Saturation Comparison of Massachusetts, California, and New York: Final Report

March 2015

Prepared by:

NMR Group Inc.

Prepared for:

The Electric and Gas Program Administrators of Massachusetts

Part of the Residential Evaluation Program Area

The Cadmus Group, Inc.

An Employee-Owned Company • www.cadmusgroup.com

This page left blank.

CADMUS

Prepared by:
Michael Strom
Alyssa Na'im
Lisa Wilson-Wright
Lynn Hoefgen
NMR Group, Inc.

Doug Bruchs
Bryan Ward
Cadmus

This page left blank.

CADMUS

Table of Contents

This page left blank.

CADMUS

Executive Summary

Introduction and Research Goals

This report summarizes the findings of the Saturation Comparison research between Massachusetts (MA), California (CA), and New York (NY). NMR, as a subcontractor on the Cadmus-led MA Residential Research Area evaluation team (the Team), performed this research and developed this report for the Massachusetts Program Administrators (PAs) and Energy Efficiency Advisory Council (EEAC) Consultants. In addition, Cadmus performed quality control, and DNV GL conducted interviews that informed the research.

The purpose of this research was to compare the saturation estimates for MA, CA, and NY, with an eye toward the circumstances and strategies that may have been most responsible for boosting efficient bulb saturation by 8% in CA from 2009 to 2012 – a time period during which MA and NY saw a saturation plateau. The Team attempted to achieve this by interviewing individuals heavily involved in the design, implementation, and evaluation of the CA lighting program, as well as reviewing the evaluation and saturation calculation methodologies from CA and NY to examine any differences from MA.[1] The Team was mindful of programmatic changes in NY in 2009/2010, when the New York State Energy Research and Development Authority (NYSERDA) greatly expanded incentives for CFLs, and again in 2012, when NYSERDA dropped incentives for most standard CFLs but retained them for specialty CFLs and LEDs.[2] Finally, the team analyzed purchase data across the three states to check for any notable differences that could have led to the differing saturation trajectories.

The following are some important caveats: although the impetus for this research was to understand saturation stagnation in MA (and, to a lesser extent, NY) compared to CA, the 2014 MA on-site saturation results indicated that saturation had increased by five percentage points between 2013 and 2014 (Table 1)[3]. Furthermore, during the time period under investigation (2009 to 2012), MA, CA, and NY started at different points, with MA exhibiting higher saturation at the outset (26%) than either CA (22%) or NY (19%/21%). As such, the initial saturation gains CA experienced between 2009 and 2012 only brought the state up to a level MA had already achieved. The results of the current investigation should keep these caveats in mind. Nevertheless, the question remained as to why CA had seen such a boost between 2009 and 2012 that MA had not, so the Team continued its inquiry into the topic.

1 The Team did not perform similar in-depth interviews in NY due to the substantial regulatory and programmatic shifts currently underway there.

2 As of December 31, 2014, NYSERDA will cease offering incentives for all light bulbs.

3 For more information on the recent MA saturation gains please see: NMR, Cadmus, DNV GL, Navigant, and Tetra Tech. *Results of the Massachusetts On-site Lighting Inventory 2014.* Final delivered to the PAs and EEAC Consultants March, 2015.

Table 1: CFL Saturation over Time by State

State	2009	2010	2011	2012	2013	2014
MA Confidence Interval (CI)	26% (22% - 30%)	26% (22% - 30%)	-	27% (24% - 30%)	28% (24% - 32%)	33% (29% - 37%)
CA	22%	-	-	30%	-	-
NY (Upstate) CI	19% (17% - 21%)	24% (22% - 26%)	-	-	25% (20% - 30%)	-
NY (Downstate) CI	21% (18% - 24%)	31% (28% - 34%)	-	-	29% (25% - 33%)	-
90% confidence intervals are shown in parentheses						

Data Sources

The data sources for the current research included the qualitative insights from in-depth interviews, published evaluation reports corresponding to the 2009 through 2013 program years/cycles in CA, MA, and NY, as well as the point-of-sale (POS) data that the Team purchased through LightTracker, an initiative of the Consortium for Retail Energy Efficient Data (CREED).

Findings

The literature review of the evaluation methodologies and saturation comparisons between CA, NY, and MA revealed only one substantial difference in how saturation was estimated: CA evaluations did not include empty sockets in the saturation calculation, while MA did. However, when re-calculating the CA numbers to include empty sockets, the same saturation gains were observed. The Team therefore determined that the differences between the states were actual differences and did not result from differences in methods, and continued with further research into why saturation rates diverged. The NY estimation methods mirrored those in MA in large part because the same evaluation firm (NMR) managed the studies in both states.

In-depth interviews with program managers, California Public Utility Commission (CPUC) staff and consultants, and program evaluation team members in CA focused on a number of hypotheses for CA saturation gains. Interviewers sought experts' opinions on the influence of specific aspects of the CA program design and recent changes to it, external factors brought on by legislative changes such as CA's earlier implementation of the Energy Independence and Security Act (EISA) or AB1109,[4] and other potentially impactful factors like changes in state codes and standards (Title 24 and Title 20) or CA's push for lighting marketing and education.

Although interviewees were not unanimous about the single most influential factor in boosting CA saturation, they did feel that external legislative factors such as EISA and AB1109 had much more impact than changes to codes and standards or lighting educational programs, suggesting that as EISA continues

[4] AB 1109 called for a 50% reduction in lighting energy use in CA residences and state facilities and a 25% reduction in CA commercial facilities by 2018.

to progress other states are likely to catch up to CA (as the most recent onsite saturation studies in MA demonstrate). The programmatic changes that CA program managers and experts in the CA program implementation cited as being instrumental in increasing saturation included the CA program's move away from big box and hardware retailers (only about 14% of program bulbs from 2010-2012) and toward grocery, drug, dollar, and club retail channels for the distribution of program bulbs, which seemed to succeed in targeting customers who would otherwise not have been touched by the program. Currently, MA has also been increasing its program focus on such channels, but it continues to move about one-half of its program bulbs through big box retailers and hardware stores.[5] If MA were to focus even more on these additional channels, interviewees argued, it could have the potential to affect saturation similarly to what occurred in CA.

The examination of sales data revealed that changes in CA bulb prices over time corresponded to changes in those bulbs' market shares. As CFLs and LEDs became more affordable, they also became more popular at the point of sale. However, in 2013 CA removed support for standard CFLs, leading to a price increase. In turn, the CFL market share in CA decreased and the market share of halogen bulbs increased. This change coincided with the implementation of the ban on 38W and the widely used 57W incandescent in CA, which implemented EISA one year ahead of most states in the nation, leaving open the question of whether the cessation of incentives, the phase-out of 38W and 57W bulbs, or a mixture of the two explains the change in CA market share in 2013.[6] Similarly, when examining CFL price trends in NY, which dropped incentives for standard CFLs in 2012, the Team observed a substantial increase in price from 2011 to 2013, which coincided with a lack of efficient saturation gains. These results suggest that price remains an important predictor of bulb purchases, but other factors may also play a role. The convergence of pricing trends observed between MA and CA for LEDs in recent years indicates that this bulb type is likely to continue gaining market share in MA.

Table 2 details the explanations that the Team explored to explain the saturation gains in CA from 2009 to 2012, and the evidence in support of such claims (or lack thereof). It also presents the conclusions the Team reached based on the results of the various lines of inquiry in the present research and other lighting-focused MA evaluation efforts.

Table 2: Key Explanations, Observations and Conclusions

Possible Explanation	Evidence	Conclusion
Team concludes this 1st set of explanations played at least some role in saturation differences		
Saturation point estimates are not truly different, if confidence intervals and error bounds are taken into account.	When taking the confidence intervals into account (Table 1, Table 3) the MA 2012 saturation estimate overlaps with that of CA.	This analysis demonstrates that although the saturation point estimates differ between MA and CA, actual saturation rates may not.

[5] According to Team analysis of program data for 2012 and 2013 from Parago.

[6] California passed a law, Title 20, requiring that all 100W, 75W, 60W, and 40W bulbs be reduced in wattage such that they had to be manufactured as 95W, 71W, 57W, and 38W from 2008 onward.

Focus on retail channels other than the "big box stores"*	CA moved majority (~86%) of bulbs through grocery, drug, and other "small store" channels; MA moved a smaller proportion (~50%) through those channels. CA also began adopting this strategy in its 2006 to 2008 program cycle (sooner than MA). NY's reporting requirements meant that few "big box stores" were ever a part of its program.	Seems likely that CA earlier adoption and embracing of a "small store" approach had some role in its boost in saturation between 2009 and 2012.
Early adoption of EISA in CA	CA adopted EISA incandescent phase-outs one year ahead of the rest of the nation (2011 to 2013 vs. 2012 to 2014) and experienced a saturation boost by or in 2012. No other state in comparison groups experienced this boost until 2013.	Given the increased saturation in CA in 2012, the Team thinks it is likely that early EISA implementation may have played a role. Future saturation estimates from CA, MA, and other states may provide more clarification on how much impact EISA had on CFLs.
Team concludes explanation may have played a role in saturation differences, but evidence is mixed		
CFLs replacing other CFLs	The 2014 Massachusetts on-site panel study provided the opportunity to measure how often newly purchased CFLs replaced CFLs that had burned out. The evidence supported high rates of CFL-to-CFL replacement between 2013 and 2014. Prior research had already shown that the CFL measure life, installation rates, and purchase rates made this theoretically possible.	Although lacking the CFL-to-CFL replacement rate from prior years, the evidence from earlier explorations and the current panel study strongly suggest the possibility that CFL-to-CFL replacement could explain why the millions of bulbs sold through the MA program achieved only modest increases in saturation through 2013. While we lack data to draw definitive conclusions, CA has lower saturation rates than MA in the early years, i.e., newer CFLs which likely led to proportionally fewer CFLs burned out in that state so that more newly purchased CFLs entered new sockets, boosting saturation. Additionally, the length of day in CA makes its on-average lighting usage lower than MA, also extending the life of the CFLs installed.
Team concludes explanation likely played little or no role in saturation differences		
Relative support of standard and specialty bulbs	In the 2009-to-2012 period, CA decreased support for standard bulbs and increased support for specialty bulbs. However, MA did the same in 2010, and NY dropped all standard CFL incentives in 2012 but kept specialty ones.	Evidence suggests that this may not play a large role in explaining saturation rates. Depends largely on the proportion of specialty sockets in the state and the assumption that consumers fill specialty sockets with specialty bulbs. On-site saturation visits make clear that many specialty sockets hold standard bulbs.

CA's Title 24 Building Codes and Standards and Title 20 Appliance Codes and Standards that mandated bulbs with lower wattages per lumens in CA than rest of nation.	None of the CA interviewees believed Title 24 or Title 20 affected saturation rates.	With no evidence to the contrary, the Team accepted the conclusions of the interviewees.
CA program marketing and education	None of the CA interviewees believed the marketing and education in CA was influential or varied in ways from MA to explain differences in saturation.	With no evidence to the contrary—and knowing that the MA PAs invested a great deal in marketing and education—the Team accepted the conclusions of the interviewees.
Methodological differences (*e.g.*, weighting schemes, screw-base types, treatment of empty sockets, etc.)	The CA evaluation team was able to provide estimates for all base types, thereby making them comparable with MA. Inquiries into weighting schemes and the handling of empty sockets revealed minimal impact on saturation rates.	Given steps taken to bring screw-bases into alignment and little evidence that other methodological differences affected saturation rates, the Team concludes methodological variations did not underlie differences in saturation rate point estimates.
Differences in operationalization of similar on-site protocols	While following fairly similar protocols, the firms conducting the work may vary in how they interpret those protocols while on-site. Table 6 in Appendix A presents the firm collecting the data in each year and the saturation rate.	As Table 6 in Appendix A shows, there are no discernible patterns in saturation rates by data collection firm.
* "Big box" defined largely as home improvement, mass merchandise, and warehouse.		

Based on the results of the in-depth interviews and the analysis of sales data, as well as concurrent saturation research in MA and other jurisdictions, the Team feels that a key takeaway from the current line of research is that the earlier implementation of EISA in CA had an important impact on the move toward CFLs in that state, which was reflected in the saturation gains CA experienced relative to MA from 2009 to 2012. In addition, the CA program's move away from big box stores and toward grocery, drug, dollar, and club channels also likely promoted saturation increases, as this program shift made efficient bulbs available to customers who may not have otherwise been touched by the program. CFL-to-CFL replacement rates in MA, which had higher CFL saturation than CA in 2009, also likely played a role in the saturation stagnation over that period. Finally, as brought up by one of the interviewees, although the saturation point estimates of MA and CA had differed in 2012 (27% and 30%, respectively), when taking the confidence intervals into account, MA rates overlapped with those of CA, suggesting that while CA did demonstrate greater saturation gains over the 2009 to 2012 period, the actual saturation rates in 2012 between the two states were comparable. Other explanations that the Team considered were not supported by the research findings.

Although unrelated to relative differences in saturation gains from 2009 to 2012 in MA, CA, and NY, the Team feels that another key finding from the present research is that the POS data revealed CFL market

share decreased in CA from 25% in 2012 to 19% in 2013, while halogen sales increased from 4% to 15% over that same period (which coincided with CA dropping incentives for standard CFLs). This suggests that cutting CFL incentives to coincide with the EISA restrictions on 60W and 40W bulbs may not have had the desired effect. Instead, dropping incentives may lead to an unintended consequence of increasing inefficient bulb sales, a result MA may want to consider in its incentive structure moving forward.

Introduction

This document presents the results of the Saturation Comparison research between Massachusetts (MA), California (CA), and New York (NY) an investigation utilized to inform the MA Saturation Stagnation study.[7] This draft report was developed for the MA Program Administrators (PAs)[8] and the Energy Efficiency Advisory Council (EEAC) consultants. NMR, as a subcontractor on the Cadmus-led MA Residential Research Area evaluation team (the Team), performed the comparison research, while Cadmus performed Quality Control. DNV GL also completed a series of interviews with light bulb suppliers and retailers, and utility managers, certain questions of which informed the current research.

The PAs and EEAC consultants requested and approved the Saturation Stagnation study early in 2013, at a time when MA had failed to achieve significant gains in efficient bulb saturation as determined by the latest round of onsite saturation studies (Table 3).[9] Compared to CA, which saw an efficient bulb saturation gain of 8% from 2009 to 2012, MA saw an increase of only 1% over that same time period (Table 3). Further, when extending the timeline out another year, MA achieved only a single percentage point gain from 2012 to 2013 (thereby garnering a 2% overall increase over the four year period from 2009 to 2013).[10] At the same time, saturation in NY also appears to have stagnated similarly to Massachusetts. The impetus for the current research then, was to explore reasons for the gains in CA that, in comparison, would help to explain stagnation in MA and NY and suggest CA strategies that could be implemented in MA.

Table 3: CFL Saturation over Time by State*

State	2009	2010	2011	2012	2013	2014
MA Confidence Interval (CI)	26% (22% - 30%)	26% (22% - 30%)	-	27% (24% - 30%)	28% (24% - 32%)	33% (29% - 37%)
CA	22%	-	-	30%	-	-
NY (Upstate) CI	19% (17% - 21%)	24% (22% - 26%)	-	-	25% (20% - 30%)	-
NY (Downstate) CI	21% (18% - 24%)	31% (28% - 34%)	-	-	29% (25% - 33%)	-
*The 90% confidence intervals are shown in parentheses						

7 NMR, Cadmus, DNV GL, and Tetra Tech. *Lighting Saturation Stagnation Assessment: Evaluation Plan.* Final delivered to the PAs and EEAC Consultants on January 13, 2014.

8 The Team uses *PAs* when referring exclusively to the MA Program Administrators but uses *program administrators* when referring more generally to companies or organizations that may sponsor lighting incentive programs.

9 NMR. *Results of the Massachusetts Onsite Lighting Inventory*. Final delivered to the PAs and EEAC Consultants on June 7, 2013.

10 It is important to note that, as shown in Table 3, MA had the highest saturation of any state under investigation in 2009. As such, one might expect greater increases in CA over the 2009 to 2012 period as initial saturation gains would only bring them to level already achieved by MA.

As will be explained in more detail below, two factors led to variations in the study objectives and design approved in the work plan. First, as shown in Table 3, the 2014 on-site saturation study in MA suggested that the state may have overcome its stagnation: saturation increased by five percentage points between spring 2013 and spring 2014. Second, not only did the New York State Energy Research and Development Authority (NYSERDA) cease supporting standard CFLs in 2012, but the State of NY is engaged in a large scale revision of its delivery of energy-efficiency programs and services. Therefore, the Team focused almost exclusively on the program experience in CA, although we do draw on data and insights from NY in some of the analyses below.

Overall Research Goals

The goal of this saturation comparison research was to explore possible explanations for the increases in efficient bulb saturation in CA, which could in turn help both to explain the reasons for the MA stagnation from 2009 to 2013, and to suggest potentially helpful programmatic changes. Information drawn from NY—which stopped incentives for standard CFLs in 2012—serves as a third comparison to provide more insights into saturation trends. More specifically, the research sought to accomplish the following:

- Examine experts' opinions on the reasons for the success of the California programs in increasing efficient bulb saturation;
- Identify any differences in evaluation methodology or saturation calculations that may have been responsible for the disparate saturation changes in CA, MA, and NY; and
- Track sales and pricing of efficient bulbs (captured at the point-of-sale for select channels) in the program states of CA and MA, and the former-program state of NY, to see if these shed light on reasons for different saturation levels in the areas.

Data Sources

In-Depth Interviews

The Team conducted a series of in-depth interviews with CA's Upstream Lighting Program managers, their evaluation team, and California Public Utilities Commission (CPUC) staff and consultants. These interviews examined the potential reasons behind the gains in efficient saturation in CA between 2009 and 2012, and also explored interviewees' opinions on why other states, particularly MA, demonstrated a plateau in CFL saturation during that same period. The breakdown of interviewees, and their respective roles, is shown in Table 4. The interviews took place between September 24, 2014 and November 10, 2014.

Table 4: Interviewee Roles and Numbers

Role	Number of Interviewees
CA IOU Program Administrator/Program Manager	11
CPUC Staff/Consultants	3
Program Evaluation Team	3

Review of CA Evaluation Methodologies

The Team also reviewed several evaluation reports of the CA lighting program over the prior two program cycles. These reports included the Compact Fluorescent Lamps Market Effects Final Report[11], the Final Evaluation Reports of the Upstream Lighting Program (Volumes 1 and 2)[12] [13], and the California Residential Replacement Lamp Market Status Report: Upstream Lighting Program and Market Activities in California Through 2013.[14] In addition, DNV GL, the lead evaluation firm on the CA residential lighting program, presented a briefing to the Team on the intricacies of the CA program itself and the evaluation methodology.[15] Both the briefing and the literature review allowed the Team to ascertain whether the saturation estimates between the two states were directly comparable, or necessitated changes to the calculations to allow for comparison.

Point-of-Sale Data

The Team also purchased a large light bulb point-of-sale (POS) dataset through LightTracker, an initiative of the Consortium for Retail Energy Efficiency Data (CREED).[16] Also utilized more extensively in the MA POS Modeling research[17] this data set includes lighting sales data for grocery, drug, dollar, club, and mass market distribution channels.[18] While the data allows for an important, and novel, analysis of state-level purchase and pricing estimates, a substantial shortcoming is the non-inclusion of home improvement and hardware retail channels. Unfortunately, the POS data represent only roughly 23% of MA market-level bulb sales, and 22% of MA program bulb sales. Key aspects of the UDS Report include:

- Sales volume and pricing from 2009 to 2013 for CFLs, LEDs, halogens, and incandescent bulbs for all channels combined
- Data reporting by state (with 44 states included) and bulb type
- Inclusion of all bulb styles and controls

---

11 Cadmus, KEMA, Itron Inc., NMR, and A Goett Consulting. *Compact Fluorescent Lamps Market Effects Final Report.* Final delivered on April 12, 2010.

12 Kema, Cadmus, Itron Inc., PA Consulting Group, Jai J. Mitchell Analytics. Final Evaluation Report: Upstream Lighting Program Volume 1. Final delivered February 8, 2010

13 Kema, Cadmus, Itron Inc., PA Consulting Group, Jai J. Mitchell Analytics. Final Evaluation Report: Upstream Lighting Program Volume 2. Final delivered February 8, 2010

14 DNV GL. *California Residential Replacement Lamp Market Status Report: Upstream Lighting Program and Market Activities in California Through 2013*. Final Delivered September 10, 2014.

15 DNV GL. *California Residential Lighting Saturation Briefing.* Presented September 9, 2014.

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

17 NMR, Cadmus, DNV GL, and Tetra Tech. *MA Residential Point-of-Sale Modeling: FINAL Report.* Final report delivered to the PAs and EEAC Consultants on January 25, 2014.

18 The POS data do not include the home improvement and hardware retail channels, which can account for a substantial amount of statewide bulb sales. Utilizing statewide market-level estimates from the most recent MA onsite study, the Team estimates that the POS data capture roughly one-quarter of MA market-level bulb sales. The Team discusses this shortcoming in more detail in the Threats to Validity section.

The Team utilized the POS data to examine bulb sales and pricing trends over time, to see if such analyses could shed light on the reasons for CA's successful saturation gains from 2009 to 2013, and MA's stagnation.

Existing Literature and Professional Experience

Many members of the Team have worked—or continue to work—on residential lighting evaluations in NY, including market effects and saturation studies in 2009, 2010, and 2013 (see citations below). We have drawn on published reports as well as our own professional knowledge of current program activity there. Any information presented is publically available. The studies we draw on include the following:

- NMR Group, Inc. 2010. *IMPACT EVALUATION: NYSERDA CFL Expansion Fast Track Program: Random Digit Dial and Onsite Survey Results.* Delivered to NYSERDA in March.
- NMR Group, Inc. 2011. *IMPACT EVALUATION: NYSERDA CFL Expansion Program: Random Digit Dial and Onsite Survey Results.* Delivered to NYSERDA in June.
- NMR Group, Inc., and Apex Analytics, LLC. 2014. *Market Effects, Market Assessment, Process and Impact Evaluation of the NYSERDA Statewide Residential Point-Of-Sale Lighting Program: 2010-2012.* Delivered to NYSERDA in May.

Findings

Key Interview Takeaways

Interviews with program managers/administrators, stakeholders, and evaluation staff focused on a number of possible explanations for higher CFL saturation levels in CA relative to MA and the rest of the country. The prevailing opinions of interviewees converged on two main conclusions for CA's saturation successes: program design/changes and external legislative related factors such as EISA and AB1109.[19] Individuals felt that other external factors like changes in state codes and standards (Title 24 and Title 20) or marketing and education had little or no impact in this area.

Upstream Lighting Program Activities

Three interviewees felt very strongly that CA's residential lighting program activities were a major contributor to the higher levels of CFL saturation compared to MA. The interviewees indicated that the relatively large budgets between 2006 and 2012 helped facilitate the CFL saturation gains. One interviewee noted specifically that two strategic program changes likely led to their success, stating "There have been two big changes. One has been [the] shift in bulbs, and [the other] the shift from big box stores to grocery and discount channels."

- The shift in retail channels refers to a tactical effort during 2006-2008 to transfer efforts from big box retailers such as Home Depot and Lowes to grocery, discount, and drug stores. According to interviewees, this occurred as a result of findings from the 2004-2005 evaluation which showed that analyses by retail channel revealed higher NTG ratios for bulbs sold through discount and grocery rather than big box stores. As a result, the program increased the volume sold through these channels. This effort additionally helped the program to target hard-to-reach (HTR) populations.

- The shift in bulbs refers to the IOUs' strategy in 2010-2012 to move program support gradually away from standard to specialty CFLs.

External Legislative Factors: EISA, AB1109

Interviewees also felt that legislative restrictions on the manufacture and availability of incandescents had a significant impact on CFL saturation in CA. One individual in particular felt that the early implementation of EISA through AB1109 in CA led to the divergence in CFL saturation in CA and MA, and explained as follows:

[19] AB 1109 (or the Huffman Lighting Efficiency & Toxics Reduction Act) tasks the California Energy Commission with reducing lighting energy usage in indoor residences and state facilities by 50% and in commercial facilities by 25% by 2018. This necessitates the Commission applying its existing appliance efficiency standards to include lighting products, and require minimum lumen/watt standards for different categories of lighting products. The bill also expanded existing incentives for energy efficient lighting. For more information visit: http://www.cawrecycles.org/issues/current_legislation/ab1109_07

> One possibility is the CA state law that accelerated the implementation of EISA by a year, so that as each phase of EISA came in nationally, that same phase hit CA a year early. To the extent that that's driving this divergence up to 2012, I think that's possible. And to the extent that's true, you'd expect MA to catch up. It may be that this latest surge that we're seeing in MA in the 2014 onsite results represents MA catching up and CA losing that year head start due to its state law.

Another interviewee stated that EISA and AB1109 had an indirect effect on CFL saturation by influencing programming. The individual noted, "We felt that we were trying to reinforce the strategic plan and the CA vision for what was going on." Other interviewees were less certain, and in one instance did not believe that these legislative factors directly or indirectly affected CFL saturation in CA. This individual felt that consumers were not particularly aware of EISA and its impact on the market during this period and believed that the legislation had little or no influence on consumers' bulb purchasing decisions.

Other External Factors: Title 24, Title 20, Marketing and Education

Interviewees also expressed their opinions on the influence of factors such as Title 24 and Title 20 and marketing and educational activities.

- Overall, interviewees did not feel that either Title 24 or Title 20 had a strong effect on CFL saturation. Only one interviewee stated that it was a possibility, but another said that there was no connect as "code almost always lags the market." Other interviewees either did not address this topic directly or were not appropriately familiar with the restrictions.

- Interviewees also did not feel that marketing and education activities were a solid contributing factor. While a number of individuals mentioned various efforts and spoke of the strong presence of POS marketing materials, they did not state that these endeavors could be linked directly to CFL saturation levels.

Alternate Explanations

In addition to exploring and commenting on the Team's pre-identified hypotheses for higher CFL saturation in CA, interviewees also touched on a number of other considerations:

- One interviewee commented that a notable external force was the high oil prices in 2007, which led to a significant push on sustainability from the corporate sector (the individual cited one retailers green energy initiative in particular) as well as greater awareness from the general public on matters related to energy and energy efficiency.[20]

- One interviewee stated that programs are stuck in a paradigm that is focused on measuring short-term annual incremental effects, when the nature of these effects are longer term, and,

[20] The fact that this push toward sustainability didn't manifest itself until three years later would mean that the impact of the high oil prices lagged a few years behind the actual price increases, as 2008 did not demonstrate a notable difference in saturation.

therefore cannot be accurately captured in relatively short windows of time. The interviewee noted that, "In both CA and MA, we're in a payback period where some huge effects from these programs that occurred around 2006-2008 are now being paid back. The programs hugely accelerated adoption of CFLs back in those years, but they didn't *cause* that adoption they just accelerated it by five years or so. Now you've got the rest of the country catching up and these programs, in incremental terms, are producing relatively low NTG ratios. I think the long term strength of these programs is that you have pretty good evidence that they've had long term market transforming effects."

- Another interviewee indicated that the differences in CFL saturation between CA and MA could be explained partially by different saturation tracking rates employed by the two evaluation teams. This individual noted that the MA data are tracked yearly with smaller samples while the CA data cover a three-year period with a larger sample. As a result, the point estimates are different, but taking the margin bounds into consideration shows that they may not differ as much. This claim was substantiated by calculating the confidence intervals for MA, which did overlap with the CA estimate in 2012.

Comparison of Saturation and Evaluation Methodologies

Along with exploring the insights of interviewees who were knowledgeable about the CA program, ensuring that the saturation estimates in Table 3 were comparable between the states of interest was also crucial to the present research. This necessitated a review of the methods utilized to glean and calculate those saturation numbers. In other words, the Team had to be certain that the different saturation trajectories in MA and CA from 2009 to 2012 were not a result of CA evaluations calculating saturation differently, choosing onsite participants differently, or conducting their lighting inventory differently. For example, if onsite studies in CA only included households that indicated already having CFLs installed, or the saturation calculation included only certain bulb types, bases, or fixtures, then the differences between MA and CA may not have been due to actual divergences in CFL socket saturation. However, a review of recent evaluations conducted over the last two program cycles in California, as well as briefings and discussions between the Team and those involved in running CA evaluations, revealed no differences in methodology or saturation calculations substantial enough to deem direct saturation comparisons between CA and MA untenable.[21]

In the 2009 data collection efforts, the CA team utilized a simple random sample of homes throughout the state, filling quotas from each investor-owned utility in the state. Customers were offered an incentive for their participation, as they are in MA. The CA team conducted a full lighting inventory of all lamps in the homes, collecting information on room type, lamp technology and shape, wattages and storage information – a nearly identical protocol to MA. In the follow-up, 2012 effort, the California

[21] It is worth re-stating the previously referenced interviewees' point here, that although the methodology and saturation calculations between MA and CA are comparable, the time span between saturation studies differ, with MA tracking data annually on smaller samples, and CA data covering a three-year period with a larger sample. This could partially explain the differences in saturation point estimates.

Lighting and Appliance Saturation Survey (CLASS), the CA team once again utilized a random sample, this time stratifying not only by IOU service territory but also climate zone group, Low-Income categorization, and average energy use. The data collection protocol was identical to 2009, meaning the slightly different sampling approach was the only change from the prior efforts. The team also weighted the data to make the data sets comparable, using iterative proportional fitting (IPF), sometimes referred to as "raking," the same technique utilized by the MA team, but on a smaller scale. The weights were raked in CA to 2010 US census demographics of home ownership and residency type. While the MA Team weights onsite data to home ownership and education, the discrepancies brought about by this difference were not deemed by the Team, or the MA PAs/EEAC involved in these discussions and briefings, to necessitate changes to the MA/CA comparison.

In CA, as in MA, the actual saturation estimates were calculated as the total number of CFLs found in onsite homes divided by the total number of sockets. However, the reported CA saturation estimates did not include empty sockets in their calculation, which MA does. This required a slight re-calculation of the CA saturation numbers to include empty sockets, which dropped the CA estimate by roughly 1%. The estimates shown in Table 3 are those with empty sockets included, to be directly comparable to MA. As noted, the CA numbers continued to show the jump in saturation from 2009 to 2012, even with the identical saturation calculation to MA, thus confirming that the increase in CA saturation compared to MA was not a result of calculation divergences. It is worth noting once again, however, that MA had a higher saturation estimate than CA in 2009.

The New York Experience

The Team did not ask the California interviewees to speak directly to the NY experience. However, NY provides a third example of trends in socket saturation and the factors that may explain them. The socket saturation rates in both Upstate and Downstate NY[22] (19% and 21% respectively) were similar to those in CA (22%) and below those in MA (26%) in 2009 (see Table 3 above). By 2010, however, the saturation rates in both areas of NY had increased, to 24% Upstate and 31% Downstate. NYSERDA staff members believe the increase reflected a critical program change between 2009 and 2010—namely, NYSERDA moved from a largely marketing- and education-based program design to one that relied more heavily on upstream incentives, the CFL Expansion Program.

Yet, this change seems to have created a one-time increase, as saturation rates in 2013 remained nearly the same as those in 2010 (25% for Upstate and 29% for Downstate).[23] Importantly, NYSERDA experienced another large programmatic change during this period: the cessation of incentives for most

[22] The 2009 and 2010 studies defined Downstate to include only New York City, due to its unique characteristics. In 2013, NYSERDA requested that the evaluation of Downstate also include Westchester County to match the PSC definition more closely. The inclusion or exclusion of Westchester had little impact on the saturation rate.

[23] The higher saturation rate in Downstate NY largely reflects the smaller home size and socket numbers in New York City. That is, a home with fewer than 20 sockets that installs five CFLs has a 25% saturation rate, whereas one with the more a more typical 40 sockets for a single-family, detached home would have a saturation rate of only 13%.

standard CFLs.[24] NYSERDA will cease offering incentives for all lighting products (including specialty CFLs and LEDs) as of December 31, 2014. The 2013 measurement represents the only existing saturation estimate following both the end of the CFL Expansion program and the period of limited incentives offered through NYSERDA programs. The MA PAs and EEAC consultants have recently approved a work plan to gather saturation data in portions of Upstate New York in late 2014 and early 2015. This information will help to clarify if Upstate New York experienced a boost in saturation between 2013 and 2015, similar to that observed in MA between 2013 and 2014, or if the rate remains stagnate in Upstate New York. The outcome may help to clarify whether program activity or EISA plays a bigger role in determining saturation.

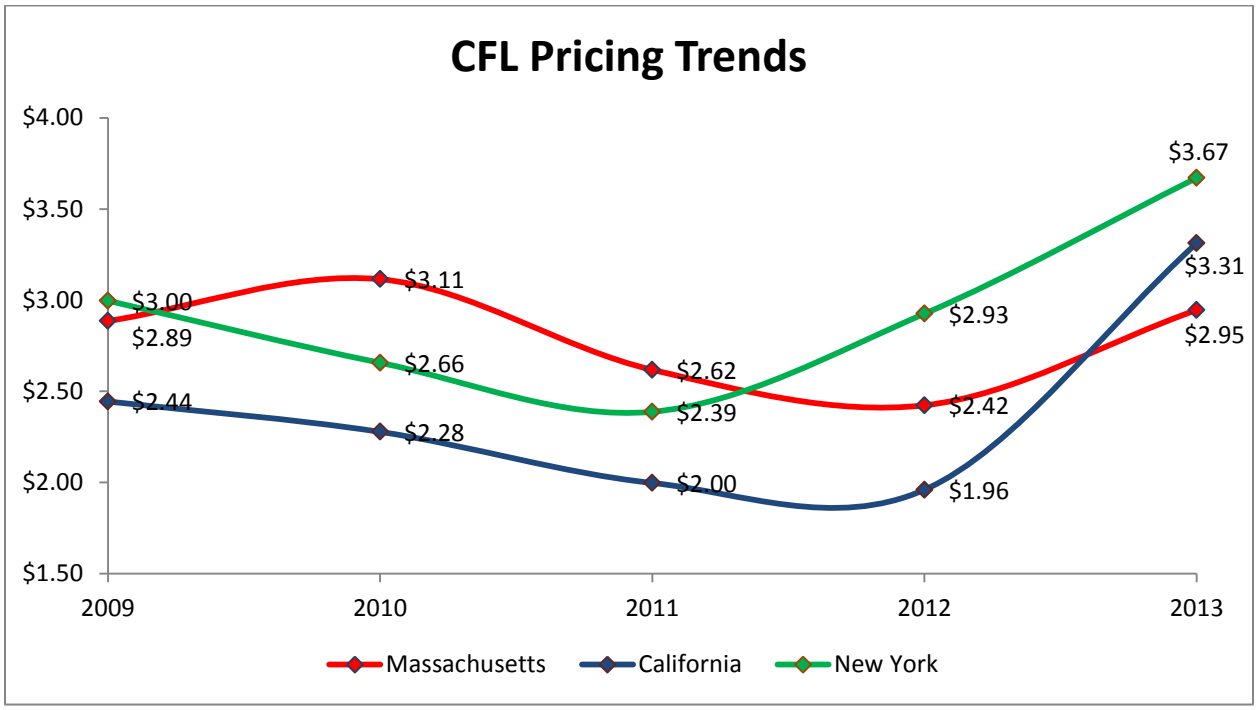
Comparison of Sales Data Findings

Utilizing the sales data purchased through LightTracker, the Team also investigated lighting purchase and pricing trends between MA, CA, and NY. The goal of this investigation was to determine if pricing differences influenced the market share of efficient bulb types, thereby leading to any of the observed differences in saturation. It is important to note that while this sales data represents the best current point-of-sale bulb data available, it only covers select retail channels and does not include home improvement and hardware channels, which move a substantial proportion of both MA market-level and program-level sales. The Team estimates that the sales data represents approximately 23% of MA market-level sales, and 22% of MA program-level sales.

[24] NYSERDA staff reports that it continued to offer incentives on standard CFLs in select locations in New York City through April 2014, selling the bulbs largely through convenience stores and small groceries that targeted populations considered to be HTR.

As shown in Figure 1, CA exhibited lower average CFL prices in the retail channels represented by the POS data, than did either MA or NY, from 2009 through 2012. While this is also influenced by the fact that the CA program tends to move a greater proportion of its program bulbs (roughly four out of five bulbs) through the channels included in the database than does MA, it does reveal that CFLs were more affordable in these channels in CA than MA during the years that CA saw saturation gains. The trend also makes clear that CFL prices increased coincident with the removal of price supports in NY in 2012 and CA in 2013; prices in MA also went up but not to the same degree as in CA and NY.

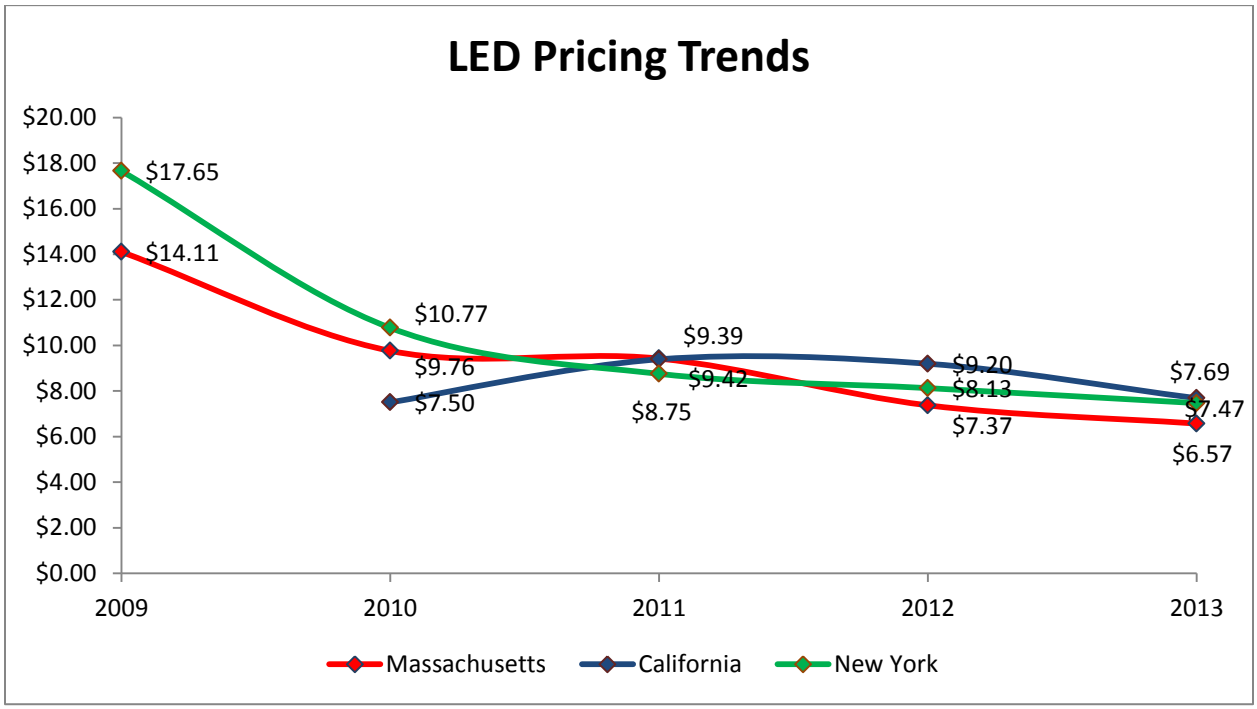
Figure 1: CFL Pricing Trends



Alternatively,

Figure 2 demonstrates that when considering LED prices between the three states over the same time period, there was a convergence in pricing trends. Interestingly, as shown in Table 5, although LEDs comprised only a small amount of the market from 2009 to 2012, the similarities in pricing trends between MA, CA, and NY between 2010 and 2013 were echoed by an almost identical *all* efficient bulb saturation gain.[25] That is, the difference between CFL saturation and CFL + LED saturation in 2012 was roughly 1% for all three states, indicating comparable LED installation rates between them. Also important to note is that MA displayed the lowest LED prices of the three states in 2012 and 2013, suggesting that this new technology is likely to remain an important aspect of the MA program, and become an increasingly popular bulb in MA homes.

Figure 2: LED Pricing Trends



[25] The average 2009 LED price for CA was $1.00, which the Team feels reflects a data error.

Table 5: CFL and LED Saturation over Time MA, CA, and NY

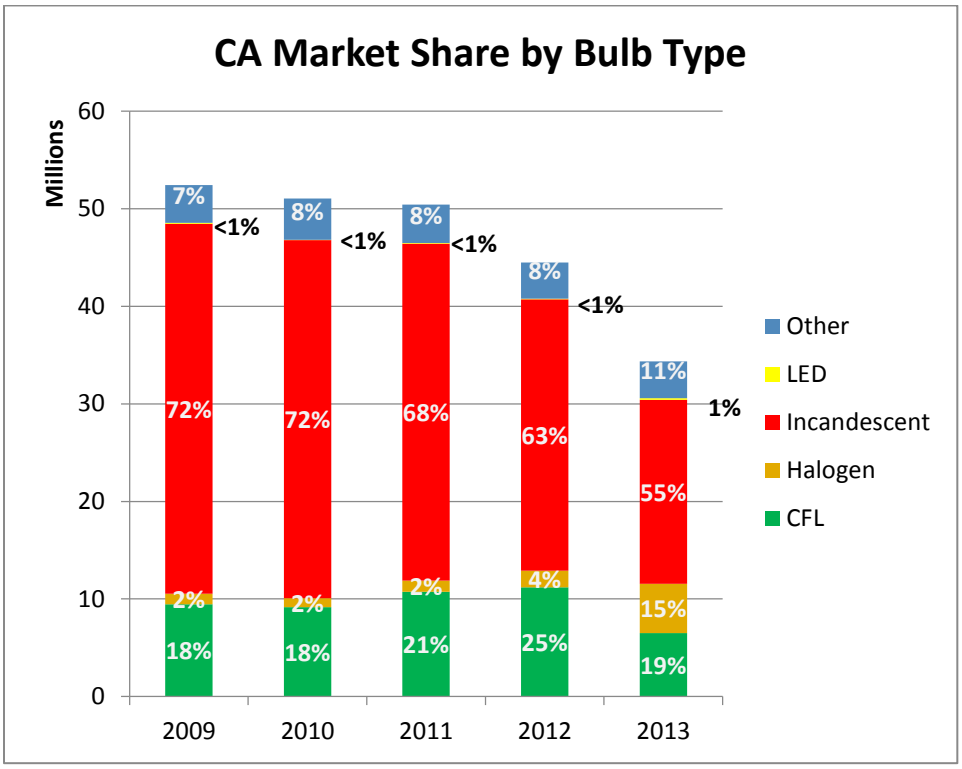
MA	2009	2010	2011	2012	2013	2014
CFLs	26%	26%		27%	28%	33%
CFLs + LEDs	26%	26%		28%	30%	35%
CA	2009	2010	2011	2012	2013	2014
CFLs	22.3%			29.9%		
CFLs + LEDs	22.4%			31.1%		
NY Upstate	2009	2010	2011	2012	2013	2014
CFLs	19%	24%			25%	
CFLs + LEDs	20%	25%			26%	
NY Downstate	2009	2010	2011	2012	2013	2014
CFLs	21%	31%			29%	
CFLs + LEDs	22%	31%			30%	

Turning to purchase trends, the Team examined the differences in bulb market share between the three states, particularly as they related to the previously discussed pricing trends. In this way we could gauge the potential influence of bulb pricing on bulb purchasing. Figure 3 through Figure 5 show the market share of each bulb type from 2009 to 2013 for CA, MA, and NY. As shown in Figure 3, the market share of CFLs in CA displayed a consistent increase from 18% in 2009 to 25% in 2012, before declining to 19% in 2013, mostly at the expense of increased halogen sales. This may help to explain the increase in CFL saturation during the same time period, particularly as the later figures make clear that MA and NY did not see the same increase in CFL market share.

Yet, the California data also suggest another lesson. The state began to implement EISA during this period, starting with the CA equivalent of the 100W (95W) incandescent phase-out in 2011 and ending with the 2013 phase-out of 40W (38W) and the ubiquitous 60W (57W) bulbs in 2013.[26] Also in 2013, however, CA dropped incentives for bare spiral CFLs. Thus, in exactly the same year in which the most popular incandescent bulb started to be phased out, CA ceased offering incentives for standard CFLs—and standard CFL market share dropped by 6% while that of halogens increased by 11%. While the evidence is anecdotal, it suggests that standard CFL incentives prior to 2013 may have been holding the purchase of halogen bulbs at bay. Of course, it is also the case that consumers finally turned to halogens only with the onset of the 60W (57W) incandescent phase-out regardless of the price of CFLs. Future research into bulb market share, price, and saturation in CA and other areas will have to clarify this matter. However, the data do suggest that the MA PAs proceed with caution as they consider when to reduce their support of standard CFLs.

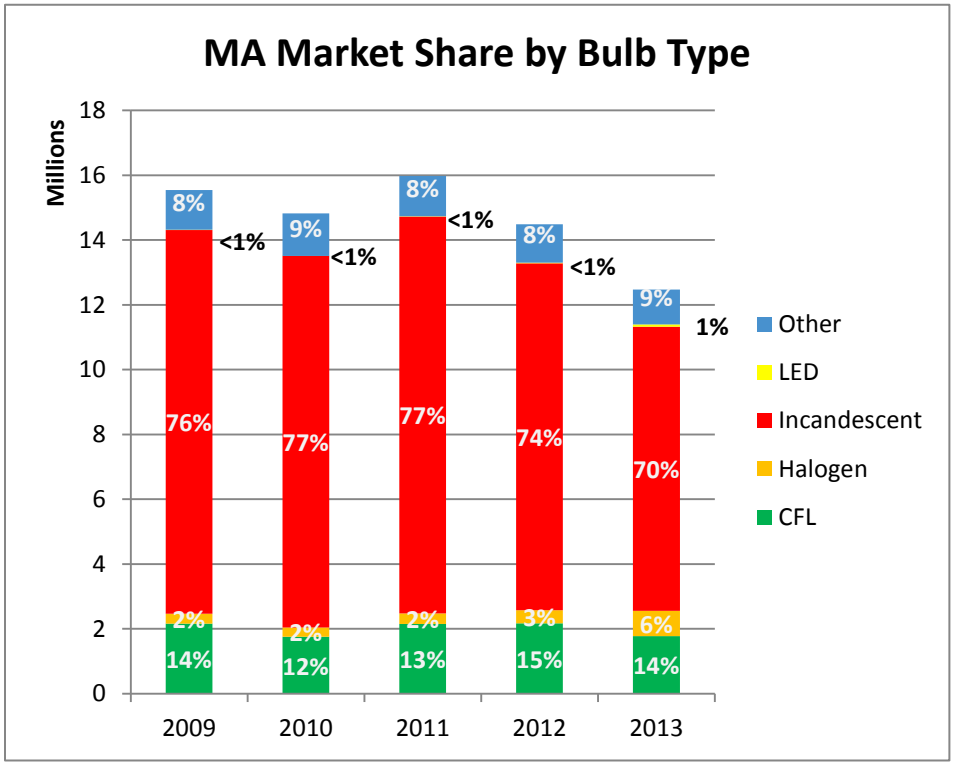
[26] Title 20 in California required that 100W, 75W, 60W, and 40W bulbs be reduced in wattage and manufactured as 95, 71, 57, and 38 Watts from 2008 onward.

Figure 3: CA Market Share by Bulb Type



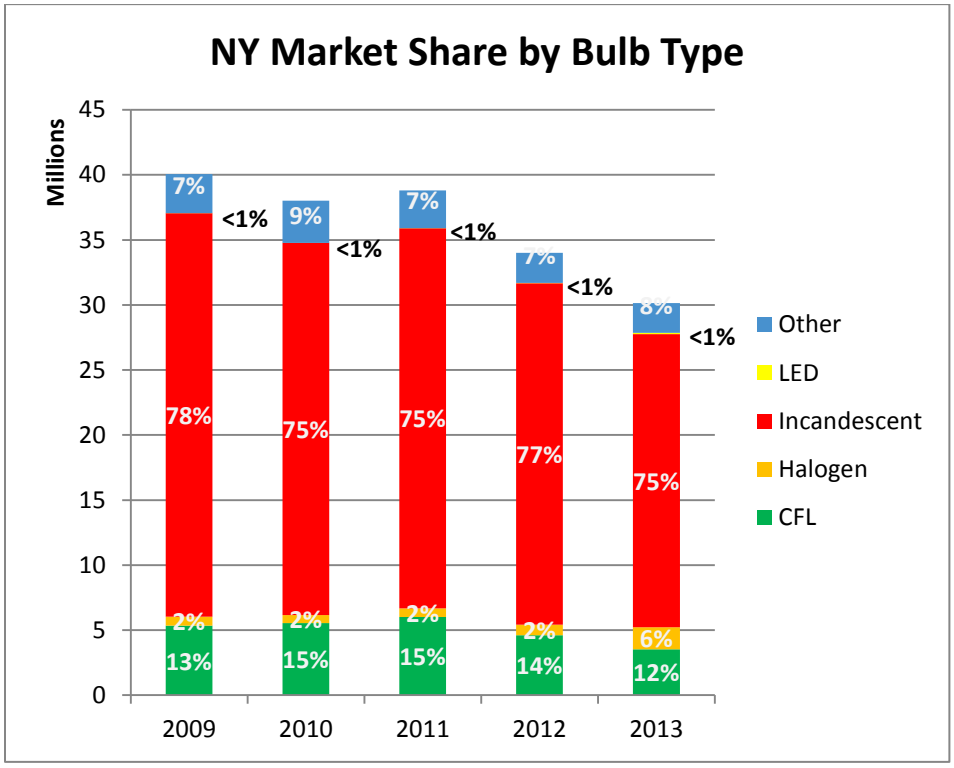
When looking at the market share figures for MA, the Team did not observe the same gains for CFLs from 2009 to 2012 in these retail channels as observed in CA, which may explain, at least in part, the accompanying lack of saturation increases. As shown in Figure 4, CFLs represented 14% of the MA market in these retail channels in 2009, increasing to only 15% in 2012. Further, while CA saw the market share of incandescent bulbs drop 9% over that time period (from 72% to 63%), the incandescent market share in MA dropped only 2% from 2009 to 2012 (from 76% to 74%). Notably, MA had not implemented the 60W phase-out in 2013, although MA *did* continue to offer incentives on standard CFLs in 2014. Therefore, when the 2014 sales data become available, it will be important to assess whether the post-60W phase-out market share diverges from that of CA. This will help to clarify the degree to which consumer incentives alter post-EISA consumer purchase behavior. Of course all of these results must be taken in context, as they represent only the small portion of actual market-level sales and program-level sales captured by the POS data. It is also important to remember that CA and MA sell different percentages of program bulbs through big box channels, with MA moving approximately half of their bulbs through them compared to only 14% in CA. While the POS data do not contain home improvement channels, the current results do nevertheless shed some light on potential reasons for lacking CFL saturation gains in MA from 2009 to 2012.

Figure 4: MA Market Share by Bulb Type



Finally, when considering the former program state of NY, the Team observed a similar trend to MA, but to a greater extent. NY, which dropped program incentives for bare spiral CFLs in 2012, had the smallest CFL market share of all states by 2013 at only 12%. This was interesting to observe, given the finding that CFL market share was 15% in NY in 2011, meaning it dropped by 3% over two years even after the start of the implementation of EISA in 2012. Although less dramatically so, like the CA data above, these results suggest that maintaining incentives for efficient bulbs may help to preserve market share of these bulbs in a post-EISA period. Again, when they are available, the 2014 market share data will help to clarify this matter.

Figure 5: NY Market Share by Bulb Type



Threats to Validity

Important to note with regard to all analyses conducted utilizing the POS data is the fact that this dataset represents only a small portion of the full lighting market. Utilizing the market-level sales estimate from the most recent onsite saturation study, the Team estimates that the POS data represents approximately 23% of all bulb sales in MA. Further, by looking into the MA lighting program-tracking records, which trace all program bulb sales to particular retailers and locations, the Team was able to estimate that the POS data represent a similarly small percentage of program-level sales – roughly 22%. As such, any conclusions reached from the POS data should only be applied to the specific retail channels captured by that dataset, and should not be used to make broad conclusions about the entire MA program. Furthermore, as the POS data do not separate standard CFL sales from specialty CFL sales, it is difficult to know how and if the program had differential effects on those bulb types.

With regard to the conclusions drawn from the in-depth interviews, it is important to note that such interviews are anecdotal by nature, and reflect the opinions of interviewees who may or may not have all the best information necessary to inform those opinions. It is also possible that the interviewees in the current research have their own agendas, which may or may not align with those of the MA PAs, EEAC, or evaluation team.

Finally, since the three states under investigation had different saturation levels in 2009 (the beginning of the period under investigation), they do not align perfectly as comparisons to one another. If both MA and CA had demonstrated 22% CFL saturation in 2009, for example, and CA then experienced an 8% increase over the next three years compared to a 1% increase in MA, the evidence that CA program approaches should be implemented in MA would be stronger. However, since MA had higher saturation than CA in 2009, much of the saturation gain CA experienced through 2012 only brought them to the prior MA level. As such, it is still interesting and informative to understand the approaches that were successful in CA, but those saturation gains need to be taken in context. Further, since the most recent saturation estimate from CA is from 2012, the current MA to CA comparison is still a question that needs to be addressed.

Conclusions

The Team is withholding recommendations and considerations until the final lighting market assessment report, but does provide the following conclusions from the three lines of inquiry covered in the present research. Interviewees cited program activities and legislative factors such as EISA and AB1109 as likely reasons for higher CFL saturation levels in CA than in MA. They expressed that a number of dynamics could have, and likely did, contribute to the gains in CFL saturation in CA, so that a single factor was unlikely to have brought about such increases in and of itself. In general, the interviewees acknowledged the value of the Team's inquiry even if the effort surfaced various or competing perspectives. A number of individuals also identified additional challenges for lighting programs and the market in general, which would have implications in CA, MA, and elsewhere. These interviewees consistently referred to the challenge of continuing a cost-effective intervention in the face of EISA and growing commercialization of LEDs. Interviewees implied that these issues should be monitored regularly in an effort to inform program design and implementation. Several interviewees did feel that the programmatic move toward grocery, discount, and drug stores, and away from big box retailers, was influential in increasing saturation by targeting hard-to-reach populations who otherwise would not be touched by the program. This programmatic move was prompted by earlier research in CA showing higher NTG ratios for these channels.

The background research that the team conducted and the briefings held by CA evaluators on the saturation methods and calculations in CA did not reveal differences from MA substantial enough to deem direct comparisons between the states inappropriate. One difference in the CA saturation calculation, not including empty sockets, did necessitate a slight recalculation of CA numbers, but these brought the overall saturation estimates down by less than 1%, and the saturation gains that served as the impetus for this research remained intact. The Team does suggest acknowledging, however, the insightful comments of one interviewee on this topic, who indicated that MA saturation and onsite data are tracked over smaller time periods and with smaller sample sizes than CA. MA generally collects onsite data and estimates saturation rates annually, on sample sizes ranging from 100-200 homes. CA runs program *cycles*, spanning several years, with 1,000-2,000 onsite participants. As a result, one could observe substantially different saturation point estimates, but the margins of error around the MA saturation estimates could, and did in fact, overlap with those of CA (Table 3). This is not to suggest that the saturation increases in CA from 2009 to 2012 are not evident or worthy of exploration, only that the initial differences in 2012 estimates between MA and CA may not be as large as originally considered.

The analysis of bulb pricing and bulb sales trends revealed that the gains in CA's CFL saturation from 2009 to 2012 were accompanied by increased CFL market share, and also lower average CFL prices in CA than either MA or NY. Although the POS data utilized for this analysis did not represent either full market-level or program-level sales, it nevertheless demonstrated that CFL price and market share in the channels represented by the data were associated with gains in saturation for CA. Conversely, the lack of increasing CFL market share in MA over that same time period also mirrored the lack of saturation increases.

Importantly, the sales data for CA show an increase in prices in 2013 for CFLs as incentives were removed, and a concurrent increase in halogen sales. This suggests a potential stagnation in CA CFL saturation moving forward, if more consumers move to the less efficient halogen bulbs when CFL incentives no longer exist. Such a finding would imply that MA should exhibit caution in removing CFL incentives. Purchasing the POS data for 2014 and onward would allow the Team to examine how these trends continue in future EISA phase outs, as will the more recent saturation estimates coming out of CA.

In conclusion, the Team feels that the key findings from the present research are that the earlier implementation of EISA and the CA programmatic move toward grocery, discount, and drug stores were likely to have been the most influential factors in CA's saturation gains from 2009 to 2012. Furthermore, given the higher initial saturation in MA than CA (i.e., more older CFLs), CFL-to-CFL replacement rates in MA were also likely to have been higher from 2009 to 2012 than in CA, which could explain saturation stagnation over that period. Concurrent research in MA and varying comparison states both with and without programs sheds more light on these relationships.[27]It also makes clear that legislation and programmatic changes are not the only factors influencing increases in efficient bulb saturation. These topics will be covered in greater detail in the overall reporting from the current MA evaluation cycle.

[27] NMR, Cadmus, DNV GL, Navigant, and Tetra Tech. *Results of the Massachusetts On-site Lighting Inventory 2014.* Final delivered to the PAs and EEAC Consultants March, 2015.

Appendix A

The following table presents the years in which saturation was tracked for the states of interest, as well as the evaluation firm undertaking that research. The Team did not feel there was a trend in evaluation results by firm that would substantiate the claim that differences in estimates were a result of differences in relevant firms' techniques or methodologies.

Table 6: Saturation Studies by Year, State, and Evaluation Firm

State	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
MA	7%	9%	11%		21%		26%	26%		27%	28%	33%
	ODC	ODC	RLW		RLW		KEMA	KEMA		DNV-KEMA	DNV GL	NMR
GA							16%					19%
							Cadmus					NMR
KS							21%	19%				29%
							Cadmus	Cadmus				Navigant
CA - IOUs				10%			22%			30%		
				Itron			Cadmus			DNV-KEMA		
UNY							19%	24%			25%	
							Apprise	Apprise			NMR	
DNY							21%	31%			29%	
							Apprise	Apprise			NMR	
NE State							24%			26%	32%	
							KEMA			NMR	NMR	