



THE STATE OF OUR SOCKETS: A REGIONAL ANALYSIS OF THE RESIDENTIAL LIGHTING MARKET

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Residential lighting has long been a centerpiece of ratepayer-funded energy efficiency program portfolios. In New England, residential lighting measures have produced over 30 percent of all efficiency program savingsⁱ (Figure 1). The large savings potential along with straightforward nature of replacing lightbulbs in sockets makes residential lighting the classic low hanging fruit. So it comes as no surprise that since the late 1980s, program administrators from Maine to Maryland have designed and implemented large programs that educate consumers on new products, leverage the latest in lighting technology, target hard-to-reach customer segments, save consumers money, and lower carbon emissions.

Even though residential lighting makes up a significant portion of efficiency program portfolios, the lighting market as a whole is in a state of flux. Program administrators, public utility commissions, state energy offices, and others are asking key questions:

- Has the residential lighting market been transformed?
- Where is the market headed? What impacts will EISA 2020 have?
- Is there a role for residential lighting programs in the current environment? What are the short-term and long-term priorities?

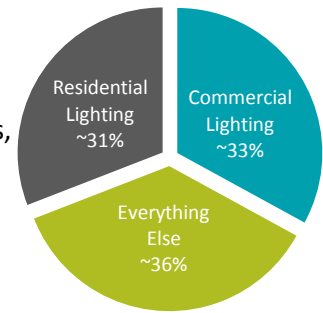


Figure 1: Total Program Savings

This document, a companion piece to NEEP’s Northeast Residential Lighting Strategy (RLS)ⁱⁱ suite of reports, sets out to provide clarity on the residential lighting market. NEEP conducted a comprehensive literature review, consulted with experts in the field, and reviewed the RLS and NEEP’s Regional Energy Efficiency Database (REED). Based on our assessment of the current state of the market, and bolstered by regional stakeholder input, we conclude that **the residential lighting market is not fully transformed** and recommend **strong support for the continuation of residential lighting efficiency programs in the near term**. There is more to be done to fill remaining sockets with high performance lighting and policy makers should set their sights on this opportunity. Lighting programs in the next several years will be instrumental in ensuring the adoption of high efficiency lighting. Long term, lighting programs will still be necessary for product categories not transformed by federal standards.

What is residential lighting?

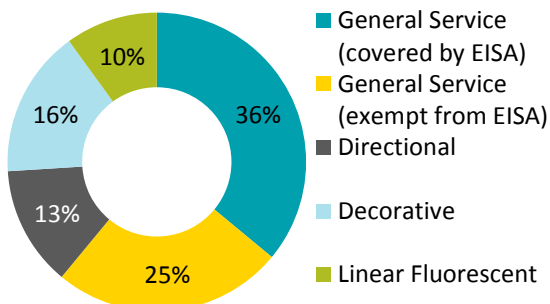


Figure 2: Residential Lighting Product Breakdown

Residential lighting is a complex product category; as demonstrated in Figure 2ⁱⁱⁱ, there are many types of lighting in a home. With approximately 50 sockets in the average residence^{iv}, and several technologies to choose from to fill those sockets, understanding the dynamics of the residential lighting market can quickly become challenging. For the purposes of this analysis, NEEP focused on the sockets for



screw-based light bulbs which are most common, though it is worthwhile to note that approximately 10 percent of residential lighting is filled with linear fluorescent tubes that are inherently efficient light sources and have not been the focus of efficiency efforts to date.

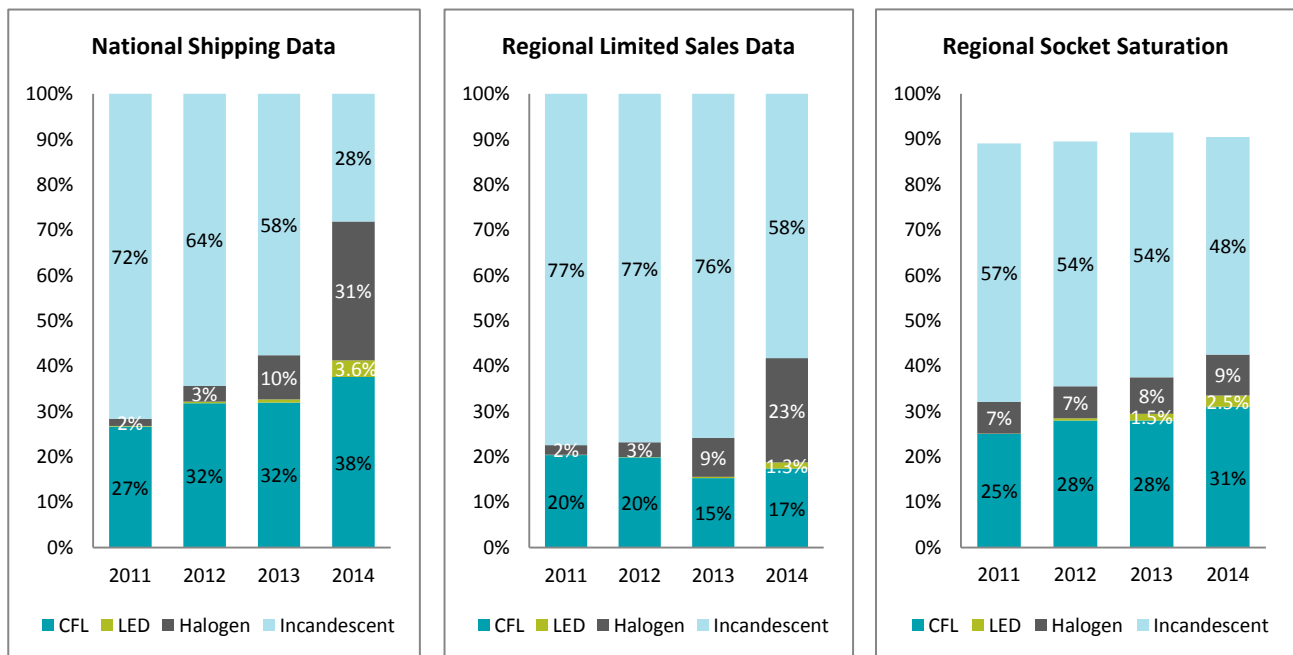
The remaining sockets can be filled with either efficient or inefficient technologies, as outlined in Table 1.

	Efficiency (lumens per watt)	Currently available technologies and their lpw
Inefficient	< 45lpw	<ul style="list-style-type: none"> Incandescent (11-16lpw) Halogen (16-22lpw)
Efficient	≥ 45lpw	<ul style="list-style-type: none"> Light Emitting Diode, LED (60-100lpw) Compact Fluorescent Lamp, CFL (50-70lpw)

Depending on the application in the home, the light bulb could be a standard A-bulb, a directional spot or flood light, or a decorative bulb. Among these options are several efficiency opportunities.

Table 1: Technologies and Efficiencies

What is the status of the residential lighting market in the Northeast?



Figures 3: Shipping, Sales, and Socket Saturation Data, years 2011-2014

Efficiency programs have been promoting efficient lighting in the region for decades and have seen many changes in the market in that time period. Figures 3^v give a sense of the residential lighting markets from years 2011-2014 for shipping, sales, and socket saturation. The *national shipping data* represented are provided quarterly by the National Electrical Manufacturers Association (NEMA)^{vi} and include information from NEMA members for A-bulb replacements. This perspective is helpful and publically available, but is limited as it does not include all global manufacturers and manufacturer shipping is several steps removed from the lamps used in individual homes. The *regional sales data* represented here are Northeast A-bulb sales for grocery, drug,



discount, club, and mass merchandiser channels (estimated at about 25 percent of the residential lighting market) that came from LightTracker, an initiative of the Consortium for Retail Energy Efficiency Data (CREED)^{vii}. These data provide market insights, but are limited as they lack home improvement and hardware retail channels which make up the majority of the retail space. These sales data may reflect different customers than a more complete data set, and there is a need to combine this information with other key retailers to gain a more complete understanding of the market. Finally, the *socket saturation data* presented is averaged across the Northeast and based on periodic socket saturation surveys and includes all lamp types, not just A-bulbs. Not all states perform socket saturation surveys every year, and survey methodologies can vary. (Note linear fluorescent technology is taken out of this view, so the socket saturation totals do not add up to 100 percent.)

Each market data source—shipping, sales, and socket saturation—has benefits and shortcomings, but many trends can be seen in all three that will be discussed shortly. While these charts demonstrate the impact of efficiency programs have had in changing the market, what these charts don’t show is that when efficiency programs have stopped supporting efficient CFLs, such as in New York and California, there has been observed significant increases in sales of inefficient halogen, the closest available option to traditional incandescent. As incandescents leave store shelves, cost-conscious consumers have a choice between efficient CFLs and inefficient halogens as the low cost option (typically in the \$1.50-\$3.00/bulb range). Instances where programs have not provided an adequate incentive to make CFLs the cost-compelling option, sales of halogen have increased^{viii}. All available data shows that **efficiency programs have been crucial to filling sockets with efficiency lighting options throughout the region.**

Is the residential lighting market transformed?

For the purposes of this analysis, NEEP defines market transformation of the residential lighting market as when the large majority of sockets are filled with quality efficient lighting. While there will always be loopholes and specialized products filling some sockets, it is our expectation that the residential lighting market should be able to reach a socket saturation of 80-90 percent efficient lighting when transformed. Provided that most Northeast sockets are still filled with inefficient lighting, and considering the gaining traction of low efficiency options (halogens), it is clear that the **residential lighting market is not yet transformed.** While great progress has been made, there is still a long way to go to transform this market.

What is EISA^{ix} and what impact will it have on transforming the lighting market

The Energy Independence and Security Act of 2007 (EISA) established minimum efficiency standards for General Service Lamps (GSLs). The legislation has 3 phases, described in Table 2^x. Phase 1 went into effect over 2012-2014; it was a manufacture and import rule that required increased levels of efficiency that incandescents at the time did not meet, though the availability of traditional incandescents continued far beyond the date the standard took effect.

Phase	Implication	Timing
Phase 1	100W Incandescent → 72W	2012
	75W Incandescent → 53W	2013
	60W Incandescent → 43W 40W Incandescent → 29W	2014
Phase 2	45 lumen per watt backstop	2020
Phase 3	TBD	2025

Table 2: The Three Phases of EISA



EISA also directs The U.S. Department of Energy (DOE) to conduct two additional GSL rulemakings. Phase 2 of EISA (henceforth referred to as EISA 2020) is currently underway, with a notice of proposed rulemaking (NOPR) expected in December 2015. EISA 2020 would set a **sales** restriction on GSLs that did not meet the standard. When the law was passed in 2007, a **backstop** efficiency level was established which would be triggered if the rulemaking process does not achieve at least the same amount of energy savings as a 45 lumens per watt (lpw) standard. Based on the current efficiencies of available technologies, halogen bulbs are not expected to meet the backstop levels of EISA 2020 (as their efficiencies are in the 16-22 lpw range, see Table 1). **EISA 2020 represents a major opportunity to transform the market for GSLs, but does not go into effect until 2020.**

What are the limitations of EISA and what impact do those limitations have on the market?

EISA 2020 is expected to have deep impacts on the residential lighting market starting in 2020, but the rulemaking does not apply to all lights in a home, as some products are **excluded** from its scope while other products are **exempt** from the law. EISA applies to “general service lamps” (GSLs) which include general service incandescent lamps, compact fluorescent lamps (CFLs), and general service light emitting diode (LED or OLED) lamps^{xi}. **Excluded** from EISA’s coverage are general service fluorescent lamps (such as linear fluorescent), and reflector or directional lamps¹. **Exemptions** from the law include 3-way lamps, specialty application lamps, and lamps with special shapes or bases under certain wattages (which includes most decorative lamps). Table 3 provides more information to what is covered, excluded, or exempted from the EISA rulemaking.

General Service Lighting: EISA Standard Covers These (36%)	General Service Lighting: Exempt from EISA Coverage (25%)	Non-General Service Lighting: Excluded from EISA Scope (39%)
Standard A-bulbs CFLs: Covered and Bare Spiral Omnidirectional LEDs 40W 60W 75W 100W	<40W >100W Three Way Service: Rough, Vibration Modified spectrum Shatter Resistant Other non-standard applications	Fixtures Decorative (Globe, candelabra) Linear Fluorescent Directional (PAR, BR) ^{xii}

Table 3: EISA Coverage, Exemptions, and Exclusions

While general service lighting is the majority of what is found in the home (approximately 60 percent of the sockets, Figure 2: Residential Lighting Product Breakdown), the General Service Lamps impacted by EISA are only about one-third of the lighting products in a home. Beyond those limitations, there has been concern that some manufacturers may be exploiting a **loophole** in the rulemaking to sell exempted products that are very similar to the traditional incandescent lamps that were phased out in Phase 1. Specifically, there has been unprecedented growth in the rough and vibration service incandescent lamp sales in recent years^{xiii}; though this is only a small portion of the entire market (in the case of vibration service lamps, moving from less than 1M units shipped in

¹ Directional lamps are covered by their own federal rulemaking for Incandescent Reflector Lamps. This law went into effect in 2012 and while it raised the baseline for reflector lamps, it essentially allowed a halogen technology product to meet the standard, with CFL and LED reflector lamps meeting much higher efficiencies.



2010 to over 5M shipped in 2015), this is a trend to watch as these products are only slightly different than traditional incandescents and as such would be the lowest-cost (and least efficient) option to a consumer. **Since the scope of EISA only applies to one-third of the lamps in a home, and EISA loopholes may be exploited by manufactures, efficiency programs may have a significant longer term role to promote products exempted or excluded from EISA 2020.**

What is the status, and expected outcome, of the EISA 2020 rulemaking?

EISA 2020 is a rulemaking in progress, expected to reach a Final Rule by the end of 2016. There are two caveats to EISA 2020 that should be considered before making planning decisions for efficiency programs; first is the interpretation of the 45lpw **backstop as an average** efficacy. This would allow halogens (at 16-22lpw) to continue to be sold after 2020 as long as there were enough high efficiency products being sold to reach a fleet average of 45lpw^{xiv}. While this is not the interpretation NEEP and other efficiency organizations take, until the NOPR is released, it is unknown what interpretation DOE will make. The second caveat is a congressional budget **rider**, passed in November 2014 that prohibits DOE from enforcing EISA. The rider has not adversely impacted the roll out of EISA Phase 1 to date, as major lighting manufacturers had already stopped production of incandescent GSLs by the time the rider was passed. For the 2020 rulemaking, however, whether all manufacturers would comply with the law knowing that there would be no enforcement is impossible to know, but leaves open a major potential loophole for inefficient products to be sold after 2020.

Scenario	Description
1: Highest Efficiency	Rulemaking is completed, the enforcement rider is repealed, and a strong standard is set starting in 2020 (≥45lpw)
2: Medium Efficiency	Rulemaking is completed, but the congressional rider stays in effect. As such some low-cost halogens continue to be sold.
3: Lowest Efficiency	There is a political change of heart and the EISA standards are repealed.

Table 4: Three Possible EISA Phase 2 Scenarios (2020)

One final complication with EISA 2020 is the potential for political tides to change and for EISA to be further limited or even struck down via legislation. While EISA is written into law, no other federal efficiency standard has been quite the lightning-rod for consumer backlash like this “bulb-banning” standard^{xv}. EISA has been bemoaned as a prime example of big government overregulation, and while there are global benefits to the standard moving forward as scheduled,

there are several staunch opponents. It is possible that EISA could be held up as an example under a new administration or Congress and be repealed. NEEP considered three plausible scenarios as described in Table 4. **Since the fate of EISA 2020 is still somewhat uncertain, it is important to help ensure a strong standard is in place through stakeholder engagement in the rulemaking process.** NEEP plans to work on establishing a strong standard and will continue monitoring and communicating any potentially impactful changes to the standard.

Where is the residential lighting market headed?

While the fate of EISA 2020 may not be certain, there are observable market trends and trajectories that can help shape our expectations of where residential lighting is headed in the meantime. While inefficient traditional incandescents impacted by Phase 1 of EISA are nearly off shelves, inefficient halogen products are



gaining in market availability and will likely continue to do so as some customers remain committed to the low-cost, familiar option regardless of the efficiency. However, in territories where efficiency programs are supporting efficient technologies (LEDs and CFLs), it is expected that halogen will not sell or be installed at nearly the rate of non-program areas.

Efficient LED technology is taking off^{xvi}; efficiency programs have been supporting LEDs since they became market ready and have made a significant impact on the uptake of LEDs. That impact, however, represents only a very small portion of the installed base in the region (between 2-5 percent, Figures 3); while projections are encouraging, there is still a long way to go before LEDs gain acceptance beyond the early adopters and move into the majority markets. ENERGY STAR has certified thousands of high quality LEDs^{xvii}, but several lower-priced, non-certified LEDs are entering the market, creating opportunities for customer dissatisfaction with this efficient technology. Additionally, while LED prices have come down significantly, they have not come down consistently across product categories or lumen bins and are still relatively expensive. Finally, the CFL market is reactive and considered a second-choice option when other technologies are available. When cost is a consideration, halogens are preferred as a lower-cost option unless incentives bring down the cost of CFLs. When efficiency is a consideration, LEDs are preferred for a range of technological and customer preference reasons^{xviii}. As such, the CFL market is likely to stay relatively steady, but may waiver depending on the LED and halogen markets.

Moving forward, there is uncertainty as to whether the expected growth in LED for all lamp types will be at the market share “expense” of the efficient CFLs or inefficient halogens. **Program promotion has the opportunity to ensure this growth is at the expense of the inefficient halogen market, boosting overall market penetration of efficient lighting.**

With EISA 2020 looming, is there a role for programs from now until 2020?

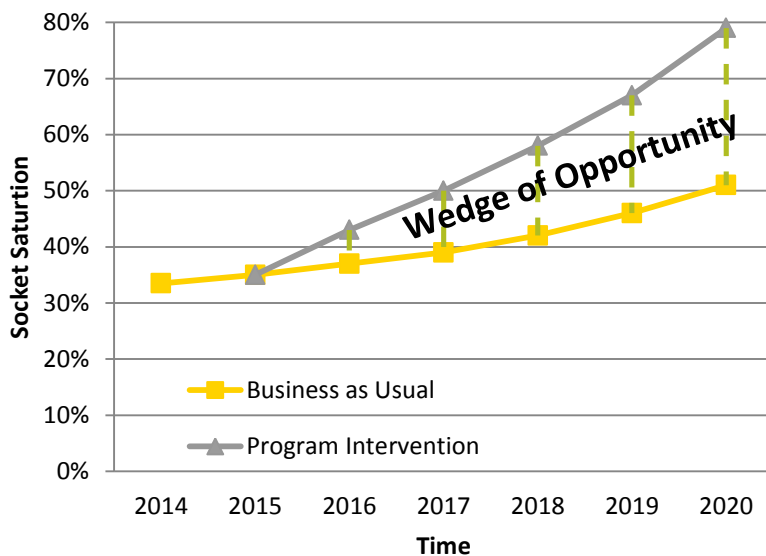


Figure 4: Efficient Lighting into the Future, Impact of Program Intervention

While lighting programs continue to be cost-effective, after decades of promotion in these markets, whether it is the most appropriate use of ratepayer funds to continue lighting promotions is a very legitimate question. Through our analysis, however, we have concluded that **efficiency programs are critical to the advancement of all efficient lighting in the short term.** Additionally, **for lighting products not impacted by the EISA 2020 rulemaking, there may be an important role for programs into the longer term.** As shown in Figure 4^{xix}, developed based on



expert consultation and judgment of anticipated market trends, the efficient lighting market will move much more slowly without program intervention, offering efficiency programs a significant wedge of opportunity to intervene in the market. This trajectory is expected from now until 2020 regardless of the ultimate fate of EISA 2020. Should EISA 2020 run into significant challenges such as those described in scenario 2 or 3 (see Table 4), this trajectory of savings opportunity for A-bulbs might continue past 2020.

What should program priorities be in the short term (2016-2018) and long term (post 2020)?

Between offsetting higher initial costs, encouraging product innovation to fill all sockets, educating consumers, and providing quality assurance, efficiency programs have a number of potential roles to play in the residential lighting market. Given the relatively recent introduction of LED technology, the low current penetration, and some of the challenges for LED adoption, it is clear that efficiency programs can play a significant continued role in the short term promotion of LEDs across all types of lighting. Depending on what happens with EISA 2020, however, it may not be necessary for programs to promote general service LEDs in the long term. The continued promotion of decorative and directional LEDs, however, may be appropriate well beyond 2020 regardless of EISA, as those products would not be impacted by the rulemaking.

For general service CFLs, as long as LEDs remain a relatively high cost product, it is still appropriate for programs to support CFLs as a low-cost efficient option. For decorative and directional products, however, we have recommended programs shift support towards the LED alternatives, as LED technology is much better suited for most decorative and directional applications than CFL. The prices of many LEDs are coming down rapidly, so NEEP recommends revisiting these trajectories in 2017 to ensure continued promotion of general service CFLs remains appropriate. It is not expected that long term promotion of CFLs will be appropriate. For both LEDs and CFLs, in the short and the long term, NEEP stresses the need to rely on promoting only ENERGY STAR Certified products to ensure quality. Additionally, coordination amongst program administrators in the region is important to ensure all opportunities are exploited and barriers overcome. Refer to NEEP's Residential Lighting Strategy for more details.

Conclusions

This analysis is intended to bring attention to the progress that has been made in the transformation of the residential lighting market and provide education on various factors that will likely impact the market in the years ahead. Residential lighting is a complex category and not just composed of general service lamps; it is our hope that the impacts of all phases of EISA are made clearer through this document. Our key findings are summarized as follows:

- Inefficient lighting still fills the majority of sockets in the Northeast. It is clear that the residential lighting market has NOT been transformed. Policy makers should set their sights on the remaining opportunity to fill most sockets with efficient lighting.
- There is a great opportunity for efficiency programs to remain engaged with the entire residential lighting market to achieve significant cost-effective energy saving in the next three years and in the process, drive a complete regional market transformation of residential lighting.



- EISA 2020 has the potential to eventually drive market transformation of general service lighting, but it will not be effective until 2020; there continue to be opportunities for intervention in the short term.
- There are many potential challenges to EISA 2020 moving forward. Regional Stakeholders should support a strong final rule of 45 lpw or greater with reduced exemptions. This standard would help drive market transformation for most general service lamps, a major category in residential lighting.
- EISA 2020, even with a favorable result, will not be a silver bullet to drive complete market transformation of residential lighting. The scope of EISA only applies to one-third of the lamp types in homes. In the long term, programs still may have a significant role to play for products exempted or excluded from EISA 2020.
- As efforts continue in this space, there is a strong need for better and more consistent data to track progress to allow policy makers and program administrators to make more informed decisions. While NEEP will prioritize tracking the transformation of the residential lighting market in the years to come, regional stakeholders should assist this effort by collecting consistent market data using consistent methodologies.

NEEP stands ready to assist the transformation of this lighting market by developing regional market transformation strategies and market progress reports to track market movement and inform modifications to strategy elements. NEEP invites interested stakeholders to join the ongoing Residential Lighting Strategy process to get involved with these efforts and to look out for the forthcoming update to the Residential Lighting Strategy, expected in the Fall, 2015.

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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 The Regional Energy Efficiency Database (REED) coordinates with ISO-NE to collect consistent energy efficiency program information in New England. ISO-NE's measure level data, which was used to conduct this analysis can be found here:

http://www.iso-ne.com/static-assets/documents/2015/02/draft_ee_forecast_measure_data_2018_to_2024.pdf

ⁱⁱ Available from: <http://neep.org/initiatives/high-efficiency-products/residential-lighting>

ⁱⁱⁱ This chart was put together using a variety of data sources. Most notably, we referenced information from the 2012 DOE Lighting Market Characterization, NEEA's 2013-2014 Northwest Residential Lighting Long-Term Market Tracking Study, and information presented at the 2015 ACEEE Market Transformation Symposium by Cadeo Group. Some of the information is



taken from shelf stocking surveys and some from in-home socket studies, but in general the findings were similar from all data sources. Even so, these percentages should be considered approximate, not exact.

^{iv} Department of Energy, Lighting Market Characterization Study, 2012

<http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2010-lmc-final-jan-2012.pdf>

^v Disclaimer regarding the Regional Limited Sales Data: 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://www.nema.org/news/Pages/First-Quarter-Proves-to-be-a-Mixed-Bag-for-Consumer-Lamp-Indexes.aspx>

^{vii} For more information on joining the CREED effort, contact Scott Dimetrosky, scottd@apexanalyticsllc.com

^{viii} As presented to Connecticut Energy Efficiency Board Retreat, May 20th 2015, presentation available at

<http://www.energizect.com/about/eeboard/main-board>

^{ix} Law available <http://www.gpo.gov/fdsys/pkg/BILLS-110hr6enr/pdf/BILLS-110hr6enr.pdf>, starting on page 82.

^x Energy Independence and Securities Act, 2007

^{xi} <https://www.law.cornell.edu/uscode/text/42/6291>

^{xii} Directional lamps are covered by their own federal rulemaking for Incandescent Reflector Lamps. This law went into effect in 2012 and while it raised the baseline for reflector lamps, it essentially allowed a halogen technology product to meet the standard, with CFL and LED reflector lamps meeting much higher efficiencies.

http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/58

^{xiii} Five Lamp Types 2014 Shipment Comparison, Docket EERE-2011-BT-NOA-0013, DOE, Spreadsheet

^{xiv} NEMA's comment letter to DOE regarding the General Service Rulemaking, February 2015,

<https://www.nema.org/Policy/Documents/EERE2013BTSTD0051%20NEMA%20Comments%20DOE%20Genl%20Svc%20Lamp%20Rule%20pTSD%20February%202015.pdf>

^{xv} "Stop Blaming Obama for your Lightbulb Problems," The Atlantic, Sept 2011, accessible:

<http://www.theatlantic.com/politics/archive/2011/09/stop-blaming-obama-for-your-lightbulb-problems/244463/>

^{xvi} Department of Energy, Solid State Lighting Multi-year Program Plan, 2014, accessible:

http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ssl_mypp2014_web.pdf

^{xvii} <https://www.energystar.gov/productfinder/product/certified-light-bulbs/results>

^{xviii} NEEP, Residential Lighting Strategy 2014-2015 Update. <http://www.neep.org/northeast-residential-lighting-strategy-2014-2015-update>

^{xix} This chart was created using projections for the socket saturation that NEEP staff put together based on industry and DOE projections from the MYPP, the Northeast Residential Lighting Strategy reports, replacement rate calculations, and expert review. This chart is meant to reflect what impact Efficiency Programs could have in the Northeast. The role of efficiency programs demonstrated was assuming strong promotion of LEDs and limited promotion of CFLs in the 2016-2018 timeframe to ensure customer uptake of LED increased and customers did not backslide to halogen when program support for CFL ended. In 2018, it is assumed that program support for CFLs would be over or very minimal. Efficiency program support of LEDs is assumed to continue strongly from 2016-2018 and to decrease but not end from 2018-2020, though the trajectory of LEDs has been changed based on strong program investment in 2016-2018.