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EVALUATION OF FIRST YEAR LOAD IMPACTS OF SOUTHERN CALIFORNIA EDISON'S 1994 COMMERCIAL ENERGY EFFICIENCY INCENTIVES AND AUDIT PROGRAMS

STUDY ID NUMBERS 516 AND 519

Prepared for
Pierre Landry
Measurement and Evaluation
Southern California Edison Company

Prepared by
Andrew Goett, Synergic Resources Corporation
Kirtida Parikh
Michael Parti, Applied Econometrics, Inc.

March 1, 1996

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OVERVIEW

Southern California Edison has explored multiple approaches to estimating the gross and net savings from its 1994 commercial programs. The three sections which follow report on three separate efforts to estimate parameters of the programs. Each section is organized as a free-standing and separate report.

Section A: Regression and Survey Analysis for Estimating Net and Gross Savings for Three End Uses in the Incentive and Audit Programs
Andrew Goett, Jamie Howell, and Gregg Frank, Synergic Resources Corporation

The first section reports on a cross-section time series statistical analysis that explains the average daily electricity consumption per month of participants in Edison's commercial audit and rebate programs. It uses a statistically adjusted engineering analysis approach to develop realization rates on initial program estimates of each sampled participant's savings. Estimates are developed for three major end uses: lighting, heating/ventilating/air conditioning (HVAC), and other. Because the explanatory variables include a trend variable for the electricity consumption of all similar Edison customers, the resulting savings estimates are of net savings. Data for the analysis were collected on site and in telephone surveys, as well as from Edison electricity consumption and weather databases. Some survey questions probed participants' reasons for implementing the energy efficiency measures, and the responses to these questions were used to develop an independent estimate of the net-to-gross ratio for the three major end uses in each of the two programs. The program level net savings estimates are about 80% of the level initially reported by the company, with gross savings between 90 and 100% of the levels initially reported.

Section B: Qualitative Choice Analysis for Net-to-Gross Ratios for the Incentive Program
Kirtida Parikh
This section provides a qualitative choice analysis of customers' likelihood to implement energy efficient HVAC and lighting measures as a result of or in the absence of Edison's rebate program. It produces net-to-gross ratios for the HVAC and lighting rebates of between 60 and 70 percent.

Section C: Participant/Comparison Group Regression Analysis for a Difference of Differences Approach to Net Savings from the HVAC Incentive and Audit Programs
Michael Parti, Applied Econometrics

The third section provides an alternative regression approach to estimating net savings for rebates and audit recommendations by end use, using on-site and telephone survey data from samples of both participants and nonparticipants. This contrasts with the approach in section A, where the comparison with nonparticipants is accomplished by

using a total consumption series for all customers of the same business type. Like the regression approach in Section A, this study estimates net savings directly, following the difference of differences approach.

The variety of regresssion-based approaches developed in these studies provide somewhat varying estimates for the net and gross load impacts and net-to-gross ratios of the two programs and their included end uses. Together, however, they confirm that total energy savings provided to Edison's customers are close to those estimated by the company and previously reported.

SRC 8217-R1

SECTION A

FIRST - YEAR IMPACT STUDIES OF THE 1994 COMMERCIAL SERVICES PROGRAM AND THE COMMERCIAL RETROFIT INCENTIVE PROGRAM

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March 1, 1996

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EXECUTIVE SUMMARY

This report presents the results of an impact evaluation of the commercial sector portion of Southern California Edison Company's 1994 Energy Management Hardware Rebate and Energy Management Services Programs. The Energy Management Hardware Rebate Program pays financial incentives for the installations of certain energy efficient measures that SCE determines are cost effective. The Energy Management Services Program provides informational audits to commercial customers and makes recommendations about cost-effective, energy-saving operational practices and measures. This study does not include the two manufacturers' rebate programs that Edison offered in 1994 for two types of commercial equipment (compact fluorescent lamps and small motors).

The objective of the impact evaluation was to estimate the electric energy and peak demand savings that resulted from these two programs in the first year following their implementation. The estimates include the gross changes in electricity consumption and peak demand from the program and the net changes, after accounting for the effects of actions that participants would have taken in the absence of the program.

This was accomplished by means of a series of statistical analyses of consumption patterns for a representative sample of commercial participants for the period spanning January 1993 through November 1995. The analysis used statistical regression techniques to quantify the average realization rates of savings from the measures installed under the programs, after controlling for the effects of weather, changes in operations, and trends in electricity consumption among similar customers.

Separate estimates of realization rates were obtained for lighting, HVAC, and other measures in each program. These estimates of realization rates were applied to the energy and peak demand savings that SCE had claimed for the commercial portions of the EMHR and EMS Programs in 1994.

The estimates of program impacts, broken down by end-use category, are summarized in the following table.

Summary of Verified EMHR and EMS Program Impacts (MWh/yr)

End Use	EMHR Program		EMS Program	
	Claimed First-Year Net Energy Savings	*Ex Post* First-Year Net Energy Savings	Claimed First-Year Net Energy Savings	*Ex Post* First-Year Net Energy Savings
Lighting	120,519	90,445	4,959	4,815
HVAC	73,826	42,749	40,892	29,779
Other	55,756	57,804	13,444	11,422
Total	250,101	190,998	59,295	46,016

The EMHR Program saved approximately 191,000 MWh in the first year, which is 78% of the net savings that SCE initially claimed for the program. The EMS Program saved 46,000 MWh, which coincidentally also represents 78% of the net savings that SCE initially claimed for that program. Given the specification of the regression model used in the analysis, these represent net savings after controlling for the effects of economic trends, naturally occurring conservation, and other factors that influence electricity use. Based on the performance of the statistical models used to derive these estimates, we can state with a 90% confidence that the estimates for the EMHR Program are within 13% of the "true" impacts. For the EMS Program, the 90% confidence interval is +/- 27%.

As a separate piece of analysis, the rates of free ridership for various end-use categories were estimated based on the responses to survey questions for a sample of program participants. Free ridership is the rate at which participants would have installed the efficient measures (and realized the associated energy savings) in the absence of the programs. The analysis obtained free rider estimates of 40% for lighting measures and 51% for HVAC and other measures. Overall, the free ridership rate for the EMHR Program was estimated to be 46%.

The estimated free ridership rates for the EMS Program ranges from 29% for HVAC measures to 75% for lighting. The overall rate was 43%. Given the small sample size used to obtain these estimates, the results are very sensitive to the responses by a few large participants.

Chapter 1

INTRODUCTION

Chapter 1

INTRODUCTION

1.1 STATEMENT OF IMPACT EVALUATION OBJECTIVES

The objective of the impact evaluation was to estimate the electric energy and peak demand savings that resulted from Southern California Edison's (SCE) 1994 Energy Management Hardware Rebate (EMHR) and Energy Management Services (EMS) Programs. The estimates include the gross changes in electricity consumption and peak demand from the program and the net changes, after accounting for the effects of actions that participants would have taken in the absence of the program.

The data collection and analysis used to obtain the impact results must conform to the requirements of the Protocols for the Verification of Demand-Side Management (DSM) Programs (Verification Protocols). These protocols govern the procedures used by the California investor owned utilities to estimate the impacts of their DSM programs. The Verification Protocols specify a series of requirements about data sources, analysis procedures, and reporting for impact evaluations. Some of the key requirements include the following:

- Measurement Methodology: The protocols call for applications of a quasi-experimental design approach to estimating DSM program impacts by means of comparisons of usage between representative samples of program participants and nonparticipants. These comparisons should be based on accepted statistical techniques, including regression analysis, that control for the effects of other variables on energy consumption. The statistical techniques should conform to accepted practices in their application to analyzing energy consumption. When regression techniques are used, they should address the common computational issues that arise in such analysis.

- Sample Design: The samples upon which the analysis is performed should be designed to achieve a minimum precision of plus/minus 10% at a 90% confidence level. If the primary method of data collection is on-site, the minimum number of participants in the analysis must be at least 150.

- Billing Data Requirements: When the measurement methodology uses billing data, the number of observations per participant should be at least 12 months prior to participation and 9 months in the first impact year.

- Reporting: The protocols specify that the program impact measurement study report the average usage for participant and comparison groups used in the analysis, the average net and gross end-use load impacts, the net-to-gross ratio, and the precision of the load impact estimates.

- Documentation: The load impact studies must provide detailed information about the data management, screening, interpretation and application.

- Commercial Incentive and Energy Management Services Programs: The protocols specify additional requirements specific to commercial energy efficiency incentives and energy management services programs, including allowable models, data sources, treatment of existing standards, and weather adjustments.

1.2 DESCRIPTION OF THE EMHR AND EMS PROGRAMS

Southern California Edison promotes energy efficient measures and practices to its existing commercial customers through two major programs. The first is the Energy Management Hardware Rebate Program that pays financial incentives for the installations of certain energy efficient measures that SCE determines are cost effective. The second is the Energy Management Services Program that provides informational audits to commercial customers on cost effective, energy-saving, operational practices and measures for which financial incentives are not available.

While SCE distinguishes between its EMHR and EMS Programs and tracks the performance of each in a separate database, both are typically delivered to customers through a common mechanism. A SCE energy service representative (ESR) performs an energy audit of the customer's facility that identifies cost effective energy efficiency measures and actions. Some of these measures qualify for rebates and others do not. If the customer agrees to install a measure that is eligible for a rebate, the SCE ESR prepares an application (termed a rebate coupon) that describes the measure, its projected savings, and other relevant information. After the customer has adopted one or more of the recommendations (either rebated ones or the others), the ESR conducts a follow-up inspection to verify that the measure or practice was instituted. Only after the verification does SCE enter the claimed savings and related information in the program tracking systems.

The savings that SCE claims for the measures are based on accepted engineering algorithms. In most cases, the claimed savings for measures under the 1994 programs were derived using a computer based system called the Computerized Book of Standards (CBOS). CBOS uses information about each customer site and the operation of affected equipment to estimate the savings from prospective efficiency measures.

The savings are based on accepted engineering algorithms that incorporate this information and account for any existing state or federal standards. The estimates are computed on an annual basis under normal weather conditions for the area where the facility is located. These savings are recorded for each measure in the program tracking database along with documentation on the specific type of measure installed, the calculation procedure used, and whether the measure replaced existing equipment or was new.

1.3 SUMMARY OF CLAIMED PROGRAM PERFORMANCE

Table 1-1 below summarizes the program performance for both the audit/rebate (EMHR) and audit-only (EMS) programs as recorded in the program tracking databases. Note that the number of measures, although presented below, is not an entirely useful statistic. This is due to the fact that measures can be defined, for instance, as several fixtures for a single lighting technology. A more meaningful summary of program performance is claimed savings. Average annual savings per EMHR participant was estimated to be 145,174 kWh, and 95,491 kWh per EMS participant (i.e. treated business location).

Table 1-1
Summary of EMHR and EMS Program Performance
Commercial Sector

Performance Standard	EMHR	EMS	Total*
Number of Participants	2,269	1,242	3,511
Number of Measures	5,277	1,900	7,177
Claimed Savings (GWh)			
Lighting	167.4	9.9	177.3
HVAC	92.3	81.8	174.1
Other	69.7	26.9	96.6
Total Claimed Savings	329.4	118.6	448.0

*Totals include 830 customers who participated in both programs.

As outlined, the majority of claimed savings for the EMHR Program was for efficient lighting technologies, while most of the claimed savings in the EMS program were for HVAC measures. This is illustrated more clearly in Figures 1-1 and 1-2. In the EMHR Program, lighting technologies constituted 52% of total claimed savings, followed by HVAC measures at 28%. In the EMS Program, HVAC measures constituted almost 70% of total claimed savings, followed by refrigeration measures at 16%.

Figure 1-1
Claimed Savings per End-Use
EMHR Program

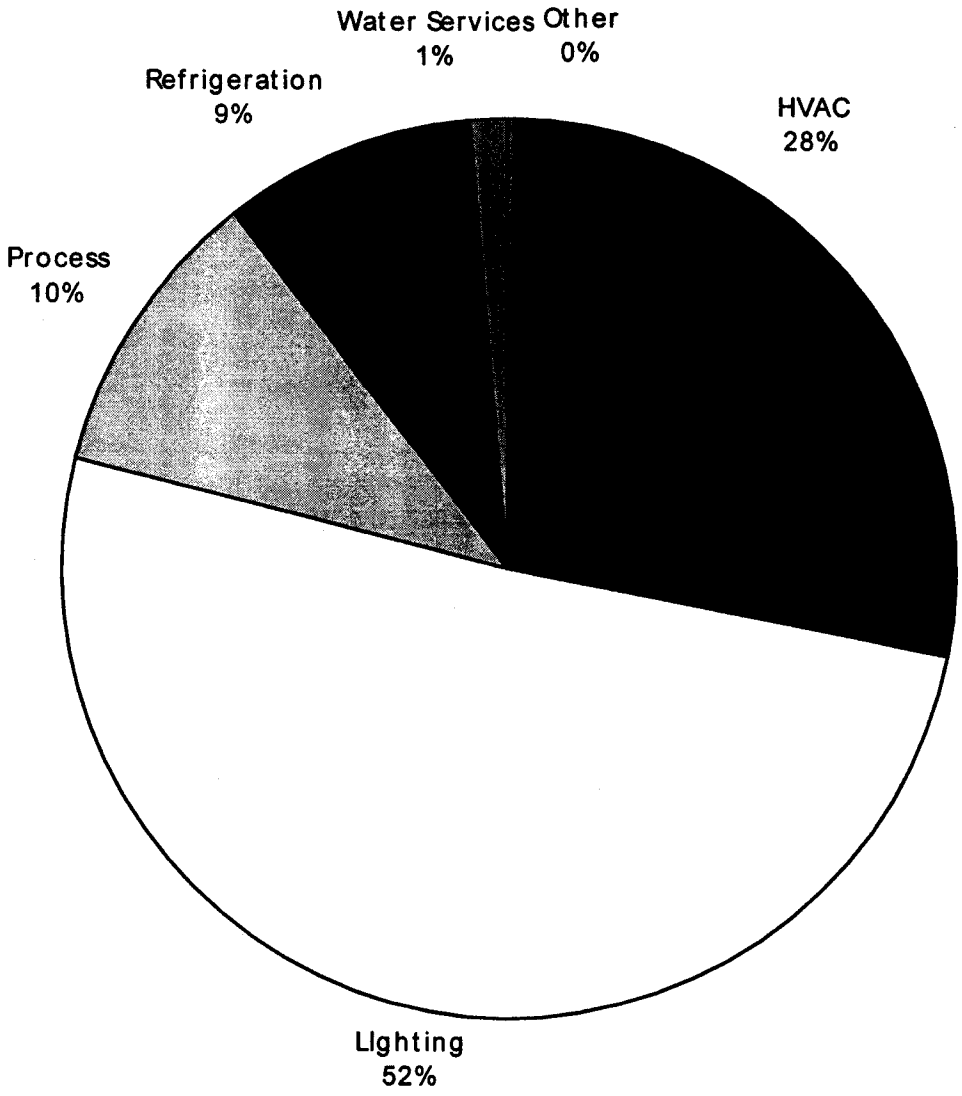
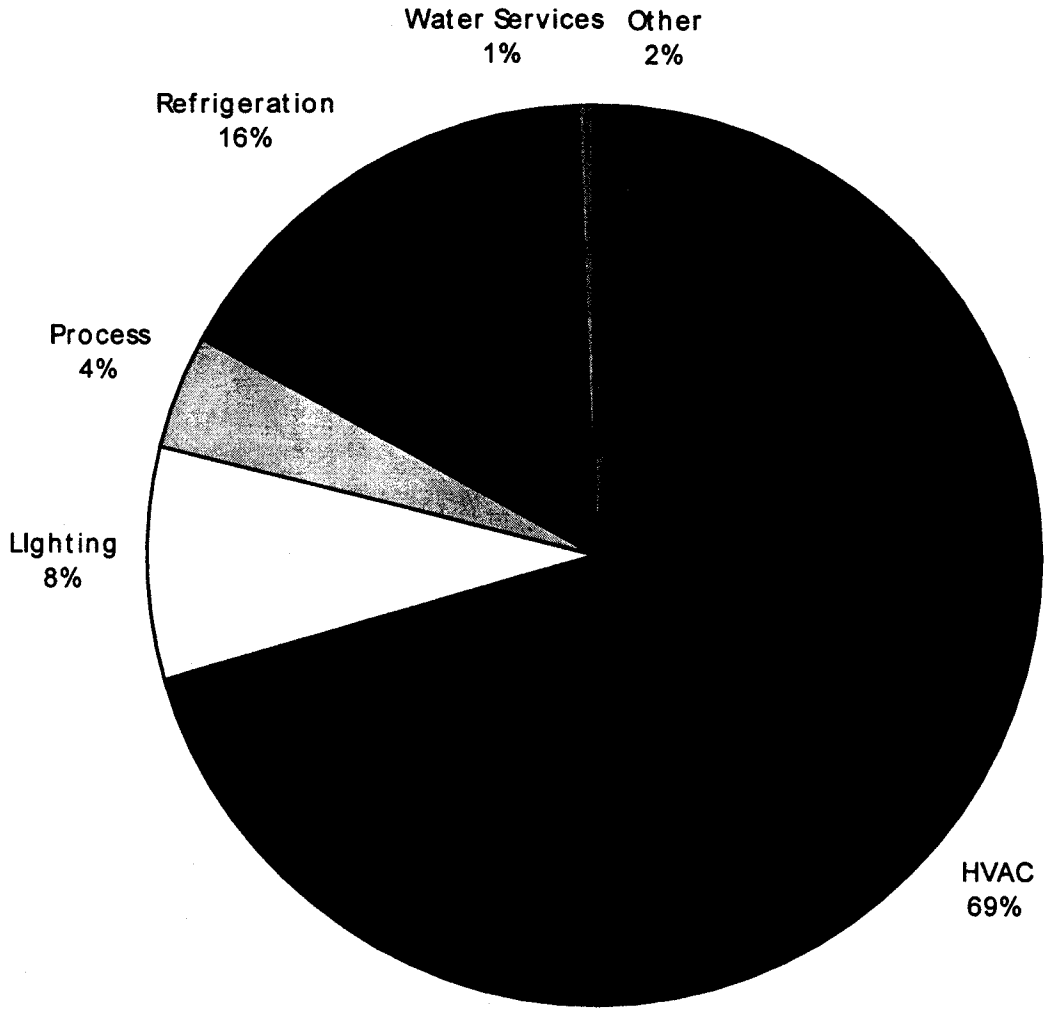


Figure 1-2
Claimed Savings per End-Use
EMS Program



1.4 SUMMARY OF METHODOLOGY

The approach that SRC used to estimate the impacts of SCE's EMHR and EMS Programs was to conduct a regression analysis on the monthly billing data for a sample of participants covering the period from January 1993 through the end of 1995. The analysis conforms to the definition of a load impact regression model as described in the protocols.

The form of the regression model used in this evaluation is commonly known as a statistically adjusted engineering (SAE) model, in the terminology used by analysts of individual customer energy consumption data. This model includes key explanatory variables representing "prior" (typically engineering-based) estimates of the savings associated with the measures installed by each customer in the sample. The regression analysis tests whether the prior estimates are consistent with the overall energy use patterns in the sample, after controlling for the effects of other factors, such as weather variations. The numerical estimates of the coefficients of the engineering priors quantify any systematic bias in the engineering estimates. These coefficients can be considered realization rates in the sense that they represent the percent of the engineering-based savings estimates that are "realized", based on the recorded consumption.

The form of the statistical model used in our analysis falls in the class of models known as analysis of covariance (ANCOVA). This is a form of regression analysis where the explanatory variables include combinations of classification (i.e. binary variables denoting some classification) variables and continuous effects. In the application to estimate the program effects, the electricity consumption is regressed against variables representing the prior (continuous) engineering estimates of savings and a series of customer specific (classification) constants and weather sensitivity terms (interactions of the classification and continuous weather effects). The baseline and weather sensitive portions of consumption are allowed to vary from one customer to the next, but the effects of the programs, defined in terms of the claimed savings, are common across customers. This form of specification avoids the need to include a detailed inventory of building and customer characteristics in the model. The details of the algebraic specification of the model are presented in Section 2.1.

1.5 GUIDE TO REMAINING CHAPTERS

The remainder of this report presents the results of the analysis of the 1994 EMHR and EMS Program impacts. Chapter 2 describes the model specification in greater detail. Chapter 3 documents the data collection and preparation process. Chapter 4 summarizes the results of the analysis of the data, including the regression model results and the examination of the stability of estimated model parameters across different customer segments. Chapter 5 presents the results of an analysis of free ridership using self-reports from the surveys that was used to corroborate the reliability of statistically based estimates. Chapter 6 presents the estimates of the energy and peak demand savings for the two programs that are based on the statistically estimated model parameters.

Chapter 2
DESCRIPTION OF APPROACH

Chapter 2
DESCRIPTION OF APPROACH

2.1 GENERAL MODEL SPECIFICATION

The load impact regression model that was used to estimate the first year energy impacts of the Southern California Edison's (SCE) Energy Management Hardware Rebate (EMHR) and Energy Management Services (EMS) Programs is a statistically adjusted engineering (SAE) model. The general form of the specification is:

$$Dayuse_{it} = \beta_{0i} + \beta_{1i} CDD_{it} + \beta_{2i} SICINDX_{it} + \sum_{j=3}^{n} \beta_j X_{jit} + \sum_{k=n+2}^{n+6} \beta_k EngSav_{kit} + \varepsilon_{it}$$

where

$Dayuse_{it}$	=	Average daily electricity consumption by customer i in period t
β_{0i}	=	Customer specific constant for customer i
β_{1i}	=	Customer specific coefficient of cooling degree days (CDD)
CDD_{it}	=	Cooling degree days per day for customer i's billing period t
β_{2i}	=	Customer specific coefficient of SICINDX
$SICINDX_{it}$	=	Index of consumption trend for customers in same 2 digit SIC code as customer i
β_j	=	Coefficients for other variables whose effects are common to all customers
X_{jit}	=	Other variables whose effects are common to all customers
β_k	=	Coefficient of engineering-based claimed savings calculated from program tracking database, i.e., realization rate for claimed savings
$EngSav_{kit}$	=	Engineering estimate of savings calculated from program tracking database, broken down by program and lighting, HVAC, and other end-use categories

The first three parameters of the model are specific to each customer in the sample. The first two capture any underlying differences in baseline and weather sensitive electricity consumption across customers. They are included instead of attempting to model cross sectional variations in energy use by explicitly including variables that represent business type, size, equipment characteristics, and the like. Given the focus of the analysis on quantifying the impacts of the program, this approach avoids the need to model all of the other factors that influence electricity consumption in order to isolate the effects of the program measures.

The third parameter also varies across customers. It is intended to capture underlying, background trends in electricity consumption over the period of analysis. The variable SICINDX was constructed by computing the monthly electricity consumption for all commercial customers in SCE's service territory by two digit Standard Industrial Code (SIC). The index is simply the

average consumption per month divided by the average consumption in January 1993 for that SIC group. The index is matched to each observation in the same two digit group by month. This variable, which is only included in some model specifications, picks up the effects of economic changes for the SIC group, any naturally occurring conservation, and other background factors.

The X_{jit} variables represent various types of changes in business activity or equipment. These include such factors as seasonal indicators for schools, and responses to survey questions about whether any significant changes had occurred at the premise in operating hours, vacancy rates, employment, or business activity.

The key variables in the analysis are the $EngSav_{kit}$. These are based on the estimates of electricity savings made by the SCE energy service representatives (ESR's) when they performed their verification audits of the measures that were installed under the EMHR and EMS Programs. These savings estimates are the ones recorded in SCE's EMHR and EMS Program tracking systems. These estimates were tabulated to compute the total program savings that SCE claimed for these programs in 1994.

The energy estimates computed by the SCE ESR's were transformed into daily values, so that they would be in the same units as the dependent variable. For non-weather sensitive measures, such as lighting, this was done by simply dividing the annual estimate by 365 days. For weather sensitive measures, the allocations to billing periods were based on simulations of electricity use for different building types and efficient technologies. This allocation procedure is described in detail in Chapter 3.

There were six separate variables representing the engineering estimates that were included in the model specification. These were the savings estimates for HVAC, lighting, and other measures, respectively. Separate variables were tabulated for each of the two programs, resulting a total of six separate coefficient estimates.

Chapter 3
DATA COLLECTION AND PREPARATION

Chapter 3

DATA COLLECTION AND PREPARATION

3.1 SUMMARY OF DATA USED IN THE ANALYSIS

The data used to estimate Southern California Edison's (SCE) 1994 Energy Management Hardware Rebate (EMHR) and Energy Management Services (EMS) Program electricity savings were drawn from several sources. These sources are summarized here. The process of data extraction, cleaning, and merging is summarized in Section 3.2.

EMHR Program Tracking System

SCE provided an extract from its EMHR program tracking system for all measures installed in 1994. The program tracking system is organized by measure, and it records extensive information about the characteristics of the rebated measure and the customer. Important variables include a summary description of the measure, its estimated savings, the method by which the savings were calculated, the date of installation, the account affected by the measure, the annual electricity consumption for that account, and the participant's Standard Industrial Classification (SIC) Code.

EMS Program Tracking System

SCE also provided an extract of the EMS Program tracking database for the 1994 measures. The EMS Program tracking system contains similar data to that in the EMHR Program tracking system, including measure description, estimated savings, account affected by the measure, and customer characteristics.

Coupon Sample Databases

In addition to the EMHR Program tracking database, SCE has compiled a series of files that record the information coded on the rebate coupons for a sample of approximately 1,000 rebate coupons. These data sets contain more detailed information drawn from the hard copies of the completed coupons. The key data set created from the rebate coupons is organized by measure. (One rebate coupon may contain multiple measures.) It contains a more detailed description of the rebated measure, the estimated consumption of the replaced equipment and the new equipment, the estimated hours of operation of the equipment, and other useful information.

Participant Surveys

The analysis used information gathered in three separate surveys. The first was an on-site inspection/survey. Its primary purpose was to determine the retention of measures installed in 1994. This is referred to as the 1994 measure retention survey. The sample for the measure retention study was designed with the primary objective of fulfilling the requirements of the Measurement and Verification protocols regarding measure retention verification. Under these requirements, SCE must inspect measures in seven technology categories that account for the top 50% of the claimed program savings in 1994. The on-site inspections also verified the installation of other EMHR and EMS measures at each site. In addition to verifying the continued operation of rebated measures, the survey collected information about any changes in occupancy, renovations, or other factors since 1992 that would significantly affect electricity consumption.

The second survey was conducted to supplement the coverage of the first survey. This was a telephone survey aimed at EMHR participants who were not included in the 1994 measure retention survey sample. For the most part, these were customers who had only installed measures outside the seven categories covered by the 1994 retention survey. This survey collected information on all of the measures that the participant installed under the program in 1994, as well as information relating to actions they may have taken under the EMS Program.

The third survey was aimed at customers who had participated in the EMS Program in 1994, but not in the EMHR Program. It asked questions about the actions that were taken in 1994 and claimed under the EMS Program, as well as questions about any other changes that significantly affected electricity consumption since 1992.

It is important to note that there was considerable overlap in the coverage of these surveys. Each survey asked about all of the actions taken under both the EMHR and EMS Programs. Since many, if not most, participants took multiple EMHR measures as well as EMS actions, the retention survey collected considerable data about "bottom 50%" measures and EMS actions. The EMHR telephone survey collected information about EMS actions. The EMS survey only collected information about actions claimed under that program, since the target population was 1994 EMS participants who were not in the EMHR program.

Billing Data

SCE provided monthly billing data for samples of customers in the EMHR and EMS Programs covering a period from January 1993 through November 1995. The data were provided for all accounts serving the business location affected by the measure. That is, if a customer had multiple accounts at a business location (service address) that had received program measures in 1994, then SCE provided data for all of the accounts serving that location. The data included the billed electricity consumption and (in some cases) the peak demand for each billing period, and the meter read dates. SCE also appended summary weather variables (heating degree days and

cooling degree days) to the billing data. These weather variables were contemporaneous with the billing cycle in the period, and they were based on temperature readings at a weather station close to the business location.

The billing data were only provided for a portion of the participants in the EMHR and EMS Programs. These were the "gross" sample frames used for the surveys described above. That is, they were the lists of customers from which the surveys were conducted, after screening the program and coupon data sets for missing data on key variables and other characteristics. These screening steps and the associated attrition are described in further detail below.

3.2 PROGRAM, CUSTOMER DATA BASE, AND BILLING DATA PREPARATION

The data preparation for analysis was performed in three distinct phases. The first covered extraction and preparation of the "gross" samples that were used for the three surveys of 1994 participants. These gross samples comprised the lists of participants from which the surveyors contacted prospective respondents. The second covered the process from the delivery of data sets of completed survey responses through the compilation of the master data set used in the regression analysis. The third covered some additional data attrition that occurred in the course of the analysis when outliers and cases with implausible values for key variables were identified. This section summarizes and documents each step in these three phases. Specific technical issues of sample design (i.e. specification of completion quotas from the gross samples) are discussed in Section 3.3, and of the effects of attrition on the impact estimates are discussed in conjunction with the results presented in Chapter 4.

Extraction of Gross Samples

The following three separate and mutually exclusive samples were drawn from the program databases:

- the 1994 Retention Study Sample
- the 1994 Supplemental EMHR Program Telephone Survey, and;
- the 1994 EMS Program Telephone Survey

The steps in extracting these samples are summarized in Figures 3-1, 3-2, and 3-3. Each step is described here.

1994 Retention Study. The 1994 retention study is an on-site survey/inspection whose primary objective is to verify the retention of measures installed under the 1994 EMHR Program. The inspections were directed at the measures that accounted for the top 50% of the claimed savings for that program year. These measures were:

- electronic ballasts
- compact fluorescent bulbs (modular)
- T8 lamps
- delamping/reflectors
- EMS (space conditioning)
- chillers
- adjustable speed drives

The gross sample for this study was drawn for SCE's coupon database. The coupon database is itself a sample of the rebate applications that were approved under the 1994 program. The coupon database contains information on 2,237 of the 5,274 measures for which SCE claimed savings for the commercial portion of the 1994 EMHR Program.

The gross sample for this study was created by extracting all of the cases in the coupon database corresponding to the seven measures listed above. If the number of cases in any measure stratum was insufficient to meet completion targets, additional cases were added from the program database.

Once the gross sample was drawn, cases for all other EMHR and EMS measures installed at the participating premise were extracted from the coupon and program databases. The total number of accounts in the gross sample for the 1994 retention study was 1,064. According to the program records, these premises had installed a total of 1,227 of "top 50%" measures under the EMHR Program.

The EMHR Program Supplemental Telephone Survey. Since the 1994 retention study focused on the measures that accounted for the largest portion of savings, a separate survey was conducted for the other measures. (The retention study included some of these smaller measures because recipients of the large measures may have also installed one or more small ones.) The frame for the EMHR telephone survey was the premises in the coupon database that were not included in the retention study. Most (though not all) of these only installed measures outside of the seven categories listed above.

The gross sample for this survey was extracted by deleting all cases (measures) from the 1994 EMHRP coupon database that were in the retention study gross sample. All other measures and actions taken by the treated premises in the remaining subset under the 1994 EMHR and EMS Programs were merged into the database. The measures and actions were then aggregated to the premise level.

EMS Telephone Survey. The EMS telephone survey was directed at customers who had participated in the 1994 EMS Program, but not the EMHR Program. The gross sample for this survey was drawn by deleting all cases in the EMS program tracking database with premise numbers that appeared in the 1994 Retention Study gross sample and the EMHR Supplemental Telephone Survey sample. The remaining cases were aggregated to the premise level. This data set comprised the gross sample for the EMS telephone survey.

Sample Extraction Flow Charts

Figures 3-1 through 3-4 below chart the flow of steps required to extract the final number of sites used for the billing analysis.

Figure 3-1 outlines the sample extraction for the 1994 measure retention study. From the coupon database, all cases with measures in the "top 50%"of savings were extracted. These were supplemented with cases from the EMHR Program database.

Figure 3-1.
On-Site 1994 Retention Study
Sample Extraction

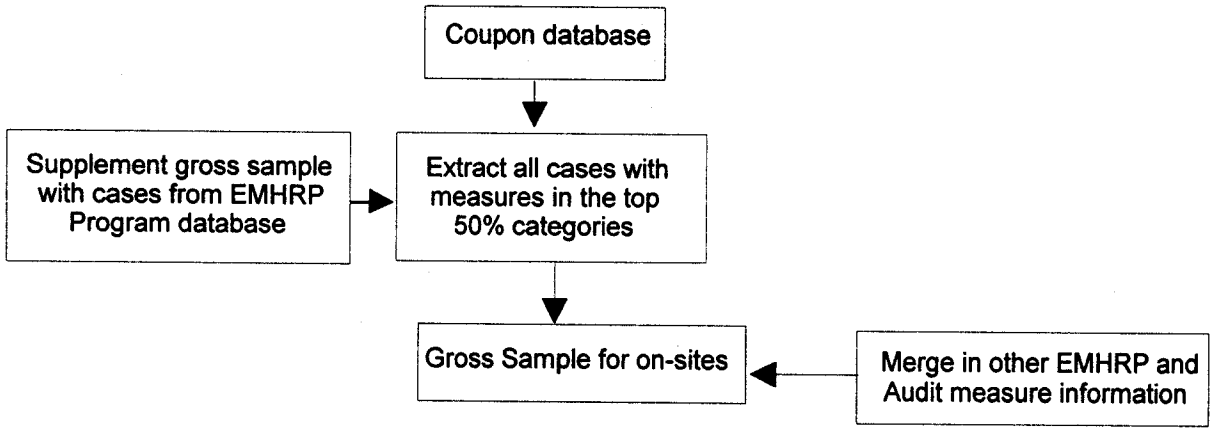


Figure 3-2 provides the steps taken to extract the sample for the EMHR telephone survey. Any coupon with at least one measure from the category of those in the "top 50%"of savings was deleted from the coupon database. After additional screening criteria, 285 records were provided to the survey implementation subcontractor, Northwest Research Group (NRG) for the telephone survey.

Figure 3-2
EMHRP Telephone Survey
Sample Extraction

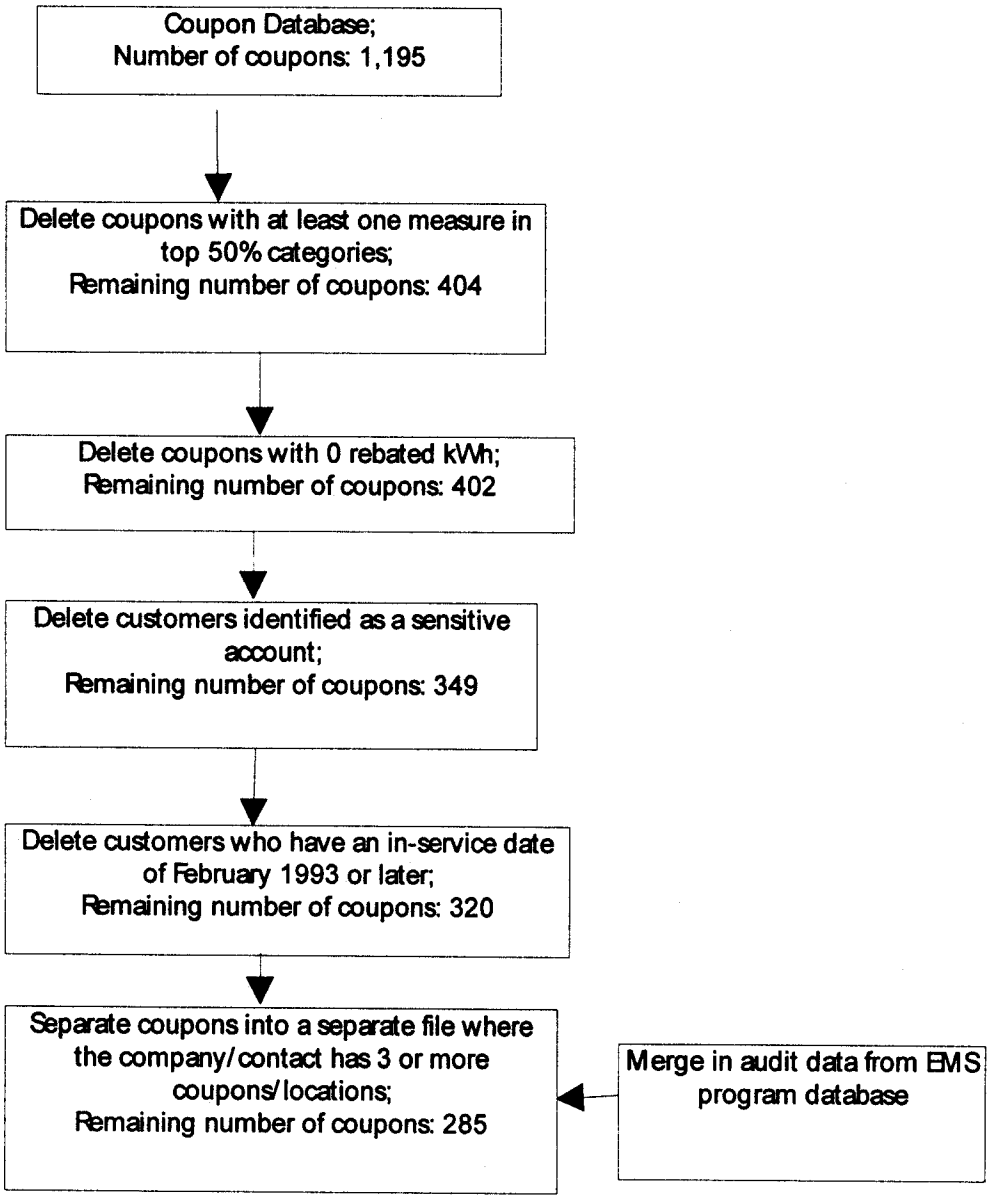


Figure 3-3 outlines the sample extraction for the EMS telephone survey. There were originally 1,252 commercial customer accounts in the EMS program database. After several cleaning steps, 302 records were provided to NRG for the telephone survey.

Figure 3-3
EMS Telephone Survey
Sample Extraction

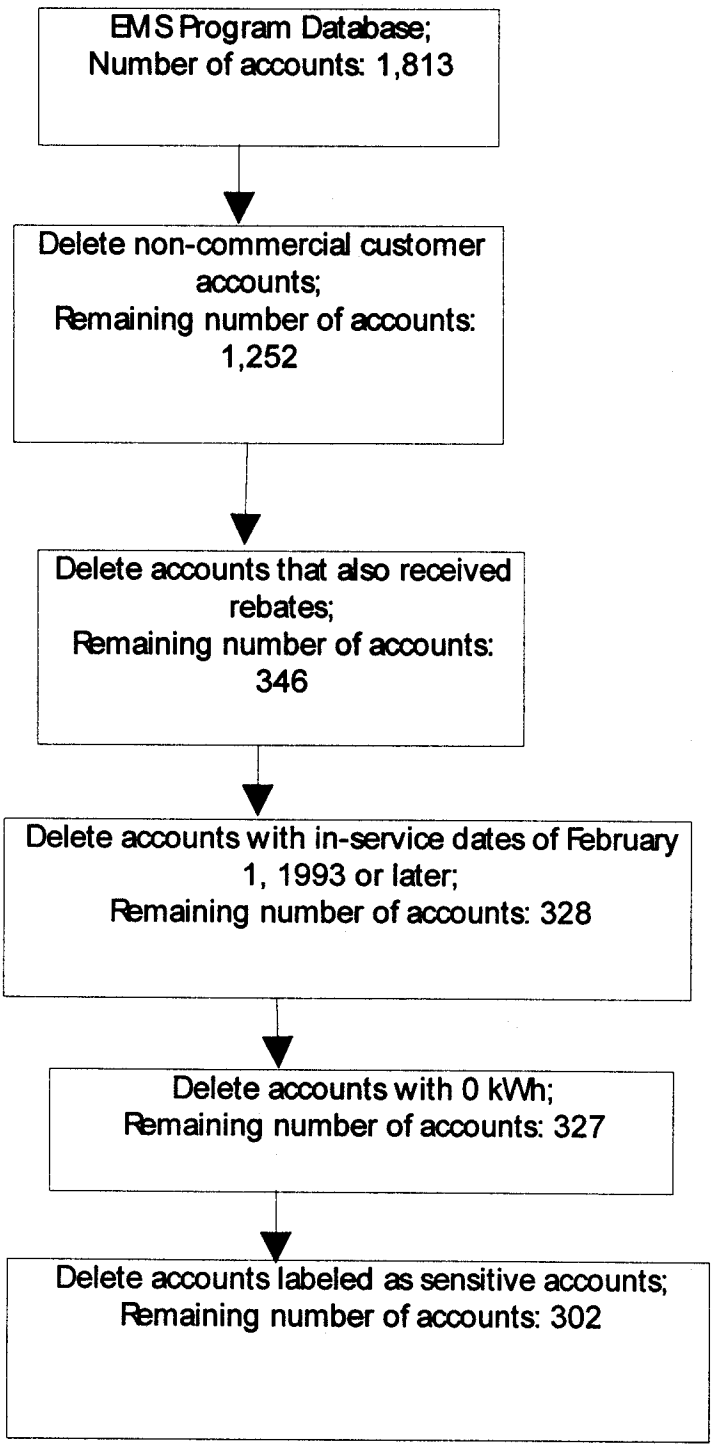


Figure 3-4 charts the flow of steps to derive the final number of sites used in the billing analysis. A total of 232 on-site surveys were completed. Of the 285 records provided to NRG for the EMHR telephone survey, 113 surveys were completed, and of the 302 records provided for the EMS telephone survey, 89 resulted in a completion. After deleting an additional 34 records from the EMHR survey due to an industrial or agricultural SIC code, 400 total surveys were combined with SCE billing data.

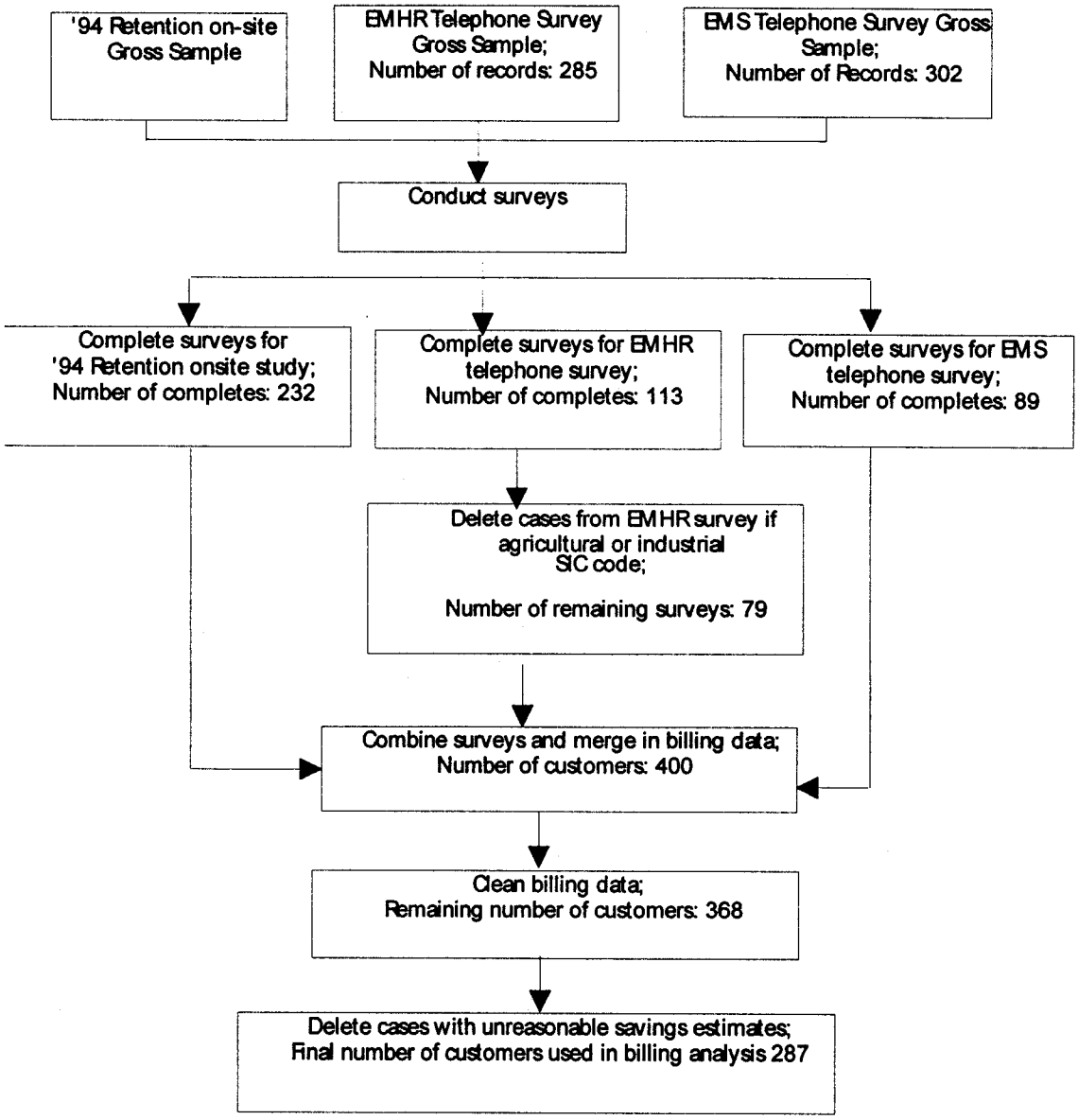
A screening criterion applied to the billing data was that all customers must have had at least six months of billing data in the pre-installation period and six months of billing data in the post-installation period. This cleaning step resulted in the deletion of 32 additional customers.

Finally, additional screening criteria were applied that required savings estimates to be reasonable, and customers to meet further specifications. Specifically these criteria were (resulting deletions in parentheses):

- Savings estimates must not be "deferred" loads (26 deletions);
- Savings estimates must be less than 50% of consumption (43 deletions);
- Customers must use less than 100,000 kWh per day (5 deletions);
- Customers could not have changes in number of accounts accompanied by significant changes in usage (5 deletions); and
- Customers could not have unexplained large changes in usage over the sample billing period (2 deletions).

The final number of customers used in the billing analysis totaled 287.

Figure 3-4
Billing Analysis
Sample Extraction



3.3 SAMPLE DESIGN

RETENTION STUDY SAMPLE DESIGN*

The data on measure retention were collected for a sample of facilities chosen from among Edison customers who participated in Edison's EMHR Program in 1994. The sample of facilities was chosen through measure-based sampling. The measures for which data was collected include the following:

- Electronic ballasts
- CFBs (modular)
- T8 lamps
- Delamping/Reflectors
- HVAC EMS systems
- High-Efficiency Chiller Systems
- Adjustable Speed Drives

The goal in preparing the sample design was to permit results for a measure to be reported with a relative precision of ±20 percentage points at the 80 percent confidence level. It was permissible to use a sample that combines sample points from the EMHR Program for 1993 and 1994 to satisfy these precision/confidence requirements. At the same time, it was desirable to incorporate features into the sample design that lower the data collection costs.

ANALYTICAL FRAMEWORK FOR SAMPLE DESIGN

The analytical framework for the development of the sample design for the study was provided by survival analysis techniques. Survival analysis pertains to the analysis of data that correspond to the time from a well-defined time origin until the occurrence of some particular event or end-point. For this study, the time origin is defined by the installation of a measure under the EMHR program, while the end-point is defined by the removal or failure of the measure or the discontinuance of its use.

The measure survival data have several features that warranted special treatment in preparing the sample design.

- The measure survival data will probably not be symmetrically distributed and cannot be reasonably represented by a normal distribution.

* This discussion of the Measure Retention Study is taken largely from the research plan for the study submitted to SCE by the prime contractor, ADM Associates, Inc.

- The survival data are *right-censored* in that the removal/failure/discontinuance end-points are not observable for some of the installed measures.

- The survival data for some types of measures (e.g., lighting measures) may be affected by clustering. That is, a single customer may have multiple occurrences of a particular type of measure (e.g., T8 lamps). For a single customer, there can be expected to be some homogeneity in the lifetimes for the particular type of measure, since they were all installed at the same time and are subject to similar operational conditions. Because of this homogeneity, a sample of clustered measure occurrences provides less information than a similar sample that does not exhibit such homogeneity.

The sample design addresses these and other features of the data that are to be collected.

The sample design was developed through the following steps.

- First, the number of removals/failures required to meet the precision/confidence specifications for each type of measure was determined.

- Second, the probability of removal/failure for each type of measure over the period of the study was determined and applied to the required number of removals/failures to determine the number of points required in the sample.

- Third, the required sample size was adjusted to account for the effects of clustering.

- Fourth, sample points for a measure were allocated among facilities.

DETERMINING NUMBER OF REQUIRED REMOVALS/FAILURES

The first step in preparing the sample design was to arrive at quantitative estimates of the required sample sizes for the various types of measures. To do this, it was necessary to use a parametric representation for the measure survival data. For the sample design, it was assumed that the survivor function for a measure's life data can be represented with the exponential distribution:

$$S(t) = e^{-\lambda t}$$

For this function, the mean survival time is given by $\mu = 1/\lambda$, with its standard error given by $\frac{\mu}{\sqrt{r}}$, where r is the number of measure occurrences within a sample that have been removed or have failed. Thus, with an exponential survivor function, the standard error for the estimated mean from a sample depends on the number of removals/failures that are observed.

The precision/confidence requirements for the sample were that the estimate of mean effective useful life for a measure must have relative precision of ±20 percent at the 80 percent confidence level. This implies the following:

$$0.2\mu = \frac{z\mu}{\sqrt{r}}$$

where μ and r are defined as above and z is the upper point of the standard normal distribution defining the desired level of confidence. For the 80 percent confidence level, $z = 1.28$. Thus, the number of removals/failures required to estimate mean measure life for a particular measure at the specified precision/confidence is $r = 41$.

ACCOUNTING FOR "RIGHT CENSORING"

As noted above, there likely is right-censoring of the occurrences of a measure in the sample; not all of the occurrences will be observed until their life end-point. Accordingly, the number of measure occurrences brought into the sample must be greater to accommodate this right censoring phenomenon. The sample size needed to provide the required number of removals is determined as follows:

$$\text{Sample Size} = \frac{\text{Number of required removals / failures}}{\text{Probability of removal / failure}}$$

The probability of removal/failure with an assumed survivor function can be calculated as a function of (1) specified values for the survivor function, (2) the study accrual time (i.e., the period when measure occurrences take place) and (3) the study follow-up time (i.e., the period when occurrences are tracked to see whether they are removed or fail). For this study, the accrual period is 24 months (the years 1993 and 1994 for the EMHR Program), and the follow-up period is 48 months (the four years 1995-1998 when on-site and telephone data collection occur).

Given that the length of the study is fixed, the probability of removal/failure is determined primarily by the expected mean life of a measure. The shorter the mean life of a measure, the higher the probability of removal or failure. For example, the probability of removal/failure is 0.593 for a measure with a mean life of 5 years and 0.368 for a measure with a mean life of 10 years. With the required number of removals/failures for either type of measure being 41, the respective sample sizes are 69 and 112.

ACCOUNTING FOR EFFECTS OF CLUSTERING

For measures where there are multiple occurrences at a site (e.g., for lighting measures), an additional step in the sample design was to adjust for the intra-site correlation among useful lives for the different occurrences at a site. A sample drawn from clusters with some degree of homogeneity carries less information than a random sample of the same size but which is heterogeneous. On the other hand, using a cluster sampling approach allows us to reduce the number of sites that need to be visited, thereby reducing costs.

To determine the necessary sample size of sites to visit and measure occurrences to collect data on at each site, a two-stage sampling procedure is used. For this sampling, sites are designated as primary sampling units (PSUs) and measure occurrences as secondary sampling units. A sample of sites is chosen first and then a sample of measure occurrences is chosen within each selected site.

Table 3-5 reports the total number of sites and total number of occurrences for which data need to be collected for each measure to satisfy the precision/confidence requirements. As can be seen, whether information is collected for all or for a sample of measure occurrences depends on the type of measure.

- Sampling of occurrences is generally used for lighting measures. For each type of lighting measure, 10 occurrences of the measure are being inspected at a sample site. Fixture groups are defined that have equivalent physical design and approximately similar operating hours (based on lighting system operating controls). Detailed information is recorded on ballast, reflector, lens, bulb, controls, task use, and other features as installed under the program and as noted on program records.

- A census approach is generally appropriate for HVAC measures (e.g., EMS, high-efficiency chillers). The field staff verify the presence and operation of all program-installed measures. Because of the long lives of most HVAC equipment, removal/failures may not occur often. However, changes in utilization for such equipment is of interest, so that data are collected that pertain to how conditions that affect equipment operation may have changed.

SAMPLE ALLOCATION AND SELECTION

Table 3-5 shows the number of sites and occurrences that need to be sampled for each type of measure for this measure retention study to meet the specified precision/confidence requirements. The final step in the sample design is to allocate the sample points for each type of measure among sites and to select the sites from which data are collected.

In practice, the sample allocation/selection process has been performed for 1993 and 1994 EMHR Program participants separately. The number of sample points required for any particular measure is divided equally between 1993 and 1994 participants. The sample allocation and selection work for 1993 and 1994 EMHR Program participants has made use of files that Edison staff prepared that contain information on the participants.

Table 3-5

Numbers of Sites and Numbers of Measure Occurrences Required for the 1993 and 1994 Measure Retention Studies:* By Type of Measure

Measure	Number of Sites	Number of Measure Occurrences
Commercial:		
Electronic ballasts	61	614
CFBs (modular)	72	719
T8 lamps	38	381
Delamping/reflectors	61	614
HVAC EMS systems	112	112
High-efficiency chillers	199	199
ASDs (commercial)	84	167
Industrial and Agricultural:		
ASDs (industrial)	84	167
Pumps	77	155
Pump system (hardware) improvements	77	155
Ballasts	61	614
Lamps	61	614
Totals:	988	4,511

For each type of measures, 1993 and 1994 EMHR Program participants were stratified according to business sector and size.

- With the business sector stratification, participants were separated into a commercial customer class and an industrial/agricultural customer class.
- Within each measure/sector grouping, customers were further stratified according to size using a program category variable developed by Edison program staff. Customers

* This table shows figures for both years combined. Table 3-6 shows the allocation for 1994 alone.

are assigned to categories according to kW demand, using information available on Edison files.

- Small (S) includes customers with demand between 0 and 49 kW.
- Medium (M) includes customers with demand between 50 and 499 kW.
- Large (L) includes customers with demand of 500 kW or more.

If this program category assignment was not available for a customer on the Edison files, the customer was assigned to an Unknown (U) category.

Data were available on the Edison files regarding the kWh savings associated with a measure. The distribution of these savings among program categories was calculated for each measure.

For most measures, sample points for a measure were allocated to program categories in proportion to the distribution of savings. However, for some types of measures, the required sample size exceeded the number of customer facilities available on the sampling frame. For example, the sample size calculations design called for 199 sample points allocated to commercial locations that installed high efficiency chillers, of which 100 would be allocated to 1993 participants and 99 to 1994 participants. However, in actuality there were only 39 sites where high efficiency chillers were installed under the 1994 program. Accordingly, this left 60 sample points to be reallocated among measures for the commercial sector. This re-allocation is shown in Table 3-6, where the sample design for the 1994 commercial sector measures is summarized. Since the original sample sizes satisfied the confidence/precision requirements that Edison desired, the increases in sample sizes for the various measures in effect should improve the precision with which the measure lives are estimated.

Primary preference for selection to the sample is given to the customers represented in the Coupon Files that Edison has drawn. (These customers are the basis for other evaluation work that Edison is performing, and data for these customers are to be collected during this study that can support that evaluation work.) For some types of measures, it is possible to select sample sites from among only those EMHR Program participants represented in the Coupon File. However, for other measures, EMHR Program participants not represented in the Coupon File needed to be included in the sample pool to ensure that a sample of the required size can be recruited.

Within each sector/measure/program category combination, participants that are candidates for the sample were sorted first according to their Coupon File status; participants represented in the Coupon File were sorted to the beginning of a list, followed by any participants not in the Coupon File who needed to be added to meet the sample size requirement. Within each of these two groupings, customers were randomly

sorted. In the sample recruiting, customers were contacted according to their ordering on these sorted lists until the required number of sites were recruited for the sample.

In practice, customers who have been surveyed within the past year for another Edison study were not contacted again. Where possible, the data collected on such customers for the other studies are used.

A copy of the data collection instrument for the 1994 Measure Retention Study is presented in Appendix 3.

Table 3-6

Sample Allocation for Commercial Sector Measures: 1994 EMHR Program Participants

Measure	Program Category	Total Sampling Population[1]	Number from Coupon File	1994 Sample n
Electronic Ballasts	S	66	66	1
Electronic Ballasts	M	211	211	14
Electronic Ballasts	L	152	152	22
		429	429	37
CFBs (Modular)	S	13	13	2
CFBs (Modular)	M	46	46	21
CFBs (Modular)	L	26	26	17
		85	85	40
T8 Lamps	S	60	60	1
T8 Lamps	M	203	203	14
T8 Lamps	L	145	145	22
		408	408	37
Delamping/Reflectors	S	5	5	1
Delamping/Reflectors	M	25	25	26
Delamping/Reflectors	L	17	17	10
		47	47	37
HVAC EMS	S	79	19	20
HVAC EMS	M	127	58	31
HVAC EMS	L	45	27	11
		251	104	62
High-Efficiency Chillers	A	1	1	1
High-Efficiency Chillers	S	0	0	0
High-Efficiency Chillers	M	4	3	4
High-Efficiency Chillers	L	34	23	34
		39	27	39
ASDs	S	3	1	1
ASDs	M	67	32	29
ASDs	L	74	31	32
		144	64	63
Total Sample				315[1]

[1] 232 surveys were completed in time to be included in the 1994 impact evaluation.

EMHR Supplemental Telephone Survey

Some of the customers in the 1994 EMHR Program are candidates for data collection for the nonresidential measure retention study, and data for these customers and measures were collected to support the impact evaluation of the 1994 program. However, data were also needed for the impact evaluations on customers and measures not represented among those who are candidates for the measure retention study. That is, a sampling plan was required to provide coverage of the "bottom 50" measures.

The sample design work for the "bottom 50" measures made use of SAS data sets that Edison staff prepared that contain information on the 1994 participants in the EMHR Program. One file contains information on all customers in the program (i.e., "program" file), while a second set of files contains information on customers whose coupons were selected for more detailed data entry (i.e., "coupon" file).

Based on data in the program file, the kWh savings for which Edison paid rebates to 1994 EMHR Program participants totaled 643 million kWh. Of these savings, nearly 80% (513.2 million kWh) are associated with customers and measures represented in the coupon file. Of the savings represented in the coupon file, about 46% (236.5 million kWh) are associated with customers and measures not represented in the sample pool for the measure retention study. It is this final category that is the target population for the "bottom 50" sample.

The target population for the "bottom 50" sample consists of 400 coupons for which rebated kWh savings total 236.5 million kWh. For sample design purposes, the Dalenius-Hodges stratification procedure was applied to rebated kWh savings for a coupon to stratify these 400 coupons into four strata:

- Stratum 1 contains coupons with rebated kWh savings less than 160,000 kWh.
- Stratum 2 contains coupons with rebated kWh savings in the range 160,000 kWh to 625,000 kWh.
- Stratum 3 contains coupons with rebated kWh savings in the range 625,000 kWh to 2,570,000 kWh.
- Stratum 4 contains coupons with rebated kWh savings above 2,570,000 kWh.

Table 3-7 shows the numbers of coupons falling into each stratum, the mean kWh savings for the coupons, and the total kWh savings by stratum. Table 3-7 also shows the recommended sample allocation. Because the coupons in stratum 4 represent the highest savings, it is recommended that these coupons be sampled with certainty. For the other three strata, random samples of coupons are selected. With a total sample of

60, allocated as shown in Table 3-6, the precision of estimated kWh savings for the "bottom 50" measures would be about 6% at the 90% confidence level.

Table 3-7

Proposed Sample Allocation for "Bottom 50" Measures

Stratum	N	Mean kWh Savings	Std Dev	CV	Total kWh Savings	Sample	Contribution to Variance	Precision
1	216	44,484.26	40,751.48	0.9161	9,608,600	10	7,389,375,559,194	
2	91	306,947.29	123,891.98	0.4036	27,932,203	10	11,313,911,183,003	
3	73	1,142,121.12	511,142.27	0.4475	83,374,842	20	50,541,988,193,884	
4	20	5,778,441.20	4,836,256.54	0.8369	115,568,824	20	0	
ALL	400				236,484,468	60	69,245,274,936,080	5.77%

Energy Management Services Program Telephone Survey

A second sample was required for customers who received an energy audit from Edison during 1994 and who did not subsequently receive any rebate for installing recommended measures. Essentially, these customers are "audit only" customers.

To identify "audit only" customers, a file provided by Edison on customers who received audits was matched against the EMHR Program program file. (This matching was done on the basis of CIS account number.) This matching provided a target population of 415 commercial accounts that had received an audit but which were not identified in the EMHR Program file as having received a rebate.

For sample design purposes, the Dalenius-Hodges stratification procedure was applied to expected kWh savings for the "audit only" customers to stratify the 415 accounts into four strata:

- Stratum 1 contains accounts with expected kWh savings less than 34,000 kWh.
- Stratum 2 contains accounts with expected kWh savings in the range 34,000 kWh to 97,000 kWh.
- Stratum 3 contains accounts with expected kWh savings in the range 97,000 kWh to 272,000 kWh.
- Stratum 4 contains the 50 accounts with largest expected kWh savings (above 272,000 kWh.

Table 3-8 shows the numbers of accounts falling into each stratum, the mean kWh savings for the accounts, and the total kWh savings by stratum. Table 3-8 also shows that the sample allocation based on a total sample size of 65 provides a precision for estimated kWh savings for the "audit only" accounts that would be about 8.7% at the 90% confidence level. (Random samples of accounts are selected for the sample from within each stratum.)

Table 3-9 shows an alternative sample allocation for the audit only sample in which the total sample size is increased to 90 so that all accounts in stratum 4 (which represent the highest expected savings) can be sampled with certainty. With this sample size and allocation, the precision is about 3.4% at the 90% confidence level. The precision improves significantly because the large accounts contribute most significantly to the variation in the population, as well as accounting for over half (about 53%) of the kWh savings expected from audit only commercial customers.

Table 3-8
Initial Sample Allocation for Audit Only Customers

Stratum	N	Mean kWh Savings	Std Dev	CV	Total kWh Savings	Sample	Contribution to Variance	Precision
1	152	15,296	9,755	0.6377	2,325,062	10	205,378,954,673	
2	94	60,631	17,841	0.2942	5,699,315	10	251,319,263,724	
3	119	168,626	42,642	0.2529	20,066,473	20	1,071,118,251,647	
4	50	644,317	418,375	0.6493	32,215,856	25	8,751,862,747,330	
ALL	415				60,306,706	65	10,279,679,217,374	8.72%

Table 3-9

Alternative Sample Allocation for Audit Only Customers

Sample	Contribution to Variance	Precision
10	205,378,954,673	
10	251,319,263,724	
20	1,071,118,251,647	
50	0	
90	1,527,816,470,044	3.36%

3.4 SUMMARY OF SURVEY DESIGN AND ADMINISTRATION

EMHR Program

SRC originally provided NRG with 285 sample elements after applying several screening criteria to the EMHR program database. Of these, 13 records were duplicate contact names/phone numbers and were deleted. If a contact name and number was listed twice, the record with the lower strata number was deleted.

Table 3-10 provides a complete sample disposition report for each EMHR sample element attempted. It should be noted, as the strata cells were completed sample was moved out of the active database, resulting in higher dispositions than would have occurred if the cells were not closed. Specifically, the dispositions for no answer, busy, answering machine, non-working number and callbacks were not reached. The detailed field services report and a copy of the survey instrument are presented in Appendix 3.

Table 3-10
Sample Disposition Report - EMHR Telephone Sample

Disposition	Sample	Percent
No Answer	12	4.4%
Busy	8	2.9%
Answering Machine	6	2.2%
No Telephone Number	4	1.5%
Non-Working / Disconnected Number	36	13.2%
Additional Duplicate Sample	5	1.8%
Business Moved / Not At Address	2	0.7%
Immediate Refusal	18	6.6%
Not SCE Customer	1	0.4%
No One Knowledgeable	12	4.4%
Callbacks Not Reached	34	12.5%
Left Message	19	7.0%
Mid-Terminate	2	0.7%
Completes	113	41.5%
Sample Attempted	**272**	**100.0%**

EMS Program

SRC originally provided NRG with 302 sample elements from the EMS program database. Of these, 101 records were duplicate contact name / phone numbers and were deleted.

Table 3-11 provides a complete sample disposition report for each EMS sample element attempted. As with the EMHR sample, as the strata cells were completed sample was moved out of the active database, resulting in higher dispositions than would have occurred if the cells were not closed.

It should be noted that SRC completed an additional 10 EMS telephone surveys, bringing the total number of completions to 89.

A detailed field services report and a copy of the survey instrument are presented in Appendix 3.

Table 3-11
Sample Disposition Report - EMS Sample

Disposition	Sample	Percent
No Answer	5	2.5%
Busy	4	2.0%
Answering Machine	6	3.0%
Non-Working / Disconnected Number	8	4.0%
Additional Duplicate Sample	11	5.5%
Business Moved / Not At Address	13	6.5%
Immediate Refusal	17	8.5%
Not SCE Customer	2	1.0%
No One Knowledgeable	9	4.5%
Callbacks Not Reached	36	17.9%
Left Message	7	3.5%
Mid-Terminate	4	2.0%
Completes	79	39.3%
Sample Attempted	**201**	**100.0%**

Table 3-11B below provides a breakdown of survey completions, by program type and end-use.

Table 3-11b
Number of Survey Completions
By Program and End-Use

	EMS			EMHR			
Program	Lighting	HVAC	Other	Lighting	HVAC	Other	Total
EMS Telephone Survey	25	73	21	0	0	0	89
1994 Retention Study	11	106	8	177	132	21	232
EMHR Telephone Survey	3	16	1	45	34	11	79
Total	39	195	30	222	166	32	400

3.5 POST SURVEY DATA PREPARATION

The preparation of data for analysis proceeded in two steps. The first step was the extraction and cleaning of billing data. The second step involved the construction of variables used in the regression analysis. These steps are documented below.

Bill Extraction and Cleaning

Files with the account numbers for all of the customers in the gross samples for the three surveys were sent to SCE for bill extraction. SCE returned files of all of the bills that served the business locations where these accounts were located, covering the period from January 1993 through the most recently available month (typically November 1995). The files that were returned included information on the consumption and number of days in the billing period, as well as merged cooling degree days for that period based on readings at the nearest weather station. In total the files contained 85,056 billing records representing 2,458 accounts, at 1,765 business locations.

These data were screened according to several criteria that are summarized in the following table. A total of almost 77,000 bills were available for the simple tabulations of average consumption per month of participants over the period of analysis. Slightly more than 13,000 were available for use in the regression analysis.

Table 3-12
Bill Attrition by Screening Criterion

Deletion Criterion	Number of Deleted Bills	Number of Remaining Bills	Number of Accounts	Number of Business Locations
Original Data Set		85,056	2,458	1,765
Negative Consumption or Missing Number of Days	8	85,048		
Duplicates	23	85,025		
Overlapping Bills	105	84,920		
Non-participant customer	3,430	81,490		
Zero Usage for entire Period	481	81,009	2,336	1,734
Billing Period > 90 days	119	80,890		
Bills with less than 6 mos before, 6 mos after, or 20% gaps	4038	76,852	2,160	1,593
Bills for Accounts matched to Survey Responses		13,117		368

CONSTRUCTION OF VARIABLES FOR REGRESSION ANALYSIS

With the significant exception of the allocation of the engineering estimates of savings, the construction of variables for the regression analysis was relatively straightforward. All of the key variables (electricity consumption, cooling degree days) were transformed into daily averages per billing period by dividing the values by the number of days in that period.

In the case of the engineering estimates of savings, the transformation was more complicated. Customer energy savings due to the implementation of energy conservation measures were estimated by SCE on an annual basis. To perform customer billing analyses, it was necessary to allocate the annual savings estimates on a monthly basis to conform with the customer billing cycle. The allocation methodology employed was a function of the affected end use(s). Three allocation strategies were used:

1. Allocate annual savings based on monthly operating hours. This approach was used for non-weather sensitive end uses such as lighting
2. Allocate annual savings based on the monthly distribution of cooling loads. This approach was used for measures that would reduce, but not alter, the cooling load shape
3. Allocate annual savings based on measure specific calculations. This approach was used for measures such as economizers and cooling system adjustable speed drives that would alter the cooling load shape.

The methodology used to allocate annual savings estimates on a monthly basis was:

1. Identify unique measure descriptions from the EMS and EMHR databases using the description contained in the "COMP DESC" field
2. Assign measures to an end use
3. Determine whether an end use was weather sensitive or not
4. Determine whether a measure would alter, rather than just reduce, an end use load shape
5. Identify cities in SCE's planning regions using the "WZONE" field from the EMHR database
6. Select weather data representative of SCE's planning regions
7. Perform building simulations using micro-Axcess and normal year weather data to develop allocation factors for weather sensitive end uses
8. Develop allocation factors for non-weather sensitive end uses based on the number of commercial operating hours per month.

UNIQUE MEASURE DESCRIPTIONS, END USES, AND SAVINGS ALLOCATION STRATEGIES

Eighty-one unique measure descriptions were identified from the EMS database, and 150 unique measure descriptions were identified from the EMHR database. In some cases, measure descriptions were unique only because of the way the name was entered (i.e., abbreviated) in the databases. The measures were assigned to one of the following categories:

1. Air conditioning ..... efficiency measure
2. Air conditioning .. load shape modification
3. Compressed air ..... efficiency measure
4. Lighting ..... efficiency measure
5. Miscellaneous ..... efficiency measure
6. Process ..... efficiency measure
7. Refrigeration ..... efficiency measure
8. Space conditioning ..... efficiency measure
9. Water heating ..... efficiency measure

Compressed air, lighting, miscellaneous, process, refrigeration and water heating measures were assumed to be non-weather sensitive and savings allocation factors were estimated based on the number of commercial operating hours per month. The monthly allocation of savings due to air conditioning efficiency measures was assumed to be the same as the monthly allocation of cooling system energy use. It was assumed that the penetration of electric space heat was not significant and therefore the air conditioning efficiency allocation factors were also used for space conditioning efficiency measures.

Economizers and adjustable speed drives (ASDs) primarily reduce energy use during off-peak conditions and as a result modify the end use load shape. Separate calculations were performed to develop allocation factors for economizers and cooling system ASDs. The savings for non-cooling system ASDs was assumed to be allocated based on monthly operating hours because the affected end uses were not weather sensitive.

WEATHER DATA

The "WZONE" field in the EMHR database contained four unique values (i.e., 7, 8, 9 and 10). Matching city names from the EMHR database with their corresponding WZONE designations resulted in the following conclusions:

1. Zone 7 is the service territory north and east of Los Angeles
2. Zone 8 is downtown Los Angeles
3. Zone 9 is an area surrounding Los Angeles
4. Zone 10 is primarily desert area east of Los Angeles

Weather data was located for four locations in and around the SCE service territory. Specifically, normal year weather data was located for Fresno, Long Beach, El Toro and Burbank. The available weather data was not an exact match for the SCE service territory zones. As an approximation, the available weather was mapped to the SCE service territory zones as follows:

1. Zone 7 - Fresno weather
2. Zone 8 - Long Beach weather
3. Zone 9 - Burbank weather
4. Zone 10 - Fresno weather

The weather data from the El Toro weather station was essentially the same as for Long Beach.

The objective of the mapping of weather data to SCE service territory zones was to estimate monthly savings allocation factors and not actual loads. Consequently, the weather mapping was assumed to be reasonable for this purpose.

BUILDING SIMULATIONS

Building simulations were performed using micro-AXCESS version 10.2. Building prototypes developed during prior SRC studies were used to estimate monthly cooling loads. The prototypes used included an office, a retail establishment, a restaurant, a hotel, a hospital and a school. Based on preliminary simulations, it was concluded that the annual shapes of the cooling load curves for the commercial establishments were approximately the same and the retail establishment curve was representative of the commercial sector. Due to summer vacation, the cooling and lighting end use curves for schools are significantly different than for the

commercial sector, so simulations were performed separately for schools. The simulations performed included:

1. Retail ..... Fresno weather..... for cooling load allocation factors
2. Retail .....Long Beach weather..... for cooling load allocation factors
3. Retail ..... Burbank weather..... for cooling load allocation factors
4. School ..... Fresno weather..... for cooling load allocation factors
5. School .....Long Beach weather..... for cooling load allocation factors
6. School ..... Burbank weather..... for cooling load allocation factors
7. Retail ..... Fresno weather.....for economizer allocation factors
8. Retail .....Long Beach weather.....for economizer allocation factors
9. Retail ..... Burbank weather.....for economizer allocation factors
10. School ..... Fresno weather.....for economizer allocation factors
11. School .....Long Beach weather.....for economizer allocation factors
12. School ..... Burbank weather.....for economizer allocation factors
13. Hospital ..... Fresno weather..... for cooling ASD allocation factors
14. Hospital ....Long Beach weather..... for cooling ASD allocation factors
15. Hospital ..... Burbank weather..... for cooling ASD allocation factors

The hospital prototype was used to simulate a chiller with a adjustable speed drive and the resulting allocation factors were assumed to apply to all building types.

MATCHING TO PARTICIPANT BILLING DATA

The monthly allocations were then summarized based upon three categories:

1. Weather Zone (Fresno, Burbank, Long Beach)
2. Measure Type (Non-HVAC, HVAC cooling dependent, Economizers, and ASDs)
3. Schools (Yes or no)

Based upon these three categories, the monthly allocation (per calendar month) was then matched to the billing data. Then, based upon the billing date and number of days in the billing cycle, a final allocation ratio was estimated.

For example, a 30-day bill on March 11 would have 10 days in March and 20 days in February. The savings ratio would then be a weighted average of the March allocation factor of 10/30, or one-third) and the February allocation factor (20/30, or two-thirds). This new ratio would then be applied to the annual savings estimate, and the resulting product was used as the expected savings for the month.

ADJUSTING FOR ACTUAL WEATHER AND EQUIPMENT STANDARDS

The final two steps in the process were to adjust the monthly allocations for weather sensitive end-uses for actual weather rather than long term average values, and to account for the effects of state and federal standards on chillers and air conditioners.

The savings estimates for weather sensitive measures in SCE's program tracking database are calculated using long term average weather conditions. These estimates were adjusted to actual weather conditions by using the ratio of recorded cooling degree days per day in the billing period to long term average daily cooling degree days for that month.

The savings estimates for chillers, air cooled condensers, single package air conditioners, split systems, and air source air conditioners were recorded in the EMHR Program tracking database after accounting for the impacts of state and federal standards on these systems. For the purposes of our analysis, we required the estimates of gross changes before accounting for these standards. Once the key model parameters, representing "realization" rates for measures aggregated to end-use category, were estimated, they could be applied to the estimates in the program database (i.e. the savings net of standards) to obtain the net "realized savings.

The values in the program database were adjusted based on simulations for chillers and packaged air conditioners that were performed as part of the evaluation of SCE's 1990 EMHR and EMS programs. These simulations estimated that the standards accounted for 40% of the savings for chillers and 78% of the savings for packaged air conditioners (see *1990 SCE EMHR and EMS Program Evaluation*, Study Nos. 87 and 88, Volume 5. p. 13). Based on these numbers, the values of chiller savings in the program database were divided by 0.60, and the values for air conditioners were divided by 0.22. The effect of these adjustments was to reduce the realization rates for HVAC measures in the final regression model used to estimate savings.

Chapter 4
PRESENTATION AND DISCUSSION OF RESULTS OF THE STATISTICAL ANALYSIS

Chapter 4
PRESENTATION AND DISCUSSION OF RESULTS OF THE STATISTICAL ANALYSIS

4.1 PRESENTATION OF SUMMARY STATISTICS

Table 4-1 summarizes the annual level of electricity consumption for the commercial sector and for program participants during the years 1993 through 1995. The average consumption among program participants declined 7.9 percent between 1993 and 1995, while average consumption per customer in the commercial sector increased 4 percent over the same period.

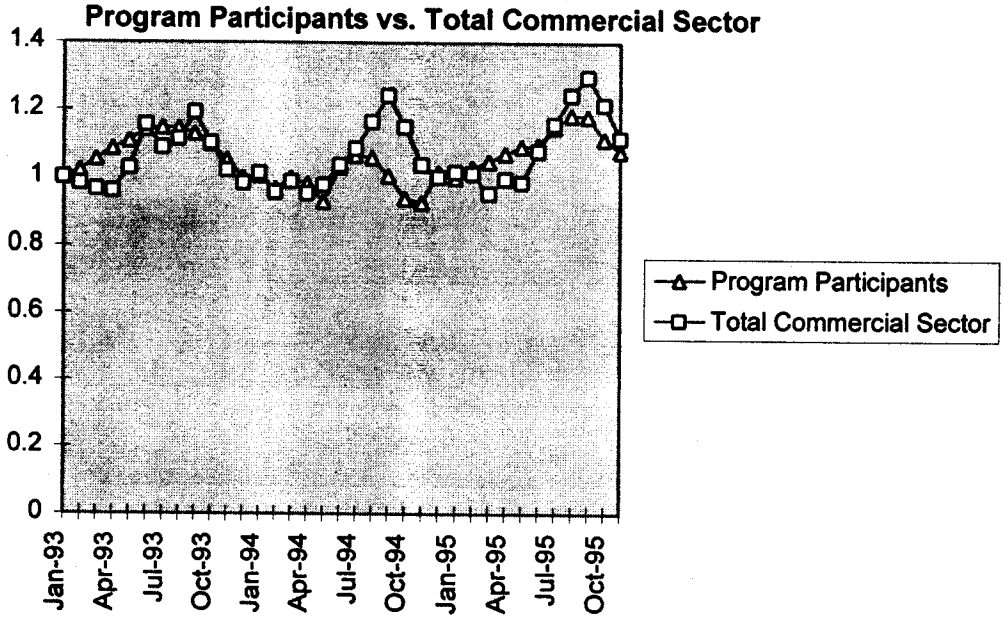
Table 4-1
Total Electricity Consumption
Commercial Sector and Program Participants

	Total Commercial Sector			Program Participants		
Year	Total Consumption (GWh)	Number of Premises	Average Consumption per Premise (kWh)	Total Consumption (GWh)	Number of Premises*	Average Consumption per Premise (kWh)
1993	21,022	299,811	70,116	6,739	1,536	4,387,370
1994	22,310	316,634	70,461	7,037	1,575	4,467,937
1995	21,573	295,747	72,944	6,304	1,560	4,041,026

Figure 4-1 below presents the relative consumption for program participants and the overall commercial sector. The index is derived by calculating the ratio of monthly consumption to consumption in January 1993. As expected, the index of consumption among program participants drops below that of all commercial customers beginning in mid-1994, when the impact of the program becomes greatest.

* Based on the bills in the gross sample; see Table 3-12.

Figure 4-1
Index of Monthly Consumption
Program Participants vs. Total Commercial Sector



4.2 Model Estimation Results

This section presents and discusses the results of the regression analysis of the merged billing, program, and survey data. In all, nine model specifications were estimated. The parameter estimates and key statistics are presented in Tables 4-2 through 4-10.

The first model was a simple specification with the basic set of variables that were included in all subsequent models. These are customer specific intercept and cooling degree day terms, and the engineering estimates of savings broken down by program and end-use category. The end-use categories are HVAC, lighting, and other. The labels of these variables for the rebate program are REBACSAV, RLITESAV, and ROTHSAV. For the audit program, they are AUDACSAV, ALITESAV, and AOTHSAV. The expectation is that the coefficients of these last six parameters should be negative and fall in a range around negative one(-1).

The initial model specification was estimated on the entire sample for which complete billing data were available (368 premises and over 13,000 bills). The parameter estimates for the key variables are shown in Table 4-2. The results are mixed. The parameter estimates for the rebated HVAC measures and the audit lighting measures are negative, reasonable in magnitudes, and statistically significant. The parameter for rebate lighting is also negative, but very large relative to the expected magnitude. The other parameters have positive values, which are judged to be implausible.

Table 4-2
MODEL #1

VARIABLE	PARAMETER ESTIMATE	T-STATISTIC
REBACSAV	-1.2969	-13.46
AUDACSAV	0.8096	5.84
RLITESAV	-2.8565	-24.91
ALITESAV	-0.8435	-2.08
ROTHRSAV	0.2287	1.74
AOTHRSAV	1.2438	1.26

Other Variables: prem9fin (i.e. customer specific constant weather coefficient)
cdd_day(prem9fin) (i.e. customer specific constant weather coefficient)

# of Observations: 368 sites, 13117 bills
R-Squared: .960683

Comments: Basic Model with core variables and all observations

Based on these results, the observations were reviewed more closely to identify outliers and cases with implausible values for key variables. Twenty-six cases involved measures that SCE classified as deferred loads. These are cases where the customer installed equipment that actually increased loads. SCE claimed savings by providing rebates that induced customers to install high efficiency measures rather than standard efficiency ones. As a result, the increases were less than would have occurred if standard efficiency models had been used. These cases were deleted from the analysis dataset because there is no direct way to statistically model the savings from these measures for the participant sample.

In addition, several cases were identified where the claimed savings by the ESR's were very large relative to billed consumption. In many instances, the savings were greater than the pre-participation annual consumption. In these cases, we felt that the identification of the affected accounts with the installed measures had not been done properly when the ESR's completed the rebate applications. This appeared to be true even though we had aggregated all of the accounts serving the treated business location identified in the application for each participant. Based on this finding, we eliminated 43 observations where the engineering estimate of savings for all measures installed at the premise was greater than 50% of the pre-program annual use.

The second model is the same as the first, but estimated on only 299 sites that remained after deleting these cases. The results are qualitatively similar to the previous ones.

Table 4-3
MODEL #2

VARIABLE	PARAMETER ESTIMATE	T-STATISTIC
REBACSAV	-1.4180	-12.58
AUDACSAV	1.4310	6.28
RLITESAV	-3.4816	-24.76
ALITESAV	-0.9816	-2.04
ROTHRSAV	0.1202	0.80
AOTHRSAV	1.1798	1.07

Other variables: prem9fin, cdd_day(prem9fin)

# of observations: 299 sites, 10729 bills
R-Squared: .960725

Comments: Eliminates customers with "deferred load" measures and those where estimated savings > 50% of annual consumption

Next, we decided to eliminate a few very large customers whose consumption appeared to influence the results inordinately. There were 5 customers in the sample with average daily consumption greater than 100,000 kWh. For the most part, the consumption patterns of these customers for the period of analysis were highly irregular. This was true in spite of the fact that the survey responses failed to identify any significant changes in operation or other equipment. Plots of the daily consumption for these five customers are presented in the Appendix 4A.

The elimination of these cases changes the results dramatically (Model 3, Table 4-4). Four of the six key parameters in Model 3 are negative, and only one is statistically insignificant. The parameters for the "other" category in both programs continue to have the wrong signs.

Table 4-4
MODEL #3

VARIABLE	PARAMETER ESTIMATE	T-STATISTIC
REBACSAV	-0.22640	-6.28
AUDACSAV	-0.11329	-1.69
RLITESAV	-0.42453	-10.95
ALITESAV	-0.85347	-7.31
ROTHRSAV	1.07105	16.66
AOTHRSAV	0.12168	0.46

Other Variables: prem9fin, cdd_day(prem9fin)

# of observations: 294 sites, 10546 bills
R-Squared: .989360

Comments: Eliminates customers with average daily consumption > 100,000 kWh

Model 4 adds variables (SMRSCH1-SMRSCH55) for educational facilities to capture the seasonal operation of schools. It also includes a variable to flag cases where the number of accounts serving a premise changed over the period of analysis. There were significant changes in loads when this occurred, suggesting that some change in capacity had taken place. These changes did not materially affect the magnitudes of the estimated parameters, nor the overall performance of the model.

Table 4-5
MODEL #4

VARIABLE	PARAMETER ESTIMATE	T-STATISTIC
DNACCT	1795.57378	11.48
REBACSAV	-0.23376	-6.50
AUDACSAV	-0.10169	-1.53
RLITESAV	-0.42920	-11.14
ALITESAV	-0.85668	-7.39
ROTHRSAV	0.98390	15.31
AOTHRSAV	0.12986	0.49

Other variables: prem9fin, cdd_day(prem9fin), smrsch1-smrsch55

# of observations: 294 sites, 10546 bills
R-Squared: .989570

Comments: Introduces seasonal variables for educational facilities (smrsch1-smrsch55) and variable for customers that change number of accounts (DNACCT).

Model 5 deletes the cases where there was a change in number of accounts and a significant change in load that accompanied it. Also, some cases with anomalous bills in specific months were flagged (PMVAR1-PMVAR5). The results improve moderately from the earlier ones. Most notably, the coefficient of the variable representing "other" rebate measures turns negative and statistically significant.

TABLE 4-6
MODEL #5

VARIABLE	PARAMETER ESTIMATE	T-STATISTIC
REBACSAV	-0.32467	-10.10
AUDACSAV	-0.06779	-1.19
RLITESAV	-0.40226	-11.94
ALITESAV	-0.94118	-9.25
ROTHRSAV	-0.31373	-3.70
AOTHRSAV	0.24952	1.08

Other variables: prem9fin, cdd_day(prem9fin), pmvar1-pmvar5, smrsch1-smrsch53

# of observations: 287 sites, 9805 bills
R-Squared: .992621

Comments: Eliminates customers with change in number of accounts and significant contemporaneous shift in consumption, flags cases with "anomalous" bill changes (pmvar1-pmvar5).

Model 6 introduces a variable that controls for the effects of background trends in electricity use in the analysis. As noted in Section 4.1, electricity consumption in the commercial sector has grown overall during the period from 1993 to 1995. According to SCE's SIC coded billing files, average consumption per customer has increased by 4% during the period.

Table 4-7
MODEL #6

VARIABLE	PARAMETER ESTIMATE	T-STATISTIC
REBACSAV	-0.54992	-11.88
AUDACSAV	-0.28466	-3.49
RLITESAV	-0.50560	-10.36
ALITESAV	-0.50929	-3.56
ROTHRSAV	0.05187	0.43
AOTHRSAV	0.29705	0.90

Other variables: sicindx(prem9fin), cdd_day(prem9fin), pmvar1-pmvar5 smrsch1-smrsch53

# of observations: 287 sites, 9805 bills
R-Squared: .984974

Comments: Introduces index for background changes in consumption by 2 digit SIC code.

This general trend masks some of the effects of the measures installed under the two programs. In order to account for this trend and isolate the program effects from it, we constructed an explanatory variable that is an index of sales patterns for all customers in the same two-digit SIC code as each participant. This index is simply the average consumption for all SCE customers in the same two-digit group relative to the average in January 1993. By definition, the index starts at one in the first billing period and changes over time. These changes pick up both seasonal variations in use for the class of customers in similar businesses, as well as year-to-year trends. The parameter for this variable is allowed to differ from one customer to the next.

The inclusion of the SICINDX variable in the model specification has the effect of controlling for any trends in energy consumption in the general commercial population, including the effects of "naturally occurring" conservation. As a result, the estimates of savings rates should be interpreted as **net** savings, rather than gross ones. To understand this, consider the method by which net savings are typically estimated using a comparison group. The trend in consumption for a random sample of nonparticipants is interpreted as a proxy for the pattern of energy consumption by participants in the absence of the program. The changes for the comparison group are subtracted from the changes for the participant sample to obtain the net impacts.

The introduction of these nonparticipant trends as a right-hand-side variable in the regression model is comparable to this subtraction. The regression model controls for, or effectively subtracts, the trend in energy consumption for the general commercial population from the participant group's before attributing any changes in consumption to the installed measures.

When this index variable is added to the model specification, the magnitudes and significance of the parameter estimates change noticeably. The coefficients of the two HVAC and the rebate lighting variables increase in magnitude significantly. The audit lighting variable declines in magnitude, but remains negative and plausible. The parameters for the "other" measures are insignificant.

Model 7 adds variables based on information from the survey to the model specification. These are binary variables based on responses to questions of whether there have been any significant changes at the business location involving number of employees (EMPINC, EMPDEC), hours of operation (HRSINC, HRSDEC), vacancy rate (VACINC), equipment holdings (EQUINC, EQUDEC), remodeling or renovations (RENINC), or the nature of the business (BUSCHG). The addition of these variables did not change the results in any material manner.

Table 4-8
MODEL #7

VARIABLE	PARAMETER ESTIMATE	T-STATISTIC
BUSCHG	-176.75260	-0.56
HRSINC	340.09540	1.51
HRSDEC	94.63540	0.34
VACDEC	24.31705	0.10
EMPINC	212.62329	0.91
EMPDEC	-219.81553	-1.10
RENINC	391.67602	2.09
EQUINC	330.66175	2.83
EQUDEC	-671.64779	-2.80
REBACSAV	-0.56560	-12.16
AUDACSAV	-0.29933	-3.65
RLITESAV	-0.50021	-10.20
ALITESAV	-0.50953	-3.57
ROTHRSAV	-0.03030	-0.25
AOTHRSAV	0.27365	0.83

Other Variables: sicindx(prem9fin), cdd_day(prem9fin), pmvar1-pmvar5 smrsch1-smrsch53

# of observations: 287 sites, 9805 bills
R-Squared: .985028

Comments: Introduces variables that capture other changes at business location -- employment, hours of operation, vacancy, equipment, renovations, other business changes.

Model 8 reformulates the specification slightly to collapse different types of operational changes into a single variable, but allows its coefficient to vary by customer (OTHCHG1-OTHCHG50). Changes in business are flagged separately (BUSCHG1-BUSCHG4). The revised specification causes the coefficient of ROTHSAV to increase and become statistically significant.

Table 4-9
MODEL #8

VARIABLE	PARAMETER ESTIMATE	T-STATISTIC
REBACSAV	-0.55315	-11.73
AUDACSAV	-0.36640	-4.24
RLITESAV	-0.52266	-10.48
ALITESAV	-0.48537	-3.46
ROTHRSAV	-0.82547	-5.56
AOTHRSAV	0.42965	1.30

Other variables: sicindx(prem9fin), cdd_day(prem9fin), pmvar1-pmvar5 smrsch1-smrsch53, buschg1-buschg4, othchg1-othchg50
# of observations: 287 sites, 9805 bills
R-Squared: .985744
Comments: Replaces survey variables with customer specific variables when any change occurs.

The final model (#9) adjusts the engineering savings estimates for chillers and air conditioners to account for the effects of state and federal standards for these technologies. In the program tracking database, SCE only claimed savings for chillers and air conditioners beyond those realized by the existing standards. We increased the values of the explanatory variables for these end-uses in the model to reflect the full gross change of replacing the old unit with the new one. This allows us to account for the standards properly when the net savings are estimated. As expected, the increases in the values of the explanatory variables reduces the parameter for REBACSAV without changing the other coefficients appreciably. The complete set of parameter estimates for the final model and associated statistics are presented in Appendix 4B.

Table 4-10
MODEL #9

VARIABLE	PARAMETER ESTIMATE	T-STATISTIC
REBACSAV	-0.46324	-10.51
AUDACSAV	-0.36412	-4.33
RLITESAV	-0.54033	-10.89
ALITESAV	-0.48546	-3.46
ROTHRSAV	-0.82938	-5.58
AOTHRSAV	0.41961	1.27

Other variables: sicindx(prem9fin), cdd_day(prem9fin), pmvar1-pmvar5 smrsch1-smrsch53, buschg1-buschg4, othchg1-othchg50

# of observations: 287 sites, 9805 bills
R-Squared: .985706

Comments: Corrects engineering estimates for effects of state and federal standards.

4.3 DIAGNOSTICS OF STABILITY OF MODEL PARAMETER ESTIMATES

The final model specification was examined to assess the stability of the parameter estimates across customer electricity consumption and expected savings strata. This was considered an important issue given the complex manner in which the analysis sample had been drawn.

The samples used for the analysis were drawn based on different stratification variables. The sample for the 1994 retention study was drawn based on the types of measures installed by the participants. Within measure category, the sample was further stratified by customer size, defined in terms of kW. Due to schedule requirements, analysis was undertaken on a partial sample before the completion of the study.

The samples for the supplemental EMHR telephone and the EMS telephone survey were stratified by the magnitude of expected savings. The strata definitions for each survey were different. In the case of the EMHR telephone survey, there were three strata corresponding to less than 160 MWh savings per year, 160-625 MWh, and above 625 MWh. For the EMS sample, the strata were much lower - <34, 34-97, 97-272, and above 272 MWh per year.

The differences in stratification methods made it impossible to compute sampling weights for the entire dataset used in the regression analysis. We did not consider this to be a serious problem, since there is no underlying reason to expect that there would be any systematic differences in reliability of the engineering estimates by customer size or the magnitude of the projected savings. However, it was important to examine this issue as part of the analysis.

This was accomplished by stratifying the sample into different size ranges and re-estimating the model for each stratum. This effectively allowed the realization parameters to vary by size stratum. Simple tests were applied to determine whether the parameters are significantly different from a statistical standpoint across strata.

This exercise was performed for two stratification schemes. The first stratified the sample by size in terms of average daily electricity consumption. The second stratified the sample according to the engineering estimates of savings. The consumption strata were defined as <1000kWh per day, 1000-5000 kWh per day, and 5000+ kWh per day. The savings strata were <50,000 kWh per year, 50,000-200,000 kWh per year, and 200,000+ kWh per year.

The estimated parameters and associated t-statistics for the models that were estimated are presented in Tables 4-11 and 4-12. The results are qualitatively similar for both stratification breakdowns. In each case, the parameter estimates in the top stratum are very comparable to the values for the full dataset. The numerical values are very similar. In no case does the values of the t-statistic computed to test whether there is any significant difference exceed .52.

Table 4.11
Parameter Estimates for Model Stratified by Annual Consumption

Strata 1: premean<1000 kWh/day
92 sites, 3129 bills
R-squared: 0.863811

Variable Name	Parameter Estimate	t-statistic
REBACSAV	-0.052109	-0.92
AUDACSAV	-0.150241	-1.84
RLITESAV	-0.291854	-5.06
ALITESAV	-0.329658	-1.08
ROTHRSAV	0.266374	1.70
AOTHRSAV	-0.227383	-1.97

Strata 2: 1000<=premean<5000 kWh/day
104 sites, 3548 bills
R-squared: 0.900629

Variable Name	Parameter Estimate	t-statistic
REBACSAV	-0.100404	-1.55
AUDACSAV	-0.387469	-4.41
RLITESAV	-0.304617	-7.60
ALITESAV	0.293634	1.36
ROTHRSAV	-0.193825	-0.23
AOTHRSAV	0.433354	1.83

Strata 3: premean>=5000 kWh/day
91 sites, 3128 bills
R-squared: 0.980167

Variable Name	Parameter Estimate	t-statistic
REBACSAV	-0.47697	-6.05
AUDACSAV	-0.34618	-2.23
RLITESAV	-0.59604	-6.23
ALITESAV	-0.53212	-2.14
ROTHRSAV	-0.84309	-3.27
AOTHRSAV	0.46160	0.66

Table 4.12
Parameter Estimates for Model Stratified by Claimed Savings

Strata 1: totsav<50K kWh/yr
93 sites, 3164 bills
R-squared: 0.929176

Variable Name	Parameter Estimate	t-statistic
REBACSAV	0.246289	0.91
AUDACSAV	-0.079328	-0.27
RLITESAV	0.187337	0.56
ALITESAV	0.185671	0.23
ROTHRSAV	0.131322	0.22
AOTHRSAV	-0.843266	-1.02

Strata 2: 50K<=totsav<200K kWh/yr
99 sites, 3364 bills
R-squared: 0.981695

Variable Name	Parameter Estimate	t-statistic
REBACSAV	-0.37036	-3.54
AUDACSAV	-0.20869	-1.04
RLITESAV	-0.87936	-5.34
ALITESAV	2.87401	1.93
ROTHRSAV	-0.12140	-0.11
AOTHRSAV	-0.13178	-0.33

Strata 3: totsav>=200K kWh/yr
95 sites, 3277 bills
R-squared: 0.982530

Variable Name	Parameter Estimate	t-statistic
REBACSAV	-0.46970	-6.40
AUDACSAV	-0.38066	-2.71
RLITESAV	-0.53040	-6.48
ALITESAV	-0.49292	-2.16
ROTHRSAV	-0.83973	-3.47
AOTHRSAV	0.57875	0.96

In the bottom stratum for both stratification breakdowns, the results are very different. The parameter estimates change dramatically in some cases, and their statistical significance falls dramatically. The parameter values are often implausible (i.e. positive). T-statistics computed to test for the significance of differences are generally high.

In the middle stratum, the results are mixed. When the sample is stratified by savings, only the lighting parameters are very different. For the rebate lighting measures, the parameter is significantly greater (more negative). For the audit lighting measures, the parameter is implausible (positive).

A closer inspection of the parameter estimates indicates that the changes in values tend to offset each other across strata. If the value in the bottom stratum turns positive, the values for the parameter in the other strata become more negative. Overall, we expect that using the parameter estimates for the model estimated on the full sample versus using the (plausible) estimates for each stratum would have little effect on the value of program impacts. This question is addressed in Chapter 6.

Other Statistical Issues

No additional tests were performed to investigate other potential statistical problems in the models. Given the model specification, we believe that such issues as serially correlated or non-homoskedastic errors are not likely to be significant. The model specification is highly parameterized, with at least three coefficients for each customer. These parameters are expected to absorb the significant variations in the unexplained component from one customer to the next. This minimizes the likelihood of heteroskedastic errors.

The data is a time series cross sectional data set. There are a number of instances of gaps in the time series due to missing values for a given period and other problems in the billing data. A test for serial correlation would undoubtedly reveal instances where the errors for a given customer are serially correlated, while they are not for others. The procedure for dealing with such a mixed set of data is unclear.

In any case, the procedure used to estimate the model coefficients will produce unbiased parameter estimates even in the presence of serial correlation or heteroskedastic errors. Only the standard errors will be biased. The direction of such bias is indeterminate. Regardless of the effect of failure to deal with possible violations of the assumptions about the error structure in the ordinary least squares model, the point estimates of the realization rates will be the "best" estimates.

Chapter 5

FREE RIDERSHIP ESTIMATION

Chapter 5
FREE RIDERSHIP ESTIMATION

ENERGY MANAGEMENT HARDWARE REBATE PROGRAM

As a means of confirming whether the net-to-gross estimates based on the statistical analysis are reasonable, SRC also estimated free ridership for the EMHR and EMS Programs using the self-reports of program participants. Following is a discussion of the methodology used in this estimation, as well as the results of the analysis.

METHODOLOGY

From December 1995 through the beginning of February 1996, telephone and on-site surveys were conducted with EMHR participants. Customers receiving rebates for at least one of the seven measure types that accounted for the "top 50%" of estimated program benefits* were surveyed on-site; the on-site survey responses of 229 program participants provided usable free ridership data for 146 "bottom 50%" measures and 486 "top 50%" measures. Customers receiving rebates solely for measure types accounting for the lower 50% of program benefits were surveyed by telephone; free ridership data were obtained for 97 "bottom 50%" measures from telephone surveys with 76 program participants. In total, free ridership data were available for 729 EMHR program measure installations, based on telephone or on-site surveys with 305 program participants.

Using a decision-tree analysis technique, a free ridership percentage was assigned to each rebated measure about which participant survey responses were obtained. A battery of free rider questions was included in the telephone and on-site survey questionnaires. Telephone survey respondents were asked these questions with regard to a maximum of two measures per respondent (i.e., if a respondent had installed two measures, then two sets of free ridership questions were asked). On-site survey respondents were asked the free rider questions for all measures installed (including both lower 50% and "top 50%" measures). The free rider questions were as follows:

- Prior to hearing about SCE's rebate program, were you planning to purchase this measure?
- Had there been *no* program rebate and no program information available, would your purchase have been different?
  - → (If yes) How would it have been different?

* Electronic ballasts, T8 lamps, modular compact fluorescent bulbs, delamping/reflectors, adjustable speed drives, high efficiency chillers, and HVAC energy management systems

→ (If purchase would have been delayed) When would you have purchased and installed the measure? (1-6 mo., 6-12 mo., 12-18 mo., 18-24 mo., Other, Don't know)

- If the rebate had been only 50% of what you received, or about (ACTUAL REBATE TIMES 0.5), would your purchase have been different?
- (For those purchasing energy-using equipment) Why did you decide to purchase a *high-efficiency* (NAME OF MEASURE)?
- Why did you decide to install (NAME OF MEASURE)?

In addition, for the on-site surveys, respondents who indicated that they would have purchased less efficient equipment or fewer efficiency measures in the absence of the program or if the rebate had been lower, were also asked to specify what they meant by "less efficient" and "fewer measures."

Each respondent's answers to the free ridership questions were analyzed as a group; that is, analysis of the answers to several key questions created an argument for assigning a specific free ridership percentage to each measure being discussed in the survey. Five free ridership percentage assignments were possible: 0%, 25%, 50%, 75%, and 100%.

The general arguments (or logic) for assigning each of these percentages are presented below. The two primary arguments for assigning free ridership percentages were as follows:

- If the firm did not have prior plans to install the measure or the respondent did not know whether the firm had had prior plans to install the measure, this was interpreted as a lack of real intention to install the measure in the absence of the program. Free ridership of 0% was assigned.

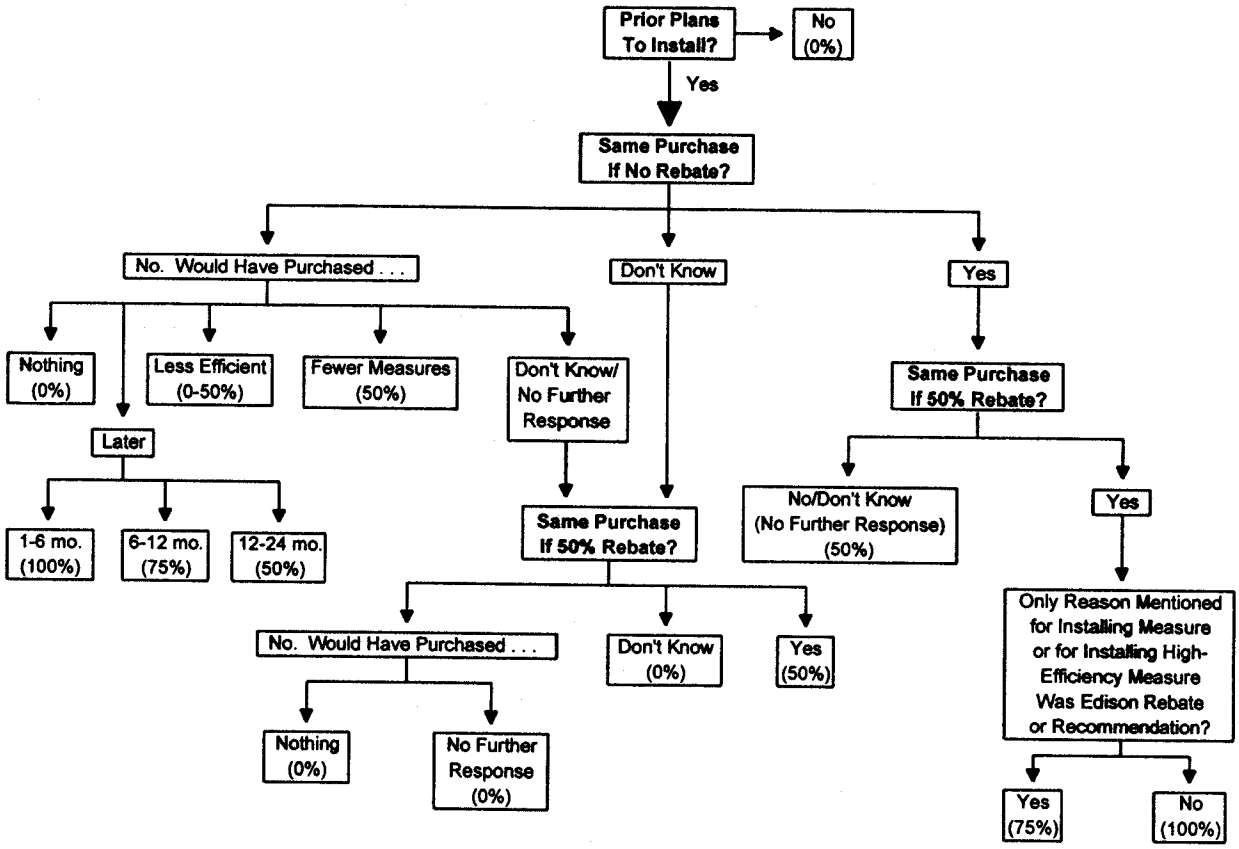
- If the firm had prior plans to install the measure and reported that halving and eliminating the rebate each would have made *no* difference in its purchase decision, this was interpreted as a strong intention to install the measure in the absence of the program. Free ridership of 100% was assigned.

Free ridership was discounted 25% if the respondent reported that the firm would have installed the same measure but not until six to twelve months later. An additional 25% discounting was assessed if the respondent reported a 12-24 month delay in installing the same measure. These delays were assumed to reflect decreasing likelihood of actually installing a measure the further into the future they were projected.

Also, if respondents who otherwise indicated 100% free ridership for a program measure gave "Edison rebate," "Edison representative's recommendation," or "Edison program" as their only reason for installing the program measure (or for installing the high-efficiency version of the program equipment), the measure was assigned a 75% free ridership percentage. This apparent contradiction in intention to install the measure was seen as evidence that an assignment of 100% free ridership was questionnable.

The general logic for assigning free ridership percentages is presented in Figure 5-1. The detailed set of arguments used to assign 0%, 25%, 50%, 75%, and 100% free ridership for the EMHR program appear in Appendix 5A.*

Figure 5-1. EMHR MEASURES FREE RIDERSHIP DECISION TREE



Once free ridership percentages were assigned to all measures for which survey data were available, these percentages were multiplied by the kWh savings estimated for each of these measures in the EMHR program data base. The resulting product represented the "free ridership savings" associated with each measure. Free ridership savings were totaled, overall and by three measure-type categories (HVAC, lighting and other), as were the data base estimates of savings. The free ridership savings were divided by the data base savings to obtain overall program and measure-type free rider rates.

* For example, the possible sets of answers that could lead to an assignment of 0% free ridership are presented on the first page; the sets of answers that could lead to an assignment of 25% appear on the second page; and so on.

Table 5-1

Category	Free Rider MWh	Data Base MWh	Free Rider Rate
HVAC measures	16,076.7	31,655.5	51%
Lighting measures	15,961.1	39,799.4	40%
Other measures	4,809.9	9,427.0	51%
Total EMHR Program	36,847.6	80,881.9	46%

As the table indicates, free ridership hovers around 50% for the program overall, and for each of the three major measure types as well. Free ridership is slightly lower for lighting measures.

ENERGY MANAGEMENT SERVICES PROGRAM

SRC also estimated free ridership for the Energy Management Services (EMS) Program using the self-reports of program participants as a validation check for the statistically based estimates. The methodology used was similar to that used in the EMHR program free ridership estimation. Following is a discussion of this methodology and the results of the analysis.

METHODOLOGY

Surveys were conducted with EMS participants in December 1995 and January 1996. Survey data regarding 93 measure installations were obtained through telephone surveys with 74 program participants. Using a decision-tree analysis technique, a free ridership percentage was assigned to each measure about which participant survey responses were obtained. The battery of free rider questions included in the survey was asked with regard to a maximum of two measures per respondent (i.e., if a respondent had installed two measures, then two sets of free ridership questions were asked). These questions were as follows:

- Prior to hearing about SCE's audit program, were you planning to implement this measure?
- Had there been *no* SCE audit program, how likely would you have been to implement this measure? (Very likely, somewhat likely, not very likely, or not at all likely)
  - (If not "very likely") What would you have done instead?
  - (If implementation would have been delayed) When would you have implemented the measure? (1-6 mo., 6-12 mo., 12-18 mo., 18-24 mo., Other, Don't know)
- Would you have implemented the measure at the same time if you had not participated in the program?
  - (If no) When would you have implemented the measure?

Each respondent's answers to the free ridership questions were analyzed as a group; that is, analysis of the answers to several key questions created an argument for assigning a specific free ridership percentage to each measure being discussed in the survey. Five free ridership percentages were possible: 0%, 25%, 50%, 75%, and 100%.

The general arguments (or logic) for assigning each of these percentages are presented below. The two primary arguments for assigning free ridership percentages were as follows:

- If the firm did not have prior plans to implement the measure or the respondent did not know whether the firm had had prior plans to implement the measure, this was interpreted as a lack of real intention to implement the measure in the absence of the program. Free ridership of 0% was assigned.

- If the firm had prior plans to implement the measure and (1) reported being "very likely" to have implemented the measure in the absence of the program **and** (2) reported that the measure would have been implemented at the same time in the absence of the program, this was interpreted as a strong intention to implement the measure in the absence of the program. Free ridership of 100% was assigned.

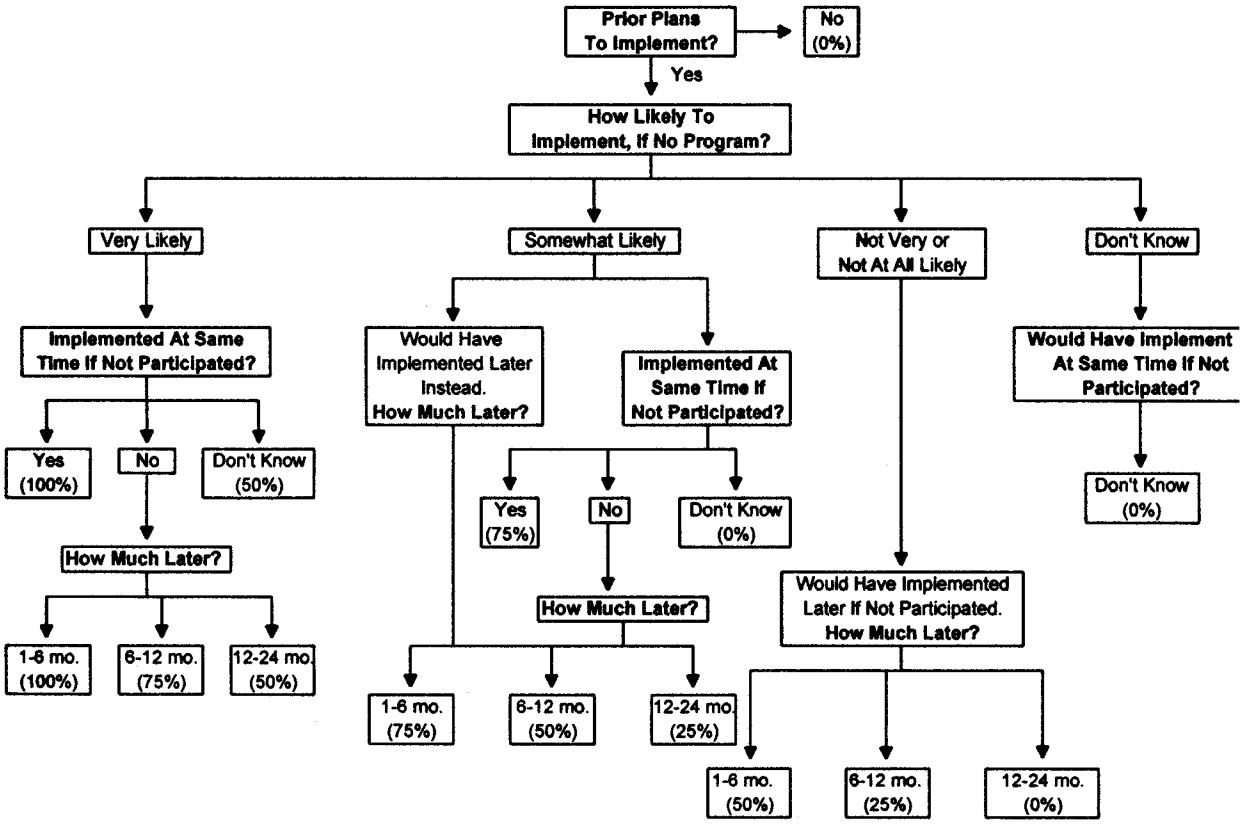
Free ridership was discounted 25% for a response of being only "somewhat likely" to implement the measure in the absence of the program, and 50% for a response of being "not very likely" or "not at all likely."

Free ridership was also discounted for reported delays in implementing program measures in the absence of the program. A discount of 25% was applied if the respondent reported that the firm would have implemented the same measure but not until six to twelve months later. An additional 25% discounting was assessed if the respondent reported a 12-24 month delay in implementing the same measure. These delays were assumed to reflect decreasing likelihood of actually implementing a measure the further into the future the installations were projected.

The general logic for assigning free ridership percentages is presented in Figure 5-2. The detailed set of arguments used to assign 0%, 25%, 50%, 75%, and 100% free ridership for the EMS program appear in Appendix 5B.*

* For example, the possible sets of answers that could lead to an assignment of 0% free ridership are presented on the first page; the sets of answers that could lead to an assignment of 25% appear on the second page; and so on.

Figure 5-2. EMS MEASURES FREE RIDERSHIP DECISION TREE



Once free ridership percentages were assigned to all measures for which survey data were available, these percentages were multiplied by the kWh savings estimated for each of these measures in the EMS program data base. The resulting product represented the "free ridership savings" associated with each measure. Free ridership savings were totaled, overall and by three measure type categories (HVAC, lighting and other), as were the data base estimates of savings. The free ridership savings were divided by the data base savings to obtain overall program and measure-type free rider rates.

Table 5-2 below presents the results of the free ridership analysis:

Table 5-2

Category	Free Rider MWh	Data Base MWh	Free Rider Rate
HVAC measures	1,535.3	5,253.3	29%
Lighting measures	1,434.0	1,904.5	75%
Other measures	421.9	711.6	59%
Total EMS Program	3,391.2	7,869.4	43%

As the table indicates, free ridership was approximately 45% for the program overall, with HVAC measures having much lower free ridership, and lighting and other measures having much higher free ridership. However, these free ridership estimates are not very robust. The sample size for these estimates is relatively small, such that, for example, changing the free ridership assignment of the measure accounting for the largest savings (a lighting measure) from 100% to 0% causes lighting free ridership to change from 75% to 17% and overall free ridership to change from 43% to 29%.

Chapter 6

PRESENTATION AND DISCUSSION OF PROGRAM IMPACTS

Chapter 6

PRESENTATION AND DISCUSSION OF PROGRAM IMPACTS

6.1 PROGRAM IMPACTS

Tables 6-1 and 6-2 present the estimates of the EMHR and EMS energy and peak demand impacts. These are based on the parameter estimates from the final model estimated on the full sample, with the exception of the coefficient for the "other" audit measures. The estimated coefficient for this category was implausible (positive). As a substitute, the average of the parameters for the other two audit categories was used for the realization rate for this component.

Table 6-1
Energy Savings (MWh) Based on Final Model

Program and enduse	Total Database Savings	Total Verified Savings	90% Confidence Interval		80% Confidence Interval	
			Lower Limit	Upper Limit	Lower Limit	Upper Limit
Rebate program HVAC	92,283	42,749	38,329	47,169	39,305	46,193
Rebate program lighting	167,388	90,445	81,456	99,434	83,441	97,449
Rebate program other	69,695	57,804	46,685	68,923	49,140	66,468
Total Rebate Program	329,366	190,998	166,469	215,526	171,886	210,110
Audit program HVAC	81,784	29,779	22,268	37,290	23,927	35,632
Audit program lighting	9,919	4,815	3,265	6,366	3,607	6,023
Audit program other	26,888	11,422	8,086	14,758	8,822	14,021
Total Audit Program	118,590	46,016	33,618	58,413	36,356	55,676

Table 6-2
Demand Savings (kW) Based on Final Model

Program and enduse	Total Database Savings	Total Verified Savings	90% Confidence Interval		80% Confidence Interval	
			Lower Limit	Upper Limit	Lower Limit	Upper Limit
Rebate program HVAC	8,354	3,870	3,470	4,270	3,558	4,182
Rebate program lighting	33,649	18,181	16,374	19,988	16,773	19,589
Rebate program other	10,108	8,383	6,771	9,996	7,127	9,640
Total Rebate Program	52,110	30,434	26,615	34,254	27,458	33,411
Audit program HVAC	23,193	8,445	6,315	10,575	6,785	10,105
Audit program lighting	2,025	983	667	1,300	737	1,230
Audit program other	3,771	1,602	1,134	2,070	1,237	1,967
Total Audit Program	28,990	11,030	8,116	13,945	8,759	13,301

The realization rates were applied to the claimed savings in the EMHR and EMS Program tracking database for commercial customers in 1994. These database savings are shown in the tables. The net savings from the EMHR Program are 191,000 GWh per year and 46,000 GWh for the EMS Program. Overall, the realization rates imply an energy net-to-gross ratio of 58% for the EMHR Program and a ratio of 39% for the EMS Program. The ratios are only slightly less for peak demand.

The 90% and 80% confidence intervals for the estimates are also presented in the tables. These are based on the standard errors of the parameter estimates. In computing these confidence intervals, the covariances of the parameter estimates were not included in the calculation. These were not taken into account because the procedure that was used to estimate the model parameters did not provide them as an output option. If the covariances were taken into account, we expect that the confidence interval would be smaller.

At a 90% confidence level, one can state that the actual EMHR Program energy savings were within 25,000 Gwh of the estimated value. This is equivalent to 13% of the estimated net savings. The range for the peak demand is very similar in terms of the percent of the estimated impact.

For the EMS program, the range of the 90% confidence level is plus or minus 12,500 Gwh. This is approximately 25% of the estimated net savings. The range for the peak demand is very comparable in percentage terms.

All of the calculations were performed on all of the measures claimed in the program tracking databases. This included cases comparable to those that were deleted from the analysis sample. The final model excluded cases where savings were claimed for deferred load measures (i.e. ones that increased loads, but less than a standard efficiency measure would have been installed), cases where the claimed savings were more than 50% of the pre-participation annual consumption, and cases where the customer's average daily use exceeded 100,000 kWh. The breakdown of savings for these types of cases in the population is shown in Table 6-3. Of the total 448,000 Gwh claimed savings for the two programs, almost 147,000 fall into one of these categories that were excluded from the estimation sample.

Table 6-3
Gross Energy (MWh) Savings Estimate for EMHR and EMS Populations

Filter	Total Savings	Audit			Rebate		
		HVAC	Lighting	Other	HVAC	Lighting	Other
Total	447,957	81,784	9,919	26,888	92,283	167,388	69,695
Deferred Savings	52,370	6,556	210	5,665	4,344	4,187	31,408
Est sav over 50% pre	67,384	10,388	2,041	709	11,583	33,866	8,797
Over 100 k day	27,310	1,374	291	-	8,176	12,039	5,430
Remaining Savings	300,893	63,466	7,377	20,514	68,180	117,296	24,059

The rationale for including these is that there is no reason to expect that the realized savings for these cases should be qualitatively different from the savings for the other cases. The deferred load measures are similar to those that replace existing loads, only they are installed in new or expanded facilities. The cases where the claimed savings are an inordinately large percentage of annual consumption appear to involve instances where the savings were not properly matched to the affected accounts. The large customers involve cases where the effects of the program are masked by other factors that affect electricity consumption. In none of these situations is there a strong reason to believe that the realization rates for these subpopulations will be qualitatively different from the remaining participants.

6.2 SAVINGS PER TREATED SQUARE FOOT

Table 6-4 presents the estimated net savings per square foot for each program and end-use category. The estimates were obtained using the cases in the program tracking database that contained estimates of the square footage of affected floor space. The number of cases with valid data by end-use are shown in the table. The estimates are based on the total claimed savings for these customers divided by their square feet. In the case of HVAC measures, we based the calculation on the number of conditioned square feet. For the other two measures, the reported total square feet were used.

Table 6-4
EMHR and EMS Program Savings per Square Foot

Program and Enduse	Number of Locations With Measures	Number of Locations With Square Feet	Total Savings (kWh)	Realization Rate	Net Savings (kWh)	Total Square Feet	Net kWh/Foot
Rebate program HVAC	724	654	89,691,192	0.46324	41,548,548	63,998,108	0.6492
Audit program HVAC	1,139	992	71,677,529	0.36412	26,099,222	73,465,787	0.3553
Rebate program lighting	1,628	1,417	144,449,119	0.54033	78,050,192	109,281,997	0.7142
Audit program lighting	171	128	7,240,764	0.48546	3,515,101	14,225,197	0.2471
Rebate program other	385	329	67,181,172	0.82938	55,718,720	20,753,988	2.6847
Audit program other	168	130	20,453,580	0.42479	8,688,476	7,506,256	1.1575

Notes: Square feet for the HVAC measures refers to conditioned square feet only. A location had to have a mininum of 500 square feet to be included in the analysis. Square feet from the survey was selected first; if this was not available, the program databases were used.

The results show that the savings per square foot are higher for all end-uses in the rebate program than in the audit program. The savings from the "other" category per square foot is significantly higher than for lighting and HVAC. "Other" items include measures for water pumping and refrigeration whose size is not closely related to square feet. In contrast, the savings from space heating and lighting measures are strongly correlated with the square feet of the affected area.

6.3 COMPARISONS OF ESTIMATES WITH THOSE BASED ON STRATIFIED MODELS

One of the key questions raised in the previous chapter was whether the realization rates vary significantly across different ranges of customer size or expected savings. This issue was examined by allowing the rates to vary by size and expected savings, then testing whether the values of the coefficients differ significantly across strata. The results indicated that the parameters for the higher strata are very comparable to those in the unstratified model, but they differ significantly in the bottom strata.

As a means of determining whether these variations made a significant difference in terms of the estimated savings, the parameters from the stratified were used to estimate the savings. In cases where the parameter values from the stratified models were implausible (positive), the average realization rate from the other end-uses in that program were substituted. The estimates produced by these stratified models were compared to those based on the full model to determine if they are significantly different.

These comparisons are summarized in Tables 6-5 and 6-6. These show that the savings estimates for the rebate program are approximately 19% lower when they are based on the model that was stratified by annual energy consumption. The estimate for the rebate program savings based on the model stratified by claimed savings is 3% higher.

Table 6-5
Summary Of Energy Savings (MWh) For Rebate Program

Stratfication Method	Mean Expected Savings	90% Confidence Interval		80% Confidence Interval	
		Lower Limit	Upper Limit	Lower Limit	Upper Limit
Total Model	190,998	166,469	215,526	171,886	210,110
Energy Consumption	154,350	72,016	236,684	90,197	218,503
Estimated Savings	197,420	120,195	274,645	137,248	257,592

Table 6-6
Summary Of Energy Savings (MWh) For Audit Program

Stratfication Method	Mean Expected Savings	90% Confidence Interval		80% Confidence Interval	
		Lower Limit	Upper Limit	Lower Limit	Upper Limit
Total Model	46,016	33,618	58,413	36,356	55,676
Energy Consumption	38,224	11,726	64,723	17,577	58,871
Estimated Savings	42,418	(7,025)	91,861	3,893	80,943

The confidence intervals for the estimates based on the stratified models are much larger than those for the full model. This is because the standard errors for the parameter estimates in the stratified models are much larger than those in the full model. This is reasonable, since there are three times as many parameters (one set for each stratum) in the stratified models.

The 80% and 90% confidence intervals for the stratified model based estimates all cover the ranges for the full model. Based on this, we conclude that the estimate from the full model is the most reliable one.

The findings from the comparisons of estimates for the EMS Program are qualitatively similar. The estimates based on the stratified models are lower than the one from the full model parameters. To a large extent, this is because so many of the parameter estimates in the stratified models are implausible and must be replaced by ones using the plausible values. In any case the confidence intervals for the full model fall entirely within those for the stratified models. This leads to the conclusion that the estimates based on the full model parameters are the most reliable ones.

Appendix 6

Protocols Tables 6 and 7

SOUTHERN CALIFORNIA EDISON

M&E PROTOCOLS TABLE 6 - RESULTS USED TO SUPPORT PY94 EARNINGS CLAIM FOR COMMERICAL RETROFIT INCENTIVE PROGRAM

FIRST YEAR LOAD IMPACT EVALUATION, FEBRUARY 1996, STUDY ID NO. 519

Designated Unit of Measurement: LOAD IMPACTS PER SQUARE FOOT PER 1000 HOURS OF OPERATION

ENDUSE: LIGHTING

				5. A. 90% CONFIDENCE LEVEL				5. B. 80% CONFIDENCE LEVEL			
				LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND
1. Average Participant Group and Average Comparison Group		**PART GRP**	**COMP GRP**	**PART GRP**	**PART GRP**	**COMP GRP**	**COMP GRP**	**PART GRP**	**PART GRP**	**COMP GRP**	**COMP GRP**
A. Pre-install usage:	Pre-install kW	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Pre-install kWh	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Base kW	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Base kWh	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Base kW/ designated unit of measurement	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Base kWh/ designated unit of measurement	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
B. Impact year usage:	Impact Yr kW	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Impact Yr kWh	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Impact Yr kW/designated unit	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Impact Yr kWh/designated unit	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
2. Average Net and Gross End Use Load Impacts		**AVG GROSS**	**AVG NET**	**AVG GROSS**	**AVG GROSS**	**AVG NET**	**AVG NET**	**AVG GROSS**	**AVG GROSS**	**AVG NET**	**AVG NET**
	A. i. Load Impacts - kW	18.75	11.25	16.2	21.3	9.72	12.78	16.76	20.74	10.06	12.44
	A. ii. Load Impacts - kWh	93280	55968	80591	105970	48355	63582	83391	103170	50035	61902
	B. i. Load Impacts/designated unit - kW	0.015	0.009	0.013	0.017	0.008	0.010	0.013	0.016	0.008	0.010
	B. ii. Load Impacts/designated unit - kWh	0.073	0.044	0.063	0.083	0.038	0.050	0.065	0.081	0.039	0.049
	C. i. a. % change in usage - Part Grp - kW	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	C. i. b. % change in usage - Part Grp - kWh	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	C. ii. a. % change in usage - Comp Grp - kW	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	C. ii. b. % change in usage - Comp Grp - kWh	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
D. Realization Rate:	D.A. i. Load Impacts - kW, realization rate	0.90055		0.764516506	1.036583494			0.794534839	1.006565161		
	D.A. ii. Load Impacts - kWh, realization rate	0.90055		0.764516506	1.036583494			0.794534839	1.006565161		
	D.B. i. Load Impacts/designated unit - kW, real rate	0.90055		0.764516506	1.036583494			0.794534839	1.006565161		
	D.B. ii. Load Impacts/designated unit - kWh, real rate	0.90055		0.764516506	1.036583494			0.794534839	1.006565161		
3. Net-to-Gross Ratios		**RATIO**		**RATIO**	**RATIO**			**RATIO**	**RATIO**		
	A. i. Average Load Impacts - kW	0.6									
	A. ii. Average Load Impacts - kWh	0.6									
	B. i. Avg Load Impacts/designated unit of measurement - kW	0.6									
	B. ii. Avg Load Impacts/designated unit of measurement - kWh	0.6									
	C. i. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kW	OPTIONAL		OPTIONAL	OPTIONAL			OPTIONAL	OPTIONAL		
	C. ii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kWh	OPTIONAL		OPTIONAL	OPTIONAL			OPTIONAL	OPTIONAL		
4. Designated Unit Intermediate Data		**PART GRP**	**COMP GRP**	**PART GRP**	**PART GRP**	**COMP GRP**	**COMP GRP**	**PART GRP**	**PART GRP**	**COMP GRP**	**COMP GRP**
	A. Pre-install average value - square feet	256285		116116.195	396453.805			147047.062	365522.938		
	B. Post-install average value - square feet	256285		116116.195	396453.805			147047.062	365522.938		
6. Measure Count Data		**NUMBER**									
	A. Number of measures installed by participants in Part Group	222									
	B. Number of measures installed by all program participants in the 12 months of the program year	2586									
	C. Number of measures installed by Comp Group										
7. Market Segment Data											
	Number of Participants										

SOUTHERN CALIFORNIA EDISON

M&E PROTOCOLS TABLE 6 - RESULTS USED TO SUPPORT PY94 EARNINGS CLAIM FOR COMMERICAL RETROFIT INCENTIVE PROGRAM

FIRST YEAR LOAD IMPACT EVALUATION, FEBRUARY 1996, STUDY ID NO. 519

Designated Unit of Measurement: LOAD IMPACTS PER SQUARE FOOT

ENDUSE: HVAC

				5. A. 90% CONFIDENCE LEVEL				5. B. 80% CONFIDENCE LEVEL			
				LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND
1. Average Participant Group and Average Comparison Group		PART GRP	COMP GRP	PART GRP	PART GRP	COMP GRP	COMP GRP	PART GRP	PART GRP	COMP GRP	COMP GRP
A. Pre-install usage:	Pre-install kW	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Pre-install kWh	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Base kW	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Base kWh	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Base kW/ designated unit of measurement	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Base kWh/ designated unit of measurement	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
B. Impact year usage:	Impact Yr kW	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Impact Yr kWh	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Impact Yr kW/designated unit	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Impact Yr kWh/designated unit	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
2. Average Net and Gross End Use Load Impacts		AVG GROSS	AVG NET	AVG GROSS	AVG GROSS	AVG NET	AVG NET	AVG GROSS	AVG GROSS	AVG NET	AVG NET
	A. i. Load Impacts - kW	10.97	5.37	9.346024676	12.5922234	4.579552091	6.170189464	9.70419189	12.23405618	4.755054026	5.984687529
	A. ii. Load Impacts - kWh	121171	59373	103241.4646	139100.8082	50588.31765	68159.39602	107197.9818	135144.291	52527.0111	66220.70257
	B. i. Load Impacts/designated unit - kW	0.0947	0.0464	0.080725061	0.108763676	0.03955528	0.053294201	0.083818683	0.105670054	0.041071155	0.051778327
	B. ii. Load Impacts/designated unit - kWh	1.047	0.513	0.891734596	1.201464969	0.436949952	0.588717835	0.925908494	1.16729107	0.453695162	0.571972624
	C. i. a. % change in usage - Part Grp - kW	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	C. i. b. % change in usage - Part Grp - kWh	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	C. ii. a. % change in usage - Comp Grp - kW	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	C. ii. b. % change in usage - Comp Grp - kWh	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
D. Realization Rate:	D.A. i. Load Impacts - kW, realization rate	0.945		0.79741793	1.09335758			0.830070238	1.060705272		
	D.A. ii. Load Impacts - kWh, realization rate	0.945		0.79741793	1.09335758			0.830070238	1.060705272		
	D.B. i. Load Impacts/designated unit - kW, real rate	0.945		0.79741793	1.09335758			0.830070238	1.060705272		
	D.B. ii. Load Impacts/designated unit - kWh, real rate	0.945		0.79741793	1.09335758			0.830070238	1.060705272		
3. Net-to-Gross Ratios		RATIO		RATIO	RATIO			RATIO	RATIO		
	A. i. Average Load Impacts - kW	0.49									
	A. ii. Average Load Impacts - kWh	0.49									
	B. i. Avg Load Impacts/designated unit of measurement - kW	0.49									
	B. ii. Avg Load Impacts/designated unit of measurement - kWh	0.49									
	C. i. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kW	OPTIONAL		OPTIONAL	OPTIONAL			OPTIONAL	OPTIONAL		
	C. ii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kWh	OPTIONAL		OPTIONAL	OPTIONAL			OPTIONAL	OPTIONAL		
4. Designated Unit Intermediate Data		PART GRP	COMP GRP	PART GRP	PART GRP	COMP GRP	COMP GRP	PART GRP	PART GRP	COMP GRP	COMP GRP
	A. Pre-install average value - square feet	121716		92223.795	151210.205			96732.022	144701.978		
	B. Post-install average value - square feet	121716		92223.795	151210.205			96732.022	144701.978		
6. Measure Count Data		NUMBER									
	A. Number of measures installed by participants in Part Group	166									
	B. Number of measures installed by all program participants in the 12 months of the program year	1133									
	C. Number of measures installed by Comp Group										
7. Market Segment Data											
	Number of Participants										

SOUTHERN CALIFORNIA EDISON

M&E PROTOCOLS TABLE 6 - RESULTS USED TO SUPPORT PY94 EARNINGS CLAIM FOR COMMERICAL SERVICES PROGRAM

FIRST YEAR LOAD IMPACT EVALUATION, FEBRUARY 1996, STUDY ID NO. 516

Designated Unit of Measurement: LOAD IMPACTS PER SQUARE FOOT PER 1000 HOURS OF OPERATION

ENDUSE: LIGHTING

				5. A. 90% CONFIDENCE LEVEL				5. B. 80% CONFIDENCE LEVEL			
				LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND
1. Average Participant Group and Average Comparison Group		PART GRP	COMP GRP	PART GRP	PART GRP	COMP GRP	COMP GRP	PART GRP	PART GRP	COMP GRP	COMP GRP
A. Pre-install usage:	Pre-install kW	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Pre-install kWh	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Base kW	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Base kWh	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Base kW/ designated unit of measurement	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Base kWh/ designated unit of measurement	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
B. Impact year usage:	Impact Yr kW	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Impact Yr kWh	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Impact Yr kW/designated unit	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Impact Yr kWh/designated unit	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
2. Average Net and Gross End Use Load Impacts		AVG GROSS	AVG NET	AVG GROSS	AVG GROSS	AVG NET	AVG NET	AVG GROSS	AVG GROSS	AVG NET	AVG NET
	A. I. Load Impacts - kW	22.11206897	5.528017241	2.137713026	42.08642491	0.534428256	10.52160623	6.545428045	37.67870989	1.636357011	9.419677472
	A. ii. Load Impacts - kWh	108310.9195	27077.72989	10471.09901	206150.7401	2617.774753	51537.68502	32061.28433	184560.5547	8015.321083	46140.13869
	B. i. Load Impacts/designated unit - kW										
	B. ii. Load Impacts/designated unit - kWh										
	C. i. a. % change in usage - Part Grp - kW	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	C. i. b. % change in usage - Part Grp - kWh	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	C. ii. a. % change in usage - Comp Grp - kW	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	C. ii. b. % change in usage - Comp Grp - kWh	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
D. Realization Rate:	D.A. I. Load Impacts - kW, realization rate	1.9									
	D.A. ii. Load Impacts - kWh, realization rate	1.9									
	D.B. I. Load Impacts/designated unit - kW, real rate	1.9									
	D.B. ii. Load Impacts/designated unit - kWh, real rate	1.9									
3. Net-to-Gross Ratios		RATIO		RATIO	RATIO			RATIO	RATIO		
	A. I. Average Load Impacts - kW	0.25									
	A. ii. Average Load Impacts - kWh	0.25									
	B. I. Avg Load Impacts/designated unit of measurement - kW	0.25									
	B. ii. Avg Load Impacts/designated unit of measurement - kWh	0.25									
	C. I. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kW	OPTIONAL		OPTIONAL	OPTIONAL			OPTIONAL	OPTIONAL		
	C. ii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kWh	OPTIONAL		OPTIONAL	OPTIONAL			OPTIONAL	OPTIONAL		
4. Designated Unit Intermediate Data		PART GRP	COMP GRP	PART GRP	PART GRP	COMP GRP	COMP GRP	PART GRP	PART GRP	COMP GRP	COMP GRP
	A. Pre-install average value - square feet			92223.795	151210.205			98732.022	144701.978		
	B. Post-install average value - square feet			92223.795	151210.205			98732.022	144701.978		
6. Measure Count Data		NUMBER									
	A. Number of measures installed by participants in Part Group	39									
	B. Number of measures installed by all program participants in the 12 months of the program year	222									
	C. Number of measures installed by Comp Group										
7. Market Segment Data											
	Number of Participants										

SOUTHERN CALIFORNIA EDISON

M&E PROTOCOLS TABLE 6 - RESULTS USED TO SUPPORT PY94 EARNINGS CLAIM FOR COMMERICAL SERVICES PROGRAM

FIRST YEAR LOAD IMPACT EVALUATION, FEBRUARY 1996, STUDY ID NO. 516

Designated Unit of Measurement: LOAD IMPACTS PER SQUARE FOOT

ENDUSE: HVAC

				5. A. 90% CONFIDENCE LEVEL				5. B. 80% CONFIDENCE LEVEL			
				LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND
1. Average Participant Group and Average Comparison Group		PART GRP	COMP GRP	PART GRP	PART GRP	COMP GRP	COMP GRP	PART GRP	PART GRP	COMP GRP	COMP GRP
A. Pre-install usage:	Pre-install kW	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Pre-install kWh	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Base kW	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Base kWh	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Base kW/ designated unit of measurement	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Base kWh/ designated unit of measurement	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
B. Impact year usage:	Impact Yr kW	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Impact Yr kWh	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Impact Yr kW/designated unit	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	Impact Yr kWh/designated unit	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
2. Average Net and Gross End Use Load Impacts		AVG GROSS	AVG NET	AVG GROSS	AVG GROSS	AVG NET	AVG NET	AVG GROSS	AVG GROSS	AVG NET	AVG NET
	A. i. Load Impacts - kW	13.75304211	9.764659695	10.2210195	17.28506471	7.256923845	12.27239594	11.00042631	16.5056579	7.810302681	11.71901711
	A. ii. Load Impacts - kWh	48496.47719	34432.49681	36041.73064	60951.22374	25589.62876	43275.36886	38790.10328	58202.8511	27540.97333	41324.02428
	B. i. Load Impacts/designated unit - kW										
	B. ii. Load Impacts/designated unit - kWh										
	C. i. a. % change in usage - Part Grp - kW	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	C. i. b. % change in usage - Part Grp - kWh	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	C. ii. a. % change in usage - Comp Grp - kW	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
	C. ii. b. % change in usage - Comp Grp - kWh	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL	OPTIONAL
D. Realization Rate:	D.A. i. Load Impacts - kW, realization rate	0.676									
	D.A. ii. Load Impacts - kWh, realization rate	0.676									
	D.B. i. Load Impacts/designated unit - kW, real rate	0.676									
	D.B. ii. Load Impacts/designated unit - kWh, real rate	0.676									
3. Net-to-Gross Ratios		RATIO		RATIO	RATIO			RATIO	RATIO		
	A. i. Average Load Impacts - kW	0.71									
	A. ii. Average Load Impacts - kWh	0.71									
	B. i. Avg Load Impacts/designated unit of measurement - kW	0.71									
	B. ii. Avg Load Impacts/designated unit of measurement - kWh	0.71									
	C. i. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kW	OPTIONAL		OPTIONAL	OPTIONAL			OPTIONAL	OPTIONAL		
	C. ii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kWh	OPTIONAL		OPTIONAL	OPTIONAL			OPTIONAL	OPTIONAL		
4. Designated Unit Intermediate Data		PART GRP	COMP GRP	PART GRP	PART GRP	COMP GRP	COMP GRP	PART GRP	PART GRP	COMP GRP	COMP GRP
	A. Pre-install average value - square feet			92223.795	151210.205			98732.022	144701.978		
	B. Post-install average value - square feet			92223.795	151210.205			98732.022	144701.978		
6. Measure Count Data		NUMBER									
	A. Number of measures installed by participants in Part Group	195									
	B. Number of measures installed by all program participants in the 12 months of the program year	1460									
	C. Number of measures installed by Comp Group										
7. Market Segment Data											
	Number of Participants										

SIC3	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	41	1.9	41	1.9
132	1	0.0	42	2.0
153	1	0.0	43	2.0
162	1	0.0	44	2.1
172	2	0.1	46	2.2
174	1	0.0	47	2.2
251	1	0.0	48	2.2
252	1	0.0	49	2.3
265	1	0.0	50	2.3
273	1	0.0	51	2.4
281	1	0.0	52	2.4
283	2	0.1	54	2.5
321	1	0.0	55	2.6
357	1	0.0	56	2.6
371	2	0.1	58	2.7
372	2	0.1	60	2.8
376	1	0.0	61	2.9
381	5	0.2	66	3.1
394	1	0.0	67	3.1
411	12	0.6	79	3.7
421	5	0.2	84	3.9
422	14	0.7	98	4.6
431	6	0.3	104	4.9
449	2	0.1	106	5.0
451	1	0.0	107	5.0
458	2	0.1	109	5.1
461	1	0.0	110	5.1
473	3	0.1	113	5.3
481	19	0.9	132	6.2
483	1	0.0	133	6.2
484	1	0.0	134	6.3
492	8	0.4	142	6.6
495	8	0.4	150	7.0
498	1	0.0	151	7.1
501	4	0.2	155	7.2
502	1	0.0	156	7.3
504	4	0.2	160	7.5
505	2	0.1	162	7.6
506	3	0.1	165	7.7
507	4	0.2	169	7.9
508	6	0.3	175	8.2
511	5	0.2	180	8.4
512	1	0.0	181	8.5
514	9	0.4	190	8.9
516	3	0.1	193	9.0
518	2	0.1	195	9.1
519	3	0.1	198	9.3
521	5	0.2	203	9.5
523	3	0.1	206	9.6
525	3	0.1	209	9.8
531	73	3.4	282	13.2
533	5	0.2	287	13.4
539	11	0.5	298	13.9
541	154	7.2	452	21.1
542	1	0.0	453	21.2
543	1	0.0	454	21.2
546	2	0.1	456	21.3
549	1	0.0	457	21.4
551	12	0.6	469	21.9
553	18	0.8	487	22.8

SIC3	Frequency	Percent	Cumulative Frequency	Cumulative Percent
554	3	0.1	490	22.9
556	1	0.0	491	23.0
557	1	0.0	492	23.0
561	1	0.0	493	23.0
562	3	0.1	496	23.2
564	1	0.0	497	23.2
565	22	1.0	519	24.3
566	48	2.2	567	26.5
569	2	0.1	569	26.6
571	11	0.5	580	27.1
572	2	0.1	582	27.2
573	1	0.0	583	27.3
581	412	19.3	995	46.5
591	5	0.2	1000	46.8
592	1	0.0	1001	46.8
593	7	0.3	1008	47.1
594	16	0.7	1024	47.9
596	1	0.0	1025	47.9
599	10	0.5	1035	48.4
602	31	1.4	1066	49.8
603	63	2.9	1129	52.8
606	1	0.0	1130	52.8
614	1	0.0	1131	52.9
616	2	0.1	1133	53.0
621	1	0.0	1134	53.0
632	4	0.2	1138	53.2
633	2	0.1	1140	53.3
637	1	0.0	1141	53.3
641	6	0.3	1147	53.6
651	173	8.1	1320	61.7
653	16	0.7	1336	62.5
655	3	0.1	1339	62.6
671	1	0.0	1340	62.6
673	1	0.0	1341	62.7
701	46	2.2	1387	64.8
704	3	0.1	1390	65.0
721	7	0.3	1397	65.3
723	9	0.4	1406	65.7
724	2	0.1	1408	65.8
729	1	0.0	1409	65.9
733	5	0.2	1414	66.1
734	1	0.0	1415	66.2
735	1	0.0	1416	66.2
736	2	0.1	1418	66.3
737	2	0.1	1420	66.4
738	9	0.4	1429	66.8
742	2	0.1	1431	66.9
751	1	0.0	1432	66.9
753	4	0.2	1436	67.1
754	1	0.0	1437	67.2
762	1	0.0	1438	67.2
769	2	0.1	1440	67.3
781	6	0.3	1446	67.6
782	9	0.4	1455	68.0
784	1	0.0	1456	68.1
792	1	0.0	1457	68.1
793	2	0.1	1459	68.2
794	1	0.0	1460	68.3
799	44	2.1	1504	70.3
801	36	1.7	1540	72.0

SIC3	Frequency	Percent	Cumulative Frequency	Cumulative Percent
802	3	0.1	1543	72.1
804	3	0.1	1546	72.3
805	10	0.5	1556	72.7
806	34	1.6	1590	74.3
811	2	0.1	1592	74.4
821	323	15.1	1915	89.5
822	36	1.7	1951	91.2
823	6	0.3	1957	91.5
824	2	0.1	1959	91.6
829	4	0.2	1963	91.8
832	14	0.7	1977	92.4
833	2	0.1	1979	92.5
835	2	0.1	1981	92.6
836	5	0.2	1986	92.8
839	2	0.1	1988	92.9
841	1	0.0	1989	93.0
861	2	0.1	1991	93.1
864	3	0.1	1994	93.2
866	41	1.9	2035	95.1
869	1	0.0	2036	95.2
871	3	0.1	2039	95.3
873	5	0.2	2044	95.6
874	2	0.1	2046	95.7
911	17	0.8	2063	96.4
912	2	0.1	2065	96.5
919	17	0.8	2082	97.3
921	6	0.3	2088	97.6
922	24	1.1	2112	98.7
941	10	0.5	2122	99.2
944	2	0.1	2124	99.3
953	2	0.1	2126	99.4
962	2	0.1	2128	99.5
963	2	0.1	2130	99.6
965	1	0.0	2131	99.6
971	3	0.1	2134	99.8
999	5	0.2	2139	100.0

Frequency Missing = 127

CECBTYPE-USES FSIC/TC

BTYPEF2	Frequency	Percent	Cumulative Frequency	Cumulative Percent
001	91	4.0	91	4.0
002	445	19.6	536	23.7
003	421	18.6	957	42.2
004	56	2.5	1013	44.7
005	216	9.5	1229	54.2
006	192	8.5	1421	62.7
007	15	0.7	1436	63.4
008	60	2.6	1496	66.0
009	331	14.6	1827	80.6
010	45	2.0	1872	82.6
011	33	1.5	1905	84.1
012	22	1.0	1927	85.0
013	53	2.3	1980	87.4
014	204	9.0	2184	96.4
018	77	3.4	2261	99.8
999	5	0.2	2266	100.0

DOCUMENTATION PROTOCOLS FOR QUALITY AND PROCESSING: TABLE 7

A. OVERVIEW INFORMATION

1. **Study Title:** First Year Impact Studies of the 1994 Commercial Services Program and The Commercial Retrofit Incentive Program

   Study I.D.: Study I.D. numbers 519 and 516, respectively

2. **Program:** Southern California Edison's 1994 Commercial Services Program and the Commercial Retrofit Incentive Program

   Description: The EMHR and EMS Programs promotes the adoption of energy efficient measures and actions by providing informational audits (Commercial Services Program) and audits and rebates on recommended and installed equipment (Commercial Retrofit Incentive Program) to commercial customers. Detailed descriptions are provided Chapters 1 pages 1-2, 1-3.

3. **End Uses and Measures Covered:** Lighting and HVAC.

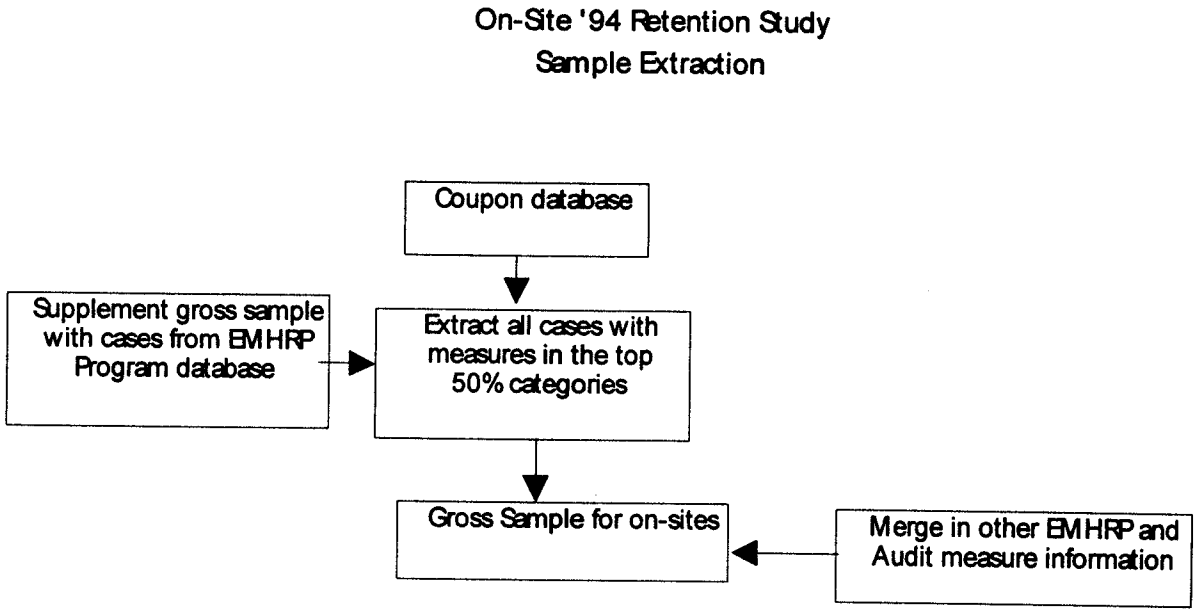
4. **Methods and Models Uses:** The final model was a linear Statistically adjusted engineering model specifications with customer specific constant, weather sensitivity, and consumption trend index. The model specification is presented and discussed in Chapter 2, page 2-1 , and Chapter 4 in conjunction with the sequence of models estimated.

5. **Participant Definition:** Commercial Services Program participants were those customers for whom SCE confirmed that a recommended measure or actions had been adopted in 1994. Commercial Retrofit Incentive Program participants were customers who installed the recommended equipment and received a rebate. The coverage of the programs is discussed in Chapter 3 pages 3-3 through 3-5.

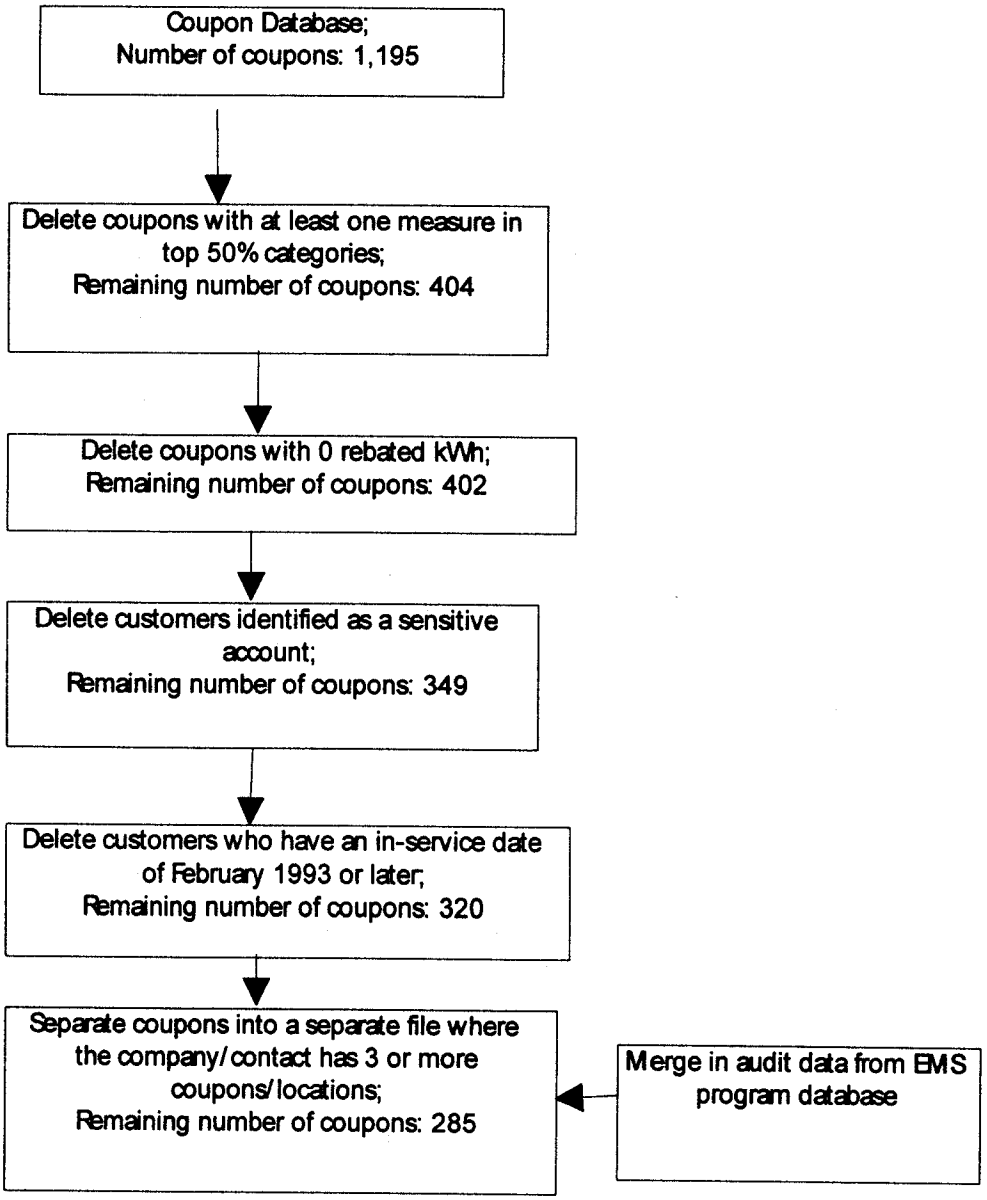
6. **Analysis Sample Size:** The sizes of the samples used in the analysis are summarized in Table 3-11b, and discussed in Chapter 3 page 3-23, 3.25, 3.26 .

B. DATABASE MANAGEMENT

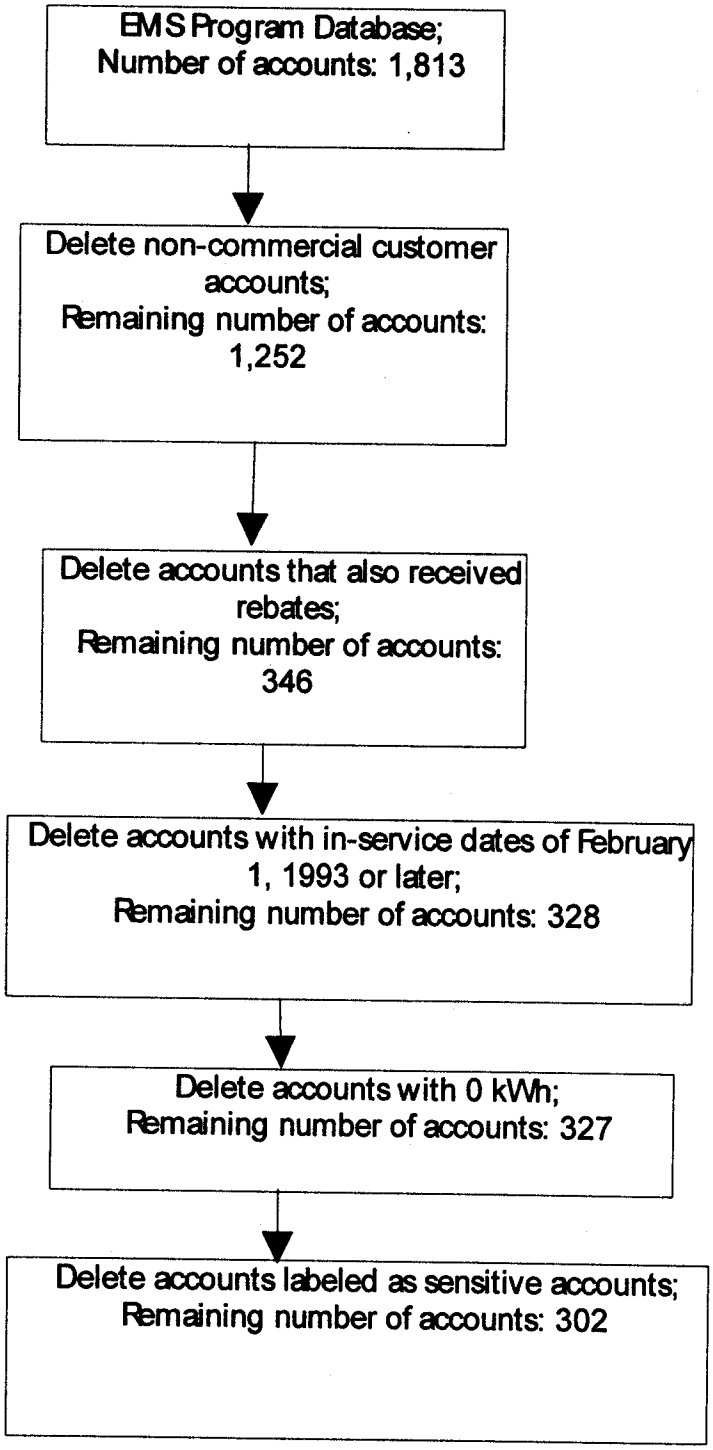
1. **Relationships Between Data Elements and Data Sources:** These are summarized in the following flow charts. They are described in detail in Chapter 3 .



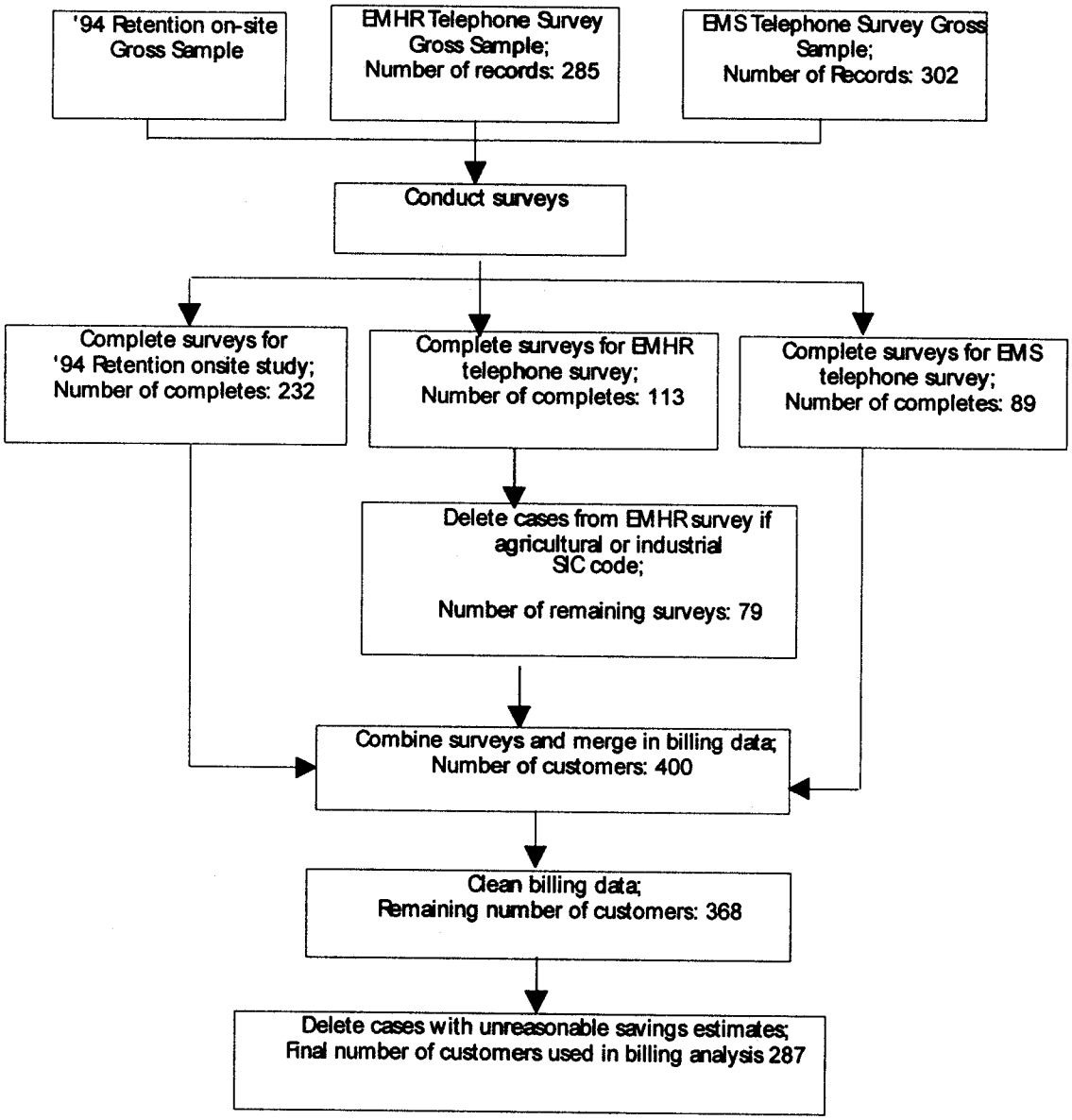
EMHRP Telephone Survey
Sample Extraction



EMS Telephone Survey
Sample Extraction



Billing Analysis
Sample Extraction



3. **Data Attrition:** The data attrition is documented in Chapter 3. It is summarized in the flow charts above. The following table describe the data attrition process for the billing data and for the billing database.

Bill Attrition by Screening Criterion

Deletion Criterion	Number of Deleted Bills	Number of Remaining Bills	Number of Accounts	Number of Business Locations
Original Data Set		85,056	2,458	1,765
Negative Consumption or Missing Number of Days	8	85,048		
Duplicates	23	85,025		
Overlapping Bills	105	84,920		
Non-participant customer	3,430	81,490		
Zero Usage for entire Period	481	81,009	2,336	1,734
Billing Period > 90 days	119	80,890		
Bills with less than 6 mos before, 6 mos after, or 20% gaps	4038	76,852	2,160	1,593
Bills for Accounts matched to Survey Responses		13,117		368

4. **Quality Checks:** These are discussed in Chapter 3 and Chapter 4 in conjunction with the regression results

5. **Data Collected But Not Used:** Various data from the surveys were not used in the analysis, either because they were not needed or because the survey information was gathered for the purpose of the retention study.

C. SAMPLING

1. **Sampling Procedures and Protocols:** The sampling procedures are discussed in detail in Chapter 3 .

2. **Survey Information:** The survey instruments are provided in Appendix 3.

3. **Statistical Descriptions of Variables:** These are presented in Chapter 3 and Appendix 4B.

D. Data Screening and Analysis

1. **Procedures for Treatment of Outliers, Missing Data Points, and Weather Adjustment.** Outliers were identified in the course of data preparation and analysis. Their treatment is discussed in Chapter 4 in conjunction with the presentation of the different models that were estimated, pp. 4-2 through 4-9. Cases with missing data for key variables were excluded from the analysis dataset. These are documented in Chapter 3, section 3.2, pp. 3-3 through 3-10. A weather variable, cooling degree days to base 60, was included as an explanatory variable in the regression model.

2. **Effects of Background Variables.** Different variables were included to control for general background trends and specific changes at the business location. These are discussed in conjunction with the estimation results in Chapter 4, pp. 4-2 through 4-9.

3. **Data Screening Procedures.** These are documented in Chapter 3.

4. **Regression Statistics.** Key regression statistics for all models are presented in Chapter 4. The full regression results and statistics for the final model are presented in Appendix 4b.

5. **Specification.** Chapter 4 presents the sequence of models that were estimated and the rationale for each.

   A. The heterogeneity of customers was addressed primarily by including customer specific constants and weather sensitivity variables in the model specification. This is discussed in Chapter 2.

   B. The regression model specifications included several variables that represent changes in factors that affect energy consumption over time. These are discussed in conjunction with the presentation of the sequence of models in Chapter 4, Section 2.

   C. Self Selection. No statistical procedures were used to address self selection. The model parameters represent the effects of the installed measures on consumption for the participants, rather than for the commercial population as a whole. This is the effect that the analysis should be estimating. Therefore no correction is required.

   D. The relevant factors were represented by customer specific constants and weather sensitivity parameters. These absorb the effects of factors that cause any cross sectional

and weather related temporal variations in consumption. Indices of commercial sector consumption trends and other variables were included to capture the remaining temporal variations. The treatment of cross sectional, weather sensitivity, and business trends as "random" effects through customer specific terms eliminated the need to represent building and customer characteristics explicitly in the model.

E. The model specification includes customer specific terms that represent the electricity consumption growth rate for all customers in each participant's 2 digit SIC code. This controls for background effects, including an "naturally occurring" conservation. As a consequence, the impact estimates are net of such effects. This is discussed in Chapter 2

6. **Error in Measurement.** The key variables were the claimed savings from the program tracking database, binary variables based on survey responses, or indices based on SCE's billing files. These should not be subject to measurement error. Therefore, this was not considered a problem.

7. **Autocorrelation.** No tests were performed to check for autocorrelation. This is discussed in Chapter 4, p. 4-15.

8. **Heteroskedasticity.** No tests were performed to check for heteroskedastic errors. This is discussed in Chapter 4, p. 4-15.

9. **Collinearity.** This was not considered a problem in the estimated models. Regardless of whether significant collinearity is present, the parameter estimates and associated standard errors are unbiased.

10. **Influential Data Points.** The diagnoses of influential data points and treatment of outliers are discussed in Chapter 4, in conjunction with the estimation results.

11. **Missing Data.** There were no missing data in the analysis dataset.

12. **Precision.** The confidence intervals for the net impacts were computed from the standard errors of the parameter estimates. This is discussed in Chapter 6, p. 6-2.

E. Data Interpretation and Application

1. **Net Impact Calculation.** The parameters in the regression model represent a combined realization rate and net-to-gross ratio by end-use category. These were multiplied by the savings claimed by SCE in its program tracking database.

2. **Rationale for Choices**. The method was the direct result of the model specification. The model is a Statistically Adjusted Engineering model, with variables that represent the consumption trends of the entire commercial sector. The parameters from this model capture the combined realization rate and net-to-gross ratio for each program measure category.