Study It 'til You're Sick of It: CFL Research as an Example for Other Efficiency Markets

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ABSTRACT

CFLs represent one of the energy-efficiency industry's greatest successes in the transformation of a consumer market, and we have to make sure we finish what we have started, both in supporting the technology and in conducting research to track programs' effects. Research conducted for the Massachusetts Residential Lighting Program provides an example of much of the research needed in other markets we hope to transform. Specifically, the paper discusses how reanalysis of data collected over the past 13 years answered two key remaining questions about the CFL market.

The first was an apparent contradiction between residential lighting use and purchase data: estimates of consumer CFLs purchases in 2011 were more than three times larger than the increase in sockets filled with CFLs from 2010 to 2011, thus raising the question, where had all the CFLs gone?

Second, the research addressed the question of how lighting purchases and saturation might change over the next few years in response to EISA. This includes estimating the savings that could be achieved by the program as incandescents burn out and are replaced by halogens, CFLs, LEDs, and lower-wattage incandescents.

The consistent tracking of key market metrics in the Massachusetts residential lighting evaluation provides a model for market transformation evaluations going forward—albeit a model that can be enhanced by the following: encompassing an even longer timeframe; conducting more collaborative, cross-jurisdictional research; specifying program theory and associated indicators early on; and adjusting regulatory frameworks.

Introduction

The preliminary results of research conducted in early 2012 for the Massachusetts Residential Lighting Program raised some eyebrows: the evaluation estimated that 6.6 million CFLs had been purchased by households in 2011, but the number of CFLs in residential sockets had increased by only 1.4 million from late 2010 to early 2012. This raised the question, what happened to the other 5.2 million CFLs? And this question, in turn, raised more fundamental questions, such as what does this mean about the net impacts of the program, which had supported sales of 4.8 million CFLs during 2011? And what does it mean about the design of future programs?

Another question the Massachusetts Program Administrators (PAs) were grappling with was how the Energy Independence and Security Act (EISA) would affect the market for CFLs and LEDs and the place of their program in the market.

As it turned out, both questions could be at least partially addressed through analysis of seemingly mundane market metrics and indicators the PAs had been tracking for years. Moreover, it was the long-term and consistent nature of the tracking, along with some complementary one-time research efforts, that made finding answers possible. Table 1 below lists some of the key metrics and indicators that fed into the analysis of these two questions.

Table 1: CFL Metrics and Indicators Measured in Massachusetts

Metric or Indicator	Collected Since	Frequency	Data Source(s)
Market-level Shipments (U.S.)	2000	Quarterly	U.S. Dept. of Commerce
Program-supported Sales	1998	Monthly	Program Records
Market-level Sales	2005	Annually	Retailer surveys & on-site saturation surveys
Number in Use	2005	Annually	On-site saturation surveys
Proportion of Households Currently Using	2002	Annually	On-site saturation surveys
Saturation	2002	Annually	On-site saturation surveys
Number in Storage	2005	Annually	On-site saturation surveys
Awareness	2002	Annually	Telephone surveys
Familiarity	2002	Annually	Telephone surveys
Satisfaction	2002	Annually	Telephone surveys
Share of retail shelf space	2005	Annually	Shelf stocking surveys
Retail prices	2005	Annually	Shelf stocking surveys

Where Have All the CFLs Gone?

Through on-site saturation survey results extrapolated to Massachusetts as a whole, the evaluators estimated that 6.6 million CFLs had been purchased by households in 2011, but the number of CFLs in residential sockets had increased by only 1.4 million from 2010 to 2011 (out of about 110 million total sockets in Massachusetts, including all bulb types). This seeming discrepancy—a gap of 5.2 million CFLs—on one hand raised the question of what had happened to all those CFLs and what the implications were for net savings and program design, and on the other hand caused at least some parties to question the validity of the evaluation results. And, in truth, because the rate of CFL installations and burnouts could not be computed directly, there were numerous threats to the validity of the data. It was the evaluators' belief based on their familiarity with the research, however, that the internal consistency of the data from a variety of sources would establish their validity to a reasonable degree. The team's hypothesis was that the most of the CFLs purchased in 2011 and 2012 had replaced other CFLs that had burned out, and used three approaches to explore this possibility.

The first approach, summarized in Table 2, involved adding the total number of CFLs found in homes (both installed and in storage) in Massachusetts in 2010 to the estimated market-level sales from 2011. We then subtracted the total number of CFLs found in Massachusetts homes in early 2012. This approach suggests that 7.7 million bulbs may have burned out in 2011, and that many of them may have been replaced by newly purchased CFLs and CFLs in storage.

Note that this approach does not take installation rates into account, other than by including stored CFLs in the estimate of CFLs found in the homes in late 2010 and early 2012.

Table 2: Estimating CFL Failures in 2011 – Method 1

Measures Used in Estimate	Source	Number of CFLs
A. CFLs in Homes in late 2010*	On-site saturation survey	34,518,832
B. Market-level CFLs sales 2011	On-site saturation survey	6,611,870
C. A + B	NA	41,130,702
D. CFLs in Homes early 2012*	On-site saturation survey	33,416,942
E. C - D Implied Replacements	NA	7,713,760

* Includes installed and stored CFLs; there were 6.4 million CFLs in storage at the end of 2010, but only 4.0 million in the beginning of 2012—hence the saturation went up slightly even though the total number of CFLs in households decreased.

The second approach, as summarized in Table 3, relies on a similar logic as the first, but takes installation rates into account. A 2009 study conducted for the Massachusetts PAs in cooperation with other PAs in New England (NMR and DNV/KEMA 2009) had estimated the installation rate for CFLs to be 77% in the first year and 97% for the lifetime of the bulb. For this analysis, we made the simplistic assumption for illustrative purchases that annual installation rates were 77% in the first year), 10% in the second year, and 10% in the third year; this is a way of taking CFLs in storage into account. We added the number of installed CFLs at the end of 2010 (28,098,169) to the number of CFLs purchased in 2011, 2010, and 2009 that we expected to be installed in 2011 (5,091,140, 1,087,031, and 844,738, respectively). This leads to an estimate of 35,121,078 CFLs installed in Massachusetts homes by early 2012, compared to the actual observed estimate of 29,396,859—a discrepancy of about 5.7 million. This approach, then, suggests that 5.7 million CFLs burned out in Massachusetts homes in 2011, which is lower than the estimate derived with the first approach but still suggests a substantial number of burnouts.

Table 3: Estimating CFL Failures in 2011 – Method 2

Measures Used in Estimate	Source	Number of CFLs
A. Observed installed in late 2010*	On-site saturation survey	28,098,169
B. Market-level CFLs sales, 2011	On-site saturation survey	6,611,870
C. Market-level CFLs sales, 2010	On-site saturation survey	10,870,314
D. Market-level CFL sales, 2009	On-site saturation survey	8,447,382
E. B x 77%	NA	5,091,140
F. C x 10%	NA	1,087,031
G. D x 10%	NA	844,738
H. A + E + F + G	NA	35,121,078
I. Observed installed in early 2012*	On-site saturation survey	29,396,859
J. H – I Implied Replacements	NA	5,724,219

* Installed in sockets—not including bulbs in storage

The third and most complicated approach considers not only installation rates but also the failure rates of CFLs as estimated in a 2008 study conducted for the PAs of the Massachusetts programs and the PAs of other New England lighting programs. That study estimated the proportions of CFLs burning out each year after they are initially installed[1]; the year-by-year failure rates, extrapolated starting in the seventh year (because the oldest CFLs in the study were six years old), are shown in Table 4. (Cells with empirically observed data are shown in white, and cells with extrapolated data are shaded gray.)

Table 4: CFL Failure Rates by Year

Year after Purchase	Failure Rate
First	4%
Second	9%
Third	8%
Fourth	15%
Fifth	10%
Sixth	8%
Seventh	7%
Eighth	6%
Ninth	5%
Tenth	4%
Eleventh	4%
Twelfth	3%
Thirteenth	3%
Fourteenth	2%

Table 5 shows estimated numbers of CFL failures by year derived by applying these proportions. (Again, cells with empirically observed data are shown in white, and cells with extrapolated data are shaded gray.) This approach takes into account the history of market-level CFL purchases in Massachusetts from 1998 to 2011, based on purchase data for 2005 to 2011 reported in prior studies delivered to the PAs (NMR, DNV/KEMA, and Conant 2008; NMR 2010; NMR 2011) and data for 1998 to 2004 extrapolated from program-level sales relative to national shipment trends.

At this point, having both installation and failure rates, we estimated the total number of bulbs installed by year. We applied the failure rates to those installations, allowing us to estimate burnouts per year.

To use a simple example, the estimated number of CFLs that burned out in 2000 includes 4% (first-year failure rate from Table 4) of the CFLs installed in 2000, plus 9% (second-year failure rate) of the CFLs installed in 1999, plus 8% (third-year failure rate) of the CFLs installed in 1998. The numbers are 4% * 494,034 + 9% * 457,161+ 8% * 235,016, or a total of about 79,000 CFLs estimated to have burned out during 2000. The estimate of the number of CFL failures in 2011 takes the same approach, but starts with CFLs purchased in 1998 (and after) that were expected to fail in 2011.

This third method results in an estimate of about 5.5 million CFL burnouts in 2011, similar to the results derived with Method 2. Moreover, this method produces an estimate of a total of 26.2 million CFLs that have burned out since the start of the PAs' lighting programs in

[1] The study also estimated an average CFL measure life (6.8 years), but that figure is not used in this analysis.

1998, suggesting that the replacement of burned out CFLs with newly obtained ones has been occurring for quite some time.

It is also worth noting that subtracting the estimated 2011 CFL burnouts (5.5 million) from the estimated 2011 CFL installations (7.0 million) yields an estimate of 1.5 million additional CFLs installed in homes, meaning CFLs that did not replace existing CFLs. This is very close to the 1.4 million-CFL increase in saturation observed during the onsite visits.

Table 5: Estimating CFLs Replacing Other CFLs – Method 3

Year	Market Level Purchases	Source	Newly Installed in Given Year*	Burned out in a Given Year**
1998	305,216	Extrapolation	235,016	9,039
1999	554,077	Extrapolation	457,161	38,674
2000	530,006	Extrapolation	494,034	79,202
2001	979,811	Extrapolation	862,863	149,326
2002	892,859	Extrapolation	838,483	241,637
2003	3,565,495	Extrapolation	2,932,698	397,649
2004	4,565,862	Extrapolation	3,961,549	715,257
2005	6,308,402	On-site saturation survey	5,670,605	1,111,072
2006	10,426,466	On-site saturation survey	9,115,805	1,842,775
2007	13,330,771	On-site saturation survey	11,938,180	2,816,050
2008	4,248,761	On-site saturation survey	5,647,270	3,675,274
2009	8,447,382	On-site saturation survey	8,262,437	4,386,324
2010	10,870,314	On-site saturation survey	9,639,756	5,294,248
2011	6,611,870	On-site saturation survey	7,022,909	5,485,426
TOTAL	71,637,292		67,078,766	26,241,951

* Sum of 77% of the current year market-level purchases and 10% of each of the two previous years' market-level purchases.
** Sum of the burnouts occurring in that year based on all installations occurring prior to that year.

These results from different methods, a form of triangulation, suggest that between 5.5 million and 7.7 million CFLs failed in Massachusetts households in 2011. (See Table 6.) The CFLs that burned out in 2011 could have been replaced by CFLs or by other bulb types, but the saturation data strongly suggest that most replacements were not incandescent bulbs, whose saturation decreased during that period. Moreover, while the saturation of halogen bulbs did increase, this is largely due to flood-shaped and not A-line bulbs. It therefore appears very likely that many, if not most, of these failed CFLs have been replaced with other CFLs, thus largely explaining where the 6.6 million CFLs purchased by Massachusetts households in 2011 have gone. These results raise the question of whether the program has supported purchases of CFLs that would have happened anyway, or if it has kept incandescents from replacing CFLs. The evaluators think it is possible that program support may have helped prevent "backsliding" toward increased use of incandescents, but the results clearly warrant a new net-to-gross study (as the most recent NTG study was conducted in 2010). The results also raise questions— unanswered to date— about how to design a program in a world in which most new CFLs are replacing burned out CFLs rather than incandescents.

Table 6: Summary of Results

Method	Total CFLs Installed in 2011	CFLs Purchased in 2011 that Replaced Other CFLs	Increase in CFLs Installed in Sockets, 2010-2011*
1	NA	7.7 million	-0.7 million
2	NA	5.7 million	1.3 million
3	NA	5.5 million	1.5 million
Observed on-site	7.0 million	NA	1.4 million

Forecasting the Effects of EISA on CFL and LED Sales and Saturation

Another product of the evaluation conducted for the Massachusetts Residential Lighting Program was a lighting market adoption model (MAM) showing the estimated annual net energy savings that the Program could aim to achieve by altering consumers' responses to changes in the lighting market brought about by EISA. EISA stipulated that no additional 100 watt general service lamp (GSL) incandescent bulbs could be manufactured in or imported into the United States starting January 1, 2012. Similar phase-outs happened with 75 watt incandescents on January 1, 2013 and will happen with 60 and 40 watt incandescents on January 1, 2014. The MAM also projects the effects of EISA on delta watts.

The MAM is a spreadsheet that computes savings based on the wattages and types of bulbs that are currently installed, the rate at which these bulbs can be expected to burn out, and what consumers and other market actors said they are likely to install in place of the incandescent bulbs being phased out by EISA. (The MAM assumes that the saturation of each phased-out incandescent bulb type will gradually decrease to zero over six years, taking that long to account for retailer sell-through, as well as consumer stockpiling.) The inputs used to develop these projections are derived from data gathered through previous lighting research in Massachusetts and beyond, including years of lighting saturation studies, shelf-stocking studies, and supplier interviews. The starting point—bulbs in place or in storage in people's homes—is empirically based and fixed, but later points—being, as they are, in the future—are speculative and variable, but based on market actors' expectations.

Importantly, the MAM provides a baseline or no-program scenario as well as a with-program scenario, and allows the user to vary the assumptions in order to gauge how different consumer—and programmatic—responses may alter expected savings. The spreadsheet includes a starting baseline worksheet with initial assumptions developed by NMR, an adjustable baseline worksheet which allows users to change the initial assumptions, and an adjustable program impact worksheet which allows users to make assumptions about incremental CFL and LED sales due to the program. There are separate calculations for four wattage bins (100w, 75w, 60w, and 40w equivalents), corresponding to each of the EISA categories. The totals for each wattage-equivalent category are based on an early 2012 onsite saturation study, with adjustments for growth in the number of sockets each year through 2023. For example, Table 7 shows a few cells of the spreadsheet with percentages of each bulb type with each wattage-equivalent category through 2017, and demonstrates how the user can make assumptions about program impacts. The differences between the adjustable baseline and the adjustable program impact are carried through the spreadsheet taking estimated measure life, installation rates, annual hours of use, and Delta watts into account to estimate projected annual net savings. Net savings are the difference between adjustable baseline energy usage and adjustable program impact energy usage.

Table 7: Example Cells from Market Adoption Model, 100 Watt Incandescents and Replacements

Year	2012	2013	2014	2015	2016	2017
Adjustable Baseline						
100 Watt incandescents	60%	19%	12%	8%	3%	1%
CFLs (average 23 Watts)	26%	26%	26%	26%	26%	26%
LEDs (average 13 Watts)	0.0%	1.6%	4%	6%	8%	9%
72 Watt halogen	10%	31%	44%	53%	58%	61%
150 Watt incandescent	0%	0%	0%	0%	0%	0%
75 Watt incandescent	2%	20%	12%	5%	3%	1%
Other (unknown wattage)	2%	2%	2%	2%	2%	2%
TOTAL	100%	100%	100%	100%	100%	100%
Adjustable Program Impact						
100 Watt incandescents	55%	12%	6%	4%	2%	1%
CFLs (average 23 Watts)	34%	34%	34%	34%	34%	34%
LEDs (average 13 Watts)	0.0%	1.9%	5%	8%	13%	19%
72 Watt halogen	7%	35%	43%	48%	47%	43%
75 Watt incandescent	2%	16%	10%	4%	2%	1%
Other (unknown wattage)	2%	2%	2%	2%	2%	2%
TOTAL	100.0%	100.8%	100%	100%	100%	100%
Difference						
100 Watt incandescents	-5%	-7%	-6%	-4%	-1%	0%
CFLs (average 23 Watts)	8%	8%	8%	8%	8%	8%
LEDs (average 13 Watts)	0%	0%	1%	2%	5%	10%
72 Watt halogen	-3%	4%	-1%	-5%	-11%	-18%
75 Watt incandescent	0%	-4%	-2%	-1%	-1%	0%
Other (unknown wattage)	0%	0%	0%	0%	0%	0%
TOTAL	0%	1%	0%	0%	0%	0%

The MAM provides the PAs with projected savings through 2023, allowing them to identify where savings are possible; because the results are based on the difference between with-program and without-program energy use, there is no need to apply a separate net-to-gross estimate to the net savings estimates. The model also allows analysis of how different consumer responses (e.g., variations in the types and wattages of bulbs they are installing to replace EISA-restricted bulbs, and the number of CFLs and LEDs that are replacing CFLs as opposed to incandescents) may affect savings. Figure 1 shows the savings that the MAM predicts could be attributed to a hypothetical program when compared to the no-program baseline. Note that the figures reflect starting assumptions that MAM users may vary based on additional information about the market or possible changes in program emphasis. The assumptions reflected in Figure 1 are that the availability of 100, 75, 60, and 40 watt incandescents gradually drops to zero by 2019, and that early on the program is successful in shifting sales from incandescents and halogens to CFLs and LEDs. Further, Phase II of EISA takes effect in 2020, which makes CFLs or their equivalents the effective minimum standard, so that the only remaining savings reflect the difference in energy usage between CFLs and LEDs. Also, CFLs installed after 2014 do not result in any savings after 2020, effectively shortening their measure life. Finally, the program ramps up promotion of LEDs, which gradually become the dominant bulb type.

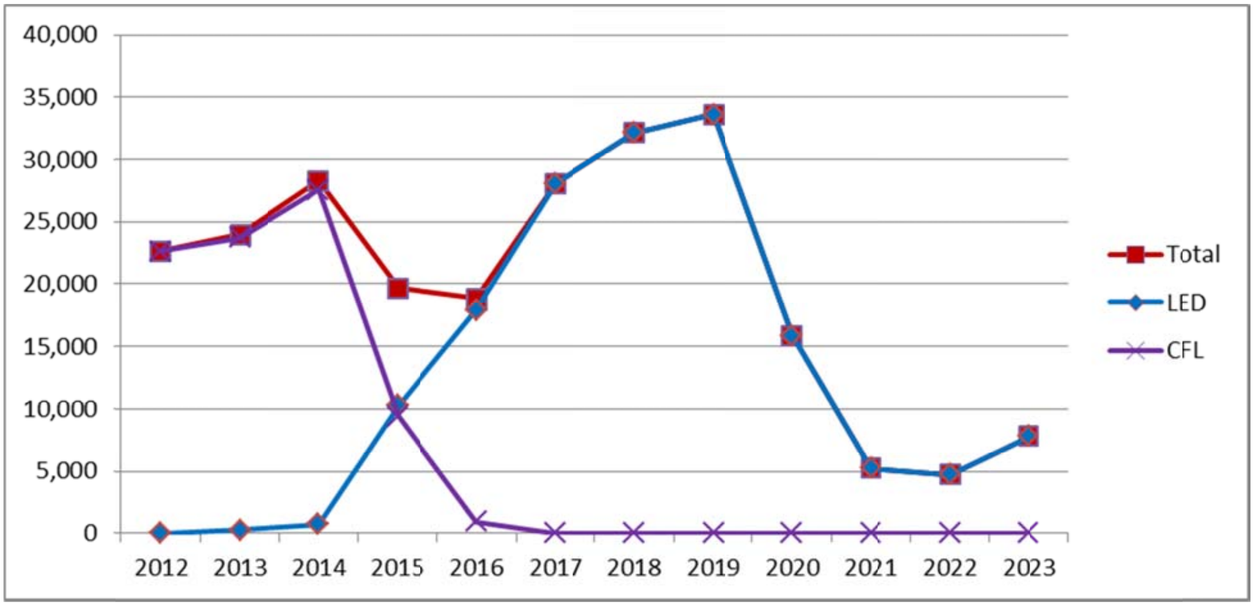

Figure 1: Net Savings (MWh) Induced by a Hypothetical Program

Delta watts represent the difference in wattage between the efficient lighting measure and the assumed baseline measure. The MAM is dynamic in that it can adjust for an increasingly efficient baseline over time, and thus decreasing delta watts. Unlike other models that leave delta watts fixed, the MAM can capture naturally occurring CFL and LED adoption as well.

The estimates from a hypothetical example of average delta watts across 100, 75, 60, and 40 watt equivalents through 2023 are summarized in Figure 2 below, effectively showing gross savings per bulb with and without the program. As sales shift away from incandescents toward other lighting products, PAs will no longer be able to claim seven years of savings from all CFL purchases at the current delta watts. Even so, depending on consumers' choices, delta watts could vary considerably: PAs will be able to generate savings by shifting consumers' lighting choices away from less efficient replacements (*i.e.,* halogens, other incandescents) and toward CFLs and LEDs. The MAM provides estimates of these parameters and expected annual savings depending on the proportions of consumers making different choices.

The model, given its assumptions, predicts that while delta watts for both CFLs and LEDs will decline over the years as there are fewer inefficient bulbs to be replaced, the potential savings per bulb will remain substantial—and for the first few years will come more from CFLs than from LEDs. One of the effects of early program success is decreasing delta watts in later years; as bulbs whose placement was induced by the program are replaced, potential savings per bulb is lower than would have been the case if less efficient bulbs had been installed instead. Chances are, however, that delaying savings by delaying the program would reduce total savings.

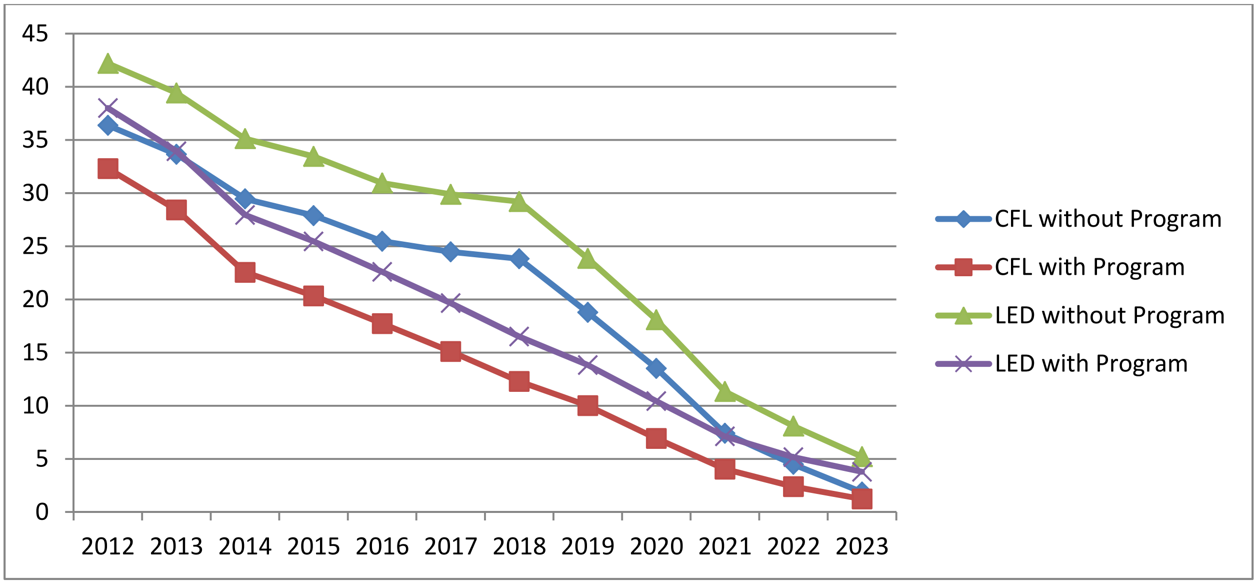

Figure 2: Delta Watts over Time with and without a Hypothetical Program

One likely long-term effect of EISA is to reduce opportunities for savings through programmatic interventions. A possible short-term effect of EISA is to give program administrators the opportunity to increase saturation of CFLs dramatically, after stagnation at about the 27%-30% level in the last few years. Program success early on appears likely to reduce long-run savings opportunities even more than would otherwise have been the case. The size of these early opportunities compared to the later ones, though, would seem to call for aggressive promotion of efficient lighting over the next several years.

Discussion

Massachusetts Residential Lighting Evaluation as a Model for Other Efforts

In advertising they say that, to be effective, an ad has to run way past the point at which the clients become sick of it. People in the energy efficiency industry may be tired of hearing about CFLs, but we haven't yet finished the job, either in our programs or our evaluations. The depth and consistency of research done for Massachusetts is rare and perhaps unparalleled in the industry, and provides an example of what is needed in other market transformation efforts. This research includes many years' worth of consistent collection of annual on-site lighting saturation and purchase data in representative samples of homes, providing not only counts of different bulb types installed, but also counts of bulbs in storage and estimates of numbers of recently purchased bulbs. In combination with other data—such as estimates of installation rates and measure life, national CFL shipment data, shelf stocking surveys, supplier interviews, and consumer surveys—the research has provided Massachusetts PAs with perhaps the most complete picture available of the residential lighting market.

For example, the research has furnished enough data to permit the after-the-fact detective work necessary to understand how it was possible for market-level CFL sales to remain high while saturation barely budged, to project the possible savings that might be achieved by programs during and after EISA's incandescent phase-out takes place, and to show how delta watts in particular are likely to be affected. In addition to the examples discussed in this paper, the Massachusetts lighting research conducted over the years has also permitted estimation of gross and net savings (the latter through multiple and converging net-to-gross estimates), as well as tracking of proximate indicators of market transformation, such as consumer awareness, consumer satisfaction, product usage, sales, incremental costs, and product availability. Collectively, the research provides a model for future efforts, and shows the importance of consistent, detailed tracking of market metrics, including market-level sales and saturation, which otherwise would be lost to history.

Improving the Evaluation Model

Evaluations focused on market transformation programs, more than those focused on resource acquisition programs, have to take the long view. An evaluation of a resource acquisition program, because the focus is short-term, can be a one-shot effort (even if not ideally), in which the researchers look back on a short period to determine how many kWh or therms the program has bought, at what price, how effective the delivery was, etc. In contrast, market transformation programs, by their nature, focus on the long term: "Market transformation is long-lasting, sustainable changes in the structure or functioning of a market achieved by reducing barriers to the adoption of energy efficiency measures to the point where continuation of the same publicly-funded intervention is no longer appropriate in that specific market" (CPUC 2009, 89). (In practice, of course, many programs cannot be clearly delineated as focusing exclusively on resource acquisition or on market transformation.)

Accordingly, Prahl and Keating (2011, 6-7) point out the following key lesson (among others) learned from 15 years of market transformation evaluation: "Effective planning and evaluation of market transformation initiatives requires regular, ongoing research into the status of the market—from the initial planning/baseline phase, through every stage of implementation, and even after programming has ended." As far back as the CFL market metric and indicator tracking in Massachusetts goes and as complete as it may be compared to what is available elsewhere, even that model could be improved in future efforts. Tracking of many of the indicators listed in Table 1 started in Massachusetts in 2005, beginning with the transition to a new evaluation contractor. By that point, however, much of the progress toward market transformation had already taken place and savings were peaking.[2] In the meantime, while tracking began in 2005, or 2002 for some indicators, the CFL program offered by the Massachusetts PAs as a group had begun much sooner—in 1998—and individual Massachusetts PAs had offered CFL programs since the early 1990s.

Also, while the metrics and indicators listed in Table 1—and others tracked by the Massachusetts PAs—have helped assess change over time, causal inference is facilitated not only by analysis of changes over time, but also by analysis of comparative or cross-sectional change, which in the case of CFLs would involve examining changes over time in program areas compared to non-program areas and/or areas with different program histories. The Massachusetts PAs have sponsored CFL research in comparison areas, but only sporadically, in large part because of the extra cost and the fact that areas previously without programs later adopted programs extremely similar to those implemented in Massachusetts. Future efforts should involve more extensive and consistent cross-sectional research.

[2] See Hoefgen et al. 2008, which predicted that the faster rate of market adoption of CFLs in program areas than in non-program areas would decline soon after the 2006 program year.

The high cost of long-term, comprehensive market tracking and analysis brings up another suggested improvement over what Massachusetts has been doing in the CFL market: more collaborative research with other entities promoting similar programs. And, in fact, the main reason for collaboration may not even be the high cost of going it alone, but rather the national, or even international, nature of the lighting market, with myriad market actors and complex interactive effects that are difficult to circumscribe at the state level. Again, Massachusetts has conducted research in collaboration with other entities, (see, for example, Russell et al. 2011), but these have largely been one-shot efforts, not the kind of long-term undertaking suggested here. In any case, one of the most effective ways for PAs from different jurisdictions to collaborate would not necessarily involve high costs: working together to persuade manufacturers and retailers to provide comprehensive, detailed sales and shipment data—and there is some hope for future availability of such data for lighting (see http://apexanalyticsllc.files.wordpress.com/2013/03/creed-perspectus-february-1-2013.pdf).

One reason that the Massachusetts PAs had not tracked many of the key metrics and indicators before 2005 is that they had not fully articulated how they expected market transformation to take place. This underscores another of the key lessons learned about market transformation as summarized by Prahl and Keating (2011, 7): “Attribution of observed market changes to programs generally involves establishing a preponderance of evidence as to whether the ‘story’ found in the initial program theory is borne out by experience.” Future market transformation efforts should, at their inception, spell out both the mechanisms by which the program is expected to affect the market, as well as the indicators that can establish whether those changes are taking place. Then, if those indicators occur as expected, the theory is validated, and the PAs have a good story to tell to make the case for assigning some of the credit to their program (cf. Rossi, Lipsey, & Freeman 2004 and Weiss 1998). In the absence of systematic gathering of data from the very inception of CFL programs in order to assess how indicators align with program theory, it is still possible to make a believable case for the role of CFL programs in transforming the market (see, for example, Miller 2012), but the case is generally not strong enough for regulators to allow PAs to claim all the savings that otherwise might have been attributable to their programs.

Regulatory frameworks themselves are part of the problem, which in most jurisdictions have traditionally focused narrowly on a specific period of time—e.g., one year or three years—rather than on the longer-term timeframe in which market transformation takes place. This short-term focus most often means that the effects of a program in year 1 and area A on the market in year 2 and in area B cannot be counted. This can make PAs gun shy about undertaking market transformation programs rather than more straightforward resource acquisition programs (see MA DPU 2012); it seems clear that regulators need to expand the time horizon during which program effects can be counted.

The case of CFLs should serve as an object lesson to the energy-efficiency community: if your programs are designed to transform the market or if you believe they may transform the market, spell out how you expect that to happen and how to track it, and start tracking as early as you can—well before you think your programs might be having an impact on the market. Moreover, insofar as markets are national rather than local, conduct evaluations cooperatively, sharing resources in order to make a good case, which requires a sustained, long-term commitment. Not to do so may make market transformation efforts less effective because less well thought out, and may also risk the credibility of market transformation programs as an important policy tool.

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