MARKET EFFECTS SUMMARY STUDY

FINAL REPORT

Volume 1

Submitted to:

Noah Horowitz, Project Manager
California Demand Side Measurement Advisory Committee

Submitted by:

Jane S. Peters, Ph.D.
Research Into Action, Inc.

Bruce Mast
Patrice Ignelzi
Pacific Consulting Services

Lori M. Megdal, Ph.D.
Megdal & Associates

December 15, 1998

ACKNOWLEDGEMENTS

The Research Into Action team would like to thank Noah Horowitz of NRDC who, as project manager, provided guidance and support at all the appropriate times. We would also like to thank the Market Effects Subcommittee members for their support and feedback throughout the project. And of course, without the 15 Market Effects Study authors and the Scoping Study authors (Joe Eto, Jeff Schlegel, and Ralph Prahl) this project could not have been done. The Scoping Study and the 15 Market Effects Studies were well executed and a pleasure to review.

TABLE OF CONTENTS

VOLUME 1: SUMMARY STUDY

VOLUME 2: PROGRAM STUDIES

APPENDIX B

VOLUME 3: APPENDICES C AND D

APPENDIX C

APPENDIX D

SCE HIGH QUALITY COMPACT FLUORESCENT LAMP STUDY

STUDY OBJECTIVES AND PROGRAM DESCRIPTION

COMPARISON WITH SCOPING STUDY FRAMEWORK

STRENGTHS AND WEAKNESSES OF METHODOLOGIES

STRENGTHS AND WEAKNESSES OF DATA COLLECTION PROCEDURES

SUSTAINABILITY AND LASTINGNESS

OPPORTUNITIES FOR USE OF THE MARKET EFFECTS EVALUATION

EXECUTIVE SUMMARY

The Market Effects Subcommittee of the California Demand Side Advisory Committee (CADMAC) contracted with Research Into Action, Inc. to prepare a Summary Study of 15 studies commissioned to evaluate the market effects of utility-based, demand side management programs. These 15 studies were undertaken between 1996 and 1998, at a total cost of over $2 million. The Summary Study team included Research Into Action, Inc., Pacific Consulting Services, and Megdal & Associates.

The Summary Study was prepared in two phases. The first phase, which reviewed the first four reports to be finalized, permitted the Summary Study team to test and refine the summary methodology with the Market Effects Subcommittee. This Final Report includes the first four reviews, plus reviews of an additional nine studies completed before July 15, 1998. The centerpiece of this report is an analysis of the 13 studies relative to five functional areas. Reviews of the remaining two studies are provided in the appendices.

A key document referenced throughout the Summary Study is the Scoping Study (Eto, Prahl, Schlegel, 1996). This study set the framework for assessing and reviewing the 15 studies. The Scoping Study was commissioned by the California Public Utilities Commission to address fundamental questions about market transformation. A key objective of the study was to propose an operational definition of market transformation based on assessing the degree to which utility programs had had market effects and had overcome underlying market barriers to energy efficiency in a lasting fashion. As part of our first phase we reviewed the Scoping Study; that review is included in Appendix A.

The 15 market effects studies were designed to provide the most extensive attempt to date to evaluate energy-efficiency programs for market transformation and market effects. The studies focused on demand side management programs. Demand-side management programs are designed to save energy, not necessarily to transform markets. The context for the studies, therefore, was quite different from what future programs, since they are consciously designed to transform markets, will experience. Market effects will be a focus of market transformation program evaluation, but we anticipate that the data sets for market transformation programs will be different from those for the demand side management reviewed here, resulting in different analysis strategies and an improved ability to draw conclusions about market effects.

STUDIES REVIEWED

The 13 studies reviewed in Volumes 1 and 2 of this Final Report are:

- *Residential New Construction: Market Transformation Study (study number 3301/3501)* was conducted by Barakat & Chamberlin, Inc. for Southern California Edison (SCE) and Pacific Gas & Electric (PG&E).

- *Residential Market Effects Study: Refrigerators and Compact Fluorescent Lights (study number 3302/3902)* was conducted by Hagler Bailly Consulting, Inc. for San Diego Gas & Electric (SDG&E) and PG&E.

- *PG&E and SDG&E Commercial Lighting Market Effects Study (study number 3303/3903)* was conducted by Xenergy, Inc. for PG&E and SDG&E.

- *PG&E Energy Center Market Effects Study (study number 3304)* was conducted by TecMRKT Works for PG&E.

- *Study of Market Effects on the Supermarket Industry (study number 3305)* was conducted by Quantum Consulting, Inc. for PG&E.

- *Commercial/Industrial Market Effects Baseline Study (study number 3306)* was conducted by Quantum Consulting, Inc. for PG&E.

- *Consumers' Attitudes Toward Energy-Efficient Appliances Study (study number 3504)* was conducted by Brown & Whiting, under subcontract to DOE's program administrator, D&R International, for SCE.

- *CTAC Market Effects Study (study number 3504*) was conducted by Hagler Bailly Consulting for SCE.

- *Evaluating the Market Effects of Southern California Edison's Commercial and Industrial Energy Efficiency Programs (study number 3505/3506)* was conducted by Quantum Consulting, Inc. for SCE.

- *Hydraulic Services Market Effects Study (study number 3507)* was conducted by RLW Analytics, Inc. for SCE.

- *Home Energy Fitness Program Market Effects Evaluation (study number 3701)* was conducted by AAG & Associates for Southern California Gas Company (SCG).

- *Residential Market Effects Study (study number 3702/3904)* was conducted by Regional Economic Research, Inc. for SCG and SDG&E. The study focuses on gas end-uses in new residential construction.

- *Indirect Costs and Benefits Pilot Study of SDG&E's Commercial Lighting Program (study number 2092T)* was conducted by Barakat & Chamberlin, Inc. for the California Demand-Side Management Measurement Advisory Committee.

- *Residential Lighting Market Transformation Study (study number 3505)* was conducted by Decision Sciences Research Associates, Inc. for SCE.

- *PG&E Multi-Year Billing Analysis Study: Commercial Lighting Technologies (study number 2026P)* was conducted by Quantum Consulting, Inc. for PG&E.

KEY FINDINGS

The following summarizes the key findings for each of the five functional areas we focused on in conducting the review: comparison with the Scoping Study framework, evaluation design and methodology, data collection procedures, sustainability and future use of the market effects evaluations.

COMPARISONS WITH SCOPING STUDY FRAMEWORK

Of the 13 studies reviewed, 10 of them were designed and implemented according to guidelines established by the Scoping Study. Nine of the 10 focused on identifying, characterizing and, in some cases, quantifying, the market effects of the utility DSM programs under consideration. All 10 described their findings in the vocabulary of the Scoping Study, with occasional modifications.

Of the remaining three studies, the PG&E Energy Center Study applied a diffusion of innovation approach to the analysis. This approach offers an important addition/alternative to the Scoping Study framework. The DOE Labeling Study and the Indirect Costs and Benefits Study were not conducted with market transformation in mind.

The key findings that emerge by comparing these 10 studies to the Scoping Study framework are:

- In many studies, the difference between market effects (caused by the program) and market changes (caused by other factors) were not clearly distinguished or applied. These differences should be a focus of future evaluations.

- The diffusion of innovation model provides a viable enhancement to the Scoping Study's strict adherence to barriers and economic relationships. By focusing on information and communication flows, the model clarifies the human dimensions of how market effects occur and last. This approach provides an important contribution to the Scoping Study focus on what occurs and lasts.

- Establishing a causal link between targeted market barriers, the intervention and the expected effect was difficult for many authors, yet is critical to demonstrate market effects.

- The Scoping Study provided no test or suggested method to determine which market effect is the best measure of change resulting from any particular intervention. We doubt a single method will ever be demonstrated as multiple methods appear to be viable.

- Most of the studies included a market characterization study, which was effective. Some study authors hypothesized the market barriers in order to fit the framework; in only one case did this approach prove satisfactory. The most effective strategies were to develop the market barriers from primary data collection with market participants.

- The classification system for market barriers in the Scoping Study is comprehensive, but the nomenclature is imprecise and distinguishing between categories sometimes was arbitrary on the part of study authors.

- Some authors constructed new market barriers with no apparent theoretical basis, and most continued to refer to high first cost as a market barrier despite counter arguments in the Scoping Study.

- High first cost was a frequent response from market participants that seemed to overshadow efforts to identify the "true" market barriers. The Scoping Study did not address how to deal with this and few studies successfully overcame this problem. However, those that did were able to more effectively address market effects.

- Finally, the Scoping Study provided no specific criteria to judge the lastingness or sustainability of any particular market effect. The studies that approached the issue systematically were most successful in drawing convincing conclusions. Clearly, criteria need to be set forth at the onset of the program and the evaluation in order to be able to draw conclusions on sustainability.

EVALUATION DESIGNS AND METHODOLOGIES

All 13 studies relied on tabulation and summary of qualitative and quantitative responses from various market actors using surveys and interviews. Three studies also sought to carefully analyze market share data collected from outside sources. Many of the studies included focus groups, which proved to be valuable in the identification of market barriers. A variety of quantitative analysis methodologies were used including: multi-variate regression models, analytic hierarchy process (AHP), structural equation modeling (SEM), factor analysis, and gap analysis.

As noted above, the PG&E Energy Center Study used the diffusion of innovation paradigm instead of the economic framework inherent in the Scoping Study.

We found the use of these techniques innovative and promising for future market effects studies. For example, the diffusion of innovation paradigm offers much to expand the strict economic view of the Scoping Study. Some methods, however, such as AHP, are data-intensive and required the study authors to limit sample size in order to be able to carry out the project. Unfortunately, we did not observe sufficient benefits from AHP to warrant the tradeoff. These studies offered an opportunity to note the strengths and weaknesses so that appropriate applications can be selected.

Our overall findings on evaluation methods follow.

- About half the studies used a cross-sectional design approach. A cross-sectional analysis focuses on differences between population segments. However, the proper focus of a market effects study is changes within a population segment over time. This conceptual mismatch between evaluation objective and method, combined with the practical difficulties of finding the ideal comparison area, make strictly cross-sectional analysis a less-than-ideal study design for future market effects studies. In future evaluations, we anticipate that time-series analyses, perhaps with a cross-sectional component, will tend to be preferred over a strictly cross-sectional approach.

- For studies that took a time-series approach, the evaluation baseline had to be established retrospectively, relying on respondent recall. This is problematic primarily because recall is vulnerable to bias. The bias generally cannot be readily predicted or defended against. One study demonstrated a method for collecting baseline data that was independent of respondent recall. The study collected name plate data for refrigerators by screening survey respondents to determine when they purchased their refrigerator and having the respondents open the door and provide the name plate data over the phone.

- We noted an inconsistency between the focus on market-level versus participating customer-level effects. Some of the studies focused on participant responses as measures of market effects. If there was no market characterization study, there was no credible story and the studies could not explain how the participant effects could be justified as market effects.

- Several studies provided market characterizations. These studies confirmed the significant benefit and need for a market characterization study before market effects conclusions can be drawn. We hope that such studies will become commonplace at the

program design stage; if not, evaluations will have to include this activity as a first step to ensure that appropriate strategies are used to measure the market effects.

DATA COLLECTION PROCEDURES

The quality of the data collected in the 13 studies was quite good and adhered to industry standards. Most used a great deal of qualitative data, demonstrating both the strengths and weaknesses of these types of data. None of the studies, however, was flawless in terms of data completeness, and some of the studies exhibited problems in terms of generalizability of the results to the population as a whole, either due to small sample size or respondent pool choice.

The following key lessons emerged from our review of data collection procedures:

- Most significant is the demonstration by several studies that data collected from multiple segments of market participants is required to adequately understand market activities. Those studies that developed market characterizations, attempted to estimate market share changes and to identify reductions in market barriers throughout the market required collection and analysis of large amounts of data from multiple sources.

- Studies that had a limited view of the market or too few data points had incomplete data and difficulty drawing conclusions.

- As noted above, many of the studies included a market characterization. However, all of the market characterizations could be criticized as being incomplete. But the studies that included a thorough characterization were much more successful at making a coherent and convincing case for the market effects they attributed to the program.

- Some of the first studies completed showed insufficient focus on identifying the market barriers and measuring proximate indicators to track whether market barriers had been reduced or eliminated. Later studies put this at the center of their efforts. This greatly improved the authors' ability to draw conclusions.

- Several studies used data from prior studies, proving in each application the value of looking at past program results and/or other market-related studies in order to assess market changes over time.

SUSTAINABILITY AND LASTINGNESS

Sustainability was the most poorly developed of all the areas we examined. Only half of the 11 studies actually designed to measure market effects addressed sustainability. This is the area

most in need of improvement in future market effects and market transformation studies and, we anticipate, the area in which much methodological work will focus.

- Four of the 13 studies provided specific criteria for measuring sustainability related to the program and market being examined. Another quarter had specific criteria that we did not feel met the definition of sustainability. Those studies with specific criteria were able to draw conclusions; without such criteria conclusions often were not persuasive, or were not made at all.

- Studies that relied on measures of persistence or indicators that participants were continuing to use the knowledge they had gained from the program were not persuasive. We understand sustainability to refer to a shift by and continued commitment among (the same or other) customers after the reduction or elimination of the program. In this parlance, sustainability refers to future actions, not continued effects from a past customer action.

- Our review identified that the determination of sustainability of market effects is a two-step process. First one must find market effects, and second, one must find that these effects are sustainable.

- With their emphasis on change overtime, diffusion of innovation models may be useful in assessing the sustainability or lastingness of market effects.

OPPORTUNITIES FOR FUTURE USE OF THE MARKET EFFECTS EVALUATIONS

Our assessment of these 13 studies is that none of the DSM programs appears to be a highly efficient market transformation program. Nonetheless, market effects were observed in several markets, and the authors at times were willing and able to declare that the effects were likely to be long-lasting and sustained without further program intervention.

One set of programs did result in significant transformation, such that the market may require minimal intervention in the future. This is the commercial lighting market in which several segments appear to have experienced significant transformation: office, institutional sector, large commercial businesses and owner-occupied facilities. These market segments now rely on T-8s and electronic ballasts. Other commercial lighting market segments, however, have barely been touched (small facilities, leased facilities, retail and miscellaneous businesses).

One other study found a transformed market. The PG&E C&I Baseline Study found the industrial market for motors over 50 HP had been transformed.

Findings of sustained market effects, but not market transformation include:

- The Hydraulic Services Study estimated that 50% of the pump testing that resulted from the program would continue without the program.

- The Refrigerator and CFL Market Study found that the barrier of awareness of energy-efficient refrigerators and CFLs had been permanently reduced and that the performance standards for CFLs had been permanently improved. However, significant barriers remain, suggesting reduction of these barriers has been insufficient to transform the market.

- The Pacific Energy Center Study found that the Center was reaching 40% of its target market and that that target market was being influenced by their experience with the Center.

Some of the important lessons for informing market transformation program design and evaluation include the following:

Program Design

- We cannot conclude from these studies which type of interventions are causally linked to market effects. The commercial lighting programs offered significant rebates; but so did other less "successful" programs. We could not discern whether the rebates or the program delivery strategy was the key driver in the success of the lighting programs. Our sense is that a delivery strategy that is responsive to the market, in tandem with rebates, was critical to effectively gaining market share.

- These 13 studies provided a wealth of information for use in market transformation program design. Most of the studies either completed a market characterization or provided sufficient information to develop market characterizations for the following end-use markets or market segments:
  - Commercial lighting
  - Residential new construction
  - Supermarket refrigeration
  - Commercial building maintenance and design
  - Commercial HVAC
  - Commercial motors

Market Transformation Evaluation

- The data collection methods used for market effects evaluation comparable to those for demand side management market and process program evaluation.
- The analysis methods, however, derive more broadly from marketing, social science and economics.
- Given the experience in these studies, it is clear that there will be a significant reliance on qualitative data for determination of attribution.
- Two areas are likely to see a focus of methodological efforts:
    1. The measurement of sustainability
    2. Development of questions to elicit underlying market barriers and to identify self-sustaining changes in behaviors and communications.

RECOMMENDATIONS

These 13 studies are leading examples of how to evaluate market effects. Some of the studies demonstrated things that just don't work, but in general, the studies provided fertile ground for learning about market effects measurement and the effects DSM programs have had in some California markets.

Given the limited market effects found in most markets, there remain significant opportunities to increase energy efficiency in California. These 13 studies provide information with which to develop market transformation programs.

In addition, the review provided key lessons about the design and implementation of market effects studies. We hope that these lessons ensure that future market effects studies measure effects better. In that light, we offer the following recommendations for market effects measurement:

The Scoping Study provides an excellent framework for market effects and market transformation program design and evaluation. However, we strongly feel that the diffusion of innovation literature should be incorporated in efforts to measure and design market transformation programs. We also propose some slight modifications to the Scoping Study that should be kept in mind by those who use the Scoping Study and the CBEE Policy Guidelines. The changes we recommend are:

- Emphasize knowledge of market structure and information flows that emerge from an understanding of the diffusion of innovation literature.

- Clarify the definition of market barriers and how these concepts should be used in both program design and evaluation.

- Emphasize the links between market barriers, program interventions and market effects in both program design and evaluation.

- Policy makers should encourage applied research into the nature of market barriers.

- Distinguish between market changes observed independent of the program and market effects attributed whole or in part to the program.

- Policy makers and evaluators should develop and elaborate on the process standards or criteria that can best be used to measure sustainability.

Evaluations of market transformation programs can use data collection methods similar to those used in process and market evaluations of DSM programs. These include: surveys, focus groups, interviews and secondary data review. However, the quantitative tools for analysis of these data will expand to include techniques such as factor analysis, structural equation modeling, forecasting of market share, analytical hierarchy process, etc. This will result in more comprehensive knowledge of the market. We also anticipate an increase in the collection of baseline data and the reliance on time-series analyses, perhaps with a cross-sectional component, rather than strictly cross-sectional analyses. Most important, these studies will be market-focused, not participant-focused.

Program designers and evaluators should adopt a two-tiered approach to market effects measurement. The first tier should include a market characterization study, and the second tier a market effects study designed around the first tier results. We feel that this strategy should be a high priority element of evaluations that assess market effects.

Data collection procedures should be grounded in a comprehensive understanding of the market. The following steps will ensure a more complete data collection strategy.

- Define market barriers from a characterization of the market, and then collect data to test whether the barriers remain.

- Market effects studies should collect data directly from market participants; using market experts as proxies to identify market actor attitudes, preferences, decision factors and program effects is insufficient at best and inappropriate at worst.

- While determining what is "enough" data is tricky, a market effects study must be based on data from a large enough number and variety of relevant market participants to give the results credibility.

- Market effects studies need to clearly identify each market participant population to ensure that the selected sample is indeed representative of the market.

Researchers should refer to the goals and objectives of the effort and set criteria for the sustainable effects that are likely to emerge based on those goals and objectives. Potential sustainable effects should be measured and an assessment made as to the likelihood that the transformation will be permanent. Based on the lessons learned in this review and our reflection on how to think about sustainability, some of the likely conditions for sustainable market effects are:

- New market entrants

- Valuing of non-energy benefits

- Position and momentum in the diffusion process

- Institutional adoption

- Market structure changes that eliminate barriers

- The development of profitable private market entities to facilitate continued market transformation.

MARKET EFFECTS SUMMARY STUDY

Final Report

Volume 1

SUMMARY STUDY

PREFACE

These studies were developed in response to the California Public Utilities Commission's (CPUC) order (Decision 96-12-079) in 1997 requiring energy utilities to identify the market transformation effects of their previous DSM programs. In collaboration with other members of the California DSM Measurement Advisory Committee (CADMAC), the utilities evaluated several of their DSM programs that represented the broadest coverage of program types.

For the most part, the series of studies ordered by the CPUC was intended to be a retrospective look at "traditional" DSM programs that were not designed to produce market effects. It was a "last look back" at impact programs before California turned its attention to the design, implementation, and evaluation of programs *intended* to produce market effects, toward an eventual transformation of segments of the energy-efficiency market. For most of the studies, there were at least two goals: to look for *any* evidence of market transformation from past programs, and to develop tools for the evaluation of market effects from the new era of market transformation programs. A few of the studies (e.g., the SCE High Quality Compact Fluorescent Lamp Study and the PG&E Statewide Multi-Year Billing Study) did not fit this general mold, but they contributed other information about DSM programs in California during this transition period.

In assessing the choices made in the course of these studies, there are several caveats that should be kept in mind.

1. **Cost Cap.** First of all, there was a target total cost for these studies in the CPUC decision, which served as a cap on the resources that would be allocated for them. The total amount was distributed among the utilities by CADMAC, effectively creating a utility-specific cap.

2. **Time Constraints**. Originally these studies were targeted for completion by December 31, 1997, as stated in D. 96-12-079. That deadline was eventually relaxed a bit, but during at least the first three-quarters of that year, research decisions were based upon a steadily shrinking window of time within which to conduct the studies. Thus, there was a fast track for rolling out the research projects, no expectation of time extensions, and no opportunity to conduct time-series analyses or to measure sustainability well.

3. **Imposed Variety.** The subcommittee intentionally attempted to vary the market sectors, methodologies, and theoretical approaches represented by the range of selected programs. The consequences include the possibility that good DSM impact programs with measurable market effects were left unstudied.

4. **Learning Curve.** The proposed work plans for these studies were reviewed, revised and/or approved by the members of the subcommittee, thereby taking some of the control away from the utilities and their research contractors. There was also a learning process in the subcommittee; so later studies were held to higher standards and earlier studies might have been done differently if they had been able to benefit from the Subcommittee's experience.

5. **Science By Litigation.** Finally, the utilities were ordered by the CPUC to conduct these studies, and compliance with that order (e.g., finishing by 12/31/97) was necessarily paramount in the utilities' decision-making processes. After compliance, good science, of course, was the guide.

The body of knowledge developed by this series of research projects is rich and unique, and this Summary Study was commissioned with the intention of making all the lessons learned from these studies available to the widest possible audience, both inside California and elsewhere in the nation. It is important that the conclusions drawn from these studies make use of *all* the available information, including the context within which the studies were conducted. This preface is intended to provide some of the necessary information for interpreting the research results.

1.1 INTRODUCTION

PURPOSE OF THE PROJECT

In fall 1997, the California Demand Side Management Advisory Committee (CADMAC) Market Effects Subcommittee (the subcommittee) requested a review of 14 market effects studies conducted between 1996 and 1997. In June 1998, the list was expanded to 15. The purpose of the 15 studies was to evaluate the market effects of utility-based, demand side management (DSM) programs.

The purpose of the Summary Study was to give the subcommittee an analysis comprising several components. First, the Summary Study was to include a systematic summary of the factual aspects of the 15 studies. Second, the Summary Study was to assess the individual studies' applicability of data, effectiveness of methods, likelihood of market effects sustainability, ability to reuse the collected data and the effectiveness of the studies in using the Scoping Study. Third, the Summary Study was to identify lessons learned. And fourth, the Summary Study was to make recommendations for improving future evaluations and conducting future market effects studies.

DISCUSSION OF REVIEW METHODOLOGY

The methodology Research Into Action, Inc. (RIA), Pacific Consulting Services and Megdal & Associates proposed for the Summary Study was a broad spectrum, multiperson team review of each study. Each study was assigned a lead investigator responsible for preparing and summarizing the review comments developed by the team.

In addition, we identified seven functional areas that mapped directly to the subcommittee's objectives for the Summary Study. These areas were also assigned to a lead investigator from the four-member team. The organizing functional areas are:

1. Tabular summary of studies
2. Comparison with Scoping Study framework
3. Assessment and review of data completeness and collection methodology
4. Review of data analysis methodology
5. Assessment of value for future evaluation needs and uses
6. Assessment of sustainability of market effects

7. Overall conclusions and recommendations

This approach was designed to ensure that the Summary Study team could provide the subcommittee with a summary review of each study and with a summary across studies on the functional areas of interest to the subcommittee.

As the primary focus, the review has as its basis the Scoping Study.[1] As part of the development of the work plan for the project we prepared a review of the Scoping Study and other market transformation literature. This review is included in Appendix A of this report. Lessons we learned in developing that review have contributed greatly to our analysis of the 15 studies. A significant component of our review is a comparison of each study to the Scoping Study framework. Secondarily, we have looked at each study to determine if the study provides lessons on how to improve or modify the Scoping Study framework. Finally, we have examined each study to see if there are models of market transformation and market effects that the Scoping Study failed to address and which thus need to be considered, either in contrast to, or as support for, the Scoping Study framework.

Initially all four team members read each study. Then each of us prepared a set of comments on the study and circulated this to the other team members. We then held a telephone conference call to discuss the comments and prepare a set of questions for follow-up with the study authors. The lead assigned to each study contacted the study authors to discuss questions on the study. Once this follow-up was completed, the lead prepared a review of the study. The review was circulated to team members for comment and then included in the report.

We quickly discovered that the depth of review required to accomplish the subcommittee's objectives was greater than the resources available for the project. In addition, members' comments often were identical. As a result, our reviews of the first three studies took almost twice the allocated time. We recognized that we needed to revise our approach. For the remaining studies, we assigned two members of the team to each study, one as lead and one as second. Each team followed the same steps. We found that our reviews of these remaining studies were comparable with the three initial studies and better utilized project resources.

One other slight modification was made to the follow-up process with study authors. After completing the draft reviews, we provided them to the studies' authors for comment. We felt this would reduce errors and surprises that might occur on publication of the Summary Study report.

---

[1] Eto, Joe, Ralph Prahl and Jeff Schlegel. *A Scoping Study on Energy-Efficiency Market Transformation by California Utility DSM Programs - LBNL-39059 UC-1322*. Ernest Orlando Lawrence Berkeley National Laboratory. July 1996. The Scoping Study was commissioned by the CPUC to address fundamental questions of market transformation. A key objective of the Scoping Study was to propose an operational definition of market transformation based on assessing the degree to which utility programs had market effects and overcame underlying market barriers to energy efficiency in a lasting fashion.

INTRODUCTION TO THE REVIEWED REPORTS

The Summary Study was commissioned to review 15 studies; this final report includes reviews of 13 of the 15 studies. Two other studies are included in Appendices C and D. The 15 studies are:

- *Residential New Construction: Market Transformation Study (study number 3301/3501)*. The study was conducted by Barakat & Chamberlin, Inc. for Southern California Edison (SCE) and Pacific Gas & Electric (PG&E). The study focused on market effects of SCE's Welcome Home program and PG&E's Comfort Home Program, both residential new construction programs. Both programs included advertising and information packets directed at increasing the energy-efficiency information available to homeowners and Realtors, and promotion of energy-efficient mortgages. In addition, the programs worked directly with builders and subcontractors, offering incentives for the use of energy-efficient measures and setting standards for ductwork installation, among other efforts. This study included a detailed analysis of market characteristics and an assessment of market effects. We named this study the *PG&E and SCE Residential New Construction Study*.

- The *Residential Market Effects Study: Refrigerators and Compact Fluorescent Lights (study number 3302/3902)* was conducted by Hagler Bailly Consulting, Inc. for San Diego Gas & Electric (SDG&E) and PG&E. The study focused on residential appliance efficiency incentive programs sponsored by the utilities for refrigerators and compact fluorescent lights (CFLs) between 1989 and 1997. The implementation of these programs varied considerably over the time period, but generally offered incentives to consumers in the form of a rebate to be claimed after purchase. At times the utilities also offered incentives to manufacturers and/or retailers. In one program strategy, direct installation was offered to low-income customers. This study included a detailed analysis of market share. We named this study the *Refrigerator and CFL Study*.

- The *PG&E and SDG&E Commercial Lighting Market Effects Study (study number 3303/3903)* was conducted by Xenergy, Inc. for PG&E and SDG&E. The focus of the evaluation was the commercial fluorescent lighting programs funded between 1992 and 1996. The implementation of these programs – particularly the delivery mechanisms and rebate formats – varied considerably over the time period. However, all used incentives, either to the purchaser or the building owner. This study provided a detailed analysis of market characteristics and assessment of market share and market effects. We named this study the *Commercial Lighting Study*.

- The *PG&E Energy Center Market Effects Study (study number 3304)* was conducted by TecMRKT Works for PG&E. The study focused on market effects arising from educational programs, consulting services and building performance tools to professional and business people making design and operational decisions for commercial buildings. The study was the only one to be grounded in the diffusion of innovations literature. The study covered the period from the Energy Center's opening in 1991 to 1997, with an emphasis on 1995 to 1997. We named this study the *PG&E Energy Center Study* or *PEC Study*.

- The *Study of Market Effects on the Supermarket Industry (study number 3305)* was conducted by Quantum Consulting, Inc. for PG&E. The study was unique in its focus on a single segment of the commercial business market: supermarkets. It also uniquely offers a market characterization with a limited assessment of market effects for this market segment only. It is not an evaluation. The study included effects from a few targeted information programs and from various commercial incentive programs targeted more generally at the commercial market. The study covered the period from 1991 to 1997. We named this study the *Supermarket Study*.

- The *Commercial/Industrial Market Effects Baseline Study (study number 3306)* was conducted by Quantum Consulting, Inc. for PG&E. The study focused on market effects for packaged air conditioning and motors in 1996. This study was a baseline study, rather than an evaluation of past program effects. The study included a detailed market characterization and assessment of market conditions for the energy-efficient technologies. We named this study *PG&E's C&I Baseline Study*.

- The *Consumers' Attitudes Toward Energy-Efficient Appliances Study (study number 3503)* was conducted by Brown & Whiting, under subcontract to DOE's program administrator, D&R International, for SCE. The study was not initially conceived as a market effects study, therefore, it bears virtually no relationship to the market transformation framework outlined in the Scoping Study. SCE attempted to bridge the gap between this study and the Scoping Study via a cover memo. The memo discussed program implementation, market barriers hypothetically addressed by the program, hypothetical market effects that would result, evaluation research planned and conducted, evaluation finding and conclusions and recommendations. We named this study the *DOE Appliance Labeling Study*.

- The *CTAC Market Effects Study (study number 3504*) was conducted by Hagler Bailly Consulting for SCE. The study focused on the Customer Technology Application Center (CTAC). CTAC offers a combination of information services such as demonstration projects, showcases and seminars targeted at all customer sectors and trade allies in the SCE service territory. The information services are provided free of

charge. The program covered the years 1990 to 1997. We named this study the *CTAC Study*.

- The report *Evaluating the Market Effects of Southern California Edison's Commercial and Industrial Energy Efficiency Programs (study number 3505/3506)* was conducted by Quantum Consulting, Inc. for SCE. The study focused on programs for five commercial end-use technologies: fluorescent lighting, packaged air conditioning, motors, adjustable speed drives and energy management systems. It included a market characterization and market effects analysis. The programs – the Commercial Industrial Energy Management Hardware Rebate and Energy Management Services Program – were examined for program years 1995-1997. We named this study the *SCE C&I Market Effects Study.*

- The *Hydraulic Services Market Effects Study (study number 3507)* was conducted by RLW Analytics, Inc. for SCE. The study examined the Hydraulic Services Program, which is a long-standing (over 80 years) information program providing services to agricultural and municipal water pump end users. The program provides pump-testing services at no cost to the participants. This testing provides information that is expected to influence maintenance procedures to increase the energy efficiency of the pumps and the purchase of more energy-efficient pumps. We named this study the *Hydraulic Services Study*.

- The *Home Energy Fitness Program Market Effects Evaluation (study number 3701)* was conducted by AAG & Associates for Southern California Gas Company (SCG). The study evaluated the market effects of an information-based program to residential customers. The program offered a mail-based energy analysis to residential customers between 1993 and 1997. The study included a market characterization, a billing analysis and a survey approach to market effects measurement. We named this study the *HEF Study.*

- The *Residential Market Effects Study (study number 3702/3904)* was conducted by Regional Economic Research, Inc. for SCG and SDG&E. The study focused on gas end-uses in new residential construction. The study targeted programs offered between 1990 and 1997, and included a variety of technologies: gas furnaces, gas water heaters, gas ovens, heating ducts, heat traps for water heaters, and some envelope measures. The programs included information and incentives prior to mid-1994, when the incentives were dropped. The study included a market characterization, estimates of market share and an assessment of market effects. We named this study the *SCG/SDG&E Residential New Construction Study*.

- The *Indirect Costs and Benefits Pilot Study of SDG&E's Commercial Lighting Program (study number 2092T)* was conducted by Barakat & Chamberlin, Inc. for the

California Demand-Side Management Measurement Advisory Committee. The study focused on the commercial lighting program offered by SDG&E in 1995. The purpose of the study was to test whether indirect costs and benefits associated with a lighting rebate program could be quantified. The study offered important insights, but was not designed as an evaluation and was not implemented as a market effects study. For this reason, the review is included in Appendix B. We named this study the *Indirect Costs and Benefits Pilot Study*.

- The report *Residential Lighting Market Transformation Study (study number 3502)* was conducted by Decision Sciences Research Associates, Inc. for SCE. The study was among the last completed and is included in Volume 3 as Appendix D. The goal of the study was to collect baseline data for a multiyear study of residential lighting products. The study provided a characterization of the retail sales environment for lighting products and measures, consumers' knowledge, attitudes and practices in shopping for lighting. We named this study *The High Quality Compact Fluorescent Lamp Study*.

- The report *PG&E Multi-Year Billing Analysis Study: Commercial Lighting Technologies (study number 2026P)* was conducted by Quantum Consulting, Inc. for PG&E. The study was among the last completed and is included in Volume 3 as Appendix C. The objective of the study was to measure the total net load impact of the PG&E Commercial Energy Efficiency Incentives over a four-year period. The study included estimates of total nonparticipant market transformation load impacts and participant spillover contribution to gross impacts. We named this study the *PG&E Statewide Multi-Year Billing Analysis.*

REPORT FORMAT

This report is presented in two volumes, plus appendices. In addition to this introductory chapter, Volume One includes four chapters. Chapter 2 provides tables summarizing the 13 studies over a variety of issues. Chapter 3 presents our comparison of the 13 studies with the Scoping Study framework. Chapter 4 reviews the methods used in the 13 studies focusing on three issues:

1. Assessment and review of data completeness and collection methodology,
2. Review of data analysis methodology, and
3. Assessment of sustainability of market effects.

Chapter 5 presents our conclusions and recommendations, including conclusions from our assessment of these programs as market transformation efforts and a discussion of future uses for

the evaluations. It also includes our recommendations for lessons that can be learned from the evaluations.

Volume 2 includes 12 chapters, each addressing one of the 13 studies we reviewed; Appendix A contains the thirteenth study reviewed. Each review chapter begins with a set of tables summarizing the study period. These tables are followed by our review, which presents findings for each study relative to the five functional areas. The thirteenth study, as noted above, was placed in Appendix B because the study was not designed as an evaluation, or to follow the Scoping Study framework. Volume 3, with Appendices C and D, contains the remaining two studies. These two studies were not included in the Summary Study discussion chapters due to their late completion.

1.2 SUMMARY OF RESULTS

SUMMARY TABLES

The 13 studies reviewed in this summary contain a wealth of information for market transformation planners and evaluators. We consolidated and tabulated it to make it more useful.

Our summary of information is presented in a series of tables designed to allow readers to selectively scan different components in each study and cursorily compare information across the reports. The first table is a quick overview; the next few attempt to summarize the methodology, data, and results of the studies; and the last tallies the effectiveness of the programs as reported in the studies.

Table 1-1 provides a summary of all of the reports to guide readers to those that interest them most. It identifies the focus of each program and analysis in each study. A detailed review of each study in this table is contained in Volume 2 of this report.

To save space, this table uses a bit of shorthand and simplification. Here is more information about the abbreviations used and information included:

- The Study Reference labels are abbreviated names we used throughout this report, but are not necessarily the exact study titles. Exact titles are noted in Section 1.1.
- "Sector" refers to the customer market to which the program evaluated in the study was directed. At least one of the programs that operated an information center was directed to commercial and industrial customers, but also available to residential customers. The sector abbreviations used are:
  - Res = residential
  - C/I = commercial and industrial
  - Ag = agricultural
- "Market" refers to the intended or eligible part of the building market. Some programs applied to new construction and retro markets, except for one that made no statement about the market it allowed.
  - New = new construction
  - Retro = retrofits, remodels, and replacements

- Some of the programs were focused on making energy-efficiency improvements in specific end uses. Others cast a broader net. The end use label "All" refers to programs focused explicitly on the whole building or open to changes in any component of the building, and any study in which specific end uses were not mentioned.

- "Program Stimulus" refers to the intervention(s) used in the program to encourage energy-efficiency improvements. Many of the programs studied used information only; two programs emphasized the use of financial incentives. The others blended the two.

  - Info = educational/promotional materials, advertising campaigns, audits, and information centers

  - Rebate = program defined by any monetary incentive including rebates to customers, program or product reps, retailers, or manufacturers

- A "Baseline" was defined, either explicitly or by ready inference, in most of the studies. Three types generally were used to compare program participants: participants prior to program participation, program-eligible nonparticipants, and counterparts in nonprogram areas. Table 1-3 contains detailed information about the baseline used in each study.

- A "Market Characterization" was included in most of the studies, as Table 1-1 indicates. The breadth and depth of these characterizations varied widely. In some cases, readers' interpretations of market characterizations may differ from ours. The workshop we conducted with other market transformation evaluation practitioners (as an adjunct to this summary study) showed that there is no consensus in the evaluation community regarding what a market characterization should include. The summary from that workshop stated, "Market characterization is an important element of market effects evaluation and should be done in some form or another. ...It should at least identify/describe all the market actors, their transaction relationships (market processes), and what is/is not working in these transactions."[2] We used this list of components to guide what we put in this table; very few failed this test.

- Achievement of at least some "Market Effects" by the programs was reported in most of the studies. If we included a check mark in this portion of the summary, it does not represent an assessment of the credibility of those effects, but a statement of

[2] Summary of the CADMAC Market Effects Workshop, July 1998.

items covered in each study. The types and extent of the effects the authors reported are described in Table 1-4.

Table 1-1: The Studies at a Glance

Study Reference	Sector	Market	End Use	Program Stimulus	Baseline Defined	Market Charac-terization Included	Market Effects Reported	Market Barriers Identified	Sustain-ability Discussed
PG&E/SCE Residential New Construction Study (3301, 3501)	Res	New	All	Info Rebate	✓	✓	✓	✓	✓
Refrigerator and CFL Study (3302, 3902)	Res	Not stated	Refrig Light	Info Rebate	✓	✓	✓	✓	✓
Commercial Lighting Study (3303, 3903)	C/I	New Retro	Light	Rebate	✓	✓	✓	✓	✓
PG&E Energy Center Study (3304)	C/I	New Retro	All	Info		✓	✓		✓
Supermarket Study (3305)	C/I	New Retro	Refrig Light	Info Rebate	✓	✓	✓	✓	✓
PG&E's C&I Baseline Study (3306)	C/I	Retro	HVAC Motor	NA	✓	✓		✓	
DOE Appliance Labeling Study (3503)	Res	New Retro	Refrig	Info				✓	
CTAC Study (3504)	C/I (Res)	Retro	Light HVAC	Info	✓		✓	✓	✓
SCE C&I Market Effects Study (3505, 3506)	C/I	Retro	Light HVAC Motor	Info Rebate	✓	✓	✓	✓	
Hydraulic Services Study (3507)	Ag	Retro	Pump	Info	✓	✓	✓	✓	✓
Home Energy Fitness (HEF) Study (3701)	Res	Retro	All (gas)	Info	✓	✓	✓	✓	✓
SCG/SDG&E Residential New Construction Study (3702, 3904)	Res	New	All	Info Rebate		✓		✓	
Indirect Costs and Benefits Pilot Study (2092T)	C/I	Retro	Light	Rebate				✓	
Total Studies = 13	Res = 5 C/I = 7 Ag = 1	New = 2 Retro = 6 Both = 4		Info = 5 Rebate = 2 Both = 5	9	10	9	12	8

- "Market Barriers" are identified in some form in all but one study, as Table 1-1 indicates. Most studies at least mentioned familiarity with the Scoping Study and many used the study's market barrier terminology. Table 1-4 notes the specific

market barriers addressed by each study. To facilitate comparison, we have used the Scoping Study terminology, even if the authors did not do so explicitly.

- Sustainability, or lastingness, was discussed in some form in most of the studies, as Table 1-1 indicates. The discussions, however, ranged from very brief to extensive. They included some or all of the following: a definition of sustainability, criteria for achieving it, and findings that it had or had not been achieved. A study that recognized sustainability as a relevant concept but made no attempt to define or measure it was judged not to have discussed it. The extent to which sustainability was addressed in the studies is described briefly in Table 1-4.

The next three tables summarize the primary features and findings reported in each of the 13 studies reviewed for this report. The intent of the tables is to facilitate cross-study comparisons and to summarize the key information gained from the studies.

Table 1-2 summarizes general descriptive information about the studies, including the sponsoring utility, evaluation contractor, and the program's targeted market, sector and end-uses. It also includes program information relating to program year(s) studied in the evaluation, number of program participants and program interventions.

Table 1-3 describes the basics of the evaluation approach. It documents data collection methods, primary data collected and associated sample sizes, existing or secondary data sources, the evaluation definition of the baseline, analysis methods and the market actors considered within the scope of the evaluation.

Table 1-4 extends the documentation of the evaluation approach to cover those concepts addressed by the Scoping Study as a means of facilitating comparison within that framework and across the studies. Thus, it documents the market barriers each study examined, the market effects measured, identified changes in market barriers, evidence for estimated market effects, evaluators' reported likelihood that documented market effects will be lasting and the criteria used to determine lastingness.

Table 1-5 provides a synopsis of which types of programs had findings reported in the studies. It shows that, overall, 9 of 11 studies reported effects; 7 of the 9 claimed evidence of lasting effects. As a set of study-reported results, the only interpretation we made was whether authors did or did not report having found effects. We do not agree with every report of market effects or their lastingness. Our reasons for disagreeing are discussed in the reviews. Also, with so few studies in each sector and program type, fair interpretation of which types of programs are most effective cannot be made. This table might, however, help program planners and evaluators set their expectations about a ready set of resources on program effects.

The reader would do well to keep in mind two limitations inherent in these tables. First, the information presented in the tables is, of necessity, greatly simplified from the authors' original studies. Second, in order to present comparable information from different studies side-by-side, occasionally we have had to categorize or recategorize information in ways that are not literal restatements of the studies. In doing so, we have attempted to respect the authors' original intent. Given these two limitations, it is certainly conceivable that an author would not recognize his or her work as reflected in these tables. We caution the reader against treating these tables as primary information sources. Rather, we recommend using them as an exploratory tool to identify possible strengths, weaknesses, key results or trends. The reader should then research any potentially interesting findings in the more detailed study reviews in this report and in the authors' own work before drawing any definite conclusions.

Table 1-2: Summary Information

Project Number	Study Title	Sponsoring Utility	Evaluation Contractor	Sector	Target Market	End-use Elements	Program Year(s)	# Program Participants	Program Intervention(s)
3301, 3501	Residential New Construction: Market Transformation Study	PG&E, SCE	Barakat & Chamberlin, Inc.	Residential	New Construction	Whole Building	SCE: 1990-1994; PG&E: 1992-1996	Not stated	Advertising and information packets to home-owners and Realtors; promotion of energy-efficient mortgages; incentives to builders, subcontractors to use energy-efficient measures; standards for ductwork installation
3302, 3902	Residential Market Effects Study: Refrigerators and Compact Fluorescent Lights	PG&E, SDG&E	Hagler Bailly Consulting, Inc.	Residential	Not stated	Refrigeration and lighting	1989-1997 (emphasis on 1996)	Not stated	Refrigeration: customer, dealer, and manufacturer rebates; information; direct installation Lighting: customer, retailer, and manufacturer rebates; information and no-cost distribution to customers
3303, 3903	PG&E and SDG&E Commercial Lighting Market Effects Study	PG&E, SDG&E	Xenergy	Commercial/ Industrial	Retrofit, new construction	Lighting	1992–1996	Not stated	Incentives

Continued

3304	PG&E Energy Center Market Effects Study	PG&E	TecMRKT Works	Commercial	All	Whole Building	Study focus was 1995–1997	~30,000 since 1991; 1,258 since January 1995	Workshops, library services, lighting classroom, lending measurement devices, one-to-one consultation services
3305	Study of Market Effects on the Supermarket Industry	PG&E	Quantum Consulting Inc.	Commercial	Supermarket	Lighting, refrigeration	Not stated	Not stated	Rebates, audits, information, demonstrations
3306	Commercial/ Industrial Market Effects Baseline Study Results	PG&E	Quantum Consulting Inc.	Commercial/ Industrial	10-100 hp motors in school, hospital, and office packaged AC markets	Packaged AC, motors	Not applicable	Not applicable	Not applicable
3503	Consumers' Attitudes Toward Energy Efficient Appliances	SCE	Brown & Whiting	Residential	Equipment replacement	Refrigeration	1996-1997	30 Circuit City retailers	Appliance labeling; sales staff compensation, education and training; point-of-purchase displays; advertising; promotion; and consumer finance options
3504	CTAC Market Effect Study	SCE	Hagler Bailly Consulting, Inc.	All sectors	Retrofit, replacement	Lighting and HVAC	1990-1997	140,000 CTAC visitors	Information services such as demonstration projects, showcases, and seminars

Continued

3505, 3506	Evaluating the Market Effects of Southern California Edison's Commercial and Industrial Energy Efficiency Programs	SCE	Quantum Consulting Inc.	Commercial/ Industrial	Retrofit, replacement	CF lighting, packaged air conditioning, motors, EMS	Emphasis on ≥1995	Not stated	Audits, rebates
3507	Hydraulic Services Program Market Effects Study	SCE	RLW Analytics, Inc.	Agricultural	Retrofit	Pumps	1911-1997	1996: 294 agricultural customers, 296 water supply customers	No-cost pump testing services
3701	Home Energy Fitness Program Market Effects Evaluation	SCG	AAG & Associates	Residential	Retrofit	Whole Building	1994 (includes some 1993 participation)	124,164 households	Information
3702, 3904	Residential Market Effects Study	SCG, SDG&E	Regional Economic Research, Inc.	Residential	New Construction	Whole Building	SDG&E: 1990-1994, SCG: 1990-1997	SDG&E: ~14,000, SCG: 100,000+	Incentives, advertising, workshops
3901	Indirect Costs and Benefits Pilot Study of SDG&E's Commercial Lighting Program	SDG&E	Barakat & Chamberlin, Inc.	Commercial	Retrofit	Lighting	1995	Not stated	Rebates

Table 1-3: Evaluation Approach - Part 1

Project Number	Data Collection Method(s)	Data Collected /Sample Size	Existing Data Used	Definition of Baseline	Analysis Method(s)	Market Actors Considered
3301, 3501	In-depth telephone interviews	Surveyed 12 participating builders, 8 nonparticipating builders, 10 Realtors, 9 sales agents, 6 HVAC subcontractors, 4 Title 24 consultants Interviewed 17 experts as part of market characterization report	NAHB home buyer survey; SCE, PG&E, CEC home buyer surveys; CEC ener-gy consumption survey; SCE RASS survey and customer decision study	Interviewee recall of historic conditions	Tabulation of survey data; qualitative analysis; quantitative analysis using AHP	Builders, subcontractors, lenders, Realtors, homeowners, builders
3302, 3902	Phone surveys and interviews	Surveyed 337 1996 CFL purchasers, 150 nonpurchasers who were aware of CFLs, and 717 refrigerator surveys (213 refrigerator participants), 29 California CFL retailers, 29 national CFL retailers Interviewed staff at national HQ for Sears and Circuit City Surveyed 62 California and 50 national refrigerator retailers Interviewed representatives from Whirlpool and General Electric and staff at two key companies in residential new construction market	Program records and savings estimates	Comparison with rest of U.S. (with and without programs)	Tabulation of survey data; calculation of net energy savings based on reported actions	Customers, building owners, manufacturers, retailers
3303, 3903	In-depth phone interviews, some conducted in person	Interviewed 78 program and 30 nonprogram distributors, 57 program and 25 nonprogram designers, 30 program and 8 nonprogram installers, 20 national/state manufacturers, 25 government and others, 10 real estate investment management firms 579 program area and 287 nonprogram area end users	22 utility studies on programs and technologies conducted 1993-1996, 3 U.S. Census Bureau studies	Change over study period and comparison with nonprogram service areas (in AR, KS, LA, MD, MS, NM, NC, OK, PA, SC, TX)	Tabulation of comparative survey results	Customers, designers, distributors, government

Continued

Project Number	Data Collection Method(s)	Data Collected /Sample Size	Existing Data Used	Definition of Baseline	Analysis Method(s)	Market Actors Considered
3304	In-person interviews Telephone interviews	38 in-depth interviews of key informants 216 interviews of PEC participants	PEC participation records; membership lists from BOMA, IES, AIA; Dun & Bradstreet data	None stated	Diffusion of innovations approach	Architects, engineers, lighting designers, end-users
3305	Focus groups Interviews	Three customer focus groups: two within PG&E's service territory (1 large customers, 1 small groceries and convenience stores) and one in Commonwealth Edison comparison territory Interviews with 4 program staff; 12 supermarket suppliers; EPRI supermarket specialist; 5 PG&E and 5 comparison area architects, designers, and technical specification managers; 15 PG&E and 15 vendors and manufacturers; 15 PG&E and 10 comparison area supermarket decision makers	Program and billing data, Web site, marketing materials, impact evaluations, other studies/ surveys, other industry and technology reports	Comparison area	Qualitative analysis of survey and focus group results	Supermarkets
3306	Interviews Phone Surveys Focus Groups	4 program staff, 20 comparison area motor vendor, 25 comparison area HVAC vendor interviews 100 PG&E and 100 comparison area motor user, 200 PG&E and 100 comparison area HVAC user, 15 PG&E and 10 comparison area A&E surveys 2 motor vendor and 2 HVAC vendor focus groups	Utility program and evaluation reports, technology reports from 1996, 1997; New England Motor Baseline Study from 1992	Stated market barrier perception, program exposure, purchase intentions	Bivariate analysis, factor analysis, structural equation modeling (SEM)	Motors and HVAC end-users

Continued

Project Number	Data Collection Method(s)	Data Collected /Sample Size	Existing Data Used	Definition of Baseline	Analysis Method(s)	Market Actors Considered
3503	In-person intercept interviews Focus groups	Interviews with 147 shoppers and 12 sales representatives; 2 focus groups with 10 and 8 participants, respectively; sales staff interviews with 13 sales representatives and 4 department managers	DOE study of Milwaukee, San Francisco, Tampa, Washington DC in 1996	None	Tabulation of survey data, qualitative analysis	Consumers
3504	In-person interviews, focus groups, telephone surveys	20 in-depth customer interviews with CTAC users; 2 focus groups with CTAC users; 175 interviews with users; 48 interviews with trade allies	None noted	Interviewee recall of historic conditions	Tabulation of survey data, qualitative analysis	Consumers
3505, 3506	Phone surveys	Customers: nonparticipants (n= 2000); Replacement/Attitude Data (n = 300) Contractors/Distributors: HVAC (n= 50); Lighting (n= 50); Motors/ASDs (n= 50) Design/Engineering Firms (n = 50)	SCE data (on-site, mail, phone) from energy use, attitude, segmentation, and program evaluation surveys 1985-1995	Comparison with data from SCE nonparticipants and other service territories	Factor analysis	Customers, designers
3507	In-person and telephone interviews	7 water agency customers; 7 dealers, contractors, vendors; 10 manufacturers; 10 banks or credit institutions; 7 SCE staff; 8 TX and AZ utility staff; 2 pump testers; 19 pump dealers; 10 distributors; 10 water personnel; 9 experts, 9 consultants	SCE pump test database 1990-1997; motor market reports 1992 and 1997; field pump testing studies 1994 and 1995	Arizona comparison area	Tabulation of survey data, qualitative analysis	Customers
3701	Interviews, surveys	SCG program personnel interviews; supplier interviews; participant and nonparticipant interviews and surveys 700+ participants and 700+ nonparticipants in survey tabulations 1,000+ households in billing analysis	1992 delivery chain report; SCG program and saturation data	Change over study period and comparison with nonparticipants	Survey tabulations, billing analysis, factor analysis	Customers, suppliers

Continued

Project Number	Data Collection Method(s)	Data Collected /Sample Size	Existing Data Used	Definition of Baseline	Analysis Method(s)	Market Actors Considered
3702, 3904	Phone interviews Phone surveys Mail surveys	Gas heating (5), gas water heater (5), window manufacturers (4); gas heating (5), gas water heater (5), window (5) distributors; builders and developers (30 program, 15 control); architects (9 program, 5 control); Title 24 consultants (9 program, 2 control); HVAC contractors (8 program, 4 control); plumbing contractors (4 program, 2 control); building inspectors (9 program, 2 control); government staff (12) Sales agents (30 program, 15 control); Realtors (10 program only) Participants (556), nonparticipants (608), control (301)	1990–1994 post-occupancy residential survey data; utility program records; 1994 RER study database	SGC/SDG9E area Title 24 compliance records and program records	Comparison of survey results	Builders, consumers
3901	Focus groups In-depth telephone surveys	One group of 9 program participants employed by office facilities; one group of 4 program nonparticipants employed by mixed facility types; one group of 10 participants employed by retail and lodging facilities 70 participants and 26 nonparticipants	Utility O&M cost reduction estimates	Not applicable	Gap analysis, willingness to pay analysis	Customers, retail/ restaurant/ grocery businesses

Table 1-4: Evaluation Approach - Part 2

Project Number	Market Barriers Examined	Market Effects Measured	Change in Market Barriers	Estimated Market Effects	Reported Likelihood of Lastingness	Criteria for Determining Lastingness
3301, 3501	Split incentives Lack of awareness Insufficient information Bounded rationality	Homeowner demand; Realtor knowledge; Realtor promotion; lender mortgage awareness; mortgage availability; home builder marketability belief; builder marketing; Title 24 consultant reporting; builder information; builder awareness; practice changes; ductwork testing	Slight limited reduction in split incentives, practices, awareness/ information barriers	Weak evidence for most market effects; no change in Title 24 consultant reporting	Most market effects judged "likely permanent"	Changes assumed permanent unless evidence to the contrary; no evidence of permanent physical or institutional changes required
3302, 3902	Information or search costs Bounded rationality Product unavailability Inseparability of product features Split incentives Irreversibility Performance uncertainty	Customer awareness, knowledge, and interest in energy efficiency compared with national sample; retailer interest compared with national sample	Increase in customer awareness, knowledge, and interest in energy efficiency. Higher refrigeration retailer participation. No change noted in other barriers.	Californians appear more aware and better educated on refrigerator efficiency issues; higher ratings of customer knowledge of efficient refrigerators by retailers; customers show greater interest in energy efficiency for both refrigeration and lighting; less concern about lightbulb purchase prices	Refrigerator and CFL awareness may be lasting; CFL price reduction and performance standards permanently improved; unable to conclude that market share effects would last	No specific criteria, but applied rigorous standards

Continued

Project Number	Market Barriers Examined	Market Effects Measured	Change in Market Barriers	Estimated Market Effects	Reported Likelihood of Lastingness	Criteria for Determining Lastingness
3303, 3903	Information or search costs Performance uncertainties Hassle or transaction costs High first cost Hidden costs Bounded rationality	Market share; customer awareness, attitudes, and actions; manufacturer changes in product features; stocking, specification, and promotion	Strong evidence of reduction in information cost, hidden costs, and bounded rationality; varying degrees of program attribution Great deal of self-reported change in specification practices during the study period	High percentage of program participants are aware of a broad range of product advantages including: longer useful life, reduced lumen degradation, reduced maintenance costs	Durable effects for T-8s and electronic ballasts in office, institution, owner-occupied, and larger company lighting market facilities	Three criteria: where efficient lighting is directly related to management or competitiveness; adoption of purchase policies; high saturation
3304	None stated	Market penetration Influence on professionals and social networks Changes in building design behaviors	None stated	PEC seems to have reached nearly 40% of building owner managers and a large number of the employees of owner managers More than half of survey respondents took actions based on PEC event, including: used technical data, changed internal and design policies/ practices, suggested use of PEC ideas to others, increased use of energy efficiency as equipment selection criterion	Majority of respondents said they expect to continue changes in behavior that they had made as a result of their interactions with the PEC	Criterion: when interpersonal channels begin to work

Continued

Project Number	Market Barriers Examined	Market Effects Measured	Change in Market Barriers	Estimated Market Effects	Reported Likelihood of Lastingness	Criteria for Determining Lastingness
3305	Bounded rationality performance uncertainties Organization practices Hidden cost Product unavailability Asymmetric information Split incentives	Increased penetration of energy-efficient technologies	Reduction of motor and compressor unavailability and performance concerns; lesser reduction in organization practices, bounded rationality	Increased penetration of energy-efficient technologies	Evidence for sustainability of controls, PSC motors, freezer doors, and cycling as standard	Customer attitudes, uses of information, perceptions of market barriers provide "evidence of sustainability"; no systematic assessment or criteria
3306	Spilt Incentives Hassle avoidance Product availability Performance uncertainty	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
3503	Information or search costs Performance uncertainties Asymmetric information	None measured	Unknown changes in market barriers	Not applicable	Not applicable	Not applicable

Continued

Project Number	Market Barriers Examined	Market Effects Measured	Change in Market Barriers	Estimated Market Effects	Reported Likelihood of Lastingness	Criteria for Determining Lastingness
3504	Information costs Performance uncertainties Asymmetric information Bounded rationality	Market demand for and adoption of efficient measures; vendor stocking/ promo practices; manufacturer practice changes; availability and variety of measures; reduction in prices of measures	Significant reductions for participants for information costs, performance uncertainties, information asymmetry; limited reductions for participants for bounded rationality	Increase in purchase of energy efficient alternatives among participants; limited evidence of manufacturers increasing promotions; improved diversity and quality of energy efficient lighting; prices have come down for energy efficient lighting	None demonstrated	Interviewees' qualitative assessment; no evidence of permanent physical or institutional changes required
3505, 3506	Hidden costs Asymmetric information	Comparison to SCE nonparticipants and to others in no-program (GA Power) and audit-only (Louisiana P&L and NYSEG) service territories	No significant change	Significantly higher level of customer familiarity with EE lighting among future replacers in Edison territory than other territories Higher proportion of EE lighting specified by designers Significantly higher percent of EE installations in Edison territory; strongest program effects for lighting	Most likely to be sustained through continued interaction between proponents of energy efficiency and the design community	None stated

Continued

Project Number	Market Barriers Examined	Market Effects Measured	Change in Market Barriers	Estimated Market Effects	Reported Likelihood of Lastingness	Criteria for Determining Lastingness
3507	Information search/hassle costs Performance uncertainties/hidden costs Asymmetric information availability Bounded rationality Organization practices Financing Externalities Mispricing Misplaced/split incentives Product feature separability	Info collection time/cost; pump test hassles; indirect info flows to nonparticipants; purchase doubts; dealer info disadvantage; dealer info advantage; customer complaints; test-driven pump repairs; predictive maintenance incidence; practice changes	Reduced participating customer barriers of information search/hassle costs, performance uncertainties/ hidden costs, asymmetric information, bounded rationality, organization practices	Across the board significant evidence of market effects for participating customers; little evidence of market effects for nonparticipating customers	Likely partial persistence of program impacts	Evidence of institutional changes
3701	None stated; information search cost inferred	Change in customer awareness, attitudes, actions	Reduction in lack of customer awareness and interest	Moderate change and acceleration of adoption; effect of change on energy use evident only in first year after participation; savings do not persist	No support found	Energy savings persistence

Continued

Project Number	Market Barriers Examined	Market Effects Measured	Change in Market Barriers	Estimated Market Effects	Reported Likelihood of Lastingness	Criteria for Determining Lastingness
3702, 3904	Split incentives Asymmetric information	Comparison of participant and comparison area nonparticipant survey results	None	Southern California participants appear to be significantly more aware of these options than Southern California nonparticipants and (with a couple of exceptions) builders in the control area; the programs also seem to have increased awareness levels of architects	No effects; not applicable	None stated
3901	Hassle costs; Performance uncertainty Irreversibility Hidden costs Transaction costs	Not stated	Not analyzed	Identified indirect O&M cost savings	Not addressed	Not addressed

Table 1-5: Studies that Reported Effects

PROGRAM SECTOR AND STIMULUS	STUDIES REVIEWED	MARKET EFFECTS REPORTED	LASTING EFFECTS REPORTED
Residential			
• Information	2	1	0
• Rebates	0	0	0
• Both Information and Rebates	3	2	2
Total Residential Studies	**5**	**3**	**2**
Commercial/Industrial			
• Information	2	2	1
• Rebates	1	1	1
• Both Information and Rebates	2	2	2
Total C/I Studies*	**5**	**5**	**4**
Agricultural			
• Information	1	1	1
Total Agricultural Studies	**1**	**1**	**1**

* *Studies 3306 and 3901 are excluded from this table since they were not designed to measure market effects.*

1.3 COMPARISON WITH SCOPING STUDY FRAMEWORK

Of the 13 studies reviewed, 10 of them were designed and implemented according to guidelines established by the Scoping Study. Nine of the 10 focused on identifying, characterizing, and, in some cases, quantifying, the market effects of the utility DSM programs under consideration. All 10 described their findings in the vocabulary of the Scoping Study, with occasional modifications. While strict adherence to the Scoping Study is not a prerequisite for a top-quality market effects study, by conforming their work to the Scoping Study framework, the authors provided an opportunity to test the practical application of that framework.

Of the remaining three studies, the PG&E Energy Center Study applied a diffusion of innovations framework to the analysis. The DOE Appliance Labeling Study and the Indirect Costs and Benefits Pilot Study were not conducted with Scoping Study in mind. Since the PG&E Energy Center Study included an important critique of the Scoping Study framework, it is discussed, along with the 10 studies that referenced the Scoping Study, throughout the remainder of this chapter. The two remaining studies that did not reference the Scoping Study are not discussed further.

MARKET EFFECTS

As noted above, 10 of the 13 studies we reviewed incorporated the Scoping Study notion of market effects in their evaluation design and implementation, with varying degrees of success. The PG&E Energy Center Study, without necessarily applying the Scoping Study terminology, provided ample evidence of program effects on its target market. Two issues relating to assessing market effects within the Scoping Study framework emerged as problematic: (1) translating the conceptual definition to a functional or operational definition and (2) making the distinction between market effects and market changes.

Applying the Definition of Market Effects

The Scoping Study defined market effects as "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 intervention(s)." The authors explained that market effects "are evidence of whether and to what extent a market barrier(s) has been addressed effectively" (p. 9).

From this and other language in the Scoping Study, it is clear that market effects, as distinct from market changes, are linked directly to market barriers and program interventions. It is also evident that market effects can be either ultimate or proximate indicators of change. By ultimate

indicators, we mean those indicators such as sales volumes and penetration rates that are indicative of or directly measure a program's ultimate success at increasing the adoption of energy-efficient products, services or practices. By proximate indicators, we mean those that may or may not directly measure or be indicative of increases in the adoption of energy-efficient products, services or practices.

The Refrigerator and CFL Study and the Commercial Lighting Study used market share as an indicator of market effects and market transformation. In doing so, they provided an example of the full application of the Scoping Study framework. The authors of the Refrigerator and CFL study, in particular, carefully distinguished between lagging and leading indicators of market effects in order to differentiate their analyses of market barrier reduction and market share.

The authors of the Supermarket Study interpreted that the Scoping Study contained three basic components: program interventions (i.e., programs), customer actions (i.e., specific energy-efficiency measures installed) and barriers (i.e., impediments to those energy-efficiency measures). This interpretation, for the Supermarket Study, the HCF Study and the SCE C&I Market Effects Study, implicitly examined market effects and customer actions. We feel that it is significantly narrower than the Scoping Study's intent. Table 2-1 of the Scoping Study made it clear that the authors intended market effects to extend beyond customers and installation of energy-efficiency measures.[3] While the narrower interpretation encompassed ultimate indicators, it excluded proximate indicators.

This more restricted vision of market effects can produce two negative consequences: it can encourage a focus on end users to the exclusion of other market actors, and it can encourage over-dependence on sales data as the primary measure of program success. The Supermarket Study and the SCE C&I Market Effects Study largely (but not entirely) avoided the pitfalls of the narrow interpretation. Both studies looked at the market from the perspective of a number of market actors and examined a range of indicators of effects, including changes in market actor awareness and attitudes, as well as behavior.

However, the danger of the pitfall was evident from the HEF Study. This Study focused its market effects analysis on measuring changes in customer adoption of energy-efficient technologies and changes in energy consumption. By focusing narrowly on ultimate indicators and end users, the study sacrificed any ability to provide insight into the program's effect on upstream market actors and on the dynamics of the market. The study attempted to establish program attribution by comparing adoption rates and energy consumption of program

[3] We do not believe that Table 2-1 ever was intended to represent a comprehensive list of potential market effects. Rather, we believe that it illustrates the types of effects that offer significant analysis value. Based on our review of these studies, any attempt to develop a comprehensive list of market effects applicable to all types of energy-efficiency and market transformation programs faces enormous obstacles and may be of limited value.

participants to those of program nonparticipants. However, this strategy merely assured that the final results did not accurately depict the overall market. In a nutshell, the evaluation demonstrated that the old DSM impact evaluation paradigm is not well suited for evaluating market transformation programs.

Distinguishing Between Market Effects and Market Changes

In those studies that addressed market effects, making the distinction between market effects and market changes was occasionally problematic. In one case, the Hydraulic Services Study, the authors found it useful to define market change as a formal concept. They defined market change as any kind of observable and measurable change in the market. Market effects were defined as market changes that could be attributed to the program. Likewise, the authors of the Commercial Lighting Study carefully distinguished between market changes that occurred as a result of overall market factors and market effects that were attributable to the utility programs being studied.

The authors of the Customer Technology Application Center (CTAC) evaluation, on the other hand, made no such distinction. As a consequence, the authors at times discussed "market effects" that had no apparent relation to the program intervention or the hypothesized market barriers. In our opinion, the quality of this study would have been improved with greater recognition of the distinction between market changes and market effects.

MARKET BARRIERS

Definitional Issues

The Scoping Study defined market barriers as "any characteristic of the market for an energy-related product, service, or practice that helps to explain the gap between the actual level of investment in or practice of energy efficiency and an increased level that would appear to be cost beneficial" (p. 7). The authors specified that the cost-benefit test should be made from a consumer's or society's point of view.

The importance of this definition became more apparent when we reformulated it in the context of what we consider to be the four central assumptions of the Scoping Study framework of market transformation:

1. Markets can and do operate at less-than-optimal economic efficiency. Reasons for sub-optimal operation are described in the economics literature as market failures.

2. One consequence of inefficient market operation is the inefficient use of energy resources.

3. Evidence of economically-inefficient energy use can be described by reference to market barriers.

4. Interventions can be designed and implemented that reduce market barriers, increase the efficiency of energy use, and produce a net increase in economic efficiency, thus a net increase in social welfare.

Two key points become evident from the Scoping Study assumptions: (1) the policy goal of market transformation is economic efficiency and, (2) the concept of market barriers is a key tool for diagnosing potential economic inefficiencies and tracking progress toward greater efficiency. It also should be evident that the technical definition of market barriers, at least as stated in the Scoping Study, differs significantly from the colloquial understanding of the term, which focuses on market barriers as evidence of *less-than-complete market saturation or adoption* of energy-efficient technologies and practices.

Two examples illustrate the differences between the two definitions. First, the Supermarket Study cited as a case of bounded rationality the fact that energy-efficiency investments are given less priority than investments that spur sales. As evidence of this barrier, the study pointed out that an energy-efficiency investment that reduces costs by $10,000 contributes as much to total profits as an investment that generates $1 million in sales. It would appear that economic efficiency could be improved if supermarkets could be convinced to give energy-efficiency investments higher priority relative to sales-inducing investments. However, the study did not explore the long-term economic value supermarkets derived from expanded market share, even when it came at the short-term expense of return on investment. Without this type of information, one cannot be sure whether a bounded rationality barrier actually existed or whether supermarket managers were, in fact, acting consistently with their economic self-interest.

As a second, more general example, studies cited high first cost as a market barrier. In doing so, they often quoted responses to market actor interviews and surveys. While it is virtually indisputable that high first cost is a barrier to increased market saturation (i.e., a colloquial market barrier), it was not at all evident from the studies reviewed that high first cost was a barrier to increased economic efficiency (i.e., a technical market barrier). In fact, the Scoping Study advanced a fairly cogent argument against *ever* considering first cost as a technical market barrier (while acknowledging its potential as a symptom of underlying barriers).

None of the studies reviewed explicitly addressed the issue of economic efficiency in their discussion of market barriers. However, before dismissing the analyses as failures, it is important to consider the mitigating circumstances. The studies under review examined historic DSM programs that had not been designed with market transformation in mind. Furthermore, the studies focused, for the most part, on providing a retrospective, rather than prospective evaluation. In other words, the studies primarily considered whether the past programs had had effects on past barriers (retrospective focus) and then, secondarily, the studies considered

whether significant barriers continued to exist that could and should have been addressed by future programs.

Of course, for a prospective assessment of market barriers, application of the technical definition is central to the policy objective implicit in the Scoping Study. Policy makers need to know, at least qualitatively, whether improvements in economic efficiency can be attained before committing resources to a particular market transformation initiative. Program planners and designers need to understand how the current market functions inefficiently and which barriers are primarily responsible for that malfunction in order to design well-targeted interventions.

However, for a retrospective assessment, strict focus on reductions in technical market barriers may be overly restrictive. Since resources have already been committed to the program, and the program already has been designed and implemented, it is legitimate to consider the program's effect on all market barriers, whether or not they qualify as technical market barriers, based on economic efficiency criteria. This broader view of market barriers is justifiable, in part, because programs can be expected to affect their targeted markets in ways that had not been anticipated during the design process. The key question to address is whether the program has had an effect in increasing the adoption of energy-efficient products, services or practices.

Based on these considerations, we took a somewhat broader view of market barriers than is defined in the Scoping Study. We did not insist that study authors demonstrate the economic inefficiency of those market conditions they called market barriers. However, we looked for a nexus between the identified barriers and the program design, since such a nexus is a precondition for addressing the question of program effects on adoption. Using this criterion, the market barrier discussions were largely satisfactory, with some exceptions. For example, the Refrigerator and CFL Study identified low energy prices as a historic market barrier. While it is true that higher energy prices tend to encourage energy conservation, the studies presented no evidence that the program could have increased energy prices, either by design or as a side effect. If energy prices were a current market barrier, the study would have had to demonstrate that the combination of higher energy prices and greater energy efficiency would result in greater economic efficiency.

Classification Issues

The Scoping Study listed the following market barrier categories:

1. Information or search costs
2. Performance uncertainties
3. Asymmetric information and opportunism

4. Transaction costs
5. Hidden costs
6. Access to financing
7. Bounded rationality
8. Organization practices or custom
9. Misplaced or split incentives
10. Product or service unavailability
11. Externalities
12. Nonexternality mispricing
13. Inseparability of product features
14. Irreversibility

This list reflects a combination of market failures from neo-classical and transaction cost economics. As such, it includes data from many years' economic research into the workings of markets and the process by which market actors allocate resources. An in-depth understanding of the various barrier categories is an extremely useful tool for diagnosing market imperfections from an economist's perspective.

Nevertheless, economists do not have a monopoly on understanding and explaining the function of markets. Diffusion of innovation theory, through its focus on communication flows and information channels, also lends itself to an analysis of market structure that diagnoses market strengths and weaknesses and identifies opportunities to improve market performance through program interventions. The PG&E Energy Center Study noted the similarity between market barriers described in the Scoping Study and factors influencing the rate of diffusion of innovation. The authors pointed out a number of general factors influencing the rate of diffusion, including the nature of the social system, communication channels, attributes of the product or innovation, characteristics of the market actors involved, type of innovation decision and the extent of promotional efforts.

With these general considerations in mind, we initially expected, and our review confirmed, that strict adherence to the Scoping Study barrier categories, though useful, was not essential to conducting a solid analysis of market barriers. Though this review placed great emphasis on mapping specific study barriers to the barrier categories found in the Scoping Study, that approach reflected our unique need to compare results from multiple studies consistently.

Much more important than using the Scoping Study terminology, in our opinion, is the need to understand thoroughly the market dynamics that contribute to the barrier. We found that the most successful studies consistently and thoroughly characterized the market dynamics and the market barriers' function in limiting the adoption of the technology or practice being studied. These studies supported their characterizations with significant amounts of primary data or, at a minimum, thorough literature reviews and interviews with industry experts. The less successful studies, though they sometimes described their results in the terminology of the Scoping Study, generally exhibited at least one of three types of problems:

- Barriers that were primarily hypothetical or speculative.
- Barriers that showed a tenuous relationship to the Scoping Study, economic theory in general, diffusion of innovation theory or any other conceptual framework.
- Barriers that were so general as to be uninformative.

COMPARISON TO OTHER MARKET TRANSFORMATION FRAMEWORKS

The PG&E Energy Center Study provided a useful case study of diffusion of innovation as a practical approach for tracking market transformation. Furthermore, it provided a valuable perspective for reviewing and critiquing the Scoping Study framework. Diffusion of innovation may not represent a completely different framework. We hope our critique will provide a useful basis upon which to advance a market transformation framework that maximizes the strengths of both perspectives.

The PG&E Energy Center Study discussed the Scoping Study market transformation model at some length. In doing so, it offered several important and valid criticisms. In particular, the study stated: "The [Scoping Study] model focuses on barriers to transformation rather than the process of transformation. ... The model assumes a flow of information but it does not describe the structure and functioning of information flows. ... The perceived characteristics of the product or innovation have much to do with whether and how rapidly an innovation is adopted and markets transformed. The [Scoping Study] market transformation model only partially speaks to this issue through the identification of barriers. ... [T]he market transformation literature does not yet deal with characteristics of those doing the adopting. Transformation occurs in stages and the importance of the barriers change(s) with the stage. ... [T]here are well-established personal characteristics that are correlated with [each] stage of adoption."[4]

[4] PG&E Energy Center Study, p. 12.

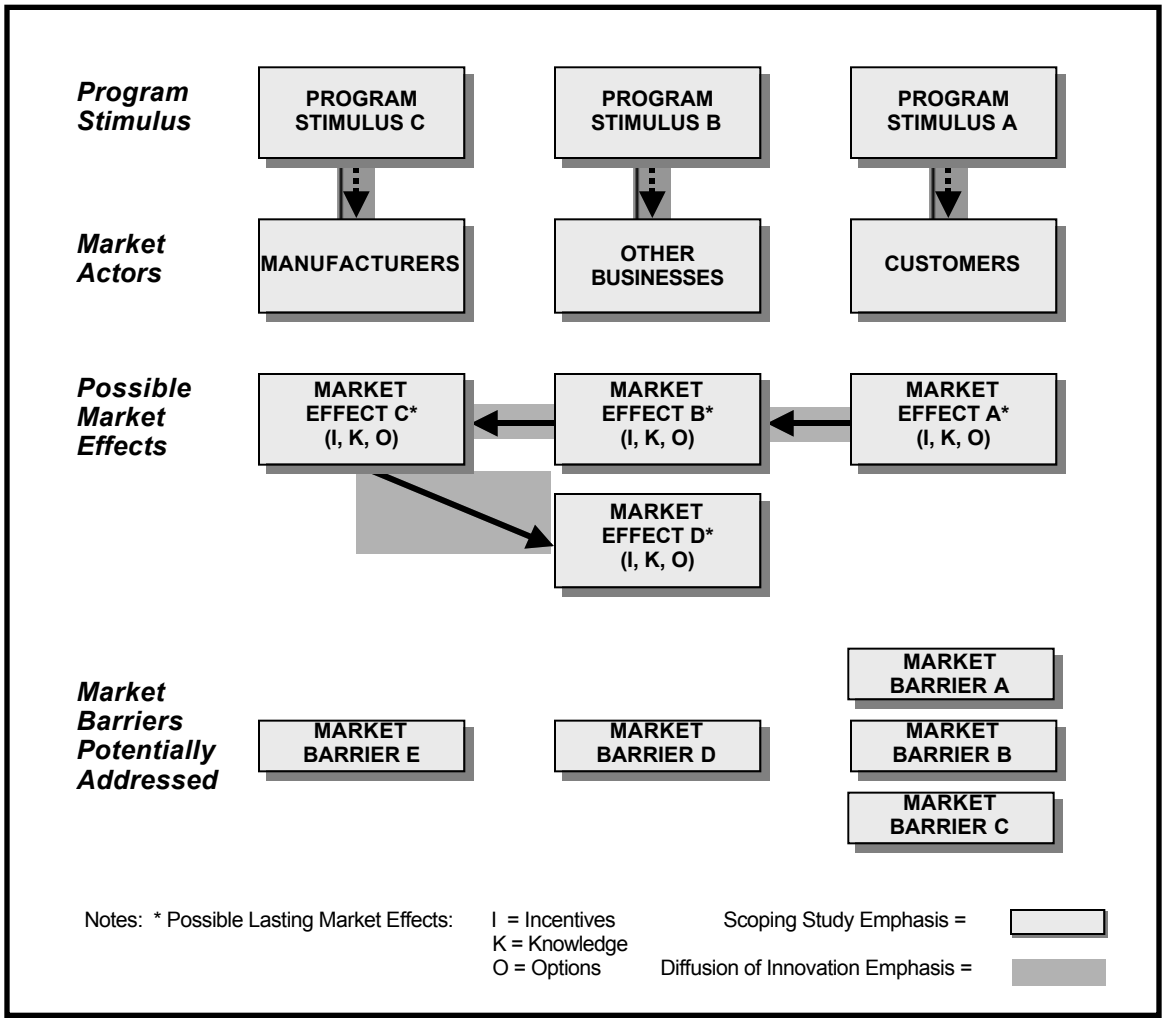
Throughout our review of studies we became aware of a focus on market barriers over information flow in the Scoping Study. Looking at the Scoping Study text it is apparent that this was consistent with the Scoping Study direction.[5] The PG&E Energy Center Study articulated that emphasis most explicitly because of its authors' disagreement with it. However, this disagreement should not be construed as fact that the Scoping Study and diffusion of innovation are completely different views of the marketplace. The Scoping Study recognizes that information must flow among and through market actors. While the text says little about this, the market influence diagrams in the Scoping Study acknowledge it. Figure 1-1 reproduces one of these diagrams, accented to show the elements that the Scoping Study approach emphasizes in contrast with those a diffusion of innovation approach would emphasize.

[5] Scoping Study, p. 17.

Figure 1-1: Scoping Study Market Influence Diagram with Emphases Noted

Reference: Scoping Study, Fig. 3-1

What the accented diagram points out is that the Scoping Study approach uses a market framework that includes diffusion of innovation elements. In this context, we suggest that the



Scoping Study and diffusion of innovation are best seen as different interpretations rather than different frameworks. Where they differ the most is in emphasis. The thin black lines that suggest relationships in the Scoping Study diagrams might be fat with information flow elements in a diffusion of innovation diagram. Integration of the two approaches offers the challenge of finding the optimal balance between focus on "markers" (program stimulus, market actors, market effects, market barriers) and focus on information flow between markers (e.g., how program stimulus information reaches – is seen and interpreted by – market actors). Ultimately, by integrating them we can better understand how and what information about market effects from one market actor triggers effects in another market actor.

The Scoping Study's lack of emphasis on information flows, communication networks and the process of transformation contributed to our concern about the Commercial Lighting Study. In that study, we sensed a lack of clarity about why the utility programs were successful at changing the market. The evaluation, which applied the Scoping Study process of analyzing market effects from a barriers reduction point of view, did an excellent job of cataloging if "x" happened, when it happened and whether it happened because of utility or market factors. But it did not explain how the utility intervention produced outcome "x" beyond attributing the effects to rebates. Returning to Figure 1-1, had the authors paid more attention to the arrows between the marker items, that study might have been even more complete.

Related to this lack of emphasis on information flow in the Scoping Study and primary emphasis on it in diffusion of innovation research, is the element of time. The Scoping Study does little to address the time dimension of market transformation. How and how quickly people process information; how and how quickly this translates into changes in attitudes and behavior are not addressed. This is not to suggest that the Scoping Study authors did not appreciate the time element, only that the text speaks little about it. Again using the Scoping Study market influence diagram as an example, the market is portrayed as static. In fact, we all know that markets are dynamic. The "active" portions within this diagram change over the lifetime of a market transformation program. The components of the diagram itself may change; e.g., new and unforseen energy-efficiency suppliers might enter the market as a successful program matures. Market transformation measurement efforts can benefit from diffusion of innovation ideas by explicitly injecting a time dimension into depictions of the market since diffusion of innovation is all about explaining adoption and change over time.

A final point of distinction that the PG&E Energy Center Study authors made between the Scoping Study and diffusion of innovation is about which characteristics matter most in measuring market transformation. The Scoping Study puts characteristics of the market in the forefront, defining market barrier as a "characteristic of the market" [6] and then focusing analysis around reduction in market barriers. While market actors, and therefore their characteristics, are inherently included in what should be looked at, the text leaves the entire area of examining specific characteristics untouched. In contrast, diffusion of innovation research has yielded systematic characterizations of consumer types within the ultimate user market actor group (e.g., early adopters, late adopters) and revolves around an understanding that specific characteristics of the ultimate user group and of the innovation itself to determine both the timing and the extent of the adoption. Thus, while the Scoping Study approach and diffusion of innovation approach can be accommodated within the Scoping Study framework, the difference in focus, along with the difference in emphasis (markers vs. information flow) has implications for the data that might be collected to measure market transformation.

[6] Scoping Study, p. 7.

We believe the Scoping Study model would be greatly enhanced by incorporating a theory of communication from the diffusion of innovation literature. We concur with the authors of the PG&E Energy Center Study that diffusion of innovation theory complements and fills in aspects of market change that were left unaddressed in the Scoping Study instead of replacing or competing with it.

SUSTAINABILITY AND LASTINGNESS

While the Scoping Study did not spell out specific criteria for assuming lastingness of any particular market effect, its application of the notion of lastingness in its discussion of past program results seemed to rely on relatively strict standards of evidence. As evidence of lastingness, the Scoping Study cited changes in government standards or regulations, physical changes in production or distribution practices that are not easily undone and institutional changes in standard practice that do not rely on the continuing influence of individuals or program intervention for their permanence. On the issues of behavioral effects, the Scoping Study provided the following guidance:

> [I]f the overall process by which a utility energy-efficiency program affects the market can be described in a causal sequence of specific behavioral changes on the part of various market actors, then the behavioral changes that are posited as coming before the end of this sequence are, by definition, not lasting. ... [W]hether the behavioral changes that are posited as coming at the end of the sequence can be regarded as lasting is largely a matter of whether a case can be made that, once the program is withdrawn, there are no obvious incentives...present that would cause behavior to revert to the original 'pre-intervention' scenario.[7]

As will be discussed in more detail below, few of the studies reviewed approached the issue of lastingness or sustainability systematically. Many of them did not address the issue at all and some that did simply relied on professional judgment to assess the probable sustainability of the effects they observed. Four studies that provided more in-depth assessment of sustainability were the Refrigerator and CFL Study, the Commercial Lighting Study, the Hydraulic Services Study, and the PG&E Energy Center Study.

The first three studies did a good job of addressing the issue of sustainability within the guidelines provided in the Scoping Study. The Hydraulics Study applied a standard of proof of sustainability that was generally consistent with the one discussed and applied in the Scoping Study. The authors of the Refrigerator and CFL Study did not specify any criteria for sustainability but did require that multiple indicators point to sustainability before they would

[7] Scoping Study, p. 19.

conclude that there was a lasting market effect. This, we feel was an acceptable level of rigor. The authors of the Commercial Lighting Study, on the other hand, hypothesized a set of conditions that would have to be met before sustainability of the market effects (which the study referred to as "durability") could be assured. These conditions were relatively independent; proof of one did not guarantee that the other conditions would be met. Even with this rigorous approach, however, the authors were able to identify segments where durable or sustainable change was likely. They also noted others in which long-term change appeared less likely but which they couldn't substantiate from the data.

In all three of these studies, the analysis of sustainability suffered from a weakness in the Scoping Study framework, upon which the studies were based. The Scoping Study did not develop a coherent model of market dynamics that provide necessary preconditions for sustainable market-transforming effects. Using the framework, it was difficult to relate different sets of market changes to each other, or present changes to past changes, and to understand the implications of past and present changes for future changes.

The PG&E Energy Center Study came the closest to applying a coherent model of market dynamics by applying diffusion of innovation theory to the analysis. An attractive feature of the diffusion of innovation framework for estimating market effects and their sustainability is the framework's usefulness in modeling the rate of adoption as a function of time. (In this context, adoption should be understood broadly to include adoption of practices and behaviors as well as technologies.) The literature describes successful applications of diffusion models to project future adoption rates, based on past adoption rates. Short of a quantitative analysis to estimate a diffusion curve, diffusion of innovation theory provides critical insights into market dynamics that would permit a qualitative assessment of the likelihood of sustainable effects, based on knowledge of adoption rates, information flows, decision-maker characteristics and characteristics of the product or practice. While a quantitative analysis was out of the scope of the PG&E Energy Center Study, the general emphasis on diffusion of innovation in this study opened the door for increased application of these diffusion of innovation concepts for market transformation evaluation.

RECOMMENDATIONS FOR MODIFICATIONS TO THE SCOPING STUDY FRAMEWORK

Based on our review of these studies, we have developed the following recommendations for advancing the art of evaluating market transformation programs. Making modifications to the Scoping Study framework certainly is one option for communicating these issues to the wider evaluation community.

- **Emphasize knowledge of market structure and information flows.** Market transformation programs focus on markets, not isolated groups of customers. To be

successful, the program design, implementation, and evaluation must be firmly rooted in a detailed understanding of market dynamics. Rebalancing the focus from specific markers, such as market barriers, to include information flow for understanding market dynamics would make for better evaluations.

- **Clarify the definition of market barriers and how these concepts should be used in both program design and evaluation**. As noted above, the appropriate definition of market barrier may depend on its intended application.

- **Emphasize links between market characterizations, market barriers, program interventions and market effects in both program design and evaluation.** Industry practitioners should be clear that program interventions should be tailored to address specific identified barriers in the marketplace and that market effects selected for tracking throughout the program should provide direct evidence of changes in those barriers as a result of the program interventions.

- **Policymakers should encourage applied research into the nature of market barriers.** Future research efforts could make a contribution by establishing a direct correspondence between specific diffusion rate-limiting factors and market barriers from the Scoping Study typology or market failures from transaction cost economics. At a minimum, diffusion of innovation concepts could be applied to analyze how the Scoping Study barriers relate to each other and how they affect rates of adoption, based on product and service features and the characteristics of the market actors involved.

- **Distinguish between market changes observed independent of the program and market effects attributed in whole or in part to the program**. While the Scoping Study includes the notion of market change, the casual reader may overlook it. One solution would be to elevate the notion of market change to the status of a formal well-defined concept.

- **Policymakers and evaluators should develop and elaborate on the process, standards, or criteria that can best be used to measure sustainability.** The notion of sustainability or lastingness should be clearly defined to provide unambiguous direction for its measurement. Diffusion of innovation theory may be of particular value by describing necessary preconditions for self-sustaining diffusion processes. Again, rebalancing the emphasis to also focus on information flow for market change would be an improvement.

1.4 STUDY METHODS REVIEW

STRENGTHS AND WEAKNESSES OF THE EVALUATION DESIGNS AND METHODOLOGIES

Evaluation Designs

Two significant issues emerged during our review of the evaluation designs employed in the 12 market effects studies: (1) the establishment of an evaluation baseline, and (2) an evaluation focus at the market level versus the program level. Since these studies focused on programs that had not been designed to transform markets, they did not have the luxury of turning to appropriate baseline data that had been collected during program design. Thus nearly all studies had to grapple with establishment of an appropriate baseline for measurement of market effects. (The DOE Appliance Labeling Study looked only at baseline market conditions in conjunction with a pilot program. No market effects were analyzed. Similarly, PG&E's C&I Baseline Study focused primarily on baseline conditions, though some discussion of historical program market effects was included.)

Evaluation Baselines

Two general strategies were used to establish evaluation baselines: cross-sectional comparisons between groups of market actors and time-series comparisons between current and historical market conditions. In our opinion, the studies producing the most robust results were those that used a combination of those strategies.

Five studies relied heavily on time-series data for the analysis baseline and several other studies included a time-series analysis of specific parameters. For the most part, studies developed time-series data by interviewing market actors about current and historic market conditions. This technique was particularly prevalent for measuring changes in intangibles such as awareness and attitudes. By comparing market actor descriptions of current conditions with reported baseline conditions, the evaluators attempted to estimate the change in market conditions. This method suffered from several inevitable weaknesses. Notably, it was most vulnerable to bias due to poor recall on the part of interviewees and potential bias due to interviewees' tendency to represent past actions and conditions in a light that would be most favorable to their current and future situations.

In addition to self-report or recall data, several studies were able to assemble time-series data from other sources. For example, the Gas SCG/SDG&E Residential New Construction Study was able to document baseline efficiency data for several technologies from a number of existing data sources as well as from Title 24 documentation maintained by various city building

departments in Southern California. The Commercial Lighting Study compiled extensive time-series data to track trends in factors such as ballast shipments, program expenditures and equipment prices. Similarly, the PG&E Energy Center Study drew on historic participation data to document changes in market-actors' exposure to PG&E Energy Center programs over time. Clearly, assembling time-series data without relying on self-reports, while desirable, is heavily dependent on secondary data sources.

In addition to the time-series approach, about half the studies included a cross-sectional analysis. Table 1-6 shows selected comparison areas for studies that used cross-sectional designs. The rationale for the selection of the comparison areas was generally well argued and sufficiently supported with empirical evidence of its similarity to the program area. Of course, almost inevitably, all the selected comparison areas presented opportunities to question the influence of possible cross-sectional differences on the study conclusions.

Table 1-6: Studies Using Cross-Sectional Design

STUDY	COMPARISON AREA
Hydraulic Services	Arizona
Supermarket	Commonwealth Edison
SCE C&I Market Effects	Georgia Power, Louisiana Power & Light, NYSEG
SDG&E Residential New Construction	Austin/San Antonio Corridor
Commercial Lighting	Arkansas, Kansas, Louisiana, Mississippi, Missouri, New Mexico, North Carolina, Oklahoma, Pennsylvania, South Carolina, Texas
PG&E's C&I Baseline	Commonwealth Edison
Refrigerator & CFL	National

The Refrigerator and CFL Study uniquely used interviews with purchasers of equipment to assemble cross-sectional, time-series data. Calling consumers in the utility service territory and nationally, using random digit dialing, the authors located purchasers of refrigerators in 1986, 1991 and 1996. The purchasers provided the name plate data for their refrigerator, allowing the authors to make highly accurate estimates of market share for each year.

The PG&E Energy Center Study provided the most detailed formal discussion of time-series versus cross-sectional analyses. In a nutshell, a cross-sectional analysis focused on differences between population segments. However, the proper focus of a market effects study is changes

within a population segment over time. This conceptual mismatch between evaluation objective and method, combined with the practical difficulties of finding the ideal comparison area, make strictly cross-sectional analysis a less-than-ideal study design.
In future evaluations we anticipate that time-series analyses, perhaps with a cross-sectional component, will tend to be preferred over strictly cross-sectional analyses. As programs are designed specifically to meet market transformation objectives, collection of appropriate baseline data during program design should increasingly become the norm and the potential bias inherent in time-series analysis should be greatly reduced. As the PG&E Energy Center Study argued, and as our review findings corroborated, the best study designs will include a strong time-series component, with a cross-sectional component for triangulation purposes.

Market Focus

A second methodology issue that emerged from our review was the evaluation focus at the market level versus the program level. In our opinion, the ability to learn about market effects from several studies, notably the Hydraulic Services Study, the CTAC Study, the HEF Study and the SCE C&I Market Effects Study, was significantly compromised by the lack of a market focus. The first two studies, Hydraulic Services and CTAC, focused their data collection efforts on program participants and ignored the larger market. Thus market effects were equated with direct program effects. The third study, the HEF Study collected data from program participants and nonparticipants but considered only differences between the two groups as evidence of market effects. As a result, market effects were equated with direct program effects after subtracting out potential indirect effects. Finally, the SCE C&I Market Effects Study focused on program nonparticipants, so market effects were equated with indirect program effects.

All four studies lacked quantitative data regarding overall market size and market share for the efficient technologies and practices targeted. The studies did not offer enough information to compare sampled customers to the population they presumably represented. Thus, the studies were unable to comment on the programs' effects on the overall market.

The need for a market focus was further emphasized by the successful inclusion of a market characterization in a number of the study designs, particularly those that were completed later in the process. These studies demonstrated the inherent complexity of the markets being examined. Furthermore, as the PG&E Energy Center Study highlighted, years of research into the diffusion of innovations point out the danger of focusing on isolated market elements to the exclusion of the overall market structure and communication networks. Collectively, these studies showed the importance of understanding the entire market structure and dynamics in order to:

- Demonstrate the existence of market barriers (i.e., provide a rationale for market interventions).

- Identify changes in the market over time.
- Attribute changes to program interventions.
- Assess the likelihood that observed changes will be sustainable.

Of course, all the market characterizations could be criticized for being incomplete in one way or another. But the studies that included a thorough characterization were much more successful at making a coherent and convincing case for the market effects they attributed to the program. The set of studies reviewed provided relatively thorough market characterizations for the following market segments and technologies:

- Commercial lighting
- Residential new construction
- Supermarket refrigeration
- Commercial building maintenance and design
- Commercial HVAC
- Commercial motors

In addition, useful information to support a complete market characterization could be found for residential refrigeration and gas appliances.

We believe that adopting a two-tiered approach – the first tier being a market characterization study and the second tier being a market effects study designed around the first tier results – should be a high priority element of any evaluation that attempts to assess the market effects of programs that were not explicitly designed as market transformation programs. Adopting such an approach may be less critical for future market transformation programs that include detailed market characterization studies. In any event, the focus of the evaluation should be on the entire market.

Evaluation Methods

For the most part, the studies we reviewed relied primarily on tabulations and cross-tabulations of survey data to derive their quantitative results. The studies also used summaries of qualitative responses to interview questions. While a couple of studies used linear regression techniques to demonstrate relationships between key parameters, reliance on complex statistical techniques

was minimal. However, a few studies applied approaches that, historically, have not been used widely in DSM evaluations. These approaches are discussed below.

Focus Groups

Several studies made excellent use of focus groups as part of their evaluation design, notably, the DOE Appliance Labeling Study, PG&E's C&I Baseline Study, the Supermarket Study and the Indirect Costs and Benefits Pilot Study. Focus groups appeared to be most effective when they were part of the market characterization to explore in depth various issues related to market dynamics and hypotheses about possible market barriers. Focus group results often were used to refine hypotheses about market effects and to target evaluation resources toward issues in greatest need of evaluation. In a sense, focus groups served to "pre-test" the evaluation design.

The most notable such application was in the Supermarket Study, where focus group results, combined with literature review findings and in-depth interviews with program staff, provided the basis for limiting the evaluation to large supermarkets with centralized refrigeration systems. In contrast, studies that lacked such in-depth preliminary reconnaissance were more prone to rely on untested notions of market dynamics for the entire evaluation design or to test for possible market barriers using generic survey questions that were not necessarily linked to the particular conditions of the market segment being investigated.

Multivariate Procedures

Several studies very effectively used multivariate procedures such as factor analysis and principal components analysis. These studies included the PG&E Energy Center Study, PG&E's C&I Baseline Study, SCE C&I Market Effects Study, the Indirect Costs and Benefits Pilot Study and the HEF Study. These techniques generally were used to analyze survey respondents' answers to multiple, related questions to identify a reduced number of latent variables or factors that distinguished between sets of questions or sets of respondents. The techniques were particularly useful in identifying underlying relationships between numerous interrelated market barriers. Using multivariate techniques, evaluators were able to identify a few salient barriers and key market actor segments that experienced those barriers.

Other Specialized Techniques

Several studies included relatively more complex or specialized techniques among their evaluation methods. For example, the PG&E C&I Baseline Study used structural equation modeling (SEM) to establish links between parameters that might be related, in this case, program exposure, perceived barriers and purchase intentions. The PG&E and SCE Residential New Construction study attempted an innovative quantitative analysis using analytic hierarchy process (AHP).

While, based on this study, AHP would appear to hold great promise for use in market transformation contexts, the application in this study was significantly compromised by resource constraints that limited the amount of data that could be collected to support the analysis.

The Indirect Costs and Benefits Pilot Study also introduced a technique from market research – gap analysis – that could prove very effective for market effects analysis. This study analyzed the differences between expected and experienced indirect costs and benefits to examine market barriers/effects.

Finally, the PG&E Energy Center Study, which applied diffusion of innovation concepts to market effects evaluation, examined using diffusion curve estimation as a way of modeling the rate of adoption as a function of time. (In this context, adoption should be understood broadly to include adoption of practices and behaviors as well as technologies.) While study resources did not actually permit diffusion curves to be estimated, the study did link market effects evaluation to a body of literature that describes successful applications of diffusion models to project future adoption rates, based on past adoption rates. In the context of adoption of technologies, a quantitative modeling technique could circumvent at least one of the objections to the use of sales data, namely, that it is a lagging indicator of program success. Put simply, prospects for sustainable effects could be analyzed from a diffusion model forecast of future adoption rates, eliminating the need to wait an extended period after the program intervention to observe if adoption rates proved sustainable.[8]

Comparison to Economic Framework

For the most part, the studies reviewed as part of this project adhered, with varying degrees of success, to the Scoping Study framework. While the wealth of experience of these studies provided a solid basis for critiquing the Scoping Study, the studies did not, with two exceptions, either extend the Scoping Study's application of economics or propose an alternative perspective. One study discussed a few Scoping Study concepts from the perspective of welfare economics, but the principles of welfare economics did not appear in any way central to the evaluation design or results.

The two exceptions were the Indirect Costs and Benefits Pilot Study and the PG&E Center Study. The first study attempted to extend the application of economic concepts by monetizing indirect costs and benefits for use in a cost-effectiveness analysis. In this way, the study contrasted with the other studies reviewed, which took a more qualitative approach to assessing costs and benefits. Based on our review of this study, it appears that monetizing indirect costs

[8] Provided the model can be meaningfully estimated with policy-relevant explanatory variables (i.e., with variables that could be influenced by the intervention).

and benefits is feasible, although the particular results of this study are open to question. Also uncertain is the value of quantifying costs and benefits so precisely, given the resources required to produce valid results.

The PG&E Center Study offered a valuable critique of the economic framework, in that it documented the need to integrate the complementary concepts of diffusion of innovation research into market transformation research and the Scoping Study for a more comprehensive picture of market dynamics. By emphasizing the importance of communication channels, diffusion of innovation theory recognizes the fundamental sociability of human beings. This perspective contrasts sharply with the classical economic model, which envisions humans as isolated, purely rational, fully informed, self-interested decision-makers. By emphasizing diffusion of innovation concepts, this study avoided some of the blind spots inherent in an economic-dominated perspective of human behavior. In doing so, it also helped identify those blind spots.

STRENGTHS AND WEAKNESSES OF THE DATA COLLECTION PROCEDURES

Assessment of Data Completeness

There is often a tradeoff in data collection: you can either collect all the data you wish or stay within a resource limit and risk collecting too little data. Prioritizing data needs and then focusing study design and data collection efforts on high-priority needs are critical to balancing the two. In many ways, these initial market effects studies pioneered issues involved in and methods for performing market effects studies. However, determining priorities is still in progress.

The data completeness assessment identified issues relating to the following topics:

- Selecting and prioritizing data collection efforts on identification of market players and market conditions, comparison area data, historical conditions and on program participant and nonparticipant data
- Obtaining enough data to examine market effects for the whole market
- Collecting relevant data to measure effects on each market barrier identified and their proximate indicators
- Using data collected in prior studies and
- Collecting enough data for defensible results.

Selecting and Prioritizing

A primary difference between a demand side management (DSM) evaluation and a market effects study (or market transformation measurement study) is at the locus of change. In a DSM study, the focus is on one market actor—the participant—while the focus in market transformation studies is the market, including all market actors. This difference necessitates that data be collected from a broader spectrum of market participants.

Most of these initial market effects studies had problems in the data completeness; they had either limited their view of the market, or used too few data points. The PG&E and SCE Residential New Construction study conducted interviews with market actors using well-designed instruments that provided data for an innovative tradeoff analysis model. However, the study had extremely small sample sizes (49 market actors) and did not collect primary data from home buyers (a group that presented several market barriers) or lenders (another key population with an identified market barrier).

The CTAC study collected customer data from a sample of program participants and used interviews with a small sample of trade allies to provide identification of the market examined or potential market effects in the overall market or sub-market. However, in neither sample did they specify the size of the population.

Similarly, the DOE Appliance Labeling study did not collect or analyze data to ensure that it could be extrapolated to represent the market as a whole. The Hydraulic Services Study did not collect current data from nonparticipants. (However, this latter study incorporated some of the prior nonparticipant studies in its final analyses.)

The HEF Study contained large sample sizes (700 respondents from both participants and nonparticipants). Generally, researchers prefer as large a sample size as possible. Yet, in this case we believe that the study's authors misallocated their resources. The study lacked many elements of authentic market effects analysis. If the authors had used much smaller sample sizes they could have reallocated resources to address these missing elements.

Examining the Whole Market

The market effects perspective also changes the overriding approach evaluators should take to measurement. Rather than examining programs, studies of market effects and market transformation measurement need to concentrate on the markets themselves and then simultaneously examine all programs as well as nonprogram influences that affect those markets. This was highlighted by the CTAC and Supermarket studies in which the trade allies in the overall market analysis discussed other utility interventions more often than the CTAC or Supermarket programs.

Separating program effects from overall market changes also requires significant changes in the way measurement studies are planned, coordinated, funded and managed. Many of the studies addressed overlapping markets, such as residential new construction, refrigerators and residential lighting. Yet most of the market studies were designed around programs rather than around the markets themselves.

At a minimum, every study should provide a description of the market being analyzed. This needs to include some indication of who the participants are and the market's size and general operation. It is no longer sufficient to provide an overview of a program without a clear understanding of how that program fits into the market it is attempting to change.

The Supermarket Study presented a useful range of basic market statistics at the national level. Numbers and types of market actors were analyzed for the study area, but with little direct connection to the national numbers.

Many of the studies' authors interviewed a broad spectrum of the market participants. Studies of significant breadth included: both Residential New Construction studies, the Commercial Lighting Study, the Refrigerator and CFL Study, the PG&E Energy Center Study, and the Supermarket Study. Some studies focused on the ultimate consumers and missed the important difference between a market transformation focus on the whole market versus the DSM paradigm's focus on the program participant.

Another problem occurred when study authors included information from all potential market participants instead of concentrating on recent participants' perspectives on the current market. Unfortunately, the latter often requires lengthy and costly screening to determine which customers actually have been in the market (by purchasing or considering a purchase). Such an approach was implemented in the Refrigerator and CFL Study. Authors of SCE's C&I Market Effects Study considerably improved the quality of their work by performing this screening and using it to examine actual behaviors and reactions rather than just attitudes or hypothetical intentions. In another approach, PG&E's C&I Baseline Study used purchase intentions as the most downstream variable examined.

Measuring Market Barrier Effects

Several of these initial market effects studies would have benefited from research designs and data collection efforts that were more focused on the market barriers and on measuring their proximate indicators. In many of the studies, we found the discussions of market barriers and market effects to be almost disconnected from the actual research conducted, rather than focusing the research tightly around their goals.

Several studies, however, were noteworthy exceptions. One of these was the development and use of a market characterization study in the PG&E and SCE Residential New Construction Study. However, this study relied almost exclusively upon interviews with DSM professionals rather than actual market actors.

From reviewing these studies it became clear that it is wise to use the initial study steps to develop the final study design. This is particularly important in cases where a market characterization study has not already been performed. The multitier design we recommend can include a significant literature review followed by initial focus groups to identify the market barriers and to help develop the appropriate phrasing for questions for a larger survey. This strategy would help avoid study "blind spots" from overlooked questions, excluded market actors or small sample sizes. Elements of this technique were used effectively in the Supermarket Study. That study was initiated by an in-depth literature review. That review, and subsequent and informal interviews conducted at the Food Marketing Institute Show in Chicago, were used to design the remaining study elements. Initial open-ended interviews were used in the HEF Study to focus the development of its larger fixed question surveys. A thorough literature review served this purpose in PG&E's C&I Baseline Study. The Indirect Costs and Benefits Study also used customer focus groups initially to define the indirect costs and benefits to be examined.

The PG&E Energy Center Study provided an innovative examination of communication flows in related professional organizations. This required using data sources and types of analyses that often have been ignored.

Using Data Collected Previously

A positive lesson from these studies was provided by the Hydraulic Services Study, which used nonparticipant information from prior studies. This illustrated the potential benefits of adopting this approach in the future, especially for market characterization efforts. SCG/SDG&E's Residential New Construction Study also contained good examples of using prior data in developing a baseline. However, the efficiency program evaluation field generally has made limited use of prior research.

Using a variety of data, particularly previously collected data, can enhance greatly a market effects study. However, successful usage can be determined only if the secondary data and their use in the study is well documented. The HEF Study used secondary data, but did not document this use sufficiently. In contrast, the Refrigerator and CFL Study did an excellent job of documenting how each survey provided data for each component of its analysis.

Compromises often are required when using previously collected data. In the HEF Study, the 1992 pre-program survey was conducted by mail, while the 1997 survey for the market effects study was conducted by phone. In the analysis, the difference between the two approaches was

noted as one explanation of why findings were difficult to confirm. The HEF Study should have used a mail survey to increase confidence in the comparative results.

Collecting Data for Defensible Results

We found results to be more credible in the studies that focused on how the market operated and why market actors behaved as they did. Our confidence increased when the studies were based on a market characterization, a thorough literature review or initial focus groups from which the study design was drawn.

The Commercial Lighting Study had a very comprehensive approach, collecting surveys from numerous market actors and from adequately sized samples. Yet, we recognize that not all studies and market transformation efforts can cost-effectively sample and survey to the extent that this study's authors did.
Reductions in sample sizes and depth often are caused by resource limitations. Decisions about these characteristics should be made carefully. PG&E's C&I Baseline Study used responses from small focus groups with vendors to determine penetration. We agree with the authors that it can be very difficult to assure accuracy and also watch costs when obtaining penetration estimates through customer surveys. We believe that larger vendor interview samples could have provided more reasonable and reliable penetration estimates.

In some studies, depth compensated for smaller sample sizes and the results appeared credible. For example, the Supermarket Study's sample sizes were small due to a limited number of market actors. Yet, many important vendors were interviewed, including corporate, marketing, R&D and field marketing and service – a depth that boosted the study's credibility.

Over time, DSM-based evaluations have become more sophisticated. In particular, study authors consider more elements (such as building type, rate class and kWh consumption) when selecting sampling criteria. This tradition was evidenced in the HEF and SCE's C&I market effects studies. However, it may not be appropriate to use so much time and other resources in a market effects study. Though the procedure for drawing a comparable out-of-territory sample was reasonable in SCE's C&I Study, the authors did not justify why they chose the approach (which used different sampling methods for the service-territory sample and the comparison group) when a simpler method could have been used for both groups, thereby reducing costs and doubts about comparability.

Comparisons to similar markets in other regions likely will be an important component of market effects studies. Many of the studies used such an analysis. Often study authors compared customer surveys. However, market effects studies need to include comparisons among other market participants. A few of the studies used this type of innovation. For instance, SCE's C&I Market Effects Study used contractor and trade ally interviews in comparison areas. This greatly

enhanced the examination of market barriers and the comparison of program and nonprogram areas. Another example was the use of focus groups in Chicago as part of the Supermarket Study.

When using comparison groups, study authors must document properly why they chose the comparison group. This was well done in the Hydraulics Services Study but not in the Supermarket Study.

Sample disposition also must be documented carefully. Sample disposition is particularly important in studies with low response rates. Many of them did not provide this documentation which reduced their credibility. Several of these studies examined multiple market actors, across time, regions, or both. We found this particularly problematic in the Commercial Lighting Study. We would like to have seen a sample disposition. This would have helped us understand the sample's sufficiency, given its nonrandomness due to poor response rate, and would inform researchers in this market and improve future efforts. A similar lack of sample disposition was noticeable in the Indirect Costs and Benefits Pilot Study, which suffered from an extremely poor response rate from nonparticipants.
In addition, attention to detail can add significantly to the credibility of any study. This was obvious in the Refrigerator and CFL Study where the collection of usable name plate data was innovative and successful and the amount of data collected was exceptional. Similarly, significant effort proved fruitful in the SCG/SDG&E Residential New Construction Study. In this study the authors examined Title 24 information obtained from city building departments.

Assessment of Data Collection Procedures

Overall, the quality of the data collected was quite good. Most of the studies followed data collection procedures consistent with industry standards.

Representativeness of the market was one of the greatest issues we noted in the studies' general data collection procedures. For example, the DOE Appliance Labeling Study used intercept interviews and focus groups with Circuit City shoppers. We question if this sample's results correctly represent either the populations of Circuit City shoppers or the general Los Angeles area. This issue was not addressed in the study and is of particular concern since it is easy to hypothesize that Circuit City shoppers are more price-conscious than the average shopper.

The problems with the PG&E and SCE Residential New Construction Study included extremely small sample sizes and a reliance on DSM professionals rather than market actors for the market characterization. Therefore, we question the generalizability of the study results.

Market effects studies, unlike DSM-based evaluations, also require careful attention to how questions regarding program attribution are phrased. This becomes even more difficult when researchers try to measure effects of indirect program interventions. Social psychology research

suggests that once people adopt a particular behavior or attitude, they ascribe the cause of the behavior to their own action rather than to other causes. As a result, analysis based on direct questions only would tend to overestimate the importance of individual choices and underestimate the importance of other factors, such as program interventions. This was true for the SCG/SDG&E Residential New Construction Study, which could have been improved if a less direct line of questioning, using setup questions and questions focused on the decision process had been used. The resulting information would have been less vulnerable to bias.

Bias also may occur in the selection of comparison groups. Using an out-of-state national sample can overestimate the amount of naturally-occurring savings (or market trend activity) since the national sample would include other regions where energy-efficiency activities also are taking place. This occurred and was pointed out in the Refrigerator and CFL Study. Comparison groups must be selected carefully.

Interesting qualitative data collection methods were pursued in these studies. In particular, we felt that the quality of the data collected from customers and trade allies in the CTAC Study was excellent. However, the research design did not provide the information from the most appropriate sectors and the analysis failed to use the wealth of data available to provide a market characterization.

Well-planned market transformation efforts are expected to begin with a market assessment or market characterization study that discovers the market structure and operation, and the market barriers that exist in the market and can be reduced or eliminated by a market transformation effort. Then the design of the market transformation program can proceed while a baseline study is conducted to measure the proximate, distant and ultimate indicators. These efforts will provide an excellent foundation for a well-focused before/after measurement of the market transformation effects.

This type of approach can avoid several weaknesses found in these initial market effects studies. The Hydraulic Services Study spent a significant portion of its funds on distributor and manufacturer interviews. Yet the study found no significant market barrier related to product availability. Had this information been available in a prior market assessment, the study's resources could have better been used (for example, to collect current nonparticipant information). Similarly, the CTAC Study was weakened by not having been designed around an identified market or submarket. The PG&E and SCE Residential New Construction Study attempted to address the lack of historical data by using two strategies to ask questions about historical conditions versus current change-of-conditions. The authors' choice of methods contained a significant threat to the validity of the results. Such a problem would not occur if baseline measurements were available.

Market characterization also could be used effectively to compare the service territory to comparison groups. In this way, the market characterization would help build a case for

causality. The Commercial Lighting Study was very successful in this regard. Such an approach would greatly have helped the SCE C&I Market Effects Study, which lacked strong evidence of causality.

One of the more sophisticated elements in survey design was seen in PG&E's C&I Baseline Study. The survey for this study used random assignment to determine if market barrier questions referred to "high efficiency" as equipment with SEER 11 or SEER 14. Further development of this type of research could prove fruitful. For example, does the relationship between market barriers and market acceptance change as we move from SEER 11 to SEER 14?

We recognize that some of the weaknesses in the studies' data collection processes reflect the fact that they were some of the first market effects studies ever done and that they were not carried out on market transformation programs *per se*. Future measurement efforts will benefit from lessons learned from these studies and from evaluating true market transformation efforts. This should significantly reduce the types of weaknesses discussed above.

We feel that the following guidelines may help guide future market effects and market transformation evaluations:

1. Define market barriers based on a characterization of the market. Collect data to test whether the barriers remain after the program is completed. Do not collect data from market participants and then retrospectively label these findings as the market barriers the program might have addressed.

2. Market effects studies should collect data directly from market participants; using market experts as proxies to identify market actor attitudes, preferences, decision factors and program effects is insufficient at best and inappropriate at worst.

3. While "enough data" is vague, a market effects study must be based on data from a large enough number of relevant market actors to ensure that the results are credible given market size and the magnitude of expected intervention expenditure.

4. To ensure that the selected sample is indeed representative of the market, market effects studies need to identify clearly each market participant population before developing a sampling plan.

SUSTAINABILITY AND LASTINGNESS

Sustainability was the most poorly developed of all the areas this review examined. Six of the 13 studies either failed to address sustainability at all or did so only cursorily. One of the six was

not designed to address sustainability, although others were.[9] Clearly, it is the area most in need of improvement in future market effects and market transformation studies, and, we anticipate, the area in which much methodological work will focus.

Criteria Examined for Sustainability

In general, discussions of designing market transformation programs for sustainability and assessing sustainability are in their infancy. As discussed earlier in this report, while the Scoping Study introduced the issue of sustainability as an important element in the move to market transformation, it provided little definitive guidance on this topic. Nonetheless, when conducting evaluations, one should refer to the goals and objectives of the effort and determine which sustainable effects are likely to emerge. These potential sustainable effects then should be measured and an assessment made as to the likelihood that the transformation will be permanent given:

- New market entrants
- Valuing of non-energy benefits
- Position and momentum in the diffusion process
- Institutional adoption
- Market structure changes that eliminate barriers
- The development of profitable private market entities to facilitate continued market transformation.

Our review found that future evaluations of market transformation or market effects should provide specific criteria for measuring sustainability early on. Most likely this will be done during program design, but at least should be part of the evaluation design. There must be logic behind the selected criteria and how the criteria relate to the market barriers and program interventions being examined. This will enable researchers to create a step-by-step, systematic approach for measuring sustainability. This type of approach was the main element lacking in the initial market effects studies reviewed in this study.

Half of the studies provided no specific criteria for measuring sustainability related to the program and market being examined. Another quarter had specific criteria that we did not feel met

[9] The Indirect Costs and Benefits Pilot Study, reviewed in the Appendix, was not designed as a market effects study and, therefore, did not address sustainability.

the definition of sustainability. Four studies did provide sufficient analysis of sustainability: the Commercial Lighting Study, the Hydraulic Services Study, the Refrigerator and CFL Study and the PG&E Energy Center Study.

Yet only one provided a set of criteria for the assessment. The authors of the Commercial Lighting Study used the term durability and provided three primary criteria to determine if customers would continue to select efficient lighting equipment. These were:

- Use of efficient lighting products that is directly related to key modes of competition or management
- Adoption of stated purchase policies
- High saturation of efficient equipment.

The other studies, whether they were successful in other ways or not, failed to be explicit in their criteria. For instance, the PG&E Energy Center Study was designed around a theoretical foundation from the diffusion of innovation field. From this, the authors concluded, "transformation of the market does not kick in until the interpersonal channels really begin to work." This was their criterion for sustainability.

The CTAC Study provided the following specific criteria for sustainability:

- The program intervention caused permanent changes in the process used by customers to search for, select or consider energy-using equipment.
- Private market actors will step in and continue to fulfill the function or service provided by the program intervention.[10]

Yet the CTAC Study did not follow through with subsequent research steps to evaluate sustainability according to these criteria. The authors stated that a measure of sustainability was not easily provided in the context of a "one-time retrospective study." We do not agree fully. While sustainability may take repeated measurement efforts, and true sustainability may take years to demonstrate, if the focus of the research is clearly stated, single-point measurement can provide evidence of sustainability that is reliable and valid.

The PG&E and SCE Residential New Construction Study applied a relatively generous standard that observed effects were likely to be permanent, even when they were slight. Absent evidence of permanence, we do not think that the authors could draw this conclusion. We are inclined to

[10] CTAC Study, p. 3-2.

assume that the rapid pace of change in every sector of the economy and society will quickly dilute or negate observed market effects once the market intervention is withdrawn.

On the other hand, the Refrigerator and CFL Study began with a very weak statement about criteria, indicating that they would use triangulation. However, when they applied this method, the authors were rigorous, and were unable to conclude that many effects would last. This points out that, while criteria are important, it is the application of the criteria that determines how effective the study is in assessing sustainability.

We noted one use of persistence measurement to equal sustainability, in the HEF Study. Another study examined the sustainability of market transformation of participants (long-term participant spillover) as evidenced by participants' indication that they still refer to CTAC material and remembered what they had learned. Both of these studies did not really address sustainability, but rather persistence of the customers' action.

Persistence is important to DSM impact analysis but as discussed in the Scoping Study does not equate to sustainability. Sustainability, in the Scoping Study framework, refers to a shift by and continued commitment among (the same or other) customers after the reduction or elimination of the program. In this parlance, sustainability refers to future actions or propensity to act by nonparticipants and participants, not continued effects from a past customer action.

Assessment of Sustainability Findings

There are two steps required for a finding of sustainability of market effects. These are a finding of market effects and then a finding that these effects are sustainable. Several of the studies reviewed did not find market effects. Given this, they could not be expected to find sustainable market effects. The studies falling into this latter situation were: both Residential New Construction studies, the Supermarket Study, PG&E's C&I Baseline Study, the DOE Appliance Labeling Study, the SCE C&I Market Effects Study and the HEF Study.

Among the studies that did find market effects, the Commercial Lighting Market Effects Study provided the most convincing evidence of sustainability of market effects. The authors could prove some durable market effects for T-8s and electronic ballasts in the lighting markets of the office, institutional, owner-occupied and larger company sectors. In addition to finding significant market share for T-8s and electronic ballasts, the authors cited multiple sources with significant rigor for these conclusions. This makes their conclusions convincing, even though they are by inference.

An indication of at least one significant contribution that future studies could make was presented by the PG&E Energy Center Study. Its diffusion of innovation approach provided a useful framework for examining possible sustainability and forecasting future adoption rates.

Using this approach, the PG&E Energy Center Study examined the level of information flow through interpersonal channels by examining the roles of program participants in opinion-making institutions such as professional associations. The authors did not find enough information flow through these channels to indicate that they could be self-sustaining. Both the theoretical approach and the techniques designed to gather evidence were quite innovative and offered significant useful information for the design of future sustainability analyses.

The authors of the Refrigerator and CFL Study found two permanent changes for CFLs (price reductions and technical performance standards), and one likely permanent change for both measures (increased awareness). The findings for CFLs noted that these changes were caused by the California utility programs. However, given the existence of similar programs in other parts of the country, attribution solely to California utilities at times seemed a stretch despite the rigor applied to the study.

The Supermarket Study listed "evidence of sustainability."[11] Yet, some of these items supported sustainability while others were arguments against it, with no systematic assessment presented. The study authors expressed the opinion that customer attitudes, uses of information and perceptions of market barriers indicated likely sustainable areas of market effects. Nevertheless, this conclusion contradicted the authors' finding that program effects other than general awareness were linked to rebates and that the program may have fostered an overdependence on rebates as a precondition for undertaking energy-efficiency actions.

The Supermarket Study also missed an excellent opportunity to measure the effects of the program in the absence of its incentives. The study found that the number of market actors was quite limited in the utility's service territory and nationally. They also had collected data from participants on their behavior in the service territory (where incentives were available) and in other areas, as well as in a comparison territory. Examination of the behavior of the participants in other areas and the comparison territory would have indicated how they would have behaved after incentives had been removed, and, therefore, the possible sustainability of market effects.

By using the generous criteria for sustainability in the PG&E and SCE Residential New Construction Study, the authors concluded that most observed effects likely would be permanent, even when they were considered slight. We are quite skeptical of both sets of claims. Small effects are likely to mean that the diffusion has not gone far enough to be self-propelling, leading to easy erosion of the effects as new market participants enter and the larger community network influences market participants to move back to the norm.

[11] Supermarket Study, Exhibit 4-7.

The Hydraulic Services Study examined sustainability more thoroughly. The study estimated that 50% of the pump testing would continue to occur in the absence of the program.[12] An important data element for this sustainability analysis was the information that 60% of current SCE-area nonparticipants reported pump testing through non-SCE sources – a fact that would not have been available if the earlier nonparticipant surveys had not been used in the final analyses.

Given the degradation that could occur in customer attitudes without continued support and with the movement of new customers into the market, the study provided a sustainability estimate of pump testing in the absence of the program of 34% of affected premises and savings of 40%.

There was, however, a significant gap in the sustainability assessment. An important part of assessing sustainability needs to be the sustainability of the entire chain involved in reaching the program's ultimate goals. The goal of a market transformation pump-testing program should be to develop markets for efficient equipment and better, more regular, pump maintenance. This would boost energy efficiency. All of the sustainability criteria and findings in the study were for pump testing, not the ultimate desired impacts of energy savings.

[12] Hydraulic Services Study, pp. 2-12.

1.5 CONCLUSIONS AND RECOMMENDATIONS

This chapter includes our assessment of the future use of the market effects studies and our summary of conclusions based on our review. Overall, the market effects studies provided the most extensive attempt to date to evaluate energy-efficiency programs for market transformation and market effects.

Recognizing that the studies focused on demand side management programs, not market transformation programs, the Market Effects subcommittee of CADMAC wisely termed these efforts market effects studies, i.e., studies to determine if there had been any market effects resulting from demand side management programs. The context for the studies, however, was quite different from that which market transformation programs now experience or may be expected to experience in the future. Though market effects always will be a focus, the data sets will be different for future market effects studies. More than likely, they will include the ability to conduct periodic measurement of market characteristics. Most important, we expect that baseline data collection will be commonplace.

Even though the context of future studies will differ from those we reviewed, we found a wealth of information in these market effects studies. We believe they can be used by program planners in California and elsewhere to design viable market transformation programs. They also can be used by evaluation researchers to show how different techniques can be used to measure market effects.

In this chapter we discuss the future use of the market effects studies and then summarize our conclusions.

OPPORTUNITIES FOR FUTURE USE OF THE MARKET EFFECTS EVALUATION

Potential for these Programs as Market Transformation Programs

In truth, none of the DSM programs examined in the market effects studies proved to be highly efficient market transformation programs. Nonetheless, market effects were observed in several markets, and the authors at times were willing and able to declare that the effects were likely to be long-lasting and sustained without DSM program interventions. Of these it appears that one market already had experienced significant transformation and may require minimal intervention in the future.

The programs for which there appeared to be the greatest evidence of market transformation are those examined in the Commercial Lighting Study. The authors of this study found that several market barriers had been reduced and that the majority of office and institutional sector and large

commercial businesses and owner-occupied facilities had switched to using T-8s and electronic ballasts. In contrast to the transformation in these segments, other segments had barely been touched (small facilities, leased facilities, retail and miscellaneous businesses). Throughout these market effects studies for PG&E's and SDG&E's customers in the commercial sector we noted additional references to these commercial lighting rebate programs. An important component of the PG&E Energy Center activities is commercial lighting, as was noted in the Commercial Lighting Study.[13]

Another finding of lighting market effects is noted in the SCE C&I Market Effects Study. In the lighting market "at least some evidence of market effects could be observed for each chain in the market."[14] The Supermarket Study also found that the rebate programs had had significant impacts on the supermarket segment's ability and willingness to invest in lighting energy efficiency.

Another finding of sustained market effects occurred in the Hydraulic Services Study, which estimated that 50% of the pump testing that resulted from the program would continue, even without the program.[15] The study reported that 60% of nonparticipants used non-Edison sources for pump testing and also reported that the water masters were requiring pump testing. These findings suggest that pump testing will continue in the market.

Some of the other studies successfully documented lasting market effects. One was the Refrigerator and CFL Market Study. The study found that the barrier of awareness of energy-efficient refrigerators and CFLs likely has been permanently reduced and that the performance standards for CFLs has been permanently improved. However, the authors concluded that increases in market share for both technologies could not be expected to last.

A strong finding of market effects was found for the Pacific Energy Center. Using the diffusion of innovation research paradigm, the authors found that the Center was reaching 40% of its target market and that customers in that target market were being influenced by their experience with the Center.

The PG&E C&I Baseline Study found permanent market effects for motors over 50 HP, suggesting that the market for these motors had been transformed in the industrial sector. As noted in the discussion on sustainability and lastingness, methodologies for measuring long-term effects were weak in most of the studies. Thus, it is difficult to conclude that market effects from

---

13 *PG&E and SDG&E Commercial Lighting Study,* pp. 1-4.

14 *Evaluating the Market Effects of Southern California Edison's Commercial and Industrial Energy Efficiency Programs,* p. ES-4.

15 Hydraulic Services Study, pp. 2-12.

these DSM programs were minimal. However, when we read these studies, it was apparent that the market effects were limited, and that without some type of continued intervention they were unlikely to persist on their own.
What we cannot conclude from these studies is what actually makes market effects occur. The commercial lighting programs offered significant rebates. But so did other less "successful" programs. As noted previously and in our review of the Commercial Lighting Study, we cannot discern whether the rebates or the program delivery strategy was the key driver in the program's success. We sense that a delivery strategy that is responsive to the market, in tandem with rebates, is critical to effectively gaining market share.

OPPORTUNITIES FOR IMPROVEMENTS IN MARKET TRANSFORMATION PROGRAM DESIGN

These 13 studies provided a wealth of information for market transformation program design. As noted previously, several of the studies gave sufficient information to develop market characterizations for specific end-use markets or market segments, including:

- Commercial lighting
- Residential new construction
- Supermarket refrigeration
- Commercial building maintenance and design
- Commercial HVAC
- Commercial motors.

It should be noted, however, that future program designers will have to analyze these studies carefully and may want to compare data in one study against others. The CTAC and the PG&E Energy Center studies data sets cover such a range of commercial technologies that they are likely to be useful in developing market characterizations for many segments or end-uses. As noted in the discussion of data completeness, markets are complex. Several studies we reviewed, when viewed together, provide a more comprehensive picture of the market for energy efficiency. In particular, anyone interested in the commercial sector should examine the entire set of studies, beginning first with the PG&E Center Study and then including the other studies to increase the depth and clarity of the market place.

Several studies also sought to develop baseline data. The DOE Appliance Labeling Study focused on developing a baseline for residential appliances. This study was quite good but was limited to shoppers at a single chain, Circuit City. Additional data would be required to develop a full

baseline. The PG&E C&I Baseline Study also sought to develop a baseline. This study was unsatisfactory largely because the penetration estimates emerged from focus group results. However, it could provide a basis for additional baseline estimation.

The SCG/SDG&E Residential New Construction Study, the Refrigerator and CFL Study and the Commercial Lighting Study provide sound documentation of historic trends for the markets they studied. These studies were thoroughly executed and therefore provide good baseline measures for future program development.

Other benefits for market transformation program designers from these studies are more qualitative. Reading these studies would clearly inform program designers about the methods used to conduct market characterization studies. Similarly, the studies provide insights on each segment of interest. Even the weakest studies provide new data. Ultimately, however, more data will be required for most technologies or market segments with transformation potential.

Opportunity for Improvements in New Market Transformation Evaluation

These 13 studies tested a variety of evaluation research strategies. In general, the studies demonstrated that the application of traditional data collection and analysis techniques could be effective (i.e., surveys, focus groups, interviews, and analysis of past program and market data work). However, we discovered that if the wrong question is asked, the evaluation technique won't solve the problem. Similarly, it is essential to include all market participants of potential interest; if researchers skip a group they can severely compromise their ability to draw definitive conclusions.

On the other hand, as might be expected, measuring sustainability will require a different research strategy than that used in DSM. Billing analysis for the measurement of persistence is not the same as measuring for sustainable market effects. While the techniques may be similar to DSM program evaluation, the questions are different and therefore application of the techniques must be different and must reflect the issues of market transformation. What we expect to see in future market effects studies of market transformation programs is the ability to spell out the anticipated effects in the program design stage and to measure for these effects.

As discussed in the methods section, a few specialized techniques emerged: structural equation modeling, analytical hierarchy process and gap analysis. Each of these techniques has potential to add to our ability to analyze and understand market effects. In addition, the PG&E Center Study relied on the diffusion of innovation literature to study market effects. Of all of the new techniques we observed in these studies, this one seemed to provide benefits that could not have been obtained from other strategies. As noted in our discussion of the Scoping Study framework, the melding of the Scoping Study framework with the diffusion of innovation literature shows great promise for improving our ability to measure and monitor market effects.

Another area that will challenge evaluators is the development of questions to explore market barriers, and the underlying reasons "high first cost" is often heard as a response from retailers and customers. Another area for question development is to explore whether there are self-sustaining interpersonal communication channels resulting from market transformation programs. Such data would enhance a diffusion of innovation approach to evaluation of a program.

We found that most of the studies that used prior evaluation results in their analyses did so quite effectively. The Hydraulic Services Study, the Refrigerator and CFL Study and the Commercial Lighting Study all used past program evaluations. This strategy demonstrated that past evaluations can be "mined" for information that may prove useful for enhancing evaluation analyses without collecting additional data.

Most of the studies relied heavily on qualitative data, especially to justify claims of attribution of effects to the utility programs. We note two lessons from these studies:

1. Sample sizes must be sufficient so that results can be generalized or considered representative of the market actors under consideration, even if qualitative data are used.

2. Qualitative data are not very useful for making claims of the amount and value of various market effects, or for estimating market penetration. However, they are useful for discerning attribution of measured effects where market effects must be differentiated from market changes. In these instances, qualitative data gathered from a variety of sources can be used to make reliable claims of attribution.

Finally, though none of the studies had access to baseline or time-series data, almost all noted this as a critical necessity to answer questions about market changes and market effects. The Refrigerator and CFL Study demonstrated that for certain technologies, baseline and time-series data can be gathered after-the-fact, but refrigerators probably present a unique situation. No other technology we know of has such easily-obtained and consistently high-quality name plate data. Without baseline data, gathered during program design or in the initial months of program implementation, market effects studies will be as difficult to do for market transformation programs as they were for DSM programs.

The key lessons that emerge are that future evaluations of market transformation programs will use data collection methods similar to those used in process and market evaluations of DSM programs. However, the quantitative tools for analysis of these data, the types of questions asked and the contacts from whom data are collected will expand. Time-series data are a necessity and can be enhanced when combined with comparable cross-sectional data. The result will be more comprehensive knowledge of the market. And with the collection of baseline data as well, the results of future market studies will become valid and reliable indicators of market effects.

SUMMARY CONCLUSIONS AND RECOMMENDATIONS FOR PROGRAM DESIGN AND EVALUATION

The 13 market effects studies are leading examples of how to study market effects. Some of the studies demonstrated things that just don't work, e.g., billing analysis for sustainability, small samples and failure to include nonparticipants. But in general, the studies provided fertile ground for learning about market effects measurement and the effects DSM programs have had in some California markets.

Our review suggests that one market has been transformed as a result of DSM investment: commercial sector use of T-8s and electronic ballasts. Additional effort could be expended in segments that have been slower to transform, and if these are cost-effective, they warrant attention. However, given the limited market effects found in other markets, there remain significant opportunities to increase energy efficiency in California. These 13 studies provide information with which to develop market transformation programs.

In addition, the review provided key lessons about the design and implementation of market transformation programs and their evaluation. We hope that these lessons ensure that future market effects studies measure effects better. In that light, we offer the following recommendations:

The Scoping Study provides an excellent framework for market effects and market transformation program design and evaluation. However, we feel strongly that use of the diffusion of innovation literature should be expanded in efforts to measure and design market transformation programs. By including the diffusion of innovation perspective in market effects measurement, some of the weaknesses of the Scoping Study will be alleviated. We also propose some slight modifications to the Scoping Study that should be kept in mind by those who use the Scoping Study and the CBEE Policy Guidelines. The changes we recommend are:

- Emphasize knowledge of market structure and information flows that emerge from an understanding of the diffusion of innovation literature.
- Clarify the definition of market barrier as pertains to its application.
- Emphasize the links between market barriers, program interventions and market effects.
- Expand research into the nature of market barriers.
- Distinguish between market effects and market changes.

- Elaborate on measurement standards for sustainability.

Program designers and evaluators should adopt a two-tiered approach to market effects measurement. The first tier should include a market characterization study, and the second tier a market effects study designed around the first tier results. We feel that this strategy should be a high priority element of evaluations that assess market effects. Adopting such an approach may be less critical for future market transformation programs that include detailed market characterization studies in the program design. However, if the program design does not include a market characterization, one should be included in the evaluation.

Evaluations of market transformation programs will use data collection methods similar to those used in process and market evaluations of DSM programs but will analyze those data differently. These include: surveys, focus groups, interviews and secondary data review. However, the quantitative tools for analysis of these data will expand to include techniques such as factor analysis, structural equation modeling, forecasting of market share, analytical hierarchy process, etc. This will result in more comprehensive knowledge of the market. We also anticipate an increase in the collection of baseline data and the reliance on time-series analyses, perhaps with a cross-sectional component, rather than strictly cross-sectional analyses. Most important, these studies will be market-focused, not participant-focused.

Data collection procedures should follow from a comprehensive understanding of the market. The following steps will ensure a more complete data collection strategy.

- Define market barriers from a characterization of the market, and then collect data to test whether the barriers remain. Do not collect data from market participants and then retrospectively label these findings as the market barriers the program might address or might have addressed.

- Market effects studies should collect data directly from market participants; using market experts as proxies to identify market actor attitudes, preferences, decision factors and program effects is insufficient at best and inappropriate at worst.

- While determining what is "enough" data is tricky, a market effects study must be based on data from a large enough number of relevant market actors to give the results credibility (given market size and the magnitude of expected intervention expenditure).

- Market effects studies need to clearly identify each market participant population before developing a sampling plan to ensure that the selected sample is indeed representative of the market.

Researchers should refer to the goals and objectives of the effort and set criteria for the sustainable effects that are likely to emerge based on those goals and objectives. Potential

sustainable effects should be measured and an assessment made as to the likelihood that the transformation will be permanent. Based on the lessons learned in this review and our reflection on how to think about sustainability, some of the likely conditions for sustainable market effects are:

- New market entrants
- Valuing of non-energy benefits
- Position and momentum in the diffusion process
- Institutional adoption
- Market structure changes that eliminate barriers
- The development of profitable private market entities to facilitate continued market transformation.

MARKET EFFECTS SUMMARY STUDY

Final Report

APPENDIX A:
A REVIEW OF THE SCOPING STUDY

APPENDIX A

A REVIEW OF THE SCOPING STUDY

INTRODUCTION

The Scoping Study was in many ways ground-breaking work when it was written in July 1996. Most of the work in the energy efficiency field that directly addressed market transformation at that time focused upon defining market transformation and what it means to this industry. The Scoping Study provided an important contribution to the market transformation debate by clearly defining that term and by clarifying the relationship between the conceptual framework provided by economics and the notion of market transformation based on experience and observation.

It may be worth noting that many of the basic ideas contained in the Scoping Study had been published and discussed previously by the Scoping Study authors and others. However, the Scoping Study advanced the market transformation debate in two important ways: (a) it explored key ideas in a level of detail not found in previous published sources; and (b) it brought those ideas to a wider audience, by virtue of the high visibility of the authors and the sponsor.

Market transformation has drawn increased attention in the energy-efficiency field since the publication of the Scoping Study. As a consequence, new ideas and refinements in the theory and practice of market transformation continue to emerge. In view of recent developments in the field, this review provides a summary of the Scoping Study, discusses its results and conclusions within the context of other relevant publications, and discusses the implications of these findings for conducting a review of the 14 market effects evaluations recently commissioned by CADMAC.

SCOPING STUDY SUMMARY

For purposes of this review project and evaluation in general, the core content of the scoping study is contained in Chapters 2 through 5. The Scoping Study also devotes considerable attention in Chapters 4 and 5 to a discussion of regulatory and policy issues that promote and impede the implementation of market transformation. While important and insightful, those issues are not central to the evaluation issues that motivate this review and thus will be ignored.

Chapter 2 provides definitions of key terms and lists of relevant market barriers and market effects. This chapter establishes the conceptual framework for market transformation that is used throughout the rest of the study. Chapter 3 develops a strategy for reviewing energy efficiency programs for evidence of market effects, based on the conceptual framework for market transformation developed in Chapter 2, and then applies the strategy to four classes of utility programs: incentives programs, information programs, new construction programs and direct

assistance programs. Chapter 5 provides conclusions and recommendations pertaining to both policy issues and issues pertaining to evaluation design and implementation. We will restrict our review of Chapter 5 to the latter.

Chapter 2: Market Barriers, Market Effects and Market Transformation

Chapter 2 provides the following definitions and concepts.

Market Barrier: "Any characteristic of the market for an energy-related product, service, or practice that helps to explain the gap between the actual level of investment in or practice of energy efficiency and an increased level that would appear to be cost beneficial" (p. 7). Eto, Prahl and Schlegel specify that the cost-benefit test should be from a consumer's or society's point of view. A list of market barriers includes:

- Information or search costs
- Performance uncertainties
- Asymmetric information and opportunism
- Transaction costs
- Hidden costs
- Access to financing
- Bounded rationality
- Organization practices or custom
- Misplaced or split incentives
- Product or service unavailability
- Externalities
- Nonexternality mispricing
- Inseparability of product features
- Irreversibility.

Descriptions of these barriers are provided on pages 13 through 16. Eto, Prahl and Schlegel note that the list is empirical rather than reflective of a consistent conceptual framework. Where appropriate, they indicate important relationships among barriers and identify areas in which they overlap.

High first cost is not considered a market barrier because it is not useful in explaining the gap between the actual level of investment in or practice of energy efficiency and an increased level that would appear to be cost-beneficial. For example, "…if high first cost is considered to be a market barrier and is the only market barrier addressed by a program, then discontinuation of the program would, by definition, result in a reversion to purchasing and operating practices that existed prior to the program. As a result, there would be no evidence of market transformation" (p.12).

Market Failure: "A condition of a market that violates one or more neoclassical assumptions (e.g., perfect information, costless transactions, no externalities, rational behavior, etc.) [p. 8]." Harris and Carmen list eight major market failures: imperfect competition, excessive competition, anticompetitive conduct, imperfect information, side effects, public goods (de)merit goods and income maldistribution.

Market Intervention: "A deliberate effort by government or utilities to reduce market barriers and thereby change the level of investment in (or practice of) energy efficiency. … A net beneficial outcome requires that the increase in the adoption, procurement, or practice of energy efficiency is not offset by other losses. …[pp. 8-9]."

Market Effect: "A change in the structure of a market of 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 casually related to market intervention(s). … If there is no observable market effect, then… the relevant market barriers have not been reduced to a noticeable degree [p. 9]." Market effects are interactive and can be transient or lasting. Table 2-1 lists market effects potentially attributable to utility energy efficiency programs by market actor.

Market Transformation: "A reduction in market barriers resulting from a market intervention, as evidenced by a set of market effects, that last after the intervention has been withdrawn, reduced, or changed [p. 10]." Eto, Prahl and Schlegel focus only on transformations that affect economic efficiency, not social equity.

Market Actors include but are not limited to the following: "(a) consumers; (b) retail providers (such as equipment vendors, material suppliers, and new home sales staff); (c) wholesale distributors; (d) ancillary, nonfinancial intermediaries (such as design professionals and auditors); (f) financial intermediaries (such as banks and other lending institutions); (g) manufacturers (including, to some extent, builders and their subcontractors); and (h) government agencies (including both state and local building code officials) [p.17]." The methodological orientation of

the scoping study focuses on the behavior of actors in the market rather than the underlying social structure of markets.

Chapter 3: Evidence for Market Transformation from Recent California Utility Energy-Efficiency Programs

Eto, Prahl and Schlegel set out the following strategy for reviewing utility energy-efficiency programs: (a) describe how programs operate, market barriers targeted, and strategies used to overcome them; (b) identify market effects and the extent to which they can be attributed to programs; (c) speculate about which effects might be lasting (p. 21).

They summarize the findings of their review using a market influence diagram, which illustrates the interrelationships between market interventions (program stimulus), market actors, market effects and market barriers. Market effects are categorized by the type of mechanism believed to be driving the behavioral change: changes in options, changes in incentives and changes in knowledge, awareness, and attitudes.

In reviewing a number of utility energy-efficiency programs, Eto, Prahl and Schlegel find an array of anecdotal evidence suggesting that programs have had significant market effects. However, more systematic evidence is generally restricted to the existence of monitoring and evaluation reports that document measurable spillover effects. For the most part, Eto, Prahl and Schlegel conclude that claims of market effects are entirely plausible but generally unproven.

Chapter 5: Conclusions and Recommendations

Recommendations 8, 12 and 15 address evaluation design and implementation issues. These recommendations are provided below.

Recommendation #8 is that "…the CPUC and others consider adopting broad definitions of performance and success…" As part of the discussion of this recommendation, Eto, Prahl and Schlegel list three metrics for defining success:

- Ultimate outcomes (energy and demand savings, product sales or market penetration)
- Indicators of market effects (indicators of lasting market effects and/or reductions in market barriers)
- Effective and efficient performance of planned activities (good-faith implementation).

Eto, Prahl and Schlegel further note that ultimate outcomes may not be practical or viable for most market transformation activities. Thus they recommend that indicators of market effects be

used as the metric because the indicators are timely and observable, the agent has the ability to affect them, they can often be used to develop or forecast estimates of market penetration and load impacts, and the information collected can help improve the initiative in a timely manner. Eto, Prahl and Schlegel also discuss conditions under which reliance on good-faith implementation as the metric would be appropriate.
Recommendation #12 states that "Evaluation and research related to market transformation efforts should not be focused solely on end-results, to be used primarily for performance incentives." Eto, Prahl and Schlegel emphasize the importance of evaluation and research to support program planning and design and short-term performance measurement as well as long-term impact evaluation.

Recommendation #15 provides a list of considerations for the evaluation of market effects:

- Articulate specific theories about what market effects and reductions in market barriers specific interventions are expected to have
- Measure a wide range of market indicators, both before, during, and after interventions, using a variety of methods
- Compare observed changes in market indicators (i.e., market effects), and the sequence of these changes, to what would be expected if the program is working as intended, as well as to estimates of what would have occurred in the absence of the intervention (i.e., market effects caused by the program)
- Link observations of market effects to reductions in market barriers
- Develop a system for ongoing feedback, so that indicators of effects can be assessed along the way
- Use the forecasts and scenario analysis to assess likely future outcomes and inform interim decisions (because it is not practical to wait for longer-term results)
- When quantifying environmental and resource benefits, focus efforts on the causal role of the program in increasing market adoption of measures, rather than on estimating the net savings per measure adopted
- Recognize that changes can take place in multiple markets and market segments, and can result from multiple interventions over several years (rather than from one program in a single year)
- Accept that the estimates and results, though they may well be sufficient for the needs of policy makers, will still be relatively imprecise (compared to the results of load impact studies conducted under a resource acquisition framework).

SCOPING STUDY IN THE CONTEXT OF PREVIOUS AND SUBSEQUENT PUBLISHED DISCUSSIONS OF MARKET TRANSFORMATION

Definition of Market Transformation

Feldman (1995) provides a useful review of definitions of market transformation that were in currency in 1995. Many were originally put forward at EPRI's market transformation workshop in July 1994. Among the definitions he cites are the following:

- Schlegel, Edgar, Prahl, Kushler (1993 report for the California Public Utilities Commission): "..when DSM programs induce a lasting, beneficial change in the behavior of some group of actors within a market system."

- Prahl (EPRI Workshop): "when a DSM program induces some group of market actors to change its behavior in a manner that leads to lasting increases in the diffusion of energy efficiency measures and practices."

- Schlegel (NARUC Summer Meetings, 1994):"...a strategic effort by utilities and other entities to induce lasting structural or behavioral changes in the market that result in increases in the adoption and penetration of energy efficient technologies and practices."

- Nadel and Geller (1994 ACEEE Summer Study): "…process whereby energy efficient innovations are introduced into the marketplace and over time penetrate a large portion of the eligible market…"

- Feldman (EPRI Workshop): "…any change in a market such that the set of individuals or groups is modified in its nature or size, the mix of economic goods and services exchanged is altered, [or] the rules of exchange are reconstructed."

- Bonneville Power Administration: "An activity with a limited duration and a definite end date, with the potential to transform the market by increasing end-use efficiency after the sponsor's funding has ended."

- Farhang (EPRI Workshop) "…an evolutionary process through which products/processes/ practices are introduced into the market and over time penetrate a large portion of the target market… [it] involves ongoing and lasting changes [and such a] market does not regress."

Feldman concludes his review with a summary of the generally accepted definition from the EPRI Workshop: "…the continuing effect on the market beyond intervention by a market player…a planned objective that may be accomplished by a broad variety of marketing strategies." Key attributes of market transformation are: "can affect a submarket, not necessarily the entire

market; achieves earlier adoption of energy-efficient technologies and behavior; achieves higher penetration; creates lasting effects on behavior; represents effects beyond or after withdrawal of promotional program; focuses on energy-user behavior, not just measures or technologies; [and] targets specific actors in the (sub)market."

Elsewhere Feldman (1996) defines market transformation as those programs that are "…specifically designed to overcome identifiable problems in an existing market for energy-efficient products or services, and to do so in a manner that persists once the program has been terminated."

In addition to Feldman's work, a number of other definitions have appeared in the professional literature. For example, Kitchin (1993) offers the following definition: "…the change in the market for energy services where new products, new processes and new practices that were once available only in specialty niches become widely available and used."

Tatsutani (1995), writing in a special market transformation issue of the *Energy Service Journal*, defines market transformation by stating that its objective is "…to create broad and sustained changes in markets that persist beyond specific utility efforts."

Gordon and Eckman (1995), writing in the same issue, offer the following: "Market transformation programs are designed to change what is 'normal,' to induce permanent increases in the efficiencies resulting from everyday purchasing and operation decisions. The objective is to find ways to eliminate critical market barriers that keep consumers and vendors from making economically rational choices, and then make inefficiency noncompetitive, inconvenient, or illegal.

Again from the same issue, Rosenberg (1995) has this to say about the subject: "Market transformation refers to the utility's contribution to longer-term market developments that accelerate the adoption of efficiency measures…Market transformation is a longer term process that involves a sequence of adjustments in suppliers' competitive strategies, government policies, utility regulation and program, and customer behavior and beliefs." He goes on to cite Prahl and Schlegel (1993) as providing the convergent definition of market transformation.

Suozzo and Nadel (1996) also cite Schlegel and Prahl when they write "…market transformation generally refers to the process by which collective action, policies, and programs effect a positive, lasting change in the market for energy-efficient technologies and services, such that these technologies and services are produced, recommended, and purchased in increasing quantity. Underlying this concept is the assumption that strategic actions have the potential to fundamentally change the course of the evolution of market such that efficient products or services can ultimately flourish in the absence of incentives (Schlegel and Prahl 1994)."

Judging from the volume that Schlegel and Prahl have written on the subject of market transformation and the frequency with which their works are cited as sources, it is evident the

two have been particularly influential in establishing a degree of consensus around the definition of market transformation. Thus it is not surprising that the definition provided in the Scoping Study is generally consistent with the range of definitions provided in the literature. There appears to be broad consensus that market transformation stems from strategic or intentional interventions in the marketplace, as opposed to undirected changes in market structure due to the internal dynamics of the market itself. There also seems to be agreement that market transformation results in a redefinition of what constitutes standard practice or business as usual among market actors.

The most notable difference among the definitions is the different emphasis authors place on the evidence considered symptomatic of fundamental changes in standard practice. Many authors emphasize the notion of lastingness, in the sense that observed changes should remain in evidence well after the intervention is discontinued. But some other authors, notably Nadel and Geller but also Kitchin and Farhang, emphasize broad market penetration as the key indicator that standard practices have been transformed. Interestingly, the definition Schlegel offered at the 1994 NARUC Summer Meetings combines both the emphasis on lastingness and market penetration. However, the Scoping Study drops any reference to market penetration in its definition of the concept.

The primary operational difference between the two may be one of timing. Market penetration is a trailing indicator of the effect of market transformation programs. Only after the effects of the intervention have rippled through the entire market structure would the impact of the intervention become apparent in the form of expanded market penetration. While lastingness itself is also a trailing indicator, the prospects for lastingness can be assessed via leading indicators such as permanent institutional changes in physical plant or corporate culture.

Along with the basic features of market transformation discussed above, a few authors elaborate on the concept in interesting ways. For example, some authors emphasize ultimate outcomes, in the form of diffusion of technology and practices. Others emphasize intermediate outcomes, such as changes in the behavior or decision-making process of market actors. Feldman makes the explicit link between program interventions and "identifiable problems in an existing market for energy-efficient products or services." Gordon and Eckman take this notion one step further, suggesting that a market transformation program should reduce identifiable barriers to adoption of more efficient technologies and practices and that it should *erect* barriers to inefficient technologies and practices.

Theory-Based Versus Ad Hoc

The conceptual framework put forward in Eto, Prahl, and Schlegel reflects an economic regulator's view of the world. It begins with the premise that the level of investment in or practice of energy efficiency is less than would appear to be cost beneficial and that the gap between

actual and cost-beneficial levels is due to one or more market barriers. The market barriers hypothesized roughly correspond to market failures or breakdowns in neoclassical economic assumptions discussed in the broader economic literature. From this perspective, proper design of a market transformation program entails identification of these market barriers and development of a strategy to reduce or eliminate them. Evaluation of such a program entails measurement of proximate indicators of changes in market barriers referred to as market effects.

A key contribution of the Scoping Study is this link it makes between theory and practice. By developing the notion of market transformation as a response to market barriers and making the connection between market barriers and the formal economic concept of market failure, the Scoping Study unambiguously positions market transformation within the broader debate over appropriate conditions for public policy interventions. Furthermore, the link with economic theory provides a benchmark for determining the appropriateness of a market transformation intervention, in the form of cost-benefit analysis. In the words of the Scoping Study: "An intervention's success in reducing market barriers…hinges on whether it leads to or causes a net beneficial outcome from a societal perspective. A net beneficial outcome requires that the increase in the adoption, procurement, or practice of energy efficiency is not offset by other losses (such as the cost of the intervention or its consequences)."

Beyond establishing a theoretical link between market transformation and economic theory, the Scoping Study develops a conceptual framework that establishes the relationship between theory and action. The key elements in the framework are the definitions of "market intervention" and "market effect." Market intervention is defined as being a deliberate effort to reduce market barriers. Market effects are, by definition, causally related to the interventions and serve as evidence of whether and to what extent a market barrier has been addressed effectively. In establishing the links between the various definitions, the Scoping Study provides a methodological framework for designing, implementing, and evaluating market transformation programs. Perhaps Feldman (1996) best articulates the steps required to apply this framework:

- Assess the market for the energy-efficient product or service of interest
- Describe the transaction costs that are inhibiting the efficiency of that market
- Identify changes in marketing participants or behaviors that will remove or reduce those costs
- Design a market transformation program to accomplish the specified changes
- Specify measurable indicators of the pertinent transaction costs and assess their baseline levels

- Implement the program and monitor changes in the indicators, as well as the costs of the intervention(s)

- Assess the effectiveness and cost-efficiency of the market transformation program as a function of changes in transaction costs.

If one reads "transaction costs" as market barriers and "indicators" as market effects, then this step-by-step approach is consistent with the framework outlined in the Scoping Study.

Circumstantial evidence for the efficacy of this framework can be found in published descriptions of programs that were apparently designed, implemented and evaluated without reference to this or any other theory-based framework. Several such examples are to be found in the literature, including Tatsutani (1995), Nadel and Geller (1995), Rosenberg (1995), and Suozzo and Nadel (1996). All of these studies ignored market barriers. Thus, none of them explained why the good ideas being promoted by the programs had not already made it into the marketplace and saturated it on their own. In other words, the programs described were apparently implemented without first determining the reasons for less-than-socially optimal levels of investment in the targeted technologies or whether the observed level of investment in the targeted technologies was less than socially optimal to begin with. Since no market barriers were identified, the design of program interventions was empirical, even ad hoc, rather than tailored for optimal effectiveness. In the absence of known market barriers and expected market effects, evaluators generally had no metric for assessing program success other than sales and changes in government efficiency standards. Not surprisingly, evaluation results were inconclusive. Rosenberg at least attempted to analyze market effects but the appropriate effects to consider are postulated rather than determined empirically through analysis of the market structure and identification of actual market barriers.

Robustness of Market Barrier Definitions

A number of authors have discussed market transformation from the perspective of economic theory. For example, Feldman (1996) emphasizes economic efficiency when he writes: "The market transformation task is not to ensure that the product or service attains any particular level of sales or market share; it is to ensure that the market for energy-saving products and services is as efficient as possible." Similarly, Megdal, et al. (1997) go into considerable detail in their discussion of market transformation from the perspective of microeconomic theory. As they explain, the basis for intervening in an energy-efficiency market is to change the outcomes from that market by shifting the demand curve, and/or the supply curve for energy-efficient products and services. The reason for doing so is that goods and services with external benefits will be under-invested in from a societal maximization perspective.

This results from the fact that energy efficiency has greater benefits for society, lower pollution and overall costs, than is seen in the individual customer's decision-making process. In classical microeconomics, the marginal social benefits (MSB) are greater than the overall demand curve. Society's desired DSM quantity and price are significantly greater than the market equilibrium, a case of market failure. This is one of the reasons regulators required greater DSM investments than the utility otherwise would make, and why market transformation programs are still being considered for the new utility environment.

By framing market transformation as a set of strategic interventions to address one or more market barriers, the Scoping Study implicitly embraces the concepts articulated above. However, the important contribution of the Scoping Study is that it goes beyond acknowledging the existence of market failures and probes the reasons for those failures. In doing so, it attempts to discuss the failures in concrete, empirical terms that are conducive to developing a strategy for addressing and, hopefully, correcting those failures.

This emphasis on empirical descriptions is both a strength and weakness. As noted on page 11 of the Scoping Study, "…market barriers are not classified based on a consistent conceptual framework… Therefore, an inescapable degree of subjectivity plays a role in assembling a list of market barriers that is (1) comprehensive but not extremely long, and (2) robust in the sense that any particular market barrier is not immune to re-interpretation as a different manifestation of another market barrier or vice versa." The study makes an effort to indicate important relationships among barriers and identify areas in which they overlap. Nevertheless, different studies of a single market might arrive at a different list of market barriers, depending on particular issues or market characteristics the studies emphasize. As programs are designed and evaluated around this framework, a key test will be whether the descriptions of market barriers are useful problem-solving tools; that is, whether they lend themselves to design and implementation of effective interventions to make energy usage more economically efficient.

Reliance on Economic Theory

Another key test for the framework outlined in the Scoping Study will be whether reliance on economic theory is necessary or even desirable. A review of the literature reveals that economics is not the only theoretical basis available for conceptualizing market transformation (which Eto, Prahl and Schlegel acknowledge). For example, the social sciences have produced a large body of literature focusing on diffusion of innovation. The social sciences' definition of diffusion of innovation is strikingly similar to the utility industry's definition of market transformation. This academic tradition focuses on the transfer of information and experience through social networks as the mechanism by which adoption of an innovation spreads through society. One particular model described by Reed and Hall (1997) models the diffusion process as a phased progression from awareness through persuasion, decision and implementation, to confirmation. The model incorporates product characteristics and characteristics of the decision-maker to predict diffusion

rates. A relatively thorough summary of the diffusion literature is provided in *Diffusion of Innovations* by Everett M. Rogers, 1995.

While the economic and innovation diffusion frameworks for market transformation are not necessarily contradictory, the conceptual differences between the two can make their applications somewhat different. A large part of the difference between the two is simply emphasis. While the economic framework implicitly includes information about communication networks in the form of information barriers, it basically conceptualizes each decision-maker as an isolated, perfectly rational, self-interested individual who engages in economic transactions with other isolated, perfectly rational, self-interested decision-makers. The innovation diffusion framework, on the other hand, can accommodate some information about market barriers in the form of product and decision-maker characteristics, but the emphasis is placed on decision-makers as social beings who rely on their social and business interactions for clues about whether to adopt or avoid innovations.

Of course, the choice between competing theoretical frameworks is not necessarily an either/or proposition. These two perspectives can be married conceptually through the use of a paradigm developed in labor market and household studies integrating economics and sociology. From microeconomics, the market demand curve is the aggregation (horizontal summation) of individual demand curves at each respective price for each potential buyer (which follows from viewing each consumer as an independent, rational decision-maker). The individual's demand curve is derived by examining how the quantity demanded changes with the price of the good, where the individual is always maximizing her marginal utility from the quantity of good purchased as it relates to the price of that good in comparison to the marginal utility and price of alternative goods (uses of the money). This utility maximization occurs where her budget line intersects an indifference curve that provides her highest level of available utility. The indifference curve represents trade-offs between packages of goods and services that provide equal levels of utility to the individual (for which the individual is indifferent between the packages of goods and services). The subjective benefits an individual receives for each good in each potential package creates the relative slopes of her indifference curves between two alternative goods.

Microeconomics emphasizes the derivation and movement of market demand curves. However, it places little emphasis on how individuals develop or change their indifference curves. These indifference curves measure what value an individual places on a good relative to other goods and services (to include her time).

Sociology, socio-economics, social psychology, and psychology all offer a wealth of theory and research that can help explain how individuals make value choices from their own view of their world, and as they obtain influence and interactions from and with their social environment. In other words, the other social sciences can be used to understand how indifference curves are developed and changed, and microeconomics can then examine how these changes follow through into demand curves and market behavior. In turn, the market itself can create an economic

environment that can influence the social environment (socio-economics). These economic and sociological interactions, integrating economics and sociology, have been used to better understand household dynamics and their changes in a changing environment, and labor markets among those living in ghettos. This perspective can also be used by energy-efficiency practitioners to better guide market transformation program planning and measurement.

In sum, while the economic perspective that underpins the Scoping Study is certainly a useful one from which to view market transformation, it is by no means the only possible perspective. The choice of analytical perspective may hinge largely on one's analysis objectives. Thus, an economic perspective appears particularly suited to addressing questions of *whether* to expend public resources toward accomplishment of an agreed-upon public policy goal (e.g., wealth maximization, optimized resource use, or equitable wealth distribution). However, other social science disciplines, perhaps in combination with economic concepts, may be better suited to address *how* to intervene most effectively.

Proximate versus Ultimate Indicators

Eto, Prahl and Schlegel focus on the measurement of market effects as an intuitively satisfying strategy for detecting changes in market barriers. However, the Scoping Study does not provide a conceptual framework for determining which market effects are the most appropriate targets of a program evaluation's resources. That exercise is left to Feldman (1995a, 1995b).

Feldman argues that evaluation resources should focus on measures of success at achieving intermediate steps rather than the final objective (ultimate versus proximate effects). In support of this thesis, he develops the following set of requirements for indicators of market transformation:

- Meaningful (results can be communicated to senior executives)
- Theoretically defensible (results relate to an underlying theory of market transformation)
- Easy to apply (measurement rules can readily be learned and used)
- Inexpensive (requires only limited, readily available data)
- Reliable (different evaluators can repeat the measurement procedures)
- Sensitive (changes rapidly with changes in marketing strategies)
- Actionable (results suggest whether to maintain, discard or change programs)

- Verifiable (alternative measurement techniques provide convergent results).

Feldman then tests sales data as an indicator of market transformation based on the above criteria: "…sales data are readily understood and seem defensible at the gross level. However, they are expensive and may lack reliability and verifiability. Most important, sales data are unlikely to be sensitive to modifications of utility market programs and will thus provide little guidance for subsequent action."

He goes on to say: "…sales data are a lagging indicator of the effects of a market intervention program. …Given the chain of event that must occur prior to changes in sales data. It seems important to monitor changes in leading indicators–those closer in time to the intervention and earlier in the marketing cycle. ...Focusing on [leading] indicators… will alert evaluators and program managers to the effectiveness or noneffectiveness of their intervention efforts and signal the appropriate next steps. In the same vein, reviewing these indices will provide regulators and senior managers with the information needed to shape future policy in a timely fashion…"

In this way, Feldman argues that the use of proximate indicators increases confidence in causal attributions and is more likely to provide actionable information. This argument is in good agreement with the Scoping Study hypothesis that focusing on the measurement of market effects is the most productive method of demonstrating a causal link between program interventions and changes in market barriers.

Valuation of Market Transformation

By developing a conceptual framework of market transformation based on economic theory, Eto, Prahl and Schlegel have endowed market transformation practitioners with an extremely powerful set of tools for determining the optimal allocation of scarce resources. Economics can be used to determine whether actual levels of investment in a particular energy-efficient technology are socially optimal or whether market failures have produced less-than-optimal investment levels. Economic principles can be used to determine the likely cost-effectiveness of market transformation interventions. Economics can be used to forecast likely impacts of market transformation on future electricity generation capacity requirements. However, application of these tools requires the ability to quantify the costs of market failures and the benefits of successful market transformations in a common metric. On this issue, the Scoping Study is silent.

Feldman's attempt to address this issue is perhaps the most well-argued attempt to date. A sense of the importance of this issue can be gained by reviewing Feldman's comparison of market transformation to marketing frozen food entrées: "A well-known food processor recently developed a high-quality frozen food entrée to be sold in supermarkets and convenience stores. The channel objectives for this manager were clearly stated. 'We want this product to be no more

than a ten-minute drive from 75 percent of the full-time working women in the United States. We plan to reach this goal within 12 months of our product roll-out.'"

Feldman points out that this marketing strategy directly targets a significant barrier to higher frozen food sales and that proximate indicators are the best measures of the marketing program's success. By analogy, he suggests that market transformation programs should place greater emphasis on proximate indicators. In doing so, he overlooks several key differences between a privately funded marketing effort and a publicly funded market transformation program. For one, the frozen food company does not need to concern itself with determining the socially optimum levels of frozen food purchases. The company goal simply is to increase sales. The only strategy ruled out by this goal is the strategy of doing nothing. In contrast, prudent design of a market transformation program always will start by determining whether any intervention is justified. Second, while the company has an interest in determining the most cost-effective marketing strategy, it does not have a mandate to do so. If the marketing strategy fails the cost-effectiveness test, that is, if marketing costs outweigh the profits from increased sales, then the company will lose money. Long-term continuation of such a trend will drive the company to bankruptcy. Thus, market dynamics will enforce cost-effectiveness, even if the company does not. In contrast, no such mechanism exists for a publicly funded program. Thus administrators of a market transformation program have an obligation to the public to demonstrate that program expenditures are actually an efficient allocation of resources.

Feldman argues, quite convincingly, that kWh savings, sales data and market penetration are generally poor measures of program performance and that measurement of proximate indicators should be the primary basis for assessing the success of an intervention at reducing or eliminating a market barrier. In Feldman (1996), he goes on to argue, again quite convincingly, that a major, and generally overlooked component of total program benefit is the reduction of transaction costs (used here colloquially as the indirect costs of conducting economic exchanges and contracts) and the accompanying increase in consumer surplus. "To focus strictly on the increased sales of the energy-efficient product or service is to ignore much of the value created by market transformation. Indeed…The value created by decreasing transaction costs may often dwarf the value of the new sales, depending upon the total price and the existing level of demand." However, Feldman's argument that changes in transaction costs can be adequately captured via measurement of proximate indicators has yet to be demonstrated.

Conclusions

A comparison of the Scoping Study framework with other market transformation perspectives described in the literature makes it evident that a transaction economics framework is not the only valid approach to understanding the dynamics of market transformation. A related conclusion is that the Scoping Study framework and alternate frameworks that have been proposed are not necessarily incompatible or contradictory.

Given an economic approach to market transformation, a key conclusion that emerges, both from the Scoping Study and from the broader literature, is the importance of linking market barriers, program interventions and market effects. The primary value to be derived from measuring market effects is the tangible evidence they provide of changes in market barriers that can be attributed to program interventions.

An important test of the Scoping Study framework as a pragmatic guide to evaluation will be whether the definitions of market barriers are the most appropriate ones for application to a program evaluation. In the words of the Scoping Study, the definitions need to be "(1) comprehensive…, and (2) robust in the sense that any particular market barrier is not immune to re-interpretation as a different manifestation of another market barrier or vice versa."

We conclude from the Scoping Study's proposed Market Influence Diagram, as well as language in the body of the study, that market barriers and market effects can be expected to vary significantly by market actor and that all three factors can be expected to vary according to the targeted market. From this conclusion we infer that an evaluation, to produce valid conclusions, should build on an empirical analysis of the target market structure that identifies key market actors, the barriers they face to making decisions that lead to more economically efficient actions and investments, and the likely observable effects that would indicate a change in those barriers.

Our review of multiple definitions of market transformation indicate that the concept of lastingness is key to the definition of market transformation. However, a consensus operational definition of the term has yet to emerge. Furthermore, there appears to be a range of opinion about whether demonstrating it should be a priority. Among practitioners who treat the demonstration of lastingness as a priority, there is considerable variation in their approach. This variation stems from the fact that direct observation of lastingness is a lagging indicator of program success. Practitioners have thus turned to indirect evidence of lastingness such as economic feasibility, irreversibility, institutional change and market penetration.

Finally, our review has identified at least one promising area of future research that is beyond the scope of this project. We believe future market transformation program design and evaluation would be significantly improved if a systematic effort were made to compare the different conceptual frameworks that have been advanced. At a minimum, a comparative analysis of the frameworks would highlight the different sets of underlying assumptions and thus provide practitioners with clearer guidance as to when a particular framework could be expected to serve well and when an alternate framework might be more appropriate. Furthermore, a comparative analysis might produce a unified framework that incorporates successful elements from existing frameworks. Any attempt to develop an improved framework should, at a minimum, apply the following three criteria as tests of success. The new framework should:

- Explain observed market changes, absent systematic interventions, at least as well or better than existing frameworks
- Provide clearer guidance for future program design and evaluation methods
- Provide a practical and defensible strategy for determining program success at accomplishing resource allocation goals

ENERGY EFFICIENCY MARKET TRANSFORMATION LITERATURE REVIEW BIBLIOGRAPHY

MARKET TRANSFORMATION DEFINITIONS, MEASUREMENT, AND METRICS

Boston Edison Company. 1997. *Five Year Energy Efficiency Plan, Impact 2002, Initiatives for Managing Production & Conservation Technologies & Transformations*, September 2, 1997.

Cohen, Sam, Cyane Dandridge, and Neil DeSnoo. 1996. "Rebuild America: A Utility/Community Partnership for Market Transformation in the San Francisco Bay Area," *Proceedings of the 1996 ACEEE Summer Study, Asilomar*, CA: pp. 5.27-5.32.

deLaski, Andrew, and Ted Pope. 1996. "Spinning Toward High-Efficiency Clothes Washers: Progress and Directions of a National Market Transformation Initiative," *Proceedings of the 1996 ACEEE Summer Study*, Asilomar, CA: pp. 2.53-2.61.

Eklund, Ken, Tom Hewes, Tom Lineham, and Mike Lubliner. 1996. "Manufactured Housing in the Pacific Northwest: Moving from the Region's Largest Utility-Sponsored Market Transformation Venture to an Industry Marketing Program*," Proceedings of the 1996 ACEEE Summer Study*, Asilomar, CA: pp. 2.63-2.70.

Eto, Joseph, Ralph Prahl, and Jeff Schlegel. 1996*. A Scoping Study on Energy-Efficiency Market Transformation* by California Utility DSM Programs, Earnest Orlando Lawrence Berkeley National Laboratory, Berkeley, CA.

Feldman, Shel. 1997. "Apres Nous, Le Deluge? What will Happen to Energy Efficiency Markets in a Restructured Industry?", *Proceedings of the 1997 International Evaluation Conference*, Chicago, IL: pp. 533 - 539.

Feldman, Shel. 1996. *On Estimating the Value Added Through Market Transformation*, Oak Ridge National Laboratory, ORNL/Sub/96-ST788, U.S. Department of Energy contract DE-AC05-960R22464, Oak Ridge, TN.

Feldman, Shel. 1995a. "How Do We Measure the Invisible Hand*?" Proceedings of the 1995 International Energy Program Evaluation Conference*, Chicago, IL: pp. 3-8.

Feldman, Shel. 1995b. "Measuring Market Effects: Sales Data Are the Last Thing You Should Look At," *Proceedings of the 1995 AESP Annual Meeting*, Competition: Dealing With Change, Boca Raton, FL: pp. 83-90.

GDS Associates, Inc. 1997. *Evaluation Methodology, Market Assessment Plans and Tier 2 Incentive Indicators for Boston Gas Company Market Transformation Programs*, Draft Report prepared by: Richard Spellman, Shel Feldman, Kenneth Keating and Lori Megdal, Marietta, GA.

Goldstone, Sy. 1995 "Restructure: A Stimulus to Improving Utility DSM, How Economists Might Help." *Proceedings Western Economic Association, 70th Annual Conferences.* San Diego, CA July 1995.

Goldstone, Sy. 1996. *The Changing Nature of Public Interests in Energy Efficiency Due to a Restructuring: A Foundation Paper.* California Energy Commission, Sacramento, CA. April 1996.

Gordon, Frederick, and Tom Eckman. 1995. "Planning for Market Transformation: Slicing the Cake From a Different Angle," *The Energy Services Journal*, Vol. 1, No. 2, pp. 129-142.)

Haeri, Hossein, Sami Khawaja, Jennifer Stout, and Jamshid Hosseini. 1997. "Market Transformation: Measuring the Immeasurable," *Proceedings of the 1997 Energy Program Evaluation Conference*, Chicago, Ill.: pp. 311 - 318.

Hastie, Steve, and Chris Granda. 1997. "Evaluation of the IFC/GEF Poland Efficient Lighting Project (PELP)," *Proceedings of the 1997 Energy Program Evaluation Conference*, Chicago, Ill.: pp. 634 - 635.

Hall, Nicholas P. and John H. Reed. 1996. "Marketing Energy Efficiency As a Commodity," *Proceedings of the 1996 ACEEE Summer Study*, Asilomar, CA: pp. 5.61-5.68.

Herman, Patricia, Shel Feldman, Shahana Samiullah, and Kirsten Stacey Mounzih. 1997. "Measuring Market Transformation: First You Need A Story...," *Proceedings of the 1997 Energy Program Evaluation Conference*, Chicago, Ill.: pp. 319 - 325.

Herman, Patricia and Elizabeth Hicks, "From Theory Into Practice: One Utility's Experience with Applying the Value Test," *Proceedings of the 1994 ACEEE Summer Study*, Asilomar, CA: Vol. 8.

Kandel, Adrienne Vayssières, and Kirtida Parikh. 1996. "Estimating the Effect of Exposure to Market Transformation Programs on Demand or Supply of Conservation Technology," *Proceedings of the 1996 ACEEE Summer Study*, Asilomar, CA: pp. 3.51-3.58.

Lee, Allen D., and Robin Conger. 1996. "Market Transformation: Does It Work? - The Super Efficient Refrigerator Program," *Proceedings of the 1996 ACEEE Summer Study*, Asilomar, CA: pp. 3.69-3.80.

Levine, Mark and Richard Sonnenblick, "On the Assessment of Utility Demand Side Management Programs," Energy Policy, Vol. 22, No. 10, October 1994, Special Issue Markets for Energy Efficiency.

McMenamin, J.S., F. Monforte, and I. Rohmund. 1994. "DSM Technology Forecasting: Market Transformation and the Dynamic Baseline", *Proceedings of the ACEEE 1994 Summer Study on Energy Efficiency in Buildings*, pp. 10.155 - 10.162.

Nelson, Dennis J. 1996. "Expanding the Customer Service Toolkit: Mixing Electrotechnologies with Strategic Conservation," *Proceedings of the 1996 ACEEE Summer Study*, Asilomar, CA: pp. 7.115-7.119.

Nolden, Sandra L. and Stephen J. Morgan. 1996. "Super-Efficient Refrigerators for Apartments: The NYPA/NYCHA Project as a New Market Transformation Model," *Proceedings of the 1996 ACEEE Summer Study*, Asilomar, CA: pp. 2.181-2.185.

Peach, H. Gil, Pamela Brandis, C. Eric Bonnyman, and Agenta Persson. 1996. "Market Transformation in Manufactured Housing: A Pacific Northwest Experience," *Proceedings of the 1996 ACEEE Summer Study*, Asilomar, CA: pp. 3.115-3.122.

Prahl, R. and J. Schlegel. 1993. "Evaluating Market Transformation", *Proceedings of the 1993 Energy Program Evaluation Conference*, Chicago: August, 1993, pp. 469-477

Prahl, Ralph and Jeff Schlegel. 1994. "DSM Resource Acquisition and Market Transformation: Two Inconsistent Policy Objectives?" *Proceedings of the 1994 ACEEE Summer Study*, Asilomar, CA: pp. 6.157-6.166.

Raab Associates, Ltd. 1995. "Discussion Paper: Evaluating Programs With Market Effects", Prepared for the New York Public Service Commission Staff (51 pages).

Raab, Jonathan and Jane S. Peters. 1997. *First Year Status Report: Evaluation of Regional Market Transformation Efforts.* NARUC RFP #96-02. October 1997.

Reed, John, and Nicholas Hall. 1997. "Methods for Measuring Market Transformation," *Proceedings of the 1997 Energy Program Evaluation Conference*, Chicago: August, 1997, pp. 177 - 184.

Rosenberg, Mitchell. 1995. "Strategies to Quantify Market Transformation and Spillover Effects of DSM Programs," *The Energy Services Journal*, Vol. 1, No. 2, pp. 143-157.

Saxonis, William P. 1997. "Market Transformation: Real Problems, Real Answers," *Proceedings of the 1997 Energy Program Evaluation Conference*, Chicago, Ill.: pp. 171 - 176.

Schlegel, Jeff, Miriam Goldberg, Jonathan Raab, Ralph Prahl, Marshall Keneipp, Daniel Violette. 1997. *Evaluating Energy-Efficiency Programs In a Restructure Industry Environment: A Handbook for PUC Staff.* National Association of Regulatory Utility Commissioners, Washington, DC. April 1997.

Suozzo, Margaret, and Steven Nadel. 1996. "Learning the Lessons of Market Transformation Programs," *Proceedings of the 1996 ACEEE Summer Study*, Asilomar, CA: pp. 2.195-2.206.

Synergic Resources Corporation. 1996. *Market Transformation In A Changing Utility Environment.* National Association of Regulatory Utility Commissioners, Washington, D.C. March 1996.

SPILLOVER AND RETROSPECTIVE MARKET EFFECTS MEASUREMENT

Buller, Susan, Glen Weisbrod, Kenneth Train, and Richard Barnes. 1994. "Modeling Technology Adoption and DSM Program Participation Decisions," *Proceedings of the ACEEE 1994 Summer Study on Energy Efficiency in Buildings*, Asilomar, CA, pp. 1.9-1.17.

Cambridge Systematics, Inc. 1994. *DSM Program Spillover Effects: Review of Empirical Studies and Recommendations for Measurement Methods*, Prepared for Southern California Edison with California DSM Measurement Advisory Committee (CADMAC). (Also donated to the Association of Energy Services Professionals (AESP) and sold as one of their publications.)

Empire State Electric Energy Research Corporation (ESEERCO). 1994. *DSM Free Ridership Study, Final Report* ESEERCO Project EP 92-65. Prepared by: Cambridge Systematics, Inc. and Freeman, Sullivan and Company, Principal Investigators: Glen E. Weisbrod, Lori M. Megdal, and Kenneth E. Train. New York, NY.

Gallaher, Michael P. and Dan Wiecek. 1995. "Removing Program Effects: A Method for Estimating Free Riders and Market Movement," *Proceedings from the 1995 Energy Program Evaluation Conference*, Chicago, IL, pp. 839-845.

Meberg, Bruce, Shel Feldman, Corey Stone, and Elizabeth M. Tolkin. 1997. "Converging on the Effects of Utility Lighting Efficiency Programs," *Proceedings of the 1997 Energy Program Evaluation Conference*, Chicago, Ill.: pp. 327 - 334.

Megdal & Associates. 1996. *Study Design For Consolidated Edison Company of New York's Free Ridership Factors, 1996-1997.* Boxborough, MA.

Megdal, Lori, Steve Pertusiello, and Bonnie Jacobson. 1996. "All These Years Measuring Free Ridership & Now We Measure a Portion of These As Caused by Market Transformation", *1996 AESP Annual Meeting Proceedings*, Beverly Hills, CA, pp. 260-271.
Megdal, Lori, Steve Pertusiello, and Bonnie Jacobson. 1997. "Measuring Market Transformation Due to Prior Utility Efforts", *Proceedings from the 1997 Energy Program Evaluation Conference*, Chicago, IL: August, pp.163-170.

Pigg, Scott, Ralph Prahl, and Mark Wegener. 1997. "Motor Market Transformation in a Time of Utility Restructuring -- The Wisconsin Story," *Proceedings of the 1997 Energy Program Evaluation Conference*, Chicago, Ill.: pp. 447 - 453.

Rosenberg, M. 1996. "Measuring Spillover and Market Transformation Effects of Residential Lighting Programs", *Proceedings of the ACEEE 1996 Summer Study on Energy Efficiency in Buildings*, pp. 3.137 - 3.145.

Train, Kenneth, and Eric Paquette. 1995. "A Discrete Choice Method to Free-Ridership, Net-To-Gross Ratios, and the Effect of Program Advertising," *Energy Services Journal*, Vol. 1, No. 1, pp. 21-33.

Train, Kenneth, Susan Buller, Bruce Mast, Kirtida Parikh, and Eric Paquette, (1994), "Estimation of Net Savings for Rebate Programs: A Three-Option Nested Logit Approach," *Proceedings of the ACEEE 1994 Summer Study on Energy Efficiency in Buildings*, Asilomar, CA, pp. 7.239-7.247.

SELECTED RELATED ARTICLES

Mancuso, Joan and Mary Dimit. 1996. "Are Energy Audits Worth It? Teasing Apart the Role of Audits in Driving Customer Efficiency Actions," *Proceedings of the 1996 ACEEE Summer Study*, Asilomar, CA: pp. 6.97-6.103.

Mast, Bruce and Patrice Ignelzi. 1994. "The Roles of Incentives and Information in DSM Programs," *Proceedings of the ACEEE 1994 Summer Study on Energy Efficiency in Buildings*, Asilomar, CA, pp. 10.145-10.153.

Messenger, Michael. 1996. "From Resource Value to Market Transformation: The Case for a Change in the Design Goals of Publicly Funded DSM Programs," *Proceedings of the ACEEE 1996 Summer Study on Energy Efficiency in Buildings*, Asilomar, CA, pp. 7.105 - 7.113.

Rathbun, P., V. Arganbright, and K.D. Van Liere. 1990. "Comparing the Impact of Financial Incentive Programs on Customers and Trade Allies," *Proceedings: 1990 Electric Utility*

Marketing Research Symposium, EPRI Report CU-7010, Electric Power Research Institute, Palo Alto, CA, pp. 8.31-8.32.

Rogers, Everett. 1995. *Diffusion of Innovations*, 4th edition, Free Press: New York, NY.

Schlegel, Jeff, and Fred Gordon. 1996. "Using Performance Incentives to Encourage Distribution Utility Support of Market Transformation Initiatives", *Proceedings of the ACEEE 1996 Summer Study on Energy Efficiency in Buildings*, pp. 7.167 - 7.177.

Rosenberg, Mitchell. 1997. "The U.S. Motor Systems Market Assessment Overview And Preliminary Findings," *Proceedings of the 1997 Energy Program Evaluation Conference*, Chicago, Ill.: pp. 355 - 364.

Van Liere, K., Winch, R., Standen, K., Feldman, S. and Brugger, D. 1993. "The Design and Structure of a Statewide Sales Tracking System for Residential Appliances," *Proceedings of the 1993 Energy Program Evaluation Conference*, Chicago: August, 1993, pp. 458-464.

Weisbrod, G. Hub, A., and Kelleher, M. 1994. "Separating DSM program impacts from technology trends: A comparison of national and state surveys of manufacturers and distributors", *Proceedings of the ACEEE 1994 Summer Study on Energy Efficiency in Buildings*, Vol. 8, pp. 253-262.