



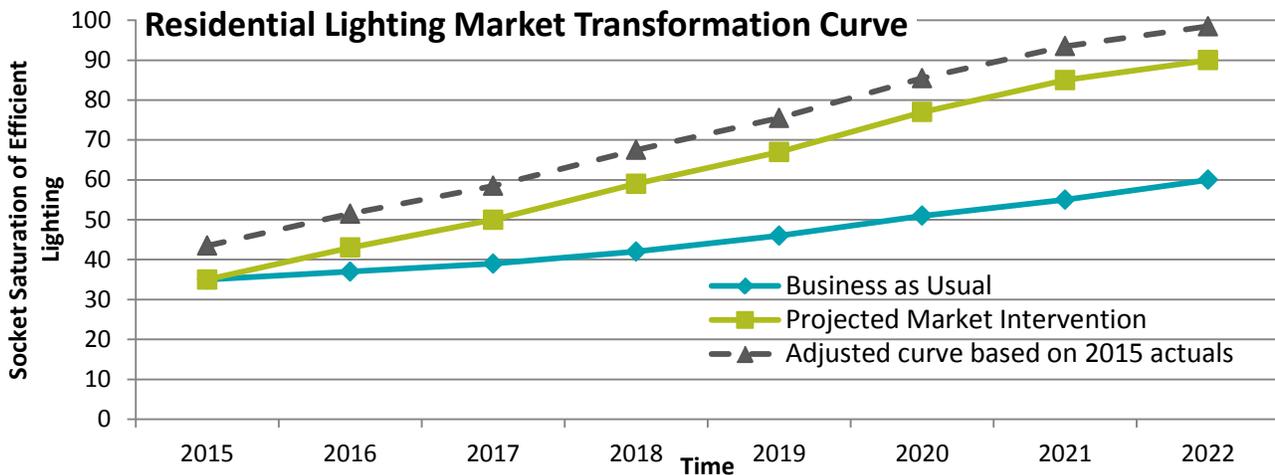
The State of the Market: A Residential Lighting Brief

Northeast Energy Efficiency Partnerships, July 2016

Introduction

Northeast Energy Efficiency Partnerships (NEEP) has been tracking the residential lighting market for several years and has provided analysis in many reports.ⁱ As the transformation of this complex market gains traction, we find the conversation and need for new information narrowing to one key topic: LEDs. While CFLs continue to play a role in residences and amongst Northeast and Mid-Atlantic program administrators, the LED has transitioned into the starring role of the residential lighting show.

In mid-2016, NEEP’s State of the Market Brief focused on updating regional residential lighting progress towards market transformation; looking also at the latest and greatest in technologies, program approaches, and trends in the LED lighting space. As can be gleaned from the curve presented below, the Northeast and Mid-Atlantic region is tracking ahead of the projections put forward in the 2015 Residential Lighting Strategy Update.ⁱⁱ



When 2015 socket saturation information started to become available, we found that what we had projected as efficient lighting socket saturation for 2016 was actually achieved in 2015. If transformation continues along the same trend line as initially predicted, the region could reach the goal of 80-90 percent efficient lighting 1-2 years ahead of schedule. As this brief will discuss, the pace of advancement is largely based on advances in the LED market.

Extra, Extra: New Lower Lifetime LEDs Certify to ENERGY STAR Lamps 2.0!

With the finalized Version 2.0 Lamps Specification released by ENERGY STAR in late 2015,ⁱⁱⁱ stakeholders across the country eagerly awaited the availability of new products to meet the new specification. Since the newly-set efficacy levels were very stringent, no CFLs from the current list will meet the new speciation. For the omnidirectional product category, ENERGY STAR and stakeholders worked hard to establish criteria that would maximize the quality, efficiency, and affordability of LEDs.





Because of the testing requirements, particularly around lifetime, it takes many months of testing to earn certification, but NEEP is pleased to announce that as of report publication, over 300 A-style LEDs have certified to Version 2.0, including the GE products pictured above, 65 of which are taking advantage of the new lower lifetime requirements of version 2.0 and offering 15,000 hour lifetimes. Of those 65 products with 15,000 hour lifetimes, below is a breakdown of the lumen buckets the products fit within.

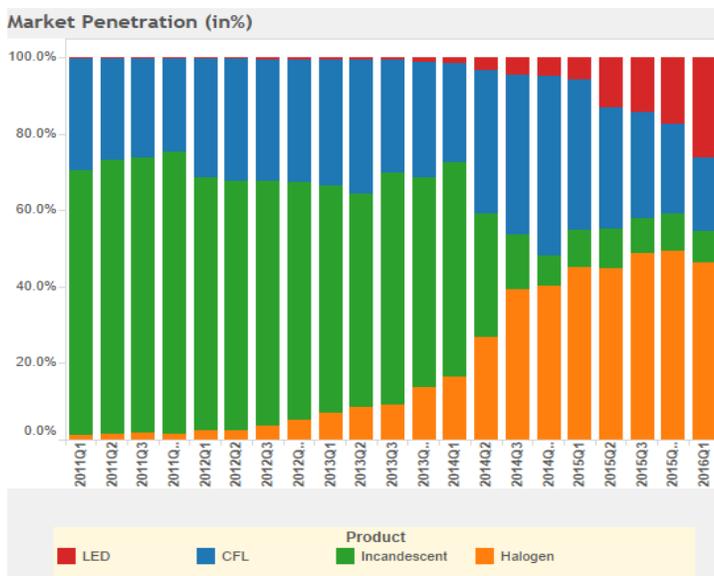
Wattage Equivalency	40W	60W	75W	100W
Number Certifying	20	28	7	10

These products are available in CRIs ranging from 81 to 94, with an average CRI of 83.3. Interestingly, while ENERGY STAR slightly lowered the power factor for some LEDs from .7 to .6, the average power factor of these products is .86, with only seven of 65 (or 11 percent) of products taking advantage of the lower power factor. Across products, there are high efficacies, with the average efficacy of these 65 product at 92.6 lumens/watt. This exceeds the ENERGY STAR levels by over 15 percent. Additionally, these products are available in a range of color temperatures; with about half the products hitting the traditional 2700K temperature, and the other half spread across the cooler temperatures.

This is only the beginning of 2.0 product certification—we expect many LEDs to earn certification in the coming months. While most of the 65 products are now in production and being shipped to retailers, they are expected to be available for purchase within the next month. Manufacturers have reported that these products will be available in single and multi-pack across a range of brick-and-mortar and online retail channels. Now that these products have earned ENERGY STAR certification, they can be considered for efficiency program rebates. Through its product certification and specification process, ENERGY STAR is again meeting consumer demand with high quality products that efficiency programs and stakeholders throughout the region can depend on.

The LED Market: a Story of Success

The residential lighting market has been made up of four technologies: incandescent, halogen, CFL, and LED. When looking at available data - whether consumer research, shipping, sales, or socket saturation - it is clear



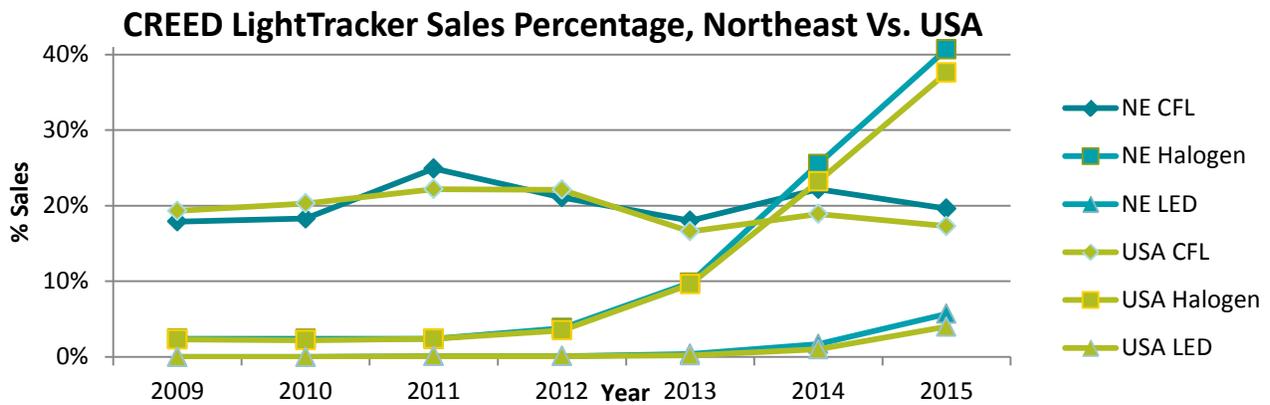
that LEDs are rapidly growing in popularity and penetration. Similarly, we are also seeing halogen bulbs growing in availability and popularity, while CFL and incandescent numbers hold steady or decrease.

Looking at the most recent national shipping data for A-line lamps published by NEMA though Q1 2016,^{iv} one can see the significant growth in the shipment of LED lamps, particularly taking off from Q1 2014. Even halogen lamps, which had steadily risen to the largest volume of shipped lamp, have decreased in shipment volume from

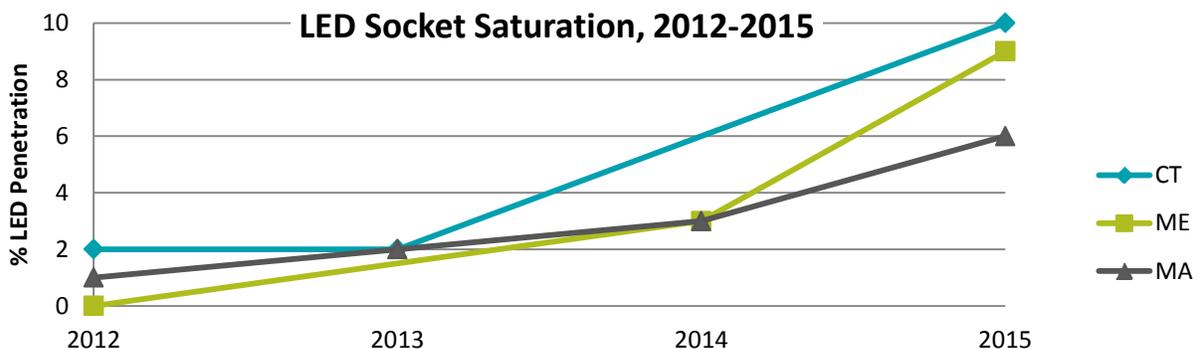


Q4 2015 to Q1 2016. While it is too early to know if halogens will start to stagnate or decrease in market share, it is very exciting to follow the success of LEDs, moving from a negligible level to about a quarter of the market in only two years. This is supported by findings from the 2016 Sylvania Socket Survey, which reports that LEDs are now the Most Likely Next Bulb Purchase technology, and the number of consumers who say they have purchased an LED in the past 12 months has increased by 17 percent in 2016.

Another important indicator of lamp trends is sales data. Looking at data collected as part of LightTracker,^v an initiative of the Consortium for Retail Energy Efficiency Data (CREED), we can compare the A-bulb sales for grocery, drug, discount, club, and mass merchandiser channels (estimated at about 25 percent of the residential lighting market). The data below provides a snapshot of aggregated sales from the Northeast, including Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, and Vermont, and compares that to a US average. It is important to note that while the Northeast, through years of robust lighting programs, has higher sales for both LEDs and CFLs, it also has slightly higher sales of halogens compared to the national average.



The socket saturation of LEDs has also increased significantly according to recent studies. In 2015, socket saturation surveys were performed in Massachusetts,^{vi} Connecticut,^{vii} and Maine,^{viii} which can help provide some indicators of LED saturation for states in the region that have not had as recent a survey. The socket saturation levels of LEDs have increased significantly from 2014 to 2015, and based on aforementioned market indicators, is expected to continue to grow. Robust programs focusing on LED promotion is a key marker of success, with preliminary results from a 2016 on-site Massachusetts study suggesting an LED socket saturation of 12 percent for early 2016.^{ix} We've charted the LED socket saturation for the aforementioned states below; the markers represent years for which data is available.



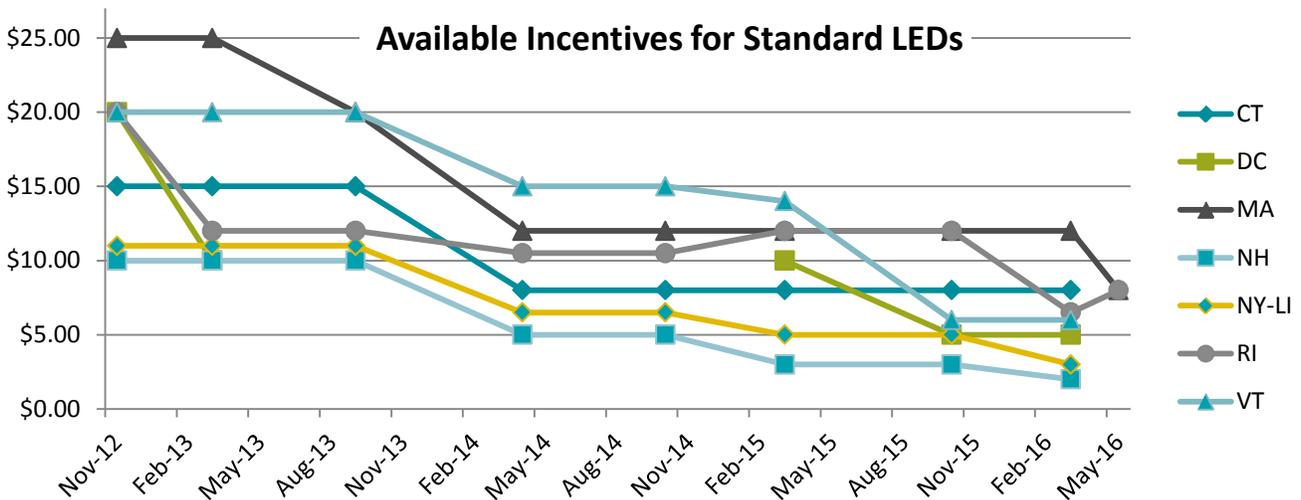


Program Administrator Accomplishments to Advance LED Uptake

While it is clear that the entire market is trending towards LED, program administrator promotion of LEDs is a large driver of that shift. In 2016, program administrators are promoting larger percentages of LEDs than ever before, as can be seen in the below table.

State	Planned 2015 Retail Residential Lighting % ^x	Actual % of LEDs through program in Q1, 2016	% LED Planned for all 2016
CT	50%	68%	65%
DC	34%	60%	66%
MA	49%	61.6%	75% ^{xi}
NH	59%	75.5%-88.5% ^{xii}	51%-84% ^{xii}
NY (PSEG Long Island)	41%	65%	63%
RI	27%	63.8%	75% ^{xi}
VT	48%	78.1%	96.5%

The per-bulb incentives for standard LEDs are also changing rapidly. While standard CFL incentive levels have remained relatively static since NEEP began tracking regional incentive levels in 2012 (hovering in the \$0.50 to \$2.00 for nearly all states in that time period), the incentives available to mark down standard LEDs have decreased significantly. The chart below shows the standard LED maximum available incentive over the past four years. With the new Lamps 2.0 products hitting shelves, it is expected that these levels will continue to fall. It is important to note that while these numbers reflect the maximum available for an incentive, most program administrators pay less than this maximum to either bring product pricing to a floor or to reach a cap on the percentage of the manufacturer suggested retail price (MSRP).



Industry Innovations and Trends

LED Fixtures: The ENERGY STAR Lamps 2.0 specification is capturing a lot of attention for impacting the residential lighting market, but there were also several impactful changes made to the design of the ENERGY



STAR Luminaires 2.0 specification. As this specification was finalized in mid-2015, luminaires have had more time to earn certification; there are already several connected and color tunable products that have started to populate the Luminaires qualified products lists, and those new product areas will be growing. As of June 24, 2016, we've found 250 connected models and 2 color tunable luminaires (out of 5680).

Furthermore, the luminaires specification had a major shift in to include a new "bulb in a box" concept. This new consideration allows a screw-based fixture to achieve ENERGY STAR recognition by meeting application-specific performance metrics and being shipped with an ENERGY STAR Certified bulb, allowing more fixtures to seek out ENERGY STAR certification with the bulk of testing time spent on certifying the bulb, not the fixture. As such, a viable and potentially overlooked application for LED technology - such as the outdoor security fixtures - can now earn ENERGY STAR Certification with relative ease. Considering the potential long hours of use for outdoor security lighting, LED is a great application for this product category.



One manufacturer, Globe Electric, is currently working to transition their non-ENERGY STAR Outdoor Security fixture to gain ENERGY STAR certification, thus opening up the efficiency program incentive channel. Currently, less than 0.01 percent of the ENERGY STAR Luminaires Qualified products list is outdoor security (19 products out of over 5000, all of which are LED as of 6/24/2016), but as efficiency programs look to tackle more residential lighting applications, and ENERGY STAR's specification makes this easier to achieve for various luminaire applications, there is growth opportunity in this area. Torchieres, another product category with low ENERGY STAR penetration (only three products listed, all of which are fluorescent), as another potential growth category for manufacturers and efficiency programs looking to expand their portfolio.

Focus on Health and Wellness: The energy savings benefits of LEDs have long been touted, but in 2016, GE launched a new LED product line focused on health and wellness. The C by GE products feature two specially-designed LED A-line bulbs, one for daytime use (C-Life), and another to help support healthy sleep (C-Sleep). These products are Bluetooth enabled and can be controlled through an app without the need for an additional hub; through the app they can be turned on and off, scheduled, and dimmed. For the C-Sleep bulbs, which are designed to be used in a bedroom, the user can establish his or her schedule and the bulb will automatically change color temperature over the course of the day to align with the user's circadian rhythm, going from brighter, bluer light in the morning (7000K, 850 lumens) to dimmer, redder light in the evening (2000K, 250 lumens). While the topic of LED lighting and health is not new (in fact, it was included in NEEP's 2014-2015 Update to the Residential Lighting Strategy^{xiii}), this is one of the first efforts to bring the health benefits of LEDs to a residential market. C by GE is available online and in Target and Lowes stores.

Smart Lighting Trends, Hubless Bulbs: Smart lighting is a growing trend, and within smart lighting there are more products entering the market that do not need separate hubs. Though a hub can typically be connected to several lightbulbs and, potentially, other smart products, it may not always be; in the efficiency worst case scenario, a hub may add multiple watts of power to the effective use of a single smart bulb. While the standby power of smart bulbs is being limited by the ENERGY STAR specifications to .5W, hub efficiency is only being



tracked. Some hubless bulbs are working with shorter range communications protocols such as Bluetooth to be controlled by an app only when in close proximity of the bulb, occupying an in-between space where the bulb can be controlled, but not remotely outside of the Bluetooth range. In the chart below we present the efficacy levels for five models of hubless smart bulbs:

Brand	Product	Wattage equivalent	Color Tuning?	Standby Power	Efficacy	Cost
LIFX	White 800	60	White light color tunable	~.5-.7W	81lpw	\$39.99
	Color 1000	75	RGB Color tunable	~.5-.7W	96lpw	\$59.99
GE	C-Life	60	No, 2700K	~1W	73lpw	\$70 for 4 bulb starter pack (2 C-Life, 2 C-Sleep)
	C-Sleep	60	3 settings: AM at 7000K, Daytime at 3000K, and PM at 2000K	~1W	77lpw	
Ilumi	Ilumi	60	RGB Color tunable	<1W	~80lpw	\$99.99 for 2 pack

Smart Lighting Trends, Program Pilots: Program administrators are starting to explore strategies in the smart lighting space. As mentioned in the 2015-2016 Residential Lighting Strategy Update,^{xiv} in 2015 Efficiency Vermont conducted a pilot to study user experience and measure energy savings potential for smart lighting products. The full results of the study are pending, but preliminary findings show a few important things:

- Consumers are excited about smart lighting. After minimal outreach, there were far more volunteers for the study than slots to participate, and participants remained engaged and responsive throughout the study period. All 15 households participated from beginning to end.
- Of all the capabilities, dimming holds the most potential promise for smart lighting products. While only 10 percent of residential lights are installed on dimmer switches, nearly all smart bulbs allow for dimming through their user interface. Many of the participants in the study took advantage of the dimming capability provided from the smart bulbs, which offers new potential opportunities for energy as well as potentially demand savings for smart bulbs that otherwise was not possible.

Though the sample was not statistically significant, the findings do indicate that smart lighting holds potential for efficiency programs and customers. The full report is expected to be published in the coming months and should help illuminate the opportunities and next steps for smart lighting.

Advances in Standards and Specifications

EISA Standard Taking on a New Meaning: While program administrators have been working tirelessly to increase penetration and availability of high efficiency lighting - especially LEDs - the US Department of Energy (DOE) has been planning to lock in those savings for all American consumers. In February 2016, DOE released its Notice of Proposed Rulemaking for General Service Lighting^{xv}, which will take effect in January 2020. This is the second of three phases in the legislation established by the Energy Independence and Securities Act (EISA) in 2007. While the 2015 NEEP resource The State of our Sockets^{xvi} listed many household products that would not be impacted by EISA, DOE has expanded its scope of coverage to include just about any product that provides general illumination that is not covered in another rulemaking. As such, many of the decorative and specialty lighting that were expected to be outside of the scope of DOE’s rulemaking are now subject to the 45



lumens/watt backstop, which effectively means only CFL or LED versions of those products would be allowed to be manufactured. This would not apply to directional or reflector products, which are subject to a separate rulemaking. This is a great achievement for the DOE and demonstrates the impact that efficiency programs have had in increasing the availability and viability of LED products, but will require keen scrutiny for long term program planning once the final rule is issued, expected later in 2016.

CEE Advance Lamp Tiers: As ENERGY STAR finalized the Lamps 2.0 Specification, the Consortium for Energy Efficiency (CEE) worked to update their performance tiers for integral replacement lamps sold at retail. These tiers build off of ENERGY STAR's specification to provide opportunities for stakeholders to promote products that go above and beyond ENERGY STAR's criteria for certain metrics, including efficacy, color, dimming, and power factor. In this structure, the first tier aligns with ENERGY STAR, the second tier pushes up several parameters, and the third tier sets stretch targets for where CEE members want to see the industry moving. Notably in this revision, a new metric for lifetime of lamps was added and the tier two lifetime requirement has been set at 25,000 hours, aligning with the previous Lamps 1.1 version of ENERGY STAR. While ENERGY STAR reached the decision to lower omnidirectional lamp lifetimes to 15,000 hours through an extensive stakeholder-informed process in 2015, there were several stakeholders who remained invested in the 25,000 hour lifetime, particularly those who prioritized education around the long lifetime of LEDs in order to encourage adoption. The CEE tiers offer options to encourage program administrators to align support for those 25,000 hour products. The tiers have been distributed to industry stakeholders for review and are anticipated to be finalized by January 2017.

Summary and Conclusion

As actors in the residential lighting market - including efficiency programs, federal agencies, manufacturers, retailers, and others - continue to work together, the market continues to chart a path towards transformation. The Northeast and Mid-Atlantic region is now closer to reaching the regional goal of 80-90 percent socket saturation of high quality efficient lighting, and looks to be on track to reach that goal by 2020 or 2021. To complete the market transformation, NEEP references back to the Northeast and Mid-Atlantic Residential Lighting Strategy: 2015 Update^{xvii} and the eight regional strategies presented:

1. Program administrators continue support for energy efficient residential lighting.
2. PAs transition portfolios in short term towards LEDs and in longer term towards specialty LEDs.
3. PAs target LEDs in hard-to-reach markets.
4. PAs consider including smart lighting in portfolios.
5. PAs explore opportunities in residential linear products.
6. Regional collaboration on residential lighting research.
7. Regional coordination on data collection and sharing.
8. Regional discussions on savings calculation inputs to ensure appropriate attribution.

Through deployment of these strategies and the continued evolution of LED products, NEEP is confident that the regional will accomplish this goal and achieve true transformation of the residential lighting market.



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This report reflects the opinion and judgments of the NEEP Staff developed in consultation with external experts and does not necessary reflect those of NEEP Board members, NEEP Sponsors, or projects participants and funders.

ⁱ See <http://neep.org/referenced/publications/59> for the complete list of reports

ⁱⁱ *The Northeast and Mid-Atlantic Residential Lighting Strategy: 2015 - 2016 Update*, NEEP, page 31:

<http://neep.org/northeast-and-mid-atlantic-residential-lighting-strategy-2015-2016-update>

ⁱⁱⁱ See 2015 RLS Update for more details on the progress, as well as NEEP's January 2016 blog,

<http://neep.org/blog/changing-guards-residential-lighting>

^{iv} NEMA Lamp Indices through Q1 2016, <http://www.nema.org/Intelligence/pages/lamp-indices.aspx>

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

^{vi} <http://ma-eeac.org/wordpress/wp-content/uploads/Lighting-Market-Assessment-and-Saturation-Stagnation-Overall-Report.pdf>

^{vii} http://www.energizect.com/sites/default/files/R154%20-%20LED%20Lighting%20Study_Final%20Report_1.28.16.pdf

^{viii} <http://www.energymaine.com/docs/Efficiency-Maine-Retail-Lighting-Program-Evaluation-Report-2015.pdf> and <http://emtplan.com/wp-content/uploads/2015/05/FY17-19-PLAN-APPENDICES-FINAL.pdf> page 5-51.

^{ix} From <http://ma-eeac.org/wordpress/wp-content/uploads/EEAC-EMV-Briefing-May-25-2016.pdf>, slide 14

^x <http://neep.org/northeast-and-mid-atlantic-residential-lighting-strategy-2015-2016-update>, page 15

^{xi} Projection provided by implementation contractor for RI and MA as an estimate.

^{xii} Range provided for the various NH program administrators

^{xiii} *Northeast Residential Lighting Strategy: 2014-2015 Update*, NEEP <http://neep.org/northeast-residential-lighting-strategy-2014-2015-update> page 27

^{xiv} <http://neep.org/northeast-and-mid-atlantic-residential-lighting-strategy-2015-2016-update>

^{xv} Department of Energy, Energy Conservation Standards for General Service Lamps; Notice of proposed rulemaking (NOPR). <https://www.regulations.gov/document?D=EERE-2013-BT-STD-0051-0044>

^{xvi} The State of our Sockets, NEEP, August 2015. <http://neep.org/state-our-sockets-regional-analysis-residential-lighting-market>

^{xvii} <http://neep.org/northeast-and-mid-atlantic-residential-lighting-strategy-2015-2016-update>