIY stores. For membership club stores, 100% of lamps sold and stocked are LEDs, so we recommend estimating sales with a sales-to-stocking ratio of 1:1 in those stores.

- 3. Key finding – lamp stocking practices:** Most store managers said that their stores used a planogram (i.e., shelf stocking plan), including all DIY and membership club store managers and more than half of small hardware store managers. Additionally, most managers of stores with planograms said that they have a regular schedule for their planograms. This suggests that most of the stores and/or corporate offices follow the sales of lamps in their stores closely and make changes to their planograms based on lamp sales.
- 2. Recommendation – averaging shelf survey data across more than one time period:** Because most stores use a planogram and have a regular schedule for changing their planogram, we believe that averaging the 2018-2019 shelf survey data with the 2017-2018 shelf survey data provides a better indication of what was stocked on the shelves over 2018 than using only the 2018-2019 data.

Appendix C: Storefront Interview Guide

Interviewer Name

Date

Store Name and Location

Storefront Staff Name

Introductory Text: We are with a non-profit called NEEA. We're funded by electric utilities to help save energy in the Northwest. Each year, we visit stores and count lamps. We use that information to estimate regional energy savings. But we're missing some information that would help us be more accurate. We are hoping you could help us with by answering a few questions.

- A1. Can you tell me your involvement with lighting at this store? (Probe if needed: Are you familiar with the stocking of shelves, do you work with lighting customers and/or discuss lighting with corporate, other?)

- A2. Now I'd like to ask you about the screw-based lamps that moved through this store in the last six months; approximately what percentage of screw based lamps sold were LEDs? CFLs? Incandescent and halogens? Your best estimate is fine. (To clarify, the question is about lamps actually ***sold***, not lamps on shelves...)
 - a. % LEDs?
 - b. % CFLs?
 - c. % Incandescent and halogens?

Note to surveyor: If they cannot speak to "sales" re-phrase the question to ask about "Of the products you see customers picking up off the shelves...?"

- A3. Does this percentage breakdown of lamps sold differ by lamp style? By style I mean A-lamps, reflectors, and specialty lamps (like decorative or globe)? If so, how? (*Stated differently, what percent of the (A-lamp/reflector/specialty) lamps you sold in the last six months were (LED/CFL/Incandescent/halogen)?*)

	A-lamp	Reflector	Specialty
% LED			
% CFL			
% Incandescent & Halogen (combined)			

If respondent does not provide sales information (A2 AND A3), ask A4:

- A4. Would you say the current percentage of LEDs, on the shelf approximates the percentage of each lamp type you sold in the last six months? For example, *since about 40% of lamps stocked are LEDs, then approximately 40% of lamps sold are LEDs?*
If no, please explain the ratio of stocking to sales. *Probe: Does this ratio vary by bulb style (a-lamp/reflector/specialty)?*
- A5. Similarly, would you say the current percentage of incandescent and halogen bulbs on the shelf approximates the percentage of each lamp type you sold in the last six months? *For example, since about 20% of lamps stocked are incandescent and halogen bulbs, then approximately 20% of lamps sold are incandescent and halogen bulbs?*
If no, please explain the ratio of stocking to sales. *Probe: Does this ratio vary by bulb style (a-lamp/reflector/specialty)?*
- A6. Do you use a written plan to stock your shelves, sometimes called a planogram [your shelf stocking plan]? IF YES: Who develops it?
- A7. Is there regular month, or maybe a season, during the year when [your shelf stocking plan] [your store's planogram] is changed? If so, what month/season?
- A8. Thinking back over just the past year, has your [shelf stocking plan] [planogram] changed all that much? If so, how have it changed? (For example, the space allocated to LEDs increased/decreased, etc.)

Appendix D: Chain Logic Model Methodology

Apex Analytics and DNV GL (the Study team), on behalf of NEEA, conducted the 2018 Residential Lighting Study to assess year-over-year changes in the Northwest lighting market. The Study team updated market shares and average lamp metrics (e.g. price, wattage) with 2018 data. To do this, we followed the “Chain Logic Model”¹⁴ with some modifications to more completely leverage the available data for calculating lamp metrics. While the Chain Logic Model method is documented in the reports from prior study years, this memo describes the modified method the Study team used for the 2019 study. Each of the steps is detailed below.

Chain Logic Model

Data

As in prior years, the Study team used the following datasets to estimate market shares:

1. **NEEA shelf survey data:**¹⁵ DNV GL conducted the 2018 shelf survey in the winter of 2018-2019, building on a historical data set going back to 2012. In a shelf-stocking survey, researchers visit a sample of sites in the territory and gather data on all the relevant products on the shelves, generating a snapshot of the number of shelf facings devoted to each technology type.¹⁶ The core assumption of this survey is that the number of facings of a given lighting technology is proportional to that technology’s sales. In line with recommendations from this year’s shelf stocking memo (see Appendix B), the Study team averaged the 2017-2018 winter shelf stocking data with the 2018-2019 data.
2. **CREED LightTracker**¹⁷ **point-of-sale (POS) data:** Apex purchased POS lighting sales data from Nielsen, and the Consortium for Retail Energy Efficiency Data (CREED) team cleaned and corrected it. The cleaning involved web scraping, automated online product lookups, and integration with the product database maintained by the CREED team, all with the ultimate goal of filling gaps in the lamp description data (e.g. wattage, lumens) provided.

¹⁴ The Chain Logic Model was originally developed by Bonneville Power Administration and their contractor Cadeo Group.

¹⁵ See Appendix B: Sales and Stocking Comparison Findings, May 2019.

¹⁶ In retail, facings are products placed at the front of the shelf or rack, facing the customer. A single item may have multiple facings.

¹⁷ CREED is a consortium of program administrators, retailers, and manufacturers working together to collect the necessary data to better plan and evaluate energy efficiency programs. LightTracker is CREED’s first initiative, focused on acquiring full-category lighting data, including incandescent, halogen, CFL, and LED lamp types, for all distribution channels in the United States.

In prior years, the sample of stores for shelf surveys included grocery, drug, and mass merchandise (for simplicity, referred to from here on as Mass Merchandise) stores, but contractors did not use the shelf survey data for this channel in the Chain Logic analysis; they only used the POS data. Because the shelf survey data for this channel had been superfluous to the analysis in prior years, this year's Team did not do shelf surveys of this channel, decreasing the overall number of stores surveyed from 68 to 34 (the 34 stores included two more stores for the Do-It-Yourself (DIY), Small Hardware, and Membership Club channels than had been included in prior years).

Segment the Market into Channels

Consistent with contractors in prior years, Apex segmented the market into channels with assigned market shares according to a presentation by a major retailer at the 2014 ENERGY STAR Partners Meeting. The assigned market shares roughly aligned with the Study Team's understanding from other market research endeavors in Illinois and Massachusetts, but a direct quantification of channel market share was difficult because retailers do not share sales data. The represented channels in prior years have been:

1. Do-It-Yourself (DIY) Stores
2. Mass Merchandise, Drug, Grocery, and Club Stores
3. Small Hardware Stores
4. Online Sales

Sales to stocking ratio: The default assumption in prior years has been that the number of facings of lighting products of a particular technology type directly correlated with sales of that technology type. However, evidence from store manager interviews conducted as part of the most recent shelf survey indicated that this ratio was not applicable for small hardware stores. Store managers reported higher sales of LEDs than stocking suggested, and lower sales of incandescents and halogens. For that reason, the Study team prepared two data sets: one with the prior assumption of a 1:1 facing to stocking ratio, and a second data set with a new assumption for small hardware stores of 2:1 facings to stocking for LEDs, and 1:2 for incandescents and halogens.

The 2018-2019 Study team continued to rely on the prior channel types, with two modifications. First, the POS data covers mass merchandise and club stores, but not the largest club retailer (Costco). Therefore, Apex broke the "Mass Merchandise and Club" channel into distinct channels for mass merchandise stores and club stores. CREED constructs state level sales totals for all states using point-of-sale data and CREED-generated estimates of total lamp sales by state. The Study team estimated the market share of the Mass Merchandise channel at 29.1% and allocated the remaining share of the prior years' 32.0% market share estimate for the channel (2.9%) to club stores. Table 27 provides the resulting market share distributions utilized by the Study team for this effort.

Table 27. 2018-2019 Market Share by Retailer Channel, Including Online

Retailer Channel	Market Share
DIY	50.0%
Mass Merchandise	29.1%
Club Stores	2.9%*
Small Hardware	14.0%
Online	4.0%

**The Study team recognizes that combining old and new calculations has resulted in a smaller channel share for Club stores than in prior years and recommends additional investigation to refresh all shares in the next cycle.*

Assign Site Weights by Region

To extrapolate the sample of stores visited during shelf stocking to the NEEA territory, the Study team calculated weighting values for each channel and region. Oregon represented one region while the other three states were combined into a second region to obtain a statistically valid sample. The regions were:

1. The state of Oregon
2. The three-state region of Washington, Idaho, and Montana

The Study team determined the weights by the ratio of total stores to sampled stores within a channel and region. Multiplying the weights by the lamp counts at the itemized level (product code and store) in the shelf stocking data resulted in an estimate for the total number of lamps on shelves in the NEEA territory, within the sampled channels. In prior years, contractors calculated store-level averages for lamp metrics, which they later weighted by a factor calculated for each retailer based on total lamp facings to calculate weighted averages for prices and wattages at the retail channel and market level. This approach runs the risk, however, of providing skewed results if a retailer carries a disproportionate number of lamps with a particular characteristic.

To address this risk, the Study team calculated weighted averages using the weighted lamp counts at the itemized product level, rather than weighting and averages at the store level. Because this calculation was performed at the itemized product level, the market shares, lamp totals, and lamp metrics calculated from those weighted lamp counts were not skewed as in the aforementioned case. This process is described further below and shown in Figure 27.

Online Channel Efficiency Mix

Neither the shelf stocking survey nor the POS data addressed the channel market share or efficiency mix for online sales. The Apex team took the following actions to attempt to secure data directly from online retailers:

1. Reached out to representatives from bulbs.com, 1000bulbs.com, and amazon.com through at least two points of contact per website
2. Reached out to representatives at Philips, Feit, Osram Sylvania, and GE
3. Reviewed recent publicly-available studies
4. Convened an internal discussion on private studies (to which Apex has contributed) that address the question of online market share

The Team was unsuccessful in acquiring direct data from market actors. Ultimately, an estimate for the online efficiency mix was informed by two studies from Massachusetts:

1. "RLPNC 17-12 Lighting Decision Making," by NMR Group, finalized on March 2, 2018.¹⁸ Page 16, Figure 13: LED and CFL Market Share by State and Channel.
2. "RLPNC Study 18-10 2018-19 Residential Lighting Market Assessment Study," by NMR Group, finalized on March 19, 2019.¹⁹ Page 37, Table 8: LED Bulbs Obtained.

Starting from RLNPC 17-12, we took the following steps:

1. We calculated the LED and CFL Market Share average across Massachusetts and New York for two channels: DIY and Online. The DIY channel was the most similar to the Online channel in terms of efficient market share, and DIY stores have online marketplaces that likely compete on price and offerings with Online retailers.
2. We extracted the ratio of inefficient lamps (Halogen and Incandescent) between Online and DIY channels from this study. In Massachusetts and New York, inefficient lamp share constituted about half as much share in the Online channel as the DIY channel.
3. We applied this value to the known DIY shares from NEEA shelf stocking surveys to estimate market share for inefficient lamps in the Online channel, then scaled the efficient lamp shares to fill in the complete Online market channel.

¹⁸ http://ma-eeac.org/wordpress/wp-content/uploads/RLPNC_1712_DecisionMaking_12Feb2018_Final-1.pdf

¹⁹ http://ma-eeac.org/wordpress/wp-content/uploads/RLPNC_1810_LtgMarketAssessment_FINAL_2019.03.29.pdf

This calculation resulted in estimates for market share by technology and lamp style, but did not provide information on pricing, wattage, or other lamp metrics. We assumed that those metrics were the same in the Online channel as in the DIY channel due to the similarity between the two channels.

Finally, we used the RLNPC 18-10 study to verify the prior Online channel share estimate. That study showed that 7% of LEDs in Massachusetts and New York were obtained online. From qualitative assessment within the study, it is likely that these states purchase online more than other areas. Using the within-channel calculations above and an assumption of 4% channel share, we estimated that 5.4% of LEDs in NEEA territory were purchased online. Given that 7% is most likely an upper bound, we determined the prior 4% online market share estimate to remain accurate for 2018.

Determine the Efficiency Mix within Channels

The Study team multiplied the count of facings of each UPC at each store by its site weight to arrive at a “weighted lamp count.” The UPCs were bucketed into one of six lumen bins according to their lumen output rating, three of which correspond to those reported in prior years. The UPC and store-level weighted lamp count within each channel were then used to calculate the following metrics by lamp style and technology:

1. **Market share:** The total weighted lamps of a given technology within a lamp style are divided by the total lamps of that style. The result is market share by technology, within a given lamp style (e.g., percent of general purpose lamps that are LEDs or percent of globe lamps that are Halogens).
2. **Price:** For a given lamp style and technology, the weighted average price by weighted lamp count (e.g., the average price of an LED Reflector lamp).
3. **Wattage:** For a given lamp style and technology, the weighted average wattage by weighted lamp count (e.g., the average wattage of an LED Reflector lamp).
4. **Efficacy:** For a given lamp style and technology, the weighted average efficacy, in lumens/watt, by weighted lamp count (e.g., the average efficacy of an LED Reflector lamp).
5. **Lifetime:** For a given lamp style and technology, the weighted average lifetime, in hours, by weighted lamp count (e.g., the average lifetime of an LED Reflector lamp).

Diagrams of the prior methodology employed for this purpose (Figure 26) and the methodology used in the current year (Figure 27), are shown below. In prior years, the total lamp count for each site was used to weight the store-level average lamp metrics. That method had the potential to skew results for stores where the share of a given lamp application (e.g., technology, lamp style) was substantially different than others. For example, if one store sold only CFLs, its influence on average price would be calculated from its total lamp sales versus other stores in the prior method. In the updated method, it would be calculated directly from its CFL sales versus CFL sales at other stores. The differences are demonstrated in the two figures on the following two pages.

Figure 26. Prior Method for Calculating Within-Channel Lamp Metrics

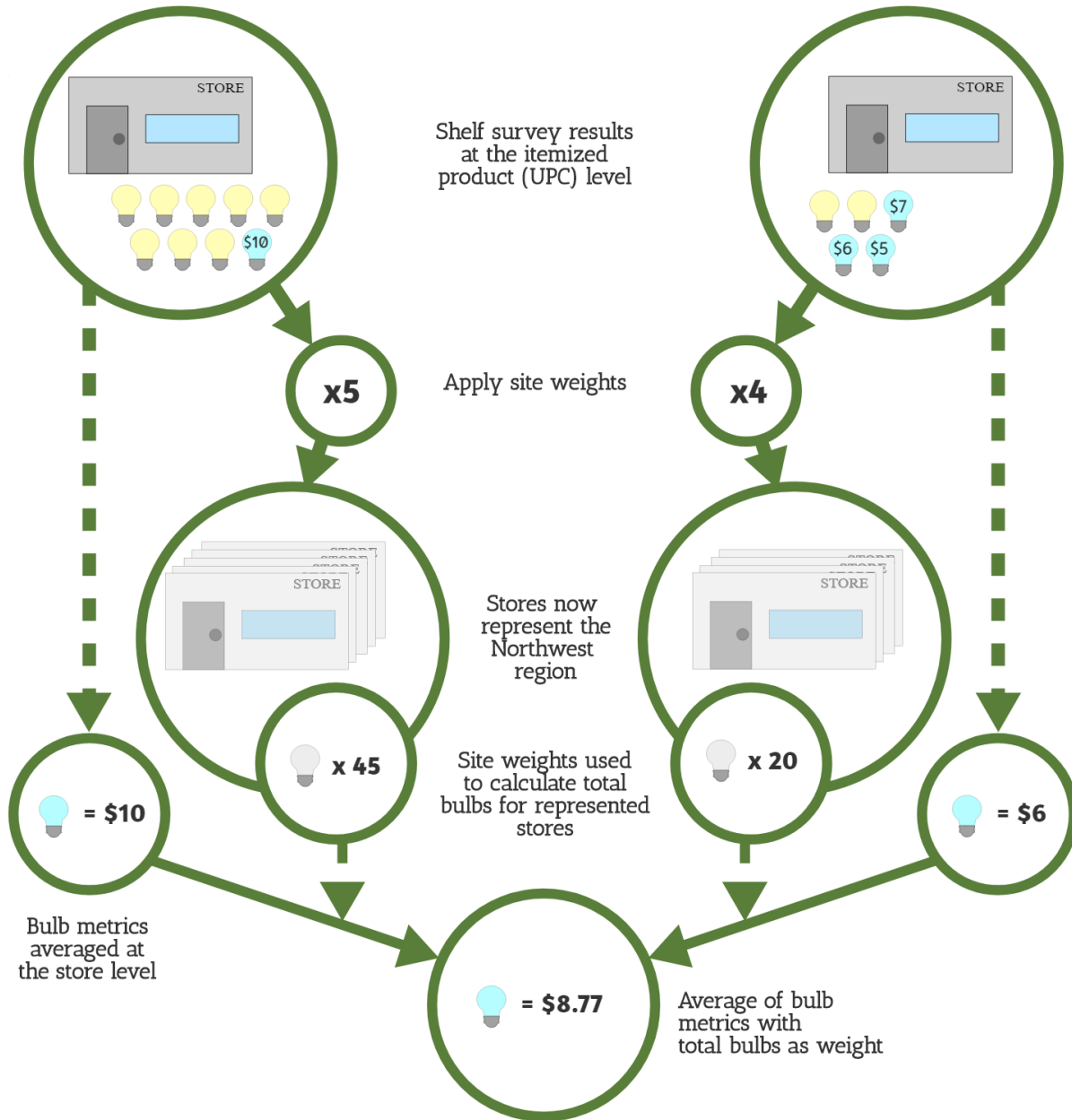
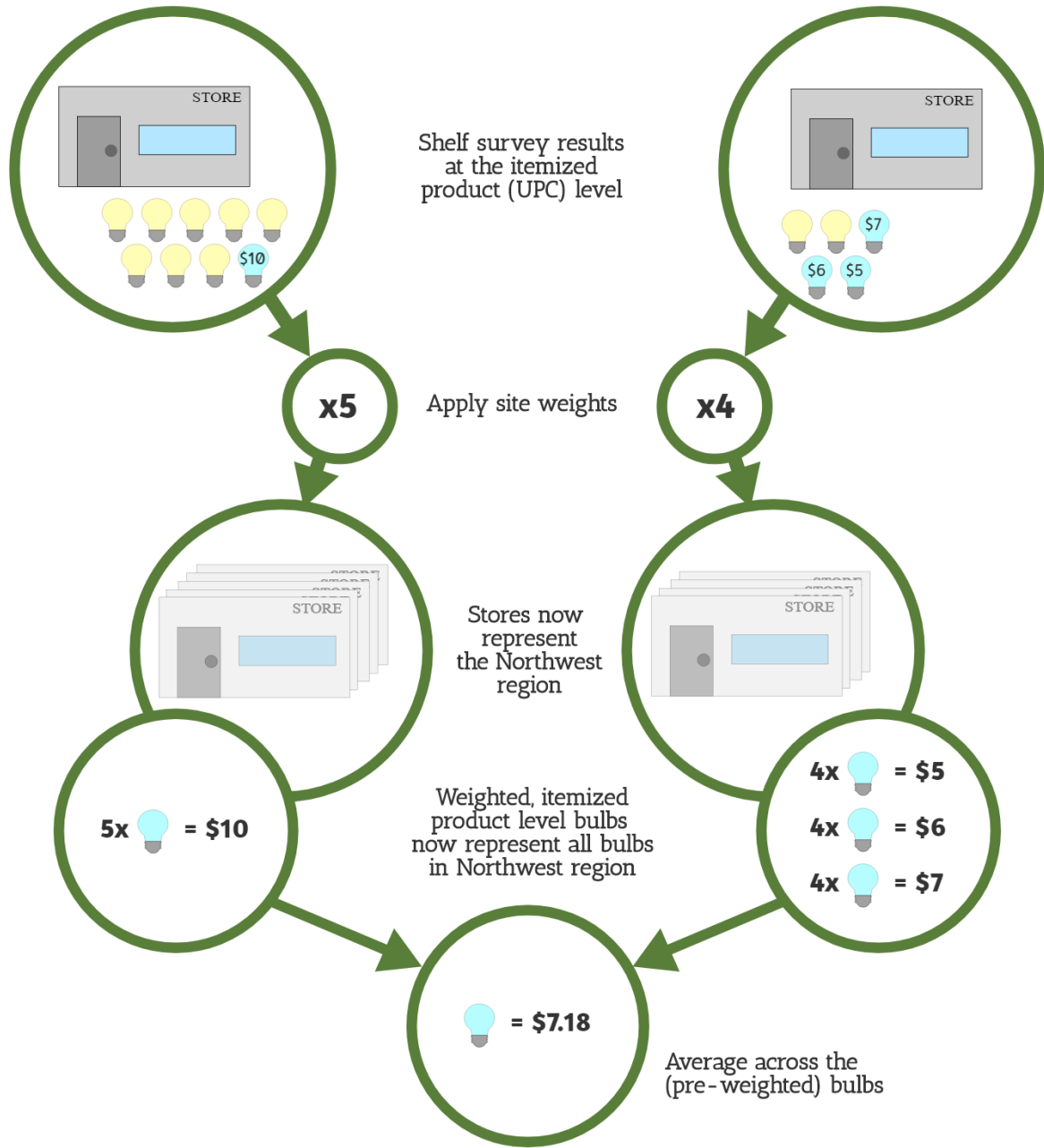


Figure 27. Current Method for Calculating Within-Channel Lamp Metrics



The result of this analysis is one table for each metric, for each channel. These tables are provided in the following form:

Table 28. Example Result Table

(Channel XX)	Lamp Style					
Lamp application	General Purpose	Reflector	Decorative	Globe	Three-Way	All Styles
CFL	\$x.xx	\$x.xx				
Halogen	\$x.xx	...				
Incandescent			...			
LED						
Overall						

The study team performed this analysis within each of the lumen bins to capture these metrics at a further level of detail.

Compute Overall Efficiency Mix and Lamp Metrics

To calculate market shares within lamp style and lumen bins, we combined data from the prior section with the channel shares of total lamp sales. The method we employed for market shares was equivalent to the Chain Logic Model detailed in prior reports. We used the formula below;

Table 29 details the meaning of each variable.

$$\text{Share}_{s,\text{total}} = \frac{\sum_{\text{channels}} (\text{Share}_{s,\text{channel}} \times \text{Share}_{\text{channel},\text{total}})}{\sum_{\text{channels}} (\text{Share}_{\text{channel},\text{total}})}$$

Table 29. Market Share Calculation Inputs, with Example Data

		<i>Share_{channel,total}</i>	<i>Share_{s,channel}</i>	<i>Share_{s,total}</i>
Channel	Lamp Tech	Channel Share of Total Market	Lamp Tech Share of Lamp Style within Channel	Lamp Tech Share of Lamp Style (Overall)
Mass Merchandise		29.1%	45%	
DIY		50%	68%	
Club	LED	2.9%	100%	58%
Sm. HW		14%	43%	
Online		4%	50%	

For lamp metrics such as price and wattage, the Study team’s method differed from prior years. In prior years, the above calculation would be performed with the share within channel *Share_{s,channel}* swapped for a lamp metric such as price. However, average lamp metrics are a different type of calculation. Whereas a market share calculation is technically a value for all lamp within the channel (number of lamps of a given kind divided by *all lamps*), a lamp metric is only a calculation for lamps of that kind.

Directly substituting values in the equation used to calculate channel share to calculate variables like average price and wattage ignores that channel share (Table 27) is a measurement of total lamps within a channel while the other metrics are limited to total lamps of a given technology. When channels have very different market shares by technology, the prior Chain Logic Method would apply too little weight to the channels with higher internal market share of that technology, and too much weight to the channels with lower internal market share of the technology. For example, Costco sells only LEDs, and accounts for roughly 3% market share for all lamps. It follows that it must account for more than 3% of LEDs sold, because other stores do not sell only LEDs. However, its weight in a calculation of LED wattage would be 3% using the prior method.

We add an additional adjustment term to account for the disparate technology and lamp style market shares between channels. The additional weighting term, in the case of Costco, would increase the weighting of its lamp metrics to above 4% for LEDs, as expected. The formula for that calculation is below;

Table 30 details the meaning of each variable.

$$\text{Metric}_{s,t,\text{total}} = \frac{\sum_{\text{channels}} (\text{Metric}_{s,t,\text{channel}} \times \text{Share}_{s,\text{channel}} \times \text{Share}_{\text{channel},\text{total}})}{\sum_{\text{channels}} (\text{Share}_{s,\text{channel}} \times \text{Share}_{\text{channel},\text{total}})}$$

Table 30. Lamp Metric Calculation Inputs, by Channel, with Example Data

A	B	<i>Metric</i>_{s,t,channel}	<i>Share</i>_{channel,total}	<i>Share</i>_{s,channel}	<i>Metric</i>_{s,t,total}
Channel	Lamp Tech	Average Lamp Price (Within Channel)	Channel Share of Total Market	Lamp Tech Share of Lamp Style	Average Lamp Price (Overall)
POS		\$2.72	29.1%	45%	
DIY		\$3.13	50%	68%	
Club	LED	\$2.73	2.9%	100%	\$3.15
Sm. HW		\$4.36	14%	43%	
Online		\$3.18	4%	50%	

These values are tabulated within lumen bins and across all lumen bins, for all metrics detailed above (price, wattage, efficacy, and lifetime).

In order to demonstrate how this methodology is different than the one used in prior years, we provide an example diagram of the calculations below. Figure 28 shows the prior calculation method, while Figure 29 shows the current calculation method. Similar to the issue with weighting by total lamps in calculating within-channel shares, weighting channels by only their total lamps skews results when the efficiency mix is different by channel. However, for this calculation we must employ a second weighting scheme instead of a more granular calculation as with within-channel lamp metrics, because of the unknown difference in sales to stocking ratio by channel. For example, we do not know whether a single facing turns over 100 times per year for DIY stores versus 15 times at Small Hardware stores. Therefore, we cannot guess the absolute sales numbers for either channel and must combine them with the market share percentages presented in Table 27. The adjustment factor is therefore also calculated using percentages instead of product-level weighting.

Figure 28. Prior Method for Combining Lamp Metrics across Channels

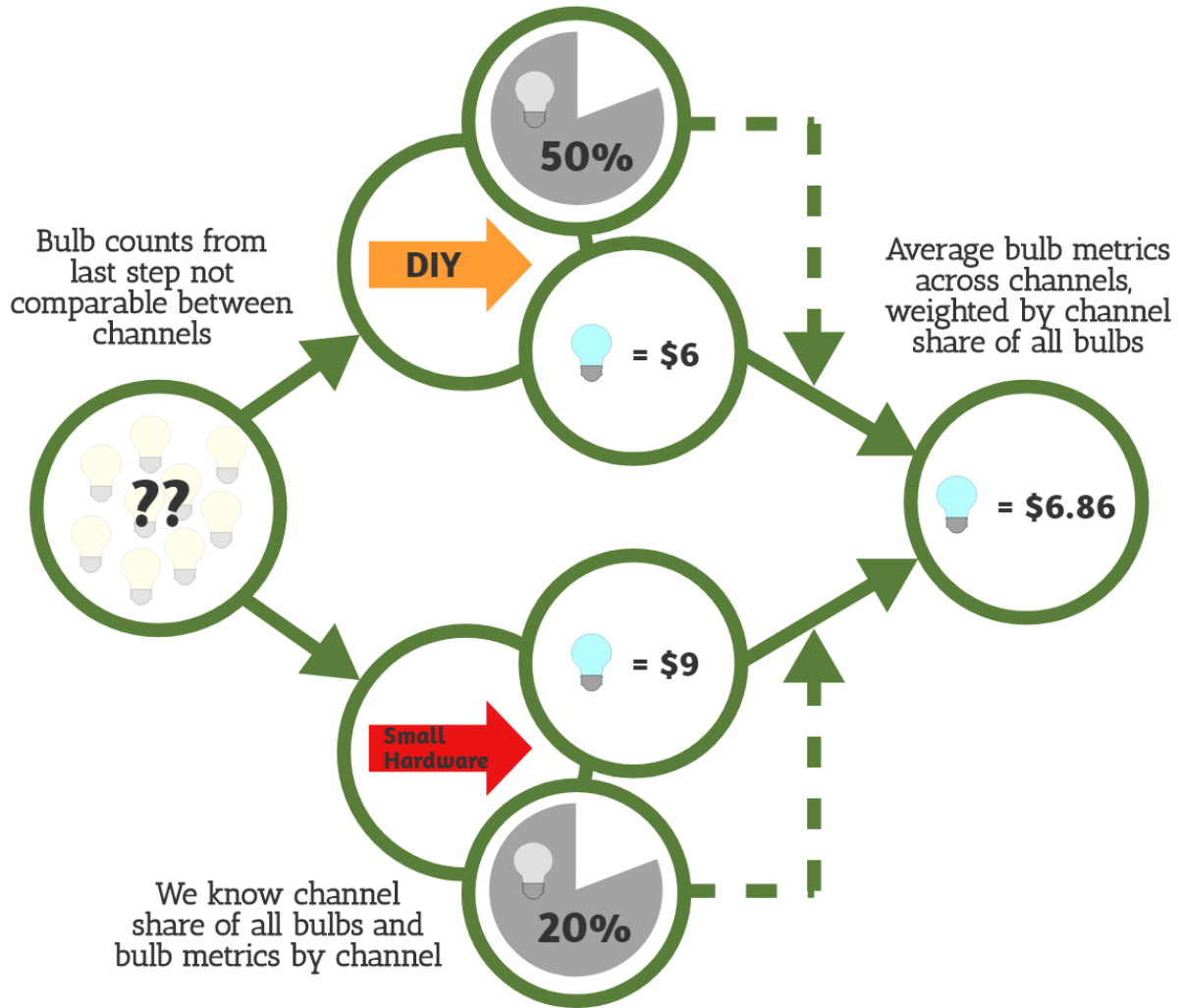


Figure 29. Current Method for Combining Lamp Metrics across Channels

