The Impact of Upstream Lighting Incentives as Measured Through Sales Data

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ABSTRACT

Gaining access to point-of-sale (POS) data has been the "holy grail" for evaluations for years, particularly for upstream programs where the ultimate purchaser of the efficient product is unknown. Recently, lighting POS data have become available through LightTracker, an initiative of the Consortium for Retail Energy Efficiency Data (CREED). The data includes 2009-2014 lighting sales data for most of the United States, all bulb types, for grocery, drug, dollar, club, and mass market distribution channels. These data have been used by a number of recent evaluations in Massachusetts, Connecticut, Georgia, and California. This paper presents the results of different analyses, including developing a multi-state sales model to determine net-to-gross (NTG); using comparison areas to determine NTG; examining sales by bulb type and year to determine lighting baselines and incandescent availability and sell-through; and examining sales in states that have eliminated CFL incentives to examine possible "backsliding" in sales of efficient bulbs. Despite only representing approximately 20-25% of total efficient bulb sales, the data have provided valuable insights into the lighting market, and demonstrated the value of having access to full-category sales data.

Introduction

Given the rapid and widespread changes to the lighting market in the United States, including the increased lighting efficiency standards stemming from the Energy Independence and Security Act of 2007 (EISA) that should phase-out general service incandescent bulbs, many have begun questioning whether residential lighting programs continue to impact efficient bulb sales.[1] The introduction of general service light-emitting diode (LED) and halogen bulbs also intended to replace incandescents only complicates the matter further, raising more questions about both the gross and net savings from lighting efficiency programs.

To help understand the impact of lighting programs on efficient bulb sales, the Consortium for Retail Energy Efficiency Data (CREED), through its LightTracker initiative, has made point-of-sale lighting data available. The data includes 2009-2014 lighting sales data for most of the United States, all bulb types and for grocery, drug, dollar, club, and mass market distribution channels. The data do not currently include the home improvement channel, all the club stores, or hardware stores, but are estimated to represent approximately 20-25% of efficient bulbs sales in most states.[2]

The data have been used in recent evaluations in Massachusetts, Connecticut, Georgia, California, Colorado, and Illinois, and have provided critical insights into net and gross savings, as well as future program design. This paper provides examples below from a number of recent evaluations, and discusses future plans for the data to be expanded to include estimated sales from all lighting retailers.

[1] Laura Morefield, *EISA and Future Residential Lighting Programs,* at www.energystar.gov for a more detailed treatment of the anticipated threat of EISA to lighting programs.

[2] The Team used MA and NY program bulb tracking data and matched them to the POS data to determine the saturation of program and market level sales.

Multi-State Modeling for Net-to-Gross

To assess the continued impact of lighting programs on efficient bulb sales, NMR, under contract to the Massachusetts Program Administrators, conducted research to determine whether states that have lighting programs tend to sell a higher percentage of efficient bulbs than states that do not have lighting programs, while controlling for other potentially biasing factors. The ultimate purpose of the research was to understand the influence of various predictors on the sales of efficient bulb types across the nation, namely the impact of program activity.

Lighting programs show great variation across the US, both in how incentives are applied and utilized and in the types of bulbs supported. The research examined the influence of whether a state had a lighting program, as well as the impact of more contextual factors like program budget, age of program, and number of program-incented bulbs across 44 continental states during the first years of EISA implementation and those immediately preceding it.

The POS data were used to create the dependent variable for all models, defined as the percentage of all bulb sales in a particular state that were energy efficient. All model inputs described below attempted to predict the percentage of statewide efficient bulb sales defined as (CFL+LED Sales)/All Bulb Sales.

Other data feeding into the model include:

- ***Program activity***: This included a simple yes/no predictor of whether a particular state had a program in a given year and a continuous predictor variable represented by the more detailed information the Team gathered on program budgets.

- ***Retailer presence***: The purpose of this background research, and the eventual model inputs resulting from it, was not only to assess the influence of stores' presence or absence on bulb sales, but also to utilize these data as control variables such that any significant impacts of other model inputs would not be a result of a particular state simply having greater or fewer stores in the channels whose bulb sales were reported.

- ***State-level demographics*** were gathered from the American Community Survey (ACS, www.factfinder2census.gov), including annual state-level data for the population, total number of households, household tenure, count of homes built before 1980, categorical education, median income, and average number of rooms in the home.[3]

Model Results

Table 1 below shows the results of the model using the proportion of total efficient bulb sales as the dependent variable. The table summarizes the estimated regression coefficients across the model. Note that interpreting the estimated coefficients related to program activity on an actual scale requires exponentiating the coefficients presented in Table1. Increased program activity, as measured by the program budget-based prog2i,j variable, is positively and significantly associated with increases in efficient bulb sales at the 90% confidence level. The results demonstrate that increases in a state's lighting program budget are associated with increases in efficient bulb sales. Specifically, for every $1,000 increase in the square root of a state's lighting program budget, there is an expected increase of 5.5% in the proportion of efficient bulb sales. To simplify interpretation of the model, this relationship can also be quantified as program expenditure elasticity. Consider a $1M increase in program budget: Based on this model, such an increase would lead to a 0.36% increase in efficient bulb sales in MA,

[3] The Team utilized single year household ACS data from 2009, 2010, 2011, and 2012.

yielding an elasticity of 0.2.

Table 1. State-Level Model Results for All Efficient Bulbs

Variable	Level	Model Results[Ω]
Intercept	--	1.6392 (1.3456)
log(cr.sqft)	Continuous	0.1794* (0.0747)
log(noncreed.sqft)	Continuous	-0.1378* (0.0545)
% built pre-1980	Continuous	-1.0199† (0.5972)
% renters paying utilities	Continuous	-2.3382 (1.5922)
Median # rooms per home	Continuous	--
Electric Price	Continuous	0.0149** (0.0054)
Cost of Living Index	Continuous	-0.0083** (0.0028)
Program Budget	Continuous	5e-05*** (2e-05)
log(non-program eff. sales trend)	Continuous	0.6934*** (0.0925)

Additional Details		
Number of States		27
Number of Observations		94
R^2		0.663

[Ω]Coefficient estimates presented with standard errors in parentheses beneath them.
log(covariate) indicates the natural logarithm of that covariate.
Note: † p<0.10, * p<0.05, ** p<0.01, *** p<0.001.

Threats to Validity

The model results are not without limitations. First and foremost is the issue of generalizability. As discussed, the sales data that serve as the dependent measure for all models do not represent full, market-level sales nationwide. Although many program and non-program bulbs sell through the retail channels included in the POS dataset, the absence of home improvement and hardware channels means that many bulb sales are not accounted for in the models. Based on the assessment of market-level bulb sales in MA calculated during the most recent onsite saturation study, the POS data represents roughly one-quarter of all sales. However, to the extent that these channels are representative of the market in each of the states then there is no bias in the results of the analyses.

This is not to discount the importance and quality of the data that are available—residential lighting program evaluators and implementers have been working for years to obtain actual bulb data captured at the point of sale for any retail channels, and the current POS data set represents the best of what is available. However, it should not be viewed as perfectly representative of the entire lighting market.

Model Conclusions

The results of the modeling efforts suggest that lighting programs continue to have an influence on the lighting market, even in the years following EISA implementation. Across the three separate bulb-proportion dependent variables (all efficient bulbs, CFLs only, and LEDs only) the model demonstrated the positive and significant influence of program activity on the percentage of energy-efficient bulbs purchased statewide. Results suggest that as the lighting market continues to progress, programs focusing on LEDs are likely to have greater relative impacts.

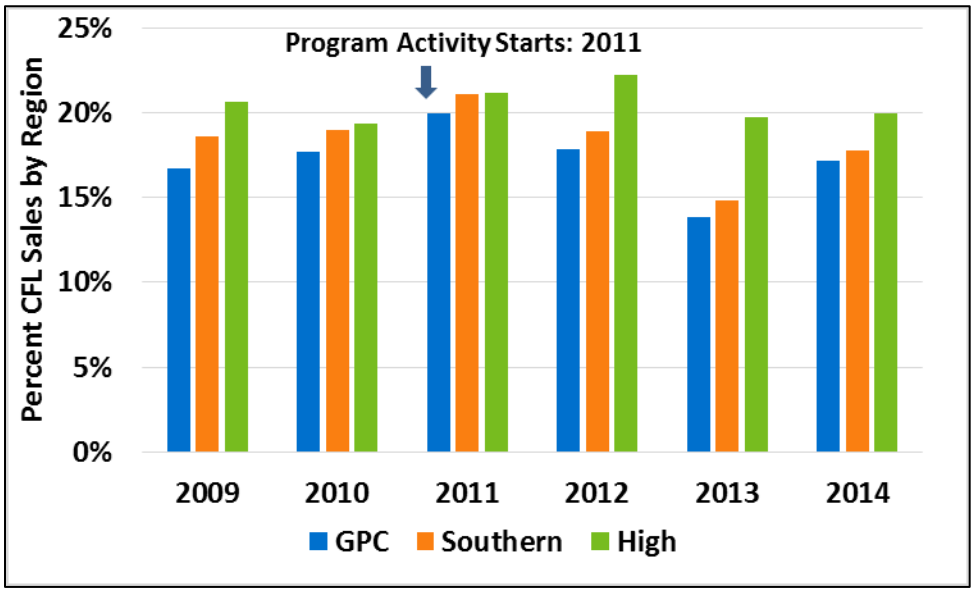
The modeling also reveals that more simplistic approaches to understanding the lighting market, considering only factors such as bulb pricing trends or the number of efficient bulbs sold, often fall short of being able to explain or account for the many interceding dynamics in the market. The models provide evidence that lighting programs matter, but the preliminary exploratory analyses hide the impact of intervening factors.

Comparison Area Approach for Net-to-Gross

Apex Analytics, on behalf of Georgia Power Company (GPC), used the lighting POS data to develop a detailed review of Georgia efficient bulb sales and how sales compared to two other regions: a southern region, defined as neighboring states that lacked a utility sponsored lighting program (Alabama, Louisiana, Mississippi, and Tennessee) and "high program activity" states (California and Massachusetts). Analysis included comparing the annual percent market share of bulbs sold in each region (percent of bulbs sold that were CFLs, LEDs, halogens, and incandescents) and the annual change in sales for these same product categories and regions. For Georgia, the retailers that are included in the dataset are estimated to provide 27% of program sales of efficient lighting products (per 2013 Georgia Power program tracking data).

As can be seen in Figure 1 below, after inception of Georgia Power lighting program activity in 2011, there is no corresponding lift in CFL sales (as a percent of overall lighting sales). Program activity peaked in 2013, including additional support to the mass merchandiser channel, which is represented by the data, yet the percent of CFL sales compared to the comparison southern region did not increase accordingly.

Figure 1. Comparison of CFL Sales in Georgia, Southern Region, and High-CFL Program States



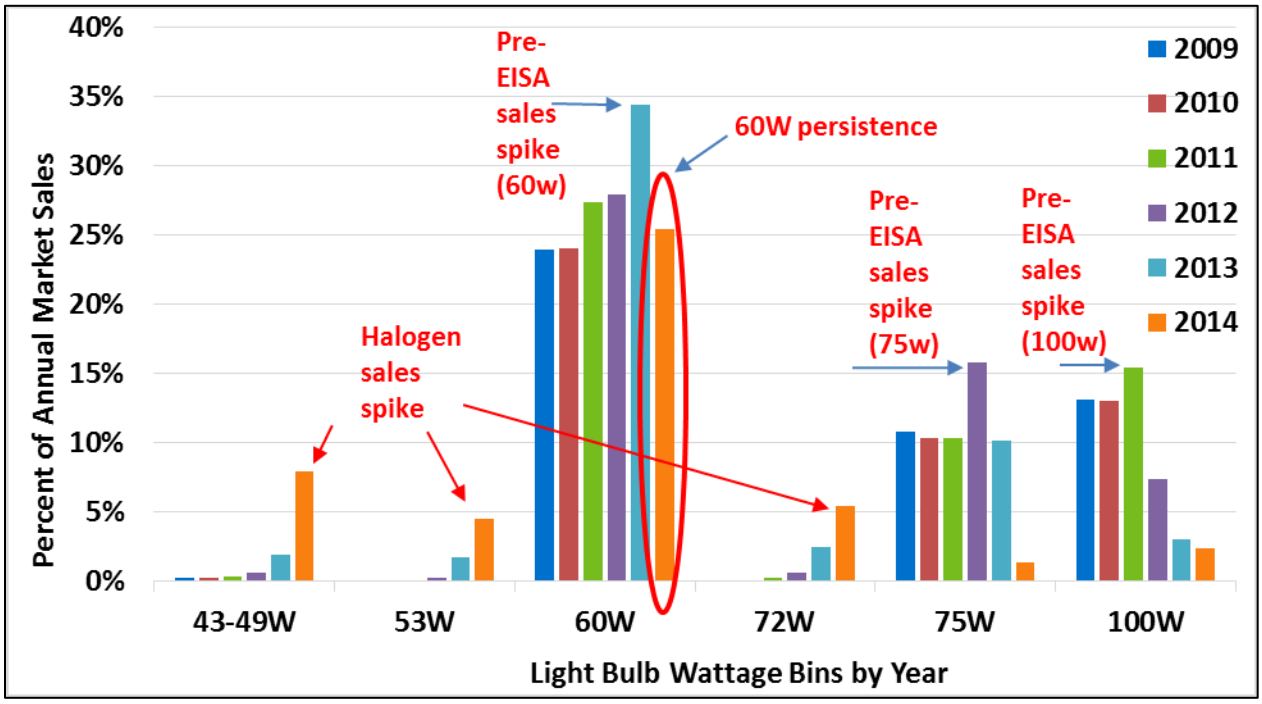
As noted above, however, a simple selection of sales in comparison states hides the many other factors that can impact efficient bulb sales, including differing demographic and housing characteristics. As a second step to the analysis, therefore, the evaluation team leveraged the multi-state model presented above to assess the budgetary impact of the Georgia Power lighting program on CFL sales. To apply this model for Georgia, the evaluation team utilized the existing parameter coefficients, but applied the Georgia specific program budget. This approach estimated NTG of 56.3% NTG

Baseline Analysis

While EISA required a three-year phase-in for efficiency standards, the legislation pertained to the domestic manufacturing and import of inefficient bulbs, not to the sales of these bulbs. There has been considerable speculation, backed up by research, to determine the magnitude and the length of the sell-through period for legacy incandescent bulbs. There are several statewide technical reference manuals (TRMs), in fact, that have recommended a half-year sell-through period that allows existing incandescent bulbs into the baseline sales (i.e., as part of the delta watts analysis). The POS data, which provide sales by wattage, provided a perfect source to assess sell-through and lighting baselines.

As can be seen in Figure 2, which shows annual sales of various bulb wattage bins in Georgia, sales of 60-W bulbs experienced a spike in 2013, the year before the standards became effective. The evaluation team looked deeper into the data, and found evidence that even in 2014, the average percentage of the market comprising 60-W bulbs did not precipitously drop, but in fact leveled off to approximately the same sales level as the four years prior to 2013 (this is highlighted by the oval in the chart). The same trend appears to have taken place for 75-W bulbs, and to a lesser extent, 100-W bulbs as well. This provides quantitative evidence that there was substantial availability of supposedly "phased-out" incandescent bulbs over a year after each EISA phase-in took effect.

Figure 2. Georgia Lighting Sales by Wattage



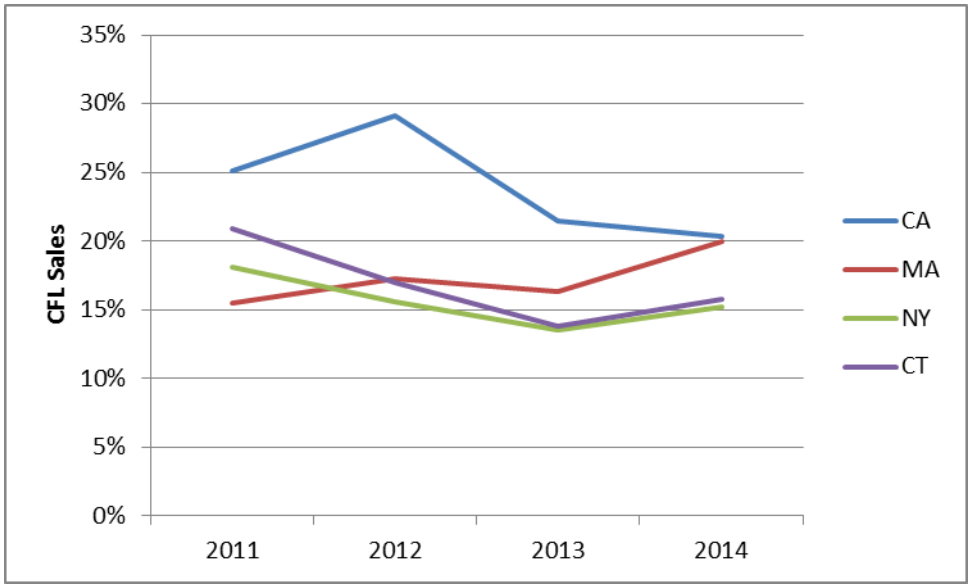
Sales Trending for Program Design

While upstream lighting programs have required sales of incented products, sales outside the program have remained unknown, making it extremely difficult for program planners and evaluators to understand not only how a program might be influencing non-program sales, but what happens when incentives are curtailed. The POS data provide helpful insights into this question, especially since two states that have historically provided aggressive support for CFLs – California and New York – have significantly cut back support.

California began cutting back CFL incentives in 2013, and the POS data – although only about 25% of total market sales – show a pronounced decline in CFL sales. California had previously have one of the highest CFL market shares in the U.S. (29%) in 2012, dropping to 21% in 2013, and continuing to drop slightly in 2014 (Figure 3). Massachusetts, on the other hand, ran one of it's most aggressive program years ever in 2014, and actually saw an increase in the percentage of CFL sales (from 16% in 2013 to 20% in 2014). Although not shown here, the sales of halogen bulbs were inversely related to CFL sales, with California showing a significantly greater increase of halogen sales (which are replacing incandescent bulbs as the baseline due to EISA) compared to Massachusetts. New York also began cutting CFL incentives in 2014, although somewhat gradually, so these data will be updated with 2015 sales data to see if New York is showing similar "backsliding" as California. A saturation study conducted in New York in 2015 suggests that this may be the case.[4]

[4] "Saturation Comparison of Massachusetts, California, and New York: Final Report," Prepared by Cadmus and NMR Group, on behalf of the MA Program Administrators, March 2015.

Figure 3. CFL Sales as a Percentage of Total Lighting Sales



Future Efforts for Sales Data

Although certain retailers have been unwilling to share sales data, LightTracker is pursuing a different approach to access estimates of lighting sales for the home improvement, hardware, and missing club retailers. Specifically, the 2015 LightTracker data will bridge this gap by merging POS sales data with data collected through the IRI National Consumer Panel (NCP) to provide an inclusive view of the ever changing lighting market (Figure 4).

The NCP tracks household purchases via a panel of over 100,000 participant households nationwide. Panel participants are constantly added and removed, depending on the quality and quantity of their data and the needs of the panel. The NCP strives to keep a large and demographically diverse panel of participants at all time. When they do not achieve a representative group, the results are weighted by state level household and demographic characteristics to ensure they represent the population as a whole. Historically, there have been over 1,000 homes per state participating in the NCP at a given time, far more than are typically examined as part of any survey or saturation study.

Each time a panel participant makes a purchase, they scan the product and provide information about it. Information provided includes:

- Price,
- Retail Outlet,
- Quantity,
- UPC, and
- Sales or discounts used.

Because homes scan in all lighting products purchased, the dataset contains purchases on all products, from all channels, including online. The data, therefore, will include estimates of sales purchased through major retailers such as Home Depot, Lowes, and Costco, which are currently not available through the POS data. In addition, because the data are scanned immediately after purchase, there is no "recall bias" which might occur through typical survey or on-site data collection that sometimes occurs more than a year after bulbs are purchased. For bulbs purchased at POS retailers, the quantities of bulb sales from the panel are also weighted up using the "control totals" from the POS data.

This is conducted via a statistical approached called Negative Binomial Distribution, shown graphically in Figure 5.

The data are validated by matching with the LightTracker UPC database, ensuring that the bulbs are properly assigned to bulb type (e.g., CFL, halogen, incandescent, and LED). The standard report will include cleaned and coded lighting sales and dollar volume by bulb type and wattage, available for most U.S. states and the total U.S., and broken out by two categories of retailers (those in the POS data and those not in the POS dataset). The POS data include sales from 2009-2015, while the sales from the NCP begin in 2015.

Figure 4. Relationship of POS and Panel Data

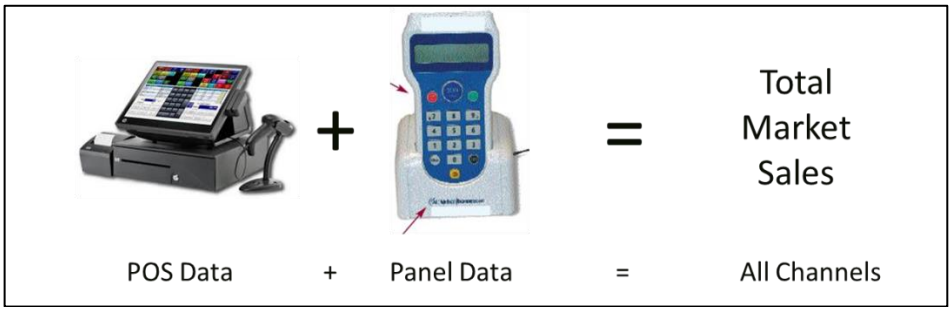
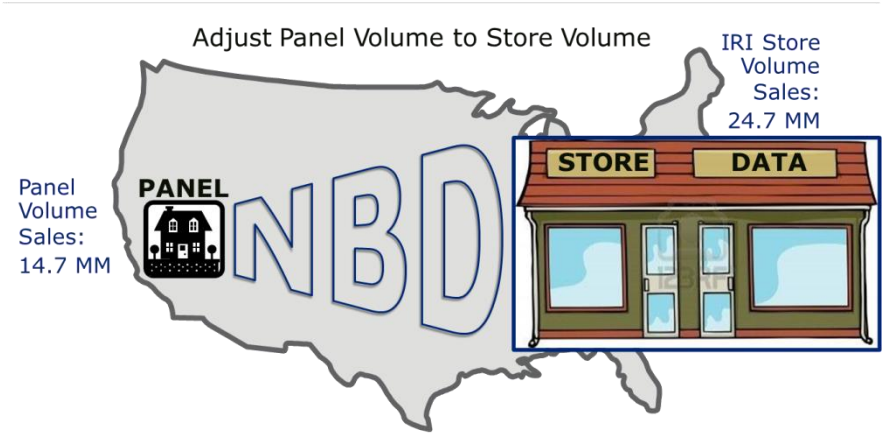


Figure 5. Negative Binomial Distribution Weighting to Calibrate Panel to POS



Overall Conclusions

While the models and the results presented here are important, these efforts also represent a victory for program administrators and evaluators of upstream lighting programs. With some exceptions, administrators of upstream lighting programs have struggled to gain access to market-level bulb sales data—that is sales of both program and non-program bulbs of all types. As a result, previous evaluations have struggled to describe market share as the sole estimates available were limited to program-supported sales or customer or supplier self-reports, each of which suffers from measurement bias (e.g., recollection error or even intentional gaming of the estimates). While the LightTracker data are not perfect—critically, they lack any estimates from the home improvement and hardware channels that have historically served as the base for many residential lighting programs—the dataset contains market-level sales for the reporting retail channels comprising both program and non-program sales for CFLs and LEDs as well as halogen and incandescent bulbs. As such, they have provided evaluators with the ability to assess trends in market share and determine the continued impact of programs on efficient bulb

sales across the nation, best so when done controlling for the many household and demographic variables that can also impact sales.