



Northeast Residential Lighting Strategy: 2014-2015 Update

Northeast Energy Efficiency Partnerships
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Scott Heinz, Suzanne Foster Porter, & David Thomsen	Ecova
Glenn Reed	Energy Futures Group

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ACEEE	Jennifer Amann
Apex Analytics	**Scott Dimetrosky**
Appliance Standards Awareness Project	Anthony Fryer
Cape Light Compact	**Briana Kane & Margaret Song**
Connecticut Light and Power	Jesus Pernia
Consortium for Energy Efficiency	Eileen Eaton
CLEAResult	**Seth Craigo-Snell & Stan Mertz**
Cree	Jon Vollers
District of Columbia Sustainable Energy Utility	Stacy Szczepanski
Efficiency Vermont	Lara Bonn, Emily Clark, & Laura Drexel
Energy Futures Group	**Glenn Reed**
Enervee	Alex Katzman
EPA/ENERGY STAR	Taylor Jantz-Sell
Globe Electric	Gillian Saidman
The Home Depot	Mike Cook
ICF International in support of EPA/ENERGY STAR	Marianne Graham & Madeline Kostic
Lockheed Martin	Michele Guerin & Dan Krasowsky
Lowes	Laura Kiernan
National Electrical Manufacturers Association	Alex Boesenberg
National Grid	Laurie Acone & Angela Li
New York State Research and Development Authority	Ryan Moore
NMR Group	**David Barclay & Lynn Hoefgen**
Northeast Utilities	**Matthew Nelson**

Osram Sylvania	Christopher Lubeck
Pacific Gas and Electric	David Thayer
Philips Lighting	Rene Burger
PSEG-Long Island	Dimple Gandhi & Linda Schwantner
Samsung Electronics	Matt Monkhouse
Southern California Edison	Richard Greenburg
TechniArt	Adam Tardif
The United Illuminating Company	Elizabeth Murphy
Vermont Energy Investment Corporation	Sam Dent

The following NEEP staff provided feedback, input, and edits: David Lis, Director of Market Strategies; Gabe Arnold, Market Strategies Program Manager; Samantha Bresler, Market Strategies Associate; and John Otterbein, Marketing Communications Associate. Layout and formatting was provided by Alicia Dunn, Marketing Communications Manager.

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INTRODUCTION

The Northeast Residential Lighting Strategy (RLS) is once again being updated to provide the most relevant and timely information regarding the efficient residential lighting market. This is the fourth document in the suite of RLS reports and works to answer some of the most critical questions in residential lighting today. This report provides narrative updates on relevant activities in the Northeast Mid-Atlantic States, summaries of completed and ongoing research and evaluations, and updated projections for regional program savings, bulbs moving through programs, and spending. This report also contains original research focused on issues identified as critical to understanding the lighting market by our Leadership Advisory Committee of experts. These original research questions can be summarized as:

- What prices can we expect from LEDs in the near term?
- When will it be more cost effective to support LEDs than CFLs?
- What other important developments have there been in the world of residential efficient lighting?

This report is broken up into three sections, which could be described as the present, the future, and tools to move forward. More specifically, the Residential Lighting Landscape Developments section provides updates to relevant activities since the prior 2013-2014 RLS Update was published. The Market Analysis of Residential Lighting section is projecting for the future of lighting markets and programs, and Key Recommendations section presents the tools to achieve this future scenario. This report is intended to build upon the previous iterations, not replace them. Some topics presented in the 2013-2014 RLS Update, such as residential controls and LED technological developments, continue to be important issues to the region; their summary in the 2013-2014 Update still stands, and may be extensively revisited in years to come.

Through the process of collecting information, interviews, anecdotes, and evaluations, one thing is clear: we are living in a time of uncertainty. Mixed signals abound regarding what products or technologies are available, being sold, and being installed in homes. Now that 40W, 60W, 75W, and 100W incandescents are no longer legally manufactured, some retailers are targeting customers with messages of “we still have incandescents in stock!” While LEDs dominate much of the retail shelf space and attention, they still have a very small install base. And what role does the CFL play: is it merely an unfortunate transition technology between incandescent and LED, or do they still serve an important function as a low cost,

cost effective option for savvy customers and programs? And what on earth is happening with halogens? While we cannot fully unravel each of these conundrums, this report does seek to organize and present existing evidence to help us understand the market.

Throughout our research, we have found the evidence for LEDs as a superior product for residential lighting applications has been mounting. Table 1 is a product attribute chart where we take an objective view at the technology to see how it compares to halogens and CFLs on a variety of critical measures.

Table 1: Comparison of Lighting Qualities by Technology

Measure	Advantage	Description
Brightness/ light output	Tie: halogen, CFL, and LED	Halogen, LEDs, and CFLs are all available in a range of light outputs up to 100W equivalent.
Efficacy	LEDs	While halogens are more efficient than incandescent, their efficacy is much lower than CFLs or LEDs. Many ENERGY STAR LEDs already far exceed the efficacy of the best CFLs. LED efficacy continues to improve while the CFL and halogen efficacy potential has been reached
Lifetime	LEDs	ENERGY STAR requires a lifetime of 10,000 hours for CFLS and 15-25,000 hours for LEDs. Halogen lifetimes are typically around 2500 hours.
Warm-up	Tie: LEDs and halogen	Many CFLs require a warm-up period before they reach full brightness, in some cases taking several minutes. LEDs and halogens reach full brightness instantly.
Dimmability	Tie: LEDs and halogen	Due to technological challenges, most dimmable CFLs dim to only 10-30 percent of their light output, while many dimmable LEDs on the market dim to 5-15 percent of their light output. Halogens are able to dim comparably to incandescents
Aesthetics	LEDs for variety, LEDs tie halogen if goal to mimic incandescents	As a fluorescent technology, CFLs are not a point source and produce a “blob” of light. They are unable to produce “sparkle”, a desirable feature with some consumers, especially with decorative luminaires where the bulb is visible. As a small, directional source, LEDs are able to better mimic the “sparkle” of incandescent bulbs. The form factor of halogens is similar to incandescents.
Beam control	Tie: LEDs and halogen	Because CFLs are not a point source, CFLs cannot precisely control the direction of light. LEDs can be designed with precise optics to precisely control the direction of light in the same way that incandescents or halogens can.
Hazards	LED	While both CFLs and LEDs contain electronic components and should be recycled, CFLs contain mercury, a dangerous neurotoxin. Toxic material is not a concern with halogens, though there can be a concern for burns or fires.
Durability/ cold weather	LED	CFLs perform poorly in cold weather. Halogens are not much more durable than incandescents. LEDs are durable and perform well in cold weather.

The results show that LEDs have the advantage over or tie with the other technologies on all

measures. With this information, it might seem that customers should only ever purchase LEDs, but in reality, there are four technologies currently interacting in the residential lighting market, and the need to point consumers in the right direction has never been more critical.

There are a few major themes and lessons echoed through this report, and the role played by the efficiency program administrators remains instrumental. Evidence continues to show that the lighting market is not transformed, and large opportunity still exists for efficiency programs to influence the market.

We hope this report can serve as a resource to help navigate this complex and uncertain space. This is an ongoing topic of interest for NEEP and we welcome stakeholder engagement for the conversations to come.

Executive Summary

The Northeast Residential Lighting Strategy (RLS) is being updated to provide the Northeast and Mid-Atlantic region with the most relevant and timely information regarding the efficient residential lighting market and to provide recommendations for how efficiency programs can effectively transform the market. This is the fourth document in the suite of RLS reports and provides narrative updates on regional activities, summaries of completed and ongoing research and evaluations, and updated projections for regional program savings. This report also contains original research focused on critical issues. This report is broken up into three sections: the Residential Lighting Landscape Developments section provides updates to relevant activities since the 2013-2014 RLS Update was published. The Market Analysis of Residential Lighting section contains projections for the future of lighting markets and programs, and Key Recommendations section outlines the strategies to achieve this future scenario. This report is intended to build upon the previous RLS iterations, not replace them.

Since the release of the 2013-2014 Update, the residential lighting landscape has continued to evolve. When looking at lamp sales trends and baselines, there is evidence of high penetrations of incandescents and halogens persisting into 2014. The A-line lighting market has not been transformed and many inefficient options still exist for consumers. This may have unexpected implications for programs that have assumed halogen alone to be the baseline, as this evidence supports a blended baseline for 2014. Based on these lamp trends, there exists a large opportunity and need for programs to influence the market.

The Northeast region has been a national leader in residential lighting programs. NEEP has been documenting the status of regional programs since the first Residential Lighting Strategy report. 2014 represents a significant shift in program portfolios as they realize the potential of LEDs for residential lighting. Regional activity shows a continued strong reliance on lighting for most residential sector portfolios and an acceleration of LED program activity. As in the past, lighting also plays a large role in many PAs' portfolios beyond just the retail channel; residential lighting continues to be a successful measure for low income, direct install, multifamily, and new construction programs.

Specifically, lighting program activity in the region ranges from less than 1 bulb/household to 4 bulbs/household. For portfolio mixes, support of specialty CFLs has decreased in some states, while standard CFLs continue to be a majority of program promotions. All states in the region are ramping up their planned support of LEDs; goal unit percentages range from 11-44 percent, but year-to-date data shows even larger percentages of LEDs moving through programs than had been planned. States are taking creative approaches to promote efficient lighting and finding considerable success, especially around LED promotions.

2014 saw the completion of several key lighting evaluation activities, ranging from an impactful Regional Hours of Use (HOU) study to shelf surveys and program impact evaluations. There

are also several studies still underway that may have regional implications upon completion. Many of these reports have involved multiple states to provide a regional perspective, demonstrating the value of regional collaboration and coordination.

Nationally, there are several relevant specification activities that we analyzed. ENERGY STAR's Lamp 1.1 specification has been implemented and tweaked since the last RLS, and ENERGY STAR is also beginning their Luminaire 2.0 specification process. The California Energy Commission's Quality LED specification is in effect and efficiency programs in California are finding more and more products are able to qualify for their high CRI lamp specifications. Additionally, California has started their standards process for small diameter and general service lighting. The Consortium for Energy Efficiency has developed a tiered lamp specification which, pending CEE Board approval, would offer program administrators the option to claim higher saving for ENERGY STAR products that had higher efficacies and had achieved CEE's tiers. The final specification is expected to be released in early 2015.

2014 was also a year for the development and advancement of many initiatives and topics of research. ENERGY STAR and NEMA came together to lead a roadmapping initiative with industry and efficiency stakeholders to push forward activities aimed at streamlining verification testing, conducting consumer education research, and to discuss the latest lighting trends. As part of their Technical Information Network on Solid State Lighting, the DOE released several resources, including an R&D Roadmap, the Multi Year Program Plan, new CALiPER Reports, a report of Early Lessons of Solid State Lighting, and resources on LED safety and health. The DOE also released a forecast of what various lighting sectors would look like if LED lighting continued to gain momentum; this demonstrated a very significant opportunity for energy savings for LEDs by 2030. LED lighting and health also received a great deal of attention in 2014 with several pieces of research and presentations discussing the potential LEDs have to both help and hurt human health. A lighting database tool was launched in 2014 by Envervee that features a platform to list lighting products based on efficiency, features, and price. Another advance in 2014 is the Consortium for Retail Energy Efficiency Data (CREED) Initiative that is working on behalf of program administrators across the nation to purchase category level sales data for lighting to demonstrate the impact efficiency programs are having on the lighting market. From the federal standards perspective, the Phase II of EISA rulemaking kicked off in 2014 and is ongoing.

Looking forward, using data collected from Northeast program administrators and other cited sources, we analyzed the pricing and cost effectiveness trends that impact the product mix in programs and revisited our projections for potential achievable program activity in the region. As LEDs have come down in price significantly in recent years, we analyzed pricing data for popular ENERGY STAR lamps from key manufactures and projected out to the expected price at the end of 2015. For example, the 60W equivalent A Lamp is expected to drop from an average low-cost price of $9.12 in August 2014 to $6.81 by the end of 2015. Overall, we see that prices will continue to drop significantly into 2015 and program administrators should adjust incentives accordingly.

Regarding cost-effectiveness, LEDs are currently a more expensive technology and their promotion in programs is less cost-effective than that of CFLs. In the years to come, however, LED prices are expected to decrease and a large portion of the possible savings from CFLs will still not be attributable to program activities. We researched the variables impacting the cost-effectiveness of CFLs and LEDs and plotted some regional averages for expected inputs impacting cost effectiveness to determine when LEDs might overtake CFLs as the more cost effective option. We found that LEDs may pass CFLs in cost-effectiveness for the 2016 Program Year. For this reason, we recommend a transition plan aimed at having a lighting portfolio where LEDs make up the majority by 2017 in order to maintain cost-effectiveness.

Using this new information, we updated our regional savings and costs projections. A high-level modeling analysis brings together the latest information on CFL and LED pricing and efficacy trends, net-to-gross evaluation findings, and expectations about the number of bulbs that could move through efficiency programs. We decided to build two models this year, one that was more optimistic and one that considered some potential challenges program administers may face. These projections show a relative plateau of consistently high level of annual savings potential for several years. These savings are also less expensive than anticipated in the 2013-2014 RLS Update, as the prices of LEDs continue to drop beyond our expectations. This forecast finds costs to attain residential lighting savings will decrease over time on a per net kWh basis ($/net kWh).

These findings reinforce the fact that while the lighting market continues to rapidly evolve, efficient lighting will continue to be an important and cost efficient resource in PAs' residential portfolios. Many of these opportunities stem from the expected contraction of standard CFL promotions and the ramp-up of support for both standard and specialty LEDs. Specialty promotions may shift more quickly from CFLs to LEDs. As standard LEDs come down in price and become more cost effective, the necessity for a large incentive is diminishing, and the opportunity is emerging for greater savings to be gained at lower spending levels. **For the next several years, lighting will and should continue to be a major component of all residential efficiency portfolios.**

Finally, we have revisited our original recommendations and present one new, two revised, as well as continued support for the seven remaining recommendations to help achieve success in efficient lighting in the Northeast Mid-Atlantic Region. Through implementation of these strategies, rapidly shifting towards LED promotion, and regional collaboration, the Northeast Mid-Atlantic region can achieve success in transforming the market for residential lighting.

New Recommendation:
Consider rapid transition of program support towards specialty LEDs and away from specialty CFLs as LED technology is better suited for the specialty applications and the prices of specialty LEDs continue to fall.
Revised Recommendations:
Accelerate use of ratepayer funds to support LED technology in near-term. PAs should develop a transition plan aimed at having a lighting portfolio where LEDs make up a majority of the lighting portfolio by 2017 in order to maintain both a portfolio and measure TRC/SCT greater than 1.
Partner with manufacturers, retailers, and ENERGY STAR to hone in on key marketing, messaging, and education. Streamline messaging to make it easier for the consumer to select the proper bulb.
Existing Recommendations to Remain:
Leverage markdown and buy-down agreements to specifically promote higher quality, and lower cost LED lamps to reduce program incentive costs, product costs, and increase consumer adoption.
Consider adoption of creative or alternative program and promotional approaches and/or markets to maximize impacts while minimizing potential free-ridership.
Support adoption and implementation of strong lighting efficiency requirements in building energy codes to help increase socket saturation of efficient lighting in new construction.
Ensure that PA efforts are focused on promoting quality lighting products using ENERGY STAR as a key indicator of product quality.
Develop and implement regional systems to track key product and market data to inform program design, implementation, and evaluation.
Continue to engage regulatory bodies early to reinforce the need for continued and aggressive PA engagement in the residential lighting market and to limit regulatory uncertainty.
Continue regional lighting engagement on an on-going basis.

Residential Lighting Landscape Developments

Since the release of the 2013-2014 Update, the residential lighting landscape has continued to evolve. This section includes many of the major developments in efficient residential lighting and presents information and trends since the last update.

Lamp Sales Trends and Baselines

With the rapid growth in the LED market and the final phase-out of 60W and 40W incandescents, the sales trends of lamps continue to be a major consideration for program planning. The National Electrical Manufacturers Association (NEMA) tracks shipment data of NEMA member manufacturers. This data set is not complete, as not every lighting manufacturer is a NEMA member and shipping data does not necessarily reflect the sales of the various technologies. Additionally, there are regional variations in product availability, with the Northeast as a leader in having efficient options available, but in general this data can help illustrate trends.

A review of recent NEMA data from the end of 2013[1] and the first two quarters of 2014[2] is summarized in Table 2. Generally, the trend has been incandescents losing shipping market share, halogens gaining, CFLs staying relatively stable at about one-third of the products, and LEDs increasing in shipment tremendously, though still representing only a small portion (<3%) of shipments. Of particular note is that while the final phase of EISA took effect January 1, 2014, incandescent shipments still represented over one-third of lamp shipments in the 2nd Quarter of 2014.

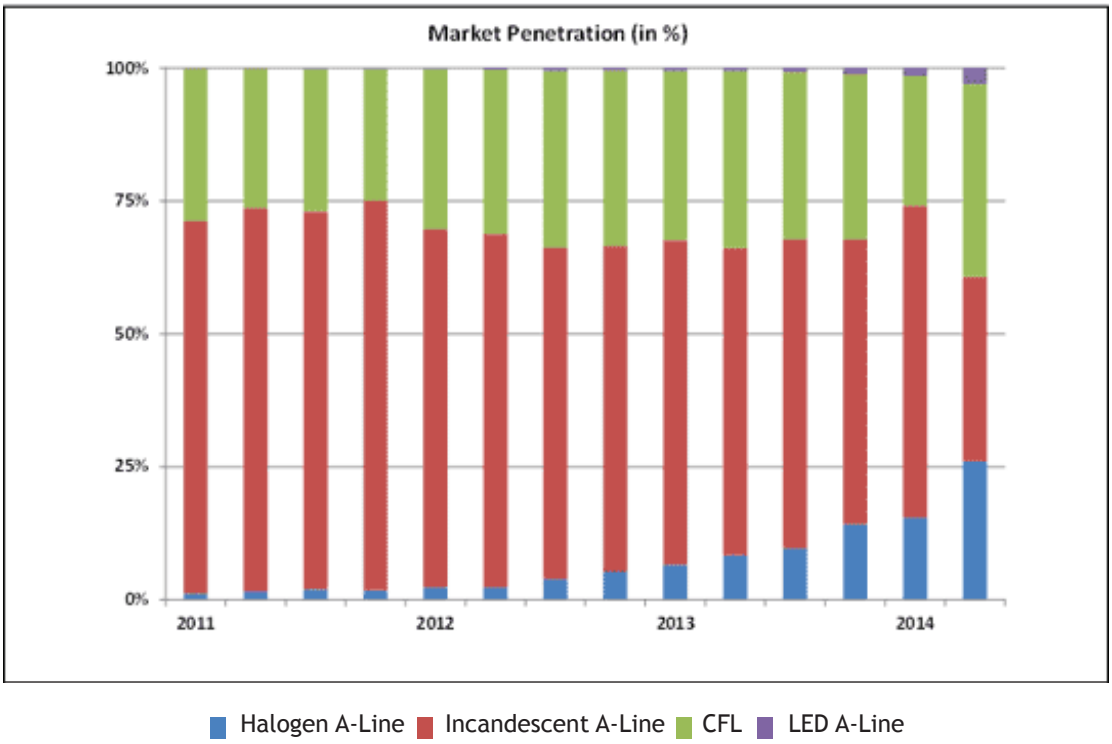
Table 2: NEMA's Shipping Trends for All Lamp Types in 2013 and 2014

Lamp Type	Incandescent	Halogen	CFL	LED
Change from 2012 to 2013	-10.6%	+41.8%	-0.4	+42.3%
Change from Q1 2014 to Q2 2014	-61.2%	+9.9%	-2.7%	+35.8%
Share of shipments year end 2013	51.5%	13.6%	33.8%	1.1%
Share of shipments Q2 2014	34.7%	26%	36.4%	2.9%

Figure 1 shows the market share of the various technology types based on shipping data from 2011 through the second quarter of 2014.

1 http://www.nema.org/news/Pages/Halogen-A-line-Lamp-Shipments-Continue-to-Rise-During-Fourth-Quarter.aspx
2 http://www.nema.org/news/Pages/Incandescent-A-Line-Lamps-Decline-Sharply-in-Second-Quarter.aspx

Figure 1: NEMA's Market Share of Lighting Technologies from 2011-2014



These shipment trends demonstrate a high penetration of incandescents and halogens persisting, which may have implications for program that have assumed halogen alone to be the baseline. While full category level sales data would show the full picture for program impact and appropriate baselines, that data is not currently available (and is discussed further in the forthcoming Consortium for Retail Energy Efficiency Data section).

A recent paper by the Cadmus Group[3] found that the impacts of the first phase of EISA were slower than anticipated. They found that many programs have been using a baseline wattage that may be higher than the reality of product availability, thus creating an opportunity for programs to claim additional savings. The continued availability of incandescents and gaining market share of halogens reinforces the lesson that the market has not yet been transformed for lighting. Even with a huge shift in portfolios towards more LEDs and their prominence on retail shelves, they are still a very new technology and their market share is small.

With this evidence, we can find that the A-line lighting market is not transformed and efficiency program promotion of CFLs and LEDs is still critical to their adoption. While the popularity of LEDs is growing fast, their market share is still very small and the market is still dominated by halogens and incandescents. On top of that, there is stronger support that programs that have been claiming a blended baseline are correct, and while stocks are dwindling, incandescents have not yet left the market altogether. These factors leave a large opportunity for programs to influence market.

3 The Golden Goose That Keeps on Laying: Why There Are Still Savings Opportunities for CFL Programs Even After EISA. The Cadmus Group, Anders Wood and Andrew Rietz, 2014. ACEEE Summer Study 2014.

Update on Regional Residential Lighting Program Activity

The Northeast region has been a national leader in residential lighting programs. NEEP has been documenting the status of regional programs since the first Residential Lighting Strategy report. 2014 represented a significant shift in program portfolios as they realized the potential of LEDs for residential lighting, and most program activities hinged around that new reality.

Program Implementation Updates

Actual results from 2013, 2014 program planning projections, and 2014 year-to-date Program Administrator (PA) activity in the region point to both a continued strong reliance on lighting for most residential sector portfolios and an acceleration of LED program activity, both at retail and through direct install (DI) efforts. Of note is the withdrawal of retail support for select CFL lamp types in both Connecticut and DC, largely due to better performance by LED alternatives and continued declines in LED pricing. Standard CFLs continue to receive large support throughout the region, however, as they are low cost and can still provide significant energy savings, especially for low-income and price sensitive markets.

Table 3 shows current planned retail lighting program activity for several of the states or individual PAs in the region. Most of this data is 2014 planning data, but for Massachusetts, these numbers are the 2013 actual program values. Planned 2014 LED program share is as high as 44 percent and for those PAs with lower planned LED market shares (New Hampshire, Massachusetts, and Rhode Island), current year-to-date performance exceeds these goals (see Table 5 below). On an overall program activity basis, The DC Sustainable Energy Utilities (DC-SEU) has the most aggressive retail program effort planned for 2014, followed by Massachusetts. PAs in MA plan to support 3.4 efficient lighting units per household in 2014 and the DC-SEU plans to support 4 units per household.

As in the past, lighting also plays a large role in many PAs' portfolios beyond just the retail channel. The 2013 Annual Reports from the Massachusetts Program Administrators allow one to calculate the actual contribution of lighting to all Residential and Low Income initiatives and to overall Residential and Low Income sector savings. In 2013, lighting represented 67 percent of all reported annual Residential savings and 81 percent of lifetime savings from most of Massachusetts (see Table 4). When Behavioral Initiative savings are excluded, lighting represented 86 percent of 2013 annual residential savings in Massachusetts. Note that in 2013, Massachusetts PAs directly installed over 1.5 Million efficient lamps and fixtures in their new construction, multifamily, and single family retrofit initiatives. This total does not include additional efficient lighting installed in low income households.

Table 3: Planned 2014 Retail Lighting Program Activity

Planned 2014 Retail Lighting Activity (# of Units)	CFLs	Specialty CFLs	CFL Fixtures	Total CFLs	LEDs	Total Units	% LEDs	Households	Units/HH
Connecticut	2,493,909	577,203	6,844	3,077,956	867,980	3,945,936	22%	1,392,677	2.8
DC SEU	350,000			350,000	100,000	450,000	22%	112,500	4.0
Long Island (PSE&G)	1,200,000	575,000	3,000	1,778,000	650,000	2,428,000	27%	999,172	2.4
Massachusetts	4,578,769	1,160,063	213,967	5,952,799	926,584	6,879,383	13%	2,053,361	3.4
NYSERDA	206,632	73,311		279,943	216,328	496,271	44%	6,275,695	0.1
Rhode Island	580,000	420,000	64,200	1,064,200	172,000	1,236,200	14%	425,083	2.9
Vermont	361,000	187,200	1,900	550,100	276,035	826,135	31%	309,019	2.7
New Hampshire	210,951		3,249	214,200	25,696	239,896	11%	518,973	0.5

As in the past, lighting also plays a large role in many PAs' portfolios beyond just the retail channel. The 2013 Annual Reports from the Massachusetts Program Administrators allow one to calculate the actual contribution of lighting to all Residential and Low Income initiatives and to overall Residential and Low Income sector savings. In 2013, lighting represented 67 percent of all reported annual Residential savings and 81 percent of lifetime savings from most of Massachusetts (see Table 4). When Behavioral Initiative savings are excluded, lighting represented 86 percent of 2013 annual residential savings in Massachusetts. Note that in 2013, Massachusetts PAs directly installed over 1.5 Million efficient lamps and fixtures in their new construction, multifamily, and single family retrofit initiatives. This total does not include additional efficient lighting installed in low income households.

Table 4: 2013 Evaluated Annual Savings for Massachusetts Program Administrators[4]

2013 MA Evaluated Annual Report (AR) Residential Savings (MWh)	2013 Evaluated Annual Savings	Annual Savings from Lighting	Percent of 2013 Annual Savings from Lighting	Percent of 2013 Non-Behavioral Annual Savings from Lighting	2013 Evaluated Lifetime Savings	Lifetime Savings from Lighting	Percent of 2013 Lifetime Savings from Lighting	Number of Units
Residential New Construction	8,045	5,391	67%		85,689	35,897	42%	140,861
HVAC	12,175	0	0%		142,457	-	0%	
Single Family Retrofit	59,056	45,635	77%		394,477	279,646	71%	1,168,756
Multifamily	21,134	19,275	91%		195,385	179,818	92%	215,098
Behavioral	90,662	0	0%		90,662	-	0%	
Lighting	207,161	207,161	100%		1,705,225	1,705,225	100%	6,658,656
Appliances	16,125	0	0%		111,124	-	0%	
TOTAL	**414,358**	**277,462**	**67%**	**86%**	**2,725,018**	**2,200,586**	**81%**	**8,183,371**

For retail lighting initiatives LED program activity has exceeded planned LED program goals in several states and 2014 year-to date retail LED activity exceeds 2013 by significant amounts for several PAs (see Table 5). For example, the Connecticut retail lighting program through the end of September of 2014 was at a 39 percent LED program market share compared to only 15 percent in 2013 and a 22 percent goal (and performance incentive metric) for 2014. For DI efforts, several PAs have pursued bulk procurement to reduce lighting product costs to their programs and, ultimately, to ratepayers. Lower LED costs obtained from these efforts have helped support increased LED installations in the PAs' low income, single family, multi-family, and new construction programs.

4 Data presented represents 95-97% of Massachusetts 2013 Residential sector annual savings.

Table 5: LED Retail Lighting Program Market Share: 2013 and 2014 Year to Date

State	2013	2014 YTD	2014 YTD through
Connecticut	15%	39%	9/30/2014
District of Columbia	4%	23%	9/30/2014
Massachusetts	15%	20%	8/31/2014
Rhode Island	9%	20%	8/31/2014
Vermont	20%	31%	9/30/2014
PSEG-LI	26%	38%	10/31/2014
NYSERDA	47%	44%	9/12/2014

State Specific Activity Through Mid-2014

As discussed in the 2013-2014 RLS Update, the **Connecticut Department of Energy and Environmental Protection** set forward a number of conditions related to lighting regarding the PA's 2014-2015 Plan Update. In response to these conditions and continued market developments, the PAs:

- Developed and implemented a number of negotiated cooperative promotions (NCPs) with retailers to address hard to reach (HTR) customers. Currently the Companies are applying the same net-to-gross (NTG) values to these savings as they do to lighting product moved through more "traditional" retailers. This is in contrast to MA and RI which claim higher NTG ratios for HTR units.
- Ceased offering rebates for dimmable CFLs.
- Have attained LED program market shares in excess of 30 percent (39 percent as of September 30, 2014). The Companies have LED unit goals and associated performance incentives for 2014 that translate to a 22 percent LED program market share. For 2015 the LED unit goals translate to 31 percent for UI and 33 percent for CL&P. However, given that the Companies are currently exceeding their 2015 LED market share goals by a substantial margin, the Companies have proposed to raise their market share goals for 2015.

Massachusetts has significantly increased proposed retail lighting program activity in the 2014 and 2015 time period from earlier estimates. This has been motivated by the significant market opportunity in retail lighting as well to help make up for C&I program shortfalls and still meet overall portfolio savings goals for some PAs. Other PAs have increased their retail lighting program activity due to improving program cost-effectiveness driven by reduced incentives, particularly for LEDs. Lower incentives allow these PAs to support more products at retail, achieve higher savings, and yet leave their program budgets largely unchanged from their initial 2013-2015 Three Year Plan estimates.

PAs in both **Massachusetts and Rhode Island** completed a successful bulk procurement of lighting products for their direct install efforts. Together, PAs in both states in 2014 will install

over one million lamps and fixtures in their new construction, low income, single family, and multifamily programs. The DI bulk procurement RFP requested pricing for CFL and LED bulb and fixture types addressing attributes such as use in damp locations, dimmability, beam angle for reflector lamps, etc. These lower bulb prices are informing ongoing discussions as to whether and when to adjust or remove caps on the number of LEDs installed through DI efforts. For example, reflector CFLs are no longer used in PAs' direct install applications in Massachusetts and Rhode Island is expected follow suit.

Efficiency Vermont expanded its HTR efforts beyond its previously successful giveaways at food banks. Efficiency Vermont has included senior centers, community grant partners, non-profit entities, and other venues in its HTR efforts. Efforts also included a new aggressive marketing campaign and consumer education efforts, based on an extensive customer, manufacturer, and retailer surveys with approximately 500 participants that focused on price sensitivity and valued key drivers to purchase. Efficiency Vermont also increased incentives to ensure that more LED form factors hit the target price of $4.99, which was shown to be the optimal price point from the price sensitivity survey.

In **New Hampshire**, NH Saves continues to rely primarily on rebate coupons rather than upstream incentives, though there have been an increased number of upstream efforts in the past year. The continued use of rebate coupons gives New Hampshire Program Administrators better control of more limited lighting program budgets and helps ensure an ongoing, yearlong presence at participating retailers. Like other PAs in the region, they have been increasing their promotion of LEDs and have been adjusting their LED incentive levels to track declining LED pricing at their key retail partners.

The **District of Columbia Sustainable Energy Utility (DC-SEU)** started a new program year on October 1. A number of noteworthy programs changes will be implemented including:

- No more support at retail for dimmable or candelabra CFLs.
- Increased focus on LEDs. The price floor for LEDs will be lowered from $4.99 to $3.99 a bulb.
- No more support for CFL multipacks with more than six bulbs per package. The DC-SEU wants to reduce storage of CFLs and not use residential program funds to support possible contractor purchases. Contractors have other program venues to use to purchase efficient lighting.

New York represents the greatest amount of transition in lighting programs in 2014-2015. For **PSEG-Long Island**, lighting promotions continue through their EFI online lighting catalog, mail-in rebates, and instant rebates in participating stores. From 2013, their promotion of efficient lighting has increased from 2.0 to 2.4 bulbs per household with an increasing reliance on LEDs to meet savings goals. PSEG-LI has also continued to lower incentives as LED product prices shrink, allowing them to stretch their budget further and claim higher levels of savings.

It is anticipated that PSEG-LI programs will continue along a similar trajectory into 2015. On the other hand, lighting programs administered in the rest of New York through the **New York State Energy Research and Development Authority (NYSERDA)** have been in transition. Recently, program efforts have been split between more traditional upstream incentives for LEDs and specialty CFLs and NYSERDA's Sales Performance Program (SPP) market lift activities, which focused on standard CFLs. The initial SPP effort was implemented with a single manufacturer with hard to reach retailers being the principal participants. While the results from this initial SPP effort are being re-evaluated, NYSERDA does not intend to move forward with further SPP program efforts in the immediate future.

Moving forward, NYSERDA is looking to move away from product incentives. Through their Clean Energy Fund Proposal,[5] NYSERDA is transitioning from resource acquisition activities to "market animation" efforts to increase the impact of their activities in efficiency markets. These efforts are intended to be temporary initiatives that stimulate market transformation. In 2015, NYSERDA will no longer be offering direct lighting incentives, though NYSERDA is still committed to educating New Yorkers on the importance of efficient lighting. If incentive programs in New York continue in 2015, besides the ongoing PSEG-LI efforts, programs will be run by the local utilities with assistance from NYSERDA. This represents a major shift and a new role for New York utilities to play in the efficiency space. As anticipated in the program projections section of this report, while 2015 might be a challenging year for lighting programs, with support from NYSERDA and the region, we are hopeful that residential lighting programs in New York are able to pick up pace with the rest of the region in 2016 and beyond.

NEEP, through the Regional EM&V Forum that we facilitate, managed the completion of the region's first market lift pilot. Work on this effort began in 2012. The market lift pilot was designed and implemented by D&R International. In addition to the participation of NEEP Sponsors in MA and VT, the Bonneville Power Authority recruited utility participation in Oregon. There were two primary goals of the pilot. The first was to field test the market lift program design. These findings are briefly described in the EM&V section below. The second was to "collect a set of full-category sales data – all medium screw-based lamps – to help inform an analysis of changes in the residential lighting market since the Energy Independence and Security Act of 2007 (EISA) standards went into effect and an assessment of whether the programs affected the lighting markets in their respective service territories." These results are also summarized in the Post-EISA Report EM&V section below.

Recent and Planned Program Evaluations

Recently Completed EM&V Studies

2014 saw the completion of several key lighting evaluation activities, perhaps the most noteworthy and impactful of which being the Regional Hours of Use (HOU) study. This study generated HOU estimates that largely confirmed existing whole house HOU estimates for most of

5 http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7BDABF6A8A-17A5-441F-AC44-48587105CF6D%7D

the program sponsors (see more below), but are considerably higher than the HOU estimates used in previous RLS lighting scenario savings estimates. Previous RLS savings estimates assumed that residential lighting operates at 1.9 hours/day. This value was informed by then recently completed HOU studies in California, the Pacific Northwest, and DOE's extrapolation of the California data to other states. The values recommended by the Regional HOU study are considerably higher.

Another noteworthy study was produced for NYSERDA and provided the first estimate of NTG for LEDs in the region. Prior to this study, all PAs in the region were using NTG assumptions for LEDs that were not based on any specific study.

Northeast Residential Lighting Hours-of-Use Study. (May 5, 2014)[6]

The Connecticut Energy Efficiency Board, NYSERDA, and PAs in Massachusetts and Rhode Island undertook one of the largest residential lighting HOU studies ever completed; second only to the previous California study. Loggers were installed between December 2012 and March 2013. Logger retrieval was completed in August 2013. On average, loggers were installed for 143 days. The report's authors summarized the Northeast study, in part, as follows: Based on data collected from 4,462 loggers, the evaluators performed a series of regression models to estimate HOU. They concluded that the region comprising Connecticut, Massachusetts, Rhode Island, and Upstate New York had a household daily HOU of 2.7 hours for all bulbs and 3.0 for efficient bulbs, with HOU by room type varying from a low of 1.7 in bathrooms to a high of 6.7 on the exterior of homes. Hours of use for Downstate New York exceeded those for the other areas included in the study, with a daily HOU of 4.1 for all bulbs and 5.2 for efficient bulbs for the household; room-specific estimates varied from 3.2 for bathrooms to 7.7 for kitchens.

The evaluators also provide detailed HOU estimates by room type, home type (i.e., single-family or multifamily), and income level for the region overall and for each individual area included in the analysis. Additionally, the report presents load shapes as well as well as coincidence factors for winter and summer peak period and winter and summer peak hours to aid in load planning and the calculation of peak demand savings.

In addition to the data collected from 848 homes in Connecticut, Massachusetts, New York (excluding Nassau and Suffolk Counties), and Rhode Island, this study leveraged data collected from two other concurrent HOU studies: the Massachusetts Low-Income Metering Study and the National Grid New York EnergyWise Study.

For program planning purposes, the report recommends the use of a 2.9 hrs/day value for MA, RI, CT and Downstate NY and 4.8 hrs/day for Downstate NY. This value reflects the efficient lighting HOU value adjusted for snapback.

6 Northeast Residential Lighting Hours-of-Use Study, NMR Group, Inc. May 5 2014. https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2014ContractorReports/2014-EMEP-Northeast-Residential-Lighting.pdf

Massachusetts Low-Income Metering Study. (March 5, 2014)[7]

As part of a larger Low Income (LI) metering study, evaluators installed over 1,500 lighting loggers in 261 homes and collected usage information from November 29, 2012, through May 2, 2013. The data from these loggers was combined with metering data for LI homes included in the regional HOU study. The Evaluation Team estimated an average weighted HOU of 2.6 hours per day. The authors concluded that this value did not vary significantly from the findings of the full regional HOU study. Subsequently, PAs in MA have adopted the regional HOU values for all housing types.

Massachusetts Residential Lighting Shelf Survey and Pricing Analysis. (June 2, 2014)[8]

In November 2013, evaluators collected data from 118,835 lighting product packages from a representative sample of 130 participant (100) and former-participant (30) stores in Massachusetts. They collected data on shelf space, shelf location, and pricing for all bulbs identified through the shelf survey. As the survey timing preceded the phase-out date for 40W and 60W incandescent bulb, data collection and reporting on incandescents focused on 75W and 100W bulbs. Key findings from the study included:

- Participant stores continue to provide a wider variety, more inventory, and better prices of CFLs and LEDs than former-participant stores.
- CFL inventory appears to be losing ground in 2013, compared to 2012, for both participant and former-participant stores, while LED inventory increased.
- The proportion of shelf space devoted to CFLs among participant stores has increased since 2010. In 2010, CFLs comprised 33 percent of all bulb shelf space, which then grew to 68 percent in 2012 and 62 percent in 2013.
- Average CFL prices for A-line bulbs in participant stores are almost double those of corresponding halogen bulbs.
- 57 percent of participating stores still stocked 100W incandescents and 63 percent stocked 75W incandescents.
- Overall, average discounted prices are less than non-discounted prices; however, the average PA incentive is larger than that difference, indicating that the full PA discount may not be passed through to consumers.

Post EISA report: The Impact of EISA on Residential A-Lamps. (November 2014)[9]

As part of the Market Lift project lead by NEEP's EM&V Forum, D&R International prepared a Post-EISA analysis to assess the impact of EISA on sales and saturation of 1100 lm (75W) and 1600 lm (100W) residential A-lamps in 2012 and 2013. The report included the following elements:

- Modeled the interaction of the installed base and sales in MD, DC, VT, MA, RI and CT using empirical saturation, import, and sales data.
- Model outputs: 2012 and 2013 sales and saturation by technology and lumen bin

7 Massachusetts Low Income Metering Study. The Cadmus Group, May 2014.
8 Residential Lighting Shelf Survey and Pricing Analysis. The Cadmus Group, June 2 2014.
9 The Impact of EISA on Residential A-Lamps. D&R International, November 2014. http://www.neep.org/impact-eisa-residential-lamps-report-2014

This report is not the final word on EISA as it too soon to understand the full impact of EISA's implementation, but it does attempt a model of socket saturation which could be re-applied in future contexts. Some of the key take-aways of the report include:

- Incentive programs for efficient lighting are likely to remain an important avenue to achieve energy savings for utilities at least through the end of 2016.
- Market saturation surveys can help determine the long-term viability of A-lamp programs.
- Programs for energy-efficient lighting technologies should continue for at least several more years.

Market Effects, Market Assessment, Process and Impact Evaluation of the NYSERDA Statewide Residential Point-of-Sale Lighting Program 2010-2012. (May 22, 2014)[10]
NMR and Apex Analytics completed a comprehensive process and impact evaluation of NYSERDA's 2010-2012 point-of-sale (POS) retail lighting program. Note that in early 2012, at the direction of the NY Department of Public Service, NYSERDA dropped support for standard CFLs and implemented a Sales Performance Program (SPP) for standard and A-lamp CFLs in late 2012 (see above). This evaluation did not address the new SPP effort.

Key research tasks included:

- In-depth interview with participating and nonparticipating retailers and manufacturers
- Telephone surveys of NYSERDA consumers and consumers in three comparison areas
- An onsite socket saturation survey of 259 households

Key findings from the study included:

- NTG values for:
  - Standard CFLs of 64 percent
  - Specialty CFLs of 87 percent for 2011 and 71 percent for 2012
  - For LEDs of 90 percent for 2011 and 75 percent for 2012
- CFL socket saturation remained unchanged at 26 percent for the NYSERDA area overall between 2011 and 2013. Saturation of CFLs was lower in Manhattan (19 percent) than Upstate (25 percent) or Downstate (29 percent).
- Satisfaction is greater for LEDs than for CFLs.
- While households have a large number of incandescent bulbs in storage, stockpiling appears to be limited.
- There are still a significant number of phased-out legacy incandescent bulbs available.
- Few consumers are aware of the Lighting Facts label or understand lumens.

10 Market Effects, Market Assessment, Process and Impact Evaluation of the NYSERDA Statewide Residential Point-of-Sale Lighting Program 2010-2012. NMR Group, Inc and Apex Analytics, LLC, May 22, 2014. http://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2014ContractorReports/2014-EMEP-pos-lighting-program.pdf

- Large, frequent program changes resulted in programming gaps and loss of partner momentum.
- The change to NYSERDA picking up 100 percent of discounts in 2012 for products addressed by the program (LEDs and specialty CFLs) benefitted the program.

Residential Lighting Market Lift Pilot Final Report. (August 1, 2014)[11]
D&R International, the firm that designed and implemented the market lift pilots in MA and VT, completed a final report at the completion of the pilot. This project, which started in 2012, was faced with challenges for retailer participation, data acquisition, and consumer uptake. Through the process, the stakeholders involved learned that identifying partner barriers first and then designing non-product incentive support to bolster participation is important. Some key lessons from the report include:

- Early involvement of program planners, evaluators, and manufacturers helps guide program design in vital ways, setting the stage for success in execution and evaluation.
- Incentive structures need to reflect retailer sales volumes, as well as program sponsor priorities.
- Non-disclosure agreements (NDAs) are necessary for collecting historical and program sales data, but negotiating those agreements takes time.
- Once data collection and delivery systems are in place, the data transfer generally proceeds smoothly.
- Retailers value field support in helping them sell more products.

Moving forward, program administrators are considering working with manufacturers directly, which might be more influential than through retailers. This would be considered on a case by case basis. An additional 3rd-party evaluation of this project is in process for Massachusetts.

Ongoing and Planned EM&V Studies

Pennsylvania Residential and Commercial Lighting Metering Study
The Pennsylvania Statewide Evaluator (SWE) is overseeing in-field metering of commercial and residential lighting. For the residential sector metering, approximately 1,470 loggers were installed in 213 homes. The SWE will calculate both HOU and coincidence factors. The primary sampling unit is the entire home, but the SWE will also examine lighting usage by room type. They are currently retrieving the loggers after being in the field since August of 2013. Results are expected to be ready by November 2014.

Vermont Trade Ally and Customer Willingness to Pay Surveys
Program evaluators in Vermont are completing analysis of a series of trade ally and consumer surveys administered earlier this year. The surveys focused on price sensitivity and consumer

11 Residential Lighting Market Lift Pilot Final Report. D&R International, August 1 2014. http://www.neep.org/file/1779/download?token=jX4aqHVy

drivers. The analyses will inform several program efforts. Most notable of these are planned consumer education and outreach efforts. The consumer surveys will also be used to complete a willingness to pay analysis. A report is expected in November 2014.

Vermont Single Family Home Characterization

Vermont will be characterizing its existing single family housing stock and single family new construction practices. This study provides a comprehensive assessment of these building types including socket saturations. Results are expected in 2015.

Massachusetts Market Lift Assessment

This MA specific report will assess the MA PAs' participation in the NEEP-led market lift pilot. The assessment will look at the design and implementation of the Market Lift pilot and develop a net-to-gross estimate for the Market Lift activities.

Massachusetts Multistage Lighting Net-to-Gross

Results from this study should be available in early 2015. MA evaluators are employing multiple strategies to inform their retail lighting NTG estimates including:

- Supplier interviews and analysis
- Demand elasticity modeling
- Point of sale analyses
- NTG of saturation data (via comparison)

Mid-Atlantic Hours of Use Study

DNV KEMA, funded by the DOE, is currently completing a residential lighting hours of use (HOU) study in New York, New Jersey and Pennsylvania. Data are currently being analyzed, and DNV KEMA continues to seek funding from others to integrate additional data into the DOE analysis. The goal is to gather more metered data in more locations to combine with existing studies, including recent Northeast HOU Study. This would paint a more accurate picture and mean less reliance on CA for their data.

Massachusetts On-site Surveys

MA evaluators completed 261 onsite surveys of households in 2014. These included 150 first-time visits and 111 panel visits of households previously surveyed in 2013. Results from this study should be available in Fall 2014 and will include updated socket saturations and an analysis of what lamps households are installing when existing lamps fail.

Connecticut Lighting Interactive Effects

This study will calculate a statewide interactive effects (IE) factor for efficient lighting. The factor may vary by primary heating fuel type and cooling system type. The factor will quantify the effects on HVAC systems of replacing incandescents with more efficient bulbs (CFLs

and LEDs). The study will leverage the REM/Rate models developed for the Connecticut Weatherization Baseline Assessment and Technical Potential Study to determine lighting IE factors for single-family. An internal draft of this study is being reviewed by the Energy Efficiency Board's evaluation consultants. A final report is expected by late fall of 2014.

Connecticut Residential Lighting Net-to-Gross
This study will estimate net-to-gross (NTG) ratios for several key retail lighting measures using several different approaches. A report is expected by the end of 2014.

DC Sustainable Efficiency Utility
Evaluators in DC have largely completed product leakage and in-service rate analyses of retailer and consumer surveys. The retail lighting survey evaluations are currently internal.

Maine Hours of Use and Socket Saturation Survey
Maine completed onsite surveys of 67 homes in 2013. Lamp counts were completed to inform a revised socket saturation estimate (the last one was completed in 2011) and light loggers were installed to derive hours of use estimates. Results should be available later this year.

Lamp Specifications

ENERGY STAR Lighting Specifications

As reported on in the 2013-2014 Update to the Residential Lighting Strategy, in August 2013, EPA released the final version of a new technology-neutral ENERGY STAR Lamps Specification, now in Version 1.1.[12] This specification went into effect on September 30, 2014. The following impacts were observed upon implementation of the new specification on ENERGY STAR's product finder database:

- 6370 CFLs and 5130 LEDs certified to the old specification
- Only 585 CFLs and 1,729 LEDs certified to the new specification

This reflects a decrease of 91 percent of CFLs and 66 percent of LEDs products with the new specification, though many more products are being certified to the new specification each day. At the time of publication of this report, the product levels were up to 1131 CFLs and 2863 LEDs.

In addition to fewer products meeting the new Lamp 1.1 specification, EPA made some slight adjustments to the specification since the final version was released in August 2013. In general, these adjustments make for a stronger and more universally applicable specification. The primary adjustments are listed below:

- EPA closed a loophole around globes passing as A-lamps and thus qualifying for a lower efficacy level. EPA provided clarification that the globe and decorative categories cannot be used as a certification pathway for general purpose lamps that do not meet the omnidirectional requirements and outlines globe lamp shape require-

12 https://www.energystar.gov/products/specs/lamps_specification_version_1_0_pd

ments more specifically.

- EPA expanded the specification to include the GU10 base and made reference to the new ANSI standard for a PAR16 with a GU10 base.
- The updated specification now provides a pathway for line voltage MR16 lamps with GU10 bases to earn the ENERGY STAR certification.
- The center beam calculator was updated so it may be used to provide benchmark performance for replacement claims for these lamps.
- EPA extended the specification to include the new MRX16 lamp type and shape specific to LED lamps, which is a taller LED lamp included in a new ANSI standard.
- Test data may now be shared amongst PAR30 lamps with variable neck length.

In addition to the revisions to the Lamp specification, ENERGY STAR is embarking on the Luminaires V 2.0 revision, which is anticipated to improve the viability of luminaires for promotion in efficiency programs. While this process just kicked off in late 2014, ENERGY STAR is proposing some new considerations for this residential-focused specification, including:

- Limiting the scope of the specification to fixtures that ship with ANSI based (including screw based) bulbs.
- Streamlining testing requirements for manufacturers.
- Establishing efficacy steps that would automatically take effect at set time intervals, thus eliminating the need for an entire specification revision process to maintain strong efficacy levels into the future.

Efficiency stakeholders are involved in the process to ensure that the new specification meets the needs of the efficiency programs.

California Quality LED Lamp Specification and Energy Commission Rulemaking

As discussed in the 2013-2014 RLS Update, in December 2012 the California Energy Commission (CEC) published the Voluntary California Quality LED Lamp Specification.[13] Among other requirements, the CEC specification required all LED lamps promoted by programs to reach at least a 90 CRI. While initially this more restrictive specification greatly reduced the number of products that could qualify for program incentives, manufacturers have responded with new products that meet the CEC requirements and California Program Administrators generally find that they are able to meet their goals while promoting the CEC products. At present, there are over 45 products that meet the specification from many manufacturers and the program is beginning to have second generation qualifying products that have made significant improvements in price and efficacy. Although the listing of products currently is not public, as California is a major market for lighting manufacturers, it is likely that products that meet the CEC LED specification will seek to enter national markets.

13 http://www.energy.ca.gov/2012publications/CEC-400-2012-016/CEC-400-2012-016-SF.pdf

While the higher CRI requirement has taken a toll on the product efficacy and price, some improvements have already been made. One example is the Cree "True White" product which was one of the first to meet the CEC specification. Their 800lm, 60W equivalent at 80 CRI was a 9.5W product with an efficacy of 84 lm/w. Their CEC Specification compliant 800lm, 60W equivalent product at 93CRI used 13.5W, an efficacy level of only 59lm/w. When originally released in September 2013, that product retailed for $19.97; it now retails for $15.97. However, the 80 CRI version continues to retail for a lower price of $9.97. While the product still has a lower efficacy and higher price than non-CEC compliant models, the improvements in price over a short time period have been significant.

In addition to the 90+ CRI, the CEC specification originally had several provisions that aligned with an older version of the ENERGY STAR LED Lamp specification. It also required lifetime testing for luminaires that currently are not required for ENERGY STAR certification. A revised Voluntary California Quality LED Lamp Specification Version 2.0 draft[14] was released in October, 2014, and includes updates to better align with the current ENERGY STAR Lamp 1.1 specification.

Though the CEC LED spec is gaining momentum and products in California, programs in the Northeast have not expressed a priority to implement high-CRI constraints for products moving through programs. Moreover, industry experts have expressed caution regarding use of a higher CRI metric by energy efficiency programs due to flaws in the CRI metric itself. An August 2014 position statement issued by the Illuminating Engineering Society[15] states "it is the position of the IES that CRI requirements should not be a metric used in energy regulations to characterize color attributes for solid state lighting until there is industry consensus on the issue." In the future, using CRI coupled with additional tests, such as Gamut Area Index which looks at the color saturation, may better assess a light source's ability to render colors. At present, however, there is not a standard alternative metric in practice, and it is unclear how this position will impact the CEC or other specifications.

California is also in the process of revising their mandatory state standards for small diameter and general service lighting. While these standards will not go into effect until 2017, they do lead the nation in movement towards state level efficiency standards for lamps. A draft of the proposed pre-rulemaking document[16] was released in September, 2014. Since a great deal of attention has been paid to the CRI metric in California, the staff proposed compliance tiers that took a weighted average of CRI and efficacy. This way, more efficacious products with lower CRIs could qualify, while high-CRI products could have a lower efficacy level and still qualify. This process is ongoing.

14 http://www.energy.ca.gov/appliances/led_lamp_spec/documents/California_Quality_LED_Lamp_Specification_Draft_2014-10-14.pdf
15 http://www.ies.org/PDF/PositionStatements/PS-8-14.pdf
16 http://www.energy.ca.gov/2014publications/CEC-400-2014-020/CEC-400-2014-020-SD.pdf

Consortium for Energy Efficiency's Tiered Lamp Specification

The Consortium for Energy Efficiency (CEE)'s new lamp specification is almost finalized, pending CEE Board approval, and is set to be released in early 2015. The specification has three tiers, building off of the ENERGY STAR Lamp Specification Version 1.1, and would allow program administrators to promote products with higher efficacies, CRI, and power factors above ENERGY STAR's levels. In discussions at the 2014 Northeast Residential Lighting Workshop, program administrators expressed continued interest in a specification that offered higher energy savings for residential lighting products. The CEE specification is not public facing and would not necessitate additional manufacturer testing or reporting; rather it would rely on data already submitted to ENERGY STAR.

The tiered structure is designed to push the industry in the direction that efficiency programs would like them to advance. Notably, the third tier, though aspirational, would align with the CEC's LED Specification for high CRI, though would be at a higher efficacy level. All three tiers have the potential to provide efficiency programs with additional claimable savings and potentially a higher incentive could be placed on products that meet a higher tier.

ENERGY STAR/NEMA Lighting Roadmapping Effort

In late 2013, ENERGY STAR and the National Electrical Manufacturers Association (NEMA) joined forces to host a series of discussions referred to as Lighting Roadmapping. With an in-person kick-off meeting in January 2014, the effort has materialized into working groups meeting to push forward three distinct efforts: streamlining current ENERGY STAR Verification Testing, aligning on common needs for consumer education and research, and innovations in efficient lighting. ENERGY STAR and NEMA have hosted several phone calls as well as a second in-person meeting as part of the ENERGY STAR Partner Meeting in October 2014. These conversations have been broad in scope with open participation, but have largely been pushed forward by lighting manufacturers. Efficiency programs are a welcome voice to these efforts and PA participation is encouraged.

At the time of publication, the verification testing streamlining conversation had a proposal put forward by NEMA and a draft guidance response issued by ENERGY STAR. NEMA's proposal has received pushback from efficiency stakeholders as potentially not adequately guarding against the early mistakes of CFLs with low-quality product hitting the market with support from ENERGY STAR and PAs. Additionally, the Consumer Education committee has put together a list of resources and studies for stakeholders. This is available at: www.clasponline.org/LightingResources. All efforts are ongoing with regular meetings. Interested stakeholders should contact Alex Boesenberg Alex.Boesenberg@nema.org for more information and to get involved.

DOE Solid-State Lighting Initiative

The United States Department of Energy (DOE) in an integral resource for efficiency programs, particularly in their efforts to support solid state lighting (SSL) research and adoption. In 2014, they published many resources, outlined below.

SSL Manufacturing R&D Roadmap and Multi Year Program Plan

In April, the DOE published the 2014 edition of the Solid-State Lighting (SSL) R&D Multi-Year Program Plan.[17] This is an annual document providing information on the technological and market developments with solid state lighting.

In August, DOE published the 2014 SSL Manufacturing R&D Roadmap,[18] which serves as a complement to the Multi-Year Program Plan. This document expanded the discussion of LED pricing as well as a focus on OLED technology.

CALiPER Reports

DOE's CALiPER program, which releases reports on product performance, looked at several LED lamps with residential applications, including:

- CALiPER Summary Report on LED MR16 Lamps[19]
- CALiPER Snapshot Report on Indoor LED Luminaires[20]
- CALiPER Report on Retail Lamps[21]
- CALiPER Report on Characteristic of LED PAR38 Lamps[22]

Early Lessons of Solid State Lighting

In February, the DOE published a Report titled Early Lessons Learned in Bringing SSL to Market.[23] This report was prepared in contrast to a 2006 report on early lessons learned from CFLs, and includes a summary of 12 key points to success of the LED market ranging from technological challenges, challenges in developing LED product lines, and difficulties in using LED as a replacement technology.

Safety and Health

In June, the DOE published a Fact Sheet on LED Lighting and Health.[24]
In October, the DOE released technical brief Clarifying Misconceptions about LED Safety.[25]

17 http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ssl_mypp2014_web.pdf
18 http://www1.eere.energy.gov/buildings/ssl/news_detail.html?news_id=21602
19 http://www1.eere.energy.gov/buildings/ssl/news_detail.html?news_id=21571
20 http://www1.eere.energy.gov/buildings/ssl/news_detail.html?news_id=21493
21 http://www1.eere.energy.gov/buildings/ssl/news_detail.html?news_id=21315
22 http://www1.eere.energy.gov/buildings/ssl/news_detail.html?news_id=21397
23 http://www1.eere.energy.gov/buildings/ssl/news_detail.html?news_id=21254
24 http://www1.eere.energy.gov/buildings/ssl/news_detail.html?news_id=21453
25 http://energy.gov/eere/ssl/doe-publishes-technical-brief-clarifying-misconceptions-about-safety-led-lighting

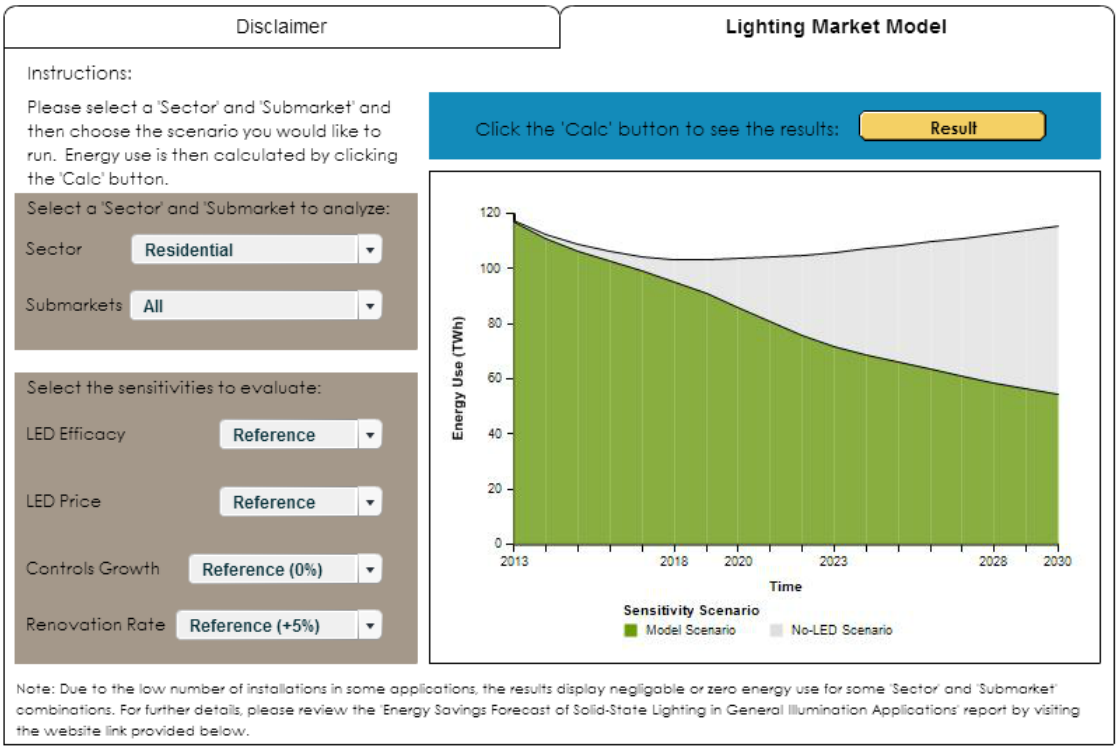
Energy Savings Forecast of Solid-State Lighting in General Illumination Applications

In September 2014, DOE published a new report[26] which forecasts the energy savings of LED white-light sources compared with conventional white-light sources. The report compares the annual lighting energy consumption in the U.S. with and without further market penetration of LED lighting.

This report concluded that LED lighting is projected to make major gains in market penetration, moving from 48 percent of lumen-hour of general illumination sales by 2020 to 84 percent by 2030. Additionally, this report anticipates that the market penetration of LEDs in all sectors is projected to yield a 40 percent reduction in energy consumption by 2030, which is the equivalent of the total energy consumed by nearly 24 million U.S. homes today.

In addition to featuring several useful graphs of the expected impact of LEDs, the report has an accompanying web tool[27] that allows users to create their own models. When we limited the scope to the residential market, but did not adjust any of the DOE's variables, we found that LEDs had an incredibly significant impact. Figure 2 depicts this model.

Figure 2: Model of DOE Energy Savings Forecast for Residential Lighting



26 http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/energysavingsforecast14.pdf
27 http://energy.gov/eere/ssl/led-lighting-forecast

LED Lighting and Health

A topic that received a lot of attention in 2014 was the impact and opportunity of LED lighting for human health. In a presentation at the 2014 Northeast Residential Lighting Workshop,[28] the Director of Educational Programs at the Lighting Research Center described the disruptive impact that exposure to blue spectrum light at night can have on the human circadian rhythm. This issue of blue light at night was also presented by a professor with the Harvard Medical School Division of Sleep Medicine[29] at the DOE SSL Market Development Workshop in November. While exposure to blue spectrum light at the wrong time can have a negative impact on human body function, there are also several exciting projects using LED light that are improving human health. The Lighting Research Center has studied using LEDs to help orient the elderly at night with great results, and LEDs are becoming more and more prevalent in hospital settings to help improve recovery time and patient wellbeing. LEDs offer the potential to both help and hurt human health, so this topic and the potential impact on efficiency will continue to be explored in years to come.

Consortium for Retail Energy Efficiency Data (CREED)

Another significant discussion in retail lighting has been the need for sales data to demonstrate program impact. The Consortium for Retail Energy Efficiency Data (CREED) is a collection of efficiency stakeholders committed to attaining retail sales data for energy efficiency products. This data is incredibly important for the planning and evaluation of efficiency programs to assess program impact on the market as a whole, and has been very difficult to obtain historically. While retailers will share with individual program administrators the specific information on which products were sold with the incentive, retailers have been very reluctant to share information about the full category data, meaning the products that were sold not through the efficiency program. Sales data are considered highly confidential by the retailers, but can be aggregated to mask the individual retailer and demonstrate to evaluators the impact of the efficiency program promotion.

CREED's primary initiative, LightTracker, is an initial effort to get sales of lighting data. The consortium is made up of program administrators, consultants, manufacturers, and EPA/ENERGY STAR. The member organizations are banding together to communicate the need for this data in a single voice to retailers. Currently, CREED has purchased lighting sales data for grocery, drug, dollar, club, and mass merchandiser channels. CREED is working with the home improvement channels to combine their data with data that has been purchased by CREED members. Current members include NEEP, National Grid, Northeast Utilities, Bonneville Power Administration, and Georgia Power. This is an ongoing effort. For any questions or to get involved, visit http://www.creedlighttracker.com/ or contact Scott Dimetrosky, scottd@apexanalyticsllc.com, (303) 590-9888, x101.

28 http://www.neep.org/sites/default/files/resources/2014RLSWorkshopMasterSlideDeck.pdf
29 http://energy.gov/sites/prod/files/2014/11/f19/lockley_spectrum_detroit2014.pdf

Enervee Lighting Database

As the lighting market continues to gain in complexity, a new online lighting resource has emerged. Enervee has created a light bulb energy efficiency platform where products are listed based on their energy efficiency/cost, purchase price and total cost. These products can be sorted to identify what is available as shown in Figure 3, and Enervee lists current prices using available offers from national retailers such as Best Buy, Sears, Amazon and eBay Commerce Network. This is a public resource that is available and updated daily to understand the changing market place of efficient lighting. If manufacturers or retailers would like to include their light bulb listings on Enervee, contact Alex Katzman alex@enervee.com.

Figure 3: Enervee Light Bulb Search Results[30]

30 http://enervee.com/lightbulbs/

Present and Future Federal Regulatory Activity

Many of the key lamp types in the residential lighting market are subject to federal minimum efficiency standards, including General Service Incandescent Lamps (GSIL). In addition to current regulations, there are a number of ongoing activities which will update those regulations in the future and are expected to have major impacts on the residential lighting market.

General Service Lamps

General Service Lamps (GSL) include general service incandescent lamps (GSILs), CFLs, general service LED lamps, organic light-emitting diode (OLED) lamps, and any other lamps that are used to satisfy lighting applications traditionally served by GSILs. GSLs are used in general lighting applications and account for the majority of installed lighting in the residential sector.

The Energy Independence and Security Act of 2007 (EISA) established minimum efficiency standards for General Service Incandescent Lamps (GSIL) that went into effect over a two year period (2012-14). Table 6 describes those levels across the spectrum of lumen output.

Table 6: Limitations on General Service Lamps Set by Phase 1 of EISA

Rated Lumen Ranges	Maximum Rated Wattages	Minimum Rated Lifetime (hrs)	Effective Date
1490-2600	72	1000 hours	January 1, 2012
1050-1489	53	1000 hours	January 1, 2013
750-1049	43	1000 hours	January 1, 2014
310-749	29	1000 hours	January 1, 2014

These standards are just the first phase of a three phase process by the federal government to improve efficiency in light bulbs. EISA also directs DOE to conduct two additional rulemaking cycles to evaluate more stringent energy conservation standards for the broader category of General Service Lamps, of which GSILs are included. Those subsequent rulemakings must be completed by January 1, 2017 (phase II) and January 1, 2022 (phase III) with effective dates no earlier than January 1, 2020 and January 1, 2025, respectively.

DOE initiated the rulemaking to satisfy phase II in December, 2013 with a Framework Document to not only evaluate standards for GSLs, but to determine whether exemptions for certain incandescent lamps should be maintained or discontinued. The scope of this phase of the rulemaking is no longer limited to incandescent lamp technologies. Additionally, the requirements direct DOE to consider phased-in compliance dates based on the impact of amending standards on manufacturers, retiring and repurposing existing equipment, stranded investments, labor contracts, workers, raw materials, and time needed to revise sales and marketing strategies.

Further, for this first cycle of rulemaking, the EISA amendments provide that DOE must consider a minimum standard of 45 lumens per watt (lm/W). If DOE fails to meet the requirements, or the final rule from the first rulemaking cycle does not produce energy savings greater than or equal to the savings from a minimum efficacy standard of 45 lm/W, manufacture of GSLs that do not meet a minimum of 45 lm/W beginning on January 1, 2020 will be prohibited. This 45 lm/W efficacy level is often referred to as the "backstop".

This backstop level of 45 lm/W is currently met by LED and CFL technologies. No form of incandescent technology that is commercially available today can meet these levels. So the new standards will move the general service lamp market completely to LED and CFL. There is always the possibility that an improved incandescent product or some other new technologies may come to market in the meantime and meet the standards.

It should be noted that even with an effective date of January 1, 2020, the full impact of a new standards may take months if not years to be fully realized, as the standards would apply to the manufacture and import of lamps. We have seen such a lag for phase 1 of EISA as discussed in the Lamp Sales Trends and Baselines sections of this report. Sell through of existing stocks is permitted. The experience of the first phase of EISA showed that this sell through process can take a significant amount of time. This factor will likely result in the presence of halogen products that meet the current efficacy levels through 2021 or 2022.

There is one additional wrinkle to the current rulemaking process that stakeholders should be aware of. There is a rider attached to the current Federal budget (Continuing Resolution), known as the "lamp rider" that defunds DOE's enforcement capabilities related to the current standards for general service incandescent lamps. According to DOE's interpretation, the rider prevents them from including general service incandescent lamps in their current rulemaking process.

The full implication for this rider on the current rulemaking is currently unclear, although DOE is moving forward with the process as the scope includes all general service lamps. This ongoing process is being monitored closely by NEEP and efficiency advocates. There may be more clarity following the release of a preliminary technical support document which was released in December 2014.

Market Analysis of Residential Lighting

In addition to presenting recent developments in the residential lighting market, NEEP researched key topics to produce forward looking analyses. These topics were agreed upon by the Residential Lighting Leadership Advisory Committee and present key pieces of information to help inform program planning. These projections used data collected from northeast program administrators and other cited sources. Across the region, LEDs are quickly becoming the major consideration for efficiency programs. This section analyzes the pricing and cost effectiveness that impact the product mix, especially regarding LEDs. This section also revisits and re-projects the levels of program activity that we feel are possible in the region.

LED Pricing Trends

A key component of successful transition from CFLs to LEDs depends on the price of LEDs. As these products have come down in price significantly in recent years, we looked at pricing trends for key product categories through 2015. This analysis includes a series of graphs that shows LED prices by lamp shape and manufacturer over the last year and projected future prices and can be used to guide program incentive strategy moving forward. This analysis looked at big-box retailers, which can often offer lower prices than smaller retailers based on economies of scale. Though the timing and exact price may vary depending on market, the general national trends are consistent.

Data Sources

The data used for this project are pulled from databases[31] to represent a robust dataset spanning many different manufacturers and retailers, accumulated directly from manufacturers and verified in-store in numerous retailer locations.

Methodology

To characterize the overall LED price trends, NEEP chose several lamp shapes and equivalent wattages to monitor. These include A19 40W equivalent, A19 60W equivalent, BR30, PAR30, and PAR38 lamps. Prices were tracked for the identified lamp type by prominent lighting manufacturers and retailers including Philips, Cree, TCP, GE, and Feit Electric. Several approaches were used to avoid issues associated with variable product characteristics and diverse market landscape of the products[32]. For each manufacturer and lamp shape, we chose prominent, low cost products to show the most aggressive pricing trends currently experienced. The chosen models represent the majority of the lighting market sales in the identified lamp categories. Overall, LED pricing for the highlighted products are dropping. Using a

31 This data is maintained by Ecova for incentive tracking purposes for programs administered throughout the US. Ecova obtains these data price points directly from manufacturers during product communications and pricing changes, and are verified by utility partners and in-field Ecova employees. They should be representative of Northeast price points.

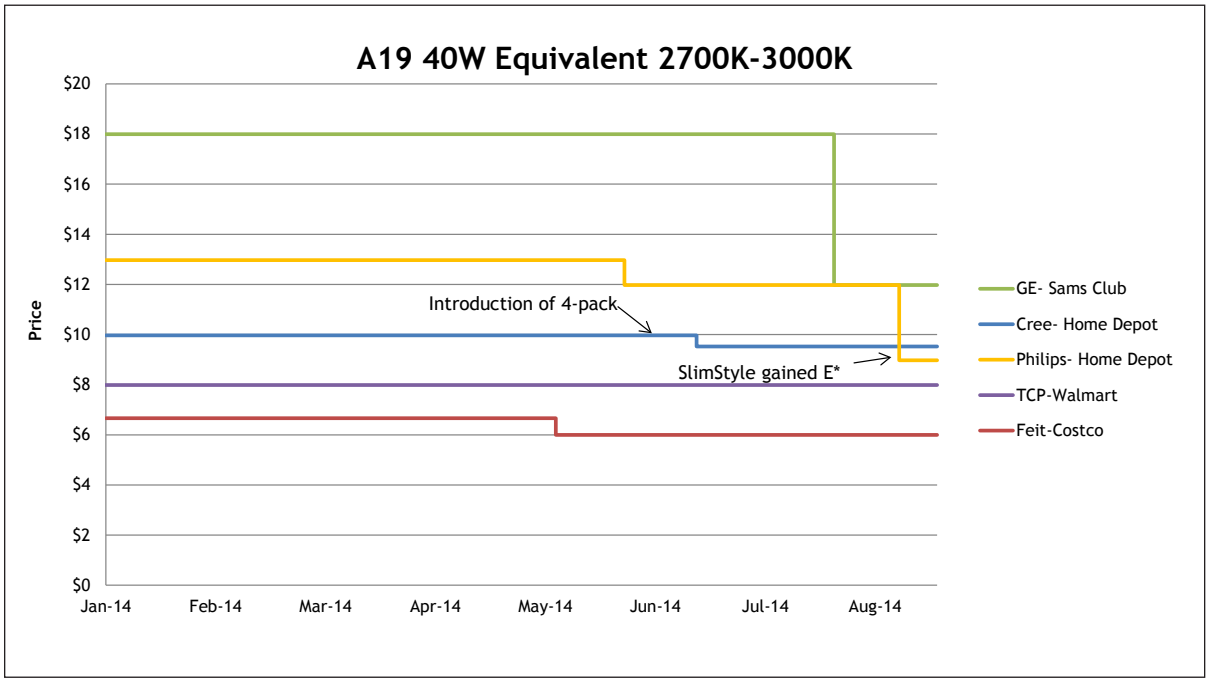
32 Methodology similar to the SSL Pricing and Efficacy Trend Analysis for Utility Program Planning 2013 report by the DOE (DOE. SSL Pricing and Efficacy Trend Analysis for Utility Program Planning. October 2013. Prepared by: Pacific Northwest National Laboratory. http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ssl_trend-analysis_2013.pdf), including restricting product search to approximately 5 major retailers and manufacturers, and for each brand, finding the lowest priced model for analysis.

linear regression to estimate the drop in price from the start of 2014 to the end of the year, we calculated an average price estimate for each of the identified lamps through the end of 2015. The following analysis was conducted using manufacturer recommended retail price.

A19 40W Equivalent 2700-3000K Lamps

Refer to Figure 4. For 40W equivalent A19 lamps, we looked at five models from prominent manufacturers and retailers including: General Electric from Sam's Club, Cree and Philips from Home Depot, TCP from Wal-Mart and Feit Electric from Costco. The prices of the highlighted products have dropped in both the second and third quarter of 2014, falling from an average of $11.10 at the start of the year to $8.89 at the end August. Extrapolating the reduction in price to the end of the year, the price will have fallen 31.3 percent over the course of the year. Based on our model, we expect the average price of an A19 40W equivalent lamp at the end of 2015 to be $6.11.

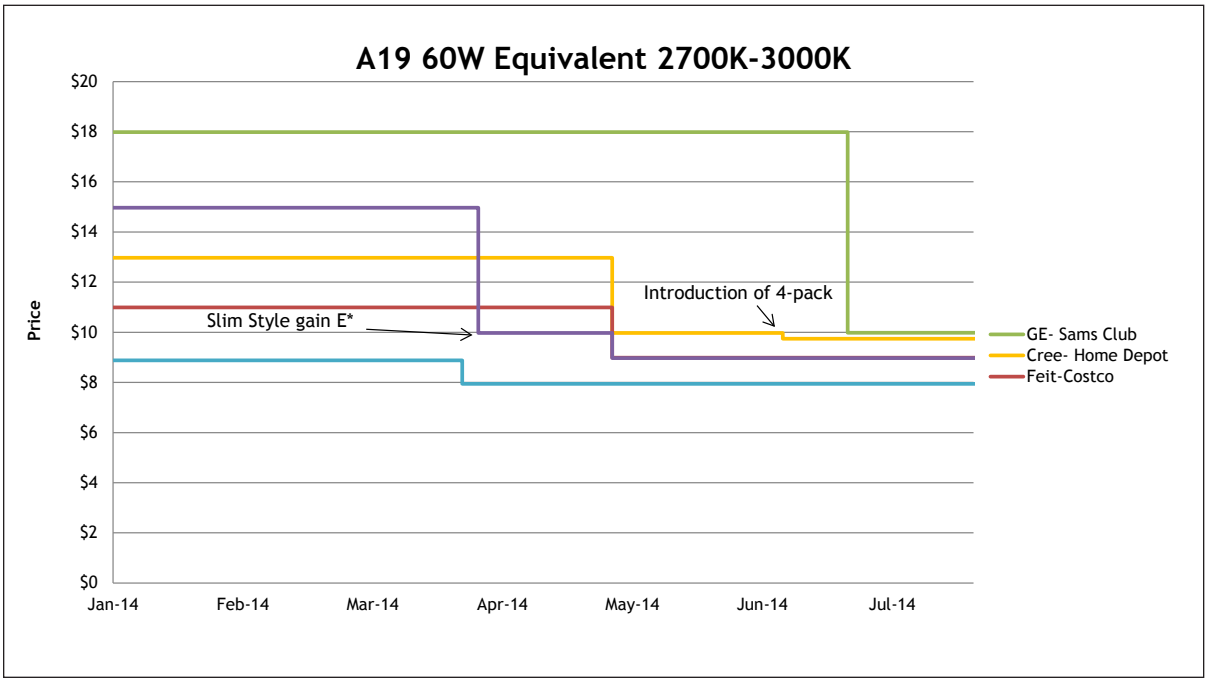
Figure 4: A19 40W Equivalent 2700K-3000K Price Tracking for 2014



A19 60W Equivalent 2700-3000K Lamps

Refer to Figure 5. For 60W equivalent A19 lamps, we looked at five models from prominent manufacturers and retailers. The prices of the highlighted products have dropped primarily in the second quarter of 2014, falling from an average of $13.16 at the start of the year to $9.12 at the end August. Extrapolating the reduction in price to the end of the year, the price will have fallen 48.2 percent over the course of the year. Based on our model, we expect the average price of an A19 60W equivalent lamp at the end of 2015 to be $6.81.

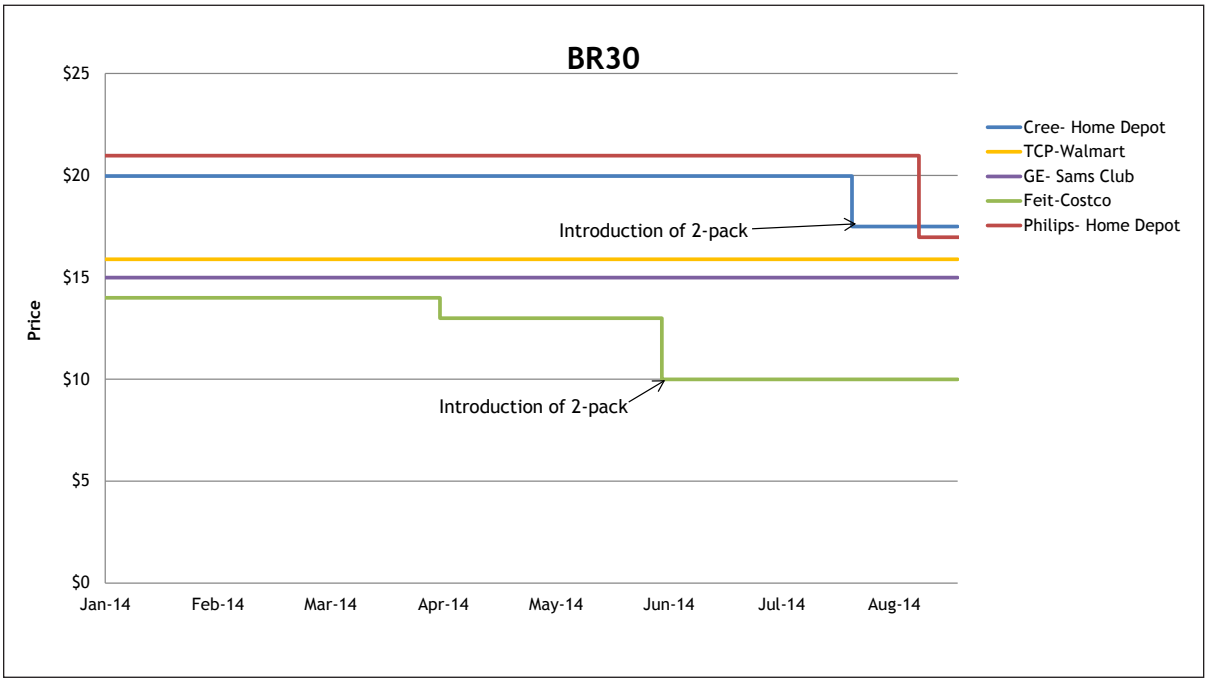
Figure 5: A19 60W Equivalent 2700K-3000K Price Tracking for 2014



BR30

Refer to Figure 6. For BR30, we looked at five models from prominent manufacturers and retailers. The prices of the highlighted products have dropped in both the second and late in the third quarter of 2014, falling from an average of $17.16 at the start of the year to $15.07 at the end August. Extrapolating the reduction in price to the end of the year, the price will have fallen 19.2 percent over the course of the year. We forecast the average price of a BR30 lamp at the end of 2015 to be $12.18.

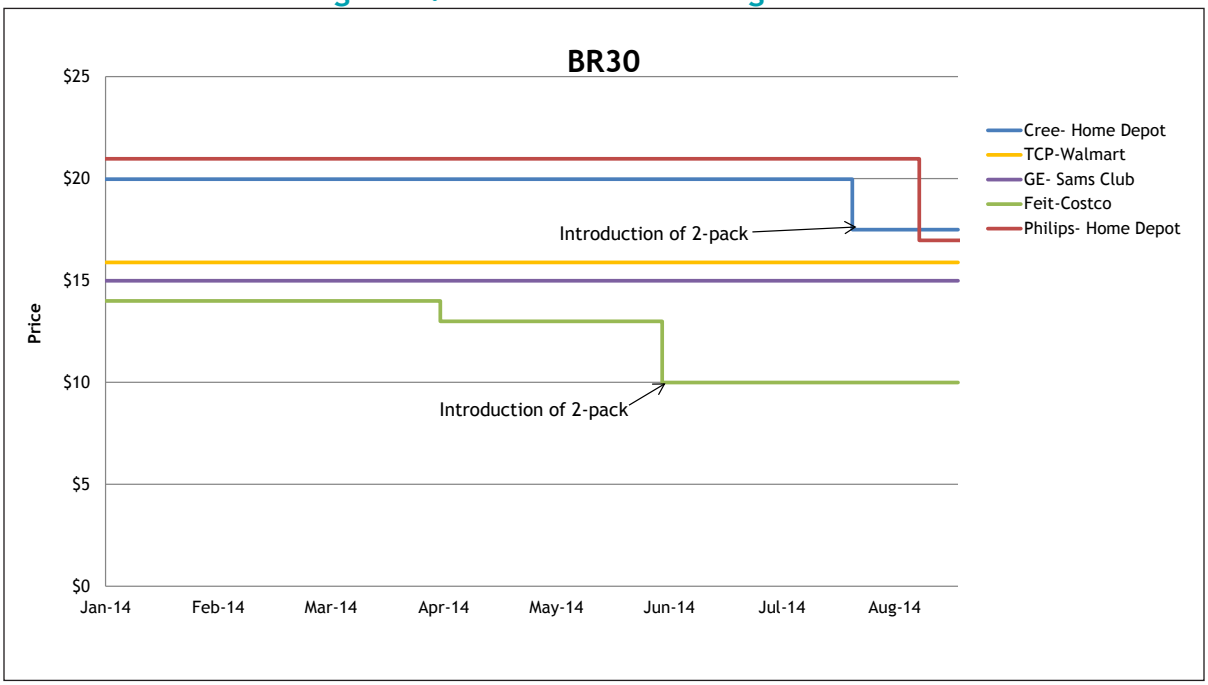
Figure 6: BR30 Price Tracking for 2014



PAR30

Refer to Figure 7. For PAR30, we looked at three models from prominent manufacturers and retailers. The prices of the highlighted products have dropped in both the second and third quarter of 2014, falling from an average of $29.32 at the start of the year to $25.89 at the end August. Extrapolating the reduction in price to the end of the year, the price will have fallen 18.4 percent over the course of the year. Based on our model, we estimate the average price of a PAR30 lamp at the end of 2015 to be $21.13.

Figure 7: PAR30 Price Tracking for 2014



PAR38

Refer to Figure 8. For PAR38, we looked at four models from prominent manufacturers and retailers. The prices of the highlighted products have dropped in both the second and third quarter of 2014, falling from an average of $26.219 at the start of the year to $23.46 at the end August. Extrapolating the reduction in price to the end of the year, the price will have fallen 16.5 percent over the course of the year. We forecast the average price of a PAR38 lamp at the end of 2015 to be $19.59.

Figure 8: PAR38 Price Tracking for 2014

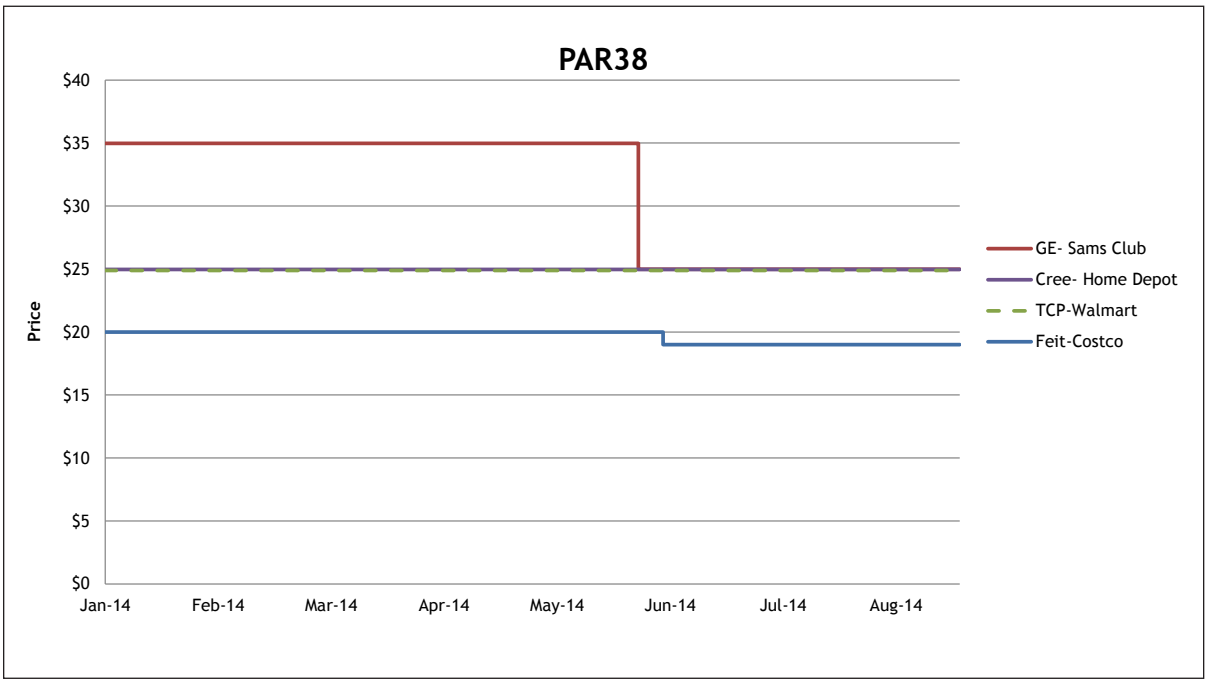


Table 7 shows a comparison of the end of August 2014 actuals and end of 2015 predicted costs. Overall, we see that prices will continue to drop significantly into 2015 and program administrators should adjust incentives accordingly.

Table 7: LED Pricing Trends Summary Table

Lamp Type	Average Low-Cost price in August 2014	Expected average low-cost price in end of 2015
A19 40W Equivalent	$8.89	$6.11
A19 60W Equivalent	$9.12	$6.81
BR30	$15.07	$12.18
PAR30	$25.89	$21.13
PAR38	$23.46	$19.59

Cost-Effectiveness Analysis: CFL to LED Transition

Another key piece of information to help inform program planning revolves around the cost-effectiveness of CFLs and LEDs. At present, LEDs are a more expensive technology and their promotion in programs is less cost-effective than that of CFLs. CFLs, however, have been the mainstay of efficiency programs for many years; in many cases, the savings to be claimed by CFLs has been impacted by low net-to-gross (NTG) ratios. In the years to come, however, LED prices are expected to decrease and a large portion of the possible savings from CFLs will still not be attributable to program activities; we anticipate that the tables will turn for the technology that is more cost effective.

To better understand this matter, we researched the variables impacting the cost-effectiveness of CFLs and LEDs, as well as at what time LEDs might overtake CFLS as the more cost effective option. This analysis includes a series of graphs that show the sensitivity of variables associated with the cost-effectiveness ratio (Combined Total Resource Cost and Societal Cost Test TRC/SCT) and projected future TRC/SCT values. Additionally, we include recommendations for how and when to transition portfolios to address these market conditions. These are average projections based on 2014 data supplied by northeast program administrators and thus do not necessarily reflect the specific scenario for any one state. That being said, the analysis can be customized based on state specific inputs and NEEP is a resource to program administrators to dive more deeply into a customized analysis.

LED and CFL Cost-Effectiveness Analysis

Data Sources and Analysis Technique

The data used for this project were provided by NEEP and NEEP sponsors from 2014 and 2013 program planning purposes. Averages and weighted averages were used to calculate the technology (CFL or LED) specific values where available. Additional data on Discount Rate and Non Energy Benefit Factor was gathered from the NEEP report: "Energy Efficiency Cost-Effectiveness Screening in the Northeast and Mid-Atlantic States"[33]

Cost-Effectiveness Ratio Sensitivity Analysis

To characterize the impact different variables have on the Northeast program cost-effectiveness tests, we conducted a sensitivity analysis on the 2014 data to understand how the range of measure level variables from each program impacted the program's cost-effectiveness ratio. To normalize the cost-effectiveness tests for this analysis, a standard TRC/SCT test was used as outlined below:

$$\frac{\text{Net Present value (Savings * Avoided Cost/kWh) * Units * Net to Gross (NTG) * Non Energy Benefit}}{\text{Admin Cost + Units * Incremental Cost(IMC) * NTG + Units * Incentives (1-NTG)}}$$

Note, for TRC the Non energy Benefit (NEB) is 1 and for SCT an addition factor is used for NEB

To break down the savings variables the following savings equation was used:

$$\text{Savings} = \Delta\text{Watts} * \text{Hours of Use(HOU)} * \text{Days/Year} * \text{Install Rate(ISR)} * \text{(W to kW Conversion)}$$

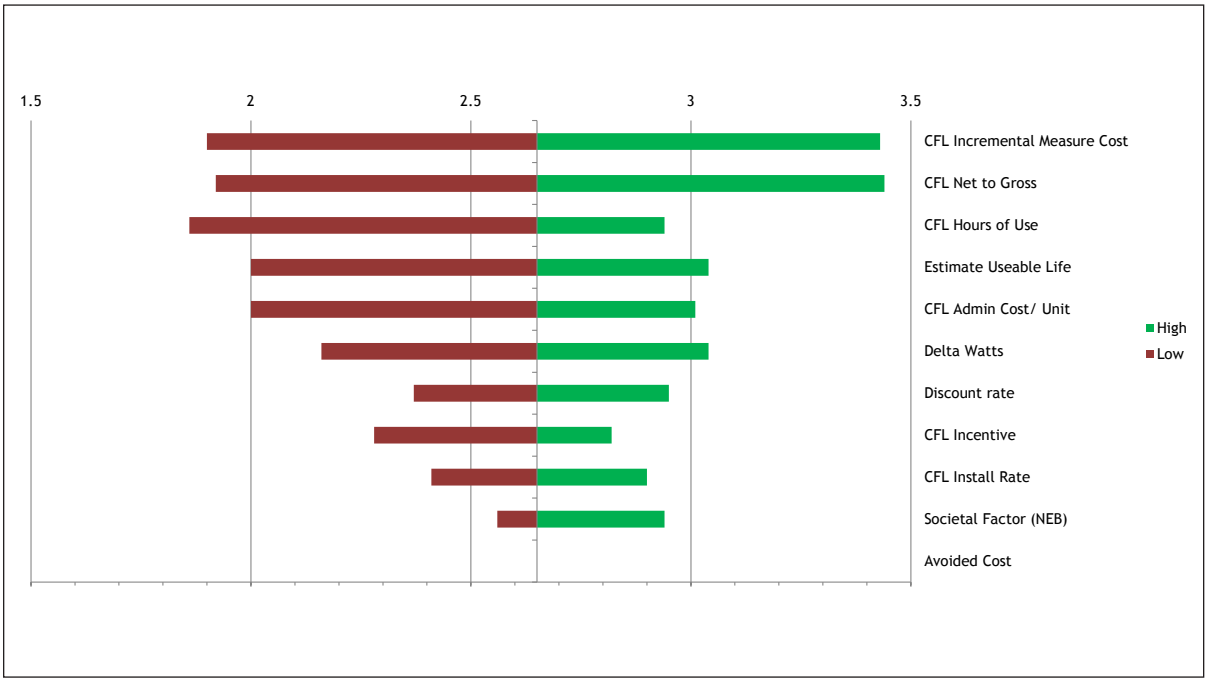
The sensitivity analysis used the high, average, and low values for each variable above, as collected from all utilities, to identify how sensitive the TRC/SCT ratio for both LEDs and CFLs is to each variable. We used blended values for specialty and standard CFLs and LEDs to show the total technology impact. We also found averages amongst the programs in the Northeast. As such, the information presented shows an average that was reached, as well as the range of responses for each measure.

33 http://www.neep.org/sites/default/files/resources/EMV_Forum_C-E-Testing_Report_Synapse_2013%2010%2002%20Final.pdf, October 2, 2013, Wolf; Malone;Kallay;Takahashi

CFL

We found that for 2014, the CFL cost-effectiveness ratio is sensitive to many variables, most notably the Incremental Measure Cost (IMC), NTG, and HOU. However, since several other variables are also important influencers, it is important for the Program Administrators to further understand how those variables have changed and might be changing in the future. Figure 9 shows how sensitive each variable is to the TRC/SCT of CFLs. The middle line at 2.65 is the TRC/SCT ratio as calculated by using the average values of each variable. The red-line and green-line are the low and high TRC/SCT ratios respectively if the impact of that given variable was isolated based on the range of values as collected from the program administrators.

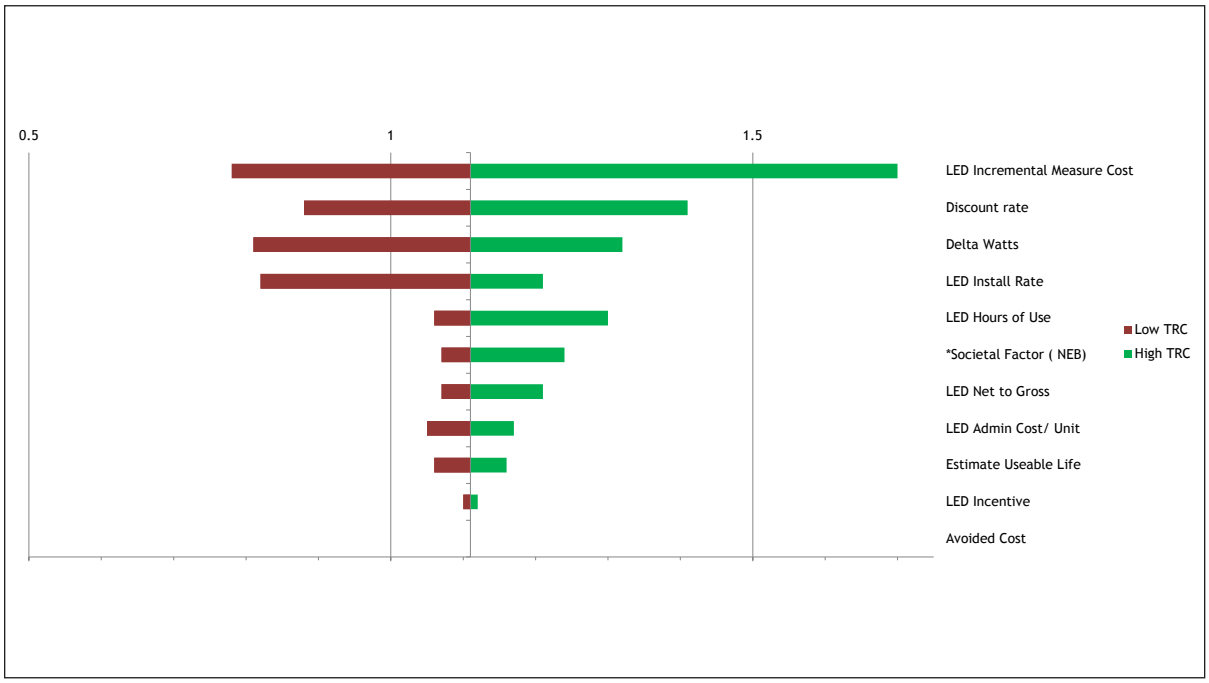
Figure 9: CFL Sensitivity Analysis



LED

The LED cost-effectiveness ratio is most sensitive to a few key variables; most notably the Incremental Measure Cost, Discount Rate, and change in power (watts). Incremental Measure Cost and product efficiency can be influenced by program design and understanding of the market and regulatory environment, so it is key for PAs to design the program with these elements mind when considering the cost effectiveness test. Specifically, looking into shifting incentives towards lower cost, more efficient products will yield improved results. Discount rate is also important, but is typically driven by internal utility finance and cannot be influenced by the program. Figure 10 shows how sensitive each variable is to the TRC/SCT of LEDs. The middle line at 1.11 is the TRC/SCT ratio as calculated by using the average values of each variable. The red-line and green-line are the low and high TRC/SCT ratios respectively if the impact of each variable was isolated based on the range of values as collected from the PAs.

Figure 10: LED Sensitivity Analysis



CFL and LED Cost-Effectiveness Projections

We modeled future Measure Level TRC/SCT values to determine when LEDs may surpass CFLs in cost-effectiveness. We examined potential future LED and CFL TRC/SCT values by modeling the previously outlined equation using average values from 2014 and updating the values by forecasting out each variable until 2017. These forecasts are based on current trends through comparing 2013 averages to 2014 and knowledge of the market. The inputs used are outlined below in Tables 8 for CFL and Table 9 for LED below.

Table 8: CFL Cost-Effectiveness Analysis Inputs

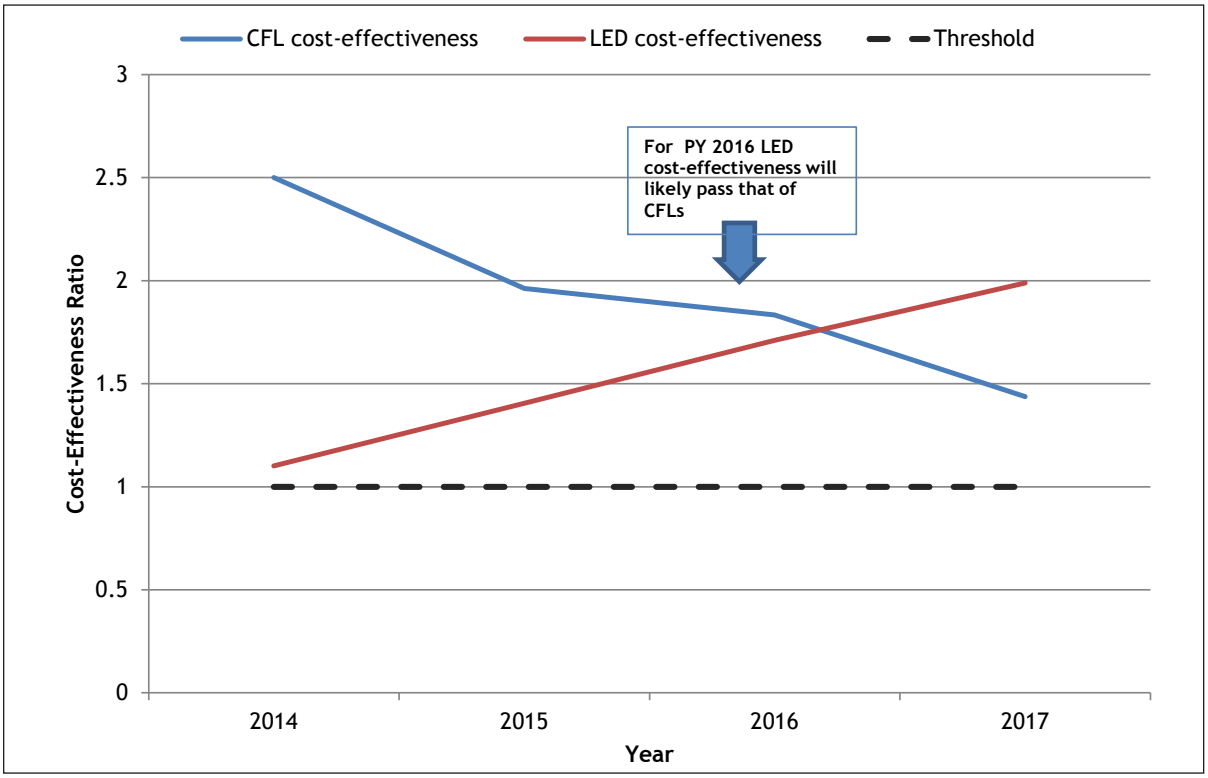
CFL	2013	2014	2015	2016	2017
* Societal Factor(NEB)	1.02	1.04	1.04	1.04	1.04
CFL Net to Gross	0.65	0.60	0.50	0.50	0.50
Discount rate	N/A	0.04	0.04	0.04	0.04
Avoided Cost/kWh	0.08	0.08	0.08	0.08	0.08
CFL Admin Cost/ Unit	$0.97	$1.16	$1.38	$1.64	$1.95
CFL Hours of Use	2.53	2.90	2.90	2.90	2.90
CFL Incentive	1.95	2.32	2.32	2.32	2.32
CFL Install Rate	0.90	0.90	0.90	0.90	0.90
CFL Incremental Measure Cost	N/A	$3.84	$1.92	$1.92	$1.92
Delta Watts	45.31	43.99	32.99	32.99	32.99
EUL	6.00	6.00	6.00	6.00	5.00

Table 9: LED Cost-Effectiveness Analysis Inputs

LED	2013	2014	2015	2016	2017
*Societal Factor (NEB)	1.02	1.04	1.04	1.04	1.04
LED Net to Gross	1.05	1.00	0.95	0.90	0.80
Discount rate	N/A	0.04	0.04	0.04	0.04
Avoided Cost/kWh	0.08	0.08	0.08	0.08	0.08
LED Admin Cost/ Unit	$7.58	$6.00	$5.50	$5.00	$4.50
LED Hours of Use	3.00	2.90	2.90	2.90	2.90
LED Incentive	15.17	10.50	7.27	5.03	3.48
LED Install Rate	0.95	0.95	0.95	0.95	0.95
LED Incremental Measure Cost	N/A	$29.98	$15	$11	$8
Delta Watts	45.99	42.27	31.70	31.70	31.70
EUL	17.00	15.00	15.00	15.00	15.00

The result of this analysis was that LEDs may pass CFLs in cost-effectiveness for the 2016 Program Year as shown in Figure 11. The key driver is the significant reduction in LED prices and thus subsequent Incremental Measure cost reductions as outlined in the LED price tracking section of this report, which will significantly boost the LED TRC/SCT in the next few years. Concurrently, several factors cause a decline of CFL TRC/SCT values over the next couple years.

Figure 11: LED and CFL Cost-Effectiveness Modeling through 2017



Conclusion

We estimate that during program year 2016 the cost-effectiveness of LEDs using the TRC/SCT ratio method will surpass that of CFLs for most programs in the northeast. This is because of a rapid change in the LED market mostly driven by lower prices, making them more cost-effective, while CFL cost effectiveness declines. We expect both CFL and LED lamps to pass the cost-effectiveness test through Program Year 2017. In 2018 and beyond, while CFLs may still screen, the inherent benefits of LEDs will mean program portfolios should not continue to promote CFLs unless there is a specific market where they continue to be the best option, such as low-income or hard to reach.

For this reason, we recommend a transition plan aimed at having a lighting portfolio where LEDs make up a majority of the lighting portfolio by 2017 in order to maintain both a portfolio and measure TRC/SCT greater than 1. Some implementers are recommending that this take the form of CFLs making up the majority of units promoted in the next few years, but LEDs accounting for the majority of spending.[34] Strategic program management over the next few years to adapt to the current market conditions will be critical in the evolving market conditions.

Updated Efficiency Program Projections

While the lighting market continues to rapidly evolve, based on our research and analysis, we have found that substantial opportunities remain for PAs to continue pursuing residential lighting savings through their retail products programs and other residential efficiency programs that promote efficient lighting. Many of these opportunities stem from the limited continued promotion of standard CFLs and the ramp-up of support for both standard and specialty LEDs. While specialty CFLs continue to play a role in program portfolios in the near term, many specialty LEDs are quickly demonstrating superior quality and expanded applications with diminishing costs. Therefore, as we move forward, most specialty promotions may be targeted at LEDs. As standard LEDs are coming down in price and becoming more cost effective, as demonstrated throughout the report, the necessity for a large incentive is diminishing, and the opportunity is emerging for greater savings to be gained at lower spending levels. For the next several years, lighting will and should continue to be a major component of all residential efficiency portfolios.

A high-level modeling analysis brings together all the latest information on CFL and LED pricing and efficacy trends, net-to-gross evaluation findings, and expectations about the number of bulbs that could move through efficiency programs. We look at bulbs per household for each state to compare apples-to-apples expectations. The intent of the projections is to understand potential savings the regional program administrators could realistically achieve in the residential lighting sector, as well as the costs needed to acquire those savings, assuming moderately aggressive program activity. This year NEEP tailored some of the projections based on state-specific situations and program achievement to produce a

34 Statements from CLEAResult at 2014 Northeast Residential Lighting Workshop. http://www.neep.org/sites/default/files/resources/2014RLSWorkshopMasterSlideDeck.pdf

more accurate model. Additionally, NYSERDA, which ran the lighting incentives in most of NY State, is undergoing a transformation of their retail programs. With the release of their Clean Energy Fund proposal, it is likely that lighting incentives will shift from NYSERDA to the state's local utilities in 2015; this will most likely take a toll on lighting promotions in New York and have regional implications. In our analysis, we accounted for 2015 being a challenging year for much of New York as the reins are passed, but 2016 and beyond charted more similarly to the rest of the northeast.

Another consideration for this year's projections was the EISA 2020 rulemaking affecting general service lamps. In years past, we had anticipated no more standard lamp support after 2020 and minimal support of specialty products as those would not be impacted directly by the EISA 2020 rulemaking. At this point in time, however, we are finding that the lag time for the first phase of EISA standards impacting incandescent lamps is slower than anticipated, with NEMA reporting in Q2 2014 that incandescents were still over 30 percent of the ship products. Given this slower than anticipated lag, we have adjusted our expectations for the 2020 rulemaking to also have a lag for standard lamps, and not drop off immediately in 2020.

Theoretical Potential: Model A

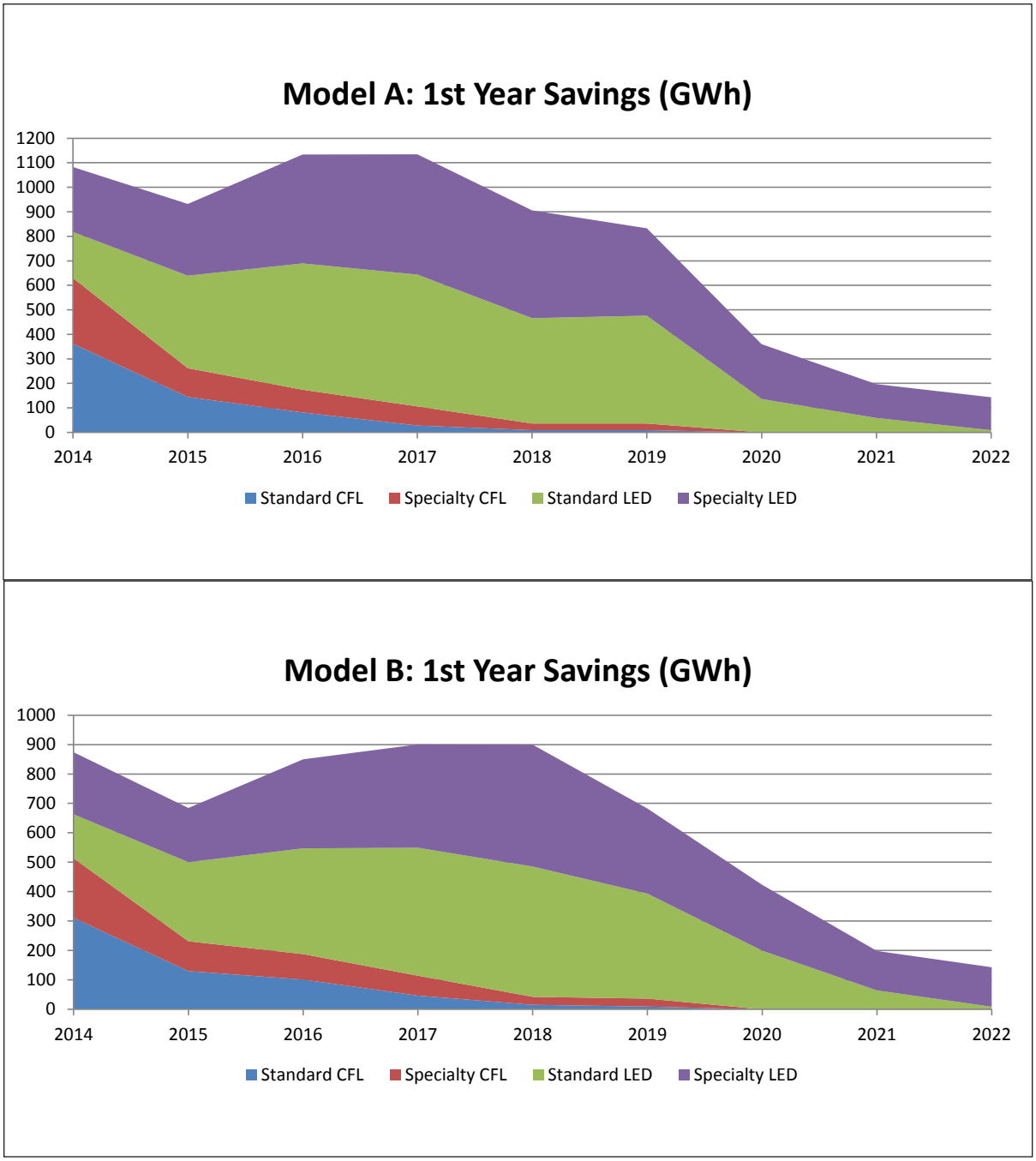
We decided to run two scenarios for this update. One focused on the theoretical potential for efficiency programs to continue very high levels of lighting promotions, in some cases upwards of 3 bulbs per household per year through 2019. We adjusted this analysis based on stakeholder feedback, 2014 performance, and anticipated programmatic events in the coming years. This is meant to represent the best case scenario for efficiency programs.

Customer Potential: Model B

For the second analysis, we looked backwards at how long individual programs had been in effect and what their socket saturation levels of efficient lighting were at present. For states with higher socket saturation and a long history of programs, we realized that while the programs may be able to promote upwards of 3 bulbs per household, customers are starting to run out of sockets to fill with efficient lighting. It may not be sustainable for some programs to continue promoting such a high number of lamps when socket saturation may be reached, and customers will not purchase unnecessary bulbs. To further exacerbate the matter, the longer lifetimes of these efficient products means there will not be as frequent a need to replace lamps. As such, we adjusted down the anticipated number of bulbs to move through these long standing, successful programs, to attempt to realistically reflect the possibility for customer adoption. Additionally, this model used less optimistic performance levels for states that have had lower performance for the past several years; while there may be potential for higher penetration of efficient lighting in their state, this model took a more conservative approach and pushed the lower-performing states to do better, but not quite to be on-par with the best-performing states.

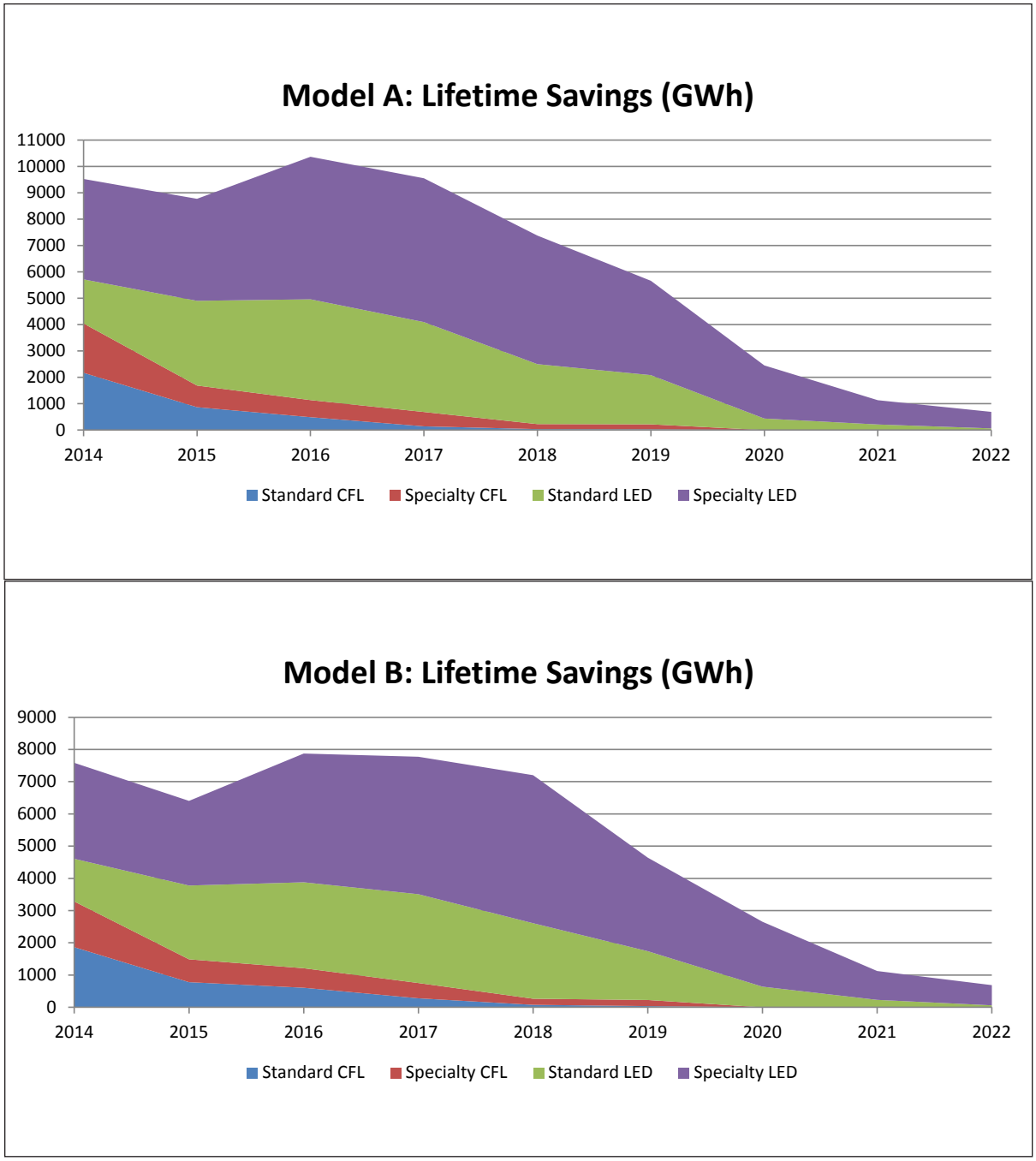
For both models, the general trends were consistent. While earlier iterations of the RLS forecasted regional savings potential peaking in 2012 and declining thereafter largely due to a reduced per-unit savings resulting from the EISA standards, this updated analysis shown in Figure 12 demonstrates relatively stable 1st year savings for several years to come, with a slight dip in 2015 due to NYSERDA's transition. This is because of the more rapid adoption and viability of LEDs in efficiency programs, including dramatic reduction in product prices.

Figure 12: Projected 1st Year Savings in Model A and Model B



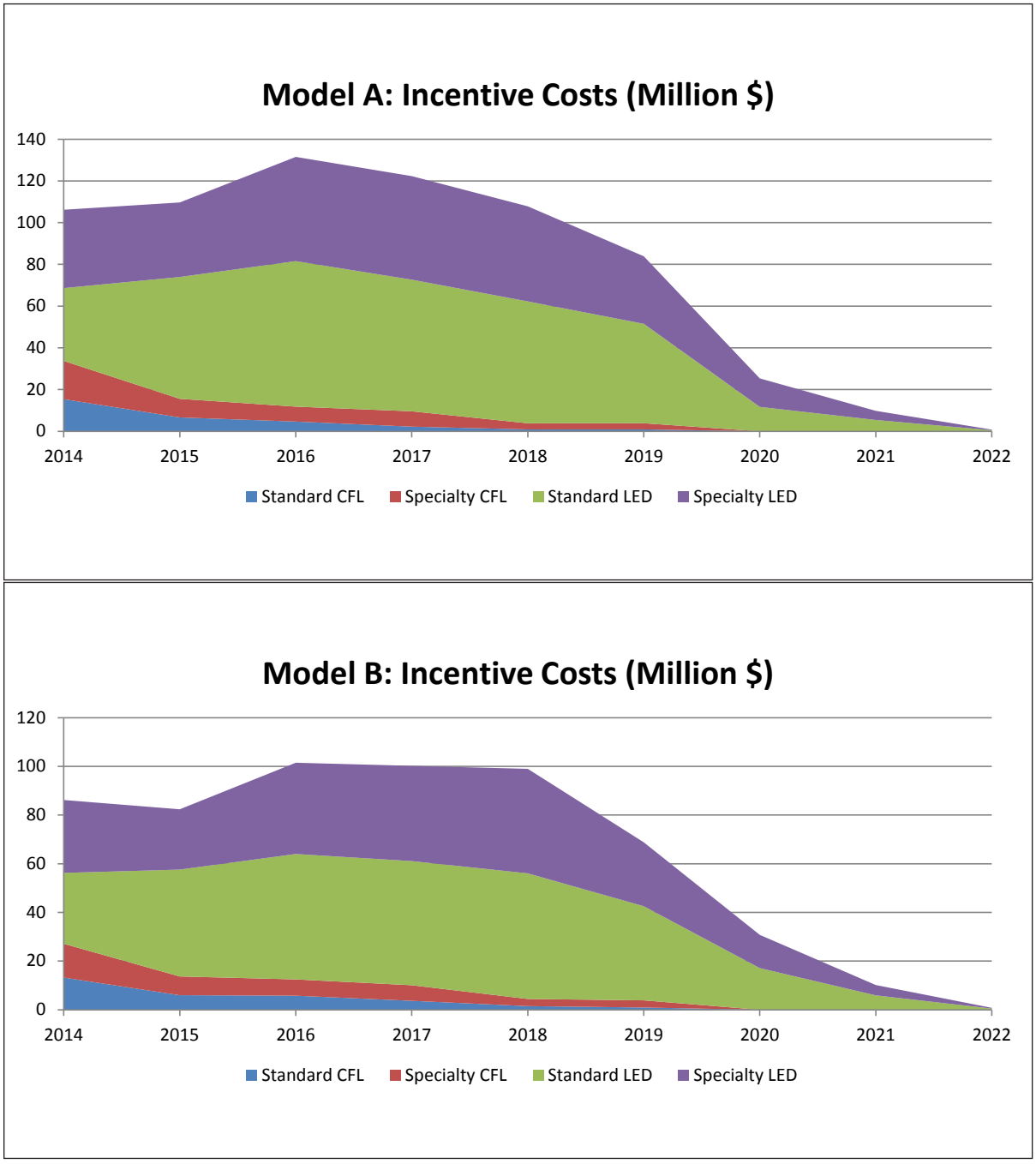
The regional lifetime savings, as detailed in Figure 13, also demonstrate significant remaining savings. As we are now understanding the lag of impact for phase 1 of EISA, while initially we had expected 2020 to represent a cliff for savings, we now can anticipate the 2020 implications of phase 2 EISA to have a lag, and programs still remaining relevant until impact of the 2020 EISA standards are fully felt. This is particularly true for specialty LEDs which are not impacted by the EISA standard for general service lamps.

Figure 13: Projected Lifetime Savings in Model A and Model B



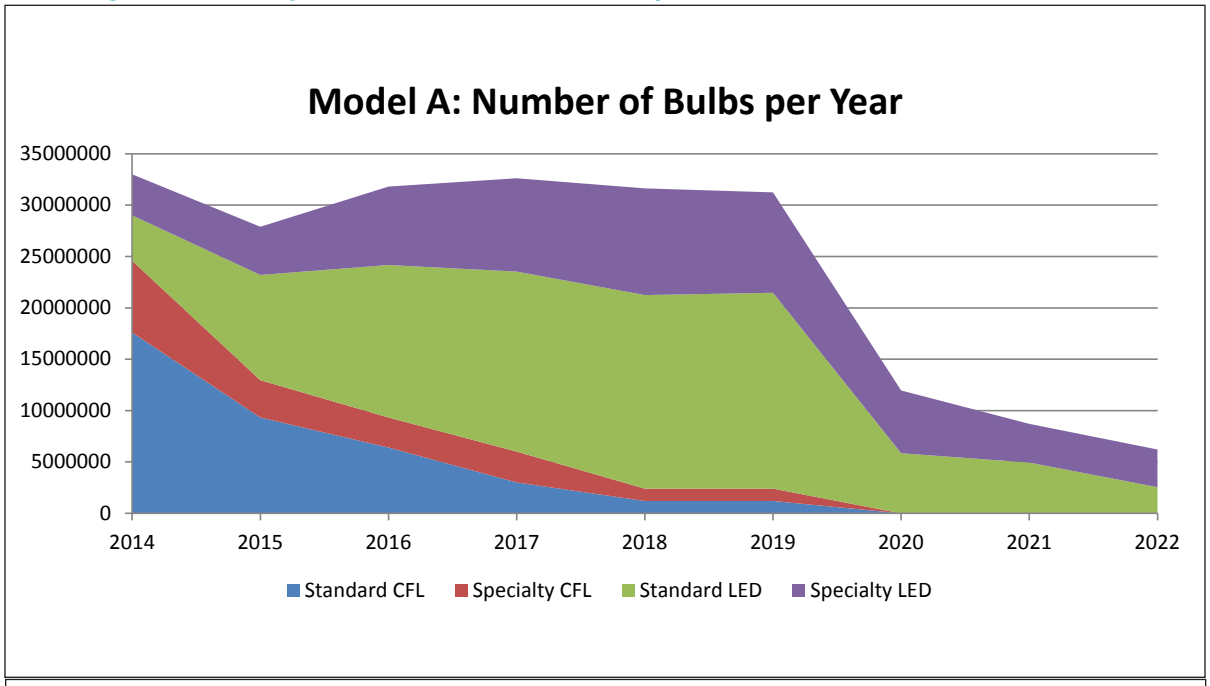
In addition to the lower price of LEDs making savings more readily achievable, the incentive dollars necessary to achieve these savings are significantly lower than anticipated in the 2013-2014 Update. The peak year for costs in the previous update was 2015 at nearly $160 million, but the updated model shows a peak of $130 million in 2016 in Model A, and just $100 million in Model B. As shown in Figure 14, incentive costs plateau until about 2016, then drop off as promotions drop off. This is largely driven by the decreasing costs of standard and specialty LEDs, but also impacted by the changes in New York. After 2020, small scale incentives for standard and specialty LEDs continue, though at a much lower level.

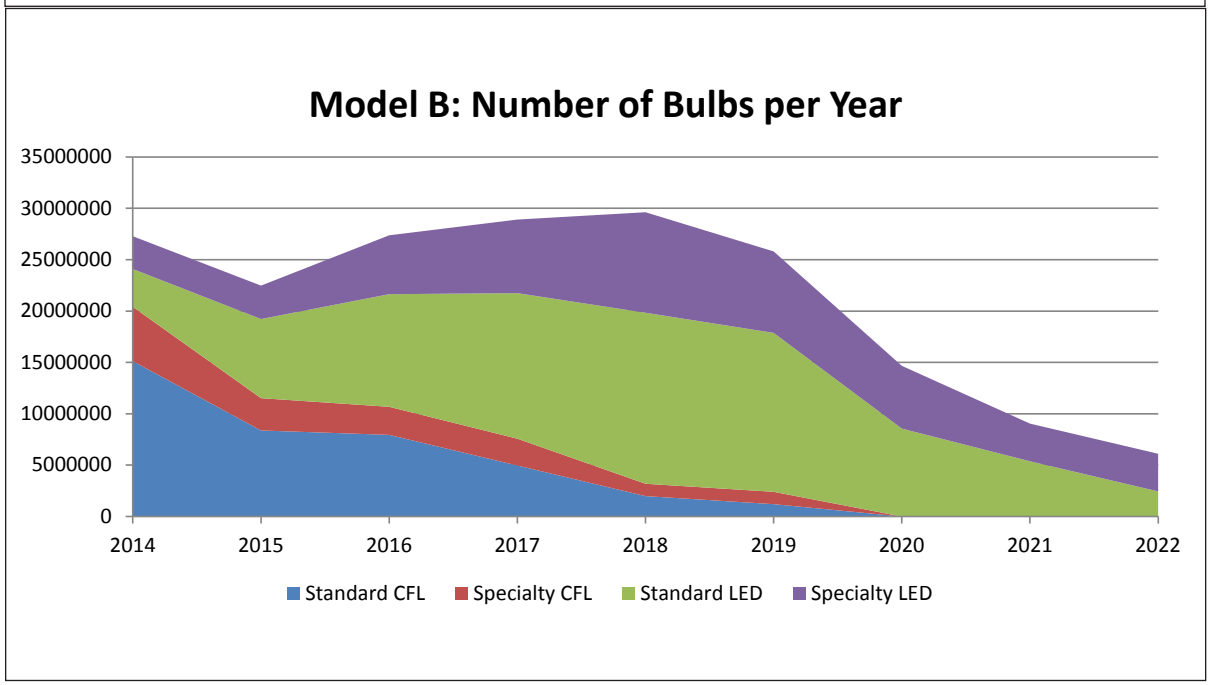
Figure 14: Projected Incentive Costs in Model A and Model B



The two models we ran differed considerably in their bulbs/household assumptions. As such, we find the more optimistic Model A with a much greater number of bulbs per household, while Model B is slightly less robust. Since New York state has the largest population and therefore number of households in the region, the changes in NYSERDA's program plans for 2015 significantly impacted the number of bulbs per household as a whole as can be seen in Figure 15. In either scenario, standard LEDs begin to dominate sales, with a greater number of LEDs being promoted over CFLs starting around 2016.

Figure 15: Projected Number of Bulbs per Year in Model A and Model B





In addition to adjusting the state-level inputs, we revised some of our EM&V inputs for this analysis. We considered higher hours of use based on the recent NMR evaluation, as described in the evaluation portion of this report. We also adjusted the net-to-gross ratios for both CFLs and LEDs; with the greater adoption and customer satisfaction surrounding standard LEDs, the substantial spillover anticipated in the 2013-2014 RLS has been adjusted down. We also adjusted down the measure lives for both CFLs and LEDs to yield a more conservative estimate.

Since most of the inputs beyond the bulbs/household estimates between the two models were the same, the analyses for Incentive/Savings were nearly identical. In general, we are finding that savings are less expensive across the board for programs. Figures 16 and 17 demonstrate the current anticipated levels in the Model A scenario.

Figure 16: Projected Incentive Amount/1st year kWh Savings (Model A)

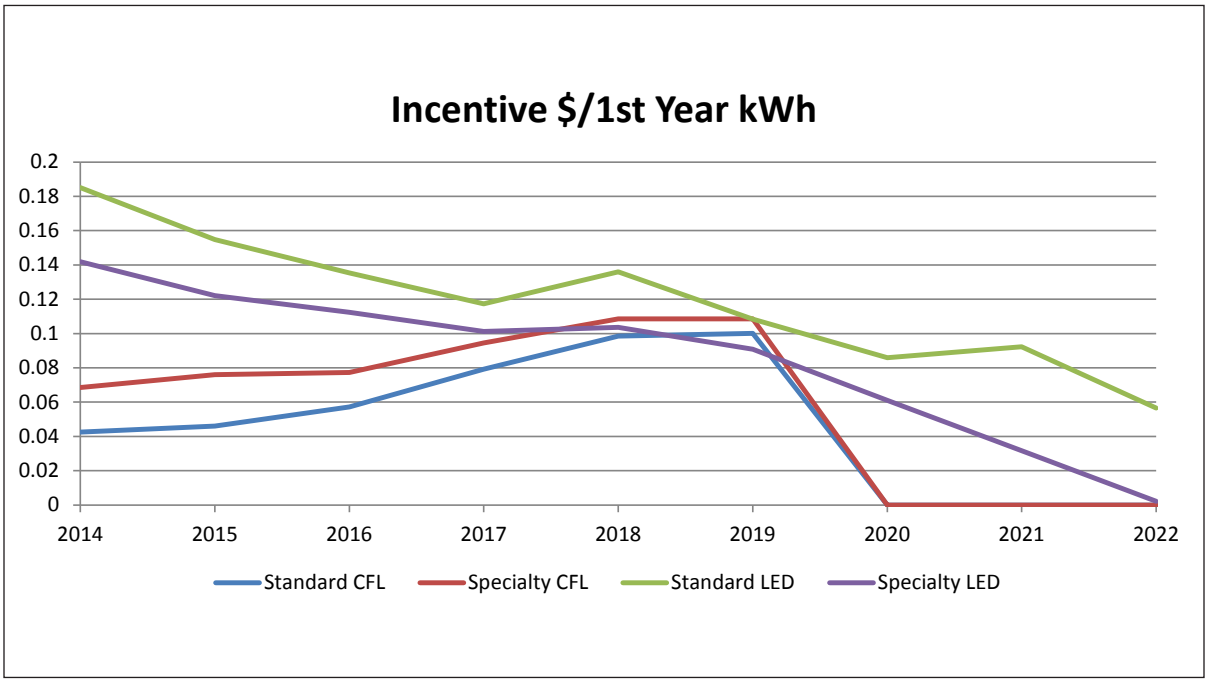
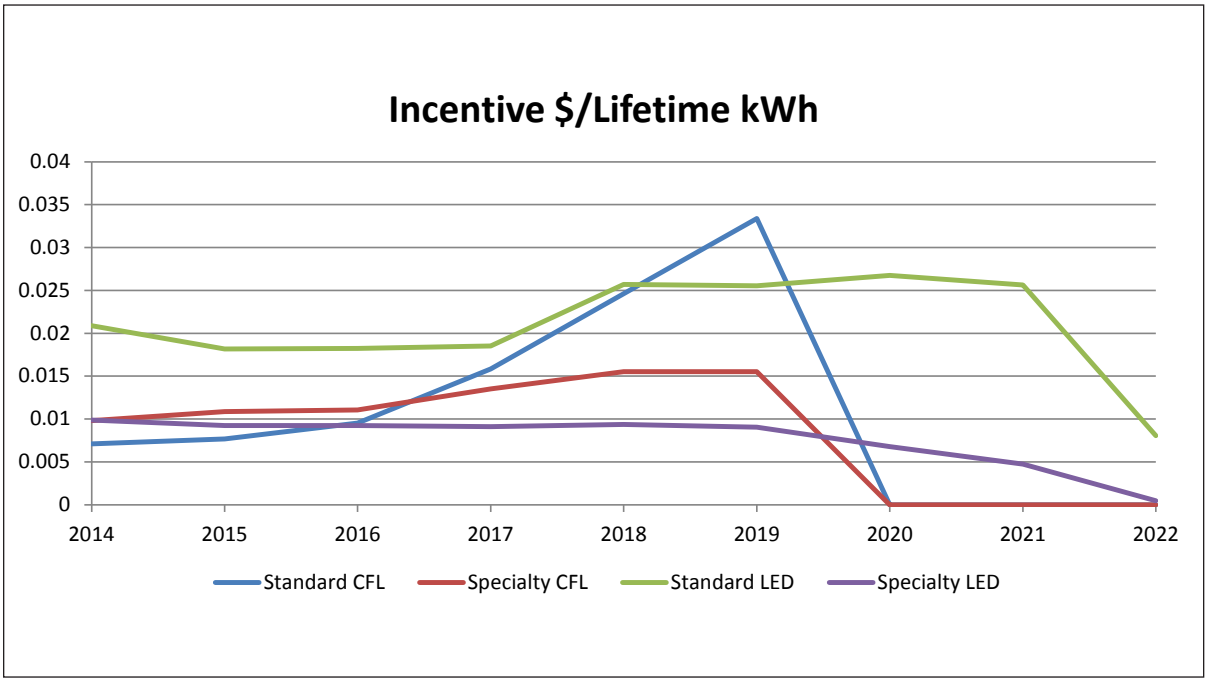


Figure 17: Projected Incentive Amount/Lifetime kWh Savings (Model A)



As with the previous iterations of the RLS, these projections are regionally aggregated outlooks for residential lighting, and they may not fully reflect current or planned program activity at the individual PA or state level. They are meant to get as close as possible with current available data.

Strategies to Transform the Residential Lighting Market: Key Recommendations

The regional recommendations put forward by the original RLS, for the most part, still hold true in this updated report. Based on the new research and analysis presented in this report, however, we have made some revisions to the original recommendations from the prior RLS reports. We present one new recommendation, two revised recommendations, as well as continued support for seven remaining recommendations.

New Recommendation:
Consider rapid transition of program support towards specialty LEDs and away from specialty CFLs as LED technology is better suited for the specialty applications and the prices of specialty LEDs continue to fall.

Revised Recommendations:
Old: Accelerate use of ratepayer funds to support LED technology in near-term due to rapidly dropping price and superior performance over CFL. PAs should develop long-term strategies to shift away from CFLs. New: Accelerate use of ratepayer funds to support LED technology in near-term. PAs should develop a transition plan aimed at having a lighting portfolio where LEDs make up a majority of the lighting portfolio by 2017 in order to maintain both a portfolio and measure TRC/SCT greater than 1.
Old: Partner with manufacturers, retailers, and ENERGY STAR to improve marketing, messaging, and education on key issues, including dimmer compatibility, using the right lamp for the application, and the most efficient lamp choices. New: Partner with manufacturers, retailers, and ENERGY STAR to hone in on key marketing, messaging, and education. Streamline messaging to make it easier for the consumer to select the proper bulb.

Existing Recommendations to Remain:	Details
Leverage markdown and buy-down agreements to specifically promote higher quality, lower cost LED lamps to reduce program incentive costs, product costs, and increase consumer adoption.	PAs only support products that are ENERGY STAR certified.
	PAs could set their own requirements beyond ENERGY STAR including factors such as warranty (which for most LEDs at present is only 3 years under ENERGY STAR) as an additional safeguard to ensure product quality.
	PAs to consider directing promotions to manufacturers with a better track record of quality. If allowed by procurement processes, PAs can limit promotions to a subset of manufacturers with whom they have had good past experiences or better historical testing results.

Existing Recommendations to Remain:	Details
Consider adoption of creative or alternative program and promotional approaches to maximize impact while minimizing potential free-ridership.	PAs to work together and with other interested stakeholders to develop and adopt consistent approaches to evaluate program impacts, such as through Regional EM&V Forum protocol development.
	PAs seek up-front regulatory engagement/approval as needed
	PAs target hard-to reach retailers and customer segments that are otherwise unlikely to adopt efficient lighting products
Support strong lighting efficiency requirements in building energy codes to help increase efficient lighting in new construction.	In anticipation of IECC 2012 75% efficient lighting requirement, NEEP and PAs work with builders, lighting designers, code development officials and others to educate them on best lighting choices in RNC. Supporting the adoption and implementation of IECC 2012 will help the region move towards a goal of higher socket saturation of efficient lighting.
PAs focus on promoting quality lighting products using ENERGY STAR as a key indicator of quality.	PAs only support ENERGY STAR qualified LEDs and CFLs with incentives and marketing
	DOE CALiPER and ENERGY STAR third-party testing efforts continue with active NEEP and PA participation, where failed products are delisted
	PAs withdraw funding from delisted products quickly.
Develop and implement regional systems to track key product and market data to inform program design, implementation, and evaluation.	PAs and industry work through NEEP and others to promote methods to track and share sales data
	Reduce the cost of evaluation and market analysis through regional approaches (e.g., EM&V Forum) to collect commonly needed data (e.g., product availability and price, socket saturation rates, customer knowledge and satisfaction with high efficiency lighting products)
	Investigate third-party efforts to track market activity; e.g Consortium for Retail Energy Efficiency Data or CREED initiative.
	Collaborative retailer efforts such as the Retail Action Council convened by the EPA/ENERGY STAR may help coordinate data sharing efforts.

Existing Recommendations to Remain:	Details
Continue to engage regulatory bodies early to reinforce need for continued and aggressive PA engagement in the residential lighting market and to limit regulatory uncertainty.	All parties reinforce message that Phase 1 EISA standards will not diminish the need for continued residential lighting market intervention: CFLs will not be the baseline
	Incorporate elements of this RLS Update into PAs' 2015 Plan submissions and public input processes to encouraging adoption of long-term market transformation goals and general strategy
	Manufacturers and retailers convey their support of the RLS to regulators in letters of support and public input hearings
	NEEP and PAs highlight large remaining savings potential in not only retail products program, but other PA residential programs
	NEEP and PAs clearly convey message that costs for lighting program savings will increase and that this may affect overall program, sector and portfolio cost rates
	PAs and regulators limit regulatory uncertainty by emphasizing the need for program flexibility and reaching agreements early on planning assumptions: net-to-gross ratios, measure lifetimes, baseline wattages.
	Regulators consider and pursue as appropriate alternative cost-effectiveness approaches
Continue regional lighting engagement on an on-going basis.	NEEP develops, with regional stakeholder input, RLS updates to provide to regulators and other key stakeholders

Conclusion

The 2014-2015 Update to the Northeast Residential Lighting Strategy has illustrated the significant remaining opportunity for residential lighting programs. With the rapid advancement and viability of LED lighting and data showing remaining incandescent and halogen sales, the role of the efficiency program is critical. The lighting market has not been transformed, and efficiency programs are key to increasing the adoption of efficient residential lighting products.

While significant savings remains for residential lighting over the course of several years, we are approaching the date when those savings will begin to diminish. In our projections section, our Model B analysis took into account some ceilings being reached for installation of efficient lighting. If programs continue to be successful, penetration of efficient lighting will eventually reach a point of market transformation. While this likely outcome would be a major accomplishment for efficiency programs, it also will represent the loss of a significant source of savings for programs. Furthermore, as states continue to adopt significant efficiency goals, meeting these goals will become more and more challenging.

Our analysis shows that lighting will still be a very significant portion of residential program savings through 2018, and will still contribute to program savings in a smaller way through 2022. While lighting is still a very major element of efficiency programs, NEEP is committed to helping the efficiency programs in the Northeast and Mid-Atlantic region continue to achieve aggressive energy efficiency savings goals however they can be met. On the products front, we have long standing efforts in technologies beyond lighting, including consumer electronics and emerging technologies. While market penetration is low and program models are still being developed, NEEP sees technologies such as Home Energy Management Systems and Air-Source Heat Pumps as the next wave of efficient products. We are leading efforts to help advance these technologies and hope that, by the time savings from lighting really begins to diminish, these technologies are ready for the main stage to help pick up some of the savings slack. Home Energy Management Systems can use algorithms to optimize efficiency for HVAC systems as well as ensure that all connected devices in a household are working in concert to their most efficient levels. There are opportunities for these systems to detect early equipment malfunction and to enable remote control so devices are not operating when you are not home. Air-Source Heat Pumps have huge potential as an incredibly efficient heating and cooling source, though a major hurdle has been their appropriate use in cold climates such as those faced by much of the Northeast US. NEEP has been working with key stakeholders to develop a Cold Climate Air-Source Heat Pump specification so that products installed in a cold climate achieve savings not only during the cooling season, but the heating season as well as.

While new efficient technologies are being developed, there are existing technologies that are being promoted using new program models that can help efficiency programs reach their goals. ENERGY STAR is facilitating a Retail Products Platform process which is moving efficient product promotion from downstream consumer incentives to mid-stream retailer incentives. This is an

effort targeted at appliances and electronics, where the product costs are high and the delta savings can be small. A small incentive paid to a retailer can make a significant difference in the stocking habits and sales strategies that the retailers use, whereas the same incentive in a large-ticket item might not have an impact on the consumer. This approach is national, with efficiency programs throughout the country coming together to offer the same program with promotion of the same products to a collection of national retailers. This Retail Products Platform is launching a pilot in 2015, with hopes to roll out a full program in 2016. This is the type of new program design that might dominate retail products promotions into the future, and may help states reach their efficiency goals as the potential for lighting runs out.

The lighting market is not yet transformed. Northeast and Mid-Atlantic efficiency programs are critical to ensure lighting savings are achieved. NEEP is a regional resource to assist stakeholders in achieving their goals, be they from lighting, other technologies, or other program approaches. NEEP will continue to lead regional efforts in Residential Lighting as well as other key products categories and program approaches. We look forward to continued broad stakeholder engagement and participation in our efforts and invite your participation. Through continued partnerships with regional efficiency programs, national experts, manufacturers, retailers, regulators, policymakers, and a strong partnership with ENERGY STAR, this region can continue to lead the nation in efficiency success for residential lighting and beyond.