IMPACT EVALUATION OF THE 1995 RESIDENTIAL DIRECT ASSISTANCE PROGRAM

FINAL REPORT

Prepared for

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E EXECUTIVE SUMMARY

This report presents impact evaluation results for Southern California Edison Company's (Edison) 1995 Residential Direct Assistance Program. The evaluation was conducted during the latter half of 1996 and early 1997. Billing, engineering and net-to-gross analyses were conducted to develop gross and net savings estimates for the program.

E.1 PROGRAM BACKGROUND

The Edison Direct Assistance Program provides direct installation of energy efficiency measures in the homes of qualified low income customers. There is no cost to the customer for the provision of these measures. In 1995, the Program focused on the installation of compact fluorescent lamps (CFLs), evaporative coolers, and weatherization measures. Each of these three measure groups was implemented by Edison through independent subprograms with separate planning, staffing, and management functions.

CFLs

The CFL component of the Program accounted for the largest level of participation (41,127 customers) and expected program savings (13.23 GWh). The CFL installations were implemented by 12 community-based organizations (CBOs), who were responsible for providing surveyors and identifying neighborhoods and homes for potential program participation.

Evaporative Coolers

The evaporative cooler component of the Program included 1,977 participants and was responsible for expected annual savings of 1.91 GWh. The evaporative cooler installations were implemented through private contractors, who were responsible for participant recruitment, cooler installations, and program reporting requirements.

Weatherization

The weatherization component of the 1995 Program included 2,963 participants and was responsible for expected annual savings of 0.62 GWh. Weatherization measures included caulking, weatherstripping, insulation, home repairs, and installation of low flow showerheads. Two private contractors were responsible for most of the 1995 installations.

E.2 EVALUATION PROJECT OVERVIEW

Objectives

A primary objective of this study was to develop first-year gross and net impacts (kWh and kW) for the Direct Assistance Program. Measure retention and customer satisfaction issues also were addressed.

Evaluation Approach

A calibrated engineering analysis was used to estimate gross savings for the CFL program. This analysis was supported by hours of operation data collected via lighting loggers. Savings estimates reflect both measure retention and measure performance. Peak period kW savings estimates are based on peak coincident factors ascertained from time-of-use lighting logger results.

Billing analyses were used to develop gross savings estimates for evaporative cooler and weatherization measures. This analytic approach utilized multivariate regression models in which household electric consumption is modeled as a function of program-related variables from the Edison tracking system and other explanatory variables, including weather and survey variables. Peak period kW savings were developed utilizing load shape data from the Edison *1994 Residential Appliance End-Use Study.*

Net program savings were developed by applying net-to-gross ratios to the gross savings estimates. These ratios were based on customer self-report data that was used to determine free ridership and spillover rates.

Data

Data used to support the evaluation came from a variety of sources, including:

- On-site survey data, including lighting logger data, used to support the CFL savings analysis (200 surveys were completed and 249 lighting fixtures were effectively logged);
- Telephone survey data, used in the billing analysis for evaporative cooler and weatherization savings (210 surveys were completed for each subprogram);
- Program tracking system data for the 1995 program year;
- Edison billing data - monthly electric usage data for the January 1994 - October 1996 period; and
- Weather data from 23 stations in the Edison service area.

E.3 KEY FINDINGS

First year gross measure savings for each program component and overall savings are presented in Table E-1. Both gross and net savings are presented. The CFL subprogram was responsible for the largest share of Program savings. Evaporative coolers achieved the highest per customer savings.

Table E-1
Summary of First Year Energy Savings (kWh)

Subprogram	Gross Program Savings	Gross Savings Per Customer	Net Program Savings	Net Savings Per Customer
CFL	9,158,983	223	9,158,983	223
Evaporative Cooler	1,130,844	572	1,142,152	578
Weatherization	1,220,756	412	1,232,964	416
Overall	11,510,583		11,534,099	

Summer coincident demand savings are presented in Table E-2. These savings reflect impacts that occur at 3 p.m. on a weekday. As could be expected, the evaporative coolers contribute most to the savings.

Table E-2
Summary of Summer Coincident Demand Savings (kW)

Subprogram	Gross Program Savings	Gross Savings Per Customer	Net Program Savings	Net Savings Per Customer
CFL	263	0.0064	263	0.0064
Evaporative Cooler	2,111	1.0680	2,132	1.0790
Weatherization	125	0.0422	126	0.0426
Overall	2,499		2,521	

Comparison to Edison Savings Estimates

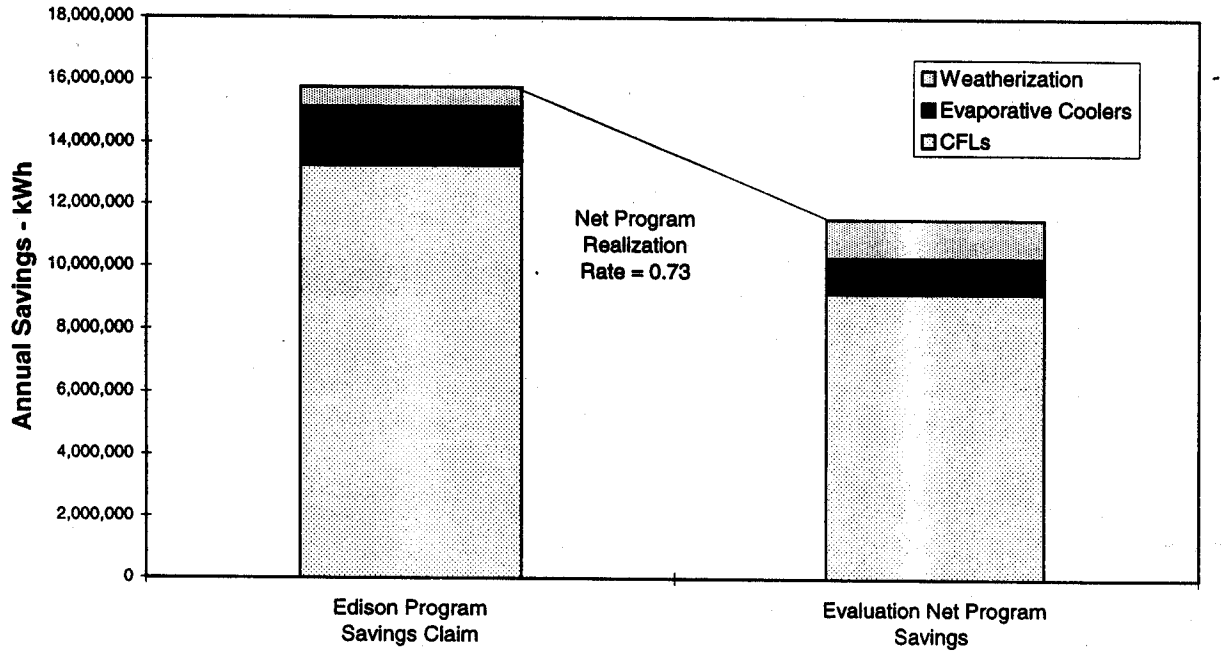
Table E-3 compares evaluation results for net first-year savings to Edison savings claims. As the table indicates, CFLs achieved 69% of expected savings, evaporative coolers achieved 60%, and weatherization measures achieved 198% of expected savings. Overall the Program is achieving 73% of expected savings.

The 0.69 CFL realization rate is the result of two factors: measure retention and hourly lighting usage. Survey results show that about 75% of the tracking system lights were effectively in place for the first year (after partially factoring in lights that were removed during the first year). In addition, annualized lighting usage for the evaluation was estimated to be 3 hours per day, which is only 90% of the estimate used in the Program calculations.

Table E-3
First Year Savings (kWh) - Comparison to Program Savings Claims

Subprogram	Net Program Savings Evaluation	Program Savings Claim Edison	Realization Rate
CFL	9,158,983	13,226,259	0.69
Evaporative Cooler	1,142,152	1,911,557	0.60
Weatherization	1,232,964	623,890	1.98
Overall	11,534,099	15,761,706	0.73

Figure E-1
First Year Savings (kWh) - Comparison to Program Savings Claims



The evaporative cooler realization rate is 0.60. Edison's estimates of evaporative cooler savings do not appear to be born out by changes in customer bills. It is possible that the lower savings estimate is in part due to snapback effects. Sixty two percent of surveyed customers indicated they were cooling their homes more after receiving the evaporative coolers.

The evaluation weatherization estimate is about twice the Edison saving claim. The ability to accurately predict savings for a weatherization program is difficult due the variety of installed measures and variation in pre-installation conditions at each home. The evaluation estimate, reflecting average savings of 412 kWh per home, does not seem unreasonable, given that most weatherized homes had both electric water heating and electric space heating.

Tables E-4 and E-5 present summer and winter coincident savings comparisons. For the summer period, the overall program savings are achieving 124% of expected savings, due to high

estimated savings for evaporative coolers. The evaluation estimate is based on the 1994 End-Use Study air conditioner profiles for the 1994 summer peak day and the assumption that evaporative cooler savings is proportionate to air conditioning load. Afternoon air conditioner usage for the peak day is over twice as high as for a typical summer day.

Table E-4
Summer Coincident Savings (kW) - Comparison to Program Savings Claims

Subprogram	Net Program Savings Evaluation	Program Savings Claim Edison	Realization Rate
CFL	263	965	0.27
Evaporative Cooler	2,132	1,075	1.98
Weatherization	126	0	-
Overall	2,521	2,040	1.24

Table E-5
Winter Coincident Savings (kW) - Comparison to Program Savings Claims

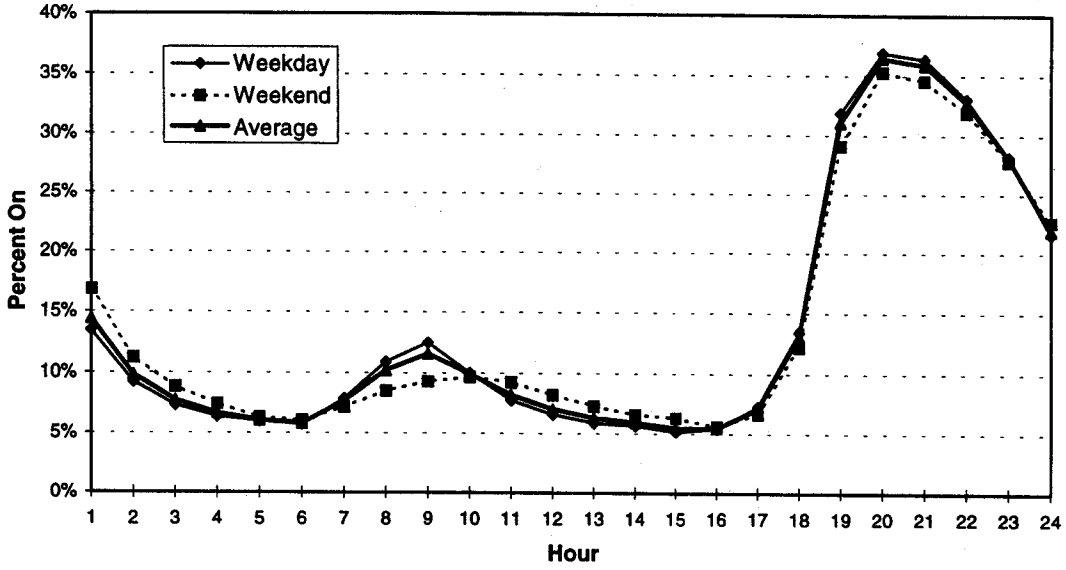
Subprogram	Net Program Savings Evaluation	Program Savings Claim Edison	Realization Rate
CFL	370	4,012	0.09
Evaporative Cooler	30	98	0.31
Weatherization	91	0	-
Overall	491	4,110	0.12

The differences in program coincident and evaluation peak kW savings estimates for the CFL subprogram can be attributed to measure retention and coincidence factor assumptions. Based on 1995 data, both the summer and winter peaks occurred at 3 p.m. on a weekday. The evaluation CFL load shape (and subsequent adjustment for seasonal use) provided a summer coincident factor of 0.036 and a winter factor of 0.051. The coincidence factors implied by the Edison savings data are 0.087 for the summer and 0.364 for the winter. It is clear from the CFL load shape generated from evaluation lighting logger data (Figure E-2), that a shift in the peak hour assumption of several hours can have a dramatic effect on the peak savings calculations.

Customer Satisfaction

Customers were generally satisfied with all three components of the Direct Assistance Program. Approximately 90% of the participants were satisfied with the installed CFLs and weatherization measures, while 99% of the surveyed customers were satisfied with their evaporative coolers.

Figure E-2
Lighting Load Shape Based on Time-of-Use Logger Data



1 INTRODUCTION

1.1 OVERVIEW

This report presents the results of an impact evaluation of Southern California Edison Company's (Edison) 1995 Residential Direct Assistance Program. This program provides for direct installation of compact fluorescent lights (CFLs), evaporative coolers, and weatherization measures in the homes of qualified residential customers.

The primary objective of the evaluation was to develop first-year gross and net impacts (kWh and kW) for the three components of the Direct Assistance Program in a manner consistent with the California M&E Protocols. A component of the analysis included an assessment of first-year measure retention rates. Secondary objectives included exploration of measure removal factors and customer satisfaction with Program measures.

1.2 PROGRAM DESCRIPTION

Edison's Residential Direct Assistance Program provides direct installation of energy efficiency measures to low income households at no cost to the customer. The 1995 Program focused on three measure groups: CFLs, evaporative coolers, and weatherization. Each measure group is implemented as an independent subprogram with separate planning, staffing, and management functions. Reported Program accomplishments are summarized in Table 1-1, and the subprograms are discussed further below.

Table 1-1
Reported 1995 Direct Assistance Program Accomplishments

Subprogram	Participating Customers	Total Savings (kWh/year)	Average Savings (kWh/year)
Compact Fluorescent Lighting	41,127	13,226,259	322
Evaporative Cooler	1,977	1,911,557	967
Weatherization	2,963	623,890	211
Total	46,067	15,761,706	342

1.2.1 Compact Fluorescent Lighting

The CFL component of the Direct Assistance Program accounted for the largest level of participation and program savings. In 1995, 41,127 customers participated in the subprogram, with 200,547 lamps installed and expected annual savings of 13.23 GWh.

The CFL installations were implemented by 12 community-based organizations (CBOs), who were responsible for providing surveyors and identifying neighborhoods and homes for potential program participation. Edison purchased the CFLs, which were shipped directly to the CBOs, and provided surveyor training. Surveyors visited homes, verified participants' income qualifications, installed CFLs, and completed a program application that was subsequently returned to Edison for approval.

1.2.2 Evaporative Coolers

The evaporative cooler component of the 1995 Program included 1,977 participants and was responsible for expected annual savings of 1.91 GWh.

To qualify for the subprogram, a customer had to satisfy low income requirements and had to have an existing air conditioner. The evaporative cooler installations were implemented through private contractors, who were responsible for participant recruitment, cooler installations, and program reporting requirements.

1.2.3 Weatherization

The weatherization component of the 1995 Program included 2,963 participants and was responsible for expected annual savings of 0.62 GWh. Weatherization measures included caulking, weatherstripping, insulation, home repairs, and installation of low flow showerheads.

1.3 EVALUATION SUMMARY

1.3.1 Objectives

The primary objective of this study was to develop first-year gross and net impacts (kWh and kW) for the three components of the Direct Assistance Program: CFLs, evaporative coolers, and weatherization. Measure retention and customer satisfaction issues also were addressed.

1.3.2 Approach

A calibrated engineering analysis was used to estimate CFL savings. The analysis was supported by hours of operation data collected via lighting loggers. Savings estimates reflect both measure retention and measure performance. Peak period kW savings are based on peak coincident factors ascertained from time-of-use lighting logger results.

Billing analyses were used to develop savings estimates for evaporative cooler and weatherization measures. This analytic approach utilizes multivariate regression models in which household electric consumption is modeled as a function of program-related variables from the tracking system and other explanatory variables, including weather and survey variables.

Site-specific data for the analyses were collected via on-site surveys (CFLs) and telephone surveys (evaporative coolers and weatherization). The surveys were administered in Spanish when necessary. Survey questions addressed measure-specific issues and general household factors and were used to develop free-ridership and spillover rates that were incorporated into net savings estimates.

1.4 REPORT ORGANIZATION

The remainder of this report is organized as follows:

- Section 2 presents the study methodology, including the sample design, data collection activities, and the analysis approach;
- Section 3 contains the evaluation results, presented by subprogram;
- Appendix A contains the data collection forms used for the project;
- Appendix B contains a tabulation of key survey results;
- Appendix C contains sample attrition tables and sample expansion weight calculations;
- Appendix D presents descriptive statistics for the billing analysis model variables; and
- Appendix E contains completed Tables 6 and 7 for the M&E Protocols.

2 METHODOLOGY

2.1 OVERVIEW

This section describes the methodology used for the 1995 Direct Assistance Program evaluation. First, the study sample design is presented, followed by a discussion of the data collection activities. Finally, the analysis approach is presented. A calibrated engineering analysis was used to estimate CFL savings, and billing analyses were used to develop savings estimates for evaporative cooler and weatherization measures.

2.2 SAMPLE DESIGN

Overall, 600 customers were targeted to be included in the study sample, as follows:

- CFL analysis: 150 program participants who were still living at the same address where they received CFLs, and 50 customers occupying homes where the original participant had moved (all 200 sites to receive on-site visits)
- Evaporative cooler analysis: 200 participants, to receive telephone surveys
- Weatherization analysis: 200 participants, to receive telephone surveys

The goal of the CFL sample design was to provide a sample that is representative of the CFL continuing participant and "mover" populations. For the evaporative cooler and weatherization samples, the goals were to provide a representative sample of homes and to provide a diversified sample of sites (based on measure category and customer characteristics) in order to facilitate quantification of savings by key segments of the population.

2.2.1 Compact Fluorescent Lighting

Disposition of Participating Customers

The first step in the CFL sample design was to determine homes with continuing participants and homes with new customers living at participating sites. This step was accomplished using account status information from the Edison billing system.

Table 2-1 shows that 25,387 participants were still living in their participating homes and had an "active" account status. A total of 9,638 homes were associated with new account numbers, indicating that a new customer had moved in. The remaining sites were mainly (1) houses with closed accounts and no new customers or (2) homes with participating customers whose account was "in-collection".

Table 2-1
Disposition of Participating CFL Customers

	Account Status	Homes
Sites with no new account numbers:	Active	25,387
	Closed	3,343
	In Collection	2,722
	Other codes	37
Sites with new account numbers		9,638
Total sites in tracking database		41,127

Continuing Participant Sample Design

The continuing participant sample design started with the 28,146 continuing customers (homes without new account numbers and homes without closed accounts). The screened customers included only continuing customers with active accounts. (It was determined that these customers would provide the best pool of homes for successful lighting logger installations.) The sample frame is segmented into dwelling type (single family/multi-family) and Edison planning area. The sample is generally allocated based on proportion of total sites in each segment. The rationale for this allocation was that CFL savings are probably not well correlated with the total bill, which is driven more by weather. The proportionate sample was adjusted slightly to facilitate field work. The sample was allocated based on groups of four sites per city to allow for the scheduling of four sites per day for each auditor. Table 2-2 presents the sample design.

Table 2-2
CFL Sample Design - Continuing Participants

Dwelling Type	Planning Area	All Homes	Screened Homes	Percent of All Homes	Proportionate Sample	Adjusted Sample
MF	Coastal (2)	9,484	8,472	34%	51	50
MF	Inland Valley (3)	3,619	3,091	13%	19	19
MF	Cent Vly/Des (1,4)	4,686	3,931	17%	25	25
SF	Coastal (2)	5,978	5,761	21%	32	32
SF	Inland Valley (3)	1,662	1,612	6%	9	11
SF	Cent Vly/Des (1,4)	2,717	2,520	10%	14	13
Total		28,146	25,387	100%	150	150

New Customer Sample Design

In addition to continuing participants, new customers who had moved into participating homes were visited to collect CFL usage and retention information. The total population in this category was calculated to be 12,981 homes (all sites where the participating customer's account had been closed). The screened sites include only homes where a new account number is

identified. Stratification and allocation of sample was similar to that of continuing participants. Table 2-3 presents the sample design.

Table 2-3
CFL Sample Design - New Customers at Participating Sites

Dwelling Type	Planning Area	All Homes	Screened Homes	Percent of All Homes	Sample
MF	Coastal (2)	5,634	4,227	43%	22
MF	Inland Valley (3)	2,370	1,759	18%	9
MF	Cent Vly/Des (1,4)	2,917	2,155	22%	11
SF	Coastal (2)	1,083	759	8%	4
SF	Inland Valley (3)	275	202	2%	1
SF	Cent Vly/Des (1,4)	702	536	5%	3
Total		12,981	9,638	100%	50

2.2.2 Evaporative Coolers

The 1,977 program sites were segmented into categories based on dwelling type (single family, multi-family), Edison Planning Area (Desert, Other), and the presence of central air conditioning. Homes then were screened for adequacy of billing data. A screened customer met the following criteria:

1. Currently active customer;
2. Active customer at the end of 1994 with at least 200 billing days in 1994;
3. Customers with unique account number (i.e. no master metering); and
4. Annual usage that is less than 50,000 kWh per year (to screen for possible master metered customers).

A total of 942 customers passed the billing data screens. This number of homes provided a sufficient pool of sites to achieve the targeted sample of 200 sites. The sample design is summarized in Table 2-4. The targeted sample is provided in column six of the table. For comparison purposes, a sample allocated in proportion to total program homes also is presented (column eight). The targeted sample attempted to allocate enough homes for each segment to enhance the ability of the billing analysis model to differentiate program savings by key attribute. Column nine shows the final number of homes that received telephone surveys. Because there was sufficient sample remaining, an additional ten surveys were completed to offset potential attrition of sites due to further problems with billing data. Cell quotas were exceeded or attained in all but one segment.

Table 2-4
Evaporative Cooler Sample Design

(1) Dwelling Type	(2) Planning Area	(3) Central Air?	(4) Total Homes	(5) Screened Homes	(6) Sample	(7) % of Screened homes	(8) Proportional Sample	(9) Surveyed Homes
MF	All Areas	All AC types	354	102	30	29%	36	35
SF	Desert (4)	No	336	158	35	22%	34	40
SF	Desert (4)	Yes	897	434	75	17%	90	76
SF	Other	No	167	117	30	26%	17	30
SF	Other	Yes	223	131	30	23%	23	29
Total			1,977	942	200	21%	200	210

2.2.3 Weatherization

Of the 2,963 sites that participated in the program, 2,050 sites are included in the program tracking database. An additional 913 sites that were weatherized in conjunction with the Southern California Gas Company program did not have sufficient customer information to merit inclusion in the tracking database. Discussions with Edison program staff indicated that these 913 homes were similar to the 2,050 databased homes in terms of measures installed and climate zone distribution. It was decided that exclusion of these 913 homes from the sample design would not significantly bias the evaluation results.

The 2,050 sites in the program database were segmented into categories based on dwelling type (single family, multi-family), Edison Planning Area (Coastal, Inland Valley, Other), high cost installations (homes where program site costs exceed $400, 25% of homes), and key measure/end use combinations. Homes then were screened for adequacy of billing data. A screened customer met the following criteria:

1. Currently active customer;
2. Active customer at the end of 1993;
3. Customers with unique account number (i.e. no master metering); and
4. Annual usage that is less than 30,000 kWh per year (to screen for possible master metered customers).

A total of 852 customers passed the billing data screens. This number of homes provided a sufficient pool of sites to achieve the targeted sample of 200 sites. The sample design is summarized in Table 2-5. The targeted sample is provided in column seven of the table. For comparison purposes, a sample allocated in proportion to total program homes also is presented (column nine). The targeted sample attempts to allocate enough homes for each segment to enhance the ability of the billing analysis model to differentiate program savings by key segment. Column ten shows the final number of homes that received telephone surveys. Because there was sufficient sample remaining, an additional ten surveys were completed to offset potential

attrition of sites due to further problems with billing data. Cell quotas were attained or exceeded for all segments.

Table 2-5
Weatherization Sample Design

(1) Dwelling Type	(2) Planning Area	(3) High Cost Install	(4) Measure/ End Use Group	(5) Total Homes	(6) Screened Homes	(7) Target Sample	(8) % of Screened Homes	(9) Prop Sample	(10) Surveyed Homes
MF	Coastal (2)	No	Shell Only	291	116	17	15%	28	17
MF	Coastal (2)	No	Shell Only w/AC	84	49	10	20%	8	10
MF	Coastal (2)	No	Water Also	317	99	18	18%	32	18
MF	Coastal (2)	No	Water Also w/AC	116	40	10	25%	11	10
MF	Coastal (2)	Yes	Shell Only	127	78	15	19%	12	20
MF	Coastal (2)	Yes	Shell Only w/AC	60	43	10	23%	6	15
MF	Coastal (2)	Yes	Water Also	143	80	15	19%	14	15
MF	Coastal (2)	Yes	Water Also w/AC	139	96	15	16%	13	15
MF	Inland Valley (3)	All Inst.	All Measures	395	84	35	42%	39	35
MF	Other	All Inst.	All Measures	183	41	20	49%	18	20
SF	All Areas	All Inst.	All Measures	195	126	35	28%	19	35
Subtotal				2,050	852	200	23%	200	210
Homes Weatherized in conjunction with SoCalGas				913					
Total				2,963					

2.3 DATA COLLECTION

This subsection outlines the data collection activities and data sources that were used for the project. Collected data supported engineering, billing, and net-to-gross analyses. Data from a variety of sources were utilized for the study, including:

- On-site survey data, including lighting loggers;
- Telephone survey data;
- Program tracking system data;
- Edison billing data;
- Weather data; and
- Secondary source data.

These data sources are discussed next.

2.3.1 On-Site Surveys

On-site surveys with lighting logger installations were used to support the calibrated engineering CFL analysis. The on-site surveys focused on 4 main data collection categories:

1. CFL accounting: how many CFLs were in place; were any additional purchases made by the customer;
2. Program CFL removals: reasons for removals, how long were they in place prior to removal;
3. Bulb usage: self report hours of usage, logger data collection and accounting;
4. Market research questions: prior awareness of CFLs, willingness to pay, CFL satisfaction, and other net-to-gross issues.

Two separate, yet similar, survey instruments were utilized for the study: one for participants who continued to live in the same homes, and one for new customers who moved into treated homes. Copies of the on-site survey instruments are provided in Appendix A.

On-Site Process

The on-site survey process included the following components:

- Surveyor/installer hiring and training
- Logger preparation
- Customer recruitment and scheduling
- Logger installation and customer surveying
- Logger retrieval
- Survey data entry and quality control
- Data retrieval and quality control

Surveyor/installer hiring and training: Surveyors were recruited from two community-based organizations that were familiar with the Edison CFL Program. Vo Vi Friendship Association was retained to conduct surveys for the western portion of the Edison service area, and the Center for Employment Training was retained to conduct surveys for the eastern areas. An additional XENERGY surveyor was utilized for a dozen homes located in the southern portion of the Central Valley.

Once the staff were hired, they were trained with regard to the survey instrument, the lighting logger installations, and on customer relations, interpersonal communication skills, and client sensitivity. The surveyors were prepared to install the loggers in a variety of settings and in a variety of fixture types.

Logger preparation: Prior to deployment, each logger was checked to ensure it was operational, its internal clock was properly adjusted (for TOU loggers), and it was reset.

Customer recruitment and scheduling: The focus in the recruitment and data collection task was collecting high-quality data while maintaining customer satisfaction. The telephone recruitment process included:

- A brief project introduction including notification of participation incentives;
- Scheduling an appointment for the survey; and
- Providing a description of the type of information to be gathering and the expected survey duration.

Each customer was offered $20 to participate in the lighting logger study.

Logger installation and customer surveying: On-site survey activities included the following: surveyor introduction and project overview, customer interviews to collect the basic survey information, verification of installed CFLs, and logger installations.

Logger retrieval: After four to eight weeks of operation, the loggers were retrieved. On a pre-specified date, the surveyors re-visited the site and removed the loggers. The logger removal dates and times were recorded and the loggers were shipped to XENERGY's office for processing.

Survey data entry: All survey data were entered into a PC-SAS dataset. Range checks on variables and spot checks of surveys were utilized to ensure data entry accuracy.

Data retrieval: Logger data were downloaded (or read) from the lighting logger by trained XENERGY staff. Each logger was related to the appropriate home and location using the logger ID numbers affixed to the logger at the start of the project. For runtime loggers, total on-time was recorded and matched against installation and removal dates to determine average daily usage. For TOU loggers, usage was summarized by key time period. Retrieved data were screened for anomalies.

2.3.2 Telephone Surveys

Telephone surveys were conducted to support the evaporative cooler and weatherization billing analyses. The telephone surveys focused on 4 main categories:

1. Measure retention: are the measures generally still in place (especially for evaporative coolers);
2. Household information: holdings of key appliances, number of residents, home size;
3. Household changes: additions/removals of major appliances, changes in residents, additional conservation;

4. Market research questions: prior awareness of measures, willingness to pay, measure satisfaction, and net-to-gross issues.

Separate survey instruments were developed for the evaporative cooler and weatherization analyses. Copies of telephone survey instruments are provided in Appendix A.

Survey Process

Luth Research, an experienced subcontractor, was used to conduct telephone surveys of program participants. Luth had been used on previous Edison projects and had demonstrated the capability to administer surveys in both English and Spanish.

XENERGY provided the survey instrument and customer sample, in electronic form, to Luth. The survey instrument was programmed into a CATI (computer-assisted telephone interviewing) system. The CATI system ensured that the survey was filled out consistently and that complete survey contact records were retained.

The survey instrument was pretested on 10 participants (five per subprogram) prior to finalization. No adjustments were required to the survey instrument.

At the completion of the survey, Luth Research returned the completed survey databases (in ASCII format) to XENERGY. XENERGY loaded the data into PC-SAS datasets for incorporation into the analyses.

2.3.3 Program Tracking System Data

Edison provided program tracking data for each of the three subprograms. These data included:

- Customer identification (name, address, phone number, account number, etc.);
- Measure installation dates;
- Measure descriptions and quantities;
- Customers demographics (age category, language type, income); and
- Home and end use information (home size, home type, presence of electric heating, electric water heating and air conditioning).

All data were sufficiently documented and organized to facilitate incorporation into the analyses.

2.3.4 Billing Data

Edison provided XENERGY with two separate extracts of billing data. First, summary data were provided for all program participants for use in the sample design. These data included account status flags to determine how long the customer had been at their residence and annual 1994 consumption to screen for unusual bills. Second, monthly billing data for the January 1994 - October 1996 period were provided for all evaporative cooler and weatherization participants

that had passed initial data adequacy screening procedures. The data spanned a period sufficient to comply with the CPUC M&E Protocols.

Billing data consisted of kWh consumption, meter read dates, days in the billing period, and read codes. The read codes were used to identify estimated bills which were then reapportioned back to the appropriate read date.

2.3.5 Weather Data

Edison provided daily average temperature data for 23 weather stations for the January 1988 - October 1996 period. This period covered the dates included in the billing histories and also provided an eight year period to construct "average" temperature conditions for use in normalizing savings estimates. A mapping of each customer to the appropriate weather station also was provided.

Heating degree day and cooling degree day variables were calculated on a daily basis. These variables were aggregated to each customer's billing month based on individual meter read dates.

2.3.6 Secondary Source Data

Data from three key secondary sources were incorporated into the analysis:

1. The *Edison 1993 Residential Lighting Study* provided metered lighting hours of use for 9 months of the year, for use in annualizing CFL logger usage results;
2. The *Edison 1994 Residential Appliance End-Use Study* provided end use load shapes for use in developing peak period kW savings estimates; and
3. The *Edison/SDG&E Compact Fluorescent Lighting 1994 First Year Statewide Load Impact Study* provided average per-bulb wattage reduction estimates, based on an analysis of Edison bounce-back cards, for use in the CFL savings analysis.

2.4 ANALYSIS APPROACH

Two different analysis approaches were used to estimate first year gross measure savings. A calibrated engineering method was used to develop savings estimates for the CFL subprogram, and a billing analysis method was used to determine savings for the evaporative cooler and weatherization subprograms. A self report analysis was used to determine free ridership and spillover rates for use in calculating net program savings. The analysis approaches are discussed next.

2.4.1 Engineering Analysis - CFLs

For the engineering analysis, gross first year measure savings are a function of measure retention and measure performance. These two analysis steps are described below.

Measure Retention

For the CFLs, surveyors noted how many program lamps were still in place. Reasons for removals were tabulated. For removed lamps, customers were interviewed to determine how many months elapsed before the CFL was removed in order to develop prorated savings estimates for removed lamps.

As part of the retention analysis, an estimate of the average CFL useful life was developed. If one assumes most lamp removals (for aesthetic reasons) and malfunctions occur during the first year, an estimate of the useful life can be estimated as follows:

$$UseLife = \frac{\left[N_{CFL} \times (REM + BROK) \times \frac{M}{12}\right] + \sum_{t=1}^{TL} N_{CFL} \times (1 - REM) \times (1 - BROK)^t}{N_{CFL}}$$

where:

$UseLife$	=	Effective useful life in years
TL	=	Technical life in years (= rated life in hours / hours of use per year)
N_{CFL}	=	Number of program CFLs provided
REM	=	Fraction initially removed
$BROK$	=	Fraction of CFLs broken annually
M	=	Number of months before CFLs were removed or broken

The numerator of the above equation determines the total amount of lamp-years. It is disaggregated into two components, lamp years for CFLs removed during the first year and lamp years for the remaining CFLs. Dividing the total number of lamp-years by the total number of lamps provides the estimate of the effective useful life, in years.

First Year Savings Analysis

Once the lighting logger data have been collected, the analysis is conducted in three steps. First, logger data is analyzed to develop average daily operating hours. Second, energy savings estimates are calculated. Third, sample results are generalized to the participant population.

To develop hours of use estimates, customers were asked to estimate average daily hours of use for each CFL. Logger data were collected for a sample of lamps. Logger data were then used to adjust the self report data using a ratio approach. The adjustments were made by major room type.

Energy savings for each bulb were estimated using the following basic equation:

$$kWh_{Saved} = [Watts_{SavedPerLamp}] \times [\text{Hours of Operation Per Day}] \times [365 \text{ Days per Year}] \times [\text{Seasonal Adjustment Factor}] \times [1 \text{ kWh} \div 1{,}000 \text{ Watts}].$$

Based on the *SCE/SDG&E Compact Fluorescent Lighting 1994 First Year Statewide Load Impact,* a value of 58 watts saved per lamp was utilized for the study. The seasonal adjustment factor of 0.87 was applied to develop annual savings based on the operating hours data that was collected in the November-January period. To develop this factor, average daily hours of use estimates for the November-January period were compared against average daily hours of use for an annual period. This analysis used monthly logged lighting data from the *SCE 1993 Residential Lighting Study.* Table 2-6 summarizes the calculation of the seasonal factor.

Table 2-6
CFL Usage - Annualization Factor

Month	Hours of Use Per Day Metered	Hours of Use Per Day Extrapolated	Days per Month	Hours of Use Per Month
January	3.5	3.5	31	108.5
February	3.5	3.5	28	98.0
March	3.3	3.3	31	102.3
April	2.7	2.7	30	81.0
May	2.3	2.3	31	71.3
June	2.3	2.3	30	69.0
July	2.2	2.2	31	68.2
August	2.2	2.2	31	68.2
September	*no data*	*2.7*	30	81.0
October	*no data*	*3.3*	31	102.3
November	*no data*	*3.5*	30	105.0
December	2.9	2.9	31	89.9
Annual			365	1044.7
Average Daily Hours - Annual				2.86
Average Daily Hours - November-January				3.30
Annualization Factor = 2.86 ÷ 3.30 =				0.87

Once per-bulb savings estimates were established, customer-level savings were calculated by summing over all program bulbs installed at the home. For bulbs that had been removed, the savings reflect the fraction of the year that the bulbs were in place. The following equation shows how savings were aggregated to the customer level:

$$kWh_{Customer} = \sum_{b,InPlace} kWh_{b,InPlace} + \sum_{b,Removed} \frac{Months_{b,Removed}}{12} \times \overline{kWh}_{b,InPlace}$$

Peak coincident factors (summer and winter) were developed using the hours of operation data from the TOU (time-of-use) lighting loggers. These factors were used to estimate demand savings using the following equation:

$$kW_{Reduced} = [Watts_{SavedPerLamp}] \times [\text{Peak Coincident Factor}] \times [1\ kW \div 1{,}000\ Watts].$$

Because data were collected during the winter months, an adjustment factor was required to develop a summer peak coincidence factor. By comparing 3 p.m. weekday usage estimates for typical summer and winter weekdays from the *Edison 1993 Residential Lighting Study*, an adjustment factor of 0.71 was developed for the summer peak. No adjustment was necessary for the winter peak.

Once kWh and kW savings were estimated on a per-customer basis, they were generalized to the participant population using the sample expansion weights.

2.4.2 Billing Analysis - Evaporative Coolers and Weatherization

A billing analysis approach was used to estimate evaporative cooler and weatherization measure savings. This methodology used multivariate regression models to estimate household energy use in terms of program participation, while controlling for changes in weather, household characteristics, and other market/demographic conditions.

The analysis was implemented using monthly data (in a pooled time series/cross-sectional model). The general form of the monthly model is:

$$kWh_{it} = \mu_i + \tau_t + \beta_1(AC \times SQFT \times CDD)_{it} + \beta_2(PART \times AC \times SQFT \times CDD)_{it} + \beta_3(EH \times SQFT \times CDD)_{it} + \beta_4(PART \times EH \times SQFT \times CDD)_{it} + \sum_{j=5}^{n} \beta_j X_{itj} + \varepsilon_{it}$$

where:

kWh_{it}	=	Average daily electric use for customer i in time period t
$PART$	=	Program participation for customer i in time period t, zero prior to implementation
AC	=	Presence of air conditioning for customer i
EH	=	Presence of electric heat for customer i
$SQFT$	=	Home square footage customer i
CDD	=	Cooling degree days customer i in time period t
HDD	=	Heating degree days for customer i in time period t
X_{itj}	=	Other explanatory variables that could affect energy use
μ_i	=	Dummy variable, 1 for customer i, 0 otherwise
τ_t	=	Dummy variable, 1 for time period t, 0 otherwise
β's	=	Estimated parameters
ε_{it}	=	Error term

The parameters of interest in the above equation are β_2 and β_4 the coefficients reflecting impacts of program participation and installing measures. For the analysis, multiple *PART* variables can be included to develop realization rates by different measure groups. The program savings

variables can be interacted with other customer attributes (such as housing type, type of air conditioner, or the presence of elderly occupants) to develop savings estimates that vary by key customer group. For the evaporative cooler model only the set of savings variables relating to space cooling would be relevant (the *PART×EH×SQFT×HDD* term would be dropped).

Using the parameters from the equation, weather normalized savings are calculated as:

$$Savings = (\beta_2 \times AC \times SQFT \times CDD_N) + (\beta_4 \times EH \times SQFT \times HDD_N)$$

Where CDD_N and HDD_N are average cooling and heating degree days per year.

The customer-specific level variables, μ_i, and the time-specific level variables, τ_t, are included to control for "fixed-effects," the stable but unmeasured characteristics of each customer and time period. The fitting of these two sets of fixed effects eliminates two important potential sources of intercorrelation among the model residuals. The customer-specific variables adjust for each customer's base use facilitating the calibration to customer bills.

The X_{itj} variables can include nonprogram factors that affect energy consumption (such as family additions, major appliance purchases, additions of cooling capacity, nonprogram conservation, etc.), and customer classification variables (housing type, weather zone, etc.). In addition to the μ_i and τ_t, variables, these variables help control for nonprogram factors that can obscure the estimates of program savings. The X_{itj} variables were developed from the telephone survey data and the tracking system data.

Peak period kW savings estimates for the weatherization and evaporative cooler measures were developed using secondary source data from the *Edison 1994 Residential Appliance End-Use Study*. The relationships between annual usage and peak usage were developed and applied to the annual savings estimates.

Details of the evaporative cooler and weatherization models are presented next.

Evaporative Cooler Model

The evaporative cooler program is designed to lower customers' cooling loads by providing them with an alternative, lower energy using, cooling option. The evaporative cooler model identifies four categories of cooling use for the savings analysis (variable names for each category are provided in brackets):

- Room air conditioning [Room AC];
- Central air conditioning for customers who are *not* generally home during weekday daytime hours [Central AC*Not Home Weekdays];
- Central air conditioning for customers who are generally home during weekday daytime hours [Central AC*Home Weekdays]; and

- Customers who reported no working air conditioner prior to the program (79% of these customers, 23 customers overall, reported adding air conditioning at about the same time as they received program measures) [No Reported AC].

Air conditioning variables for these categories were interacted with cooling degree days [CDD] and home square footage [SQFT]. Cooling degree days utilized a 70 degree base. For each of the four categories, savings estimates were developed by interacting the cooling term with a post installation variable [Post] that equals zero prior to the measure installation date and one afterwards.

Other variables that are included in the model to account for nonprogram effects include:

- An electric heating dummy variable interacted with home square footage and heating degree days, 65 degree base [Electric Heat*HDD*SQFT];
- A dummy variable indicating additional conservation activities;
- Dummy variables indicating miscellaneous factors contributing to increased electric usage and decreased electric use;
- Variables quantifying additions and removals of non weather sensitive appliances, enumerated in kWh per day;
- Dummy variables indicating additions and removals of air conditioning equipment, interacted with cooling degree days and house square footage; and
- Dummy variables indicating additions and removals of electric heating equipment, interacted with heating degree days and house square footage.

The evaporative cooler model is presented in Table 2-7. All of the key explanatory variables had the appropriate sign and most variables are statistically significant at the 95% confidence level (t-statistics greater that 1.96). The model's R^2 of 0.773 indicates that 77% of the variation in energy use is explained. This result is consistent with other models of this type.

Of the base air conditioning usage variables, the central air conditioning usage variables have the highest parameter estimates, with customers who are home during weekdays having a slightly larger effect. Room air conditioning is next, followed by homes with no reported working air conditioning. (When the "added air conditioning" effect is taken into account, the parameter estimate for customers with no reported air conditioning falls in between the central air conditioning and room air conditioning estimates.) Based on this model, average base room air conditioning usage is estimated to be 813 kWh per year, and average base central air conditioning usage is estimated to be 1,882 kWh per year. These results seem reasonable for the warmer climate zones targeted by the program.

All four program savings variables (shaded in Table 2-7) are statistically significant, have the appropriate sign, and appear to be reasonable relative to each other. Impacts are highest for central air conditioning customers who are home on weekdays (parameter estimate of

-0.000494). The next highest impact is for customers who reported not having a working air conditioner prior to program participation (parameter estimate of -0.000443). This savings impact reflects the fact that most of these customers added air conditioning at about the same time they participated in the program. This group has increased their level of cooling services, but have done so in an energy efficient manner. Lower impacts are seen for central air conditioning customers who are not generally home during weekdays (parameter estimate of -0.000353) and room air conditioning customers (parameter estimate of -0.000227).

Other nonprogram variables appear to have reasonable parameter estimates. The miscellaneous-factors variables account for actions such as increased/decreased use of pool pumps, water leaks combined with electric water heating, and more/less time spent at home. The parameter estimates for the appliance additions and removals variables reflect the fraction of the engineering-based change estimate that is reflected in customer bills. The parameter estimates (0.53 and -0.77) are in a reasonable range.

Table 2-7
Evaporative Cooler Model
Dependent Variable - Monthly kWh/day

Parameter	Estimate	t-statistic
Room AC*CDD*SQFT*Post	-0.000227	-4.28
Central AC*Not Home Weekdays*CDD*SQFT*Post	-0.000353	-4.34
Central AC*Home Weekdays *CDD*SQFT*Post	-0.000494	-15.30
No Reported AC*CDD*SQFT*Post	-0.000443	-4.13
Room AC*CDD*SQFT	0.000762	16.32
Central AC*Not Home Weekdays *CDD *SQFT	0.001150	16.82
Central AC*Home Weekdays *CDD*SQFT	0.001252	42.23
No Reported AC*CDD*SQFT	0.000654	9.55
Electric Heat*HDD*SQFT	0.000203	7.83
Other Conservation Activities	-0.032884	-0.10
Miscellaneous factors increasing use	1.413286	2.61
Miscellaneous factors decreasing use	-1.378177	-3.17
Appliance Additions kWh/day	0.531668	3.34
Appliance Removals kWh/day	-0.768729	-3.92
Added AC*CDD*SQFT	0.000391	4.67
Removed AC*CDD*SQFT	-0.000248	-1.52
Added Electric Heat*HDD*SQFT	0.000180	1.96
Removed Electric Heat*HDD*SQFT	-0.000018	-0.15
Customer Fixed Effects		F=79.1
January 1994 Dummy	2.265887	3.32
February 1994 Dummy	2.035826	2.94
March 1994 Dummy	1.001795	1.50
April 1994 Dummy	0.200545	0.30
May 1994 Dummy	-0.237766	-0.36
June 1994 Dummy	-0.312909	-0.47
July 1994 Dummy	1.358243	1.89
August 1994 Dummy	1.325190	1.78
September 1994 Dummy	0.632565	0.89
October 1994 Dummy	-0.829653	-1.24
November 1994 Dummy	0.510324	0.77
December 1994 Dummy	2.471543	3.67
January 1995 Dummy	2.822174	4.20
February 1995 Dummy	1.062959	1.59
March 1995 Dummy	0.518545	0.78
April 1995 Dummy	0.080004	0.12
May 1995 Dummy	-0.239948	-0.36
June 1995 Dummy	-0.698064	-1.06
July 1995 Dummy	-0.652844	-0.95
August 1995 Dummy	-0.135331	-0.20
September 1995 Dummy	-0.329755	-0.46
October 1995 Dummy	0.170698	0.27
November 1995 Dummy	0.745628	1.13
December 1995 Dummy	1.754655	2.66
January 1996 Dummy	2.807411	4.32
February 1996 Dummy	1.704154	2.57
March 1996 Dummy	1.419023	2.14
April 1996 Dummy	0.490905	0.75
May 1996 Dummy	0.208855	0.33
June 1996 Dummy	-0.109341	-0.17
July 1996 Dummy	-0.501211	-0.76
August 1996 Dummy	1.877537	2.71
September 1996 Dummy	1.791771	2.64
Number of Customers	176	
Number of Observations	5832	
R^2	0.773	

Weatherization Model

The weatherization program targets three primary end uses: heating, cooling, and water heating. Installed heating and cooling measures include: weatherstripping, caulking, building shell repairs, insulation, and duct repairs. Water heating measures include pipe insulation and installation of low flow showerheads.

Two conditions must be present in a given home for electric savings to occur for a targeted end use: (1) the affected electric end use must be present, and (2) measures targeting that end use must be installed. The weatherization model determined savings estimates for each end uses by taking into account these two conditions. The model's program savings variables are defined as follows (variable names are in brackets):

1. Electric water heating savings: a dummy variable indicating the presence of electric water heating interacted with a dummy variable that equals zero prior to program participation and equals one after participation if water heating measures were installed [Electric DHW*Water Heating Measures];
2. Electric space heating savings: a dummy variable indicating the presence of electric space heating interacted with heating degree days, home square footage, and a dummy variable indicating the post installation presence of installed heating/cooling measures [Electric Heat*HDD*SQFT*Heat/Cool Measures]; and
3. Air conditioning savings: a dummy variable indicating the presence of air conditioning interacted with cooling degree days, home square footage, whether the home was a single family home, and a dummy variable indicating the post installation presence of installed heating/cooling measures [AC*CDD*SQFT*Single Family*Heat/Cool Measures].

Heating degree days are calculated using a 65 degree base, and cooling degree days are calculated using a 70 degree base. For air conditioning measures, a single family home dummy variable is used because the model could only identify cooling savings in single family homes. (Multifamily cooling savings are therefore estimated to be zero.)

Other variables that are included in the model to account for non program effects include:

- An air conditioning dummy variable interacted with home square footage and cooling degree days, [AC*CDD*SQFT];
- An electric heating dummy variable interacted with home square footage and heating degree days, [Electric Heat*HDD*SQFT];
- A dummy variable indicating miscellaneous factors contributing to increased electric usage;
- Variables quantifying additions and removals of non weather sensitive appliances, enumerated in kWh per day;
- A dummy variable indicating additions of electric heating equipment, interacted with heating degree days and house square footage; and

- A variable indicating the change in residents from 1994 to 1996.

The weatherization model is presented in Table 2-8. All of the key explanatory variables had the appropriate sign and most variables are statistically significant at the 95% confidence level (t-statistic greater that 1.96). The model's R^2 of 0.759 indicates that 76% of the variation in energy use is explained. This result is consistent with other models of this type.

All three program savings variables (shaded in Table 2-8) are statistically significant and have the appropriate sign. Water heating measures are estimated to save about one kWh/day. Air conditioning measures are estimated to save about 16% of base air conditioning use in single family homes, and electric heating measures are estimated to save about 36% of base heating use. These estimates appear reasonable given the extent of measure installations (including insulation and shell repairs) and the relatively low model estimates of base heating and cooling usage (509 kWh per year and 340 kWh per year, respectively).

Other nonprogram variables appear to have reasonable parameter estimates although the parameter estimates for the appliance additions and removal variables (0.17 and -0.32) indicate that the engineering estimates over estimated the impacts of these equipment changes, or the customer-reported installations of equipment did not correlate well with bill changes.

2.4.3 Coincident Peak Savings for Evaporative Coolers and Weatherization

Because the billing analysis methodology only determines energy savings, an alternative method is required to estimate coincident demand savings for evaporative coolers and weatherization. Based on the assumptions that measure savings are proportionate to affected end use usage, end use load research data can be used to estimate coincident demand savings. Using data from the *1994 Edison Residential Appliance End-Use Study*, coincident demand fractions were developed by dividing peak hour demand by annual energy use.

Based on 1995 Edison load data, the summer period peak occurred on August 30 at 3 p.m. and the winter peak occurred on October 2 at 3 p.m. (The summer period runs from the first Sunday in June through the first Sunday in October. For 1995 this period covered June 4 through October 1.)

Table 2-9 presents calculations used to develop the coincident demand fractions (demand fractions are highlighted). All usage data for the air conditioning and water heating end uses were from the End-Use Study. Average air conditioner fractions for the weatherization and evaporative cooler program were calculated using the shares of homes with each type unit, based on collected survey data.

Table 2-8
Weatherization Model
Dependent Variable - Monthly kWh/day

Parameter	Estimate	t-statistic
Electric DHW*Water Heating Measures	**-1.048481**	**-4.19**
Electric Heat*HDD*SQFT*Heat/Cool Measures	**-0.000142**	**-3.96**
AC*CDD*SQFT*Single Family*Heat/Cool Measures	**-0.000113**	**-2.46**
AC*CDD*SQFT	0.000710	29.27
Electric Heat*HDD*SQFT	0.000394	11.56
Miscellaneous factors increasing use	0.579825	1.31
Appliance Additions kWh/day	0.175574	0.98
Appliance Removals kWh/day	-0.319607	-1.48
Added Electric Heat*HDD*SQFT	0.000141	2.29
Change in Residents	2.416783	5.53
Customer Fixed Effects		F=90.7
January 1994 Dummy	4.123679	7.27
February 1994 Dummy	2.955758	5.07
March 1994 Dummy	1.896425	3.39
April 1994 Dummy	-0.613796	-1.13
May 1994 Dummy	-1.373242	-2.52
June 1994 Dummy	-0.997795	-1.91
July 1994 Dummy	0.544574	1.04
August 1994 Dummy	0.527589	1.02
September 1994 Dummy	0.949157	1.79
October 1994 Dummy	-0.656943	-1.26
November 1994 Dummy	-0.366919	-0.68
December 1994 Dummy	3.944818	6.49
January 1995 Dummy	4.278338	7.33
February 1995 Dummy	3.102038	5.62
March 1995 Dummy	1.459724	2.73
April 1995 Dummy	0.719031	1.35
May 1995 Dummy	0.090734	0.17
June 1995 Dummy	-0.033381	-0.06
July 1995 Dummy	0.663227	1.29
August 1995 Dummy	1.668245	3.34
September 1995 Dummy	1.278366	2.40
October 1995 Dummy	0.299412	0.59
November 1995 Dummy	0.165428	0.32
December 1995 Dummy	2.195563	4.07
January 1996 Dummy	4.709380	8.27
February 1996 Dummy	3.777164	6.48
March 1996 Dummy	3.017189	5.31
April 1996 Dummy	0.500243	0.93
May 1996 Dummy	0.038419	0.08
June 1996 Dummy	-0.119634	-0.23
July 1996 Dummy	1.066907	2.10
August 1996 Dummy	2.301435	4.52
September 1996 Dummy	1.726080	3.37
Number of Customers	195	
Number of Observations	6561	
R^2	0.759	

For space heating, load shape and annual usage data were not available. To estimate the winter demand fraction, the heater fan load shape was used to determine the fraction of load on at 3 p.m. (approximately 3%), and it was assumed that approximately 4% of the annual heating load occurs in October (based on a review on monthly heating degree days). Thus, the heating fraction equals [(0.03) × (0.04) ÷ 31] which equals 0.0000387.

Table 2-9
Calculation of Coincident Demand Fractions

	End Use				
Weatherization	Central AC	Room Ac	Overall AC	Water Heating	Space Heating
Air Conditioner Share	0.54	0.46			
Annual kWh	1752	420		1800	
Summer Peak kW - 3 p.m.	2.58	1.12		0.14	
Summer Peak kw ÷ Annual kWh	0.0014726	0.0026667	0.0020219	0.0000778	0
Winter Weekday kW - 6 p.m.	0.05	0.01		0.19	
Winter Peak kW ÷ Annual kWh	0.0000285	0.0000238	0.0000264	0.0001056	0.0000387
Evaporative Coolers					
Air Conditioner Share	0.67	0.33			
Annual kWh	1752	420			
Summer Peak kW - 3 p.m.	2.58	1.12			
Summer Peak kw ÷ Annual kWh	0.0014726	0.0026667	0.0018666		
Winter Weekday kW - 6 p.m.	0.05	0.01			
Winter Peak kW ÷ Annual kWh	0.0000285	0.0000238	0.0000270		

2.4.4 Net Program Savings

General experience with low income programs has shown that free ridership and spillover effects tend to be small. This study utilizes field observation and self report data to determine the extent of free ridership and spillover. The free ridership and spillover factors were combined into a net-to-gross ratio that was applied to gross measure savings to determine net program savings.

Free Ridership

Each survey included questions for quantifying free ridership. In order to minimize casual "yes" answers to free ridership, we used a sequence of questions that isolate the various elements of the purchase decision. Generally, to qualify as a free rider, respondents need to report that:

- They were aware of the measures prior to receiving notice of the program;
- They knew where to purchase such products prior to hearing of the program;
- They actually planned to buy the products; and
- They were willing to pay market price for the product.

Spillover

For spillover, we determined what additional measures were installed by each participant since their participation in the program and whether the program contributed to their purchase of these measures. In general, a customer would have spillover affects if the customer was not aware of the measure before participating in the program and had purchased additional measures after participation.

Net-to-Gross Ratio

The net-to-gross ratio combines the affects of free ridership and spillover, as follows:

$$\text{Net-to-Gross Ratio} = (1 - FR) \times (1 + SP)$$

where:

FR = Free ridership rate
SP = Spillover rate

3 EVALUATION RESULTS

3.1 OVERVIEW

This section presents results of the 1995 Residential Direct Assistance Program Evaluation. Topics covered include gross savings estimates, net savings estimates, precision of savings estimates, measure life and lifetime impacts, comparison to program planning estimates, and customer satisfaction results. Subprograms are discussed in the following order:

- Compact Fluorescent Lighting;
- Evaporative Coolers; and
- Weatherization.

3.2 COMPACT FLUORESCENT LIGHTING

The CFL subprogram comprises the largest component of the 1995 Residential Direct Assistance Program. Evaluation savings for CFLs are based on a calibrated engineering analysis that reflects the number of program bulbs installed and the hours of use for the bulbs.

3.2.1 Gross Measure Savings

The various components of gross measure savings are presented next, followed by a tabulation of gross savings results.

CFL Installations and Removals

Table 3-1 presents the average number of program bulbs initially installed and currently in place for the 150 continuing participants included in the study. Initial installations based on Edison tracking data and on customer reported data are presented (for participating customers who were still at the same residence). As the table indicates, customer-reported installations are approximately 90% of tracking-based installations. On average, 3.04 of the program installed bulbs are currently in place.

Table 3-1
Initial CFL Installations and Current CFLs in Place for Continuing Participants

	Average Number of Bulbs	% of Tracking	% of Customer Reported
CFLs installed per home - tracking system	4.99		
CFLs installed per home - customer report	4.50	90%	
Current number of program CFLs in place	3.04	61%	68%

Table 3-2 presents continuing customer-reported reasons for removing program CFLs. In addition, the table shows the average number of months the CFLs were in place before removal.

Table 3-2
CFL Removals - Reasons and Months before Removal - Continuing Participants

Removal Reason	Number of Removals	% of All Removals	Average Months before Removal
Burned out	69	31.2%	7.2
Broken	45	20.4%	5.2
Not bright enough	26	11.8%	2.4
Did not like bulb's appearance	3	1.4%	2.0
Did not fit properly in fixture	21	9.5%	1.8
Delay in coming on	2	0.9%	6.5
Stolen	12	5.4%	7.3
Other	43	19.5%	7.0
All Reasons	221	100%	5.6

For new customers who moved into treated homes, about 50% of the program CFLs (an average of 2.5 bulbs) were in place at the time they moved in. On average, these customers have subsequently removed about 16% of the remaining bulbs (an average of 0.4 bulbs). Thus, an average of 2.1 program CFLs were still in place at "mover" homes. Most of the CFLs (72%) were removed by subsequent tenants because they were burned out or broken.

Hours of Use

CFL usage data for the study came from 2 sources, customer self report data and lighting logger data. Tables 3-3 presents a summary of CFLs studied, broken out by continuing participants and new occupants. Overall 140 continuing participants still had program CFLs in place, and 33 new occupant homes had program CFLs in place.

Table 3-3
Summary of Program and Logged CFLs in the Study

	Continuing Participants		New Occupants		
	# of CFLs	% of Total	# of CFLs	% of Total	Total
Program CFLs	455	81%	109	19%	564
Logged CFLs	205	82%	44	18%	249
% Logged	45%		40%		44%

The initial step in analyzing light usage was to examine differences in usage between homes with continuing participants and participating homes occupied by new customers. Table 3-4 presents average CFL usage for both sets of homes, based on both self-report and logged usage. While the results are inconsistent, the difference in each case is not statistically significant, based on a t-test. The remainder of the usage analysis focuses on the continuing customers.

Table 3-4
Comparison of CFL Usage Hours for Continuing Participants and New Occupants

Customer Group	Self Reported Average Daily Hours of Use*	Logged Average Daily Hours of Use*
Continuing participants	3.8	3.5
New occupants of participant homes	4.2	2.9
t-statistic for the difference	-1.14	0.94

*Difference in hours of use is not statistically significant

Table 3-5 presents a comparison of average daily lighting usage for weekdays and weekends, based on self-report and logged data. As the table indicates differences are minimal. The remainder of the analysis does not distinguish between weekday and weekend use.

Table 3-5
Comparison of Weekday and Weekend Hours of Use

Day Type	Self Reported Average Daily Hours of Use	Logged Average Daily Hours of Use
Weekday	3.83	3.47
Weekend	3.77	3.45
Combined	3.82	3.46

Table 3-6 presents the distribution of program CFL average hours of use by key location. The most popular installation areas include kitchens, bedrooms, and bathrooms. The highest usage areas include outdoor areas and dining areas. Both self report and logged usage data is presented. Overall, 44% of all surveyed program fixtures were effectively logged, and logged usage averaged about 85% of self report usage. A comparison of self report to logged usage, by location, is presented in Figure 3-1. The largest discrepancy between self report and logged results occurred in the dining rooms and bedrooms.

Table 3-6
CFL Fixture Distribution and Hours of Lighting Use

Location	Distribution of Fixtures	Self Report Daily Hours of Use - All Fixtures	Percent of Fixtures Logged	Self Report Daily Hours of Use - Logged Fixtures	Logged Daily Hours of Use	Ratio: Logged to Self Report
Kitchen	16%	3.9	59%	4.4	3.7	0.84
Dining Room	10%	5.0	57%	5.2	3.9	0.75
Living Room	12%	4.0	53%	4.6	3.9	0.85
Bedroom	21%	2.9	33%	3.2	2.2	0.68
Bathroom	16%	3.4	39%	3.6	3.6	1.00
Hall/Stairs	9%	3.1	51%	3.1	3.3	1.06
Outdoors	7%	6.5	21%	7.3	6.9	0.95
Other	9%	3.6	33%	3.1	2.5	0.82
All	100%	3.8	45%	4.1	3.5	0.85

Figure 3-1
Comparison of Self Report and Logged Lighting Use

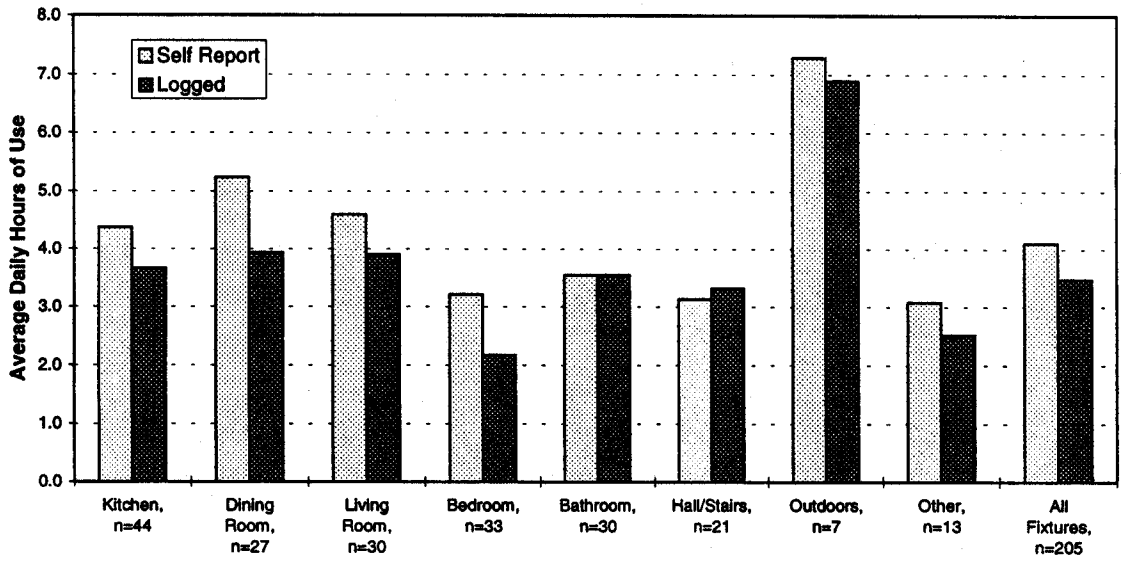
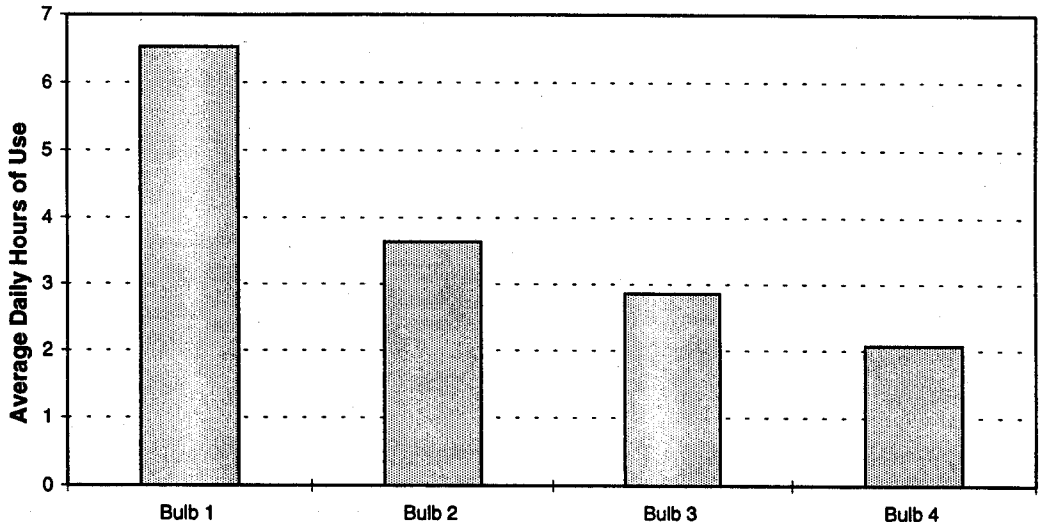


Figure 3-2 demonstrates how lighting usage hours decline as additional bulbs are considered in each home. For 60 continuing participants who had at least four bulbs installed at the time of the study, average usage data were tabulated for the most used bulb (Bulb 1) to the fourth most used bulb (Bulb 4). As the figure indicates the most used bulbs average about 6.5 hours of use per day while the fourth most used bulbs average just over 2 hours of use per day.

Figure 3-2
Lighting Usage Hours Averaged by Frequency of Bulb Use



Energy Savings

Program energy savings are estimated by combining hourly usage estimates with installed bulb estimates and an annualization factor of 0.87 (as discussed in Section 2). Average savings are presented in Table 3-7. Savings are presented for bulbs that are still in place and bulbs that were removed during the first year.

Table 3-7
CFL Program - Average First Year Savings per Customer

	kWh per Year
Savings from Installed CFLs	182.0
Partial Savings for Removed CFLs	40.7
Total	**222.7**

Savings by CEC weather zone are presented in Table 3-8. Variations in savings are due both to numbers of CFLs in place and differences in lighting usage.

Table 3-8
CFL Savings by CEC Weather Zone

	Average kWh per Year	
CEC Weather Zone	Per Home	Per Lamp
6	246	63.8
8	277	67.8
9	179	54.9
10	166	51.5
13	207	49.2
14	236	59.2
All Zones	**223**	**59.7**

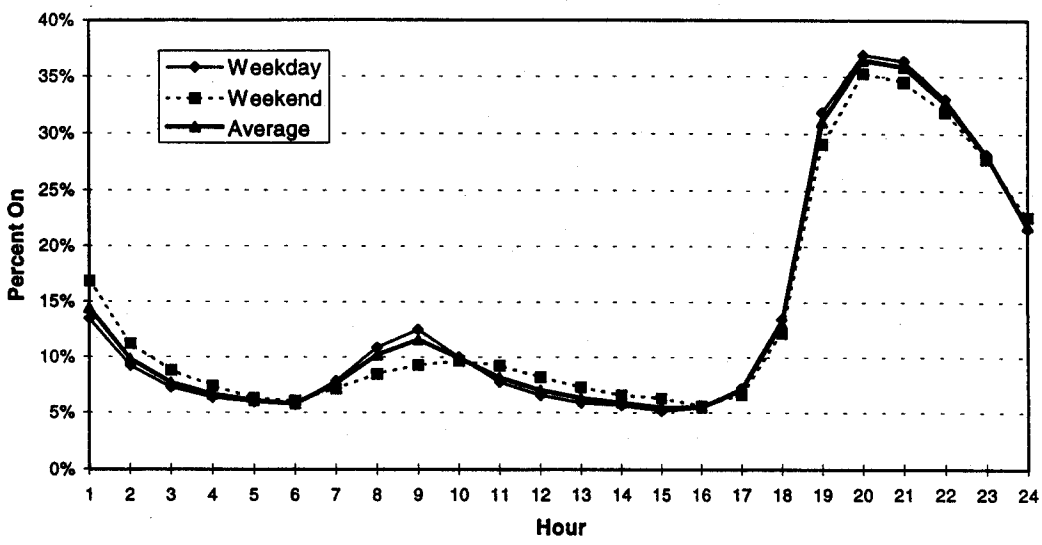
Coincident Demand Savings

Using data for the time-of-use lighting loggers, lighting coincidence factors were developed for use in calculating coincident demand savings. Figure 3-3 presents the lighting load shape developed using the logger data. As the figure shows, approximately 5% of the lights are on at 3 p.m., the hour of the summer and winter coincident peak. Table 3-9 presents coincidence factors and coincident demand savings that were developed using the lighting load shape. (The summer coincident factor was adjusted downward to reflect seasonality of use as discussed in Section 2.)

Table 3-9
CFL - Average Coincident Demand Savings per Customer

Period	Coincident Factor	Per Customer Impact (Watts)
Summer	0.036	6.4
Winter	0.051	9.0

Figure 3-3
Lighting Load Shape Based on Time-of-Use Logger Data



Program Level Savings

By combining average savings with the number program participants (from the tracking system), an estimate of total gross program savings is provided. These results are presented in Table 3-10.

Table 3-10
CFL Program - Estimated Program Level Gross Measure Savings

	Annual Savings (kWh)	Summer Coincident Demand Savings (kW)	Winter Coincident Demand Savings (kW)
Savings per Customer	222.7	0.0064	0.0090
Number of Customers	41,127	41,127	41,127
Total Gross Program Savings	9,158,983	263	370

3.2.2 Net Program Savings

Net savings incorporate the effects of free ridership and spillover. For this study, free riders and spillover customers were defined as follows:

Free riders were defined as participants who were aware of CFLs prior to participation, knew where they could buy CFLs, were planning to purchase CFLs, and were willing to pay the full market price for the CFLs (a minimum price of $7 per bulb was set).

Spillover customers were defined as participants who were not aware of CFLs prior to participation but had purchased additional CFLs after participating in the program.

Of the 150 continuing participants analyzed in this study no one qualified as either a free rider or a spillover customer. Table 3-11 summarizes gross and net CFL program savings. Overall, the program saved 9.2 million kWh in the first year.

Table 3-11
Summary of First-Year Gross and Net CFL Program Savings

	Gross Program Savings	Net-to-Gross Ratio	Net Program Savings	Net Savings Per Customer
Annual Savings -kWh	9,158,983	1.0	9,158,983	222.7
Summer Coincident Savings - kW	263	1.0	263	0.0064
Winter Coincident Savings - kW	370	1.0	370	0.0090

3.2.3 Precision

The relative precision for the CFL program is 6% after accounting for the expansion of customer savings to the population. Confidence intervals for the savings estimates are presented in Table 3-12.

Table 3-12
Precision of CFL Net Impact Estimates

	Estimate	Standard Error	Confidence Intervals	
			90 Percent	80 Percent
Annual Savings -kWh				
Net Savings Per Customer	223	13	201 - 245	206 - 240
Net Program Savings	9,158,983	549,539	8,254,991 - 10,062,975	8,455,573 - 9,862,393
Summer Coincident Savings - kW				
Net Savings Per Customer	0.0064	0.0004	0.0058 - 0.0070	0.0059 - 0.0069
Net Program Savings	263	16	237 - 289	243 - 283
Winter Coincident Savings - kW				
Net Savings Per Customer	0.0090	0.0005	0.0081 - 0.0099	0.0083 - 0.0097
Net Program Savings	370	22	333 - 407	342 - 398

3.2.4 Measure Life and Lifetime Impacts

Based on the average daily usage of 3 hours, an estimated technical life for a CFL of 10,000 hours, and CFL removal and breakage rates developed from the survey data, the useful life of a program CFL is estimated to average 5 years. The useful life calculation is presented in Table 3-13. This calculation utilizes the equation presented in Section 2.4. To calculate the useful life of the CFLs, total lamp years are first calculated and then are divided by lamps.

Table 3-13
CFL Useful Life Calculation

Component	Formula	Numbers	Result
Lamp years for 1st year removals	$N_{CFL} \times (REM+BROK) \times M/12$	$4.5 \times (0.256+0.064) \times 5.6/12$	0.7
Lamp years for remaining lamps	$\sum_{t=1}^{TL} N_{CFL} \times (1-REM) \times (1-BROK)^t$	$\sum_{t=1}^{9} 4.5 \times (0.744) \times (0.936)^t$	22.0
Total lamp years	1 year removals + remaining lamps	0.7 + 22.0	22.7
Lamps	Installed program lamps		4.5
Useful Life	Lamp-years / lamps	22.7 / 4.5	5.0

Formula Key:

TL	=	Technical life in years (= rated life in hours / hours of use per year)
N_{CFL}	=	Number of program CFLs provided
REM	=	Fraction initially removed
$BROK$	=	Fraction of CFLs broken annually
M	=	Number of months before CFLs were removed or broken

Lifetime savings estimates, based on the 5 year useful life, are presented in Table 3-14. First year savings and ensuing year savings differ because the first year impacts include partial savings from removed lamps.

Table 3-14
Lifetime CFL Program Savings

	Program Savings	Savings Per Customer
First Year Savings -kWh	9,158,983	223
Savings per Ensuing Year - kWh	7,485,114	182
Number of Ensuing Years	4	4
Total Ensuing Year Savings	29,940,456	728
Lifetime Savings - kWh	**39,099,439**	**951**

3.2.5 Comparison to Program Estimates

Table 3-15 compares evaluation results for net first-year savings to Edison savings claims. Evaluation annual energy savings are estimated to be 69% of the Edison savings claim. The 0.69 realization rate is the result of two factors: measure retention and hourly lighting usage. Survey results show that about 75% of the tracking system lights were effectively in place for the first year (after factoring in lights that were removed during the year). In addition, annualized lighting usage for the evaluation was estimated to be 3 hours per day, which is only 90% of the estimates used in the program calculations.

The differences in program coincident and evaluation peak kW savings estimates can be attributed to measure retention and coincidence factor assumptions. Based on 1995 data, both the summer and winter peaks occurred at 3 p.m. on a weekday. The evaluation CFL load shape (and subsequent adjustment for seasonal use) provided a summer coincident factor of 0.036 and a winter factor of 0.051. The coincidence factors implied by the Edison savings data are 0.087 for

the summer and 0.364 for the winter. It is clear from the CFL load shape presented in Figure 3-3, that a shift in the peak hour assumption of several hours can have a dramatic effect on the peak savings calculations.

Table 3-15
CFL Results - Comparison to Program Savings Claims

	Evaluation Net Program Savings	Edison Program Savings Claim	Realization Rate
Annual Savings -kWh	9,158,983	13,226,259	0.69
Summer Coincident Savings - kW	263	965	0.27
Winter Coincident Savings - kW	372	4,012	0.09

3.2.6 Customer Satisfaction

Two survey questions address customer satisfaction with the installed CFLs. Table 3-16 shows the percent of customers who believe the CFLs have helped lower their electric bill. Table 3-17 shows the general level of customer satisfaction with the program CFLs. Results are tabulated by participants who continue to live in their treated homes and new occupants in participating homes.

Table 3-16
Have the CFLs helped lower your electric bill?

	Continuing Participants	New Occupants at Participating Homes
Yes	66%	60%
No	29%	20%
Don't know	5%	20%
	100%	100%

Table 3-17
General Satisfaction with CFLs supplied by Edison

	Continuing Participants	New Occupants at Participating Homes
Very Satisfied	63%	54%
Somewhat Satisfied	31%	18%
Somewhat Dissatisfied	4%	4%
Very Dissatisfied	2%	0%
Don't Know / NA	1%	24%
	100%	100%

3.3 EVAPORATIVE COOLERS

Program evaporative coolers were installed in participant homes to help reduce existing air conditioning energy usage by providing a more energy efficient cooling alternative. Key factors that contribute to evaporative cooler savings impacts include weather, type of existing air conditioning system, and customers' usage of their air conditioning system. These factors have all been incorporated into the evaporative cooler billing analysis model discussed in Section 2.

3.3.1 Gross Measure Savings

Average First Year Savings

Average evaporative cooler savings per customer are presented in Table 3-18. This table presents savings by existing air conditioner system type and an average for all participants. The relatively high savings level for customers with no reported working air conditioner results because 79% of these customers installed air conditioning at about the time of the evaporative cooler installation. Their savings is relative to their post-retrofit cooling usage assuming they had they not installed the evaporative cooler.

Table 3-18
Evaporative Cooler Program - Average First Year Savings per Customer

Existing AC System Type	kWh per Year
Central Air Conditioning	727
Room Air Conditioning	243
No Working AC Reported	432
Average over All Participants	**572**

Table 3-19 reports cooler savings by CEC weather zone. Savings impact variations reflect differences in the type of cooling systems in the various regions and severity of weather as reflected in cooling degree days.

Table 3-19
Evaporative Cooler Savings by CEC Weather Zone

	kWh per Year			
CEC Weather Zone	Central AC	Room AC	No Working AC	All Systems
9	291	118	225	180
10	407	198	385	351
13	591	285	598	591
14	618	298	558	579
15	1,746	750	1,457	1,552
All Participants	**727**	**243**	**432**	**572**

Coincident Demand Savings

Using data from the *1994 Edison Residential Appliance End-Use Study*, coincident demand fractions were developed by dividing peak hour air conditioner demand by annual air conditioner use. See Section 2 for a description of these fractions. Coincident demand fractions and savings estimates are presented in Table 3-20.

Table 3-20
Evaporative Coolers - Average Coincident Demand Savings per Customer

Period	Annual Savings (kWh)	Coincident Demand Fraction	Per Customer Impact (Watts)
Summer	572	0.0018666	1,068
Winter	572	0.0000308	15

Program Level Savings

By multiplying average savings by the number program participants (from the tracking system), an estimate of total gross program savings is provided. These results are presented in Table 3-21.

Table 3-21
Evaporative Coolers - Estimated Program Level Gross Measure Savings

	Annual Savings (kWh)	Summer Coincident Demand Savings (kW)	Winter Coincident Demand Savings (kW)
Savings per Customer	572	1.068	.015
Number of Customers	1,977	1,977	1,977
Total Gross Program Savings	1,130,844	2,111	30

3.3.2 Net Program Savings

Net savings estimates incorporate the effects of free ridership and spillover. For this study, free riders and spillover customers were defined as follows:

> Free riders were defined as participants who were planning to purchase an evaporative cooler prior to participating in the program, and were willing to pay at least $150 for the cooler - a low-end estimate of a market price.
>
> Spillover customers were defined as participants who did not have an evaporative cooler and had not planned to purchase one prior to participation but had purchased an additional cooler after participating in the program.

Estimated free ridership and spillover rates are presented in Table 3-22 along with the estimated net-to-gross ratio.

Table 3-22
Evaporative Coolers - Free Ridership, Spillover, and Combined Net-to-Gross Ratio

Free Ridership Rate (FR)	0.015
Spillover Rate (SP)	0.025
Net-to-Gross Ratio (1-FR)*(1+SP)	1.010

Table 3-23 summarizes gross and net Evaporative Cooler program savings. Overall, the program saved 1.1 million kWh in the first year.

Table 3-23
First-Year Net Evaporative Cooler Program Savings

	Gross Program Savings	Net-to-Gross Ratio	Net Program Savings	Net Savings Per Customer
Annual Savings -kWh	1,130,844	1.010	1,142,152	578
Summer Coin. Savings - kW	2,111	1.010	2,132	1.079
Winter Coin. Savings - kW	30	1.010	30	0.015

3.3.3 Precision

The relative precision for the evaporative cooler program is 15%, based on results of the regression equation in Section 2 and taking into account the variance of the net-to-gross adjustment. Confidence intervals for the savings estimates are presented in Table 3-24.

Table 3-24
Precision of Evaporative Cooler Net Impact Estimates

	Estimate	Standard Error	Confidence Intervals	
			90 Percent	80 Percent
Annual Savings -kWh				
Net Savings Per Customer	578	87	435 - 721	467 - 689
Net Program Savings	1,142,152	171,323	860,326 - 1,423,978	922,859 - 1,361,445
Summer Coincident Savings - kW		0		
Net Savings Per Customer	1.079	0.162	0.813 - 1.345	0.872 - 1.286
Net Program Savings	2,132	320	1,606 - 2,658	1,723 - 2,541
Winter Coincident Savings - kW		0		
Net Savings Per Customer	0.015	0.002	0.011 - 0.019	0.012 - 0.018
Net Program Savings	30	5	23 - 37	24 - 36

3.3.4 Measure Life and Lifetime Impacts

Based on measure lives reported in the M&E Protocols, the average measure life for an evaporative cooler is 15 years. Table 3-25 presents estimated lifetime impacts for the evaporative cooler program.

Table 3-25
Lifetime Evaporative Cooler Program Savings

	Gross Program Savings	Gross Savings Per Customer	Net Program Savings	Net Savings Per Customer
Annual Savings -kWh	1,130,844	572	1,142,152	578
Measure Life - Years	15	15	15	15
Lifetime Savings - kWh	16,962,660	8,580	17,132,280	8,670

3.3.5 Comparison to Program Savings Claims

Table 3-26 compares evaluation results for net first-year savings to Edison savings claims. Evaluation annual energy savings are estimated to be 60% of the Edison savings claim. The 0.60 realization rate is similar to the results of the 1994 program evaluation which employed a similar evaluation methodology. Edison's estimates of evaporative cooler savings do not appear to be born out by changes in customer bills. The evaluation estimate of summer coincident savings is twice the Edison savings claim. The evaluation result utilizes the 1994 End-Use Study air conditioner profiles for the 1994 summer peak day. Usage for this day is over twice as high as for a typical summer day. It is possible that the evaluation result may overstate actual coincident savings because the installed evaporative coolers may not have the capacity to adequately service customers on the very hottest days. One these days, many customers may revert back to using their existing air conditioner to cool their home, thus limiting savings.

Table 3-26
Evaporative Cooler Results - Comparison to Program Savings Claims

	Evaluation Net Program Savings	Edison Program Savings Claim	Realization Rate
Annual Savings -kWh	1,142,152	1,911,557	0.60
Summer Coincident Savings - kW	2,132	1,075	1.98
Winter Coincident Savings - kW	30	98	0.31

3.3.6 Customer Satisfaction

Two questions from the telephone survey addressed customer satisfaction. Table 3-27 shows the percent of customers who believe the evaporative coolers have helped lower their electric bill. Tables 3-28 shows the general level of customer satisfaction with the program evaporative coolers. Most customers are very satisfied with the program and belief it has helped to lower their electric bill.

Table 3-27
Has the Evaporative Cooler helped lower your electric bill?

	% of Survey Participants
Yes	86%
No	14%
	100%

Table 3-28
General Satisfaction with the Evaporative Cooler supplied by Edison

	% of Survey Participants
Very Satisfied	87%
Somewhat Satisfied	12%
Somewhat Dissatisfied	1%
Very Dissatisfied	0%
Don't Know	0.5%
	100%

3.4 WEATHERIZATION

Measures installed as part of the weatherization program included weatherstripping, caulking, building shell repairs, insulation, duct repairs, pipe insulation and low flow showerheads. End uses affected included air conditioning, space heating, and water heating. The weatherization billing analysis utilized the interaction of installed measures and the presence of affected end uses to develop measure savings. This analysis is discussed in Section 2.

3.4.1 Gross Measure Savings

Average weatherization savings per customer are presented in Table 3-29. This table presents overall savings and savings by end use. The largest amount of savings is attributable to water heating, followed by space heating. The small air conditioning impact reflects the fact that savings for this end use were confined to single family homes with air conditioning, a group that represents a small fraction of the program population.

Table 3-29
Weatherization Program - Average First Year Savings per Customer

Savings Category	kWh per Year
Air Conditioning	12
Electric Heating	150
Electric Water Heating	230
All End Uses	**412**

Table 3-30 reports weatherization savings by CEC weather zone. Savings impacts reflect severity of weather and presence of key end uses.

Table 3-30
Weatherization Savings by CEC Weather Zone

CEC Weather Zone	Average kWh per Year
6	392
8	541
9	503
10	623
14	481
15	398
16	134
All Participants	**412**

Coincident Demand Savings

Using data from the *1994 Edison Residential Appliance End-Use Study*, coincident demand fractions were developed by dividing peak hour demand by annual energy use (see Section 2). Coincident demand fractions and savings estimates are presented in Table 3-31.

Table 3-31
Weatherization - Average Coincident Demand Savings per Customer

Period	End Use	Annual Savings (kWh)	Coincident Demand Fraction	Per Customer Impact (Watts)
Summer	Air Conditioning	12	0.0020219	24.3
	Water Heating	230	0.0000778	17.9
	Space Heating	150	0	0.0
	All End Uses			42.2
Winter	Air Conditioning	12	0.0000264	0.3
	Water Heating	230	0.0001056	24.3
	Space Heating	150	0.0000387	5.8
	All End Uses			30.4

Program Level Savings

By combining average savings with the number of program participants (from the tracking system), an estimate of total gross program savings is provided. These results are presented in Table 3-32.

Table 3-32
Weatherization - Estimated Program Level Gross Measure Savings

	Annual Savings (kWh)	Summer Coincident Demand Savings (kW)	Winter Coincident Demand Savings (kW)
Savings per Customer	412	0.0422	0.0304
Number of Customers	2,963	2,963	2,963
Total Gross Program Savings	1,220,756	125	90

3.4.2 Net Program Savings

Net savings estimates incorporate the effects of free ridership and spillover. For this study, free riders and spillover customers were defined as follows:

> Free riders were defined as participants who were aware of the energy saving benefits of weatherization measures, were planning to install such measures prior to participating in the program, and were willing to pay at least $25 for the measures - a low-end estimate of a market price for a reasonable effort self-installed weatherization.
>
> Spillover customers were defined as participants who were not aware of the energy saving benefits of weatherization measures and were not planning to install such measures prior to participating in the program but had undertaken additional energy saving home improvements after participating in the program.

Estimated free ridership and spillover rates are presented in Table 3-33 along with the estimated net-to-gross ratio.

Table 3-33
Weatherization - Free Ridership, Spillover, and Combined Net-to-Gross Ratio

Free Ridership Rate (FR)	0.018
Spillover Rate (SP)	0.029
Net-to-Gross Ratio (1-FR)*(1+SP)	1.010

Table 3-34 summarizes gross and net weatherization program savings. Overall, the program saved 0.9 million kWh in the first year.

Table 3-34
First-Year Net Weatherization Program Savings

	Gross Program Savings	Net-to-Gross Ratio	Net Program Savings	Net Savings Per Customer
Annual Savings -kWh	1,220,756	1.010	1,232,964	416
Summer Coincident Savings - kW	125	1.010	126	0.042
Winter Coincident Savings - kW	90	1.010	91	0.031

3.4.3 Precision

The relative precision for the weatherization program is 24%, based on results of the regression equation in Section 2 and taking into account the variance of the net-to-gross adjustment. Confidence intervals for the savings estimates are presented in Table 3-35.

Table 3-35
Precision of Weatherization Net Impact Estimates

	Estimate	Standard Error	Confidence Intervals	
			90 Percent	80 Percent
Annual Savings -kWh				
Net Savings Per Customer	416	100	252 - 580	288 - 544
Net Program Savings	1,232,964	295,911	746,190 - 1,719,738	854,197 - 1,611,731
Summer Coincident Savings - kW				
Net Savings Per Customer	0.042	0.010	0.026 - 0.059	0.029 - 0.056
Net Program Savings	126	30	76 - 176	87 - 165
Winter Coincident Savings - kW				
Net Savings Per Customer	0.031	0.007	0.019 - 0.043	0.021 - 0.041
Net Program Savings	91	22	55 - 127	63 - 119

3.4.4 Measure Life and Lifetime Impacts

Based on measure lives reported in the M&E Protocols and the types of measures installed, the average measure life for the weatherization program is approximately 10 years. Table 3-36 presents estimated lifetime impacts for the weatherization program.

Table 3-36
Lifetime Weatherization Program Savings

	Gross Program Savings	Gross Savings Per Customer	Net Program Savings	Net Savings Per Customer
Annual Savings -kWh	1,220,756	412	1,232,964	416
Measure Life - Years	10	10	10	10
Lifetime Savings - kWh	12,207,560	4,120	12,329,640	4,160

3.4.5 Comparison to Program Savings Claims

Table 3-37 compares evaluation results for net first-year savings to Edison savings claims. Evaluation annual energy savings are estimated to be 198% of the Edison savings claim. The ability to accurately predict savings for a weatherization program is difficult due the variety of installed measures and variation in pre-installation conditions at each home. The evaluation estimate, reflecting average savings of 412 kWh per home, does not seem unreasonable, given that most weatherized homes had both electric water heating and electric space heating. The

evaluation estimated modest coincident savings for the program while Edison claimed no coincident savings.

Table 3-37
Weatherization Results - Comparison to Program Savings Claims

	Evaluation Net Program Savings	Edison Program Savings Claim	Realization Rate
Annual Savings -kWh	1,232,964	623,890	1.98
Summer Coincident Savings - kW	126	0	-
Winter Coincident Savings - kW	91	0	-

3.4.6 Customer Satisfaction

Three survey questions addressed customer satisfaction. Table 3-38 shows the percent of customers who believe the weatherization measures have helped lower their electric bill. Table 3-39 shows the percent of customers who have noticed increased comfort after installation of the weatherization measures. Table 3-40 shows the general level of customer satisfaction with the program weatherization measures. Most customers stated they were generally satisfied with the measures. Less than half of the customers thought the measures lowered their bill, but over half noticed increased comfort with their weatherized homes.

Table 3-38
Have the weatherization measures helped lower your electric bill?

	% of Survey Participants
Yes	42%
No	58%
	100%

Table 3-39
Have you noticed increased comfort with the weatherization measure?

	Yes	No
Increased Comfort	61%	44%
Cooler in Summer	41%	60%
Warmer in Winter	56%	45%

Table 3-40
General Satisfaction with the weatherization measures supplied by Edison

	% of Survey Participants
Very Satisfied	59%
Somewhat Satisfied	30%
Somewhat Dissatisfied	3%
Very Dissatisfied	2%
Don't Know	6%
	100%

E

M&E PROTOCOLS - TABLES 6 & 7

M&E PROTOCOLS TABLE 6

Designated Unit of Measurement: LOAD IMPACTS PER CUSTOMER
ENDUSE: LIGHTING

1. Average Participant Group and Average Comaprison Group											
A. Pre-install usage:	Pre-install kW	na									
	Pre-install kWh	na									
	Pre-install Therms	na									
	Base kW	na									
	Base kWh	na									
	Base Therms	na									
	Base kW/ designated unit of measurement	na									
	Base kWh/ designated unit of measurement	na									
	Base Therms/ designated unit of measurement	na									
B. Impact year usage:	Impact Yr kW	na									
	Impact Yr kWh	na									
	Impact Yr Therms	na									
	Impact Yr kW/designated unit	na									
	Impact Yr kWh/designated unit	na									
	Impact Yr Therms/designated unit	na									
				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**
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	263	263	237	289	237	289	243	283	243	283
	A. ii. Load Impacts - kWh	9,158,983	9,158,983	8,254,991	10,062,975	8,254,991	10,062,975	8,455,573	9,862,393	8,455,573	9,862,393
	A. iii. Load Impacts - Therms	na	na	na	na	na	na	na	na	na	na
	B. i. Load Impacts/designated unit - kW	0.0064	0.0064	0.0058	0.0070	0.0058	0.0070	0.0059	0.0069	0.0059	0.0069
	B. ii. Load Impacts/designated unit - kWh	223	223	201	245	201	245	206	240	206	240
	B. iii. Load Impacts/designated unit - Therms	na	na	na	na	na	na	na	na	na	na
	C. i. a. % change in usage - Part Grp - kW	na	na	na	na	na	na	na	na	na	na
	C. i. b. % change in usage - Part Grp - kWh	na	na	na	na	na	na	na	na	na	na
	C. i. c. % change in usage - Part Grp - Therms	na	na	na	na	na	na	na	na	na	na
	C. ii. a. % change in usage - Comp Grp - kW	na	na	na	na	na	na	na	na	na	na
	C. ii. b. % change in usage - Comp Grp - kWh	na	na	na	na	na	na	na	na	na	na
	C. ii. c. % change in usage - Comp Grp - Therms	na	na	na	na	na	na	na	na	na	na
D. Realization Rate:	D.A. i. Load Impacts - kW, realization rate	0.27	0.27	0.24	0.30	0.24	0.30	0.25	0.29	0.25	0.29
	D.A. ii. Load Impacts - kWh, realization rate	0.69	0.69	0.62	0.76	0.62	0.76	0.64	0.74	0.64	0.74
	D.A. iii. Load Impacts - Therms, realization rate	na	na	na	na	na	na	na	na	na	na
	D.B. i. Load Impacts/designated unit - kW, real rate	0.27	0.27	0.24	0.30	0.24	0.30	0.25	0.29	0.25	0.29
	D.B. ii. Load Impacts/designated unit - kWh, real rate	0.69	0.69	0.62	0.76	0.62	0.76	0.64	0.74	0.64	0.74
	D.B. iii. Load Impacts/designated unit - Therms, real rate	na	na	na	na	na	na	na	na	na	na
3. Net-to-Gross Ratios		**RATIO**		**RATIO**	**RATIO**			**RATIO**	**RATIO**		
	A. i. Average Load Impacts - kW	1.00		1.00	1.00			1.00	1.00		
	A. ii. Average Load Impacts - kWh	1.00		1.00	1.00			1.00	1.00		
	A. iii. Average Load Impacts - Therms	na		na	na			na	na		
	B. i. Avg Load Impacts/designated unit of measurement - kW	1.00		1.00	1.00			1.00	1.00		
	B. ii. Avg Load Impacts/designated unit of measurement - kWh	1.00		1.00	1.00			1.00	1.00		
	B. iii. Avg Load Impacts/designated unit of measurement - Therms	na		na	na			na	na		
	C. i. Avg Load Impacts based on % chg in usage in Impact year relative to Base usege in Impact year - kW	na		na	na			na	na		
	C. ii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kWh	na		na	na			na	na		
	C. iii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - Thms	na		na	na			na	na		
4. Designated Unit Intermediate Data				**PART GRP**	**PART GRP**			**PART GRP**	**PART GRP**		
	A. Pre-install average value	1		na	na			na	na		
	B. Post-install average value	1		na	na			na	na		
6. Measure Count Data		**NUMBER**									
	A. Number of measures installed by participants in Part Group	749									
	B. Number of measures installed by all program participants in the 12 months of the program year	200,473									
	C. Number of measures installed by Comp Group	na									
7. Market Segment Data											
	A. Distribution of participants by CEC Climate Zone	See Page 4									

M&E PROTOCOLS TABLE 6 (Continued)

Designated Unit of Measurement: LOAD IMPACTS PER CUSTOMER
ENDUSE: EVAPORATIVE COOLERS

				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 Comeprison Group											
A. Pre-install usage:	Pre-install kW	na									
	Pre-install kWh	na									
	Pre-install Therms	na									
	Base kW	na									
	Base kWh	na									
	Base Therms	na									
	Base kW/ designated unit of measurement	na									
	Base kWh/ designated unit of measurement	na									
	Base Therms/ designated unit of measurement	na									
B. Impact year usage:	Impact Yr kW	na									
	Impact Yr kWh	na									
	Impact Yr Therms	na									
	Impact Yr kW/designated unit	na									
	Impact Yr kWh/designated unit	na									
	Impact Yr Therms/designated unit	na									
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	2,111	2,132	1,590	2,632	1,606	2,658	1,706	2,516	1,723	2,541
	A. ii. Load Impacts - kWh	1,130,844	1,142,152	851,808	1,409,880	860,326	1,423,978	913,722	1,347,966	922,859	1,361,445
	A. iii. Load Impacts - Therms	na	na	na	na	na	na	na	na	na	na
	B. i. Load Impacts/designated unit - kW	1.068	1.079	0.804	1.331	0.813	1.345	0.863	1.273	0.872	1.286
	B. ii. Load Impacts/designated unit - kWh	572	578	431	713	435	721	462	682	467	689
	B. iii. Load Impacts/designated unit - Therms	na	na	na	na	na	na	na	na	na	na
	C. i. a. % change in usage - Part Grp - kW	na	na	na	na	na	na	na	na	na	na
	C. i. b. % change in usage - Part Grp - kWh	na	na	na	na	na	na	na	na	na	na
	C. i. c. % change in usage - Part Grp - Therms	na	na	na	na	na	na	na	na	na	na
	C. ii. a. % change in usage - Comp Grp - kW	na	na	na	na	na	na	na	na	na	na
	C. ii. b. % change in usage - Comp Grp - kWh	na	na	na	na	na	na	na	na	na	na
	C. ii. c. % change in usage - Comp Grp - Therms	na	na	na	na	na	na	na	na	na	na
D. Realization Rate:	D.A. i. Load Impacts - kW, realization rate	1.96	1.98	1.48	2.44	1.49	2.47	1.58	2.34	1.60	2.36
	D.A. ii. Load Impacts - kWh, realization rate	0.59	0.60	0.45	0.74	0.45	0.75	0.48	0.71	0.48	0.72
	D.A. iii. Load Impacts - Therms, realization rate	na	na	na	na	na	na	na	na	na	na
	D.B. i. Load Impacts/designated unit - kW, real rate	1.96	1.98	1.48	2.44	1.49	2.47	1.58	2.34	1.60	2.36
	D.B. ii. Load Impacts/designated unit - kWh, real rate	0.59	0.60	0.45	0.74	0.45	0.75	0.48	0.71	0.48	0.72
	D.B. iii. Load Impacts/designated unit - Therms, real rate	na	na	na	na	na	na	na	na	na	na
3. Net-to-Gross Ratios		**RATIO**		**RATIO**	**RATIO**			**RATIO**	**RATIO**		
	A. i. Average Load Impacts - kW	1.01		0.99	1.03			1.00	1.02		
	A. ii. Average Load Impacts - kWh	1.01		0.99	1.03			1.00	1.02		
	A. iii. Average Load Impacts - Therms	na		na	na			na	na		
	B. i. Avg Load Impacts/designated unit of measurement - kW	1.01		0.99	1.03			1.00	1.02		
	B. ii. Avg Load Impacts/designated unit of measurement - kWh	1.01		0.99	1.03			1.00	1.02		
	B. iii. Avg Load Impacts/designated unit of measurement - Therms	na		na	na			na	na		
	C. i. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kW	na		na	na			na	na		
	C. ii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kWh	na		na	na			na	na		
	C. iii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - Thms	na		na	na			na	na		
4. Designated Unit Intermediate Data				**PART GRP**	**PART GRP**			**PART GRP**	**PART GRP**		
	A. Pre-install average value	1		na	na			na	na		
	B. Post-install average value	1		na	na			na	na		
6. Measure Count Data		**NUMBER**									
	A. Number of measures installed by participants in Part Group	210									
	B. Number of measures installed by all program participants in the 12 months of the program year	1,977									
	C. Number of measures installed by Comp Group	na									
7. Market Segment Data											
	A. Distribution of participants by CEC Climate Zone	See Page 4									

M&E PROTOCOLS TABLE 6 (Continued)

Designated Unit of Measurement: LOAD IMPACTS PER CUSTOMER
ENDUSE: WEATHERIZATION

				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 Comaprison Group											
A. Pre-install usage:	Pre-install kW	na									
	Pre-install kWh	na									
	Pre-install Therms	na									
	Base kW	na									
	Base kWh	na									
	Base Therms	na									
	Base kW/ designated unit of measurement	na									
	Base kWh/ designated unit of measurement	na									
	Base Therms/ designated unit of measurement	na									
B. Impact year usage:	Impact Yr kW	na									
	Impact Yr kWh	na									
	Impact Yr Therms	na									
	Impact Yr kW/designated unit	na									
	Impact Yr kWh/designated unit	na									
	Impact Yr Therms/designated unit	na									
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	125	126	76	174	76	176	87	163	87	165
	A. ii. Load Impacts - kWh	1,220,756	1,232,964	740,810	1,700,702	746,190	1,719,738	847,302	1,594,210	854,197	1,611,731
	A. iii. Load Impacts - Therms	na	na	na	na	na	na	na	na	na	na
	B. i. Load Impacts/designated unit - kW	0.0422	0.0425	0.0256	0.0588	0.0257	0.0593	0.0293	0.0551	0.0295	0.0556
	B. ii. Load Impacts/designated unit - kWh	412	416	250	574	252	580	286	538	288	544
	B. iii. Load Impacts/designated unit - Therms	na	na	na	na	na	na	na	na	na	na
	C. i. a. % change in usage - Part Grp - kW	na	na	na	na	na	na	na	na	na	na
	C. i. b. % change in usage - Part Grp - kWh	na	na	na	na	na	na	na	na	na	na
	C. i. c. % change in usage - Part Grp - Therms	na	na	na	na	na	na	na	na	na	na
	C. ii. a. % change in usage - Comp Grp - kW	na	na	na	na	na	na	na	na	na	na
	C. ii. b. % change in usage - Comp Grp - kWh	na	na	na	na	na	na	na	na	na	na
	C. ii. c. % change in usage - Comp Grp - Therms	na	na	na	na	na	na	na	na	na	na
D. Realization Rate:	D.A. i. Load Impacts - kW, realization rate	na	na	na	na	na	na	na	na	na	na
	D.A. ii. Load Impacts - kWh, realization rate	1.96	1.98	1.19	2.73	1.20	2.76	1.36	2.56	1.37	2.59
	D.A. iii. Load Impacts - Therms, realization rate	na	na	na	na	na	na	na	na	na	na
	D.B. i. Load Impacts/designated unit - kW, real rate	na	na	na	na	na	na	na	na	na	na
	D.B. ii. Load Impacts/designated unit - kWh, real rate	1.96	1.98	1.19	2.73	1.20	2.76	1.36	2.56	1.37	2.59
	D.B. iii. Load Impacts/designated unit - Therms, real rate	na	na	na	na	na	na	na	na	na	na
3. Net-to-Gross Ratios		**RATIO**		**RATIO**	**RATIO**			**RATIO**	**RATIO**		
	A. i. Average Load Impacts - kW	1.01		0.99	1.03			0.99	1.03		
	A. ii. Average Load Impacts - kWh	1.01		0.99	1.03			0.99	1.03		
	A. iii. Average Load Impacts - Therms	na		na	na			na	na		
	B. i. Avg Load Impacts/designated unit of measurement - kW	1.01		0.99	1.03			0.99	1.03		
	B. ii. Avg Load Impacts/designated unit of measurement - kWh	1.01		0.99	1.03			0.99	1.03		
	B. iii. Avg Load Impacts/designated unit of measurement - Therms	na		na	na			na	na		
	C. i. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kW	na		na	na			na	na		
	C. ii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kWh	na		na	na			na	na		
	C. iii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - Thms	na		na	na			na	na		
4. Designated Unit Intermediate Data				**PART GRP**	**PART GRP**			**PART GRP**	**PART GRP**		
	A. Pre-install average value	1		na	na			na	na		
	B. Post-install average value	1		na	na			na	na		
6. Measure Count Data		**NUMBER**									
	A. Number of measures installed by participants in Part Group	210									
	B. Number of measures installed by all program participants in the 12 months of the program year	2,963									
	C. Number of measures installed by Comp Group	na									
7. Market Segment Data											
	A. Distribution of participants by CEC Climate Zone	See Page 4									

M&E PROTOCOLS TABLE 6 (Continued)

7. Market Segment Data

A. Distribution of participants by CEC Climate Zone

CFL Participants, N = 41,127

CEC Climate Zone	% of Participants
6	13.4%
8	33.5%
9	25.8%
10	13.9%
13	6.0%
14	4.5%
15	2.2%
16	0.7%

Evaporative Cooler Participants, N = 1,977

CEC Climate Zone	% of Participants
6	0.0%
8	0.0%
9	11.9%
10	43.0%
13	7.5%
14	12.7%
15	24.6%
16	0.3%

Weatherization Participants, N = 2,963

CEC Climate Zone	% of Participants
6	49.6%
8	12.1%
9	18.4%
10	1.2%
13	0.2%
14	1.9%
15	6.2%
16	10.4%

M&E PROTOCOLS TABLE 7

A. OVERVIEW INFORMATION

1. Study Title and ID No:
   - Impact Evaluation of the 1995 Residential Direct Assistance Program
   - #527

2. Program, Program Year, and Program Description:
   - Southern California Edison's Residential Direct Assistance Program
   - 1995
   - The Program provides direct installation of energy efficiency measures in the homes of qualified low income customers. There is no cost to the customer for the provision of these measures. In 1995, the Program focused on the installation of compact fluorescent lamps (CFLs), evaporative coolers, and weatherization measures.

3. End Uses Covered:
   - Lighting, evaporative cooling, weatherization

4. Methods Used:
   - Calibrated engineering analysis
   - Billing Analysis

5. Program Participants:
   - Residential low income customers who received program measures in 1995

6. Analysis sample size:

Group	Customers	Installations	Measures	Observations
Lighting	150	150	749	150
Evaporative Cooling	210	210	210	5,832
Weatherization	210	210	210	6,561

B. DATABASE MANAGEMENT

1. Data Flow Chart:
   - See Figure B-1 for a flow chart describing the project data flow for the CFL analysis and Figure B-2 for a flow chart describing the project data flows for the Evaporative Cooler and Weatherization Analyses.

2. Data Sources:
   - See Figures B-1 and B-2

Figure B-1
CFL Data Flow Chart

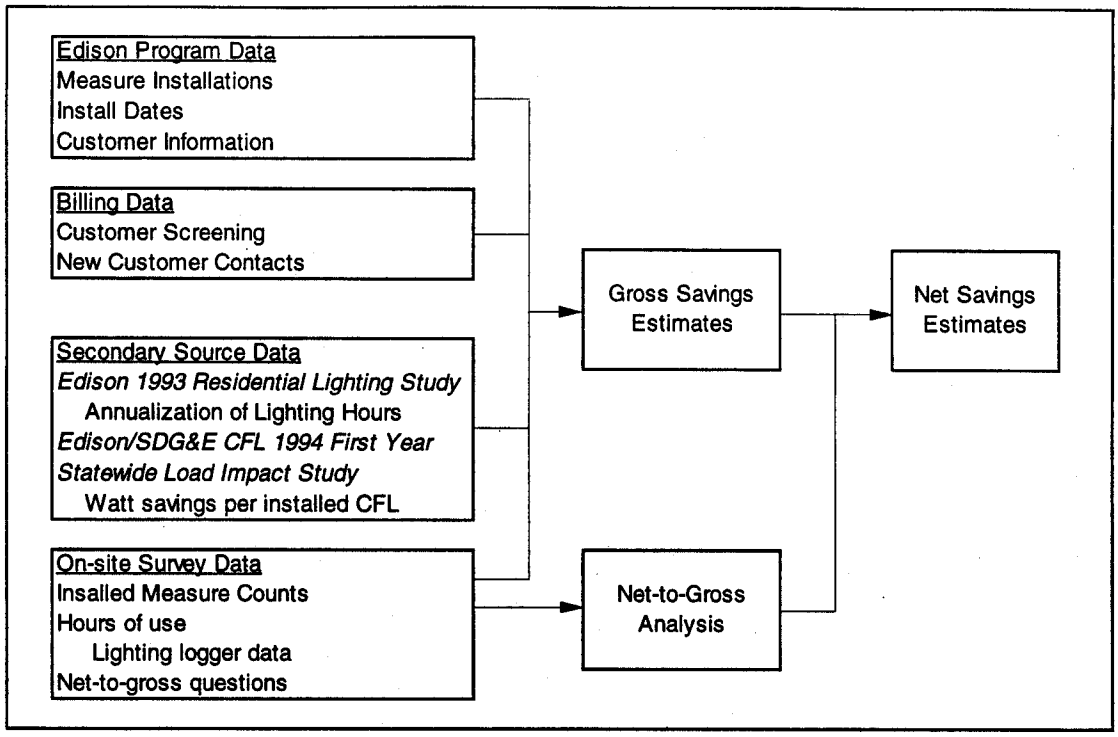
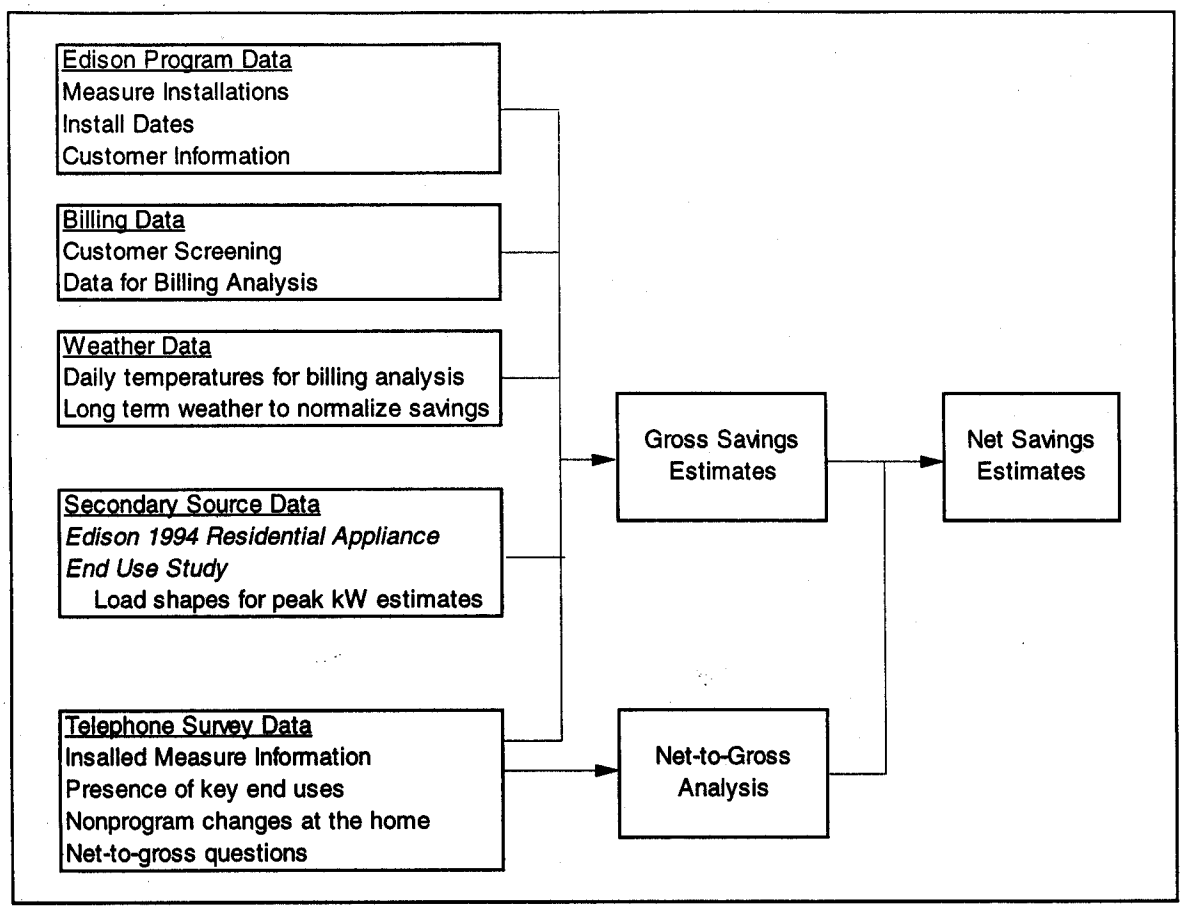


Figure B-2
Evaporative Cooler and Weatherization Data Flow Chart



3. Sample Attrition:
    - See Tables B-1 and B-2 for sample attrition; Tables B-3 and B-4 for survey disposition reports and Table B-5 for the lighting logger attrition.

    - Regarding the lighting logger attrition: Overall, 79% of installed loggers were utilized in the analysis. Loggers not continually in place included those for customers who had moved and those that fell off fixtures (and not replace by the customer). Several loggers were inadvertently left inactivated by the surveyors. A total of 60 loggers were not included in the study because they reported suspect results. TOU logger data were observed over time, and those with problematic patterns (logger activity only on the install/remove date and logger activity that disappeared after the first week or two of installation) were dropped from the analysis. For the run-time loggers, loggers with less than 0.05 hours of use per days were eliminated because it was determined that these loggers were probably not accurately recording lamp-on periods.

Table B-1
CFL Sample Attrition

	Continuing	New Occupants	Total
Total Participants	28,146	12,981	41,127
Active Accounts	25,387	9,638	35,025
Sampled	2,123	753	2,876
Completed Surveys	150	50	200

Table B-2
Evaporative Cooler and Weatherization Sample Attrition

	Evaporative Coolers	Weatherization
Total Participants	1,977	2,050
Active Accounts	1,518	1,219
Customer in 1994	1,060	865
Unique Account Number	993	853
Use < 50,000 kWh/year (evap) Use < 30,000 kWh/year (weath)	942	852
Surveyed	210	210
Usable bill history	180	199
Not master-metered	178	198
12 months pre/9 months post	176	195

Table B-3
CFL Survey Disposition

		Continuing	New Occupant	Total	
1	Missing Phone Number	587	166	753	26.2%
2	Unable to contact/Refused	911	344	1,255	43.6%
3	Surveyed	150	50	200	7.0%
4	Remaining	475	193	668	23.2%
5	Total Sample	2,123	753	2,876	100.0%

Table B-4
Evaporative Cooler/Weatherization Survey Disposition

		Evaporative Coolers		Weatherization	
1	No answer/Answering machine	433	38.6%	361	42.2%
2	Phone busy	43	3.8%	31	3.6%
3	Disconnected phone	66	5.9%	41	4.8%
4	Business/Government phone	5	0.4%	5	0.6%
5	Respondent not available	86	7.7%	25	2.9%
6	Initial refusal			11	1.3%
7	Computer tone	5	0.4%	3	0.4%
8	Language problems	12	1.1%	3	0.4%
9	Schedule callback	135	12.0%	73	8.5%
10	Call substitute phone number	4	0.4%	1	0.1%
12	MOVED	45	4.0%	20	2.3%
13	DON'T REMEMBER	4	0.4%	33	3.9%
15	CHANGED ADDRESS	6	0.5%	3	0.4%
16	QUOTA FILLED	12	1.1%		
17	Duplicate Number			2	0.2%
43	Completed Interviews	210	18.7%	210	24.5%
47	Record Over Quota	55	4.9%	25	2.9%
	Total attempts	1121	100.0%	856	100.0%

Table B-5
CFL Lighting Logger Attrition

		Units	% of Total
1.	Total loggers installed	317	100.0%
2.	Loggers not continually in place for study period	5	1.6%
3.	Loggers not activated during study period	3	0.9%
4.	Loggers with less that 0.05 hours/day	22	6.9%
5.	TOU loggers with erroneous data	38	12.0%
6.	Loggers included in analysis	249	78.5%

4. Quality Checks:
    - Edison tracking data contained verified information for Application Number and Account Number. Billing data was matched to the tracking data using the Account Number. Billing data also contained a weather station ID variable that was used to merge of the appropriate weather data. Samples for the surveys included the Application Number in order to merge survey data on to the tracking data. Telephone surveys were tracked electronically using a CATI system. Onsite surveys were reviewed for accuracy by the survey manager. For the onsite survey, installed loggers

were assigned logger ID numbers that were used to match the logger data with the appropriate survey. Matching of loggers to surveys was reviewed for accuracy by the survey manager.

5. Data not used:
    - For the lighting study, self report time of use data was collected. It was not used because it was felt that TOU lighting logger data provided superior time-of-use information. Data is contained in the on-site survey database.

C. SAMPLING

1. Sampling procedures and protocols (see Section 2 of the report for more detail)
    - Sampling frame - Participating homes with active accounts; for billing analyses master meter customers and customers without sufficient billing histories were also excluded.
    - Sampling strategy: stratified random sampling
    - Sampling basis: the customer
    - Stratification criteria:
        Subprogram (CFLs, Evaporative Coolers, Weatherization)
        Geographical area (Edison planning area)
        End uses affected (Evaporative Coolers, Weatherization)
        Dwelling type (Single family, multifamily)
        Types of measures installed (Weatherization)

2: Survey information:
    - Instruments - see Appendix A of this report
    - See Item B3 above for response rates.

3. Statistical descriptions:
    - See Appendix D of this report

D. DATA SCREENING AND ANALYSIS

1. Outliers: customers with very large bills (>50,000 kWh/year for evaporative coolers and >30,000 kWh/year for weatherization) not included in the sample frame; no other outliers were eliminated.
   Missing data: not a problem.
   Weather adjustment: weather variables were included in regression models; savings were based on average weather.
2. Background variables: variables explaining nonprogram changes at the home were included in the regression models.

3. Data screening: See Item B3 above for the sample attrition; all sites with survey data and adequate billing data were included in models.
4. Regression statistics: statistics are provided in Tables D-1 (Evaporative cooler model) and D-2 (Weatherization model)
5. Specification: Regression models are discussed fully in Section 2.4.2 of the Report.
   a. Customer-specific intercept terms were used to account for cross-sectional variation.
   b. Monthly dummy variables and site-specific nonprogram variables were included to account for time series variation.
   c. na
   d. na
   e. na - model provides gross impacts; net-to-gross analysis conducted separately.
6. Error in measuring variables: na
7. Autocorrelation: monthly dummy variables were included to minimize autocorrelation.
8. Heteroskedasticity: customer-specific intercept terms were included to mitigate heteroskedasticity.
9. Collinearity: correlations among variables were reviewed; collinearity not otherwise treated.
10. Influential data points: not considered a problem with the large numbers of observations in the studies (5000+ and 6000+ observations); no outliers were removed.
11. Missing data: na
12. Precision: Gross savings - the standard error of the regression parameters were utilized. Net-to-gross: the standard error of the mean net-to-gross ratio was utilized in the precision calculations.

E. DATA INTERPRETATION AND APPLICATION

2. E.1.c was used because the study did not require a comparison group.

Table D-1
Evaporative Cooler Model
Dependent Variable - Monthly kWh/day

Parameter	Estimate	t-statistic
Room AC*CDD*SQFT*Post	**-0.000227**	**-4.28**
Central AC*Not Home Weekdays*CDD*SQFT*Post	**-0.000353**	**-4.34**
Central AC*Home Weekdays *CDD*SQFT *Post	**-0.000494**	**-15.30**
No Reported AC*CDD*SQFT*Post	**-0.000443**	**-4.13**
Room AC*CDD*SQFT	0.000762	16.32
Central AC*Not Home Weekdays *CDD *SQFT	0.001150	16.82
Central AC*Home Weekdays *CDD*SQFT	0.001252	42.23
No Reported AC*CDD*SQFT	0.000654	9.55
Electric Heat*HDD*SQFT	0.000203	7.83
Other Conservation Activities	-0.032884	-0.10
Miscellaneous factors increasing use	1.413286	2.61
Miscellaneous factors decreasing use	-1.378177	-3.17
Appliance Additions kWh/day	0.531668	3.34
Appliance Removals kWh/day	-0.768729	-3.92
Added AC*CDD*SQFT	0.000391	4.67
Removed AC*CDD*SQFT	-0.000248	-1.52
Added Electric Heat*HDD*SQFT	0.000180	1.96
Removed Electric Heat*HDD*SQFT	-0.000018	-0.15
Customer Fixed Effects		F=79.1
January 1994 Dummy	2.265887	3.32
February 1994 Dummy	2.035826	2.94
March 1994 Dummy	1.001795	1.50
April 1994 Dummy	0.200545	0.30
May 1994 Dummy	-0.237766	-0.36
June 1994 Dummy	-0.312909	-0.47
July 1994 Dummy	1.358243	1.89
August 1994 Dummy	1.325190	1.78
September 1994 Dummy	0.632565	0.89
October 1994 Dummy	-0.829653	-1.24
November 1994 Dummy	0.510324	0.77
December 1994 Dummy	2.471543	3.67
January 1995 Dummy	2.822174	4.20
February 1995 Dummy	1.062959	1.59
March 1995 Dummy	0.518545	0.78
April 1995 Dummy	0.080004	0.12
May 1995 Dummy	-0.239948	-0.36
June 1995 Dummy	-0.698064	-1.06
July 1995 Dummy	-0.652844	-0.95
August 1995 Dummy	-0.135331	-0.20
September 1995 Dummy	-0.329755	-0.46
October 1995 Dummy	0.170698	0.27
November 1995 Dummy	0.745628	1.13
December 1995 Dummy	1.754655	2.66
January 1996 Dummy	2.807411	4.32
February 1996 Dummy	1.704154	2.57
March 1996 Dummy	1.419023	2.14
April 1996 Dummy	0.490905	0.75
May 1996 Dummy	0.208855	0.33
June 1996 Dummy	-0.109341	-0.17
July 1996 Dummy	-0.501211	-0.76
August 1996 Dummy	1.877537	2.71
September 1996 Dummy	1.791771	2.64
Number of Customers	176	
Number of Observations	5832	
R^2	0.773	

Table D-2
Weatherization Model
Dependent Variable - Monthly kWh/day

Parameter	Estimate	t-statistic
Electric DHW*Water Heating Measures	**-1.048481**	**-4.19**
Electric Heat*HDD*SQFT*Heat/Cool Measures	**-0.000142**	**-3.96**
AC*CDD*SQFT*Single Family*Heat/Cool Measures	**-0.000113**	**-2.46**
AC*CDD*SQFT	0.000710	29.27
Electric Heat*HDD*SQFT	0.000394	11.56
Miscellaneous factors increasing use	0.579825	1.31
Appliance Additions kWh/day	0.175574	0.98
Appliance Removals kWh/day	-0.319607	-1.48
Added Electric Heat*HDD*SQFT	0.000141	2.29
Change in Residents	2.416783	5.53
Customer Fixed Effects		F=90.7
January 1994 Dummy	4.123679	7.27
February 1994 Dummy	2.955758	5.07
March 1994 Dummy	1.896425	3.39
April 1994 Dummy	-0.613796	-1.13
May 1994 Dummy	-1.373242	-2.52
June 1994 Dummy	-0.997795	-1.91
July 1994 Dummy	0.544574	1.04
August 1994 Dummy	0.527589	1.02
September 1994 Dummy	0.949157	1.79
October 1994 Dummy	-0.656943	-1.26
November 1994 Dummy	-0.366919	-0.68
December 1994 Dummy	3.944818	6.49
January 1995 Dummy	4.278338	7.33
February 1995 Dummy	3.102038	5.62
March 1995 Dummy	1.459724	2.73
April 1995 Dummy	0.719031	1.35
May 1995 Dummy	0.090734	0.17
June 1995 Dummy	-0.033381	-0.06
July 1995 Dummy	0.663227	1.29
August 1995 Dummy	1.668245	3.34
September 1995 Dummy	1.278366	2.40
October 1995 Dummy	0.299412	0.59
November 1995 Dummy	0.165428	0.32
December 1995 Dummy	2.195563	4.07
January 1996 Dummy	4.709380	8.27
February 1996 Dummy	3.777164	6.48
March 1996 Dummy	3.017189	5.31
April 1996 Dummy	0.500243	0.93
May 1996 Dummy	0.038419	0.08
June 1996 Dummy	-0.119634	-0.23
July 1996 Dummy	1.066907	2.10
August 1996 Dummy	2.301435	4.52
September 1996 Dummy	1.726080	3.37
Number of Customers	195	
Number of Observations	6561	
R^2	0.759	