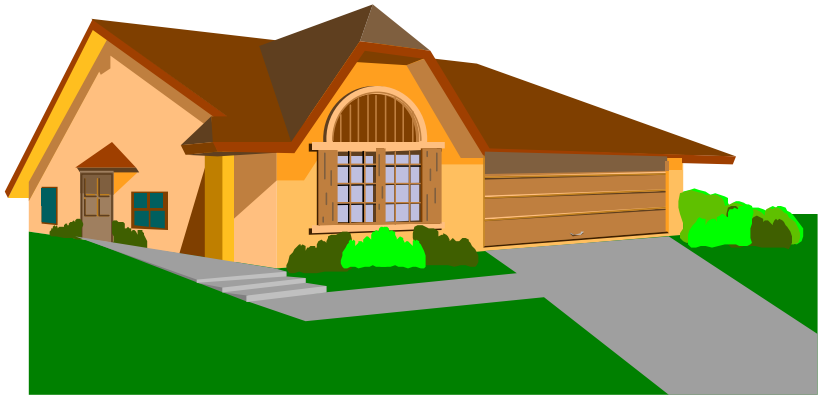
San Diego Gas & Electric
Marketing Programs & Planning
8306 Century Park Court
San Diego, California 92123

1997 Residential Energy Management Services

First Year Load Impact Evaluation

February 1999



Study ID No. 1026

Table of Contents

Executive Summary

During program year 1997, 20,930 audits were conducted through SDG&E's Residential Energy Management Services (REMS) Program. This report summarizes net energy impact estimates for participants in the two primary areas of that program; ENERGRAF and Mail-In Audits.

Program savings estimates are summarized in Table 1 below:

Table 1
NET ANNUAL ELECTRIC AND GAS LOAD IMPACTS
(Program savings are depicted as positive numbers)

	Whole House	Miscellaneous	Space Heating	Space Cooling	Water Heating
ALL AUDITS					
kWh Savings	**391.32**	**-158.52**	**532.68**	**480.48**	**75.00**
Therm Savings	**69.77**	**64.68**	**67.01**	**NA**	**4.19**

Energy Impacts

- Electric Savings: On a whole house basis, the results of the study indicate that those participating in SDG&E's Residential Energy Management Services program in 1997 reduced energy consumption to a greater degree than nonparticipants. The impacts for nonparticipants shows that energy consumption increased by over 353 kWh per year. For participants gross consumption decreased by over 38 kWhs . This results in a net savings of about 391 kWh. Electric saving were distributed between all of the major end uses except for Miscellaneous which showed an increase in consumption when compared to the nonparticipants.

- Therm Savings: The results of the study again show that energy savings resulted from participation in the 1997 EMS program. On a whole house basis, participants reduced annual gross gas consumption by an estimated 12 therms, while nonparticipants increased consumption by almost 58 therms. This results in a net savings of about 70 therms. For Gas, all major end uses indicate savings.

Introduction

Program Overview

The San Diego Gas & Electric (SDG&E) Residential Energy Management Services (REMS) Program offered four types of services to customers in 1997:

- The onsite **ENERGRAF Service** provides customers with a computer-prepared graph showing their monthly consumption and the approximate cost of using their major appliances. Customers also receive written recommendations of energy saving practices.
- The **Home Energy Profile Service (Mail-In)** employs a questionnaire mailed to customers about their energy use. After a completed questionnaire is mailed back to SDG&E, a computer-prepared graph that shows monthly consumption, the approximate cost of using major appliances, and recommendations of energy saving practices are returned to the customer.
- The **Low-Cost/No-Cost Service** offers customers a physical inspection of their appliances. Customers receive written recommendations for implementing low-cost or no-cost energy saving practices and measures.
- The **Pool/Spa Audit Service** encourages customers to use off-peak hours of operation for filtration. Free time clock trippers are provided, if needed, to reset pool and/or spa filtration time clocks.

This report summarizes the energy impact analysis of customers who received the ENERGRAF, Low-Cost/No-Cost and Mail-In audits during 1997 only. Pool/Spa audits, which constitute a minority of services, are not included in this evaluation.

Background

SDG&E's residential audit program was created in response to the U.S. Department of Energy's 1978 mandate that required all large utilities to offer in-home energy audit services. Audits were first offered by SDG&E in 1981 through the Residential Conservation Service (RCS) program, and in 1984 ENERGRAF audits were added to the services. The ENERGRAF service utilizes trained auditors to conduct in-home surveys of appliances. Data are entered into a laptop computer and the customer is provided with a graph depicting current energy usage and costs for major appliances and a written list of conservation recommendations. Recommendations can take the form of either equipment/insulation suggestions or behavioral changes that affect the way energy is used. Many of the ENERGRAF audits are conducted in response to high-bill inquiries during peak winter months.

Mail-In audits became available in late 1991. Each customer requesting this audit is mailed a Home Energy Profile questionnaire. The questionnaire is returned to SDG&E and the customer is sent a graph showing monthly consumption, energy savings recommendations, and potential annual energy savings.

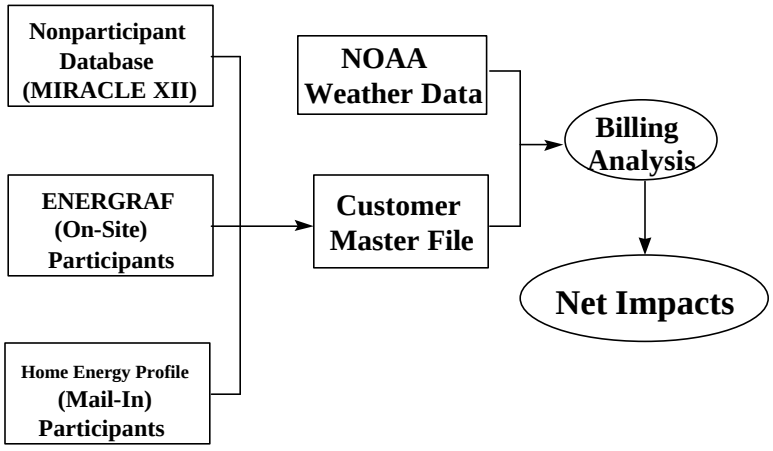
Availability of the ENERGRAF, Low-Cost/No-Cost, and Home Energy Profile Services were promoted through the Customer Service Telephone Center, the "Energy Notes" newsletter, and direct mail. A total of 20,930 services were completed during 1997.

Sampling & Data Collection

Data for the 1997 REMS analysis were obtained from several major sources:

1. Participant name, address, account number, appliance saturation, demographics, and participation date from the 1997 ENERGRAF (onsite) program tracking database;
2. Participant name, address, account number, appliance saturation, demographics ,and participation date from the 1997 Mail-In program tracking database;
3. Nonparticipant name, address, account number, appliance saturation, demographics, and conservation activity from the Home Energy Survey for 1997 (MIRACLE XIII) database;
4. 1996-1998 electric and gas consumption history from SDG&E's Customer Master File;
5. 1996-1998 hourly weather data for three climate zones from the National Oceanic and Atmospheric Administration (NOAA) files; and

A data flow diagram is provided below:



A census of the 20,874 participants (including both Mail-in Audits and Energraph) was attempted. Several criteria were established for participation in the analysis. First, the participant had to have lived in the house on a year round basis. Second, the participant had to be non-master metered. Finally the participant had to have claimed either gas or electricity as their main source of heating over the time period analyzed. After these criteria were met, 16738 participants remained. This was then reduced to 13070 electric participants and 9020 gas participants as a result of the protocol recording requirements for 12 months pre and 9 months post billing history. Once the regressions were completed, two additional filters--the RMSE criterion and a Standard Deviation check--were

applied (see "Model Filters" below). Once these two criteria were applied to the participants, an additional 133 and 197 participants were eliminated from the electric and gas equations respectively. This made the final number of participants in the regression 12,937 for the electric equations and 8,823 for the gas equations.

The Econometric Framework

The load impact analysis estimates the monthly savings for space heating, space cooling, and miscellaneous end uses for those customers who adopted energy saving measures or practices that affect those particular end uses. To estimate savings for the entire household, all program participants were evaluated in the regression models described below. Thus, the sample sizes vary across the end uses evaluated, and the sum of the average savings of the individual end uses does not equal the average savings of all the households in the program. However, for each individual program participant, the estimated savings for his household is equal to the sum of his space heating, space cooling, and miscellaneous end uses.

Electricity Model

The electricity consumption model was designed to take advantage of variation in weather over time (with months indexed by t), which allows the regression model to yield estimates of weather-related consumption for individual customers (indexed by i):

The Customer Specific End Use Electricity Consumption Model

$$\begin{aligned} \mathrm{kWh}_{it} &= a_i + q_i t + b_i(\mathrm{cdh}_{it}) + g_i(\mathrm{hdh}_{it}) \\ &\quad + \Delta a_i(\mathrm{d}_{it}) + \Delta b_i(\mathrm{cdh}_{it})(\mathrm{d}_{it}) + \Delta g_i(\mathrm{hdh}_{it})(\mathrm{d}_{it}) + e_{it} \end{aligned}$$

The term $\alpha_i + \theta_i t$ (t=1,2,3,…) is the non-weather related trended element of the household electricity consumption, such as refrigeration and lighting. The next two terms, $b_i(\mathrm{cdh}_{it})$ and $g_i(\mathrm{hdh}_{it})$, are the weather related kWh consumption based on cooling degree-hours (cdh_{it}) and heating degree-hours (hdh_{it}) respectively. The following three terms make up the estimated monthly savings associated with the audit date term d_{it} (a zero-one indicator variable): the miscellaneous end use is captured in the $\Delta a_i(\mathrm{d}_{it})$ term, the space cooling end use is estimated as $\Delta b_i(\mathrm{cdh}_{it})(\mathrm{d}_{it})$, and the space heating end use is defined as $\Delta g_i(\mathrm{hdh}_{it})(\mathrm{d}_{it})$. The least-squares regression model also contains the usual random disturbance term e_{it}. Final weather-normalized estimates are $\Delta\alpha_i$, $\Delta\beta_i(\overline{\mathrm{cdh}}_i)$, and $\Delta\gamma_i(\overline{\mathrm{hdh}}_i)$ based on the 12-year averages of $\overline{\mathrm{cdh}}_i$ and $\overline{\mathrm{hdh}}_i$.

Gas Model

The gas consumption model is identical to the electricity consumption model with the following two exceptions: (1) the left side of the equation is therms, not kWh, and (2) there are no cooling terms since that end use is associated with electricity only.

The Customer Specific End Use Gas Consumption Model

$$\text{Therms}_{it} = \alpha_i + \theta_i t + \gamma_i (\text{hdh}_{it}) + \Delta\alpha_i (d_{it}) + \Delta\gamma_i (\text{hdh}_{it})(d_{it}) + \varepsilon_{it}$$

Model Filters

Within the broad setting of residential consumption, regression analysis will not always perform with uniform success. A fraction of the regressions will not work; that is, the specified model will not be a reasonable approximation to reality. As a result, a reasonable and systematic criterion must be put in place for which there is a high probability of omitting unreasonable regression results. To accomplish this, a ratio was calculated for each customer by dividing the root-mean-squared error (RMSE) for the regression by the intercept. This ratio is very likely to be large when the regression "fails", since inadequacies in the specification of the model for a particular customer will result in excessively large estimated regression errors. Within this analysis, regressions were omitted where this ratio was greater than 40% for the electric equations, and 70% for the gas equations. The other filtering criteria was based on variance from the average. If the regression found that participants estimated savings was 4 standard deviations away from the average, that participant was eliminated from the analysis. Failing either criteria resulted in the customer being classified as an outlier.

Nonparticipants

The same models were used for both participants and nonparticipants. Nonparticipants were selected from SDG&E's MIACLE XIII survey. The 1998 Home Energy Survey (Marketing Information Research and Customer Load Estimate - or MIRACLE XIII) was designed to provide information on San Diego Gas and Electric's individually-metered residential customers. MIRACLE surveys provide data on appliance saturations, installed conservation measures, customer geo-demographics, and gas and electricity consumption patterns. Sample design and data-weighting scheme for MIRACLE XIII was developed to minimize non-response and self-selection biases. As a result, the MIRACLE XIII data are statistically representative of SDG&E's residential sector. A total of 4246 nonparticipants were selected from MIRACLE for use in the electric equations and 2330 nonparticipants were selected for use in the gas equations.

For nonparticipants, the date used for installation (d_{it}) was assumed to be mid year (July), the average install date for particpants.

Results

Energy Savings Estimates

The savings estimates for the end uses space heating, space cooling, miscellaneous, and all measures combined are derived directly from the load impact regression analysis. The coefficients from the models represent the estimated monthly load impact (kWh) associated with each end use. In Tables 2 and 3, the monthly

gross load impacts are converted into estimated annual savings. Estimates for nonparticipants are subtracted from those of participants to estimate net program savings as per Table 5 of the California M&E Protocols. Water heating savings are attributed to the difference between impacts for households with gas water heaters and impacts for households with electric water heaters where the households had similar heating and cooling systems.

The methodology described above produced the gross energy impacts and estimated net annual savings for the 1997 Residential EMS Program as shown in Tables 2 and 3 below:

Table 2
ANNUAL ELECTRIC IMPACTS AND SAVINGS
(Program savings are depicted as positive numbers)

	Whole House	Miscellaneous	Space Heating	Space Cooling	Water Heating
ALL AUDITS					
Count	12,937	12,937	535	4227	124
Gross Impact	38.16	-46.32	327.12	-37.92	-187.44
MIRACLE					
Count	4,246	4,246	111	888	75
Gross Impact	-353.16	204.84	-205.56	-518.4	-262.44
NET SAVINGS	391.32	-158.52	532.68	480.48	75.00

Table 3
ANNUAL GAS IMPACTS AND SAVINGS
(Program savings are depicted as positive numbers)

	Whole House	Miscellaneous	Space Heating	Water Heating
ALL AUDITS				
Count	8823	8823	716	8107
Gross Impact	12.00	25.20	16.98	-5.46
MIRACLE				
Count	2330	2330	462	1868
Gross Impact	-57.77	-39.48	-50.03	-9.65
Net Savings	**69.77**	**64.68**	**67.01**	**4.19**

Capacity Impacts

In order to estimate the capacity (kW) savings, the average annual whole house net savings (391.32kWh) was divided by 8,760 (number of hours in a year) which was then divided by the coincident system peak load factor (ratio of average hourly consumption to demand coincident with system peak). SDG&E's estimated residential class system peak load factor from the 1996 Class Load Studies was 0.6386. The estimated demand savings is therefore .070 kW per household.

Summary

Energy Impacts

- Electric Savings: On a whole house basis, the results of the analysis indicates that those participating in SDG&E's residential Energy Management Services program in 1997 reduced energy consumption to a greater degree than nonparticipants. The impacts for nonparticipants shows that energy consumption increased by 353 kWh per year. For participants consumption decreased by over 38 kWhs giving a net savings for the program of about 391 kWh. Electric saving were distributed between all of the major end uses except for Miscellaneous which showed an increase in consumption when compared to the nonparticipants of about 158 kWhs. Space heating and space cooling showed the greatest net savings with 533 kWhs and 480 kWhs saved. Water heating was measured as providing the smallest savings, with a net reduction of 75 kWhs in annual consumption.

- Therm Savings: The results of the study again show that savings exist for participants of the 1997 EMS program. On a whole house basis, participants reduced annual consumption by an estimated 12 therms, while nonparticipants increased consumption by almost 58 therms. This results in a net savings for the program of almost 70 therms. For Gas, all major end uses showed savings. Space heating showed the largest savings with a net reduction of about 67 therms. Water heating showed only a small reduction in consumption of 4.19 therms. For gas even the miscellaneous end use showed significant net savings of almost 65 therms for participants.

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M&E PROTOCOLS TABLE 6 - RESULTS USED TO SUPPORT PY95 SECOND EARNINGS CLAIM FOR RESIDENTIAL ENERGY MANAGEMENT SERVICES PROGRAM

FIRST YEAR LOAD IMPACT EVALUATION, FEBRUARY 1999, STUDY ID NO. 1026

Designated Unit of Measurement: LOAD IMPACTS PER DWELLING UNIT

END USE: ALL END USES COMBINED, ALL AUDITS COMBINED

				5. A. 90% CONFIDENCE LEVEL				5. B. 80% CONFIDENCE LEVEL			
				LOWER B	UPPER BO	LOWER B	UPPER BO	LOWER B	UPPER BO	LOWER B	UPPER BO
1. Average Participant Group and Average Comp		**PART GR**	**COMP G**	**PART GRP**	**PART GRP**	**COMP GR**	**COMP GR**	**PART GRP**	**PART GRP**	**COMP GR**	**COMP GR**
A. Pre-install us	Pre-install kW	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Pre-install kWh	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Pre-install Therms	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Base kW	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Base kWh	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Base Therms	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Base kW/ designated unit of measu	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Base kWh/ designated unit of meas	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Base Therms/ designated unit of m	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
B. Impact year	Impact Yr kW	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Impact Yr kWh	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Impact Yr Therms	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Impact Yr kW/designated unit	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Impact Yr kWh/designated unit	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Impact Yr Therms/designated unit	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2. Average Net and Gross End Use Load Impacts		**AVG GRO**	**AVG NET**	**AVG GROS**	**AVG GROS**	**AVG NET**	**AVG NET**	**AVG GROS**	**AVG GROS**	**AVG NET**	**AVG NET**
	A. i. Load Impacts - kW	0.0068	0.0700	0.0016	0.0121	0.0633	0.0766	0.0027	0.0109	0.0648	0.0751
	A. ii. Load Impacts - kWh	38.16	391.32	8.8	67.5	354.4	428.3	15.3	61.0	362.5	420.1
	A. iii. Load Impacts - Therms	12	69.768	9.4	14.6	65.3	74.3	10.0	14.0	66.3	73.3
	B. i. Load Impacts/designated unit	0.0068	0.0700	0.0016	0.0121	0.0633	0.0766	0.0027	0.0109	0.0648	0.0751
	B. ii. Load Impacts/designated unit	38.16	391.32	8.8	67.5	354.4	428.3	15.3	61.0	362.5	420.1
	B. iii. Load Impacts/designated unit	12	69.768	9.4	14.6	65.3	74.3	10.0	14.0	66.3	73.3
	C. i. a. % change in usage - Part G	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	C. i. b. % change in usage - Part G	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	C. i. c. % change in usage - Part G	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	C. ii. a. % change in usage - Comp	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	C. ii. b. % change in usage - Comp	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	C. ii. c. % change in usage - Comp	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D. Realization R	D.A. i. Load Impacts - kW, realizati	68%	700%	16%	121%	633%	766%	27%	109%	648%	751%
	D.A. ii. Load Impacts - kWh, realiza	125%	1280%	29%	221%	1159%	1401%	50%	200%	1186%	1374%
	D.A. iii. Load Impacts - Therms, rea	600%	3488%	470%	730%	3263%	3713%	499%	701%	3313%	3664%
	D.B. i. Load Impacts/designated un	68%	700%	16%	121%	633%	766%	27%	109%	648%	751%
	D.B. ii. Load Impacts/designated un	125%	1280%	29%	221%	1159%	1401%	50%	200%	1186%	1374%
	D.B. iii. Load Impacts/designated u	600%	3488%	470%	730%	3263%	3713%	499%	701%	3313%	3664%
3. Net-to-Gross Ratios		**RATIO**		**RATIO**	**RATIO**			**RATIO**	**RATIO**		
	A. i. Average Load Impacts - kW	10.3		40.1	6.3			23.7	6.9		
	A. ii. Average Load Impacts - kWh	10.3		40.1	6.3			23.7	6.9		
	A. iii. Average Load Impacts - Ther	5.8		6.9	5.1			6.6	5.2		
	B. i. Avg Load Impacts/designated unit of measurement - kW	10.3		40.1	6.3			23.7	6.9		
	B. ii. Avg Load Impacts/designated unit of measurement - kWh	10.3		40.1	6.3			23.7	6.9		
	B. iii. Avg Load Impacts/designated unit of	5.8		6.9	5.1			6.6	5.2		
	C. i. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact	N/A		N/A	N/A			N/A	N/A		
	C. ii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kWh	N/A		N/A	N/A			N/A	N/A		
	C. iii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - Thms	N/A		N/A	N/A			N/A	N/A		
4. Designated Unit Intermediate Data		**PART GR**	**COMP G**	**PART GRP**	**PART GRP**	**COMP GR**	**COMP GR**	**PART GRP**	**PART GRP**	**COMP GR**	**COMP GR**
	A. Pre-install average values			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Electric Patricipant Square Footage	N/A	N/A								
	Electric Patricipant Number in Household	N/A	N/A								
	Gas Participant Square Footage	N/A	N/A								
	Gas Participant Number in Household	N/A	N/A								
	B. Post-install average values	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Electric Patricipant Square Footage	N/A	N/A								
	Electric Patricipant Number in Household	N/A	N/A								
	Gas Participant Square Footage	N/A	N/A								
	Gas Participant Number in Household	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6. Measure Count Data		**NUMBER**									
	A. Number of measures installed by participants in Part Group	N/A									
	B. Number of measures installed by all program participants in the 12 months of the program year	N/A									
	C. Number of measures installed b	N/A									
7. Market Segment Data		**CZone 7**	**CZone 10**								
	Number of Participants	4,120	4,861								

Note 2: kW savings derived from 1996 Class Load Studies residential System peak load factor of 0.6386.

Note 3: Ex-Ante estimated savings and participant count used in realization rates are taken from the 1997 DSM Program Activity and Expected Earning Re

M&E PROTOCOLS TABLE 7
DATA QUALITY AND PROCESSING DOCUMENTATION
For Residential Energy Management Services Program
First Year Load Impact Evaluation
February 1999
Study ID No. 1026

A. OVERVIEW INFORMATION

1. Study Title and Study ID: 1997 Residential Energy Management Services (REMS) Program: First Year Load Impact Evaluation, MPAP-95-P03-977-702, Study ID No. 1026, February 1997.

2. Program, Program Year(s), and Program Description (Design): Residential Energy Management Services Program for the 1997 program year. The ENERGRAF (onsite), Low-Cost/No-Cost Pool/Spa, and Home Energy Profile Service (Mail-In) audits provide customers with comprehensive information about energy management measures and practices to reduce electric and gas consumption. This report covers only the ENERGRAF and Mail-In audits.

3. End Uses and/or Measures Covered: All end uses combined disaggregated by space cooling, space heating, water heating, and miscellaneous. Primary analysis was completed at the program level (all end uses combined) per protocol Table C11.

4. Methods and Models Used: The study uses a regression-based billing analysis to estimate net Program impacts. See the section of the report entitled “The Econometric Framework” on page 3 for a complete description of the final model specifications.

5. Participant and Comparison Group Definition: For the load impact analysis, the participants are defined as customers having had an ENERGRAF (onsite) or Mail-In audit during 1997. The comparison group was taken from the 1997 Home Energy Survey (MIRACLE XIII) database.

6. Analysis Sample Size:

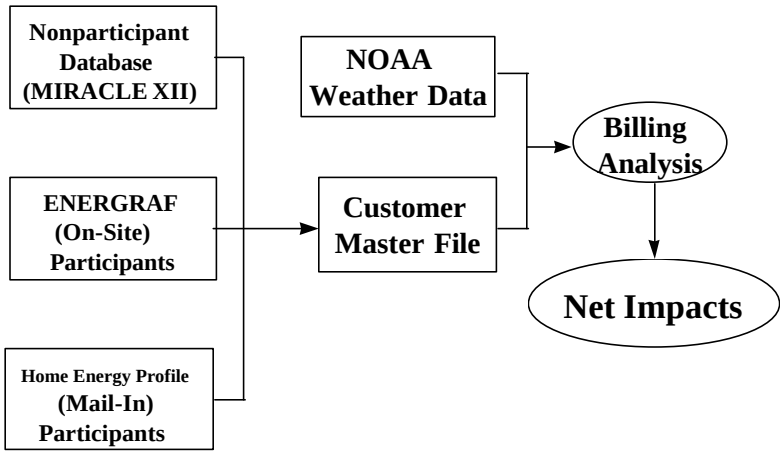
ELECTRIC PARTICIPANT SAMPLE FOR 1997 RESIDENTIAL EMS				
	# of Customers	**# of Installations***	**# of Measures***	**Avg. # of Months of Data**
Space Heating	1785	Not Available	Not Available	22.1
Space Cooling	5094	Not Available	Not Available	22.1
Water Heating	886	Not Available	Not Available	22.1
Miscellaneous	12937	Not Available	Not Available	22.1
Total	12937	Not Available	Not Available	22.1

GAS PARTICIPANT SAMPLE FOR 1997 RESIDENTIAL EMS				
	# of Customers	**# of Installations***	**# of Measures***	**Avg. # of Months of Data**
Space Heating	8826	Not Available	Not Available	22.1
Water Heating	8115	Not Available	Not Available	22.1
Miscellaneous	8826	Not Available	Not Available	22.1
TOTAL	8826	Not Available	Not Available	22.1

* Only the number of ***recommended*** installations and measures is available on the audit databases. Actual adoptions of recommendations are not available.

B. DATABASE MANAGEMENT

1. Flow Charts:



2. Data sources: the data came from the following sources:

a. Participant name, address, account number, appliance saturation, demographics, and participation date from the 1997 ENERGRAF (onsite) program tracking database;
b. Participant name, address, account number, appliance saturation, demographics, and participation date from the 1997 Mail-In program tracking database;
c. Nonparticipant name, address, account number, appliance saturation, demographics, and conservation activity from the Home Energy Survey for 1997 (MIRACLE XIII) database;
d. 1996-1998 electric and gas consumption history from the Customer Master File;
e. 1996-1998 hourly weather data for three climate zones from the National Oceanic and Atmospheric Administration (NOAA) files; and
f. Participant survey of implementation of audit recommendations by measure and practice.

The data were merged together to form the dataset for the regression analysis leading to the estimated energy savings per dwelling unit. The savings were further disaggregated by space cooling, space heating, water heating, and miscellaneous end uses.

3. Data Attrition:

a. Participant Sample – Electric Load Impact Analysis

Number of Participants for Electric Load Impact Analysis	
1997 REMS Participants Initial Database	21,035
Remaining accounts after meeting basic criteria (Non-mastermetered, lived in the house year round, claimed gas or electricity as the main source of heating)	17,627
Participants meeting minimum pre/post data requirements	13,070
Participants after econometric filtering (RMSE & variance from the mean)	12,937

b. Participant Sample – Gas Load Impact Analysis

Number of Participants for Gas Load Impact Analysis	
1997 REMS Participants Initial Database	21,035
Remaining accounts after meeting basic criteria (Non-mastermetered, lived in the house year round, claimed gas or electricity as the main source of heating)	17,627
Participants meeting minimum pre/post data requirements	9,020
Participants after econometric filtering (RMSE & variance from the mean)	8,823

c. Nonparticipant Sample – Electric Load Impact Analysis

Number of Nonparticipants for Load Impact Analysis	
1997 MIRACLE XII nonparticipants	5,596
Remaining accounts after meeting basic criteria (Non-mastermetered, lived in the house year round, claimed gas or electricity as the main source of heating)	4,861
Participants meeting minimum pre/post data requirements	4,351
Participants after econometric filtering (RMSE & variance from the mean)	4,246

d. Nonparticipant Sample – Gas Load Impact Analysis

Number of Nonparticipants for Load Impact Analysis	
1997 MIRACLE XII nonparticipants	5,596
Remaining accounts after meeting basic criteria (Non-mastermetered, lived in the house year round, claimed gas or electricity as the main source of heating)	4,861
Participants meeting minimum pre/post data requirements	2,570
Participants after econometric filtering (RMSE & variance from the mean)	2,506
Customers claiming gas space heating (used for whole house regressions)	2,330

4. **Data Quality Checks:** The data sets for the regression analysis were merged in SAS by the appropriate key variables. Counts of the data sets before and after the merges were verified to ensure accurate merging.

5. **All data collected** for this analysis were utilized.

C. SAMPLING

1. Sampling procedures and protocols: A census of participants was attempted. See section B.3.a. of this Table 7 for a detailed description.

D. DATA SCREENING AND ANALYSIS

1. Outliers and influential points: In determining **outliers** and **influential** data points, the root mean square error in the regression equation was divided by the intercept for each individual household and used as a proxy for volatile data streams. For electric consumption, the influential point definition was >40% while for gas consumption, (which generally has less volatility than electric consumption), the outlier definition was 70%. Outliers were defined as those estimates which were at least four standard deviations away from the sample mean

2. Background Variables: A trend variable was included in the model to control for the effect of "background" variables.

Weather Adjustments are described in "The Econometric Framework" section of the report on page 3.

3. Screening: See sections B.3.a. and D.1. of this Table 7 for data screening for inclusion in the final analysis dataset.

4. Regression statistics: see Table 6 of the report for coefficients and confidence intervals.

5. Specification:

a. The model is estimated entirely at the customer level (the extreme case of accounting for customer heterogeneity); the sources of variation are variation in weather over time and the date of the audit.

b. The cooling degree-hour and heating degree-hour regressors are based on estimates of hourly temperature (which are, in turn, based on daily high and low temperatures). The base for the cooling degree-hour and heating degree-hour are 65 degrees Fahrenheit. Other time-dependent regressors are a trend variable, an audit date indicator variable, and interactions between degree-hours and the indicator variable.

c. Self-selection was not addressed.

d. No factors were eliminated from the regression model as it was originally specified.

e. The difference between pre-audit consumption and post-audit consumption is calculated directly from the regression equation, yielding gross impacts. Net impacts are defined as the difference in the gross impacts between participants and the comparison group.

6. Error in Measuring Variables: A series of reasonability checks were run on survey data to verify fuel types and account for missing answers to the water heater fuel type. Billing data were screened for changes in occupancy.

7. Autocorrelation: Not Addressed.

8. Heteroskedasticity: Not Addressed.

9. Collinearity: With both cooling degree-hours and heating degree-hours in the electric model, it is likely that collinearity exists. However, since the goal is to estimate all end uses combined at the dwelling level, while the savings allocated to the end uses may be biased, the savings in the aggregate are reliable.

10. Influential Data Points: See part D.1. Influential data points were eliminated from all calculations.

11. Missing Data: See part D.1. Remaining missing data points were ignored in all calculations.

12. Precision: The standard errors for the estimates were calculated from the variances of the samples of participants on the variable(s) in question.

E. DATA INTERPRETATION AND APPLICATION

1. Calculation of Net Impacts is specified by item a: the difference between participant impacts and nonparticipant impacts.

2. The **process** used in calculation of net impacts is that specified in Table 5 of the M&E Protocols.