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2016-2017 Northwest Residential Lighting Long-Term Monitoring and Tracking Study

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Executive Summary

Background

Since 2004, the Northwest Energy Efficiency Alliance's (NEEA) Residential Lighting Long-Term Monitoring and Tracking (LTMT) Study has been assessing the state of the Northwest residential lighting market year-over-year.

The study tracks trends in sales shares and pricing of efficient residential lighting technologies, and key market developments, including federal legislation impacting residential lighting products. The study provides NEEA and the region's utilities with robust data on market status, and insights that residential lighting program planners and managers will find informative in their ongoing consideration of possible adjustments to program strategy and design.

As in previous years, the primary research activities for 2016-17 were collecting and analyzing the current year's shelf survey and sales data for lamps, and folding the new year's analysis into the ongoing longitudinal findings. The focus is on 2011 to 2016, years of particularly dramatic market change. This year's study also included interviews with manufacturers to gather their opinions and expectations regarding trends in manufacturing, and the potential impacts of the new federal legislation and ENERGY STAR specification. The report also describes insights on the challenges and data needs of Northwest residential lighting program planners and managers in this rapidly changing market, based on observations of interactive sessions with these staff facilitated by NEEA.

Key Findings and Their Implications

The overall takeaway is that from 2011 to 2016, the region's residential lighting market shifted dramatically toward more efficient products, and prices dropped precipitously for these products. The primary drivers of this transition have been regulation, technological change, and residential lighting efficiency programs. In the general purpose (screw in) and reflector lamp categories, LEDs now have primacy. Compact fluorescent lamps (CFLs) are exiting the market. New specifications and standards (if implementation stays on track), will continue to push greater efficiency.

These developments represent huge progress towards transforming the Northwest market. The market changes also have important implications for residential lighting programs, raising issues such as: if/when to scale back or even eliminate lamp incentive programs, what incentive levels are appropriate, and where there might be new program opportunities. Many of the region's program planners and managers find themselves at a strategic and design crossroads.

Key Findings

The primacy of LED general purpose and reflector lamps is a huge step towards regional market transformation. Within general purpose lamps sales (which make up over 50% of all residential lamp sales), the percentage of LEDs rose dramatically from just 1% in 2011 to a dominant 43% in 2016. In reflectors (about 20% of all residential lamp sales), the percentage of LED sales rose from 4% to 51%.

LED prices decreased by 70% between 2011 and 2016, greatly narrowing the incremental cost for consumers of choosing an LED over inefficient lamps. The average price for a general purpose LED lamp (after application of utility incentives) dropped to about $5 in 2016, and many general purpose lamps are available for $1 or less, particularly in the so-called "value LED" category. LED prices across all lamp categories fell to less than $10 per lamp. Manufacturers say key drivers are the maturing LED manufacturing infrastructure, the accompanying economies of scale that allow for lower-cost manufacturing, and utility program incentives.

Market actors are shifting away from the perception that so-called "value LEDs" will harm energy-efficiency progress although market findings are nuanced. In terms of energy use, value LEDs are on par with ENERGY STAR lamps. Notably, at least one utility is offering incentives on these lamps. However, value LEDs can have lower durability and lifetimes, and may lack design features (e.g. omnidirectionality). Manufacturers said value LEDs meet varying customer needs and are becoming more popular, but interestingly, the shelf data revealed that the share of ENERGY STAR certified lamps increased between 2011 and 2016; it should continue to grow because of the new ENERGY STAR specification.

New federal standards, if implementation stays on track, will continue to push and lock in efficiency gains. That said, major manufacturers do not see EISA 2020 as a watershed moment, as they are certain that LEDs are here to stay. EISA 2020,[1] an expected change in federal standards for residential lighting, could increase efficacy requirements if fully implemented. The new standard is expected to cover many more product types such as decorative and mini-base lamps and many reflector lamps. Major manufacturers and those most heavily invested in LED technology say they have already retooled and do not see EISA 2020 as having a major impact on their manufacturing.

Specialty lamp sales are still largely inefficient. Many specialty lamps, such as decorative and mini-base lamps, are exempt from the current federal standards, and have not shifted as rapidly toward efficient technologies. The 2016 data showed that incandescent still dominated decorative and mini-base lamp sales at 73%. While only a minority (18%) of all lamps sold fall into these categories, this is a portion of the residential lighting market that has not yet transitioned to high-efficiency technologies.

Compact Fluorescent Lamps (CFLs) are exiting the market. Between 2011 and 2016, the sales share of CFLs went from 31% to just 12%, and in anticipation of EISA 2020, manufacturers say they are ramping down CFL production. EISA 2020 is expected to require a level of efficacy (lumens per watt) that is on par with LEDs, a level most CFLs cannot meet.

Implications of Findings

The residential lighting market changes described in this report are positive in terms of the dramatic story they tell about market transformation, yet challenging from a programmatic perspective. The region's residential lighting program planners and managers should continue to share ideas on program designs and strategies, and to collect and share information and data collaboratively.

[1] This change is known as EISA 2020, in reference to the Energy Independence and Security Act of 2007.

The following discusses programmatic implications of the dramatic market change.

Implication	Discussion
The dominance in the Northwest of LED technology in general purpose lamps (43% of sales) and reflectors (51% of sales) begs the question of when to say the Northwest market is transformed.	NEEA asked utility program planners and managers in interactive workshop held in May, "At what sales share of LED technology for general purpose lamps might we consider the market transformed?" Participants said 50 to 60% might be that point. While this was an informal and limited poll, their response indicates the importance of continued close tracking of market conditions to guide program decisions.
The rapid drop in LED prices is making it more difficult to determine appropriate incentive levels or if incentives are even necessary; planners say they need more frequent price analysis.	Planners of residential lighting programs are redoubling their efforts to determine what incentive levels, if any, can be offered cost effectively on different products. The analysis of pre-incentive lamp prices in Appendix E of this report was requested by planners at the workshop to help inform that effort. Some utilities are purchasing sales data and analyzing prices more frequently; sharing this information regionally would be helpful.
The market presence of low-price "value LEDs" may require further examination of program designs and assumptions.	Market actors are shifting away from the perception that so-called "value LEDs" threaten energy-efficiency progress. Indeed, the energy use of value LEDs is on par with ENERGY STAR lamps. However, ENERGY STAR lamps have additional quality features. Two questions emerge: Given rapidly increasing LED market share, driven in part by value LEDs, should baselines for calculating savings be adjusted? And are there still compelling reasons for incentives on ENERGY STAR lamps?
Specialty applications with a high share of inefficient technologies could be a program opportunity	The study found that decorative and mini-base lamps were still over 70% incandescent. If implemented as written, EISA 2020 will encompass decorative and mini-base lamps, but utilities may want to assess the practicality and cost-effectivity of programs that would target these particular lamps in the short term.

2016-2017 Northwest Residential Lighting Long-Term Monitoring and Tracking Study

Introduction

NEEA's Northwest Residential Lighting Long-Term Monitoring and Tracking (LTMT) Study assesses the current state of the Northwest residential lighting market, and identifies year-over-year trends in sales and pricing by comparing data collected in the current year with historical data collected in previous LTMT studies.

The specific research objectives for the 2016-2017 study included:

- Characterize the impacts of the updated ENERGY STAR specification, effective January 1, 2017 (ENERGY STAR 2.0), and the forthcoming EISA residential lamp standards, expected to go into effect January 1, 2020 (EISA 2020).
- Understand manufacturer opinions and expectations regarding the impact of EISA 2020 and ENERGY STAR 2.0, and other market and manufacturing trends in the Northwest.
- Describe 2016 Northwest residential CFL and LED sales and pricing and confirm the assumption that CFLs are exiting the market.
- Better understand current residential lighting program activities in the Northwest, and program planners' and managers' needs for research to inform program design/planning.

Cadeo conducted sales and stock data analysis for this study, interviewed manufacturers to collect their market insights, and supported and observed two interactive sessions conducted by NEEA with regional program planners and managers. DNV-GL conducted the shelf stocking data collection.

This report is organized as follows:

- Description of study methodology and research activities.
- Description of findings, including manufacturer insights, on the following aspects of the residential lighting market:
    - Federal standards and the ENERGY STAR specification
    - Sales trends in residential lamps
    - Market presence of "value LEDs"
    - Avenues for residential lighting innovation
    - Price trends in residential lamps
- Summary of findings and implications

Methodology Overview

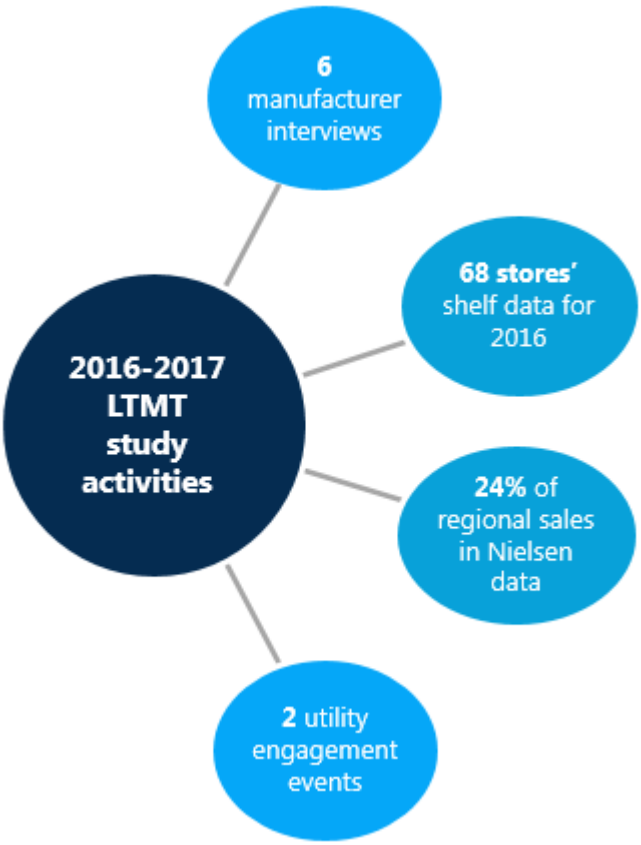
This section summarizes the study's methodology, with detailed information provided in Appendix C. The Cadeo team's analysis drew on the following data sources:

Manufacturer Interviews

To provide context for the shelf and sales data, the team conducted six in-depth interviews with residential lamp manufacturers. The goal of these interviews was to understand manufacturer opinions and expectations for shelf stocking, sales, and manufacturing trends in the Northwest, and the anticipated impacts of EISA 2020 and the 2017 ENERGY STAR specification.

Note: Findings from these interviews are woven into each section of the report, rather than reported separately.

Figure 1. 2016-2017 LTMT Study Activities



Shelf Data and Sales Data Collection and Analysis

NEEA collected data on residential lamp sales from two key sources:

Shelf survey data (collected by DNV-GL). This includes data collected from 68 stores for the 2016 study, as well as previous years' studies for 2011 through 2014 and two studies in 2015 (summer and winter).

Nielsen sales data. This includes 2016 data acquired for the current study as well as previous years' data for 2011 through 2015. Nielsen collected data from a subset of Northwest retailers, representing approximately 24% of total residential lamp sales in the region.

The Cadeo team combined these data using the chain logic method. This method, described in detail in Appendix C, uses market characterization data to estimate total market sales by combining sales data from multiple sources.

Utility Engagement

NEEA conducted two events for sharing the results of this study with residential lighting program planners and managers, and simultaneously took the opportunity to collect questions and insights from event participants. The intent of these events was to make interim findings available to regional program planners and managers in a timeframe that would allow the findings to be considered during program planning. Cadeo collected information at both events.

- An interactive workshop at the May 2017 Efficiency Exchange Conference; and

- An interactive webinar in June 2017.[2]

Participants in these events raised questions regarding LED prices unadjusted for incentives. In response, NEEA collected residential lighting program incentive information, which Cadeo used in combination with the pricing data collected for this study to analyze pre-incentive prices. The details and results of that analysis are presented in Appendix E.

Study Findings

Federal Standards and ENERGY STAR Specification: Impacts and Insights

As described earlier, the residential lighting market has changed dramatically since 2011. By 2016 the LED lamp rose to the top; for the first time in the Northwest, LEDs outsold all other technologies in the general purpose and reflector lamp categories.

Drivers of this market change include advancements in LED technology, heavy investment from manufacturers, energy-efficiency programs, and federal standards and the ENERGY STAR specifications. This section describes the latter drivers in detail, and manufacturers' insights and reactions to them.

The latest developments in standards and specifications are as follows:

- New federal standards, if implemented in 2020, will increase the efficiency requirements for many residential lighting products, eliminating inefficient products from the market.
- Changes in the voluntary ENERGY STAR program for general purpose lamps mean that only LEDs will be marked with the well-known ENERGY STAR label.

Key Impacts of Federal Standards[3]

For context on the new federal standards, the following page starts with a detailed description of key federal standards since 2007 and their impacts.

[2] A recording of the webinar is available at http://neea.adobeconnect.com/pdy7h73gtf6h

[3] The final rule on Energy Conservation Standards for General Service Lamps was released by the Energy Efficiency and Renewable Energy Office on January 19, 2017. Full text available online: https://www.regulations.gov/document?D=EERE-2013-BT-STD-0051-0097

The Latest on Federal Standards

The 2007 EISA legislation required that the US Department of Energy (DOE) revisit general purpose lamp efficiency standards and finalize new efficiency requirements by January 2017. This mandate contained an important backstop requirement: if the DOE did not further increase efficacy levels for general purpose lamps through a new rulemaking by the end of 2016, then the standards would automatically increase to 45 lumens per watt (lm/W) in 2020. Since the updated standard will become effective on January 1, 2020, industry stakeholders commonly refer to the impending standard as EISA 2020

In February 2016, it seemed as though the DOE would set new standards of between 70 and 105 lm/W, depending on the lamp's lumen output. Ultimately, the DOE opted not to adopt these or *any* new efficacy requirements. As a result, the 45 lm/W backstop requirement included in the original EISA legislation will go into effect on January 1, 2020, unless Congress takes action to change or eliminate it.

The DOE did, however, expand the 2020 legislation's scope to include most of the lamps exempt from the current legislation. The expansion in scope will result in significant energy savings since previously exempted lamps, such as reflector, decorative, and mini-base lamps, collectively represent nearly 30% of retail sales in the Pacific Northwest. The new scope also removes existing loopholes for rough service, shatter-resistant, vibration service, and 3-way lamps. In total, the new scope will cover 96% of the currently exempt lamps. Only a small number of low volume specialty categories like appliance lamps, black lights, bug lights, and infrared lights will continue to be exempt.

The manufacturers interviewed for the LTMT study reported that although there is some uncertainty about the future of federal regulations (see above for a recap), they believe the LED is here to stay.

Manufacturer interviewees fell into two camps on the topic of EISA 2020:

- Major manufacturers and those that have invested most heavily in LED technology say they have already switched over to LED production by retooling some factories and even shutting down some legacy-technology factories. These manufacturers do not see EISA 2020 as a watershed moment.
- A few smaller manufacturers (who are not as invested in energy-efficiency) say they will focus on selling a broad range of technologies as long as this is allowed under federal standards.

Manufacturers agreed that they want certainty when it comes to regulations. In April 2017, the National Electrical Manufacturers Association (NEMA), the major trade association representing lighting manufacturers, wrote a letter to the DOE formally requesting that the Secretary of Energy complete a

rulemaking for general purpose lamps. This shows the industry's continued desire for certainty, despite the DOE's decision not to adopt new requirements in 2016.

The 45 lumen per watt (lm/W) backstop, assuming it takes effect, would effectively eliminate halogens from the retail lighting market, while allowing manufacturers to continue producing CFLs. Most manufacturers, however, said they planned to transition away from CFLs, regardless of EISA 2020, and will focus their research and development and marketing resources on LEDs. As a result, it is unlikely the backstop provision, which would allow CFL production, will derail—or even meaningfully slow—the residential lighting market's inevitable movement toward LEDs.

ENERGY STAR 2.0 Highlights

Increased efficacy requirements mean very few general purpose CFLs qualify for ENERGY STAR labeling.

Expanded eligibility for connected and color-tunable lamps.

Decreased lifetime requirements for general purpose lamps from 25,000 to 15,000 hours.

Key Impacts of ENERGY STAR 2.0

The DOE and Environmental Protection Agency (EPA) established a new ENERGY STAR lighting specification that became effective in January 2017. The new lighting specification, known as ENERGY STAR 2.0, increased efficacy requirements to reflect recent improvements in LED technology and capture greater energy savings. Notably, CFLs typically do not meet the new efficacy standard for general purpose lamps, which will hasten the technology's departure from efficiency programs and the retail lighting market in general.[4] The new specification also increased the range of ENERGY STAR-eligible products to include connected and color-tunable lamps. While efficacy requirements increased for all lamp types, lifetime requirements actually *decreased* for omnidirectional (general purpose) lamps—from 25,000 to 15,000 hours.

Most manufacturers interviewed say they are happy with ENERGY STAR 2.0. Interviewees say the new specification makes ENERGY STAR LED products more attractive (by adding quality features) while allowing cost minimization (by allowing for shorter lifetimes). Some see ENERGY STAR as an opportunity to push LED toward higher quality, and were disappointed that the new specification did not go further in pushing for longer lifetimes and better lamp design. A few manufacturers think that ENERGY STAR is losing its relevance for customers.

Sales Trends in Residential Lamps

NEEA's LTMT study allows for assessment of year-over-year trends in the residential lamp market. This section summarizes 2016 northwest residential lamp sales data along with historical data collected in prior LTMT studies.

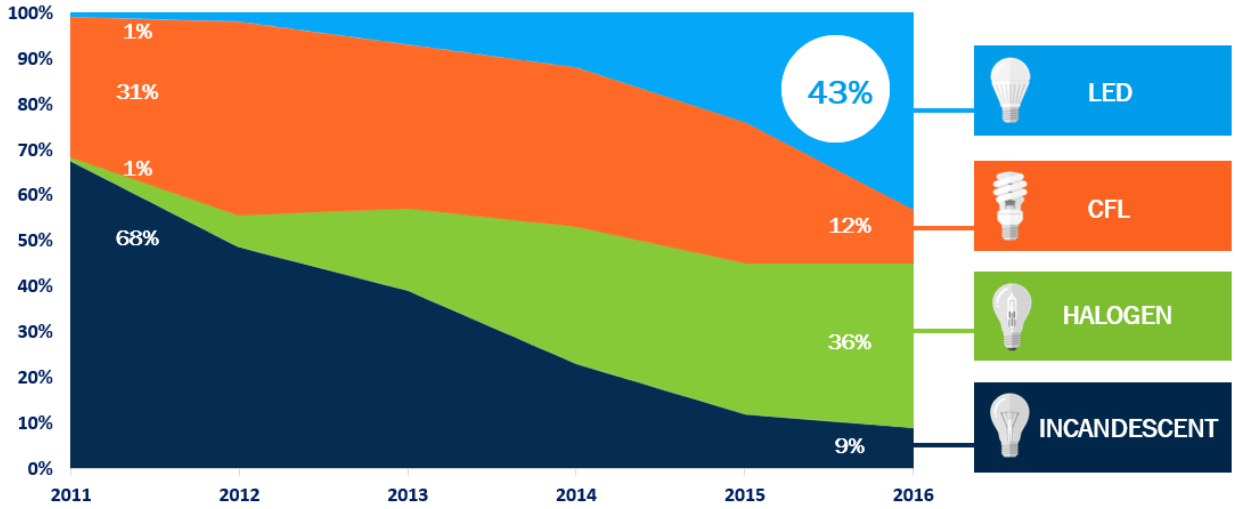
[4] As of August 2017, a very small number of general purpose CFLs are listed as ENERGY STAR qualified. These lamps make up less than 0.1% of ENERGY STAR qualified products, and many of them are for special applications such as damp environments.

For the first time ever, LED was the top selling general purpose lamp technology in 2016 with 43% market share.

For general purpose lamps, which made up 51% of lamp sales in 2016, the rapid market changes over the past five years are clear: LED and halogen sales have boomed, while CFL and incandescent sales have plummeted. Figure shows sales of general purpose lamps by technology from 2011 to 2016. LED and halogen lamps went from non-factors in 2011 to being the two dominant technologies in 2016. Incandescent market share, meanwhile, plummeted from 68% to 9% over the same timeframe.

The result of these changes is a general purpose lamp market containing a very different technology mix in 2016, in which the majority of sales are efficient. For the first time ever, LED was the top selling technology in 2016 with 43% market share. By comparison, the CFL market share peaked in 2012 at 43%, and has since declined as LED market share increased. This illustrates that in 2016 LEDs were as prevalent as CFLs were in 2012, and that CFLs have lost their primacy among energy-efficient technologies.

Figure 1. General Purpose Lamps - Technology Shares, 2011-2016



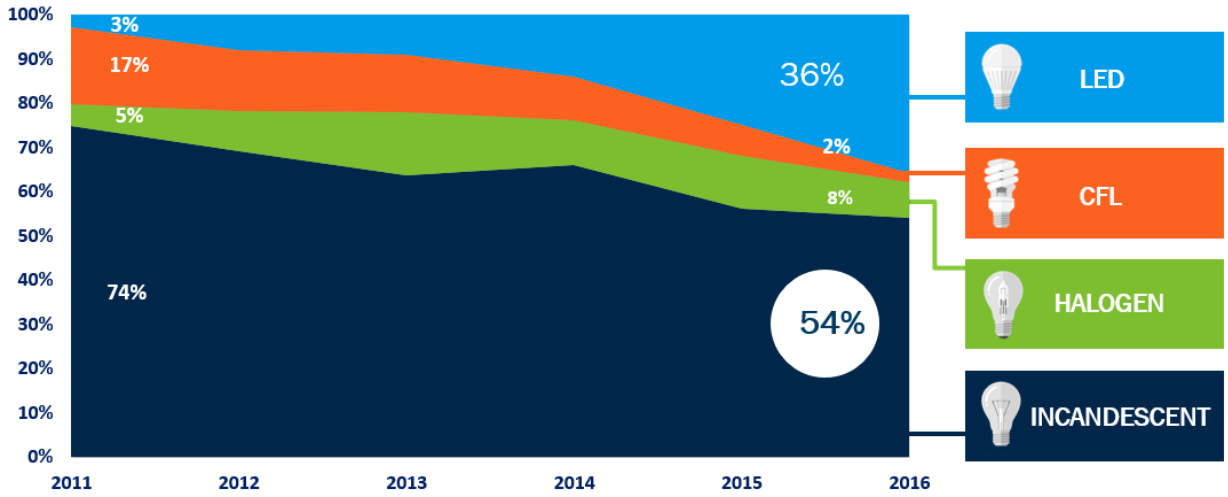
Data source: Weighted combination of sales data and NEEA shelf data.

General purpose lamps have been the fastest to transition to LED, driven in large part by federal standards. Other lamp types have been slower to change.

Figure displays the weighted sales mix of specialty lamps from 2011 to 2016. The category of "specialty lamps" encompass reflectors, decorative (including mini-base), globe, and three-way lamps. Specialty lamps made up 49% of lamp sales in 2016. Although the sales trends for specialty lamps are also substantial in their overall trends towards more LED and fewer incandescents, there is less change as compared to general purpose lamps. This is primarily due to the fact that some specialty lamp types are

exempt from the federal standards that have driven massive change in the general purpose lamp category.

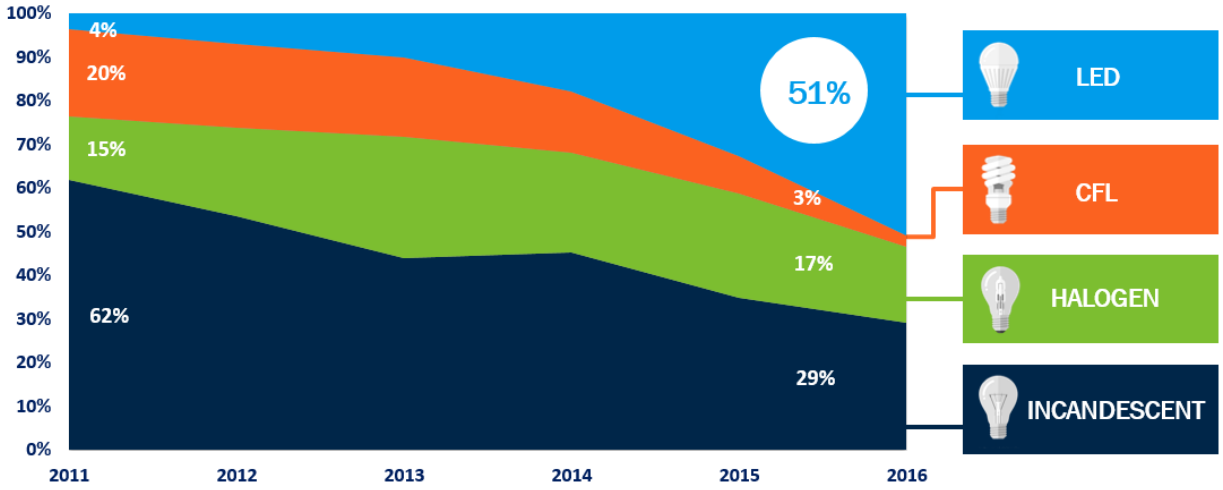
Figure 2. Specialty Lamps[5] - Technology Shares, 2011-2016



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

Among the various types of specialty lamps, however, sales trends differ substantially. Specifically, reflectors have seen a rapid transition to LED, while decorative lamps have remained largely incandescent. Figure shows the technology mix of reflector lamps from 2011 to 2016. Reflector sales, which were 19% of the market in 2016, are trending heavily towards LED. Many (but not all) reflectors are exempt from current standards, but that is expected to change with the forthcoming EISA 2020 standards.

Figure 3. Reflector Lamps (a subset of Specialty Lamps) - Technology Shares, 2011-2016

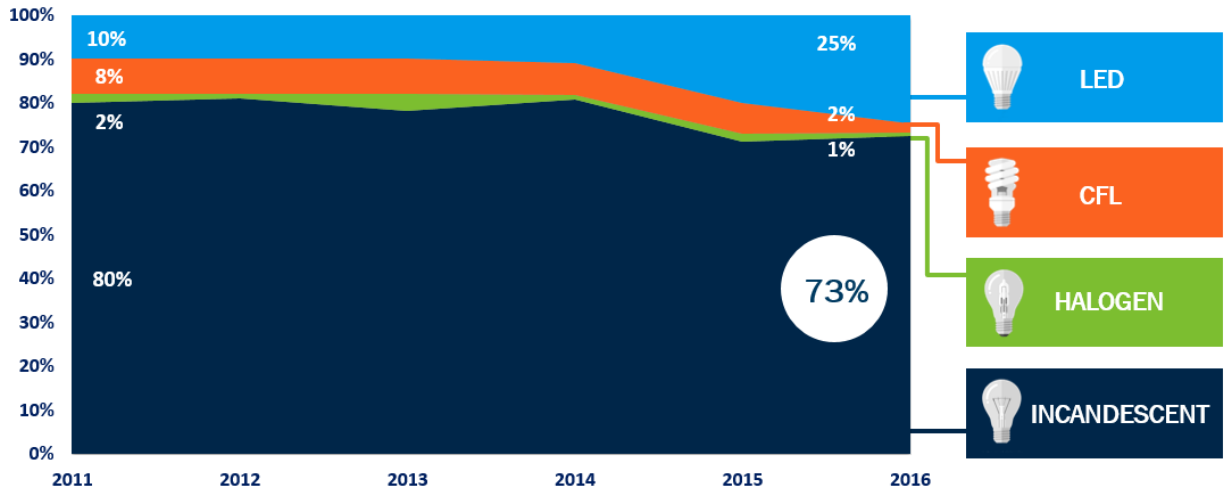


Data source: Weighted combination of sales data and NEEA shelf data.

[5] Reflectors, decorative (including mini-base), globe, and three-way lamps

In contrast to reflectors, technology shares for decorative and mini-base lamps (also a subset of the larger category of specialty lamps) have remained relatively constant over the last five years. Figure displays the technology mix of decorative and mini-base lamps from 2011-2016. This lamp category made up 18% of the market in 2016. Although LED lamps have been steadily increasing in share, over 70% of decorative and mini-base lamps are still incandescent. These products are exempt from EISA efficiency standards, so shares of efficient technologies are growing more slowly here. However, EISA 2020 is expected to cover many decorative lamps, which would drive a faster transition to efficient technologies (LED and CFL).

Figure 4. Decorative and Mini-Base Lamps (a subset of Specialty Lamps) - Technology Shares, 2011-2016



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

Are CFLs Exiting the Market?

All signs point to yes. CFL is no longer the efficient technology of choice: across all lamp types, sales and shelf data show that LEDs have a larger market share than CFLs. And although the forthcoming EISA 2020 efficacy standards would allow for continued CFL manufacturing, it is unlikely manufacturers will roll back their shift toward LED to take advantage of that option. On the whole, manufacturers agree that 2016 was a watershed year for the decline of the CFL, with many suppliers exiting the market or planning to do so soon.

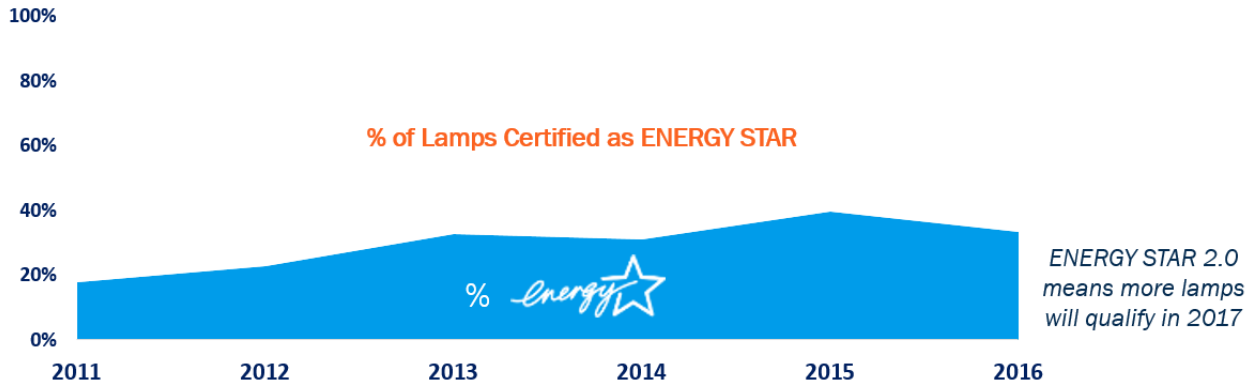
Market Presence of "Value LEDs": Perceptions and Impacts

The market's transition toward LED as the efficient technology of choice has raised the question of price versus quality: many manufacturers are offering high-quality ENERGY STAR-labeled LED lamps, while others offer so-called "value LEDs," or lower-cost lamps that do not qualify for ENERGY STAR labeling. These include both general purpose lamps and other lamp types. Some manufacturers offer both ENERGY STAR and value LEDs, to meet the needs of various customers. While non-ENERGY STAR LEDs tend to be

just as efficient as their ENERGY STAR labeled competitors, they may lack other quality features like lamp design, durability, and lifetime.

Most manufacturers interviewed said they think value LEDs are becoming more popular, which implied that there might be a shift away from ENERGY STAR lamps. However, the shelf data revealed that is not the case: Figure shows the share of ENERGY STAR certified lamps from 2011-2016. The percentage of lamps with ENERGY STAR labeling has actually increased since 2011, and because of the change in the ENERGY STAR 2.0 specification, the market will see a jump in the share of ENERGY STAR lamps in 2017.[6]

Figure 5. Percentage of Lamps Certified as ENERGY STAR, 2011-2016

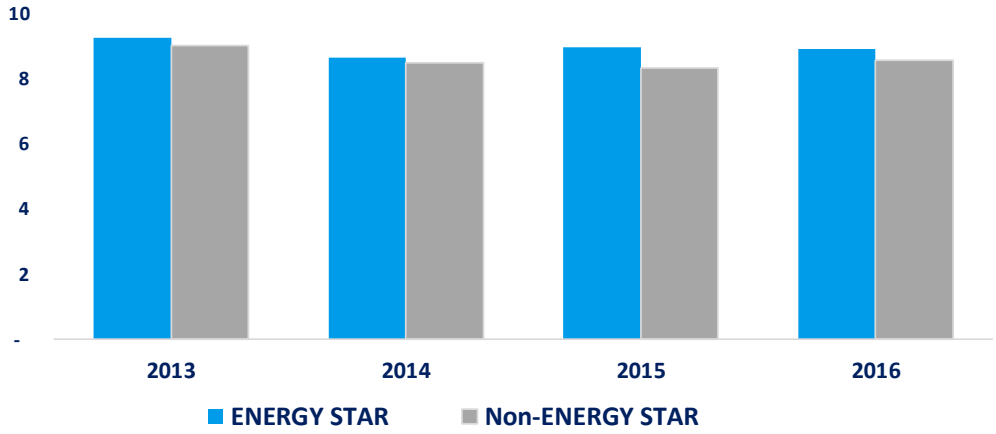


Data source: Weighted combination of sales data and NEEA shelf data.

In the energy-efficiency world, value LEDs have gotten a lot of attention, and some say they threaten to disappoint customers and drive them away from LEDs. However, manufacturers say value LEDs are meeting customer needs, and they perform well in terms of efficiency. Figure compares the average wattage of ENERGY STAR and non-ENERGY STAR LEDs over the past four years. On average, ENERGY STAR lamps use about the same amount of energy as value LEDs. The figure shows that non-ENERGY STAR lamps actually have slightly lower average wattages than ENERGY STAR lamps, which is likely due to differences in lamp design. For example, ENERGY STAR lamps must meet requirements for omnidirectionality, which may result in slightly higher-wattage lamp design. While lamp design and quality features are important, there is little difference in energy consumption between ENERGY STAR and non-ENERGY STAR lamps.

[6] The increase shown between 2014 and 2015 is due to additional data from the Summer 2015 shelf study, which should provide a more accurate assessment of ENERGY STAR labeling.

Figure 6. Wattage Comparison of ENERGY STAR and Value LEDs, 2011-2016



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

Avenues for Residential Lighting Innovation

Manufacturer interviewees offered four examples of where they see the residential lighting market heading.

Connected Home

Most manufacturers mentioned connected home products as an area they are exploring, including products such as lamps with integrated wi-fi or speakers. These products are still not mass-market ready, because they still come at a high price, which limits their widespread adoption.

Incandescent Look LEDs

Manufacturers are introducing LED filament lamps: lamps that mimic the look of an incandescent lamp. These are a niche product, but several manufacturers mentioned they are expanding offerings in that category, including developing an LED general purpose lamp that mimics the look of a frosted incandescent lamp.

Dimmability

One manufacturer mentioned dimmable LEDs as a product type that consumers are looking for but that has not gotten much traction yet.

Chip Scale Packaging

A new technology in LED design, chip scale packaging or CSP, means three-dimensional light output off of a chip, rather than the one-directional light you get now. This could open up new possibilities in lamp design.

Price Trends in Residential Lamps

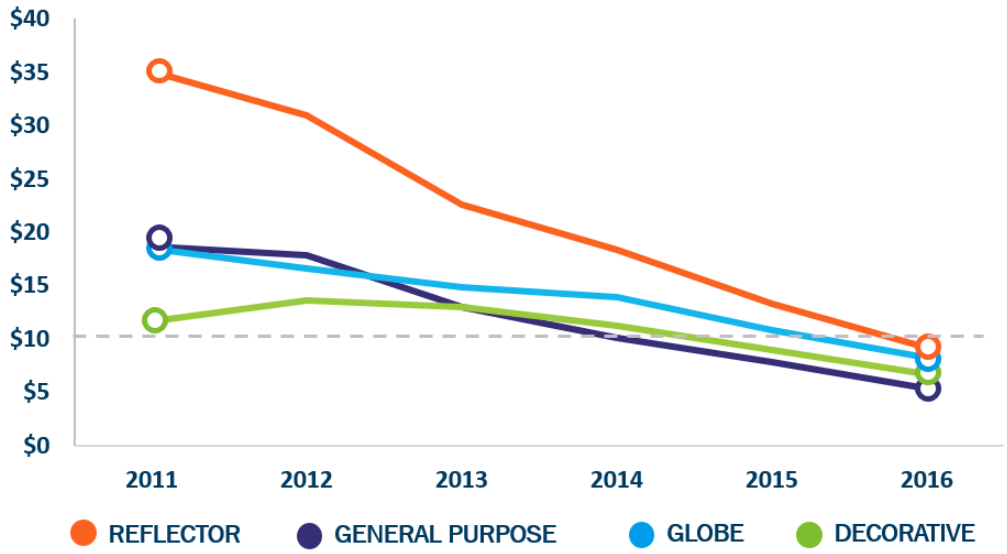
In addition to the sales trends presented in the prior section, the Cadeo team analyzed pricing data collected in the sales data and shelf stocking study. The data corroborate manufacturers' statements in interviews: they agree that LED prices are dropping and it is likely they will continue to do so.

Manufacturers say falling LED prices are driven by market maturation. As the LED market matures, manufacturers have invested in their production infrastructure and have begun to reap the benefits of these investments. Furthermore, as LEDs gain market share, manufacturers are able to achieve economies of scale in LED production. Further, both of these factors are supported by the influence of federal standards, pushing LEDs ahead.

Figure and

Table 1 compare the average LED price per lamp across lamp categories, representing prices paid by customers after any retailer, manufacturer, or utility discounts.[7] LED prices have dropped dramatically over the past several years and, for the first time ever, all LED lamps now have average prices under $10. Comparing LED price trends across lamp types, we see lower prices across the board. This graph also illustrates how extreme the price drop for reflectors is – LED reflector prices are now coming in line with other LED lamp types, although there is still a significant price difference between reflector lamps (the most expensive type) and general purpose lamps (the least expensive). Falling prices are a big deal given how strong an influence price is on shoppers.

Figure 7. LED Average Price ($/lamp), 2011-2016



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

[7] An analysis of pre-incentive prices informed by self-reported incentives from regional utilities is provided in Appendix E. As previously mentioned, that analysis and memo are an extension of this project's utility engagement efforts.

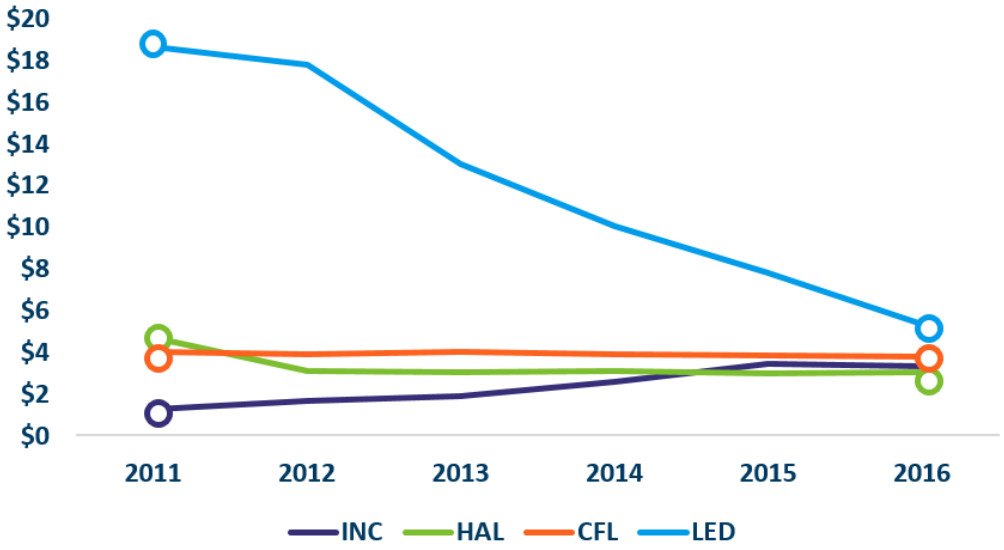
Table 1. LED Average Price ($/lamp), 2011-2016

Year	General Purpose	Reflector	Globe	Decorative and Mini-Base
2011	$18.63	$35.07	$18.41	$11.62
2012	$17.80	$30.89	$16.60	$13.61
2013	$12.99	$22.57	$14.80	$13.01
2014	$10.06	$18.30	$13.88	$11.19
2015	$7.77	$13.28	$10.82	$8.91
2016	$5.31	$9.13	$8.24	$6.66

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

Figure shows the average cost of general purpose lamps by technology, from 2011 to 2016. The price of a general purpose LED lamp has fallen dramatically, while the CFL price stayed fairly consistent over time. Although the average LED price was $5.31, there are lower-priced LEDs available – including lamps that cost less than $1. The shelf stocking data showed that the most frequently stocked LED lamps are lower in cost than the average price.

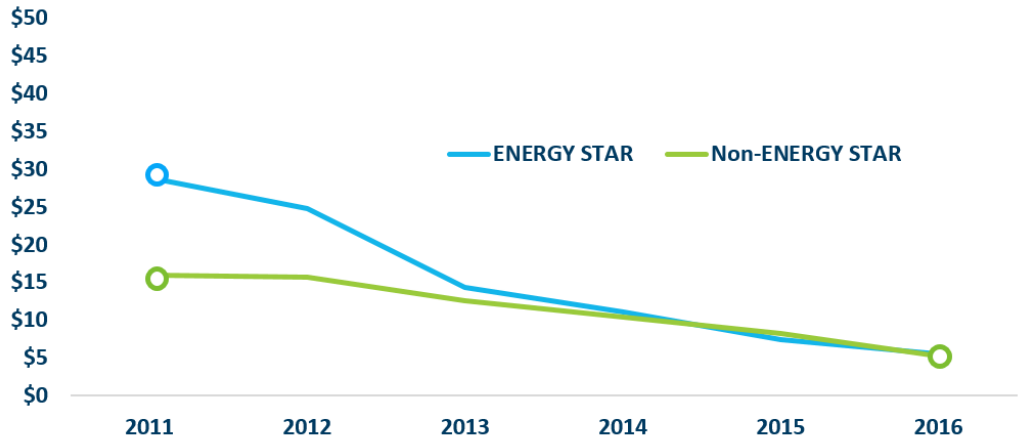
Figure 8. General Purpose Average Price ($/lamp) by Technology, 2011-2016



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

Figure , which compares the average price of ENERGY STAR and non-ENERGY STAR general purpose LED lamps over the past six years (after utility incentives are applied), displays a trend of price convergence to reach equal average prices in 2016. Two factors drive this pattern: (1) the overall trend of falling prices for LEDs pushed prices down across the board, but (2) utility incentives, which were introduced for LEDs in 2013, made the biggest impact in bringing ENERGY STAR and non-ENERGY STAR prices together. With utility incentives, ENERGY STAR LED prices are now comparable to value LED prices, meaning that consumers can choose ENERGY STAR LEDs without paying more.

Figure 9. General Purpose LED Average Price ($/lamp) by ENERGY STAR Status, 2011-2016

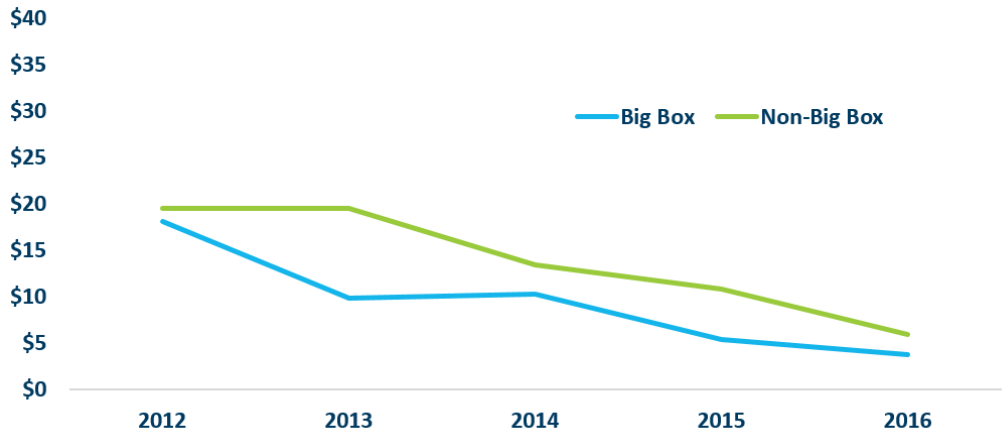


Data source: Weighted combination of sales data and NEEA shelf data.

By contrast, CFL prices have remained relatively constant over time and this is true for both ENERGY STAR (with utility incentives applied) and non-ENERGY STAR CFLs. However, CFLs prices for ENERGY STAR versus non-ENERGY STAR have differed over time by only roughly $2 as opposed to the convergence seen with LEDs.

Figure compares the average price seen by the customer for general purpose LEDs in these two store types. The price for general purpose LEDs at both store categories started high in 2012 and both have steadily decreased over time. Big box stores still sell less expensive LEDs, but the price gap between store types has seen plenty of variation over these five years. Utility incentives, as well as the overall drop in LED prices, were contributors to these changes over time. Regardless, lower-cost LEDs are now available in all stores, not solely big box stores.

Figure 2. Big Box General Purpose Average LED Price ($/lamp)



Data source: NEEA shelf data.

Summary of Key Findings and Implications

Finding	Implication
 **The primacy of LED general purpose lamps (43% sales share) and reflector lamps (51% share) is a huge step towards regional market transformation.**	*When is the Northwest market considered transformed?* Close regional market tracking and discussion are needed to guide program decisions.
 **LED prices dropped 70% between 2011 and 2016, greatly narrowing incremental cost. Many general purpose lamps are $1.**	*With the rapid price drop, how are appropriate regional incentive levels determined, or if incentives are even necessary?* Planners say they need more frequent price analysis, and some are doing this; sharing this regionally information would be helpful.
 **Market actors are shifting away from thinking "value LEDs" will harm efficiency progress. Indeed, value LED energy use is on par with ENERGY STAR LEDs.**	*Is there a need to reassess (1) incentives on ENERGY STAR lamps, and (2) current baselines used for savings calculations?* The presence of value LEDs may require further examination of program designs and assumptions.
 **EISA 2020, if fully implemented, will continue to push and lock in efficiency gains.**	Implications for program design will become more clear as 2020 approaches.
 **Specialty lamp sales, such as decorative and mini-base lamps, are still largely inefficient.**	*What are new program opportunities given the rapid market changes?* EISA 2020 is to include decorative and mini-base lamps, but in the near-term, these could be a program opportunity.
 **CFLs are exiting the market. Manufacturers are ramping down production. EISA 2020 is expected to require an efficacy level that most CFLs cannot meet.**	

Appendix A: Detailed Data Summary Tables

The tables in this appendix summarize the shelf survey results.

Table A-2. Lighting Retailer Shelf Survey Completes by Store Type, 2016-2017

Store Type	Number of Stores in Sample	Percentage of Stores in Sample
DIY	9	13%
Drug and Grocery	20	29%
Mass Merchandise	16	24%
Membership Club	3	4%
Small Hardware	20	29%
Overall	68	100%

Table A-3. Summary of EISA Efficiency Standards

EISA effective dates	Incandescent lamp wattage (watts)	Typical incandescent light output (lumens)	Typical incandescent efficacy (lumens/watt)	EISA replacement wattage (watts)	EISA light output ranges (lumens)	EISA minimum efficacy ranges (lumens/watt)
1/1/2012	100 W	1690 lm	17 lm/W	72 W	1490-2600 lm	21-36 lm/W
1/1/2013	75 W	1170 lm	16 lm/W	53 W	1050-1489 lm	20-28 lm/W
1/1/2014	60 W	840 lm	14 lm/W	43 W	750-1049 lm	17-24 lm/W
1/1/2014	40 W	490 lm	12 lm/W	29 W	310-749 lm	11-26 lm/W

Table A-4. Percent of Northwest Stores Stocking Lamps by Lamp Technology, 2015 and 2016

Lamp Technology	2015	2016
GP CFLs	95%	63%
Specialty CFLs	91%	73%
LED	93%	97%
Incandescent	97%	96%
Halogen	95%	96%
Number of Stores	76	68

Figure A-3. Percent of Northwest Stores Stocking Lamps by Lamp Technology, 2015 and 2016

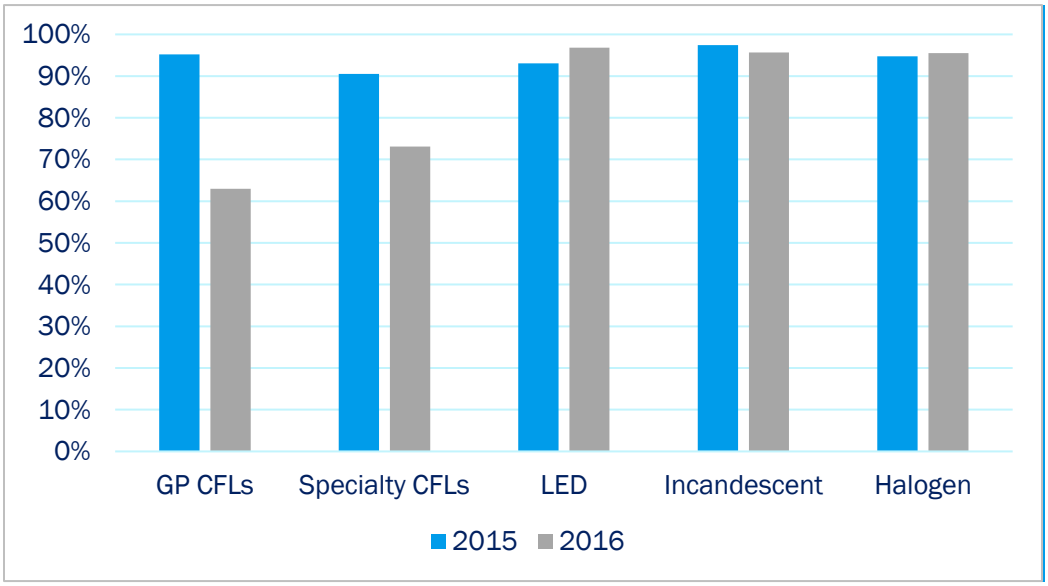


Table A-5. Percent of Northwest Stores Stocking Lamps by Lamp Technology and Store Category, 2015 and 2016

	2015		2016	
Lamp Technology	Big Box	Non-Big Box	Big Box	Non-Big Box
GP CFLs	94%	95%	63%	63%
Specialty CFLs	89%	91%	85%	69%
LED	92%	93%	93%	98%
Incandescent	95%	98%	95%	96%
Halogen	89%	97%	88%	98%
Number of Stores	32	44	28	40

Table A-6. Percent of Northwest Stores Stocking Lamps by Lamp Technology and Geography, 2015 and 2016

	2015		2016	
Lamp Technology	Urban	Rural	Urban	Rural
GP CFLs	94%	100%	65%	52%
Specialty CFLs	89%	100%	70%	93%
LED	94%	89%	96%	100%
Incandescent	97%	100%	95%	100%
Halogen	94%	100%	95%	100%
Number of Stores	66	10	58	10

Table A-7. Percent of Lamps Stocked by Lamp Technology, 2015 and 2016

Lamp Technology	2015	2016
GP CFLs	16%	4%
Specialty CFLs	4%	2%
LED	21%	36%
Incandescent	35%	35%
Halogen	24%	23%
Number of Lamps	233,564	235,449

Figure A-4. Percent of Lamps Stocked by Lamp Technology, 2015 and 2016

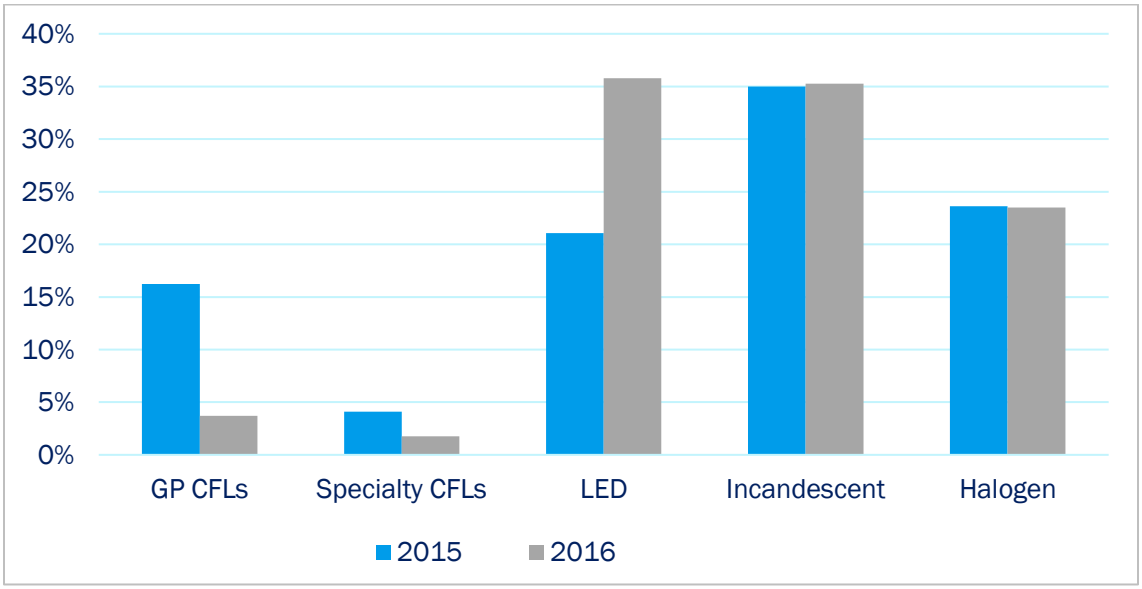


Table A-8. Percent of Lamps Stocked by Lamp Technology and Store Category, 2015 and 2016

	2015		2016	
Lamp Technology	Big Box	Non-Big Box	Big Box	Non-Big Box
GP CFLs	18%	13%	3%	5%
Specialty CFLs	4%	4%	2%	2%
LED	25%	15%	42%	28%
Incandescent	30%	43%	31%	41%
Halogen	22%	26%	22%	25%
Number of Lamps	177,290	56,274	176,636	58,813

Table A-9. Percent of Lamps Stocked by Lamp Technology and Geography, 2015 and 2016

	2015		2016	
Lamp Technology	Urban	Rural	Urban	Rural
GP CFLs	14%	27%	4%	1%
Specialty CFLs	5%	2%	2%	1%
LED	21%	20%	34%	44%
Incandescent	36%	28%	36%	30%
Halogen	24%	22%	24%	23%
Number of Lamps	197,885	35,679	198,814	36,635

Table A-10. Percent of MSB LED A-Lamps Stocked by Energy Star Qualification, 2015 and 2016

Energy Star Qualification	2015	2016
Energy Star MSB A-Lamp	40%	34%
Non-Energy Star MSB A-Lamp	60%	66%
Number of Lamps	30,599	53,544

Table A-11. Percent of MSB LED A-Lamps Stocked by Energy Star Qualification by Store Category, 2015 and 2016

	2015		2016	
Energy Star Qualification	Big Box	Non-Big Box	Big Box	Non-Big Box
Energy Star MSB A-Lamp	44%	29%	39%	25%
Non-Energy Star MSB A-Lamp	56%	71%	61%	75%
Number of Lamps	26,883	3,716	43,375	10,169

Figure A-5. Percent of MSB LED A-Lamps Stocked by Energy Star Qualification by Store Category, 2015 and 2016

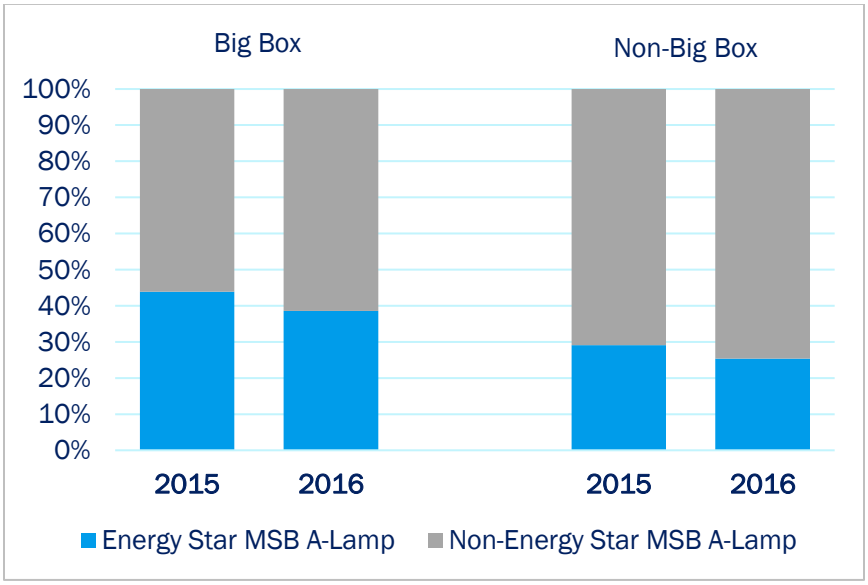


Table A-12. Percent of MSB LED A-Lamps Stocked by Energy Star Qualification by Geography, 2015 and 2016

	2015		2016	
Energy Star Qualification	Urban	Rural	Urban	Rural
Energy Star MSB A-Lamp	38%	50%	35%	31%
Non-Energy Star MSB A-Lamp	62%	50%	65%	69%
Number of Lamps	25,945	4,654	43,644	9,900

Figure A-6. Percent of MSB LED A-Lamps Stocked by Energy Star Qualification by Geography, 2015 and 2016

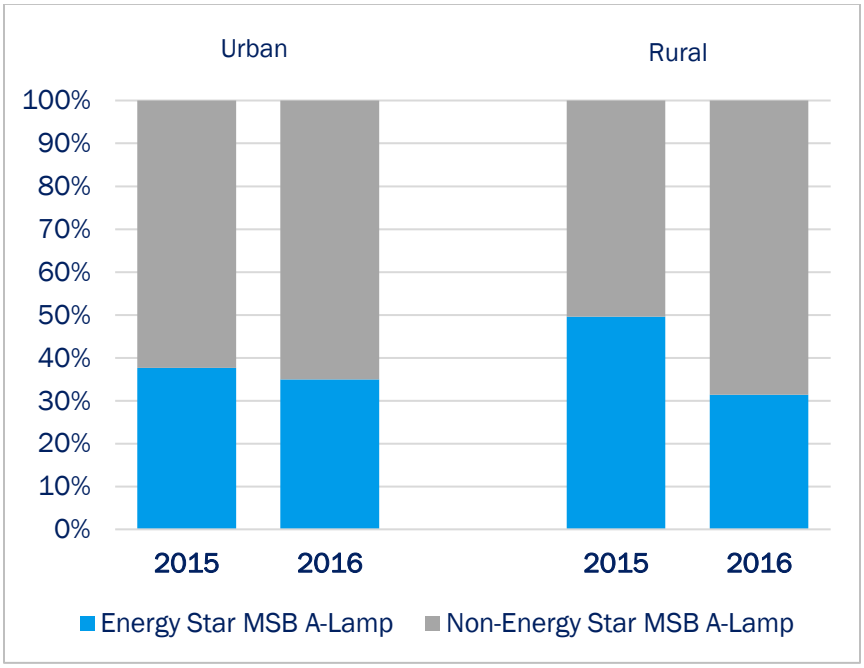


Table A-13. Percent of MSB LED Reflector Lamps Stocked by Energy Star Qualification, 2015 and 2016

Energy Star Qualification	2015	2016
Energy Star MSB Reflector	69%	67%
Non-Energy Star MSB Reflector	31%	33%
Number of Lamps	13,365	24,142

Table A-14. Percent of MSB LED Reflector Stocked by Energy Star Qualification by Store Category, 2015 and 2016

	2015		2016	
Energy Star Qualification	Big Box	Non-Big Box	Big Box	Non-Big Box
Energy Star MSB Reflector	69%	70%	68%	65%
Non-Energy Star MSB Reflector	31%	30%	32%	35%
Number of Lamps	11,193	2,172	20,301	3,841

Table A-15. Percent of MSB LED Reflector Lamps Stocked by Energy Star Qualification by Geography, 2015 and 2016

	2015		2016	
Energy Star Qualification	Urban	Rural	Urban	Rural
Energy Star MSB Reflector	70%	66%	67%	67%

Non-Energy Star MSB Reflector	30%	34%	33%	33%
Number of Lamps	12,135	1,230	21,270	2,872

Table A-16. Percent of General Purpose CFLs Stocked by Energy Star Qualification, 2015 and 2016

Lamp Technology	2015	2016
Energy Star General Purpose	91%	90%
Non-Energy Star General Purpose	9%	10%
Number of Lamps	35,978	8,789

Table A-17. Percent of General Purpose CFLs Stocked by Energy Star Qualification by Store Category, 2015 and 2016

	2015		2016	
Energy Star Qualification	Big Box	Non-Big Box	Big Box	Non-Big Box
Energy Star General Purpose	92%	90%	93%	88%
Non-Energy Star General Purpose	8%	10%	7%	12%
Number of Lamps	28,711	7,267	5,881	2,908

Table A-18. Percent of General Purpose CFLs Stocked by Energy Star Qualification by Geography, 2015 and 2016

	2015		2016	
Energy Star Qualification	Urban	Rural	Urban	Rural
Energy Star General Purpose	89%	96%	91%	72%
Non-Energy Star General Purpose	11%	4%	9%	28%
Number of Lamps	28,290	7,688	8,174	615

Table A-19. Percent of MSB Reflector CFLs Stocked by Energy Star Qualification, 2015 and 2016

Energy Star Qualification	2015	2016
Energy Star MSB Reflector	71%	50%
Non-Energy Star MSB Reflector	29%	50%
Number of Lamps	3,020	857

Table A-20. Percent of MSB Reflector CFLs Stocked by Energy Star Qualification by Store Category, 2015 and 2016

	2015		2016	
Energy Star Qualification	Big Box	Non-Big Box	Big Box	Non-Big Box
Energy Star MSB Reflector	69%	74%	78%	19%
Non-Energy Star MSB Reflector	31%	26%	22%	81%
Number of Lamps	2,420	600	648	209

Table A-21. Percent of MSB Reflector CFLs Stocked by Energy Star Qualification by Geography, 2015 and 2016

	2015		2016	
Energy Star Qualification	Urban	Rural	Urban	Rural
Energy Star MSB Reflector	70%	84%	51%	27%
Non-Energy Star MSB Reflector	30%	16%	49%	73%
Number of Lamps	2,706	314	752	105

Table A-22. Percent of MSB Halogen/Incandescent A-Lamps (310–2600 lumens) That Meet EISA Standards, 2015 and 2016

Lamp Technology	2015	2016
EISA Compliant Halogen A-lamp	73%	97%
EISA Non-Compliant Halogen/Incandescent A-lamp	27%	3%
Number of Lamps	36,431	35,002

Table A-23. Percent of MSB Halogen/Incandescent A-Lamps (310–2600 lumens) That Meet EISA Standards by Store Category, 2015 and 2016

2015 and 2016	2015		2016	
Lamp Technology	Big Box	Non-Big Box	Big Box	Non-Big Box
EISA Compliant Halogen A-lamp	58%	93%	92%	100%
EISA Non-Compliant Halogen/Incandescent A-lamp	42%	7%	8%	0%
Number of Lamps	25,664	10,767	24,816	10,186

Table A-24. Percent of MSB Halogen/Incandescent A-Lamps (310–2600 lumens) That Meet EISA Standards by Geography, 2015 and 2016

2015 and 2016	2015		2016	
Lamp Technology	Urban	Rural	Urban	Rural
EISA Compliant Halogen A-lamp	75%	61%	97%	97%
EISA Non-Compliant Halogen/Incandescent A-lamp	25%	39%	3%	3%
Number of Lamps	30,540	5,891	28,972	6,030

Table A-25. Average Number of Lamp Models by Lamp Technology, 2015 and 2016

Lamp Technology	2015	2016
GP CFLs	14	5
Specialty CFLs	12	7
LED	35	50
Incandescent	58	61
Halogen	26	26
Number of Models	2,902	3,091

Figure A-7. Average Number of Lamp Models by Lamp Technology, 2015 and 2016

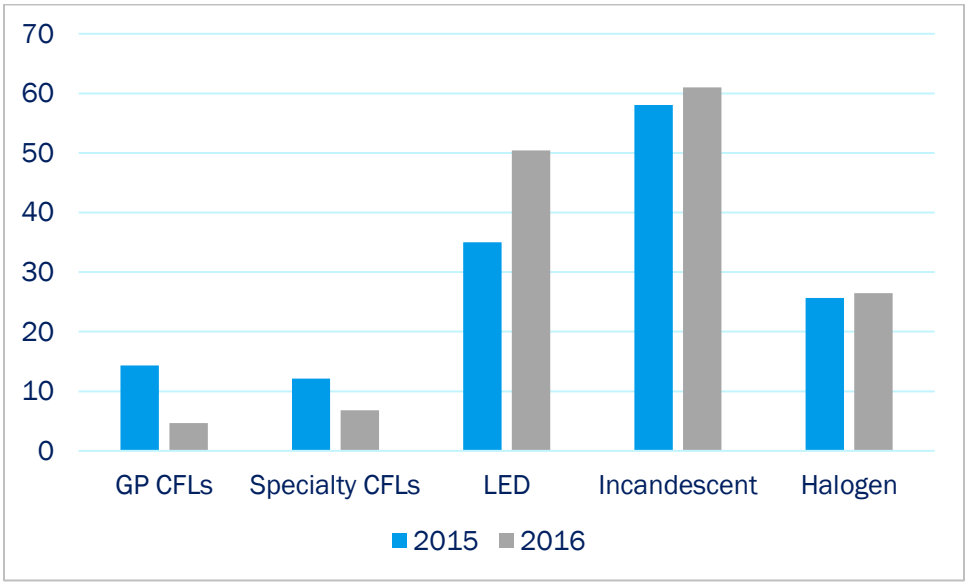


Table A-26. Average Number of Lamp Models by Lamp Technology and Store Category, 2015 and 2016

	2015		2016	
Lamp Technology	Big Box	Non-Big Box	Big Box	Non-Big Box
GP CFLs	20	13	4	5
Specialty CFLs	20	9	9	6
LED	68	24	81	40
Incandescent	77	51	75	56
Halogen	42	20	36	23
Number of Models	1,877	1,554	1,886	1,819

Figure A-8. Average Number of Lamp Models by Lamp Technology and Store Category, 2015 and 2016

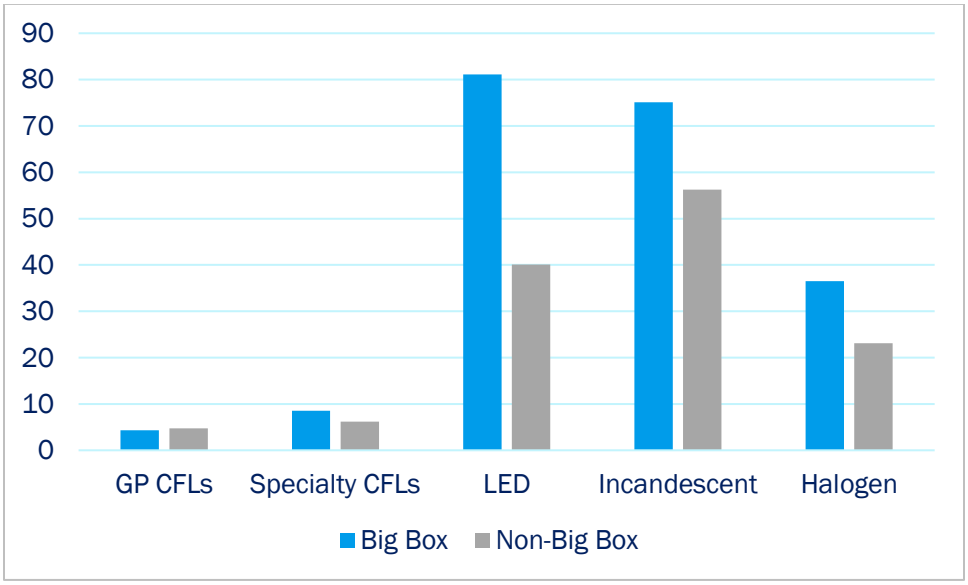


Table A-27. Average Number of Lamp Models by Lamp Technology and Geography, 2015 and 2016

	2015		2016	
Lamp Technology	Urban	Rural	Urban	Rural
GP CFLs	14	15	5	3
Specialty CFLs	12	12	7	8
LED	32	58	44	88
Incandescent	56	70	59	71
Halogen	25	30	26	29
Number of Models	2,831	1,197	2,893	1,299

Table A-28. Average Shelf Price per General Purpose Lamp by Technology, 2015 and 2016

Lamp Technology	2015	2016
MSB CFL Spiral	$2.91	$3.31
MSB CFL A-lamp	$6.85	$5.18
MSB LED A-lamp	$6.81	$4.61
EISA Compliant MSB Halogen A-Lamp	$1.71	$2.10
EISA Non-Compliant MSB Halogen/Incandescent A-Lamp	$1.70	$1.98
Number of Lamps	108,358	98,169

Table A-29. Average Shelf Price per General Purpose Lamp by Technology and Store Category, 2015 and 2016

	2015		2016	
Lamp Technology	**Big Box**	**Non-Big Box**	**Big Box**	**Non-Big Box**
MSB CFL Spiral	$2.26	$4.24	$2.59	$3.90
MSB CFL A-lamp	$5.80	$8.60	$3.85	$6.00
MSB LED A-lamp	$5.45	$10.81	$3.95	$5.94
EISA Compliant MSB Halogen A-Lamp	$1.62	$1.92	$1.64	$5.20
EISA Non-Compliant MSB Halogen/Incandescent A-Lamp	$1.61	$1.77	$2.07	$1.92
Number of Lamps	84,347	24,011	73,841	24,328

Table A-30. Average Shelf Price per General Purpose Lamp by Technology and Geography, 2015 and 2016

	2015		2016	
Lamp Technology	Urban	Rural	Urban	Rural
MSB CFL Spiral	$3.29	$1.99	$3.25	$4.13
MSB CFL A-lamp	$6.83	$7.27	$5.17	$5.45
MSB LED A-lamp	$6.57	$7.72	$4.65	$4.49
EISA Compliant MSB Halogen A-Lamp	$1.78	$1.45	$2.10	$2.06
EISA Non-Compliant MSB Halogen/Incandescent A-Lamp	$1.74	$1.46	$1.99	$1.91
Number of Lamps	89,480	18,878	81,342	16,827

Table A-31. Average Shelf Price per Reflector Lamp by Technology, 2015 and 2016

Lamp Technology	2015	2016
CFL Reflector	$8.14	$8.71
LED Reflector	$13.40	$9.17
Halogen Reflector	$8.06	$8.77
Incand Reflector	$4.59	$4.48
Number of Lamps	35,699	40,883

Table A-32. Average Shelf Price per MSB Reflector Lamp by Technology and Store Category, 2015 and 2016

	2015		2016	
Lamp Technology	Big Box	Non-Big Box	Big Box	Non-Big Box
CFL Reflector	$6.78	$10.30	$5.27	$12.54
LED Reflector	$11.00	$18.10	$7.42	$12.46
Halogen Reflector	$7.34	$10.67	$8.03	$10.31
Incand Reflector	$4.23	$5.46	$4.28	$4.82
Number of Lamps	27,920	7,779	31,695	9,188

Number of Lamps

2015 and 2016	2015		2016	
Lamp Technology	Big Box	Non-Big Box	Big Box	Non-Big Box
CFL Reflector	2,412	599	649	208
LED Reflector	11,193	2,169	20,469	3,673
Halogen Reflector	6,325	1,745	4,149	1,854
Incand Reflector	7,990	3,266	6,428	3,453
Total	27,920	7,779	31,695	9,188

Table A-33. Average Shelf Price per Reflector Lamp by Technology and Geography, 2015 and 2016

	2015		2016	
Lamp Technology	Urban	Rural	Urban	Rural
CFL Reflector	$8.17	$7.91	$8.85	$5.92
LED Reflector	$13.06	$15.83	$9.10	$9.56
Halogen Reflector	$8.21	$7.08	$8.73	$9.03
Incand Reflector	$4.59	$4.58	$4.47	$4.60
Number of Lamps	31,510	4,189	36,021	4,862

Table A-34. Average Shelf Price per MSB LED A-Lamp by Energy Star Qualification, 2015 and 2016

Energy Star Qualification	2015	2016
Energy Star MSB A-Lamp	$6.02	$4.25
Non-Energy Star MSB A-Lamp	$7.34	$4.80
Number of Lamps	30,599	54,257

Table A-35. Average Shelf Price per MSB LED A-lamp by Energy Star Qualification and Store Category, 2015 and 2016

	2015		2016	
Energy Star Qualification	Big Box	Non-Big Box	Big Box	Non-Big Box
Energy Star MSB A-Lamp	$5.14	$9.96	$3.39	$6.84
Non-Energy Star MSB A-Lamp	$5.70	$11.15	$4.30	$5.63
Number of Lamps	26,883	3,716	44,825	9,432

Table A-36. Average Shelf Price per MSB LED A-lamp by Energy Star Qualification and Geography, 2015 and 2016

	2015		2016	
Energy Star Qualification	Urban	Rural	Urban	Rural
Energy Star MSB A-Lamp	$5.72	$6.89	$4.27	$4.18
Non-Energy Star MSB A-Lamp	$7.08	$8.54	$4.85	$4.63
Number of Lamps	25,945	4,654	44,093	10,164

Table A-37. Average Shelf Price per MSB LED Reflector Lamp by Energy Star Qualification, 2015 and 2016

Energy Star Qualification	2015	2016
Energy Star MSB Reflector	$11.91	$9.12
Non-Energy Star MSB Reflector	$16.74	$9.27
Number of Lamps	13,365	24,142

Table A-38. Average Shelf Price per MSB LED Reflector Lamp by Energy Star Qualification and Store Category, 2015 and 2016

	2015		2016	
Energy Star Qualification	Big Box	Non-Big Box	Big Box	Non-Big Box
Energy Star MSB Reflector	$9.17	$17.24	$6.74	$13.80
Non-Energy Star MSB Reflector	$15.08	$20.07	$8.84	$10.02
Number of Lamps	11,193	2,172	20,469	3,673

Table A-39. Average Shelf Price per MSB LED Reflector by Energy Star Qualification and Geography, 2015 and 2016

	2015		2016	
Energy Star Qualification	Urban	Rural	Urban	Rural
Energy Star MSB Reflector	$11.53	$14.71	$8.96	$10.13
Non-Energy Star MSB Reflector	$16.54	$18.02	$9.40	$8.43
Number of Lamps	12,135	1,230	21,270	2,872

Table A-40. Average Shelf Price per General Purpose CFL by Energy Star Qualification, 2015 and 2016

Energy Star Qualification	**2015**	**2016**
Energy Star General Purpose	$2.36	$2.58
Non-Energy Star General Purpose	$0.48	$0.66
Number of Lamps	35,978	8,789

Table A-41. Average Shelf Price per General Purpose CFL by Energy Star Qualification and Store Category, 2015 and 2016

	2015		2016	
Energy Star Qualification	Big Box	Non-Big Box	Big Box	Non-Big Box
Energy Star General Purpose	$1.84	$3.46	$2.15	$2.94
Non-Energy Star General Purpose	$0.38	$0.68	$0.46	$0.83
Number of Lamps	28,711	7,267	5,881	2,908

Table A-42. Average Shelf Price per General Purpose CFL by Energy Star Qualification and Geography, 2015 and 2016

	2015		2016	
Energy Star Qualification	Urban	Rural	Urban	Rural
Energy Star General Purpose	$2.57	$1.86	$2.58	$2.59
Non-Energy Star General Purpose	$0.63	$0.11	$0.61	$1.39
Number of Lamps	28,290	7,688	8,174	615

Table A-43. Average Shelf Price per MSB Reflector CFL by Energy Star Qualification, 2015 and 2016

Energy Star Qualification	2015	2016
Energy Star Reflector	$7.46	$6.50
Non-Energy Star Reflector	$9.83	$10.91
Number of Lamps	3,020	857

Table A-44. Average Shelf Price per MSB Reflector CFL by Energy Star Qualification and Store Category, 2015 and 2016

	2015		2016	
Energy Star Qualification	Big Box	Non-Big Box	Big Box	Non-Big Box
Energy Star Reflector	$6.24	$9.26	$4.94	$13.57
Non-Energy Star Reflector	$8.00	$13.27	$6.44	$12.30
Number of Lamps	2,420	600	649	208

Table A-45. Average Shelf Price per MSB Reflector CFL by Energy Star Qualification and Geography, 2015 and 2016

	2015		2016	
Energy Star Qualification	Urban	Rural	Urban	Rural
Energy Star Reflector	$7.46	$7.46	$6.50	$6.33
Non-Energy Star Reflector	$9.81	$10.15	$11.30	$5.77
Number of Lamps	2,706	314	752	105

Table A-46. Percent of Northwest Stores Stocking Linear Fluorescent Lamps by Lamp Type and Store Category, 2015 and 2016

	2015		2016	
Lamp Style	Big Box	Non-Big Box	Big Box	Non-Big Box
T12	87%	35%	71%	39%
T8	60%	26%	60%	27%
Number of Stores	32	44	28	40

Table A-47. Percent of Northwest Stores Stocking Linear Fluorescent Lamps by Lamp Type and Geography, 2015 and 2016

	2015		2016	
Lamp Style	Urban	Rural	Urban	Rural
T12	43%	78%	44%	67%
T8	27%	83%	28%	83%
Number of Stores	66	10	58	10

Table A-48. Percent of Linear Fluorescent Lamps Stocked by Lamp Type and Store Category, 2015 and 2016

	2015		2016	
Lamp Style	Big Box	Non-Big Box	Big Box	Non-Big Box
T12	65%	69%	58%	75%
T8	35%	31%	42%	25%
Number of Lamps	5,656	1,362	5,465	1,240

Table A-49. Percent of Linear Fluorescent Lamps Stocked by Lamp Type and Geography, 2015 and 2016

	2015		2016	
Lamp Style	Urban	Rural	Urban	Rural
T12	68%	58%	65%	60%
T8	32%	42%	35%	40%
Number of Lamps	5,775	1,243	5,368	1,337

Table A-50. Average Number of Fluorescent Models by Lamp Type and Store Category, 2015 and 2016

2015 and 2016	2015		2016	
Lamp Style	Big Box	Non-Big Box	Big Box	Non-Big Box
T12	3.63	1.10	3.29	1.53
T8	1.77	0.60	1.82	0.72
Number of Models	58	27	57	25

Table A-51. Average Number of Fluorescent Models by Lamp Type and Geography, 2015 and 2016

	2015		2016	
Lamp Style	Urban	Rural	Urban	Rural
T12	1.60	2.63	1.82	2.96
T8	0.73	1.99	0.81	2.12
Number of Models	62	27	61	30

Table A-52. Average Shelf Price per Fluorescent Lamp by Technology, 2015 and 2016

Lamp Style	2015	2016
T12	$4.48	$4.94
T8	$3.82	$4.12
Number of Lamps	9,033	8,721

Table A-53. Average Shelf Price per Fluorescent Lamp by Technology and Store Category, 2015 and 2016

	2015		2016	
Lamp Style	Big Box	Non-Big Box	Big Box	Non-Big Box
T12	$4.34	$4.78	$4.71	$5.26
T8	$3.48	$4.65	$3.72	$5.25
Number of Lamps	5,656	1,362	5,465	1,240

Table A-54. Average Shelf Price per Fluorescent Lamp by Technology and Geography, 2015 and 2016

	2015		2016	
Lamp Style	Urban	Rural	Urban	Rural
T12	$4.46	$4.63	$5.05	$4.35
T8	$3.97	$3.30	$4.09	$4.22
Number of Lamps	5,775	1,243	5,368	1,337

Appendix B: Supplier Interview Results

This appendix contains summarized themes from the six in-depth interviews with manufacturers, conducted in January 2017.

Shelf stocking strategies and approaches

Manufacturers use multiple data sources to track and respond to stocking needs. Data sources include Nielsen, Homescan, and point-of-sale (POS) data. They look at this data across retailers to understand broader market trends, not just store-by-store trends. They work closely with each retail partner to adjust orders if sales change, e.g., if a promotion leads to higher sales volumes. One manufacturer described their stocking strategy as "performance-driven" and "tactical," meaning that they respond to changing sales and market conditions. Another manufacturer mentioned that they factor in how quickly they can produce specific products, offering higher volumes of quick-to-produce products to retailers.

Shopper decision-making is an important consideration in stocking strategies. The manufacturers and their retail partners consider the decision tree that shoppers go through when they select a lighting product. For example, what comes first: looking for an A-shaped lamp, or looking for energy efficiency? The answer is typically first product type (e.g., A-shaped lamp), then price, and then other factors like color temperature, quality, and energy efficiency. They work directly with the retail buyer to design how the planograms look, and determine which store gets which planogram – the retailer has final say on the planograms.

Utility programs can affect stocking strategies. One manufacturer noted that stores are typically "classed" into categories depending on their location, size, and sales patterns. This manufacturer said that all stores participating in utility programs are treated like a "Class A" store (i.e., the biggest/highest volume store class) in terms of stocking. This means they stock higher volumes of high-efficiency products.

Manufacturers design a "program" of products to offer to each of their retail partners. The planning horizon for these offerings typically includes short term (one year), medium term (three years), and long term (five years). A primary driver of what products manufacturers offer to retailers is communication from retail partners about what they want to see on their store shelves. Some retailers – like big box hardware stores – require "one of everything," while other retailers want only the high-volume products like general-purpose lamps.

The effects of EISA 2020

Manufacturers cited significant uncertainty about the future of EISA 2020. One interviewee said, "We are completely unsure [about the future EISA 2020] – everything is up in the air right now with the new administration." This manufacturer also reported their retail partners are uncertain about the standard's implementation: a retail buyer has stated that there is "plenty of in-fighting" about EISA 2020 behind the scenes among regulators and industry actors, and there is a good chance it will be rolled back.

Manufacturers fall into two camps on the potential effect of deregulation or a roll-back in regulations. (1) Some manufacturers think that the change to LED had already occurred and is here to stay, and they say that major manufacturers have already invested in retooling their factories to produce LEDs and that there would be no business sense in reversing this significant investment. (2) Others

(particularly those who have not moved as decisively away from inefficient technologies) think the EISA 2020 standard – if implemented – will push manufacturers to stop making halogens and ramp up LED production.

The effects of the 2017 ENERGY STAR specification

Manufacturers are generally supportive of the ENERGY STAR 2.0 specification, but some were opposed to the relaxation of required lamp life for omnidirectional lamps. Those that opposed these changes (which reduced the required lamp life from 25,000 to 15,000 hours) said the laxer specification introduces risk for customer dissatisfaction. Other manufacturers supported the relaxation of the specification, saying the new spec made LED products more attractive to consumers by keeping costs down, while maintaining high performance/efficacy.

Sales and pricing trends for residential lighting products

Manufacturers agree that LED prices will continue to drop, in the general purpose category and in other product types, and both for ENERGY STAR qualified lamps and non-ENERGY STAR lamps. Economies of scale, and the maturation of the LED manufacturing infrastructure will contribute to continuing decreases in price. Manufacturers emphasized that the cost of the product still is the number one decision point for the residential consumer. One manufacturer noted that although the EISA standards have targeted only general-purpose lamps, the same or similar technology is used in the full array of LED lighting, so if the cost for components of the A19 lamp come down, that benefits other product types too. For example, the cost for LED BR30 lamps is going to come down too.

Non-ENERGY STAR LEDs (also called "value LEDs") are meeting consumer price preferences and retailers are eager to capture sockets. With LED prices falling, some retailers are decreasing their emphasis on ENERGY STAR LEDs. As one manufacturer described it, the retailers are "racing to fill sockets," since the long life of LED lamps means slower product turnover. This results in a demand for the lowest cost LEDs available, which are non-ENERGY STAR. Some manufacturers noted that ENERGY STAR is becoming less meaningful to consumers and therefore retailers, now that the label connotes many non-energy features (e.g., omni-directionality and color rendering). One manufacturer put it bluntly: "big retailers don't give a darn about ENERGY STAR anymore."

The future of the CFL lamp

2016 was a watershed year in the demise of the CFL. Major market actors (both manufacturers and retailers) took steps toward exiting the CFL market in 2016. GE announced in February 2016 they would stop producing CFLs, and several retailers either reduced the numbers of CFLs on their shelves or ceased stocking them entirely. Others continue to produce and sell CFLs, but all interviewees agreed that CFLs have been supplanted by LEDs as the dominant technology for energy-efficient lighting products going forward. One manufacturer interviewee stated, "ENERGY STAR 2.0 is going to kill the CFL," but noted that their company would continue to manufacture and sell CFLs as long as it was legal to do so and there was demand for the product. Another interviewee said that even for specialty lamps, he does not anticipate CFLs being around for much longer, since LEDs will be available at comparable price points.

Appendix C: Methodology

Shelf Survey

DNV GL has conducted lighting retail store shelf surveys for NEEA on a roughly an annual basis since 2004. 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 2016-2017 study, DNV GL developed a sampling approach similar to the approaches used in the prior five studies except for a reduction in sample points from 76 to 68. As in prior periods, the 2016-2017 approach allocates these sample points among two store categories and five retail store types including the big box category (which includes membership club, do-it-yourself, and mass merchandise stores) and the non-big box category (which includes drug or grocery and small hardware stores). The sampling approach described below was designed to allow analysts to continue the year-to-year, category-to-category (big box and non-big box), and urban versus rural comparisons of lamps observed on store shelves using an efficient sample.

Shelf Survey Sampling

In 2015-2016, the shelf survey sample included 76 stores—10 in the rural sector and 66 in the urban sector. For the 2016-2017 survey, NEEA requested a reduction in the sample size to reduce costs. Cost considerations are an important part of the sample design process in any study. As with other factors affecting field studies, sample size is a determinant in the statistical precision of the results as well as their reliability. DNV GL's sampling expert ran multiple simulations and removed the 8 sites from the 2015-2016 shelf survey sample that had the least impact on the estimated mean of the proportion of lamps stocked in stores while also minimizing the decline in statistical precision and reliability.

Table C-55 below shows the population of Northwest retail stores that sell replacement lamps by store type and urban/rural designation.[8] The vast majority of stores are in urban locations (86%), and only 14% are in rural locations. Non-big box stores comprise three-quarters of all stores and big box stores comprise the remaining quarter of stores. Membership club stores comprise the smallest percentage of stores (1%) and drug and grocery stores comprise the largest percentage (41%).

[8] DNV GL used the same sample frame for the 2016-17 study as used in previous years, which is a list of retail stores in the Northwest compiled for NEEA by PECI, Inc. in the mid-2000s.

Table C-55. Northwest Lighting Retail Store Population by Geography and Store Type, 2016-2017

Store Type	Number of Stores			Percentage of Stores		
	Urban	Rural	Overall	Urban	Rural	Overall
Membership Club	33	0	33	100%	0%	1%
Do-It-Yourself	148	7	155	95%	5%	6%
Drug and Grocery	974	55	1,029	95%	5%	41%
Mass Merchandise	391	61	452	87%	13%	18%
Small Hardware	633	236	869	73%	27%	34%
Overall	2,179	359	2,538	86%	14%	100%

The 2015-2016 and 2016-2017 shelf survey samples are distributed nearly proportionally within the urban and rural sectors (see Table C-56 below). As shown, rural stores comprise 13% of the 2015-2016 shelf survey sample and 15% of the 2016-2017 sample (both of which are roughly proportional the proportion of rural stores in the population of rural stores [14%]). With respect to store type, DNV GL increased the number of sample points for some store types to achieve adequate representation for these stores; the proportion of stores in the sample is higher than the proportion of stores in the population for membership club, do-it-yourself (DIY), and mass merchandise stores, but lower for drug and grocery and small hardware stores.

While DNV GL stratified the 2016-2017 shelf survey sample by geography and store category, as in prior study years, the sample does not have an adequate number of sample points to provide reliable results at the store type level. In other words, the shelf survey data collected for this study should not be used to make generalizations about specific store types, such as membership club stores or small hardware stores. The shelf survey data should also not be used to make generalizations at the state level. However, data from the 2016-2017 shelf survey sample can be analyzed by store category and geography (as in prior years) and results can be compared to results from earlier studies.

To determine how best to reduce the number of sample points in the 2016-2017 shelf surveys, DNV GL's sampling expert considered the overall number of sample points for a given cell (e.g., urban DIY stores) as well as variation in the proportion of lamp technologies stocked for a given store type based on the 2015-2016 shelf survey data (e.g., the share of lamps comprised by LED lamps, CFLs, incandescent lamps, and halogen lamps). After conducting this analysis, DNV GL's sampling expert reduced the number of membership club stores and DIY stores by one each and the number of drug and grocery stores, mass merchandise stores, and small hardware stores by two each. While the total number of urban sample points decreased by eight (from 66 to 58), the total number of rural stores in the sample remained the same at 10, since reducing the number of rural sample points any further would make data from these stores less representative.

Table C-56. Northwest Lighting Retail Store Samples by Geography and Store Type, 2015-2016 and 2016-2017

Store Type	2015-2016 Shelf Surveys					
	Number of Stores			Percentage of Stores		
	Urban	Rural	Overall	Urban	Rural	Overall
Membership Club	4	0	4	100%	0%	5%
Do-It-Yourself	8	2	10	80%	20%	13%
Drug and Grocery	19	3	22	86%	14%	29%
Mass Merchandise	16	2	18	89%	11%	24%
Small Hardware	19	3	22	86%	14%	29%
Overall	66	10	76	87%	13%	100%

Store Type	2016-2017 Shelf Surveys					
	Number of Stores			Percentage of Stores		
	Urban	Rural	Overall	Urban	Rural	Overall
Membership Club	3	0	3	100%	0%	4%
Do-It-Yourself	7	2	9	78%	22%	13%
Drug and Grocery	17	3	20	85%	15%	29%
Mass Merchandise	14	2	16	88%	13%	24%
Small Hardware	17	3	20	85%	15%	29%
Overall	58	10	68	85%	15%	100%

Data Sources, Chain Logic Method, and Data Analysis

The Chain Logic Method

The Chain Logic Method is an analytical framework for logically combining disparate data sources to estimate a given market's sales efficiency mix. Ultimately, it provides a means of weighting various data points into a market average—in this case, the market average efficiency mix in each year of the analysis. The Cadeo team developed this methodology for the Bonneville Power Administration's Residential Lighting Market Characterization, and applied the same methodology for analysis of the 2016-2017 shelf stocking and sales data.

The research team followed a six-step analytical process to estimate the efficiency mix:

- Step 1: Develop the efficiency mix for each retailer for which the team has data
- Step 2: Segment the market into distinct channels; assign a market share to each market channel
- Step 3: Assign each retailer to a market channel (i.e., market segments)
- Step 4: Determine the relative market share of each retailer within each channel
- Step 5: Compute each retailer's market share of the overall market
- Step 6: Compute the overall market efficiency mix

Step 1: Develop the Efficiency Mix for Each Retailer for Which the Team Has Data

For the purposes of this analysis, an efficiency mix reflects the market share of lamps sold in a given calendar year among four technologies: incandescent, halogen, compact fluorescent, and LED.

Data Sources

The research team used two primary data sources to characterize the efficiency mixes of individual retailers: NEEA shelf-stocking data and Nielsen sales data. The following describes each of these data sources as well as others that the research team reviewed to corroborate the primary data analysis.

NEEA shelf-stocking data. Since 2005, NEEA has undertaken the Northwest Residential Lighting Long-term Market Tracking (LTMT) study. NEEA uses the study, repeated on an annual basis, to track regional lighting market metrics and to estimate the market transformation savings generated by its previous CFL program. The 2016-2017 shelf stocking study, completed by DNV GL, added one more year of data to the historical data set.

The research team is aware that stocking practices do not perfectly reflect consumer purchasing behavior, as merchandising strategies and other market factors greatly affect the product volume and placement on shelves. However, the team determined during interviews with major do-it-yourself (DIY) and mass merchandise retailers that these retailers develop their shelf planograms with the goal of achieving a 1:1 ratio between the number of products on the shelves and actual sales. These retailers explained that the goal of aligning shelf space and sales is mainly about restocking efficiencies: ideally these retailers want to restock everything at once each night. They shared that stocking the shelves to mirror sales levels enabled this process and avoided inefficient, ad hoc restocking throughout the day.

Nielsen sales data. To complement the shelf-stocking data collected through the LTMT study, NEEA purchased retailer sales data gathered by Nielsen, a consumer insights company. Unlike the shelf-stocking data, the Nielsen data reflects the actual sales that occurred annually from 2011 through 2016 for a subset of contributing retailers. The Nielsen data is extremely detailed and provides insight into sales by technology, wattage, lumen bin, and pack size. However, the Nielsen data is not fully representative of the entire residential retail lighting market, as several high-volume lighting retailers do not provide sales data to Nielsen. The research team estimates that the retailers providing data to Nielsen represent approximately 24% of the total residential retail market.

Online retailer sales data. As part of its ongoing non-residential lighting distributor data collection efforts, BPA solicited 2015 sales data from a prominent online retailer. Based on customer information and shipping addresses, the online retailer estimated that 30% of its total sales (in terms of units) are to residential customers.

The research team also reviewed the following sources which were not directly incorporated into the analysis:

CLEAResult-tracked retailer data. The CLEAResult dataset is a mixture of program and non-program lamp data collected from Northwest retailers. However, the dataset is limited: it only includes CFLs and LEDs (i.e., no inefficient technologies); it does not include any stock keeping unit details; and it is a mixture of actual and estimated sales.

The research team compared the CLEAResult data with the Nielsen sales and NEEA shelf-stocking data above. The research team found that the CLEAResult data was generally similar with regard to technology and lamp type mixes to the Nielsen and NEEA data. This finding validated the team's decision to rely primarily on the Nielsen and NEEA data, which are more detailed and comprehensive (i.e., contain efficient and inefficient technologies) than the CLEAResult data. The research team was able to use the CLEAResult data, which reports sales by retailer, to develop the team's market share estimates for individual retailers.

National Electrical Manufacturers Association (NEMA) shipment data. The research team compared annual results for the Pacific Northwest to national sales data reported by NEMA. The team found the regional data generally mirrored national trends, which validated the reasonableness of its regional data sources. It is important to note that NEMA shipment data is limited to general purpose lights only.

Data Cleaning and Mapping

Each of the raw datasets uses different naming conventions for lamp shapes, bases, and technologies. The research team created standardized naming conventions in order to map the data to its model applications. The lamp types for the analysis and lamp styles from the data assigned to each are shown in Table C-57. To the extent possible, the research team matched the binning choices made by the RTF in the current measure workbook.

Table C-57: Summary of Lamp Styles and Base Types by Application

Application	Lamp Types Included	Base Types Included
General Purpose and Dimmable	A-Lamp, Spiral/Twister, Edison, Tube	Medium, Intermediate
Globe	Globe	Medium, Intermediate
Reflector	Downlight, PAR, Reflector, MR Type	Medium, Intermediate
Decorative and Mini-Base	C-Type, Chandelier, Decorative, Globe, T Type	Candelabra, European (E14), Mini Candelabra
3-Way	A-Type, Reflector, Globe, Tube	Medium, Intermediate
Linear	T12, T8, T5	Pin Base

Step 2: Segment the Market into Distinct Channels; Assign Market Share to Each Market Channel

There are many ways to segment a market. The research team elected to divide the residential brick and mortar retail market into three channels: DIY home stores (e.g., Home Depot, Lowe's), mass merchandise retailers and club stores (e.g., Walmart, Costco), and small hardware (e.g., ACE Hardware, True Value Hardware). The team chose these channels, first and foremost, because it had foundational data on the market share associated with these groupings, which a major retailer presented at the 2014 ENERGY STAR

Partners Meeting. Additionally, these categories left little doubt as to what stores belonged to them, reducing any uncertainty in assigning retailers to the correct channel.

This channel share data did not include the online sales channel. The research team estimated the share of residential lighting sold through the online category based on a November 2015 interview with a prominent online retailer, as well as the team's subsequent analysis of that retailer's 2015 unit sales data by sector. Using this information, the research team estimated that approximately 4% of total residential lamp purchases are made online. The team reduced the market shares of the three brick and mortar channels proportionally, resulting in the channel shares shown in Table C-58.

Table C-58: Market Share by Retailer Channel, Including Online

Retailer Channel	Market Share
DIY	50%
Mass Merchandise and Club Stores	32%
Small Hardware	14%
Online	4%

Source: Research team analysis of sales and interview data

Step 3: Assign Each Retailer to a Market Channel (i.e., Market Segments)

The research team then assigned each retailer in the Nielsen data, NEEA's shelf-stocking data, and the online channel data to one of the market channels (Table C-59). Each retailer could belong to only one channel.

Table C-59: Retailers by Retail Channel

Retailer Channel	Retailer
DIY	The Home Depot
	Lowe's
Mass Merchandise and Club Stores	Walmart
	Target
	K-Mart
	Fred Meyer
	Costco
	Sam's Club
	Other Mass Merchandise and Club Store Retailers
Hardware	Ace Hardware, True Value Hardware
	Other Small Hardware
Online	Bulbs.com
	1000Bulbs.com
	Amazon

Step 4: Determine the Relative Market Share of Each Retailer within Each Channel

Next, the research team estimated the market share of each retailer within its market channel. For the DIY and hardware categories, the team used retailer store counts in the Pacific Northwest (obtained from retailer websites in 2016) as well as the average number of lamps stocked by each retailer (determined through NEEA's shelf studies) to estimate each retailer's relative market share within each retailer channel.

Since NEEA's shelf study did not visit every retailer within a given channel, the research team created an "Other" category to reflect the market share held by these retailers. The team used professional judgment to assign channel market shares to the "Other" hardware and mass merchandisers retailer categories.[9] The research team assumed the efficiency mix of the retailers associated with the "Other" designation was the weighted average of the known retailers in that category. Table C-60 provides an illustrative example of this methodology.

Table C-60: Example of Retailer Share Calculation for Hardware Channel, Including Other

Retailer	Store Count (A)	Average Lamps/Store from Shelf Survey (B)	Total Regional Lamps Stocked (A*B)	Market Share
Hardware #1	30	500	15,000	23.75%
Hardware #2	60	750	45,000	71.25%
Other Hardware	N/A	N/A	N/A	5.0%

Note: Illustrative example, not actual data.

The research team followed this same approach for the DIY channel, the hardware channel, and—with one modification—the mass merchandise and club channel. The modification resulted from the research team having actual sales totals for one retailer in this latter category from CLEAResult and the sales total of all other retailers in the category from Nielsen. The team used these two sales totals to estimate the channel market share of the single retailer. The team then assigned the remaining market share to the other retailers in the channel using store counts and average lamps per store data, as described above for the hardware stores.

The team only had sales data from one retailer in the online channel, so it extrapolated that retailer's efficiency mix to the entire online channel because that retailer estimated its mix was consistent with the others in the channel.

Retailer market share over time. The retailer store counts, shelf data, Nielsen data, and CLEAResult data that informed the calculation of retailer market shares were based upon 2014 data. The research team held the retailer market shares constant across the analysis period due to lack of information about shifts in retailer market share between 2011 and 2016.

Step 5: Compute Each Retailer's Market Share of the Overall Market

The research team then converted each retailer's market share within each channel into a market share of the total market. To do this, the team multiplied each retailer's market share within each channel by the market share of the channel to which the retailer belonged. For example, as shown by the illustrative data in Table C-61, the DIY 1 retailer has a 55% share of the channel to which it belongs, while the channel

[9] The BPA research team worked with regional program staff to determine that insufficient DIY retailers existed—beyond those visited through the LTMT—to merit creating a similar "Other" category for the DIY channel.

itself constitutes 50% of the market. Taken together, that means the DIY 1 retailer has 27.5% of the overall market. The final share represents the weight applied to the efficiency mix calculated in this retailer's sales data.

Table C-61: Example of Combining Channel and Retailer Market Shares (Illustrative Only)

Channel	Market Share of Channel	Vendor	Vendor Market Share of Channel	Vendor Market of Overall Market
DIY	50%	DIY 1	55%	27.5%
		DIY 2	20%	10.0%
		DIY 3	25%	12.5%

Note: Illustrative example, not actual data.

Step 6: Compute Overall Market Efficiency Mix

After estimating each retailer's efficiency mix (Step 1) and overall market share (Step 5), computing the market's overall efficiency mix is done by taking the weighted average of those two results. Table C-62 shows the actual technology mixes the research team calculated using the Chain Logic Method as described.

Table C-62: Estimated Actual Efficiency Sales Mixes by Year, General Purpose Lamps (250-1049 Lumens)

Year	Incandescent	Halogen	CFL	LED
2011	29%	0%	14%	0%
2012	23%	3%	16%	1%
2013	22%	8%	14%	4%
2014	11%	13%	12%	5%
2015	4%	17%	12%	13%
2016	3%	17%	4%	20%

Source: Research team analysis of sales and shelf data

The research team made select adjustments to individual application and lumen bin efficiency mixes from this analysis when there was insufficient data.[10]

[10] In the Decorative and Mini-Base 250-1049 lumen bin, the research team replaced 2011 shares with the 2012 shares, as the CFL share was unrealistically high (20% higher than 2012). The team believes this is because of small lumen bins and less detailed data in 2011 compared to later years. In the Decorative and Mini-Base 1050-1489 lumen bin, the team replaced 2014 and 2015 shares with 2013 shares to remove odd trends in the halogen shares. In the Globe 250-1049 lumen bin, the research team replaced 2011 shares with 2012 shares. The CFL share was unrealistically high, and the 2011 data was less detailed than in later years.

Supplier Interviews

The Cadeo team conducted interviews with six residential lamp manufacturers in January 2017 to supplement stock and sales data collection.

Purpose

The purpose of the supplier interviews was to understand supplier attitudes and expectations for shelf stocking, sales, and manufacturing trends in the Northwest, particularly the expected impact of EISA 2020 and the 2017 ENERGY STAR specification.

Approach

The Cadeo team developed an interview guide (below) that aimed to draw out supplier opinions and thoughts through qualitative in-depth interviewing. The interviewer recorded each interview for the purpose of reviewing and completing interview notes, and each interviewee was guaranteed anonymity.

Lighting product suppliers (manufacturers and retailers) operate in a competitive industry and value confidentiality and respect of their time and their relationships. Therefore, NEEA and the Cadeo team determined an outreach approach that prioritized maintaining confidentiality and deferred to manufacturer preferences on reaching out to their partner retailers.

- Interview five individuals representing manufacturers.
- Interview up to five additional people representing manufacturers or retailers, identified through snowball sampling.

Cadeo targeted respondents who know the market and their companies' data and decision making around manufacturing, sales, and stocking. Cadeo used snowball sampling – asking interviewees to identify and connect us with other individuals at lamp suppliers (manufacturers or retailers)— to efficiently identify additional interview subjects.

Sample Frame and Dispositions

Following the approach described above, Cadeo's outreach efforts resulted in the following final dispositions.

Table C-63: Supplier Interview Sample Frame and Final Dispositions

Sample Frame	
Manufacturer Contacts	17
Retailer Contacts (Obtained via Snowball Sampling)	2
Total Number of Contacts	19
Final Dispositions	
No Contact (additional contacts at companies for which a different individual had already completed an interview)	4
Complete	**6**
Declined	6
Exhausted	3
Interviewee Titles	
Director of Utility Programs/Solutions	3
National Sales Manager	1
Senior Retail Account Manager	1
Rebate Consultant	1

Lighting Supplier Discussion Guide

Note: This italicized section below is for NEEA's review. The discussion guide itself begins on page 2.

Objectives and Target Individuals for Discussions

With NEEA's guidance and collaboration, the team designed this discussion guide to capture residential lighting supplier (manufacturer and retailer) perspectives on a variety of market trends with the goal of contextualizing the quantitative data gathered through the Shelf Survey and Sales Data Analysis. This guide aims to uncover suppliers' knowledge, attitudes, and expectations regarding the following areas of interest for the Residential Lighting LTMT study:

- *Shelf stocking strategies and approaches for residential lighting products.*
- *The effects of EISA 2020 and the 2017 ENERGY STAR specification.*
- *Sales and pricing trends for residential lighting products, including the future of the CFL lamp.*

The team plans to target the ideal individuals listed below for the discussions. The team also listed an alternate individual in the event the ideal individual is unavailable.

- ***Manufacturer product manager.*** *This individual is typically most knowledgeable about current and anticipated product trends. The alternate individual is the manufacturer's government/industry relations manager or the utility relations manager.*

- ***Retailer merchant/buyer.*** *This individual is typically most knowledgeable about stocking and sales trends. An alternate individual would be the retailer's primary account manager at a major manufacturer. The account manager would typically be able to speak on behalf of the retailer on these issues. The next best position would be retailer's government/industry relations manager, followed by the utility relations manager.*

For many manufacturers and retailers, Cadeo has existing relationships with the people in one or more of these positions. In these cases, we will target the person best positioned to (and most likely to) answer our questions.

Discussion Guide

[**Instructions:** Questions for manufacturers and/or retailers are marked with M and R respectively.]

Introduction

Hello, this is [interviewer name] with Cadeo. We had time scheduled to talk today and first I just want to make sure that this is still a good time to talk.

I'd also like to thank you for being willing to have this chat with me. As I said, I work for Cadeo, which is an independent research company. Other companies hire my firm when they want to objectively understand opinions and perspectives about a topic. They hire a third party, like us, because they want the people we talk with to feel comfortable to say whatever is on their minds – we want to hear the good, the bad, and everything in between. Our job is to listen to you and the others we talk to like you, and to share what we learned with the company who hired us. We will keep your responses anonymous, so none of your statements will be associated with your name or your company.

My client is in the energy industry – they do not manufacture or sell any lighting products, but they do have an interest in understanding lighting trends in the marketplace. And that is what we will be discussing today. There are no right or wrong answers to the questions I'm going to ask. This is all about the world according to you.

With your permission, I'd like to record our call today. The purpose of recording is to allow me not to take notes while we're talking – I will listen back to the recording to summarize our discussion and then delete the recording. [*For first interview only:* Two members of our client's market research team would like to listen to this recording for learning purposes. Would that be alright with you? This will not change the anonymity of our reporting – nothing we write will identify you or your company.]

Do you have any questions before we get started?

Stocking Strategy

[Note: this section is for Retailers only. Skip to next section for Manufacturers]

1. **[R]** To get started, why don't you give me a brief overview of your role as it relates to lighting products.
    - How much influence do you have on what lighting products end up on the shelf? *(Probe on fixtures versus lamps, and one store only versus multiple stores.)*
    - What do you do to influence the shelf set of lighting products?
    - Do you have a role in the planogram? What is your role?
    - Do others play a role? What is their role?

2. **[R]** Let's talk more about the planogram.
    - How does one go about designing a planogram for lighting products?
        - What factors does one consider, and what are the sources of those factors? [Probe on use of quantitative information versus qualitative]
        - Are the factors the same for a planogram for replacement lamps versus a planogram for light fixtures?
        - How does one determine how much shelf space a product should get? Is that process the same for replacement lamps?
        - What does a successful planogram for replacement lamps do?

3. **[R]** *[If not clear from above discussion]* Do all the stores use the same planogram for replacement lamps, or do they vary by store?
    - *IF VARY:* What factors differ in replacement lamp planograms from store to store?

4. **[R]** In general, what causes your store or your company to change a replacement lamp planogram?
    - Planned vs. unplanned changes?
    - How do changes get incorporated? Who is involved?
    - How do you know if the changes your store made are the right ones? What does your store or company do if they aren't?

5. **[R]** In general, do you have a role in deciding how many replacement lamp SKUs to stock for each replacement lamp type? What role do you play? [Do others play a role? What?]
    - How do you or others decide how many SKUs is too many, or not enough within a lamp type category?
    - What are the main influences that cause a SKU to get into the planogram?
      [Probe for the following – hold the utility incentive program and energy efficiency probes for last:]
        - Sales data
        - Manufacturer influences, like slotting fees?
        - Changes in technology?
        - Customer input?
        - Advertising & Promotions?
        - Any other factors?
        - Utility incentives for particular lamps?
        - Energy efficiency of the lamps

6. **[R]** One thing we are curious about is how well the mix of replacement lamps on the shelf represents the mix of replacement lamps sold.
    - What factors contribute to the similarities and/or differences in shelf mix versus sales mix?
    - Is the shelf / sales mix closer for certain classes of products or not (probe on LEDs, CFLs, general purpose, specialty, and incandescents)
        - What are the drivers for some having a closer shelf / sales mix and some not?
    - Do you ever ***purposely*** stock a product in a different proportion to the sales you expect? IF YES:
        - What are the reasons you might choose to do that?
        - How often might you do that?
        - If you don't ever do that, why not?

7. **[R]** Are you aware of any regional variations in sales of different lamp types? (Probe for the Northwest region)? What is driving those differences? [Probe for: Consumer awareness, stocking practices, retail prices, utility incentives?]

START OF MANUFACTURER SECTION – RETAILERS SKIP TO Q 14

8. **[M]** To get started, why don't you give me a brief overview of the residential lighting products your company manufactures? Can you give me a rough breakdown of how much of your product is replacement lamps versus light fixtures?

9. **[M]** How much influence do you have on what lighting products your company manufactures? (Fixtures versus replacement lamps?)
    - What do you do to influence what lighting products are manufactured?

10. **[M]** How does your company plan what they are going to manufacture?
    - What factors does your company consider, and what are the sources of those factors? [Probe on use of quantitative information versus qualitative]
    - Are the factors the same for replacement lamps as for light fixtures?
    - How far ahead do you have to plan?

11. **[M]** How do you decide how much of one type of replacement lamp to manufacture versus another?

12. **[M]** Do you plan for any regional variations for what lamp types sell? (Probe for the Northwest region)? What is driving those differences? [Probe for: Consumer awareness, stocking practices, retail prices, utility incentives?]

13. **[M]** In general, what causes your company to change what replacement lamps they manufacture?
    - How do you know if the changes you made are the right ones? What does your company do if they aren't?

14. **[M&R]** Thinking about the replacement lamps you [manufacture][stock and sell] what changes do you see happening in the future? And what do you think will drive those changes?
    - *Explore after they have had time to respond…*
        i. *Changes of interest: market share, price, types/features.*
        ii. *Lamp types: CFLs, CFL A-line lamps, ENERGYSTAR LEDs, non-ENERGYSTAR LEDs, LED A-line lamps, halogens of different categories, incandescents.*

    - *[Listen for whether they say they plan changes in manufacture of ENERGYSTAR and non-ENERGYSTAR LEDs.*
    - *[Listen for mention of the Jan 2017 ENERGYSTAR specification or the 2020 EISA Standard as drivers for CFL and LED changes, probe on how significant a driver they think it is in the change. Otherwise, do not mention these specs until later with Q17]*

15. **[M&R]** Do you currently [manufacture][stock/sell] non-ENERGYSTAR LEDs?
    - *If no:* Why don't you [manufacture][sell/stock] them? Do you plan to start? Why or why not?
    - *If yes:* Do you plan make any changes to your [manufacturing][selling/stocking] of non-ENERGYSTAR LEDs? What changes and why?
    - Do you anticipate changes to the price of non-ENERGYSTAR LEDs in the future?

16. **[M&R]** Last, do you anticipate a change in the proportion of non-ENERGYSTAR LEDs versus ENERGYSTAR LEDs in the future? What will drive the change?

ENERGY STAR® 2.0 and EISA 2020

If the respondent <u>did not mention</u> the Jan 2017 ENERGY STAR specification or the 2020 EISA Standard as drivers for market changes…

17. **[M&R]** Are you familiar with the new ENERGY STAR specification that went into effect January 2017? Are you familiar with the EISA standard scheduled to come out in 2020? *[If they are not familiar with either, skip ahead.]*

- Do you think the spec will impact the replacement lamps you [manufacture][stock/sell]? *If yes:* How?
  - *Probe on CFLs and LEDs after a time if respondent doesn't mention.*
- Do you have a sense of whether the new EISA standard is going to happen?
  - *If uncertain:* How does that uncertainty affect your planning around the replacement lamps you [manufacture][stock / sell]?
  - *If certain:* How do you think the standard will impact the replacement lamps you [manufacture][stock/sell]? *If yes:* How?
  - *Probe on CFLs and LEDs after a time if respondent doesn't mention.*
- Is there anything you find unclear or confusing about the ENERGY STAR or EISA specs?

18. **[M&R]** *[If not clear from above]* What is your organization's overall plan for CFLs moving forward?
    - How does this plan differ for different product categories -- general purpose, high wattage, reflectors?

19. **[M&R]** Are there any other things you can think of that will impact the future of CFLs? How about the future of LEDs?

20. **[M&R]** Are there any residential lamp types or applications for which there are currently no good LED substitutes or for which the LED substitutes have failed to gain traction?

21. **[M&R]** Are there any other developments or expected changes in general service A-line lamps that you anticipate?

22. **[M&R]** We're also interested in understanding the market for residential fixtures. Does your company produce/sell fixtures?
    - [If yes] How big is the fixture business relative to the lamp business in terms of units?
      - How have your fixture offerings changed over the past few years, and why?
        - Have you added more fixtures with integrated light sources?
        - Do you offer more/fewer ENERGY STAR qualified fixtures? Why?
    - Where do you see the market for residential fixtures going in the near future? Why?

23. **[M&R]** Before we wrap up, are there any important changes or developments in general service lamp sales trends that we haven't already discussed? Is there anything that has surprised you?

Closing

Thank you again for taking the time to talk with me today. This has been a really interesting conversation, and I appreciate your time and your input.

[If respondent has asked to know who the study sponsor is, we will tell them at the end of the discussion, and explain that NEEA does this research to understand the long-term trends in the residential lighting market.]

Appendix D: ACE Model Review

The Cadeo team reviewed certain questions regarding the ACE Model. This appendix contains the memo summarizing the results of this review.

Memorandum

To: NEEA

From: Cadeo Residential Lighting Team

Date: June 28, 2017

Re: 2016-17 Residential Lighting LTMT ACE Model Review Questions

The review of NEEA's Residential Lighting ACE Model is a typical task in its residential lighting long-term monitoring and tracking studies. However, NEEA expects to use a different model to quantify and forecast residential lighting savings next year (and thereafter). Rather than review the ACE Model in its entirety, NEEA asked Cadeo to provide perspective on four critical areas of inputs and/or assumptions important to the next model as well as the existing ACE model. This memo discusses our review of each of the questions posed by NEEA.

Market Size and Market Share Forecasting

NEEA asked Cadeo to forecast the size of the Northwest residential lighting screw-in market for 2017 to 2021, as well as 2025 and 2030. In addition, NEEA requested Cadeo use its professional judgment to forecast the market shares of incandescent, halogen, LED general purpose, LED specialty, CFL general purpose, and CFL specialty lamps. These two forecasts—market size and market mix—are inextricably linked because the mix of technologies in the stock is a key driver behind the quantity of lamp failures (and thus sales) in a given year.

Market Size

The team relied on BPA's Residential Lighting Market Model[11] to estimate total lamp sales in the market. The BPA model is a stock turnover model that calculates the installed stock of lamps based on NEEA's 2011 RBSA. That stock grows over time due to new construction (using the latest available data from the Council's 7th Power Plan[12]), growth in average home size, and the trend towards increasing lamp density in newer homes. The mix of lamps in the installed stock also changes over time as the stock turns over (lamps burn out and are replaced with different types of lamps). Annual sales reflect the sum of the lamps sold to replace failed lamps and those sold to fill new sockets created by new construction. The historical mix (market shares) of lamp types in the annual sales is a key input to the model and is based on several data sources including: NEEA's retailer shelf-stocking surveys, regional Nielsen sales data, online retailer sales data, and CLEAResult-tracked retailer and program data[13].

[11] https://www.bpa.gov/EE/Utility/research-archive/Pages/lighting-market-research.aspx

[12] https://www.nwcouncil.org/energy/powerplan/7/plan/

[13] The team reviewed this data set and found it to be consistent with the other sources but less comprehensive and lacking key attributes (i.e., inefficient technology sales data) so no primary data from this source was used in the model

Table 64 shows the market size forecast by the BPA model through 2020 both in terms of annual sales as well as total installed stock.

Table 64: Market Size (Sales and Installed Stock) Forecast in Lamps

Year	Total Sales	Total Installed Stock
2017	58,375,927	289,651,597
2018	52,905,434	293,032,986
2019	50,890,385	296,279,837
2020	48,037,052	299,391,261

Source: BPA Model

Because the model does not forecast past 2020, the team made several assumptions to forecast market size in later years. To forecast the installed stock in these later years, the team extrapolated stock growth from 2020 onward using the compound average annual growth rate of the stock between 2017 and 2020, which was 1.11%. Any market forecast of annual unit sales will contain much more uncertainty because different lamp technologies have dramatically different lifetimes. Therefore, the projected market size in terms of unit sales depends primarily on technology mix of the installed stock, which itself is a function of the preceding years' sales mixes. A stock comprising exclusively long-lasting LED lamps will yield far smaller annual market sales than a diverse market mix of technologies (like that which currently characterizes the Northwest market). It is precisely this shift to longer life lamps that is driving the consistent downward trend of the total market lamp sales from 2011 to the present.

Regulatory uncertainty also increases the range of possible outcomes for an extended lighting market forecast. A key Department of Energy rulemaking, known as EISA 2020, was slated to effectively eliminate all incandescent and halogen lamps from the market after 2020. The fact that manufacturers and retailers are moving away from CFLs means LEDs will likely be the only technology remaining if EISA 2020 takes hold. Following the administration change, however, it is not clear whether that standard will take effect in its current form, or at all.

Given this uncertainty, the team created two scenarios to bound the range of possible market sizes:

1. The **All-LED** scenario (representing the lower bound on total market size) effectively characterizes the situation in which DOE's EISA 2020 standard is implemented as currently written, resulting in a market of only LEDs by (at least) 2025. This scenario results in the longest average lamp lifetime, and therefore the slowest turnover and smallest annual market for lamp sales. Market size estimates for 2025 and 2030 in this scenario were estimated by assuming that the weighted average lifetime of lamps in the installed stock in 2025 would be 12 years, which is consistent with the BPA model's assumption for an LED lamp's lifetime.
2. The ***2020-Mix scenario*** (representing the upper bound) assumes the market share mix estimated by the BPA model in 2020 remains unchanged through 2030. This results in a relatively shorter average lifetime, faster turnover, and an upper bound on the total market size estimate. We used the weighted average lifetime of the lamp mix in the 2020 stock to calculate annual turnover (and

therefore sales) in 2025 and 2030. This is meant to reflect a rough approximation of the stock's turnover rate (and replacement sales) in the scenario in which the sales mix is frozen at 2020.

In addition to 2025 and 2030, NEEA requested a market size estimate for 2021. For both scenarios, the team interpolated this 2021 market size by fitting a trendline to the market size estimates available from the BPA model (2009 to 2020) with our 2025 estimate in each scenario. Results of these two scenarios are shown in **Table 65**.

Table 65: Calculated Upper and Lower Bound Forecast of Market Size in Lamps

Year	Total Sales		Total Installed Stock
	All-LED Scenario	2020-Mix Scenario	
2021	43,857,086	46,366,464	302,710,057
2025	29,869,969	38,360,511	316,357,235
2030	31,562,648	40,534,333	334,284,640

In each scenario, the market size declines until the average lifetime (and therefore turnover rate) plateaus. When that occurs, the replacement market bottoms out, and total lamps sales gradually grow in proportion to new construction growth.

Market Share Forecast

For the market share forecast, the team assumed that by 2030 LEDs will have completely taken over the lighting market. The team interpolated all *non-LED* lamps' market shares in 2021 and 2030 using a linear trend that starts in 2020 with the BPA model's market share for each lamp type and ends with 0% in 2030. The team allocated the rest of the market to LED lamps in each year from 2021 to 2030.

Next, the team used the average annual ratio of general purpose-to-specialty lamp types in the installed stock to allocate LEDs between general purpose and specialty lamps. From 2009 to present, the total market's stock mix between general purpose and specialty lighting has been constant, with 64% of lamps characterized as general purpose use and 36% specialty use. The team decided to continue this trend through 2030. The results of these calculations can be seen in **Table 66** below.

Table 66: Market Share Forecast

Year	INC	HAL	CFL		LED		Total
			General Purpose	Specialty	General Purpose	Specialty	
2016	18%	29%	7%	3%	22%	21%	100%
2017	15%	29%	6%	2%	26%	23%	100%
2018	13%	31%	3%	1%	30%	22%	100%
2019	11%	33%	1%	0%	34%	21%	100%

Year	INC	HAL	CFL		LED		Total
			General Purpose	Specialty	General Purpose	Specialty	
2020	10%	34%	0%	0%	36%	20%	100%
2021	9%	31%	0%	0%	39%	21%	100%
2025	5%	17%	0%	0%	50%	28%	100%
2030	0%	0%	0%	0%	64%	36%	100%

LED Market Data

NEEA also requested Cadeo comment on its methodology for estimating total regional LED sales. To estimate total LED general purpose and specialty lamps sold in 2016 (**Table 67**), NEEA added the total sales of each lamp from the utility survey to the non-incented totals for each lamp type provided by CLEAResult.

Table 67: 2016 LED Market Data

	NEEA Utility Survey	Non-incented From CLEAResult	Total for ACE model
LED General Purpose	7,712,805	1,819,103	9,531,908
LED Specialty	5,363,516	1,496,533	6,860,049
Total	13,076,321	3,315,636	16,391,957

CLEAResult's data on LED sales comes from its relationships with retailers and utility programs that it has established as the implementer of retail lighting programs in the region. However, as NEEA noted, the CLEAResult totals for non-incented lamps do not attempt to account for non-incented LED lamps that are not voluntarily reported to them by the retailers from whom they are collecting program data. Those retailers have no requirement to report non-incented lamps to the utilities that sponsor lighting programs in their stores. In fact, more than 70% of the non-incented LED lamps in the CLEAResult data come from a single retailer. This suggests that not accounting for non-incented LED lamps could substantially understate total LED lamp sales in the region.

The introduction of LEDs that do not qualify for ENERGY STAR, commonly referred to as "value LEDs," may be one driver of significant sales of non-incented LED lamps. While utilities typically do not incent these lamps, continued price declines have made the technology affordable to a wider swath of consumers, even without incentives.

The BPA model estimated LED sales of 27.3 million in 2016. Based on that estimate, we believe that NEEA's current methodology is a conservative estimate.

LED Growth Rates

NEEA provided growth rate assumptions used to forecast sales of LED general purpose and specialty lamps (Table 68) and asked Cadeo to comment on their reasonableness.

Table 68: LED Growth Rates (NEEA assumptions)

Year	General Purpose	Specialty
2017	10%	15%
2018	10%	15%
2019	10%	10%
2020	5%	5%
2021	5%	5%

Based on a comparison with the BPA model, these growth assumptions appear aggressive. The BPA model estimates LED specialty sales peak in 2016 while LED general purpose sales will peak in 2019. As such, LED lamp sales are projected to slow on an absolute basis following these peak years. The share of LEDs, as a percentage of annual sales, and as a percentage of the installed stock, will continue to increase, but due to the long lifetime of these lamps, the overall market will decline, leading to lower year-over-year LED sales totals. DOE's national LED stock projections[14] corroborate those estimates found in the BPA model. As a percentage of the national installed lamp stock, LEDs are expected to grow from 30% to 59% of the market from 2025 to 2030. The prospect of a declining total market (in absolute unit sales) dominated by LEDs is the major reason why the traditional 'Big 3' lighting manufacturers—Osram Sylvania, Phillips, and GE—have all divested or spun off their lamp business units in recent years.

Table 69 shows the growth rates implied by BPA's stock turnover model for LED general purpose and specialty lamps. General purpose LED lamp growth rates are relatively consistent with NEEA's assumptions until 2020 while specialty lamp growth rates are significantly lower.

Table 69: LED Growth Rates (BPA model)

Year	General	Specialty
2017	8%	-0.4%
2018	7%	-14%
2019	9%	-11%
2020	-0.4%	-10%

[14] Table 4.1 DOE Forecast of Solid State Lighting Report https://energy.gov/sites/prod/files/2016/09/f33/energysavingsforecast16_2.pdf

LED Incentives

In its ACE Model forecast, NEEA assumed that utility-incented LED lamps as a percentage of all LED sales would remain at 2016 levels from 2017 to 2020. Specifically, for both general purpose LEDs and specialty LEDs, NEEA calculated the ratio of incented lamps (gathered through its utility program survey) to the total number of LED lamps (incented and non-incented) reported by CLEAResult. In 2016, that ratio was 78% for specialty LEDs and 81% for general purpose LEDs, as shown in Table 70. NEEA asked Cadeo to comment on this assumption.

Table 70: Percent of LED Lamps Incented, 2016

Product	Total Units	Incented Units Through Local Programs	% Incented
LED Specialty	6,860,049	5,363,516	78%
LED General Purpose	9,531,908	7,712,805	81%

We discuss two aspects of NEEA's assumption separately. The first regards the percentages NEEA calculated for 2016; the second deals with the question of whether to hold that figure constant through 2020.

There is no reason to doubt the accuracy of NEEA's utility survey and its resulting incented LED lamp count. Therefore, the quality of NEEA's estimate regarding the share of LED lamps that are incented by utilities depends entirely on the accuracy of its estimate of total LEDs sales. As discussed in Question 2, we believe the current total market estimate is quite conservative and that actual LEDs sales are significantly higher than NEEA currently estimates. If this is the case, then the share of incented LEDs would be much lower than the current figures of 78% and 81% for specialty and general purpose lamps, respectively. For example, using the LED sales estimates from the BPA model, the percentage of general purpose and specialty LEDs incented by utilities would fall to 56% and 39%, respectively.

Whatever the number, the absolute percentage of incented LED lamps is a methodological question about which market size number to use in the denominator. The second part of this question is one of professional judgment about the future of program policy and strategy in the region. That is, will utilities continue to incentivize LED lamps at the pace implied by their 2016 investment, as NEEA assumes?

We have no reason to assume otherwise over the next few years. Our analysis indicates LED saturation will continue to achieve greater market share, and will likely become the most common lighting technology for all lamp types. However, the residential lighting sector remains a critical contributor to most residential energy savings portfolios, so it is difficult to imagine programs abandoning the market without a clear regulatory signal such as an LED-only minimum federal standard. Furthermore, as LED prices continue to decline, utilities will likely be able to stay in the market at lower per-lamp incentive levels. Programs could thereby continue to capture savings from LED lamps, but with a lower overall investment.

With respect to the years following 2020, NEEA currently assumes that EISA 2020, which would essentially set a minimum standard that only CFL and LED technology could meet, will drive utility incentive support for LED lamps to 0%. At this time, the potential standard is essentially in regulatory limbo under the new administration, and it is impossible to forecast whether it will take effect on January 1, 2020, as originally conceived, or whether it will be delayed or modified. Nonetheless, given the momentum LEDs have in the

marketplace and LED price trends, we view NEEA's assumption that utilities will exit the market in 2021, either driven by the standard or complete market transformation, as a reasonable projection.

Appendix E: Analysis of Pre-Incentive Prices for LEDs

As an extension of the Residential Lighting Long-Term Monitoring and Tracking Study, the Northwest Energy Efficiency Alliance (NEEA) asked Cadeo to estimate the pre-incentive price of LEDs. This appendix contains the memo summarizing the results of this analysis.

To: Northwest Energy Efficiency Alliance (NEEA)

From: Cadeo

Date: August 7, 2017

Re: Pre-Incentive Prices for LEDs

Background

As an extension of the Residential Lighting Long-Term Monitoring and Tracking Study, the Northwest Energy Efficiency Alliance (NEEA) asked Cadeo to estimate the pre-incentive price of LEDs using sales and shelf stock data NEEA has collected in Oregon, Washington, Idaho, and Montana, combined with regional utilities' self-reported incentive amounts.

The purpose of this memo is to document the team's findings and describe the analytical approach used.

Summary of Results

Table 71 shows Cadeo's estimate of pre-and post-incentive prices in the Northwest for LED lamps across the full range of lumen bins and applications.

Table 71. Pre- and Post-Incentive LED Prices (2016)

		Regional Average of Incented Lamps Only			Regional Average of All Lamps		
Lumens	Application	Post-Incentive Price ($ per Lamp)	Incentive ($ per Lamp)	Pre-Incentive Price ($ per Lamp)	% of Total Lamps Receiving Incentive	Post-Incentive Price ($ per Lamp)	Pre-Incentive Price ($ per Lamp)
250 to 1049 (24in)	Decorative and Mini-Base	$5.94	$2.29	$8.23	14%	$6.24	$6.56
	General Purpose	$4.91	$2.20	$7.11	54%	$4.90	$6.09
	Globe	$8.62	$2.27	$10.89	7%	$8.40	$8.57
	Reflector	$9.03	$3.32	$12.34	89%	$8.90	$11.86
	Three-Way	$4.92	$2.20	$7.12	0%	$4.90	$4.90
1050 to 1489 (48in)	Decorative and Mini-Base	$15.65		$15.65		$15.65	$15.65
	General Purpose	$11.16	$1.81	$12.97	19%	$10.98	$11.32
	Globe	$11.08		$11.08		$11.08	$11.08
	Reflector	$14.82	$4.28	$19.10	26%	$14.78	$15.89
	Three-Way	$11.16	$1.81	$12.97	0%	$10.98	$10.98
1490 to 2600 (96in)	Decorative and Mini-Base	$11.72		$11.72		$11.09	$11.09
	General Purpose	$11.72	$2.49	$14.21	37%	$11.33	$12.26
	Globe	$20.55		$20.55		$20.55	$20.55
	Reflector	$22.15	$3.44	$25.59	9%	$24.15	$24.46
	Three-Way	$15.06	$2.49	$17.55	37%	$16.05	$16.97

Note: data for shaded cells are not available.

Self-reported regional utility incentives generally range from $2 to $4 across applications and lumen bins. However, this analysis suggests only a small fraction of regional sales for most applications (i.e., decorative and mini-base, globe, and three-way) is receiving incentives.

Cadeo's analysis did not include an in-depth analysis of the statistical precision of these results. Because the counts of incented lamps derived from regional utilities and regional sales data are heavily weighted to the 250-1049 lumen range (see Table 72 below), we can surmise that the results in Table 71 for that lumen range are the most reliable.

Table 72. Count of In-Region Incented Lamps (in 000s)

	Lumens		
Application	250 to 1049 (24in)	1050 to 1489 (48in)	1490 to 2600 (96in)
General Purpose, dimmable, and 3-way	6,478	134	400
Globe	229	2	0
Reflectors and Outdoor	3,515	238	12
Decorative and Mini-Base	745	0	0

Approach

Northwest utility program data are a key component of this regional analysis. NEEA requested residential lighting program lamp counts and incentive data from regional utilities; the utilities that did not provide program data account for a small proportion of regional LED incentive counts and thus do not make a material impact on assertions about the region as a whole. The other sources of data leveraged in this analysis are described in Table 73.

Table 73. Data Sources

Data Description	Source
Total estimated sales by lumen bin, application	BPA Momentum Savings model for residential lighting
Utility incentives and program lamp counts	Regional utilities
Lamp prices by lumen bin, application, and ENERGY STAR status	Regional shelf and sales data, combined using chain logic method
ENERGY STAR shares by lumen bin and application	Regional shelf and sales data, combined using chain logic method

Program lamp counts and incentives provided by utilities were aggregated regardless of ENERGY STAR status. Though most incented LEDs in the region are ENERGY STAR qualified, incentives also exist for non-ENERGY STAR lamps (often referred to as "value LEDs"). Therefore, this analysis uses the data sources in Table 73 to estimate the quantity and price of three segments within every application type and lumen bin:

- Lamps that received a utility incentive
- ENERGY STAR lamps that did not receive an incentive
- Non-ENERGY STAR lamps that did not receive an incentive

Table 74 shows total estimated regional lamps and the share across the three segments above. These shares form the basis for our price estimation.

Table 74. Regional Lamps and Segmentation

			Share		
Lumens	Application	Estimated Regional Lamps (# in 000s)	Utility-Incented Lamps	ENERGY STAR Lamp, no incentive	Non-ENERGY STAR Lamp, no incentive
250 to 1049 (24in)	Decorative and Mini-Base	5,273	14%	28%	58%
	General Purpose	12,033	54%	0%	46%
	Globe	3,126	7%	31%	62%
	Reflector	3,934	89%	0%	11%
	Three-Way	0	0%	34%	66%
1050 to 1489 (48in)	Decorative and Mini-Base	0	0%	100%	0%
	General Purpose	721	19%	32%	49%
	Globe	107	1%	99%	0%
	Reflector	917	26%	59%	15%
	Three-Way	0	0%	51%	49%
1490 to 2600 (96in)	Decorative and Mini-Base	0	0%	0%	100%
	General Purpose	998	37%	1%	61%
	Globe	29	0%	100%	0%
	Reflector	131	9%	61%	30%
	Three-Way	78	37%	20%	43%

The price data available for this analysis are disaggregated by ENERGY STAR status. To estimate post-incentive prices for the utility-incented lamps, the analysis makes two assumptions

1. If there are **fewer** utility-incented lamps than ENERGY STAR lamps, then the post-incentive price is equal to the ENERGY STAR price; and
2. If there are **more** utility-incented lamps than ENERGY STAR lamps, the post-incentive price is a weighted average of ENERGY STAR and non-ENERGY STAR prices.

The analysis also assumes:

- Utilities that did not provide program data account for a small proportion of regional incented LEDs and thus do not make a material impact on the results; and
- Lamp distribution by lumen bin (within application) does not vary meaningfully across utilities.

The details of this analysis are in the analysis spreadsheet, which is available upon request.

Analysis Scope

The scope of this analysis is for LED lamps sold or available on retailer shelves in calendar year 2016. NEEA also acquired utility program data solely for 2016. Thus, our analysis provides a point-in-time estimate of the impact of utility program incentives on LED lamps rather than a time trend.