



2019 Regional Lighting Sales Data Analysis (MA20R22-E)

FINAL

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SUBMITTED TO:

Massachusetts Program Administrators and Energy
Efficiency Advisory Council Consultants

New Hampshire Program Administrators

National Grid Rhode Island

SUBMITTED BY:

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Regional Lighting Sales Data Analysis

Analyzing Market Trends for Light Bulbs

NMR conducted a study to examine light bulb market share, shipment, and prices in the New England region. The study examines market share and bulb prices (provided by CREED) in four Study States: Connecticut, Massachusetts, New Hampshire and Rhode Island. It compares the Study States to non-program areas. The sales data analysis reveals that lighting programs still influence LED sales, but this influence varies by state, bulb shape, and retail channel. Market share trends in non-program areas suggest that naturally occurring adoption of LEDs increasingly drives the retail lighting market.

Consideration



The Program Administrators in each of the Study States should consider developing and implementing targeted, state-specific retail lighting strategies, which may include plans for continued program intervention or exiting the market. These strategies should balance demographics, federal regulations and legal decisions, program histories, sales volumes, naturally occurring market adoption (as demonstrated by non-program areas), NTG ratios, impact parameters, and cost-effectiveness.

Key Findings



LED market share continues to grow in both program and non-program states. Program areas still have higher LED market share, but non-program areas are closing the gap.



Prior to 2018, LEDs mainly displaced CFL market share; after 2018, LEDs also displaced halogen shares.

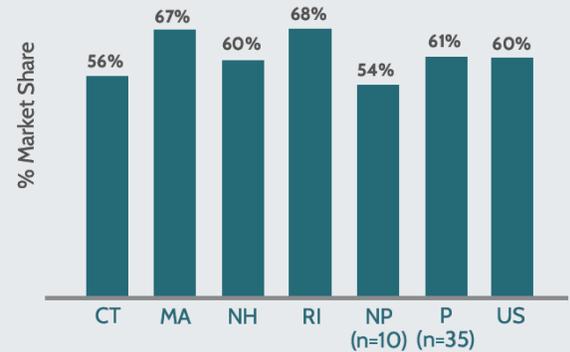


Halogens are the most common alternative to LEDs for A-line, whereas incandescents are the primary LED alternative to globes and candelabras.



LEDs made up the majority of light bulb sales in all areas with non-program areas at 54% and Study States with shares ranging from 56% to 68% (right).

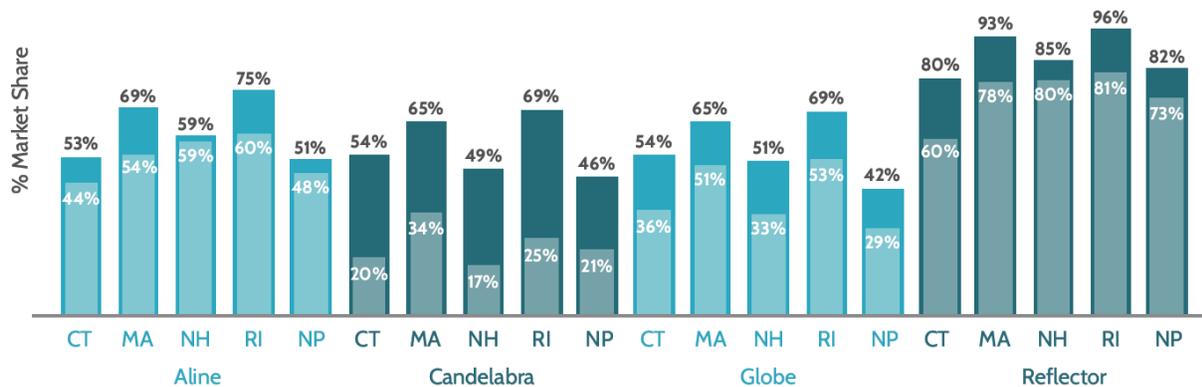
2019 LED Market Share by Area



Growth by Bulb Shape

While reflectors had the highest LED market share, candelabras saw the largest growth in market share between 2018 and 2019. A-line LED market share showed modest increases in Connecticut, New Hampshire, and non-program states.

LED Market Share by Shape



Lighter shade = 2018 Darker shade = 2019

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Executive Summary

This report describes recent screw-base light bulb market share, shipments, and prices in Connecticut, Massachusetts, New Hampshire, Rhode Island, and program and non-program states (defined below).¹ The analyses draw on light bulb sales data compiled by the LightTracker Initiative of the Consortium for Residential Energy Efficiency Data (CREED) and shipment data reported by the National Electrical Manufacturers of America (NEMA).^{2,3,4} The primary purpose of this study is to characterize the current lighting market and track market share over time.

Table 1 summarizes the topics explored in this report and their relevant data sources (**Table 4** provides additional details). LightTracker provided NMR with three different datasets:

- **Full category data (FCD):** covers all retail channels (discount, dollar, drug, grocery, hardware, home improvement, mass merchandise, and membership stores)
- **Point-of-sale (POS) data:** only includes discount, dollar, drug, grocery, mass merchandise, and some membership stores (**Table 2** lists market coverage)
- **Non-POS data:** only includes home improvement, hardware stores, and remaining membership stores (**Table 2** lists market coverage)

While representing only a portion of bulb sales, the POS data allow for more detailed analyses of ENERGY STAR[®] qualification, lumens, and prices by shape. The POS data also provide an additional six years of history (POS data have been available since 2009 compared to 2015 for the FCD). Non-POS data, derived from taking the difference of FCD and POS data, allow for the comparison of sales trends between the home improvement and hardware channels to all other channels (in the POS data).

For most topics, NMR compared Connecticut, Massachusetts, New Hampshire, and Rhode Island to states without lighting programs, and identified state-specific trends. NMR also explored NEMA shipment data from 2011 to 2019, including data collected prior to and after NEMA's

¹ A separate Connecticut report that incorporates many of the results presented here and expands on Connecticut program and sales trends. NMR Group and Cadeo. 2020. *R1963a Short-term Sales Data Report*, NMR Group, Inc. and Cadeo. 2020. Available at <https://www.energizect.com/sites/default/files/R1963a%20Short-term%20Lighting%20Report%202020%2009%2011%20FINAL.pdf>.

² The information contained herein is based in part on data reported by IRI through its Advantage service, as interpreted solely by LightTracker, Inc. Any opinions expressed herein reflect the judgement of LightTracker, Inc., and are subject to change. IRI disclaims liability of any kind arising from the use of this information.

³ Data presented include LightTracker calculations based in part on data reported by Nielsen through its Strategic Planner and Homescan Services for the lighting category for the 52-week period ending approximately on December 31, 2019, for the available state level markets and Expanded All Outlets Combined (xAOC) and Total Market Channels. Copyright © 2020, Nielsen.

⁴ NEMA revised its calculation method to include newly available international shipment data for LEDs, CFLs, and halogens. They also removed incandescents from the market share estimation. They provided data for 2017 using the prior and current calculation methods, but only share the current calculation method for 2018 onwards. See [Section 1.2.2](#). NEMA has since removed some of the historic information from its website, but NMR has been tracking NEMA shipment data for many years and was able to preserve the pre-2018 data using the old methodology.

methodological change in tracking A-line bulb shipments. NEMA only publicly reports shipment data at the national level.

Table 1: Study Topics and Data Sources

Topic	Years Analyzed	Data Source
Market share over time by type	2015 to 2019	LightTracker full category, POS, non-POS
Market share over time by type	2009 to 2019	LightTracker POS
Market share over time by shape	2016 to 2019	LightTracker POS
Market share by type by shape	2018 to 2019	LightTracker full category, POS, non-POS
LED ENERGY STAR qualifications	2017 to 2019 ¹	LightTracker POS
Market share by lumen bins	2019	LightTracker POS
Market share (shipments) over time	2011 to 2019	NEMA
Market share by program spending	2019	LightTracker full category and state program activity data
LED and halogen bulb prices	2016 to 2019	LightTracker full category

¹ Main report focuses on ENERGY STAR qualification in 2019 but [Appendix A](#) includes trends over time.

OVERVIEW OF FINDINGS



The retail lighting market showed strong signs of transformation in the Study States and in non-program areas, but the depth of the transformation varied among the areas and retail channels considered. The results suggest that lighting programs still influence LED sales, but naturally occurring adoption of LEDs may now play a more important role in driving the market for efficient light bulbs.

LEDs now represent the majority of light bulb sales in the four Study States, program states, non-program states, and the nation. LEDs account for nearly all reflector sales sold throughout the areas, one-half or more of A-line sales, and about one-half of globe and candelabra sales. LED market share in home improvement, hardware, and membership stores (non-POS stores) for all shapes exceeds that of the share in discount, dollar, drug, grocery, mass merchandise, and other membership stores (POS stores). LED prices have fallen over the past four years in non-program areas, despite the absence of incentives, but they remain higher than halogen prices across all channels. In POS channels, LED reflector prices fell below those for halogens, but above those for incandescents.

Massachusetts and Rhode Island have the highest market shares among the areas considered, while Connecticut and New Hampshire appear to lag slightly behind these other two states. The lag could reflect differences in program spending. Both states spend less per household than Massachusetts and Rhode Island. In 2018, Connecticut had to reduce program activity and incentives due to state-induced budget cuts; LED market share decreased as halogen market share increased. Program spending and LED market share rebounded somewhat in 2019, but both the spending and the sales still fell short of 2017 levels.⁵ The coincident timing of the shifts in program support and market shares suggests that there is continued program influence on the

⁵ R1963a *ibid*.

market. The structure of the retail market and demographic factors (not addressed in this study), may also explain the differences across states.

These findings suggest that, overall, LEDs have become the dominant light bulb in many retail channels and for some bulb shapes. The remaining market opportunities in selected channels or for specific bulb shapes will likely yield substantially lower savings than the programs have achieved over the past decade. The time may soon arrive when the programs decide to exit the retail lighting market. The nature and timing of exit strategies may vary across states, based on market and demographic characteristics.

FINDINGS

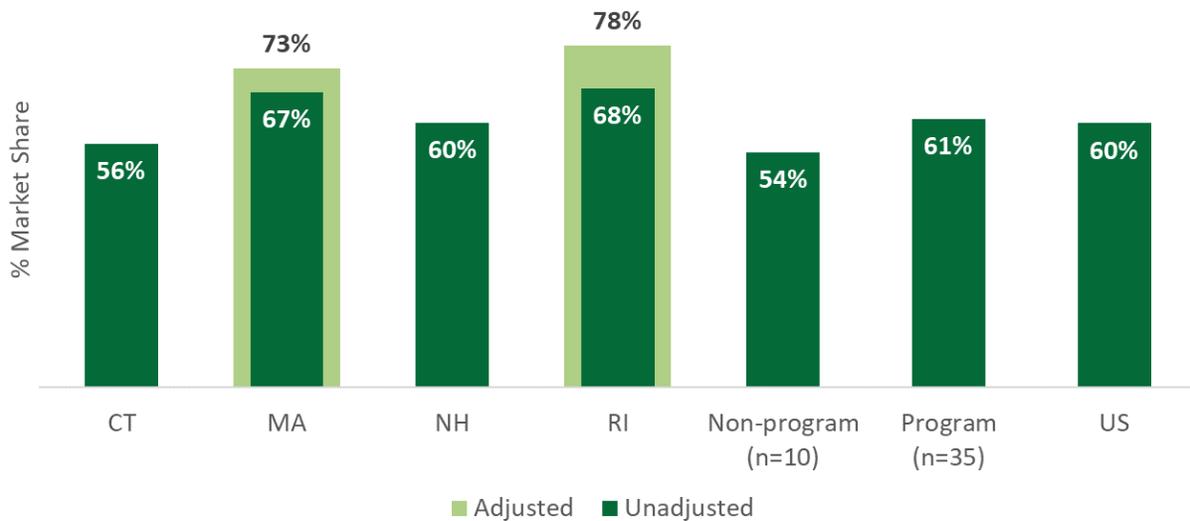


In 2019, LEDs made up the majority of light bulb sales in all areas with at least 54% market share, including non-program states.

Figure 1 shows that, in 2019, LEDs accounted for a majority of light bulb shares in all areas with market share at or above 54%. Regionally, Connecticut’s market share (56%) was just above non-program areas (54%), and New Hampshire’s (60%) share was similar to all program areas (61%) and the nation (60%). Market shares in Massachusetts and Rhode Island exceeded the other areas, with or without the CREED adjustment for program sales (Section 1.2.1).

Figure 1: 2019 LED Market Share Across Areas¹

(Source: LightTracker FCD – All Retail Channels)



¹ CREED adjusted FCD LED sales upwards so that program-supported sales would not exceed 90% of ENERGY STAR sales or 81% of total LED sales in a state. See Section 1.2.1 for additional information.



Prior to 2018 and in all areas examined, LEDs mainly displaced CFL market share; after 2018, LEDs also displaced halogen shares.

LED market share exhibited high levels of growth between 2015 and 2019, even in non-program areas. Prior to 2018, LED growth in market share primarily displaced CFL market share. In or after 2018, LED market share began to displace halogen market share as well. [Figure 9](#) in [Section 2.1.1](#) shows that halogen market share in non-program areas was 52% in 2016 and 53% in 2017. In 2018, halogen market share decreased to 37%, whereas LED market share increased to 46% (a 77% increase from 2017).



LED market share in the POS channel increased from zero to 40% over the past decade, but this share lags that of the FCD (54%).

[Figure 2](#) presents LED market share over time for the POS and FCD channels in non-program states (see [Section 2.1.1](#) for Study State graphs). The data show that consumers in non-program areas began to purchase LEDs in POS channels in 2012, coinciding with the Phase I implementation of the Energy Independence and Security Act of 2007 (EISA). The rate of market share growth increased after 2014, when EISA phased out 40 Watt and 60 Watt incandescent bulbs, reaching 40% in 2019. The increase in LED purchases by consumers in non-program areas can partly be attributed to the influence of LED program funding in program states throughout the US. The FCD data, available since 2015, follow a similar pattern to the POS, but the steepness of the two curves diverges year-to-year. Both the POS and FCD suggest slower LED market share growth between 2018 and 2019. NMR requires additional market share data to clarify if this slower growth represents a temporary or permanent change to the market share curve.

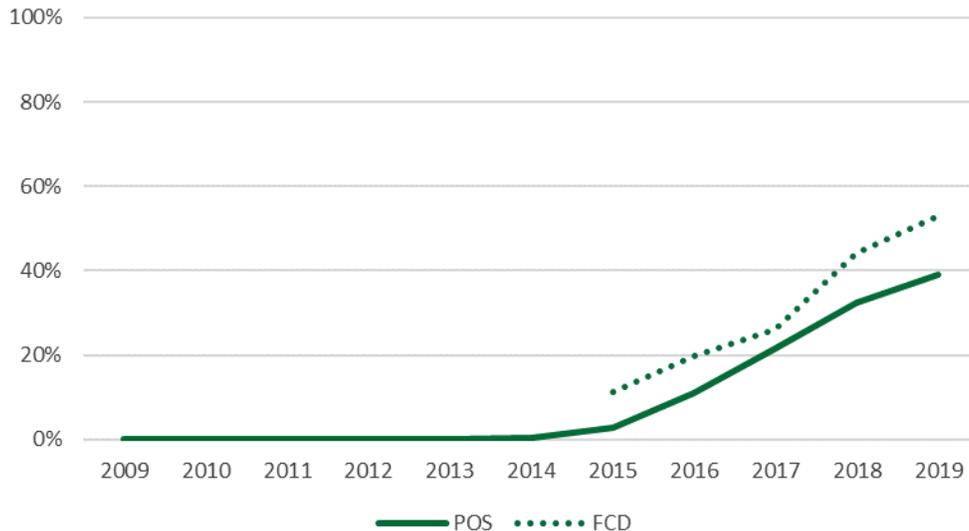


While reflectors had the highest LED market share (at least 80%) in all areas studied, candelabras saw the largest growth in market share between 2018 and 2019. A-line LED market share in non-program areas increased by only 3 percentage points, from 48% to 51%.

[Figure 3](#) shows that reflectors had the highest LED market share of all bulb types – exceeding 60% of market share in all areas in 2018 and 80% in 2019. Candelabra market share more than doubled in all areas, which represents the largest growth in market share between 2018 and 2019. This is true even in non-program areas, where candelabra LED market share grew from 21% to 46%. Globes also showed an increase in market share in all areas, with the smallest being for non-program areas, which grew from 29% to 42% market share between 2018 and 2019. However, A-line LED market share did not increase as much as other bulb shapes in Connecticut, New Hampshire, and non-program areas; it only increased by nine percentage points in Connecticut, three in non-program areas, and zero in New Hampshire. NMR requires additional data from later years to determine if this smaller change indicates a temporary or permanent change to the market share trends. Massachusetts and Rhode Island saw greater market share increases compared to non-program areas for all bulb shapes. Note that CREED adjust both 2018 and 2019 sales by shape for Massachusetts, but only 2019 for Rhode Island.

Figure 2: Non-program LED Market Share, 2009-2019^{1,2}

(Source: LightTracker FCD – All Retail Channels, POS)

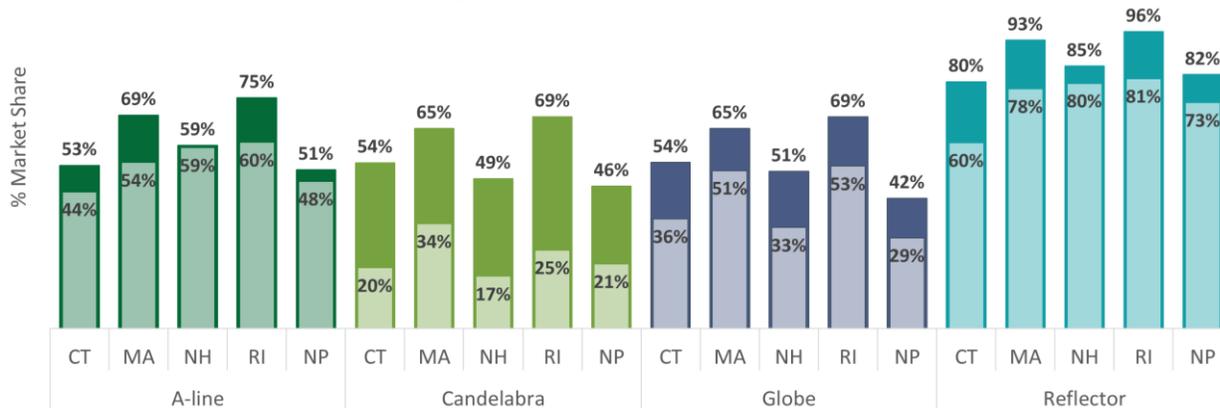


¹ POS includes discount, dollar, drug, grocery, mass merchandise, and some membership stores. POS data are not affected by CREED’s adjustment for known program sales.

² For consistent comparison across years, non-program states are restricted to Alabama, Delaware, Kansas, Kentucky, Mississippi, Nebraska, Tennessee, and Virginia for all years shown. Therefore, the market shares for non-program states in the figure above differ slightly from market shares for the full list of current non-program states, such as those reported in Figure 11.

Figure 3: Massachusetts, New Hampshire, and Comparison Areas LED Market Share by Bulb Shape, 2018-2019^{1,2}

(Source: LightTracker FCD – All Retail Channels)



¹ 2018 market share = lighter shade, 2019 market share = darker shade; NP = Non-program areas

² Massachusetts and Rhode Island market shares are adjusted for known program sales; unadjusted shares are not available.



LED market shares in POS channels lag those of non-POS channels.

Figure 16 in Section 2.1.2 shows lower 2019 LED market share for all shapes in POS channels when compared to non-POS channels. Without exception, LED market shares in hardware, home improvement, and some membership stores exceeded those in the discount, dollar, drug, grocery, mass merchandise stores, and remaining membership stores. This is especially true for candelabra and globe LED market share, which never exceed 33% across the areas in POS channels but were 58% or higher in all areas in the non-POS channels. Reflector shares neared or exceeded 90% in the non-POS channels, but were 73% or lower in POS channels.



Halogens are the most common alternative to LEDs for A-line and reflector bulbs, whereas incandescents are the primary LED alternative to globes and candelabras.

Halogens made up the second largest market share for A-lines (ranging from 21% to 42% across the areas) and reflectors (4% to 11%) after LEDs whereas incandescents dominated the market for candelabras (31% to 53%) and globes (24% to 42%), shown in Figure 18 in Section 2.1.2.



LED market share continues to grow in both program and non-program states. Program areas still have higher LED market share, but non-program areas are closing the gap.

Figure 4: shows that LED market share of program states had a nine to ten percentage point lead over non-program states between 2016 and 2017 and a seven percentage point lead between 2018 and 2019. While the percentage difference between program and non-program states has mostly remained unchanged, the relative difference has declined because LED market share increased in non-program states. LED market share of program states had a 37 percent relative lead over non-program states in 2016 and a 12 relative percent lead in 2019.

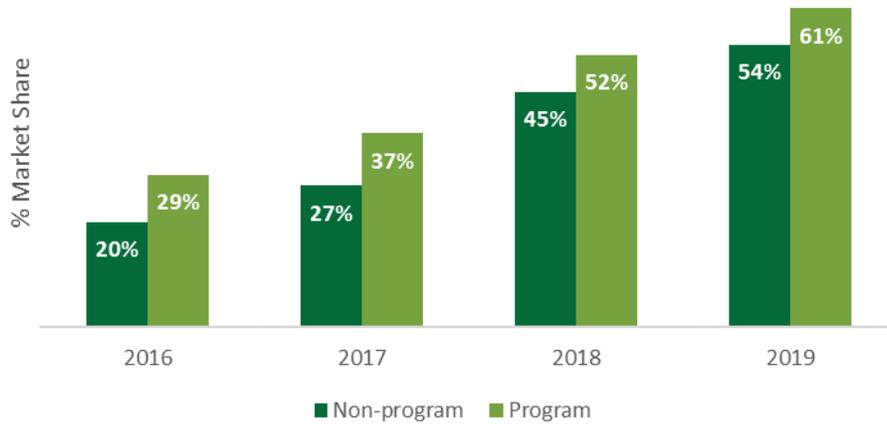


Market share of ENERGY STAR qualified LEDs was at least 66% or higher, including in non-program areas.

As seen in the POS data, ENERGY STAR qualified LEDs accounted for 91% of LED sales in the POS subset of retail channels in Rhode Island, 88% in Massachusetts and New Hampshire, and 84% in Connecticut (Figure 5). ENERGY STAR qualified LED market share in program areas (74%) was still notably higher than non-program areas (66%). CREED identifies ENERGY STAR qualification in a manner that may overstate its market share, but this shortcoming applies across all areas.

Figure 4: LED Market Share Comparison of Program and Non-program States, 2016-2019¹

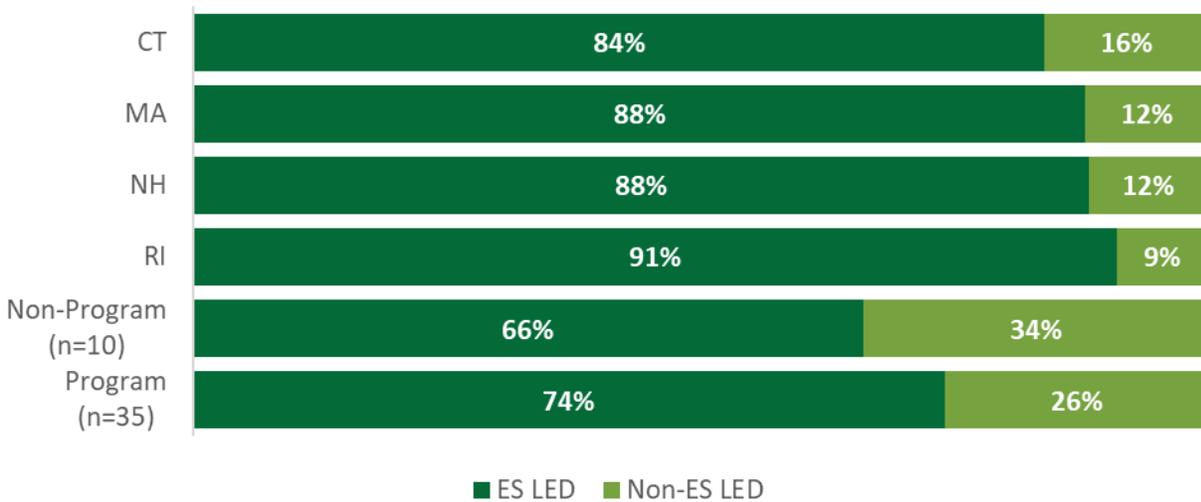
(Source: LightTracker FCD - All Retail Channels)



¹ Program market shares are adjusted for known program sales.

Figure 5: ENERGY STAR Status of 2019 LED Sales¹

(Source: LightTracker POS)



¹ POS includes discount, dollar, drug, grocery, mass merchandise, and some membership stores. POS data are not affected by CREED's adjustment for known program sales.



LEDs dominated the A-line market in lumen bins most closely associated with 60 Watt incandescent bulbs, but incandescents remained the most common bulb in low and high lumen bins (representing 2% to 6% of the market) in most areas.

The 750 to 1,049 lumen bin (a 60 watt incandescent equivalent) garnered the majority of bulb sales in the Study States with 52% of sales in Connecticut (of which 68% were LEDs), 53% of sales in Massachusetts and New Hampshire (73% and 72% were LEDs, respectively), and 56% of sales in Rhode Island (78% were LEDs). Halogens had the largest market share in the remaining three lumen bins currently subject to EISA (37% to 66% were halogens). In contrast, EISA exempt bulbs that are below 310 lumens and above 2601 lumens tend to be dominated by incandescents, shown in [Figure 21](#) in [Section 2.1.5](#). Non-EISA covered lumen bins represent only 2% to 6% of all lamp sales.



Across all channels, LED prices continued to fall in non-program areas, but the pace slowed. In POS channels, LED prices for reflectors in non-program areas fell below those for halogens, but remained higher than incandescents.

As described more in [Section 2.2](#), LED prices in non-program areas fell from \$4.93 in 2016 to \$2.59 in 2018. At the same time, halogen prices fell from \$1.75 to \$1.43. Both bulbs saw slight upticks in 2019, to \$2.68 for LEDs and \$1.48 for halogens ([Figure 22](#)). The LED uptick might reflect a shift in mixes by bulb shape, such as an increase in specialty LED sales. The POS data allow sufficient detail to look at prices for bulb shapes in the aggregated non-program states but not in the Study States (due to small sample sizes for some bulb shapes). Reflector LED prices were \$3.99 in POS channels in non-program areas, compared to \$4.63 for halogens and \$3.18 for incandescents ([Figure 23](#)). Notably, incandescents made up 64% of non-LED reflector sales in POS channels in non-program areas, compared to about one-half of non-LED reflector sales in the FCD data. For all other shapes, LEDs remained the more expensive bulb shape in POS channels in non-program states. Program state prices in the LightTracker dataset described in [Section 2.2](#) reflect the application of program incentives.

CONSIDERATION

The research described in this report seeks to provide critical information to help the PAs in the four Study States decide the nature of their future engagement in the residential retail lighting market. However, this study had a limited scope, focusing primarily on market share estimates derived from LightTracker sales data. Decisions about the future of residential retail lighting programs will have to take other information into account. This information includes, but is not limited to, additional market and program insights from other studies and sources, net-to-gross (NTG) ratios, the results of cost-effectiveness testing, and regulatory directives.

Consideration 1: The PAs in each of the Study States should consider developing and implementing targeted, state-specific retail lighting strategies, which may include plans for continued program intervention or exiting the market. These strategies should balance demographics, federal regulations and legal decisions, program histories, sales volumes, naturally occurring market adoption (as demonstrated by non-program areas), NTG ratios, impact parameters, and cost-effectiveness. State-specific strategies may differ in terms of the placement (i.e., product, channel, and location) and the amount of incentive offered. The length of continued program support in the market will also likely vary across the states. We expand on possible components of such a strategy below.

Rationale: We believe the results point to the need for retail lighting strategies that vary by Study State. Each Study State is firmly on a path to LED market dominance across all bulb shapes. However, New Hampshire and, especially, Connecticut have lower LED market shares compared to Massachusetts and Rhode Island. Market structure, consumer demographics and preferences, and program histories all likely contribute to these observed differences. Finally, the incoming Biden Administration could attempt to reinstate aspects of EISA that had been rolled back under the Trump administration, although the timing, scope, and outcome of such efforts is unknown. Potential components of state-specific strategies could include the following:

- Focus incentives on a few high impact products, identified by a combination of sales volumes, expected savings, NTG ratios, and cost-effectiveness.⁶ Currently, the program offers incentives on a wide range of products; it may not be advisable to continue this practice in a mature market. Any focus on high volume products must be mindful of free-ridership, as these same products likely have high rates of naturally occurring market adoption. Based on the results of this study, we believe it is likely that certain reflectors⁷ and 60 Watt incandescent-equivalent A-lines fall into the high volume / high free-ridership

⁶ NMR wishes to acknowledge discussions we had with SCS ANALYTICS, who also conducted research in Connecticut. These discussions informed the considerations reported here, specifically those about targeted incentive strategies and variations across retail channels. The SCS study relied on a strategic shelf stocking and incremental cost study, focused on a few SKUs of LEDs, halogens, and incandescents within each bulb shape. The SCS study offers additional recommendations and considerations that may be of interest to the PAs in all four Study States. NMR cautions that the SCS suggestions may not adequately take into account market conditions outside of Connecticut. Specifically, while we concur with SCS that the PAs should consider focused incentive strategies, we believe that these strategies must balance the desire for high volume sales with the likelihood of high free-ridership rates in a mature LED market. See SCS ANALYTICS. 2020. *R1963b Short Term Residential Lighting Report*. Available at https://www.energizect.com/sites/default/files/R1963b_STLighting_FINAL%20Report_102920_0.pdf.

⁷ The LightTracker data does not report reflectors by shape, but we believe the popular BR30 bulb may have high rates of natural adoption.

category. The PAs in the Study States should carefully consider the pros and cons of maintaining or reducing support for these bulbs. Focusing on high volume bulbs will likely be most beneficial to Connecticut and New Hampshire since they have lower market share relative to Massachusetts and Rhode Island.

- Shift some of the remaining incentives going to hardware and home improvement (non-POS) stores to discount, dollar, drug, and grocery channels stores, with mass merchandise stores and membership stores considered on a case-by-case basis. This strategy is likely to have the greatest impact in New Hampshire, where consumers buy a larger portion of their light bulbs in POS channels (50%) relative to the other three Study States (less than 35%).
- Allow for variation in the maximum achievable LED market share by bulb shape, retail channel, and state due to consumer demographics and preferences. In other words, approaching 100% market share for 60 Watt incandescent-equivalent LEDs in home improvement stores may be achievable, but not so for candelabra bulbs at grocery stores.
- Conduct market research to understand the lighting-related shopping habits of consumers considered hard-to-reach (HTR) in each state. The current HTR strategy in the Study States targets LED sales in discount, dollar, and neighborhood grocery stores. This strategy increases the availability of LEDs in stores often assumed to have high percentages of HTR customers. Such stores also sell very small numbers of light bulbs relative to mass merchandise channels (included in the POS data) and home improvement and hardware stores (representing the non-POS data). Market research could help clarify where HTR shoppers buy light bulbs and where current HTR LED adopters obtained their LEDs. This information may help the PAs identify the best path forward to increasing LED adoption among HTR customers. The research may also help the PAs to increase market share of LED bulbs in lagging retail channels by uncovering the reasons for such lags, even if those reasons go beyond factors related to HTR shoppers.

Regardless of the selected strategy, the PAs in each of the Study States should prepare for a future in which light bulbs cease to be an important component of retail products programs and perhaps even the entire residential program portfolio.

Section 1 Introduction

This report describes recent light bulb market share, sales, and shipment trends in Connecticut, Massachusetts, New Hampshire, and Rhode Island (referred to as the Study States), as well as the entire United States, states with upstream residential lighting programs (program states), and states without upstream residential lighting programs (non-program states). The study findings reflect analyses of light bulb sales data compiled by the LightTracker Initiative of the Consortium for Residential Energy Efficiency Data (CREED).^{8,9,10,11} This study also presents updated shipment data from the National Electrical Manufacturers of America (NEMA).¹² Finally, this study examines trends in light bulb shelf prices.

The electric Massachusetts' Program Administrators (PAs) and Energy Efficiency Advisory Council (EEAC) Consultants commissioned the study in conjunction with the PAs in New Hampshire, National Grid Rhode Island, and the Evaluation Administration Team (EA Team) to the Connecticut Energy Efficiency Board (EEB).¹³ The joint regional report highlights critical state-specific results, as needed.

⁸ The study uses data purchased by CREED from IRI and Nielsen. IRI (<https://www.iriworldwide.com/en-us/Company/About-Us>) and Nielsen (<https://www.nielsen.com/us/en.html>) track and compile information on sales and purchases in numerous sectors of the economy. Nielsen is better known for its tracking of television-viewing habits.

⁹ CREED serves as a consortium of PAs, retailers, and manufacturers working together to collect the necessary data to better plan and evaluate energy-efficiency programs. LightTracker, CREED's first initiative, is focused on acquiring FCD lighting data, including incandescent, halogen, CFL, and LED bulb types for all distribution channels in the entire United States. As a consortium, CREED speaks as one voice for PAs nationwide as they request, collect, and report on the sales data needed by the energy-efficiency community (<https://www.creedlighttracker.com>).

¹⁰ The information contained herein is based in part on data reported by IRI through its Advantage service, as interpreted solely by LightTracker, Inc. Any opinions expressed herein reflect the judgement of LightTracker, Inc., and are subject to change. IRI disclaims liability of any kind arising from the use of this information.

¹¹ Data presented include LightTracker calculations based in part on data reported by Nielsen through its Strategic Planner and Homescan Services for the lighting category for the 52-week period ending approximately on December 31, 2019, for the available state level markets and Expanded All Outlets Combined (xAOC) and Total Market Channels. Copyright © 2020, Nielsen.

¹² The data presented in this report come from the NEMA "Lamp Indices" and have been supplemented with data provided to NMR by NEMA. The most recent update available at the time of writing is available at <https://www.nema.org/analytics/indices/view/led-a-line-lamp-shipments-decrease-in-fourth-quarter-2019-compared-to-third-quarter-2019-and-the-previous-year>. See the main body of this report for more details about NEMA's estimation of bulb shipments.

¹³ A separate Connecticut report that incorporates many of the results presented here and expands on Connecticut program and sales trends. NMR Group and Cadeo. 2020. *R1963a Short-term Sales Data Report*, NMR Group, Inc. and Cadeo. 2020. Available at <https://www.energizect.com/sites/default/files/R1963a%20Short-term%20Lighting%20Report%202020%2009%2011%20FINAL.pdf>.

1.1 STUDY OBJECTIVES AND RESEARCH QUESTIONS

The study objectives included the following:

- Examine current market share in the Study States individually, the states with upstream lighting programs, the states without upstream lighting programs, and the entire nation.
- Provide breakdowns of market share by bulb type (i.e., LEDs, CFLs, halogens, and incandescents), shape (A-line, reflector, globes, and candelabras), and ENERGY STAR® status for each of the Study States (individually) and non-program states (collectively).
- Investigate overall market share and market share by shape for different groups of retail channels (see [Section 1.2.1](#)):
 - Point-of-Sale (POS) channels comprising discount, dollar, drug, grocery, mass merchandise, and some membership stores
 - Non-POS channels comprising home improvement, hardware, and some membership stores
 - Full Category Dataset (FCD) comprising all channels combined
- Create adoption curves of overall market share by bulb technology (inclusive of all shapes) for each Study State and non-program areas from 2009 to 2019 using POS data, and LED market share from 2015 to 2019 using FCD data.
- Explore trends in NEMA reported quarterly bulb shipment share from 2017 through the second quarter of 2020, noting the implications of NEMA's revised methodology that was instituted in 2017.
- Compare average prices of LEDs (prices will include incentives, where applicable) and halogens over time, including an examination of price by shape using the POS data.
- Assess market share in very low (<310) and very high lumen bins (>2,600), which roughly coincide with ranges that are exempt from Phase 1 of the Energy Independence and Security Act (EISA), which was the original incandescent phase-out that went into effect between 2012 and 2014.

The study achieved these objectives by exploring the following research questions:

- What are the short- and long-term trends in light bulb market share in each of the four Study States and light bulb shipments nationally?
- How do these trends compare with non-program states and, for select topics, with other program states and the nation?
- What do the market share adoption curves across areas tell us about the current state of lighting market regionally and in states without programs?
- What is the bulb price of LEDs compared to halogens in each of the Study States and non-program states? LED prices in Study States include mark downs due to incentives.
- Does the current LED share of bulbs in very high and very low-lumen bins suggest any future program opportunities?

- What is the size of the total LED market and what portion of market-level LED sales receive direct PA support?

1.2 DATA SOURCES

The Lighting Sales Data study draws on two datasets: LightTracker Initiative Sales Data and NEMA shipment data.

[Table 2](#) summarizes the topics examined and the sources of data. This section describes the datasets.

1.2.1 LightTracker Data

CREED generates sales data from two sources: (1) POS state sales data (representing discount, dollar, drug, grocery, mass merchandise, and some membership stores) as scanned at the register, and (2) National Consumer Panel (NCP) state sales data (representing home improvement, hardware, online, and selected club stores, as well as the same channels covered by the POS). CREED purchases the data from third-party vendors and the LightTracker team¹⁴ cleans, processes, and calibrates the data for analysis (including isolating non-POS sales to avoid double counting sales for channels represented in both the POS and NCP). The end product is the LightTracker dataset with sales data broken out for POS channel sales, non-POS channels, and the FCD, which combines POS and non-POS sales in all retail channels for the nation and for most states (some lower population states are not included due to lack of data). [Table 2](#) summarizes the three subgroups of LightTracker data. [Table 4](#) provides a cross walk of research topics by data subgroup and year.

¹⁴ Currently Apex and Demand Side Analytics make up the LightTracker team. Data users such as NMR assist in the collection and verification of program data.

Table 2: Summary of LightTracker Dataset

(Source: LightTracker)

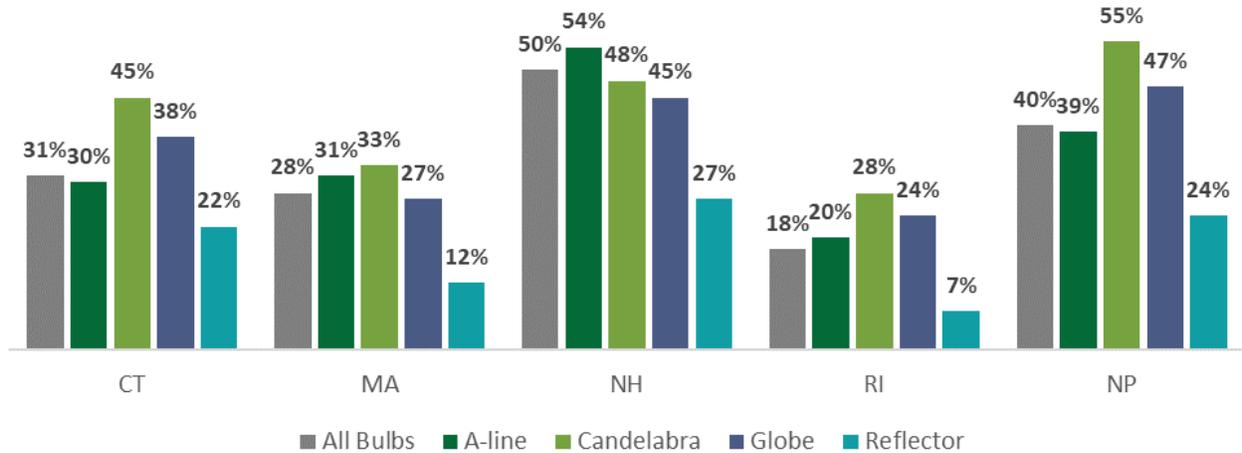
Data Group	Channels	% of All Lighting Sales	Indicators Analyzed
POS	<ul style="list-style-type: none"> Discount Dollar Drug Grocery Mass merchandise Some membership 	CT 31% MA 28% ¹ NH 50% RI 18% ¹ Non-program 40% Program 33% Nation 33%	Market share: <ul style="list-style-type: none"> For All Screw-based bulbs By Shape ENERGY STAR qualification By Lumen bins (A-line only) Shelf price by shape
Non-POS	<ul style="list-style-type: none"> Hardware Home improvement Remaining membership 	CT 69% MA 72% ¹ NH 50% RI 82% ¹ Non-program 60% Program 67% Nation 67%	Market share: <ul style="list-style-type: none"> For All Screw-based Bulbs By Shape
FCD	<ul style="list-style-type: none"> All of the above 	All areas: 100%	Market share: <ul style="list-style-type: none"> For All Screw-based Bulbs By Shape Shelf price for All Screw-based Bulbs

¹ Includes the CREED adjustment for program sales. Pre-adjustment, MA POS market coverage was 33% and RI was 26%; non-POS coverage was 67% and 74%, respectively. See [Figure 6](#) for breakouts by bulb shape.

[Figure 6](#) shows the percentage of all light bulb sales made in the POS channels broken out by bulb shape. Compared to the other areas, New Hampshire consumers bought a greater portion of their light bulbs of all shapes from discount, dollar, drug, grocery, mass merchandise, and certain membership stores. New Hampshire was the only area in which more than one-half of A-line sales occurs in POS channels. Outside of New Hampshire, candelabra bulbs were the most common shape purchased in POS channels and reflectors the least common shape. Note that, although the POS shares for reflectors tended to be low relative to other shapes for all areas, the lower POS share estimates in Massachusetts and Rhode Island likely reflect the impact of the program sales adjustment discussed below.

Figure 6: POS Share of Total Lighting Sales, by Bulb Shape^{1,2}

(Source: LightTracker POS)



¹ POS includes discount, dollar, drug, grocery, mass merchandise, and some membership stores. POS data are not affected by CREED's adjustment for known program sales.

² Massachusetts and Rhode Island market shares are adjusted for known program sales; unadjusted shares are not available.

CREED continuously improves its LightTracker data cleaning and vetting procedures. Beginning with the 2017 dataset and onward, they instituted two changes. First, the IRI and Nielsen data are unable to determine ENERGY STAR qualification for all LEDs. Therefore, CREED assigned ENERGY STAR LED qualification based on a combination of the status reported in the original IRI and Nielsen databases and the rated measure life of LEDs. For the rated measure life of LEDs, CREED assumed that all bulbs with 15,000 hours or more were ENERGY STAR qualified. Reviews of shelf stocking data from Massachusetts and Rhode Island provided to NMR by TRC suggest that the 15,000 hours cut-off may overstate the number of ENERGY STAR qualified bulbs on store shelves. However, because CREED assigned ENERGY STAR status similarly in all states, the exaggeration would be more pronounced in states that have lower ENERGY STAR sales.

The second change that CREED introduced in 2017 involved instituting a process to align the FCD total LED sales with known program-supported sales in the state. Prior to 2017, FCD total LED sales often seemed low compared to verified program sales. Starting in 2017, in states in which program-supported sales (which are almost universally ENERGY STAR-qualified across the nation) exceeded or rivaled LED sales (comprising both ENERGY STAR and non-ENERGY STAR sales), they adjusted LED sales as reported in the FCD (but not POS) upwards so that program-supported sales would not exceed 90% of ENERGY STAR sales or 81% of total LED sales in a state. In 2017, CREED made this adjustment to five states, including Rhode Island and Massachusetts. In 2018, Massachusetts was the only state that required this adjustment. In 2019, CREED made the same adjustment to Rhode Island and Massachusetts. CREED has not had to adjust Connecticut or New Hampshire data because the reported program sales and CREED estimates of total LED sales aligned. [Table 3](#) summarizes the adjustments for Massachusetts and Rhode Island.

Table 3: Unadjusted and Adjusted LED Market Share, Massachusetts and Rhode Island, 2017 to 2019

(Source: LightTracker FCD – All Retail Channels)

	Massachusetts		Rhode Island	
	Unadjusted	Adjusted	Unadjusted	Adjusted
2017	36%	49%	42%	55%
2018	50%	53%	57%	N/A
2019	67%	73%	68%	78%

Without the adjustment in the subset of states where program exceed LightTracker sales, it is almost certain that unadjusted LightTracker data would have underreported the LED market. Yet, because the adjustment only applied to LEDs,¹⁵ it increased LED market share, which may have caused the adjusted LightTracker to overstate LED market share. In prior reports for Massachusetts and Rhode Island, NMR had typically prioritized the adjusted market share estimates. However, given the regional focus of this year's study, coupled with the fact that CREED does not adjust Connecticut or New Hampshire, we have instead prioritized the unadjusted overall Massachusetts and Rhode Island market shares for 2019. However, we do show adjusted shares for some analyses, such as those by shape, as CREED did not estimate unadjusted market share. Each graph and figure with Massachusetts and Rhode Island states clearly whether the data do or do not reflect the sales data adjustment.

The **key strengths and weaknesses** of the LightTracker dataset include the following:

- **Strengths:**
 - FCD sales reflect the entire market, comprising program and non-program sales, as well as all retail channels.
 - Comparable data are available for most states in the nation.
 - Characteristics such as lumens, bulb shape, and pricing are included.
- **Weaknesses:**
 - POS data, which is used for the ENERGY STAR qualification, lumen bins, and price analyses, only cover a portion of the retail market, notably missing the important hardware and home improvement channels.
 - The method used to assign ENERGY STAR status may overstate the percentage of ENERGY STAR qualified LEDs sold in all areas.
 - Raw sales data do not always align with program sales, leading CREED to make adjustments for some states (including Massachusetts and Rhode Island) that may overstate the market share of LEDs.

¹⁵ CREED concluded that adjusting all bulb types would lead to unreasonable estimates of total bulb sales per household. Moreover, although they had program sales data for LEDs, CREED had insufficient information to make informed adjustments to other bulb types.

- Reliability is reduced when analyzing subsets of the market, such as those by bulb shape, lumen bins, and bulb prices.

1.2.2 NEMA Shipment Data

We also examined quarterly NEMA A-line national shipment data for Q1 2011 to Q2 2020.¹⁶ Prior to 2017, NEMA estimated shipment share from a survey of NEMA members but, in 2017, the federal government began to track international shipments into the US of LEDs and halogens meant for domestic consumption.¹⁷ The new international shipment data indicated that NEMA reports had been underrepresenting LED shipments (although not halogens, as many are manufactured in the US). Accordingly, in 2017, NEMA began to augment the surveys with the international shipment data for CFLs, LEDs, and halogens.¹⁸ NEMA also stopped tracking incandescent shipment share in 2017, arguing (and supported by the CREED data in [Figure 21](#)) that most A-line incandescent shipments fell into categories not considered general service lamps (e.g., low-lumen appliance bulbs, or high-lumen grow lamps). NEMA says that low- and high-lumen LEDs, CFLs, and halogen bulbs were already excluded from shipment share estimates, so this step brought incandescents in alignment with the other bulb types.

The **key strengths and weaknesses** of the NEMA dataset are as follows:

- **Strengths:**
 - Prior method represented national shipments of A-line bulbs; revised 2017 method still describes the national market for EISA-compliant A-line bulbs
 - Improved accounting of international shipments, particularly for LEDs
- **Weaknesses:**
 - Revised 2017 method is only limited to EISA-compliant A-lines (low/high lumen bins are excluded)
 - Current method does not report incandescent shipment share
 - Data are not available for individual states
 - Break in the time series due to a revision in shipment share calculation methods
 - Data may also be out of sync with sales, as shipments precede sales and could end up being stockpiled in retailer warehouses.

1.3 PROGRAM ACTIVITY

Many of the analyses in this report assess market share and price by the presence and level of upstream lighting program activity. To determine program activity, the LightTracker team contacted program administrators across the nation to obtain program budget and sales

¹⁶ NMR regularly obtained data from NEMA via links that they have subsequently removed. NMR also directly corresponded with NEMA to get more precise shipment share estimates using the current calculation method. NEMA only releases national shipment share data and does not provide shipment counts or data for individual states. The most recent NEMA updates at the time of writing can be found here: <https://www.nema.org/analytics/indices/view/led-a-line-lamp-shipments-decrease-in-fourth-quarter-2019-compared-to-third-quarter-2019-and-the-previous-year>.

¹⁷ Prior to this time, the federal government only tracked CFLs. Data are available at <http://dataweb.usitc.gov/>

¹⁸ Direct correspondence with NEMA.

information. The LightTracker team also conducted a literature review of annual reports that were publicly available on the internet or that were provided by PAs or their evaluators. Additionally, the team accessed DSM Insights, an E Source product that provides a detailed breakdown of program-level spending, including incentives, marketing, and delivery for over 100 PAs around the country.¹⁹ Finally, the team reviewed ENERGY STAR reports.²⁰ The team categorized all states with at least some program activity in 2019 as *program states*; the team categorized all remaining states as *non-program states* (although Nevada was a program state until 2018). [Appendix A](#) provides additional details.

1.4 REPORT ORGANIZATION

The report organization is as follows:

- Market share by bulb ([Section 2.1.1](#)) (includes NEMA data and S-curves)
- Market share by bulb shape ([Section 2.1.2](#))
- Market share by Program Activity ([Section 2.1.3](#))
- LED Market Share by ENERGY STAR qualification ([Section 2.1.4](#))
- Market share for A-line bulbs by lumen bins ([Section 2.1.5](#))
- Bulb Price Analysis ([Section 2.2](#))

¹⁹ E Source. “DSM Insights.” April 2019.

²⁰ Specifically, the team began by searching the ENERGY STAR Summary of Lighting Programs website <https://www.energystar.gov/ia/partners/downloads/2017%20ENERGY%20STAR%20Summary%20of%20Lighting%20Programs.pdf> and referenced the Database of State Incentives for Renewables & Efficiency (www.dsireusa.org).

Section 2 Data Examination

NMR examined trends in market share, ENERGY STAR market share for LEDs, and bulb prices using the LightTracker and NEMA shipment data. Table 4 summarizes the topics, sources of data, and years examined in the analyses, drawing on LightTracker data. The results generally describe market share and bulb prices in the four Study States and non-program states, but some analyses also include program states and the US.²¹ The study also reviews NEMA shipment data in Section 2.1.1, which only cover national shipments. The program activity review in Section 2.1.3 considers all available states.

Table 4: Analysis by Topic, Sub-dataset, and Year¹

Topics	2009 – 2014	2015			2016			2017			2018			2019			
	P	P	N	F	P	N	F	P	N	F	P	N	F	P	N	F	
Market share by type																	✓
Market share over time by type		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Market share over time by type for MA	✓	✓			✓			✓			✓			✓			
Market share over time by shape					✓			✓			✓			✓			
Market share by type by shape											✓	✓	✓	✓	✓	✓	✓
LED ENERGY STAR status																	✓
LED ENERGY STAR status over time								✓			✓			✓			
Market share by lumen bins																	✓
LED and Halogen Price / Bulb							✓			✓			✓				✓

¹ LightTracker datasets: F = Full Category Data, P = POS, N = Non-POS

²¹ Prior reports for Massachusetts and Rhode Island provide more detailed results for program states and the US. The decision to limit analyses of data for program states and the US reflect a desire to focus attention on the regional market shares trends compared to non-program areas. This focus helps to clarify to what extent regional programs still influence the retail light bulb market.

2.1 MARKET SHARE

2.1.1 Market Share by Bulb Technology

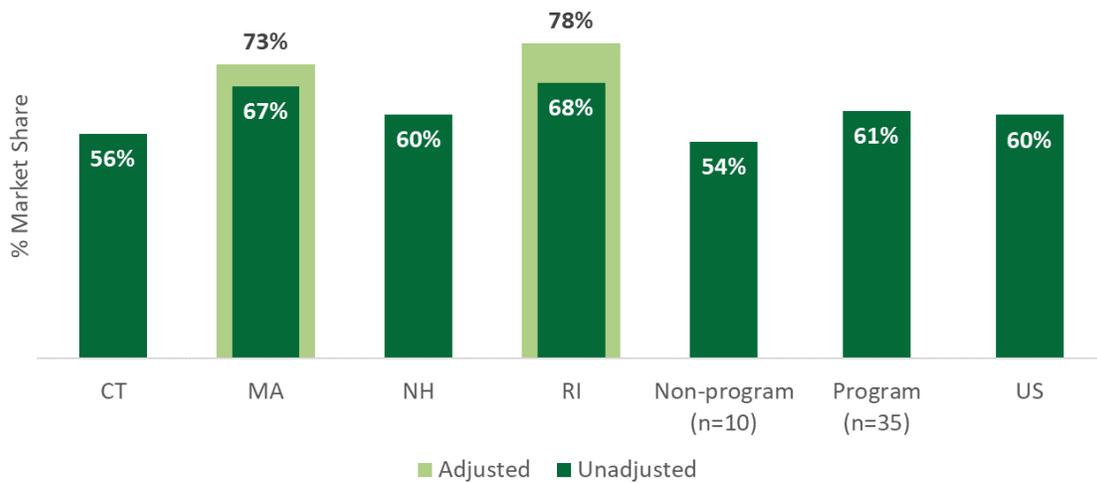


LEDs made up the majority of light bulb sales in all areas in 2019, but market share in the Study States varied by over ten percentage points.

Figure 7 reports the 2019 LED market share for the four Study States, program areas, non-program areas, and the US. With LED market share at 54% in non-program areas and even higher in the Study States, program areas, and the US, the data suggest that LEDs are now the most common bulb technology sold nationwide. Regionally, Connecticut’s market share (56%) was just above non-program areas, and New Hampshire’s share (60%) was similar to all program areas and the nation. Market shares in Massachusetts and Rhode Island exceeded the other areas, with or without the CREED adjustment for program sales (Section 1.2.1). Prior to the adjustment, 2019 LED market share was 67% in Massachusetts and 68% in Rhode Island. After the adjustment, 2019 LED market share was 73% and 78%, respectively. LED market shares reflect both current and historical program activity. The highest incentive levels and their consistency over time in Massachusetts and Rhode Island are likely driving the largest difference in LED market share from non-program states.

Figure 7: 2019 LED Market Share Across Areas

(Source: LightTracker FCD – All Retail Channels)



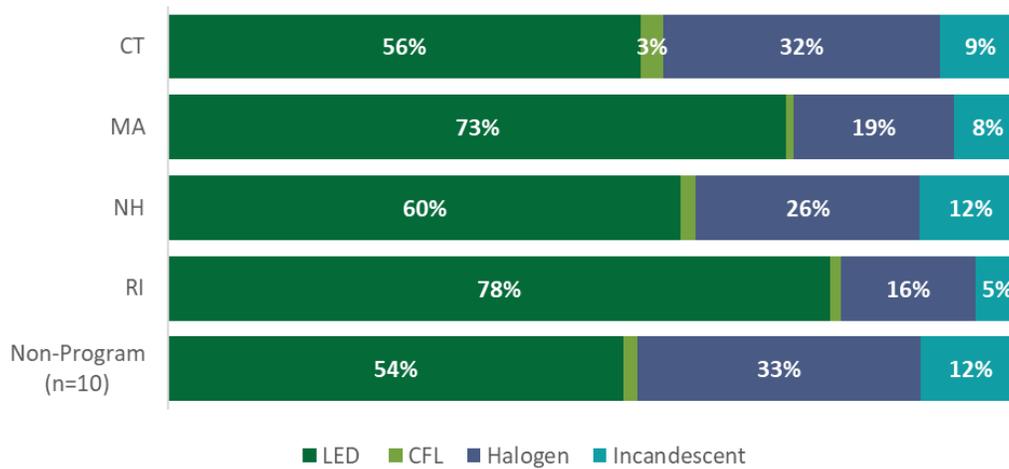


Halogens accounted for most non-LED bulb sales in all areas, but consumers still bought incandescents and a small number of CFLs.

Halogens made up about one-sixth to one-third of bulb sales across the areas (Figure 8). Although CFL market shares were negligible (3% or less), incandescent bulbs accounted for 5% or more of sales in every area (10% or more pre-adjustment in Massachusetts and Rhode Island). Findings in Section 2.1.2 show halogens are the most common alternative to LEDs for A-line and reflector bulbs, but incandescents largely make up the remaining market share of globes and candelabras.

Figure 8: 2019 Market Share by Bulb Technology Across Areas¹

(Source: LightTracker FCD – All Retail Channels)



¹ Subject to CREED adjustment for program sales. Prior to the adjustment, 2019 LED market share in Massachusetts was 67% and Rhode Island was 68%.



Programs still influence LED sales, but growth in market share between 2015 and 2019 remains high, even in non-program areas.

Three of the Study States consistently demonstrated higher LED market share than non-program areas (Figure 9, Figure 10).²² States with program activity were able to boost LED adoption earlier and non-program states are now catching up. Connecticut serves as the exception. Prior to 2018, LED market share in Connecticut exceeded that of non-program areas, but a state-induced budget reduction in 2018 led the program to reduce sales.²³ At the same time, LED market share also decreased and halogen shares increased. Connecticut is the only Study area in 2018 that exhibited these LED and halogen market share changes. Connecticut LED market share recovered in 2019, surpassing 2017 shares even though the program budget and program sales volumes were not fully restored. Yet, 2019 Connecticut LED market share lagged those of the

²² Both figures present unadjusted market share for Massachusetts and Rhode Island for comparability over time as CREED did not institute the adjustment until 2017 (see Figure 24 in Appendix A for trends with adjusted market shares).

²³ See R1963a *ibid*.

other Study states. This suggests that the LED market share is cumulative – building over time – and a setback may have longer-term implications.

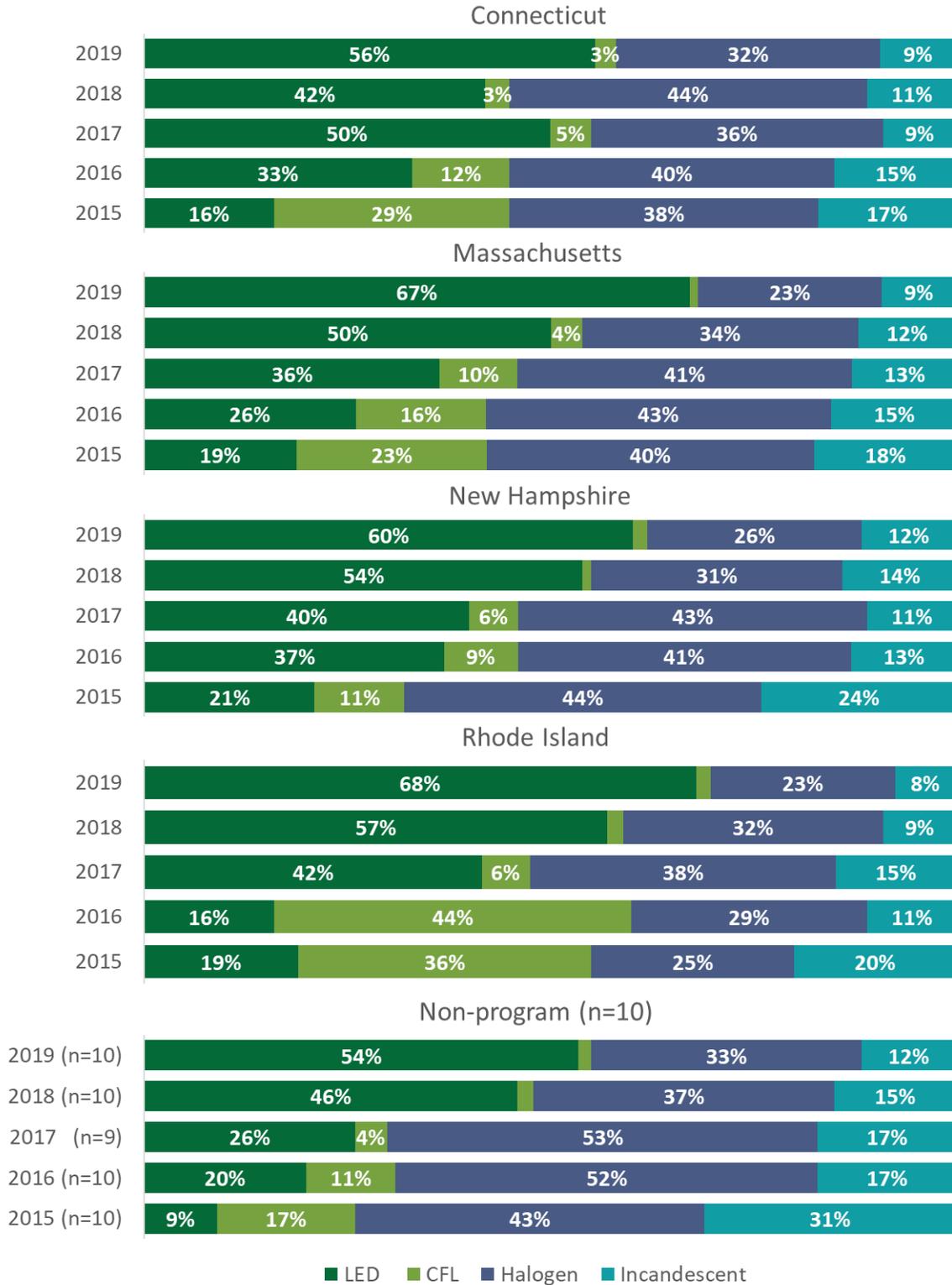
Both the higher market share in the Study States and the market reaction to reduced program sales in Connecticut suggest that the program still influenced LED sales in 2018, as would be expected if net-to-gross (NTG) ratios remain above zero. Yet, other indicators suggest that there is strong progress towards market transformation beyond program influence. All areas – including non-program areas – saw LED market share increase by about 40 to 50 percentage points between 2015 and 2019. Additionally, prior to 2018, LEDs largely displaced CFL market share but, after 2018, LEDs have also displaced halogen shares.

Regionally, Connecticut and, to a lesser extent, New Hampshire LED market shares fell below those of Massachusetts and Rhode Island in 2018 and 2019. As discussed in [Section 2.1.3](#), differential program spending may explain the lower shares in Connecticut and New Hampshire. In fact, in a separate study, lighting manufacturers and retailers as well as the implementation contractor cited lower program budgets in Connecticut and New Hampshire as the reason they believed LED market shares to be lower in those two states compared to Massachusetts.²⁴ However, from 2015 through 2017, both Connecticut and New Hampshire had shares that rivaled or exceeded those in Massachusetts and Rhode Island. We cannot offer any definitive explanation for this shift, but CREED notes that LightTracker data perform best in the aggregate (e.g., groups of states or the entire nation). State-level data are sensitive to such factors as the number of households in the NCP panel that informs the non-POS sales and to the number of reporting retailers per state reporting POS sales. Likewise, as mentioned above, short-term but substantial program changes – such as the budget reductions in Connecticut – could have lasting impacts.

²⁴ When asked to describe differences among the LED markets in the three states, suppliers and the implementation contractor cited lower program budgets in Connecticut and New Hampshire as reasons for predicted lower LED market shares and less product and retailer diversity compared to Massachusetts. See *R1963a ibid.*

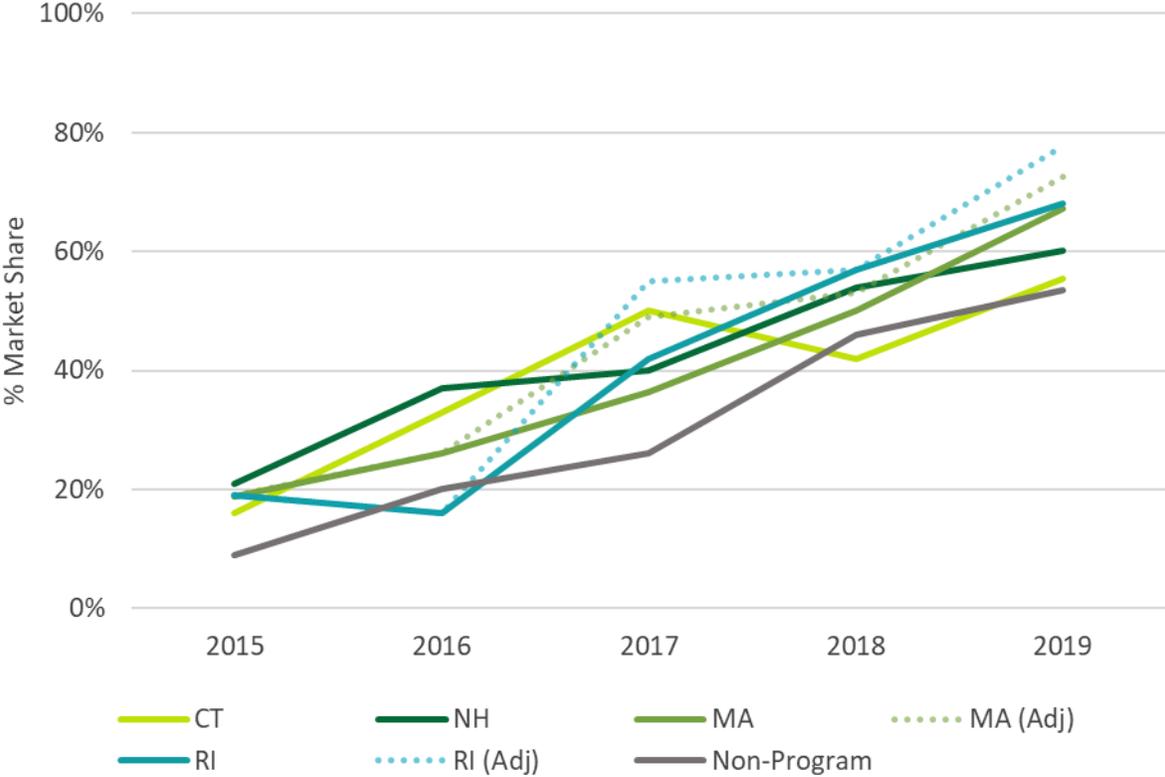
Figure 9: Market Share by Bulb Technology, 2015-2019¹

(Source: LightTracker FCD – All Retail Channels)



¹ Massachusetts and Rhode Island market shares are not adjusted for known program sales.

Figure 10: LED Market Share, 2015-2019
(Source: LightTracker FCD – All Retail Channels)





LED market share in the POS channel lags the non-POS channel.

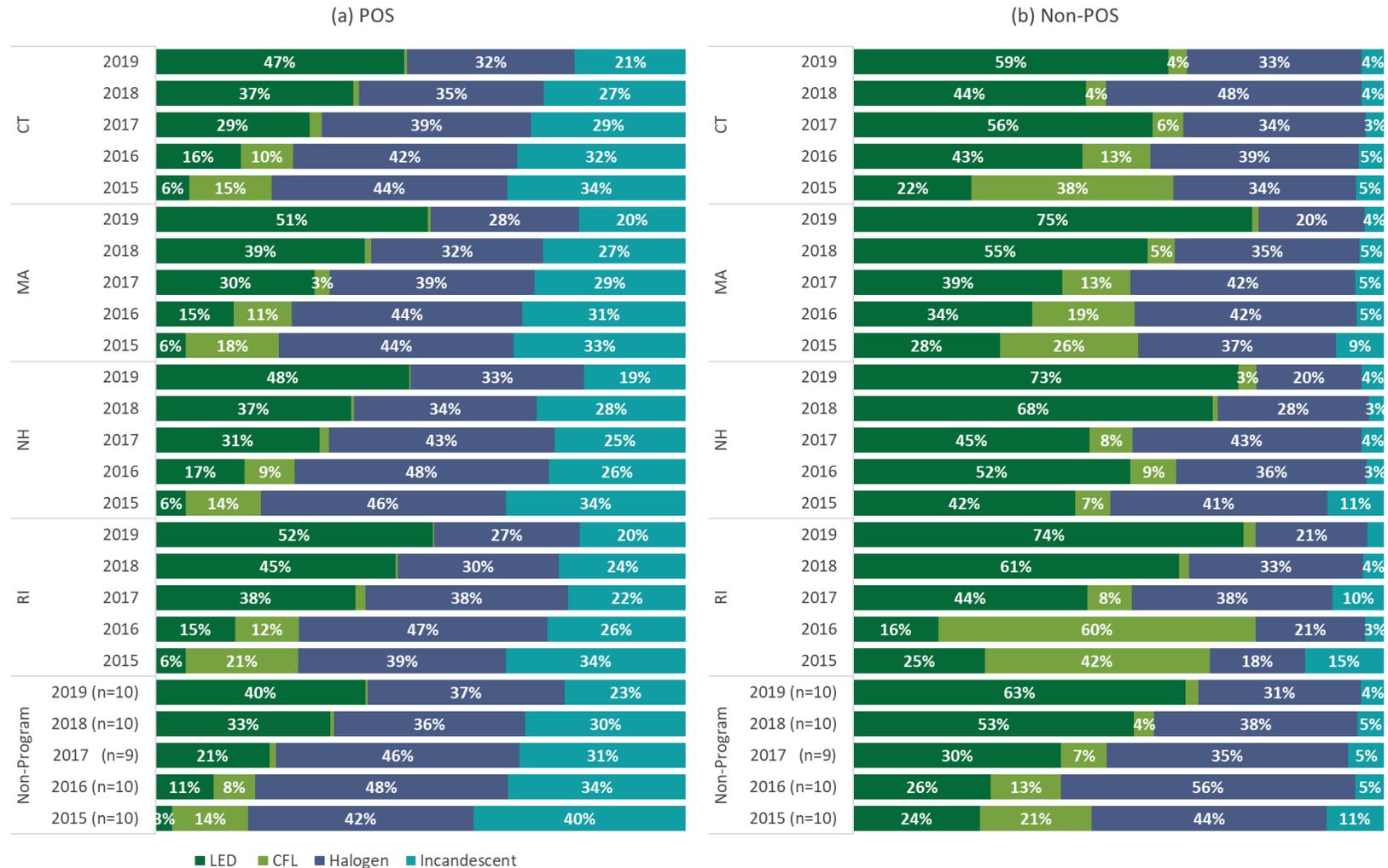
The comparison of POS and non-POS data in [Figure 11](#) suggests that LED market share was lower in the POS channels than in the non-POS channels for every Study State and non-program state in every year. This means that LEDs account for a much larger share of bulb sales in hardware, home improvement, and some membership stores than in discount, dollar, drug, grocery, mass merchandise, and other membership stores.

[Figure 12](#) and [Figure 13](#) plot the 2009 to 2019 LED market shares for the Study States and for non-program areas. The figures include POS data for the entire period and FCD data for 2015 to 2019. CREED first released the LightTracker dataset – including FCD data – in 2015. In the 2015 LightTracker dataset, CREED also provided POS data for 2009 to 2014. [Figure 25](#) to [Figure 29](#) in [Appendix A.1.2](#) provide 2009 to 2019 market share data for all bulb technologies in the Study States and non-program areas.

Focusing on the POS data, the results show that consumers in all areas began to purchase LEDs in POS channels in 2012, coinciding with the Phase I implementation of EISA 2007. Yet, POS LED market share in the Study States and non-program states grew at different rates. All four Study States exhibited small, but noticeable, increases in market share between 2013 and 2014; it took non-program areas another year to show a noticeable change. By 2017, three of the Study States had reached a POS LED market of about 30% and Rhode Island achieved 38% market share.²⁵ In contrast, POS LED market share in non-program areas in 2017 was only 21%. These differences continued, with each of the Study States having POS market share of about 50% in 2019, compared to about 40% in non-program areas. The FCD data also point to increased market share, but the trend lines for this period are *jumper* compared to the smooth S-curves of the POS data. This jumpiness most likely results from the NCP data, which are sensitive to the sample size and diligence of the panelists.

²⁵ See [Figure 25](#) to [Figure 29](#) for area graphs that also list the point estimates for LEDs.

Figure 11: Market Share by Bulb Technology, 2015-2019 – POS and Non-POS Channels Comparison^{1,2}
 (Source: LightTracker POS and non-POS)

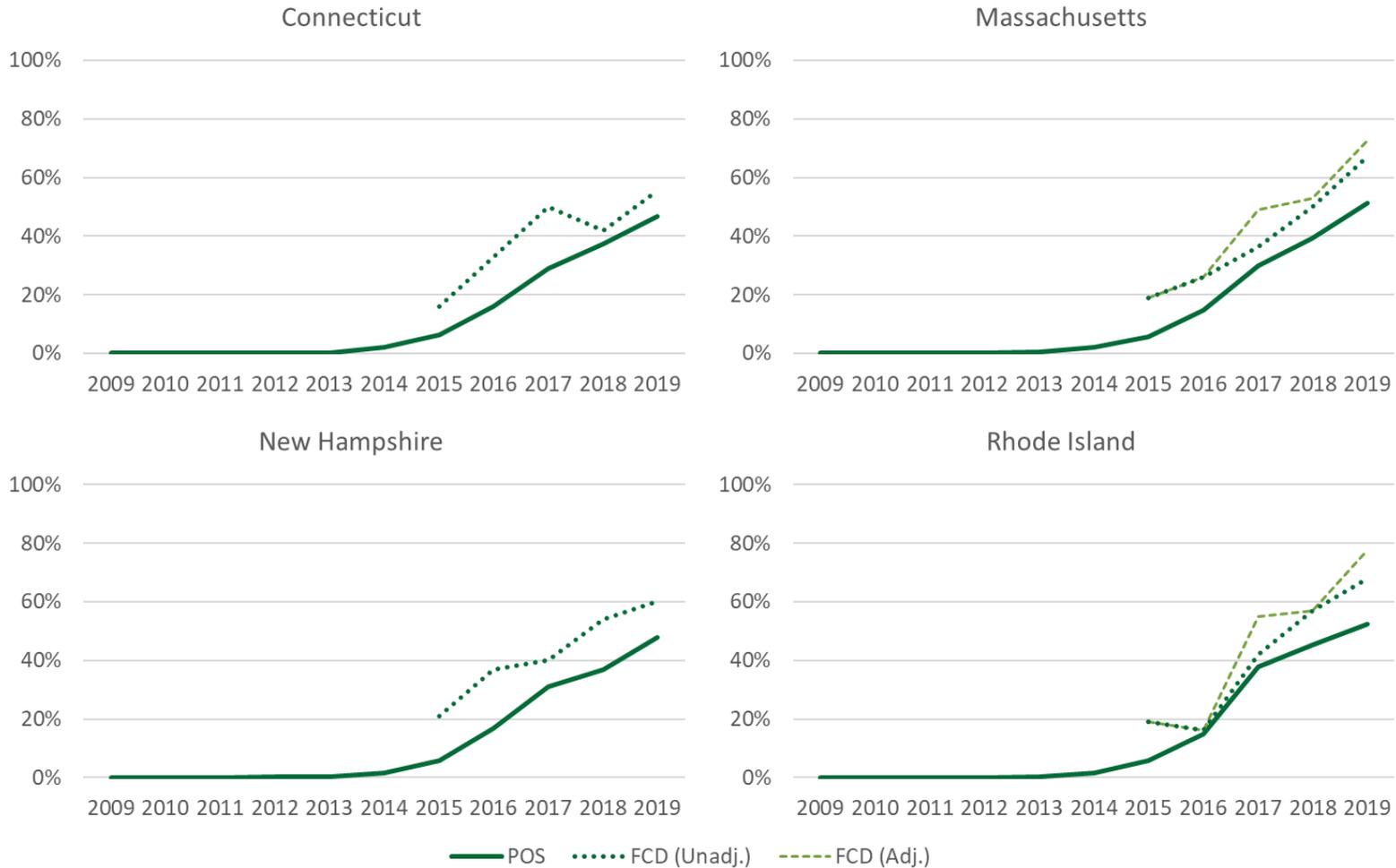


¹ POS includes discount, dollar, drug, grocery, mass merchandise, and some membership stores, while non-POS includes hardware, home improvement, and the remaining membership stores. See Table 2 for market share coverage for each data group.

² Massachusetts and Rhode Island market shares are not adjusted for known program sales.

Figure 12: Market Share by Technology, 2009-2019^{1,2}

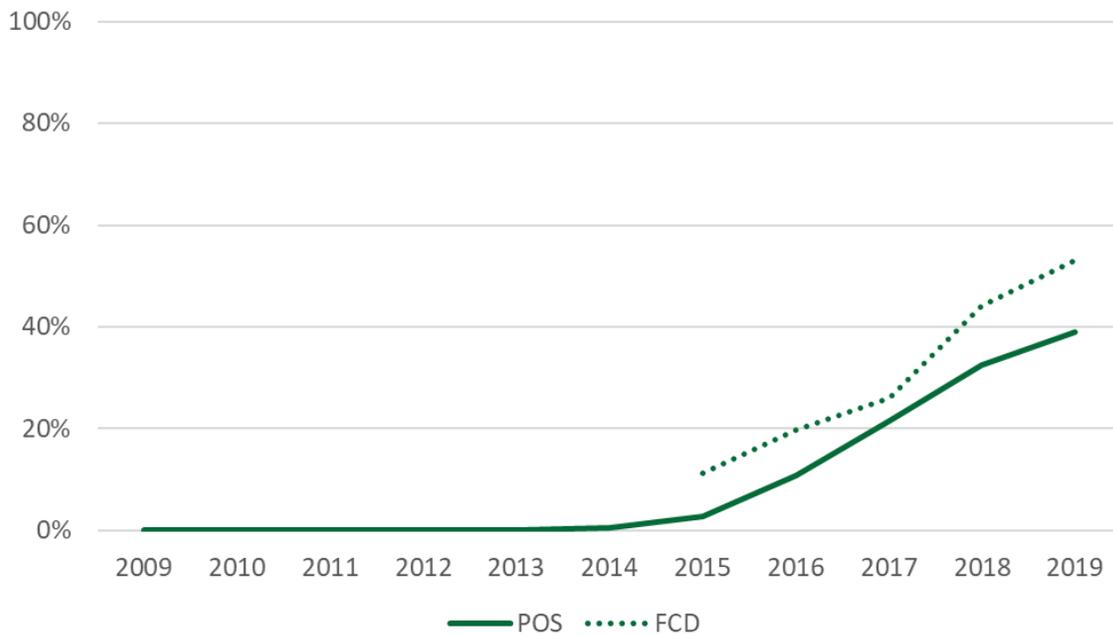
(Source: LightTracker – All Retail Channels, POS)



¹ POS includes discount, dollar, drug, grocery, mass merchandise, and some membership stores. POS data are not affected by CREED's adjustment for known program sales.

² Massachusetts and Rhode Island market shares are not adjusted for known program sales.

Figure 13: Non-program Market Share by Technology (n=8), 2009-2019^{1,2,3}
 (Source: LightTracker – All Retail Channels, POS)



¹ POS includes discount, dollar, drug, grocery, mass merchandise, and some membership stores. POS data are not affected by CREED’s adjustment for known program sales.
² Massachusetts and Rhode Island market shares are not adjusted for known program sales.
³ For consistent comparison across years, non-program states are restricted to Alabama, Delaware, Kansas, Kentucky, Mississippi, Nebraska, Tennessee, and Virginia for all years shown. Therefore, the market shares for non-program states in the figure above differ slightly from market shares for the full list of current non-program states, such as those reported in [Figure 11](#).

NEMA Shipment Share

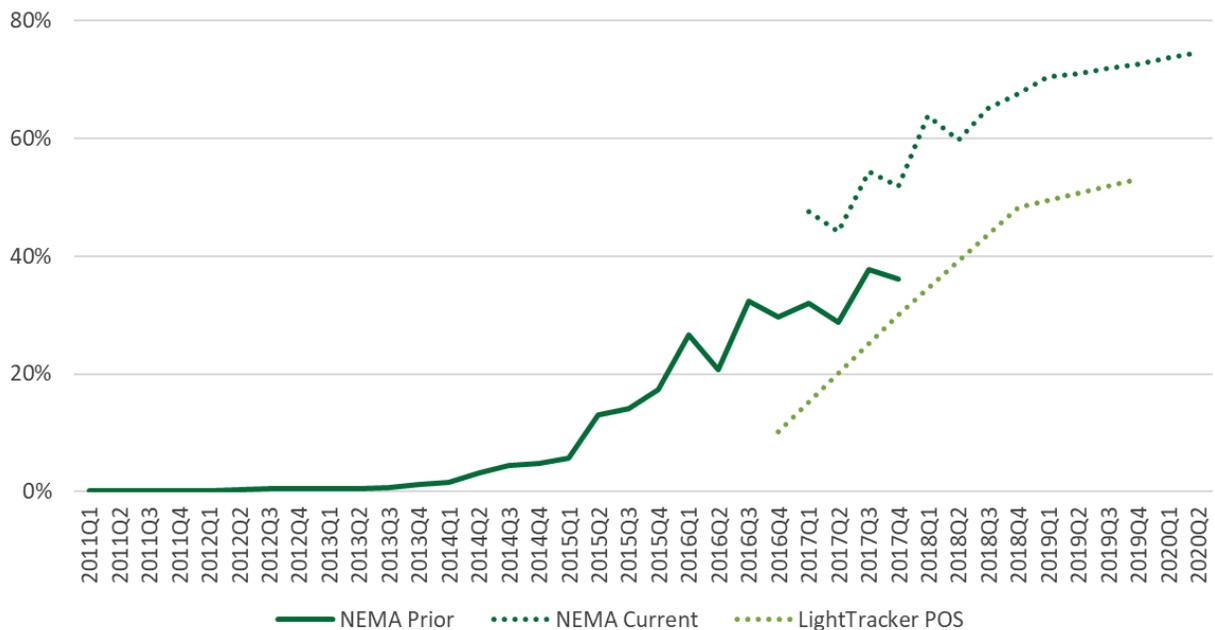
Figure 14 shows NEMA A-line bulb quarterly shipment shares for 2011 to Q2 of 2020 using two different methods. It also shows comparable annual POS data for 2016 to 2019. The takeaway from the graph is that LED shipment share grew rapidly between 2015 and 2018 but appears to have slowed in 2019 thru Q2 of 2020, a period in which POS (and FCD) shares for A-lines also slowed down. Both shipment shares and sales shares grew by five percentage points between 2018 and 2019 (actually Q2 2020 for NEMA).

When reviewing the NEMA data, two points must be kept in mind. First, sales often lag shipments as bulbs may sit in warehouses before being placed on store shelves and sold to customers. Second, as described above (Section 1.2.2), NEMA revised its approach to estimating shipments in 2017, incorporating international sales and dropping incandescents and low- and high-lumen bins from the shipment share calculations. In Figure 14, the solid line shows the LED portion of A-line bulb shipments among NEMA members from Q1 2011 to Q4 2017 (the prior method). The darker dashed line shows the LED portion of A-line bulb shipments of NEMA members augmented with data on international shipments into the US for Q1 2017 to Q2 2020 (the current

method).²⁶ Through 2017, both NEMA methods pointed to the same trend of growing LED market share, although they differed in magnitude. The average LED shipment shares for 2017 were 34% using the prior method and 50% using the current method, a difference of 16%. This suggests that the new method may be overstating LED shipments by excluding incandescents and low and high lumen bulbs. The lighter dashed line shows the total annual U.S. LED portion of A-line bulb sales for POS channels, with incandescents and high and low lumen bulbs removed to increase comparability to the new NEMA method. The POS data mirror new NEMA shipment estimates, with a steep increase in 2017 and 2018, followed by slower growth through 2019. We lack the data to analyze the relationships between shipments, sales, and socket saturation. However, it is logical to expect that shipments of LEDs will slow as more sockets get filled with these long-lived bulbs that do not need frequent replacement.

Figure 14: A-line LED Shipment Share Over Time per NEMA and LightTracker^{1,2} (Prior and Current NEMA Calculation Methods)

(Sources: NEMA, LightTracker POS)



¹ POS includes discount, dollar, drug, grocery, mass merchandise, and some membership stores. POS data are not affected by CREED’s adjustment for known program sales.

² For comparison with NEMA shipment data, total U.S. LED market share excludes incandescents and A-lines below 310 and above 2600 lumens. LightTracker only made lumen data available in 2016.

²⁶ Appendix A.2 compares the shipment share for all four A-line bulb types. The prior method included incandescents in the calculation of shipment share, while the current method does not.

2.1.2 Market Share by Bulb Shape



LED market share for reflectors were at least 80% in all areas studied. Candelabras saw the largest growth in market share between 2018 and 2019.

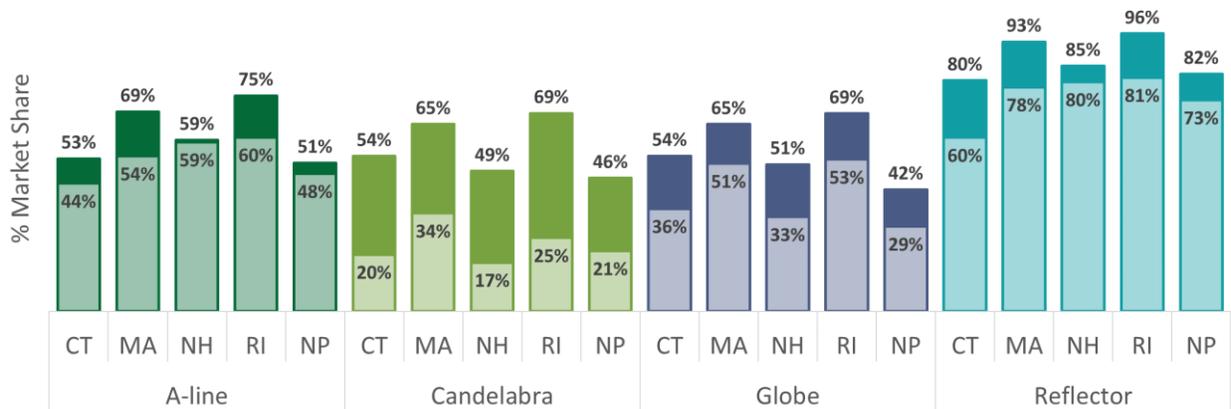
Figure 15 compares the market share for all retail channels (represented by FCD data) by bulb shape in 2018 and 2019. The Massachusetts and Rhode Island data reflects the CREED adjustment for known sales volumes, limiting comparisons across the areas. Therefore, we encourage the reader to focus on market share trends within areas by bulb shape.

In both years, reflectors had the highest LED market share of all bulb types, exceeding 60% of market share in all areas in 2018 and 80% in 2019. Candelabra market share in all areas had the largest growth (25 to 44 percentage point increase), followed by globes with a 13 to 18 percentage point increase between 2018 and 2019. In 2019, candelabra LED market share was 46% in non-program areas and globe LED market share was 42%, which is below market share for the Study States. The popularity of filament-style bulbs (vintage-style) as a decorative choice, coupled with the general market trend towards LEDs, likely explains the boost in market shares for candelabra and globe LEDs in 2019.

The A-line market share in 2019 was 51% in non-program areas and 53% or higher in each of the Study States. The percentage point increase in A-line market share between 2018 and 2019 in non-program areas, Connecticut, and New Hampshire was smaller than the increase for the other bulb shapes. Massachusetts and Rhode Island saw relatively similar percentage point increases in A-line, globe, and reflector shares but large increases in candelabra shares. These market share estimates do reflect CREED’s adjustment for program sales.

Figure 15: Massachusetts, New Hampshire, and Comparison Areas LED Market Share by Bulb Shape, 2018-2019^{1,2}

(Source: LightTracker FCD – All Retail Channels)



¹ 2018 market share = lighter shade, 2019 market share = darker shade; NP = Non-program areas

² Massachusetts and Rhode Island market shares are adjusted for known program sales; unadjusted shares are not available.



Home improvement, hardware, and some membership store channels are driving globe and candelabra LED market shares.

Figure 16 breaks LED market share by bulb shape out by FCD, POS, and non-POS channels for each state, while Figure 17 reports 2016 to 2019 market share by bulb shape for the POS channels. As a reminder, the POS data comprise of discount, dollar, drug, grocery, mass merchandise, and some membership stores; the non-POS data comprise of hardware, home improvement, and some membership stores; and the FCD comprise of all the channels. The lower LED market shares for candelabras and globes in New Hampshire may be caused by the fact that half of all lighting sales in New Hampshire are in POS channels, a much higher proportion than in the other Study States.

Figure 16 shows that 2019 LED market share across all shapes and areas was higher in non-POS channels than in POS channels. This is especially true for candelabra and globe LED market share, which never exceed 33% across the areas in POS channels but were 58% or higher in all areas in the non-POS channels. While reflector market share in non-POS channels is 87% or higher across areas, the shares are 25 to 30 percentage points lower in POS channels. The fact that POS reflector shares fall below those of non-POS shares may indicate that there is still room for program influence in this subset of stores. Yet, the programs currently support reflectors in these channels. For example, in 2019, 22% of program reflector sales in Massachusetts went through two mass merchandise stores, the same proportion as the A-lines that went through these same two stores. Likewise, non-program market share in the POS channel was 63%, compared to 88% in non-POS channels; however, this POS reflector share was similar to Massachusetts (66%) and New Hampshire (62%), and higher than Connecticut (56%). Only Rhode Island (73%) had substantially higher reflector market share than non-program areas in POS channels. Thus, capturing the remaining reflector share in POS channels in the Study States may require a shift in program strategy to move the shares above naturally occurring market adoption.

Figure 17 demonstrates that, within the POS channels, LED shares across bulb types seemed to gain steam in 2017, particularly for reflectors.

Figure 16: 2019 Massachusetts, New Hampshire, and Comparison Areas LED Market Share by Bulb Shape and Subset¹

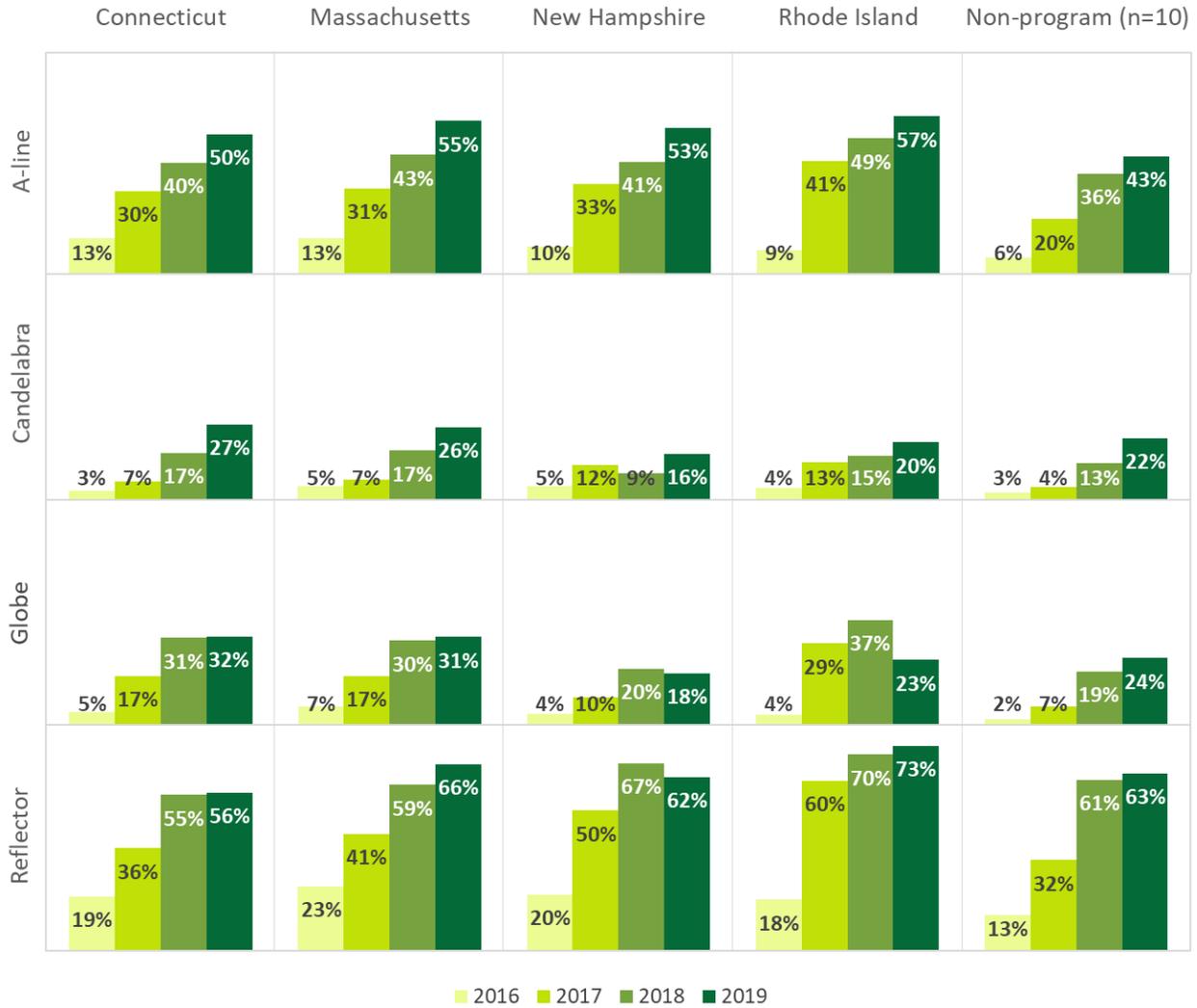
(Source: LightTracker FCD – All Retail Channels, POS, non-POS)



¹ FCD includes all retail channels. The POS subchannel includes discount, dollar, drug, grocery, mass merchandise, and some membership stores, whereas the Non-POS subchannel includes hardware, home improvement, and the remaining membership stores. Massachusetts and Rhode Island market shares are adjusted for known program sales in FCD and Non-POS data. POS data are not affected by CREED's adjustment for known program sales.

Figure 17: LED Market Share by Bulb Shape, 2016-2019¹

(Source: LightTracker POS)



¹ POS includes discount, dollar, drug, grocery, mass merchandise, and some membership stores. POS data are not affected by CREED's adjustment for known program sales.

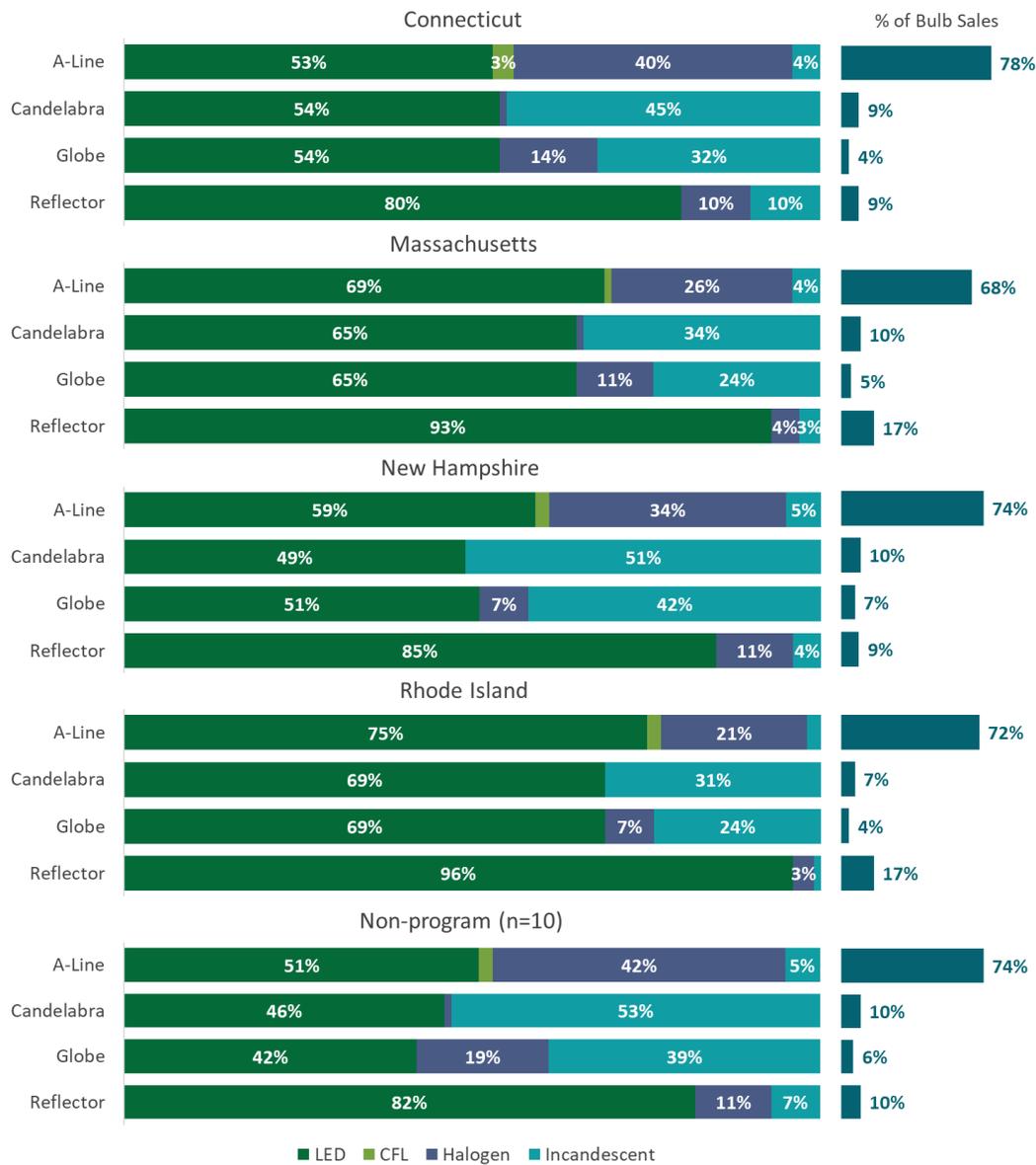


Halogens are the most common alternative to LEDs for A-line, whereas incandescents primarily make up the remaining market share of globes and candelabras. For reflectors, consumers across the areas are nearly equally as likely to opt for halogens and incandescents if they do not select an LED.

Across all Study States and non-program areas in 2019, halogens made up the second largest market share for A-lines (21% to 42%) after LEDs (Figure 18). Consumers generally show a slight preference for halogen over incandescent reflectors, but, in some areas, the two technologies are equally likely to be selected as an alternative to LED reflectors. In contrast, incandescents dominated non-LED bulbs in the markets for candelabras (31% to 53%) and globes (24% to 42%).

Figure 18: 2019 Market Share by Bulb Shape¹

(Source: LightTracker FCD – All Retail Channels)



¹ Massachusetts and Rhode Island market shares are adjusted for known program sales.

2.1.3 Market Share by Program Activity Analysis

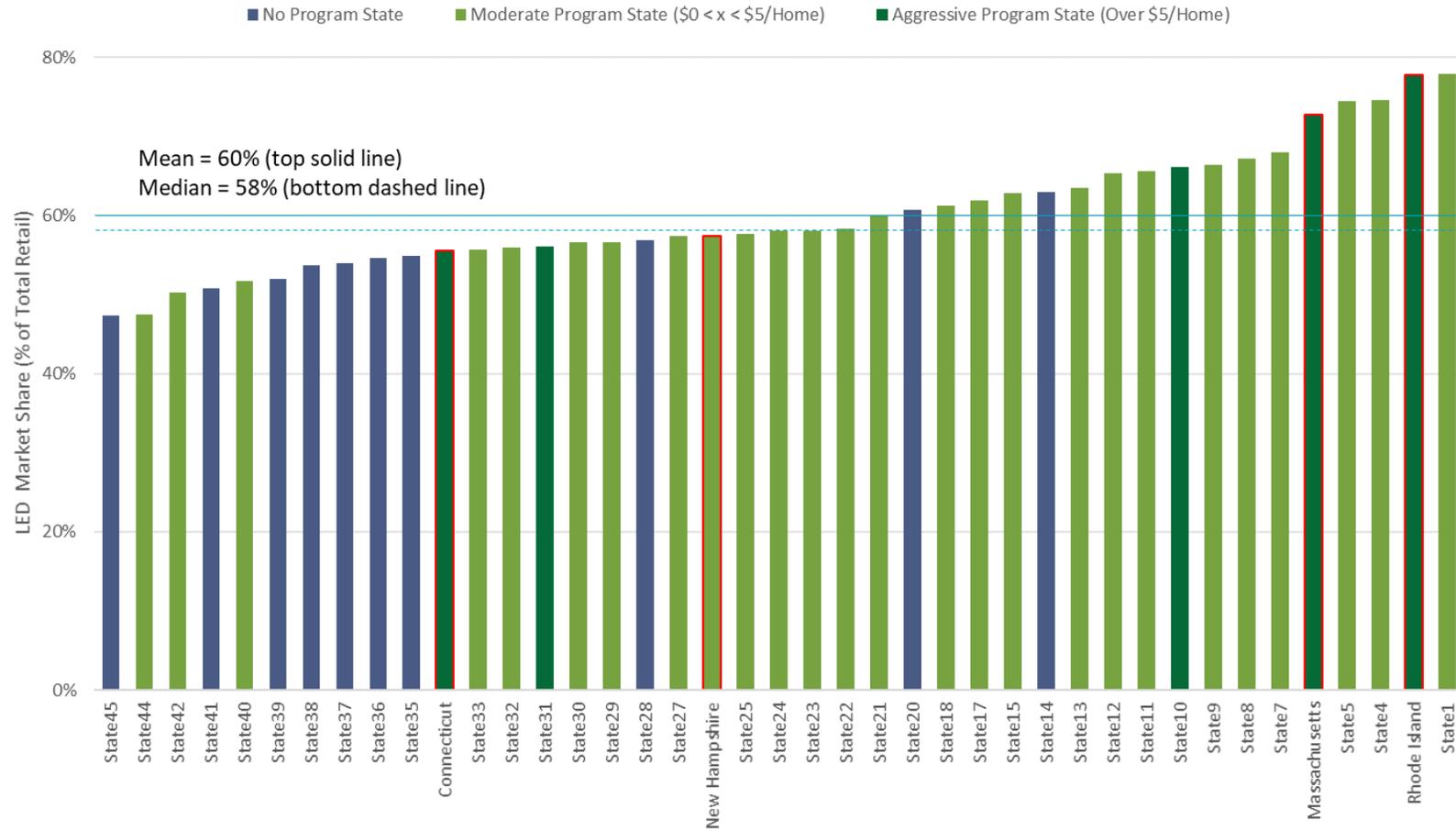


Massachusetts and Rhode Island, states with higher program spending, had higher LED market shares than any non-program state.

In [Figure 19](#), the states denoted in dark green had aggressive programs (program spending more than \$5 per household). Blue bars represent non-program states, and light green bars represent states with moderate spending between \$0 and \$5 per household. The mean LED market share across all states was 60%, and the median was 58%. With rare exceptions – State 20 used to have a program – non-program states had among the lowest market shares. Yet, aggressive program spending was not always associated with high market shares. Rhode Island ranked second (post-adjustment) and Massachusetts ranked sixth (post-adjustment) for LED market share. Even when considering pre-adjustment market share, Rhode Island and Massachusetts remained in the top ten states in terms of market share.

Market share in several non-program and moderate states, such as New Hampshire, rivaled or exceeded some of the few remaining aggressive program states, including Connecticut, which was likely still exhibiting the set-backs of the 2018 budget and program reductions. Aggressive, moderate, and non-program states each exhibit low to moderate market shares. Additionally, no state had less than 47% LED market share. These findings suggest that the natural market adoption of LEDs is slowly supplanting program incentives in boosting LED sales. However, despite the high average state market share, the clustering of the majority of non-program states at the bottom quarter of market shares suggest that program spending contributed to the high rankings of program states.

Figure 19: 2019 LED Market Share Across States by Program Spending¹
 (Source: LightTracker FCD – All Retail Channels)



¹ Massachusetts and Rhode Island market shares are adjusted for known program sales.

2.1.4 LED Market Share by ENERGY STAR Qualification



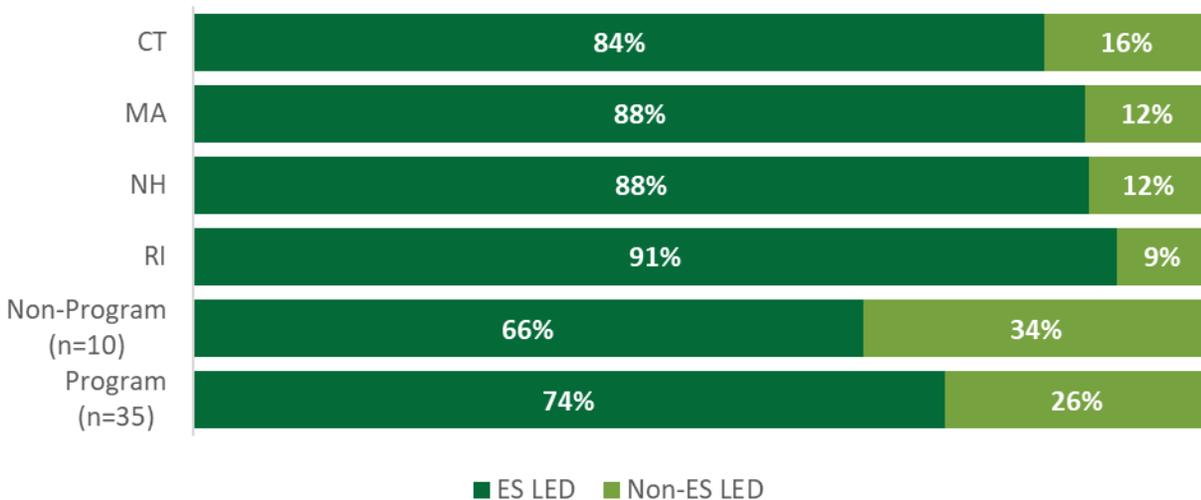
Market share of ENERGY STAR qualified LEDs among LEDs was at least two-thirds (66%) in all areas, including non-program areas.

The Study States’ upstream residential lighting programs only support ENERGY STAR qualified products. Recalling the shortcomings of the dataset for determining ENERGY STAR qualified market share (Section 1.2.1), their exclusive support of ENERGY STAR qualified bulbs is evident in the LightTracker data. ENERGY STAR qualified LEDs accounted for 91% of LED sales in this subset of retail channels in Rhode Island, 88% in Massachusetts and New Hampshire, and 84% in Connecticut (Figure 20). Rhode Island ranked fourth nationally for the percentage of LED sales that were ENERGY STAR, one percentage point behind the leading state. Massachusetts and New Hampshire ranked eighth, and Connecticut ranked 19th. Overall, the Study States are higher ranked in LED sales than program (74%) and non-program states (66%).

Study State ENERGY STAR qualified market share saw increases of at least ten percentage points from 2018 to 2019. In contrast, the increases were six percentage points for all program states and seven points for all non-program states (see Figure 30 Appendix A.1.3). New Hampshire had the largest ENERGY STAR qualified LED market share increase at 28% (19 percentage points), followed by Connecticut at 20% (14 percentage points).

Figure 20: ENERGY STAR Status of 2019 LED Sales¹

(Source: LightTracker POS)



¹ POS includes discount, dollar, drug, grocery, mass merchandise, and some membership stores. POS data are not affected by CREED’s adjustment for known program sales.

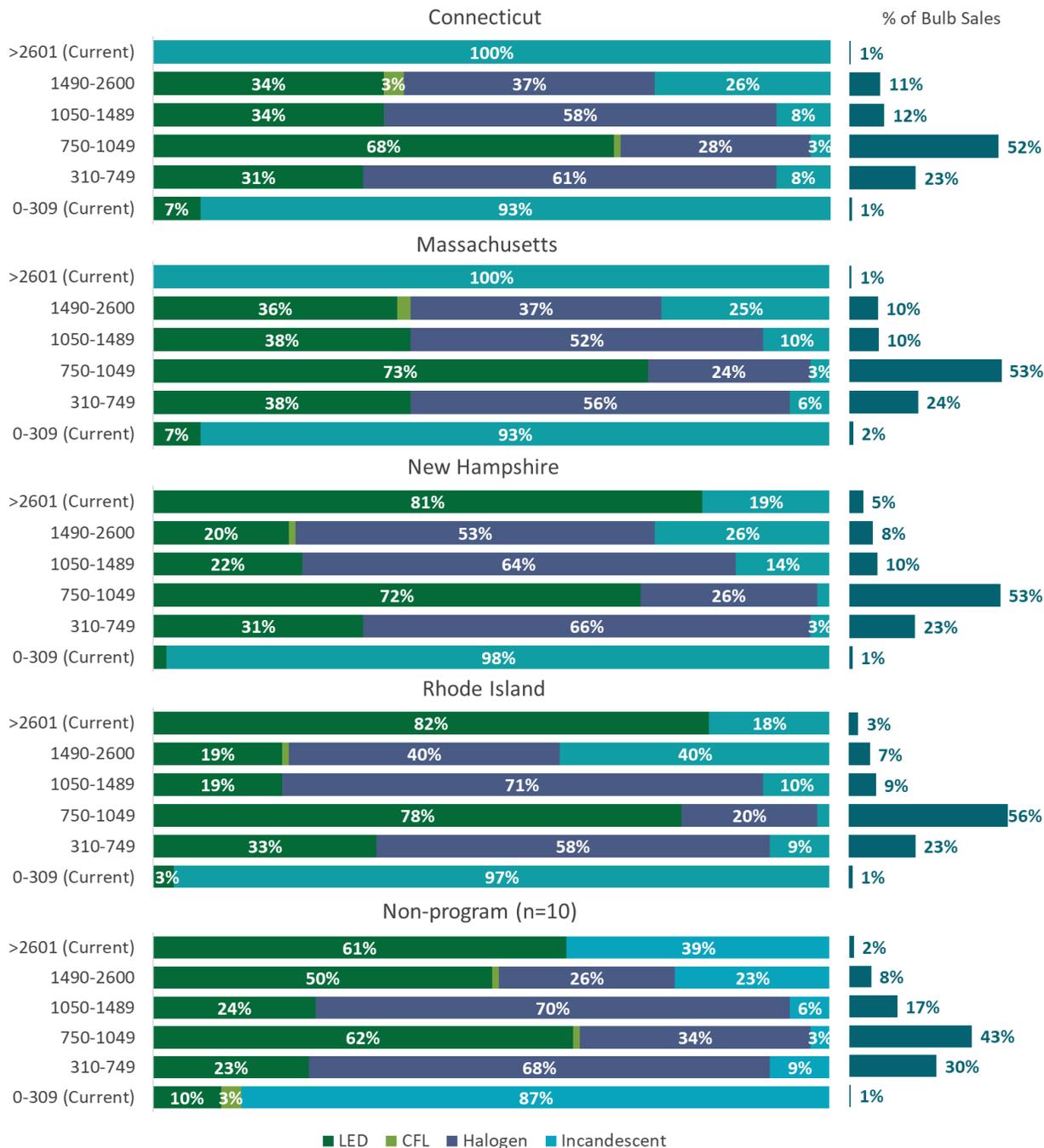
2.1.5 Market Share by Lumen Bin



LED sales in the Study States are strongest in lumen bins most closely associated with 60 Watt incandescent bulbs.

Figure 21 presents A-line market share by bulb type and lumen bins. It demonstrates that the 750 to 1,049 lumen bin (a 60 Watt incandescent equivalent) garnered 52% of sales in Connecticut (of which 68% were LEDs), 53% of sales in Massachusetts and New Hampshire (73% and 72% were LEDs, respectively), and 56% of sales in Rhode Island (78% were LEDs). LEDs also accounted for 31% to 38% of market share in the 310 to 749 lumen bin (23 to 24% of sales). In contrast, market share of bulbs that are below 310 lumens, which are currently exempt from EISA, remained dominated by incandescents for all areas. The market share of bulbs that are above 2,601 lumens, also currently exempt from EISA, remained dominated by incandescents in Connecticut and Massachusetts; LEDs led the market share in New Hampshire and Rhode Island for the same lumen bin. Non-EISA covered lumen bins represent only 2% to 6% of all lamp sales.

Figure 21: 2019 A-line Bulb Market Share by Lumen Bin^{1,2,3}
 (Source: LightTracker POS)



¹ Wattage equivalence: 0-309 lumens = <40W, 310-749 lumens = 40W, 750-1049 lumens = 60W, 1050-1489 lumens = 75W, >2601 = ≥150W

² Bins currently EISA Exempt: less than 310, above 2,600

³ POS includes discount, dollar, drug, grocery, mass merchandise, and some membership stores. POS data are not affected by CREED's adjustment for known program sales.

2.2 BULB PRICE ANALYSIS

NMR compared the average price of LEDs and halogens for the Study States and non-program areas using the FCD lighting data. The prices in the LightTracker dataset reflect the application of program incentives. However, the third-party sources do not report prices for private label bulbs (also known as store brands). Store brands usually sell for less than brand name models, so the prices reported in this section should be considered on the high end of what consumers pay at the register. We also compared average price of bulbs by technology and shape in non-program areas using the POS lighting data.



The high incentives in Connecticut, Massachusetts, and Rhode Island have contributed to them having some of the lowest shelf prices of the comparison areas.

In 2019, LEDs saw a continued decline in prices from previous years, resulting in smaller price differences from halogens in Connecticut (66 cents), Massachusetts (42 cents), and Rhode Island (64 cents). However, LEDs cost about \$1.37 more in New Hampshire, a moderate program state, and \$1.20 more in non-program areas. While LED prices in New Hampshire and non-program areas have increased slightly from 2018, the general trend suggests the difference in LED and halogen prices is narrowing.

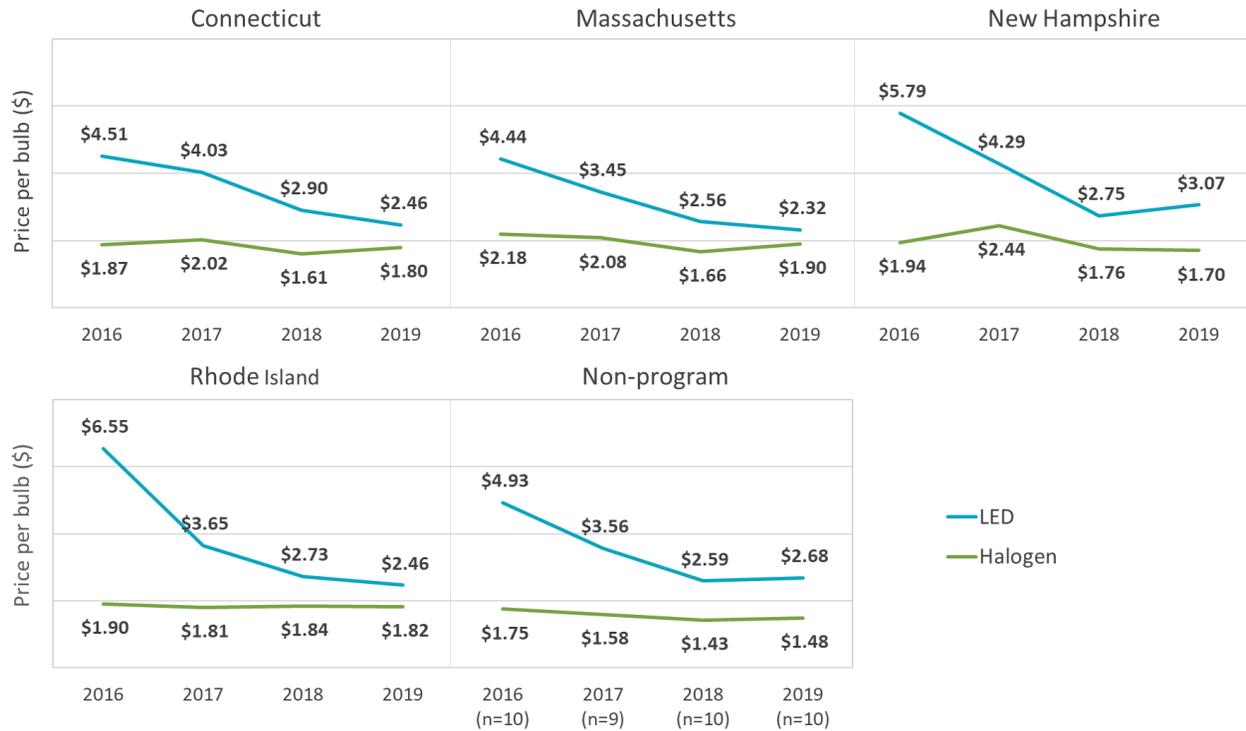
NMR believes that the low average LED price in non-program areas likely reflects a combination of factors. First, the prices include both ENERGY STAR and non-ENERGY STAR LEDs; non-program states had the highest proportion of non-ENERGY STAR LEDs, which tend to be less expensive than ENERGY STAR models (Figure 22).²⁷ Second, it could also be that retailers have discounted the price of all LEDs in non-program areas either because of the lower cost-of-living in non-program states²⁸ or to boost LED sales, given that, prior to 2018, LED sales in non-program areas lagged those in program areas. Finally, data collection and reporting error could be influencing the result. Although the explanation remains unclear, the low price of LEDs in non-program areas provides additional evidence that market transformation has been increasing across the nation.

²⁷ At the ENERGY STAR Partners meeting in September 2019, manufacturers and retailers also reported that sales of non-ENERGY STAR LEDs are higher in the absence of program incentives for ENERGY STAR qualified bulbs.

²⁸ See analysis of cost-of-living differences in halogen prices in the *MA19R06 Sales Data Study* *ibid*.

Figure 22: Average Price per Bulb, 2016-2019¹

(Source: LightTracker FCD – All Retail Channels)



¹ Does not include private label (i.e., store brand) bulbs sold at specific retailers. The prices reported here are likely somewhat higher than actual shelf prices because private label bulbs often cost less than name-brand bulbs.

¹ Massachusetts and Rhode Island prices based on the adjusted sales estimate.



Average reflector shelf prices for LEDs fell below halogens in non-program states but remain higher than incandescents.

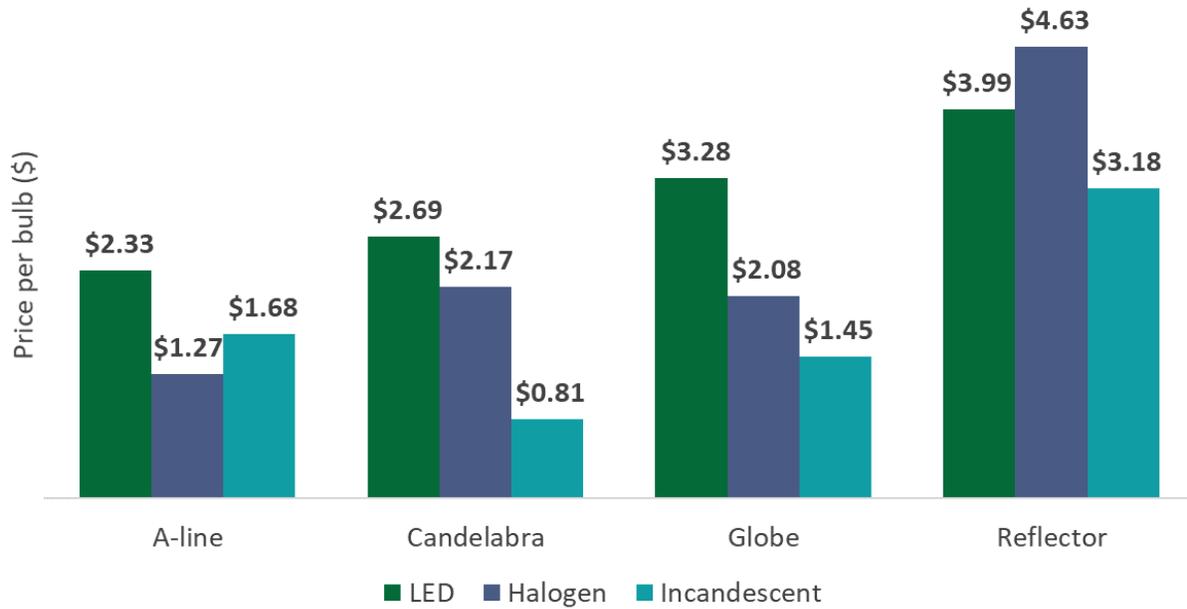
Figure 23 displays the shelf price by technology and shape for POS data in non-program areas. The average reflector shelf price for LEDs is lower than halogens by 64 cents, which suggests that LEDs are price competitive with halogens without program intervention.²⁹ However, incandescent bulbs remain lower in price, likely explaining why incandescents account for 64% of non-LED reflector sales (or 24% of all reflector sales) in POS channels.³⁰ LED shelf price is only slightly higher (52 cents) than halogens for candelabras; whereas, LED shelf price continues to be notably higher for A-lines and globes in POS channels in non-program areas. The analysis of POS price data by shape focuses on non-program areas because the aggregation of non-program states overcomes small sample sizes and removes any influence of program discounts, both of which that may bias results in individual Study States.

²⁹ A study conducted by SCS ANALYTICS for Connecticut raises concerns about certain incentive levels in that state. SCS found that the incentives sometimes exceeded the incremental first cost between LEDs and baseline halogens or incandescents. For example, SCS explains, “Incentives levels exceed the incremental first cost of 65W equivalent BR30 Directional bulbs ... in all retail channels except Discount where the increment first cost is highest.” (Emphasis in the original). It is likely that a similar incremental cost analysis may reveal similar concerns in all four Study States given the similarities in program designs and the reliance on the same implementation contractor. See SCS ANALYTICS. 2020. *R1963b Short Term Residential Lighting Report Public*. Page 7. Available at https://www.energizect.com/sites/default/files/R1963b_STLighting_FINAL%20Report_102920_0.pdf.

³⁰ Recall that halogens and incandescents generally split the market share for non-LED reflector FCD sales. See Figure 18.

Figure 23: Average Price per Bulb in Non-program Areas by Technology and Shape^{1,2}

(Source: LightTracker POS)



¹ Does not include private label bulbs sold at specific retailers, so the prices reported here are likely somewhat higher than actual prices.

² POS includes discount, dollar, drug, grocery, mass merchandise, and some membership stores. POS data are not affected by CREED's adjustment for known program sales.

Appendix A Data Sources and Data Cleaning

This appendix provides a detailed discussion of data sources, data cleaning, and the strengths and weaknesses of each source.

A.1 LIGHTING SALES DATA

CREED compiled the LightTracker Initiative dataset. These data fill a gap in the availability of market-level lighting sales data. While many program partners readily share program sales data, they are reluctant to share non-program sales data. Non-program retailers and manufacturers also rarely share sales data with PAs or evaluators. The LightTracker Initiative pools the resources of multiple PAs to make a new source of market level information available. While not perfect (see [Section 1.2.1](#) for a listing of strengths and weaknesses), it offers improved estimates of market-level sales for all retail channels and most states. LightTracker provides data for 45 of the 50 United States (see [Table 5](#) for a listing of states).

Though the dataset CREED received included detailed records of lighting data purchases, the data required a considerable effort to ensure data integrity and inclusion of all the necessary bulb attributes. For example, some records did not have critical variables populated, such as bulb type, shape, or wattage. In addition, some records had clearly erroneous values (e.g., 60-watt LEDs). After thorough review and quality control of the dataset, CREED re-classified and standardized the data. CREED also populated missing records, created additional variables, and performed general enhancements to the data. To populate missing records, validate existing records, and include additional bulb attributes, CREED created a proprietary Universal Product Code (UPC) database with approximately 36,000 bulbs from the following five sources:

- Manufacturer product databases provided to LightTracker
- Product catalogs downloaded from manufacturer web sites via web scraping
- Product offerings downloaded from retailer web sites
- Automated lookups of online UPC databases, such as www.upcitemdb.com
- ENERGY STAR databases available online at <https://www.energystar.gov/productfinder/product/certified-light-bulbs>

Table 5: Program Strength and Data Quality Confidence

Program States	Non-program States	Unable to Categorize/ Excluded from LightTracker ¹
Arizona	Alabama	Alaska
Arkansas	Delaware	Hawaii
California	Kansas	Iowa ²
Colorado	Kentucky	Montana
Connecticut	Mississippi	North Dakota
Florida	Nebraska	
Georgia	Nevada	
Idaho	Tennessee	
Illinois	Virginia	
Indiana	Wyoming	
Louisiana		
Maine		
Maryland		
Massachusetts		
Michigan		
Minnesota		
Missouri		
New Hampshire		
New Jersey		
New Mexico		
New York		
North Carolina		
Ohio		
Oklahoma		
Oregon		
Pennsylvania		
Rhode Island		
South Carolina		
South Dakota		
Texas		
Utah		
Vermont		
Washington		
West Virginia		
Wisconsin		

¹ LightTracker was unable to assign program status to these states or the states lacked sales data or LightTracker.

² CREED was able to obtain program data for Iowa, but the state’s representation in the POS and NCP data used to create the LightTracker dataset is too small to allow for estimation of bulb sales and market share.

CREED then merged the bulb database with the POS/Panel data, populating fields based on a hierarchy of data sources believed to be most reliable. Prioritization was typically in the following order: manufacturer specifications, UPC lookups, original data provider (IRI and Nielsen), and database values. The LightTracker team also conducted manual web lookups on individual bulbs to determine final assignments.

In addition, CREED investigated the bulb assignment and the quantity of bulbs per package by examining the average price per unit and by identifying outliers in terms of per bulb prices. This process helped identify misclassification of certain bulb types (e.g., bulbs that were flagged as low cost LEDs but were really LED nightlights, so they needed to be moved to the *other* category) and misclassification of bulb counts that represented box shipments (e.g., a package identified as having 36 bulbs was really a six-pack of CFLs that was shipped with six packages per box).

Key aspects of the final lighting dataset include the following:

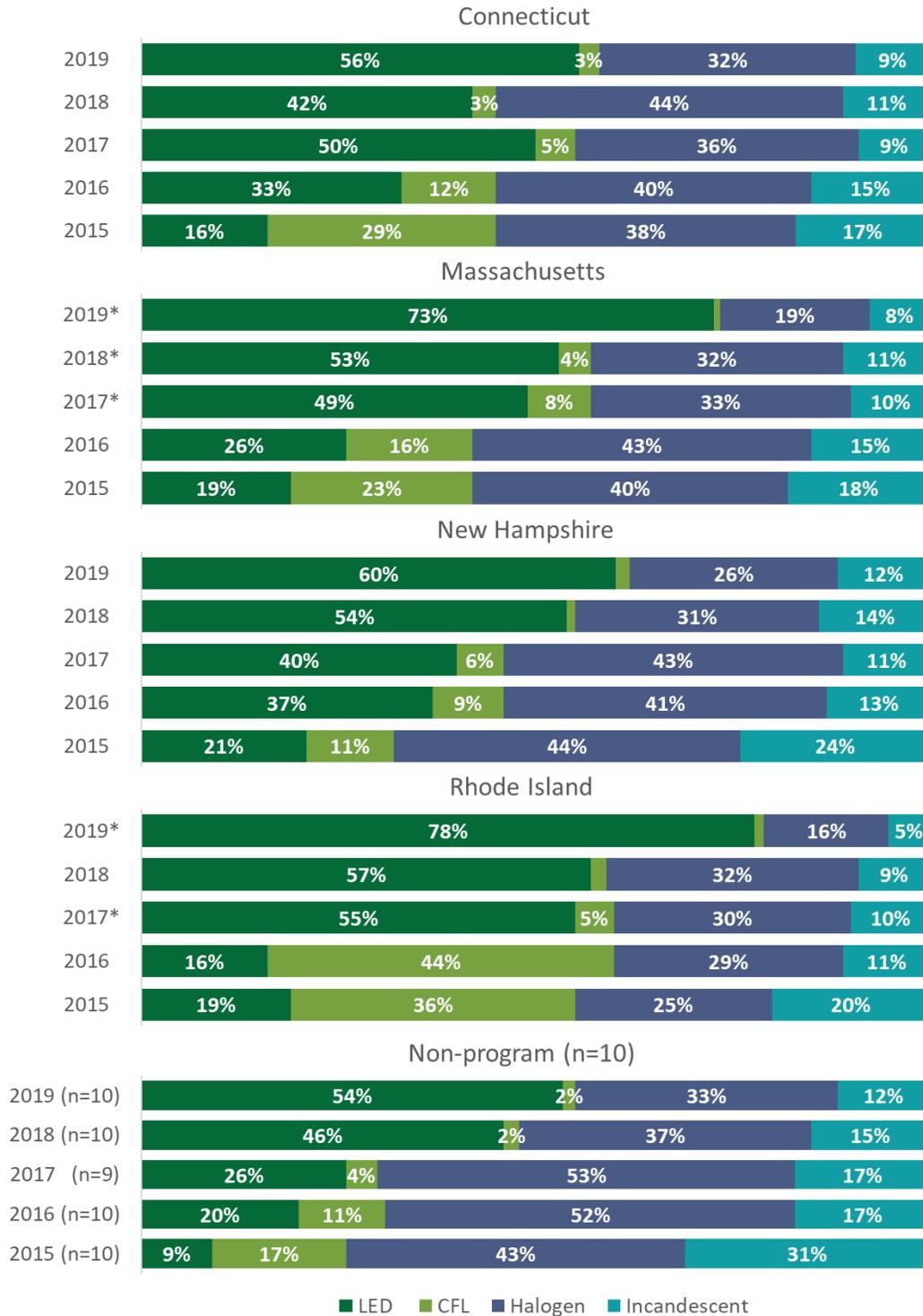
- 2019 sales volume and pricing for CFLs, LEDs, halogens, and incandescent bulbs for all channels combined, and broken out by the POS and non-POS channels
- Data reporting by state (with 45 states included) and bulb type
- Inclusion of all bulb shapes (e.g., candelabra, globe, etc.) and controls (e.g., three-way, dimmers, etc.)

A.1.1 Market Share Adjustment

Figure 24 shows FCD market share over time, adjusted for program sales for Massachusetts and Rhode Island.

Figure 24: Adjusted Market Share by Bulb Technology, 2015-2019¹

(Source: LightTracker FCD – All Retail Channels)



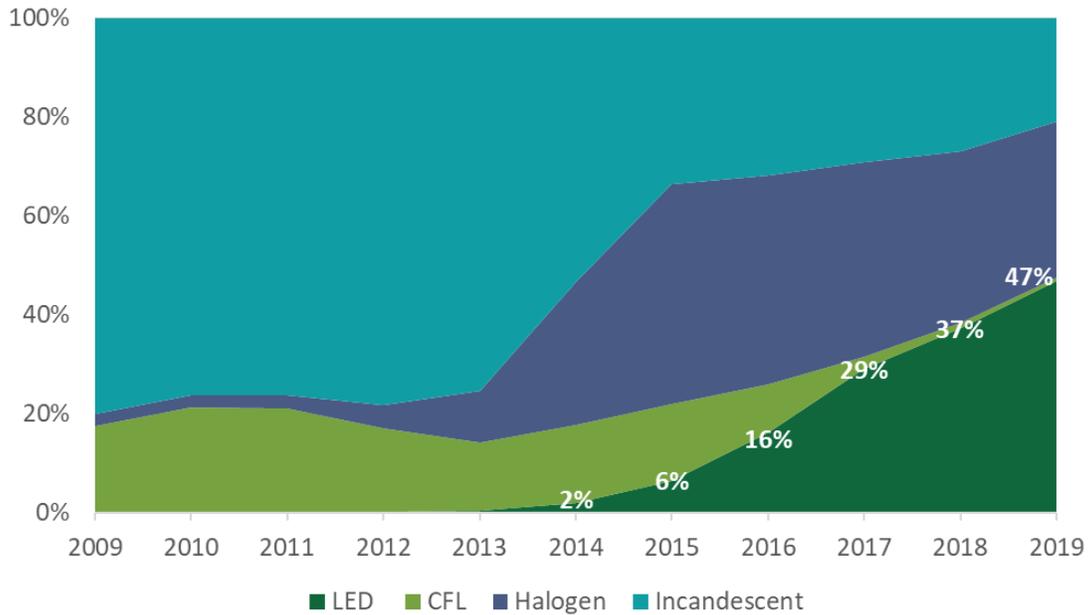
¹ Massachusetts and Rhode Island market shares are adjusted for known program sales, indicated with an (*).

A.1.2 POS Market Share, 2009 to 2019

Figure 25 to Figure 29 present area graphs of POS market share from 2009 to 2019 for all light bulb technologies. They demonstrate the rapid decline in incandescent and CFL market shares, the initial growth and then decrease in halogen market shares, and the large and consistent growth in LED market shares across all of the areas. However, LED growth occurred more quickly in the four Study States – especially Rhode Island – compared to non-program states.

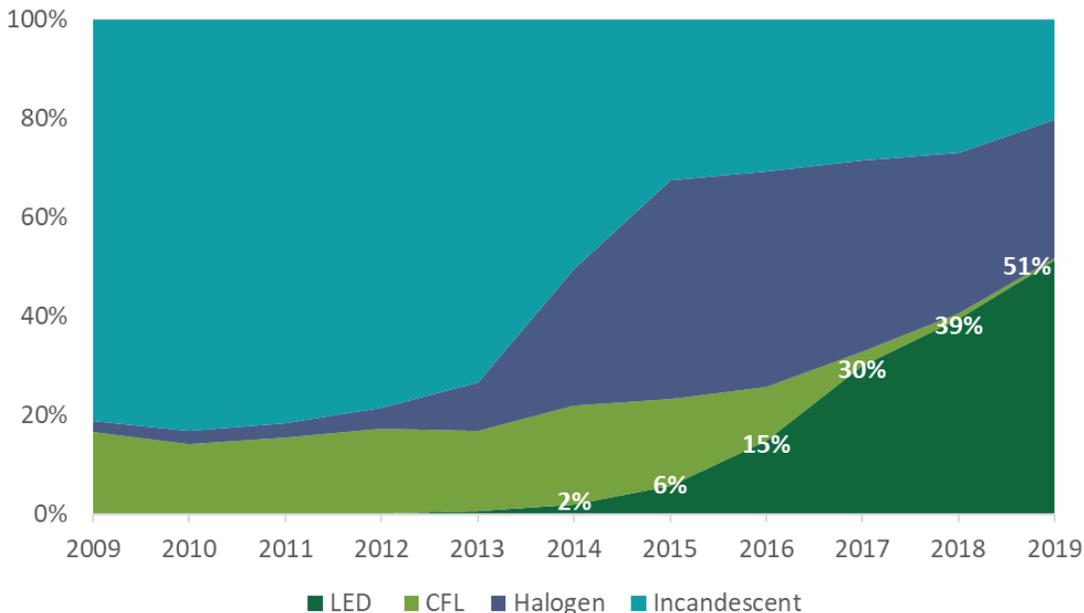
Figure 25: Connecticut LED Market Share by Technology, 2009-2019¹

(Source: LightTracker POS)



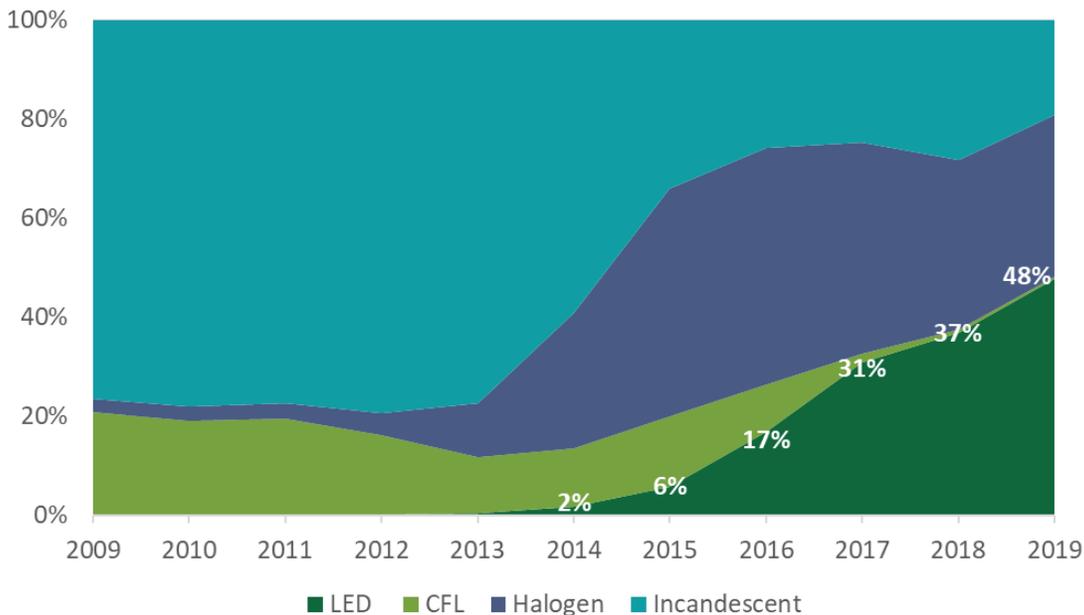
¹ POS includes discount, dollar, drug, grocery, mass merchandise, and some membership stores. POS data are not affected by CREED's adjustment for known program sales.

Figure 26: Massachusetts LED Market Share by Technology, 2009-2019^{1,2}
 (Source: LightTracker POS)



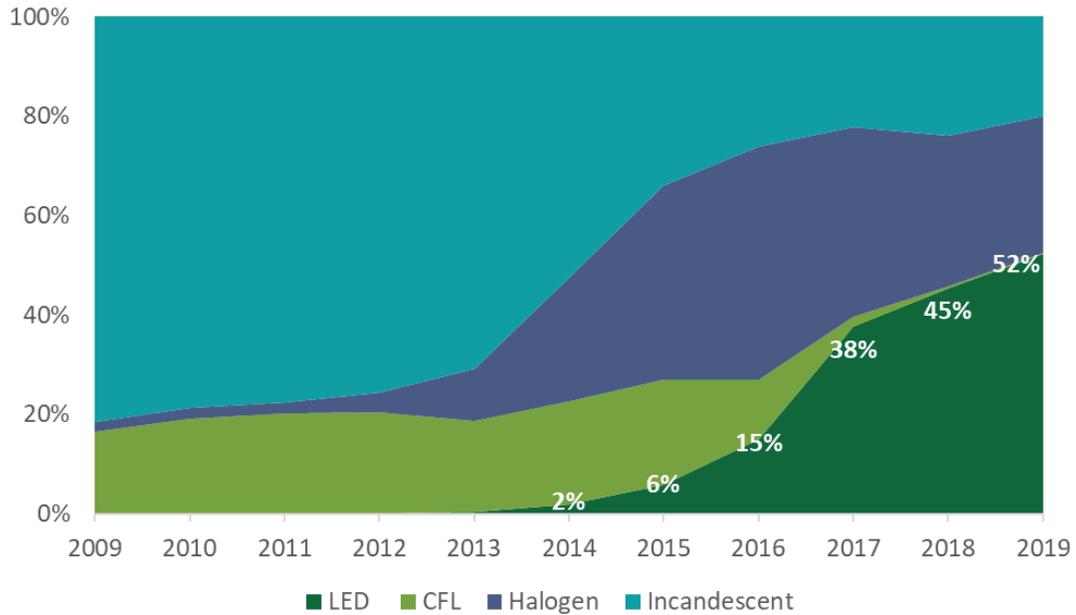
¹ POS includes discount, dollar, drug, grocery, mass merchandise, and some membership stores. POS data are not affected by CREED's adjustment for known program sales.

Figure 27: New Hampshire LED Market Share by Technology, 2009-2019¹
 (Source: LightTracker POS)



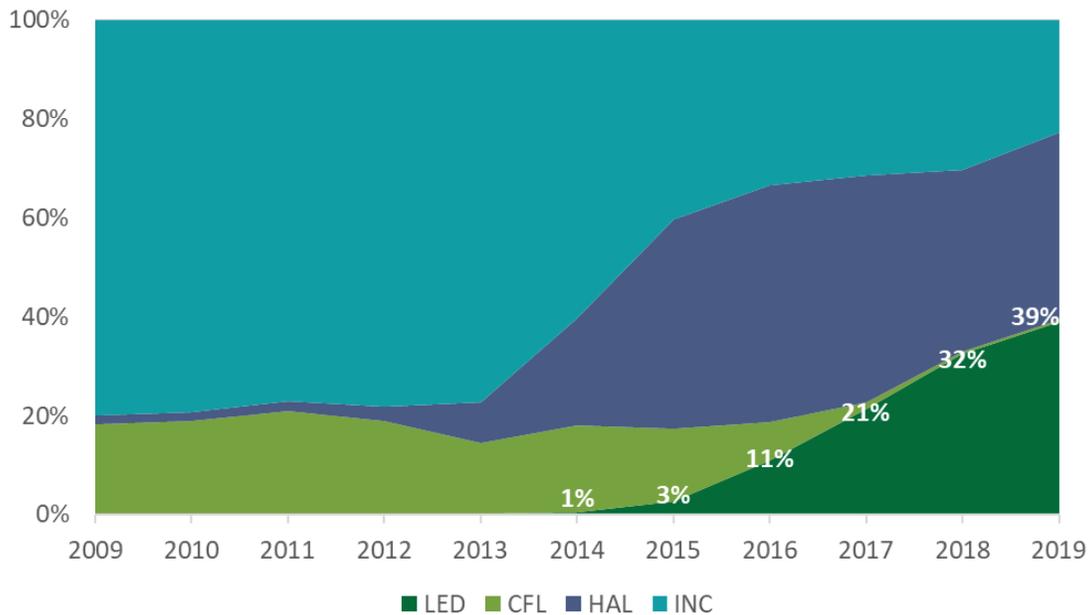
¹ POS includes discount, dollar, drug, grocery, mass merchandise, and some membership stores. POS data are not affected by CREED's adjustment for known program sales.

Figure 28: Rhode Island LED Market Share by Technology, 2009-2019^{1,2}
 (Source: LightTracker POS)



¹ POS includes discount, dollar, drug, grocery, mass merchandise, and some membership stores. POS data are not affected by CREED's adjustment for known program sales.

Figure 29: Non-program LED Market Share by Technology, 2009-2019¹
 (Source: LightTracker POS)



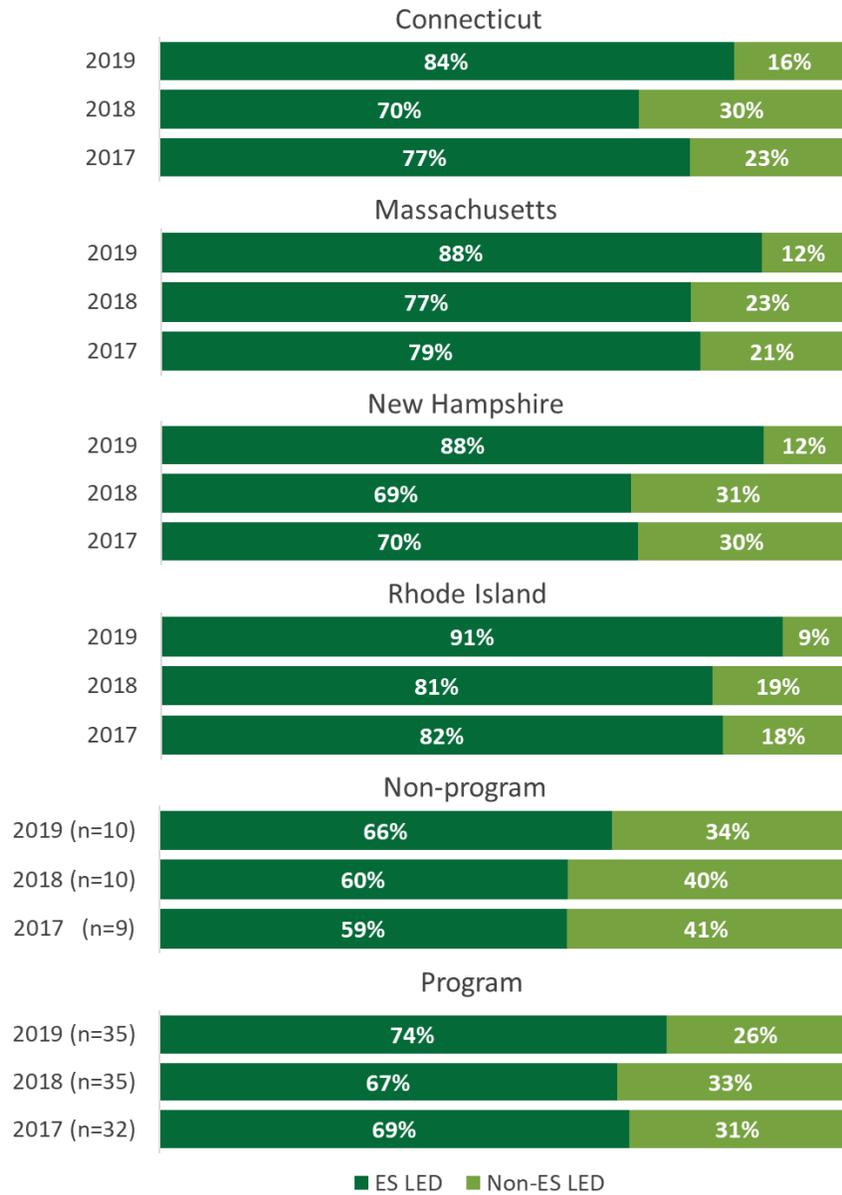
¹ POS includes discount, dollar, drug, grocery, mass merchandise, and some membership stores. POS data are not affected by CREED's adjustment for known program sales.

² For consistent comparison across years, non-program states are restricted to Alabama, Delaware, Kansas, Kentucky, Mississippi, Nebraska, Tennessee, and Virginia for all years shown. Market share for non-program states shown in the figure above may differ from market share for non-program states shown elsewhere in this report.

A.1.3 ENERGY STAR Qualification Over Time

Figure 30: ENERGY STAR Status of LED Sales, 2017-2019¹

(Source: LightTracker POS)

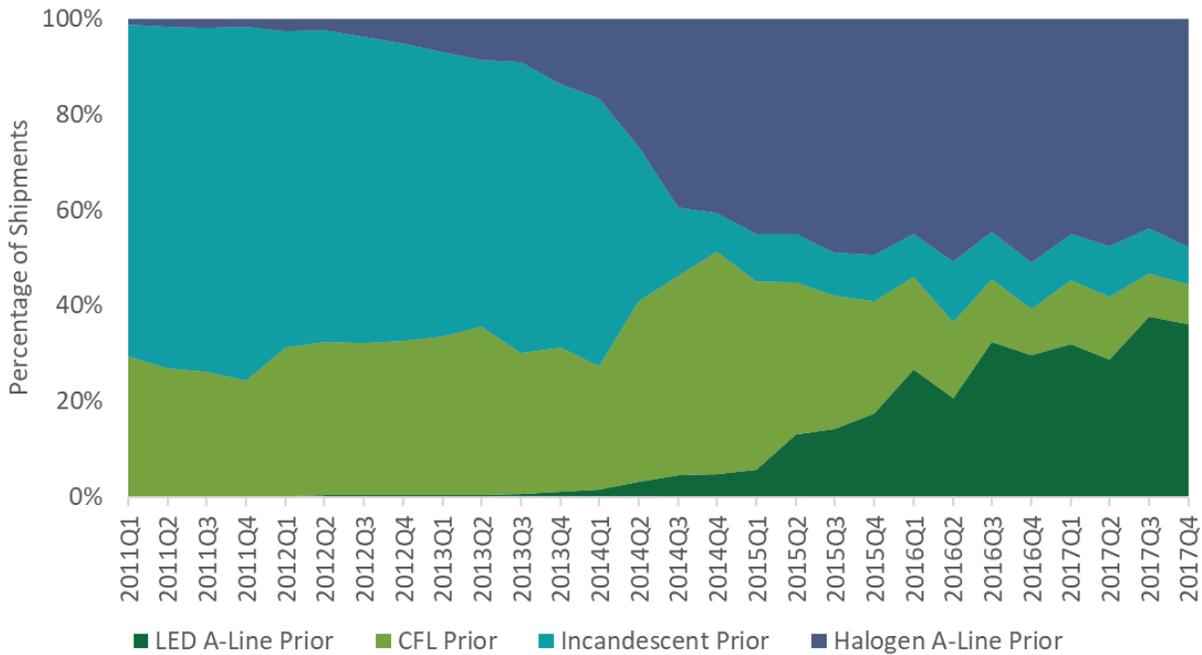


¹ POS includes discount, dollar, drug, grocery, mass merchandise, and some membership stores. POS data are not affected by CREED's adjustment for known program sales.

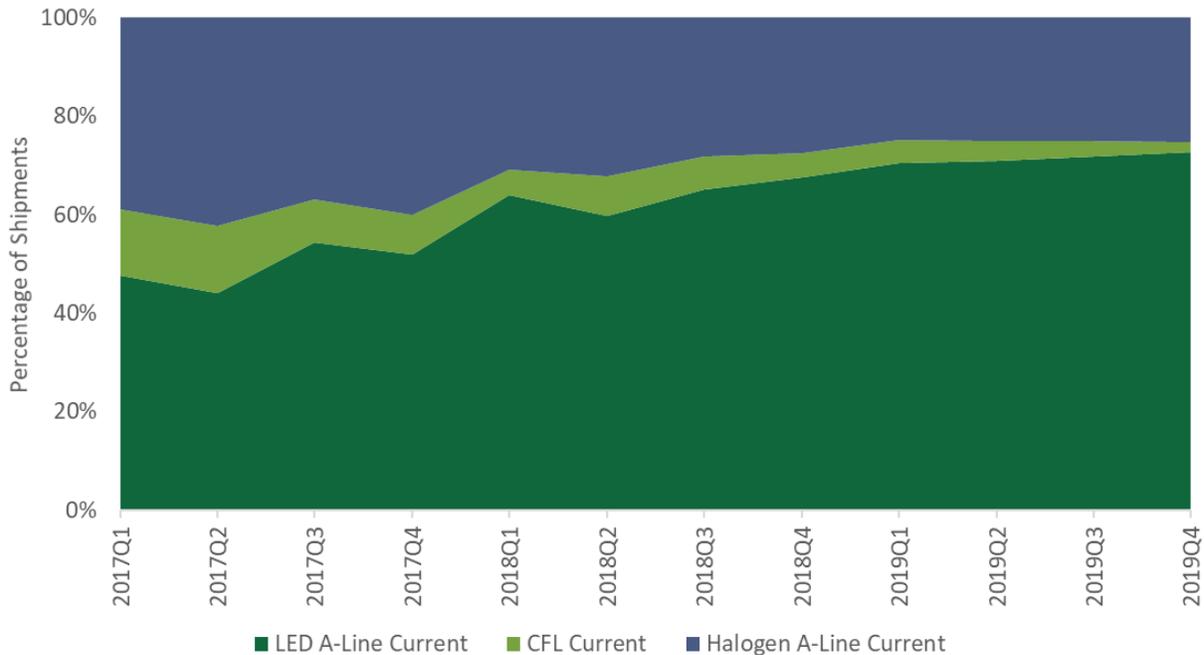
A.2 NEMA SHIPMENT DATA

Section 1.2.2 of the main body of the report describes the NEMA shipment data and discusses the recent change NEMA made to its method of calculating shipment shares. Section 2.1.1 presents data on LED shipment shares using the prior and current NEMA estimation methods and compares the shipment shares to sales shares. Figure 31 and Figure 32 present the shipment shares over time for all bulb types, from 2011 to 2017 using the prior NEMA calculation method and including incandescents (Figure 31) and from 2017 to Q1 2019 for LEDs, halogens, and CFLs (Figure 32). Both figures demonstrate the shrinking CFL share. Figure 31 also shows the decline in incandescent shares. Figure 31 and Figure 32 differ in that the former suggests relatively steady market share for halogens from late 2015 through 2017, with LEDs encroaching on CFLs and incandescent, while the latter suggests that LEDs are also encroaching on halogen shares.

Figure 31: NEMA Shipment Share, All Bulb Types (Prior Calculation Method)



**Figure 32: NEMA Shipment Share All Bulb Types
(Current Calculation Method, Excludes Incandescents)**



A.3 PROGRAM ACTIVITY

To research program activity, the LightTracker team used internal resources and conducted a literature review of publicly available reports that they found on the internet or that were provided by PAs or their evaluators.³¹ The team contacted local utilities in each given area when reports with the relevant information were not available. Additionally, the team accessed DSM Insights, an E Source product that provides a detailed breakdown of program-level spending, including incentives, marketing, and delivery for over 100 PAs around the country.³²

The team collected the following program data:

- Total number of claimed LED upstream program bulbs reported by each program
- Upstream LED incentives
- Total upstream program budget

Where available, the team used actual program data. In other cases, the team turned to DSM Insights, ENERGY STAR reported expenditures, or planning values as proxies.³³

The team categorized all states with at least some program activity in 2019 as *program states*; the team categorized the remaining states as *non-program states*, as shown in [Table 5](#).

³¹ Specifically, the team began by searching the ENERGY STAR Summary of Lighting Programs website <https://www.energystar.gov/ia/partners/downloads/2018%20ENERGY%20STAR%20Summary%20of%20Lighting%20Programs.pdf> and referenced the Database of State Incentives for Renewables & Efficiency (www.dsireusa.org).

³² E Source. “DSM Insights.” April 2018.

³³ Note that because the ENERGY STAR report only included expenditure ranges, the midpoints of the ranges were used to represent the expenditures.