CFL MARKET EFFECTS STUDY

FINAL STUDY PLAN

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INTRODUCTION

The purpose of this draft study plan is to propose a general approach to the performance of a study of the cumulative effects of California's energy efficiency programs on the market for compact fluorescent lamps (CFLs).

This study is envisioned as:

- Being performed in a manner that is consistent with the CPUC protocols for market effects evaluations.

- Having the following objectives:

    - Understanding the cumulative effects of California's energy efficiency programs on the market for CFLs.

    - Quantifying the kWh and kW savings caused by the above market effects, occurring in the years 2006-2008, and not claimed as direct or participant spillover savings in any of the 2006-2008 impact evaluation studies.

    - Supporting the CPUC's strategic planning efforts by clarifying whether savings from market effects can be quantified with sufficient reliability to be treated as a resource and, potentially, afforded shareholder incentive payments.

- Being performed primarily as an addition by the CPUC to the scope of work for the Residential Retrofit Impact Evaluation team. The main reason for this approach is that there are extensive synergies between the work already proposed to be performed by that team in connection with evaluation efforts for the Upstream Lighting programs, and the work needed for the current study.[1] However, we envision the planning, analysis, and reporting for the two projects being kept separate.

- Being performed on a timeline that roughly coincides with that for Upstream Lighting evaluation study. because of the overlaps between the two studies and the administrative arrangement described above,. However, due to the CPUC's need for timely results to inform its strategic planning efforts, we recommend that a final report be provided no later than the Summer of 2009, ahead of the March 2010 date envisioned for the final report on the Residential Retrofit study. We also recommend that an interim report be provided in the late summer or early fall of 2008.

This plan has been reviewed by, and reflects input from, the CPUC staff and the Master Evaluation Contractor Team (MECT). However, the methodological approaches

[1] This plan also envisions some relevant work being performed by the Marketing and Outreach evaluation team, but it is not yet clear whether that work would require an expansion to the current scope of work for the M&O evaluation as represented in the draft evaluation plan.

discussed in the plan should be viewed as tentative, pending discussions between the CIEE Market Effects team, the MECT, and the Residential Retrofit Impact Evaluation team. The intent is to forge a general consensus on what should be studied and how, so that more detailed planning for the study can commence.

The remainder of this draft plan is organized into six sections, each corresponding to a key step in the market effects study. These steps are: (1) scoping study; (2) analysis of market evolution; (3) analysis of market effects; (4) assessment of attribution; (5) estimation of net energy and demand savings from non-participant spillover; and (6) assessment of sustainability.[2]

The proposed study is summarized in Table 1, below.

[2] While these steps may end up corresponding fairly closely to tasks, we intentionally use the broader term "step" to reflect the fact that the purpose of this plan is to move toward consensus on a general approach to the study rather than to provide a detailed scope of work.

Table 1. Summary of Proposed CFL Market Effects Study

Step	Research Activities
1. Scoping Study	• Characterize CFL market using existing data sources • Review CFL market effects studies from other states • Develop integrated market and program theories • Refine study approach • Detail market indicators to be studied
2. Analysis of Market Evolution	• Using existing data sources, reconstruct historical trends in the CFL market in California, both actual and baseline.[3]
3. Analysis of Market Effects	• Analyze current actual retail CFL sales in California. o Draw on results from evaluation RDD surveys and on-site visits o Expand evaluation retailer interviews to encompass site visits, shelf and stocking studies, and analysis of retailer sales records. o Triangulate among results • Analyze baseline retail CFL sales in California. o Draw on results of evaluation "U.S. minus program states" analysis. o Supplement with other, more targeted quasi-experimental sales data analyses. o Triangulate among results • Interview retailers, manufacturers, and other retail market actors regarding market effects, leveraging interviews already planned for evaluation purposes. • Perform limited exploratory research into the potential market effects of non-retail residential programs. • Interview supply-side actors involved in commercial lighting markets to develop initial insights into possible non-retail non-residential CFL market effects • Leverage and expand planned evaluation econometric analysis of CFL pricing effects. • Leverage planned Marketing and Outreach (M&O) evaluation activities.
4. Attribution Analysis	• Sift through the evidence collected in Steps 1-3 to make a case regarding the nature and magnitude of any market effects produced by California's CFL programs.
5. Estimation of Non-Participant Spillover Savings	• Estimate non-participant spillover savings for years 2006-2008. o Estimate total program savings by comparing actual and baseline sales, with appropriate adjustments based on other evaluation findings. o Subtract direct net and participant spillover savings associated with retail CFL sales and documented in the 2006-2008 impact evaluations. o Systematically analyze the uncertainty surrounding the results. • Develop recommendations regarding treatment of any CFL market effects savings in next program cycle.
6. Sustainability Assessment	• Using results from all of the above steps, assess the extent to which any observed market effects are likely to persist in the absence or reduction of public intervention.

[3] As discussed later in this plan, "baseline" refers to a hypothetical projection of CFL sales patterns in the complete historical absence of publicly funded energy efficiency programs targeting CFLs.

STEP 1: SCOPING STUDY

California's protocols for market effects evaluations emphasize the importance of performing a scoping study before actually embarking on a market effects study. In the words of the protocols:

> The appropriate approach for a market effects study cannot be readily determined without a scoping study to define the market to be studied, develop a market theory to test in the analysis, assess data availability for the market effects study, specify a model of market change, develop a methodology for data collection and recommend an analysis approach. (p. 149.)

A later passage in the market effects protocol succinctly summarizes the required components of a scoping study when performed at an enhanced level of rigor, as follows:

> Define the market by its location, the utilities involved, the equipment, behaviors, sector and the program years of interest. Develop market theory and logic model. Detail indicators. Identify available secondary data and primary data that can be used to track changes in indicators. Outline data collection data collection approach. Recommend hypotheses to test in the market effects study. Recommend the analysis approach most likely to be effective. (p. 150.)

Consistent with the protocols, the first step in this CFL market effects study will be a scoping study, to include all of the components summarized above. The current document is itself the first step of the scoping study, but represents only the beginning of the process. While methodological approaches are discussed in this study plan, these should be viewed as tentative, pending the results of the full scoping study and an associated public workshop.

The remainder of this section highlights some of the components of the scoping study that we believe will be most important.[4]

A. Sorting Out the Programs

A key issue that will need to be addressed early in the scoping study is the handling of the many different programs in California that are either currently targeting CFLs or have done so in the past. The market effects protocols specify that market effects studies should be performed at the market level, focusing on the effects of groups of programs in the market over multiple program cycles. (p. 143.) This is exactly how we propose to approach the current study. However, there are dozens of programs currently targeting CFLs in California, ranging from giveaways, to direct install programs, to small C&I rebate programs. In order to get an initial sense of what kinds of market effects to look

[4] Our intent is to highlight and resolve some key conceptual issues, and not to propose a detailed plan for the scoping study. As such, not all important components of the scoping study are reviewed here. For example, while the following issues are not discussed further here, the scoping study will need to include interviews with industry experts, program staff and other key informants, and will need to clarify what data will need to be requested from the utilities and other program administrators.

for and how, it will be helpful to assess which of these programs seem most likely to be contributing to any market effects for CFLs.

The vast majority of current in-program CFLs appear to be getting distributed through two primary mechanisms: the Upstream Lighting programs and the wide range of C&I programs that include CFLs as potential measures. There are also numerous other residential programs distributing CFLs through non-retail channels. We consider each of these categories in turn.

Upstream Lighting Programs. The Upstream Lighting programs appear to meet most possible criteria for a significant research effort aimed at market effects. First, these programs have reportedly subsidized upwards of 30 million units since 2006, probably accounting for a significant portion of sales of CFLs in the U.S. Second, while the Upstream Lighting programs are formally treated as resource acquisition efforts, their design closely parallels programs in other states that are classified as market transformation initiatives, and many stakeholders in California appear to think of them as being as much the latter as the former. Lastly, upstream CFL incentive programs have been the subject of fairly extensive market effects research in other states, and that research has produced some evidence of significant market effects. For all these reasons, we believe the retail market for CFLs in California, and the effects of the Upstream Lighting programs on this market, should be a primary focus of this study.

As the retail market is largely oriented to residential customers, this implies a primary focus on the residential sector. However, it will be necessary to pay some attention to the phenomenon of non-residential participation in the Upstream Lighting programs, and of retail purchases of CFLs by non-residential customers in general.

Non-Retail Residential Programs. While there are many residential programs in California that are promoting CFLs through non-retail channels, we have two reasons for believing these should be a secondary focus of the study. First, despite the large number of programs, the total volume of CFLs being distributed through these programs appears to be relatively limited compared to the upstream lighting programs and C&I rebate programs. Second, many of these programs involve the free distribution of CFLs. While this is an effective resource acquisition approach, it essentially bypasses market mechanisms, in the sense that it involves no transaction between the consumer and a seller, which tends to some extent to limit the potential for market effects.

There are three major mechanisms through which non-retail residential CFL programs could arguably be having market effects, and these need to be taken into account in the study. However, we believe the research implications of all three of these mechanisms are likely to be relatively limited.

First, these programs are contributing to total CFL sales volume, and many observers believe that volume-driven effects on prices are one of the most important market effects resulting from CFL programs. However, as discussed later in this plan, volume-driven pricing effects will be studied holistically, and for the purposes of that analysis all we

really need to know about non-retail CFL programs is the total sales volume associated with them – something which can presumably be derived from program tracking systems.

Second, it is unclear to what extent the program administrators who are distributing CFLs through non-retail programs are obtaining them through retail channels, as opposed to other procurement approaches such as buying in bulk from wholesalers or manufacturers. We believe this is an important issue to clarify in the scoping study.

Third, it is probable that non-retail CFL programs are introducing significant numbers of California residents to CFLs for the first time, and that some of the participants will be led by this experience to seek out CFLs on their own, contributing to retail demand. We recommend that this issue be addressed by opportunistically including appropriate questions in participant surveys administered as part of impact and process evaluation studies.[5]

Non-Retail Non-Residential Programs. While C&I programs in California appear to be distributing almost as many CFLs as the Upstream Lighting programs, the variety of program approaches being used appears to be much broader than for the Upstream Lighting programs. The main things the majority of these programs appear to have in common are as follows:

- *For the most part they do not involve retail distribution channels.* Instead, CFLs may be acquired through wholesale routes, purchased in bulk by program sponsors, or installed by contractors. Given that many of the CFL-related market effects that have been hypothesized and documented in other states revolve around changes in retail practices, this is an important distinction from a market effects perspective.

- *For the most part they appear to target broader markets than just CFLs, with CFLs representing a small subset of the wide range of products involved.* One implication of this is that it is unclear whether we should expect any market effects associated with CFLs in these programs to revolve around CFLs alone, or to involve broader combinations of measures and practices. The relatively limited non-residential market effects research that has been performed in other states has often found that those market effects that can be documented revolve around complex changes in the behavior of vendors who are involved in a wide range of measures, such as engineers, lighting designers, and distributors. This suggests that it may make more sense to study market effects from these programs through a separate study.

- *For the most part they appear to be viewed by stakeholders as being primarily resource acquisition programs, with few systematic claims being made for market effects.*

[5] In fact, as a form of participant spillover, the issue may already be getting addressed in some impact evaluations.

For all of these reasons, for the purposes of this study we recommend that research into the non-residential non-retail CFL market be limited to:

- Using the scoping study to improve our understanding of how CFLs fit into broader non-residential energy efficiency markets, and possible CFL-specific market effects.

- Interviews with supply-side actors aimed at gaining some initial, qualitative insights into possible CFL-related market effects.

- As needed, research intended to clarify the total volume of non-retail-based CFL sales in California and elsewhere, to support the primary effort to quantify savings from retail-based market effects.[6]

Summary. To summarize, we propose that the central focus of the study be on the retail market for CFLs in California, and the effects of the Upstream Lighting programs on that market. However, we recommend that opportunistic and exploratory research also be performed to gain insights into the possible market effects of non-retail programs in both the residential and non-residential sectors. We also recommend that research be performed as necessary to understand the ways in which non-retail programs may be indirectly influencing the retail market.

B. Development of Market and Program Theories

Another key component of the scoping study will be the development of market and program theories for CFLs. In the words of the protocols:

> The assessment, refinement, and/or development of a market theory with logic models are key activities of the scoping study. The *2001 Framework Study* and the *Evaluation Framework* both address the value and process of developing a program or market theory. The evaluation contractor will need to articulate a market theory in order to proceed with baseline measurement for market effects evaluation. At a minimum, this market theory shall describe how the market operates and articulate market assumptions and associated research questions. This must be done at a level of detail sufficient to develop data collection instruments for baseline measurement. If the assessment includes programs that are designed specifically to change the way a market operates the program theory should also be consistent with and embedded in the theory of how the market operates. (p. 150.)

A later passage details what should be included in a market theory and logic model:

> Articulate market theory and, if reasonable, develop graphical model of market theory. Market theory should include market operations and conditions, and changes occurring in the market… Develop multiple program theory and logic models for those programs intervening in the market. Integrate the market theory and program theory/logic models to examine

[6] As discussed later in this plan, some quasi-experimental sales data analyses may require that non-residential and non-retail sales be stripped out in order to avoid comparing apples to oranges.

> external and programmatic influences, assumptions about changes in the market and associated research questions. Theories and logic models should be generated through interviews or workshops with program staff from each of the programs and a sample of a wide variety of market actors. Use a literature review and other studies of these markets and iteration with program staff to ensure thoroughness in measuring the critical parameters for both market development from external influences and market effects. (p. 151.)

Articulating a market theory seems particularly critical in the case of CFLs. The CFL market appears to have entered a period of rapid change of late, with enormous growth in U.S. sales. At the same time, in many parts of the country CFLs show some indications of taking on iconic status as tools that individuals can use to help fight global warming. It would be difficult to understand the market effects of California's CFL programs without a solid understanding of these trends, their causes and their effects.

The protocols appear to require the development of detailed *program* theories only when the programs involved have been designed specifically to change the way a market operates. Our understanding of the various California programs targeting CFLs is that for the most part the CPUC views them as primarily resource acquisition programs, rather than programs intended specifically to change markets. However, we have reasons for believing that the development of detailed program theories laying out how the programs might be influencing CFL markets is nonetheless a critical component of the study. As noted above, in the case of the Upstream Lighting programs, many stakeholders appear to view these programs as being focused as much on market transformation as on resource acquisition, suggesting that it is important to elucidate the manner in which these stakeholders anticipate that the programs will generate market effects. Furthermore, the discussion in the preceding section seems to make clear that non-retail programs in both sectors have at least some potential to generate market effects, suggesting that to ignore them could give us an oversimplified picture.

At the same time, the network of programs promoting CFLs in California is large and complex, and developing specific program theories for all of them would quickly grow into an unmanageable endeavor.

For the purposes of this study, we propose the following approach:

1. Develop a market theory for CFLs, focusing primarily on the retail market, but also giving some attention to non-retail distribution channels.

2. Develop a program theory for the Upstream Lighting programs, and integrate or embed this within the market theory, to show how the effects of the programs are viewed as interacting with the current operations and conditions of the market, and ongoing changes in the market.

3. For each of the other two categories of programs discussed above (Residential and Non-Residential Non-Retail programs) develop generalized program theories

elucidating how the programs might be collectively interacting with and influencing the CFL market. Again, integrate or embed these within the market theory.[7]

The development of detailed program theories must await the full scoping study. However, the design of the Upstream Lighting programs, along with program theories and evaluation evidence for similar programs from other states, suggest a few possible hypotheses:

- Upstream financial incentives have increased both the volume and the diversity of CFLs produced by manufacturers and shipped to California.
- Increased volume has generated economies of scale in the production of CFLs, leading to further decreases in effective prices.
- These reductions in the effective price of CFLs have induced many non-users to try the technology, increasing their awareness and acceptance of it, thus leading to further purchases.
- Program-induced increases in consumer demand have led to changes in retailer stocking and promotional activities, above and beyond the changes needed to participate in the programs.
- The popularization of CFLs resulting from the above changes has led to important changes in corporate behavior, such as Walmart's well-publicized campaign to sell 100 million CFLs annually.

C. Literature Review

A third important component of the scoping study will be a review of the existing literature on market effects from CFL programs, with an eye toward lessons learned, methods that are worth replicating, and any available data that may usefully be transferred to the California context.[8] Core to this review, to the extent they can be obtained, will be CFL market effects studies that have been performed in recent years in Massachusetts, New York, Vermont, Wisconsin, Long Island, and British Colombia.[9]

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[7] In developing program theories, it may prove beneficial to segment programs in more detail than the three categories discussed above. For example, another program category that may be worth breaking out separately is marketing and outreach efforts. However, we leave resolution of this issue to the full scoping study.

[8] While this component is listed third for purposes of exposition, chronologically it would probably be preferable to perform it first, so that it can inform the rest of the scoping study.

[9] Note that a broader review of the literature on market effects from energy efficiency programs is already planned as a separate CIEE project, so that effort is not repeated here.

STEP 2: ANALYSIS OF MARKET EVOLUTION

Because market effects generally occur slowly over time, understanding the long-term evolution of the market is critical to any market effects evaluation. Ideally, this is achieved through ongoing evaluation efforts over the course of many years. However, in the current study we do not have this luxury. Instead we are making a one-shot effort to develop our best understanding of the long-term market effects of California's CFL programs. As a result, we anticipate that it will be necessary to resort to a wide range of existing data sources to do the best job we can of reconstructing the evolution of the CFL market, both within and beyond California. A central focus of this effort will be attempting to reconstruct historic trends in both actual and baseline sales of CFLs in California. However, trends in other key variables such as consumer awareness and attitudes, prices, and retailer stocking behavior are also of interest.

We recognize that developing an accurate picture of long-term trends in these variables will be challenging. However, there is a wide range of existing data sources that may prove useful, including the following:

- *California Residential Lighting Market Share Tracking Study*. Since 2000, California has been performing an ongoing study of the market share of CFLs, and related market indicators. In recent years the representativeness of this ongoing study has been called increasingly into question, as important retail channels have dropped out. However, particularly for the earlier years, we anticipate that this will still be a valuable data source for helping to reconstruct the evolution of the CFL market in California.

- *CFL market effects studies in other states.* The numerous CFL market effects studies performed recently in other states seem likely to provide useful insights into the long-term evolution of the CFL market in California and elsewhere. For example, in some cases these studies collected baseline data from other regions that may be useful in reconstructing baseline trends in California. In other cases the studies included interviews with major market players that may provide transferable indications of nationwide market conditions at the time the interviews were performed. One objective of the literature review discussed earlier will be to determine what other useful data can be derived from these earlier studies.

- *Energy Star qualifying CFL sales data to be provided by EPA*. In the fall of 2007, the EPA announced its intent to begin releasing nation-wide, quarterly data on Energy Star CFL sales at the state- and standard metropolitan area-levels. In December the EPA released the first installment of this data, covering the first quarter of 2007. In its initial form, the data released covers only qualifying CFLs, and includes only a limited set of national retailers. However, at the time of this writing, discussions were proceeding regarding what kinds of changes would make the data more useful for the purpose of understanding the market effects of regional support programs. While this is still very much an evolving issue, it seems likely that this data will prove useful for at least some aspects of the current study.

- *EPA's annual national Energy Star awareness study, and associated California over-samples*. For the past several years, the EPA has performed an annual study of awareness, attitudes, and participation in Energy Star programs across the U.S. CFLs have not been a specific focus of these studies, but have been addressed in passing. While the overall objective has been to compare trends in awareness in areas with low, medium, and high levels of Energy Star support programming, individual states and regions have also had the opportunity to sponsor over-samples of their territories. Our understanding is that a number of California over-samples from these studies are available. We believe this may be another useful data source in reconstructing long-term trends in CFL markets.

- *Other sources*. Other existing data sources that may be useful in reconstructing CFL market trends include: past saturation studies; the Database for Energy Efficiency Resources (DEER); utility process evaluations and market assessment studies; and research performed during and after the California energy crisis to understand the effects of the crisis and programming developed in response to it.

STEP 3: ANALYSIS OF MARKET EFFECTS

While the analysis of market evolution described above is expected to contribute to the assessment of market effects from California's CFL programs, the mainstay of this effort will be a quasi-experimental comparison of current actual and baseline CFL sales patterns, buttressed by interviews with manufacturers, retailers, and consumers regarding the market effects of the programs. By "baseline" we mean a hypothetical projection of what CFL sales patterns would have looked like in the complete absence of any programs promoting CFLs in California, either now or at any time in the past.[10]

A fair amount of the data needed to support this effort is already being collected as part of the Residential Retrofit Impact Evaluation Plan. However, because the Impact Evaluation Plan is focused on measuring direct program impacts, the data collection efforts described in the Impact Evaluation Plan will need to be expanded and, in some cases, supplemented with separate data sources.

As with the analysis of market evolution, a wide range of market indicators other than sales are also of potential interest. Development of the specific indicators to be measured must await the completion of the scoping study. However, they are likely to include measures of consumer awareness, attitudes, and behavior; retailer stocking, promotional, and pricing practices; and manufacturers' business strategies. Our primary objective in developing and measuring these non-sales market indicators is to build a convincing case

[10] It is important to keep in mind that the word "baseline" has various other meanings in energy efficiency evaluation, none of which is intended here. One alternative meaning is the market conditions in force at the beginning of a period of public intervention. Another meaning, used in the context of M&V, refers to the most likely alternative equipment or practice to the one that was actually adopted. Despite these alternative meanings of the work, we use the term "baseline" for the no-program scenario because we believe this has become a convention in the field of market effects research.

regarding CFL market effects by assessing whether or not the indicators have changed in a manner consistent with what would be predicted by the program theory.

The core of the effort to analyze market effects will consist of a quasi-experimental comparison of current actual and baseline CFL sales patterns in California, with the baseline being based on current CFL sales patterns in a number of alternative comparison areas, as discussed in more detail below. Underlying this approach is the assumption that one or more comparison areas can be found that are reasonably representative of what would be happening in California in the absence of public purpose CFL programs. In an ideal world, we would use a more powerful quasi-experimental design, such as a pre-post/test-comparison design, under which we would compare the change in CFL sales between two periods for the test versus the comparison area. However, as discussed above, because this is primarily a retrospective study, for the most part we do not have the luxury of collecting detailed pre-program data. As a result, it will be necessary to take a number of steps to buttress the validity of the results.

Key to the effort to strengthen validity will be the use of multiple methods both to analyze current actual retail CFL sales patterns in California and to develop comparison areas.

A. Analysis of Current Actual Retail CFL Sales Patterns in California

The Impact Evaluation Plan already encompasses a significant effort to estimate current residential CFL sales in California, using large-scale RDD surveys followed by on-sites, as well as retailer and manufacturer interviews. We believe these activities will go a long way toward meeting this objective, but for the purposes of the market effects study we recommend that they be expanded in several ways.

First, we recommend that retailer interviews be expanded to include site visits, shelf and stocking studies, and analysis of retailer sales records. All of these methods have been used to good effect in CFL market effects studies in other states. For example, a recent study in Wisconsin succeeded in collecting detailed CFL sales records from virtually all major retailers in Wisconsin and a comparison state, Michigan. However, much effort was needed to obtain and analyze this data. Similarly, a recent study in Massachusetts used analysis of current CFL shelf space and stocking, combined with detailed questions to retailers about the frequency with which they restock, to estimate current CFL sales patterns. With each of these methods, significant effort will be needed to develop representative samples from the overall universe of retailers selling CFLs. At the end of the day, these methods will produce retailer-based estimates of current CFL sales patterns that can be triangulated with the consumer-based estimates to be produced by the RDD surveys and on-sites that are already planned.

Second, in both the retailer-based and the consumer-based efforts, we believe it will be important to focus not only on estimating total current CFL sales, but also on characterizing specific CFL sales *patterns*. For example, which specific kinds of out-of-program CFLs are being purchased, who is purchasing them, and where are they being

purchased? Answers to these questions are likely to be invaluable in constructing a solid case regarding market effects.[11]

B. Analysis of Baseline Retail CFL Sales Patterns in California.

The Impact Evaluation Plan already includes an effort to estimate baseline CFL sales in California by using the rest of the U.S., minus other states with public purpose CFL programs, as a comparison area. Under this approach an estimate is first developed of total CFL sales in the U.S. outside of California, and then secondary data sources are used to systematically strip out sales in other states with programs. This is a commonly used approach for CFL market effects studies, and we believe it is entirely appropriate for California. However, it does pose significant threats to validity, including significant, unavoidable uncertainties surrounding a number of the key parameters, and obvious questions regarding the comparability of California and those portions of the U.S. without CFL programs. Furthermore, this approach will not produce many insights into baseline CFL sales *patterns,* which, as discussed above, we believe will be critical in building a solid case regarding market effects. As a result, we believe this approach to estimating baseline CFL sales patterns in California needs to be buttressed.

The approach we propose to use to strengthen the evidence regarding baseline CFL sales patterns is the collection of detailed sales data for one or more specific states, regions, and/or retail chains. We can envision a variety of approaches to the development of such targeted comparison areas. One approach, used in Wisconsin as noted above, would be to look at an entire state or states, using either retailer sales data or an RDD survey. Another approach that we believe might hold promise would be to focus on a particular retail chain or sets of chains, and compare sales patterns in a set of carefully matched stores in and out of California.[12] Whichever approaches are used, as with the estimation of actual CFL sales patterns, we believe it will be as important to characterize baseline CFL sales *patterns* as total CFL *sales*. Further, whichever approaches are used, triangulation will be used to integrate the results of the "entire country minus program states" analysis with those from the targeted comparison area approach, and develop final estimates of baseline CFL sales patterns in California.

We believe that this combined approach, employing both the broad-based look at the entire country ex-California that is already called for in the Impact Evaluation Plan and a

[11] For example, the recent Massachusetts study noted above found a huge increase between 2005 and 2006 in the total number of out-of-program CFLs sold. The study showed that the bulk of out-of-program sales were occurring at the same stores at which large numbers of in-program units were being sold, suggesting, in combination with other results, that the increase in out-of-program sales was due in part to changes in retailer practices.

[12] One potential advantage of this approach is that, depending on the nature of the sales records maintained by the particular chains being studied, and the cooperativeness of the chains, it may be possible to collect trend data covering a number of past years. Another potential advantage is that it would allow for comparisons with stores in multiple states outside of California, helping to sort out the confounding effects of unique events and conditions in individual states.

more detailed look at one or more targeted comparison areas, provides the best likelihood of getting a reliable picture of baseline sales patterns in California.

C. Analysis of Market Effects From Non-Retail Programs

As discussed in the scoping study section of this plan, the primary focus of this study is to be on market effects associated with retail distribution of CFLs, and the programs that target this particular market. However, there are two reasons why it is important to analyze market effects from non-retail programs. First, the study is also intended to produce *initial insights* into any market effects associated with these programs. Second, in some cases the quasi-experimental methods discussed above may require that non-retail CFL sales be stripped out of either the actual or the baseline total in order to ensure that we are not comparing apples to oranges.[13] Our primary focus in this section is on the former issue. While the latter issue, of ensuring that quasi-experimental analyses of retail sales are comparing apples with applies, is important, we believe it is best handled as a refinement once there is consensus on exactly what quasi-experimental approaches are to be used.

In the remainder of this section, we discuss the research activities that may be needed for Non-Retail Residential and Non-Retail Non-Residential programs, respectively.

Non-Retail Residential. As discussed in the scoping study section, we believe there are three issues that we need to improve our understanding of regarding Non-Retail Residential CFL programs. These issues and the research activities that we believe are likely to be needed to address them are discussed below.

1. *To what extent are the administrators of these programs obtaining CFLs through retail channels?* This issue can probably be clarified in the scoping study through interviews with program staff and a review of program descriptions. If the programs prove to have significant retail connections, then the study will need to develop reliable estimates of the total retail sales associated with the programs, in order to help understand the role these sales are playing in the overall retail market.

2. *To what extent are these programs contributing to the retail demand for CFLs by introducing consumers to the technology for the first time?* As discussed in the scoping study section, this issue can be researched through opportunistic additions to participant surveys in impact and process evaluations.

3. *Are there other unique market effects that might be attributed to these programs?* The research needed to answer this question cannot be determined until the full scoping study has been completed.

[13] For example, depending on how it is implemented, the RDD/on-site approach discussed in the Impact Evaluation Plan may result in sales counts that include residential CFLs not acquired through retail distribution channels. Similarly, the "U.S. minus program states" baseline approach typically begins with an estimate of national CFL sales that includes all CFLs, including non-residential ones that are not for the most part distributed through retail stores, and residential CFLs not acquired through retail stores.

Non-Retail Non-Residential. A primary market effect that has often been hypothesized for non-residential non-retail CFL programs is changes in awareness, attitudes, or organizational practices after participants gain experience with the technology. However, this is a form of participant spillover and is thus covered by the evaluation studies, obviating the need to address it here.

At the end of the day, we believe the only steps that need to be taken in order to gain some initial insights into CFL market effects outside of retail distribution channels are likely to be the following:

- Initial characterization of the market, performed as part of the scoping study.
- Interviews with non-residential supply-side vendors such as lighting contractors, designers and distributors, architects and engineers aimed at further characterizing the non-residential CFL market, estimating total non-residential non-retail sales, and eliciting self-reports regarding potential market effects.
- Incorporating issues involving non-retail distribution into the interviews that are already planned with manufacturers and retailers.

D. Interviews With Retailers, Manufacturers, and Other Supply-Side Players Regarding the Cumulative Effects of California's CFL Programs

The activities described above should produce a wealth of insights into how CFL sales patterns and trends have differed between California and other areas, which can be translated in a fairly straightforward fashion into estimates of total savings from market effects. However, the case regarding market effects from CFL programs can be greatly strengthened by integrating the sales data analyses with depth interview results from manufacturers and retailers. These interviews will need to:

- Carefully target interviews to enhance the likelihood that respondents will be well informed regarding CFL market developments.

- Focus on specific mechanisms for market effects that have been posited under the program theories.

- Recognize up front that manufacturers and retailers may well have a business interest in representing the market effects of CFL programs in one manner or another, and approach the interviews in a manner that minimizes the potential resulting bias.

- Probe for any perceived differences in the market effects of different programs, distinguishing primarily between the Upstream Lighting programs and all other programs.

- For major players, include multiple levels within the corporate hierarchy, reflecting the facts that: (1) programs may change business practices in different

ways at different levels within the organization, and (2) individuals at different levels within the hierarchy may have different sources of information regarding market conditions.

The Residential Retrofit Impact Evaluation Plan already calls for interviews with participating manufacturers and retailers. However, for the purposes of the market effects study, it will be necessary both to add interviews with non-participating firms, and to expand the participant interviews to address market effects. It might also be necessary to talk to more levels within the corporate hierarchy than would be contacted for evaluation purposes alone. Lastly, depth interviews with additional players beyond manufacturers and retailers are likely to be needed to fully understand the current state of the CFL market.

E. Leveraging the Planned Econometric Analysis of Pricing Effects

The Residential Retrofit Impact Evaluation Plan includes an econometric analysis that incorporates linked models of the effects of public purpose programs on CFL prices, and of consumer behavior under alternative program scenarios, including different prices. A primary data source for this analysis is intercept interviews with purchasers or both subsidized and unsubsidized CFLs.[14] While the details of this analysis are not yet clear, it may be possible to leverage it for the purposes of the market effects study. Reductions in prices stemming from the large volume of in-program sales have long been hypothesized as one of the key market effects of CFLs programs, and evaluations in other states have produced some evidence to support these hypotheses. Thus any analysis that can shed light on the longer-term effects of California's programs on CFL prices, and the response of consumers to these effects, would be invaluable in helping to understand market effects.

It is not spelled out in the Impact Evaluation Plan, but given that the primary focus of that plan is on analyzing the direct effects of the 2006-2008 programs, we assume that the intent in analyzing pricing effects is to focus on program-induced price reductions over the course of that 3-year period. In order to be useful from a market effects perspective, the time frame for the analysis of pricing effects would need to be broadened significantly. Our impression is that this might be accomplishable at limited incremental cost and without interfering with the existing objectives of the analysis.[15]

The methods to be used to estimate the effects of California's programs on CFL prices are not spelled out in the Impact Evaluation Plan. From a market effects perspective, the

[14] The Impact Evaluation Plan does not appear to explicitly state that both subsidized and unsubsidized CFLs will be included in the analysis, but this appears to be implied by the fact that both participating and non-participating retailers are to be included in the intercept interviews discussed in this paragraph.

[15] One complication that may need to be dealt with here is the potential for program-induced changes in consumer price elasticities. One of the objectives of efficiency programs is to provide customers with the knowledge that they have options to decrease their operating costs. One effect of this educational effort may be to increase their responsiveness to price signals for lighting products. We are indebted to Lori Megdal for this comment.

defensibility of these methods is critical. The pricing effects of CFL programs are a complex issue, for a number of reasons. First, over the past 10 years or so, CFL prices have fallen from the vicinity of $25 apiece to their current range (unsubsidized) of $1.50-$5.00. This is a huge decline, but a slow one, and one which has almost certainly had multiple causes. Furthermore, it is likely that there have been reciprocal effects, with California's programs helping to cause price reductions throughout the U.S., and nation-wide price reductions in turn influencing the marketplace in California. Lastly, given the geographic range and length of time over which price reductions have occurred, any one market observer is likely to have a limited perspective on just what has happened. To be defensible, all these methodological challenges will have to be surmounted. We recommend that the Market Effects and Residential Retrofit teams confer on this issue.

F. Leveraging Marketing and Outreach Evaluation Activities

The draft Statewide Marketing & Outreach (M&O) Impact Evaluation Plan contains a number of activities that may prove useful in helping to further clarify the market effects of California's CFL programs. In general, our understanding is that the primary objective of these activities is to assess the attitudinal and behavioral impacts of the statewide umbrella marketing campaigns that support California's 2006-2008 energy efficiency programs, and to gain some understanding of the effects of the marketing efforts associated with individual programs.

An overarching issue that must be grappled with in considering what the M&O evaluation activities might be able to contribute to the current study is the time frame being studied. In a nutshell, the focus of the M&O evaluation is on the effects of marketing efforts occurring from 2006 through 2008, while the focus of the current study is on market effects that manifest themselves in 2006 through 2008, but are likely to have been caused by the joint effect of many years of programming, extending well before 2006. As a result, the applicability of the results of the M&O evaluation to the current study is not straightforward.

Despite this divergence in time frames, we believe the M&O evaluation activities may have much to contribute to the current study. As noted earlier, evidence from CFL market effects studies in other states suggests that the CFL market is currently changing very rapidly, with an enormous increase in nationwide sales beginning in 2006 and continuing as of this writing. It seems fairly clear from these other market effects studies that state-level programs have played some role in helping to induce this change. However, what seems less clear at this point is the role that marketing efforts have played in helping to generate market effects, above and beyond the straightforward effects of the large volume of CFLs that have been sold through the programs.[16] Equally unclear is

[16] We recognize that marketing efforts may well have played a significant role in causing the large number of in-program CFLs to be sold in the first place, and that this is an important researchable issue for the M&O evaluation. However, from a market effects perspective, the large volume of in-program CFLs is an established fact, and the interesting question that remains is whether marketing efforts have generated significant market effects in their own right, above and beyond the market effects stemming directly from the increase in CFL sales volume induced by public purpose programs.

whether, if umbrella marketing efforts have made a significant contribution, this contribution continues to this day, as opposed to the changes having become self-sustaining. It is in helping to provide qualitative answers to questions like these that we believe the M&O evaluation activities can be most useful to the current study.

The following is a brief discussion of some key components of the M&O evaluation that we believe may be useful to the current study, given effective coordination.

Internet Panel Surveys and Structural Equation Modeling. The M&O plan calls for: (1) identifying 1,000 purchasers per quarter of a small set of key targeted energy efficiency measures or their standard efficiency alternatives, with the targeted measures potentially to include CFLs; (2) interviewing these purchasers via an internet panel; and (3) using structural equation modeling to understand the behavioral and other impacts of public purpose energy efficiency marketing efforts. Our understanding is that the primary focus of this effort is to be on understanding the effects of umbrella marketing, but program-specific marketing efforts would also be represented in the model. If this is correct, we believe this analysis could make a significant contribution to understanding the key market effects-related questions posed above. We therefore recommend that CFLs be adopted as one of the targeted measures as suggested in the draft M&O evaluation plan, and that the M&O and Market Effects teams confer on the specific modeling steps that might enhance the usefulness of the results from a market effects perspective.

General Population Tracking Survey. The M&O plan also proposes to conduct a large-scale RDD survey to track changes in awareness, attitudes and behavior in California and a comparison state, noting in a footnote that:

> …we cannot be assured that the SEM approach will work when we attempt to fit the model… Having a comparison group provides us with another set of data from which we can provide another measurement to compare and contrast with the SEM. We see including a comparison group as the most responsible way to ensure reliable results.

As the fundamental objective of this work is quite similar to that described immediately above, we believe this activity too could be useful in answering the key market effects questions we have posed regarding the marketing of CFLs. We therefore recommend that the tracking survey include questions specific to CFLs, and that the M&O and Market Effects teams confer on this component of the effort. It might also make sense to coordinate the comparison state to be used for the M&O study with the comparison areas to be used for the market effects study, so the results from the two comparative analyses can be synthesized.

Research With Participants in Resource Acquisition Programs, and Market Specific Data Collection Efforts. Finally, the M&O plan sets aside funds to perform a variety of research efforts targeted at individual resource programs, including surveys with participants, point-of-purchase intercepts, and contractor interviews. If CFLs are to be targeted here, we believe these activities, too, could be useful to the market effects study.
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STEP 4: ASSESSMENT OF ATTRIBUTION

This step will involve sifting through all the evidence developed by the evaluation to make a case regarding the nature of the market effects produced by California's CFL programs, if any, and the total number of CFL sales induced by these market effects that occurred in the years 2006-2008. Conclusions regarding these issues will be based on:

- Whether comparisons between estimates of actual and baseline CFL sales in California consistently show significant differences.
- Whether supply-side informants attribute market effects to the programs, and if so, what kind.
- Whether the results of the attempt to reconstruct the evolution of the CFL market within and beyond California are suggestive of long-term market effects.
- Whether differences in the specific *pattern* of CFL sales under the actual and baseline scenarios show differences that are suggestive of market effects.
- Whether the econometric analysis shows that the programs have had long-term pricing effects, and that consumers have responded to these effects.
- Whether the analysis of CFL marketing efforts conducted as part of the M&O evaluation show significant marketing impacts on sales, above and beyond the effects of specific CFL programs.

Above all, conclusions regarding the extent of the market effects that can be attributed to California's CFL programs will be based on the extent to which all of the above findings are consistent with one another and with the program theory developed as part of Task 1. At the end of the day, attribution in this study will be based on a preponderance of evidence approach, under which the researcher attempts to 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.

STEP 5: ESTIMATION OF NET ENERGY AND DEMAND SAVINGS

In this task, the results of the analysis of market effects discussed in Steps 3 and 4 will be converted into a stream of estimated savings. Initial estimates of savings from market effects will be based upon the difference between total actual and baseline CFL sales, with triangulation among the alternative estimates of these two quantities, and adjustments as appropriate based on other evaluation findings discussed above.

It is important at the outset to understand the basic nature of the savings estimates produced using this method, as it is the source of several analytic complications discussed in this section. Fundamentally, because we are comparing actual CFL sales with a hypothetical estimate of the level of sales that would exist in the historical absence of any

CFL programs, the difference between actual and baseline CFL sales represents the *current, total, cumulative effects of all programs that have ever been run in California.* As such, it does not differentiate between impacts induced now versus in the past, between different categories of current impacts such as direct program impacts or spillover, or between impacts induced by one program versus another.

Backing Out Direct and Participant Spillover Savings. Our ultimate objective in this step of the study is to estimate savings from program effects in years 2006-2008 which are not covered in the direct and participant spillover effects being measured by the impact evaluation studies (i.e., non-participant spillover). Because the methods described above will produce estimates of *total* savings from California's CFL programs, in order to reach this objective we need to subtract from our initial savings estimate all savings estimates produced in the 2006-2008 impact evaluations that:

1. Are clearly associated with retail sales of CFLs.
2. Are program induced.
3. Are not counted in other impact evaluation results.

In mathematical terms:

Non-Participant Spillover = Total Program-Induced Savings – Direct Savings – Participant Spillover

One example of a set of savings estimates that can clearly be expected to meet the three prerequisites above is the direct and participant spillover savings produced by the Upstream Lighting programs and estimated as part of the Residential Retrofit Impact Evaluation study. As such, these savings will need to be subtracted.

Beyond this, the issue grows murkier. For example, there are tentative plans for the Marketing and Outreach evaluation to estimate total savings from CFL purchases that are caused in whole or in part by statewide marketing efforts. To the extent that this is done, the resulting savings estimates would appear to meet the first and second of the three criteria above. However, because CFL sales caused in part by statewide marketing efforts can also be caused in part by resource programs such as the Upstream Lighting programs, it is unclear whether they will meet the third criterion.

We anticipate that the different sources of direct and participant spillover savings that will need to be subtracted should become clearer as the impact evaluations progress. However, we recommend that this issue be analyzed further in the scoping study.[17]

Dealing With the Timing of Program Influence. A second complication is that we must decide whether what we want to count is all non-participant spillover *realized* in 2006-

[17] Two other examples of savings that might need to be subtracted are those resulting from municipal programs and any savings associated with non-retail programs that are obtaining CFLs through retail channels.

2008, or only that which was also *caused* in these years.[18] Because we are dealing with a cumulative savings estimate, it is very likely that some of the observed impacts will have been caused due to efforts prior to 2006, as a result of California's long history of programs promoting CFLs. In other words, it is likely that, even if the 2006-2008 programs had never been run, CFL sales would still be higher than the baseline, due to the lingering effects of pre-2006 programs.

To the extent that our objective is to estimate non-participant spillover both *caused* and *realized* between 2006 and 2008, another step would be needed to estimate what fraction of the observed savings was caused by the current cycle of programs. Such an estimate would probably have to be subjective in nature, adding uncertainty to the results.[19] We are not aware of any formal CPUC policy regarding whether impacts must have been not only realized but also caused in the current program cycle to be counted. However, our understanding is that for the purposes of this study, the CPUC staff prefers that we attempt to *quantify* the additional savings that were realized in 2006-2008, but seek only to *gain qualitative insights* into how much of these savings were also caused in 2006-2008.

Extrapolating From the Current Year to the Overall 2006-2008 Period. Because the primary focus of data collection activities for this study will be on CFL sales over the most recent year or so, in order to derive savings estimates for the period 2006-2008, it may be necessary to extrapolate the estimates of actual and baseline sales backward to the beginning of 2006.

Capturing Possible Savings From California's Effects on the National CFL Market. A final complication that may need to be confronted in this step is the complexity of some of the specific mechanisms for market effects that have been hypothesized for CFL programs. For example, as discussed earlier, many observers believe that state-level support programs have jointly produced sales volumes that resulted in national or international economies of scale, generating price reductions that fed back to influence the market conditions for CFLs in both sponsor and non-sponsor states. To the extent that this is true, it will not be accurately reflected in the difference between actual and baseline CFL sales, and may in fact distort estimates of savings from other market effects. Alternative savings estimation methods may thus need to be developed for this particular market effect.

Dealing With Uncertainty. As discussed at the beginning of this plan, a key purpose of this study is to help establish whether savings from market effects can be quantified with sufficient reliability to be treated as a resource by the CPUC. Given this objective, a key

[18] A concrete example of the difference between these two terms would be lighting a stick of dynamite with a long fuse. The resulting explosion would be *caused* at the time the fuse was lit, but *realized* at the time of the explosion.

[19] However, if it proves possible to retroactively develop meaningful estimates of actual and baseline CFL sales as of 2005, it might be possible to use these estimates to estimate total market effects savings as of that year. Subtracting this figure from the estimate as of 2008 would then yield an estimate of market effects savings caused between 2006-2008.

component of this step will be an effort to understand and manage the uncertainty surrounding estimates of savings from CFL market effects. Specifically:

- *The uncertainty surrounding final estimates of savings from market effects will be systematically analyzed*, using either Monte Carlo simulations or other appropriate methods.

- *Different types of market effects may be handled differently in the process of estimating net energy savings from market effects*. For example, the uncertainty surrounding estimates of savings from the feedback effects between California's programs and nationwide CFL prices may be qualitatively greater than that for other types of market effects. Thus it may be appropriate to keep this and the savings estimates from other, more straightforward types of market effects separate in the analysis.

- *Based on the results of the study, recommendations will be made regarding whether and how savings credit for CFL market effects might reliably be established in the next program cycle*. For example, one approach that has been used in other jurisdictions is to develop a range for estimated savings from market effects and, in order to be conservative, credit program administrators with the bottom of the range. However, other approaches are also possible.

Finally, as part of this task, the effects of any savings from market effects documented by this evaluation on the cost-effectiveness of California's CFL programs will be analyzed.

STEP 6: ASSESSMENT OF SUSTAINABILITY

As defined by the Protocols, sustainability refers to the extent to which the observed market effects can be expected to last into the future. Thus defined, it would appear that analyzing the sustainability of any CFL market effects documented by this study is not necessarily essential to support either of the two primary objectives of the study, estimating savings from market effects for the years 2006-2008, and clarifying the extent to which savings from market effects can be quantified with sufficient reliability to be viewed as a resource. It is not needed to support the first of these objectives because we do not need to know about future savings in order to estimate savings for the years 2006-2008. It is not needed to support the second of the objectives because our understanding is that the CPUC's primary focus is on understanding current rather than future savings.

Nonetheless, we believe that it is important to include an assessment of the sustainability of market effects in this study, and our understanding is that the CPUC staff is interested in pursuing such an assessment. Our primary rationale is the rapid change that the CFL market appears to be undergoing, suggesting that gaining an understanding of the sustainability of any observed market effects could be very helpful in shaping the direction of future programming efforts in this market. Particularly critical is the question of whether the huge surge in CFL sales nationally since 2006 would be likely to sustain itself if regional support programs were withdrawn or scaled back.

If a sustainability analysis is included, we recommend that a primary focus be, in the words of the Protocols,

> Identifying changes in market structure and operations, and how the changed market contains mechanisms to sustain them. This could include examining profitability analyses for important support businesses or business operations and how these are maintained without continued program intervention.

Recent market effects evaluation work in Massachusetts provides a potential model for applying the general approach described above to the CFL market. The Massachusetts work draws on a 2000 paper by David Hewitt[20] that proposed answering the following questions in order to help assess the extent to which a market has been transformed:

- 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?

The Massachusetts evaluation work brings to bear a wide range of data sources deployed for other purposes to answer the above questions. Implementing this approach in the current study would thus impose few incremental data collection costs.

To the extent that the results of this step suggest that sustainability has not yet been reached, two additional questions that will need to be addressed are:

- How will we know when the CFL market is self-sustaining?
- What further programming efforts, and how much more time, will be needed in order to make the CFL market self-sustaining?

SCHEDULE

The development of a detailed schedule for this study must await the completion of the scoping study. In general, however, because of the extensive overlaps with the Upstream Lighting component of the Residential Retrofit evaluation study, we envision the two studies being performed on roughly parallel tracks. At the same time, our understanding is that the CPUC would like to have results from the market effects studies as soon as possible in order to inform its strategic planning efforts in a timely manner, and a final report for the Residential Retrofit study is not scheduled until March, 2010.

[20] 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.

It appears that most of the individual data collection tasks that the market effects study is intended to draw on would be completed by Spring of 2009, suggesting that it may be possible to have a final report on the market effects study by Summer, 2009. We recommend that the possibility of accelerating the final report from this schedule be explored once the study scope is established in more detail.

Given the CPUC's need for timely results, we propose that an interim report also be provided, perhaps in the late summer or early fall of 2008. The interim report would incorporate all results to date, and include initial technical and policy recommendations to the extent possible.