



**Massachusetts ENERGY STAR[®]
Lighting Program:
2010 Annual Report**

Volume 1

FINAL

6/13/2011

Volume 1: Overall Final Report

Submitted to:

Energy Efficiency Advisory Council Consultants

Cape Light Compact

NSTAR

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Executive Summary

This report summarizes the 2010 and early 2011 evaluation activities completed and findings developed in support of the multi-year evaluation of the Massachusetts ENERGY STAR® Lighting Program (the Program). The evaluation activities were completed for the Energy Efficiency Advisory Council Consultants and the Massachusetts Program Administrators (PAs), including Cape Light Compact, National Grid, NSTAR, Unitil, and Western Massachusetts Electric (WMECO). NMR Group, Inc. (NMR) served as the primary contractor, and KEMA, The Cadmus Group, Inc. (Cadmus), and Tetra Tech served as sub-contractors for the effort (the Team). The evaluation activities describe market conditions and program effects for 2009 and 2010.

The results summarized in this report include the following:

- Net-to-gross (NTG) ratios for all compact fluorescent lamps (CFLs), spiral and specialty CFLs, and CFL purchases among hard-to-reach (HTR) customers, as derived from five different primary methods
- Net-to-gross ratios for all CFLs and for spiral and specialty CFLs, as integrated from a Delphi panel
- Assessment of the current definition of HTR customers
- Understanding market segmentation of HTR customers versus other customers
- Description of the current state of the CFL market

This executive summary highlights those findings related to the four topics of greatest concern to the PAs and EEAC Consultants per the evaluation work plan of 2010, as follows:

1. Estimates of NTG ratios
2. Specialty CFLs
3. Hard-to-reach customers
4. Potential impacts of the Energy Information and Administration Act of 2007 (EISA)

Separate reports describing the methodologies used and detailed findings from each of the major research tasks have been delivered to the PAs and are included as Appendices to this report.

Program Design

The Massachusetts PAs have supported CFLs through various programs since 1998. From 1998 to 2002, the statewide program supported CFLs through the ENERGY STAR Lights catalog, as well as through website and instant rebate coupons found in retailers' lighting aisles close to the products eligible for the rebate. In 2002, the PAs adopted the Negotiated Cooperative Promotion (NCP) program, an “upstream” high-volume sales initiative offered in conjunction with manufacturers and retailers. The catalog and coupon components still continue as a small part of the program offerings, but the NCP program now accounts for the vast majority of products supported through the program.

An impact evaluation of the 2008 Program found declining CFL sales and stabilizing CFL saturation, which both contributed to a dramatically lower NTG ratio in 2008 (0.41) than the Program had achieved in prior years (over 2.0).¹ Among other revisions, the 2008 evaluation recommended an increased focus on specialty CFLs and HTR customers who use CFLs in smaller numbers. In response, the PAs and EEAC consultants developed a three-year plan that included separate, but declining, negotiated NTG

¹ Nexus Market Research, RLW Analytics, and Dorothy Conant (2008) *Market Progress and Evaluation Report (MPER) for the 2007 Massachusetts ENERGY STAR Lighting Program*. Delivered July 1, 2008 to the program administrators. NMR Group, Inc. (2010) *The Market for CFLs in Massachusetts*. Delivered to the Massachusetts Program Administrators on January 28. NMR Group, Inc (2010) *Results of the Multistate CFL Modeling Effort*. Delivered to the Massachusetts ENERGY STAR Lighting Program Sponsors, February 4, 2010.

ratios for spiral and specialty CFLs and CFLs targeted at HTR customers.² The plan involved adopting two key revisions to the program in 2010. The first revision involved targeting HTR customers for increased purchases of CFLs, both specialty and spiral. The PAs defined HTR customers according to the following characteristics:

- Non-Caucasian
- Ethnic minorities
- Household primarily speaks a language other than English
- Household income between 60% and 120% of the state median income
- Has not attained a college degree

In an effort to increase CFL purchases and saturation among HTR customers, the PAs expanded the participation of dollar stores, discount stores, bargain stores, thrift stores, ethnic markets, and stores of various types located in low-income neighborhoods or market areas.³

The second revision in 2010 entailed focusing more heavily on specialty CFLs, in keeping with incentives provided for this focus in the negotiated NTG values for the three-year plan. Prior to 2010, approximately 90% or more of the CFLs supported by program incentives had been medium-screw base spiral CFLs. In contrast, in 2010, only 55% of the CFLs supported were spiral. Instead, the PAs increased support of CFLs that were dimmable or had three-way capabilities, that had small, candelabra bases, or that had shapes other than spiral, including being A-shaped, flood, globe, tubes/bent tubes, decorative, or bullet-shaped.

Net-to-Gross Estimates

The rapidly changing CFL market challenges the ability of traditional net-to-gross (NTG) methods to provide reliable and valid estimates of CFL program NTG ratios, and no single methodology stands out as the latest best practice NTG estimation.⁴ For this reason, the Massachusetts PAs and EEAC Consultants approved an evaluation plan for 2010 that involved estimating NTG ratios using five primary methods, along with a Delphi panel to integrate the results. Five of the methods described in Table ES-1 provide overall estimates of NTG, one method provides a NTG for specialty CFLs only, and four methods provide separate NTG estimates for spiral and specialty CFLs. In addition, two of the methods provide NTG estimates for hard-to-reach (HTR) customers. As agreed with the PAs and EEAC consultants, the Team recommends use of the separate Delphi NTG estimates for spiral CFLs (a NTG of 0.43) and specialty CFLs (0.60), or combining them into a single estimate for all CFLs (0.47).

² Massachusetts Program Administrators (2010) "Program Description." PDF document submitted with the Request for Proposals for the *Residential Retail Products Evaluation*.

³ As described by Lockheed Martin in an email response to a request from NMR on May 10, 2011.

⁴ It is unlikely that any single method will ever be a "best practice" for CFL (or other) NTG ratio estimation. Data availability, program design, target population, and budget, among other factors must be taken into account when deciding which NTG approach to use in net savings estimation. See NMR and Research Into Action (2010) *Net Savings Scoping* Paper. Prepared for the Northeast East Energy Efficiency Partnerships Evaluation, Measurement, and Verification Forum and Goldberg, Miriam, Oscar Bloch, Ralph Prael, David Sumi, Bryan Ward, Rich Winch, and Tom Talerico (2006) *Net-to-Gross Method Selection Framework for Evaluating Focus on Energy Programs*. Prepared for Wisconsin Focus on Energy, among others.

Table ES-1: Comparison of Estimated NTG Ratios*

Method	Sample Size	All CFLs		Spiral CFLs		Specialty CFLs		HTR	
		NTG	CI	NTG	CI	NTG	CI	NTG	CI
Delphi Panel	19	0.47		0.43		0.60			
Conjoint	300					0.59			
Multistate Modeling	1,495	0.45	0.08 - 0.90						
Revealed Preference	105	0.36	0.29 - 0.43	0.37	0.29 - 0.45	0.31	0.21 - 0.41	0.34 - 0.38	0.25 - 0.45
Supplier Self-Reports	201	0.41		0.39		0.49		0.72	
Willingness to Pay	75 ^a 37 ^b	0.45	0.39 - 0.51	0.49	0.42 - 0.56	0.31	0.22 - 0.40		

* The data did not allow for estimates in the shaded cells. All studies achieved at least a 90/10 level of precision, with the conjoint method achieving 95/5.

^a For spiral CFLs

^b For specialty CFLs

The Team has identified three patterns in the NTG results that may have important implications for the future of the Program. First, each of the NTG ratio methods yielded an estimate falling below one, with most of the ratios falling between 0.3 and 0.5. The conjoint analysis (limited to a subset of specialty CFLs), supplier interview estimates for HTR customers and certain retail channels, and the Delphi panel for specialty CFLs yielded NTG estimates of greater than 0.5. While each method certainly has its limitations, the Team believes that the convergence of results may quell at least some concerns about the validity of individual results; multiple methods led to similar conclusions, suggesting that the results are in the right ballpark of the actual “real world” value. The convergence by no means *proves* that the results have a high level of validity, as they could all still be biased in the same direction, but the evidence does provide some support for the conclusion that the results are valid.⁵

⁵ Note that assessing validity—the knowledge that the estimate truly measures what it was supposed to measure—is not entirely possible for NTG ratio estimation as it inherently involves measuring a counterfactual—that is, what would have happened if the program had not occurred.

Second, the results also provide some unexpected findings regarding specialty CFLs. With most methods, the NTG for specialty CFLs is similar to—sometimes even lower than—that for spiral CFLs. The pricing elasticity analyses provide an explanation for this pattern: consumers appear to be willing to buy specialty CFLs at almost any price, while they are less willing to pay more for spiral CFLs. In other words, consumers are more likely to be “free riders” for specialty CFLs than they are for spirals CFLs, leading to lower NTG ratios for specialties. The lower price elasticity and NTG for specialty CFLs likely reflects the following: 1) specialty CFLs are early in their adoption/diffusion cycle, so small NTG ratios are to be expected as “innovators” who like new technologies dominate purchases; 2) consumers are less of familiar with specialty CFLs and not yet able to judge a “fair” price for the products; and 3) the prices of specialty CFLs are higher and more varied, so consumers are more comfortable paying higher prices for them than for spiral CFLs. The conjoint analysis yielded the highest NTG for specialty CFLs (0.59), but this was based on only A-line and flood bulbs; in contrast, all other NTG ratios estimated for specialty products were “blended” estimates, taking into account all the types of specialty products supported by the program. This suggests that different types of specialty products may have different NTG ratios, but it would not be cost effective to estimate NTG for each type of specialty CFL. Instead, the PAs may want to conduct a study into which specialty products appeal most to consumers, as we discuss below.

Finally, the NTG results for HTR customers appear contradictory: the revealed preference approach suggests a relatively low NTG ratio for HTR customers (about 0.35), while the supplier interviews suggest a higher NTG ratio (about 0.7 to 0.8). Even so, these two results are not as contradictory as a simple comparison suggests. The revealed preference method asked *individuals* identified as having lower education levels or lower household incomes about their personal lighting purchase behavior, while the supplier interviews with manufacturers, retailers, and store managers in specific *retail channels* asked about the influence of the program on sales. Importantly, many stores within the HTR retail channels are dollar stores at which the prices of goods on the shelves cannot exceed one dollar; the Program incentive was vital to their decision to carry CFLs and still meet the one dollar price limitation. Moreover, these stores may be located in areas with a high percentage of HTR residents or they may serve a large proportion of HTR customers, but *any consumer* can shop at these stores. The HTR NTG estimate from the supplier interviews is really an estimate for specific retail channels, and it appears that the program has been successful at moving CFLs in these channels regardless of the characteristics of the purchasers.

Specialty Bulbs

One of the specific goals of the 2010 Program, based on a negotiated agreement, was to increase sales of specialty CFLs. In 2009, 10% of the products incentivized by the PAs through the Program were specialty CFLs, whereas in 2010 45% of the products were specialty CFLs. PAs increased support of CFLs that were dimmable, had three-way capabilities, had small candelabra bases, or had shapes other than spiral, including A-shaped, flood, globe, tubes/bent tubes, decorative, and bullet-shaped. The implication of this change is that specialty bulbs were the only *program-supported* CFLs on the shelves of many traditional retail partners (*e.g.*, home improvement and hardware stores) in 2010.

The WTP and revealed preference analyses used simulation modeling to compute the elasticity of demand for specialty and spiral CFLs. These analyses found that the price elasticity for specialty CFLs is lower for specialty CFLs than for spiral CFLs, with likely reasons for the lower elasticity (and NTG ratios) discussed above. In other words, consumers will continue to buy specialty CFLs even if the price increases, but are likely to stop buying spiral CFLs (or buy fewer of them) if the price increases. Moreover, revealed preference respondents meeting at least some of the criteria for HTR showed only slightly greater sensitivity than all respondents to specialty prices. This unexpected finding may reflect the consumer’s desire—or need—for the specialty bulb because of its shape or features and are unwilling—or unable—to find a halogen or incandescent bulb for the desired application. The results also

provide context for the NTG ratios: specialty NTG is slightly lower than for spirals because consumers are willing to buy them at any price point, not just ones deemed sufficiently low.

Finally, the pricing analysis led to the finding that the “realization rate” for specialty CFLs is less than one. The realization rate in this sense refers to how much of the PA incentive the manufacturers and retailers are passing along to the consumer; by falling below one, the results indicate that the full discount is not being passed along to consumers. A simple story that could explain the confluence of these findings is that retailers have noticed the lower price elasticity that consumers exhibit with specialty bulbs, and have reacted by choosing to retain more of the incentive for themselves, knowing that it would have relatively little effect on how many they would sell. If this is in fact what is going on, it would seem to suggest that the effectiveness of the specialty bulb component of the program could be enhanced if the PAs revised the program so that it directly responded to the retailers’ strategic behavior, as discussed in the conclusions, recommendations, and considerations (Section 5).

Hard to Reach Customers

The Massachusetts PAs revised the Program in 2010 to increase targeting of so-called hard-to-reach (HTR) customers. Their working definition of these customers includes non-Caucasians, ethnic minorities, households primarily speaking a language other than English, household with incomes between 60% and 120% of the state median income, and those who have not attained college degrees; customers may very well have more than one of these characteristics. The Team sought to explore this definition of HTR and to provide information on whether it accurately describes HTR customers in Massachusetts. We did this by calling cellular phone numbers as well as landlines and fielding the survey in both English and Spanish.

RDD survey respondents who did not self-identify as white were statistically less likely than those who did to be aware of CFLs (84% non-white vs. 95% white) and to say they were familiar with CFLs (70% non-white vs. 87% white). Respondents who self-identified as Latino were statistically less likely to report having purchased or been given CFLs than were their non-Latino counterparts (70% Latino vs. 90% non-Latino).

Higher-income households were more likely than lower-income households to be aware of CFLs (98% vs. 90%), to be familiar with CFLs (91% vs. 78%), and to have used CFLs for four or more years (46% vs. 24%). Awareness of CFLs was very consistent across education groups (93% or higher), but familiarity and duration of CFL use are higher among those with college degrees (94% for familiarity and 38% have used CFLs for four or more years) than among those who have no more than an Associate’s degree (85% or lower for familiarity and 29% or lower have used CFLs for four or more years).

Prior use of CFLs was higher among both high-income (98%) and moderate-income households (93%) compared to low-income ones (78%).⁶ Respondents with college educations were also statistically more likely to have used CFLs than those with just high school diplomas.

Due to the overall small onsite sample sizes for many individual demographic groups, the ability to generalize from the results of the HTR analysis is limited. One key finding, however, is that the PAs should not assume that *saturation* is lower among the groups they currently consider as HTR. Among HTR customer groups, only non-white households have saturation rates that fall below those of white households (21% for non-white vs. 27% for white). No Latino households took part in the onsite surveys, but self-reported prior use also suggests that saturation may be lower in these households as well. In most cases, HTR households have saturation levels that rival or exceed those of their college-educated, higher-

⁶ Low-income households make less than 60% of median household income, moderate-income households make between 60% and 120% of median household income, and high-income households make more than 120% of median household income.

income, home-owning counterparts—a finding largely driven by smaller home sizes and fewer sockets, especially sockets that may require a specialty bulb such as candelabras in a dining room. In other words, many customers currently considered HTR may not use as *many* CFLs, but they have CFLs installed in enough sockets to have relatively high saturation. Note that detailed examination of CFLs given to respondents through PA programs reveals that direct install programs in Massachusetts cannot be assumed to explain this high saturation in low-income homes; instead, most bulbs obtained through PA programs were installed by MassSAVE in moderate- and high-income households. These results again point to the *possibility* of identifying which *sockets* are HTR and why households have yet to fill them with CFLs, as opposed to focusing on which *customers* are HTR, while still targeting non-white and Latino households in an effort to increase saturation in such households. Note also that very few households primarily speaking a language other than English took part in the onsite; this may indicate a cultural bias about having strangers enter the home, particularly strangers who may not speak the primary language in the home. For this reason, we believe that those who speak a language other than English in the home may still be considered HTR.

Regarding market segmentation for HTR customers, most of the demographic groups reported shopping for incandescent (asked in RDD only) and CFL bulbs (asked in both surveys) primarily at home improvement stores. Renters, however, are less likely to shop at home improvement stores when compared to members of other demographic groups. Other common store types at which respondents shop for incandescents and CFLs include bargain, warehouse, grocery, discount, and hardware stores. Onsite households with respondents with some college, who are white, or who are homeowners also named PAs as a common source of CFLs.

The evidence suggests that diversifying the types of stores carrying CFLs would expand the venues at which the products are available and make them easier to access, but the only group that would likely increase its CFL use as a result *relative to the other groups* is renters. Moreover, most of the renters in our sample pay their own electricity bills. Although their landlords may supply light bulbs, it is likely that many renters are buying their own bulbs or could easily swap out screw-in incandescents for CFLs to save money even if the landlord does provide the bulbs. Still, it must be kept in mind that saturation among renting respondents is the same as for owners, suggesting that boosting purchases among *all* types of households is the most likely way to boost CFL saturation.

Energy Independence and Security Act

In December of 2007 Congress passed the Energy Independence and Security Act (EISA), an energy bill that, among other provisions, calls for a gradual phaseout of inefficient lamps over time starting in 2012. One-fourth (25%) of 2010 RDD survey respondents had heard of traditional incandescent bulbs being phased out, a significantly greater percentage than in 2009 (18%).

Few manufacturers thought that CFL sales would increase in the period leading up to the phaseout. Their reasons included the continued availability of most incandescent wattages, consumer ignorance of EISA and its implications, and the fact that some consumers simply do not like CFLs. Manufacturers thought that CFL sales would increase the most from 2012 to 2014, due not only to the incandescent phaseout but also because they thought that LEDs would not yet be viable replacements. We also asked the manufacturers and high-level retailers about the impact of EISA on incandescent bulbs. Some high-level takeaways include the following:

- Incandescent production is already being curtailed and this is putting some upward pressure on prices for incandescent bulbs;
- Manufacturers of incandescent bulbs are actively exploring EISA-compliant alternatives, but these will likely take the form of energy-efficient halogen products (there was general consensus

that conventional incandescent bulbs will not be able to meet EISA standards), and some of these manufacturers will shift production capacity to CFLs or LEDs;

- Some retailers have already stopped promoting incandescent bulbs, some plan to stop a few months before the phaseout, and some plan to keep selling them until they are phased out;
- Discounters expect to have a deluge of incandescent bulbs as they acquire close-out/liquidation supplies from mainstream retailers; and
- Consumers will likely hoard some incandescent bulbs but it likely will not start until the EISA phaseout gets more publicity and it will likely not be significant with 100-watt bulbs due to their lower saturation (3% in Massachusetts).

Given the fact that specialty incandescents will not be affected by EISA, sales of specialty CFLs created through program efforts have the potential to continue to yield savings across a full range of specialty bulbs.

Conclusions, Recommendations, and Considerations

The NMR Team completed a wide range of activities in support of the 2010 evaluation of the Program. These activities led to the following conclusions, recommendations, and considerations.

Net-to-Gross Ratios

The NTG ratios displayed a great deal of convergence, with only the estimate for the HTR retail channel diverging from the other estimates. The convergence suggests—although by no means proof—that the methods have some validity, meaning that they have come close to measuring the “true value” in the “real world.” Although the methods largely converge, the Team asked a panel of experts to take part in a Delphi process in an effort to integrate the results, ultimately providing guidance on which NTG ratio to recommend for CFLs overall, for specialty CFLs, and, if the data support it, for HTR customers as well. After integrating the results of the five individual estimation methods, the Delphi panel recommended the use of a 0.43 NTG for spiral CFLs and 0.60 for specialty CFLs, resulting in a NTG of 0.47 for all CFLs based on proportions of spiral CFLs and specialty CFLs supported by the program.

Recommendation: Based on the results of the Delphi panel, we recommend using a 0.43 NTG for spiral CFLs and 0.60 for specialty CFLs, or 0.47 overall for the 2009 and 2010 program years.

Although it had a lower maximum likelihood R^2 than the eighteen-month model and presented challenges in terms of the appropriate calculation and interpretation of NTG, the multistate model limited to the first-half of 2010 leads to two interesting conclusions about the Program. The first conclusion is the negative NTG (-2.77) that results when setting prior program activity equal to zero is that CFL sales were lower in 2010 than they would have been had the program not existed. This is because the Program encouraged households to adopt CFLs at an earlier time period, providing evidence that the Program reaped greater savings and for a longer period of time had it not existed. The second conclusion relates to the NTG ratio of 0.83 that results when the model assumes the actual level of prior program activity. This ratio indicates that the program, in its current form, is still boosting CFL sales.

Consideration 1a: The fact that the NTG ratio for the 2010-only model points to increased CFL sales due to the current program, even after controlling for prior program activity, suggests a continued need for the program. In fact, given the uncertainties associated with EISA (discussed below), the Team believes that the PAs should continue the program largely in its current form, with perhaps some adjustments related to specialty products and consumer education targeted at HTR customers and hard-to-convert sockets as discussed below, and more frequent monitoring of the market for rapid response to changing lighting market conditions (see below on LEDs as well). We understand that the PAs are currently considering a “market lift” model for the program, and this approach could include negotiated NTG ratios. The ultimate impact of this approach, however,

remains to be seen, as channel shifting could potentially negate any gains achieved with the new approach. The tracking of sales data and estimated NTG will still be important in evaluation in order to assess the program impacts; this tracking would be greatly enhanced if the data provided through the market lift approach were comprehensive, across all retailers and lighting categories.

Consideration 1b: While we suggest that the PAs continue to support CFLs, technological advancements in light emitting diodes (LEDs) are occurring at a very rapid rate and this market needs to be closely monitored. Currently there are only two A-shaped LEDs among the approximately 150 LEDs with the ENERGY STAR label and these products have the lumen output equivalent to a 40-watt incandescent.⁷ Later in 2011, however, it is expected that LEDs with lumen outputs equivalent to a 75-watt incandescent will be available, and several manufacturers have indicated that a 100-watt replacement is not far behind. The prices for A-shape LEDs are in the \$10 to \$30 range, and even at these prices, retailers have anecdotally reported that they are selling out of stock completely, an indication that the “innovators”⁸ are buying LEDs. We suggest that the PAs monitor the technological advancement of LEDs very closely and consider reserving some funding in their memorandum of understanding (MOU) allotments to support LED products that seem promising, even if these LEDs become available in the middle of the year.

Consideration 1c: The PAs should consider introducing new technologies without having the products completely “road tested.” One way they can monitor consumer acceptance of the products is to attract “early adopters;” they may consider doing so by offering a coupon or rebate for LEDs and collect consumer data so that evaluators can easily identify and solicit the opinions of the customers who will be positioned to influence others to use LEDs as the technology advances and prices drop.

Specialty CFLs

One of the more unexpected conclusions from this evaluation is that consumers appear willing to buy specialty CFLs at a fairly high price point, for reasons discussed above. Perhaps because specialty purchasers really *want* specialty CFLs or cannot find a suitable halogen or incandescent alternative to fulfill their specialty needs. Earlier, we suggested that lower realization rates for specialty products may reflect retailers and manufacturers noticing the inelastic prices of specialty CFLs and retaining more of the incentive for themselves than they do for spiral CFLs. If this is indeed the case, the Team suggests that the PAs consider revising the program in a manner that responds directly to this strategic behavior.

Consideration 2a: The PAs may want to consider negotiating agreements for specialty bulbs to include requirements regarding how the bulbs must ultimately be priced. Specifically, the PAs may consider requiring manufacturers to report a “Suggested Retail Price” for each type of product covered in the MOU agreement. The agreed incentive amount paid by the PAs would be subtracted from the “Suggested Retail Price” and partners would agree that the retail price would not exceed that difference (Suggested Retail Price – PA incentive). This would allow manufacturers and retailers to add *additional* discounts to the MOU incentive, if they desire, and would allow more transparency for the PAs to monitor the concern that the full incentive amount was not being passed to the customer. Adoption of the “market lift” model may obviate the need for negotiated price agreements. Focus groups (discussed below) may also provide the PAs with information on which specialty CFLs they should focus their efforts.

⁷ ENERGY STAR qualified LED Lighting listing
http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=ILB (Accessed 5-27-11).

⁸According to the Everett Rogers Diffusion of Innovations theory, there are five stages of consumer acceptance of a product: Innovators, early adopters, early majority, late majority, and laggards.

Consideration 2b: Given the possibility that specialty CFLs are in the early phases of the adoption/diffusion curve and that their prices remain high, the PAs may want to consider keeping the incentive they offer at current or even higher levels. This consideration could be adopted in tandem with Consideration 2a.

Hard-to-Reach Customers and Hard-to-Convert Sockets

When compared to the current working definition of HTR customers, our research concludes that only those who self-identify as non-white or Latino consistently exhibit lower levels of CFL awareness, familiarity, use, and saturation than those self-identifying as white or non-Latino. Moreover, respondents in all groups reported similar patterns in where they shop for incandescent bulbs and CFLs, with home improvement stores being the most common source of all types of light bulbs. Based on these results, we believe the PAs may want to consider the following change to the definition of HTR customers.

Consideration 3: The definition of hard-to-reach customers should perhaps be revised to focus on those self-identifying as non-white or Latino as well as households that do not speak English as a primary language. Based on our research, income and education do not appear to be consistent characteristics of HTR households. A shift in focus to this potentially revised definition of HTR may be best implemented through continued efforts to partner with stores serving (or located in areas with) a higher percentage of customers who are non-white, Latino, or do not speak English as a first language. Our findings suggest that the Program boosts CFLs sales in these stores, and they could play an important role in increasing CFL saturation among all customers groups, not just HTR ones. Within these stores, marketing materials could be targeted at particular populations (*e.g.*, program materials in Korean in stores serving Korean-speaking customers). Similarly, stores widely patronized by HTR customers, even if not located in HTR neighborhoods (*e.g.*, Wal-Mart or K-Mart) could also be targeted to increase use among HTR customers.

The onsite study suggests that it may be more appropriate to think about hard-to-convert sockets instead of hard-to-reach customers. Increases in CFL saturation have slowed in Massachusetts, as well as in California, but the majority of remaining sockets could be filled with a standard, medium-screw base spiral CFL. Specialty CFLs certainly have a role to play in increasing saturation beyond the current level of 26%, but better communication with consumers about the benefits of choosing CFLs over halogens, incandescents (at least those that are still available), and other lighting technologies is needed. This need will become more acute when (and if) the EISA phaseout goes into effect and incandescents become scarce, as discussed below.

Consideration 4: Continue and expand efforts to educate consumers about the range of CFLs, LEDs, and other efficient lighting available and the benefits of using efficient light bulbs over other types of light bulbs. See *Consideration 5* below on more details on what this education campaign might include.

Potential Impacts of and Preparation for EISA

Few manufacturers and retail buyers thought that CFL sales would increase in the period leading up to the phaseout, but they did believe that CFL sales would increase the most from 2012 to 2014. This would be due not only to the incandescent phaseout but also because they thought that LEDs would not yet be viable replacements, although this may be changing rapidly. Since the completion of the supplier interview report, Team members have learned that anecdotal evidence in California, where they have already instituted a phaseout, suggests that many 95-watt incandescents remain on store shelves as retailers continue to stock those bulbs already in their possession as well as those that were manufactured just before the cutoff for the first stages of the phaseout. The continued availability of near-100-watt incandescents also likely reflects that fact that they fill fewer sockets than the more common 75-watt and 60-watt incandescents (based on manufacturer and retailer reports).

In light of information from manufacturers and retail buyers as well as the recent findings from California, it is likely that 100-watt incandescents will continue to be widely available well after they are no longer allowed to be manufactured; the anticipated effects of EISA may, therefore, become significant only in 2013. Thus, we repeat our suggestion that the PAs consider continuing to offer substantially the same Program in 2012 as they offered in 2010 and 2011, with the minor revisions discussed above regarding specialty CFLs and HTR customers and market segments and acknowledging that the PAs may already have plans to adopt a market lift approach. We also offer an additional consideration regarding consumer education that will work in tandem with *Consideration 4* above.

Consideration 5: The PAs should work with other industry partners to educate consumers that the lighting world is changing. Incandescents are ceasing to be the “standard” bulbs they once were. PAs may need to work with retailers and manufacturers to educate consumers about the importance of lumens in selecting light products and the fact that wattage does not mean very much when a 60-watt incandescent, a 13-watt CFL, and a 12-watt LED all have the same light output as measured in lumens, and will mean even less when 60-watt incandescents are phased out. Part of this education could also involve explaining the new “Lighting Facts” label that is currently expected to be included on packaging beginning January 1, 2012. For LEDs, the educational campaign could also stress their dimmability, which is one of the more persistent complaints about CFLs, including dimmable ones.

Research Priorities for June 2011 through December 2012

The Team has compiled a list of research priorities that the PAs may wish to consider for the second half of 2011 and 2012. We discuss each study in more detail in the full body of the report.

1. The Team suggests that the PAs consider working with the California Public Utilities Commission to learn more about the actual lighting availability trends in California in 2011 and beyond and what the implications may be for both states as phaseouts move beyond 95/100-watt incandescents to 75-watt and 60-watt incandescents.
2. With the rapidly changing market, we suggest consideration of quarterly surveys of consumers to assess awareness of EISA, plans in relation to EISA (including hoarding), and recent purchases.
3. The PAs may also wish to consider performing additional onsite saturation studies in late summer/fall of 2011 and again in late summer/fall of 2012. In addition to assessing saturation, the onsites could be used to determine recent purchases as well as storage behavior of *all* lighting types, not just CFLs, in a search for any effects of EISA on purchases, saturation and hoarding.
4. A fourth potential study to consider would involve quarterly or semi-annual surveys of retailers to assess awareness of EISA, current stocking of lighting, plans for the rest of 2011, plans after January 1, 2012, and their predictions about consumer reactions to EISA.
5. The PAs may also consider a fifth study involving the performance of a sensitivity analysis to assess potential savings given different scenarios associated with the implementation of EISA.
6. A sixth potential study to consider would involve focus groups with consumers to help understand their current understanding of and reactions to changes in the lighting market. These focus groups could provide more information on such topics as barriers and drivers to increasing saturation above current levels, which types of specialty CFLs most appeal to consumers, the new “Lighting Facts” label expected to be released in January 2012, and reactions to LEDs and other efficient lighting choices, among other potential topics.
7. Other possible studies to consider include repeating interviews with manufacturers in late 2011 and late 2012 to learn more about their current production and plans in light of EISA as well as NTG ratios. Additional multistate work perhaps involving multistate modeling, shelf-stocking surveys, and/or saturation studies may also be options.

1 Program Description and Evaluation Components

This report summarizes the 2010 and early 2011 evaluation activities completed and results developed in support of the multi-year evaluation of the Massachusetts ENERGY STAR[®] Lighting Program (the Program). The evaluation activities were completed for the Energy Efficiency Advisory Council Consultants and the Massachusetts Program Administrators (PAs), including Cape Light Compact, National Grid, NSTAR, Unitil, and Western Massachusetts Electric (WMECO). NMR Group, Inc. (NMR) served as the primary contractor, and KEMA, The Cadmus Group, Inc. (Cadmus), and Tetra Tech, served as sub-contractors for the effort. The evaluation describes market conditions and program effects for 2009 and 2010.

The results summarized in this report include the following:

- Net-to-gross (NTG) ratios for all compact fluorescent lamps (CFLs), spiral and specialty CFLs, and CFL purchases among hard-to-reach (HTR) customers, as derived from five different primary methods
- Net-to-gross ratio for all CFLs and for spiral and specialty CFLs, as integrated from a Delphi panel
- Assessment of the current definition of the hard-to-reach (HTR) customers
- Understanding market segmentation of HTR customers versus other customers
- Description of the current state of the CFL market

1.1 Program History and Key Revisions for 2010

The Program is an on-going effort to encourage the use of ENERGY STAR-qualified lighting among residential customers. According to the 2010 program description provided by the PAs, “The ENERGY STAR Lighting ... program [is] administered jointly in order to streamline processes, maximize retailer and manufacturer relationships, and minimize vendor costs.” The primary objective is “To increase consumer awareness of the importance and benefits of purchasing ENERGY STAR-qualified lighting products and expand the availability, consumer acceptance, and use of high-quality energy-efficient lighting technologies and controls.”⁹

The PAs work with “key market players in the residential lighting market, from manufacturers to retail sales staff, with the emphasis on involving upstream market players to leverage program resources.”¹⁰ The PAs also partner with other regional programs through the Northeast Energy Efficiency Partnerships (NEEP) to leverage program effectiveness by aggregating markets and coordinating consumer messaging. Additionally, all PA lighting initiatives are coordinated with and designed to support the national ENERGY STAR program. In this section, we describe the

⁹ Massachusetts Program Administrators (2010) “Program Description.” PDF document submitted with the Request for Proposals for the *Residential Retail Products Evaluation*. Both quotes from page 164.

¹⁰ *Ibid* page 165.

history of the program and the key revisions made in 2010 to target hard-to-reach customers and specialty compact fluorescent lamps (CFLs).

1.1.1 History of the Program

The PAs have had a statewide CFL program since 1998, although individual PAs had supported CFLs through various programs on their own prior to 1998. From 1998 to 2002, the statewide program supported CFLs through the ENERGY STAR Lights catalog, as well as through website and instant rebate coupons found in retailers' lighting aisles close to the products eligible for the rebate. In 2002, the PAs adopted the Negotiated Cooperative Promotion (NCP) program, an “upstream” high-volume sales initiative offered in conjunction with manufacturers and retailers. The catalog and coupon components still continue as a small part of the program offerings, but the NCP program now accounts for the vast majority of products supported through the program. In the NCP, the program invites industry partners to propose plans using either a markdown mechanism (which bases all of the incentive payments on sales data) or a buydown mechanism (which pays the majority of the incentive to the industry partner upon receipt of confirmed shipment reports and the remaining amount based on confirmed sales data). Both markdowns and buydowns provide reduced product pricing for the consumer, who frequently may have no indication that she is taking part in a PA-sponsored program. Both the coupon and the NCP components also provide promotional support such as advertising, point-of-purchase (POP) materials, and consumer education activities.

Since 2006, the NCP program has structured incentive levels using a tiered approach based on wattage level, package size, program model, and additional product features, with higher incentives paid for specialty CFLs, higher wattage CFLs, and those sold through markdowns rather than buydowns. From January 2009 through June 2010, the NCP buydown program reduced product prices by as little as \$1.45 to as high as \$6.18 for each standard bulb and up to \$8.70 for each specialty bulb. Due to these incentives, prices for bulbs sold through the NCP program have in some cases been comparable to prices for incandescents.

1.1.2 Key Revisions for 2010

An impact evaluation of the 2008 Program found declining CFL sales and stabilizing CFL saturation, both of which contributed to a dramatically lower NTG ratio in 2008 (0.41) than the Program had achieved in prior years (*i.e.*, over 2.0; see Figure 1-3 below).¹¹ The 2008 evaluation recommended an increased focus on specialty CFLs and HTR customers that use CFLs in smaller numbers to counter the declining NTG and sales, even as the evaluators also suggested some continued support of spiral CFLs because of the remaining potential in medium-screw base sockets with an A-Line profile. In response, the PAs and EEAC Consultants developed a three-

¹¹ Nexus Market Research, RLW Analytics, and Dorothy Conant (2008) *Market Progress and Evaluation Report (MPER) for the 2007 Massachusetts ENERGY STAR Lighting Program*. Delivered July 1, 2008 to the program administrators. NMR Group, Inc. (2010) *The Market for CFLs in Massachusetts*. Delivered to the Massachusetts Program Administrators on January 28. NMR Group, Inc (2010) *Results of the Multistate CFL Modeling Effort*. Delivered to the Massachusetts ENERGY STAR Lighting Program Sponsors, February 4, 2010.

year plan that included separate, but declining, negotiated NTG ratios for spiral and specialty CFLs and CFLs targeted at HTR customers (Table 1–1).

Table 1–1: Three-year Negotiated NTG Ratios*

	Spiral	Specialty	HTR
2010	0.3	0.8	0.7
2011	0.0	0.8	0.7
2012	0.0	0.65	0.7

* Source: Massachusetts Program Administrators. 2010. “Program Description.” PDF document submitted with the Request for Proposals for the *Residential Retail Products Evaluation*. Page 165.

The plan involved the adoption of two key revisions to the program in 2010. The first revision involved targeting HTR customers for increased purchases of CFLs, both specialty and spiral. The PAs defined HTR customers according to the following characteristics:

- Non-Caucasian
- Ethnic minorities
- Household primarily speaks a language other than English
- Household income between 60% and 120% of the state median income
- Has not attained a college degree

In an effort to increase CFL purchases and saturation among HTR customers, the PAs expanded the participation of dollar stores, discount stores, bargain stores, thrift stores, ethnic markets, and stores of various types located in low-income neighborhoods or market areas.¹²

The second revision in 2010 entailed focusing more heavily on specialty CFLs. Prior to 2010, 90% or more of the CFLs supported by program incentives were medium-screw base spiral CFLs (shown for 2008 through 2010 in Table 1–2; prior to 2008 nearly all CFLs supported were spirals). In contrast, in 2010, only 55% of the CFLs supported were spirals. Instead, the PAs increased support of CFLs that were dimmable or had three-way capabilities, had small, candelabra bases, or had shapes other than spiral, including A-bulbs, floods, globes, tubes/bent tubes, decorative, and bullet-shaped CFLs.

Table 1–2: Percentage of Spiral and Specialty Bulbs Supported by the Program*

	2008	2009	2010
Spiral	91%	90%	55%
Specialty*	9%	10%	45%
Number of Program CFLs	2,424,94	3,318,081	2,618,856

* Source: EFI Program Database; specialty bulbs as identified in the database.

Implementing these two revisions led the PAs and their implementation vendor, Lockheed Martin, to institute a substantial change in the CFLs they supported in different types of stores: beginning in 2010, they only supported spiral CFLs in stores identified as serving a high

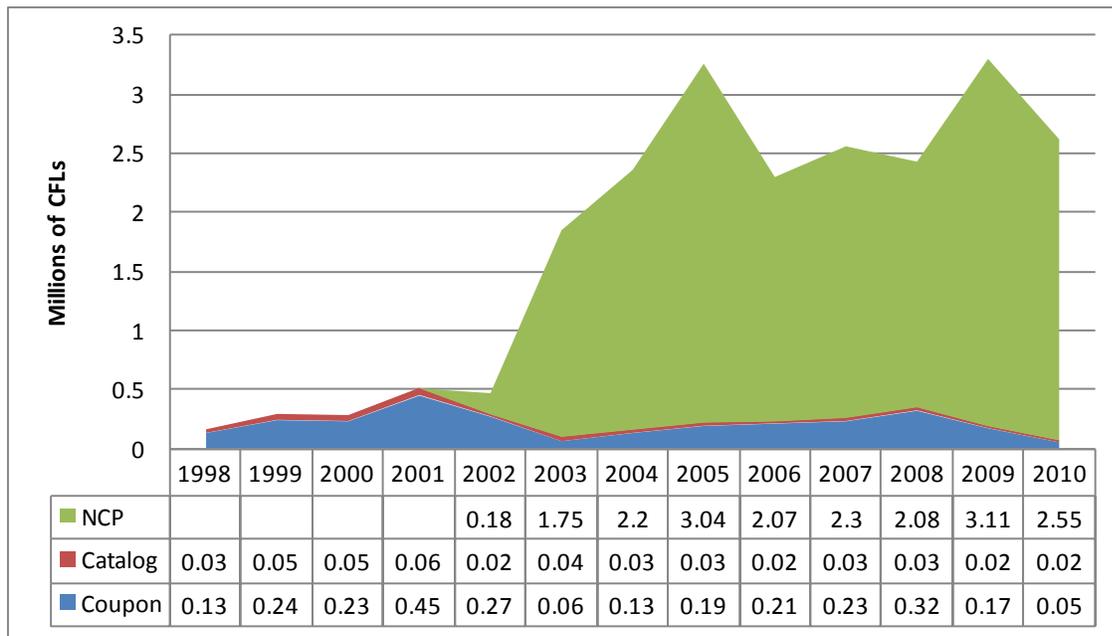
¹² As described by Lockheed Martin in an email response to a request from NMR on May 10, 2011.

proportion of HTR customers (*i.e.*, the dollar, ethnic, and other stores described above).¹³ The implication of this change is that specialty bulbs were the only *program-supported* CFLs added to the shelves of many traditional retail partners (*e.g.*, home improvement and hardware stores) in 2010.¹⁴ These stores may very well have added spiral CFLs to their shelves in 2010, but these spirals were not incented directly by the Program. It is also important to note that both HTR and non-HTR customers shop in a variety of stores; therefore, both types of customers would still have access to program-supported spiral and specialty CFLs if they happened to shop in the particular stores carrying one or both of those types of bulbs.

1.1.3 Program Support over Time

Figure 1-1 displays the number of CFLs supported by the program over time broken down by the method of program delivery. The figure illustrates the importance of the NCP for adding substantially to the number of CFLs supported by the program. Specifically, the program supported approximately 160,000 CFLs in 1998, mostly through the coupon program. The PAs introduced the NCP in 2002, and the number of supported CFLs quadrupled from 2002 to 2003 (from 462,000 to 1,845,000). Program-supported CFLs have fluctuated between 2.3 million and 3.3 million since 2004.

Figure 1-1: Number of Program CFLs Supported by Program Delivery Method*



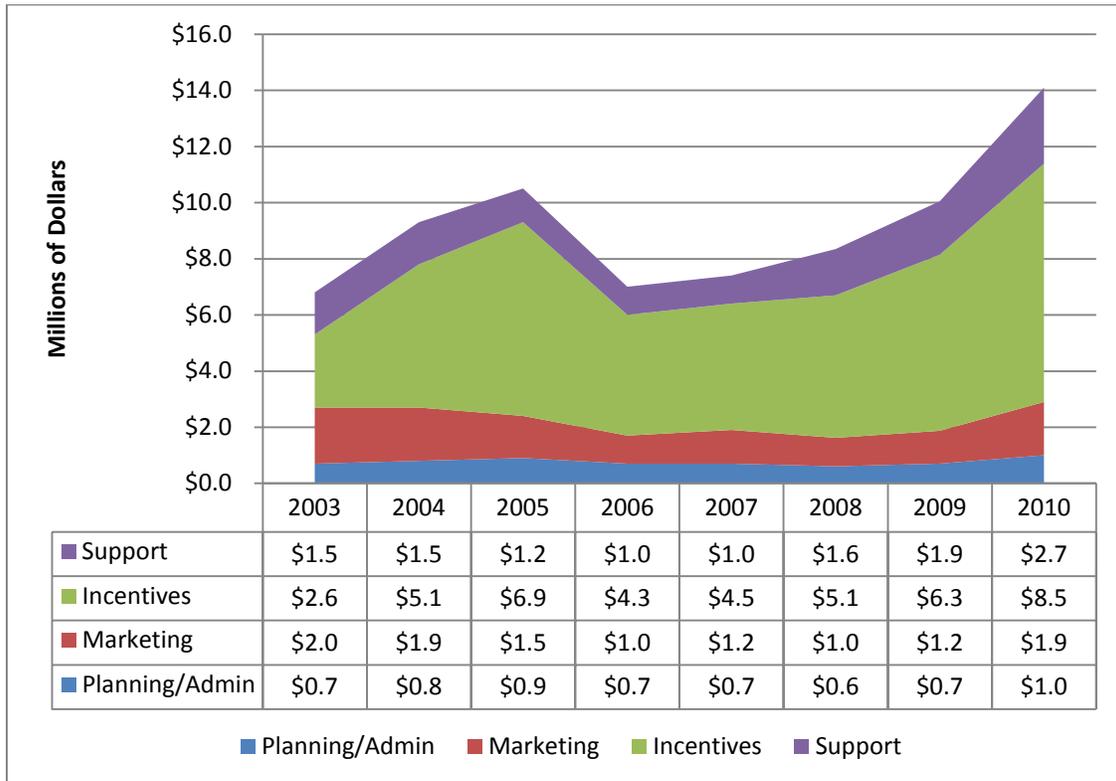
* Source: EFI Program Database – based on program shipments

¹³ Lockheed Martin (2011) *2010 ENERGY STAR Lighting Practices Report: Lighting Retailer Product Stocking, Pricing and Promotional Practices*. Submitted on January 20, 2011 to the Massachusetts and Vermont Program Administrators. Confirmed in email exchanges between Lockheed Martin, Birud Jhaveri, and NMR.

¹⁴ Some of these traditional stores did carry spirals, if they happened to meet other criteria such as serving a high proportion of customers identified as HTR. In addition, some stores still had CFLs supported by the 2009 program on their shelves in 2010.

Figure 1-2 illustrates the CFL program budget by expense category over time. The budget expanded from 2003 to 2005, the time of the greatest expansion associated with the NCP approach. The budget contracted in 2006, and then began to increase again from 2007 through 2010. The 2010 budget is the largest ever, likely due in part to the need to support the program revisions that target specialty CFL and HTR customers.

Figure 1-2: Implementation Budget by Expense Category 2003 to 2010*



*Source: Program Administrators

1.1.4 Trends in Net-to-Gross Ratios over Time

The Market Progress and Evaluation Reports (MPER) for 2007 documented the many positive effects that the Program has had on the CFL market in Massachusetts.¹⁵ Section 4.3 of this report updates many of these market effect indicators, such as CFL awareness, saturation, use, storage, and purchase behavior, the availability of CFLs, and the prices for CFLs, among others. In this section we focus on one of the most important—and most controversial—indicators of market effects, the NTG ratio.

The development of the NTG ratio for the Program stems from the recognition that some CFL sales would have been made in the absence of the program (*i.e.*, free ridership), while the program may very well have induced additional sales beyond those receiving incentives (*i.e.*,

¹⁵ Nexus Market Research, RLW Analytics, and Dorothy Conant (2008) *Market Progress and Evaluation Report (MPER) for the 2007 Massachusetts ENERGY STAR Lighting Program*. Delivered July 1, 2008 to the program administrators.

spillover).¹⁶ The NTG ratio is applied to estimates of gross sales or gross savings in an attempt attribute impacts to the program for which it is directly responsible.

The PAs began tracking NTG ratios for the Program in 2005; Figure 1-3 on the next page presents the ratios for the Massachusetts program as well as the Focus on Energy CFL program in Wisconsin for 2005 through 2008.¹⁷ Importantly, the Wisconsin program remained more heavily focused on coupons during this time period than Massachusetts, but the two programs used similar methods for calculating NTG from 2005 to 2008. In fact, they even relied on the same baseline comparison area (Michigan) in 2005 to 2007, and estimated NTG ratios based on per-household CFL sales in each area. The comparison shows that the NTG ratios for both areas hovered just above one in 2005; in 2006, Wisconsin's NTG ratio began to fall, but the ratio in Massachusetts increased to nearly 2.8. Both areas experienced decreases in 2007, although the ratio in Massachusetts was still well above that in Wisconsin. We speculate that the higher NTG in Massachusetts during this period was due to the much greater reliance on markdowns and buydowns than was the case in Wisconsin.

In 2008, both Massachusetts and Wisconsin took part in a multistate modeling effort in which a statistical model created the baseline scenario from which NTG ratios were calculated. This method pointed to continued decreases in NTG ratios for both states, with a precipitous decline in NTG for Massachusetts from 2.15 in 2007 to 0.41 in 2008. Wisconsin, by this time substantially increasing its reliance on the upstream buydown/markdown approach, experienced a smaller decrease in its NTG ratio. California also took part in the multistate modeling effort, yielding a NTG ratio of 0.23 for that state. Importantly, however, California also estimated NTG using a variety of other approaches, yielding estimates for 2008 that ranged from 0.06 to 0.42, depending on the method. A NTG ratio developed for the full three-year program period of 2006 to 2008 was 0.74. In this case, evaluators speculate that the higher CFL sales in Massachusetts and California than in Wisconsin in the 2003 to 2007 period may have led to higher CFL saturation, and hence to lower CFL sales in 2008.¹⁸ The trends in NTG ratios in Massachusetts serve as one of the primary impetuses to the topics addressed in this evaluation; we now turn to this topic.

¹⁶ For a detailed discussion of net energy savings, other adjustments to gross savings, and the many concerns surrounding these issues, see NMR and Research Into Action (2010) *Net Savings Scoping* Paper. Prepared for the Northeast East Energy Efficiency Partnerships Evaluation, Measurement, and Verification Forum. <http://neep.org/uploads/EMV%20Forum/EMV%20Products/FINAL%20Net%20Savings%20Scoping%20Paper%2011-13-10.pdf>.

¹⁷ The PAs and evaluators used Wisconsin and Michigan data as comparisons to Massachusetts because the data were available publically and for free. This allowed for a low-cost estimation of NTG ratios for Massachusetts, as no additional data needed to be collected on a comparison area.

¹⁸) KEMA (2010) *Final Evaluation Report: Upstream Lighting Program*. Delivered to the CPUC February 8; NMR Group (2010) *Multistate Modeling*.

Figure 1-3: CFL Program NTG Ratios in Massachusetts and Wisconsin 2005 to 2008

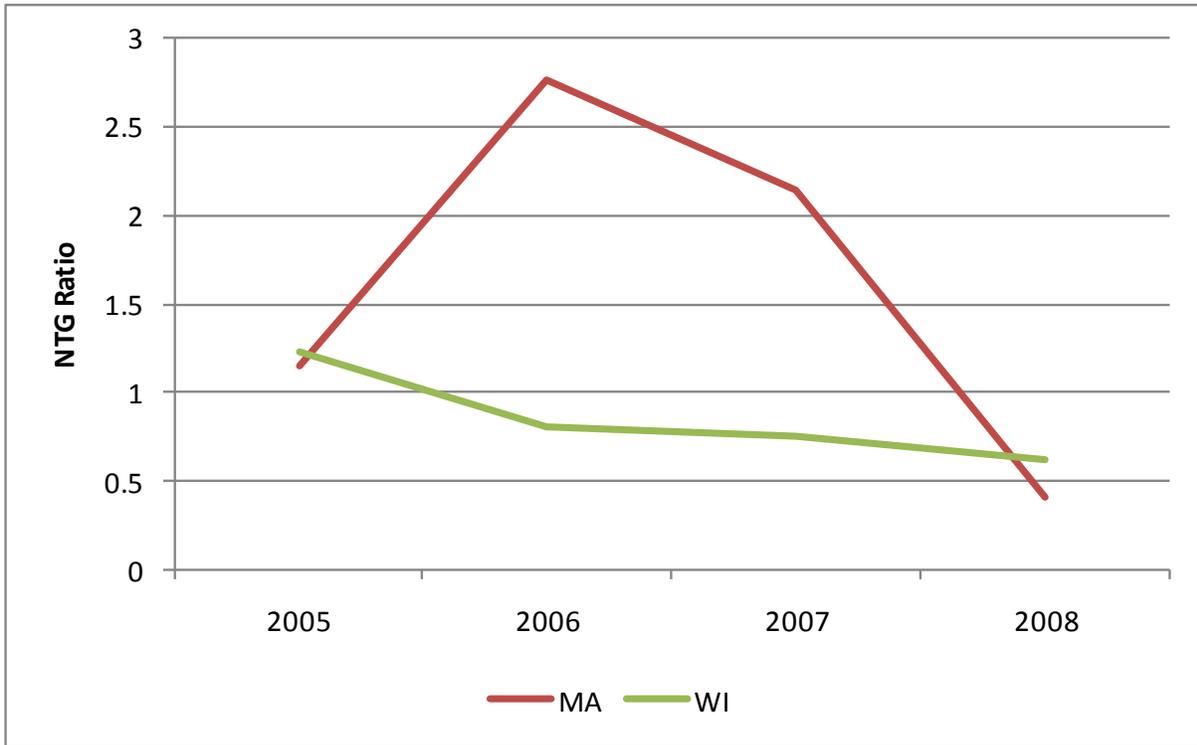
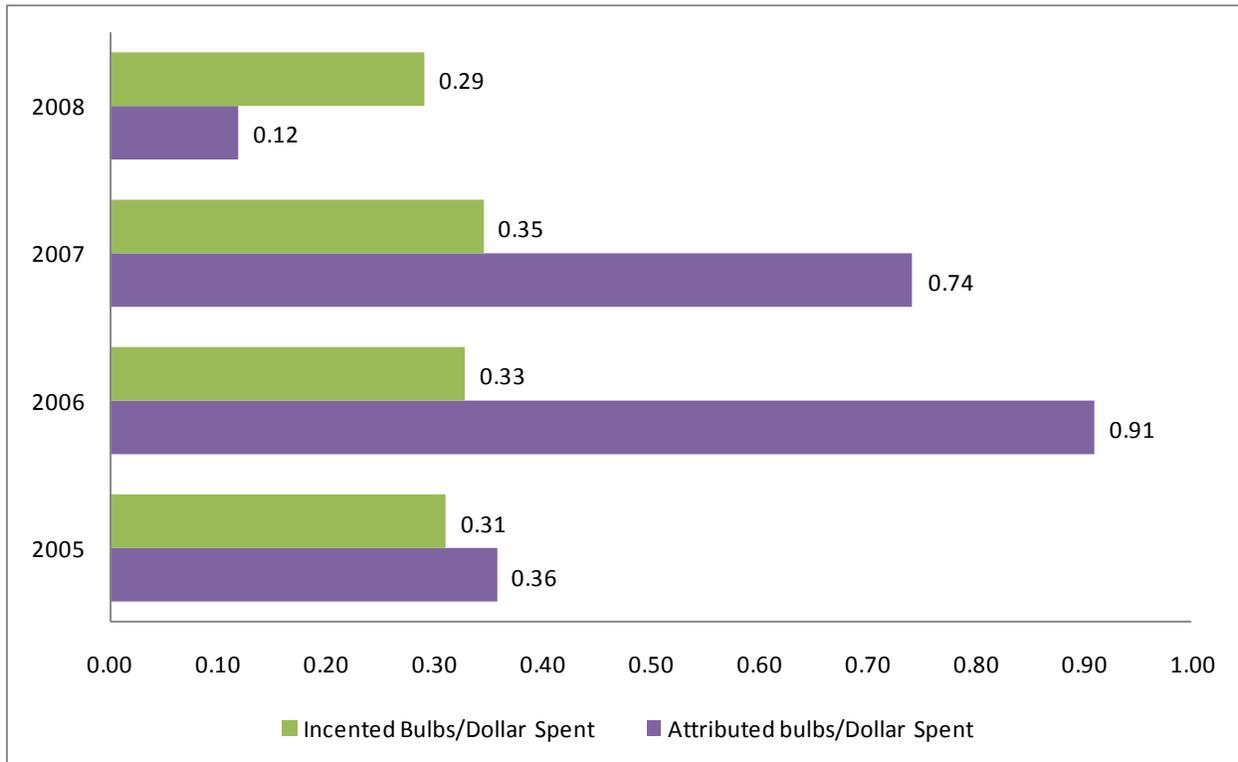


Figure 1-4 displays the number of CFLs incented per dollar spent by the program. When the NTG ratio was high, as in 2007 and 2008, the program more than doubled the number of CFLs purchased per dollar spent on the program, approaching one CFL purchased for every dollar spent. In 2008, however, this ratio dropped to 0.12, and the program was attributed fewer purchases than they actually incented per dollar spent.

Figure 1-4: CFLs Incented and Attributed to the Program per Dollar Spent, 2006 to 2008



1.2 Evaluation Components: Spring 2010 through Spring 2011

The declining and lower-than-expected NTG ratio in Massachusetts in 2008 provided one justification for the 2010 revisions to the program. The PAs hoped that targeting HTR customers and specialty sockets would increase sales beyond what would have happened without the program, thereby boosting the NTG ratio for 2010. They sought an evaluation of their 2009 and 2010 activities relying on NTG ratios derived from a variety of methods in an effort to limit the drawbacks of any one NTG estimation method and allow for triangulation of the results. For this reason, the evaluation activities described in this report focus heavily on NTG ratio estimation as well as the impact of the program on CFL purchases and saturation related to HTR customers and specialty CFLs.

The evaluation also addresses topics that the PAs have tracked in prior evaluation activities such as broader market effects, CFL saturation, potential, and satisfaction, disposal of CFLs,

awareness and reaction to the Energy Independence and Security Act of 2007 (EISA), and awareness and use of light emitting diodes (LEDs) and other efficient lighting technologies.

Table 1–3 lists the seven data collection methodologies the NMR team used to gather the information necessary to complete the 2010 evaluation tasks. Some of the methodologies (*e.g.*, the onsite visits) provided data used in multiple reports, while other methodologies supported just one report (*e.g.*, supplier interviews). Five of the reports yielded NTG estimates:

1. Conjoint: for specialty only
2. Multistate modeling: for all CFLs only
3. Revealed preference: overall, spiral, and specialty as well as some information on HTR
4. Supplier interviews: overall, spiral, and specialty including for HTR
5. Willingness to pay: overall, spiral, and specialty but no information on HTR

Some of these methods had been used in the evaluation of the 2006-2008 California CFL program, and had resulted in a wide range of NTG ratio estimates. While the California NTG estimates were not as contradictory as they might appear on first glance (because lower NTG estimates tended to address 2008 only, while higher NTG estimates addressed 2006 through 2008—which is consistent with the drop in the 2008 NTG observed in Massachusetts), the EEAC consultants and the PAs wanted a way to resolve possible conflicting results across methods. Therefore, NMR employed a Delphi panel approach in which experts reviewed the results of the five methods to develop recommendations for the final 2009-2010 NTG.

In addition to NTG ratios, the RDD/onsite, supplier interview, and revealed preference reports specifically address CFL use and purchase behavior for respondents considered HTR according to the PAs' current definition, while the RDD/onsite and supplier interview reports also discuss where HTR customers shop (*i.e.*, HTR market segmentation). With the exception of the multistate modeling report, all reports present results on customer use and purchases of specialty CFLs. Finally, the RDD/onsite, multistate modeling, and supplier interview reports include results on a wide range of market effects, awareness of and reaction to EISA, awareness and use of other lighting technologies, and additional factors that could affect CFL use and purchase behavior.

Table 1–3: Primary Data Sources and Topics Addressed

Data Collection Method	Population Targeted	Sample Size	Related Reports *	Topics Addressed
RDD Telephone Survey	Households in MA, Pennington County, SD	381 in MA 500 in SD	RDD/Onsite (2A) Multistate Modeling (2C)	Recruitment for new onsite visits; contributes to multistate modeling; wide range of lighting market characteristics and effects; environmental opinions; early adopter behavior; knowledge of and reaction to EISA, demographics; HTR market segmentation
Onsite Visits	Households visited in 2009 onsites (revisits); households identified in current RDD telephone survey (new visits)	75 “revisits” in MA 75 “new visits” in MA 93 in SD	RDD/Onsite (2A) Willingness to pay (2B) Multistate modeling (2C)	NTG via WTP analysis; contributes to multistate modeling; CFL saturation, use, purchase behavior, and potential
Supplier Interviews	Manufacturers, retail buyers, store managers	11 manufacturers 9 high-level retail buyers 181 store managers*	Supplier Interview (2D)	NTG for standard, specialty, and HTR CFLs; additional market effects, HTR definition and segmentation; impacts of EISA
Shelf-stocking Survey	Participating and non-participating stores carrying lighting products	95 stores 2,849 CFL packages	Pricing/Conjoint (3E) Revealed Preference (3F) Willingness to Pay (2B)	CFL pricing analysis; shelf-space dedicated to CFLs; contributes to the conjoint analysis
Conjoint Survey	Electric customers	300	Pricing/Conjoint (3E)	Specialty NTG; Impact of variation in CFL price, characteristics on light bulb choices
In-store Intercepts	Lighting purchasers	105	Revealed Preference (3F)	Lighting purchase decisions
Delphi Panel	Lighting program experts	19	Delphi (3G)	Integration of NTG estimates from other methodologies

* Letters and numbers behind each report name refer to the volume and appendix in which each report can be found. For example, 2A refers to Volume 2, Appendix A.

^a Also interviewed 38 store managers in Rhode Island in a joint evaluation effort between the Massachusetts PAs and National Grid in Rhode Island.

2 Estimation of Net-to-Gross Ratios

CFL program evaluators nationwide are finding it increasingly difficult to provide valid and defensible estimates of net-to-gross (NTG) ratios for CFLs. Numerous recent studies employing various methods have struggled to provide estimates that are widely accepted as realistic and valid estimates of NTG.^{19,20} The CFL program evaluation community has turned to a diverse range of estimation methods only to be frustrated by what some reviewers have seen as counterintuitive or unreliable NTG estimates. The studies completed to date make clear that the available estimation methods have strengths and weaknesses that ultimately influence the results.²¹ Given the rapidly changing CFL market, marked by volatile sales nationwide over the past three years, former “best practices” (e.g., self reports of free ridership and spillover and simple comparison-state approaches) have become increasingly problematic. Numerous circumstances underlie the struggle to provide valid estimates of NTG, but chief among these is the rapid expansion of CFL programs throughout the nation, the increased availability of CFLs regardless of CFL program activity, and limited access to CFL sales data from participating and non-participating retailers in both program and non-program areas. Not only do such circumstances limit the usefulness of former best practices to estimating NTG, but no clear methodology currently stands out as the latest best practice in NTG estimation. For this reason, the Massachusetts PAs and EEAC Consultants approved an evaluation plan for 2010 that involved estimating NTG ratios using the five primary methods described in Section 1.2 as well as the Delphi panel, an integrative approach discussed in Section 2.3.

In all of these methods, “gross” refers to program-supported CFL sales or purchases (not energy savings), and “net” refers to total market-level sales—possibly including both program-supported and non-program-supported CFLs—that would have been sold or purchased in the absence of the program. All methods estimate the NTG for a given program year or a few years, and do not attempt to calculate possible spillover from program activity to CFL sales in non-program states.

- A NTG of 1.0 would indicate that the program is responsible for exactly as many CFL sales as the program supported; if the program had not existed, market-level sales would have been reduced by a number equal to the number of CFLs supported by the program.
- A NTG of 2.0 would indicate that the program is responsible for market-level sales that are two times the number of CFL sales supported by the program; if the program had not existed, market-level sales would have been reduced by twice the number of CFLs supported by the program.

¹⁹ For example, 1) KEMA (2010). *Final Evaluation Report: Upstream Lighting Program*. 2) Summit Blue Consulting (2009) *Energy Efficiency/Demand Response Plan Year 1 (6/1/2008-5/31/2009) Evaluation Report: Residential Energy Star Lighting*. Delivered to ComEd, November 16, 2009. 3) NMR Group (2010). *Multistate Modeling*.

²⁰ See NMR and Research Into Action (2010) *Net Savings Scoping Paper*.
<http://neep.org/uploads/EMV%20Forum/EMV%20Products/FINAL%20Net%20Savings%20Scoping%20Paper%2011-13-10.pdf>

²¹ See also NMR and Research Into Action (2010).

- A NTG of 0.5 would indicate that the program is responsible for only half as many sales as it supports; if the program had not existed, market-level sales would have been reduced by one-half the number of CFLs supported by the program.

It is at least theoretically possible to have a negative NTG, which would mean that more CFLs would have been sold if the program had not existed, and that the program had somehow suppressed CFL sales, at least temporarily. For example, a program could shift CFL sales to earlier time periods, thereby reducing current sales but leading to overall greater savings as the purchases occurred earlier.

Table 2–1 summarizes the NTG ratio estimates derived using each of the five primary methods. With only a few exceptions, the results suggest that less than one-half of the program-supported sales can be attributed to the program; the majority of sales would have occurred in the absence of the program. The conjoint analysis provides the first exception to this pattern; this approach found that the program was responsible for 59% of specialty CFL purchases, but was based on A-line and flood CFLs only; all other specialty NTG estimates are based on all types of specialties supported by the Program. In the second exception, a multistate purchase model limited the first-half of 2010 suggested a NTG ratio of 83%, but this model carries with it a series of caveats discussed more below that draw this estimate into question—and in fact includes a complementary negative NTG that would also have to be taken into account. The supplier interviews provide the final exception, suggesting that the program is responsible for 71% or more of CFL purchases in retail channels that serve a high proportion of HTR customers.

Table 2–1: Comparison of Estimated NTG Ratios*

Methodology	Overall	Spiral	Specialty	HTR NTG		
				Overall	Spiral	Specialty
Conjoint			0.59			
Multistate Modeling	0.45 ^a 0.83 ^b					
Revealed Preference	0.36	0.37	0.31		0.38 [∞] 0.36 [†]	0.37 [∞] 0.34 [†]
Supplier Interviews	0.41	0.39	0.49	0.72	0.71	0.77
Willingness to Pay	0.45	0.49	0.31			

* Excludes the Delphi panel results, as this was an integrative approach, not a primary estimation method.

The data did not allow for NTG estimation for the shaded cells.

^a Model capturing sales from January 2009 through June 2010

^b Model capturing sales from January 2010 through June 2010

[∞] Attained Associates degree or less

[†] Income below \$50,000.

Importantly, each of the five primary methods has strengths and weaknesses (see Section 2.1 below), and the PAs, EEAC Consultants, and NMR Team members worked under the assumption that estimating NTG using a variety of methods limited the negative influence of the weaknesses of any one approach and allowed for comparison of results across them. In this chapter, we provide an overview of the various NTG estimation techniques and results, including

a summary of their strengths and weaknesses. We then address the conclusions that can be drawn from the NTG estimation approaches, focusing on patterns across the various methods and what these may mean for the past—and future—of the Program.

2.1 Description of Methods and Key Results

The five primary NTG estimation methods represent innovative approaches to estimating NTG for CFLs. Although each of the methods has been used to varying extents in process and impact evaluations of energy efficiency, only recently have they been applied to estimating NTG ratios for efficient lighting programs. For this reason, the NMR Team finds it useful to describe each of the methods and how they were used to calculate NTG ratios. We also discuss the key results, focusing on the estimates of the NTG ratios but also bringing in other key findings that provide additional context or information related to the NTG estimates. Before doing so, however, we briefly describe the shelf-stocking survey and the hedonic pricing analysis, as they contributed data to three of the NTG ratio estimation techniques.

2.1.1 Shelf-Stocking Study and Hedonic Pricing Analysis

The shelf-stocking study involved visits to a representative sample of 95 stores in Massachusetts, to collect data on 2,849 CFL packages, followed by matching the shelf-stocking data to the PAs' tracking database of both CFL sales and the paid incentives. This was the basis for comparing the advertised retailer discount amount to the manufacturer and retail partner incentives paid by the PAs. The hedonic pricing regression analysis used data collected in the shelf-stocking study to create a regression model in which the price of a product is regressed on the product's characteristics. The idea behind the hedonic pricing model is that variation in product prices can be explained by the products' observable attributes, which are not explicitly traded in the market. The results of the pricing analysis and of the hedonic pricing regression are discussed in more detail in Section 4 of this report.

Here it is important to note that the data collected on the price of CFLs and the results of the hedonic pricing analysis provided information necessary for the completion of the conjoint/pricing elastic analysis, the revealed preference analysis, and the WTP analysis.

2.1.2 Conjoint/Pricing Elasticity Analysis (Volume 3: Appendix E)

The conjoint/pricing elasticity analysis drew upon a shelf stocking/pricing survey, a hedonic pricing regression analysis, and a conjoint survey to estimate the NTG for specialty CFLs only (in this case only A-bulbs and floods). The conjoint survey involved 300 randomly recruited electric customers across Massachusetts. The survey questions contained descriptions of different light bulbs that were characterized by a consistent set of six or fewer distinct attributes (the levels of which vary across questions). Respondents were asked to choose between the different options presented. The conjoint analysis used simulation modeling to (1) compute an elasticity of demand for specialty CFLs, and (2) estimate the respondents' willingness to pay at each price point for both A-Line and Flood CFL bulbs. Then, combined with the results of the

hedonic pricing regression model, this allowed the development of a specialty CFL NTG ratio. The NTG ratio estimated from the conjoint analysis was 0.59.

The conjoint willingness to pay and price elasticity results both contribute to the NTG ratio. These results provide the context that helps to explain the NTG ratio of 0.59. Specifically, the price elasticity analysis suggests that the PAs could capture 100% of the A-Line CFL market if the product was purchased at \$0.75 per bulb, and also that pricing discounts above \$3.25 would have a greater impact on market share than those priced below that amount. The willingness-to-pay analysis within the conjoint study (as opposed to that completed onsite, reported in Section 2.1.6) found that about 24% of the population was willing to pay the average non-discounted price of \$5.42 for A-Line CFLs while 54% were willing to pay the full discounted price of \$2.75. For flood CFLs, the price elasticity analysis suggested that 100% of consumers would buy the product if it was priced at \$1.70; discounts of \$4.02 or more would, furthermore, have a great impact on market share than discounts below this amount. The willingness-to-pay analysis found that 26% of consumers would buy a flood CFL at the non-discounted price of \$7.09, while 64% would buy it at the fully discounted price of \$3.48.

The key strength of the conjoint approach is that, when combined with a pricing analysis, it provides a robust estimation of program-induced sales. Also, by asking respondents to choose among different products with varying characteristics, conjoint avoids directly asking the question, “What are you willing to pay?,” and is closer to real-world decision making.

The approach also has some weaknesses. Despite some similarity to real-world decision making, the conjoint survey was conducted in a controlled study environment. The complete product information for the identified attributes is provided to the respondent and is thus unlikely to reflect the typical consumer’s actual purchase decision. Moreover, only A-bulbs and floods were included in the analysis, leaving out other types of specialty bulbs (*e.g.*, bug lights, candelabras, dimmables, *etc.*). The method also does not account for non-price program effects, impulse purchases (*i.e.*, it assumes the consumer will purchase lighting), or product availability (*i.e.*, it assumes the described products will be available). A final drawback of the method is that it does not take into account the possibility that past program activity could affect CFL sales in the current year.

2.1.3 Multistate Modeling (Volume 2: Appendix C)

Multistate modeling used household-level data collected from different geographic areas across the United States, in 1,495 randomly selected households (150 of them in Massachusetts and another 93 in South Dakota funded by the PAs). The effort sought to isolate the net impact of program activity on CFL purchases. The method yielded an estimate of CFL purchases in the presence of the program as well as CFL purchases in the absence of the program. The NTG ratio was calculated using the equation $([\text{Per Household Purchases with the Program} - \text{Per-household purchases without the program}] \div \text{Per-household CFLs incented by the program})$, with the values for purchases with and without being derived from a statistical model to control for other factors

that can affect CFL purchases. The model included areas with long-standing CFL programs, with newer CFL programs, and with no sustained CFL programs. In each model developed for the effort, CFL purchases in a specific time period served as the dependent variable. Independent variables tested in the models included measures of program support, CFL saturation at the beginning of the time period, the length of prior program support in the area, and various household-level measures of demographic, economic, and social characteristics.

The modeling effort relied on non-linear regression technique known as zero-inflated negative binomial modeling to estimate CFL purchases. This statistical method helps to differentiate between the numerous households that have zero purchases in a particular time period, but for different reasons—for example, some households may have purchased zero CFLs because they had many CFLs installed and did not need any more, while others may have purchased zero CFLs because they did not like them. The approach yielded a NTG ratio for all CFLs, with no breakdowns for spiral, specialty, or HTR.

The multistate modeling effort yielded two separate purchase models. The first model estimated purchases for the eighteen-month period of January 2009 to June 2010. This model yielded a NTG ratio of 0.45 and had a maximum likelihood R^2 of 18%, suggesting that it was the stronger of the two models from a statistical standpoint. The second model estimated purchases for the first-half of 2010 and resulted in a NTG ratio of 0.83; the maximum likelihood R^2 was 12%. Importantly, the variables in these two models differ, with the most substantial difference involving a variable that captures the impact of the number of years the program has been operating on current purchase behavior; this variable is included in the 2010 model but was not found to be statistically significant in the eighteen-month model.

Table 2–2: Multistate Modeling NTG Ratios

Input	Full 18 Months	First half of 2010	Alternative 2010
Total NTG	0.45	0.83	-2.77

Importantly, the multistate model is one of the few NTG ratio estimation methodologies that has successfully controlled for the impact of prior program activity on current CFL purchases. Yet, the nature of the variable for prior program activity presents a statistical and theoretical challenge. In order to estimate the baseline scenario, the Team set the program variables equal to zero, thereby forcing the model to assume that the program did not exist. The question then became whether prior program activity should be considered a program variable or another context variable. The NTG estimate of 0.83 assumes the latter—that the prior existence of the program sets the context for “current” program activity. If, however, we assume the former and set the variable for prior program activity equal to zero, the NTG ratio plummets to -2.77 (negative 2.77).

The pattern of the NTG ratios resulting from the 2010-only model points to the following conclusions: 1) prior program activity shifted CFL sales to earlier time periods, securing greater

savings overall but reducing 2010 sales that may have happened if the program had never existed, but 2) taking this prior program activity into account reveals that the *current* program is still boosting CFL sales beyond what they would be if the PAs had ceased all promotions by January 1, 2010. In choosing between the two models to describe the NTG ratio for 2009 and 2010, the NMR Team believes that the higher maximum likelihood R^2 justifies selecting the eighteen-month model and NTG ratio of 0.45 over the model for the first-half of 2010. Moreover, the appropriate calculation of the baseline scenario for the 2010 model is not clear due to the model's inclusion of the variable for prior program activity, muddying the interpretation of the model and how it should be most appropriately used.

The primary strength of the multistate modeling approach is that it reduces the need for an “ideal” comparison area because the model controls for factors at the household level, and thus creates a statistically modeled baseline or control area. One of the factors that can be controlled for is presence and strength of CFL programs, because data are included from areas with and without programs, and from areas with programs of varying strength and longevity. The modeling allows the identification of key drivers of CFL purchases in real-world conditions. Because it includes a variable for saturation, the model takes into account the possibility that past program activity could affect CFL sales in the current year.

One weakness is that the estimate of CFL purchases in a given time period is obtained by having study team members walk through homes asking the occupants when they had purchased each individual CFL, which leads to error and reliability issues. Note that the Team attempted to mitigate this issue through the inclusion of a subsample of homes that had taken part in a similar study a year ago, allowing comparison of change in the number of CFLs installed with respondents' estimates of purchases in the previous year. Their self-reported purchase estimates coincided with the numerical change in CFLs found in their homes.

Another weakness is that only the factors for which data are available—and found to be statistically important—are included in the model; hence the model provides an incomplete explanation of CFL purchases. Finally, although the model uses household-level purchase and demographic data, the program data are the same for all households in an area, thus reducing variability.

2.1.4 Revealed Preference (Volume 3: Appendix F)

This method, for Massachusetts, involved in-store intercept interviews with 105 consumers who were actively purchasing lighting products, combined with a stocking and pricing analysis. Of the 105, 43 bought CFLs, 52 bought incandescent bulbs, and 12 bought some other type of bulb; note that a few respondents purchased more than one type of lighting product so the totals sum to more than 105. In the intercept survey, consumers were asked how many CFLs they would have purchased if the price were higher or lower. Non-CFL purchasers were asked how many CFLs they would have purchased if the CFL price had been lower than the shelf price. These surveys provided data on the change in number of CFLs each purchaser would have bought at a given

change from the observed price. This information was used to estimate the elasticity of purchase quantity with respect to price.

To quantify the price impacts of the program, the team relied on a shelf stocking pricing study and a hedonic pricing regression analysis described briefly above. A regression analysis was then used to estimate the elasticity of quantity with respect to price as a function of other bulb characteristics. This approach yielded NTG ratios for CFLs overall as well as spiral and the full range of specialty (*i.e.*, A-bulb, bug light, candelabra, dimmable, flood/spot, globe, quad tube, 3-way, and torpedo) CFLs.²² The analysis also provided NTG ratios broken down by income and education categories in an effort to provide results related to HTR customers.

The revealed preference model yielded an overall NTG ratio of 0.36, a spiral NTG ratio of 0.37, and a specialty NTG ratio of 0.31.²³ In an effort to understand NTG ratios for HTR customers, the Team calculated ratios for respondents with an associate's degree or less and with incomes below \$50,000. The NTG ratios are fairly similar between these groups and the sample overall, largely suggesting that most program-supported purchases would have occurred in the absence of the program. It is important to note when interpreting these NTG ratios that the method does not account for spillover. The adjustments here take only free ridership into account. This likely explains why these NTG ratios are among the lowest calculated in any of the five primary estimation methods used in the course of this evaluation.

Table 2–3: Revealed Preference NTG Ratios

Input	Overall	Spiral	Specialty
By Bulb Type	0.36	0.37	0.31
No more than Associate's Degree	Not calculated	0.38	0.33
Income below \$50,000	Not calculated	0.36	0.34

In order to develop these NTG ratios, the Team modeled the price elasticity for spiral and specialty CFLs separately. Price elasticity refers to how sensitive consumers are to the price of a product. The higher the number, the greater elasticity, meaning that consumer are less likely to purchase the product if the price increases. In contrast, consumers are likely to purchase a product with low elasticity no matter the price. Table 2–4 displays the price elasticity for spiral and specialty CFLs overall and also separately for those consumers with lower levels of education or income. In each case, the price elasticity is greater for spiral CFLs than for specialty CFLs. In other words, consumers are likely to stop buying spiral CFLs (or buy fewer of them) if the price increases, but they will continue to buy specialty CFLs even if the price increases. Moreover, respondents meeting at least some of the criteria for HTR showed only slightly greater sensitivity to specialty prices than all respondents. The lower price elasticity and NTG for specialty CFLs likely reflects the following: 1) specialty CFLs are early in their adoption/

²² In contrast, the conjoint analysis provided NTG for A-line and flood specialty CFLs only.

²³ The report also provided NTG ratios by retail channel and whether the respondent was asked about different price scenarios in an ascending (*i.e.*, lowest price first) or descending order.

diffusion cycle so small NTG ratios are to be expected as “innovators” who like to purchase new technologies dominate sales,²⁴ 2) consumers are less familiar with specialty CFLs and not yet able to judge a “fair” price for the products, and 3) the prices of specialty CFLs are higher and more varied, so consumers are more comfortable paying higher prices for them than for spiral CFLs. The results also provide context for the NTG ratios—specialty NTG is slightly lower than for spirals because consumers are more willing to buy them at higher price points, not just ones deemed sufficiently low.

Table 2–4: Price Elasticity for Spiral and Specialty CFL

Input	Spiral	Specialty
By Bulb Type	1.36	0.75
No more than Associate’s Degree	1.35*	0.83*
Income below \$50,000	1.30 ^a	0.86 ^a

* Compared to 1.39 and 0.73 for those with higher education levels

^a Compared to 1.40 and 0.67 for those with higher incomes.

The revealed preference model has one important strength: it involved less speculation on the part of respondents, because they were interviewed during the act of making a purchase, when they were able to make what was probably a more realistic assessment of how they would have changed their purchases given higher or lower prices. The method does have weaknesses, however. Despite the real-world setting among consumers in the act of purchasing bulbs, this method relies on hypothetical purchase decisions at alternate prices. Also, because it required retailers’ permission, access to non-participating stores was very difficult to obtain, and some participating retailers did not allow access. Moreover, even with store access, the method required waiting for consumers to make bulb purchases, which was very time-consuming and expensive for relatively small sample sizes. This method does not take into account the possibility that past program activity could affect CFL sales in the current year.

2.1.5 Supplier Interviews (Volume 2: Appendix D)

This method is based on in-depth interviews and computer-assisted telephone interviews (CATI) with market actors participating in the Program, including 11 manufacturers accounting for 95% of program-supported sales, nine high-level buyers representing large national retail chains and accounting for 75% of program-supported sales, and 181 managers of stores in Massachusetts. The NTG estimate is based on their responses to a series of questions about what total CFL sales (including program-supported and non-program-supported sales) actually were, and what they would have been in the absence of the 2009/2010 Program. Store types represented included discount, drug, grocery, large home improvement, mass merchandise, membership clubs, small hardware, and miscellaneous. Respondents were asked separate questions about spiral CFLs and specialty (*i.e.*, A-bulb, bug light, candelabra, dimmable, flood/spot, globe, quad tube, 3-way, and torpedo) CFLs.

²⁴ See NMR (2010) *Multistate Modeling* for hypothetical examples of adoption/diffusion curves that demonstrate the reasons for low NTG ratios early and late in adoption/diffusion cycles.

The supplier interviews yielded an overall NTG ratio of 0.41 and an overall NTR ratio for HTR customers of 0.72. The spiral NTG ratio was 0.39 overall and 0.71 for HTR, while the specialty NTG ratio was 0.49 overall and 0.77 for HTR. As with the revealed preference and WTP approach (discussed below) the specialty NTG includes all types of specialty CFLs, in contrast to the conjoint which is based on A-line and flood CFLs only. The supplier interviews approach was the only method that found a substantially higher NTG ratio for specialty products for HTR customers, but this ratio is based on particular *retail channels* that serve large proportions of HTR customers, not on the purchase behavior of individuals identified to be HTR. Importantly, many stores within the HTR retail channels are dollar stores at which the prices of goods on the shelves cannot exceed one dollar; the Program incentive was vital to their decision to carry CFLs and still meet the one dollar price limitation, thereby explaining the higher NTG ratio.

The supplier interview approach also allowed for the calculation of NTG for spiral and specialty CFLs by retail channel (Table 2–5). The purpose of this exercise is to understand, at least from suppliers' perspectives, at which types of stores the Program continues to have the greatest effect. The suppliers associated with discount stores and stores identified as HTR believe that the Program had the greatest impact on CFLs sales in 2009 and 2010. For specialty CFLs, suppliers associated with membership clubs and miscellaneous stores also noted a greater program impact. The NTG for spiral CFLs was also relatively higher at miscellaneous stores. In contrast, NTG ratios were lowest for large home improvement, grocery, drug, and mass merchandise stores.

Table 2–5: Supplier Interviews NTG Ratios by Retail Channel and Bulb Type*

Retail Channel	Spiral	Specialty
Discount, other HTR	0.72	0.79
Drug	0.35	0.36
Grocery (non-HTR)	0.34	0.34
Large home improvement	0.22	0.33
Mass merchandise	0.37	0.33
Membership club	0.49	0.68
Small hardware	0.50	0.45
Miscellaneous	0.60	0.60

* Results are weighted to program sales for each bulb type. Results weighted to estimated total sales are similar.

The major strength of this approach is that a large portion of the market is accounted for by respondents, some of whom have been following the market for years, in both program areas and non-program areas. It is also worth noting that the supplier interview approach is the only one of the five methods that takes non-residential CFL sales into account, which other studies have estimated to make up about 5% to 10% of total CFL sales. The chief weakness of the approach reflects the fact that suppliers have an inherent self-interest in the continuation of the program, and hence may be biased. Also, suppliers are not the ones who actually make the decisions to purchase CFLs for home installation, and they are answering for their customers about what they would have done. Finally, this method does not take into account the possibility that past program activity could affect CFL sales in the current year.

2.1.6 Willingness to Pay (Volume 2: Appendix B)

This method is based on a survey of householders, combined with a stocking and hedonic pricing analysis. During onsite assessments at people's homes, 75 householders who had recently purchased standard spiral CFLs and 37 householders who had recently purchased specialty CFLs (*i.e.*, A-bulb, bug light, candelabra, dimmable, flood/spot, globe, quad tube, 3-way, and torpedo) were asked questions about their willingness to pay for a single bulb at various price points. After completing the hedonic pricing regression analysis with data from the shelf-stocking survey, the NMR team performed an elasticity analysis. This, in turn, provided data for an assessment of the impact of the discount on respondents' willingness to purchase the bulb at different price points in order to estimate the NTG ratio.

The results indicate a NTG ratio of 0.45 overall, 0.49 for standard CFLs, and 0.31 for specialty CFLs, including all variety of specialties supported by the program. It is important to note two things about these estimates: 1) the sample sizes of purchasers were relatively small and, 2) the results do not take spillover into account. Similar to the revealed preference approach, the WTP method also found that consumers were more sensitive to the price of spirals than they were to the prices of specialty products.

Strengths of the WTP analysis include the fact that it was a simple and straightforward way of calculating NTG, and the Team was easily able to add this task to the onsite data collection being performed for the saturation study and multistate modeling effort. The weaknesses of the WTP approach include the fact that the sample sizes for specialty bulbs are very small, thus affecting the reliability of the estimate. Moreover, this method relies on respondent self-reporting about what they would have done under hypothetical circumstances, which is speculative, thus affecting the validity of the estimate. In addition, only free-ridership is addressed with this method, not spillover. Finally, the WTP approach does not take into account the possibility that past program activity could affect CFL sales in the current year.

2.2 Conclusions from the Five Primary NTG Estimation Methods

The Team has identified three patterns in the NTG results that may have important implications for the future of the Program.

Each of the NTG ratio methods yielded an estimate falling below one, with most of the ratios falling between 0.3 and 0.5. Only the conjoint analysis (limited to a subset of specialty CFLs), the multistate model for the first half of 2010, and supplier interview estimates for HTR customers and certain retail channels yielded NTG estimates of greater than 0.5. While each method certainly has its limitations, the Team believes that the convergence of results may quell at least some concerns about the validity of individual results; multiple methods led to similar conclusions, suggesting that the results are in the right ballpark of the actual "real world" value. The convergence by no means *proves* that the results have a high level of validity, as they could all be biased in the same direction, but the evidence does provide some support for the conclusion that the results are valid.

The results also provide some unexpected findings regarding specialty CFLs. With most methods, the NTG for specialty CFLs is similar to—sometimes even lower than—that for spiral CFLs. The pricing elasticity analyses provide an explanation for this pattern: consumers appear to be willing to buy specialty CFLs at almost any price, while they are less willing to pay more for spiral CFLs. In other words, consumers are more likely to be “free riders” for specialty CFLs than they are for spiral CFLs, leading to lower NTG ratios for specialty bulbs. This situation is likely due to the early stage of the specialty CFL adoption/diffusion cycle, lack of consumer familiarity with what constitutes a “fair” price for specialty CFLs, and the overall higher price of specialties compared to spirals.

Finally, the NTG results for HTR customers may appear contradictory: the revealed preference approach suggests a relatively low NTG ratio for HTR customers (about 0.35), while the supplier interviews suggest a higher NTG ratio (about 0.7 to 0.8). Yet, these two results are not as contradictory as a simple comparison suggests. The revealed preference method asked *individuals* identified as having lower education levels or household incomes about their personal lighting purchase behavior, while the supplier interviews with manufacturers, retailers, and store managers of specific *retail channels* asked about the influence of the program on sales. Importantly, many of these stores would not have been able to carry CFLs and abide by their store policies of keeping prices at approximately one dollar without the program incentives to do so. Moreover, these retail channels may be located in areas with a high percentage of HTR residents or they may serve a large proportion of HTR customers, but *any consumer* can shop at these stores. The HTR NTG estimate from the supplier interviews is really an estimate for specific retail channels, and it appears that the program has been successful at moving CFLs in these channels whatever the characteristics of the purchasers.

We will return to these patterns in Section 5, the overall Conclusions, Recommendations section.

2.3 Delphi Panel Recommendations (Volume 3: Appendix G)

The NMR Team relied on a Delphi panel to help determine which, if any, of the NTG ratios developed from the five primary estimation methods were the most accurate for the 2009 and 2010 Program. The Delphi method is often characterized as a group communication process or forecasting method that relies upon panels of experts to develop an estimate or group judgment on a topic or issue. It is an interactive process that involves at least two rounds of questions or interviews with panels. The Delphi technique is based on the principle that structured responses from experts will be more accurate than unstructured response from individuals.

Data collection using the Delphi technique used the following steps. First, 20 panelists who are experts regarding CFL markets or programs were recruited to participate in the Delphi panel. Next, we asked panelists to consider the various NTG estimates developed from the five primary estimation techniques, providing them with background data as well as a questionnaire to aid their consideration. We summarized the data from the first round and incorporated it into a second questionnaire that we circulated to the panelists. The summary included measures of central tendency, such as a median or mean, measures summarizing the dispersion of the data, such as inter-quartile ranges and outlier responses, and assumptions and reasoning offered by fellow panelists from their first-round responses. In the second questionnaire, respondents were asked to review the data summary and their own original responses, provide revisions to their original responses (if necessary), and provide their reasoning for revising (or retaining) their original responses. Most panelists stood by their original estimates, but a few altered their responses after considering the opinions of their peers. A total of 20 panelists representing the following categories took part in the first round of the Delphi: CFL manufacturers, program implementation contractors, employees of entities that implement programs (utilities or government agencies), regulators, evaluation contractors and efficiency experts. Nineteen of the original 20 experts were also able to take part in the second round as well, with one member from the CFL manufacturers group being unable to participate. This panelist's input was included in the first round results as presented in the second round questionnaire, however.

We asked the Delphi panel to provide their own NTG estimates spiral CFLs and specialty CFLs. Table 2–6 summarizes the mean and median NTG ratios resulting from their responses for spiral and specialty CFLs, after removing outliers as identified by the interquartile plot method, and the weighted NTG for all CFLs based on the panel’s NTG estimates for spiral and specialty CFLs. For spiral CFLs, the Delphi panel NTG yielded a median of 0.43 and a mean of 0.45, within the range resulting from the five primary estimation techniques. For specialty CFLs, the Delphi panel suggested a NTG ratio of 0.60, just above the highest estimate from the five primary method, with open-ended comments from the panel indicating that the NTG ratios developed for specialty CFLs were falsely low. Taking the proportional average of the Delphi spiral and specialty estimates resulted in a NTG estimate of 0.47 for all CFLs, just above the high end of the range developed from the five primary estimation methods.

Table 2–6: NTG Estimates Resulting from Delphi Panel

Measure	Delphi NTG Estimate		Range of Primary NTG Estimates
	Median	Mean	
Spiral CFLs (n=16)	0.43	0.45	0.36 - 0.49
Specialty CFLs (n=17)	0.60	0.60	0.31 - 0.59
All CFLs*	n/a	0.47	0.36 - 0.47

* Proportional average of spiral and specialty CFLs for Delphi estimates

The work plan for this evaluation states that the Team would recommend NTG ratios based on the results of the Delphi panel unless the results seemed unreasonable. Given that the NTG ratios resulting from the Delphi fall within or just above the range developed from the other five methods, we believe the approach in fact produced reasonable estimates of NTG. For this reason, *the Team recommends that the PAs and EEAC consultants use a NTG ratio of 0.47 for all CFLs or 0.43 for spiral CFLs (the median is less sensitive to high or low estimates than the mean) and 0.60 for specialty CFLs.*

3 Hard-to-Reach Analysis

The Massachusetts PAs revised the Program in 2010 to increase targeting of so-called hard-to-reach (HTR) customers. Their working definition of these customers includes the following:

- Non-Caucasian
- Ethnic minorities
- Household primarily speaks a language other than English
- Household income between 60% and 120% of the state median income
- Has not attained a college degree

Note that individuals may have more than one of these characteristics. The Team sought to explore this definition of HTR and to provide information on whether it accurately describes HTR customers in Massachusetts. The first step in this exploration was to increase the number of respondents matching the current definition of HTR by fielding the RDD survey using both cell phone and landlines and allowing respondents to answer the survey in Spanish or English. The second step involved examining the remaining potential for CFLs, as it may be that converting sockets still filled with non-CFLs is “harder to reach” than particular sub-groups within the population. The final step explores CFL awareness, familiarity, use, saturation, and purchases by demographic, economic, and social characteristics. Before presenting the results of this final set of analyses, we must caution that, despite our efforts to recruit households currently defined as HTR, the sample sizes for some of the groups were quite small, particularly for the onsite survey. Therefore, the ability to generalize the results remains limited. The revealed preference study did not explicitly focus on HTR customers, but it did analyze results by education and income level.

3.1 CFL Market Characteristics for HTR Customers

The majority of lighting manufacturers and retail store managers agreed with the definition of HTR as defined by the PAs as including low-income, ethnic, non-English-speaking, and less educated customers, but only 38% of the high-level retail buyers agreed with the definition, saying that a definition of HTR customers could include additional considerations of geography, age, and CFL awareness. The supplier interviews suggest that the program is responsible for 71% or more of CFL purchases in retail channels that serve a high proportion of HTR customers.

The RDD survey explored consumer awareness, familiarity, and experience with CFLs by demographic, economic, and social characteristics. The onsite survey studied usage of CFLs with similar breakdowns. The findings do not suggest there are large distinctions between HTR customers and other customers on awareness, familiarity and use of CFLs. Furthermore, in most cases, HTR households have saturation levels that rival or exceed those of their college-educated, higher-income, home-owning counterparts—a finding largely driven by smaller home sizes and fewer sockets. In other words, many customers currently classified as HTR may not use as *many* CFLs, but they have CFLs installed in enough sockets to have relatively high

saturation. The exceptions to this general trend include households that self-identify as non-white or Latino; most market indicators suggest that such customers continue to purchase and use CFLs in smaller proportions than white or non-Latino households. Overall, the results point to the *possibility* of prioritizing which *sockets* are hard to convert and why households have yet to fill them with CFLs as opposed to focusing on which *customers* are hard to reach, while still taking actions to target non-white, Latino, and non-English speaking customers in an effort to increase saturation in their homes.

3.1.1 Awareness, Familiarity, Prior Experience with CFLs

Regardless of race, ethnicity, and the primary language spoken, the vast majority of RDD survey respondents were aware of and familiar with CFLs. Still, respondents who did not identify as white were statistically less likely to be aware of CFLs (84% non-white vs. 95% white) and to express familiarity with CFLs (70% non-white vs. 87% white). Although linguistic, ethnic, and racial minority groups consistently reported using CFLs for fewer years, only the difference between self-identified Latinos and non-Latinos was statistically significant (20% Latino vs. 33% non-Latino).

Awareness of CFLs was very consistent across education groups (93% or higher), but both familiarity and duration of CFL use were higher among those with college degrees (94% for familiarity and 38% have used CFLs for four or more years) than among those who have no more than an Associate's degree (85% or lower for familiarity and 29% or lower have used CFLs for four or more years). High-income households were more likely than low-income households to be aware of CFLs (98% vs. 90%), familiar with CFLs (91% vs. 78%), and to have used CFLs for four or more years (46% vs. 24%).

Although homeownership status is not currently a part of the PAs' definition of HTR, the Team explored the potential role that being a homeowner or renter may play in CFL awareness, familiarity, use and purchases. The results indicate that homeowners were statistically more likely to be aware of CFLs (96% vs. 90%) and familiar with CFLs (89% vs. 75%).

3.1.2 CFL Use, Saturation, Purchases

In the RDD survey, only those who self-identify as Latino were statistically less likely to report having purchased or been given CFLs (70% Latino vs. 90% non-Latino) or used CFLs (72% Latino vs. 90% non-Latino) than were their non-Latino counterparts. The onsite study suggests non-white households had an average of seven CFLs installed and saturation of 21%, both considerably lower than white household, who had an average of 13 CFLs installed and saturation of 27%. No Latino households took part in the onsite studies, so we cannot draw conclusions about their *actual* versus RDD self-reported use of CFLs or CFL saturation in Latino households; however, trends in self-reported prior experience with CFLs would suggest that CFL use and saturation are also lower among Latino households.

Prior use of CFLs, as reported in the RDD survey, was higher among both high-income (98%) and moderate-income households (93%) compared to low-income ones (78%). Note that this finding draws into question the inclusion of moderate-income households as HTR. Respondents with a college education were also statistically more likely to have used CFLs (92%) than those with just a high school diploma (80%).

Most respondents in all income groups used CFLs, but *every* high-income household in the onsite visit sample had at least one CFL installed at the time of the onsite survey. The average number of CFLs installed, furthermore, was higher in higher-income households (17.4) than in moderate- or low-income households (12.6 and 7.8, respectively). Saturation was comparable across all three incomes groups.²⁵

Turning to purchases, we find that, no matter what their income level, many consumers from the onsite samples did not buy CFLs in 2009 or 2010. Across the eighteen-month period, high-income households purchased the largest number of CFLs (8.0), while purchase rates among low- and moderate-income households were comparable (4.6 for low-income and 4.7 for moderate-income).

In both time periods, white households purchased greater numbers of CFLs (3.9 in 2009 and 2.4 in 2010), on average, than did non-white households (3.0 in 2009 and 0.7 in 2010). Similarly, there were lower levels of CFL purchases among renters (just over one purchase in each time period) than among homeowners (4.9 CFLs in 2009 and 2.5 in the first half of 2010).

The revealed preference study analyzed results by education and income level and found that free-ridership estimates for specialty and standard CFLs are very consistent across the breakout groups, the lone exception being respondents who would not disclose their incomes (with higher free-ridership estimates).

3.2 Market Segmentation for HTR Customers

In an effort to increase CFL purchases and saturation among HTR customers in 2010, the PAs expanded the participation of dollar, discount, bargain, and thrift stores, ethnic markets, and stores of various types located in low-income neighborhoods or market areas. The RDD and onsite surveys explored where consumers buy their lighting products and CFLs in particular. Lighting supplier interviews explored whether program efforts created new sales or merely shifted the venues where consumers bought CFLs.

²⁵ In Rhode Island we found that high CFL saturation among low-income households could be at least partially explained by their participation in low-income programs administered by National Grid or the federal Low Income Heating Assistance Program. This is not the case in Massachusetts, where most respondents saying they obtained CFLs from program administrator programs were moderate to high income; this could reflect CFLs obtained through MassSAVE.

3.2.1 Where Consumers Buy Lighting

The RDD survey asked HTR customers where they shopped for lighting products in general and CFLs in particular. Most of the demographic groups reported shopping for *both* types of bulbs primarily at home improvement stores. For those groups who primarily shopped elsewhere, home improvement stores were the second most likely store at which they shopped for bulbs. Only one group differed from this pattern: renters did not typically shop at home improvement stores for incandescent bulbs, although they did shop there for CFLs. Other common store types at which respondents shopped for incandescents and CFLs include grocery, discount, bargain, and hardware stores. Only one store type was unique to any demographic group: Spanish speakers and those self-identifying as Latino (two groups with a high-degree of overlap) listed office supply stores among their top three locations to buy both CFLs and incandescent bulbs.

The onsite lighting inventory also asked participants where they had purchased the CFLs installed or stored in their homes. Home improvement stores served as the most common store type at which respondents recalled obtaining the CFLs found in their homes, but the percentages of respondents buying CFLs at home improvement stores varied from a low of 18% for renters to a high of 62% for non-white and low-income households. Overall, the second most common store type named is bargain stores. Warehouse stores and hardware stores were also common store types at which households obtained CFLs, but only renters named grocery stores among the top sources of CFLs in their homes. Onsite respondents, moreover, named one important source of CFLs not cited in the RDD survey: program administrators. Households with some college named PA programs as the second most common source of CFLs in their homes, and moderate income respondents and home owners cited PAs as the third most common source of CFLs. Renters, households with moderate to high incomes, and college educated households bought CFLs from a wider variety of stores (as evidenced by their lower percentages of purchases from home improvement stores) than other demographic groups.

Eighty-eight percent of the Massachusetts store managers thought that discount and small grocery stores were the best ways to reach HTR lighting customers, while lighting manufacturers were much more likely than the high-level retailers to say that there were additional channels to reach HTR customers besides discount and small grocery. They pointed out that chain stores—including both national and regional chains—could be located in areas with low-income demographics; these manufacturers must not have been aware that the program included the demographic characteristics of the surrounding area in its classification of stores as HTR. A couple of manufacturers mentioned Wal-Mart specifically as a chain store that serves many low-income customers, even if the Wal-Mart store itself is not located in an area dominated by HTR customers.

The evidence suggests that diversifying the types of stores carrying CFLs, by expanding the venues at which the products are available, would make them easier to access, but the only group that would likely increase its CFL use as a result *relative to the other groups* is renters. Moreover, most of the renters in our sample pay their own electricity bills. Although their

landlords may supply light bulbs, it is likely that many renters are buying their own bulbs or could easily swap out screw-in incandescent for CFLs to save money even if the landlord does provide the bulbs. Still, it must be kept in mind that saturation among renting respondents is the same as for owners, suggesting that boosting purchases among *all* types of households is the most likely way to boost CFL saturation.

3.2.2 Retail Channel Shifting

One concern about program strategies promoting greater CFL sales in retail channels such as discount stores in an effort to reach HTR customers is that such strategies may simply shift sales from national chain retailers such as Wal-Mart or Home Depot to these discount stores, rather than creating additional sales. This phenomenon is sometimes called “retail channel shifting” or even “retail cannibalization.” We asked the lighting manufacturers and high-level retail buyers whether they think these discount and small grocery stores are creating new ENERGY STAR CFL product sales or taking away ENERGY STAR CFL sales that otherwise would have gone to national chain retailers. The consensus is that wide-scale channel shifting is not occurring.

About one-half of the lighting manufacturers and high-level buyers said that there was no shifting of sales. One of the lighting manufacturers and one of the high-level retail buyers said there was a little shifting of sales, but not much. Only one respondent—one of the high-level buyers—said that there was significant shifting of sales. Among store managers, only one to two percent said the program was shifting but not creating sales; a majority thought that the program was both shifting sales and creating new sales.

3.3 Refining the Definition of HTR

Overall, it appears that CFL awareness, familiarity, and prior use are high, but some evidence suggests that these attributes are lower in many households currently considered HTR (especially non-white and Latino households) than among their non-HTR counterparts. However, the lower rates of awareness, familiarity, and prior use do not mean that the PAs should assume that *saturation* is lower. Only households self-identifying as non-white had saturation rates lower than households identifying as white. No Latino households took part in the onsite surveys, but self-reported prior use also suggests that saturation may be lower in these households as well. In all other cases, saturation rates rivaled or exceeded those of college-educated, and higher-income, home-owning counterparts—a finding driven by smaller home sizes and fewer sockets, particularly sockets that may require a specialty bulb such as candelabras in a dining room. In other words, many customers currently considered HTR may not use or buy as *many* CFLs, but they have CFLs installed in enough sockets to have relatively high saturation. These results again point to the possibility of prioritizing which *sockets* are hard to convert and why households resist filling them with CFLs as opposed to focusing on which *customers* are hard to reach, while still targeting non-white, Latino, and non-English speaking households in an effort to increase saturation in such households. Note also that very few households primarily speaking a language other than English took part in the onsites; this may indicate a cultural bias about having

strangers enter the home, particular strangers who may not speak your dominant language. For this reason, we believe that those who primary speak a language other than English may still be considered HTR.

4 Current Residential Lighting Market

The NMR Team examined the current residential lighting market through five activities, some of which also contributed to the estimation of NTG ratios, as discussed above:

1. Shelf-stocking survey
2. Hedonic pricing analysis
3. Conjoint analysis
4. Supplier interviews
5. RDD and onsite surveys

In this section, we summarize the current residential lighting market as described by these five evaluation activities.

4.1 Retail Stocking Inventory and Pricing Analysis

The retail stocking inventory and pricing analysis used a shelf-stocking survey coupled with a hedonic pricing regression analysis to isolate the effects of the program on CFL prices, and a conjoint survey of customers to assess:

- CFL prices in the state;
- The amount of shelf area dedicated to CFLs, comparing participating retailers to non-participating retailers; and
- The impact of price variations and other CFL characteristics on consumers' light bulb choices.

4.1.1 Shelf Stocking Survey

The shelf-stocking study was performed between September and December 2010 by the evaluation team among a representative sample of 95 stores in Massachusetts, and collected data from 2,849 CFL packages. The Team matched the shelf-stocking data to the PAs' tracking database of both CFL sales and the paid incentives, so that we could compare the advertised retailer discount amount to the manufacturer and retail partner incentives paid by the PAs.

The store sample was also designed to be representative of the retail channels through which Massachusetts CFL sales occur, and included drug, mass merchandise, home improvement, and grocery stores. However, because most home improvement stores did not cooperate with the shelf-stocking survey, the final sample is not representative of CFLs by sales channel. CFLs sold in large home improvement stores are underrepresented in the sample.²⁶

²⁶ The underrepresentation of CFLs in home improvements is troublesome but would be an even greater concern if the pricing analysis was sales-weighted, as home improvement stores probably sell more of each CFL model they stock than grocery, drug, and mass merchandise stores. For more information on this approach and breakdowns by channel used in this study see Volume 3, Appendix E: *Residential Lighting Shelf Survey, Pricing Analysis, and Conjoint Results*. See also Table 4–9.

4.1.1.1 Key Details about the Sample

- Mass merchandise stores (such as Wal-Mart or Target) comprised the largest single category, accounting for 25% of stores in the sample.²⁷
- Small hardware and grocery stores each accounted for 18%.
- Seventy percent of stores were located in the National Grid or NSTAR service territories.

The store sample was designed to be representative of the channels through which program CFL sales occur, but because some stores refused to take part in the inventory, the final sample may not have been entirely representative.

Table 4–1 shows the mean percentage of shelf space dedicated to CFLs,²⁸ incandescent bulbs, halogen bulbs, and other bulb types. It is further organized by whether the store was a participating or non-participating store.

The largest percentage of shelf space in both participating and non-participating stores was dedicated to incandescent bulbs. Participating stores had less shelf space allocated to lighting products, but a larger percentage of that space (33%) was allocated to CFLs. However, non-participating stores had only 14% of shelf space allocated to CFLs. This difference is statistically significant based on a t-test of means ($t=4.71$, $p<0.0001$).

Table 4–1: Allocation of Shelf Space to Lighting Technologies

Status	Count	Average Display Space (Cu. Feet)	CFL	Incandescent	Other*
Participant	54	369	33%	43%	23%
Nonparticipant	31	618	14%	38%	48%

* Other includes halogen, LED, fluorescent, krypton, metal halide, neon, and high pressure sodium bulbs.

²⁷ Home improvement stores comprise the largest category of retailers in the program; however, most of them did not cooperate with our requests to perform shelf-surveys.

²⁸ Results are unweighted. Because sales by store data are not available we cannot compute a weighted area-wide average.

Table 4–1 shows the percentage allocation of shelf space to lighting products by retail distribution channel for participating and nonparticipating stores. Small sample sizes for some store types suggest caution in interpreting the results. Among participants, discount and membership stores allocated the most shelf space to CFLs—50% and 73%, respectively. Among nonparticipants, drug stores allocated the highest share of shelf-space to CFLs, with 52%. There were, however, significant differences in the allocation of shelf space to CFLs between participants and nonparticipants for several store types, including small hardware, discount, grocery, membership, and large home improvement. For instance, among home improvement stores, which were underrepresented in the sample, participants allocated 34% of shelf-space to CFLs while nonparticipants allocated 13%. Only in drug stores did nonparticipants allocate more relative space to CFLs than participants.

Table 4–2: Allocation of Space by Retail Distribution Channel

Store Type	Participants					Nonparticipants				
	Count	Average Display Space (CuFt)	CFL	Incandescent	Other	Count	Average Display Space (CuFt)	CFL	Incandescent	Other
Small Hardware	12	378	29%	40%	30%	5	79	15%	43%	42%
Discount	8	101	50%	34%	16%	3	12	14%	80%	6%
Grocery	11	113	27%	64%	10%	5	6	14%	79%	7%
Membership	2	542	73%	20%	7%	0	-	-	-	-
Drug Store	7	20	41%	58%	1%	3	25	52%	40%	8%
Large Home Improvement	3	955	34%	40%	25%	3	5348	13%	35%	52%
Mass Merchandise	11	844	30%	46%	24%	12	215	18%	56%	26%

According to regression results, only four variables (participating status, drug store, Pittsfield MSA, and survey month) had statistically significant impacts on the allocation of shelf space.²⁹

- On average, participating stores had 18% more shelf space allocated to CFLs than non-participating stores. This result should be viewed as a correlation. Without more information about how stores became participants, it is not possible to infer that participation increased the allocation of shelf space to CFLs.
- Also, the shelf space allocated to CFLs was 19 percentage points higher in drug stores than in grocery stores. (Keep in mind, however, that the total amount of shelf space allocated to CFLs in drug stores was less than in grocery stores.)

²⁹ We estimated another version of the model in which we omitted utility fixed effects. The statistical significance and signs of the other coefficients did not change.

- Stores in the Pittsfield metropolitan statistical area allocated a significantly smaller percentage of their space to CFLs than stores in other MSAs.

The estimated impacts of the other explanatory variables were imprecise and statistically insignificant.

4.1.2 Hedonic Pricing Regression Analysis

The hedonic pricing regression analysis used data collected in the shelf-stocking study to create a regression model in which the price of a product is regressed on the product's characteristics. The idea behind the hedonic pricing model is that variation in the product's price can be explained by the product's observable attributes, which are not explicitly traded in the market. The shelf stocking survey and hedonic pricing regression analysis considered both standard spiral and specialty CFLs. The results of the hedonic pricing regression analysis also provided data for the WTP, Conjoint, and Revealed Preference NTG estimation methodologies, as described in Section 2.

4.1.2.1 Economic Theory of Program Incentives

The economic theory behind this analysis focuses on profit-maximizing retailers such as drug stores or home improvement stores that sell CFLs. These retailers have some ability to choose prices for CFLs because of product and store differentiation and, thus, the retailers face a downward-sloping demand curve rather than a flat, perfectly elastic one. However, while these retailers have some ability to select a price for CFLs, their ability to raise prices is limited by competition from similar retailers offering the same products.

Figure 4-1 shows the downward-sloping demand curve of CFLs for a typical Massachusetts retailer. The horizontal axis shows the quantity of CFLs, and the vertical axis shows the retail price. Below the demand (D) curve is the marginal revenue (MR) curve, which shows the additional revenue earned by the retailer for each CFL it sells. The figure also shows the retailer’s marginal cost of sales curve (MC^0), which is the cost of selling each additional CFL. This curve is upward-sloping, indicating that the marginal cost of sales is increasing and that the retailer requires a higher price to sell more CFLs. The profit maximizing price is chosen by equating marginal revenue and marginal cost. This occurs at Q^0 and results in a price of P^0 .

Figure 4-1: Illustration of Retail Price Impact of PA Incentives

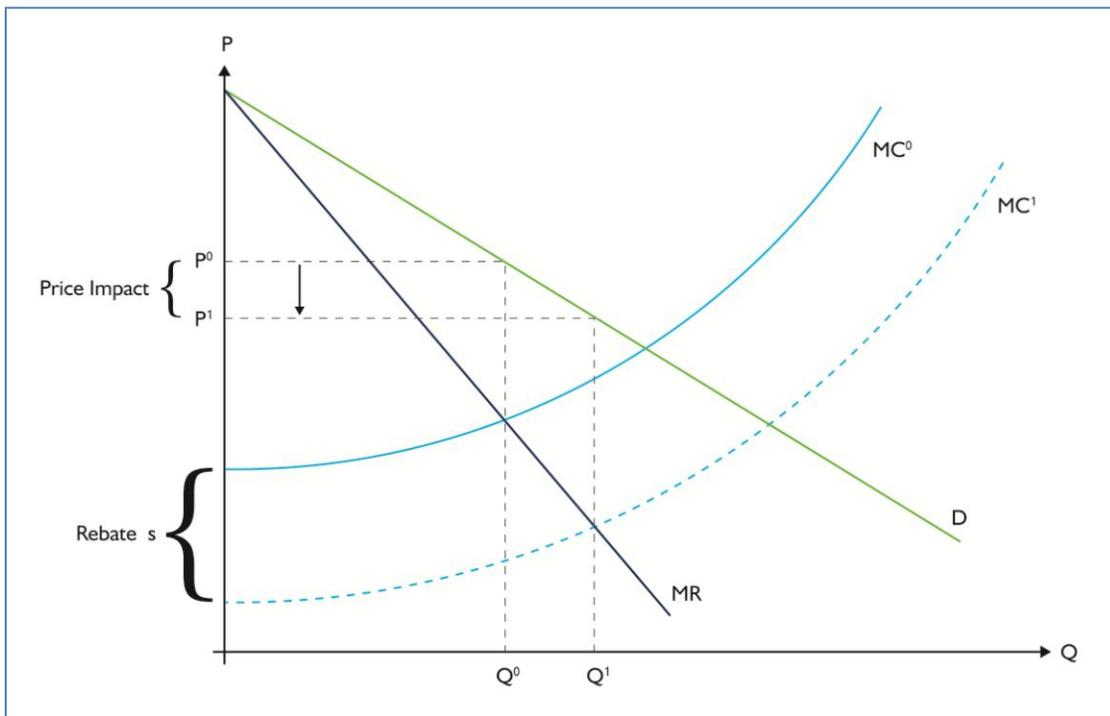


Figure 4-1 also shows the impact of a program incentive per CFL of s on the retail price of CFLs. For example, if a manufacturer passes the full amount of the subsidy to retailers, then at every quantity of output, a subsidy of s shifts the marginal cost curve down by the amount of the subsidy. Consequently, instead of a price of P to sell Q units of CFLs, the retailer now requires only a price of $P-s$.

The retailer selects a new price by choosing a quantity Q^1 that equates marginal revenue with the new marginal cost (MC^1). This new equilibrium price is P^1 . The new subsidized price will always be below the original price if the demand curve is downward sloping. The difference in the prices before and after the subsidy will depend on the price elasticity of demand and the shape of the marginal cost curves, and it may be less than or equal to the amount of the subsidy. The impact of the subsidy on retail price will be smaller when demand is very inelastic.

The NMR team does not purport that retailers select CFL prices exactly as described in this simple economic theory model. But an economic theory model does not have to describe exactly how retailers select prices to be useful. A good theoretical model approximates actual retailer behavior and yields accurate predictions about retail prices. For instance, retailers may not explicitly compare marginal revenue with cost but follow simple heuristics such as “mark-up CFLs 50 percent above cost.” This heuristic would likely result in prices similar to those predicted by the model. If it did not, retailer profits would lag, and adjustments would be made. The theoretical model also identifies what is being measured in the hedonic pricing analysis. This helps in the interpretation of the results.

In the context of Figure 4-1, the hedonic pricing regression analysis attempts to measure the difference between P_0 and P_1 . This is the impact of the PA incentive on the retail price to consumers. There are, however, several reasons why the estimated impact of the PA incentive may differ from the impact predicted in the model.

- Retailers may reduce or increase the prices of discounted CFLs relative to the theoretical price, so that prices end in 9 or 99 cents.
- The actual and theoretical price effects may differ because PA subsidies may lead retailers to reduce the prices of non-discounted bulbs. In a cross-sectional analysis of CFL prices, this would have the effect of reducing the impact of the subsidy on CFL prices.

The CFL pricing model used in this study followed the basic hedonic formulation:

$$\text{Register price per bulb} = \beta_0 + \beta_1 \text{DiscountPA} + \beta_2 \text{DiscountOther} + \beta_3 \text{Product Characteristics} + \beta_4 \text{Retail Channel} + \beta_5 \text{MetroArea} + \beta_6 \text{MonthYear} + \varepsilon$$

Where:

- The dependent variable was the price per bulb in the package.
- The independent variables were the characteristics of the CFL (wattage and ENERGY STAR Label, where 1=Yes, 0=No).
- The dummy variables were used for the number of bulbs in the package and the fixed effects (the manufacturer, metropolitan statistical area, and year-month).

We allowed the impact of the number of CFLs in the package on the price per bulb to vary non-parametrically (i.e., without making functional form assumptions) with the number of bulbs in

the package. This was done by including separate indicator variables for the number of CFLs in the package.³⁰

In addition, the right-side variables included indicator variables for whether the package was discounted by a PA (1=Yes, 0=No) or by another source, such as the retailer (1=Yes, 0=No). We expect both variables to have negative and statistically significant effects on register price, but the magnitudes of the coefficients are *a priori* unclear.

Finally, to test the hypothesis about the relationship between retail channel and the impact of the PA discounts, our team needed to augment the main regression equation with interaction terms between PA incentives and the sales channel variables.

4.1.2.2 Hedonic Pricing Regression Model

This section reports the results of the Ordinary Least Squares (OLS) estimation of the hedonic CFL pricing model. We estimated separate models for each bulb type. We report estimates of the coefficients only for selected variables, including the PA discount and Other Discount variables.

³⁰ The price per bulb is typically lower the more bulbs there are in the package. However, the relationship may be non-linear. We selected a functional form that allows the relationship between price per bulb and number of bulbs to vary in a general way. If we were make assumptions about the functional relationship between price per bulb and the number of bulbs that were incorrect, this would have the effect of introducing additional error in the model and reducing the statistical precision of the estimates.

Table 4–3 reports the results of our preferred model, which includes a large number of explanatory variables and has the greatest explanatory power based on the adjusted R² specification for A-Line bulbs, floods, and globes.

The average impact of a PA discount was to reduce the register price of an A-line bulb by \$2.67, a reflector CFL by \$3.61, and a globe by \$2.33. All of these price reductions are statistically significant at the 99% level of confidence.

Table 4–3: Regression Model Results of A-Line, Reflector, and Globe CFLs

Variable	A-Line Bulb	Flood	Globe
Sample Size	142	384	217
Intercept	6.65*	9.09*	8.01*
	(1.17)	(0.97)	(1.77)
PA Discount	-2.67*	-3.61*	-2.33*
	(0.51)	(0.35)	(0.43)
Other Discount	-3.48*	-2.06*	-1.39*
	(0.40)	(0.36)	(0.36)
Energy Star	-0.29	-0.28	-0.38
	(0.3)	(0.46)	(0.31)
Wattage	Yes	Yes	Yes
Pack Quantity	Yes	Yes	Yes
Manufacturer	Yes	Yes	Yes
Retail Channel	Yes	Yes	Yes
MSA	Yes	Yes	Yes
Site Visit Month	Yes	Yes	Yes
F-Value	13.89	20.04	11.24
Adjusted R-Squared	0.73	0.62	0.61

Notes: Dependent variable in all models is price per bulb. Standard errors in parentheses. All models estimated by OLS. * denotes statistically significant at the 5 percent level.

In addition to estimating the average impact of a PA discount on the retail price of CFLs, the NMR team estimated the average reduction in retail price per dollar of the PA incentive. This is a “realization rate,” indicating how much of the PA incentive was passed along to the consumer in the final sales price. In Figure 4-1, the realization would be $(P^0 - P_1)/s$.

We estimated realization rates by substituting the incentive amount for the dummy variable for PA discount in the CFL price regressions. These models were estimated only with CFLs matched to the PA incentives listed in the tracking database. Table 4–4 reports estimates of the realization rates for the different CFL types using our preferred Model 5 specification.

Table 4–4. Estimated PA Discount Realization Rates by Bulb Type

Bulb Type	Realization Rate	Standard Error
Twister-Spiral	-1.17*	-0.24
A-Line Bulb	-0.71*	-0.17
Flood	-0.83*	-0.08
Globe	-0.76*	-0.13

Notes: Dependent variable in all models is price per bulb. All models estimated by OLS. * denotes statistically significant at the 5 percent level.

The realization rate was greater than one for twister-spiral CFLs and less than one for the other CFLs. Specifically,

- After controlling for differences in wattage, sales channel, manufacturer, and other characteristics between discounted and undiscounted CFLs, the program-discounted CFLs cost on average \$1.46 less than the undiscounted CFLs. The difference was 117% of the average discount paid to industry partners, for a realization rate of 1.17. For every dollar the PA's paid the industry partners for sales of standard, twister-spiral CFLs, the retail price decreased by \$1.17.
- For A-bulb, reflector, and globe CFLs, the program-discounted CFL cost less than the undiscounted CFLs by amounts ranging from \$2.33 to \$3.61. The realization rates for these specialty CFLs ranged from 0.71 to 0.83, meaning that the discount was *less than* the incentive paid by the PAs. These CFLs may have realization rates less than one because retailers had more power to choose the prices of these specialty products than the prices of standard, twister-spirals.³¹ Thus, retailers would have been able to keep a larger share of the PA incentives.³²
- Store managers surveyed said that increasing the incentive levels for specialty CFLs would help to increase sales. However, the majority of these same store managers also said that the current incentive levels were adequate; a small group of store managers in the Drug (20%) and Small Hardware (35%) channels expressed the opinion that the incentive levels were not sufficient.

³¹ Specialty CFLs are differentiated products that are not as ubiquitous in the market as twister-spirals. Retailers may have faced less competition for sales of specialty CFLs, giving them the ability to keep the prices of discounted bulbs high.

³² It is also possible that manufacturers are not passing along the full amount of the incentive to retailers.

4.2 Program Efforts to Increase Sales of Specialty CFLs

One of the specific goals of the 2010 Program was to increase sales of specialty CFLs. In 2009, 10% of the products incentivized by the PAs through the Program were specialty CFLs, whereas in 2010 45% of the products were specialty CFLs. PAs increased support of CFLs that were dimmable, had three-way capabilities, had small candelabra bases, or had shapes other than spiral, including A-shaped, flood, globe, tubes/bent tubes, decorative, and bullet-shaped. The implication of this change is that specialty bulbs were the only *program-supported* CFLs on the shelves of many traditional retail partners (*e.g.*, home improvement and hardware stores) in 2010.

4.2.1 Lighting Suppliers on Specialty CFLs

The team conducted in-depth interviews and Computer-Aided Telephone Interviewing (CATI) surveys with suppliers who had participated in the Massachusetts ENERGY STAR lighting program. Findings from the market actor interviews that pertain to specialty CFLs include the following:

- *Percent of stores not selling specialty CFLs:* Twenty-four percent of the Massachusetts store managers said that their stores do not sell specialty CFLs. Seventy percent of the Massachusetts store managers who did not sell specialty CFLs were in the Drug channel.
- *Why stores do not sell specialty CFLs:* Massachusetts store managers who did not sell specialty CFLs explained that they did not sell them because the decision was made at the corporate/retail buyer level or that their store or lighting section was too small to accommodate the specialty CFLs; others (36%) did not know the reason why they did not sell specialty CFLs.
- *Sales trends for specialty CFLs:* We asked the Massachusetts store managers who sold specialty CFLs whether they would characterize their sales over the past year as “excellent,” “good,” “fair,” or “poor.” The large majority of the store managers characterized their sales as either “good” or “fair.” Massachusetts store managers in the Discount, Large Home Improvement, Membership Club, and Miscellaneous retail lighting channels were more likely to say that their specialty CFLs sales were “excellent” or “good.” Conversely store managers in the Drug and Grocery lighting channels were much more likely to say that their sales of specialty CFLs had been “fair” or “poor.”
- *Barriers to specialty CFL sales:* The barrier to sales of specialty CFLs cited by far the most often by Massachusetts store managers was the higher price point for the specialty products. The second-most-cited barrier was the need for more customer education about the existence of specialty CFLs, their features, and their appropriate applications.
- *Future specialty CFL prices:* When asked whether prices for specialty CFLs over the next few years will go up, go down, or stay about the same, the most common response was that prices would go down.

- *Assessing MA program efforts to promote specialty CFLs:* We told the Massachusetts store managers to rate the effectiveness of the program's efforts to promote specialty CFLs using a scale where 10 meant "very effective" and 0 meant "not very effective at all." They gave the program a middling rating with a mean rating of 5.4 and a median rating of 5.0.
- *Whether incentives for specialty CFLs are adequate:* We told Massachusetts store managers the average incentive levels offered by the program and then asked them whether they thought these were adequate to move consumer demand for these products. Eighty percent of store managers thought the incentives were adequate. However, store managers in the Small Hardware channel were much less satisfied with the specialty CFL incentive levels than store managers in other channels.
- *How the program can increase specialty CFL sales:* The most-cited recommendations from the Massachusetts store managers included increasing the incentive levels, providing more consumer education about specialty CFLs, and providing more general advertising of the specialty CFLs and the ENERGY STAR program.

4.2.2 Consumers on Specialty CFLs

The RDD survey and onsite survey explored consumer use of CFLs. Findings from the onsite visits suggest that CFLs have not made great headway into various types of specialty applications. Most bulbs of non-spiral shapes are not CFLs. However, the saturation of dimmable and three-way bulbs that are CFLs increased significantly from 2009 to 2010 (by 10% for each of these specialty bulb types), which may indicate some success in the PAs' increased support of specialty CFLs (Table 4–5). Some mislabeling of the lighting technology for certain bulb types (e.g. globes and circline bulbs) may have occurred in either 2009 or 2010 as it is unlikely that their saturations changed that much in one year.

Table 4–5: Socket Saturation by Bulb Features

(Base: All onsite respondents)

Sockets Containing	2009 Onsite	2010 Onsite
<i>Sample Size</i>	100	150
Bug Light	0%	75%
Bullet/Torpedo	0%	50%
Globe**	11%	40% [†]
Flood/Spot	10%	17%
Tube	14%	14%
Circline**	44%	2% [†]
A-Bulb*	3%	2%
Candelabra	1%	1%
Other	0%	6%
<i>Dimmable**</i>	9%	19% [†]
<i>Three-way**</i>	17%	27% [†]

[†] Statistically significant at the 90% confidence level.

*A-shaped bulbs are the typical shape for standard incandescent bulbs. A-shaped CFLs are made to look and feel like traditional incandescent bulbs.

** Differences in the pictures provided to identify CFLs may have influenced whether technicians classified these products as CFLs or other types of lighting. Moreover, sample sizes for circline bulbs are small.

***Dimmable and three-way bulbs also fall within shape categories and therefore are not additive.

The results for socket saturation and potential are presented both as percentages of bulbs in Table 4–6. It is important to keep in mind that the stated potential serves as a best case scenario. Actual potential will be lower due to limitations of fixture shape, lighting application, and the preferences of the householder.

Table 4–6: Socket Saturation by Bulb Features – Number of Sockets

(Base: All onsite respondents)

Sockets Containing	All Sockets	CFL	Potential for CFLs or LEDs
<i>Sample Size</i>	<i>150</i>	<i>150</i>	<i>150</i>
Total Sockets (in millions)	109.9	28.1	73.2
A-Bulb	44.8	0.9	43.6
Spiral	21.5	21.5	0.0
Tube	13.6	2.0	9.2
Flood/Spot	14.9	2.5	7.0
Candelabra	4.9	0.05	4.9
Globe	4.1	1.6	2.4
Circline	1.2	0.02	1.1
Bullet/Torpedo	.06	0.03	0.0
Bug Light	.04	0.03	0.01
Other	4.8	0.3	4.0
<i>Dimmable**</i>	.9	5.1	3.5
<i>Three-way**</i>	.5	2.0	1.5

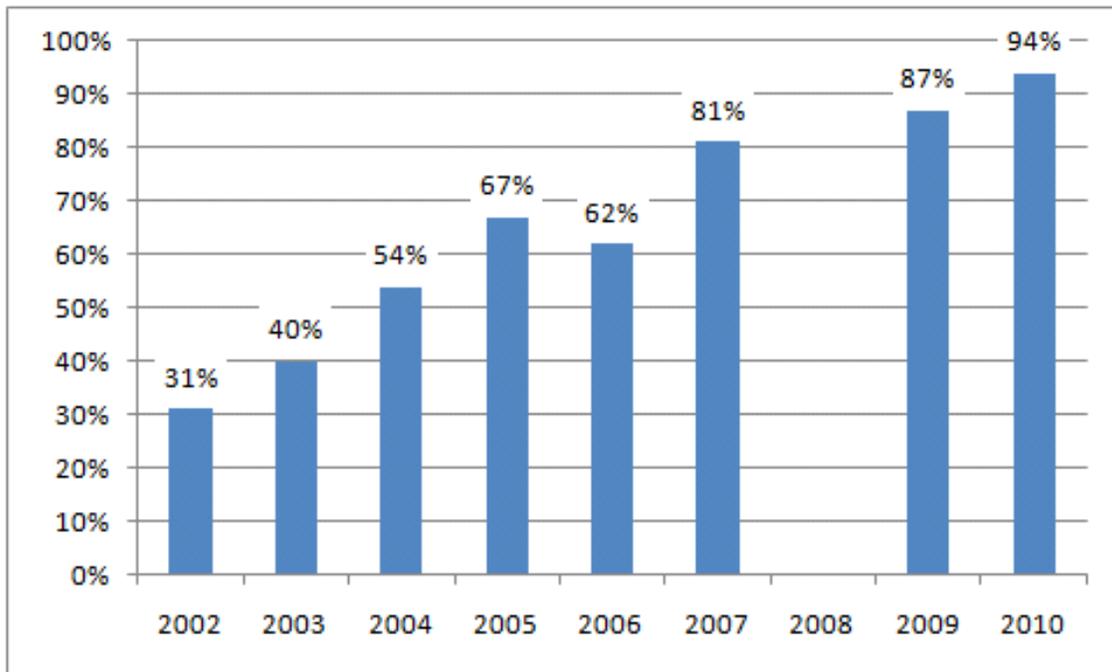
*A-shaped bulbs are the typical shape for standard incandescent bulbs. A-shaped CFLs are made to look and feel like traditional incandescent bulbs.

**Dimmable and three-way bulbs also fall within shape categories and therefore are not additive.

4.3 Consumer Awareness, Experience with Energy-Efficient Lighting

The vast majority of Massachusetts households said they were aware of CFLs: 94% of 2010 Massachusetts RDD respondents reported being aware of CFLs, and 42% reported being “very familiar” with CFLs. The increased awareness in 2010 continues an upward trend in the state that can be traced back at least through 2002, when awareness stood at only 31% (Figure 4-2). This means that CFL awareness in Massachusetts has tripled over the past eight years.

Figure 4-2: CFL Awareness 2002 through 2010*



* Source 2007 MPER and 2009 and 2010 RDD surveys; data not available for 2008

4.4 Use and Storage of CFLs and LEDs

More than three-fourths (77%) of 2010 RDD survey respondents reported having purchased or received a CFL at some point and 78% reported having used a CFL. The vast majority of homes visited onsite (92% of the total onsite sample) had CFLs installed.

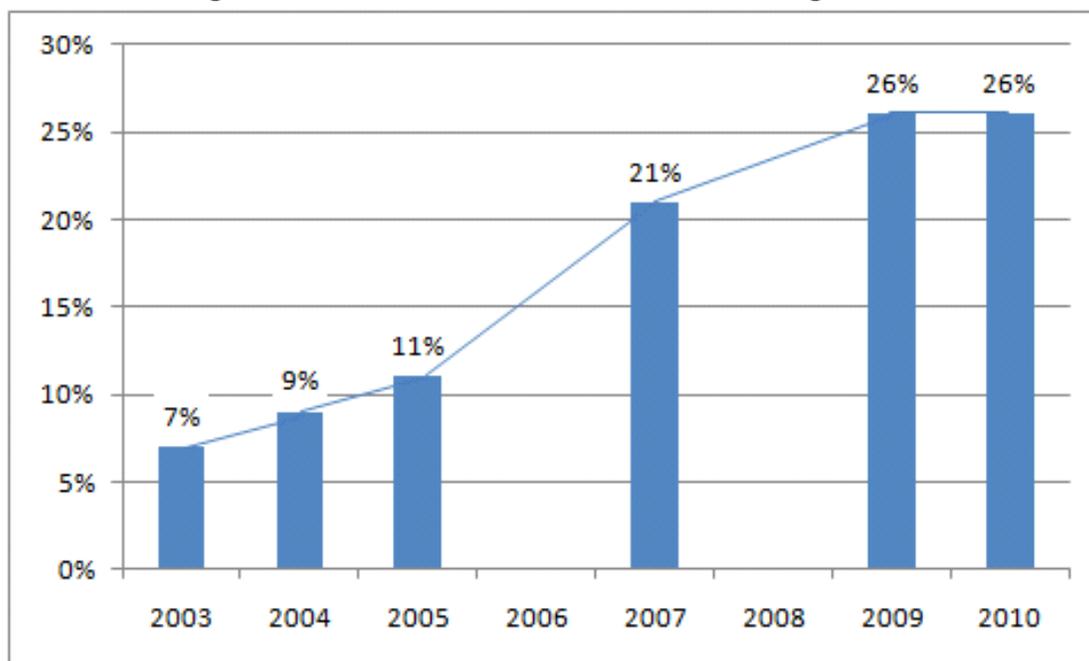
Most of the homes from the combined Massachusetts onsite sample (61%) had at least six CFLs installed in them. More homes had standard CFLs (88%) than specialty CFLs (57%). Onsite homes had an average 11.7 CFLs installed (8.4 standard, 3.4 specialty).

There was an average of 2.5 CFLs in storage in the onsite homes, with over half of them (51%) found in the small percentage of homes (4%) with sixteen or more CFLs in storage. However, a few homes are responsible for these averages, as most homes (63%) have zero CFLs in storage, yielding a median of zero.

Just over one-fourth (26%) of sockets in Massachusetts onsite homes contained CFLs. The remaining potential for CFLs and LEDs in Massachusetts is 62% based on all remaining

incandescent and halogen bulbs in the home, although the actual potential is likely lower by an undetermined amount due to limitations of fixture shape, lighting application, and the preferences of the householder. Compared to data reported in the 2007 MPER, it appears that socket saturation has reached a period of relative stability, in some ways resembling the “S” curve of adoption suggested by Rogers (2003) by showing a relatively low adoption rate in earlier years (2003 to 2005), a period of rapid adoption (2005 to 2009), and then a gradual decrease in the adoption rate (2009 to 2010).³³ It may indeed be that certain types of sockets—even many that could easily be converted to a standard spiral—may be “hard to reach.” (Figure 4-3)

Figure 4-3: CFL Socket Saturation 2003 through 2010*



* Source 2007 MPER and 2009 and 2010 onsite surveys. Data not available for 2006 and 2008.

4.5 LEDs and Other Energy-Saving Technologies

Over one-half of Massachusetts RDD survey respondents in 2009 (54%) and over three out of five (61%) in 2010 were familiar with LEDs. The types of LED applications respondents were most likely to be familiar with were flashlights or lanterns (28% in 2009, 26% in 2010), automotive lighting (17% in 2009, 8% in 2010), holiday lighting (11% in 2009, 13% in 2010), and lighting for electronic devices (11% in both 2009 and 2010). In both 2009 and 2010, the vast majority of RDD respondents could not name any energy-saving lighting technologies other than CFLs and LEDs.

³³ Rogers, E.M (2003) *Diffusion of Innovations*. (Fifth Edition). Free Press: New York.

4.6 CFL Purchase Behavior

The team explored CFL purchase behavior primarily through the RDD and onsite surveys. The onsite survey serves as the primary source of information on the *number* of CFLs purchased, while both surveys provide information on where consumers shop for lighting in general and CFLs in particular. The new visit (*i.e.*, took part only in the 2010 study) and revisit (*i.e.*, took part in both the 2009 and 2010 studies) onsite samples differed substantially in the number and date of self-reported CFL purchases. For this reason, we discuss the results of the two samples separately. Moreover, due to the timing of the onsite surveys, the purchase estimates reported here pertain to all of 2009 but only to the *first half* of 2010 even though we refer to the latter as “2010” throughout the report for ease of discussion.

4.6.1 Number of CFLs Purchased

Approximately two out of five new Massachusetts onsite participants (40% in 2009, 44% in 2010) reported obtaining CFLs in these two time periods; a comparable portion (44%) of revisit onsite participants reported obtaining CFLs in 2009, but fewer (12%) reported obtaining CFLs in 2010.

The fact that the percentage of revisit households purchasing CFLs in 2010 differs significantly from both the percentage of revisit households purchasing CFLs in 2009 and the percentage of new visit households purchasing in 2010 may be due, in part, to a reactive effect of revisit households in response to their 2009 participation. By taking part in the 2009 onsites, the revisited participants may have changed their purchasing behavior or altered their strategies for estimating when they obtained CFLs, leading to substantially different self-reported purchase behavior for 2010. It is worth noting that New York City and New York State displayed similar patterns, with self-reported purchases being lower for the revisit sample compared to the new visit sample. In contrast, Houston showed the opposite pattern, with CFL purchases being higher among the revisit sample. We hypothesize that, in the more mature markets of Massachusetts, New York City, and New York State where many households already have CFLs, our initial visit served to make them more aware of their CFL-related behavior, while in the growing CFL market of Houston, our initial visit also induced participants to purchase more CFLs.³⁴

³⁴ The NMR Team thanks Victoria Engel-Fowles for permission to cite these patterns from the NYSERDA CFL saturation studies in this report.

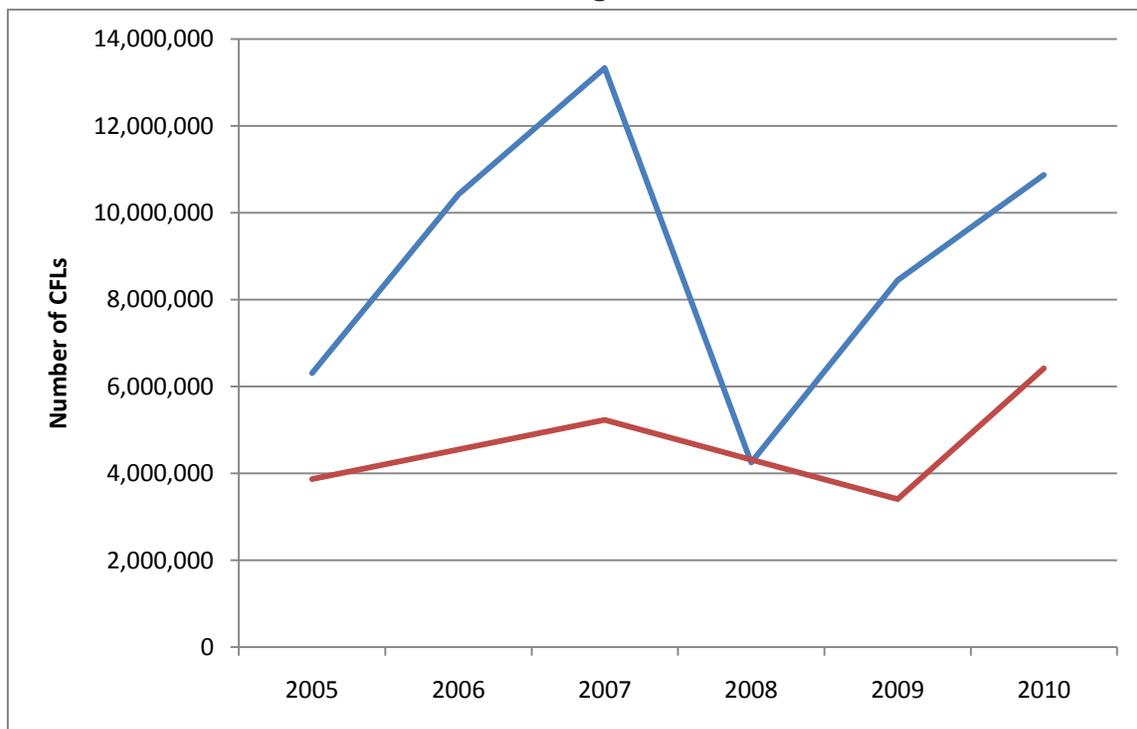
In order to extrapolate these purchases to all households in Massachusetts, we combined the revisit and new visit samples and weighted them to the population of all households in the state. This extrapolation suggests that Massachusetts households purchased a total of 8.5 million CFLs in 2009 and 5.3 million CFLs in the first half of 2010. Standard spiral CFLs accounted for 6.8 million of the CFLs purchased in 2009 and 4.1 million in the first half of 2010. Households purchased a total of 1.6 million specialty CFLs in 2009 and 1.2 million in the first half of 2010. At the time of the onsite, it appears that Massachusetts households were on track to exceed the number of CFLs obtained in 2009. According to national CFL shipment data, shipments in the second half of 2010 were slightly higher than in the first half of the year, with a ratio of 1.05. If we assume that the shipment rate in Massachusetts matches that of the nation, then we can conclude that approximately 10.9 million CFLs were sold in Massachusetts in 2010, comprising 8.4 million standard CFLs and 2.5 million specialty CFLs. In keeping with the program revision, specialty products comprised a slightly larger percentage of CFLs in the first half of 2010 than in 2009 (Table 4–7).

Table 4–7: Estimates of All CFLs Purchased in Massachusetts 2009 and 2010

Products	2009*	First Half 2010	All 2010
<i>Total CFLs Purchased</i>	<i>8,447,382</i>	<i>5,302,592</i>	<i>10,870,314</i>
Standard CFLs			
Total CFLs Purchased	6,806,150	4,078,801	8,361,543
% of All CFLs Purchased	81%	77%	77%
Specialty CFLs			
Total CFLs Purchased	1,641,2326	1,223,790	2,508,771
% of All CFLs Purchased	19%	23%	23%

Figure 4-4 illustrates the estimated number of CFLs purchased and in storage in Massachusetts between 2005 and 2010. The number of CFLs purchases increased steadily from 2005 through 2007 and then decreased steeply between 2007 and 2008. This decrease likely reflects the impact of the recession, and the storage data supports this conclusion with the number of CFLs in storage declining between 2007 and 2009. The decreased sales may also be a symptom of increasing saturation in Massachusetts—respondents simply did not need to purchase many CFLs because they already had them in their sockets, and were particularly reluctant to make such purchases given the poor economic conditions. After 2008, it appears that CFL sales have recovered, although the rate of increase appears to have slowed between 2009 and 2010. Further estimates will be needed for 2011 and 2012 to determine if this is a one year aberration in the rate of sales or a long-term leveling of sales.

Figure 4-4: Estimates of All CFLs Purchased and in Storage in Massachusetts 2005 through 2010*



* Source: 2005 to 2007, NMR and RLW telephone surveys; 2008 to 2010, NMR and KEMA onsite surveys. Estimates of the number of spiral and specialty CFLs purchased not available until 2008, when 84% of CFLs purchased were specialty bulbs. See Table 4-7 for data on 2009 and 2010. Storage data for 2006 and 2008 are interpolated.

4.6.2 Type of Stores where Respondents Shop for Light Bulbs

In 2010, all RDD respondents were asked where they had purchased incandescent bulbs; those who said they had also purchased CFLs were asked where they had purchased the latter. As Table 4–8 shows, incandescent bulbs were most likely to be bought at mass merchandise or discount stores, home improvement stores, grocery stores or supermarkets, and hardware stores. CFLs were most likely to be bought at home improvement stores, mass merchandise or discount stores, and hardware stores.

Table 4–8: Type of Store where Bulbs were Purchased

(Base: RDD respondents for incandescent in 2010 and respondents who purchased CFL bulbs in 2010; multiple response)

Store Type	Massachusetts 2010	
	Incandescent Bulbs	CFL Bulbs
<i>Sample Size</i>	<i>381</i>	<i>314</i>
Grocery/supermarket	21%	16%
Warehouse	4%	5%
Home improvement	40%	48%
Hardware	14%	13%
Mass merchandise/discount	28%	21%
Drugstore	5%	3%
Convenience	<1%	0%
Specialty lighting/electrical	1%	3%
Home furnishing	0%	1%
Mail order catalog	0%	<1%
Internet	1%	1%
Bargain	9%	6%
Office supply	2%	1%
Do not purchase	10%	0%
Military Base	0%	0%
Someone else buys / bought	1%	5%
PA program	<1%	4%
Where price is best	1%	1%
Other	0%	1%
Don't know / refused	0%	0%

Onsite respondents were asked when and where they had purchased any CFLs found installed or in storage in their homes. As Table 4–9 shows, one-half or more of the CFLs purchased by Massachusetts households in 2009 were bought at home improvement stores, with much smaller numbers bought at warehouse stores, bargain stores, grocery stores or supermarkets, and hardware stores. In 2010, the percentage of CFLs purchased at home improvement stores decreased by about 30%, with respondents turning increasingly to warehouse stores, bargain stores, and mass merchandise or discount stores to buy CFLs. Programs offered by the Massachusetts PAs provided 4% of the CFLs obtained in 2009 and 16% of those obtained in 2010.

Table 4–9: Type of Store where Bulbs were Purchased: Revisits and New Visits*

(Base: All onsite respondents; percentages based on weighted number of CFLs reported purchased in each time period; multiple response by time period but not by bulb)

Store Type	2009	2010	% Supported CFLs 2009/2010*
<i>Sample Size</i>	150	150	n/
Number of CFLs Purchased	406	205	4,612.805
Home improvement	52%	25%	37%
Warehouse	8	16	23
Bargain	7	15	10
Mass merchandise/ discount	5	10	3
Hardware	3	7	11
Grocery/supermarket	8	2	10
Drugstore	2	2	5
Home furnishing	1	1	<1
Internet	1	0	1
PA program	4	16	n/a
Other	0	0	<1
Don't know/refused	10	7	n/a

* Percentage of CFLs supported by the program through each retail channel, January 2010 through June 2011 as provided by Energy Federation Incorporated in July 2011.

4.7 Consumer Attitudes

The RDD survey included questions to assess consumer satisfaction with CFLs and to explore how consumers are disposing of CFLs.

4.7.1 CFL Disposal

Seven out of ten RDD survey respondents (69%) had not disposed of any CFLs in the past 12 months. Thirteen percent of RDD respondents in said they had thrown CFLs away while 12%

said they had recycled CFLs. Only 1% of respondents who had ever used a CFL cited mercury or concern about CFL disposal hazards among the reasons for dissatisfaction with CFLs.

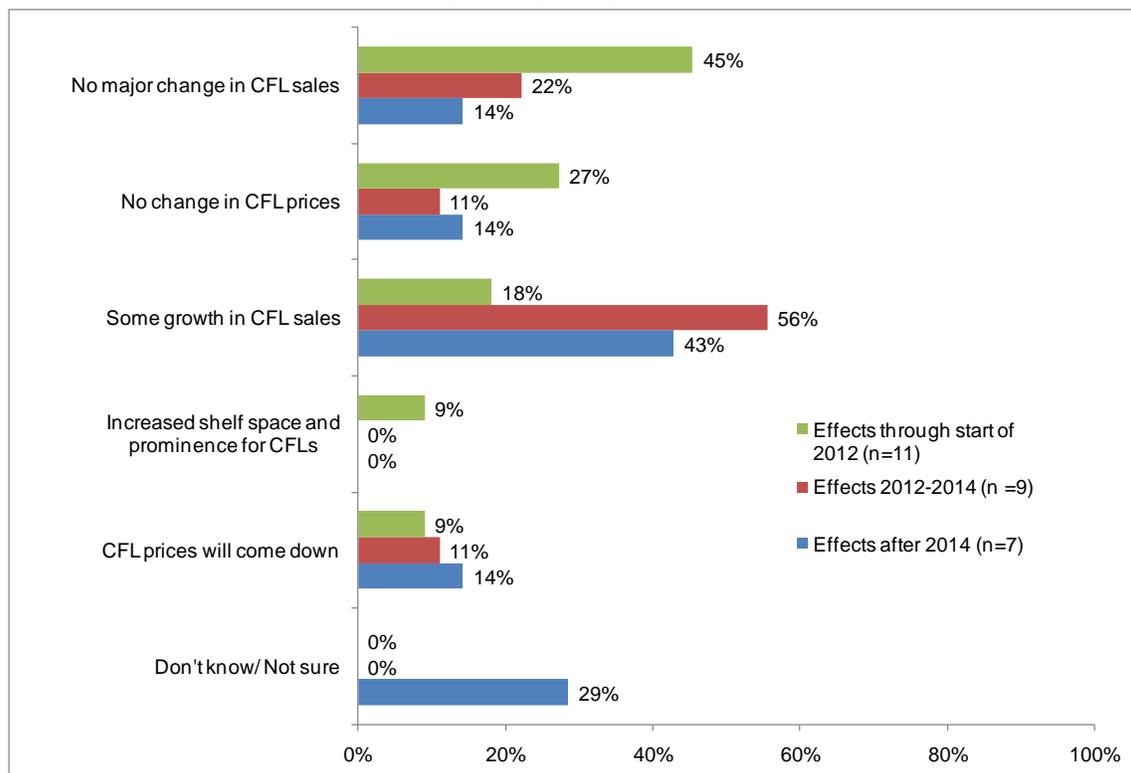
4.7.2 Satisfaction with Installed CFLs

Telephone survey respondents in Massachusetts continued to be satisfied with CFLs, with 86% in 2010 stating that they were “very satisfied” or “somewhat satisfied” with CFLs. Respondents voiced very little dissatisfaction with CFLs, but the most common reason for dissatisfaction with CFLs among Massachusetts respondents in 2010 was that the light is perceived as not bright enough (36%). One out of five 2010 respondents (20%) also disliked the light color or quality of the light, 13% were dissatisfied with the delay in the light coming on, 12% named mercury or disposal hazard, and 11% cited dissatisfaction with the fit of a CFL in a fixture.

4.8 Federal Lighting Standards

In December 2007 Congress passed EISA. One component of the bill calls for a gradual phaseout of inefficient lamps over time starting in 2012. We asked lighting manufacturers and high-level buyers what they thought the impact of EISA would be on CFL sales and prices for three different time periods: 1) through the start of 2012; 2) 2012-2014; and 3) after 2014. The questions were open-ended. Figure 4-5 shows the responses of the lighting manufacturers.

Figure 4-5
EISA Impacts on CFL Sales/Prices
According to Lighting Manufacturers



Few manufacturers thought that CFL sales would increase in the period leading up to the phaseout. Their reasons included the continued availability of most incandescent wattages, consumer ignorance of EISA and its implications, and the fact that some consumers simply do not like CFLs. Manufacturers thought that CFL sales would increase the most during 2012-2014. This would be due not only to the incandescent phaseout but also because they thought that LEDs would not yet be viable replacements. However, they also thought that CFL sales growth during this period would be constrained somewhat by:

- Some consumers staying with incandescent but just being satisfied with lower wattages;
- The continued availability of some incandescent bulbs due to loopholes in the EISA law;
- Some market share gained by qualifying halogens; and
- Some consumers not buying CFLs because they are working their way through their stockpiles of incandescent bulbs.

After 2014 many manufacturers thought that CFLs would continue to increase, but a few thought that CFLs at this point would start to lose market share to LED lighting products.

In general, the high-level buyers gave similar responses to the manufacturers with a few exceptions, which included:

- They were less likely to think that CFL sales or prices would change in the period through the start of 2012;
- They were more likely to think that consumers would be hoarding incandescents during the phaseout; and
- They thought that halogens would play a bigger role in the post-2014 period.

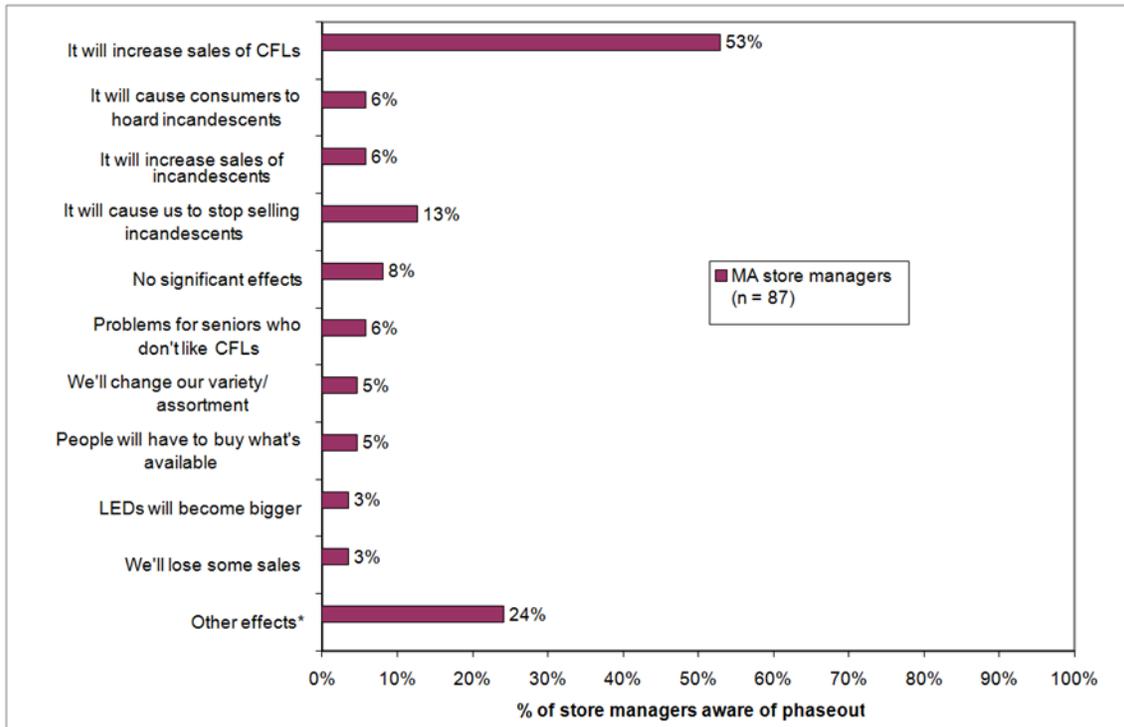
We also asked the manufacturers and high-level retailers about the impact of EISA on incandescent bulbs. Some high-level takeaways include the following:

- Incandescent production is already being curtailed and this is putting some upward pressure on prices for incandescent bulbs;
- Manufacturers of incandescent bulbs are actively exploring EISA-compliant alternatives, but these will likely take the form of energy-efficient halogen products (there was general consensus that conventional incandescent bulbs will not be able to meet EISA standards), and some of these manufacturers will shift production capacity to CFLs or LEDs;
- Some retailers have already stopped promoting incandescent bulbs, some plan to stop a few months before the phaseout, and some plan to keep selling them until they are phased out;
- Discounters expect to have a flood of incandescent bulbs as they acquire close-out/liquidation supplies from mainstream retailers; and

- Consumers will likely hoard some incandescent bulbs but it likely will not start until the EISA phaseout gets more publicity and it will likely not involve the 100-watt bulbs due to their lower saturation.

Forty-eight percent of the Massachusetts store managers said they were aware of the phaseout. Figure 4-6 shows that over half of the Massachusetts store managers who were aware of the phaseout thought that it would increase their sales of CFLs.

Figure 4-6
What MA Store Managers Thought
Would be the Effects of EISA Lamp Phase Out



*Other effects include cutting out some of their products, CFL prices will go down, they'll sell more specialty CFLs, they're already phasing out their incandescents, consumers will panic, consumers will be angry, it will increase consumer knowledge of CFLs, we'll sell more CFL-ready fixtures, etc.

RDD survey respondents were asked if they had heard that some incandescent bulbs will be phased out and whether they planned to buy extra incandescent bulbs before 2012 and save them for use when the new standards go into effect. One-fourth (25%) of 2010 RDD survey respondents had heard of traditional incandescent bulbs being phased out, a significantly greater percentage than in 2009 (18%) (Table 4–10). Once EISA provisions were briefly described to them, three out of ten (30%) of the 2010 respondents and 29% of 2009 respondents said they were very or somewhat likely to buy extra incandescent bulbs for use when the new standards go into effect. If we limit the analysis to only those respondents already aware of EISA, the percentages “very likely” to stockpile in 2009 and 2010 are higher, but the difference is statistically significant only in 2009.

Table 4–10: EISA and Incandescent Purchases

(Base: English-speaking RDD respondents)

Heard of EISA phaseout	Massachusetts 2009		Massachusetts 2010	
	All Respondents	Aware of EISA	All Respondents	Aware of EISA
<i>Sample Size</i>	503	n/a	365	n/a
Yes	18%	n/a	25%*	n/a
Plan to buy extra incandescent light bulbs before 2012				
<i>Sample Size</i>	503	104	365	108
Very likely	14%	22%*	15%	20%
Somewhat likely	15	17	15	9*
Somewhat unlikely	13	9	11	14
Very unlikely	52	49	52	52
Don't know/Refused	6	3	8	5

Finally, onsite technicians gathered information that allowed for the estimation of A-line incandescent bulb saturation by wattage categories. A-line incandescent bulbs with wattages between 40 and 100 make up the vast majority of bulbs that will be subject to EISA standards. As Table 4–11 demonstrates, only 3.3% of the bulbs currently installed in the 150 onsite homes will be affected by the first phase of EISA, which applies to the equivalent of the current 100-watt incandescent bulb, and only about 3.7% will be affected by the phaseout of the 75-watt incandescent bulbs in 2013. However, incandescent A-line bulbs in the 40- to 74-watt ranges comprise 30.2% of all bulbs currently installed in homes. Therefore, it appears that the initial effects of EISA may be minimal, but they will become more substantial when the standards apply to 40- and 60-watt bulbs. Note that another 19% of incandescent bulbs currently installed in onsite homes will not be subject to EISA because their wattage falls below 40 or above 100, or because their shape or features designate them as specialty bulbs.

Table 4–11: Saturation of Incandescent Bulbs by Wattage Categories

Bulb Type and Wattage	Percent of Sockets
Incandescent bulbs affected by EISA	
100-watt	3.3%
75-watt to 99-watt	3.7%
60-watt to 74 watt	22.2%
40 watt to 59 watt	8.0%
Other incandescent ^a	19.2%
CFLs	26.2%
Fluorescent tubes	9.5%
Halogens	6.7%
Other (including LEDs)	1.0%
TOTAL	100.0%

* These percentages are based on all 6,741 sockets (weighted) in the 150 onsite homes; for example, 3.4% of sockets in the homes have A-line incandescent bulbs installed, which would be subject to EISA standards.

^a Specialty bulbs, bulbs greater than 100-watts, and bulbs less than 40-watts

5 Conclusions, Recommendations, and Considerations

The NMR Team completed a wide range of activities in support of the 2010 evaluation of the Program. These activities led to the following conclusions, recommendations, and considerations. We have structured this section such that we present the conclusions and pair it with related recommendations and considerations, where applicable. We conclude this report with suggestions on research priorities to consider for the remainder of 2011 and for 2012.

5.1 NTG Ratio Estimates

Each of the five primary methods used to estimate NTG yielded ratios well below zero, with the results for all CFLs ranging from 0.36 to 0.45 (or -2.77 to 0.83 if we include the multistate model limited to the first-half of 2010). Ratios for spiral CFLs ranged from 0.37 to 0.49, while those for specialty CFLs ranged from 0.31 to 0.59, with the lower estimates blending NTG for all specialty CFLs and the highest estimate being limited to A-line and flood CFLs. The NTG ratios developed for some segments of the HTR population ranged from 0.34 to 0.38, while suppliers estimated a NTG ratio for *retail channels* between 0.71 and 0.77. The convergence of NTG ratios for all but the HTR retail channel provides some evidence—although by no means proof—that the methods have some validity, meaning that they have come close to measuring the “true value” in the “real world.”

Although the methods largely converge, the Team asked a panel of experts to take part in a Delphi process in an effort to integrate the results, ultimately providing guidance on which NTG ratio to recommend for CFLs overall, for specialty CFLs, and, if the data support it, for HTR customers as well. The Delphi panel recommended an overall NTG ratio of 0.47, with a spiral NTG of 0.43 and a specialty NTG of 0.60.

Recommendation: Based on the results of the Delphi panel, we also recommend applying 0.43 NTG for spiral CFLs and 0.60 for all specialty CFLs, or 0.47 overall for the 2009 and 2010 program years.

The Team did *not* submit the results of the multistate model limited to the first-half of 2010 to the panel because it had a lower maximum likelihood R^2 than did the eighteen-month model, and because the proper way to treat the variable capturing prior program support—and the interpretation of the resulting NTG ratios—remained unclear. However, the Team believes that this model points to two important conclusions. The first conclusion stems from the *negative* NTG ratio associated with forcing to model to estimate NTG assuming the program never existed. The implication of this negative NTG (-2.77) is that prior program activity has had an impact on 2010 sales; sales are lower now than they would have been had the program not existed. This is because the Program encouraged households to adopt CFLs at an earlier time period, providing evidence that the Program reaped greater savings and for a longer period of

time than would have been the case had it not existed. The second conclusion relates to the NTG ratio of 0.83 that results when the model assumes the actual level of prior program activity. This ratio indicates that the program, in its current form, is still boosting—some would say lifting—CFL sales. In other words, if the program were to stop tomorrow, CFL sales would drop.

Consideration 1a: The fact that the NTG ratio for the 2010-only model points to increased CFL sales due to the current program, even after controlling for prior program activity, suggests a continued need for the program. In fact, given the uncertainties associated with EISA (discussed below), the Team believes that the PAs should continue the program largely in its current form, with perhaps some adjustments related to specialty products and consumer education to reach HTR customers and hard-to-convert sockets as discussed below and more continual monitoring of the market for rapid response to changing lighting market conditions (see below on LEDs as well). We understand that the PAs are currently considering a “market lift” model for the program, and this approach could include negotiated NTG ratios. The ultimate impact of this approach, however, remains to be seen, as channel shifting could potentially negate any gains achieved with the new approach. The tracking of sales data and estimated NTG will still be important in evaluation in order to assess the program impacts; this tracking would be greatly enhanced if the data provided through the market lift approach were comprehensive, across all retailers and lighting categories.

Consideration 1b: While we suggest that the PAs continue to support CFLs, technological advancements in light emitting diodes (LEDs) are occurring at a very rapid rate and this market needs to be closely monitored. Currently there are only two A-shaped LEDs among the approximately 150 LEDs that have the ENERGY STAR label and these products have the lumen output equivalent to a 40-watt incandescent.³⁵ Later in 2011, however, it is expected that LEDs with lumen outputs equivalent to 75-watt incandescents will be available, and several manufacturers have indicated that a 100-watt replacement is not far behind. The prices for A-shape LEDs are in the \$10 to \$30 range and even at these prices, retailers have anecdotally reported that they are selling out of stock completely, an indication that the “innovators”³⁶ are buying LEDs. We suggest that the PAs monitor the technological advancements for LEDs very closely and consider reserving some funding in their memorandum of understanding (MOU) allotments to support LED products that seem promising, even if these LEDs become available in the middle of the year.

Consideration 1c: The PAs should consider introducing new technologies without having the products completely “road tested.” One way they can monitor consumer acceptance of the products is to attract “early adopters,” who tend to buy after innovators. They may

³⁵ ENERGY STAR qualified LED Lighting listing http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=ILB (Accessed 5-27-11).

³⁶According to the Everett Rogers Diffusion of Innovations theory, there are five stages of consumer acceptance of a product: Innovators, early adopters, early majority, late majority, and laggards.

consider doing so by offering a coupon or rebate for LEDs and collect consumer data so that evaluators can easily identify and solicit the opinions of the customers who will be positioned to influence others to use LEDs as the technology advances and prices drop.

5.2 Specialty CFLs

One of the more unexpected conclusions from this evaluation is the fairly consistent finding that consumers are more sensitive to the price of spiral CFLs than they are to the price of specialty CFLs. Price elasticity, realization rates, and NTG ratios are all lower for specialty CFLs than they are for spiral CFLs. Put another way, consumers appear willing to buy specialty CFLs at a fairly high price point. This situation is likely due to the early stage of the specialty CFL adoption/diffusion cycle, lack of consumer familiarity with what constitutes a “fair” price for specialty CFLs, and the overall higher prices of specialties compared to spirals. Earlier, we suggested that lower realization rates for specialty products may reflect retailers and manufacturers noticing the inelastic prices of specialty CFLs and retaining more of the incentive for themselves than they do for spiral CFLs. If this is indeed the case, the Team suggests that the PAs consider revising the program in a manner that responds directly to this strategic behavior. This conclusion leads to the following considerations:

Consideration 2a: The PAs may want to consider negotiating agreements for specialty bulbs to include requirements regarding how the bulbs must ultimately be priced. Specifically, the PAs may consider requiring manufacturers to report a “Suggested Retail Price” for each type of product covered in the MOU agreement. The agreed incentive amount paid by the PAs would be subtracted from the “Suggested Retail Price” and partners would agree that the retail price would not exceed that difference (Suggested Retail Price – PA incentive). This would allow manufacturers and retailers to add *additional* discounts to the MOU incentive, if they desire, and would allow more transparency for the PAs to monitor the concern that the full incentive amount was not being passed to the customer. Adoption of the “market lift” model may obviate the need for negotiated price agreements. Focus groups (discussed below) may also provide the PAs with information on which specialty CFLs they should focus their efforts.

Consideration 2b: Given the possibility that specialty CFLs are in the early phases of the adoption/diffusion curve and that their prices remain high, the PAs may want to consider keeping the incentive they offer at current or even higher levels. This consideration could be adopted in tandem with Consideration 2a.

5.3 Hard-to-Reach Customers and Hard-to-Convert Sockets

According to the current definition, the PAs consider HTR customers to have one or more of the following characteristics:

- Non-Caucasian

- Ethnic minorities
- Household primarily speaks a language other than English
- Household income between 60% and 120% of the state median income
- Has not attained a college degree

Our research concludes that only some of these characteristics are actually associated with being “hard-to-reach.” More specifically, the evidence suggests that only those who self-identify as non-white or Latino consistently exhibit lower levels of CFL awareness, familiarity, and use than those self-identifying as white or non-Latino. In contrast, moderate-income households (as well as lower-income ones) and respondents lacking a college degree may have indicated lower levels of CFL awareness, familiarity, or prior use, but onsite visits to their homes reveals saturation levels that rival or exceed those of their higher-income or college-educated counterparts. Moreover, respondents in all social and economic groups reported very similar patterns in where they shop for incandescent bulbs and CFLs as well as where they actually obtained the CFLs found in their homes, with home improvement stores being the most common source of all types of light bulbs among all groups. These results lead to the following suggested change to the definition of HTR customers. The results of the RDD and onsite surveys also found little evidence of market differentiation between those groups currently defined as HTR and to non-HTR groups. However, the supplier interviews suggested high NTG ratios among the retail channels with a high proportion of customers matching the current definition of HTR. In short, the Program boosted CFL purchases at dollar, bargain, and discount stores as well as stores located in areas with a large concentration of HTR customers, even though it is likely that both HTR and non-HTR customers bought CFLs in these stores.

Consideration 3: The definition of hard-to-reach customers should perhaps be revised to focus on those self-identifying as non-white or Latino as well as households that do not speak English as a primary language. Based on our research, income and education do not appear to be consistent characteristics of HTR households. A shift in focus to this potentially revised definition of HTR may best be implemented through continued efforts to partner with stores serving (or located in areas with) a higher percentage of customers who non-white, Latino, or do not primarily speak English. Our findings suggest that the Program boosts CFLs sales in these stores, and they could play an important role in increasing CFL saturation among all customers groups, not just HTR ones. Within these stores, marketing materials could be targeted at particular populations (*e.g.*, program materials in Korean in stores serving Korean-speaking customers). Similarly, stores widely patronized by HTR customers, even if not located in HTR neighborhoods (*e.g.*, Wal-Mart or K-Mart) could also be targeted to increase use among HTR customers.

The onsite study suggests that it may be more appropriate to think about hard-to-convert sockets instead of hard-to-reach customers. Increases in CFL saturation have slowed in Massachusetts, as well as in California, but the majority of remaining sockets could be filled with a standard, medium-screw base spiral CFL. Specialty CFLs certainly have a role to play in increasing

saturation beyond the current level of 26%, but better communication with consumers about the benefits of choosing CFLs over halogens, incandescents (at least those that are still available), and other lighting technologies is needed. This need will become more acute when (and if) the EISA phaseout goes into effect and incandescents become scarce, as discussed below.

Consideration 4: Continue and expand efforts to educate consumers about the range of CFLs, LEDs, and other efficient lighting available and the benefits of using efficient-light bulbs over other types of light bulbs. See *Consideration 5* below on more details on what this education campaign may include.

5.4 Potential Impacts of and Preparation for EISA

Few manufacturers and retail buyers thought that CFL sales would increase in the period leading up to the phaseout. Their reasons included the continued availability of most incandescent wattages, consumer ignorance of EISA and its implications, and the fact that some consumers simply do not like CFLs. Manufacturers and retail buyers thought that CFL sales would increase the most during from 2012 to 2014. This would be due not only to the incandescent phaseout but also because they thought that LEDs would not yet be viable replacements. However, they also thought that CFL sales growth during this period would be constrained somewhat by:

- Some consumers staying with incandescent but just being satisfied with lower wattages;
- The continued availability of some incandescent bulbs due to loopholes in the EISA law;
- Some market share gained by qualifying halogens; and
- Some consumers not buying CFLs because they are working their way through their stockpiles of incandescent bulbs.

Manufacturers and retailers further believed that discount retailers would see an influx of incandescent bulbs as they acquired close-outs/liquidations from mainstream retailers, and that consumers would likely hoard incandescent bulbs but at a time period closer to the actual phaseout and when the phaseout receives more publicity.³⁷

Since the completion of the report, Team members have learned that anecdotal evidence in California, where they have already instituted a phaseout, suggests that many 95-watt incandescents remain on store shelves as retailers continue to stock those bulbs they had in their possession as well as those that were manufactured just before the cutoff for the first stages of the phaseout. The continued availability of near-100-watt incandescents also likely reflects that fact that they fill fewer sockets than the more common 75-watt and 60-watt incandescents (based on manufacturer and retailer reports).

³⁷ It is important to note that the supplier interviews were completed *prior* to the recent media attention associated with legislation aimed at blocking the phaseout.

Based on the information from manufacturers and retail buyers as well as the recent findings from California, it is likely that 100-watt incandescents will continue to be widely available well after they are no longer allowed to be manufactured. In addition, 100-watt incandescents occupy only about 1% of sockets in Massachusetts, and 75-watt incandescents, targeted for the next phase of EISA in 2013, occupy only about 3% of sockets. The anticipated effects of EISA may, therefore, become substantial only in 2014, when 60-watt and 40-watt incandescents (occupying 29% of sockets) are phased out. Thus, we repeat our suggestion that the PAs consider continuing to offer substantially the same Program in 2012 as they offered in 2010 and 2011, with the minor revisions discussed above regarding specialty CFLs and HTR customers and market segments and acknowledging that the PAs may already have plans to adopt a market lift approach. We also offer an additional consideration regarding consumer education that will work in tandem with *Consideration 4* above.

Consideration 5: The PAs should work with other industry partners to educate consumers that the lighting world is changing. Incandescents ceasing to be the “standard” bulbs they once were. PAs may need to work with retailers and manufacturers to educate consumers about the importance of lumens in selecting light products and the fact that wattage does not mean very much when a 60-watt incandescent, a 13-watt CFL, and a 12-watt LED all have the same light output as measured in lumens, and will mean even less when 60-watt incandescents are phased out. Part of this education could also involve explaining the new “Lighting Facts” label that is currently expected to be included on packaging beginning January 1, 2012. For LEDs, the educational campaign could also stress their dimmability, which is one of the more persistent complaints about CFLs, including dimmable ones.

5.5 Research Priorities for June 2011 through December 2012

Based on the research conducted here, prior conversations we have had with the PAs and EEAC consultants, and the uncertainties involving the impacts of EISA, the Team has compiled the following list of research priorities that the PAs may wish to consider for the second half of 2011 and 2012.

1. Given the recent information about the continued widespread availability of 100-watt incandescent CFLs in California months after the initial implementation of that state’s own EISA-like legislation, the Team suggests that the PAs consider working with the California Public Utilities Commission to learn more about the actual lighting availability trends in California in 2011 and beyond and what the implications may be for both states as phaseouts move beyond the 95/100-watt incandescents to 75-watt and 60-watt incandescents. The Team has already begun conversations with the PAs and EEAC Consultants as well as the CPUC regarding this possibility, but the exact nature of the study is yet to be determined. At this time, it appears that the CPUC is less enthusiastic about consumer surveys but may be willing to entertain these if given a compelling

reason. Shelf-stocking surveys or other methods may also be employed. Note that this study could also include secondary research on what has happened in other locations that have already phased out incandescents, such as Europe and Australia, as well as those with phaseouts planned on a similar schedule as in the US (*e.g.*, Canada).

2. With the rapidly changing market, we suggest consideration of quarterly surveys of consumers to assess awareness of EISA, plans in relation to EISA (including hoarding by type of lighting technology and wattage of bulbs³⁸), what type of light bulbs they anticipate using for specialty applications that are not affected by EISA, and recent purchases (number and type in the past three months). Questions may be tailored to the timing of the phaseout, focusing on 100-watt incandescents in 2011 and including 75-watt incandescents in 2012. Suggested schedule of interviewing: July 2011, October 2011, January 2012, and April 2012 (probably to continue after this time).
3. In addition to the consumer surveys described above, the PAs may also wish to consider performing additional onsite saturation studies in late summer/fall of 2011 and again in late summer/fall of 2012. Importantly, in addition to assessing saturation, the onsites could be used to determine recent purchases as well as storage behavior of *all* lighting types, not just CFLs, in a search for any effects of EISA on purchases, saturation and hoarding. These studies could be performed as a panel study, provided the instruments and methods used in 2011 are explicitly designed to facilitate a repeat visit in 2012. The PAs may also wish to take the opportunity to revise current estimates of energy savings parameters such as delta watts and hours of use, which may change substantially when the phaseout begins. Finally, the Team is aware that Connecticut plans to perform saturation studies in 2011 and 2012, creating possible opportunities for leveraging evaluation resources.
4. A fourth potential research study to consider would involve quarterly or semi-annual surveys of retailers to assess awareness of EISA, current stocking of lighting (by wattage, technology, and specialty features), plans for the rest of 2011, plans after January 1, 2012, and their predictions about consumer reactions to EISA. Suggested schedule of interviewing: July 2011, October 2011, January 2012, and April 2012 (probably to continue after this time).
5. The PAs may also consider a fifth study involving the performance of a sensitivity analysis to assess potential savings given different scenarios associated with the implementation of EISA, such as length of time 100-watt incandescents (or the similar 95-watt bulbs) will be available after January 1, 2012, the amount of hoarding that takes place, the wattages of bulbs that households use to replace 100-watt incandescents, and similar questions. Similar sensitivity analyses could be performed to assess the anticipated impacts of the later phaseouts of lower wattage incandescents as well. This

³⁸ Although we expect most hoarding to involve incandescent bulbs, a few anecdotal responses to the Massachusetts RDD in 2010 suggested that few respondents were storing *CFLs* in anticipation of shortages that may result from the implementation of EISA.

work would ideally begin as early as July 2011, with follow-up studies dependent on the results of consumer surveys and other studies.

6. A sixth potential study to consider would involve focus groups with consumers to help understand their current understanding of and reactions to the “brave new world” of lighting—for example, how many now accept the spiral shape as a standard, what they know about EISA and what they think they will do, and what they know about LEDs and their willingness to buy them at current prices. These focus groups could provide more information on such topics as barriers and drivers to increasing saturation above current levels, which types of specialty CFLs most appeal to consumers, the new “Lighting Facts” label expected to be released in January 2012, and reactions to LEDs and other efficient lighting choices, among other potential topics.
7. Other possible studies to consider include repeating interviews with manufacturers in late 2011 and late 2012 to learn more about their current production and plans in light of EISA as well as NTG ratios. If enough PAs from across the nation wanted to take part, the Massachusetts PAs may also consider taking part in a third multistate modeling effort. If multistate modeling is not possible, then the Massachusetts PAs may consider working with other PAs to perform shelf-stocking surveys and onsite visits in non-program areas or even in comparison areas with programs.