

Compact Fluorescent Lamps Market Effects Final Report

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**For the
California Public Utilities Commission
Energy Division**

April 12, 2010

CFL Market Effects Final Report

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ACKNOWLEDGMENTS

The CFL Market Effects Team would like to thank a number of additional parties for their input and assistance in preparing this report, including Ed Vine and Ralph Prahl of CIEE, Mikhail Haramati and Tim Drew of the CPUC, Lori Megdal, Jeff Hirsch, and Nikhil Gandhi.

EXECUTIVE SUMMARY

The investor-owned electric utilities (IOUs) in California—Pacific Gas and Electric (PG&E or PGE), San Diego Gas & Electric (SDG&E or SDGE), and Southern California Edison (SCE)—have been operating energy-efficiency programs, with the most recent iteration of these programs implemented in 2006 for a three-year program cycle that ended in 2008. The California IOU programs are among the longest-running energy efficiency efforts in the country, particularly for compact fluorescent lamps (CFLs).¹ Most of the state’s 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 are also some of the country’s largest in terms of 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. In 2006-2008, the IOUs paid incentives on over 95 million CFLs through the Upstream Lighting Program.²

The IOU energy efficiency programs’ maturity, program size, and use of both resource acquisition and market transformation strategies may lead to changes in the CFL market, measured not just in terms of direct energy savings and peak demand reductions, but in terms of other progress indicators, including changes in awareness, attitudes, behaviors, product offerings, and reduced product retail prices and production costs. These other factors may create short-term and potentially long-term market structural and operational changes, which may in turn result in energy and demand savings. To the extent these market changes are program-induced, indirect savings (savings not derived from program participation, i.e., savings from participant and nonparticipant spillover) are the program’s market effects additional to direct program impact savings.

The California Impact Evaluation Protocol³ is quite specific about not including market effects and nonparticipant spillover in savings estimates to avoid counting them towards utility energy efficiency savings goals. However, in an October 2007 Decision (D.07-10-032), the CPUC directed its staff to explore (during 2008-2009) the ability to credibly quantify and credit “nonparticipant spillover” market effects. The CPUC further directed its staff to report their findings following the process evaluation and market impact studies of the 2006-2008 program cycle on the ability of current protocols to measure such “nonparticipant spillover” savings and to propose possible revisions to market effects protocols, utility savings goals, and/or performance incentive mechanisms for subsequent action by the CPUC. As part of the study effort, the CPUC is examining possible market effects in three areas: CFLs, residential new construction, and high-bay lighting. Working with the CPUC, the California Institute for Energy and Environment (CIEE) developed Study Plans for (and is assisting in overseeing) each of these market effect studies.⁴

For the CFL Market Effects Study, the Residential Retrofit Impact Evaluation Team was chosen by CIEE and the CPUC to investigate the cumulative effects of California’s energy-efficiency programs on the CFL market. The study has three primary objectives:

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

² Total CFLs 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.

³ State of California Public Utilities Commission, 2006

⁴ The CIEE market effects study plans are available at <http://uc-ciee.org/energyeff/energyeff.html>.

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- 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 CFL Market Effects Team began this study in March 2008. As required by the Market Effects Protocol, the Team's first undertaking was a scoping study designed to: help gain a better understanding of the evolution of California and U.S. CFL markets; characterize California's current CFL program offerings; provide integrated market and program theories for California's CFL programs; review CFL market effects studies conducted in other regions of North America; and gain a better understanding of the data sets available for the evaluation of possible CFL market effects in California. The CFL Market Effects Scoping Study and Work Plan was finalized on October 31, 2008, and was made available to the public via posting on the CPUC's Website shortly thereafter.⁵

The Team also prepared an interim report that was finalized and made public via posting on the CPUC's Website in May 2009. In the interim report we presented preliminary findings from: research on the evolution of the CFL market and CFL programs; regression analysis to determine the effect of CFL programs on CFL sales; a CFL user telephone survey, and interviews with corporate-level manufacturer and retailer participants (and one nonparticipant) in California's CFL programs.

Throughout this project, the CFL Market Effects Team has not presupposed any particular result: the Team has consistently been neutral as to whether there would be market effects and, if there were, whether they would be positive, negative, or some combination thereof.

ES.1 Methodology

The CFL Market Effects report is the culmination of a tremendous research effort in California and other states. As summarized in Table ES-1, the study included telephone surveys with approximately 2,500 end-use customers, telephone interviews with about 600 CFL retailers and manufacturers (representing the vast majority of market-level CFL sales in California), in-home audits of 269 homes, comprehensive retailer lighting shelf stocking 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.

The analysis included qualitative and quantitative data approaches, including descriptive statistics and multivariate regression modeling techniques. Primary research was conducted in California and in three comparison states (Georgia, Kansas and Pennsylvania) selected to serve as a baseline for California. The customer survey and in-home audit data were combined with primary data from 11 additional states (in a collaborative effort conducted with other program states, and analyzed in a single set of models) as part of the analysis.

⁵ These documents are also available on CIEE's website at <http://uc-ciee.org/energyeff/energyeff.html>.

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Table ES-1. Summary of Primary Data Collection Activities

Data Collection Activity	Sample Sizes	
	California	Comparison Area*
Residential lighting program manager, policymaker, and evaluation consultant interviews	17	
CFL User (Telephone) Survey ⁶	699	1,757
In-Home Survey	76	193
Comprehensive Shelf Stocking Survey	50	135
Participant Manufacturer/Importer Interviews	22 ⁷ (accounted for 97% of market-level CA CFL sales)	NA
Participant Corporate-Level Retailer Interviews	18 ⁸ (accounted for 81% of market-level CA CFL sales)	NA
Nonparticipant Manufacturer and Corporate-Level Retailer Interviews	6	
Store-Level Retailer Survey	242 participants 45 nonparticipants	297

* Georgia, Kansas and Pennsylvania

The study was guided by the development of a logic model and researchable questions that were developed as part of the CFL Market Effects Scoping Study. These research questions addressed leading market indicators including CFL awareness, availability, pricing, and satisfaction, as well as coincident and lagging market indicators such as CFL sales and saturation, respectively.⁹

⁶ The values shown here are based on Wave 2 of the Residential Retrofit CFL User Survey, the only one of the 5 total Residential Retrofit CFL User Survey waves that contained CFL Market Effects questions.

⁷ The CFL Market Effects team interviewed 16 participant manufacturers/importers in 2008 and 16 participant manufacturers/importers in 2009. Fourteen of these respondents were interviewed in both years. Over the two-year period, then, we spoke with 18 unique manufacturers/importers. In addition, we interviewed 4 unique distributors/retailers with their own CFL labels.

⁸ The CFL Market Effects team interviewed 16 corporate-level retailer participants in 2008 and 13 corporate-level retailer participants in 2009. Eleven of these respondents were interviewed in both years. Over the two-year period, then, we spoke with a total of 18 unique corporate-level retailer participants.

⁹ Leading indicators are early indications of changes in the level of CFL market activity. They may be used to predict a forthcoming change in CFL market activity. Coincident indicators are signs that the level of CFL market activity is changing that occur concurrently with the altered level of activity. Lagging indicators are indications of changes in the level of CFL market activity that occur after the level has changed.

ES.2 Key Findings

Assessment of Leading Market Indicators

Key findings for the leading indicators include:

- ***California IOU consumer awareness increased dramatically in the past decade and remains higher than awareness in the Comparison Area.*** Awareness of CFLs in California increased from 58% in 1998 to 96% in 2008. In nonprogram states, consumer awareness was 92% in 2008. The difference between 2008 CFL awareness in and out of California was statistically significantly at the 90/10 confidence/precision levels.
- ***Awareness of the IOU Upstream Lighting Program was low among consumers.*** Respondents to the CFL User Survey reported that approximately 26% of their CFL purchases in fall 2008 were through the IOU incentive program, yet IOU-discounted bulbs likely represented closer to 80% of all CFL sales.
- ***Availability of CFLs was extremely high, but higher in certain distribution channels in California compared to the Comparison Area.*** CFLs are now nearly universally available in California: the vast majority of retailers that carried lighting products participated in the ULP and nearly 100% of nonparticipating retailers that carried lighting products also reported they carried 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).
- ***California retailers devoted more floor space and a greater percentage of their displayed lighting product to CFLs compared to the Comparison Area.*** Participating retailers in the ULP reported that approximately 58% of their lighting sales floor is dedicated to CFLs, significantly higher than the Comparison Area, where only 42% of the floor space was dedicated to CFLs. In addition, the percentage of CFL models in the discount, grocery, and hardware stores—channels through which the 2006–2008 ULP sought to actively promote CFLs—was significantly greater than the percentage of CFL models in the same channels 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.
- ***The average IOU-discounted standard twister style bulb retails for significantly less than the equivalent nonprogram bulb due to the incentives and additional discounts offered by participating retailers and manufacturers.*** The average IOU-discounted standard twister shelf price was \$1.30, \$2.63 less than the equivalent non-IOU discounted bulb. Retailers and manufacturers are also offering “add-on” discounts to the utility incentive, thus this discount is 172% of the average incentive of \$1.57.
- ***Nondiscounted 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 willingness to pay for CFLs in California.

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- ***Although there is little difference in the prices of nonprogram CFLs in California and the Comparison Area, participating retailers and manufacturers report that the California programs helped decrease CFL prices throughout the U.S. through increased sales.*** Nonprogram CFLs in California sold for nearly the identical price of equivalent bulbs in the Comparison Area (and slightly higher when controlling for other factors affecting price). Most of the participant manufacturers/importers we interviewed, however, linked decreases in production costs with increases in sales volumes, and most credited the ULPs with helping to increase their sales volumes. In other words, these manufacturers credited the ULPs with cost decreases in California and elsewhere.
- ***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 CFL User 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 (which is not statistically different from California's recent rating).

Assessment of Coincident and Lagging Market Indicators

Key findings from the lagging indicators include:

- ***CFL saturation is significantly higher in California than in the Comparison Area.*** Nearly eight of ten (79%) households in California said they use at least one CFL inside or outside their home, significantly (at the 90% confidence level) more than the 66% of households in the Comparison Area who were using CFLs. In addition, the average California home now has 10.3 CFLs (approximately 29% of all medium-screw base (MSB) sockets), compared to 8.4 CFLs per home in the Comparison Area (approximately 22% of all MSB sockets)—a statistically significant difference.
- ***During fall 2008, CFL sales per household were higher in the Comparison Area than in California, but CFLs 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 the past three months (47%) than in the Comparison Area (57%); if the sales figures are examined as a market share (the percent of all bulb sales that are CFLs), the CFL market share in California was higher (30%) than in the Comparison Area (24%). This suggests that the higher saturation of CFLs in California homes may be leading to fewer bulb sales, and thus fewer CFL sales per home compared to the Comparison Area.¹⁰
- ***The California ULPs had a small positive effect on CFL purchases in 2008 and a larger effect on current CFL saturation.*** CFL programs also had an effect on prior CFL use and the length of time respondents had used CFLs. The estimated total net impact (including free ridership, spillover, and impacts of prior program activity) for California in 2008 is 0.23 (or 23%). Using this value, the IOUs' CFL programs would claim only

¹⁰ While we found California homes to have fewer medium screw-base sockets than homes in the Comparison Area, the difference was not statistically significant. Socket counts per household, therefore, do not seem to explain the differences in California and Comparison Area CFL sales or market shares.

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23% of the savings they had assumed would result from the 2008 ULP. However, given the positive relationship between program activity and prior CFL use, it is likely that the total net impacts for 2006 and 2007 were higher. In 2008, in contrast, our research shows fewer differences in sales between program and nonprogram areas. Unfortunately, the model does not allow us to estimate how much higher the total net impacts may have been in 2006 and 2007.

ES.3 Conclusions

Estimate Cumulative Effects of CA Programs on the CFL Market

One of the key goals of the study was to estimate the cumulative effects of California's energy-efficiency programs on the CFL market. While the interviews provided fairly strong qualitative evidence and some quantitative evidence that there were effects from the ULP at one time (e.g., changes in awareness of CFLs, attitudes and acceptance of CFLs, CFL availability, and declines CFL prices), most of the analyses of current market conditions yielded no quantitative evidence of market effects at the end of the 2006 to 2008 program cycle.

Though they may initially seem contradictory, we believe these findings actually tell a consistent story. The upstream market actor interviews asked respondents about their perceptions of the ULP in 2006 through 2008 (and some questions included earlier time periods). Data for other, more quantitative analyses (i.e., CFL User Survey, In-Home Survey, Shelf Stocking Surveys, pricing analysis, and regression analysis), however, was collected in 2008 and 2009. Thus, the CFL Market Effects Team reasons the upstream interviews provide evidence California's programs caused market effects in both California and nationally in the past, and the quantitative analyses provide evidence that these effects have largely eroded over the past two years.

Additionally, we have identified several other phenomena that likely contributed to our findings:

- ***Increasing CFL Saturation in California, Leading to Fewer Recent CFL Sales per Household.*** Because of the long expected useful life of CFLs, as the saturation of CFLs increases, one would expect to see fewer sales of all bulbs—including CFLs and incandescents—per household. Data from the CFL User Survey seemed to suggest this phenomenon may be playing a role in the lower number of CFL sales per household in California versus the Comparison Area.
- ***Dominance of Large National ENERGY STAR Partners in Driving up Sales Nationally.*** The analysis showed national ENERGY STAR Partner square footage was consistently a very strong predictor of ENERGY STAR Partner CFL sales across U.S. states. This fact, coupled with the lack of significance of the program variable in the regression analysis, suggests large ENERGY STAR retailer partner (e.g., Wal-Mart and Home Depot) sales may currently have such an overwhelming effect on the national CFL market that variations in the larger retailers' presence in each state simply drown out the signal from other influences on sales, including programs.
- ***Shift of Sales (i.e., Channel Shift) in California from Large National ENERGY STAR Partners to other Distribution Channels.*** The stakeholder interviews suggested the programs have succeeded in introducing and stimulating CFL sales in distribution channels that have not traditionally carried CFLs, such as ethnic groceries and discount stores. This could mean that CFL sales from non-traditional retail channels have come at the expense of CFL sales from more traditional channels (i.e., sales in the National

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ENERGY STAR Partner stores have shifted to non-traditional channels, therefore the overall CFL sales per household for the Partner stores are lower), although available data does 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 have increased availability of CFLs in grocery stores, discount stores, and hardware stores, even in very recent years. 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 has occurred in California), it means 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.

Quantify kWh and kW Savings not Claimed as Direct Savings

Another goal of the CFL Market Effects report is 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 a regression approach, this study estimated that cumulative 2008 total net impacts, inclusive of both free ridership and spillover, were 0.23 (i.e., 23% of IOU claimed gross savings). This estimate, although inclusive of market effects, is lower than the estimated NTG ratio in the Residential Retrofit Upstream Lighting Report, which recommends a NTG of 0.54 across the three IOUs.¹¹ These studies, however, differ in a number of important ways:

- The net effects estimate for this study is only based on a 2008 model, whereas the ULP report estimates the NTG for 2006-2008;¹²
- The net effects estimate for this study is based on a model of cumulative net effects *realized in 2008*, whereas the ULP report estimates the NTG *caused* in 2006-2008. In other words, impacts from previous program cycles are included in the market effects approach (e.g., higher saturation will reduce total sales estimates), whereas the ULP report attempts to isolate impacts from the 2006-2008 cycle.

Taken together, the findings did not provide evidence that market effects in the form of energy/demand savings (nonparticipant spillover) can be unequivocally claimed or quantified due to 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 been significantly higher than—the 2008 estimate.

¹¹ Draft Evaluation Report: Upstream Lighting Program, Prepared by Kema and Cadmus for the CPUC, December 10, 2009.

¹² The reasons for including only the final program year are that (1) the development of the total and baseline sales estimates requires a substantial amount of data, and (2) because this study was not initiated until 2008, earlier data were not available.

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Had the data required for the regression model (from either retailer or manufacturer sales data, or from customer telephone surveys and the onsite lighting audits fielded in California, the Comparison Area, and the other regions) been collected in *each program year*, the study would have had sufficient information to estimate cumulative net program effects for the entire 2006-2008 ULP period. Furthermore, had a reliable estimate of cumulative net program effects for 2005 and earlier been available, the study 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

Market effects from upstream CFL programs have been claimed as savings throughout the United States. Recent evaluations in Massachusetts (2006), Vermont (2005), and New York (2005), in fact, have identified NTG ratios (inclusive of free ridership and spillover) that exceeded 100%. In other words, in the relatively recent past, the programs found total CFL sales in the respective utility service territories were far greater than they would have been in absence of the program, so the utilities could claim savings from more CFLs than they incented. Given the intensive marketing and outreach nature of these programs, the substantial price buy-downs they offered, and the nascent CFL market a few years ago, these findings do not appear unreasonable.

However, the CFL market has changed substantially in more recent years and the findings from this report indicate that the baseline for CFL sales has risen throughout the U.S., including regions with no utility efforts to promote CFLs. Because this study did not find evidence that market effects energy/demand savings attributable the 2006-2008 ULP can be unequivocally quantified, we conclude that market effects savings from the CFL programs *cannot* be 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.

ES.4 Recommendations

The CFL Market Effects Team drew on the key findings and conclusions described above to formulate recommendations for this study. Decisions about policy changes and changes to program design, however, are the responsibility of the CPUC and are beyond the scope of this study.

Sustainability and Future Program Direction

The IOU programs continue to influence CFL sales in California, but that influence is not essential for the market to sustain itself. Despite a recent drop in U.S.CFL sales that may reflect the economic recession, increased CFL saturation, and other factors, areas in the U.S. where there are no utility sponsored program activities are rapidly “catching up” to California and other states that have mature CFL programs.

Despite years of aggressive promotions, price discounts, and increased availability in additional distribution channels, however, California CFL saturation remains at approximately 21% of all sockets (and approximately 29% of MSB sockets). There are various reasons why these remaining sockets have yet to be replaced with CFLs, including use of lighting controls for dimming, dissatisfaction with CFLs, lack of awareness, and lower hours of use for remaining sockets (reducing the cost-effectiveness of this measure).

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The buy-down approach, even under the market transformation paradigm, may have run its course for “plain vanilla” CFLs. The decline in nationwide CFL sales over the past two years notwithstanding, the CFL Market Effects Team expects the CFL market to rebound.¹³ Though it is difficult to forecast the timing or strength of this rebound, we believe factors such as the momentum exhibited by the CFL market prior to the recession, the public’s increasing concern about global climate change and, in several years, implementation of the impending federal lighting efficiency standards (the Energy Independence and Security Act of 2007, or EISA) will ultimately result in increasing CFL sales trends. For sockets that do not require specialty bulbs, utilities should consider an aggressive resource acquisition approach, such as a resource acquisition that targets groups least likely to use CFLs.¹⁴

The market for specialty CFLs still faces many of the barriers faced by standard twistlers just a few years ago, including quality concerns, high pricing, availability, and lack of consumer awareness. A buy-down approach, therefore, may still be viable for specialty bulbs. Continued consumer education about the variety of CFLs available, appropriate CFL applications, and proper CFL disposal should also be a key component of future CFL programs.

Suggestions for Changes to Market Effects Evaluation Protocol

One of the greatest challenges the CFL Market Effects Team faced in trying to quantify the energy/demand savings from market effects of the 2006-2008 ULP was the lack of earlier market effects data—both to establish a (pre-2006) baseline, and to understand the market effects for the first portion of the program period.¹⁵ While the Market Effects Evaluation Protocol states, “a baseline study must be conducted as early as possible,” we recommend some subtle but important changes to the scoping study section of the Protocol. Specifically, we recommend that through the scoping study the evaluation contractor be required not only to conduct a thorough review of relevant past studies, but also to explicitly delineate the quality and usefulness of any extant baseline data. CPUC-ED should then use this assessment of baseline data availability to define the timing and scope of the subsequent market effects study.

In addition, the CFL Market Effects Team recommends the scoping study be required to include a description of the market’s evolution over time. Documentation of the market history provides a context for the market effects assessment. An understanding of this context may be of critical importance if, for example, significant program impacts occurred prior to the timeframe under evaluation.

Once a market effects study has been authorized, the Market Effects Evaluation Protocol recognizes two approaches for estimating causal attribution: preponderance of evidence and modeling. The CFL Market Effects Team endeavored to assess the markets effects attributable to California’s 2006-2008 ULP using the preponderance of evidence approach for some metrics (e.g., CFL awareness, availability, and the program’s effect on CFL pricing) and modeling for others (i.e., energy and demand savings). We found the preponderance of evidence approach—in

¹³ Total CFL imports to the U.S. peaked in 2007 at 397 million, dropped to 337 million in 2008, and are projected to drop to 250 to 275 million in 2009. The discussions with upstream market actors indicate the economic recession, perhaps coupled with other factors, played a major role in the this CFL sales downturn.

¹⁴ Earlier studies have found that CFL purchasers are more likely to have a graduate degree, live in single-family homes, to own (rather than rent) their homes, and to have middle or high incomes. See for example Nexus Market Research, Inc. and RLW Analytics, Inc. 2004.

¹⁵ This study was initiated in early 2008—more than two years into the three-year program period.

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this case employing customer surveys, in-home lighting audits, retail shelf stocking surveys, and trade ally surveys—worked well for qualitatively assessing the market effects attributable to California’s ULP.

However, modeling the nonparticipant spillover effect of an upstream program on the market as a whole—without the benefit of adequate annual sales data or being able to readily identify end use customer participants—poses unique challenges. In light of the challenges inherent in modeling the market effects attributable to upstream energy-efficiency programs, we suggest the Protocol allow for the estimation of *total net effects* (i.e., a net-to-gross ratio that is inclusive of free ridership, participant spillover, and nonparticipant spillover) for upstream programs rather than focusing solely on nonparticipant spillover.

Suggestions for Future Market Effects Evaluation Work

In the endeavor to accurately estimate the magnitude of CFL market effects, the assessment 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 and the more recent national downturn in sales, makes it extremely difficult for any program state, including California, to now 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 be less costly by using longitudinal analytic approaches that implement ongoing data collection activities.

In addition to establishing baseline and ongoing, more regular data collection, this study has a number of other methodological recommendations for CFL or other market effects studies, including:

- The multistate regression approach improves on the simple difference of means (i.e., delta sales) approach by controlling for other factors that impact sales of energy efficient measures, including income, education, housing characteristics, and utility rates.
- The key to successful implementation of the multistate approach is collecting good estimates of sales, which, for lack of reliable secondary data, requires consistent approaches across states in terms of primary data collection activities (survey questions, time horizons, etc.).
- Shelf-stocking surveys are less useful as a proxy for sales since they cannot fully capture sell-through rates (i.e., lowest cost products may have sold quickly and not be available during the stocking survey), but they are valuable for understanding availability and pricing characteristics.
- Future studies should also consider examining a diffusion of technology curve to understand how efficiency gains in California might impact standard practices in other areas of the country.

Market effects studies also provide important market characterization findings that can inform both impact evaluations and program planning efforts. For example, the primary data collection

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activities taken for this study produced estimates for a number of important parameters, including:

- Upstream interviews: A qualitative estimate of historic and current market effects
- CFL user survey and in-home lighting audits: Saturation, penetration, current buying patterns
- Shelf stocking surveys: Current offerings (model types, features), stocking patterns, and program pricing effects (e.g., pricing multiplier effects) across all retailer channels and differences by retail channel.

1. INTRODUCTION AND OVERVIEW

The investor-owned electric utilities (IOUs) in California—Pacific Gas and Electric (PG&E or PGE), San Diego Gas & Electric (SDG&E or SDGE), and Southern California Edison (SCE)—have been running energy-efficiency programs, with the most recent iteration of these programs rolled out in 2006 for a three-year program cycle that ended in 2008. These programs represent a significant effort to increase the reliability of energy delivery and to control costs for ratepayers in the state. In addition, the programs represent an equally intense effort to manage the environmental impacts of energy consumption in California.

1.1 Background

The California IOU programs are some of the longest running efforts in the country, particularly for compact fluorescent lamps (CFLs).¹⁶ Most of the state's 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 are among the country's largest. In 2006-2008, all the California IOUs reported energy savings representing over 1% of electric sales, some of the highest in the U.S. In 2006-2008, the IOUs rebated over 95 million CFLs through the Upstream Lighting Program (ULP).¹⁷

Over the years, the California IOU efficiency programs have adopted a blend of traditional resource acquisition strategies, modified resource acquisition strategies, and market transformation strategies. These have included varying combinations of direct financial incentives and direct installations for end-user customers, manufacturer buy-down/retailer point-of-sale “buy-downs, consumer education, technical assistance, training, and cooperative advertising. The IOU CFL programs have been intended to work through existing market channels; increase the availability, diversity, and promotion of CFLs through supplier interventions; and increase consumer awareness, knowledge, acceptance, and purchases by affecting the supplier market and consumer marketing. The CFL program administrators have also supported the Program for Evaluation and Analysis of Residential Lighting (PEARL) and national ENERGY STAR lighting efforts in monitoring and improving product quality by funding quality assurance efforts. In addition, the CFL programs have coordinated with and leveraged the national ENERGY STAR program and other local and statewide programs in California, such as Flex Your Power (FYP).

The IOU efficiency programs' maturity, size, and use of resource acquisition and market transformation strategies may have led to changes in the market that otherwise would not have occurred. Such “market effects” may have taken the form of direct energy savings and peak demand reductions. Market effects may also have taken the form of changes in awareness, attitudes, behaviors, product offerings, and reduced product retail prices and production costs. This latter set of changes could create short-term and long-term market structural and operational changes that also (ultimately) result in energy and demand savings. To the extent such market changes are program induced, indirect savings (savings not derived from program participation) would be the program's additional effects.

¹⁶ The CFLs discussed throughout this report are medium-screw base spirals.

¹⁷ Total CFLs based on utility quarterly reporting to the CPUC for the IOU programs that offer incentives to manufacturers to “buy down” the cost of CFLs.

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While market effects for California IOU programs may exist, they are difficult to quantify and are typically not examined. As a result, they typically are not examined. In fact, the California Impact Evaluation Protocol, in accordance with CPUC policy for the 2006-2008 program cycle, is quite specific about not including market effects and nonparticipant spillover in determining the impacts of the IOU programs.¹⁸

Current impact evaluations of energy-efficiency programs in California are limited to addressing the direct impacts of the program on participants and estimating participant spillover impacts.¹⁹ Program-influenced changes in the way a market operates on nonparticipants are addressed in the Market Effects Evaluation Protocol.

1.2 Overview of the CFL Market Effects Study

In an October 2007 decision (D.07-10-032), the CPUC directed its staff to explore (during 2008–2009) the ability to credibly quantify and credit “nonparticipant spillover” market effects. The Market Effects Protocol provides the following definition of market effects:

A change in the structure of a market or the behavior of participants in a market that is reflective of an increase in the adoption of energy-efficient products, services, or practices and is causally related to market interventions...” where a “market” is defined as “the commercial activity (manufacturing, distributing, buying and selling) associated with products and services that affect energy usage.”²⁰

The Market Effects Protocol acknowledges that two types of market effects are recognized in the energy-efficiency industry:

- Those that occur while the program is running and are a result of how the program is changing markets.
- Those that are forecasted to occur after the program has ended and are due to the changes established or put into motion by the program.²¹

The protocol clearly states, however, that it was designed to measure only the first of these two categories – that is, concurrent market effects.²²

The CPUC directed its staff to report its findings following the process evaluation and market impact studies of the 2006–2008 program cycle on the ability of current protocols to measure such “nonparticipant spillover” savings and to propose possible revisions to market effects protocols, utility savings goals, or performance incentive mechanisms for subsequent action by the CPUC. Consequently, the CPUC is examining possible market effects in CFLs, residential new construction, and high-bay lighting. Working with the CPUC, the California Institute for

¹⁸ California Evaluation Protocols, p. 36.

¹⁹ For a thorough evaluation, impact evaluations should estimate direct program savings and participant spillover savings. Whenever possible, these estimates need to be separate, not combined. Current CPUC policy states only direct program savings will be counted towards program and administrator goals and performance (i.e., participant and nonparticipant spillover is excluded).

²⁰ California Evaluation Protocols, pp. 143-145.

²¹ Ibid.

²² Note that because this analysis will not include market effects forecasted to occur later, total market effects may be greater than those estimated here.

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Energy and Environment (CIEE) developed study plans for, and is assisting in overseeing, each of these market effect studies.²³

CIEE and the CPUC chose the Residential Retrofit Impact Evaluation Team to investigate the cumulative effects of California's energy-efficiency programs on the CFL market. The CFL Market Effects Study had three primary objectives:

- Understand the cumulative effects of California's energy-efficiency programs on the CFL market.
- Quantify 2006–2008 kilowatt-hour and kilowatt 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 study was performed as an addendum to the CPUC's scope of work for the Residential Retrofit Impact Evaluation Team. There were extensive overlaps between the data collection needed for the CFL market effects evaluation and the data collection efforts already underway for the Upstream Lighting Program impact evaluation. (The former was designed to meet the requirements of the Market Effects Protocol and allow the measurement of the indirect/nonparticipant effects across utility programs affecting the CFL market, while the latter was designed to meet the requirements of the Impact Evaluation Protocol for measurement of direct savings.) These overlaps included interviews with CFL manufacturers and retailers, in-store visits, in-home surveys, and consumer intercept surveys. The data needs of the CFL market effects study, however, went beyond those of the Upstream Lighting Program evaluation, requiring the exploration of additional topics, larger samples, and far more comprehensive collection and analysis of additional CFL sales data. While the two projects were performed simultaneously, their planning, analysis, and reporting were maintained separately.

The CFL Market Effects Team (the Team) began its study in March 2008. As required by the Market Effects Protocol, the team's first undertaking was a scoping study designed to help gain a better understanding of the evolution of the California and U.S. CFL markets, characterize California's current CFL program offerings, provide integrated market and program theories for California's CFL programs, review CFL market effects studies conducted in other regions of North America, and gain a better understanding of the data sets available for the evaluation of possible CFL market effects in California. The *CFL Market Effects Scoping Study and Work Plan* were finalized on October 31, 2008, and made available to the public via posting on the CPUC's Web site shortly afterwards.²⁴

Because the CPUC needed timely results to inform its strategic planning efforts, mid-way through the CFL market effects study the team presented its then-current findings in an interim report. The *CFL Market Effects Interim Report* was finalized and made available to the public in May 2009 on both the CPUC and CIEE websites.

²³ The CIEE market effects study plans are available at <http://uc-ciee.org/energyeff/energyeff.html>.

²⁴ These documents are also available at CIEE's website at <http://uc-ciee.org/energyeff/energyeff.html>.

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In undertaking this work, the CFL Market Effects Team did not presuppose any particular result; that is, throughout the study the team was neutral on whether there would be market effects and, if there were, whether they would be positive, negative, or some combination of the two.

The remainder of Section 1 presents the theoretical underpinnings of this evaluation and then an overview of the subsequent sections of the report. The study's methodology is discussed in Section 2. We present the study's results in Sections 3, 4, and 5; the CFL Market Effects Team's conclusions and recommendations are presented in Section 6.

1.3 CFL Market and Program Theories

1.3.1 Market Theory and Logic Model

Although there are some code requirements for mandatory CFL installation in the new construction sector, the CFL market in California is primarily driven by voluntary installation of these lamps. CFLs branded as ENERGY STAR compliant were heavily incentivized by utility programs from 2006–2008. The major outlets for CFLs tended to be “big box” retailers, although smaller chains and grocery stores were increasingly carrying them. Non-ENERGY STAR CFLs also had a market presence—as a competing product in some stores and as a flagship product in others such as IKEA.

Market theory for the 2006–2008 programs focused on decreasing consumer barriers to adoption by addressing the perceived lack of information, performance uncertainty, and high initial costs. Supply and availability of CFLs are driven by the demand for product, competition among manufacturers and retailers, and competing demands in the national and international markets. Utility programs and incentives address some of these barriers.

Figure 1 represents the CFL market in California absent the 2006–2008 IOU CFL programs.

Figure 1. CFL Market Model

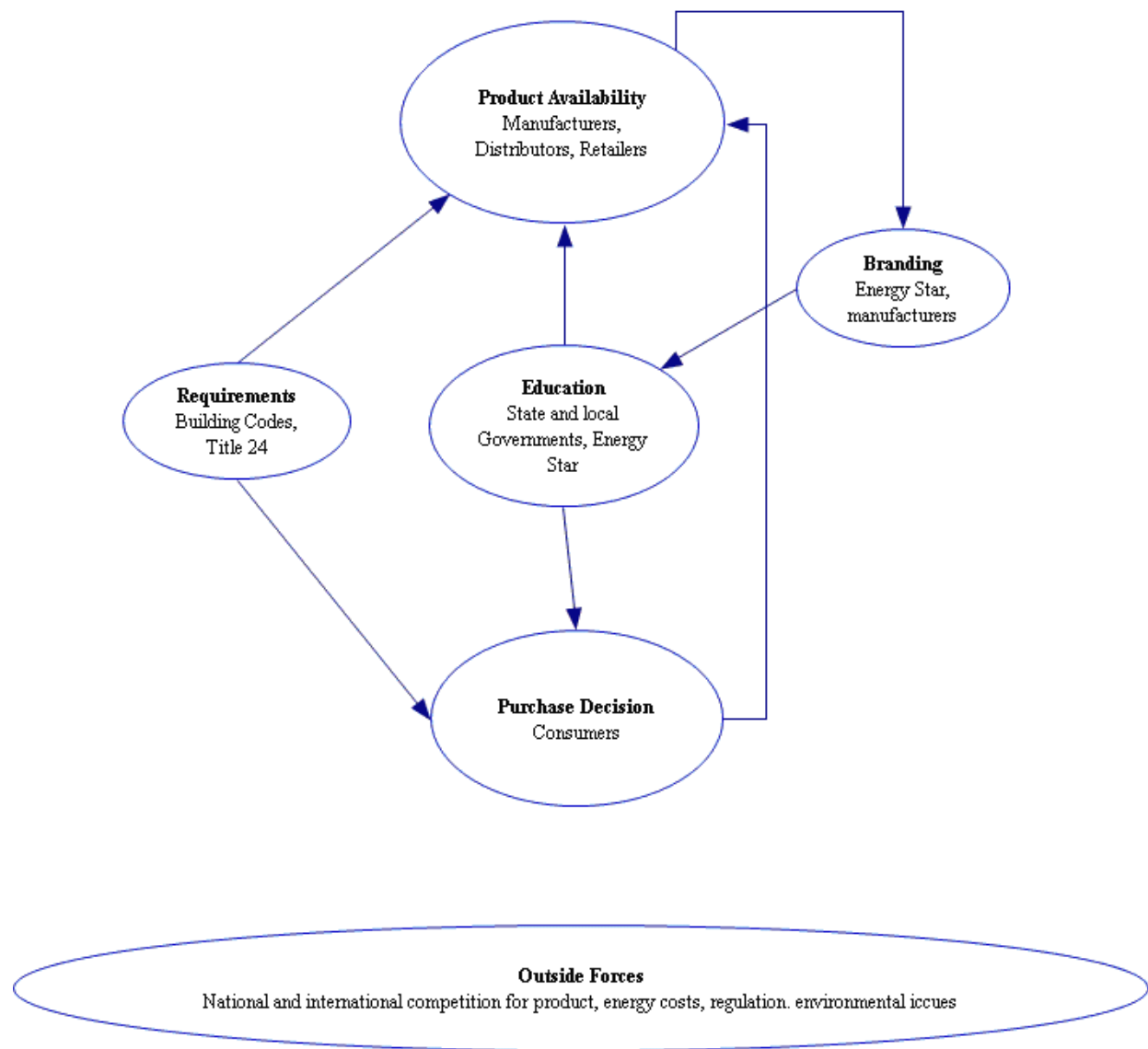


Table 1 summarizes the market drivers and barriers for manufacturers/distributors, retailers, and consumers.

Table 1. Major Drivers and Barriers

Market Actor	Market Driver	Market Barrier
Manufacturers/Distributors	<ul style="list-style-type: none"> • Consumer demand • Economies of scale • Market position • Product availability • Profit motive • Technological breakthroughs 	<ul style="list-style-type: none"> • Current practice–performance uncertainty • Retailer purchasing decisions • Information costs • Profit motive²⁵
Retailers	<ul style="list-style-type: none"> • Consumer demand • Product availability • Market position 	<ul style="list-style-type: none"> • Current practice • Information costs • Performance uncertainty
Consumers	<ul style="list-style-type: none"> • Operating cost savings • Early adoption • Environmental ethic 	<ul style="list-style-type: none"> • Information costs • Performance uncertainty • High first costs

1.3.2 Program Theory and Logic Model

The program theory for the California IOUs' 2006–2008 ULP is reflected in the logic model presented in Figure 2. By encouraging customer and retailer participation through direct outreach, by encouraging manufacturer participation through incentives, and by coordinating program design across utilities, the ULP sought to increase the demand for CFLs, increase CFL availability and sales volumes, decrease CFL retail prices, reduce performance uncertainty, and encourage the adoption and availability of new products (with greater energy efficiency or additional functionality).

Improvements to CFL retail prices and availability were theorized to result from increasing economies of scale, adoption of CFLs as “common practice,” and increasing market presence in nonprogram settings.

To render Figure 2 a truly useful logic model, it was designed to be as simple as possible while still capturing all of the basic elements of the theory and the linkages among these elements. The elements of the logic model are:

- **Activities** the program undertakes: coordination among the utilities, program design activities, and outreach, including incentives.
- **Outputs** the program produces: primarily outreach materials, including store displays, events, advertising, and direct outreach.
- **Outcomes** that result:
 - In the **short term**, expected outcomes include changes in awareness and knowledge, some price effects, and increasing product availability and diversity.
 - In the **medium term**, the program's effects are expected to deepen to encompass a reduction of market barriers, increased product availability, increased price

²⁵ Profit motive can be perceived as a potential market driver and as a barrier. For example, manufacturers that exclusively produce CFLs are driven by a profit motive. Larger manufacturers that produce CFLs as well as other lighting products, however, may perceive CFL sales as detracting from sales of other products.

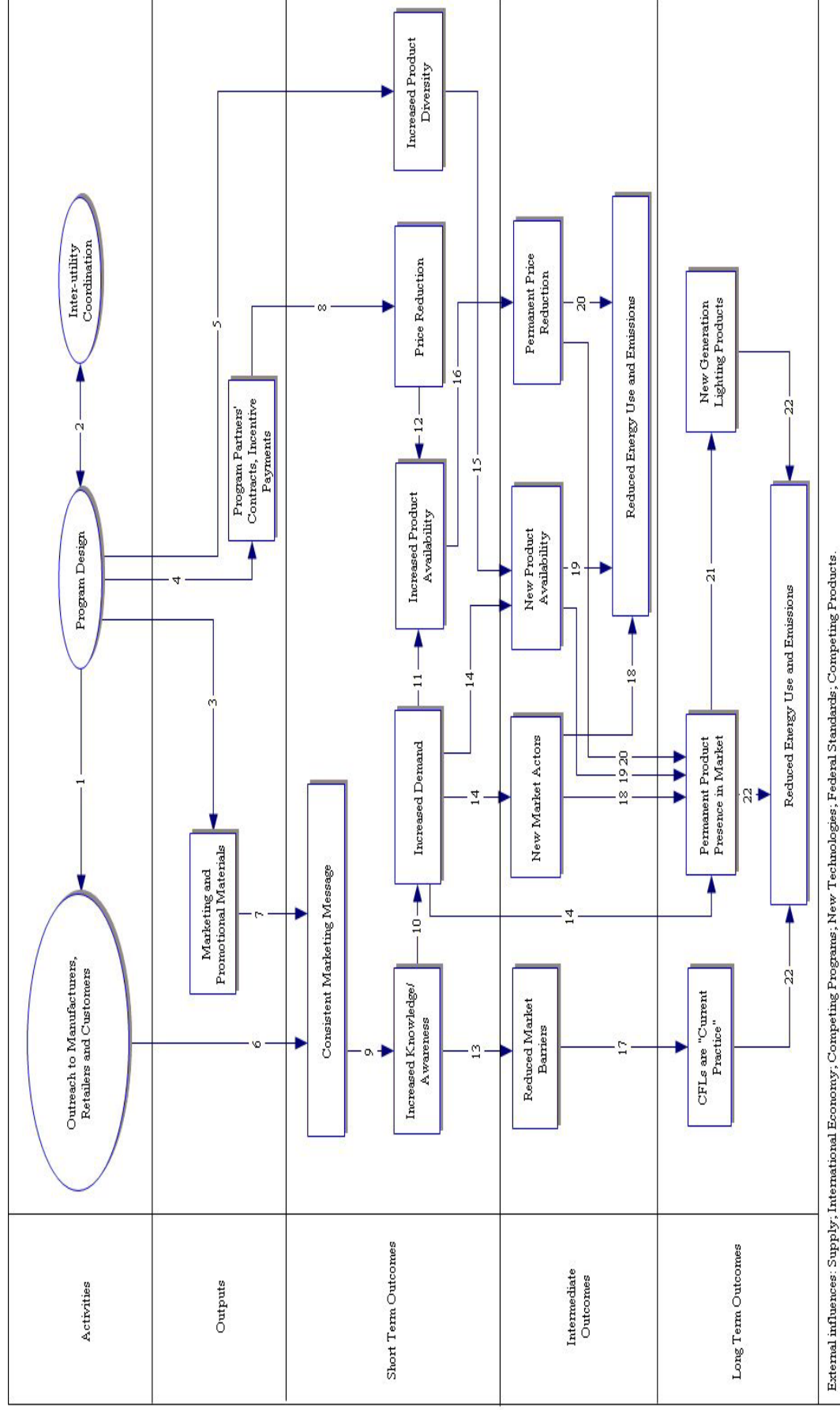
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effects, reduced energy use and emissions, and increased effects outside of the program.

- Finally, in the *long term*, outcomes include fundamental changes in the way customers view CFLs, the widespread availability of CFLs in the market, and the beginning of a transition to the next lighting technology.

Table 2 describes the linkages among the elements and presents a list of progress indicators proposed to evaluate the elements and their linkages.

Figure 2. Upstream Lighting Program Logic Model



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Table 2. ULP Logic Model Links: Working Hypotheses and Indicators

Link	Working Hypotheses	Indicators
1	Outreach to manufacturers encourages the availability of product and marketing to retailers; outreach to retailers ensures program participation and increases availability of market channels; outreach to customers addresses information barrier and raises awareness	Satisfaction with the program, the products, and the marketing materials; number of events, bill inserts, and promotional materials
2	Inter-utility coordination ensures that the program is a consistent, statewide activity and that utility efforts are coordinated	Meetings scheduled; work papers; agreements; program changes
3	Consistent program design leads to consistent development of outreach materials	Content of outreach materials; number of program announcements and promotions; availability of materials
4	Program design leads to implementation, including contracts with, and incentive payments to, program partners	Contracts with upstream program partners; incentive payments to program partners
5	Program design encourages increasing diversity of product	Measures added, modified or deleted; lumen output increases
6	Standardized outreach to manufacturers, retailers and customers includes consistent marketing messages	Lack of confusion among retailers and customers on marketing messages
7	The development of marketing materials in a standardized way will lead to consistent marketing messages.	Lack of confusion among retailers and customers on marketing messages.
8	Program incentives reduce the price of available measures	Comparison of price between participating and nonparticipating retailers and manufacturers, and during program- and nonprogram periods.
9	Consistent marketing message leads to increased information and awareness	Customer general knowledge of benefits of CFLs; customer awareness of products, availability and advantages
10	Increased knowledge and awareness leads to increased demand for product	Increased customer satisfaction, increased sales of program and nonprogram products
11	Increased demand leads to increased product availability	Increased sales during nonprogram periods; increased sales in nonparticipating retailers; new manufacturers entering the market
12	Program-induced price reduction affects price of nonprogram products	Product prices in nonparticipating retailers; product prices for nonparticipating products
13	Customer market barriers are decreased due to increased knowledge and awareness among retailers and customers.	First cost; performance uncertainty; knowledge and awareness
14	Increased customer demand leads to new actors entering the market, new products, new product availability, and eventually permanent market presence	New manufacturers; product available in non-mass market outlets, specialty stores, etc.; new products, price reductions; overall sales

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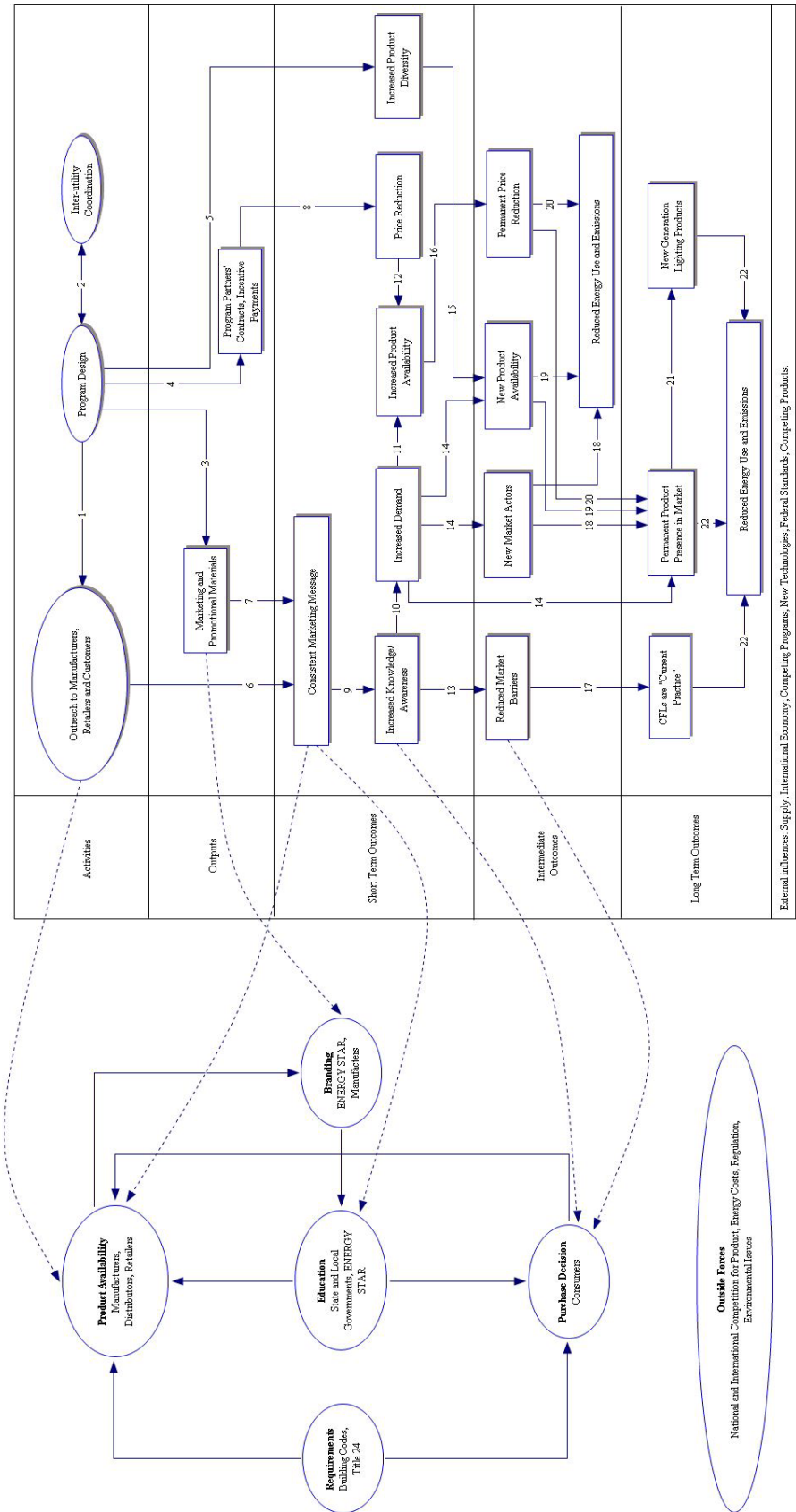
Link	Working Hypotheses	Indicators
15	Increased product diversity means new products become available	Increasing lumen quality; availability of three-way and other specialty products
16	Increased availability lowers costs on a permanent basis	Nonparticipant retailer price differential decreased; nonparticipating product price differential approaches zero; no differences between event and nonevent prices.
17	Reduction of market barriers leads to CFLs becoming standard bulbs	Number of sockets increases; incandescents replaced with CFLs; older CFLs replaced with the same or better models; sales of incandescent bulbs decrease
14 18 19 20	New market actors, new products, lower prices, and increased demand lead to CFLs being a commodity product like incandescents	Overall sales; lower prices, reduced energy use and emissions
21	New technologies begin to penetrate the market and replace CFLs	Sales of LEDs and other new lighting products
22	Market saturation of CFLs and introduction of new technologies lead to long-term energy and environmental impacts	Reduced energy use; reduced emissions

1.3.3 Integrated Market and Program Logic Model

Figure 3 combines the market logic model with the ULP logic model to show how the IOU program interacts with the overall market. The dotted lines show the alignment of the ULP to the market model. With the exception of the mandatory requirements, which are addressed by the IOU nonretail programs,²⁶ there appears to be good congruence.

²⁶ As noted earlier, the ULPs account for over 95% of the California IOUs' CFL savings claims; therefore, nonretail programs were not modeled.

Figure 3. CFL Market and CA IOU ULP Integrated Logic Model



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1.3.4 Testable Hypotheses and Researchable Issues

To determine whether the market has been influenced by the IOU CFL programs—and if so, to what extent—the CFL Market Effects Team developed the list of researchable issues presented in Table 3.²⁷ The center column of the table shows the research activities the team conducted in an effort to address each question. The right-hand column maps the researchable questions to the sections of this report in which they are addressed.

Table 3. Researchable Issues and Associated Research Activities

Hypothesis/Researchable Issue	Primary Research Activities	Report Section(s) that Address Issue
1. Are new actors entering the market and attributing their entry to the influence of the program?	Upstream Interviews	Section 3.2
2. Have ULP incentives reduced the price consumers pay for IOU-sponsored CFLs in California? a. To what degree have any of the incentives paid to upstream market actors been passed on to consumers? b. What fraction or multiple of the upstream incentives is passed on to consumers in the form of lower retail prices? c. Does the impact of ULP incentives vary by IOU or sales channel?	Shelf Stocking Survey Pricing Analysis	Section 3.3
3. To what extent have IOU incentives resulted in lower retail prices for non-discounted CFLs and CFLs discounted by non-IOU market actors?	Pricing Analysis	Section 3.3
4. Are consumers able to distinguish between program and non-program CFLs?	CFL User Survey	Section 3.1
5. How do CFL sales at participating retailers compare to sales at nonparticipating retailers? a. Have sales of CFLs increased over time? b. Has the saturation of CFLs increased over time?	Shelf Stocking Survey In-Home Survey Historical Saturation Data	Section 4
6. To what extent is customer behavior guided by external influences such as ENERGY STAR outreach, energy and gas prices, and environmental issues?	CFL User Survey M&O Findings	Section 3.1
7. To what extent are manufacturers influenced by competing demands for CFLs, and to what extent have product costs shrunk due to economies of scale?	Upstream Interviews	Sections 3.2, 3.3
8. Are new products and specialty CFL products entering the market due to IOU coordination and incentives?	Upstream Interviews Shelf Stocking Survey	Section 3.2

²⁷ Note that the phrasing of these researchable questions has been refined during the course of this study. For this reason, the phrasing shown here differs slightly from that originally presented in the *Compact Fluorescent Lamp Market Effects Scoping Study and Work Plan*, although the intent/nature of the questions remains the same.

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Hypothesis/Researchable Issue	Primary Research Activities	Report Section(s) that Address Issue
9. To what extent are non-incentivized CFLs being adopted by consumers?	CFL User Survey In-Home Survey Shelf Stocking Survey	Section 4
10. To what extent are products promoted through the program available in nonparticipating retail outlets?	Shelf Stocking Survey	Section 3.2
11. Where do adopters of incentivized CFLs get their information about CFLs in comparison to where non-adopters get their information? How does this affect the decision or adopter in comparison to other inputs to these decisions?	CFL User Survey	Section 3.1
12. To what extent have the IOU programs caused the changes identified in this research?	Upstream Interviews CFL User Survey In-Home Survey Shelf Stocking Survey	Sections 4.3, 5.1, 5.2

1.4 Overview of the CFL Market Effects Final Report

In this report, the CFL Market Effects Team presents its assessment of the cumulative effects of the California IOUs' 2006–2008 ULPs on the CFL market. Our evaluation involved a number of primary data collection efforts and both qualitative and quantitative analyses. Our assessment is based on assembling and triangulating all study data including: CFL market and program sales data, market actor interviews and surveys, retail store shelf stocking data, data gathered about lighting products in consumers' homes, and analytical data (e.g., regression modeling). The team's assessment takes a "preponderance of evidence" approach through which we "construct an argument as to just what has transpired based on the convergence of evidence from a wide range of sources, and the consistency of this evidence with the program theory."²⁸

The primary data collection activities, analyses, and coordination efforts that were used in this assessment are the following:

- Primary data collection activities
 - o CFL User Telephone Survey: Conducted in California and in three baseline comparison states (Georgia, Kansas and Pennsylvania) to query consumers about their familiarity with CFLs, CFL purchases, and CFL usage to gain insight into the differences between CFL market penetration rates in California and nonprogram states.
 - o In-home Lighting Audits: Conducted in California and in three baseline comparison states to verify respondents' answers to the CFL User Survey and to gain insight into the saturation of CFLs in homes.

²⁸ *CFL Market Effects Study, Final Study Plan*. Prepared by Ralph Prael for CIEE Market Effects Team. January 16, 2008 (available at <http://uc-ciee.org/energyeff/energyeff.html>).

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- o Shelf Stocking Survey: Conducted in California and in three baseline comparison states as another means of estimating and comparing CFL stocking, pricing, and availability in California to CFL stocking, pricing, and availability in the Comparison Area.
- o Manufacturer and retailer interviews: Designed to supplement the (primarily participant) manufacturer and retailer interviews conducted for the Residential Retrofit Impact Evaluation by (1) eliciting information from nonparticipating large/national retailers, (2) eliciting information from nonparticipant smaller/independent corporate-level retailers in California and the Comparison Area, (3) eliciting information from retail stores in California and the Comparison Area, and (4) incorporating questions in the participant interviews that were explicitly related to market effects.
- Analyses
 - o CFL market and program evolution: Described the history of the CFL market and CFL promotional programs in California and throughout the U.S. using quantitative (e.g., CFL sales, CFL retail prices) and qualitative (e.g., consumer familiarity and satisfaction with CFLs) metrics.
 - o Comparison state analysis: Used as the team's primary approach to estimating the market effects attributable to the IOUs' CFL programs; compared CFL sales in baseline states, where minimal/no CFL promotional activity has taken place, to sales in California to gain an understanding of what the CFL market in California would have looked like in the absence of programs.
 - o Regression analysis: As another means of analyzing the market effects attributable to the IOUs' CFL programs, the team participated in a multistate effort to develop a statistical model that estimates CFL sales at the household level as a function of a number of explanatory variables.
 - o Attribution analysis: Pulled together results from the primary data collection activities and earlier analyses to estimate the number of CFLs attributable to the IOUs' CFL programs, beyond those attributable either directly from programs or through participant spillover.
 - o Net savings analysis: Computed the energy and demand savings attributable to the program from market effects.
 - o Program-induced market effects on CFL pricing: Assessed the effect of the IOUs' CFL programs on the retail prices of CFLs.
 - o Sustainability analysis: Assessed what would happen to California's CFL market if the IOUs' programs were discontinued or significantly scaled back.

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- Coordination Efforts
 - Customer intercept surveys.²⁹
 - Leveraging marketing and outreach (M&O) evaluation activities.
 - Coordination with Residential Retrofit Evaluation and DEER Database Teams.
 - Other inter-contract group coordination.

The remainder of this report is organized around our findings regarding specific potential market effects and researchable questions. The discussion in each section draws on the relevant combination of the data collection, analysis, and coordination activities listed above to document the study's results. It is structured as follows:

- Section 2 discusses the study's overall methodology and the specific methodologies we employed for each of the primary data collection, analysis, and coordination tasks.
- Section 3 provides an assessment of leading indicators for the CFL market (i.e., the early indications of changes in the level of CFL market activity; leading indicators may be used to predict a forthcoming change in market activity).
- Section 4 presents assessments of coincident CFL market indicators (i.e., signs that the level of CFL market activity is changing that occur concurrently with the altered level of activity)—namely CFL sales, and lagging CFL market indicators (indications in changes in the level of CFL market activity that occurred after the level had changed)—namely CFL saturations.
- Section 5 discusses our approach and findings regarding the quantification of the energy and demand savings not claimed as direct savings from the ULP.
- Section 6 presents the study's conclusions and recommendations.

Some of the detailed task descriptions, results, and survey instruments used in this study and contributing to the findings in this report were presented in the *Compact Fluorescent Lamps Market Effects Final Interim Report*, while others have been developed since May 15, 2009, when that document was published. The appendices to this report include documents pertaining only to those tasks and survey instruments that were completed after the publication of the interim report. They are:

Appendix A: In-Home Audit Findings

Appendix B: Comprehensive Shelf Stocking Survey: Sampling Plan and Survey Instrument; In-Store Retailer Interview Guide

Appendix C: Comprehensive Shelf Stocking Survey Findings

Appendix D: 2009 Participant Manufacturer and Corporate-Level Retailer Interview Guides

Appendix E: 2009 Participant Manufacturer and Corporate-Level Retailer Survey Findings

²⁹ The Residential Retrofit Evaluation Team conducted point-of-sale research with customers purchasing lighting products at participating retailers throughout California. Trained researchers "intercepted" customers after they had made lighting purchase decisions and recruited them to participate in a brief in-aisle survey. The positioning of the researchers coupled with the timing of the surveys enabled the researchers to discuss the range of light bulbs available at the stores with customers who had just selected from among those products.

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Appendix F: Nonparticipant Manufacturer and Nonparticipant Corporate-Level Retailer Survey Instruments

Appendix G: Nonparticipant Manufacturer and Nonparticipant Corporate-Level Retailer Survey Findings

Appendix H: Store-Level Retailer Telephone Survey Instrument and Sampling Plan

Appendix I: Store-Level Retailer Telephone Survey Findings

Appendix J: Hedonic Pricing Model Finding

Appendix K: Multi-State Attribution Analysis Regression Model Findings

Appendix L: References

Appendix M: State-Level CFL User Survey Findings For Comparison Area

To aid the reader in locating specific survey instruments and their associated results, we provide Table 4 as a reference.

Table 4. Location of CFL Market Effects Data Collection Documents

Data Collection Activity/Document	Location of Survey Instrument		Location of Survey Findings	
	Interim Report	Final Report	Interim Report	Final Report
CFL User (telephone) Survey	Appendix B	NA	Section 4; Results for Comparison Area II are in Appendix C	NA
In-Home Survey	Appendix E	NA	NA	Appendix A
Comprehensive Shelf Stocking Survey	NA	Appendix B	NA	Appendix C
In-Home Survey Procedures Guide	Appendix F	NA	NA	NA
2008 Participant Upstream Market Actor Interviews	Appendix D	NA	Section 5	NA
2009 Participant Upstream Market Actor Interviews	NA	Appendix D	NA	Appendix E
Nonparticipant Manufacturer and Corporate-Level Retailer Interviews	NA	Appendix F	NA	Appendix G
Store-Level Retailer Survey	NA	Appendix H	NA	Appendix I

2. METHODOLOGY

As suggested in the CIEE CFL Market Effects Study Plan, the CFL Market Effects Team focused on quantifying the market effects *realized* during the 2006–2008 program timeframe, providing only qualitative insights into the portion of these savings that were also *caused* during 2006–2008. Due to data limitations and the timing of this study, our focus is on the 2007 and 2008 program years.

2.1 Overview of the CFL Market Effects Approach

Market effects can be measured by analyzing the difference between total energy-efficiency market share realized in the presence of a program and the market share that would have been attained absent any program activities. Given the external influences on the CFL market, including a Wal-Mart initiative to double its CFL sales in 2007 (i.e., in the middle of the 2006–2008 program period), promotion of CFLs by the popular press as a strategy for individuals to address climate change, and passage of the federal Energy Independence and Security Act of 2007 (EISA 2007) requiring more-efficient lighting beginning in 2012, it is clear that a number of important factors—aside from the ULP—influenced sales of CFLs in California. Baseline sales estimates were, therefore, critical to assessing the importance of these other influencing factors.

There are at least three approaches to estimating baseline sales:

- Examining sales per household in a group of comparison states that do not offer CFL programs.
- Developing a regression model to predict sales per household as a function of program activity and other influencing factors.
- Selecting a set of retailers and comparing California sales to sales in comparable metropolitan areas that do not have programs.

2.1.1 Comparison State Approach

The primary approach the CFL Market Effects 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 utility- or government-sponsored CFL promotional efforts.³⁰ The presumption was that the CFL sales in these states would approximate what sales would have been in California without the CFL programs.

The selection of the comparison states (explained in greater detail in Section 2.3.2) was based on a mix of socio-economic indicators, including median household income and education levels (percentage of college graduates), comparable to those in California.³¹ This approach has been used—and accepted by regulators—in recent evaluations of programs in Wisconsin and Massachusetts. The primary shortcoming of this methodology was that no single state directly compared to California, which is often considered a country unto itself given its size (land area is

³⁰ The approach used to select the comparison states is described in more detail later in Section 2.3.2.

³¹ A detailed discussion of the comparison state selection process can be found in the Compact Fluorescent Lamps Market Effects Scoping Study Findings and Work Plan, October 31, 2008 (available at <http://uc-ciee.org/energyeff/energyeff.html>).

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third in the U.S.), population (first in U.S.), economy (first in U.S. and between seventh and tenth in the world depending on sources), resources (oil, gas, minerals, etc.), and politics. To mitigate this issue, three states (Georgia, Kansas, and Pennsylvania), rather than one, were chosen for the purposes of comparison. Throughout this evaluation, we compare the findings for California with findings from those states, which are referred to collectively as the Comparison Area.

2.1.2 Regression Model Approach

Another approach for estimating baseline sales is the use of a regression model. The development and use of a regression model enables CFL sales to be predicated as a function of a comprehensive list of explanatory variables, including the level of program activity, socio-economic characteristics, energy prices, and population center distribution (urban/suburban/rural).

The primary advantage of a regression-based approach is its ability to control for a comprehensive list of factors that can affect CFL sales (e.g., income, education, economic conditions, utility rates, program length/effort, and big-box store saturation) that cannot all be captured through a California vs. Comparison Area approach.

The primary limitation of the regression-based approach is that it requires CFL sales estimates for as many data points (e.g., states, individual consumers) as possible. 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 multi-state regression effort that developed following the initial efforts of this evaluation. The CPUC joined other sponsoring organizations and agreed to pool its data for use in the multistate analysis that modeled CFL purchases, use, and saturations at the household—rather than the state—level. The collaborative effort drew on data from 16 states including California and produced results with a level of rigor that otherwise would not have been affordable.

2.1.3 Store-to-Store Comparison Approach

The third approach to estimate baseline sales is to compare CFL sales for a selected retail chain or set of chains in California and a set of carefully matched stores both in and out of California. The advantages of this approach, identified in the CIEE Study Plan, are that it may provide data over a period of years (depending on the cooperation of the retailers) and, by providing data in multiple states, helps to balance out the nonprogram variables that affect CFL sales.

While the store-to-store comparison is a potential approach to estimating baseline sales, the CFL Market Effects Team decided not to pursue it for a number of reasons:

- ***Retail store sales vary dramatically based on socio-economic variables and other factors.*** Retail CFL sales vary dramatically between stores based not only on program activity but also on the socio-demographics and other variables presented above. The process of matching stores is problematic, particularly without the use of a regression model that can control for as many variables as possible.
- ***Product market share varies dramatically by state.*** The 2006–2008 ULP in California made tremendous progress in promoting CFL sales in distribution channels that have had low CFL sales, including grocery stores and bargain (e.g., dollar) stores. CFL sales in some of the larger national retailers in California may have shifted to these non-

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traditional CFL retailers, thus leading to lower CFL sales estimates for some of the large national chains (e.g., Home Depot and Lowes) in California compared to similar stores elsewhere.

2.1.4 Possible Unintended CFL Market Effects

Public comments posted in response to the June 2008 release of the draft *Compact Fluorescent Lamps (CFL) Market Effects Scoping Study Findings and Work Plan* suggested that the CFL Market Effects Team focus additional attention on possible unintended market effects of the California IOUs' CFL programs. In this context, we define potential "unintended market effects" as IOU program-induced changes in the behavior of any market actor, or in any CFL product, that inadvertently reduces or slows CFL production, stocking, sales, adoption, installation, or price reductions. A shift in consumer purchases from CFLs to less-efficient alternatives such as incandescent bulbs is one example of an unintended market effect. Another is consumers purchasing fewer CFLs from one retail channel (e.g., large home-improvement stores) because they are instead purchasing CFLs through other retail channels (e.g., grocery or discount stores).

In this study, we measured the "net effects" (i.e., the positive effects less the unintended, possibly negative effects) of the IOUs' CFL programs on the CFL market through a quasi-experimental sales data analysis, as described in the *Compact Fluorescent Lamps Market Effects Scoping Study Findings and Work Plan* (October 31, 2008). Findings from the quasi-experimental sales data analysis are presented throughout Sections 3, 4, and 5 of this report.

The quasi-experimental sales data analyses cannot, however, explain what the possible unintended market effects are, nor can they provide information about the possible magnitude of the effects on CFL sales. An understanding of the nature and the impacts of unintended market effects is important because:

- If the IOUs' CFL programs, and their ULPs in particular, are indeed producing clear "winners" and "losers" in the CFL marketplace—whether these be CFL products or CFL suppliers—it will be useful from a policy and program planning perspective to know who or what these are and the relative significance of each.
- With this understanding, the IOUs may be able to make the ULP more effective by mitigating some or all of the unintended market effects the program may be causing.

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Our list of possible unintended effects on the CFL market includes:

- Retailer channel shift (i.e., a shift in sales from one retailer—or retail channel—to another, whereby the increase in the second retailer's sales comes at the expense/loss of the first retailer's sales).
- Discouraging CFL innovation and specialty CFL products.
- Adversely affecting CFL quality and performance.
- Adversely affecting sales of non-program discounted CFLs.
- Contributing to concerns about mercury contained in CFLs.
- Contributing to the belief that buying a CFL means you have done your part for energy efficiency and, therefore, are not inclined to take further energy-saving actions.

A brief summary of each potential unintended market effect, as well as a description of the primary research/data collection activities the team undertook to assess the significance and magnitude of each effect, are discussed in the revised memorandum of November 26, 2008, that the team prepared for the CPUC (see:

http://www.energydataweb.com/cpucFiles/18/UnintendedCFLMarketEffects_2.pdf).

2.2 Primary Data Collection Activities

The team used a variety of primary data collection activities to query actors with many different roles in the CFL market. We spoke with end-use customers in California and the Comparison Area to learn about their familiarity, use, and satisfaction with CFLs. We also spoke with participant and nonparticipant manufacturers/importers and retailers familiar with California, Comparison Area, or national CFL markets to gain a wide range of perspectives on CFL stocking practices, pricing practices, supply chains, program participation characteristics, market trends, and other topics. Because we completed interviews with upstream CFL market actors that together accounted for the vast majority of California's total market-level CFL sales, and because we made a dedicated effort to interview as many nonparticipants as possible, the interviews provided us with a nearly comprehensive collection of upstream actors' perspectives. Finally, we interviewed residential lighting program managers, policymakers, and evaluation consultants who were very familiar with historic California or other residential lighting programs across the nation.

In addition, we developed and employed two survey instruments—the In-Home Lighting Audit and the Comprehensive Shelf Stocking Survey—to gather data about CFL stocking and sales patterns, penetration rates, and saturations. A summary of all primary data collection activities is presented in Table 5 and presented graphically in Figure 4. The methodology employed for each of these activities is discussed in turn below.

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Table 5. Summary of Primary Data Collection Activities

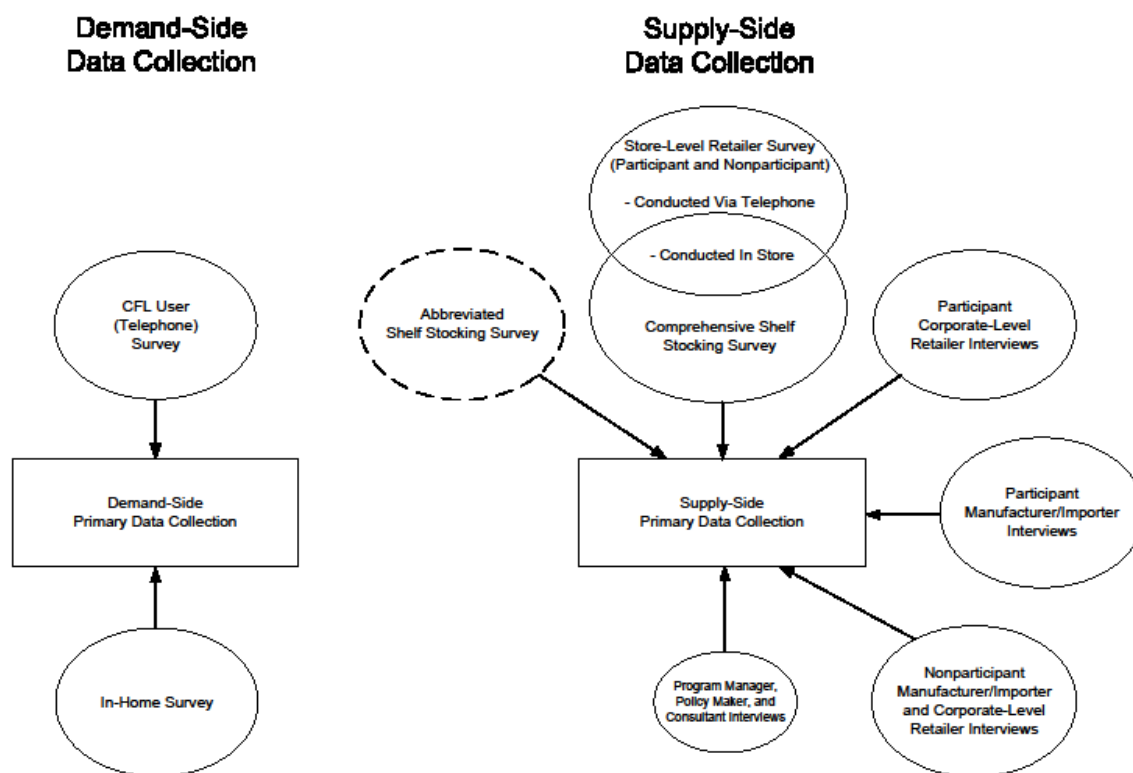
Data Collection Activity	Sample Sizes	
	California	Comparison Area
Residential lighting program manager, policymaker, and evaluation consultant interviews	17	
CFL User (Telephone) Survey ³²	699	1,757
In-Home Survey	76	193
Comprehensive Shelf Stocking Survey	50	135
Participant Manufacturer/Importer Interviews	22 ³³ (accounted for 97% of market-level CA CFL sales)	NA
Participant Corporate-Level Retailer Interviews	18 ³⁴ (accounted for 81% of market-level CA CFL sales)	NA
Nonparticipant Manufacturer/Importer and Corporate-Level Retailer Interviews	6	
Store-Level Retailer Survey	242 participants 45 nonparticipants	297

³² Based off of Wave 2 of the Residential Retrofit CFL User Survey, which contains a total of five waves, although only the second wave contained the CFL Market Effects questions.

³³ The CFL Market Effects team interviewed 16 participant manufacturers/importers in 2008 and 16 participant manufacturers/importers in 2009. Fourteen of these respondents were interviewed in both years. Over the two-year period, then, we spoke with 18 unique manufacturers/importers. In addition, we interviewed 4 unique distributors/retailers with their own CFL labels.

³⁴ The CFL Market Effects team interviewed 16 corporate-level retailer participants in 2008 and 13 corporate-level retailer participants in 2009. Eleven of these respondents were interviewed in both years. Over the two-year period, then, we spoke with a total of 18 unique corporate-level retailer participants.

Figure 4. Primary Data Collection Activities



2.2.1 Residential Lighting Program Manager, Policymaker, and Evaluation Consultant Interviews

The CFL Market Effects Team conducted interviews with 17 residential lighting program managers, policymakers, and evaluation consultants, who were very familiar with historic California or other residential lighting programs across the nation.³⁵ The interviews were intended to gather qualitative information about factors (including California IOUs' historic residential lighting programs) that have influenced California's CFL market over time. We intentionally interviewed many stakeholders who represented different time periods and varying perspectives (e.g., program manager, evaluation manager, participating supplier), to assess whether the information we gleaned from the interviews could be corroborated by multiple individuals, thereby lending validity to a particular point of view. The Team also focused the interviews on how interviewees felt the IOUs' programs influenced the CFL market so that we

³⁵ One California evaluation consultant was interviewed to represent the viewpoint of California ULP participant retailers and manufacturers: this consultant was interviewing these participants for a related study and reviewed relevant survey transcripts for the CFL market effects interview.

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could assess the results in combination with our knowledge of the market and previous independent market studies and program evaluations.

While the interviews covered the time period began from the late 1980s to the present, the focus of the interviews was on the 1999 to 2005 time period. The team focused mainly on California's CFL market and the factors inside the state that influenced it, although we did touch upon the possible influence of programs and factors outside California.

2.2.2 CFL User (Telephone) Survey

The CFL User surveys fielded in the PG&E, SCE, and SDG&E service territories and in the Comparison Area were intended to supplement the CFL User Surveys being conducted through the Residential Retrofit study.³⁶ Key topics from these surveys addressed in this section are:

- Awareness and familiarity with CFLs
- Past and recent purchases of CFLs
- Use and storage of CFLs
- Satisfaction with CFLs
- Disposal of CFLs
- Awareness of the ENERGY STAR label
- Awareness and use of light-emitting diodes (LEDs)
- Environmental attitudes
- Respondent demographics

Respondents to the survey in California were randomly selected from residential customers in the California IOU service territories in proportion to each utility's number of customers. Respondents in the three comparison states—Georgia, Kansas, and Pennsylvania—were selected through random-digit dialing (RDD). All respondents were responsible for purchasing light bulbs for their households. The surveys targeted a minimum of 100 respondents who had purchased CFLs in the past three months in California and each of the comparison states. The status of other groups of interest—including CFL purchasers from 2006 through 2008, nonusers, nonpurchasers, and those unaware of CFLs—was monitored, but no quotas were set. In total, we completed surveys with 699 respondents in California and 1,757 in the Comparison Area.

The survey instrument was very similar to the CFL User Survey, Wave 1 and Waves 3-4 (conducted as part of the California Residential Retrofit project) although some new questions were added to address CFL market effects and a few other modifications were made. With the exception of some questions specifically addressing the California IOU CFL program, the same survey questions were used in California and the Comparison Area.

All survey data were weighted based on tenancy (owner/renter status) and the educational status³⁷ of respondents to represent households in the California IOU service territories.

³⁶ A total of five waves of CFL User Surveys were conducted as part of the Residential Retrofit study. The additional questions necessary for the CFL Market Effects Study were added on the second wave.

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Telephone survey respondents' demographic characteristics do not always mirror those of the general population. The weighting scheme helps correct differences, so estimates better reflect purchasing habits of households in California and the Comparison Area. Weighting the Comparison Area to California household demographics also adjusts for differences between the actual demographics in California and the Comparison Area, reflecting the fact that there is no such thing as a perfect comparison state. When presenting results, all results were weighted unless otherwise indicated.

2.2.3 In-Home Lighting Audit

In-Home Lighting Audits were conducted in homes in PG&E, SCE, and SDG&E service areas in California, as well as in homes throughout the Comparison Area. The purpose of these audits was to determine the penetration and saturation of CFLs in California and the Comparison Area states.

Survey Sample

The CFL Market Effects Team recruited In-Home Lighting Audit participants from the CFL User (telephone) Survey respondents. The goal was to complete 70 In-Home Lighting Audits per state to meet 90% confidence and 10% precision levels.³⁸ In California, the sample was stratified by IOU service territory. Consistent with the breakdown of California respondents for the CFL User Survey, the Team aimed to conduct 40% of the audits in PG&E's service area, 40% in SCE's service area, and 20% in SDG&E's service area.

Table 6 shows the number of completed In-Home Lighting Audits by state. Due to low interest among telephone survey respondents in participating in the In-Home Lighting Audit, as well as to difficulties in scheduling the audits and high audit cancelation rates, the team fell slightly short of the 70 homes per state target for two states in the Comparison Area. Nonetheless, the overall precision level for the Comparison Area was approximately 6% with 90% confidence. In California, in contrast, we exceeded the 70-home goal.

Table 6. Completed In-Home Lighting Audits

State	Completed Audits
California	76
Georgia	63
Kansas	70
Pennsylvania	60
Total	269

Survey Instrument

³⁷ These variables help predict light purchase patterns, as noted in the Market Progress and Evaluation Report (MPER) for the 2007 Massachusetts ENERGY STAR Lighting Program, Final Report. Submitted to Cape Light Compact, Massachusetts Electric Company, Nantucket Electric Company, NSTAR Electric Company, Western Massachusetts Electric Company, and Unitil by Nexus Market Research, Inc., RLW Analytics, Inc., and Dorothy Conant. July 1, 2008.

³⁸ These levels are based on a binomial assumption (50% proportion) regarding the stated vs. actual presence of CFLs in respondent households.

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The In-Home Lighting Audit consisted of two components: a short battery of questions for participants and a data collection form on which the surveyor entered information about the number, location, and type of medium screw-base (MSB) lamps and sockets in the home.³⁹ The complete In-Home Survey instrument is provided in Appendix E in the *Compact Fluorescent Lamps Market Effects Final Interim Report*.

On average, the In-Home Lighting Audit took 20 minutes to complete. All participants received a \$50 gift card upon completion of the audit.

Weighting

Data collected through the In-Home Lighting Audit were weighted in two ways. First, as was done with the CFL User Survey, all data were weighted to demographically represent households in the California IOUs' service areas—that is, to correct for differences between the demographics of the In-Home Audit participants and the demographics of households in California's IOU service areas. This weighting scheme was based on tenancy (owner/renter status) and the educational status of respondents, variables which help to predict lighting purchase patterns.^{40, 41} The resulting, weighted data set replicates the demographics and the number of households in the California IOUs' service areas.

Second, the In-Home Lighting Audit data were weighted to reflect the percentage of the population with at least one CFL currently installed in their primary residence. The rationale for this weighting is described below in the section on “CFL Penetration and Saturation.”

Scope of the In-Home Lighting Audit

In order to be as efficient as possible with project resources, the team opted to collect only information about MSB lamps and sockets through the In-Home Lighting Audit; the study did not collect information about pin-based and small screw-based lamps or sockets. The CFL Market Effects Team based this decision on the fact that the majority of residential sockets are MSB, and MSB sockets account for the highest percentage of CFLs—and CFL potential—in homes. In fact, according to the 2008 CPUC Residential Retrofit Upstream Lighting verification results of over 600 homes in California,⁴² 69% of all residential sockets are MSB, 19% are pin-base (typically tubular fluorescent), 10% are small screw-base, and 2% are other or unknown. This same study found that CFLs are most prevalent in MSB sockets.

³⁹ The In-Home Lighting Audit survey instrument and data collection forms are included in Appendix D of the *Compact Fluorescent Lamps Market Effects Final Interim Report* (May 15, 2009).

⁴⁰ This pattern has been noted in the Market Progress and Evaluation Report (MPER) for the 2007 Massachusetts ENERGY STAR Lighting Program, Final Report. Submitted to Cape Light Compact, Massachusetts Electric Company, Nantucket Electric Company, NSTAR Electric Company, Western Massachusetts Electric Company, and Unitil by Nexus Market Research, Inc., RLW Analytics, Inc., and Dorothy Conant. July 1, 2008.

⁴¹ The reference for weighting was the 2003 California Energy Commission's Consortium RASS database. See: <http://websafe.kemainc.com/RASSWEB/DesktopDefault.aspx?tabindex=0&tabid=1>, Accessed December 3, 2008. The use of the RASS database allowed us to represent demographic characteristics of the California IOU service areas rather than of the entire state. More information on the demographic weighting used can be found in Section 4.2 of the Compact Fluorescent Lamps Market Effects Interim Report.

⁴² Report is expected to become publicly available December 2009.

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2.2.4 Comprehensive Shelf Stocking Survey

The CFL Market Effects Team conducted the Comprehensive Shelf Stocking Survey during store visits to assess the stocking, pricing, and availability of a wide variety of lighting products in retail stores in California and the Comparison Area.⁴³ Store visits took place in April 2009 and consisted of a short interview with the store or lighting manager, measurements of lighting display space, and the recording of the full lighting inventory.

Prior to our development of a survey and sampling plan for the market effects project, the Residential Retrofit Team had fielded two waves of a similar survey. Because the two teams' data needs were similar and the data gathered by each team would be shared and used by the other, the teams collaborated on developing the survey instrument and sampling plan for the market effects project and on revising the survey instrument (the "Abbreviated Shelf Stocking Survey") and updating the sampling plan for the Residential Retrofit project.⁴⁴

Survey Sample

Retailers surveyed in California and the Comparison Area included stores from all of the major retail lighting distribution channels, including large home improvement, small hardware, grocery, discount, mass merchandise, and club/membership stores.

In California, the CFL Market Effects Team planned to gather data from 40 stores as a supplement to the stores visited as part of the Residential Retrofit impact evaluation. Within the sample of 40 stores we aimed to: survey at least three stores in each retail channel, mirror the distribution of market-level CFL sales by retailer type, and include a number of nonparticipant stores.

For the Comparison Area sample, we planned to visit approximately 40 stores in each of the three comparison states. The sample was drawn to match as closely as possible the state-specific distribution of stores and retail channels CFL User Survey respondents had mentioned, while ensuring that the Comparison Area stores we would visit were similar to those we would visit in California.

Survey Instrument

The Comprehensive Shelf Stocking Survey data collection instrument was based on the Abbreviated Shelf Stocking Survey developed earlier for the Residential Retrofit project.⁴⁵ The two instruments were intentionally designed to be very similar to facilitate using the results from

⁴³ Note that the Shelf Stocking Survey discussed here is different from the store-to-store comparison approach discussed above. The Shelf Stocking Survey was designed to compare availability of CFLs across a variety of retail channels in California to the availability of CFLs across the same channels in the Comparison Area. This is in contrast to the store-to-store approach that would have focused on one or more specific chain retailers in California and the Comparison Area. Because the Shelf Stocking Survey sampled from all retail channels through which CFLs are commonly sold, it did not need to account/adjust for factors complicating the store-to-store comparison approach, namely: (1) the socio-economic characteristics typical of shoppers in one retail channel or another; and (2) possible channel shift in California due to the ULP.

⁴⁴ The Abbreviated Shelf Stocking Survey was conducted in over 400 stores (in 5 waves, during 2008 and 2009) for the Residential Retrofit and utility process evaluations. The relationship between the Abbreviated and Comprehensive Shelf Survey sampling plans is described in the next section; differences between the instruments used for the two surveys are described in the "Survey Instrument" section below.

⁴⁵ Note, however, that this was a collaborative process: the Residential Retrofit Team made changes to the version of the Abbreviated Shelf Survey they would be using in subsequent store visits, so that their data collection tool would be as similar to the CFL Market Effects Team's as possible.

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both surveys in their respective analyses. The two instruments included identical lighting display space measurement forms that captured information about the types of bulbs available for sale, and the presence and dimensions of a variety of types of lighting displays for CFLs and other light bulbs.

The Comprehensive Survey was designed to capture data from a wider spectrum of lighting products than the Abbreviated Survey—all incandescents, CFLs, halogens, and LEDs. The Abbreviated Survey, in contrast, limited data collection to all CFLs and their incandescent equivalents. The Comprehensive Survey also went beyond the Abbreviated Survey in that it captured the *number of packages* of each unique model/package on a store's shelves in addition to capturing descriptions of each unique model/package. Both bulb inventories gathered data on the following bulb characteristics:

- | | | |
|--------------|------------------|--------------------|
| ▫ Bulb Type | ▫ Wattage | ▫ Special Features |
| ▫ Bulb Shape | ▫ Lumens | ▫ Price |
| ▫ Base Type | ▫ Package Size | |
| ▫ Make/Model | ▫ Package Counts | |

Finally, the store or lighting department manager survey was a component of the Comprehensive Shelf Stocking Survey, but not of the Abbreviated Survey instrument. It was a pared-down version of the Corporate-Level Retailer Interview Guide and included a battery of questions that covered lighting products: stocking patterns (including seasonal fluctuations), sales patterns (including seasonal fluctuations), and factors that drive sales. The Team completed manager surveys in roughly 25% of the stores we visited. To maximize the number of completed manager surveys in the stores with completed shelf surveys, the 75% of store managers who did not complete surveys while we were in their stores made up our prioritized sample for the Store-Level Retailer (Telephone) Survey (described in Section 2.2.7 below).

The complete Comprehensive Shelf Stocking Survey instrument and sampling plan comprise Appendix B to this report. Detailed findings from the survey are presented in Appendix C.

Weighting

The results from the shelf stocking surveys are summarized in two ways. For the Comprehensive Shelf Stocking Survey we had full package counts by make/model, so we were able to present data at the bulb level (i.e., reporting the percent of bulbs on display with certain characteristics). Where the results of the Abbreviated Shelf Survey were incorporated, however, the results were reported at the make/model level (i.e., the percent of make/models on display with certain characteristics).

Many of our findings from the shelf survey are presented at the retail sales channel level. However, to estimate state- or region-wide averages (for California and the Comparison Area, respectively) from the shelf stocking survey data, we needed to weight retail channel-specific data so that the overall result would be representative of the entire California market (and thereby correct for any under- or over-sampling in the Comprehensive Shelf Stocking Survey). Since reliable CFL sales data by retail channel were not available, we instead developed weights based on the number of stores in California in each channel, combined with the average lighting

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display space within each channel.⁴⁶ Shelf stocking data from the Comparison Area was developed with similar weights, thus comprising a baseline estimate of what shelf stocking in California might have looked like in the absence of the program.

The shelf stocking study provides a static, “snap shot” of lighting stocking practices; it is not necessarily representative of annual sales. Sales of lighting products by channel are presented in the other analyses conducted in this report, and are based on the CFL User Survey, the EPA data, and the Program tracking data.

2.2.5 Participant Manufacturer and Corporate-Level Retailer Surveys

The CFL Market Effects Team coordinated with the Residential Retrofit Team to interview participant manufacturers/importers and corporate-level retailers in 2008 and to conduct follow-up interviews in 2009. Our goal was to ask these upstream market actors about their perspectives on entry into the CFL market, current and historical retail CFL sales and stocking patterns, CFL pricing trends, production costs, and market drivers.

Participant manufacturers produced 98% of all CFLs sold in California from 2006 through 2008,⁴⁷ and the participant manufacturers/importers we interviewed together accounted for almost all CFLs sold in California during that program period. Similarly, the participant corporate-level retailers we interviewed accounted for the vast majority of all CFLs sold in California between 2006 and 2008. Given their dominant market presence, the collective viewpoints of these participant market actors was crucial to an understanding California’s CFL market from an upstream perspective.

Although each company was interviewed individually, we found the lighting manufacturers/importers and retailers generally told a consistent story. In cases where their perspectives differed, these differences usually corresponded with differences in market position (e.g., large, established manufacturers versus new, smaller manufacturers) or retailer offerings (e.g., large home improvement versus discount stores). When reporting participant market actor responses below, we provide the ratio of respondents with a particular viewpoint and the percentage of ULP sales the respondent group represents. This is intended to provide the reader with a sense of the relative significance of each viewpoint participant market actors expressed.

Survey Samples

The sample for the participant upstream market actor surveys was the entire pool of manufacturers and retailers who had participated in at least some portion of the 2006–2008 ULP. They included the 32 manufacturers/importers⁴⁸ who supplied the CFLs rebated through the 2006–2008 ULP, and the 1,217 retailers⁴⁹ who sold program-discounted CFLs. In 2008 and

⁴⁶ We determined the total number of California stores by retail channel using market data purchased from SSI. We calculated lighting display space by channel from the measurements taken during the Comprehensive Shelf Stocking Survey.

⁴⁷ The 98% of CFLs sold in California that were produced by participant manufacturers is different from the percent of CFLs sold that were program-discounted: not all CFLs produced by participant manufacturers were discounted by the ULP. Similarly, not all CFLs sold through participant retailers were program-discounted.

⁴⁸ This manufacturer/importer count includes four distributors/retailers with their own labels on CFLs.

⁴⁹ This retailer count includes 11 organizations that distributed program CFLs to consumers but that are not retailers (e.g., schools, utilities).

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2009, the CFL Market Effects Team interviewed 18 participating manufacturers/importers⁵⁰ that together accounted for 97% of 2006–2008 market-level CFL sales in California. We also interviewed 18 corporate level participant retailers—representing all major retail channels through which CFLs are sold—who accounted for 81% of all 2006–2008 market-level sales in the state.

Survey Instruments

Since the CFL market effects upstream participant interviews were to be conducted in conjunction with the Residential Retrofit upstream participant interviews, we used the participant manufacturer/importer and corporate-level retailer interview guides that had already been developed by the Residential Retrofit Team. The CFL Market Effects guides incorporated a series of additional questions that explicitly addressed market effects.

The topics addressed through the 2008 manufacturer/importer and corporate-level retailer in-depth interviews—including topics added especially for the market effects study—were:

- Program participation characteristics, motivation
- Sales data request, program sales confirmation
- Recent program trends and policies
- Free-ridership assessment
- Spillover, other market effects assessment
- Supply chain characterization
- Stocking practices (retailers only)
- Program leakage assessment⁵¹
- Pricing practices
- Market characterization (market share, policies, global sales)
- Product quality, recycling
- Program satisfaction

The 2009 interview guides asked respondents to verify and update information about program and nonprogram sales of standard and specialty CFLs,⁵² supply chain characterizations (manufacturers/importers only), CFL pricing and incentives, supply- and demand-side barriers, and CFL disposal. The 2009 instruments also included questions about recent ULP trends and policies, market changes (e.g., ENERGY STAR 4.0), respondents' participation in lighting programs outside of California, respondents' sales in and knowledge of lighting markets in the

⁵⁰ In addition, we interviewed four distributors/retailers with CFL products with their own labels. Their sales were included in the retailer, rather than the manufacturer/importer totals.

⁵¹ Leakage is the sale of ULP-discounted CFLs to consumers who are not customers of the California IOUs (PG&E, SCE, and SDG&E). These sales may be to non-IOU customers in California or to non-California customers. Some Internet sales of ULP-discounted bulbs have been identified, although the extent of these sales has not been fully assessed.

⁵² The interview guides also asked questions about light fixtures, but these products are beyond the scope of the CFL Market Effects study.

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Comparison Area, shifts in CFL sales between retail channels, and their expectations for future sales of all types of CFLs. The 2009 manufacturer/importer interview guide also asked respondents about manufacturing costs for specialty CFLs and LEDs.

The 2009 participant manufacturer/importer and corporate-level retailer interview guides are included as Appendix D to this report. Detailed findings from the 2009 interviews are described in Appendix E.

2.2.6 Nonparticipant Manufacturer and Corporate-level Retailer Surveys

To complement the participant market actor interviews and help us gain a broader perspective on the CFL market, we also interviewed nonparticipating manufacturers/importers and corporate-level retailers.

Survey Samples

The CFL Market Effects Team sought to interview executives of firms that manufacture/import or sell CFLs at the retail level in the U.S., but had not participated in any portion of the California IOUs' ULPs during 2006–2008.

We began developing the nonparticipant manufacturer/importer sample by extracting the names of all CFL manufacturers/importers from our Comprehensive Shelf Stocking Study database.⁵³ We culled the list to exclude all manufacturers/importers and their subsidiaries that participated in California's ULPs from 2006 to 2008 and those that were no longer in business. Due to the broad reach of the ULP, only 13 manufacturers/importers remained in the sample and we were able to complete interviews with two of them.⁵⁴ CFLs made/imported by the nonparticipant manufacturers/importers we spoke with accounted for less than 1% of the CFLs we found on store shelves during the Comprehensive Shelf Stocking Survey.

To develop the nonparticipant retailer sample, we used Dunn & Bradstreet data to compile a long list of candidate stores by retail channel for California and each of the comparison states. We narrowed the list, which spanned all major lighting retailer types, to include only retailers with at least three locations in their state that actually sold CFLs.⁵⁵ (Interviews with smaller nonparticipant retailers were captured through the store-level surveys described below.) After an intensive survey effort, we completed interviews with four nonparticipant corporate-level CFL retailers in the discount, grocery, and home improvement channels. Two of the respondents

⁵³ The Comprehensive Shelf Stocking Study was conducted in the Spring of 2009 in California as well as in the three comparison states of Georgia, Kansas, and Pennsylvania.

⁵⁴ In the interest of full disclosure, one of the two manufacturers/importers we interviewed has been loosely involved with the 2009 "Change the World, Start with ENERGY STAR" campaign tour that The Cadmus Group is under contract to assist with. On the tour, a 30-by-50-foot exhibit house travels to different cities to teach consumers about ENERGY STAR products and energy-efficient practices that they can take back to their communities. The contact whom we spoke with for this survey provides fixtures and bulbs for a new, interactive lighting display in the traveling house.

⁵⁵ One complication with attempting to interview national chain stores is that the buyer of CFL products generally represents the entire country rather than a single state or region. Thus, while our intention was to interview participant and nonparticipant retailers separately, this was not always possible. A number of large retailers span both of these categories, since they have participant stores in California as well as stores in Georgia, Kansas, or Pennsylvania.

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represented retailers with thousands of stores across all/most of the U.S. The other two respondents had at least 100 stores each, spread across 6 to 12 U.S. states.

Survey Instruments

The nonparticipant CFL manufacturer/importer and corporate-level interview guides were developed by adapting the participant interview guides for use with nonparticipants. Like the participant interview guides, the nonparticipant market actor 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.

Appendix F contains the interview guides we used for our discussions with nonparticipant CFL manufacturers/importers and corporate-level retailers. Appendix G contains the findings from these interviews.

2.2.7 Store-Level Retailer (Telephone) Survey

The Store-Level Retailer Survey was developed for use in the CFL Market Effects and the Residential Retrofit impact evaluations, and conducted by PA Consulting. Its purpose in the CFL Market Effects study was to aid the comparison state analysis by:

- Helping us understand whether the findings from the Comprehensive Shelf Stocking Survey represented typical lighting product stocking patterns.
- Providing insights into the lighting product market from the perspective of additional upstream actors—store-level participant lighting managers in California, store-level nonparticipant lighting managers in California, and store-level nonparticipant lighting managers in the Comparison Area.

Survey Sample

The CFL Market Effects Scoping Study and Work Plan set sample sizes of 50 nonparticipant retailers in California and 100 nonparticipant retailers in the Comparison Area. To obtain a mix of participant and nonparticipant retailer perspectives, participant retailers were interviewed through the Residential Retrofit Evaluation; that evaluation's plan set a sample size of 300 California participant retailers. The 40 retail stores in each state where we had collected data for the Comprehensive Shelf Stocking Survey were the priority stores for all three samples.

We developed the sample of participating retailers from the California IOUs' ULP participant databases. To ensure the California participant sample was geographically representative of 2006–2008 ULP participation, we first stratified the sample by the distribution of CFL shipments to each of the IOUs' service areas. This distribution and the California participant sample sizes by IOU service area based on this distribution are shown in Table 7.

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Table 7. California Participant Stratification by Utility Service Area

Utility	2006-08 ULP CFL Shipments	% of Total Shipments	Targeted Participant Sample Size ⁵⁶	Completed Interviews
PG&E	52,938,751	55%	144	133
SCE	35,284,687	37%	118	84
SDG&E	7,611,804	8%	38	25
Total	95,835,242	100%	300	242

While the large chain stores in the California IOUs' service areas may have sold the largest number of program bulbs, they did not represent the majority of participant storefronts. To develop a participant retailer sample that accurately represented 2006–2008 ULP activity, we stratified the sample by retail channel and storefront size. PA Consulting completed surveys with 242 California participants.

For the California nonparticipant sample, PA Consulting supplemented the list of nonparticipant California stores where we had conducted Comprehensive Shelf Stocking Surveys with retailer data purchased from Survey Sampling International. We stratified this sample by the distribution of CFL shipments to each of the IOUs' service areas (as we had done with the California participant sample), by store size (mirroring the participant store size stratification described above), and by retail channel (following the breakout we used in the Shelf Stocking Survey).⁵⁷ PA Consulting completed 53 surveys with California nonparticipants.⁵⁸

We stratified the nonparticipant store-level retailer sample in the Comparison Area by retail channel following the same percentages we used in the Comprehensive Shelf Stocking Survey. The team completed 297 surveys with store-level retailers in the Comparison Area.

The Store-Level Retailer Survey and sampling plan are presented as Appendix H.

Survey Instrument

Similar to the lighting department manager survey component of the Comprehensive Shelf Survey, the Store-level Retailer Survey instrument was a pared-down version of the Corporate-Level Retailer Interview Guide. It also included questions that covered lighting products: stocking patterns (including seasonal fluctuations), sales patterns and trends (including seasonal fluctuations), and factors that drive CFL sales. In addition, the Store-Level Retailer Telephone Survey included questions about sell-through, pricing, the store's (or chain's) marketing and promotional practices, and firmographics.

⁵⁶ The sample sizes were developed based on preliminary estimates of ULP CFL shipments, so the targeted samples by utility differ slightly from the final proportion of utility ULP CFL shipments.

⁵⁷ The sampling plan for the "Shelf Stocking Survey" we refer to here was developed for the Abbreviated Shelf Stocking Survey (conducted as part of the Residential Retrofit study) and the Comprehensive Shelf Stocking Survey (conducted as part of the CFL Market Effects project). Please see the Comprehensive Shelf Stocking Survey for the details of that sampling plan.

⁵⁸ Of the 53 nonparticipant surveys completed with California retailers, 55% were with retailers in PG&E's service area, 30% were in SCE's service area, and 15% were in SDG&E's service area. The completed nonparticipant surveys spanned all major retail channels through which CFLs are commonly sold.

2.3 Analyses

2.3.1 CFL Program and Market Evolution

To provide context for the 2006–2008 market effects assessment, the CFL Market Effects Team described the California (and, as relevant, national) CFL market and program histories in great detail in the interim report. We felt that an understanding of this context could be critical if many impacts of the California IOUs' programs on the CFL market occurred before 2007.

In performing this analysis, we reviewed numerous program-related documents, conference papers, and industry publications. We also interviewed CFL program managers and stakeholders to gather their perspectives on cumulative historic market effects.

Findings from our market-level research detailed relevant market events that likely affected California's CFL market, as well as CFL market indicators. We drew upon CFL demand and supplier market data from evaluations of prior California IOU programs that were intended to track indicators of market change and progress toward addressing barriers to CFL sales. The CFL market evolution discussion covered:

- Market events, including the California energy crisis of 2000–2001, increased attention to global warming, Wal-Mart's sustainability initiatives, and regulation of light efficacy.
- Leading market indicators that provided early indications of changes in CFL market activity levels. These indicators included consumers' general energy efficiency knowledge, awareness, and attitudes; consumer CFL awareness and purchase rates; consumer satisfaction with CFLs; CFL purchases by retail channel; average CFL retail prices; and product availability.
- Coincident market indicators—that is, signs that the level of CFL market activity was changing that occurred concurrently with the altered level of activity. Coincident market indicators included market-, program-, and baseline-level CFL sales data.
- Lagging market indicators, or indications of changes in the level of CFL market activity that occurred after the level of market activity changed. Examples included changes in household CFL penetration and saturation.

Our examination of California's market and program histories included information about consumer awareness, consumer purchases, and CFL retail prices for the California IOUs' first-generation CFL programs (1989 to 1997), their market transformation programs (1998 to 2000), and their resource acquisition programs (2001 to the present). We also presented information about other relevant CFL programs in California (e.g., the statewide Flex Your Power (FYP) advertising campaign), nationwide (e.g., ENERGY STAR; Change-A-Light; and quality assurance, third-party testing, and verification programs), and in other regions of North America (e.g., the Pacific Northwest, Wisconsin, and New England).

Finally, we conducted a qualitative historic market effects assessment based on stakeholder interviews and a literature review. This assessment described the early CFL market, the introduction of large-scale upstream lighting programs in response to California's 2000–2001 energy crisis, and the more recent expansion of the CFL retail market.

Please refer to Section 2 of the *CFL Market Effects Final Interim Report* for a full discussion of the CFL market and program evolution. References for all data sources used in the CFL market

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and program history analysis are provided in Appendix A of the *CFL Market Effects Interim Report*.

2.3.2 Comparison State Analysis

The initial approach for estimating baseline CFL sales in California was to examine per household CFL sales for a comparison group of states that had little or no utility or government sponsored programs to promote CFLs. The assumption was that CFL sales in these states would approximate what sales would have been in California without the CFL programs.⁵⁹

This approach has been implemented in recent program evaluations in Wisconsin and Massachusetts to assess program effects, and it provided reasonable estimates that were accepted by regulators. The primary shortcoming of this methodology is that no single state directly compares with California, which is often considered a country unto itself when examining its size (land area is third in U.S.), population (first in U.S.), economy (first in U.S. and between seventh and tenth in the world depending on sources), resources (oil, gas, minerals, etc.) and politics. In fact, economic studies often compare California to other countries instead of states since it has such a large economy. To mitigate this issue, we decided to select a comparison group of states—the Comparison Area—in lieu of a single comparison state. Because none of the comparison states were in the same region of the country as California (see below), we did not need to grapple with a potential second shortcoming of this approach, namely that California CFL sales may have spilled over into neighboring states because of regional ordering patterns.

The selection of the comparison states was based on a mix of socio-economic indicators and other variables that might affect CFL sales, including:

- **Median household income and education levels (% graduated from college) comparable to those in California.** We used the most current data available, from the 2006 American Community Survey. The percentage of the state population that had graduated from college was used as a proxy variable for education.
- **Alternative socio-economic indicators comparable to those in California (e.g., political affiliation, “eco-consciousness index,” English-speaking households, foreign-born, percentage below the poverty line, white/non-white).** The majority of these data also were collected from the 2006 American Community Survey. State-level political affiliation, however, was calculated by using the 2004 presidential election results (<http://www.cnn.com/ELECTION/2004>) and the political affiliation of the 2004 state legislature elections (<http://www.ncsl.org>).
- **Absence of (or presence of very small) utility or government-sponsored CFL promotional programs.** Relevant data were collected from the Residential Lighting Programs National Summary prepared by the Consortium for Energy Efficiency in September 2007. North Carolina State University’s Database of State Incentives for Renewables and Efficiency (DSIRE.org) website and state-and utility-level programs found on the web were also used to verify program activity by state.

⁵⁹ Note that all programs that promote CFLs, including the ULPs and Marketing and Outreach campaigns, influence sales of CFLs. Methods for parsing out the impacts of these two major efforts are discussed below.

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- **Saturation of influential CFL retailers (e.g., square feet of Wal-Mart per capita) comparable to California's.** Data were gathered from publicly available company Web sites and SEC (10-K) filings.

We first ranked the states according to income and education by creating an income/education index; then we developed an initial list of 20 candidate states. States in which CFL programs were known to be active were eliminated from this list, resulting in seven candidate comparison states. We then reduced the selection to three states using the alternative socio-economic variables and information on the saturation of major CFL retailers described above. The states selected as the study's Comparison Area were Georgia, Kansas, and Pennsylvania.⁶⁰

2.3.3 Regression-based Attribution and Net Savings Analysis

In order to control for the many factors that can drive CFL sales, the CFL Market Effects Team also undertook a regression-based attribution and net savings analysis. In the *CFL Market Effects Interim Report* we presented preliminary results from a regression-based model that was based on the best data available at that time. The analysis included one observation for each of the 50 U.S. states. It incorporated state-specific information on 2007 ENERGY STAR CFL sales, whether there were any CFL promotional programs in the state, economic data, and demographic characteristics. While this model provided some insights into the determinants of household demand for CFLs, we recognized its limitations in terms of comprehensiveness⁶¹ and the total number of observations.

When the opportunity to participate in a multistate regression analysis to be conducted at the household level—which would overcome the limitations of our original regression analysis by pooling household-level data from a number of jurisdictions throughout the U.S.—emerged in the summer of 2009, the CFL Market Effects Team decided to join the effort. As mentioned earlier, the multistate modeling was conducted by a subset of the CFL Market Effects Team; this subset is referred to as the Multistate Regression (MR) Team in both this document and Appendix K.

Similar to the goal of the initial regression model, the goal of the multistate regression analysis was to identify the total cumulative program effects of all historical CFL program activities realized in 2008, net of free ridership and spillover.⁶² However, the California Evaluation Protocols allow the inclusion of free ridership—but not spillover—when calculating net-to-gross (NTG). Although the goal of this analysis was to examine market effects (i.e., spillover), this statistical approach could not disaggregate these various effects. The analysis presented here refers to measurement of the total net impact.

Throughout the regression discussion we use the term “sponsors” to refer to the diverse set of organizations supporting the multistate effort: electric utilities, energy service organizations, public service commissions, and state agencies. The sponsors of the multistate regression

⁶⁰ The analysis assumed that Delaware was too small (and the population was likely to shop in neighboring states), and that Alaska and Hawaii, lying outside the contiguous United States, had unique characteristics that made them less suitable as comparison states.

⁶¹ For example, we used a binary variable to show the presence or absence of CFL programs, although a continuous variable—which would have required extensive research to populate—may have been more meaningful.

⁶² While the CPUC's CFL Market Effects evaluation covers the entire 2006-2008 program cycle, the analyses conducted here focus only on 2008 due to data availability from the other sponsors.

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analysis in addition to the CPUC were the New York State Energy Research and Development Authority (NYSERDA), the Public Service Commission of Wisconsin (PSCW), Consumers Energy in Michigan (CE), the Connecticut Energy Conservation Management Board (ECMB), Connecticut Light and Power (CL&P), Northeast Utilities, The United Illuminating Company (UI), the Cape Light Compact (Cape Light), NSTAR, National Grid, Unitil, Western Massachusetts Electric (WMECO), and Xcel Energy. The discussion presented here draws on data from 16 states, but was written specifically for the CPUC in order to meet its planning and reporting schedule.⁶³

Regression-based Attribution Background

Market effects methods have evolved over time to account for free ridership and spillover, adoption of upstream programs, and changes in the CFL market. Sponsors in various areas have recently turned to a “nonprogram comparison state” approach to estimate market effects, but rapid expansion of CFL programs and recent changes in the CFL market have hindered the ability of this approach to provide reliable estimates of net program impact.

The principal goals of the statistical analyses presented in this section, therefore, were to identify and examine factors associated with CFL purchases in 2008 generally, and the effect of CFL programs on those purchases specifically, in this changing CFL market. The analyses are based on data from telephone surveys of 9,325 households and onsite saturation surveys (including confirmation of when CFLs were purchased) for 1,444 households from 16 different states, counties, or cities in the U.S. The net impacts assessment, however, is based on onsite data from about 1,034 households, as some of the key variables used in the development of the model were not available for all of the states.

Areas Included in the Analyses

The multistate modeling effort relies on telephone and onsite data from areas with longstanding CFL programs, those with newer or smaller programs, and those with no CFL programs through 2008. The seven sponsors of this effort collectively account for the following areas:

- California: areas served by Pacific Gas and Electric (PG&E), San Diego Gas and Electric (SDG&E), and Southern California Edison (SCE)—collectively the investor-owned utilities’ (IOUs’) service territory.
- Colorado: the area served by Xcel Energy.
- Connecticut: the entire state.
- Massachusetts: the entire state.
- Michigan: the area served by Consumers Energy (CE) only.
- New York State (less New York City and Nassau and Suffolk Counties) and New York City: Surveyed separately due to the demographic and economic differences between the two regions; the Long Island Power Authority was not a study sponsor.

⁶³ Data from Xcel Energy Colorado was not included in the final multistate regression models presented in this document and in Appendix K because their inclusion biased the regression model. However, the report summarizes descriptive statistics on CFL use, purchases, and saturation as well as demographics for the Xcel Energy respondents.

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- Wisconsin: the entire state

The sponsors and their evaluation teams selected Comparison Areas that, to the extent possible, shared demographic characteristic similar to their own. Furthermore, they sought Comparison Areas with no CFL programs or relatively small or newer ones.⁶⁴ The sponsors variously funded the fielding of data collection in the following states:

- Georgia, Kansas, and Pennsylvania: funded by the CPUC, which chose three combined states because no single nonprogram state was similar to the combined California IOU service territories. We refer to these states plus California as the “CPUC states.”
- The District of Columbia and Houston, Texas: funded by NYSERDA, which chose two Comparison Areas because no single nonprogram city or county resembled New York City.
- Ohio: funded by NYSERDA as a comparison to New York State; the NYSERDA evaluation team excluded the 513 and 283 area codes, which greatly overlap the Duke Energy service territory because the utility had an active CFL program there in 2008.
- Maryland: funded by the Sponsors of the Massachusetts ENERGY STAR Lighting Program as a comparison to Massachusetts. The Maryland electric utilities launched CFL programs in late 2007 and expanded them in 2008; therefore, the state represents a substantial but new program area in our model.
- Indiana: funded by the WPSC as a Comparison Area for Wisconsin.

Table 8 lists all the areas included, their program status, and the sizes of the sample for the telephone and onsite surveys conducted in each area.

⁶⁴ For example, Georgia Power included information about CFLs on its Web page, but did not offer an incentive program for CFLs. As noted in the *CFL Market Effects Interim Report (May 15, 2009)*, however, removing Georgia from the analysis had no impact on the conclusions.

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Table 8: Participating Areas and Sample Sizes

Area	Program Status		Telephone Sample Size	Onsite Sample Size
	2008	Past 3 Months		
California IOU service territories	Established program	Established program	699	77
Colorado – Xcel Energy (data being reviewed)	Moderate Program	Moderate Program	600	70
Connecticut	Established program	Established program	500	95
District of Columbia	No program	No program	500	97
Georgia	Minor program	Minor program	579	62
Houston, Texas	No program	No program	503	99
Indiana	No program	No program	600	88
Kansas	No program	No program	525	71
Maryland	New program	New program	500	57
Massachusetts	Established program	Established program	503	100
Michigan – Consumer Energy service territory	No program	New program	657	86
New York State, excluding New York City, Nassau and Suffolk Counties	Moderate program*	Moderate program*	1,000	203
New York City	Moderate program*	Moderate program*	502	100
Ohio, excluding Duke Energy service territory	No program	No program	501	98
Pennsylvania	No program	No program	653	59
Wisconsin	Established program	Established program	503	82
TOTAL SAMPLE AVAILABLE			9,325	1,444

* Past NYISERDA CFL programs supported CFLs mainly through education, advertising, and marketing, including marketing undertaken with the cooperation of retailers and manufacturers, but markdown CFLs were a smaller component of the program. The current CFL expansion program expands the markdown component, among other activities, but had not been implemented at the time of the survey.

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Telephone and Onsite Surveys: Comparability Across Areas

The sponsors and their evaluation teams collectively fielded seven survey efforts, including seven telephone surveys and seven onsite surveys in 16 areas, with some questions tailored to either program or nonprogram respondents. To achieve comparability on the key issues explored in the multistate modeling effort, each telephone survey instrument included a core set of questions about awareness, familiarity, satisfaction, use, and purchases, as well as a standard suite of demographic questions. Each onsite survey also followed similar procedures to identify CFLs, perform socket counts, and ascertain when CFLs were obtained by the household.

While each sponsor was interested in gathering information to develop an estimate of net program impact, most also had additional issues they wanted to explore in the surveys. For this reason, both the telephone and onsite surveys differed in question number and order, topics addressed, response categories, and (to a small extent) the wording of the core questions. In order to preserve comparability among surveys, the MR Team limited these differences as much as possible. Some potential sources of differences involving timing, survey design, and onsite methodology still remain. Consequently, the MR Team applied statistical controls, when possible, to account for these differences. However, some models included data for only some states if a question was not asked in a particular survey or if the question differed to such an extent that the MR team judged it to be incompatible with the related question asked in other areas. Most notable for the CPUC, the survey instrument used in California, Georgia, Kansas, and Pennsylvania did not ask about purchases for all of 2008, so any models that used 2008 purchases or variables derived from it (e.g., saturation at the beginning of 2008) were developed without *observed* data for the CPUC states. We did, however, use data from the surveys to *estimate* 2008 purchases and market effects as described in Section 4.3 below. Furthermore, California is included in the current use model derived from onsite data and in most of the models developed using telephone survey data. The onsite protocols for the CPUC states directed the technicians to collect data on medium screw-base sockets only, while the protocols in other states involved collecting data on all sockets. Therefore, we adjusted the socket counts for the CPUC states to reflect likely total socket counts and not just medium screw-base sockets. Appendix K provides a detailed discussion of this adjustment for California. The adjustment takes into account the results of the saturation surveys conducted in support of the Residential Retrofit evaluation that included all sockets (not just medium screw-base ones). Note that the differences between the instruments used in the CPUC states and those used elsewhere reflected the fact that the multistate modeling effort coalesced *after* the CPUC instruments had been designed and the data collected.

2.3.4 Program-induced Market Effects on CFL Retail Pricing

Data sources for the CFL pricing analysis included the manufacturer and retailer interviews, the point-of-sale (POS) data, and a detailed analysis of the pricing information from the shelf-stocking study. Each of these sources is discussed below.

Manufacturer and Retailer Interviews

The manufacturers and retailers were asked a number of questions regarding CFL prices, including:

- How retailer prices for CFLs, including the program discounted bulbs, are determined?

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- If discounts, in addition to those offered by the program, are applied to program CFLs;
- The effects program-discounted CFL bulbs or fixtures had on consumer expectations regarding prices of non-discounted CFL bulbs or fixtures;
- Price differences between the California program-discounted CFLs and non-program bulbs in California and in other states that do not offer rebates or discounts from utilities or state energy efficiency programs;
- The influence of the California rebate programs, vs. other factors, in reducing CFL prices;
- Expectations regarding future prices of CFLs.

Point-of-Sale Scanner Data

The POS Scanner data, collected by Itron for its annual California Residential Lighting Market Share Tracking Study, is a combination of data purchased from The Nielsen Company that provides information from the food, drug, and mass merchandiser channels, and data purchased from Activant (Vista Information Services) that provides information for the small hardware channel. These data provide price points on individual bulb sales, and thus provide reliable estimates for CFL prices. The data are limited, however, in that they exclude the large home improvement stores, the 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.

Analysis of Pricing Information from the CFL Shelf-Stocking Study

The Abbreviated and Comprehensive Shelf Stocking Surveys, conducted in 448 California and Comparison Area retailers, contained a rich dataset for pricing analysis. In total, data was collected on over 12,000 CFL package types, representing over one million CFLs.

The surveys took place in Spring 2008, Fall 2008, and Spring 2009. The Spring and Fall 2008 surveys covered retail locations in California only; the 2009 survey covered retail stores in California as well as the Comparison Area.

The surveys covered the range of retailer channels where CFLs are most commonly purchased (e.g., mass merchandise, discount, home improvement, hardware, membership/club, grocery, and drug stores) in 27 different metropolitan statistical areas.⁶⁵ At each store location, surveyors collected information about the product characteristics of distinct packages of bulbs on the shelves, including:

⁶⁵ The metropolitan statistical area is based on the U.S. Census Bureau definitions. Each metropolitan statistical area "is a core area containing a substantial population nucleus, together with adjacent communities having a high degree of economic and social integration" and that "must have at least one urbanized area of 50,000 or more inhabitants." <http://www.census.gov/population/www/metroareas/aboutmetro.html>

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- Bulb type (CFL, incandescent, specialty, etc.),
- Bulb style (A-lamp, spiral/twister, etc.),
- Base type (screw, pin, candelabra, etc.),
- Wattage,
- Lumens (Fall 2008 and Spring 2009 only),
- Rated life (Spring 2009 only),
- Number of bulbs in the package,
- Number of packs on shelf (Spring 2009 only).
- Special features (including dimmable, three-way, and ENERGY STAR designation)

Surveyors also collected information about bulb prices displayed on packages and/or on store shelves. Surveyors recorded the register price (the price paid by customers at the register), the full or original price if the bulb was discounted and the original price was observable, and the amount of any discount for each package, if observable. The source of any discount such as the retailer or an IOU was also recorded.

Where we found identical CFLs sold in different types of packages (e.g., a specific CFL sold both in a “one-pack” and also in a “four-pack”), we counted each package as a separate observation. This enabled us to capture per-unit (i.e., per CFL) price variations that may have been based on packaging.

Using information in the survey about the discount amount, each observation in the dataset was classified as a discounted or undiscounted bulb. Furthermore, each discounted bulb was classified as an IOU discounted bulb or a non-IOU discounted bulb using information about the source of the discount. An IOU-discounted bulb was a bulb whose price was discounted through an incentive sponsored by an IOU program. In 2008 and 2009 almost all of the IOU incentives were paid to manufacturers and wholesalers, with provisions that the rebates be passed along to consumers at the retail level. A very small number of rebates were paid directly to consumers and occurred at the register. Only California had IOU upstream incentive programs in place during the survey period, so all IOU-discounted bulbs in the dataset were observed in California. A non-IOU discounted bulb was a bulb whose price was discounted under a program sponsored by a manufacturer, wholesaler, retailer, or other non-utility source. A non-discounted bulb received neither an IOU nor other type of discount.

The CFL Market Effects Team sought to use empirical data from the shelf stocking surveys to compare CFL prices in California to those in the Comparison Area. To do so, we estimated a hedonic pricing model to decompose a CFL’s price into the separate characteristics (e.g., geographic location where sold, wattage, lumens, package size) that contributed to determining its price.⁶⁶ In the model, the coefficient corresponding to a characteristic or attribute represented the “implicit price” of that attribute. In this way the hedonic pricing model allowed us to estimate prices or values of attributes or goods that were directly sold in markets.

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

⁶⁶ Please refer to Appendix J for a discussion of the model’s development.

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$$\text{Register price per CFL} = \beta_0 + \beta_1 \text{IOU Discount} + \beta_2 \text{Other Discount} + \beta_3 \text{Product Characteristics} + \beta_4 \text{Retail Channel} + \beta_5 \text{MetroArea} + \beta_6 \text{MonthYear} + \varepsilon$$

The dependent variable in the regression model was the price per CFL in a package. The independent variables were the CFL characteristics, including: watts, ENERGY STAR Label, the number of bulbs in the package, manufacturer, metropolitan statistical area, and year-month of data collection. We allowed the impact of the number of CFLs in the package on price per CFL to vary non-parametrically (i.e., without making functional form assumptions) with the number of bulbs in the package. This was done by including separate indicator variables for the number of CFLs in the package. In addition, we included indicator variables for whether the package was discounted by an IOU or discounted by another entity such as the retailer. We expected both variables to have negative and statistically significant effects on register price, but the magnitudes of the coefficients were a priori unclear.

To test several of our research questions, it was necessary to augment the main regression equation with additional independent variables. For example, to test the hypothesis about variation between retail sales channels in the upstream incentive's impact on register price, we introduced interaction terms between "IOU Discount" and the "Retail Channel" variables into the model.

2.4 Coordination Efforts

2.4.1 Coordination with Residential Retrofit Evaluation and DEER Database Teams

Throughout this project the CFL Market Effects Team worked as a subgroup within the Residential Retrofit Evaluation Team. The CFL Market Effects Team had the same members as the ULP subgroup, plus a few additional members. Details relevant to both projects were covered in bi-weekly teleconferences to discuss specific issues related to ULP and CFL market effects.

The team also worked with the DEER Team to review the sales data collected as part of the net-to-gross (NTG) updating analysis. The CFL Market Effects Team held several teleconferences with the DEER Team to ensure that, where possible, the market effects data collection met the DEER Team's needs.

2.4.2 Leveraging Marketing and Outreach Evaluation Activities

The objectives of the statewide marketing and outreach (M&O) evaluation were twofold: first, to assess the attitudinal and behavioral impacts of the statewide umbrella marketing campaigns that supported California's 2006–2008 energy-efficiency programs, and second to gain an understanding of the effect of these marketing efforts on California's CFL programs.⁶⁷

⁶⁷ Although the M&O Team initially planned to explore the impacts of California's statewide umbrella marketing campaign on several individual programs, the team eventually opted to look exclusively at CFL programs.

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While the timeframe for the M&O study did not overlap the timing of the CFL Market Effects study,⁶⁸ the M&O evaluation could help to determine the role that the statewide marketing played in generating market effects beyond those generated directly by the CFL programs.

The CFL Market Effects Team provided input to the M&O Team as it developed a consumer questionnaire and tracking survey intended to assess the role of M&O activities compared to other lighting program impacts. We also reviewed the M&O Team's Structural Equation Modeling survey to ensure it addressed the role of incremental cost and pricing on CFL sales. As of the time of this report, however, the M&O evaluation findings were not yet available, and thus could not be incorporated into this study.⁶⁹

⁶⁸ The M&O study was intended to assess the effects of the statewide marketing campaign implemented during 2006–2008, while the CFL Market Effects study was intended to assess the market effects that manifested themselves in the 2006–2008 timeframe, but were likely to have been caused by programs implemented in previous years.

⁶⁹ In a memorandum on the “Structural Equation Modeling (SEM) Effort,” dated June 10, 2009, the Marketing and Outreach Team found “that [Flex Your Power, (FYP)] messaging indirectly influenced CFL behavior, albeit to a very small degree.” The memorandum also stated that “actual energy savings associated with FYP will be addressed in the indirect impact report.” As of this writing, the indirect impact report is not yet available.

3. ASSESSMENT OF LEADING MARKET INDICATORS

In this chapter, the CFL Market Effects Team examines the ULP impacts on market preparedness or leading market indicators such as awareness and knowledge of CFLs, availability of CFLs, CFL prices, and CFL satisfaction. Coincident market indicators (i.e., signs that the level of CFL market activity is changing that occur concurrently with the altered level of activity) and lagging market indicators (indications in changes in the level of CFL market activity that occurred after the level had changed) are examined in the next chapter.

3.1 Awareness and Knowledge of CFLs

This section summarizes the results of the CFL User Survey about consumer awareness and knowledge of CFLs. The survey was fielded in PG&E, SCE, and SDG&E service territories and in the three Comparison Area states of Georgia, Kansas, and Pennsylvania. It was intended to supplement the CFL User Surveys being conducted by the Residential Retrofit study.

3.1.1 Awareness of Energy-Efficient Lighting

The survey asked a series of questions to assess respondents' familiarity with and experience using CFL bulbs. Virtually all respondents in California (95.8%) and the Comparison Area (91.6%) were familiar with CFLs by name or brief description (Figure 5). As Table 9 shows, 38% of respondents in California rated themselves as "very familiar" with CFLs, significantly⁷⁰ more than the 33% giving a similar rating in the Comparison Area. Similarly, significantly more respondents in the Comparison Area (13%) compared to California (6%) rated themselves as "not at all familiar" with the technology. In California, those not at all familiar with CFLs in Table 9 included 4.2% who were not aware of CFLs and 2.0% who were aware of CFLs, but said they were not familiar with them. In the Comparison Area, those not at all familiar with CFLs included 8.4% who were not aware of CFLs and 4.7% who were aware of CFLs, but said they were not familiar with them.

⁷⁰ Throughout this section, the symbol '*' is used to indicate that results between California and the Comparison Area are significantly different at the 90% confidence level.

Figure 5. Awareness of CFLs
(base – all respondents; California n=699, Comparison Area n=1757)

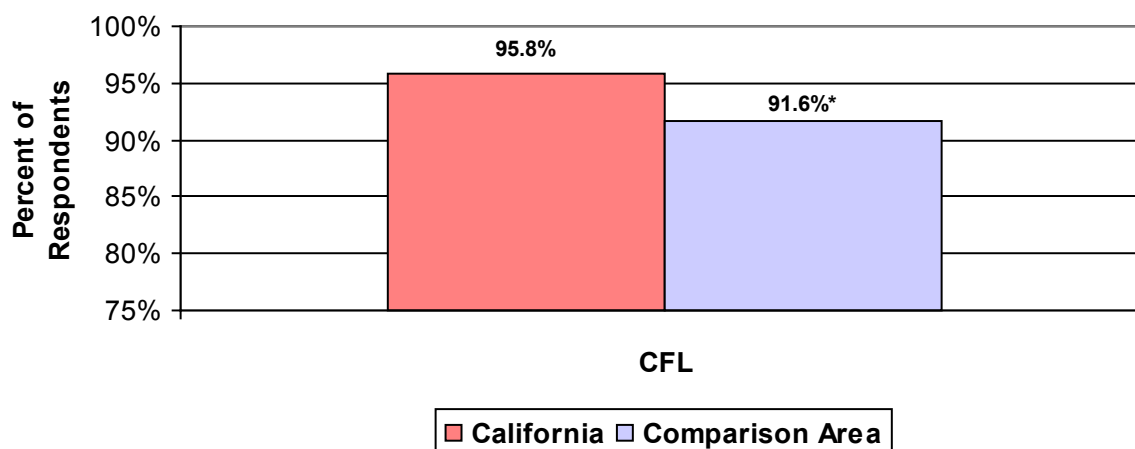


Table 9. Level of Familiarity with CFLs
(base – all respondents; results weighted to CA IOU households)

	California	Comparison Area
n	699	1757
Very familiar – 1	38.1	32.5 *
Somewhat familiar – 2	37.7	33.6 *
Slightly Familiar – 3	17.2	20.0
Not at all familiar – 4	6.2	13.1 *
Don't know/Refused	0.7	0.8

* Results between California and the Comparison Area are significantly different at the 90% confidence level.

Consumer CFL Awareness and Purchase Rates

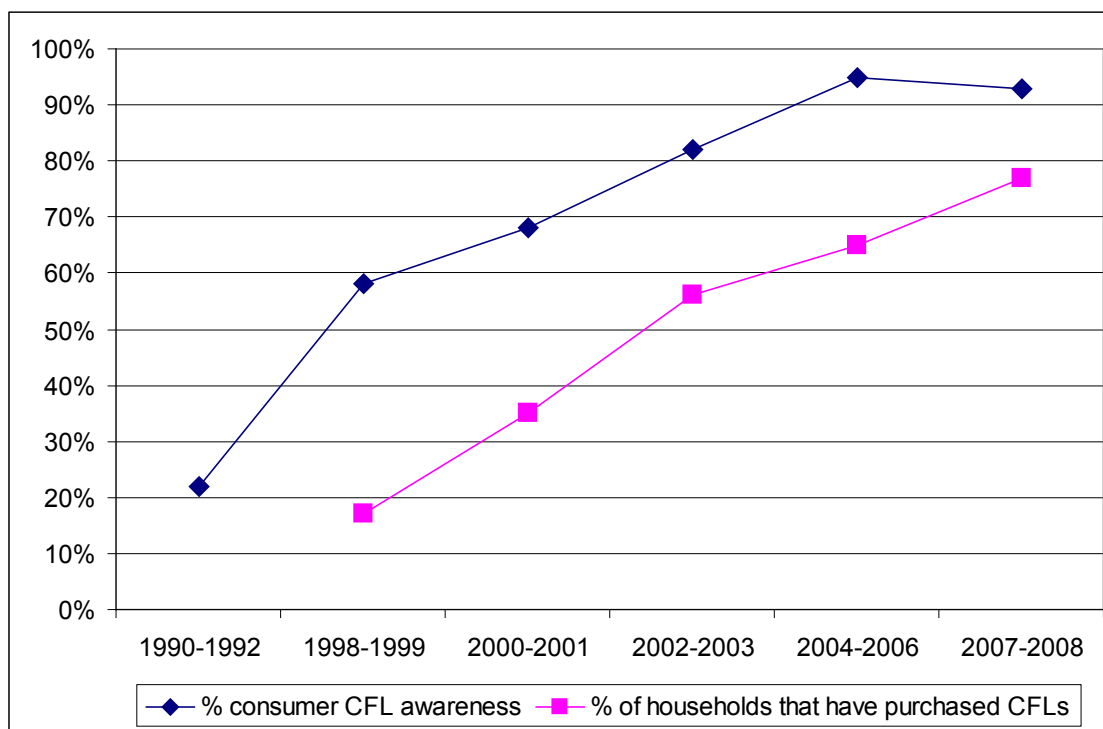
Figure 6 below shows the change in the percentage of California IOU households aware of CFLs and the percentage that have purchased CFLs.

- **1990–1992:** During the California IOUs' initial CFL program phase, the CFL awareness rate was very low: e.g., 22% of 1992 SDG&E CFL program participants had prior experience with CFLs.
- **1998–1999:** Just prior to the launching of the California IOUs' residential lighting market transformation program in 1998, 58% of California IOU customers were aware of CFLs, and 17% had purchased a CFL within the past year and a half.
- **2000–2001:** In 2001, during the energy crisis and the final year of the California IOUs' residential market transformation programs, 68% of California IOU customers were aware of CFLs, and 35% had purchased one or more CFLs.

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- **2002–2003:** After two years of sustained California IOU upstream incentives, the rate of awareness among California IOU customers increased to 82% in 2003, and the purchase rate increased to 56%.
- **2004–2006:** After another three years of even larger scale California IOU upstream incentive programs, awareness reached 95% in 2006. During 2004 and 2005, 65% of Californians bought CFLs.
- **2007–2008:** By 2008, 93% of Californians were reportedly aware of CFLs, and 77% had bought CFLs.

Figure 6. California Consumer Awareness and Purchase Rate



Sources:

1990-1992: Boutwell, B. et al., 1993 (SDG&E data only);
1998-1999 and 2000-2001: XENERGY Inc., 2002;
2002-2003 and 2004-2005: Itron and KEMA, 2006;
2007-2008: First Wave California CFL User Survey, 2008.

Notes: the 1990-1992 estimate is for SDG&E service territory only, and is of program participants; the 1998-1999 purchase rate estimate is only for purchases from mid-1997 through end of 1998; the 2004-2006 purchase rate estimate is only for purchases between 2004 and 2005.

Awareness of IOU incentive

The California IOU programs work within existing market channels to increase the availability of CFLs and provide products to consumers at a discount. Incentivized CFLs also have a label from the IOU programs affixed to their packaging and additional point-of-purchase (POP) material may be displayed at the retailer, but consumers have no obligation to provide a coupon or identify themselves to receive the discount. As a result, the consumer may not necessarily be aware that the California IOU program made the product available at its present price through the retailer. The survey asked respondents who had purchased CFLs if they knew whether the

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CFLs they purchased were part of a utility promotion or utility-sponsored sale. As Table 10 shows, 26% of the CFLs purchased by California households in the survey were attributed to the California IOU program. Note that these results are self-reported and could not be verified on-site because the ULP bulbs did not contain any marking or indication of a program bulb. Also, given the relatively low profile that the program had in the eyes of the consumer, many program participants may not have been aware that the products they purchased were program supported.

Table 10. Recollection of Utility Incentive for CFL Purchase
(base – respondents purchasing CFLs; respondents may have purchased bulbs at more than one type of store)

	California
N	99
Total # of CFL Purchased 3 months	9,998,281
Total # of CFLs for which consumers knew it was a “program bulb”	2,624,852
% of recently purchased CFLs for which consumers knew it was a “program bulb”	26%

3.2 Availability of CFLs

One of the key indicators the CFL Market Effects Team assessed was the extent to which the 2006–2008 California ULP increased the availability of CFLs. Our assessment was based on exploring the following researchable questions through manufacturer/importer, corporate-level and store-level retailer interviews; shelf-stocking studies; and a review of industry literature:

1. Are new actors entering the market and attributing their entry to the influence of the program?
2. To what extent are products promoted through the program available in nonparticipating retail outlets?
3. How do CFL sales at participating retailers compare to sales at nonparticipating retailers?

The results of our research are discussed below.

3.2.1 Are New Actors Entering the Market and Attributing Their Entry to the Influence of the Program?

Only about one-third of participating manufacturer/importers (6 of 16, representing 58% of all program sales) had sold CFLs at retail in California prior to joining the ULP. Some of these entities were established, brand-name manufacturers/importers who explained they had felt pressure to join the ULP after they had lost key accounts to new entrants.

Most new manufacturer/importer entrants were medium and small companies that reported joining the ULP prior to the 2006–2008 program cycle. They told us that when they tried to establish a presence in California’s CFL market they were unable to contract with established CFL retailers. As a result, they built new relationships with, and sold CFLs almost exclusively through, retail channels that previously had carried few or no CFLs—smaller (often ethnic) groceries and discount/99¢ stores. The manufacturer/importer respondents claimed that these

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retail outlets, in turn, made CFLs available to a new group of consumers who previously had found CFL prices in other retail channels too high.

The 2006–2008 programs included most of the CFL manufacturers/importers that had a retail presence in the state: 16 of the top 17 CFL manufacturers/importers with products found through the shelf-stocking surveys participated in the 2006–2008 IOUs' ULPs. As shown in Table 11, these 16 accounted for 86% of the CFL models found on the shelves in California.

Ten manufacturers/importers accounted for 91% of all CFL models found on the shelves in Comparison Area stores. Thus, based on the shelf-stocking survey results, the California market seemed to support a larger number of CFL manufacturers/importers than did the market in the Comparison Area. However, as shown in Table 11, many of the manufacturers/importers whose products were found in California but not in the Comparison Area had a very limited market presence even in California.

**Table 11. Presence of CFL Manufacturers/Importers in California and Comparison Area Stores
(Abbreviated and Comprehensive Shelf-Stocking Surveys)**

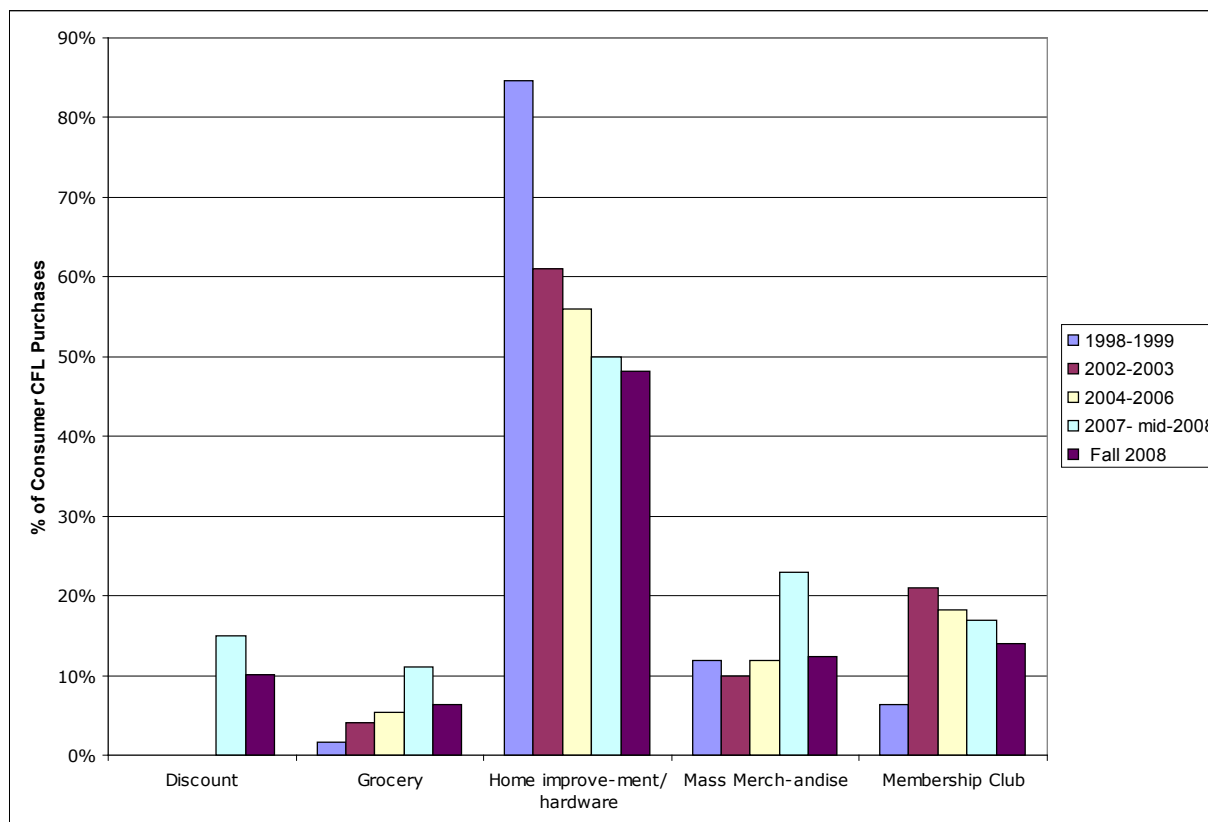
Manufacturer/Importer	Percent of Models in California Stores	Percent of Models in Comparison Area Stores
Feit Electric*	27%	24%
Sylvania*	19%	7%
IKEA	13%	0%
N:Vision*	12%	11%
General Electric*	9%	26%
EcoSmart*	3%	2%
Optolight*	3%	0%
Lights of America*	2%	1%
Bright Effects*	2%	10%
Sunrise*	2%	0%
Buffalo*	2%	0%
Philips Lighting*	1%	7%
Technical Consumer Products*	1%	2%
Great Value*	1%	1%
ULighting America*	1%	0%
Commercial Electric'	1%	0%
Bulb Star*	1%	0%
* Indicates manufacturer/importer participated in the 2006-2008 CA ULPs.		

Longitudinal studies of CFL purchases by retail channel provide insight into how the California ULPs may have affected the range of retail channels carrying CFLs over time. In the late 1990s, consumers bought CFLs primarily at home improvement or hardware stores, channels that tended to dedicate substantial portions of their shelf space to these lighting products. In recent years, consumers reported buying greater proportions of CFLs at discount, drug, grocery, and mass merchandise stores. Increases in consumer CFL purchases through these channels likely

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reflect the CFLs' increasing availability at these retailers, a change that had been promoted by the ULPs. Figure 7 shows the distribution of key retail channels where Californians bought CFLs from 1998 through 2008, based on consumer telephone survey self-reports.

Figure 7. California CFL Purchases by Retail Channel



Sources:

1998-1999: Hagler Bailly Consulting, Inc., 1998;
 2002-2003: XENERGY Inc., 2003;
 2004-2006: Itron and KEMA, 2006;
 2007- mid-2008: First Wave California CFL User Survey, 2008.
 Fall 2008: Second Wave California CFL User Survey, 2008.

Notes: 1998–1999 data are for CFLs purchased between January 1996 and June 1997 (1.5 years); 2002–2003 data are for CFLs purchased between January 2002 and June 2003 (1.5 years); 2004–2006 data are for the purchasers' most recent CFL purchase as of early 2007 (so no multiple mentions; whereas, the other data captured multiple mentions due to the possibility that more than one purchase occasion occurred in more than one retail channel); 2007–2008 data are for CFLs purchased between March and June 2008.

According to the CFL User (Telephone) Survey fielded for this study in fall 2008—and as shown in the center column of Figure 7 and in Table 12 below—almost 49% of all CFLs in California were sold at large home improvement stores. Membership clubs, such as Costco and Sam's Club, accounted for close to 16% of all CFL sales. Other popular retail outlets for CFL shoppers in California were groceries (8% of CFL sales) and discount stores (6%).

In the Comparison Area, 43% of all CFLs were sold through home improvement stores, and significantly more CFLs (compared to California) were sold at mass merchandise stores (30%). However, significantly fewer CFLs sold in the Comparison Area were purchased at drug stores

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(<1% versus 5% in California), and groceries (3% vs. 8% in California). These differences probably reflect IOU program efforts in California to focus on sales of CFLs through discount, grocery, and membership club stores. As Table 12 also shows, 35% of the CFLs rebated by the IOU program were purchased in grocery stores and 7% were purchased in drug stores.

Table 12. CFL Purchases by Retail Distribution Channel (Fall 2008)
(base – respondents purchasing CFLs; respondents may have purchased bulbs at more than one type of store)

	IOU Sales by Distribution Channel**	Households Purchasing Bulbs by Distribution Channel		Bulbs Purchased by Distribution Channel	
	California	California	Comparison Area	California	Comparison Area
N	42,508,475	102	267	9,998,281†	10,814,322†
Discount	16.8%	10.1%	6.0%	5.8%	3.2%
Drug	6.5%	5.8%	0.3% *	5.1%	0.2% *
Grocery	34.9%	6.4%	4.5%	7.6%	2.6% *
Hardware (small)	6.6%	2.6%	3.3%	4.1%	1.7%
Home improvement (large)	7.7%	45.5%	40.6%	48.6%	42.5%
Lighting electronics	1.9%	1.2%	0.9%	0.6%	0.7%
Mass merchandise	4.5%	12.4%	36.5% *	5.1%	29.7% *
Membership club	21.1%	14.0%	5.9% *	15.5%	9.6%
Other	0.0%	2.0%	2.0%	7.5%	10.0%

* Results between California and the Comparison Area are significantly different at the 90% confidence level.

** Source: 2007 IOU Program sales, percent of units rebated

† California and Comparison Area data were weighted based on tenancy (owner/renter status) and the educational status of respondents to represent households in the California IOU service territories. The resulting Comparison Area value is based on Comparison Area respondents to the CFL User Survey and represents the number of bulbs that would have been sold in the California IOU service territories.

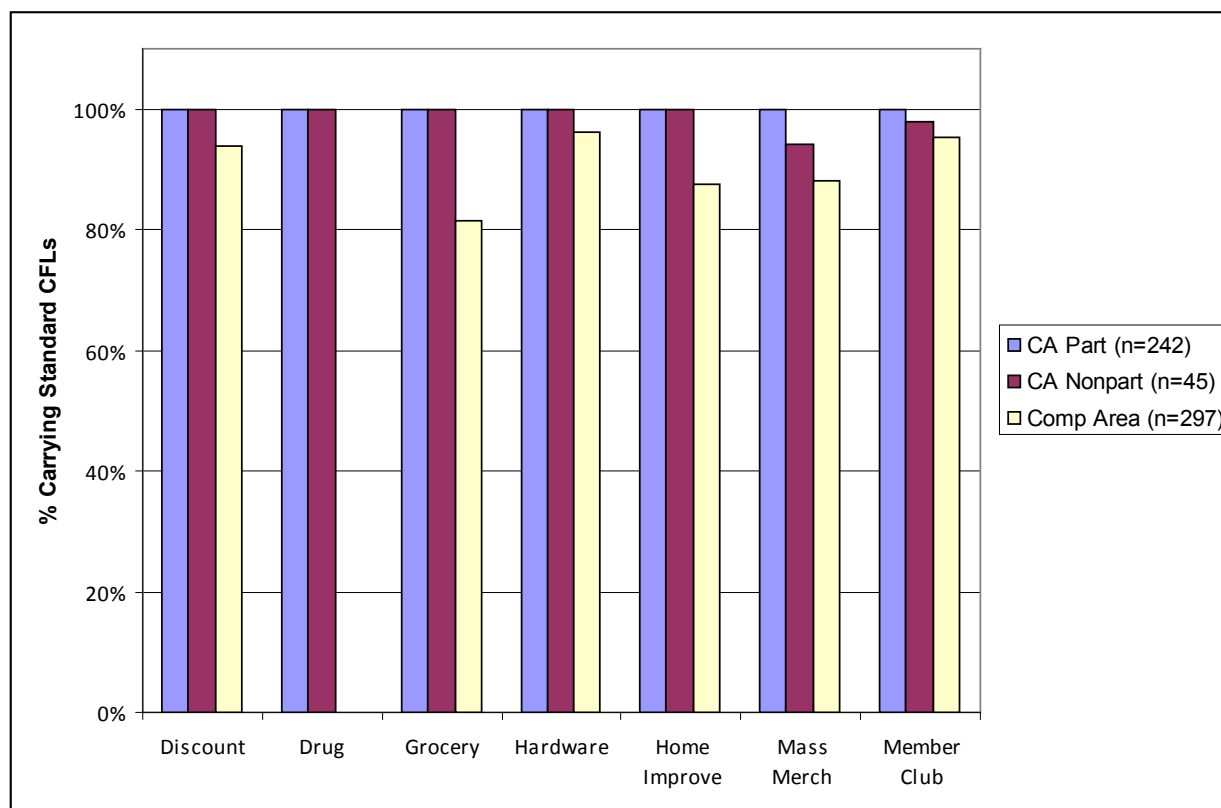
According to the IOUs' program tracking databases, over 3,800 individual storefronts participated in the 2006–2008 California ULPs. Over 80% of these stores were independently owned or had fewer than four stores with the same name; roughly 30% of all CFLs rebated through the 2006–2008 ULPs were purchased at these “independent” retailers. The relatively high percentage of program bulbs from such stores may be due largely to the ULPs' focus on independents. In contrast, when Comparison Area respondents to the CFL User Survey were asked where they bought their CFLs, fewer than 5% mentioned stores other than those we had already determined were national or local chains.

3.2.2 To What Extent Are Products Available in Nonparticipating Retail Outlets?

Pervasiveness of CFLs in Retail Stores

Nearly all store-level manager respondents, across all retail channels, said they carried standard ENERGY STAR CFLs: 100% of California participants, 98% of California nonparticipants, and 95% of Comparison Area respondents (Figure 8). Note, however, that only 82% of the grocery stores in the Comparison Area carried CFLs compared to all (100%) participating and non-participating grocery stores in California.

**Figure 8. Presence of Standard ENERGY STAR CFLs
(Store-Level Retailer Survey)**



Availability of CFLs Relative to Other Types of Lamps

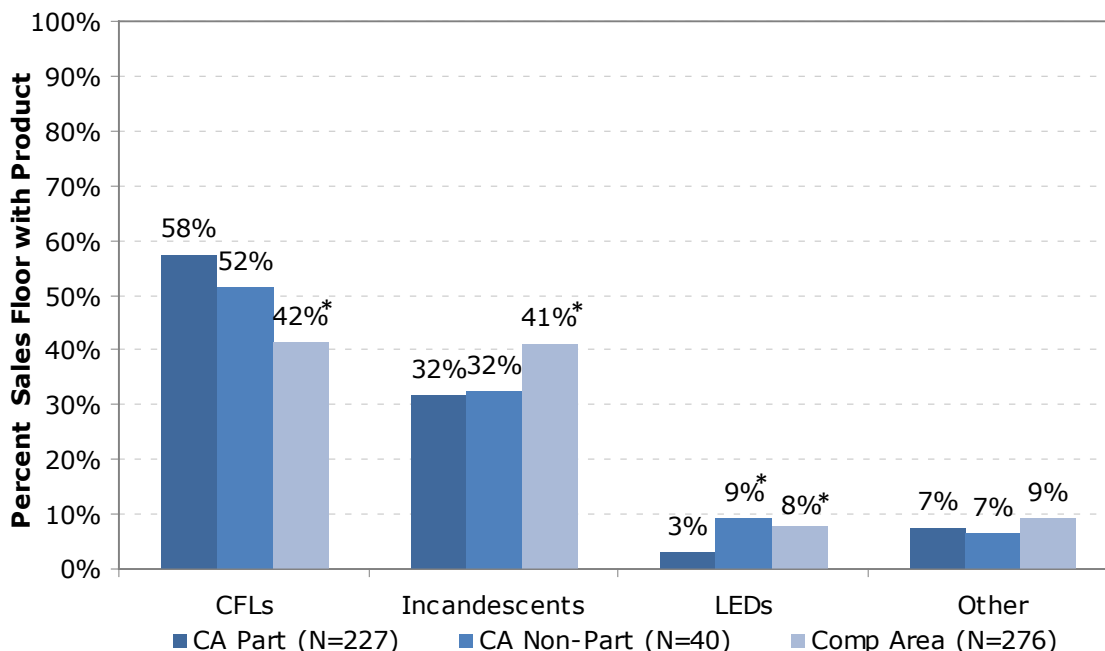
The CFL Market Effects Team also assessed the availability of CFLs relative to types of lamps through a number of metrics, including the proportion of lighting floor space allocated to CFLs and the percentage of models/bulbs on display that were CFLs.

In California, participant store-level retailer managers across all retail channels said CFLs accounted for 58% of their lighting sales floor, while nonparticipants said CFLs accounted for 52%. In the Comparison Area, CFLs accounted for a significantly smaller percentage of lighting floor space—only 42%. Comparison Area store managers reported a significantly greater percentage of their lighting floor space devoted to incandescents (41%) than did managers of

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California stores (32% for participants and nonparticipants). The proportion of sales floor area allocated to each light bulb type, reported by region and participant status, is shown in Figure 9.

Figure 9. Proportion of Sales Floor Area Allocated to Each Light Bulb Type, (Store-Level Retailer Survey)

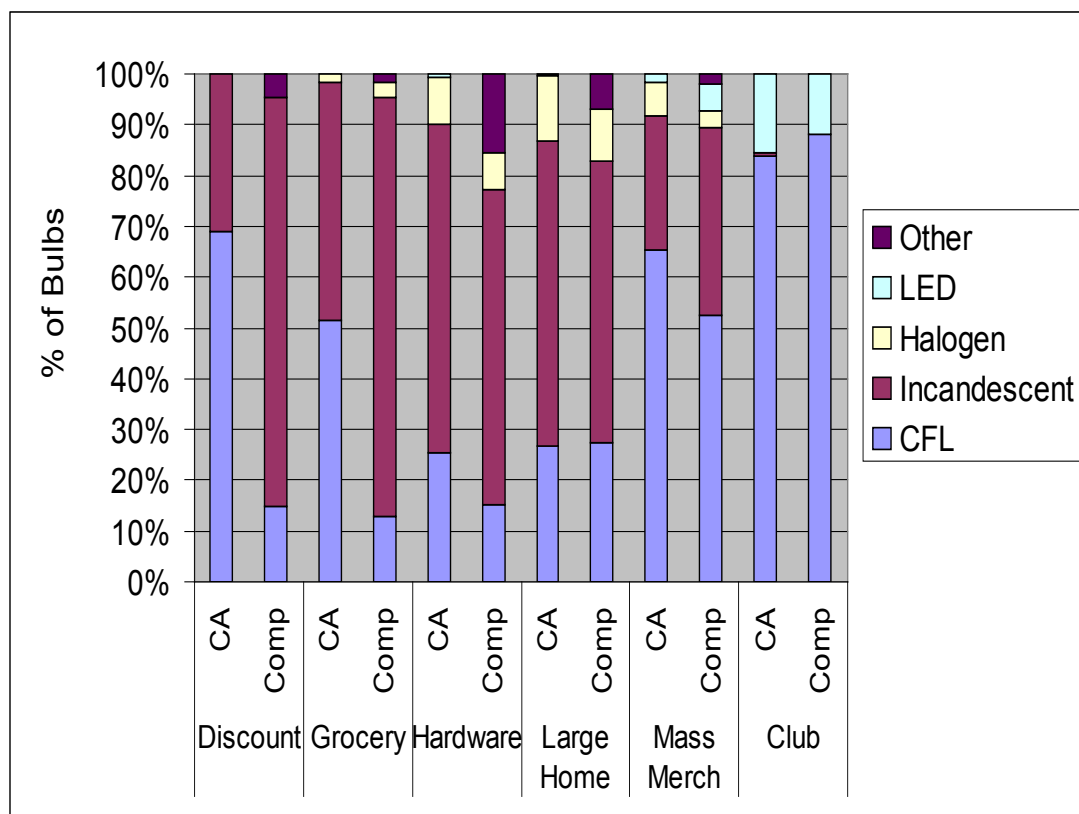


* Results between California participants and indicated respondent group are significantly different at the 90% confidence level.

As illustrated in Figure 10, the proportion of CFL, incandescent, LED, and other lighting products found on store shelves through the Comprehensive Shelf Stocking Survey varied considerably by retail channel, ULP participation status, and region. Among California participants, CFLs accounted for the largest percentage of bulb models in membership club (88%), discount (69%), mass merchandise (57%), and grocery (51%) stores. In fact, CFLs comprised the majority of models in all but hardware and home improvement participant stores (28% and 25% of floor space, respectively). In the Comparison Area stores, CFLs models accounted for the majority of models only in membership club stores (87%).⁷¹ The percentage of CFL models in the discount, grocery, and hardware stores – channels through which the 2006–2008 ULP sought to actively promote CFLs – was significantly greater than the percentage of CFL models in the same channels in the Comparison Area. Across all retail channels, the combined Comprehensive and Abbreviated Shelf Stocking Surveys found that 46% of all models were CFLs, 48% were incandescents, and 6% were other types of bulbs in California. In the Comparison Area, the combined surveys found 22% of all models were CFLs, 67% were incandescents, and 11% were other types of bulbs.

⁷¹ The combined and weighted results of the Comprehensive and Abbreviated Shelf Stocking Surveys were very similar to those of the Comprehensive Shelf Stocking Survey alone. Since the combined results are available only for CFLs versus other types of lamps grouped together, the details are not presented here by retail channel.

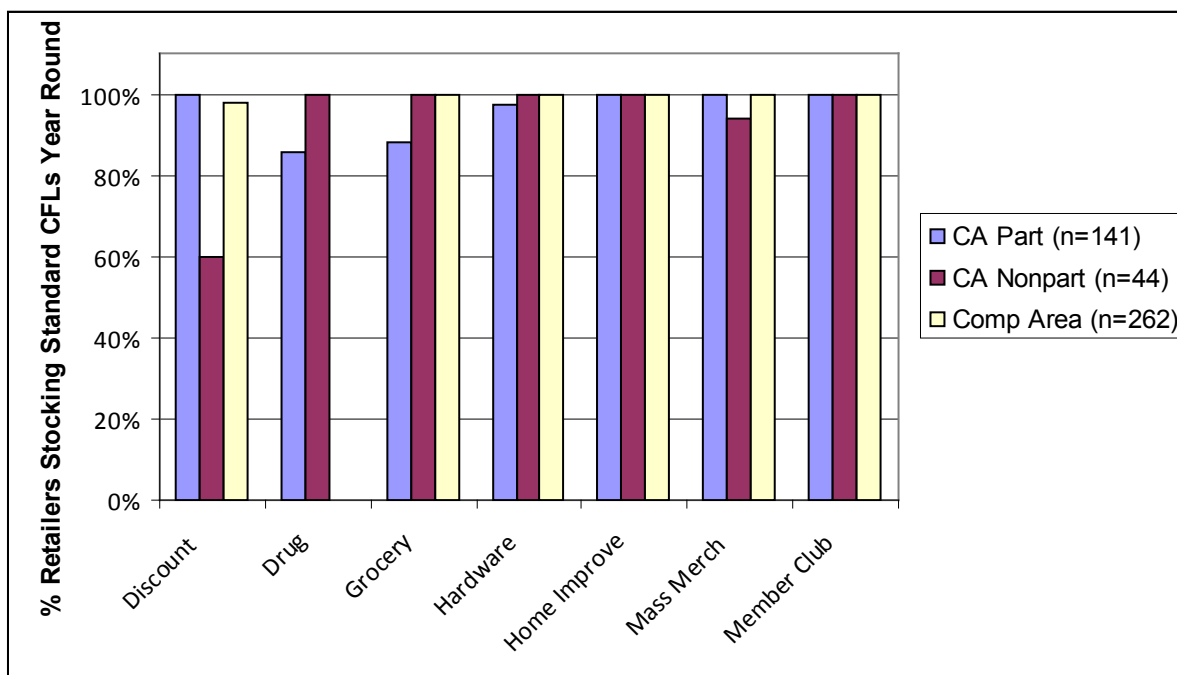
**Figure 10. Bulb Type Distribution by Retail Channel
(Comprehensive Shelf Stocking Survey)**



As shown in Figure 11, the vast majority of retailers that stocked CFLs said they carried them year-round: at least 98% of California participants in all but the drug and grocery channels.⁷²

⁷² Note that there are 9 or fewer California nonparticipant observations in all but the mass merchandise channel (where n=16), so these values are less likely to be representative of the population as a whole than are the California participant and Comparison Area values.

**Figure 11. Percentage of Retailers that Stock CFLs Year-Round
(Store-Level Retailer Survey)**



ULPs' Influence on CFL Availability in California

Half of the participant corporate-level retailers (8 of 16, accounting for 37% of 2006-2008 ULP sales) said they stocked ENERGY STAR CFLs in California before the ULP, but the responses varied notably by retail channel. Almost all (7 of 8) of the drug, hardware, home improvement, mass merchandise, and membership club corporate-level retailers said they had carried ENERGY STAR CFLs before participating in the ULP and mentioned the program had little or no influence on CFL stocking (or packaging) in their stores. In contrast, only one of the eight discount and grocery respondents said they had carried ENERGY STAR CFLs prior to participating; five were certain they did not, and the remaining two were not sure.⁷³ This latter set of respondents also said that through their participation they were encouraged to sell more CFL multi-packs, increase the shelf space they allocated to CFLs year-round, and give CFLs more prominent shelf space in their stores.

Roughly half of the participant store-level retailers (52%) also said they had carried ENERGY STAR CFLs prior to their participation. The retail channels in which the majority of store-level retailers reported carrying ENERGY STAR CFLs before the program were the same as for the corporate-level retailers: hardware (85%), home improvement (85%), mass merchandise (78%), and membership club (83%). The retail channels in which store-level retailers said they had not carried ENERGY STAR CFLs before the program were also similar to the corporate-level

⁷³ The five retailers who said they had not been selling ENERGY STAR CFLs in California before the ULP accounted for 17% of ULP-rebated lighting sales, and the three retailers who were not sure accounted for 7% of ULP-rebated lighting sales.

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responses: 79% of discount, 70% of drug, and 66% of grocery store-level respondents said they had not carried ENERGY STAR CFLs prior to their ULP participation.

Although, as shown in Figure 8 above, 100% of California participant retailers said they carried standard ENERGY STAR CFLs—whether program-discounted or not—fewer than half in the discount and grocery channels said they carried non-program standard ENERGY STAR CFLs (i.e., they said they carried only program-discounted CFLs). These findings are illustrated in Table 13. Because, as the table illustrates, the majority of their nonparticipant counterparts in California and the Comparison Area did carry standard ENERGY STAR CFLs, the Team thinks it likely that, to remain competitive, these participants may continue carrying standard ENERGY STAR CFLs in the absence of the California programs (despite the fact that most discount and grocery stores did not carry CFLs prior to their participation in the ULPs).

**Table 13. Percentage of Stores in Retail Channel Selling Non-Program Standard CFLs
(Store-Level Retailer Survey)**

	Participants	Nonparticipants	
	CA	CA	Comp Area
Discount	18%	100%*	94%*
Drug	70%	100%	NA
Grocery	46%	100%*	83%*
Hardware	89%	100%	96%
Large Home Improvement	96%	100%	90%
Mass Merchandise	57%	94%*	91%*
Membership Club	57%	100%*	95%

* Indicates a statistically significant difference from the California participant response.

3.2.3 Are new products and specialty CFL products entering the market due to IOU coordination and incentives?

Participant manufacturers/importers said the programs encouraged them to shift production to: (1) higher efficiency CFLs (through lumen level per wattage, or efficacy, requirements), (2) CFLs with longer hours of life, and (3) higher wattage CFLs. However, these assertions were not borne out by the shelf stocking survey findings. This discrepancy may be because the manufacturers/importers were asked about the program's operation from 2006 to 2008, whereas the shelf stocking surveys were conducted at the end of this period—in 2008 and 2009—by which time retail CFL offerings outside of California may have “caught up” to those within California.

Table 14 shows the average efficacies and wattages of the CFLs we found in California and the Comparison Area by retail channel. CFLs in both discount and home improvement stores in California had higher average efficacies than did CFLs in discount and home improvement stores in the Comparison Area. In all other channels, however, the efficacies were statistically the same in the two regions. Likewise, there were no statistically significant wattage differences between the CFLs found in California and comparison stores in any channel.

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**Table 14. Average CFL Efficacy and Wattage by Retail Channel
(Abbreviated and Comprehensive Shelf Stocking Surveys)**

	Average Efficacy (lumens/watt)		Average Wattage	
Retail Channel	California	Comparison Area	California	Comparison Area
Discount	63.7	57.6*	18	20
Grocery	59.2	57.3	17	18
Hardware	57.0	56.6	18	17
Home Improvement	57.3	54.9*	17	23
Mass Merchandise	55.4	55.1	16	16
Membership Club	54.8	53.3	17	16

** Indicates a statistically significant difference from the California response.*

Two-thirds of the participant manufacturer/importer respondents (10 of 16, representing 76% of all program sales) said that the product quality improvements they implemented during the 2006-2008 time period would have happened later without the ULP, while the remaining 1/3 said the improvements would have happened at the same time.⁷⁴

In contrast to the participants' responses about the effect of the ULPs on specialty CFL products, nonparticipant manufacturers/importers reported they manufactured products that already exceeded the ULP and ENERGY STAR standards. These respondents said the CFL quality improvements they implemented over the 2006-2008 time period were not linked to any programs. They explained that the improvements were a result of their desire to remain competitive and that the improvements would have happened at the same time without any utility- or government-sponsored CFL programs. However, the nonparticipant manufacturers/importers also reported that to remain price-competitive with program-discounted CFLs, they needed to provide lower-quality, less expensive CFLs to the California market.

Based on their responses to the free ridership question, a large majority of manufacturers/importers also stated that the program encouraged them to produce more specialty CFLs than they otherwise would have.⁷⁵

Table 15 below compares the percentages of ENERGY STAR, dimmable, and 3-way CFL models we found in California to the percentages we found in the Comparison Area through the Comprehensive and Abbreviated Shelf Stocking Surveys. In nearly every retail channel, California stores had a significantly higher percentage of ENERGY STAR models than did Comparison Area stores. Although many store-level managers said they carry specialty CFLs, dimmable CFL models did not account for more than 7% of all stocked CFLs in any region or

⁷⁴ While the manufacturers/importers were not asked to specify the efficiency improvements they were referring to, two respondents volunteered that in the absence of California ULP, they would not have manufactured/imported ENERGY STAR qualifying CFLs during the 2006-2008 time period. Both said they would have instead offered lower quality CFLs because ENERGY STAR qualified CFLs are more expensive to produce.

⁷⁵ These responses are detailed in the Residential Retrofit impact evaluation report.

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retail channel, and only in the home improvement and mass merchandise retail channels were there significantly more dimmables in California than in the Comparison Area. Three-way CFLs were even less prevalent than dimmables: we found the greatest percentage in membership club stores in California, where there were significantly more of them than in the Comparison Area.

Table 15. Proportion of ENERGY STAR and Controllable CFL Models on Store Shelves (Abbreviated and Comprehensive Shelf Stocking Surveys)

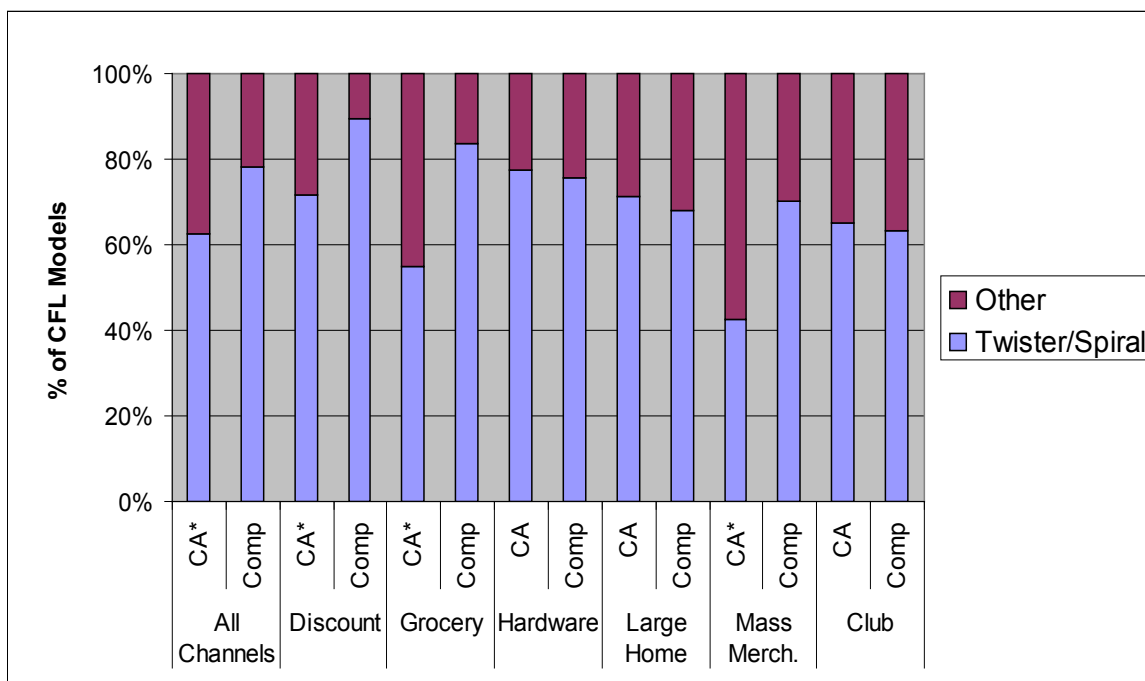
	ENERGY STAR		Dimmable		3-way	
	CA	Comp Area	CA	Comp Area	CA	Comp Area
Discount	99%	65%*	0.0%	5.6%*	0.0%	0.0%
Grocery	99%	94%*	0.1%	1.7%*	0.0%	1.3%*
Hardware	78%	62%*	3.0%	1.2%*	0.5%	1.1%*
Home Improvement	69%	55%*	6.8%	1.9%*	1.6%	0.8%*
Mass Merchandise	48%	79%*	0.3%	2.4%*	0.7%	0.3%*
Membership Club	100%	85%*	8.5%	8.0%	0.0%	0.2%*
Weighted Average of all Channels**	85%	78%	1.9%	2.1%	0.4%	1.0%

* Indicates a statistically significant difference from the California response.

The team also examined the availability of shaped CFLs—i.e., CFL spotlights, reflectors, floods, a-lamps, circline, torpedo, tube and others, which in some applications may be attractive alternatives to standard spiral/twister CFLs—in California and the Comparison Area. Figure 12 compares the percentage of CFL models we found in retail stores with a twister/spiral shape to the percentage of CFLs with any of the other shapes. The presence of shaped CFLs in California, across all channels, was significantly higher in California (37% of all CFL models) vs. the Comparison Area (22% of all CFL models). Only in the discount, grocery, and mass merchandise channels did we find a significant difference between the two regions, with twister/spirals models comprising a significantly greater share of the shelf space in the Comparison Area than in California.

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Figure 12. Percentage of Twister/Spirals versus CFL Models with Other Shapes (Abbreviated and Comprehensive Shelf Stocking Surveys)



* Indicates a statistically significant difference from the California response.

3.3 CFL Prices

As summarized in Table 16, the CFL Market Effects study examined a number of hypotheses regarding CFL prices in California. The findings from all available data sources—including the upstream interviews, POS data, descriptive statistics from the shelf stocking, and the pricing regression model—were analyzed to address each of these questions.

Table 16. Pricing Analysis Research Questions

Primary Pricing Research Questions	Secondary (Related) Pricing Research Questions
1. Have ULP incentives reduced the price consumers pay for IOU-sponsored CFLs in California?	Are program bulbs selling for less than equivalent non-program bulbs? What fraction of incentive is passed on to consumers? Does any price drop vary by utility or sales channel?
2. Have California utility rebates reduced prices of comparable models in California or the Comparison Area?	Is the average price of equivalent nonprogram bulb in CA or Comparison Area lower?
3. Do the costs of program and nonprogram CFLs tend to track downward?	Have average CFL prices dropped over time? If so, has the ULP played a role in this price drop?

3.3.1 Pricing Research Question: Have ULP incentives reduced the register price of IOU-sponsored CFLs in California?

The first research area for this analysis concerns the impact of IOU-sponsored upstream incentives on the register prices of CFLs. The overarching question is “Have ULP incentives

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reduced the register price of IOU-sponsored CFLs in California?” Specifically, to what degree have any of the incentives paid to manufacturers/importers, wholesalers, and retailers been passed on to consumers in the form of lower prices? In addition, what fraction or multiple of the upstream incentives is passed on to consumers in the form of lower retail prices—i.e., is there a “multiplier effect?” By multiplier effect, we mean that the impact of the IOU incentive on register price may be greater than the actual incentive amount. For example, a \$1 incentive would have a multiplier effect if it led to a greater than \$1 reduction in the register price. Anecdotal evidence based on interviews with managers at CFL manufacturers and wholesalers suggests that such effects may exist.

A related set of research questions addressed whether the impact of the upstream utility incentive varied by IOU service territory or retail sales channel. The answers to these questions may be of interest to policymakers and utility staffs interested in increasing the effectiveness of upstream incentive programs.

As a first step in the analysis, the descriptive statistics related to average standard CFL prices across geographic region, wattage, and distribution channel were examined. As shown in Table 17 and Figure 13, the average IOU-discounted twister style bulb retailed for \$1.30, significantly less than equivalent nonprogram bulbs in California (\$3.98) or the Comparison Area (\$4.00). The price difference between program and non-program bulbs, therefore, appears to be about \$2.70.

Discounts provided by other parties (typically the retailer) reduced the cost somewhat compared to nondiscounted bulbs, but the discount was relatively small compared to the IOU discount. The discounts were greatest in the hardware distribution channels, where the average IOU-discounted bulb sold for only 78 cents, and lowest in the large home-improvement channel, where IOU-discounted bulbs averaged \$1.46, still substantially less than the nonprogram bulbs in the California and Comparison Area large home-improvement stores.

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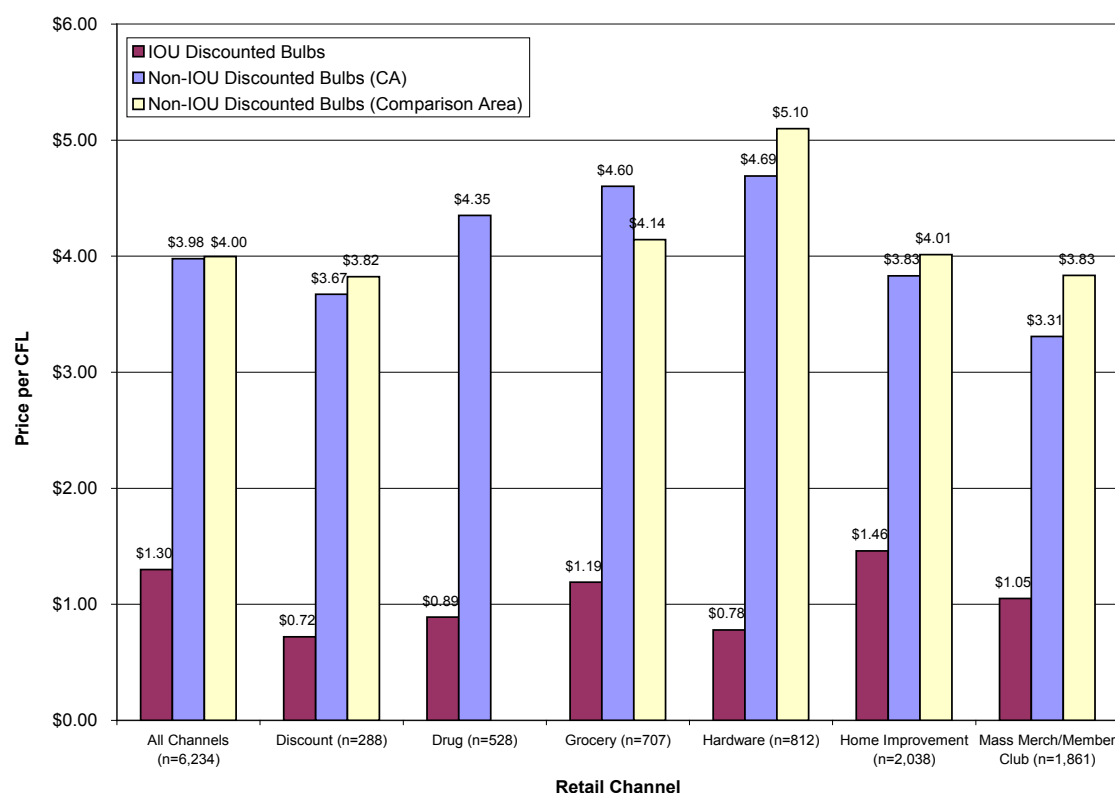
Table 17. Average CFL Prices by Region and Wattage

Geographic Region	Wattage Category	N	Retail Price (Average Price per CFL)			
			All CFLs	IOU-Discounted CFLs	Other-Discounted CFLs	Non-Discounted CFLs
California	09-13W	1,424	\$3.42	\$1.81*	\$3.31	\$3.56
California	14-18W	802	\$3.06	\$1.21*	\$2.43*	\$3.55
California	19-23W	1,444	\$3.59	\$1.13*	\$3.37*	\$4.40
California	24-30W	508	\$5.24	\$1.65*	\$5.42	\$5.59
Comparison Area	09-13W	767	\$3.31	.	\$2.79*	\$3.36
Comparison Area	14-18W	361	\$3.99	.	\$3.91	\$3.99
Comparison Area	19-23W	596	\$4.18	.	\$3.38*	\$4.26
Comparison Area	24-30W	332	\$5.25	.	\$4.11*	\$5.40

Note: All prices are per bulb at the register. N represents the number of CFL packages in the survey. Prices based on average price per bulb.

* Denotes a value that is significantly different from the value in the "Non-Discounted" column at the 5% level based on t test

Figure 13. Average CFL Prices by Region and Distribution Channel



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The hedonic pricing model, which controls for multiple variables at one time in order to isolate the impact of the IOU discount, found nearly identical results as the descriptive statistics. The model suggests that IOU-sponsored upstream incentives had a large and significant impact on the price per CFL at the register. For example, as shown in Table 18, the base regression model shows that the impact of an IOU-sponsored upstream incentive is to reduce the register price of a CFL by \$2.70 (all else being equal).⁷⁶ The t-statistic (36.6) indicates that the coefficient on “IOU Discount” was estimated precisely and is statistically significant at the 1% level.

Fraction of Incentive Passed on to Consumers in a Multiplier Effect

In order to investigate the degree to which the incentives were passed on to consumers, we compared the average retail price impact of \$2.70 with the average value of the IOU incentive. To do this, we obtained the IOUs’ 2008 program tracking data, which included information about incentives paid to CFL manufacturers/importers. These data revealed that the average incentive for twister/spirals was \$1.57 per CFL. Thus, an average incentive of \$1.57 per bulb led to an average discount at the register of \$2.70 per bulb, suggesting the existence of a multiplier effect. The ratio of the estimated price impact of the incentive to the average incentive paid to manufacturers was 1.72 (\$2.70 divided by \$1.57). In other words, the mean price impact of the rebate at the register was 172% of the mean rebate.

Discussions with manufacturers and retailers confirmed this finding. During the interviews, respondents were asked if their company ever provided any of its own price discounts in addition to those provided by the ULP. Many respondents reported offering “add-on” discounts in addition to passing through the ULP discount. Respondents cited faster sell-through, competition, and achieving a particular price point as reasons for offering additional discounts.

Differences in Price Drop by Retail Sales Channel and Utility

Next, we allowed the impact of utility incentives to vary by sales channel and utility in the regression analysis. For instance, we investigated whether there were differences in the impact of upstream incentives on home improvement and hardware stores. We added interaction terms between “IOU Discount” and indicator variables for the sales channels and utility to the specification in the base regression model.

The IOU discount appears to have had its largest impact on the register price in drug stores, where an IOU-discounted CFL sold for \$3.64 less than an otherwise identical nondiscounted CFL (Figure 14). The estimated impact of an IOU discount on the purchase price of a CFL was smallest in home improvement stores (\$2.24).

We also tested whether the impact of an IOU upstream incentive varies by IOU service territory. The results show that the impact of the upstream incentive was largest in PG&E’s service territory, where the average price reduction was \$2.92 (all else being equal). In the SDG&E service area, the average impact of an upstream incentive was \$2.36, and in SCE’s service territory, the impact was \$2.21 per CFL.

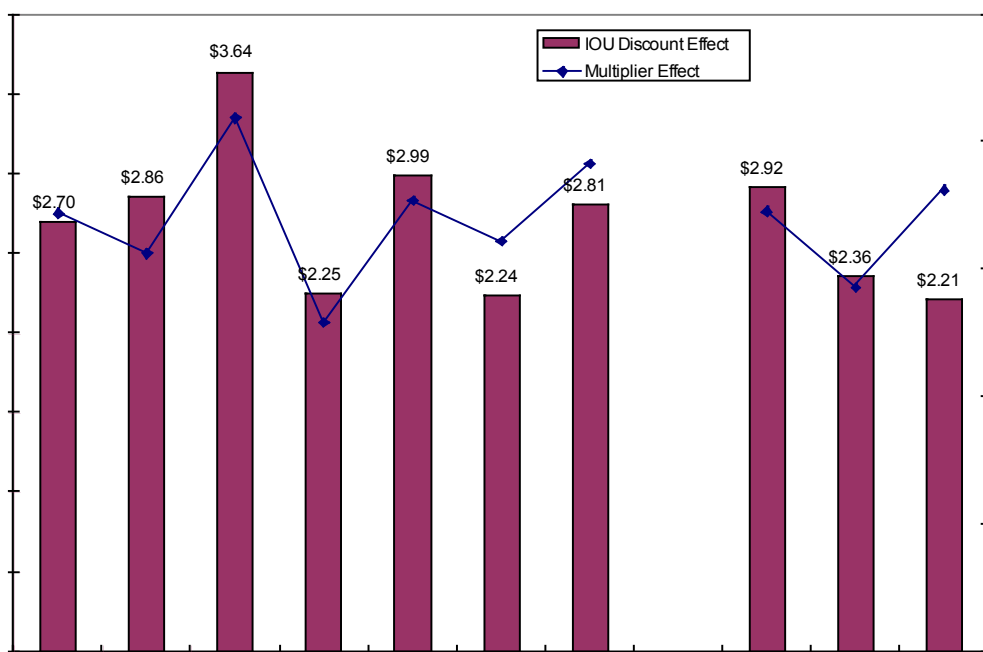
Figure 14 also shows the multiplier effect across sales channel and IOU. In general, the average incentives didn’t vary much by channel or by IOU, and thus the multiplier effect is highly correlated with the discount effect (i.e., the greater the effective discount, the greater the

⁷⁶ The full set of all regression model output is provided in Appendix J.

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multiplier effect). One exception is for SCE, which had the lowest IOU discount effect (\$2.21), yet had the highest multiplier effect because the average CFL incentive was only \$1.22, well below the other utilities.

Figure 14. Reduction in Retail Price for IOU Discounted CFLs by Retail Channel and Utility



Sales Weighted Pricing Findings

We used the IOU impacts by retail channel to develop a sales-weighted estimate of the impact of the upstream incentive on register price. In 2007 (the most recent year for which a reliable estimate of California CFL sales by channel was available), the largest percentage of CFLs was sold through membership clubs and mass merchandise stores (35%), followed by groceries (24%) and home improvement stores (21%). Applying the 2007 percentage sales as weights, we obtained a sales-channel-weighted estimate of the IOU discount of \$2.61—close to the unweighted estimate of \$2.70 in the base model. Ideally, we would weight the price impacts not only by the percentage of sales through each retail channel, but also by bulb type for each channel. However, the data necessary to do so were not available. Nonetheless, the similarity between the unweighted and weighted incentive impacts provides some assurance about the reliability of our unweighted approach.

Table 18. Summary of Regression Output for Selected Hedonic Pricing Models

	Base Regression Model (Model 5)	Model Testing IOU Impact on Non-IOU Bulbs
Intercept	3.30	3.39
	(13.61)	(14.77)
Other Discount (1='Yes', 0='No')	-0.97	-1.24
	(15.80)	(10.85)
IOU Discount (1='Yes', 0='No')	-2.70	-2.63
	(36.63)	(35.57)
ENERGY STAR Label (1='Yes', 0='No')	-0.68	-0.66
	(12.09)	(11.97)
Watts	0.08	0.08
	(24.34)	(24.47)
California (1='Yes', 0='No')		0.13
		(1.97)
Other Discount*California		0.39
		(2.97)
Package Quantity Variables	yes	yes
Manufacturer Variables	yes	yes
Sales Channel Variables	yes	yes
Metro Area Variables	yes	no
Month-Year Variables	yes	yes
Adjusted R2	0.59	0.59
N	6,234	6,234
Estimation Sample	All states and years	All states and years

3.3.2 Pricing Research Question: Have California utility rebates reduced prices of comparable models in California and the Comparison Area?

One potential market effect of an IOU discount is to lower the prices of other CFLs, including those that are discounted by other parties and those that are not. However, Table 17 and Figure 13 do not provide evidence to support such an effect: a comparison of the mean price of other-discounted or non-discounted CFLs between California and the Comparison Area does not reveal systematic differences. The average price of all non-program bulbs was \$3.98 in California compared to \$4.00 in the Comparison Area, and the mean price for all other-discounted CFLs was \$3.42 in California and \$3.37 in the Comparison Area. These differences are not statistically significant.

A hedonic pricing model was also developed to test whether IOU-sponsored upstream incentives affected the register price of other-discounted and nondiscounted CFLs. We did this by including a variable indicating whether the CFL was on a store shelf in California and an interaction term between California and “Other Discount.” In this model, the coefficient on “IOU Discount” was -2.63, suggesting that an upstream incentivized CFL was priced \$2.63 less than an otherwise identical nondiscounted CFL (Table 18). However, the results do not point to any indirect effects of upstream rebates. The coefficient for California was 0.133, suggesting nondiscounted CFLs

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were priced \$0.13 higher in California than in the Comparison Area. Similarly, CFLs that were discounted by another entity were priced \$0.39 higher in California than in the Comparison Area. Both differences were statistically significant at the 5% level. The positive price differentials for nondiscounted and other discounted bulbs in California relative to other states may reflect higher demand and willingness to pay for CFLs in California.

3.3.3 Pricing Research Question: Do the costs of program and non-program CFLs tend to track downward?

In our interviews with both participant and nonparticipant manufacturers/importers, the majority said that they had seen CFL production costs decline over the past decade.⁷⁷ These production cost decreases likely led to decreases in retail sales prices for both program- and non-program CFLs since:

- Most of the participant manufacturers/importers whom we interviewed (11 of 12, representing 80% of program sales) linked decreases in production costs with increases in sales volumes, and most of these (9 of the 11, representing 72% of program sales) credited the ULPs with increasing their sales volumes.⁷⁸
- Most of the participant manufacturer/importer respondents (11 of 16, accounting for 83% of program sales) produce/sell CFLs at retail in non-program states, and another three (representing 6% of program sales) sell CFLs in non-program states at wholesale.
- A large number of retailers use keystone pricing (i.e., they set a product's retail price at double its wholesale price) or a standard markup (over wholesale) to set retail CFL prices,⁷⁹ so decreases in wholesale costs to these retailers lead directly to decreases in CFL retail prices—for both program- and non-program bulbs sold in California and elsewhere throughout the U.S.

Although the nonparticipant manufacturers asserted that technological, factory-line, and process efficiency improvements, and not utility or government programs, were responsible for CFL production cost decreases, it is certainly possible that the California ULPs had an indirect (e.g., through changing industry standards and competition)—and, therefore, not visible—effect on nonparticipants' CFL production costs as well.

In terms of actual pricing data, there is no longitudinal source of CFL prices for all distribution channels. The POS data collected for the Residential Market Share Tracking Study, however, does contain actual pricing data for a number of channels, including groceries, drug stores, and hardware stores.^{80, 81} As shown in Figure 15, the average retail price of a CFL sold in these

⁷⁷ Seventy-five percent of participant respondents (12 of 16, accounting for 82% of program sales) said they had seen production cost reductions for standard CFLs over the past 10 years, and 73% (11 of 15, accounting for 56% of 2006-2008 ULP sales) said they had seen production cost reductions for specialty CFLs over the past 5 years. One-hundred percent of nonparticipant respondents said they had seen cost reductions, though the nonparticipants did not specify whether these reductions applied to standard CFLs, specialty CFLs, or both.

⁷⁸ Specifically, 9 of the 11 respondents gave the ULPs' influence ratings of 8 to 10 on a 10-point scale. The remaining two (representing 8% of program sales) gave the program's influence a rating of 4.5 and 5.

⁷⁹ Approximately 50% of both the corporate-level and store-level retailers whom we spoke to said they use keystone pricing or some other sort of standard markup to set retail pricing.

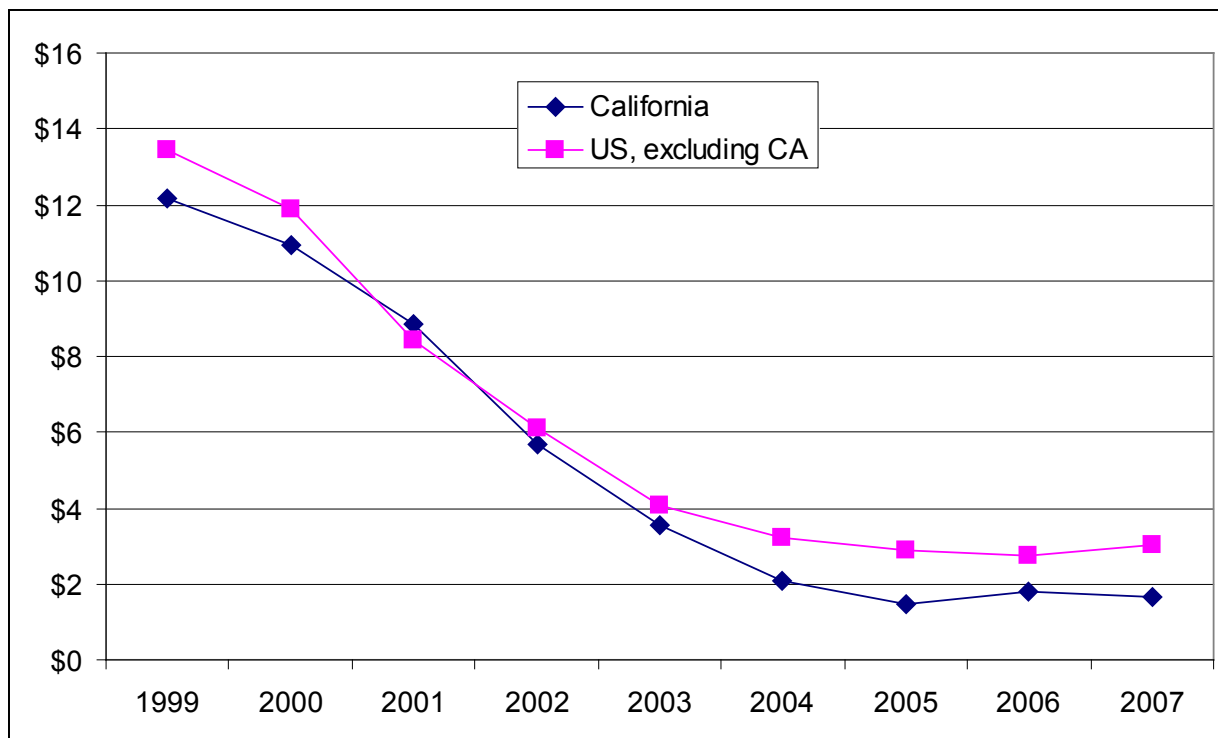
⁸⁰ Itron, 2008a.

⁸¹ Through 2001, the data include most mass merchandisers, and, through 2002, the data include the large home improvement store channel.

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channels has declined steadily during the past decade for California and the rest of the nation. Even though the data shown in Figure 15 do not completely represent all channels where consumers buy CFLs, they are valuable in showing price trends for some important retail sales channels.

Figure 15. CFL Average Retail Price



Source: Itron, 2008a.

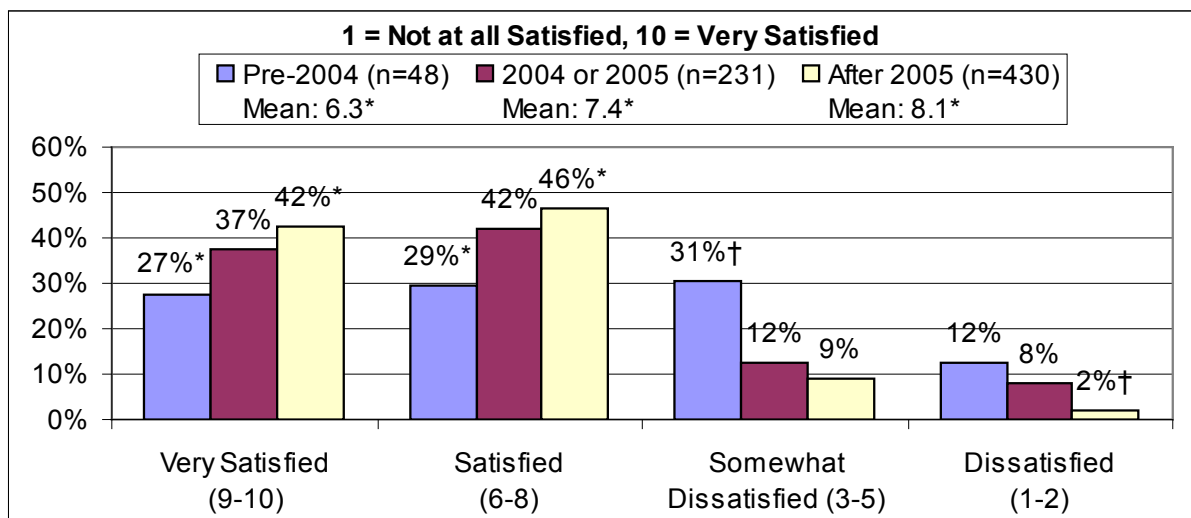
Note: Some channels are excluded, such as warehouse/membership clubs and discount stores during the entire study period, a large mass merchandiser from 2002 on, and the home improvement store channel from 2003 on.

3.4 Satisfaction with CFLs

Consumer satisfaction with CFL performance has increased in California as bulb quality has improved, likely in response to updates to ENERGY STAR product specifications and continuous manufacturer improvements. Figure 16 shows that consumer satisfaction is higher for CFLs purchased recently compared to CFLs purchased prior to 2004.

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Figure 16. California Consumers' General Satisfaction with CFLs by Date of Most Recent CFL Purchase, 2006



Source: Itron and KEMA, 2006.

* Differences are statistically significant at the 90 percent level of confidence.

† Differences from other Purchaser Groups within satisfaction category are statistically significant at the 90 percent confidence level.

The CFL User (telephone) Survey asked respondents to rate their satisfaction with a number of attributes related to CFLs using a scale of 0 to 10, with 0 being “not at all satisfied” and 10 being “very satisfied.” As Table 19 shows, California respondents gave high satisfaction ratings to CFLs currently in their homes. They also gave CFLs high ratings for having a constant light output/no flickering and for the brightness of the light. California respondents gave the lowest satisfaction ratings to CFL lifetimes before burning out and to retail price. Overall satisfaction in the Comparison Area is about the same as in California, and respondents in the Comparison Area also gave high satisfaction ratings to having a constant light output/no flickering. While the Comparison Area also gave the lowest ratings to CFLs’ lifetimes before burning out and to retail price, these ratings were significantly lower than in California, perhaps because more of them were first exposed to CFLs after they had been improved and had decreased in price. These satisfaction ratings may be influenced in part because the IOU programs have supported PEARL and the national ENERGY STAR lighting program to monitor and improve product quality by funding quality assurance efforts and encouraging suppliers in California to provide CFLs that go beyond the ENERGY STAR standards.

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Table 19. Satisfaction with Factors Related to CFLs[†]
(base – respondents who previously used or currently use CFLs)^{††}

	California (n=564)	Comparison Area (n=1228)
	Average	Average
Overall satisfaction with CFLs currently in home	8.3	8.2
Constant light output/no flickering	8.4	8.6
Brightness of light	8.0	7.8
Fit in light fixtures	7.9	7.9
Amount of time to light up	7.9	7.3
Color of light	7.7	7.6
Look in light fixtures	6.9	6.5
How long CFLs last before burning out	6.4	5.3 *
Retail Price	6.4	5.3 *
[†] 1 = Not at all Satisfied, 10 = Very Satisfied ^{††} "Don't know" responses removed from the analyses. * Results between California and the Comparison Area are significantly different at the 90% confidence level.		

4. ASSESSMENT OF CFL SALES AND SATURATION

CFL market-level sales and saturation estimates—coincident and lagging indicators of market change, respectively—are presented in this section.⁸² This section includes the findings for both historical market and program sales, as well as historical and current CFL saturation. Baseline estimates for sales and saturation are also provided, providing some insight into market conditions in the absence of the CFL programs. Finally, the results of a multi-state regression model that estimates program impacts (i.e., net savings) while controlling for demographic, household, and market variables are presented.

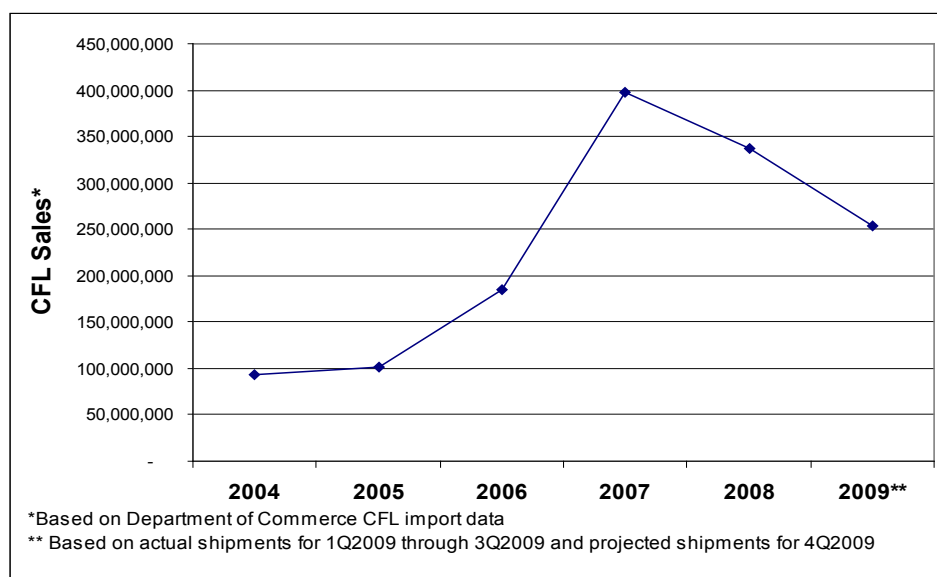
4.1 CFL Sales

This section presents CFL sales data for the U.S., California, and other areas of the U.S. (including the Comparison Area).

4.1.1 United States CFL Sales

Sales of CFLs in the U.S. had seen dramatic increases in the recent past, nearly doubling from 2006 to 2007 (to 397 million) (Figure 17). In 2008, however, CFL sales decreased by 15% from the previous year to 337 million, and projections for 2009 indicate sales this year are expected to decrease even further—perhaps by 25% (to 254 million) from 2008 sales. Manufacturers interviewed as part of this study confirmed these projections when they reported that 2009 CFL sales remained sluggish. They suggested the decline in CFL sales over the past two years is due largely to the economic recession which has affected sales of all types of lighting products. Other factors, such as nationwide increases in CFL saturation, may also have contributed as well.

Figure 17. Estimated U.S. CFL Sales by Year



4.1.2 California Market-Level CFL Sales

⁸² Coincident indicators are signs that the level of CFL market activity is changing that occur concurrently with the altered level of activity; lagging indicators are indications of changes in the level of CFL market activity that occur after the level has changed.

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For many years, the Residential Market Share Tracking Study⁸³ (RMST) has been the main source of estimates of total CFL sales in California. This ongoing study, published annually since 1999, presents analyses of aggregated POS data representing four of the key major retail channels through which lamps are sold: food, drug, mass merchandiser, and hardware stores. While RMST is a reliable source for historic CFL market share and product data, its data for the past several years⁸⁴ has significant gaps—for example, the data do not include sales from warehouse stores such as Costco, some major national home improvement and mass merchandise chain stores, and small independent stores. RMST for these years, therefore, does not track CFL sales in California. In 2007 these data represented less than one-quarter of total sales in California. However, given the lack of other reliable data on CFL sales in some retail channels in the state, these data are presented despite their limitations.

In 2007, EPA began collecting CFL sales data from its national ENERGY STAR retailer partners.⁸⁵ These data (referred to hereafter as “Cadmus ENERGY STAR sales data”) complement the RMST POS data, because ENERGY STAR retailers primarily represent some of the nation’s largest home improvement retailers, mass merchandisers, and membership clubs.⁸⁶ These data can be combined with the RMST data to fill in the majority of CFL distribution channels. The remaining distribution channels that are not covered by either of these two data sources, most notably discount stores (e.g., dollar stores) and small groceries, can then be assumed to have CFL sales that, at a minimum, are equal to program sales reported through these channels. Table 20 summarizes the combined data sources for each distribution channel.

The results of the analysis, presented in Table 21, show that a minimum of 55.6 million CFLs were sold in California in 2007 and that RMST covers approximately 20% of total estimated sales in the state. Statewide CFL sales may have exceeded 55.6 million if any nonprogram sales occurred in distribution channels not covered by either RMST or Cadmus ENERGY STAR sales data, such as discount stores and small groceries. The largest channels for which there are data include the membership clubs and mass merchandisers (35% of all CFL sales), followed by large home improvement stores (21%).

⁸³ Itron, 2008a.

⁸⁴ Beginning in December 2002, retailers that had previously been providing CFL sales data used in RMST stopped making that data available. In subsequent years, additional retailers also ceased providing CFL sales data.

⁸⁵ CFL sales data from national ENERGY STAR retail partners are collected by The Cadmus Group on behalf of EPA. While these data are provided by retailers at the store or state level, all data used in this evaluation have been aggregated nationally to the retail channel level, or at the state level across all retail channels, to protect the confidentiality of the retailers. As of this writing, EPA’s total annual ENERGY STAR CFL sales data for 2007 were still preliminary. To develop total sales estimates for this analysis, Cadmus began with these preliminary data and interpolated and projected them for missing time periods for some retailers. To address a previously noted concern that some of the EPA CFL sales data may have represented sales of CFL packages rather than sales of individual CF bulbs, Cadmus also carefully examined all of the reported sales data and, as appropriate, worked with individual retailers to ensure all CFL counts used in this analysis represented individual bulb sales. The ENERGY STAR CFL sales data used in this study, therefore, reflect Cadmus’ analysis and do not represent the EPA estimates.

⁸⁶ Note that RMST, however, includes all CFLs, while the Cadmus data record only ENERGY STAR CFLs, and the IOU ULP tracking data record only ENERGY STAR CFLs that are sold through the program.

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Table 20. Sources of CA CFL Sales Data by Distribution Channel⁸⁷

Distribution Channel	RMST	Cadmus	CA IOU ULP
Discount			√
Drug	√		
Large Grocery	√		
Small Grocery			√
Large Home Improvement	√	√	
Mass Merchandise	√	√	
Membership Clubs		√	
Hardware	√		
Other			√

Sources:

RMST: Residential Market Share Tracking Study (Itron, 2008b)

Cadmus: ENERGY STAR Partner Retailer Sales data

CA IOU ULP: Upstream Lighting Tracking Database

Table 21. Market-Level CFL Sales Estimates for California by Distribution Channel (2007)

Distribution Channel	Source	CA Sales (2007)	% of CA Sales (2007)
Discount	CA IOU ULP	6,824,855	12%
Drug	RMST	2,939,209	5%
Large Grocery	RMST	5,459,724	10%
Small Grocery	CA IOU ULP	7,897,902	14%
Large Home Improvement	Cadmus and ULP	11,717,792	21%
Membership Clubs/Mass Merchandise	Cadmus, RMST, and ULP	19,291,208	35%
Hardware	RMST	1,495,103	3%
Other	CA IOU ULP	6,990	<1%
Total		55,632,784	100%

Sources:

RMST: Residential Market Share Tracking Study (Itron, 2008b)

Cadmus: ENERGY STAR Partner Retailer Sales data

CA IOU ULP: Upstream Lighting Tracking Database

Cadmus and RMST: Combined to account for unique retailers

Because the Cadmus data were available only for 2007, this analysis could not be replicated for previous or subsequent years. Instead, for 2005 and 2006, the team extrapolated historic California CFL sales by using growth trends from other data sources. At the low end, we used national CFL market-level sales trends derived from the U.S. Department of Commerce. At the high end, we used growth rates derived from Wisconsin's historical CFL sales.⁸⁸ The Wisconsin sales data were selected for use in this analysis because of its high quality and the presence of long-running CFL promotional programs in the state. As shown in Table 22, both the low and high estimates show a dramatic increase in per-capita CFL sales from 2005 to 2007.

⁸⁷ Note the CA IOU ULP data include sales by all channel, but the RMST and Cadmus data, where available, are assumed to represent the total sales for the respective distribution channels. Thus checkmarks are included for the CA IOU ULP data only where no other data sources exist.

⁸⁸ That is, using the 2007 California market-level sales estimate as a starting point, we extrapolated backward to 2006 and 2005 using the trends in market-level CFL sales growth from the U.S. Department of Commerce and Wisconsin data.

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No market CFL sales data were available for 2008. Assuming that California followed a similar pattern as the overall U.S. market and dropped 15% from the prior year, sales are estimated at just over 47 million CFLs, or 3.49 CFLs/household.

Table 22. Market-Level CFL Sales Estimates for California (2005-2008)

Estimates	Extrapolated Data		RMST, Cadmus, and ULP Data	Extrapolated Data
	2005	2006	2007	2008
California Market-Level CFL Sales (low / high estimate)	14,293,562/ 24,026,487	25,924,597/ 31,333,228	55,632,784	47,292,907
Number of California Households	12,994,359	13,174,862	13,308,346	13,547,896
California CFL Sales Per Household (low/high)	1.10 / 1.85	1.97 / 2.38	4.18	3.49

4.1.3 California CFL Program Sales

Estimates of program sales are based on utility tracking databases and are typically summarized and presented in periodic program evaluation reports. Table 23 below shows estimates of California IOU Program shipments for 2004 through 2008.

Table 23. California IOU Program CFL Shipment Estimates

Estimates	Year				
	2004	2005	2006	2007	2008
California IOU CFL Program Shipments	6,662,739	7,796,615	14,785,487	38,448,931	42,600,824
Number of California Households	12,812,960	12,994,359	13,174,862	13,308,346	13,547,896
California IOU CFL Program Shipments Per Household	0.52	0.60	1.12	2.89	3.15

Sources: 2004-2008 Program Shipments: KEMA; Number of CA Households: U.S. Census Bureau.

4.1.4 Comparison of Fall 2008 Sales in California and the Comparison Area

Significantly more households in the Comparison Area (57%) purchased some type of bulb in the past three months than did California households (47%) (Table 24). The higher levels of recent purchases in the Comparison Area may be explained by the fact that Comparison Area homes have fewer sockets filled with longer-lasting CFLs, hence they need to purchase bulbs more often.

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**Table 24. Recent Bulb Purchasers – Past Three Months
(base – all respondents)**

	California	Comparison Area
All Bulbs	47.3%	56.6% *
CFLs	28.3	28.9
Incandescents	58.2	61.1
Specialty **	46.0	43.1

* Results between California and the Comparison Area are significantly different at the 90% confidence level.

** Specialty bulbs were defined in survey as "other types of bulbs, besides regular incandescent light bulbs and CFLs, including halogen bulbs, long fluorescent tubes and other types of specialty bulbs."

The survey also asked respondents to estimate the number of each type of light bulbs that they purchased over the past three months. Households in California purchased an average of 3.7 bulbs in the past three months, including 1.1 CFLs, 1.4 incandescents, and 1.2 specialty bulbs (Table 25). Among only light bulb purchasing households, an average of 7.9 bulbs were purchased in the past three months. Light bulb purchasing households in the Comparison Area purchased more incandescent bulbs than California purchasers: 47% for the Comparison Area versus 39% for California households. Again, this is consistent with having fewer CFLs installed in the Comparison Area.

Across all households in the Comparison Area, households purchased an average of 5.0 bulbs over the past three months, including 1.2 CFLs, 2.3 incandescent bulbs, and 1.5 specialty bulbs. Among only the light bulb purchasing households, an average of 8.7 bulbs were purchased in the past three months.

The data indicated, therefore, that the Comparison Area homes not only purchased more CFLs per home, but also purchased more incandescents and specialty bulbs. In fact, if the sales figures are examined as a market share (the percent of all bulb sales that are CFLs), the CFL market share in California was higher (30%) than in the Comparison Area (24%). This suggests that the higher saturation of CFLs in California homes may be leading to fewer current bulb sales, and thus fewer CFL sales per home compared to the Comparison Area.⁸⁹ However, when a consumer is in the market to purchase a new bulb, they are more likely to purchase a CFL (possibly replacing another CFL) in California than in the Comparison Area.

⁸⁹ While we found California homes to have fewer medium screw-base sockets than homes in the Comparison Area, the difference was not statistically significant. Socket counts per household, therefore, do not seem to explain the differences in California and Comparison Area CFL sales or market shares.

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Table 25. Recent Bulb Purchases – Past Three Months
(Average number bulbs for all purchasing households; base – all products purchased)^a

		CFLs	Incandescent	Specialty	All Bulbs
California	unweighted n	99	194	162	341
	Average # Purchased in past 3 months, All Households	1.1	1.4	1.2	3.7
	Percentage Purchased in past 3 months, Purchasing Households ^b	29%	39%	33%	7.9
Comparison Area	unweighted n	295	585	442	992
	Average # Purchased in past 3 months, All Households	1.2	2.3	1.5	5.0
	Percentage Purchased in past 3 months, Purchasing Households	23%	47%	29%	8.7

a Don't know responses removed from sample size and calculation.

b Purchasing households of each type of bulb.

4.1.5 Baseline CFL Sales

Baseline sales estimates are the sales level that theoretically would have occurred in a program's absence. While evaluation of upstream lighting program across the nation have used a variety of methods to estimate baseline sales (which, used in conjunction with market and program sales, can be used to calculate a program's net effects), previous net impact evaluations of California ULPs have opted for methods that do *not* involve baseline estimation. The 2004–2005 California IOU Single-Family Program (which included the Upstream Lighting Program) impact evaluation research plan stated the following reasons:

- “Data required to estimate CFL sales for California and for the U.S. are not currently reliable (i.e., since 2003, the Market Share Tracking study, which is the primary source of California and national CFL sales data, has excluded major home improvement retailers, and has always excluded warehouse stores, which account for a large fraction of program sales). Collecting these data directly from retailers requires a major effort and is not often comprehensive (due to resistance from retailers) and reliable (due to the need to rely on small samples for chains).
- Baseline sales estimates using this method are overstated for California in particular, because the large-scale interventions in lighting markets over time in the state have influenced the national market.
- This method implicitly captures the cumulative effects of the program, and it is probably impossible to use this method to isolate the effect of PY2004–2005 activities on the California and national lighting markets.”⁹⁰

⁹⁰ Itron and KEMA, 2006.

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Because baseline data from prior California ULP evaluations are not available, we reviewed many recent upstream lighting program net effect studies conducted elsewhere to gain an understanding of the baselines they employed and as a basis for comparison with this study.

We present a summary of reputable and relevant sources from these other recent studies in Table 26. This approach provides a helpful benchmark as to what baseline CFL sales per home might have been in California in absence of any program activity. However, in addition to the source-specific caveats listed in the table, these data do not control for differences in demographic characteristics, utility rates, “big box” store saturation, prior household CFL saturation, or other factors that can impact CFL sales. The regression model, however, does control for these factors, and as such is considered a more robust method for estimating baseline CFL sales.

Table 26. Baseline CFL Sales Per Household Estimate Sources

Source	Description	Method	Specific Caveats
DEER Low ⁹¹	DEER CFL Net-to-gross report/2004-2005 Single-Family Rebate Program Evaluation	Assume that free-rider program sales equals baseline sales; source of free-ridership estimate is participating lighting supplier self-report, free-ridership telephone survey (sample size = 37 participating suppliers).	Very narrow interpretation (intended to be a lower bound); some believe the self-reported free-ridership estimate was based on too small a sample size and/or the supplier estimates are biased.
DEER High ⁹²	DEER CFL Net-to-gross report/2007 RMST	Assume CFL sales per household in states excluding California equals baseline sales.	Estimates of U.S. sales excluding California are probably inaccurately low, as compared to more recent estimates of U.S. sales excluding program areas (see NYSEDA and Massachusetts study estimates). However, the use of this baseline also includes sales from program areas, which biases the estimate upwards.
Wisconsin (Michigan) ⁹³	Wisconsin Focus on Energy CFL Market Effects Study	Retail sales from matched pairs of chains in Wisconsin and Michigan (a comparison non-program area), controlling for differences between participating and nonparticipating stores in both states.	The comparison state, Michigan, was chosen because of its comparability with Wisconsin. The analysis included adjustments to the Michigan data to be applicable for Wisconsin. The adjusted baseline data may not be an appropriate comparison for California.
BC Hydro (North and South Dakota) ⁹⁴	Direct and Market Effects of BC Hydro's 2006-07 Residential CFL	Based on consumer telephone survey self-reported CFL purchases during 2006 in North and South Dakota (sample size = 512 households).	Difficult for respondents to recall their CFL purchases over a specific period such as a calendar year, so levels of purchase might be inaccurate (note the method was used to compare purchases between program and non-program areas, which minimized the bias).

⁹¹ Itron, 2008b.

⁹² Ibid.

⁹³ Glacier Consulting Group, LLC., 2008.

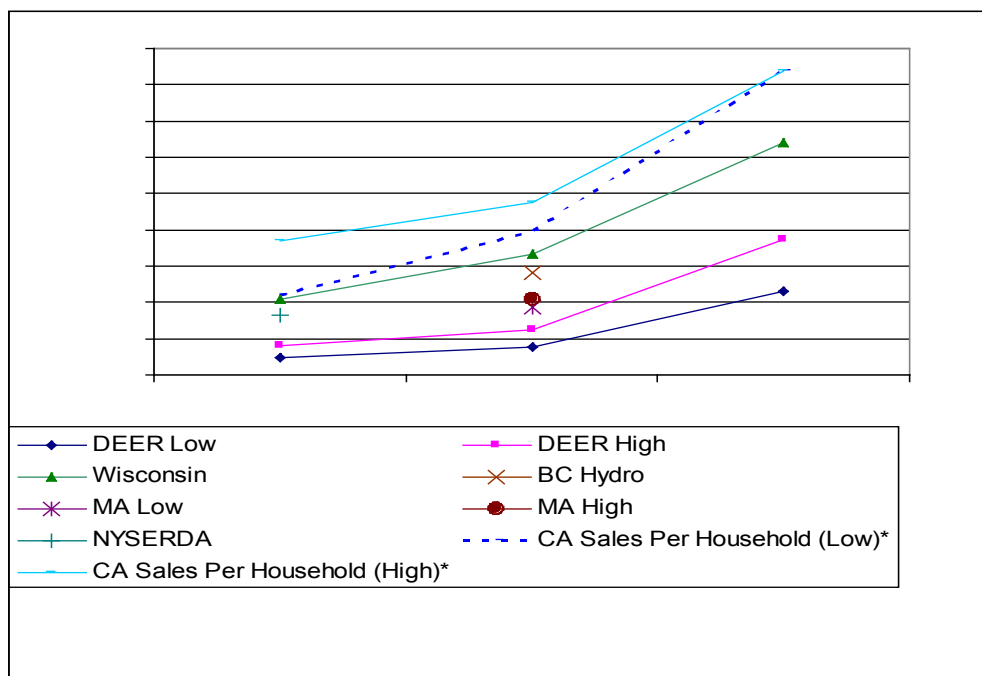
⁹⁴ Sampson Research, 2007.

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Source	Description	Method	Specific Caveats
Massachusetts ⁹⁵	Massachusetts program CFL net effects assessment: results memo	Estimates of total sales in non-program areas of the U.S. (expressed as a range with low and high estimates).	National CFL sales estimates, which underpin this method, vary widely depending on the source. Data on program sales estimates for some program areas are not readily available and were estimated. Resulting estimates are subjective.
NYSERDA ⁹⁶	NYSERDA program CFL net effects assessment: report appendix	Estimates of total sales in non-program areas of the U.S.	National CFL sales estimates, which underpin this method, vary widely depending on the source. Data on program sales estimates for some program areas are not readily available and were estimated. Resulting estimates are subjective.

Figure 18 presents baseline CFL sales per household based on the sources described above. The top two lines show the high and low total market-level sales estimates for California (discussed above). Note that baseline sales for some regions or utilities are represented by a single point (in cases where only one year's worth of data was available), while baseline sales for other regions or utilities are represented by a line connecting two or more points (in cases where two or more years of data were available). Baseline sales estimates vary widely by source and method, though the data consistently trend upward over time.

Figure 18. Estimates of Baseline CFL Sales per Household



⁹⁵ Nexus Market Research, 2008.

⁹⁶ Summit Blue Consulting and Quantec, LLC., 2006

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The data from Figure 18 above is presented in Table 27. Total market-level sales per California household are presented at the bottom of the table for comparison.

Table 27. Estimates of Baseline CFL Sales per Household

Baseline Source	Year		
	2005	2006	2007
DEER Low	0.23	0.38	1.16
DEER High	0.40	0.62	1.87
Wisconsin (Michigan)	1.04	1.66	3.21
BC Hydro (North and South Dakota)		1.40	
Massachusetts Low		0.94	
Massachusetts High		1.05	
NYSERDA	0.82		
Total California Market-Level Sales Per Household (Low/High)*	1.10 / 1.85	1.97 / 2.38	4.18

* Values developed in Table 22 above.

4.2 CFL Penetration and Saturation

Increases in household CFL penetration and saturation in California have followed CFL sales increases.⁹⁷ For example, in 2000 only 12% of California IOU households had at least one CFL installed, increasing to 57% in 2005 and 79% in 2008 (Figure 19). In the Comparison Area, however, only 66% of homes had one or more CFLs installed in 2008, a significantly lower percentage than in California.

The average number of CFLs installed in California homes has also increased dramatically over time. For example, in 2000 the average California home only had 0.3 CFLs installed, equivalent to 1% of all sockets or 1.4% of MSB sockets. By 2005, the value had increased to 3.7 CFLs per home, equivalent to a saturation of 9% of all sockets or 12% of MSB sockets. In 2008–2009 the average California home had 10.3 CFLs installed, and the saturation had climbed to 21% of all sockets and 29% of MSB sockets (Figure 20).⁹⁸ The Comparison Area homes had significantly fewer CFLs installed per home and a significantly lower saturation: in 2008–2009, the average Comparison Area home had 8.4 CFLs, for an MSB saturation of 22%.

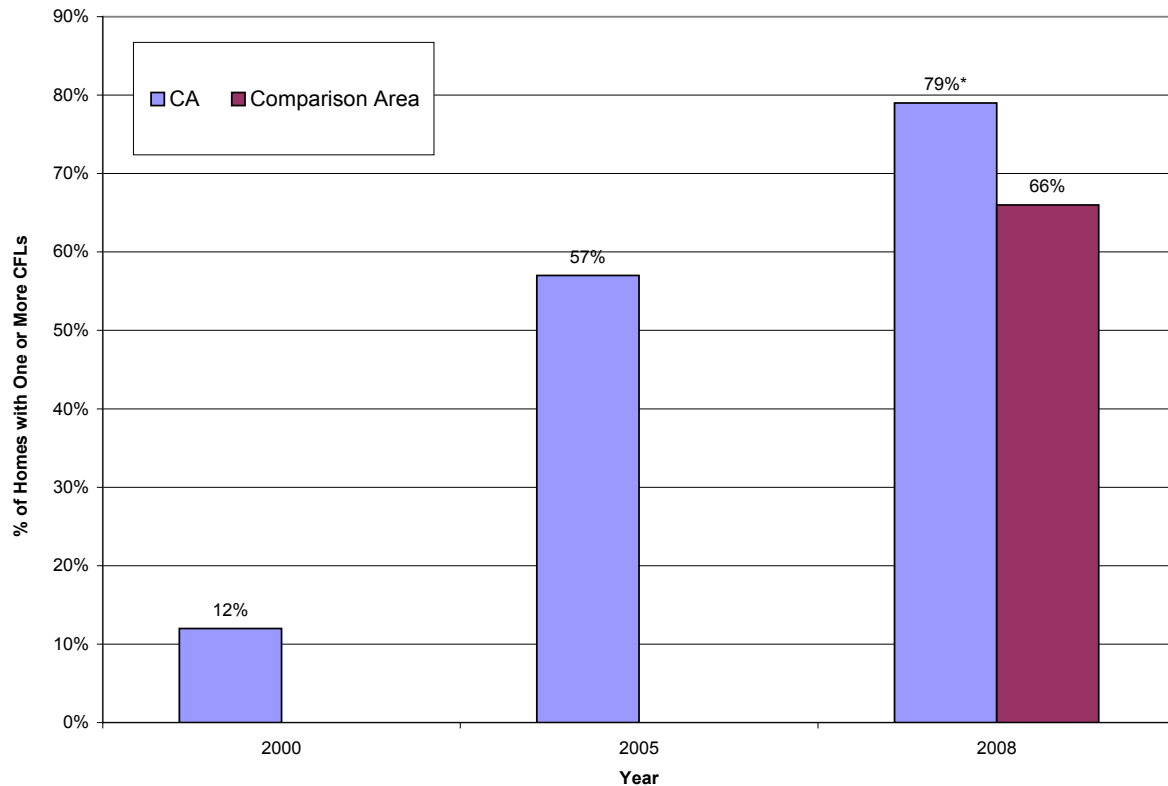
The IOU programs' sustained CFL promotional efforts appear to have contributed to the increase in CFL penetration and saturation in California during the past decade, as well as to the higher CFL penetration and saturation rates we observed in California versus the Comparison Area.

⁹⁷ For the purpose of this study, penetration is defined as the number of households with at least one CFL installed, and saturation is defined as the number of CFLs installed per household out of the total eligible lighting sockets.

⁹⁸ The saturation values presented here are the integrated results from the in-home audits undertaken as part of the CFL Market Effects study and the results of subsequent waves of in-homes surveys conducted for the Residential Retrofit evaluation. The values presented here are therefore not the same as those presented in Appendix A, which provides saturations from the single in-home survey wave conducted for the CFL Market Effects evaluation.

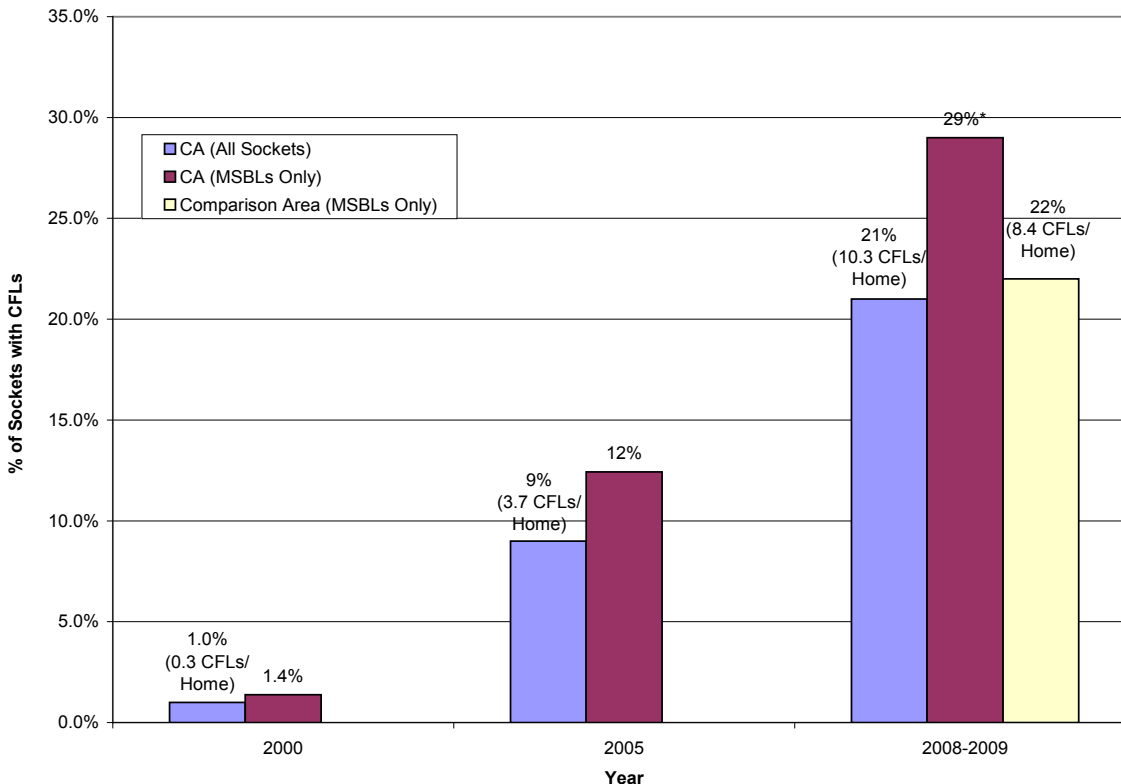
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Figure 19. California and Comparison Area Households with One or More CFLs Installed



Source: 2000 and 2005 California Lighting and Appliance Saturation (CLASS) studies; 2008 from California CFL Market Effects Wave 2 CFL User Survey. Data for the Comparison Area was not available prior to 2008. Note: the first two time-series data points are from on-site surveys, while the last series data points are from telephone self-reports, which were verified by on-site surveys.

Figure 20. CFL Saturation



Source: 2000 and 2005 California Lighting and Appliance Saturation (CLASS) studies; 2008-2009 California from the Residential Retrofit Metering Study; 2008-2009 Comparison Area from the CFL Market Effects in-home audits. Data for the Comparison Area was not available prior to 2008. All results are based on on-site verifications.

4.3 Historic and Current Net Savings Analysis; Regression-Based Attribution

4.3.1 Historic Program Net Effects

For each of the net effects studies discussed in Section 4.1.5 above, Figure 21 calculates the difference between the total market-level sales per household in California and the baseline sales per household estimated in the other study. That is, the values shown in Figure 21 represent the net effects—the number of CFLs per household that would have been attributable to California’s ULP had California used that jurisdiction’s baseline. For comparison purposes, the dashed line shows actual average California IOU program sales per household in each year.⁹⁹

For 2005, the differences between California’s total market-level sales and the baselines from other regions range from 0.44 to 1.25, compared to actual California program sales of 0.60 CFLs per household. For 2006, the differences range from 0.52 to 1.80, compared to actual California program sales of 1.27 per household. For 2007, the differences range from 0.97 to 3.02, compared to actual California program sales of 3.19 CFLs per household.

⁹⁹ The average California baseline sales per household used in this table were calculated as the average of the low and high estimates shown in Table 27.

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Figure 21. Theoretical Net Effects per Household Using Other Studies' Baseline Sales Estimates

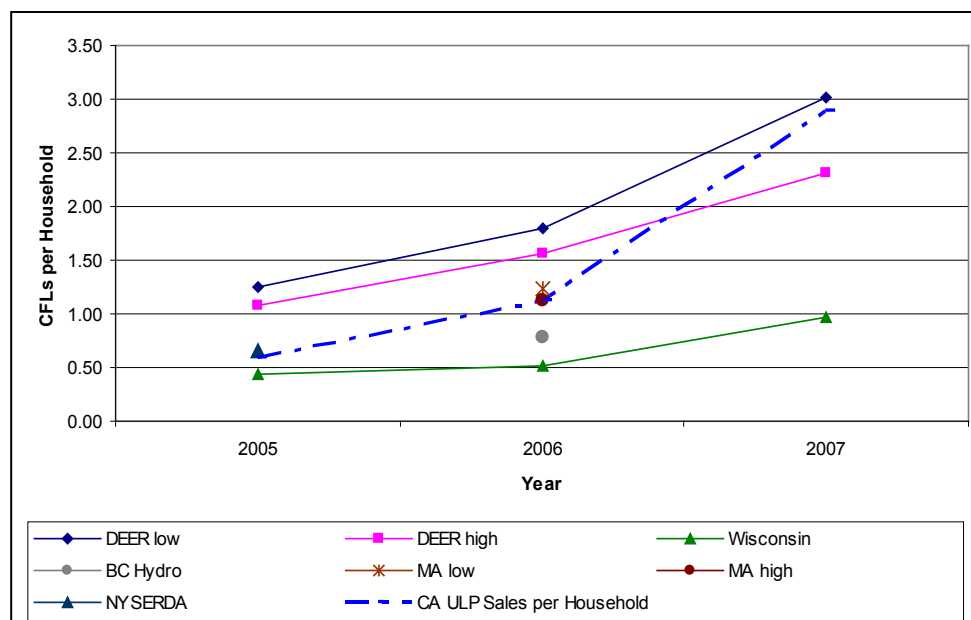


Table 28 presents the data per household shown in Figure 21 above. Actual average California program sales per household are provided at the bottom of the table for comparison.

Table 28. Theoretical Net Effects per Household Using Other Studies' Baseline Sales Estimates

Baseline Source	Year		
	2005	2006	2007
DEER Low*	1.25	1.80	3.02
DEER High*	1.08	1.56	2.31
Wisconsin (Michigan)	0.44	0.52	0.97
BC Hydro (North and South Dakota)		0.78	
Massachusetts Low		1.24	
Massachusetts High		1.13	
NYSERDA	0.66		
Actual California Program Sales per Household	1.12	2.89	3.15
* Note that the DEER Low baseline sales (i.e., the low-case DEER baseline scenario) were smaller than the DEER High baseline sales (i.e., the high-case DEER baseline scenario). Thus the difference between CA market level sales and the DEER Low baseline sales is <i>higher</i> than the difference between CA market level sales and the DEER High baseline sales.			

Table 29 presents total net effects (inclusive of free ridership, participant spillover, and nonparticipant spillover) estimates (in terms of number of CFLs) by year. The values were computed by multiplying the net effects per-household estimates from Table 28 by the number of

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households in California (shown in Table 23). Total California net effects, calculated using the average California market-level sales estimate, are shown at the bottom for comparison.

Table 29. Total Net Effects Estimates (Number of CFLs)

Baseline Source	Year		
	2005	2006	2007
DEER Low	16,177,977	23,648,877	40,191,205
DEER High	13,968,936	20,486,910	30,742,279
Wisconsin (Michigan)	5,652,546	6,785,054	12,909,096
BC Hydro (North and South Dakota)		10,210,518	
Massachusetts Low		16,270,955	
Massachusetts High		14,821,720	
NYSERDA	8,511,305		
California Net Effects (using average California market-level sales estimate)*	7,796,615	13,043,113	40,723,539

* Calculated as:

*Number of California Households (Table 23) **

Difference between Average CA Market-Level Sales and IOU Program Sales per Household (Table 28)

Program net-to-gross ratios are calculated as the ratio of net effects (from Table 29) to total program sales (from Table 23), implicitly incorporating free-ridership, spillover, and cumulative market effects. Table 30 presents these net-to-gross estimates based on the net effects data presented above. Although program net-to-gross ratios vary widely by data source—ranging from 32% to 208%, the steadily declining net-to-gross ratios across all the data sources are noteworthy. This trend is consistent with the Team’s findings of market effects in the past (e.g., as reported by upstream actors) that have diminished in more recent years (e.g., as supported by the shelf stocking survey other 2008-2009 quantitative analyses).

Table 30. Historic Program Net-to-Gross Ratio Estimates¹⁰⁰

Baseline Source	Year		
	2005	2006	2007
DEER Low	208%	181%	99%
DEER High	179%	157%	75%
Wisconsin (Michigan)	73%	52%	32%
BC Hydro (North and South Dakota)		79%	
Massachusetts Low		125%	
Massachusetts High		114%	
NYSERDA	109%		

4.3.2 Regression Modeling Background

Methods of estimating the net impacts of CFL programs have evolved over time to account for free ridership and spillover, adoption of upstream programs, and changes in the CFL market.

¹⁰⁰ Note that the CFL Market Effects Team attempted to present data prior to 2003, but struggled with data availability and reliability (notably California market-level sales).

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Recently, Sponsors in various areas – including the Sponsor of this report – have turned to a “nonprogram comparison state” approach to estimate market effects. The rapid expansion of CFL programs and recent changes in the CFL market have hindered the ability of this approach to provide reliable estimates of the net program impact.

The principal goals of the statistical analyses presented in this section, therefore, are to identify and examine factors associated with 2008 CFL purchases generally, and the effect of CFL programs on those purchases specifically, in this changing CFL market. The Multistate Regression Team (a subset of the CFL Markets Team, hereafter referred to as the “MR Team”) uses the modeling results to estimate the total net impact for each Sponsor.¹⁰¹ The MR Team bases these estimates on the models that we believe best describe CFL purchases in 2008.

4.3.3 Regression-Based Attribution and Current Net Savings Analysis

In the remainder of this section we summarize the analyses conducted in support of the multistate CFL modeling effort and highlight the results as they pertain to the market effects analysis for the California ULP. The goal of the analysis was to identify the total net program effects—net of free ridership and spillover—resulting from CFL program activity. The California Evaluation Protocols, however, only allow for the inclusion of free ridership, not spillover, when calculating net-to-gross (NTG). While the ultimate goal of this report is to examine market effects (i.e., spillover), this statistical approach does not disaggregate these various effects. The analysis presented here, therefore, refers to the total net impacts rather than the NTG.

The key result emerging from the analyses as they relate to total net impacts is that CFL programs had a small positive effect on CFL purchases in 2008 and on current CFL saturation and use. The estimated total net impact for California in 2008 is 0.23 (or 23%). Using this value, the IOUs’ CFL programs would claim only 23% of the savings they had assumed would result from the 2008 ULP.

However, given the positive relationship between program activity and prior CFL use, it is likely that the total net impacts for 2006 and 2007 were higher. This is because CFL saturation was lower, and CFL sales nationally remained low, in places without program activity during those two years. In 2008, in contrast, our research shows fewer differences in sales between program and nonprogram areas. Unfortunately, the model does not allow us to estimate how much higher the total net impacts may have been in 2006 and 2007. The rest of this section provides an overview of the methods and findings that have led to this conclusion.

4.3.4 Development of Program Variable

The primary independent variable of interest summarized CFL program activity in each of the areas included in the current analysis. To develop this important variable, the MR Team began by reviewing CFL program plans and documents, prior evaluation reports, and program summaries compiled by the Consortium for Energy Efficiency, the U.S. Department of Energy (DOE), and ENERGY STAR in order to locate CFL programs in each state and gather

¹⁰¹ Members of the MR Team also serve on the evaluation teams for at least some of the other Sponsors of the multistate effort. When discussing sampling and data collection, we refer to the evaluation teams for individual Sponsors. The MR Team is the subset of evaluators focusing on the regression analyses presented in this report.

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information on each program through 2008. We supplemented this document review with direct inquiries to energy efficiency and CFL program managers and searches of the Web sites of utilities, public service agencies, and energy service organizations. Experts on CFL programs across the nation also collectively assessed the cumulative strength of each program through 2007 in an effort to capture the effect of prior activity on current saturation levels and recent purchases.

The MR Team combined the information on programs in states or areas into three different program variables: cumulative program strength, 2008 program activity, and overall composite program activity. We performed statistical transformations necessitated by the nature of the data, and created three individual, state-level variables. The cumulative strength variable represented the average rating provided by the experts and required no transformations for inclusion in the model. The 2008 program activity variable represented a statistically transformed and combined measure that included data on the per-household CFL program budget and number of CFLs incented by programs in the state. Finally, the composite program variable combined the cumulative strength and 2008 program activity variables.

4.3.5 Comparison of Telephone and Onsite Purchases and Use

Table 31 and Table 32 compare the telephone and onsite reported CFL purchases and use for the onsite participants in each state or region included in the regression analysis. The comparisons in Table 31 suggest that onsite participants overstated their purchases for 2008 in the telephone survey (note that onsite estimates of 2008 purchases were not collected for the CPUC states).¹⁰² Table 32, in contrast, suggests that respondents often understated their current use of CFLs—only respondents in Houston overstated their current CFL use and they did so by 0.7 CFLs.

Figure 22 through Figure 25 are scatter plots that compare the number of CFLs that telephone survey respondents reported purchasing or using to the onsite verified number purchased or in current use. Specifically, Figure 22 plots telephone reported purchases in 2008 against onsite verified purchases for the same year. The graph suggests there was only a slight positive relationship between telephone reported and onsite verified purchases. Figure 23 compares the telephone reported purchases in 2008 to the self-reporting error, where the self-reporting error is the difference between the telephone estimate and the onsite verified purchases. This graph suggests that those who originally reported purchasing a greater number of CFLs exhibited higher levels of reporting error than those who self-reported making just a few CFL purchases.

The current CFL use data tell a contrasting story to the purchase data story. Figure 24 displays the telephone survey reported estimates of current CFL use and the onsite verified current use; Figure 25 plots telephone reported use against the difference between the telephone and onsite estimates. From these graphs we see that telephone survey respondents generally knew they had zero, a few, or many CFLs installed, but they exhibited a great deal of error in their point estimates of the number of CFLs actually in use. Furthermore, also unlike the purchases, the error in the point estimates was not related to the number of CFLs reported as in use in the telephone survey.

¹⁰² Onsite purchase estimates reported here do not include bulbs in storage, as the data on when stored bulbs were obtained was not available for all areas at the time of analyses. Revised analyses and reports will include data on when stored CFLs were purchased.

**Table 31. Self-Reported Purchases
for Onsite Participants by Telephone and Onsite Responses**

(Base = onsite participants, weighted on familiarity, education, and homeownership)

State	Sample Size	CFLs Purchased in Past Year	
		Telephone	Onsite
California	77	1.3	n/a*
Colorado**	70	4.1	5.1
Connecticut	95	3.9†	3.6
District of Columbia	97	2.6	2.0
Georgia	62	1.2	n/a
Indiana	88	3.3	1.6
Kansas	71	0.9	n/a
Maryland	57	3.6	2.0
Massachusetts	100	3.3	1.6
Michigan	86	2.8	2.7
New York State	203	5.0	3.8
New York City	100	3.1	2.6
Ohio	98	4.0	2.6
PA	59	1.1	n/a
Houston, Texas	99	5.0	1.1
Wisconsin	82	4.2	3.1

* The “past three month” onsite purchase estimates from the CPUC data have been verified to be higher than telephone reports in separate analyses of the same data. The CPUC onsites asked respondents about their purchases “in the past three months,” but those three months varied from the period referenced in the telephone survey. Although the CPUC onsite instrument attempted to correct for this by also determining how many of the CFLs purchased in the past three months had been obtained since the telephone survey, the discrepancy still remains. In contrast, the “three months” about which we inquired in the other states are the same three months (*e.g.*, April, May and June for Maryland and Massachusetts in both the onsite and telephone surveys). Respondents were explicitly asked to account for differences in three month purchases between the onsite and telephone surveys.

** Colorado was not included in the development of the models presented here as the data are still under review. However, we provide the summary statistics of their reported purchases and use in this document.

† One outlier removed from estimate.

**Table 32. Self-Reported CFL Use
for Onsite Participants by Telephone and Onsite Responses**
(Base = onsite participants, weighted on familiarity, education, and homeownership)

State	Sample Size	CFLs Currently in Use	
		Telephone	Onsite
California	77	8.0	12.3
Colorado*	70	5.9	10.0
Connecticut	95	9.1	10.4
District of Columbia	97	3.4	4.2
Georgia	62	7.2**	8.6
Indiana	88	6.2	7.7
Kansas	71	7.1	12.7
Maryland	57	5.8	7.3
Massachusetts	100	7.1	9.5
Michigan	86	7.8	9.0
New York State	203	6.3	11.0
New York City	100	3.5	5.8
Ohio	98	5.2	7.5
PA	59	6.8	7.3
Houston, Texas	99	5.9	5.2
Wisconsin	82	7.8	10.5

* Colorado was not included in the development of the models presented here as the data are still under review. However, we provide the summary statistics of their reported purchases and use in this document.

** One outlier was removed from the estimate.

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Figure 22. Telephone Reported vs. Onsite CFL Purchases in 2008

(n=1,012; excludes outliers and respondents not familiar with or aware of CFLs; intercept set equal to zero; not available for CPUC states)

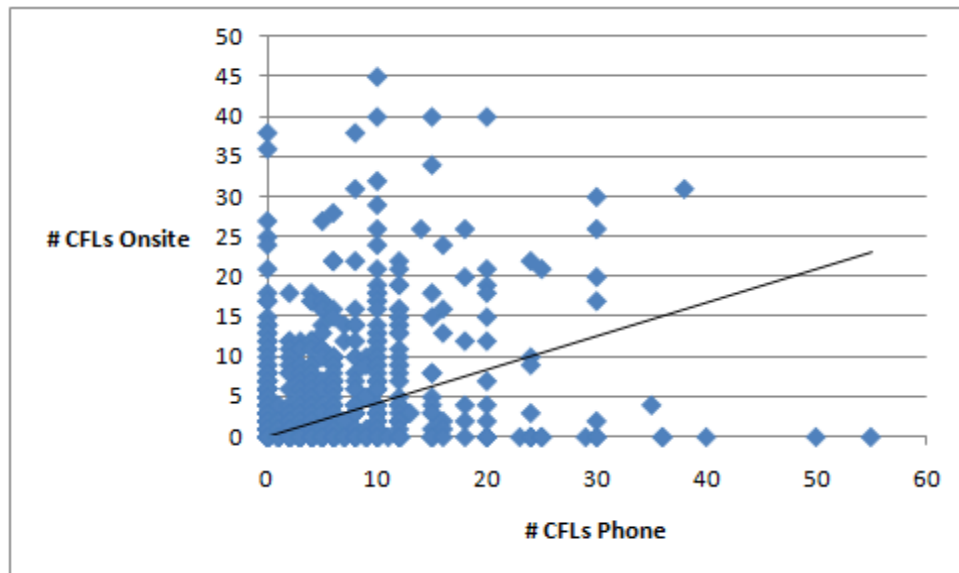
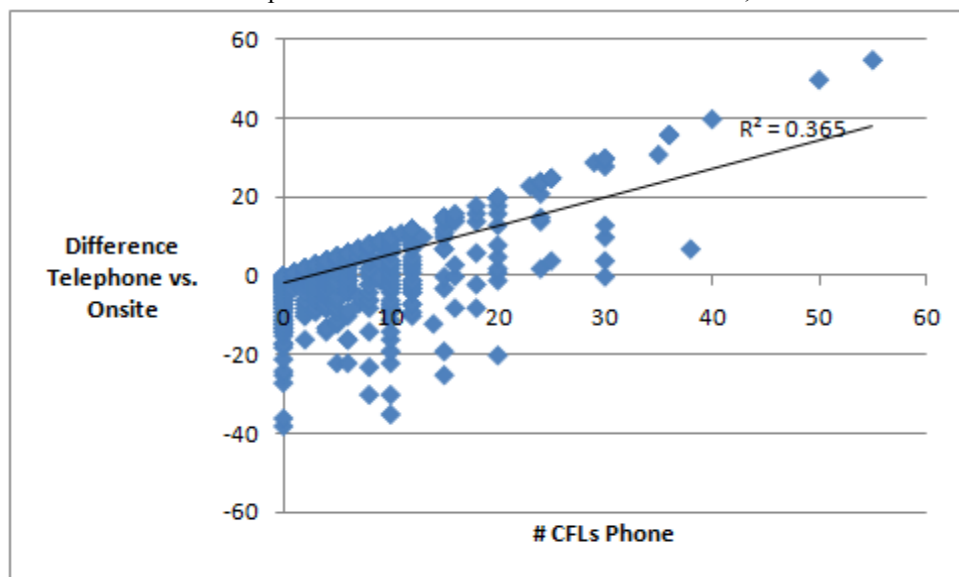


Figure 23. Difference between Telephone Self-Reported and Onsite Verified CFL Purchases in 2008

(n=1,012; excludes outliers and respondents not familiar with or aware of CFLs; not available for CPUC states)



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Figure 24. Telephone Reported vs. Onsite Verified CFL Use

(n=1,261; excludes outliers and respondents not familiar with or aware of CFLs; intercept set equal to zero)

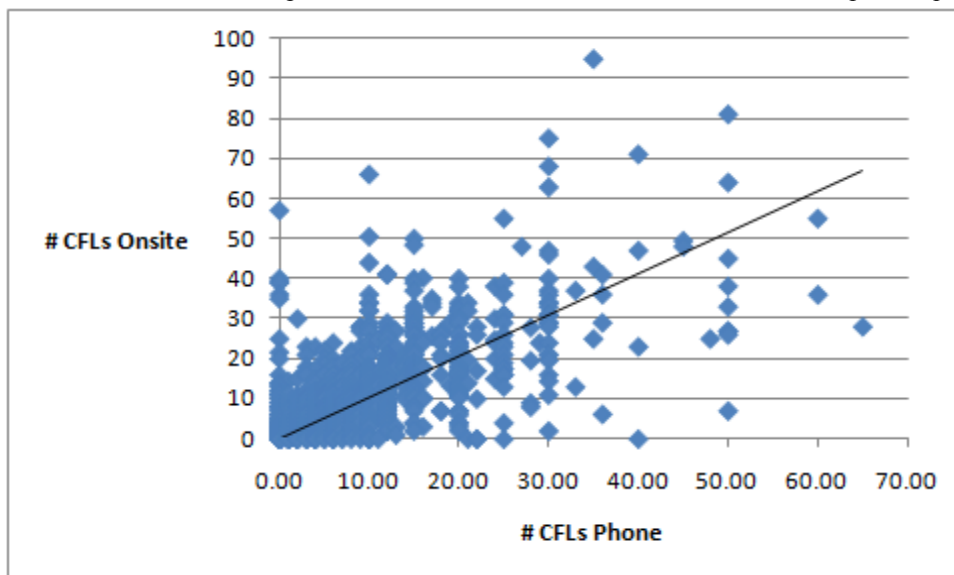
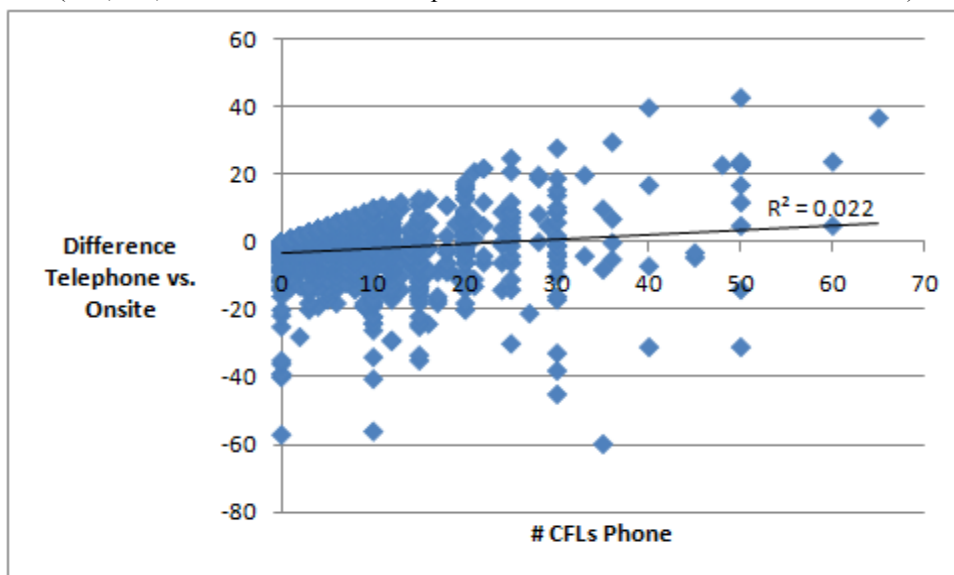


Figure 25. Difference between Telephone Self-Reported and Onsite Verified CFL Use

(n=1,261; excludes outliers and respondents not familiar with or aware of CFLs)



4.3.6 Modeling Procedures and Results

The data collected in the telephone and onsite surveys provided counts of CFL purchases, use, and storage at different time periods, and the onsite survey also counted the total number of lighting sockets in the home. The data for purchases, storage, and use are called “count” data—that is, the number of something—and they did not have the so-called normal curve assumed by the most common statistical modeling procedure, Ordinary Least Square Regression (OLS).

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Instead, they were right skewed. The MR Team attempted to transform the data to force them to meet the normality assumption using such standard approaches as taking their square or cube roots. However, the strong presence of zero purchases and zero use meant that the data were still right skewed. In response, we turned to a statistical procedure appropriate for count data with this type of distribution: the negative binomial regression model (NBRM). The MR Team used the onsite data on CFLs in use and the total number of sockets to calculate the percentage of sockets in the home filled with CFLs, also known as CFL saturation. The saturation data were also right skewed, but because they were percentage and not count data, the MR Team could not appropriately use the NBRM. Instead, for this report we relied on the OLS methods for estimating the saturation data

The MR Team ran multiple models designed to explain CFL purchases in 2008 and the past three months, current use, and current saturation. The results suggested that CFL programs had a small but statistically significant net positive effect on CFL purchases in 2008 and on current CFL use and saturation; however, the models did not find a net positive program effect on CFLs purchased in the past three months, most likely due to the small number of respondents who had purchased CFLs in the past three months and the variation in the three-month period in questions across surveys.¹⁰³

Table 33 includes the model derived from onsite data used to calculate total net impacts for California. The results are derived from NBRM; to see the impact of an individual variable on purchases, one would multiply the variable by the impact score, not by the coefficient as in OLS regression.¹⁰⁴ The development of this model did not include the observed data from the four CPUC states because the onsite instrument used in those states *did not ask about 2008 purchases*. However, we were able to predict purchases based on the other data collected for the CPUC states. Therefore, our net impact estimate presented below is based on *predicted* and not *observed* purchases for California.¹⁰⁵

¹⁰³ Further evidence in support of the timing issue is evident in the fact that, the CPUC flag (which controls for differences in the instruments and methodology) is significant in the onsite-based models of three-month purchases while the flag for fielding the instrument in the fall is significant in the telephone-based models of three-month purchases.

¹⁰⁴ For those unfamiliar with regression models, a coefficient is the value that shows the unique contribution of any single variable to the equation that describes the line. In the simplest regression model (which is equivalent to the slope-intercept equation for a straight line), $y = mx + b$, where “m” is the coefficient. In non-linear equations, the coefficient plays the same function, though in order to understand the impact of a variable on the result, one has to use the impact score, which is equivalent to the factor change score minus one. See Long, J.S. and J. Freese (2006) *Regression Models for Categorical Dependent Variables Using Stata*. College Station: Stata Press. Section 5.1 of Appendix K describes the statistical terminology and model interpretation in more detail.

¹⁰⁵ Note that in several of the other program states, the sponsors opted to use predicted rather than observed values because the observed values demonstrated a high degree of self-report error.

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**Table 33. Confidence Interval for the 2008 Purchase Composite Program Variable—
Onsite Data**

Variable	Coefficient	90% Confidence Interval		Impact Score
		Low	High	
Composite Program	0.09	0.06	0.16	0.11
Years using CFL	0.10	0.06	0.14	0.10
Number of Sockets in Home	0.01	0.00	0.01	0.01
Number of Persons in Household	0.10	0.02	0.18	0.10
Self reported as White	0.42	0.09	0.74	0.52
Conducted During Fall Season	0.60	0.33	0.86	0.82
Constant	-0.79	-1.21	-0.38	n/a

* Sample size = 1,034; Pseudo R^2 = 1%.

Though it was not possible to develop a purchase model using California data, other models were developed with data from California and its comparison states. Current CFL use was collected in all 16 sample areas and the model reflects every eligible respondent in these areas.¹⁰⁶

The best fit current use model (developed from onsite data) is shown below in Table 34. We see that several variables are common predictors for both 2008 purchases and current use—composite program score, years using CFLs, and whether or not the respondent is white, all have positive significant effects on the number of CFLs used in the home. A number of other demographic and contextual variables also are present in the model, namely positive relationships between use and whether or not English is the primary language, and the square feet of Wal-Mart stores in the state. There is a negative relationship between use and whether or not the respondent has a high school degree or less, indicating that those with higher education levels are more likely to use CFLs than are those with lower levels of education.

A full discussion of the various regression models, including those for saturation and three month purchases, as well as models developed using telephone survey data—most of which include California in their development, are presented in Appendix K.

¹⁰⁶ Any respondent who refused or skipped a question regarding whether or not they were a homeowner, their home size, their race, their level of education or the or the primary language spoken in the home, could not be included in this model since they would be missing one or more of the model's predictor values. Note that Colorado respondents were not asked to identify their race, so the entire state is excluded from this model.

Table 34. Best Fit Current Use Model– Onsite Data*

Variable	Coefficient	90% Confidence Interval		Impact Score
		Low	High	
Composite Program	0.02	0.01	0.04	0.02
Years Using CFLs	0.04	0.03	0.06	0.04
CFL Saturation in the Homer	0.04	0.04	0.05	0.04
Homeowner	0.76	0.64	0.88	1.14
Home Size	0.32	0.25	0.39	0.38
White	0.29	0.18	0.41	0.34
English is Primary Language	0.38	0.17	0.59	0.47
Sqft Wal-Mart per Household (state)	0.07	0.04	0.10	0.07
High School Degree or Less	-0.19	-0.29	-0.10	-0.18
Constant	-1.01	-1.28	-0.74	n/a

* Sample size = 1,315; Pseudo R^2 = 16%.

4.3.7 Calculation of Program Total Net Impact

Although the MR Team lacked the *dependent variable* in the model used to estimate total net impacts—namely, the number of CFLs purchased in 2008 as measured onsite—we had all of the *independent* variables in the model. Therefore, the Team was able to estimate total net impacts by applying the model to the data we had for California respondents on the independent variables. Specifically, the MR Team multiplied the impact score for each *non-program* independent variable across the onsite respondents in the sample. For the *program variable*, we multiplied the impact on purchases by the actual score for the composite program variable for California (4.91); we next repeated this step setting the composite program score equal to that for non-program areas (-3.15), creating a hypothetical California in the absence of a program. This latter calculation was used to develop an estimate of total net impacts. Table 35 provides an example of these calculations for one respondent in California. For this individual, the predicted number of CFL purchases was 2.57, but would have been 1.68 in the absence of the program. The MR Team was unable to predict purchases for the few respondents “don’t know” or refused to answer questions included as variables in the model, which we take into account when calculating NTG.

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Table 35. Example Based on 2008 Purchase Composite Program Variable Model—Onsite*

Characteristic	Impact Score	Respondent Data	Impact on Predicted Purchases with a Program	Impact on Predicted Purchases without a Program
Composite Program	0.11	4.91 w/ program -3.15 w/o program	0.54	-0.35
Years using CFL	0.10	1.0	0.11	0.11
Number of Sockets in Home	0.01	29.0	0.29	0.29
Number of Persons in Household	0.10	3.0	0.30	0.30
Self-reported as White	0.51	1.0	0.51	0.51
Conducted During Fall Season	0.82	1.0	0.82	0.82
Total Estimated Purchase			2.57	1.68

* Based on model-based predicted purchases because the onsite methodology used in the CPUC states did not ask about the number of CFLs purchased in 2008; results subject to rounding error.

As shown in Table 36, after computing the per-household estimates, we summed the predicted purchases under both program scenarios across all onsite participants. We divided the totals by the number of households for whom we could estimate CFL purchases (excluding those who refused to self-identify their race or number of people in the household). These calculations predicted that each California household purchased an average of 2.77 CFLs in the program scenario and 1.86 CFLs in the no-program scenario, yielding an estimate of 0.91 CFL purchases directly attributable to the program. Dividing by the estimated number of incited CFLs per household (3.89 including specialty CFLs) gives an estimated total net impact of 0.23.

Given the positive relationship between program activity and prior CFL use, it is likely that the total net impacts for 2006 and 2007 were higher. This is because CFL saturation was lower, and CFL sales nationally remained low, in places without program activity during those two years. In 2008, in contrast, our research showed fewer differences in sales between program and non-program areas. Because they were not collected, the MR Team lacked *observed* 2008 purchase data for California¹⁰⁷ and was therefore unable to assess how well the model predicted actual 2008 purchases. Although we could not assess the validity of the model with any certainty, the California net impact is potentially low as California was not included in the model development.

¹⁰⁷ California's observed purchase data were not available for 2008 due to the timing of California's onsite survey. When fielded in the fall of 2008, the multistate modeling effort had not yet been conceived, and our onsite methods focused only on determining purchases in the past three months, not in the whole of 2008. Had we known the multistate effort was going to occur, we would have asked about purchases in 2008 to be consistent with the other states. An onsite model was developed using three-month data that included California, but the model did not find a statistically significant program effect.

Table 36. Calculation of Total Net Impact

Input	Estimate
(A) Predicted Purchases with Program	169
(B) Predicted Purchased without Program	113
(C) Onsite Sample Size	61
(D) Per-household Purchases with Program (A÷C)	2.77
(E) Per-household purchases without Program (B÷C)	1.86
(F) Net Program Purchases per Household (D-E)	0.91
(G) Incented CFLs per Household**	3.89
(H) Total Net Impact (F÷G)	0.23

* Based on model-based predicted purchases because the onsite methodology used in the CPUC states did not ask about the number of CFLs purchased in 2008; results subject to rounding error.

** Based on final E3 calculator reports, the three IOUs incented 38,508,189 CFLs (including specialty bulbs) in 2008. We estimated a total of 9.9 million households in the service territory, yielding the estimate of 3.89 CFLs per household. Note this estimate includes only residential CFLs.

4.3.8 Regression Analysis Conclusions and Recommendations

In conclusion, the statistical modeling approach suggests that the California ULP had a small but positive effect on CFL purchases in 2008. In addition, the results indicate that CFL programs also had a positive impact on CFL storage and on the length of time a respondent had used CFLs. Using the 2008 purchase model, the MR Team estimated a net impact of 0.23

We recognize, however, that there are several issues that call into question the validity of this result: the absence of observed California data meant we were unable to include it in the development of the 2008 purchase model. Likewise, California was not included in the current saturation model since the state's survey instruments did not collect data on who paid the electricity bill, a significant predictor of saturation. However, California data was included in the development of current CFL use models, so the validity is higher for this model.

In addition, to the extent that California has impacted sales in other areas of the U.S. through historical, aggressive program activity, the sales of CFLs in other states will be higher than in absence of any California program activity. While this impact cannot be accurately quantified (there is no way to “undo” the significant program activity that has occurred in California), it means estimated baseline sales for all states—including the comparison states examined as part of this study—may be overestimated.

A full discussion of the regression-based attribution and net savings analyses is presented in Appendix K.

5. QUANTIFICATION OF 2006-2008 KWH AND KW MARKET EFFECTS SAVINGS

5.1 Quantification of kWh and kW Savings Not Claimed as Direct Savings

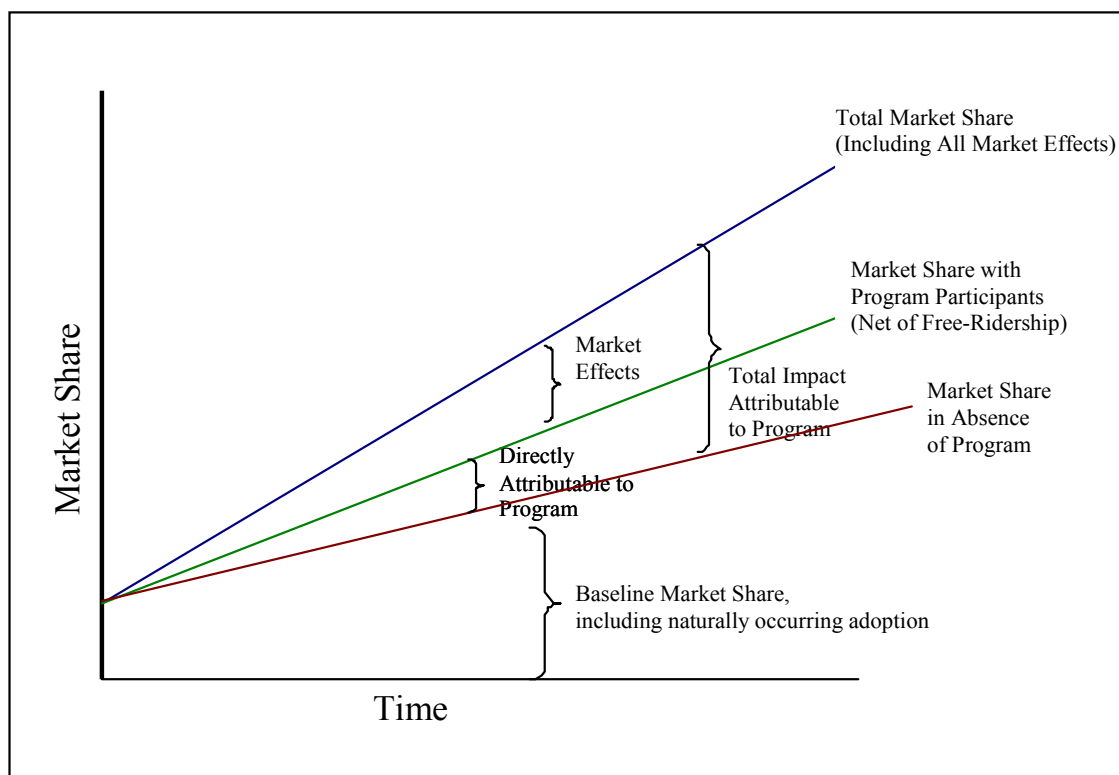
The ultimate goal of the CFL Market Effects report is to quantify the additional CFL sales in California that resulted from the IOU efforts yet were not claimed by the IOUs as part of their program activity. In theory, market effects can be measured through the analysis of the difference between total energy-efficiency market share (or CFL sales) realized in the presence of a program and the market share that would have occurred in the absence of any program activities. As noted earlier, the evaluation protocols limit analysis to impacts directly attributable (net of free ridership) to the California IOUs. In Figure 26, which illustrates the calculation of program impacts and market effects, directly attributable impacts would be based on the difference between the lower and middle lines. However, should market effects (e.g., nonparticipant spillover) exist, the actual savings should be the difference between the upper and lower lines.

This report, through the regression approach, estimated that cumulative 2008 total net impacts, inclusive of both free ridership and spillover, were 0.23 (i.e., 23% of IOU claimed gross savings). This estimate, although inclusive of market effects, is *lower* than the estimated NTG ratio in the Residential Retrofit Upstream Lighting Report, which recommends a NTG of 0.54 across the three IOUs. These studies, however, differ in a number of important ways:

- The net effects estimate for this study is only based on a 2008 model, whereas the ULP report estimates the NTG for 2006-2008.¹⁰⁸
- The net effects estimate for this study is based on a model of cumulative net effects *realized in 2008*, whereas the ULP report estimates the NTG *caused in 2006-2008*. In other words, impacts from previous program cycles are included in the market effects approach (e.g., higher saturation will reduce total sales estimates), whereas the ULP report attempts to isolate impacts from the 2006-2008 cycle.

Taken together, the findings did not provide evidence that market effects in the form of energy/demand savings (nonparticipant spillover) can be unequivocally claimed or quantified due to 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 been significantly higher than—the 2008 estimate. As noted in the interim report, a rigorous assessment of program versus estimated baseline sales conducted earlier in the life cycle of the California IOU CFL programs may well have identified a different level of market effects.

¹⁰⁸ The reasons for including only the final program year are that (1) the development of the total and baseline sales estimates requires a substantial amount of data, and (2) because this study was not initiated until 2008, earlier data were not available.

Figure 26. Calculation of Market Effects on CFL Sales¹⁰⁹

5.2 Assessment of Whether Savings Can be Claimed as a Resource

Market effects from upstream CFL programs have been claimed as savings throughout the United States. Recent evaluations in Massachusetts (2006), Vermont (2005), and New York (2005), in fact, have identified NTG ratios (inclusive of free ridership and spillover) that exceeded 100%. In other words, for these recent historic years, these programs found total CFL sales in their respective service territories were far greater than they would have been in absence of the program, so the utilities could claim savings from more CFLs than they incented.

Given the intensive marketing and outreach nature of these programs, the substantial price buy-downs they offered, and the nascent CFL market a few years ago, these findings do not appear unreasonable.

However, the CFL market has changed substantially in more recent years and the findings from this report indicate that the baseline for CFL sales has risen throughout the U.S., including regions with no utility efforts to promote CFLs. The results of this study, therefore, indicate that market effects savings from the CFL programs *cannot* be 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.

¹⁰⁹ Note that this graph (including the magnitudes and slopes of the lines) was developed for illustrative purposes only.

5.3 Sustainability Assessment

This section provides an assessment of the sustainability of the current market for CFLs in California. The goal of the sustainability assessment is to determine whether the observed market effects related to CFLs are likely to persist if California IOU program intervention is reduced or ended. The assessment is an inherently qualitative exercise that uses data collected through the evaluation effort to look forward. All of the evidence used in the assessment is based on the research results produced throughout this evaluation effort and presented in this report and in the *Compact Fluorescent Lamp Market Effects Final Interim Report* of May 18, 2009).

5.3.1 Indicators of Sustainability

The assessment of market sustainability is based on a set of seven questions formulated to determine the extent to which a market has been transformed by a good or service.¹¹⁰

- Is someone making money by offering it?
- Has a private market developed to continue the facilitation?
- Has the profession or trade adopted it as a standard practice?
- Would it be difficult or costly to revert to earlier equipment or practices?
- Are end-users requesting or demanding it?
- Have the risks to private market actors been reduced or removed?
- Are purchasers satisfied with it?

Table 37 addresses each of these questions individually, with the questions adapted to make them more applicable to the California IOU program. We provide an opinion of the outcome of each these questions in terms of whether or not it points to a sustainable CFL market in the absence of the program, present examples of supporting evidence to the outcome opinion, and indicate the source of that evidence from the evaluation effort.

¹¹⁰ Hewitt, D.C. 2000. "The Elements of Sustainability." In *Efficiency & Sustainability, Proceedings of the 2000 Summer Study on Energy Efficiency in Buildings*. Washington DC: American Council for an Energy-Efficient Economy. Pp. 6.179-6.190.

Table 37. Assessment of Sustainability of CFL Market in CA

Question	Outcome	Evidence
Can/would manufacturers and retailers make money by offering ENERGY STAR-qualified CFLs without individual regional program support (Original: <i>Is someone making money by offering it?</i>)	Yes, but some smaller manufacturers/retailers entering the market might not survive	<ul style="list-style-type: none"> Sales per household in Comparison Areas (1.2) same as CA (1.1), showing markets for CFLs have expanded beyond CA's program support Participant retailers offered additional discounts beyond IOU incentive Manufacturers new to CA program were willing to sell CFLs at lower prices or give to retailers for free to enter new retail markets through program. Nonparticipant manufacturers said some markets may open for them in program absence Wal-Mart aggressively supported CFL sales nationwide CFL shipments in 2008 were 337 million, a drop from the peak of 397 million in 2007, but still higher than every year prior to that CFLs continue to be a symbol of energy efficiency/environmental awareness National and CA legislative policy initiatives support CFL market through efficiency mandates Roughly 60% of participant discount and grocery store managers said they would stock ES CFLs without the ULP's support. <p>Sources: DOC imports, CFL User Survey, regression and store stocking survey, participant manufacturer and retailer interviews, nonparticipant manufacturer interviews, EISA 2007, CA Title 24</p>
Will manufacturers continue to develop and market CFLs and will retailers continue to market them without individual regional program support? (Original: <i>Has a private market developed to continue the facilitation?</i>)	Yes	<ul style="list-style-type: none"> Manufacturers said they increased CFL production capacity and supply for global market Majorities of all retailer types would stock standard ENERGY STAR CFLs without the support of IOU Program and most would stock specialty CFLs Non-participating manufacturers said some markets may open for them in program absence Federal EISA 2007 standards will start phasing out some incandescents beginning in 2012 62% of manufacturers said product quality improvements would have been delayed without IOU program, but cited competitive pressure to continue making improvements anyway <p>Sources: Participant manufacturer and retailer interviews, nonparticipant manufacturer interviews, EISA 2007</p>
Are CFLs now a mainstream option? (Original: <i>Has the profession or trade adopted it as a standard practice?</i>)	Yes, but not so much for specialty products	<ul style="list-style-type: none"> An average of 7.5 CFLs per household were used in CA; while most sockets are still filled with incandescents, CFLs are now a clear option, if not the first option 79% of CA households currently use CFLs Majorities of all retailer types would stock standard ENERGY STAR CFLs without

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Question	Outcome	Evidence
		<p>the support of IOU Program and most would stock specialty CFLs.</p> <ul style="list-style-type: none"> Standard CFLs (9-30 watt twisters) represented 51% of all CFL packages and 75% of all CFLs in store survey National big box, mass merchandise, home improvement stores said program had little/no influence on stocking/packaging decisions, and they will continue to stock CFLs Smaller retailers note more program influence on stocking, but growing popularity of CFLs is also encouraging CFL stocking <p>Sources: CFL User Survey, participant retailer interviews, stakeholder interviews</p>
Would it be difficult or costly to revert to earlier equipment—that is, going back to incandescents? (Original: <i>Would it be difficult or costly to revert to earlier equipment or practices?</i>)	Yes	<ul style="list-style-type: none"> Manufacturers said they have increased CFL production capacity EISA 2007 will prohibit sales of some inefficient incandescents beginning in 2012, which manufacturers have to plan for in advance However, 81% manufacturers said production costs would increase without IOU program due to loss of economies of scale/need to seek out other markets <p>Sources: Manufacturer interviews, EISA 2007</p>
Are end-users requesting or demanding CFLs? Would there be sufficient consumer demand without regional program support? (Original: <i>Are end-users requesting or demanding it?</i>)	Yes for standard CFLs, but less for specialty CFLs	<ul style="list-style-type: none"> 35% of CA households would replace the next burned out incandescent with a CFL and 88% would replace the next burned out CFL with another CFL CFL purchases per household in CA (1.1) same as Comparison Area (1.2) over three-month period in 2008, showing markets for CFLs have expanded beyond CA's program support No evidence of positive relationship between existence of CFL programs and ES sales per household in regression analysis CFL shipments in 2008 were 337 million, a drop from the peak to date of 397 million in 2007, but still higher than every year prior to that, suggesting consumers across the country—not only in CA with program support—are buying CFLs EISA 2007 standards will create more demand for incandescent alternatives Significantly more CFLs are held in storage in CA households (5.7) than in Comparison Area (4.7), and 89% of the CA CFLs being stored are intended for future use. (Note, however, that many of the California CFLs were likely purchased at a program-discounted price). Gap still exists in availability of specialty CFLs, as existing products are not price competitive with incandescents California and Comparison Area respondents recently gave high overall (and not statistically different) satisfaction ratings (8.3 and 8.2, respectively, 0 to 10 scale), whereas prior to 2004, average satisfaction rating for CFLs in CA was 6.3 (0 to 10 scale) Product quality has improved due to influence of IOU programs, improved

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Question	Outcome	Evidence
Have the risks to private market actors for manufacturing or marketing CFLs been reduced or removed? (Original: Have the risks to private market actors been reduced or removed?)	Yes—reduced, but not removed	<p>standards, and oversight by the ENERGY STAR program Sources: CFL User Survey, regression analysis on sales data, DOC imports, EISA 2007, manufacturer and retailer interviews, ENERGY STAR program</p> <ul style="list-style-type: none"> 75% manufacturers said CFL production costs decreased over past ten years Manufacturers said they increased CFL production capacity and supply to global market Manufacturers and retailers provided shelf space and were selling CFLs in Comparison Area—even with no support or history to predict consumer demand, suggesting that risks can be managed EISA 2007 standards will create more demand for alternatives to incandescents However, prices still not competitive with incandescents w/out support— regression showed IOU discount was \$2.06, weighted by number of CFLs per package 69% manufacturers and 71% retailers said sales would drop significantly w/out IOU program; impact greater on smaller retailers w/out access to other markets Smaller retailers, such as drug and grocery stores less likely to stock specialty CFLs without IOU support than big box, mass merchandise, home improvement stores that have higher sales volume and more shelf space California and Comparison Area respondents recently gave high overall (and not statistically different) satisfaction ratings (8.3 and 8.2, respectively, 0 to 10 scale), whereas prior to 2004, average satisfaction rating for CFLs in CA was 6.3 (0 to 10 scale) Product quality has improved due to influence of IOU programs, improved standards, and oversight by the ENERGY STAR program Sources: Pricing regression, shelf stocking survey, manufacturer and retailer interviews, CFL User Survey, ENERGY STAR program
Are purchasers satisfied with CFLs? (Original: Are purchasers satisfied with it?)	Yes	<ul style="list-style-type: none"> California and Comparison Area respondents gave high overall (and not statistically different) satisfaction ratings (8.3 and 8.2, respectively, 0 to 10 scale) Prior to 2004, average satisfaction rating for CFLs in CA was 6.3 (0 to 10 scale) Product quality has improved due to influence of IOU program, improved standards, and oversight by the ENERGY STAR program Sources: CFL User Survey, manufacturer interviews, ENERGY STAR program

5.3.2 Sustainability Assessment Summary

We conclude that the market for standard CFLs in California is largely sustainable; the sustainability of the specialty CFL market is less certain. The ULP programs continue to influence CFL sales in California, but that influence is not essential for the market to sustain itself. In the absence of the program, however, fewer CFLs would be sold, and fewer retailers and fewer types of retailers would stock CFLs.

Changes are unfolding nationally in the CFL market. CFL shipments to the U.S. grew from 52 million in 2002 to a peak of 397 million in 2007, which coincided with a surge in media attention about global warming and references to CFLs as a symbol of action to combat it.¹¹¹ Since that peak, CFL shipments dropped 15% to 337 million in 2008 and, based on shipments for the first half of the year, they will drop further to an estimated 256 million units in 2009. The drop in CFL shipments from 2007 levels brings into question the resiliency of the CFL market, but there appears to be a nationwide slowdown in lighting shipments overall. There is evidence that the drop in CFL shipments in 2008 coincided with a drop in shipments of incandescent bulbs that has been occurring for the past several years.^{112, 113} Manufacturers attribute the decline in CFL shipments to the economic slowdown. Further contributing to the downturn in CFL shipments is the fact that, as the saturation of CFLs increases, sales of CFLs and incandescent bulbs can be expected to slow because the CFLs last longer and need to be replaced less frequently.

As noted, we believe that additional consideration of the market for specialty CFLs, rather than standard CFLs, seems warranted in California. The evaluation effort was not designed to explicitly or fully explore the difference between standard, twister-style lights and specialty CFLs that may possess additional attributes. However, important technical differences between CFLs and incandescent bulbs that have led to the creation of a unique category of specialty CFL lighting that is emerging. (The standard incandescent bulb has characteristics that standard CFLs do not have, including an A-line shape, warm color, instant turn-on, immediate full brightness, and dimming capability.) Specialty CFLs, including those currently under development, are subject to additional barriers of high pricing, availability, and lack of consumer awareness.

For standard CFLs, barriers such as higher first cost, consumer awareness, lack of availability, and compromised quality have been greatly reduced, although not completely eliminated. Key opportunities for program support with standard CFLs exist in improving saturation levels and reaching the 21% of California households that do not currently use CFLs at all.

A recent CPUC Decision (in September 2009) approving the 2010-2012 California IOU Energy Efficiency Portfolios also addressed the sustainability and future CFL program design questions.¹¹⁴ As part of that decision, the Commission required the utilities to begin to phase out

¹¹¹ For example, Al Gore's *An Inconvenient Truth*, a documentary about global warming won the 2007 Academy Award for Documentary Feature, and Wal-Mart embarked on a campaign to improve its green profile and pledged to sell 100 million CFLs. That goal was reached in October of 2007.

¹¹² Bickel, Stephen. D&R International on behalf of the ENERGY STAR program. The CFL Market: Far to Go Little Time to Get There. Presentation at AESP Brown Bag: The CFL Market: Past, Present and Future. September 24, 2009.

¹¹³ U.S. Department of Energy (prepared by D&R International), CFL Market Profile, page 2. March 2009. Estimates of incandescent shipments have dropped from 1,679,000,000 in 2002 to 1,317,000,000 in 2008 and are projected to be 1,147,000,000 by 2010 (data provided in personal email correspondence with D&R International, June 6, 2009).

¹¹⁴ http://docs.cpuc.ca.gov/PUBLISHED/AGENDA_DECISION/107378.htm

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traditional CFL bulb promotions and move toward new lighting technologies and specialty lighting products. The commission ordered:

Reflecting rapid progress toward lighting market transformation and the upcoming federal and state mandated phase-out of conventional incandescent lights, fewer ratepayer subsidies will be needed for basic compact fluorescent lights (CFLs) that have commanded considerable funding in past portfolio budgets. Funding for basic CFL programs are reduced and reallocated to advanced lighting programs and other lighting market transformation activities.

The Commission also allocated significant funds toward a statewide Lighting Market Transformation Program with the goal of informing market actors on product choices, installation practices and lighting disposal methods. The Lighting Market Transformation Subprogram would also establish technology roadmaps and processes to define how and when to introduce and phase out various lighting technologies.

In summary, the CFL Market Effects Team's assessment of sustainability is as follows:

- The California CFL market would be viable on its own, without intervention through consumer education and incentives.
- Fewer retailers and fewer types of retailers would stock CFLs without intervention.
- CFL sales would be lower and market acceptance slower.
- Smaller retailers and retailers in grocery, drug, discount channels would be at risk.
- Specialty CFLs still do not have a wide foothold in marketplace.
- EISA 2007 standards will phase out some inefficient incandescent bulbs, opening markets for more efficient lighting. EISA 2007 sets maximum wattage levels by lumen output for medium, screw-base lamps that have a range from 310 to 2600 lumens and are capable of operating at a voltage range of 110 to 130 volts. The standards will become effective under a phased approach beginning in 2012 when general service bulbs will be required to use about 20 to 30% less energy than current incandescent bulbs.
- The market for "plain vanilla" CFLs appears to have been close to transformed, but such is not the case for specialty CFLs. Market transformation for standard CFLs is evidenced both inside and outside CA IOU territory by changes that suggest increased and enduring consumer demand and manufacturer and retailer support of CFL products nationwide. Barriers such as a lack of consumer awareness, a lack of availability, and high prices have been largely removed from this product category. EISA standards will provide continued market support for standard CFLs. A number of barriers still prevent the widespread adoption of specialty CFLs. These include the fact that specialty CFLs can have a variety of attributes that fill a number of different types of product categories, specialty technologies that are still emerging, high prices relative to their incandescent counterparts, and most specialty lighting is exempt from the EISA standards. These barriers mean lasting or enduring consumer demand and market support for specialty CFLs have not been created as of yet.
- A transformed market does not mean market dominance, although that may come with implementation of EISA 2007 standards.

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- Meanwhile, the majority of sockets still do not have CFLs.
- The buy-down approach, and even the market transformation paradigm, may have run its course for “plain vanilla” CFLs.
- Targeting remaining sockets may call for:
 - A buy-down approach for specialty CFLs to further transform the market
 - A resource acquisition approach for other sockets, targeting groups least likely to use CFLs
 - . Continued consumer education about the variety of CFLs available, appropriate CFL applications, and proper CFL disposal.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary of Findings and Conclusions

The CFL Market Effects report is the culmination of a tremendous research effort. The study included telephone surveys with approximately 2,500 end-use customers, telephone interviews with about 600 CFL retailers and manufacturers, in-home audits of 269 homes and comprehensive retailer lighting shelf stocking inventories in 185 stores (representing over one million bulbs). The analysis included qualitative and quantitative data approaches, including descriptive statistics and multivariate regression modeling techniques. Primary research was conducted in California and in three comparison states selected to serve as a baseline for California. The customer survey and in-home audit data were combined with primary data from 11 additional states (in a collaborative effort conducted with other program states, and analyzed in a single set of models) as part of the analysis.

The study was guided by the development of a logic model and researchable questions that were developed as part of the CFL Market Effects Scoping Study. A summary of the findings and conclusions is presented here.

Assessment of Leading Market Indicators

The CFL Market Effects report examined changes in consumer awareness of, and satisfaction with CFLs, as well as their availability and prices. Key findings and conclusions include:

- ***California IOU consumer awareness increased dramatically in the past decade and remains higher than awareness in the Comparison Area.*** Awareness of CFLs in California increased from 58% in 1998 to 96% in 2008. In nonprogram states, consumer awareness was 92% in 2008. The difference between 2008 CFL awareness in and out of California was statistically significant at the 90/10 confidence/precision levels.
- ***Awareness of the IOU Upstream Lighting Program was low among consumers.*** Respondents to the CFL User Survey reported that approximately 26% of their CFL purchases in fall 2008 were through the IOU incentive program, yet IOU-discounted bulbs likely represented closer to 80% of all CFL sales.
- ***Availability of CFLs was extremely high, but higher in certain distribution channels in California compared to the Comparison Area.*** CFLs are now nearly universally available in California: the vast majority of retailers that carried lighting products participated in the ULP and nearly 100% of nonparticipating retailers that carried lighting products also reported they carried 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).
- ***California retailers devoted more floor space and a greater percentage of their displayed lighting product to CFLs compared to the Comparison Area.*** Participating retailers in the ULP reported that approximately 58% of their lighting sales floor is dedicated to CFLs, significantly higher than the Comparison Area, where only 42% of the floor space was dedicated to CFLs. In addition, the percentage of CFL models in the discount, grocery, and hardware stores—channels through which the 2006–2008 ULP sought to actively promote CFLs—was significantly greater than the percentage of CFL

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models in the same channels 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.

- ***The average IOU-discounted standard twister style bulb retails for significantly less than the equivalent nonprogram bulb due to the incentives and additional discounts offered by participating retailers and manufacturers.*** The average IOU-discounted standard twister shelf price was \$1.30, \$2.63 less than the equivalent non-IOU discounted bulb. Retailers and manufacturers are also offering “add-on” discounts to the utility incentive, thus this discount is 172% of the average incentive of \$1.57.
- ***Nondiscounted 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 willingness to pay for CFLs in California.
- ***Although there is little difference in the prices of nonprogram CFLs in California and the Comparison Area, participating retailers and manufacturers report that the California programs helped decrease CFL prices throughout the U.S. through increased sales.*** Nonprogram CFLs in California sold for nearly the identical price of equivalent bulbs in the Comparison Area (and slightly higher when controlling for other factors affecting price). Most of the participant manufacturers/importers we interviewed, however, linked decreases in production costs with increases in sales volumes, and most credited the ULPs with increasing their sales volumes. In other words, these manufacturers credited the ULPs with cost decreases in California and elsewhere.
- ***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 CFL User 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 (which is not statistically different from California’s recent rating).

Assessment of Coincident and Lagging Market Indicators

The CFL Market Effects Report also examined changes in CFL sales and saturation levels.

- ***CFL saturation is significantly higher in California than in the Comparison Area.*** Nearly eight of ten (79%) households in California said they use at least one CFL inside or outside their home, significantly (at the 90% confidence level) more than the 66% of households in the Comparison Area who were 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.
- ***During fall 2008, CFL sales per household were higher in the Comparison Area than in California, but CFLs as a percentage of all bulb sales were higher in California, likely 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

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purchased light bulbs in the past three months (47%) than in the Comparison Area (57%), if the sales figures are examined as a market share (the percent of all bulb sales that are CFLs), the CFL market share in California was higher (30%) than in the Comparison Area (24%). This suggests that the higher saturation of CFLs in California homes may be leading to fewer bulb sales, and thus fewer CFL sales per home compared to the Comparison Area.¹¹⁵

- ***The California ULPs had a small positive effect on CFL purchases in 2008 and a larger effect on current CFL saturation.*** CFL programs also had an effect on prior CFL use and the length of time respondents had used CFLs. The estimated total net impact (including free ridership and spillover) for California in 2008 is 0.23. Given the positive relationship between program activity and prior CFL use, it is likely that the total net impacts for 2006 and 2007 were higher.

Role of the IOU CFL Programs Outside of California

To assess cumulative effects of the California programs on the CFL market, the CFL Market Effects Team investigated—qualitatively—the influence of the California IOU programs on the overall CFL market outside of California. The results of these interviews indicate:

- Many stakeholders felt that the combined effects of the energy crisis, media attention, and the large-volume California incentive program helped to create a cycle of events that significantly accelerated CFL market progress.
- Stakeholders reported that other program areas were mainly impacted by adopting the upstream program model used in California and by the high volume of incentives that helped to increase availability and lower retail CFL prices nationwide.
- A large majority of manufacturers (81%) and retailers (65%) believed the California rebate programs influenced the sales level of CFLs in other states.
- Participating stakeholders agreed that more recent, broad market events, such as Wal-Mart's CFL initiative, lighting efficacy regulation, and the consumer response to climate change, have all benefited from the market groundwork laid during 2001 to 2004/2005 by the California programs.

Role of the IOU CFL Programs in CFL Market Effects

As noted, the study's goal was to estimate the cumulative effects of California's energy-efficiency programs on the CFL market. Although the study noted substantial changes in awareness of CFLs, attitudes and acceptance of CFLs, CFL availability, and CFL retail prices, these changes may simply be due to market changes and not market effects (i.e., they may have occurred for reasons other than the California energy-efficiency programs). Because most of the evidence of market effects was qualitative in nature (e.g., interviews with the upstream market actors), most indicators of market effects could not be determined with a high degree of confidence.

¹¹⁵ While we found California homes to have fewer medium screw-base sockets than homes in the Comparison Area, the difference was not statistically significant. Socket counts per household, therefore, do not seem to explain the differences in California and Comparison Area CFL sales or market shares.

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One exception to this, however, is CFL availability. The results of the shelf stocking study, retailer interviews, and manufacturer interviews all indicated that the California IOU programs have increased availability of CFLs in grocery stores, discount stores, and hardware stores. These stores are not only carrying CFLs, but are devoting higher percentages of shelf space to CFL products than are similar stores in the Comparison Area, and carry higher percentages of ENERGY STAR CFLs. 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.

While we did not find unequivocal, quantifiable market effects in the form of energy/demand savings for the 2006-2008 ULP, this is not to say that the methods employed in this evaluation were inadequate. Rather, our inability to quantify (or claim) energy/demand savings from the 2006-2008 program is a result of insufficient data. Had the data required for the regression model (from either retailer or manufacturer sales, or from customer telephone surveys and the onsite lighting audits fielded in California, the Comparison Area, and the other regions) been collected in *each program year*, we would have had sufficient information to estimate cumulative net program effects for the entire 2006-2008 ULP period. Furthermore, had a reliable estimate of cumulative net program effects for 2005 and earlier been available, we would have been able to estimate the net effects of the 2006-2008 program in isolation.

It is also important to note that any quantitative analysis is limited by the qualitative assessment, presented above, that the California IOU programs have arguably accelerated CFL sales throughout the U.S. While this impact cannot be accurately quantified (there is no way to “undo” the significant program activity that has occurred in California), it means estimated baseline sales for all states—including the comparison states examined as part of this study—may be *overestimated*. In other words, sales outside California—and estimated baseline sales—might have been *lower* if no program activity had taken place in California. Note that other programs with mature CFL programs, such as Massachusetts, can also argue that their CFL programs also played a role in increasing CFL sales throughout the U.S.

6.2 Recommendations

The CFL Market Effects Team drew on the key findings and conclusions described above to formulate recommendations for this study. Decisions about policy changes and changes to program design, however, are the responsibility of the CPUC and are beyond the scope of this study.

6.2.1 Sustainability and Suggestions for Program Direction

As discussed in detail in the sustainability section, the IOU programs continue to influence CFL sales in California, but that influence is not essential for the market to sustain itself. Despite a recent drop in U.S. CFL sales that may reflect the economic recession, increased CFL saturation, and other factors, areas in the U.S. where there are no utility sponsored program activities are rapidly “catching up” to California and other states with mature CFL programs. CFL sales in the fourth quarter of 2008, in fact, were higher in the Comparison Area than in California, and although CFL saturation in the Comparison Area still significantly trails California, it will likely approach California’s levels soon if sales rates continue.

Despite years of aggressive promotions, price discounts, and increased availability in additional distribution channels, however, California CFL saturation remains at approximately 21% of all

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sockets (and approximately 29% of MSB sockets). There are various reasons these remaining sockets have yet to be replaced with CFLs, including:

- ***Use of controls.*** Dimmable and three-way CFLs are still quite costly, and there are substantial concerns about their quality.
- ***Dissatisfaction with CFLs.*** Recent focus groups conducted as part of the Residential Retrofit ULP evaluation revealed significant concern among a small number of the participants about the look and light quality of CFLs.
- ***Lack of awareness of other shaped lamps.*** The CFL focus groups conducted through the Residential Retrofit study also revealed that many people are now aware that CFLs come in shapes and sizes other than the standard twister style.
- ***Low hours of use.*** Many of the remaining sockets are in areas of low use (e.g., closets), so even if the incremental cost is small, CFLs may not be cost-effective.

The buy-down approach, even under the market transformation paradigm, may have run its course for “plain vanilla” CFLs. The decline in nationwide CFL sales over the past two years notwithstanding, the CFL Market Effects Team expects the CFL market to rebound. Though it is difficult to forecast the timing or strength of this rebound, we believe factors such as the momentum exhibited by the CFL market prior to the recession, the public’s increasing concern about global climate change and, in several years, implementation of the impending federal lighting efficiency standards (the Energy Independence and Security Act of 2007, or EISA) will ultimately result in increasing CFL sales trends. For sockets that do not require specialty bulbs, utilities should consider an aggressive resource acquisition approach, such as a resource acquisition that targets groups least likely to use CFLs.

The market for specialty CFLs, however, still faces many of the barriers faced by standard twistors just a few years ago, including quality concerns, high pricing, availability, and lack of consumer awareness. A buy-down approach, therefore, may still be viable for specialty bulbs. Continued consumer education about the variety of CFLs available, appropriate CFL applications, and proper CFL disposal should also be a key component of future CFL programs.

6.2.2 Suggestions for Changes to Market Effects Evaluation Protocol

One of the greatest challenges the CFL Market Effects Team faced in trying to quantify the energy/demand savings from market effects of the 2006-2008 ULP was the lack of earlier market effects data—both to establish a (pre-2006) baseline, and to understand the market effects for the first portion of the program period.¹¹⁶ While the Market Effects Evaluation Protocol states, “a baseline study must be conducted as early as possible,” we recommend some subtle but important changes to the scoping study section of the Protocol. Specifically, we recommend that through the scoping study the evaluation contractor be required not only to conduct a thorough review of relevant past studies, but also to explicitly delineate the quality and usefulness of any extant baseline data. CPUC-ED should then use this assessment of baseline data availability to define the timing and scope of the subsequent market effects study.

In addition, the CFL Market Effects Team recommends the scoping study be required to include a description of the market’s evolution over time. Documentation of the market history provides

¹¹⁶ This study was initiated in early 2008—more than two years into the three-year program period.

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a context for the market effects assessment. An understanding of this context may be of critical importance if, for example, significant program impacts occurred prior to the timeframe under evaluation.

Once a market effects study has been authorized, the Market Effects Evaluation Protocol recognizes two approaches for estimating causal attribution: preponderance of evidence and modeling. The CFL Market Effects Team endeavored to assess the market effects attributable to California's 2006-2008 ULP using the preponderance of evidence approach for some metrics (e.g., CFL awareness, availability, and the program's effect on CFL pricing) and modeling for others (i.e., energy and demand savings). We found the preponderance of evidence approach—in this case employing customer surveys, in-home lighting audits, retail shelf stocking surveys, and trade ally surveys—worked well for qualitatively assessing the market effects attributable to California's ULP.

However, modeling the nonparticipant spillover effect of an upstream program on the market as a whole—without the benefit of adequate annual sales data or being able to readily identify end use customer participants—poses unique challenges. In light of the challenges inherent in modeling the market effects attributable to upstream energy-efficiency programs, we suggest the Protocol allow for the estimation of *total net effects* (i.e., a net-to-gross ratio that is inclusive of free ridership, participant spillover, and nonparticipant spillover) for upstream programs rather than focusing solely on nonparticipant spillover.

6.2.3 Suggestions for Future Market Effects Evaluation Work

In the endeavor to accurately estimate the magnitude of CFL market effects, the assessment 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 and the more recent national downturn in sales, makes it extremely difficult for any program state, including California, to now 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 be less costly by using longitudinal data approaches that implement ongoing data collection activities.

In addition to establishing baseline and ongoing, more regular data collection, this study has a number of other methodological recommendations for CFL or other market effects studies, including:

- The multistate regression approach improves on the simple difference of means (i.e., delta sales) approach by controlling for other factors that impact sales of energy efficient measures, including income, education, housing characteristics, and utility rates.
- The key to successful implementation of the multistate approach is collecting good estimates of sales, which, for lack of reliable secondary data, requires consistent approaches across states in terms of primary data collection activities (survey questions, time horizons, etc.).

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- Shelf-stocking surveys are less useful as a proxy for sales since they cannot fully capture sell-through rates (i.e., lowest cost products may have sold quickly and not be available during the stocking survey), but they are valuable for understanding availability and pricing characteristics.
- Future studies should also consider examining a diffusion of technology curve to understand how efficiency gains in California might impact standard practices in other areas of the country.

Market effects studies also provide important market characterization findings that can inform both impact evaluations and program planning efforts. For example, the primary data collection activities taken for this study produced estimates for a number of important parameters, including:

- Upstream interviews: A qualitative estimate of historic and current market effects
- CFL user survey and in-home lighting audits: Saturation, penetration, current buying patterns
- Shelf stocking surveys: Current offerings (model types, features), stocking patterns, and program pricing effects (e.g., pricing multiplier effects) across all retailer channels and differences by retail channel.

ACRONYMS

ACS: U.S. Census Bureau American Community Survey
CFL: Compact Fluorescent Lamp
DIY: Do-It-Yourself
DOE: U.S. Department of Energy
EPA: U.S. Environmental Protection Agency
EEPS: Energy Efficiency Program Sponsors
FYP: Flex Your Power
IOU: Investor-owned Utility
LED: Light-emitting Diode
LRC: Lighting Research Center located at Rensselaer Polytechnic Institute in New York
NCP: Negotiated Cooperative Promotion
NEEA: Northwest Energy Efficiency Alliance
PEARL: Program for the Evaluation and Analysis of Residential Lighting
PG&E: Pacific Gas and Electric Company
POP: Point of Purchase
POS: Point of Sale
PSA: Public Service Announcement
RLP: Residential Lighting Program
RMST: Residential Market Share Tracking Study
SCE: Southern California Edison
SDG&E: San Diego Gas and Electric Company
ULP: Upstream Lighting Program