Can Market Effects from CFL Programs be Measured? Let Us Count the Ways…

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ABSTRACT

In October 2007, the California Public Utilities Commission (CPUC) directed its staff to explore whether nonparticipant spillover could be credibly quantified. This paper describes the results of our effort to understand the cumulative effects of California's investor-owned utility (IOU)-funded Upstream Lighting Programs (ULPs) on the compact fluorescent lamp (CFL) market and to quantify the energy and demand savings attributable to those market effects from 2006-2008.

For the study, we used a comprehensive, multifaceted approach to estimate market effects that included end-use customer surveys, CFL trade ally interviews, in-home lighting audits, in-store stocking/pricing inventories, and interviews with other residential lighting stakeholders across the U.S. Primary research was conducted in California and in three comparison states selected to serve as a baseline (Georgia, Kansas, and Pennsylvania). The analysis included qualitative and quantitative data approaches, involving descriptive statistics and multivariate regression modeling.

While there was evidence of effects from the ULPs at one time—e.g., changes in CFL awareness, attitudes, acceptance, and availability; and declines in CFL prices—most of the analyses of current market conditions yielded no quantitative evidence of market effects at the end of the 2006-2008 program cycle. Based on this study, we recommend that future residential lighting programs continue to educate consumers about CFL varieties and appropriate applications, and track efficient lighting technology sales. We also recommend offering reduced incentives for standard twisters, although higher incentives for specialty CFLs—which still face barriers including quality concerns, high pricing, low availability, and lack of consumer awareness—may be appropriate.

Introduction

The California IOUs—Pacific Gas and Electric, San Diego Gas & Electric, and Southern California Edison—have some of the longest-running energy-efficiency efforts in the country, particularly for CFLs.[1] Most of the state IOUs began implementing small-scale pilot programs in the late 1980s, with full-scale programs up and running by 1992. The California IOU efficiency programs also have some of the country's largest funding. In 2006, the California IOUs claimed energy-efficiency-induced energy savings that represented over 1% of their combined electric sales: one of the highest energy savings rates in the U.S. During the 2006-2008 program period of this study, the IOUs paid incentives on over 95 million CFLs through the ULP.[2]

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1 The CFLs discussed throughout this report are low-wattage screw-ins.

2 Total CFL counts are based on utility quarterly reporting to the CPUC for the IOU programs that offer incentives to upstream players, such as manufacturers or distributors, to buy down the cost of CFLs. Note that this approach differs from the markdowns available elsewhere in the U.S. where utility incentives are offered to retailers.

Background

The California Impact Evaluation Protocol is quite specific about not including market effects and nonparticipant spillover in savings estimates to avoid counting them toward utility energy-efficiency savings goals (TecMarket Works Team, 2006). However, based on an October 2007 decision (CPUC 2007), the CPUC directed its staff during 2008-2009 to explore whether nonparticipant spillover could be credibly quantified and credited to energy-efficiency programs, and to report on the ability of current protocols to measure nonparticipant spillover savings for the 2006-2008 program cycle. To accomplish this, the CPUC analyzed possible market effects in three areas: CFLs, residential new construction, and high-bay lighting.[3]

Scope

The CFL market effects team sought to investigate the effects of California's energy-efficiency programs on the CFL market. The study had three primary objectives:

- Understand the cumulative effects of California's energy-efficiency programs on the CFL market.
- Quantify 2006-2008 kWh and kW savings (if any) caused by the above potential market effects and not claimed as direct or participant spillover savings.
- Support the CPUC's strategic planning efforts by clarifying whether savings from potential market effects can be quantified with sufficient reliability to be treated as resources.

The following text is based on the final CFL market effects report that was prepared for the CPUC (Cadmus, 2010).

Methodology

Baseline Sales Estimation Approach

Market effects can be measured by analyzing the total energy-efficiency market share realized in the presence of a program and comparing it to the market share that would have been attained absent any program activities. Given the external influences on the CFL market, a number of important factors—in addition to the ULP—influenced sales of CFLs in California. External influences included a Wal-Mart initiative to double its CFL sales in 2007 (in the middle of the 2006–2008 program period), promotion of CFLs by the popular press and environmental groups as a strategy for individuals to address climate change, and passage of the federal Energy Independence and Security Act (EISA) of 2007 requiring more efficient lighting beginning in 2012. Baseline sales estimates were therefore critical to assessing the importance of these other influencing factors. The team used two approaches to estimating baseline CFL sales for this study.

Comparison State Approach. The primary approach the team used for estimating baseline CFL sales in California was to examine per-household CFL sales in a comparison region that had little or no

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[3] The final reports for these studies are available, respectively, at http://www.energydataweb.com/cpucFiles/18/FinalCFLMarketEffectsReport_1.pdf; http://www.energydataweb.com/cpucFiles/14/RNCMarketEffects_PhaseI_Report_1.pdf (phase one) and http://www.energydataweb.com/cpucFiles/14/FinalFinalEvaluationReport_1.pdf (phase two); and http://www.energydataweb.com/cpucFiles/topics/38/High%20Bay%20Lighting%20Market%20Effects%20Study-Final.pdf.

utility- or government-sponsored CFL promotional efforts. The presumption was that the CFL sales in this comparison area would approximate what sales would have been in California without the CFL programs.

We recognized the need for a multistate (rather than a single state) comparison area because no single state directly compares with California, which is often considered a country unto itself. We made our selection of comparison states based on a number of socio-economic and other indicators that were comparable to those in California. These other indicators included median household income and education levels, the absence or very small presence of utility- or government-sponsored CFL promotional programs, and the saturation of influential CFL retailers (e.g., square feet of Wal-Mart per capita). After analyzing the indicators, we selected Georgia, Kansas, and Pennsylvania, and throughout the study we compared the California findings to the collective findings from those three states.

Regression Model Approach. The team also developed and employed a regression model to estimate baseline sales. The regression model enabled us to predict CFL sales as a function of a comprehensive list of explanatory variables that could not all be captured through our comparison state approach. These variables included the level of program activity (program length/effort), socio-economic characteristics (e.g., income, education), energy prices, economic conditions, utility rates, big-box store saturation, and population center distribution (urban/suburban/rural).

Making the model as robust as possible required us to estimate CFL sales for as many data points as possible (e.g., states, individual consumers). While the cost of collecting this necessary primary data can be prohibitive for any single entity, this CFL market effects study was able to benefit from a multistate regression effort that was initiated during the early stages of this evaluation. The CPUC joined other sponsoring organizations, and they all agreed to pool their data for use in the multistate analysis that modeled CFL purchases, use, and saturations at the household level.[4]

Primary Data Collection

The team used a variety of primary data collection activities to query actors with many different roles in the CFL market. The study included telephone surveys with approximately 2,450 end-use customers, telephone interviews with roughly 600 CFL retailers and manufacturers (representing the vast majority of market-level CFL sales in California), in-home lighting audits of 269 homes, comprehensive retailer lighting shelf stocking and pricing inventories in 185 stores (representing over one million stocked bulbs), and interviews with 17 residential lighting program managers, policymakers, and evaluation consultants familiar with historic California or other residential lighting programs across the U.S. A summary of the primary data collection activities is presented graphically in Figure 1. The methodology for all of these activities is discussed below.

For the demand-side customer surveys, we spoke with a random sample of over 2,450 end-use customers in the California IOU service territories and in the comparison area to learn about their familiarity, use, and satisfaction with CFLs. The surveys targeted a minimum of 100 respondents who had purchased CFLs in the three months prior to the survey in California and a minimum of 100 recent CFL purchasers in each of the comparison states.

Also on the demand side, we employed an in-home lighting audit to determine the penetration and saturation of CFLs in California and in the comparison area. In addition to collecting data about the

[4] Subsequent to this study, a second multistate model built upon this initial model by refining the model equations and incorporating updated data from a larger group of sponsoring organizations (Russell, 2011).

number, location, and type of medium screw-base (MSB) lamps and sockets in the home, the audit included a short battery of participant questions.[5]

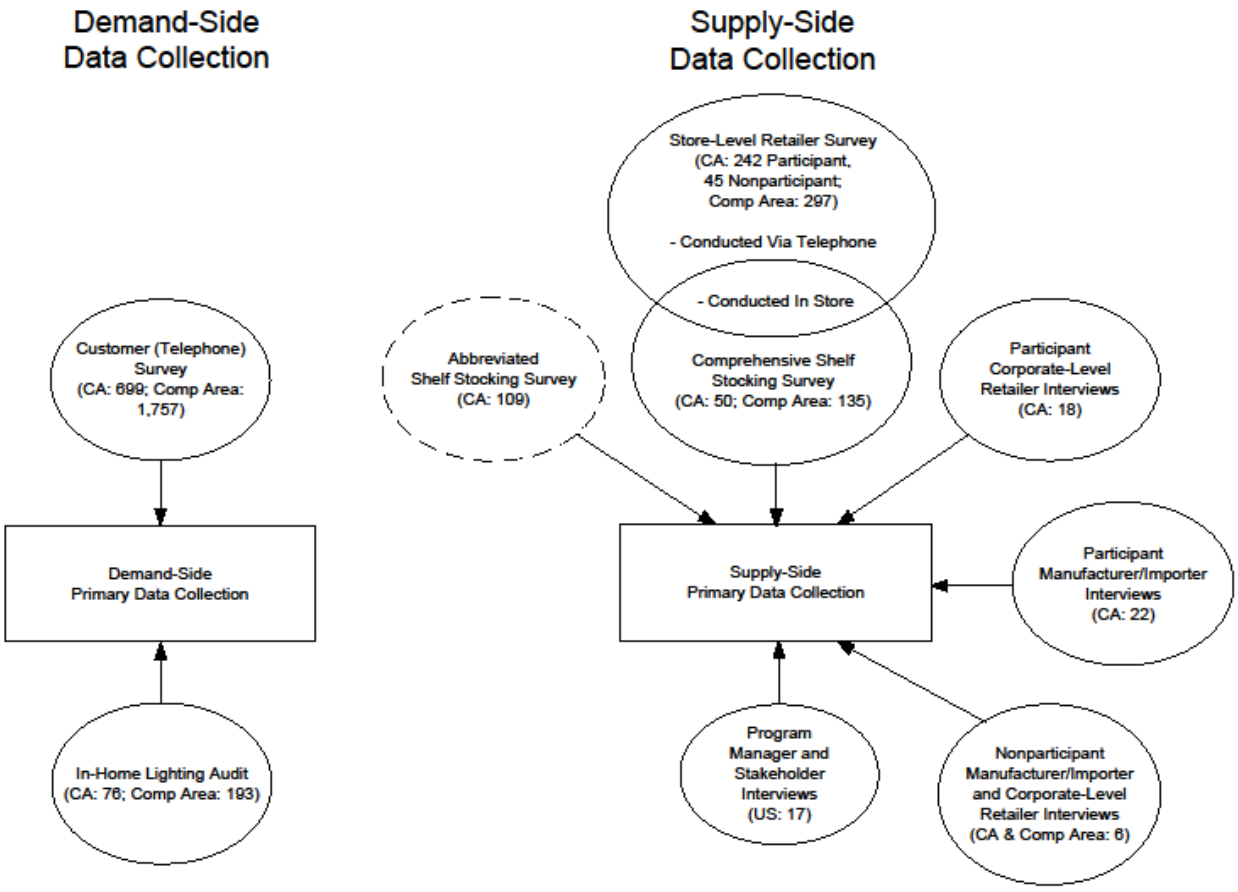

Figure 1. Primary Data Collection Activities

On the supply side, the team conducted a comprehensive shelf stocking survey to assess the stocking, pricing, and availability of a wide variety of lighting products in retail stores in California and in the comparison area. During the inventories, we measured the lighting display space and recorded the full inventory of incandescent, CFL, halogen, and LED products.[6] During store visits, we also incorporated a short interview with the store or lighting manager to determine stocking and sales patterns (including seasonal fluctuations) and factors that drive sales. We collected data from retailers in California and the comparison area from all of the major retail lighting distribution channels, including large home improvement, small hardware, grocery, discount, mass merchandise, and club/membership

[5] To be as efficient as possible with project resources, we opted to only collect information about MSB lamps and sockets; the study did not collect information about pin-based and small screw-based lamps or sockets.

[6] The information we recorded included bulb type, bulb shape, base type, make/model, wattage, lumens, package size, package count, special features, and price.

stores. We analyzed data from these inventories in conjunction with data from a similar but less exhaustive Abbreviated Shelf Stocking Survey.[7]

Also on the supply side, we conducted in-depth interviews with participant and nonparticipant manufacturers/importers and retailers familiar with California, a comparison area, or national CFL markets. The purpose of these interviews was to gain a wide range of perspectives on CFL stocking practices, pricing practices, supply chains, program participation characteristics, market trends, recycling, and other topics. Although we interviewed each company individually, we found that the lighting manufacturers/importers and retailers generally told a consistent story. In cases where their perspectives differed, variations usually corresponded with differences in market position (e.g., large established manufacturers versus new smaller manufacturers) or retailer offerings (e.g., large home improvement stores versus discount stores).

To complement the participant market actor interviews and help us gain a broader perspective on the CFL market, we also interviewed nonparticipant manufacturers/importers and corporate-level retailers. Like the participant interview guides, the nonparticipant market actor interview guides included batteries of questions about CFL product sales and trends, potential effects of California's programs on the broader CFL market, pricing, product quality, market characterization, and CFL recycling.

The supply-side, store-level retailer surveys helped us understand whether the findings from the comprehensive shelf stocking survey in California and the comparison area represented typical lighting product stocking patterns. They also provided insights from a more hands-on retailer perspective.

Finally, the team conducted interviews with residential lighting program managers, policymakers, and evaluation consultants who were very familiar with historic California or other residential lighting programs across the nation. We intentionally interviewed stakeholders who represented different time periods and varying perspectives. Throughout the interviews, we gathered qualitative information about factors that have influenced California's CFL market over time (including the IOUs' historic residential lighting programs).

Analysis

Assessment of CFL Market and Program Evolution. An understanding of California's market and program histories could be critical if many impacts of the IOU programs on the CFL market occurred before 2007. Thus, to provide needed context for the 2006–2008 market effects assessment, we analyzed the program manager and stakeholder interviews along with a review of numerous program-related documents, conference papers, and industry publications. Our analysis covered market events (e.g., the California energy crisis of 2000–2001, increased attention to global warming, Wal-Mart's sustainability initiatives, regulation of light efficacy); leading market indicators, which provide early indications of changes in the level of CFL market activity (e.g., consumer CFL awareness, consumer satisfaction with CFLs); coincident market indicators, which indicate changes that occur concurrently with changes in CFL market activity (e.g., program-level CFL sales); and lagging market indicators, which indicate changes occurring after the level of CFL market activity has changed (e.g., household CFL saturation).

Regression-Based Attribution and Net Savings Analysis. In the summer of 2009, the team joined a multistate regression analysis effort designed to identify the total cumulative program effects of all

[7] The Abbreviated Shelf Stocking Surveys were completed for the ULP evaluation (KEMA, 2010), a companion to this study. Data collected through these surveys included average prices and other characteristics of CFLs and their incandescent equivalents.

historical CFL program activities realized in 2008, net of freeridership and spillover.[8] The multistate modeling effort relied on telephone and on-site data from areas with longstanding CFL programs, those with newer or smaller programs, and those with no CFL programs as of 2008.[9] Regions with mature programs included California's IOU service areas, the entire states of Connecticut, Massachusetts, and Wisconsin, and large portions of Colorado, Michigan, and New York. In addition to this study's comparison area (Georgia, Kansas, and Pennsylvania), the regression analysis incorporated data from other regions with new, small, or no programs, including Houston (Texas),Indiana, Maryland, Ohio, and Washington DC.

The sponsors collectively fielded seven survey efforts, including seven telephone surveys and seven in-home lighting audits in 16 areas. To achieve comparability on the key issues explored in the multistate modeling effort, each telephone survey instrument included a core set of questions about CFL awareness, familiarity, satisfaction, use, and purchases, as well as a standard set of demographic questions. Each in-home lighting audit followed similar procedures to identify CFLs, perform socket counts, and ascertain when CFLs were obtained by the household.

The team's participation in the multistate effort enabled us to take advantage of a much larger data set that otherwise would have been unaffordable. However, the California Evaluation Protocols only allow the inclusion of freeridership—but not spillover—when calculating net-to-gross (NTG). Although the goal of our analysis was to examine market effects (i.e., spillover), the statistical approach in the multistate effort could not disaggregate those effects: the analysis presented in this paper refers to measurement of the total net impact.

Analysis of Program-Induced Market Effects on CFL Retail Pricing. The CFL pricing analysis drew on data from several sources:

- **Manufacturer and retailer interviews:** These included questions about how retail CFL prices are set and how program discounts are determined, whether trade allies offer discounts in addition to those provided by the IOUs, the effect of program discounts on customer expectations about CFL pricing, the influence of the IOU programs, differences between the prices of program-discounted CFLs in California and non-discounted CFLs outside of program areas, and expectations regarding future prices of CFLs.
- **Point-of-sale (POS) data:** POS scanner data, collected annually for the California Residential Lighting Market Share Tracking Study (Itron, 2008), combines data from the food, drug, mass merchandiser, and small hardware retail channels. These data provide reliable price estimates of individual CFL bulbs. The data are limited, however, in that they exclude large home improvement stores, club/membership stores, and Wal-Mart. Combined, the missing data likely make up over 50% of the CFL sales in California, and an even greater proportion nationally.

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[8] While this evaluation covered the entire 2006-2008 program cycle, the regression only focused on 2008 due to data availability from the other sponsors.

[9] The multistate regression was sponsored by a diverse set of organizations: the CPUC, the New York State Energy Research and Development Authority, the Public Service Commission of Wisconsin, Consumers Energy in Michigan, the Connecticut Energy Conservation Management Board, Connecticut Light and Power, Northeast Utilities, The United Illuminating Company, the Cape Light Compact, NSTAR, National Grid, Unitil, Western Massachusetts Electric, and Xcel Energy.

- **Detailed analysis of pricing information from the shelf-stocking surveys**: The shelf stocking surveys contained a rich dataset for pricing analysis, as the data included information about full and discounted bulb prices displayed on packages and/or on store shelves, as well as the detailed bulb characteristics described above.

Using empirical data from the shelf stocking surveys, we estimated a hedonic pricing model[10] to determine the separate characteristics that contributed to determining a CFL's price (e.g., geographic location where sold, wattage, lumens, package size).[11] In the model, the coefficient corresponding to a characteristic or attribute represented the "implicit price" of that attribute. The hedonic pricing model thereby allowed us to estimate prices or values of attributes or goods that were directly sold in markets.

Results

Leading Market Indicators

Leading market indicators may be used to predict a forthcoming change in CFL market activity. Such indicators include CFL awareness; product availability and purchases by retail channel; average CFL retail prices; and consumer satisfaction with CFLs. Key findings for these indicators are described in detail below.

Customer Awareness of CFLs. Awareness of CFLs by customers in the California IOU service territory increased dramatically in the past decade and remains higher than CFL awareness in the comparison area. Awareness of CFLs in California increased from 58% in 1998 to 96% in 2008. In the comparison area, consumer awareness was significantly lower, at 92% in 2008.[12]

CFL Availability. Availability of CFLs was extremely high, but higher in certain California distribution channels than in the comparison area. CFLs are now nearly universally available in California: the vast majority of retailers that carry lighting products participated in the ULP, and nearly 100% of nonparticipating retailers that carry lighting products also reported that they carry CFLs. Most lighting product retailers in the comparison area reported carrying CFLs, although the percentage varied by distribution channel and lagged most substantially in grocery stores (82% of comparison area groceries carried CFLs, in contrast to 100% in California). Additionally, California retailers devoted more floor space and a greater percentage of their displayed lighting product to CFLs than in the comparison area. Participating retailers in the ULP reported that approximately 58% of their lighting sales floor was dedicated to CFLs, significantly higher than the comparison area where only 42% of the floor space was dedicated to CFLs.

In the discount, grocery, and hardware stores—channels through which the 2006–2008 ULP sought to actively promote CFLs—we found CFLs were a significantly greater percentage of all bulbs on stores shelves in California than in the comparison area. California retailers also carried a significantly greater percentage of ENERGY STAR CFLs compared to the comparison area: according to the shelf survey, 85% of all available CFLs in California were ENERGY STAR versus 78% in the comparison area.

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[10] The hedonic pricing model is a regression model that uses the register price per CFL as the dependent variable and the other factors described herein as independent variables.

[11] Appendix J of the "Compact Fluorescent Lamps Market Effects Final Report" includes a discussion of the model's development (Cadmus, 2010).

[12] All results presented in this paper are statistically significant at the 90/10 confidence/precision levels.

CFL Purchases by Retail Channel. In the late 1990s, Californians bought CFLs primarily at home improvement or hardware stores, whereas in recent years, they reported buying greater proportions of CFLs at discount, drug, grocery, and mass merchandise stores. Consumers in the comparison area reported purchasing significantly fewer CFLs at drug stores, groceries, and membership club stores than Californians, and significantly more at mass merchandise stores.

CFL Pricing. The average IOU-discounted standard twister style bulb retailed for significantly less than the equivalent non-program bulb ($1.30 versus $3.93, respectively) due to the incentives and additional discounts offered by California's participating retailers and manufacturers. Retailers and manufacturers also offered add-on discounts to the IOU incentives, which discounted the bulbs by 172% of the average $1.57 incentive.

Non-discounted CFLs were priced $0.13 higher in California than in the comparison area. Similarly, CFLs that were discounted by another (non-IOU) entity were priced $0.39 higher in California than in the comparison area. These price differences may reflect higher demand and greater willingness to pay for CFLs in California.

Although we observed that non-program CFLs in California sold for roughly the same price as equivalent bulbs in the comparison area (and cost slightly more when controlling for other factors affecting price), participating retailers and manufacturers reported that the California programs helped decrease CFL prices throughout the U.S. due to increased sales. Most of the participant manufacturers/importers we interviewed linked decreased production costs with increased sales volumes, and most credited the ULPs with helping to increase their sales volumes. That is, manufacturers credited the ULPs with cost decreases in California and elsewhere.

Customer Satisfaction. Overall, consumer satisfaction with CFL performance increased as bulb quality improved. Prior to 2004, Californians' average satisfaction rating for CFLs was 6.3 out of 10. In the most recent customer survey, California respondents gave a (statistically significant) higher overall satisfaction rating of 8.3. Recent comparison area respondents also gave a high overall satisfaction rating of 8.2 (not statistically different from California's recent rating).

Assessment of Coincident and Lagging Market Indicators

Coincident market indicators are signs of altered activity levels that occurred concurrently with changes in CFL market activity. Coincident market indicators include market-, program-, and baseline-level CFL sales data. Lagging market indicators are sign of changes in the level of CFL market activity that occurred after the level of market activity was first altered. Examples include changes in household CFL penetration and saturation. Key findings from the coincident and lagging indicators are described in detail below.

CFL Sales. During fall 2008, CFL sales per household were higher in the comparison area than in California. However, CFL sales as a percentage of all bulb sales were higher in California, perhaps reflecting the higher saturation levels in California. The average number of CFLs purchased per household in the three months prior to the survey was 1.1 in California and 1.2 in the comparison area. However, significantly fewer households in California purchased light bulbs in those three months (47%) than in the comparison area (57%). When we examined the sales figures as a market share (the percent of all bulb sales that are CFLs), we found the CFL market share was higher in California (30%)

than in the comparison area (24%). This suggests that the higher saturation of CFLs in California homes may have led to fewer bulb sales, and thus fewer CFL sales per home than in the comparison area.[13]

One of our goals with the study was to quantify the additional CFL sales in California that resulted from the IOU efforts, yet were not claimed by the IOUs as part of their program activity. Through the regression analysis, we estimated that cumulative 2008 total net impacts, inclusive of freeridership, spillover, and market effects, were 0.23 (i.e., 23% of IOU claimed gross savings).[14]

CFL Saturation. CFL saturation was significantly higher in California than in the comparison area. Nearly eight of ten (79%) households in California said that they use at least one CFL inside or outside their home, significantly more (at the 90% confidence level) than the 66% of households in the comparison area that reported using CFLs. In addition, the average California home now has 10.3 CFLs (approximately 29% of all MSB sockets), compared to 8.4 CFLs per home in the comparison area (approximately 22% of all MSB sockets)—a statistically significant difference.

The California ULPs had a small positive effect on CFL purchases in 2008 and a larger effect on the current CFL saturation. Earlier CFL programs also affected prior CFL use and the length of time respondents had used CFLs. The estimated total net impact (including freeridership, spillover, and impacts of prior program activity) for California in 2008 is 23%. Using this value, the IOUs' CFL programs would claim only 23% of the savings they had assumed would result from the 2008 ULPs. However, given the positive relationship between program activity and prior CFL use, we believe it likely that the total net impacts for 2006 and 2007 were higher. 2008, in contrast, shows fewer differences in sales between program and non-program areas. Unfortunately, the model did not allow us to estimate how much higher the total net impacts may have been in 2006 and 2007.

Conclusions

Cumulative Effects of California Programs on the CFL Market

Though initially they may seem contradictory, findings indicating market effects of the ULP at one time, but none being visible at the end of 2006-2008, actually tell a consistent story. The upstream market actor interviews asked respondents about their perceptions of the ULPs in 2006 through 2008 (and some questions included earlier time periods). However, data for other, more quantitative analyses (i.e., customer surveys, in-home surveys, shelf stocking surveys, pricing analysis, and regression analysis) were collected in 2008 and 2009. Thus, the upstream interviews provided evidence that in the past, California's programs caused market effects in both California and nationally, while the quantitative analyses provided evidence that these effects had largely eroded during the 2008 to 2009 time period.

Additionally, we identified the following phenomena that likely contributed to our findings.

Increasing CFL Saturation in California, Leading to Fewer Recent CFL Sales per Household. Because of their long expected useful life, as CFL saturation increases, there are fewer sales of all bulbs

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[13] While we found California homes to have fewer MSB sockets than homes in the comparison area, the difference was not statistically significant. Socket counts per household, therefore, do not explain the differences in California and comparison area CFL sales or market shares.

[14] While this estimate is lower than the 0.54 NTG ratio estimated through the ULP study (KEMA, 2010), the studies differ in important ways. First, this study is based only on a 2008 model, whereas the ULP study estimated the NTG for 2006-2008. Second, this study is based on a model of cumulative net effects *realized* in 2008, whereas the ULP study estimated the NTG that was *caused* in 2006-2008.

per household—including CFLs and incandescents. Data from the customer survey seemed to suggest this phenomenon: the survey found a lower number of CFL sales per household in California versus the comparison area.

Dominance of Large National ENERGY STAR Partners in Increasing Sales Nationally. The analysis showed that national ENERGY STAR partner square footage was consistently a very strong predictor of ENERGY STAR partner CFL sales across the U.S. Coupled with the lack of program variable significance in the regression analysis, this suggests that large ENERGY STAR retailer partner sales (e.g., Wal-Mart and Home Depot) may have had such an overwhelming effect on the national CFL market that variations in the larger retailers' presence in each state simply drowned out the other influences on sales, including program influences.

Shift of Sales (i.e., Channel Shift) in California from Large National ENERGY STAR Partners to Other Distribution Channels. The stakeholder interviews suggested the ULPs succeeded in introducing and stimulating CFL sales in distribution channels that did not traditionally carry CFLs, such as ethnic groceries and discount stores. It is possible that CFL sales from non-traditional retail channels came at the expense of CFL sales from more traditional channels (i.e., sales in the national ENERGY STAR partner stores shifted to non-traditional channels, therefore lowering the overall CFL sales per household for the partner stores), although available data did not allow us to confirm or reject this supposition.

The notable exception to the apparent dearth of current market effects is CFL availability. Results of the shelf stocking study, retailer interviews, and manufacturer interviews all indicated that the California IOU programs increased the availability of CFLs in grocery stores, discount stores, and hardware stores, even in 2008 and 2009. While this effect is important and attributable to the programs, the impact of this effect may be eroding as CFLs are also becoming more ubiquitous, and thus more readily available among all distribution channels in the comparison area.

Finally, our analysis was likely affected by the finding that the California IOU programs arguably accelerated CFL sales throughout the U.S. Although this impact cannot be accurately quantified (there is no way to undo the significant program activity that occurred in California), estimated baseline sales for all states—including the comparison states examined as part of this study—may be *overestimated* because the baseline sales were affected by California's CFL programs.

Quantification of Energy and Demand Savings not Claimed as Direct Savings

Another goal with the CFL market effects study was to quantify the additional CFL sales in California that resulted from the IOU efforts, yet were not claimed by the IOUs as part of their program activity. Taken together, the findings did not provide evidence that market effects in the form of energy/demand savings (nonparticipant spillover) can be unequivocally quantified as caused by the California IOU programs for the 2006-2008 time period.

Note, however, that the 2006 and 2007 estimates for both NTG and total net impacts (including market effects) may differ significantly from—and may have been significantly higher than—the 2008 estimate derived through the regression model. Had the data required for the regression model been collected in *each program year*, we would have had sufficient information to estimate cumulative net program effects for the entire 2006-2008 program period. Furthermore, if a reliable estimate of cumulative net program effects for 2005 and earlier had been available, we would have been able to estimate the net effects of the 2006-2008 program in isolation.

Assessment of Whether Savings can be Claimed as a Resource

The CFL market has changed substantially in more recent years, and the findings from this study indicate that the baseline for CFL sales has risen throughout the U.S., including regions with no utility efforts to promote CFLs.[15] Because this study did not find evidence that market effects--in terms of energy/demand savings attributable the 2006-2008 ULP--can be unequivocally quantified, we conclude that market effects savings from the CFL programs *could not* have been claimed as a resource for the 2006-2008 program cycle. This is not to say that CFL market effects cannot be reliably estimated; rather, that they were not observed in 2008.

Suggestions for Future Residential Efficient Lighting Program Design

The IOU programs continue to influence CFL sales in California, but that influence is not essential for the market to sustain itself. Areas of the U.S. where there were no utility sponsored program activities are rapidly catching up to California and other states with mature CFL programs in terms of saturation and sales. Despite years of aggressive promotions, price discounts, and increased availability in additional distribution channels, California CFL saturation was approximately 21% of all sockets in 2009 (and approximately 29% of MSB sockets; KEMA, 2010). There are various reasons these remaining sockets had yet to be replaced with CFLs, including customers waiting for existing bulbs to burn-out, use of lighting controls for dimming (where only more expensive, dimmable CFLs can be used), size and shape considerations, dissatisfaction with CFLs, lack of awareness, and threshold saturation where customers are reluctant to place CFLs in seldom used sockets.

The buy-down approach, even under the market transformation paradigm, may have run its course for standard spiral CFLs in California. Nonetheless, the team expects the CFL market to remain strong due to factors such as increasing public concern about global climate change and the implementation of EISA. For sockets that do not require specialty bulbs, utilities should consider an aggressive resource acquisition approach, such as targeting groups least likely to use CFLs.

The market for specialty CFLs, LEDs, and other efficient lighting technologies still faces many of the barriers that standard twisters faced just a few years ago, including quality concerns, high pricing, availability, and lack of consumer awareness. A buy-down approach may therefore still be viable for these bulbs. Continued consumer education about the variety of efficient lighting options, appropriate applications for these bulbs, and continued tracking of efficient lighting technology sales in program and non-program areas, should also be key components of future residential efficient lighting programs.

Suggestions for Future Market Effects Evaluation Work

The endeavor to accurately estimate the magnitude of CFL market effects revealed that market effects need to be estimated throughout a program's life cycle. In other words, a rigorous assessment of program versus estimated baseline sales conducted earlier in the life cycle of the California IOU CFL programs *might* have identified quantifiable market effects that occurred earlier in the program's life. The lack of such baseline data, coupled with the rapid increase in CFL sales throughout the U.S. during the first part of the 2006-2008 program cycle, the national downturn in sales during 2008 and 2009, and the rebound in 2010, made it extremely difficult for any program state, including California, to claim or quantify savings from cumulative market effects induced by their programs alone. We highly recommend that future market effects studies gather baseline data before program implementation as well as throughout a program's lifecycle. These studies do not need to be more costly; in fact, they may

[15] Note that total CFL imports to the U.S. peaked in 2007 at 397.1 million, dropped to 337.5 million in 2008, dropped further to 271.7 million in 2009, and then rebounded to 359.6 million in 2010.

be less costly by leveraging longitudinal analytic approaches that implement ongoing data collection activities.

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